### Command Reference

<table>
<thead>
<tr>
<th>Description</th>
<th>Sections</th>
</tr>
</thead>
<tbody>
<tr>
<td>General-Purpose User Commands</td>
<td>1</td>
</tr>
<tr>
<td>Basic Networking Commands</td>
<td>1C</td>
</tr>
<tr>
<td>Form and Menu Language Interpreter</td>
<td>1F</td>
</tr>
<tr>
<td>System Maintenance Commands</td>
<td>1M</td>
</tr>
</tbody>
</table>

### Command Reference

(same as above)

### Operating System API Reference

<table>
<thead>
<tr>
<th>Library</th>
<th>Sections</th>
</tr>
</thead>
<tbody>
<tr>
<td>System Calls</td>
<td>2</td>
</tr>
<tr>
<td>BSD System Compatibility Library</td>
<td>3C</td>
</tr>
<tr>
<td>Standard C Library</td>
<td>3C</td>
</tr>
<tr>
<td>ETI-curses Library</td>
<td>3curses</td>
</tr>
<tr>
<td>Executable and Linking Format Library</td>
<td>3E</td>
</tr>
<tr>
<td>General-Purpose Library</td>
<td>3G</td>
</tr>
<tr>
<td>Identification and Authentication Library</td>
<td>3I</td>
</tr>
<tr>
<td>Math Library</td>
<td>3M</td>
</tr>
<tr>
<td>Networking Library</td>
<td>3N</td>
</tr>
<tr>
<td>Standard I/O Library</td>
<td>3S</td>
</tr>
<tr>
<td>Multibyte/Wide Character Conversion Library</td>
<td>3W</td>
</tr>
<tr>
<td>Specialized Libraries</td>
<td>3X</td>
</tr>
</tbody>
</table>

### Windowing System API Reference

<table>
<thead>
<tr>
<th>Facility</th>
<th>Sections</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desktop Metaphor</td>
<td>3Dt</td>
</tr>
<tr>
<td>Drag and Drop</td>
<td>3DnD</td>
</tr>
<tr>
<td>MoOLIT</td>
<td>3Olit</td>
</tr>
<tr>
<td>ETI-curses Library</td>
<td>3curses</td>
</tr>
</tbody>
</table>

### System Files and Devices Reference

<table>
<thead>
<tr>
<th>Facility</th>
<th>Sections</th>
</tr>
</thead>
<tbody>
<tr>
<td>System File Formats</td>
<td>4</td>
</tr>
<tr>
<td>Miscellaneous Facilities</td>
<td>5</td>
</tr>
<tr>
<td>Special Files (Devices)</td>
<td>7</td>
</tr>
</tbody>
</table>

### Device Driver Reference

<table>
<thead>
<tr>
<th>Facility</th>
<th>Sections</th>
</tr>
</thead>
<tbody>
<tr>
<td>DDI/DKI Driver Data Definitions</td>
<td>D1</td>
</tr>
<tr>
<td>DDI/DKI Driver Entry Point Routines</td>
<td>D2</td>
</tr>
<tr>
<td>DDI/DKI Kernel Utility Routines</td>
<td>D3</td>
</tr>
<tr>
<td>Portable Device Interface (PDI) Routines</td>
<td>D3G</td>
</tr>
<tr>
<td>SCSI Device Interface (SDI) Routines</td>
<td>D3I</td>
</tr>
<tr>
<td>DDI/DKI Kernel Data Structures</td>
<td>D4</td>
</tr>
<tr>
<td>SCSI Device Interface (SDI) Data Structures</td>
<td>D4I</td>
</tr>
<tr>
<td>DDI/DKI Kernel Defines</td>
<td>D5</td>
</tr>
</tbody>
</table>
SYSTEM FILES
AND DEVICES
REFERENCE

UNIX SVR4.2

Edited by Lynda Feng

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Table of Contents

Introduction

File Formats

a.out(4) .......................................................... ELF (Executable and Linking Format) files
acct(4) .......................................................................................................................... per-process accounting file format
admin(4) .......................................................................................................................... installation defaults file
aliases, addresses, forward(4) ................................................ (BSD) addresses and aliases for sendmail
ar(4) ............................................................................................................................... archive file format
archives(4) ....................................................................................................................... device header file
binariesys(4) ................................................................................................................... remote system information for the ckbinarsys command
boot(4) ............................................................................................................................. boot options
bootparams(4) ................................................................................................................... boot parameter data base
compver(4) ...................................................................................................................... compatible versions file
copyright(4) ................................................................................................................... copyright information file
core(4) ............................................................................................................................ core image file
cron, queuefs(4) ........................................................................................................... option files for crontab and at
depend(4) ......................................................................................................................... software dependencies files
dfstab(4) .......................................................................................................................... file containing commands for sharing resources
dirent(4) ............................................................................................................................ file system independent directory entry
dir (cdfs)(4) .................................................................................................................. format of CD-ROM file system (cdfs) directory data structure
dir (s5)(4) ....................................................................................................................... format of s5 directories
dir (ufs)(4) ..................................................................................................................... format of ufs directories
disk.cfg(4) ....................................................................................................................... configuration defaults for mass-storage and SCSI devices
dump(4) ............................................................................................................................ boot dump timeout file
ethers(4) .......................................................................................................................... Ethernet address to hostname database or domain
fd(4) ................................................................................................................................. file descriptor files
filehdr(4) .......................................................................................................................... file header for common object file (COFF)
fspec(4) ............................................................................................................................. format specification in text files
fstypes(4) .......................................................................................................................... file that registers distributed file system packages
fs (bfs)(4) ......................................................................................................................... format of the bfs file system volume
fs (cdfs)(4) ....................................................................................................................... format of a cdfs file system
fs (s5)(4) .......................................................................................................................... format of s5 file system volume
fs (sfs)(4) .......................................................................................................................... format of sfs file system volume
fs (ufs)(4) .......................................................................................................................... format of ufs file system volume
fs (vxfs)(4) ....................................................................................................................... format of vxfs file system volume
gettydefs(4) ..................................................................................................................... speed and terminal settings used by getty
group(4) ............................................................................................................................ group file
help(4) .............................................................................................................................. Desktop help file format
<table>
<thead>
<tr>
<th>File</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>prototype(4)</td>
<td>package information file</td>
</tr>
<tr>
<td>publickey(4)</td>
<td>public key database</td>
</tr>
<tr>
<td>Rc(4)</td>
<td>system startup script</td>
</tr>
<tr>
<td>res_major(4)</td>
<td>reserved major numbers for base system device drivers</td>
</tr>
<tr>
<td>resolv.conf(4)</td>
<td>configuration file for name server routines</td>
</tr>
<tr>
<td>rfmastert(4)</td>
<td>Remote File Sharing name server master file</td>
</tr>
<tr>
<td>routing(4)</td>
<td>system supporting for packet network routing</td>
</tr>
<tr>
<td>rpc(4)</td>
<td>rpc program number data base</td>
</tr>
<tr>
<td>rt_dptbl(4)</td>
<td>real-time dispatcher parameter table</td>
</tr>
<tr>
<td>Sassign(4)</td>
<td>configurable device variables</td>
</tr>
<tr>
<td>sccsfile(4)</td>
<td>format of SCCS file</td>
</tr>
<tr>
<td>Sd(4)</td>
<td>kernel module system shutdown script</td>
</tr>
<tr>
<td>services(4)</td>
<td>Internet services and aliases</td>
</tr>
<tr>
<td>setinfo(4)</td>
<td>set characteristics file</td>
</tr>
<tr>
<td>setsize(4)</td>
<td>disk space requirements file</td>
</tr>
<tr>
<td>shadow(4)</td>
<td>shadow password file</td>
</tr>
<tr>
<td>sharetab(4)</td>
<td>shared file system table</td>
</tr>
<tr>
<td>space(4)</td>
<td>disk space requirement file</td>
</tr>
<tr>
<td>Space.c(4)</td>
<td>configuration-dependent kernel module data structure initializations</td>
</tr>
<tr>
<td>stat(4)</td>
<td>(XENIX) data returned by stat system call</td>
</tr>
<tr>
<td>strcf(4)</td>
<td>STREAMS Configuration File for STREAMS TCP/IP</td>
</tr>
<tr>
<td>strftime(4)</td>
<td>language-specific strings</td>
</tr>
<tr>
<td>Stubs.c(4)</td>
<td>stubs for kernel module symbols</td>
</tr>
<tr>
<td>stune(4)</td>
<td>local system settings for tunable parameters</td>
</tr>
<tr>
<td>su(4)</td>
<td>su options file</td>
</tr>
<tr>
<td>syslog.conf(4)</td>
<td>(BSD) configuration file for syslogd system log daemon</td>
</tr>
<tr>
<td>System(4)</td>
<td>system-specific configuration information for a kernel module</td>
</tr>
<tr>
<td>tc.index(4)</td>
<td>configuration index file for mass-storage devices</td>
</tr>
<tr>
<td>term(4)</td>
<td>format of compiled term file</td>
</tr>
<tr>
<td>terinfo(4 N)</td>
<td>terminal capability data base</td>
</tr>
<tr>
<td>timezone(4)</td>
<td>set default system time zone</td>
</tr>
<tr>
<td>ttydefs(4)</td>
<td>file contains terminal line settings information for ttymon</td>
</tr>
<tr>
<td>ttysrch(4)</td>
<td>directory search list for ttymap and ttyname</td>
</tr>
<tr>
<td>unistd(4)</td>
<td>header file for symbolic constants</td>
</tr>
<tr>
<td>updaters(4)</td>
<td>configuration file for Network Information Service (NIS) updating</td>
</tr>
<tr>
<td>utmp, wttmp(4)</td>
<td>utmp and wttmp entry formats</td>
</tr>
<tr>
<td>utmpx, wttmpx(4)</td>
<td>utmpx and wttmpx entry formats</td>
</tr>
<tr>
<td>uuencode(4)</td>
<td>format of an encoded uuencode file</td>
</tr>
<tr>
<td>vfstab(4)</td>
<td>table of file system defaults</td>
</tr>
<tr>
<td>Xwincmaps(4)</td>
<td>XWIN color map file</td>
</tr>
<tr>
<td>Xwinconfig(4)</td>
<td>XWIN configuration file</td>
</tr>
<tr>
<td>Xwinfont(4)</td>
<td>XWIN font configuration and defaults file (scalable and bitmapped)</td>
</tr>
<tr>
<td>ypfiles(4)</td>
<td>the Network Information Service (NIS) database and directory structure</td>
</tr>
</tbody>
</table>
Miscellaneous Facilities

intro(5) .......................................................... introduction to miscellany
ascii(5) .......................................................... map of ASCII character set
environ(5) ...................................................... user environment
eqnchar(5) ...................................................... (BSD) special character definitions for eqn
eucioctl(5) .................................................... generic interface to EUC handling tty drivers and modules
fcntl(5) .......................................................... file control options
font(5) .......................................................... font description files for troff and dpost
iconv(5) ......................................................... code set conversion tables
langinfo(5) ..................................................... language information constants
man(5) .......................................................... macros to format Reference Manual pages
math(5) .......................................................... math functions and constants
me(5) .......................................................... (BSD) macros for formatting papers
ms(5) .......................................................... (BSD) text formatting macros
nl_types(5) .................................................... native language data types
priv(5) .......................................................... include file for user-level privilege definitions
privilege(5) .................................................. include file for privilege mechanism definitions
prof(5) .......................................................... profile within a function
regexp: compile, step, advance(5) ................. regular expression compile and match routines
siginfo(5) ..................................................... signal generation information
signal(5) ....................................................... base signals
stat(5) .......................................................... data returned by stat system call
stdarg(5) ..................................................... handle variable argument list
term(5) .......................................................... conventional names for terminals
types(5) ........................................................ primitive system data types
ucontext(5) ................................................... user context
values(5) ...................................................... machine-dependent values
varargs(5) .................................................... handle variable argument list
wstat(5) ....................................................... wait status

Special Files

intro(7) .......................................................... introduction to special files
adsc(7) .......................................................... Adaptec 1542A SCSI host adapter subsystem
alp(7) .......................................................... algorithm pool management module
ARP(7) .......................................................... Address Resolution Protocol
async(7) ........................................................ asynchronous serial port
clone(7) ........................................................ open any major/minor device pair on a STREAMS driver
connld(7) ..................................................... line discipline for unique stream connections
console(7) .................................................. STREAMS-based console interface
cram(7) ........................................................ CMOS RAM interface
DCD(7)  ................................................ Direct-Coupled Disk host adapter Subsystem
display(7) ................................................... system console display
dpt(7) ....................................................... DPT PM2012 SCSI host adapter subsystem
ee16(7) ...................................................... EtherExpress 16 Ethernet Adapter Driver
e116(7) ...................................................... EtherLink 16 Ethernet Adapter Driver
f0(7) ..................................................................................................................... diskette (floppy disk)
filesystem(7) ............................................. file system organization
i596(7) ...................................................... i596 Ethernet Driver
ibmtok(7) ................................................... IBM Token Ring Driver
ICMP(7) ................................................... Internet Control Message Protocol
ie6(7) ....................................................... 3C503 3Com Ethernet Driver
if(7) ....................................................... general properties of Internet Protocol network interfaces
imx856(7) ................................................... IMXLAN856 Intel Ethernet Driver
inet(7) ..................................................... Internet protocol family
IP(7) ....................................................... Internet Protocol
kbd(7) ..................................................... generalized string translation module
keyboard(7) ............................................. system console keyboard
kmem(7) ................................................... perform I/O on kernel memory based on symbol name
ldterm(7) ................................................... standard STREAMS terminal line discipline module
lo(7) ....................................................... software loopback network interface
log(7) ....................................................... interface to STREAMS error logging and event tracing
lp(7) ....................................................... parallel port interface
mcis(7) ................................................... MCIS SCSI host adapter driver
mem, kmem(7) .......................................... core memory
mouse(7) .............................................. mouse device driver for bus, serial, and PS/2 mouse devices
null(7) .................................................... the null file
pckt(7) ..................................................... STREAMS Packet Mode module
prf(7) ..................................................... operating system profiler
ptem(7) ................................................... STREAMS pseudo-terminal emulation module
pty(7) ..................................................... STREAMS pseudo-terminal driver
rtc(7) .................................................... real time clock interface
sad(7) ................................................... STREAMS Administrative Driver
sc01(7) ................................................... CD-ROM Target Driver
sd01(7) ................................................... PDI disk target driver
sockio(7) ................................................ ioctls that operate directly on sockets
st01(7) ................................................... Portable Device Interface (PDI) WORM Target Driver
streamio(7) ............................................. STREAMS ioctl commands
sw01(7) ................................................... Portable Device Interface (PDI) tape target driver
TCP(7) .................................................. Internet Transmission Control Protocol
termio(7) ............................................... general terminal interface
termiox(7) ............................................. extended general terminal interface
ticls, ticots, ticotsord(7) .............................. loopback transport providers
timod(7) .............................................. Transport Interface cooperating STREAMS module
tirdwr(7) .................................................. Transport Interface read/write interface STREAMS module
ttcompat(7) .................................................. V7, 4BSD and XENIX STREAMS compatibility module
tty(7) ............................................................ controlling terminal interface
UDP(7) ............................................................. Internet User Datagram Protocol
vxfsio(7) ........................................................ vxfs file system control functions
wd(7) .......................................................... Western Digital WD8003 Ethernet Driver
wd7000(7) ..................................................... WD7000 FASST2 host adapter subsystem
zero(7) ........................................................ source of zeroes

Permuted Index
Introduction

Computers keep track of thousands and thousands of details. To save the labor of continuously respecifying these details, information that is used repeatedly is stored in files, which the operating system references when needed. For example, when you turn the power on, the operating system reads a file that specifies which disks to mount; when you log in, it validates your password and sets up your environment; when you copy files from a remote system, it maps the software names to the network addresses.

The System Files and Devices Reference describes the system and device files in the UNIX System, including both special files and regular files. Special files pertain to a particular hardware device; regular files are hardware-independent. The book also includes a set of miscellaneous manual pages. Not all of the files and devices described in this manual are available on every UNIX system. Some of the features require additional utilities that may not exist on your system.

The System Files and Devices Reference is part of a comprehensive UNIX system reference set, which describes commands, system calls, libraries, and files. This book includes all manual pages in sections 4, 5, and 7. References to manual pages in other sections are found in other books in the reference set. The inner front cover of this book lists the various section numbers and the books in which they are found.

Manual Page Format

All manual page entries use a common format, not all of whose parts always appear:

- The NAME section gives the name(s) of the entry and briefly states its purpose.
- The SYNOPSIS section summarizes the use of the command, program or function, or names the relevant special file.
- The DESCRIPTION section describes the utility.
- The EXAMPLE section gives example(s) of usage, where appropriate.
- The FILES section gives the file names that are built into the program.
- The SEE ALSO section gives pointers to related information. Reference to manual pages with section numbers other than those in this book can be found in other reference manuals, as listed above.
The DIAGNOSTICS section discusses the diagnostic indications that may be produced. Messages that are intended to be self-explanatory are not listed.

The NOTES section gives generally helpful hints about the use of the utility.

**Request for Comment**

A Request for Comment (RFC) is a document that describes some aspect of networking technology. The RFCs cited in the SEE ALSO section of these manual pages are available in hardcopy from:

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RFC Editor  
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4676 Admiralty Way  
Marina del Rey, CA 90292-6695

Online versions of the RFCs are available by FTP from nic.ddn.mil. To connect to this host, type:

    ftp -n nic.ddn.mil

Log in with the user name *anonymous* and the password *guest*. To retrieve the RFC, type `get rfc:rfcnum.txt`, where *num* is replaced by the number of the RFC. For example, to retrieve RFC 1171, type

    get rfc:rfc1171.txt

At the end of the ftp session, type quit to exit.
NAME
a.out – ELF (Executable and Linking Format) files

SYNOPSIS
#include <elf.h>

DESCRIPTION
The file name a.out is the default output file name from the link editor, ld(1). The link editor will make an a.out executable if there were no errors in linking. The output file of the assembler, as(1), also follows the format of the a.out file although its default file name is different.

Programs that manipulate ELF files may use the library that elf(3E) describes. An overview of the file format follows. For more complete information, see the references given below.

<table>
<thead>
<tr>
<th>Linking View</th>
<th>Execution View</th>
</tr>
</thead>
<tbody>
<tr>
<td>ELF header</td>
<td>ELF header</td>
</tr>
<tr>
<td>Program header table</td>
<td>Program header table</td>
</tr>
<tr>
<td>optional</td>
<td></td>
</tr>
<tr>
<td>Section 1</td>
<td>Segment 1</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>Section n</td>
<td>Segment 2</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>...</td>
<td></td>
</tr>
<tr>
<td>Section header table</td>
<td>Section header table</td>
</tr>
<tr>
<td></td>
<td>optional</td>
</tr>
</tbody>
</table>

An ELF header resides at the beginning and holds a “road map” describing the file’s organization. Sections hold the bulk of object file information for the linking view: instructions, data, symbol table, relocation information, and so on. Segments hold the object file information for the program execution view. As shown, a segment may contain one or more sections.

A program header table, if present, tells the system how to create a process image. Files used to build a process image (execute a program) must have a program header table; relocatable files do not need one. A section header table contains information describing the file’s sections. Every section has an entry in the table; each entry gives information such as the section name, the section size, and so on. Files used during linking must have a section header table; other object files may or may not have one.

Although the figure shows the program header table immediately after the ELF header, and the section header table following the sections, actual files may differ. Moreover, sections and segments have no specified order. Only the ELF header has a fixed position in the file.

When an a.out file is loaded into memory for execution, three logical segments are set up: the text segment, the data segment (initialized data followed by uninitialized, the latter actually being initialized to all 0’s), and a stack. The text segment is not writable by the program; if other processes are executing the same a.out file, the processes will share a single text segment.
The data segment starts at the next maximal page boundary past the last text address. (If the system supports more than one page size, the "maximal page" is the largest supported size.) When the process image is created, the part of the file holding the end of text and the beginning of data may appear twice. The duplicated chunk of text that appears at the beginning of data is never executed; it is duplicated so that the operating system may bring in pieces of the file in multiples of the actual page size without having to realign the beginning of the data section to a page boundary. Therefore, the first data address is the sum of the next maximal page boundary past the end of text plus the remainder of the last text address divided by the maximal page size. If the last text address is a multiple of the maximal page size, no duplication is necessary. The stack is automatically extended as required. The data segment is extended as requested by the \texttt{brk(2)} system call.

\textbf{SEE ALSO}
\texttt{as(1), brk(2), cc(1), elf(3E), ld(1)}
NAME
acct – per-process accounting file format

SYNOPSIS
#include <sys/types.h>
#include <sys/acct.h>

DESCRIPTION
Files produced as a result of calling acct(2) have records in the form defined by
sys/acct.h, whose contents are:

typedef ushort comp_t; /* "floating point" */
/* 13-bit fraction, 3-bit exponent */

struct acct
{
    char ac_flag; /* Accounting flag */
    char ac_stat; /* Exit status */
    uid_t ac_uid; /* Accounting user ID */
    gid_t ac_gid; /* Accounting group ID */
    dev_t ac_ctty; /* control typewriter */
    time_t ac_btime; /* Beginning time */
    comp_t ac_utime; /* acctng user time in clock ticks */
    comp_t ac_stime; /* acctng system time in clock ticks */
    comp_t ac_etime; /* acctng elapsed time in clock ticks */
    comp_t ac_mem; /* memory usage in clicks */
    comp_t ac_io; /* chars transfrd by read/write */
    comp_t ac_rw; /* number of block reads/writes */
    char ac_comm[8]; /* command name */
};

extern struct acct acctbuf;
extern struct vnode *acctp; /* vnode of accounting file */

#define AFORK 01 /* has executed fork, but no exec */
#define ASU 02 /* used super-user privileges */
#define ACCTF 0300 /* record type: 00 = acct */
#define AEXPND 040 /* Expanded Record Type*/

In ac_flag, the AFORK flag is turned on by each fork and turned off by an exec.
The ac_comm field is inherited from the parent process and is reset by any exec.
Each time the system charges the process with a clock tick, it also adds to ac_mem
the current process size, computed as follows:

\[(\text{data size}) + (\text{text size}) / (\text{number of in-core processes using text})\]

The value of \(\frac{ac\_mem}{ac\_stime + ac\_utime}\) can be viewed as an approximation
to the mean process size, as modified by text sharing.

The structure tacct, which resides with the source files of the accounting commands,
represents the total accounting format used by the various accounting commands:
acct(4)

/*
 * total accounting (for acct period), also for day
 */

struct tacct {
    uid_t ta_uid;       /* userid */
    char ta_name[8];    /* login name */
    float ta_cpu[2];    /* cum. cpu time, p/np (mins) */
    float ta_kcore[2];  /* cum kcore-minutes, p/np */
    float ta_con[2];    /* cum. connect time, p/np, mins */
    float ta_du;        /* cum. disk usage */
    long ta_pc;         /* count of processes */
    unsigned short ta_sc; /* count of login sessions */
    unsigned short ta_dc; /* count of disk samples */
    unsigned short ta_fee; /* fee for special services */
};

SEE ALSO
acct(1M), acct(2), acctcom(1), exec(2), fork(2)

NOTES
The ac_mem value for a short-lived command gives little information about the actual size of the command, because ac_mem may be incremented while a different command (for example, the shell) is being executed by the process.
NAME

admin – installation defaults file

DESCRIPTION

admin is a generic name for an ASCII file that defines default installation actions by assigning values to installation parameters. For example, it allows administrators to define how to proceed when the package being installed already exists on the system.

/var/sadm/install/admin/default is the default admin file delivered with your system. The default file is not writable, so to assign values different from this file, create a new admin file. There are no naming restrictions for admin files. Name the file when installing a package with the -a option of pkgadd(1M). If the -a option is not used, the default admin file is used.

Each entry in the admin file is a line that establishes the value of a parameter in the following form:

    param=value

Eleven parameters can be defined in an admin file. A file is not required to assign values to all eleven parameters. If a value is not assigned, pkgadd asks the installer how to proceed.

The eleven parameters and their possible values are shown below except as noted. They may be specified in any order. Any of these parameters can be assigned the value ask, which means that, if the situation occurs, the installer is notified and asked to supply instructions at that time.

**basedir**

Indicates the base directory where relocatable packages are to be installed. The value may contain $PKGINST to indicate a base directory that is to be a function of the package instance.

**mail**

Defines a list of users to whom mail should be sent following installation of a package. If the list is empty, no mail is sent. If the parameter is not present in the admin file, the default value of root is used. The ask value cannot be used with this parameter.

**runlevel**

Indicates resolution if the run level (system state) is not correct for the installation or removal of a package. Options are:

    nocheck Do not check for run level (system state).
    quit Abort installation if run level (system state) is not met.

**conflict**

Specifies what to do if an installation expects to overwrite a previously installed file, thus creating a conflict between packages. Options are:

    nocheck Do not check for conflict; files in conflict will be overwritten.
    quit Abort installation if conflict is detected.
    nochange Override installation of conflicting files; they will not be installed.
admin(4)

setuid Checks for executables which will have setuid or setgid bits enabled after installation. Options are:

nocheck Do not check for setuid executables.
quit Abort installation if setuid processes are detected.
nochange Override installation of setuid processes; processes will be installed without setuid bits enabled.

action Determines if action scripts provided by package developers contain possible security impact. Options are:

nocheck Ignore security impact of action scripts.
quit Abort installation if action scripts may have a negative security impact.

partial Checks to see if a version of the package is already partially installed on the system. Options are:

nocheck Do not check for a partially installed package.
quit Abort installation if a partially installed package exists.

instance Determines how to handle installation if a previous version of the package (including a partially installed instance) already exists. Options are:

quit Exit without installing if an instance of the package already exists (does not overwrite existing packages).
overwrite Overwrite an existing package if only one instance exists. If there is more than one instance, but only one has the same architecture, it overwrites that instance. Otherwise, the installer is prompted with existing instances and asked which to overwrite. If an instance of the package was already fully installed, then it does not do a space check.
unique Do not overwrite an existing instance of a package. Instead, a new instance of the package is created. The new instance will be assigned the next available instance identifier.

idepend Controls resolution if other packages depend on the one to be installed. Options are:

nocheck Do not check package dependencies.
quit Abort installation if package dependencies are not met.

rdepend Controls resolution if other packages depend on the one to be removed. Options are:

nocheck Do not check package dependencies.
quit Abort removal if package dependencies are not met.
space Controls resolution if disk space requirements for package are not met. Options are:

nocheck Do not check space requirements (installation fails if it runs out of space).

quit Abort installation if space requirements are not met.

NOTES

The value ask should not be defined in an admin file that will be used for non-interactive installation (since by definition, there is no installer interaction). Doing so causes installation to fail when input is needed.

EXAMPLES

basedir=default
runlevel=quit
conflict=quit
setuid=quit
action=quit
partial=quit
instance=unique
idepend=quit
rdepend=quit
space=quit

SEE ALSO

pkgadd(1M)
aliases (4) (BSD System Compatibility)

NAME
aliases, addresses, forward – (BSD) addresses and aliases for sendmail

SYNOPSIS
/usr/ucblib/aliases
/usr/ucblib/aliases.dir
/usr/ucblib/aliases.pag
~/.forward

DESCRIPTION
These files contain mail addresses or aliases, recognized by sendmail, for the local host:
/etc/passwd Mail addresses (usernames) of local users.
/usr/ucblib/aliases Aliases for the local host, in ASCII format. This file can be
edited to add, update, or delete local mail aliases.
/usr/ucblib/aliases. { dir, pag} The aliasing information from /usr/ucblib/aliases, in
binary, dbm format for use by sendmail. The program,
newaliases, maintains these files.
~/.forward Addresses to which a user’s mail is forwarded (see
Automatic Forwarding, below).

In addition, the Network Information Service (NIS) aliases map mail.aliases contains
addresses and aliases available for use across the network.

Addresses
As distributed, sendmail supports the following types of addresses:

Local Usernames
username
Each local username is listed in the local host’s /etc/passwd file.

Local Filenames
pathname
Messages addressed to the absolute pathname of a file are appended to that file.

Commands
| command
If the first character of the address is a vertical bar, (|), sendmail pipes the mes-
sage to the standard input of the command the bar precedes.

DARPA-standard Addresses
username@domain
If domain does not contain any ‘.’ (dots), then it is interpreted as the name of a host
in the current domain. Otherwise, the message is passed to a mailhost that deter-
mines how to get to the specified domain. Domains are divided into subdomains
separated by dots, with the top-level domain on the right. Top-level domains
include:
Commercial organizations.
Educational organizations.
Government organizations.
Military organizations.

For example, the full address of John Smith could be:

```
js@jsmachine.Podunk-u.EDU
```

if he uses the machine named `jsmachine` at Podunk University.

**uucp Addresses**

... `[host!host!username]`

These are sometimes mistakenly referred to as “Usenet” addresses. `uucp` provides links to numerous sites throughout the world for the remote copying of files.

Other site-specific forms of addressing can be added by customizing the `sendmail` configuration file. See the `sendmail(1M)` for details. Standard addresses are recommended.

**Aliases**

**Local Aliases**

`/usr/ucb/lib/aliases` is formatted as a series of lines of the form

```
aliasname: address[, address]
```

*aliasname* is the name of the alias or alias group, and *address* is the address of a recipient in the group. Aliases can be nested. That is, an *address* can be the name of another alias group. Because of the way `sendmail` performs mapping from upper-case to lower-case, an *address* that is the name of another alias group must not contain any upper-case letters.

Lines beginning with white space are treated as continuation lines for the preceding alias. Lines beginning with `#` are comments.

**Special Aliases**

An alias of the form:

```
owner- aliasname : address
```

directs error-messages resulting from mail to *aliasname* to *address*, instead of back to the person who sent the message.

An alias of the form:

```
aliasname: :include:pathname
```

with colons as shown, adds the recipients listed in the file *pathname* to the *aliasname* alias. This allows a private list to be maintained separately from the aliases file.

**NIS Domain Aliases**

Normally, the aliases file on the master NIS server is used for the `mail.aliases` NIS map, which can be made available to every NIS client. Thus, the `/usr/ucb/lib/aliases*` files on the various hosts in a network will one day be
Domain-wide aliases should ultimately be resolved into usernames on specific hosts. For example, if the following were in the domain-wide alias file:

```
jsmith:js@jsmachine
```

then any NIS client could just mail to `jsmith` and not have to remember the machine and username for John Smith. If a NIS alias does not resolve to an address with a specific host, then the name of the NIS domain is used. There should be an alias of the domain name for a host in this case. For example, the alias:

```
jsmith:root
```

sends mail on a NIS client to `root@podunk-u` if the name of the NIS domain is `podunk-u`.

**Automatic Forwarding**

When an alias (or address) is resolved to the name of a user on the local host, `sendmail` checks for a `.forward` file, owned by the intended recipient, in that user’s home directory, and with universal read access. This file can contain one or more addresses or aliases as described above, each of which is sent a copy of the user’s mail.

Care must be taken to avoid creating addressing loops in the `.forward` file. When forwarding mail between machines, be sure that the destination machine does not return the mail to the sender through the operation of any NIS aliases. Otherwise, copies of the message may “bounce.” Usually, the solution is to change the NIS alias to direct mail to the proper destination.

A backslash before a username inhibits further aliasing. For instance, to invoke the `vacation` program, user `js` creates a `.forward` file that contains the line:

```
\js, "|/usr/ucb/vacation js"
```

so that one copy of the message is sent to the user, and another is piped into the `vacation` program.

**FILES**

/etc/passwd
/usr/ucblib/aliases
~/.forward

**SEE ALSO**

`dbm(3)`, `newaliases(1M)`, `sendmail(1M)`, `uucp(1C)`, `vacation(1)`

**NOTES**

Because of restrictions in `dbm` a single alias cannot contain more than about 1000 characters. Nested aliases can be used to circumvent this limit.
NAME
ar – archive file format

SYNOPSIS
#include <ar.h>

DESCRIPTION
The archive command ar [see ar(1)] is used to combine several files into one. Archives are used mainly as libraries to be searched by the link editor ld [see ld(1)]. Each archive begins with a unique string identifier called an archive magic string.

#define ARMAG "!<arch>
" /* magic string */
#define SARMAG 8 /* length of magic string */

Following the archive magic string are the archive file members. Each file member is preceded by a file member header which is of the following format:

#define ARFMAG "\n" /* header trailer string */

struct ar_hdr /* file member header */
{
    char    ar_name[16]; /* '/'
        terminated file member name */
    char    ar_date[12]; /* file member date */
    char    ar_uid[6]; /* file member user identification */
    char    ar_gid[6]; /* file member group identification */
    char    ar_mode[8]; /* file member mode (octal) */
    char    ar_size[10]; /* file member size */
    char    ar_fmag[2]; /* header trailer string */
};

All information in the file member headers is in printable ASCII. The numeric information contained in the headers is stored as decimal numbers (except for ar_mode which is in octal). Thus, if the archive contains printable files, the archive itself is printable.

If the file member name fits, the ar_name field contains the name directly, and is terminated by a slash (/) and padded with blanks on the right. If the member’s name does not fit, ar_name contains a slash (/) followed by a decimal representation of the name’s offset in the archive string table described below.

The ar_date field is the modification date of the file at the time of its insertion into the archive. Common format archives can be moved from system to system as long as the portable archive command ar is used.

Each archive file member begins on an even byte boundary; a newline is inserted between files if necessary. Nevertheless, the size given reflects the actual size of the file exclusive of padding.

Notice there is no provision for empty areas in an archive file.
Each archive that contains object files [see a.out(4)] includes an archive symbol table. This symbol table is used by the link editor ld to determine which archive members must be loaded during the link edit process. The archive symbol table (if it exists) is always the first file in the archive (but is never listed) and is automatically created and/or updated by ar.

The archive symbol table has a zero length name (that is, ar_name[0] is '/', ar_name[1]==', and so on). All “words” in this symbol table have four bytes, using the machine-independent encoding shown below. (All machines use the encoding described here for the symbol table, even if the machine’s “natural” byte order is different.)

```
+---+---+---+---+
| 0 | 1 | 2 | 3 |
+---+---+---+---+
0x01020304
```

The contents of the symbol table are as follows:
1. The number of symbols. Length: 4 bytes.
2. The array of offsets, one per symbol, into the archive file. Length: 4 bytes * “the number of symbols”.
3. The name string table. Length: ar_size – 4 bytes * (“the number of symbols” + 1).

As an example, the following symbol table defines 4 symbols. The archive member at file offset 114 defines name and object. The archive member at file offset 426 defines function and a second version of name.

```
Offset +0 +1 +2 +3 4 offset entries
0       4
4      114 name
8      114 object
12     426 function
16     426 name
20     name
24    \0 object
28    ect \0
32    unc
36    i on
40    n a m
44    e \0
```

The number of symbols and the array of offsets are managed with sgetl and sputl. The string table contains exactly as many null terminated strings as there are elements in the offsets array. Each offset from the array is associated with the corresponding name from the string table (in order). The names in the string table are all the defined global symbols found in the common object files in the archive. Each offset is the location of the archive header for the associated symbol.
If some archive member's name is more than 15 bytes long, a special archive member contains a table of file names, each followed by a slash and a new-line. This string table member, if present, will precede all "normal" archive members. The special archive symbol table is not a "normal" member, and must be first if it exists. The ar_name entry of the string table's member header holds a zero length name ar_name[0]=='/', followed by one trailing slash (ar_name[1]=='/'), followed by blanks (ar_name[2]==' ', and so on). Offsets into the string table begin at zero. Example ar_name values for short and long file names appear below.

<table>
<thead>
<tr>
<th>Offset</th>
<th>+0</th>
<th>+1</th>
<th>+2</th>
<th>+3</th>
<th>+4</th>
<th>+5</th>
<th>+6</th>
<th>+7</th>
<th>+8</th>
<th>+9</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>file</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>sample/</td>
<td>/</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>name</td>
<td>file</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>example/</td>
<td>/</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Member Name</th>
<th>ar_name</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>short-name</td>
<td>short-name/</td>
<td>Not in string table</td>
</tr>
<tr>
<td>file_name_sample</td>
<td>/0</td>
<td>Offset 0 in string table</td>
</tr>
<tr>
<td>longerfilenameexample</td>
<td>/18</td>
<td>Offset 18 in string table</td>
</tr>
</tbody>
</table>

SEE ALSO
a.out(4), ar(1), ld(1), sput1(3X), strip(1)

NOTES
strip will remove all archive symbol entries from the header. The archive symbol entries must be restored via the -ts options of the ar command before the archive can be used with the link editor ld.
archives (4)

NAME
archives — device header file

DESCRIPTION
/* Magic numbers */
#define CMN_ASC 0x070701 /* Cpio Magic Number for ASCii header */
#define CMN_BIN 070707 /* Cpio Magic Number for Binary header */
#define CMN_BBS 0143561 /* Cpio Magic Number for Byte-Swap header */
#define CMN_CRC 0x070702 /* Cpio Magic Number for CRC header */
#define CMS_ASC "070701" /* Cpio Magic String for ASCii header */
#define CMS_CHR "070707" /* Cpio Magic String for CHR (-c) header */
#define CMS_CRC "070702" /* Cpio Magic String for CRC header */
#define CMICSEC 0x070703 /* Cpio Magic String for TIlE header */
#define CMS_SEC "070703" /* Cpio Magic String for TIlE header */
#define CMS_LEN 6 /* Cpio Magic String LENGTH */

/* Various header and field lengths */
#define CHRSZ 76 /* -c hdr size minus filename field */
#define ASCSZ 110 /* ASC and CRC hdr size minus filename field */
#define TARSZ 512 /* TAR hdr size */
#define HNAMLEN 256 /* maximum filename length for binary and -c headers */
#define EXPNLEN 1024 /* maximum filename length for ASC and CRC headers */
#define HTIMLEN 2 /* length of modification time field */
#define HSIZLEN 2 /* length of file size field */

/* cpio binary header definition */
struct hdr_cpio {
  short  h_magic, /* magic number field */
          h_dev, /* file system of file */
  ushort_t h_ino, /* inode of file */
          h_mode, /* modes of file */
          h_uid, /* uid of file */
          h_gid; /* gid of file */
  short  h_nlink, /* number of links to file */
          h_rdev, /* maj/min numbers for special files */
          h_mtime[HTIMLEN], /* modification time of file */
          h_namesize, /* length of filename */
          h_filesize[HSIZLEN]; /* size of file */
  char   h_name[HNAMLEN]; /* filename */
};

/* cpio ODC header format */
struct c_hdr {
  char   c_magic[CMS_LEN],
          c_dev[6],
          c_ino[6],
          c_mode[6],
          c_uid[6],
          c_gid[6],
          c_nlink[6],
          c_rdev[6],
          c_mtime[11],
          c_namesz[6],
          c_filesz[11],
c_name[HNAMELEN];

} ;

/* -c and CRC header format */

struct Exp_cpio_hdr {
    char E_magic[CMS_LEN],
        E_ino[8],
        E_mode[8],
        E_uid[8],
        E_gid[8],
        E_nlink[8],
        E_mtime[8],
        E_filesize[8],
        E_maj[8],
        E_min[8],
        E_rmaj[8],
        E_rmin[8],
        E_namesize[8],
        E_chksum[8],
        E_name[EXPNLEN];
};

/* Tar header structure and format */
#define TBLOCK 512 /* length of tar header and data blocks */
#define TNAMELEN 100 /* maximum length for tar file names */
#define TMODELEN 8 /* length of mode field */
#define TUIDLEN 8 /* length of uid field */
#define TGIDLEN 8 /* length of gid field */
#define TSIZLEN 12 /* length of size field */
#define TTIMLEN 12 /* length of modification time field */
#define TCRCLEN 8 /* length of header checksum field */

/* tar header definition */
union tblock {
    char dummy[TBLOCK];
    struct tar_hdr {
        struct tar_hdr {
            char t_name[TNAMELEN], /* name of file */
            t_mode[TMODELEN], /* mode of file */
            t_uid[TUIDLEN], /* uid of file */
            t_gid[TGIDLEN], /* gid of file */
            t_size[TSIZLEN], /* size of file in bytes */
            t_mtime[TTIMLEN], /* modification time of file */
            t_cksum[TCRCLEN], /* checksum of header */
            t_typeflag,
            t_linkname[TNAMELEN],/* file this file linked with */
            t_magic[TMAGLEN],
            t_version[TVERSLEN],
            t uname[32],
            t_gname[32],
            t_devmajor[8],
            t_devminor[8],
            t_prefix[155];
        } tbuf;
    }
};
archives(4)

/* volcopy tape label format and structure */

#define VMAGLEN 8
#define VVOLLEN 6
#define VFILLEN 464

struct volcopy_label {
    char v_magic[VMAGLEN],
        v_volume[VVOLLEN],
        v_reels,
        v_reel;
    long v_time,
        v_length,
        v_dens,
        v_reelblks,       /* u370 added field */
        v_blksize,        /* u370 added field */
        v_nbblocks;       /* u370 added field */
    char v_fill[VFILLEN];
    long v_offset;      /* used with -e and -reel options */
    int v_type;         /* does tape have nblocks field? */
};
NAME
binarsys – remote system information for the ckbinarsys command

DESCRIPTION
binarsys contains lines of the form:

remote_system_name: val

where val is either Y or N. This line indicates whether that particular remote system can properly deal with messages having binary content. The absence of an entry for a particular system or absence of the binaries file altogether will imply No.

Blank lines or lines beginning with # are considered comments and ignored. Should a line of Default=y be encountered, the default condition for missing entries described in the previous paragraph is reversed to be Yes. Another line of Default=n will restore the default condition to No.

mail is distributed with the binaries file containing only a Default=y line.

FILES
/etc/mail/binarsys

SEE ALSO
ckbinarsys(1M), mailsurr(4), mail(1)
NAME

boot – boot options

DESCRIPTION

Options for the boot program can be set or changed with keywords in /stand/boot. The following are recognized by boot.

BOOTMSG=string

Change the default boot message to string.

MEMRANGE=range:flag[,range:flag ...]

Tell boot where to look when sizing memory. A range is a pair of decimal addresses, separated by a dash such as 1M-4M. The flag indicates how the range should be interpreted. The following flags are recognized:

256 - B_MEM_BASE (0x100)
512 - B_MEM_EXPAN (0x200)
8704 - B_MEM_FORCE (0x2000) + B_MEM_EXPAN

If /stand/boot does NOT exist, the boot program uses the CMOS values as the maximum when probing for RAM (default case).

If /stand/boot does exist, use the MEMRANGE entry to override the CMOS values. Examples:

Probe for the minimum of 4M or the CMOS values:

MEMRANGE=0-640K:256,1M-4M:512

Probe for 64MB and ignore the CMOS values as the maximum:

MEMRANGE=0-640K:256,1M-16M:512,16M-64M:8704

Note: if B_MEM_FORCE is set it will ignore the CMOS setting for that range. The CMOS setting can only be ignored for memory above 16MB and only if the initial address of the range is above 16MB.

In addresses, use ‘M’ to indicate megabytes and ‘K’ to indicate kilobytes. The first address in the pair is inclusive; the last address is exclusive. When sizing the base memory (0-640K usually) the boot code checks the CMOS for the current base memory setting. If this value is less than the current base memory value, the kernel uses this lower value instead of 640K.

variable=value

All other lines of the form variable=value are passed as arguments to the kernel as is, via argv[].

FILES

/stand/boot
/etc/initprog/boot

SEE ALSO

boot(1)
NAME

**bootparams** – boot parameter data base

SYNOPSIS

**bootparams**

DESCRIPTION

**bootparams** contains a list of client entries that diskless clients use for booting. Each entry contains the following information for each diskless client:

- **name**    **server names and pathnames**

The first field contains the name of the diskless client. The subsequent field is a list of keys, names of servers, and pathnames.

Fields are delineated with TABs.

A client entry in the local **bootparams** file supersedes an entry in the corresponding Network Information Service (NIS) map.

EXAMPLE

This is an example of the **bootparams** file.

```
    client1 root=grpserver:/nfsroot/client1
    swap=grpserver:/nfsswap/client1
    dump=grpserver:/nfsdump/client1
```

SEE ALSO

**bootparamd**(1M)
compver(4)

NAME
compver – compatible versions file

DESCRIPTION
compver is an ASCII file used to specify previous versions of the associated package which are upward compatible. It is created by a package developer.

Each line of the file specifies a previous version of the associated package with which the current version is backward compatible.

Since some packages may require installation of a specific version of another software package, compatibility information is extremely crucial. Consider, for example, a package called "A" which requires version "1.0" of application "B" as a prerequisite for installation. If the customer installing "A" has a newer version of "B" (1.3), the compver file for "B" must indicate that "1.3" is compatible with version "1.0" in order for the customer to install package "A."

NOTES
The comparison of the version string disregards white space and tabs. It is performed on a word-by-word basis. Thus 1.3 Enhanced and 1.3 Enhanced would be considered the same.

EXAMPLE
A sample compver file is shown below.

```
1.3
1.0
```

SEE ALSO
depend(4)
NAME

copyright – copyright information file

DESCRIPTION

copyright is an ASCII file used to provide a copyright notice for a package. The text may be in any format. The full file contents (including comment lines) is displayed on the terminal at the time of package installation.
NAME

core – core image file

DESCRIPTION

The UNIX system writes out a core image of a process when it is terminated due to
the receipt of some signals. The core image is called core and is written in the
process’s current directory (provided it can be; normal access controls apply). A
process with an effective user ID different from the real user ID will not produce a
core image.

The core file contains all the process information pertinent to debugging: contents
of hardware registers, process status and process data. The format of a core file is
object file specific.

For ELF executable programs [see a.out(4)], the core file generated is also an ELF
file, containing ELF program and file headers. The e_type field in the file header
has type ET_CORE. The program header contains an entry for every loadable and
writable segment that was part of the process address space, including shared
library segments. The contents of the segments themselves are also part of the core
image.

The program header of an ELF core file also contains a NOTE segment. This segment
may contain the following entries. Each has entry name "CORE" and presents the
contents of a system structure:

prstatus_t

The entry containing this structure has a NOTE type of 1. This structure con­tains
things of interest to a debugger from the operating system’s u-area, such as the
general registers, signal dispositions, state, reason for stopping, process ID and so forth. The structure is defined in sys/procfs.h.

fpregset_t

This entry is present only if the process used the floating-point hardware. It
has a NOTE type of 2 and contains the floating-point registers. The
fpregset_t structure is defined in sys/regset.h.

prpsinfo_t

The entry containing this structure has a NOTE type of 3. It contains infor­mation
of interest to the ps(1) command, such as process status, cpu usage,"nice" value, controlling terminal, user ID, process ID, the name of the exe­cutable and so forth. The structure is defined in sys/procfs.h.

COFF executable programs produce core files consisting of two parts: the first sec­tion is a copy of the system’s per-user data for the process, including the general
registers. The format of this section is defined in the header files sys/user.h and
sys/reg.h. The remainder of a COFF core image represents the actual contents of
the process data space.

The size of the core file created by a process may be controlled by the user [see
getrlimit(2)].

SEE ALSO

a.out(4), crash(1M), elf(3E), getrlimit(2), sdb(1), setuid(2), signal(5)
NAME
cron, queuedefs - option files for crontab and at

DESCRIPTION
Options for cron(1M) can be set or changed with keywords in
/etc/default/cron. The following keywords are recognized by cron:
CRONLOG=YES or NO  If CRONLOG is set to YES, all cron jobs are logged in
/usr/lib/cron/log. The default is NO.

Options for crontab(1) and at(1) can be set or changed with keywords in
/etc/cron.d/queuedefs. The format of the file is as follows:

   a.4j1n
   b.2j2n90w

The first line specifies how at(1) jobs are to be handled:
   Start a maximum of 4 concurrent jobs per user.
   Use a nice(1) value of 1.
   Do not retry jobs that cannot start because fork(2) fails.

The second line specifies how crontab(1) jobs are to be handled:
   Start a maximum of 2 concurrent jobs per user.
   Use a nice(1) value of 2.
   Wait 90 seconds, then try again to start jobs that cannot start because
   fork(2) fails.

FILES
/etc/default/cron Control logging of cron jobs.
/etc/cron.d/queuedefs Specify concurrency, priority, and retry interval.

SEE ALSO
at(1), cron(1M), crontab(1)
depend (4)

NAME
depend – software dependencies files

DESCRIPTION
depend is an ASCII file used to specify information concerning software dependencies for a particular package. The file is created by a software developer.

Each entry in the depend file describes a single software package. The instance of the package is described after the entry line by giving the package architecture and/or version. The format of each entry and subsequent instance definition is:

    type pkg name
    (arch)version
    (arch)version

The fields are:

- **type**: Defines the dependency type. Must be one of the following characters:
  - P: Indicates a prerequisite for installation, for example, the referenced package or versions must be installed.
  - I: Implies that the existence of the indicated package or version is incompatible.
  - R: Indicates a reverse dependency. Instead of defining the package's own dependencies, this designates that another package depends on this one. This type should be used only when an old package does not have a depend file but it relies on the newer package nonetheless. Therefore, the present package should not be removed if the designated old package is still on the system since, if it is removed, the old package will no longer work.

- **pkg**: Indicates the package abbreviation.

- **name**: Specifies the full package name.

- **(arch)version**: Specifies a particular instance of the software. A version name cannot begin with a left parenthesis. The instance specifications, both arch and version, are completely optional but each must begin on a new line that begins with white space. If no version set is specified, any version of the indicated package will match. A version preceded by a tilde (') indicates that any compatible version will be a match. [See compver(4).]

EXAMPLE

Here is a sample depend file (for the NFS package):

```
P base Base System
P nsu Networking Support Utilities
P inet Internet Utilities
P rpc Remote Procedure Call Utilities
P dfs Distributed File System Utilities
```
SEE ALSO

compver(4)
dfstab(4)

NAME
dfstab - file containing commands for sharing resources

DESCRIPTION
dfstab resides in directory /etc/dfs and contains commands for sharing resources across a network. dfstab gives a network administrator a uniform method of controlling the automatic sharing of local resources.

Each line of the dfstab file consists of a share(1M) command. The dfstab file can be read by the shell directly to share all resources, or network administrators can prepare their own shell scripts to execute particular lines from dfstab.

The contents of dfstab are executed automatically when the system enters run level 3.

SEE ALSO
share(1M), shareall(1M)
NAME
dirent – file system independent directory entry

SYNOPSIS
#include <sys/types.h>
#include <sys/dirent.h>

DESCRIPTION
Different file system types may have different directory entries. The dirent struc­
ture defines a file system independent directory entry, which contains information
common to directory entries in different file system types. A set of these structures
is returned by the getdents(2) system call.

The dirent structure is defined below.

```c
struct dirent {
    ino_t d_ino;
    off_t d_off;
    unsigned short d_reclen;
    char d_name[1];
};
```

The d_ino is a number which is unique for each file in the file system. The field
d_off is the offset of the subsequent directory entry in the actual file system direc­
tory. The field d_name is the beginning of the character array giving the name of
the directory entry. This name is null terminated and may have at most MAXNAMLEN
characters. This results in file system independent directory entries being variable
length entities. The value of d_reclen is the record length of this entry. This
length is defined to be the number of bytes between the current entry and the next
one, so that the next structure will be suitably aligned.

SEE ALSO
getdents(2)
NAME
dir (cdfs) – format of CD-ROM file system (cdfs) directory data structure

SYNOPSIS
#include <sys/fs/iso9660.h>
#include <sys/fs/cdfs_inode.h>

DESCRIPTION
In a cdfs file system, the contents of a file or directory are stored in contiguous physical sectors called an extent. The contents of a directory are stored in a single extent. The contents of a file may be stored in multiple non-adjacent extents. More than one file can share the same extent. The first sector of each extent may contain an Extended Attribute Record (XAR) that describes additional attributes of the file or directory (such as the User ID, Group ID, permissions).

Each directory in a cdfs filesystem contains two or more Directory Records. These directory records identify the file and subdirectories owned by the directory. For each file or subdirectory in the directory, there will exist one Directory Record for each extent belonging to that file/subdirectory. Each Directory Record is of variable length and contains information such as:

- the name of the file or subdirectory
- the location and size of its extent
- a System Use Area

Note: For a multi-extent file, there will be one directory record for each extent in the file.

Each Directory Record has a System Use Area (SUA) that stores information about other operating system standards, such as additional file-related information not defined by the ISO-9660 specification. The SUA can be used to store information required to support POSIX standards. For example, the SUA can contain the device file major/minor numbers, which are defined by the POSIX standard. The System Use Sharing Protocol (SUSP) defines how the information in the SUA is defined.

The Directory Record data structure is defined in the iso9660.h header file. For each cdfs file and directory currently being referenced, an in-core data structure, struct cdfs_drec, is used to store the relevant portions of all of the Directory Records belonging to that file or directory. Each cdfs_drec also stores other information relating to the extent and/or Directory Record. The cdfs_drec structure is defined in the cdfs_inode.h header file.

The cdfs_drec structure is as follows:
struct cdfs_drec {
  struct cdfs_drec *drec_NextDR; /* Pointer to next Dir Rec */
  struct cdfs_drec *drec_PrevDR; /* Pointer to previous Dir Rec */
  uint_t drec_Loc; /* Loc of media DREC (L-Sec #) */
  uint_t drec_Offset; /* # bytes from L-sec start */
  uint_t drec_Len; /* Len of media Dir Rec (Bytes) */
  uint_t drec_XarLen; /* Len of media XAR (Log Blk) */
  daddr_t drec_EncLoc; /* Location of Extent (L-Blk #) */
  uint_t drec_DataLen; /* Len of File Sec data */
  timestruc_t drec_Date; /* Recording date and time */
  uint_t drec_Flags; /* Flags - See below */
  uint_t drec_UnitSz; /* File Unit Size */
  uint_t drec_Interleave; /* Interleave Gap Size */
  uint_t drec_VolSeqNum; /* Volume Sequence Number */
  uint_t drec_FileIDLen; /* Len of File ID String */
  uint_t drec_FileIOOff; /* Dir Rec offset of File ID */
  uint_t drec_SysUseOff; /* Dir Rec offset of Sys Use Area */
  uint_t drec_SysUseSz; /* Size of Sys Use Area */
};

REFERENCES

cdfs-specific fs(4), cdfs-specific inode(4)
System Use Sharing Protocol, and Rock Ridge Interchange Protocol from Rock Ridge
for Information Processing: Volume and File Structure of CD-ROM Information Inter-
change in Optical Information Systems magazine, January/February 1987

31
NAME

dir (s5) – format of s5 directories

SYNOPSIS

#include <sys/types.h>
#include <sys/fs/s5dir.h>

DESCRIPTION

A directory behaves exactly like an ordinary file, save that no user may write into a
directory. The fact that a file is a directory is indicated by a bit in the mode word of
its i-node entry [see the s5-specific inode(4)]. The structure of a directory entry as
given in the include file is:

#ifndef DIRSIZ
#define DIRSIZ 14
#endif

struct direct
{
    o_ino_t    d_ino;    /* s5 inode type */
    char       d_name[DIRSIZ];
};

By convention, the first two entries in each directory are . for the entry itself and ..
for the parent directory. The meaning of .. is modified for the root directory of the
master file system; there is no parent, so .. has the same meaning as . has.

SEE ALSO

s5_specific inode(4)
NAME

dir (ufs) – format of ufs directories

SYNOPSIS

#include <sys/param.h>
#include <sys/types.h>
#include <sys/fs/ufs_fsdir.h>

DESCRIPTION

A directory consists of some number of blocks of \texttt{DIRBLKSIZ} bytes, where \texttt{DIRBLKSIZ} is chosen such that it can be transferred to disk in a single atomic operation (for example, 512 bytes on most machines).

Each \texttt{DIRBLKSIZ}-byte block contains some number of directory entry structures, which are of variable length. Each directory entry has a \texttt{struct direct} at the front of it, containing its inode number, the length of the entry, and the length of the name contained in the entry. These are followed by the name padded to a 4 byte boundary with null bytes. All names are guaranteed null-terminated. The maximum length of a name in a directory is \texttt{MAXNAMLEN}.

#define DIRBLKSIZ DEV_BBIZE
#define MAXNAMLEN 256

struct direct {
    u_long d_ino; /* inode number of entry */
    u_short d_reclen; /* length of this record */
    u_short d_namlen; /* length of string in d_name */
    char d_name[MAXNAMLEN + 1]; /* name must be no longer than this */
};

SEE ALSO

ufs-specific fs(4)
NAME
disk.cfg – configuration defaults for mass-storage and SCSI devices

DESCRIPTION
Default values used by the pdiadd and pdirm commands can be set or changed with keywords in /etc/conf/pack.d/*/disk.cfg, where the * represents the name of any PDI-capable devices supported by your release of the UNIX System.

Environment Variables
The following variables are recognized in disk.cfg:

**NAMES** Specifies the short name of this device, and is used in the UNIX System configuration as the directory name for the device, as represented by the * above. For example,

```
NAMES=adsc
```

means that the device driver will be known by the string adsc. The NAMES variable is required in /etc/conf/pack.d/*/disk.cfg.

**NAMEL** Specifies the long name of this device in the UNIX System configuration. For example,

```
NAMEL="Adaptec Host Adapter"
```

means that the device driver is an Adaptec Host Adapter. Notice that the long name must be enclosed in double quotes, because it contains space characters. This name is used for informational messages. The NAMEL variable is required in /etc/conf/pack.d/*/disk.cfg.

**SHAR** Specifies the value for the ishare flag for this device, and this flag is used in the UNIX System configuration for the device. For example,

```
SHAR=1
```

means that the device driver cannot share interrupts with other devices in your UNIX System.

**IVEC** Specifies the value for the interrupt vector used by this device, and is used in the UNIX System configuration for the device. For example,

```
IVEC=1
```

means that the device driver can only be configured at interrupt 1. Another way that a value for IVEC may be specified is

```
IVEC="14 15 11"
```

which means that the device driver can be configured at either interrupt 14, 15, or 11. This line also indicates that interrupt 14 is the default value, because it is the first value listed. The IVEC variable is required in /etc/conf/pack.d/*/disk.cfg. If the device does not use interrupts, the value 0 should be specified.

**DMA1** Specifies the value for the DMA channel used by this device, and is used in the UNIX System configuration for the device. For example,

```
DMA1=1
```
means that the device driver can only be configured at DMA channel 1. Another way that a value for $\text{DMA1}$ may be specified is

$$\text{DMA1}="5\;6\;7"$$

which means that the device driver can be configured at either DMA channel 5, 6, or 7. This line also indicates that DMA channel 5 is the default value, because it is the first value listed. The $\text{DMA1}$ variable is required in `/etc/conf/pack.d/*/disk.cfg`. If the device does not use a DMA channel, the value 0 should be specified.

**IOADDR**

Specifies the value for the I/O addresses used by this device, and is used in the UNIX System configuration for the device. For example,

$$\text{IOADDR}="170-178"$$

means that the device driver can only be configured at I/O address $0x170$, and needs all addresses up to and including $0x178$. Another way that a value for $\text{IOADDR}$ may be specified is

$$\text{IOADDR}="170-178\;1F0-1F8"$$

which means that the device driver can be configured at starting I/O address $0x170$ or $0x1F0$. The value specified after the dash always indicates the end of the address range required by this device. This line also indicates that $0x170$ is the default value for starting I/O address for this device, because it is the first value listed. The $\text{IOADDR}$ variable is required in `/etc/conf/pack.d/*/disk.cfg` if the device uses an address range for I/O registers. Do not use prefix $0x$ when specifying values for $\text{IOADDR}$.

**MEMADDR**

Specifies the value for the memory addresses used by this device, and is used in the UNIX System configuration for the device. For example,

$$\text{MEMADDR}="C8000-C9FFF"$$

means that the device driver can only be configured at memory address $0xC8000$ and needs all addresses up to and including $0xC9FFF$. Another way that a value for $\text{MEMADDR}$ may be specified is

$$\text{MEMADDR}="C8000-C9FFF\;D6000-D7FFF"$$

which means that the device driver can be configured at starting memory address $0xC8000$ or $0xD6000$. The value specified after the dash always indicates the end of the address range required by this device. This line also indicates that $0xC8000$ is the default value for starting memory address for this device, because it is the first value listed. The $\text{MEMADDR}$ variable is required in `/etc/conf/pack.d/*/disk.cfg`. If the device does not use an address range for a boot ROM or other purposes, a value of $0-0$" should be specified. This value is a valid value in a list of acceptable values if the use of a memory address is optional for this device. The prefix $0x$ must not be used in the specification of values for $\text{MEMADDR}$. 

35
**DEVICE**

Specifies the controller type for this device, and is used to control the UNIX System configuration for the device. For example,

```
DEVICE=DCD
```

means that the device is a Directly Coupled Device, while

```
DEVICE=SCSI
```

means that the device is a SCSI device. The `DEVICE` variable is required in `/etc/conf/pack.d/*/disk.cfg`. The only allowable values for `DEVICE` are DCD and SCSI.

**DEVTYPE**

Specifies the type of this device, and is used to control the UNIX System configuration for the device. For example,

```
DEVTYPE=DISK
```

means that the device is a disk device, while

```
DEVTYPE=TAPE
```

means that the device is a tape device. The `DEVTYPE` variable is required in `/etc/conf/pack.d/*/disk.cfg` if the value of `DEVICE` is DCD. The only allowable values for `DEVTYPE` are `DISK` or `TAPE`.

**DCD_IPL**

Must contain the same value as the default value for the `IPL` variable. This variable is used during the configuration process to record the current value of the `IPL` variable for this device. For example,

```
DCD_IPL=5
```

means that this DCD device is configured at IPL 5 in the current UNIX System kernel. The `DCD_IPL` variable is required in `/etc/conf/pack.d/*/disk.cfg` if the value of `DEVICE` is DCD.

**DCD_SHAR**

Must contain the same value as the default value for the `SHAR` variable. This variable is used during the configuration process to record the current value of the `SHAR` variable for this device. For example,

```
DCD_SHAR=3
```

means that this DCD device is configured at SHAR 3 in the current UNIX System kernel. The `DCD_SHAR` variable is required in `/etc/conf/pack.d/*/disk.cfg` if the value of `DEVICE` is DCD.

**DCD_IVEC**

Must contain the same value as the default value for the `IVEC` variable. This variable is used during the configuration process to record the current value of the `IVEC` variable for this device. For example,

```
DCD_IVEC=14
```

means that this DCD device is configured at IVEC 14 in the current UNIX System kernel. The `DCD_IVER` variable is required in `/etc/conf/pack.d/*/disk.cfg` if the value of `DEVICE` is DCD.
Files
/etc/conf/pack.d/*/disk.cfg

SEE ALSO
pdiadd(1M), pdirm(1M)
dump(4)

NAME
dump – boot dump timeout file

DESCRIPTION
The /etc/default/dump file contains keywords recognized by the timeout code. When the system boots, if there is a system dump in the swap device, the system asks if you want to save the dump. After n seconds, the system assumes that you do not. The keyword TIME specifies the number of seconds that the system should wait before timing out.

TIME=n  If n is zero, the save the dump question is never asked. If the line is missing, the system waits forever. Otherwise, the system waits n seconds.

Files
/etc/default/dump
NAME
.
environ, .pref, .variables – user-preference variable files for FACE

DESCRIPTION
The .environ, .pref, and .variables files contain variables that indicate user preferences for a variety of operations. The .environ and .variables files are located under the user’s $HOME/pref directory. The .pref files are found under $HOME/FILECABINET, $HOME/WASTEBASKET, and any directory where preferences were set via the organize command. Names and descriptions for each variable are presented below. Variables are listed one per line and are of the form variable=value.

Variables found in .environ include:
LOGINWIN[1-4] Windows that are opened when FACE is initialized
SORTMODE Sort mode for file folder listings. Values include the following hexadecimal digits:

1 sorted alphabetically by name
2 files most recently modified first
800 sorted alphabetically by object type

The values above may be listed in reverse order by “ORing” the following value:
1000 list objects in reverse order. For example, a value of 1002 will produce a folder listing with files least recently modified displayed first. A value of 1001 would produce a “reverse” alphabetical by name listing of the folder

DISPLAYMODE Display mode for file folders. Values include the following hexadecimal digits:

0 file names only
4 file names and brief description
8 file names, description, plus additional information

WASTEPROMPT Prompt before emptying wastebasket (yes/no)?
WASTEDAYS Number of days before emptying wastebasket
PRINCMD[1-3] Print command defined to print files.
UMASK Holds default permissions that files will be created with.

Variables found in .pref are the following:
SORTMODE which has the same values as the SORTMODE variable described in .environ above.

DISPLAYMODE which has the same values as the DISPLAYMODE variable described in .environ above.

Variables found in .variables include:
environ (4)

EDITOR         Default editor
PS1            UNIX shell prompt

FILES
$HOME/pref/.environ
$HOME/pref/.variables
$HOME/FILECABINET/.pref
$HOME/WASTEBASKET/.pref
NAME
ethers – Ethernet address to hostname database or domain

DESCRIPTION
The ethers file contains information regarding the known (48 bit) Ethernet addresses of hosts on the Internet. For each host on an Ethernet, a single line should be present with the following information:

    Ethernet-address    official-host-name

Items are separated by any number of SPACE and/or TAB characters. A ‘#’ indicates the beginning of a comment extending to the end of line.

The standard form for Ethernet addresses is x:x:x:x:x:x where x is a hexadecimal number between 0 and ff, representing one byte. The address bytes are always in network order. Host names may contain any printable character other than a SPACE, TAB, NEWLINE, or comment character. It is intended that host names in the ethers file correspond to the host names in the hosts(4) file.

The ether_line routine from the Ethernet address manipulation library, ethers(3N) may be used to scan lines of the ethers file.

FILES
/etc/ethers

SEE ALSO
ethers(3N), hosts(4)
NAME
   fd – file descriptor files

SYNOPSIS
   /dev/fd/*

DESCRIPTION
   These files, conventionally called /dev/fd/0, /dev/fd/1, /dev/fd/2, and so on, refer to files accessible through file descriptors. If file descriptor n is open, these two system calls have the same effect:
   
   \begin{verbatim}
   fd = open("/dev/fd/n",mode);
   fd = dup(n);
   \end{verbatim}

   On these files creat(2) is equivalent to open, and mode is ignored. As with dup, subsequent reads or writes on fd fail unless the original file descriptor allows the operations.

   For convenience in referring to standard input, standard output, and standard error, an additional set of names is provided: /dev/stdio is a synonym for /dev/fd/0, /dev/stdout for /dev/fd/1, and /dev/stderr for /dev/fd/2.

   Errors
   open(2) returns -1 and EBADF if the associated file descriptor is not open.

REFERENCES
   dup(2), open(2)
NAME
  filehdr — file header for common object file (COFF)

SYNOPSIS
  #include <filehdr.h>

DESCRIPTION
  The common object file format (COFF) is not generated by the most recent compilers provided with UNIX System V. See filehdr.h for information about COFF header files.

  See a.out(4) for information about headers generated by recent compilers.

SEE ALSO
  a.out(4)
NAME

fspec - format specification in text files

DESCRIPTION

It is sometimes convenient to maintain text files with non-standard tabs (that is, tabs that are not set at every eighth column). Such files must generally be converted to a standard format, frequently by replacing all tabs with the appropriate number of spaces, before they can be processed by commands. A format specification occurring in the first line of a text file specifies how tabs are to be expanded in the remainder of the file.

A format specification consists of a sequence of parameters separated by blanks and surrounded by the brackets <: and :>. Each parameter consists of a keyletter, possibly followed immediately by a value. The following parameters are recognized:

- **ttabs**
  The t parameter specifies the tab settings for the file. The value of tabs must be one of the following:
  1. a list of column numbers separated by commas, indicating tabs set at the specified columns
  2. a - followed immediately by an integer n, indicating tabs at intervals of n columns
  3. a - followed by the name of a "canned" tab specification

Standard tabs are specified by t-8, or equivalently, t1, 9, 17, 25, and so on. The canned tabs that are recognized are defined by the tabs(1) command.

- **ssize**
  The s parameter specifies a maximum line size. The value of size must be an integer. Size checking is performed after tabs have been expanded, but before the margin is prepended.

- **mmargin**
  The m parameter specifies a number of spaces to be prepended to each line. The value of margin must be an integer.

- **d**
  The d parameter takes no value. Its presence indicates that the line containing the format specification is to be deleted from the converted file.

- **e**
  The e parameter takes no value. Its presence indicates that the current format is to prevail only until another format specification is encountered in the file.

Default values, which are assumed for parameters not supplied, are t-8 and m0. If the s parameter is not specified, no size checking is performed. If the first line of a file does not contain a format specification, the above defaults are assumed for the entire file. The following is an example of a line containing a format specification:

```
* <:t5,10,15 s72:> *
```

If a format specification can be disguised as a comment, it is not necessary to code the d parameter.

SEE ALSO

ed(1), newform(1), tabs(1)
**NAME**

`fstypes` – file that registers distributed file system packages

**DESCRIPTION**

`fstypes` resides in directory `/etc/dfs` and lists distributed file system utilities packages installed on the system. The file system indicated in the first line of the file is the default file system. When Distributed File System (DFS) Administration commands are entered without the option `-F fstypes`, the system takes the file system type from the first line of the `fstypes` file.

The default package can be changed by editing the `fstypes` file with any supported text editor.

**SEE ALSO**

`dfmounts(1M), dfshares(1M), share(1M), shareall(1M), unshare(1M)`
NAME
fs (bfs) – format of the bfs file system volume

SYNOPSIS
#include <sys/types.h>
#include <sys/fs/bfs.h>

DESCRIPTION
The bfs superblock is stored on sector 0. Its format is:

struct bfs_bdsuphead
{
    long bh_bfsmagic; /* Magic number */
    off_t bh_start; /* Filesystem data start offset */
    off_t bh_end; /* Filesystem data end offset */
};

/*
 * The sanity structure is used to promote sanity in compaction. Used
 * correctly, a crash at any point during compaction is recoverable.
 */
struct bfs_sanity
{
    daddr_t fromblock; /* "From" block of current transfer */
    daddr_t toblock; /* "To" block of current transfer */
    daddr_t bfromblock; /* Backup of "from" block */
    daddr_t btoblock; /* Backup of "to" block */
};

struct bdsuper
{
    struct bfs_bdsuphead bdsup_head; /* Header info */
    struct bfs_sanity bdsup_sane; /* Crash recovery info whilst
                                       compacting */
    char bdsup_fsname[6]; /* file system name */
    char bdsup_volume[6]; /* file system volume name */
    long bdsup_filler[118]; /* Padding */
};
#define BFS_MAGIC 0xBADFACE /* bfs magic number */

The sanity structure is used to promote sanity during compaction. It is used by
fsck(1M) to recover from a system crash at any point during compaction.

SEE ALSO
bfs-specific inode(4)
NAME

fs (cdfs) – format of a cdfs file system

SYNOPSIS

#include <sys/fs/iso9660.h>
#include <sys/fs/cdfs_fs.h>

DESCRIPTION

The cdfs file system supports the ISO-9660 and High Sierra file system format specifications. In a cdfs file system, sectors 0-15 are reserved for boot information (this area is not used). The Volume Descriptor list begins at sector 16. The Volume Descriptor list contains the Primary Volume Descriptor (PVD) (which is known as the super-block in other types of file systems). Directory and file data make up the rest of the file system.

The PVD contains information such as:

- The location of the root directory
- The size of the file system (in logical blocks)
- Various identification strings and time stamps

For each cdfs file system that is mounted, an in-core data structure is used to store the relevant portions of the PVD. This data structure, called the cdfs structure, also stores the other file system specific information. The cdfs structure is defined in the cdfs_fs.h header file. The ISO-9660 and High Sierra PVD’s are defined in the iso9660.h header file.

The format of the cdfs file system structure is:

```c
struct cdfs {
    uint_t cdfs_Flags;          /* State flags for this FS */
    struct pathname cdfs_MntPnt; /* Pathname of mount-point */
    struct pathname cdfs_DevNode; /* Pathname of device node */
    struct vnode *cdfs_DevNode;  /* 'specfs' vnode for the device */
    struct cdfs_inode *cdfs_RootInode; /* Inode of CDFS root directory */
    struct cdfs_fid cdfs_RootFid;  /* FID of Root Inode */
    enum cdfs_type cdfs_Type;    /* File system type (9660/Hi-S) */
    daddr_t cdfs_PvdLoc;         /* PVD location (Log Sector #) */
    uint_t cdfs_LogSecSz;        /* Logical sector size (Bytes) */
    uint_t cdfs_LogSecShift;     /* Convert bytes to beg of Sect */
    uint_t cdfs_LogSecShift;     /* Convert bytes to Log Sect Num */
    uint_t cdfs_LogBlkMask;      /* Logical block size (Bytes) */
    uint_t cdfs_LogBlkShift;     /* Convert bytes to Log Blk */
    uint_t cdfs_LogBlkShift;     /* Convert bytes to Log Blk Num */
    uint_t cdfs_VolVer;          /* Version # of Vol Descr struct */
    uint_t cdfs_FileVer;         /* Version # of Dir Rec/Path Tbl */
    uint_t cdfs_VolSetSz;        /* Volume Set size (# of discs) */
    uint_t cdfs_VolSeqNum;       /* Volume Sequence # (Disc #) */
    uint_t cdfs_VolSpaceSz;      /* Volume Space Size (Bytes) */
    uint_t cdfs_PathTabSz;       /* Path Table size (Bytes) */
    daddr_t cdfs_PathTabLoc;     /* Path Table loc. (Log Block #) */
};
```

/*
 * Relevant PVD Information
 */
**fs(4)**

```c
struct timespec timestruc_t;

/* Volume Creation date/time */
timestruc_t cdfs_CreateDate;
/* Volume Modification date/time */
timestruc_t cdfs_ModDate;
/* Volume Expiration date/time */
timestruc_t cdfs_ExpireDate;
/* Volume Effective date/time */
timestruc_t cdfs_EffectDate;
uchar_t cdfs_VolID[32];
/* Volume ID string */
uint_t cdfs_RootDirOff;
/* PVD offset of Root Dir Rec */
uint_t cdfs_RootDirSz;
/* Size (bytes) of Root Dir Rec */

/* XCDR specific fields. */
struct cd_defs cdfs_Dflts;
/* Default IDs, perms and modes */
uint_t cdfs_NameConv;
/* XCDR name conversion mode */
struct cd_uidmap cdfs_UidMap[CD_MAXMAP];
/* User ID map array */
struct cd_gidmap cdfs_GidMap[CD_MAXMAP];
/* Group ID map array */

/* SUSP specific fields. */
uint_t cdfs_SuspSkip;
/* Value for finding SUFs in SUA */

/* RRIP specific field(s). */
uint_t cdfs_Devmap_Cnt;
/* Num of valid Device mappings*/
struct cd_devmap cdfs_Devmap[CD_MAXMAP];
/* Device Node (Number) Map */

);  

**REFERENCES**

cdfs-specific dir(4), cdfs-specific inode(4)
NAME
fs (s5) – format of s5 file system volume

SYNOPSIS
#include <sys/types.h>
#include <sys/param.h>
#include <sys/fs/s5filsys.h>

DESCRIPTION
Every file system storage volume has a common format for certain vital information. Every such volume is divided into a certain number of 512-byte long sectors. Sector 0 is unused and is available to contain a bootstrap program or other information.

Sector 1 is the super-block. The format of a super-block is:

```
struct filsys
{
    ushort s_isize;  /* size in blocks of i-list */
    daddr_t s_fsize;  /* size in blocks of entire volume */
    short s_nfree;  /* number of addresses in s_free */
    daddr_t s_free[NICFREE];  /* free block list */
    short s_ninode;  /* number of i-nodes in s_inode */
    o_ino_t s_inode[NICINOD];  /* free i-node list */
    char s_flock;  /* lock during free list */
    char s_ilock;  /* lock during i-list manipulation */
    char s_fmod;  /* super block modified flag */
    char s_ronly;  /* mounted read-only flag */
    time_t s_time;  /* last super block update */
    short s_dinfo[4];  /* device information */
    daddr_t s_tfree;  /* total free blocks*/
    o_ino_t s_tinode;  /* total free i-nodes */
    char s_fname[6];  /* file system name */
    char s_fpack[6];  /* file system pack name */
    long s_fi11[12];  /* ADJUST to make */
    long s_state;  /* file system state */
    long s_magic;  /* magic number to denote new file */
    long s_type;  /* type of new file system */
};
```

#define FsMAGIC 0xfd187e20 /* s_magic number */
#define Fs1b 1 /* 512-byte block */
#define Fs2b 2 /* 1024-byte block */
#define Fs4b 3 /* 2048-byte block */
#define FsOKAY 0x7c269d38 /* s_state: clean */
#define FsACTIVE 0x5e72d81a /* s_state: active */
```
#define FsBAD 0xcb096f43 /* s_state: bad root */
#define FsBADBLK 0xbbadbc14b /* s_state: bad block */

s_type indicates the file system type. Currently, three types of file systems are supported: the original 512-byte logical block, the 1024-byte logical block, and the 2048-byte logical block. s_magic is used to distinguish the s5 file system from other FSTypes. The s_type field is used to determine the blocksize of the file system; 512-bytes, 1K, or 2K. The operating system takes care of all conversions from logical block numbers to physical sector numbers.

s_state is unique for each file system and indicates the state of the file system. The numerical value of the "file system state" is computed as the sum of s_state and s_time and will ordinarily be one of FsOKAY, FsACTIVE, or FsBAD. A cleanly unmounted, undamaged file system is indicated by the FsOKAY state. After a file system had been mounted for update, the state changes to FsACTIVE. The state reverts to FsOKAY after a file system has been unmounted. A special case is used for the root file system. If it appears damaged at boot time, it is mounted but marked FsBAD.

s_isize is the address of the first data block after the i-list; the i-list starts just after the super-block, namely in block 2; thus the i-list is s_isize-2 blocks long. s_fsize is the first block not potentially available for allocation to a file. These numbers are used by the system to check for bad block numbers; if an "impossible" block number is allocated from the free list or is freed, a diagnostic is written on the on-line console. Moreover, the free array is cleared, so as to prevent further allocation from a presumably corrupted free list.

The free list for each volume is maintained as follows. The s_free array contains, in s_free[1], ..., s_free[s_nfree-1], up to 49 numbers of free blocks. s_free[0] is the block number of the head of a chain of blocks constituting the free list. The first long in each free-chain block is the number (up to 50) of free-block numbers listed in the next 50 longs of this chain member. The first of these 50 blocks is the link to the next member of the chain. To allocate a block: decrement s_nfree, and the new block is s_free[s_nfree]. If the new block number is 0, there are no blocks left, so give an error. If s_nfree became 0, read in the block named by the new block number, replace s_nfree by its first word, and copy the block numbers in the next 50 longs into the s_free array. To free a block, check if s_nfree is 50; if so, copy s_nfree and the s_free array into it, write it out, and set s_nfree to 0. In any event set s_free[s_nfree] to the freed block's number and increment s_nfree.

s_tfree is the total free blocks available in the file system.

s_ninode is the number of free i-numbers in the s_inode array. To allocate an i-node: if s_ninode is greater than 0, decrement it and return s_inode[s_ninode]. If it was 0, read the i-list and place the numbers of all free i-nodes (up to 100) into the s_inode array, then try again. To free an i-node, provided s_ninode is less than 100, place its number into s_inode[s_ninode] and increment s_ninode. If s_ninode is already 100, do not bother to enter the freed i-node into any table. This list of i-nodes is only to speed up the allocation process; the information as to whether the i-node is really free or not is maintained in the i-node itself.
```
s_tinode is the total free i-nodes available in the file system.

s_flock and s_ilock are flags maintained in the core copy of the file system while it is mounted and their values on disk are immaterial. The value of s_fmod on disk is likewise immaterial; it is used as a flag to indicate that the super-block has changed and should be copied to the disk during the next periodic update of file system information.

s_ronly is a read-only flag to indicate write-protection.

s_time is the last time the super-block of the file system was changed, and is the number of seconds that have elapsed since 00:00 Jan. 1, 1970 (UTC). During a reboot, the s_time of the super-block for the root file system is used to set the system's idea of the time.

s_fname is the name of the file system and s_fpack is the name of the pack.

I-numbers begin at 1, and the storage for i-nodes begins in block 2. Also, i-nodes are 64 bytes long. I-node 1 is reserved for future use. I-node 2 is reserved for the root directory of the file system, but no other i-number has a built-in meaning. Each i-node represents one file. For the format of an i-node and its flags, see inode(4).

SEE ALSO

fsck(1M), fsdb(1M), s5-specific inode(4), mkfs(1M), mount(2)
NAME
fs (sfs) – format of sfs file system volume

SYNOPSIS
#include <sys/param.h>
#include <sys/types.h>
#include <sys/fs/sfs_fs.h>

DESCRIPTION
Each disk drive contains some number of file systems. A file system consists of a number of cylinder groups. Each cylinder group has inodes and data.

A file system is described by its super-block, and by the information in the cylinder group blocks. The super-block is critical data and is replicated before each cylinder group block to protect against catastrophic loss. This is done at mkfs time; the critical super-block data does not change, so the copies need not normally be referenced further.

/*
 * Super block for a file system.
*/
#define SFS_MAGIC 0xbdl01155
#define UFS_MAGIC 0x011954
#define FSACTIVE 0x5e72d81a /* fs_state: mounted */
#define FSOKAY 0x7c629d38 /* fs_state: clean */
#define FSBAD 0xcb096f43 /* fs_state: bad root */

struct fs {
    struct fs *fs_link; /* linked list of file systems */
    struct fs *fs_rlink; /* used for incore super blocks */
    daddr_t fs_sblkno; /* addr of super-block in filesystem */
    daddr_t fs_cblkno; /* offset of cyl-block in filesystem */
    daddr_t fs_iblkno; /* offset of inode-blocks in filesystem */
    daddr_t fs_dblkno; /* offset of first data after cg */
    long fs_cgoffset; /* cylinder group offset in cylinder */
    long fs_cgmask; /* used to calc mod fs_ntrak */
    time_t fs_time; /* last time written */
    long fs_size; /* number of blocks in fs */
    long fs_dsize; /* number of data blocks in fs */
    long fs_ncg; /* number of cylinder groups */
    long fs bsiz e; /* size of basic blocks in fs */
    long fs_fsize; /* size of frag blocks in fs */
    long fs_frag; /* number of frags in a block in fs */
/* these are configuration parameters */
    long fs_minfree; /* minimum percentage of free blocks */
    long fs_rotdelay; /* num of ms for optimal next block */
    long fs_rps; /* disk revolutions per second */
/* these fields can be computed from the others */
    long fs_hmask; /* 'blkoff' calc of blk offsets */
    long fs_mask; /* 'fragoff' calc of frag offsets */
    long fs_bshift; /* 'iblkno' calc of logical blkno */
    long fs_fshift; /* 'numfrags' calc number of frags */
/* these are configuration parameters */
    long fs_maxcontig; /* max number of contiguous blks */
    long fs_maxbpg; /* max number of blks per cyl group */
/* these fields can be computed from the others */
long fs_fragshift; /* block to frag shift */
long fs_fabtodb; /* fabtodb and dbtobfab shift constant */
long fs_sbsize; /* actual size of super block */
long fs_csmask; /* csum block offset */
long fs_csshift; /* csum block number */
long fs_nindir; /* value of NINDIR */
long fs_inopb; /* value of INOPB */
long fs_nspf; /* value of NSPF */
long fs_optim; /* optimization preference, see below */
long fs_state; /* file system state */
long fs_spareon[2]; /* reserved for future constants */
/* a unique id for this filesystem (currently unused and unmaintained) */
long fs_id[2]; /* file system id */
/* sizes determined by number of cylinder groups and their sizes */
daddr_t fs_csaddr; /* blk addr of cyl grp summary area */
long fs_cssize; /* size of cyl grp summary area */
long fs_cgsize; /* cylinder group size */
/* these fields should be derived from the hardware */
long fs_ntrak; /* tracks per cylinder */
long fs_nsect; /* sectors per track */
long fs_spc; /* sectors per cylinder */
/* this comes from the disk driver partitioning */
long fs_ncyl; /* cylinders in file system */
/* these fields can be computed from the others */
long fs_cpg; /* cylinders per group */
long fs_ipg; /* inodes per group */
long fs_fpg; /* blocks per group * fs_frag */
/* this data must be re-computed after crashes */
struct csum fs_cstotal; /* cylinder summary information */
/* these fields are cleared at mount time */
char fs_fmod; /* super block modified flag */
char fs_clean; /* file system is clean flag */
char fs_ronly; /* mounted read-only flag */
char fs_flags; /* currently unused flag */
char fs_fsmnt[MAXMNTLEN]; /* name mounted on */
/* these fields retain the current block allocation info */
long fs_cgrotor; /* last cg searched */
struct csum *fs_csp[MAXCSBUFS]; /* list of fs_cs info buffers */
long fs_cpc; /* cyl per cycle in postbl */
short fs_postbl[MAXCPG][NRPOS]; /* head of blocks for each rotation */
long fs_magic; /* magic number */
u_char fs_rotbl[1]; /* list of blocks for each rotation */
};

/*
 * Cylinder group block for a file system.
 */
#define CG_MAGIC 0x090255
struct cg {
    struct cg *cg_link; /* linked list of cyl groups */
    struct cg *cg_rlink; /* used for incore cyl groups */
    time_t cg_time; /* time last written */
    long cg_cpg; /* we are the cgx’th cylinder group */
    short cg_ncyl; /* number of cyl’s this cg */
fs(4)

(SFS)

short  cg_niblk;    /* number of inode blocks this cg */
long   cg_ndblk;    /* number of data blocks this cg */
struct csum  cg_cs;  /* cylinder summary information */
long   cgRotor;     /* position of last used block */
long   cg_frotor;   /* position of last used frag */
long   cg_irotor;   /* position of last used inode */
long   cg_frsum[MAXFRAG];  /* counts of available frags */
long   cg_btot[MAXCPG];   /* block totals per cylinder */
short  cg_b[MAXCPG][NRPOS];  /* positions of free blocks */
char   cg_iused[MAXIPG/NBBY];"/ used inode map */
long   cg_magic;  /* magic number */
u_char cg_free[1];  /* free block map */
}

SEE ALSO
ufs-specific inode(4)
NAME

fs (ufs) – format of ufs file system volume

SYNOPSIS

#include <sys/param.h>
#include <sys/types.h>
#include <sys/fs/ufs_fs.h>

DESCRIPTION

Each disk drive contains some number of file systems. A file system consists of a number of cylinder groups. Each cylinder group has inodes and data.

A file system is described by its super-block, and by the information in the cylinder group blocks. The super-block is critical data and is replicated before each cylinder group block to protect against catastrophic loss. This is done at mkfs time; the critical super-block data does not change, so the copies need not normally be referenced further.

/*
 * Super block for a file system.
 */
#define FS_MAGIC 0x011954
#define FSACTIVE 0x5e72d81a /* fs_state: mounted */
#define FSOKAY 0x7c269d38 /* fs_state: clean */
#define FSBAD 0xcb096f43 /* fs_state: bad root */

struct fs {
    struct fs *fs_link; /* linked list of file systems */
    struct fs *fs_rlink; /* used for incore super blocks */
    daddr_t fs_sblkno; /* addr of super-block in filesys */
    daddr_t fs_cblkno; /* offset of cyl-block in filesys */
    daddr_t fs_iblkno; /* offset of inode-blocks in filesys */
    daddr_t fs_dblkno; /* offset of first data after cg */
    long fs_cgoffset; /* cylinder group offset in cylinder */
    long fs_cgmask; /* used to calc mod fs_ntrak */
    time_t fs_time; /* last time written */
    long fs_size; /* number of blocks in fs */
    long fs_dsize; /* number of data blocks in fs */
    long fs_ncg; /* number of cylinder groups */
    long fs_bsize; /* size of basic blocks in fs */
    long fs_fsize; /* size of frag blocks in fs */
    long fs_frag; /* number of frags in a block in fs */
    /* these are configuration parameters */
    long fs_minfree; /* minimum percentage of free blocks */
    long fs_rotdelay; /* num of ms for optimal next block */
    long fs_rps; /* disk revolutions per second */
    /* these fields can be computed from the others */
    long fs_hmask; /* `blkoff' calc of blk offsets */
    long fs_fmask; /* `fragoff' calc of frag offsets */
    long fs_bshift; /* `iblkno' calc of logical blkno */
    long fs_fshift; /* `numfrags' calc number of frags */
    /* these are configuration parameters */
    long fs_maxcontig; /* max number of contiguous blks */
    long fs_maxbpg; /* max number of blks per cyl group */
# Cylinder group block for a file system.

*/

#define CG_MAGIC 0x090255

struct cg {
    struct cg *cg_link; /* linked list of cyl groups */
    struct cg *cg_rlink; /* used for incore cyl groups */
    time_t cg_time; /* time last written */
    long cg_cpx; /* we are the cpx'th cylinder group */
    short cg_ncyl; /* number of cyl's this cg */
}
struct csum cg_cs; /* cylinder summary information */
long cg_rotor;  /* position of last used block */
long cg_frotor; /* position of last used frag */
long cg_irotor; /* position of last used inode */
long cg_frsum[MAXFRAG]; /* counts of available frags */
long cg_btot[MAXCPG]; /* block totals per cylinder */
short cg_b[MAXCPG][NRPOS]; /* positions of free blocks */
char cg_iused[MAXIPG/NBBY];/* used inode map */
long cg_magic;  /* magic number */
u_char cg_free[1]; /* free block map */
};

SEE ALSO
ufs-specific inode(4)
NAME
   fs (vxfs) – format of vxfs file system volume

SYNOPSIS
   #include <sys/types.h>
   #include <sys/param.h>
   #include <sys/fs/vx_fs.h>

DESCRIPTION
   The vxfs super-block always begins at byte offset 1024 from the start of the file system. The super-block location is fixed so utilities know where to look for it. The super-block contains the following fundamental sizes and offsets:
   
   **fs_magic**
   The magic number for the file system (VX_MAGIC). This number identifies the file system as being a vxfs FSType.
   
   **fs_version**
   The version number of the file system layout (VX_VERSION), currently 1.
   
   **fs_ctime**
   The creation date of the file system. The time system call supplies the time.
   
   **fs_ectime**
   This field is a placeholder in instances when the creation date for a file system is expanded for more precision. It currently is zero.
   
   **fs_logstart**
   The block address of the first Log Area block. It currently is two.
   
   **fs_logend**
   The block address of the last Log Area block. The Log Area size in blocks may be specified as part of mkfs. If not specified, a default of 256 blocks is used. A minimum size of 32 blocks is enforced.
   
   **fs_bsize**
   The block size of the file system. The current choices are 1024, 2048, 4096, and 8192 bytes.
   
   **fs_size**
   The number of blocks in the file system, expressed as the number of blocks of size fs_bsize. The fs_size field is a signed 32 bit number. The maximum number of blocks in a vxfs file system is limited to 31 bits.
   
   **fs_dsize**
   The number of data blocks in the file system. A data block is a block which may be allocated to a file in the file system.
   
   **fs_ninode**
   The number of inodes in the file system. The number of inodes in the file system is subject to the following rules:
The \texttt{fs_ninode} field is a signed 32-bit number.

The number of inodes is rounded down such that the inode list in each allocation unit is an integral number of inode list blocks (see \texttt{fs_ilbsize}).

The number of inodes may be specified as part of \texttt{mkfs}. If not specified, the default will be \texttt{fs_dsize} divided by 4.

\texttt{fs_nau}

The number of allocation units in the file system. The number of allocation units may be specified as part of \texttt{mkfs}.

\texttt{fs_defiextsize}

The default size for indirect data extents, expressed in blocks. This field is currently unused.

\texttt{fs_ilbsize}

The size of an inode list block, expressed in bytes. This size may be specified as part of \texttt{mkfs}. If not specified, a default of either 2K or \texttt{fs_bsize} (whichever is larger) is used.

\texttt{fs_immedlen}

The size, in bytes, of the immediate data area in each inode. This value is 96 for the \texttt{vxfs} file system version 1.

\texttt{fs_ndaddr}

The number of direct extents supported by the \texttt{VX_EXT4} mapping type (see the section describing inode list). This value is 10 for the \texttt{vxfs} file system version 1.

The preceding fields define the size and makeup of the file system. To reduce the calculations required in utilities, a number of values are derived from the fundamental values and placed in the super-block.

The super-block contains the following derived offsets:

\texttt{fs_aufirst}

The address, in blocks, of the first allocation unit. There can be a gap between the end of the intent log and the first allocation unit. This gap could be used to align the first allocation unit on a desired boundary.

\texttt{fs_emap}

The offset in blocks of the free extent map (emap) from the start of an allocation unit.

\texttt{fs_imap}

The offset in blocks of the free inode map ( imap) from the start of an allocation unit.

\texttt{fs_iextop}

The offset in blocks of the extended inode operation map from the start of an allocation unit.
**fs(4)**

(VXFS)

- **fs_istart**
  - The offset in blocks of the inode list (ilist) from the start of an allocation unit.

- **fs_bstart**
  - The offset in blocks of the first data block from the start of an allocation unit. An allocation unit header may contain padding to align the first data block.

- **fs_femap**
  - The offset in blocks of the first free extent map (emap) from the start of the file system.

- **fs_fimap**
  - The offset in blocks of the first free inode map (imap) from the start of the file system.

- **fs_fiextop**
  - The offset in blocks of the first extended inode operation map from the start of the file system.

- **fs_fistart**
  - The offset in blocks of the first ilist from the start of the file system.

- **fs_fbstart**
  - The offset in blocks of the first data block from the start of the file system.

- **fs_nindir**
  - The number of entries in an indirect address extent. An indirect address extent is currently 8192 bytes in length, making the current value for **fs_nindir** 2048.

- **fs_aulen**
  - The length of an allocation unit in blocks.

- **fs_auimlen**
  - The length of a free inode map in blocks.

- **fs_auemlen**
  - The length of a free extent map in blocks.

- **fs_ailen**
  - The length, in blocks, of the inode list for this allocation unit.

- **fs_aupad**
  - The length, in blocks, of the allocation unit alignment padding.

- **fs_aublocks**
  - The number of data blocks in an allocation unit.

- **fs_maxtier**
  - The log base 2 of **fs_aublocks**.

- **fs_inopb**
  - The number of inode entries per **fs_bsize** block in the inode list.
The above fields are initialized when the file system is created and do not change unless the file system is resized. These fields are replicated in each allocation unit header.

There are additional fields which are considered to be dynamic:

- **fs_free**
  The current number of free data blocks.

- **fs_ifree**
  The current number of free inodes.

- **fs_efree**
  An array of the current number of free extents of each extent size in the file system.

- **fs_flags**
  The following flags are recognized:
**fs(4)** (VXFS)

**VX_FULLFSCK**
Set when a file system requires a full structural check to recover from an error. If this flag is set, a full check will be performed after the replay recovery is finished.

**VX_NOLOG**
Set when the file system was mounted with the **VX_MS_NOLOG** option. If this flag is set, then no log replay recovery will be performed.

**VX_LOGBAD**
Set when an I/O error has invalidated the log. If this flag is set, then no log replay recovery will be performed.

**VX_LOGRESET**
Set when the log ID runs over **VX_MAXLOGID** (2^30). The log ID will be reset at the next appropriate opportunity (such as a mount or 60-second sync).

**VX_RESIZE**
Set when a file system resizing is in progress. If an fsck sees this flag, it will have to perform resize recovery. Refer to **fsadm**(1M) for a description of file system expansion.

**fs_mod**
Set whenever a mounted file system is modified. It is used to indicate if the super-block needs to be written when a sync operation is performed.

**fs_clean**
Set to **VX_DIRTY** when a file system is mounted for read/write access. Set to **VX_CLEAN** upon umount or successful fsck. The mount utility will not allow a file system to be mounted for read/write if the **fs_clean** field is **VX_DIRTY**.

**fs_reserved**
Reserved for future use.

**fs_firstlogid**
Starting intent log ID to use when the file system is next mounted.

**fs_time**
Last time the super-block was written to disk, indicated as the number of seconds that have elapsed since 00:00 January 1, 1970.

**fs_fname**
File system name (6 characters).

**fs_fpack**
File system pack label (6 characters).

**SEE ALSO**
fsck(1M), fsdb(1M), vxfs-specific inode(4), mkfs(1M), mount(2)
NAME
gettydefs – speed and terminal settings used by getty

DESCRIPTION
The file /usr/lib/saf/ttymondefs contains information used by the getty command to set up the speed and terminal settings for a line. It supplies information on what the login prompt should look like. It also supplies the speed to try next if the user indicates the current speed is not correct by typing a break character.

Each entry in ttymondefs has the following format:

    label# initial-flags # final-flags # login-prompt # next-label

Each entry is followed by a blank line. The fields can contain quoted characters of the form \b, \n, \c, etc., as well as \nnn, where nnn is the octal value of the desired character. The fields are:

label
This is the string against which getty tries to match its second argument. It is often the speed, such as 1200, at which the terminal is supposed to run, but it need not be (see below).

initial-flags
These flags are the initial ioctl settings to which the terminal is to be set if a terminal type is not specified to getty. The flags that getty understands are the same as the ones listed in the termio.h header file [see termio(7)]. Normally only the speed flag is required in the initial-flags. getty automatically sets the terminal to raw input mode and takes care of most of the other flags. The initial-flag settings remain in effect until getty executes login.

final-flags
These flags take the same values as the initial-flags and are set just before getty executes login. The speed flag is again required. The composite flag SANE takes care of most of the other flags that need to be set so that the processor and terminal are communicating in a rational fashion. The other two commonly specified final-flags are TAB3, so that tabs are sent to the terminal as spaces, and HUPCL, so that the line is hung up on the final close.

login-prompt
This entire field is printed as the login-prompt. Unlike the above fields where white space is ignored (a space, tab or new-line), they are included in the login-prompt field.

next-label
If this entry does not specify the desired speed, indicated by the user typing a break character, then getty searches for the entry with next-label as its label field and sets up the terminal for those settings. Usually, a series of speeds are linked together in this fashion, into a closed set; for instance, 2400 linked to 1200, which in turn is linked to 300, which finally is linked to 2400.

If getty is called without a second argument, then the first entry of ttymondefs is used, thus making the first entry of ttymondefs the default entry. It is also used if getty can not find the specified label. If ttymondefs itself is missing, there is one entry built into getty that brings up a terminal at 300 baud.
It is strongly recommended that after making or modifying `ttymondefs`, it be run through `getty` with the check option to be sure there are no errors.

FILES
/usr/lib/saf/ttymondefs
/usr/include/sys/termio.h

SEE ALSO
`getty(1M), ioctl(2), login(1), stty(1), termio(7)`

NOTES
To support terminals that pass 8 bits to the system (as is typical outside the U.S.), modify the entries in the `ttymondefs` file for those terminals as follows: add `CS8` to `initial-flags` and replace all occurrences of `SANE` with the values: `BRKINT IGNPAR ICRNL IXON OPOST ONLCR CS8 ISIG ICANON ECHO ECHOK`

An example of changing an entry in `ttymondefs` is illustrated below. All the information for an entry must be on one line in the file.

Original entry:
```
CONSOLE # B9600 HUPCL OPOST ONLCR # B9600 SANE IXANY TAB3
HUPCL # Console Login: # console
```

Modified entry:
```
CONSOLE # B9600 CS8 HUPCL OPOST ONLCR # B9600 BRKINT IGNPAR ICRNL IXON OPOST ONLCR CS8 ISIG ICANON ECHO ECHOK IXANY TAB3
HUPCL # Console Login: # console
```

This change permits terminals to pass 8 bits to the system so long as the system is in multi-user state. When the system changes to single-user state, the `getty` is killed and the terminal attributes are lost. So to permit a terminal to pass 8 bits to the system in single-user state, after you are in single-user state, type [see `stty(1)`]:

```
stty -istrip cs8
```

8-bit with parity mode is not supported.
NAME

group – group file

DESCRIPTION

The file /etc/group contains for each group the following information:

- group name
- encrypted password
- numerical group ID
- comma-separated list of all users allowed in the group

group is an ASCII file. The fields are separated by colons; each group is separated from the next by a new-line.

Because of the encrypted passwords, the group file can and does have general read permission and can be used, for example, to map numerical group IDs to names.

During user identification and authentication, the supplementary group access list is initialized sequentially from information in this file. If a user is in more groups than the system is configured for, {NGROUPS_MAX}, a warning will be given and subsequent group specifications will be ignored.

SEE ALSO

getgroups(2), groups(1), initgroups(3C), newgrp(1M), passwd(1), unistd(4)
help(4)

NAME
help – Desktop help file format

DESCRIPTION
The help subsystem can display plain help files as well as formatted help files. Formatted help files must conform to the format described below in order to take advantage of the hypertext functionality.

Headers
The file header contains information that is global to the file and must appear before the start of the first section of text. Each line in the file header begins with the ^ character. The following are the control codes and line formats allowed in the file header:

^*version^n
The required first line in the file header. Parse the rest of the file according to the version specified. If n is not specified or is set to 0, the help file is expected to follow the syntax below. Other values of n are reserved.

^+definition_file
Specify the name of a file containing only term definitions. Each definition is defined using the ^= option defined below. Definitions can also appear in the file header itself.

^?description
A one-line description of the application or object the help file is being written for. This description is displayed when the icon representing the application or object in the Help Desk window is selected.

^*title^string
Display the title, string, in the help window title if no section name is found and a title is not specified in the request to the desktop manager to display help.

^%keyword^reference
Specify a keyword definition global to the file. Each occurrence of keyword in the file is highlighted in color. When the user selects the keyword, the text in the help window’s pane area will be switched to the text which reference points to.

reference has the format file_name^section_tag. file_name is the name of a help file and defaults to the current file. section_tag is either a section name or a section tag associated with a section in the help file and, if not specified, defaults to the first section of a file. A tag is any ASCII string and can be used across different locales.

^=term
definition
of term
^=
Define a term global to the file. Each occurrence of term is displayed in italic font. When a term is selected, a window pops up to display the definition of the term. definition can comprise multiple lines.
Sections

A section comprises a section header followed by help text. A section header begins with a line of the format `^level^ section name=alias`. Following this line must be a section tag, and, optionally, local definitions of terms and keywords, which override any previous definitions of the same terms or keywords. The same options are used to define local and global terms and keywords. The rest is considered the body of the section until the end of file is reached or another section is defined.

```
^level^ section name[][alias]
```

Specify section number, section name, and an optional alias to the section name. `level` starts at 0 and must be a positive integer. If `level` is 0, the section appears in the Table of Contents and help window pane without a level number. This is to allow having a main section in a file. A level 0 section is optional. A section typically starts at level 1.

`section name` is used internally by the desktop manager and is in the Table of Contents but not at the beginning of a section. `section name` has to be repeated on a line by itself at the beginning of the help text if you want it to appear at the start of a section.

`alias` is optional. If `alias` is specified, it is used to look up a link; otherwise, `section name` is used. This allows a file to have more than one section with the same name and multiple keywords that are the same but linked to different parts of the file. This is useful if section tags are not available at the time keywords are defined, which may be the case if a tool is used to create the keywords.

Note that `alias` is never displayed. In addition, the `^` after `section name` is required even if no alias is specified.

```
^$tag
```

A unique section tag must be defined for each section within a section header. Since section tags are unique, they can be used to link the same keyword to different sections in a file.

Links

The following constructs are used within the help text to mark defined terms and hypertext links.

```
\d(term[, alias])
```

This indicates that the string `term` is to be displayed in italics. If `alias` is not specified, the definition of `term` is displayed in a definition popup window; otherwise, the definition of `alias` is displayed in the definition window instead. `alias` allows multiple terms to share the same definition.

Definitions are specified using the `^=` option in a definition file or section header.

```
\k(keyword[^reference])
```

This is used to indicate and set up a link within a section. `keyword` appears as part of the section. When a keyword is selected, `reference` is used to look up which file and section to jump to.
reference must be in the format file name~section tag, of which at least file name or section tag must be specified. The section associated with section tag in file name will be displayed in the help window when keyword is selected.

reference allows the same keyword to be associated with the different sections in the same or a different file.

If reference is not specified, keyword will be used to look up a link, which can be a link defined in the section or file header.

Note that if ( and ) are used within the definition of a link, the link itself must be enclosed with curly braces instead of round parentheses and vice-versa. For example:

\k{cat(1)}
\k{cat~^~cat(1)}

EXAMPLES

^*version^1
^*title^User Setup
^*width^70
^+help.defs
^?Manage user logins
^0^User Setup^`
^$10
User Setup
The User Setup window allows you to manage who can log onto your system by letting you add new or delete \d(logins~login) and change the properties of existing logins.

There are three main User Setup windows:

\k(User Setup Window)
\k(User Setup: Properties Window [Users])
\k(User Setup: Properties Window [Groups])
^1^User Setup Window^`
^$20
\k(User Setup)
1. User Setup Window
The User Setup Window lets you maintain the \d(groups~group) defined on your system as well as the user and system \d(logins~login).

The buttons available from the User Setup window are:

\k(Edit Button)
\k(View Button)
\k(Help Button)
help(4)

^2^Edit Button^3$

^30

1. \k(User Setup Window)
   1.1 Edit Button

The Edit Button lets you add, delete, and change properties and permissions for the icons shown in the User Setup window. Note that a user cannot log onto your system until you create a \d(login) for them through the User Setup Window. Clicking SELECT on the Edit Button brings up a menu with the following options:

- \k(New)
- \k(Delete)
- \k(Properties)
- \k(Permissions)

^3^New^3$

^40

1. \k(User Setup Window)
   1.1 \k(Edit Button)
      1.1.1 New

The New menu option lets you add new users to your system. Clicking SELECT on the New menu option brings up the User Setup: Add User window.

More Information:

- \k(User Setup: Add User Window)

^3^Delete^3$

^50

1. \k(User Setup Window)
   1.1 \k(Edit Button)
      1.1.2 Delete

The Delete menu option lets you delete users from your system. Once a user is deleted, they cannot log onto your system.

^3^Properties^3$

^60

1. \k(User Setup Window)
   1.1 \k(Edit Button)
      1.1.3 Properties

The Properties menu option lets you change the information associated with users and groups.

For user and system \d(logins\login) you can change the login name, comment, group, home directory, shell, and user ID.

For groups you can change the group name and group ID number.

Clicking SELECT on the Properties menu option brings up the User Setup: Properties window. A different window appears, depending upon whether user/system icons or group icons are in the User Setup window.
The Permissions menu option is only active when users are displayed in the User Setup window. This option allows you to make changes to the various permission categories, however, you must have the correct permissions to make changes. Clicking SELECT on the Permissions menu option brings up the Permissions window. The Permissions window allows the following to be changed:

- Owner's Administration Account
- Mount Removable Media
- Dialup Network Use
- Dialup Management
- Printer Management
- Network Management
- Package Management
- Share Remote Resources
- Share Local Resources

The Permissions window has four buttons: Apply, Reset, Cancel, and Help.

- Apply Button: The Apply button immediately applies any changes made in the Permissions window. After applying the changes, the Permissions window is closed.
- Reset Button: The Reset button reverses any changes you make in the Permissions window. The Permissions window remains open.
- Cancel Button: The Cancel button closes the Permissions window without making any changes.
- Help Button: The Help Button provides help for the Permissions window.

The View Button lets you choose whether to view user icons, system icons, or group icons in the Use Setup window. Clicking SELECT on the View Button brings up a menu with the following options:
The Users menu option lets you view user icons in the User Setup window. When you click SELECT on Users, user icons are displayed in the User Setup window. If user icons are already displayed in the User Setup window, then nothing happens when you click SELECT on the Users menu item.

The System menu option lets you view system icons in the User Setup window. When you click SELECT on System, system icons are displayed in the User Setup window. If system icons are already displayed in the User Setup window, then nothing happens when you click SELECT on the System menu item.

The Groups menu option lets you view group icons in the User Setup window. When you click SELECT on Groups, group icons are displayed in the User Setup window. If group icons are already displayed in the User Setup window, then nothing happens when you click SELECT on the Groups menu item.

The Help button provides online help for the User Setup window. Clicking SELECT on the Help button brings up a menu with the following options:
The User Setup menu option provides help on the User Setup window.
The Table of Contents menu option displays the list of help topics available for the User Setup window.
The Help Desk menu option opens the Help Desk window. From there, you can select the icon for the item you want to find out more about.
The User Setup Properties window (for users) lets you change the login name, full name (or Comment), login type (Desktop or Nondesktop login) and other information about users.
The buttons available from the User Setup window are:

- Apply Button
- Reset Button
- Cancel Button
- Help Button

The Apply button immediately applies any changes made in the User Setup: Properties window. After applying the changes, the User Setup: Properties window closes.
The Reset button reverses any changes you make. The User Setup Properties Window remains open.

2. Cancel Button

$190

2. \k(User Setup: Properties Window [Users])

2.3 Cancel Button

The Cancel button closes the User Setup Properties window without making any changes.

2. Help Button Help Button

$200

2. \k(User Setup: Properties Window [Users])

2.4 Help Button

The Help button provides help for the User Setup: Properties window.


3. User Setup Properties window (for Groups) lets you change the group name and group ID number.

The following \d(buttons) are available from the User Setup Properties Window (Groups):

\k(Apply Button) Apply Button

\k(Reset Button) Reset Button

\k(Cancel Button) Cancel Button

\k(Help Button) Help Button

$210

\k(User Setup)


3.1 Apply Button

The Apply button immediately applies any changes made in the User Setup: Properties window. After applying the changes, the User Setup: Properties window closes.

2. Reset Button Reset Button

$220

3. \k(User Setup: Properties Window [Groups])

3.2 Reset Button

The Reset button reverses any changes you make. The User Setup Properties Window remains open.

2. Cancel Button Cancel Button

$230

3. \k(User Setup: Properties Window [Groups])

3.3 Cancel Button

The Cancel button closes the User Setup Properties window without making any changes.

2. Help Button Help Button

$240

3. \k(User Setup: Properties Window [Groups])

3.3 Cancel Button
3. \k{User Setup: Properties Window [Groups]}

3.4 Help Button

The Help Button provides help for the User Setup: Properties window.
NAME

holidays - accounting file

DESCRIPTION

holidays contains information that accounting commands use to identify prime and non-prime computing hours. This information is used to divide user cpu usage and connection time into prime and non-prime time.

All lines in the holidays file that begin with an asterisk (*) are comment lines. The first non-comment line of the holidays file must list the year, the beginning of the prime-time period, and the end of the prime-time period. Prime time is defined as time a specified interval that occurs every day, except on Saturdays, Sundays, and holidays listed in the holidays file. For example, the following line indicates that the file is for 1992, and that prime time starts at 8:00AM and ends at 6:00PM. Time is given in 24-hour clocktime.

1992 0800 1800

Each of the remaining non-commented lines lists one holiday. These lines must begin with the date of the holiday in mm/dd format. All remaining information on the line is ignored, so a description of the holiday can be given. The following are examples of holiday lines:

1/1 New Year’s Day
5/25 Memorial Day

which is equivalent to

1/1
5/25

The holidays file should be updated at the end of each year. If the holidays file specifies a year prior to the current year, or the end of the current year is near, then the accounting commands that use the holidays file will issue a message stating that it needs to be updated.

FILES

/etc/acct/holidays

SEE ALSO

acctcmu(1M), acctcon(1M), acctprc(1M), runacct(1M)
hosts (4)

NAME
hosts – host name data base

SYNOPSIS
/etc/hosts

DESCRIPTION
The hosts file contains information regarding the known hosts on the DARPA Internet. For each host a single line should be present with the following information:

Internet-address official-host-name aliases

Items are separated by any number of SPACE and/or TAB characters. A '#' indicates the beginning of a comment; characters up to the end of the line are not interpreted by routines which search the file. This file is normally created from the official host data base maintained at the Network Information Control Center (NIC), though local changes may be required to bring it up to date regarding unofficial aliases and/or unknown hosts.

Network addresses are specified in the conventional '.' notation using the inet_addr routine from the Internet address manipulation library, inet(3N). Host names may contain any printable character other than a field delimiter, NEWLINE, or comment character.

EXAMPLE
Here is a typical line from the /etc/hosts file:

192.9.1.20 gaia # John Smith

FILES
/etc/hosts

SEE ALSO
gethostent(3N), inet(3N)
hosts.equiv (4)

NAME

hosts.equiv, .rhosts – trusted hosts by system and by user

DESCRIPTION

The /etc/hosts.equiv file contains a list of trusted hosts. When an rlogin(1) or rsh(1) request is received from a host listed in this file, and when the user making the request is listed in the /etc/passwd file, then the remote login is allowed with no further checking. The library routine ruserok will make this verification. In this case, rlogin does not prompt for a password, and commands submitted through rsh are executed. Thus, a remote user with a local user ID is said to have equivalent access from a remote host named in this file.

The format of the hosts.equiv file consists of a one-line entry for each host, of the form:

hostname [username]

The hostname field normally contains the name of a trusted host from which a remote login can be made, and username represents a single user from that host. However, an entry consisting of a single ‘+’ indicates that all known hosts are to be trusted for all users. A host name must be the official name as listed in the hosts(4) database. This is the first name given in the hosts database entry; hostname aliases are not recognized.

The User .rhosts File

Whenever a remote login is not allowed by hosts.equiv, the remote login daemon checks for a .rhosts file in the home directory of the local login. The .rhosts file controls access only to the specific login where it resides.

The .rhosts file has the same format as the hosts.equiv file, but the username entry has a different meaning. In the hosts.equiv file, a username entry restricts remote access to the specified remote user. In the .rhosts file, a username entry changes the identity of user attempting to log in. The remote user specified by username can access the host as the local login and inherit the local login’s permissions.

FILES

/etc/hosts.equiv
/etc/passwd
"/etc/hosts
/etc

SEE ALSO

rlogin(1), rsh(1), hosts(4), passwd(4)
inetd.conf (4)

NAME
inetd.conf – Internet servers database

DESCRIPTION
The inetd.conf file contains the list of servers that inetd(1M) invokes when it receives an Internet request over a socket. Each server entry is composed of a single line of the form:

service-name socket-type protocol wait-status uid server-program server-arguments

Fields can be separated by either SPACE or TAB characters. A ‘#’ (pound-sign) indicates the beginning of a comment; characters up to the end of the line are not interpreted by routines that search this file.

service-name
The name of a valid service listed in the file /etc/services. For RPC services, the value of the service-name field consists of the RPC service name, followed by a slash and either a version number or a range of version numbers (for example, mountd/1).

socket-type
Can be one of:
- stream for a stream socket,
- dgram for a datagram socket,
- raw for a raw socket,
- seqpacket for a sequenced packet socket

protocol
Must be a recognized protocol listed in the file /etc/protocols. For RPC services, the field consists of the string rpc followed by a slash and the name of the protocol (for example, rpc/udp for an RPC service using the UDP protocol as a transport mechanism).

wait-status
nowait for all but single-threaded datagram servers — servers which do not release the socket until a timeout occurs (such as comsat(1M) and talkd(1M)). These must have the status wait. Although tftpd(1M) establishes separate pseudo-connections, its forking behavior can lead to a race condition unless it is also given the status wait.

uid
The user ID under which the server should run. This allows servers to run with access privileges other than those for root.

server-program
Either the pathname of a server program to be invoked by inetd to perform the requested service, or the value internal if inetd itself provides the service.

server-arguments
If a server must be invoked with command-line arguments, the entire command line (including argument 0) must appear in this field (which consists of all remaining words in the entry). If the server expects inetd to pass it the address of its peer (for compatibility with 4.2BSD executable daemons), then the first argument to the command should be specified as ‘%a’.
FILES

/etc/inetd.conf
/etc/services
/etc/protocols

SEE ALSO

cmsat(1M), inetd(1M), rlogin(1), rsh(1), services(4), talkd(1M), tftpd(1M)
Init(4)

NAME
Init – inittab entries for a kernel module

SYNOPSIS
Init

DESCRIPTION
One of the kernel configuration files, an Init file contains information used by the
idmkinit(1M) command to construct a module’s /etc/inittab entry. When the
Init component of a module’s Driver Software Package (DSP) is installed,
idinstall(1M) stores the module’s Init file information in
/etc/conf/init.d/module-name, where the file module-name is the name of the
module being installed. Package scripts should never access /etc/conf/init.d
files directly; only the idinstall command should be used.

Init files contain lines consisting of one of three forms:

- action:process
- rstate:action:process
- id:rstate:action:process

All fields are positional and must be separated by colons. Blank lines and lines
beginning with ‘#’ or ‘*’ are considered comments and are ignored.

Lines of the first form should be used for most entries. When presented with a line
of this form, idmkinit:

- Copies the action and process field values to the inittab entry
- Generates a valid id field value (called a ‘tag’) and prepends it to the entry
- Generates an rstate field with a value of 2, and adds it to the entry, following
  the id field

Lines of the second form should be used when an rstate value other than 2 must be
specified. When presented with a line of this form, idmkinit generates only the id
field value and prepends it to the entry.

Lines of the third form should be used with caution. When presented with a line of
this form, idmkinit copies the entry to the inittab file verbatim. It is recom-
mended that DSPs avoid specifying lines of this form because, if more than one DSP
or add-on application specifies the same id field value, idmkinit will create multi-
ple inittab entries containing this id value. When the /etc/init program
attempts to process the inittab entries with the same id, it will fail with an error
condition.

Note that idmkinit determines which of the three forms is being used by searching
each line for a valid action keyword. Valid action values are:

| boot        | bootwait |
| initdefault | off      |
| once        | ondemand |
| powerfail   | powerwait|
| respawn     | sysinit  |
| wait        |          |
SEE ALSO
idinstall(1M), idmkinits(1M), inittab(4), init(1M), System(4)
inittab(4)

NAME

inittab - script for init

DESCRIPTION

The file /etc/inittab controls process dispatching by init. The processes most typically dispatched by init are daemons.

The inittab file is composed of entries that are position dependent and have the following format:

id:\rstate\:action\:process

Each entry is delimited by a newline, however, a backslash (\) preceding a newline indicates a continuation of the entry. Up to 512 characters per entry are permitted. Comments may be inserted in the process field using the convention for comments described in sh(1). There are no limits (other than maximum entry size) imposed on the number of entries in the inittab file. The entry fields are:

id   This is one to four characters used to uniquely identify an entry.

rstate This defines the run level in which this entry is to be processed. Run-levels effectively correspond to a configuration of processes in the system. That is, each process spawned by init is assigned a run level or run levels in which it is allowed to exist. The run levels are represented by a number ranging from 0 through 6. As an example, if the system is in run level 1, only those entries having a 1 in the rstate field are processed. When init is requested to change run levels, all processes that do not have an entry in the rstate field for the target run level are sent the warning signal SIGTERM and allowed a 5-second grace period before being forcibly terminated by the kill signal SIGKILL. The rstate field can define multiple run levels for a process by selecting more than one run level in any combination from 0 through 6. If no run level is specified, then the process is assumed to be valid at all run levels 0 through 6. There are three other values, a, b and c, which can appear in the rstate field, even though they are not true run levels. Entries which have these characters in the rstate field are processed only when an init or telinit process requests them to be run (regardless of the current run level of the system). See init(1M). They differ from run levels in that init can never enter run level a, b or c. Also, a request for the execution of any of these processes does not change the current run level. Furthermore, a process started by an a, b or c command is not killed when init changes levels. They are killed only if their line in inittab is marked off in the action field, their line is deleted entirely from inittab, or init goes into single-user state.

action Key words in this field tell init how to treat the process specified in the process field. The actions recognized by init are as follows:

respin If the process does not exist, then start the process; do not wait for its termination (continue scanning the inittab file), and when the process dies, restart the process. If the process currently exists, do nothing and continue scanning the inittab file.
wait When init enters the run level that matches the entry's rstate, start the process and wait for its termination. All subsequent reads of the inittab file while init is in the same run level cause init to ignore this entry.

once When init enters a run level that matches the entry's rstate, start the process, do not wait for its termination. When it dies, do not restart the process. If init enters a new run level and the process is still running from a previous run level change, the program is not restarted.

boot The entry is to be processed the first time init goes from single-user to multi-user state after the system is booted. (If initdefault is set to 2, the process runs right after the boot.) init starts the process, does not wait for its termination and, when it dies, does not restart the process.

bootwait The entry is to be processed the first time init goes from single-user to multi-user state after the system is booted. (If initdefault is set to 2, the process runs right after the boot.) init starts the process, waits for its termination and, when it dies, does not restart the process.

powerfail Execute the process associated with this entry only when init receives a power fail signal, SIGPWR [see signal(2)].

powerwait Execute the process associated with this entry only when init receives a power fail signal, SIGPWR, and wait until it terminates before continuing any processing of inittab.

off If the process associated with this entry is currently running, send the warning signal SIGTERM and wait 5 seconds before forcibly terminating the process with the kill signal SIGKILL. If the process is nonexistent, ignore the entry.

ondemand This instruction is really a synonym for the respawn action. It is functionally identical to respawn but is given a different keyword in order to divorce its association with run levels. This instruction is used only with the a, b or c values described in the rstate field.

initdefault An entry with this action is scanned only when init is initially invoked. init uses this entry, if it exists, to determine which run level to enter initially. It does this by taking the highest run level specified in the rstate field and using that as its initial state. If the rstate field is empty, this is interpreted as 0123456 and init therefore enters run level 6. This will cause the system to loop, that is, it will go to firmware and reboot continuously. Additionally, if init does not find an initdefault entry in inittab, it requests an initial run level from the user at reboot time.
Entries with this action are scanned only when `init` is initially invoked. Among other things, `sysinit` entries may be used to initialize devices on which `init` might try to ask the run level question. These entries are executed and waited for before continuing.

This is a command to be executed. The entire `process` field is prefixed with `exec` and passed to a forked `sh` as `sh -c 'exec command'`. For this reason, any legal `sh` syntax can appear in the `process` field.

The `wsinit` command is required to initialize the system console. Do not remove this file, attempt to run it from the command line, or remove the line invoking it from `/etc/inittab` or `/etc/conf/init.d/kernel`.

Application code should not attempt to modify the `/etc/inittab` file during a run-level change, since the `etc/init` program ignores inittab changes then. In particular, modifying the `/etc/inittab` file while the system is shutting down will result in minor root file system damage.

`/sbin/wsinit`

SEE ALSO
`exec(2), init(1M), open(2), sh(1), signal(2), ttymon(1M), who(1)`
NAME
inode (bfs) – format of a bfs i-node

SYNOPSIS
#include <sys/types.h>
#include <sys/fs/bfs.h>

DESCRIPTION
struct bfs_dirent
{
    ushort d_ino;  /* inode number */
    daddr_t d_sblock;  /* Start block */
    daddr_t d_eblock;  /* End block */
    daddr_t d_eoffset;  /* EOF disk offset (absolute) */
    struct bfsvattr d_fattr;  /* File attributes */
};

For the meaning of the defined type daddr_t see types(5). The bfsvattr structure appears in the header file sys/fs/bfs.h.

SEE ALSO
bfs-specific fs(4), types(5)
NAME

inode (cdfs) – format of a cdfs inode

SYNOPSIS

#include <sys/param.h>
#include <sys/types.h>
#include <sys/vnode.h>
#include <sys/fs/cdfs_inode.h>

DESCRIPTION

For each file and directory in a cdfs file system that is currently being referenced, an in-core data structure, struct cdfs_inode, is used to store all of the information related to that file or directory.

The information includes items such as:

- the Group ID and User ID of the file or directory
- the number of bytes in the file
- the file or directory’s permissions (read/execute)
- the date and time the file or directory was created
- the type of file (regular, directory, block, character, symbolic link, pipe).

The cdfs_inode structure is defined in the cdfs_inode.h header file, and is as follows:

```c
struct cdfs_inode {
    struct cdfs_inode *i_FreeFwd; /* Free list forward link */
    struct cdfs_inode *i_FreeBack; /* Free list backward link */
    struct cdfs_inode *i_HashFwd; /* Hash list forward link */
    struct cdfs_inode *i_HashBack; /* Hash list backward link */
    uint_t i_Flags; /* Inode flags - See CDFS struct */
    struct cdfs_fid i_Fid; /* File ID info */
    struct cdfs_fid i_ParentFid; /* Parent’s File ID info */
    uid_t i_UserID; /* User ID */
    gid_t i_GroupID; /* Group ID */
    uint_t i_Mode; /* File type, Mode, and Perms */
    uint_t i_Size; /* Total # of bytes in file */
    uint_t i_LinkCnt; /* # of links to file */
    dev_t i_DevNum; /* Device # of BLK/CHR file type*/
    ulong_t i_LockOwner; /* Process # of owner of lock */
    short i_Count; /* # of inode locks by lock owner */
    uint_t i_DRcount; /* # of Directory Records */
    struct vfs *i vfs; /* File sys associated with inode */
    daddr_t i_NextByte; /* Next read-ahead offset (Byte) */
    int i_mapsz; /* kmem_alloc’d size */
    long i_mapcnt; /* mappings to file pages */
    struct cdfs_drec *i_DirRec; /* 1st link-list Dir Rec of file */
    struct cdfs_xar *i_Xar; /* XAR info from last Dir Rec */
    struct cdfs_rrip *i_Rrip; /* RRIP info from last Dir Rec */
    struct vnode *i_Vnode; /* Vnode associated with Inode */
    timestruc_t i_AccessDate; /* File Access date/time */
    timestruc_t i_ModDate; /* File Modification date/time */
    timestruc_t i_CreateDate; /* File Creation date/time */
    timestruc_t i_ExpireDate; /* File Expiration date/time */

```
```c

timestruc_t i_EffectDate; /* File Effective date/time */
timestruc_t i_AttrDate;  /* File Attribute Change date/time */
timestruc_t i_BackupDate; /* File Backup date/time */
struct pathname i_SymLink;
off_t   i_DirOffset;    /* Dir offset of last ref'd entry */
ulong   i_VerCode;      /* version code attribute */
daddr_t i_ReadAhead;    /* File offset of read-ahead byte */

/* The following fields cause storage to be allocated for the
* corresponding data structures. Since each inode will usually
* need each of these structures, this is a simple mechanism for
* getting the needed storage. Reference to these structures should
* be done via the corresponding pointers allocated above. Thus,
* if the storage is to be dynamically allocated, very little
* code needs to change.
*/
struct cdfs_drec i_DirRecStorage; /* Static storage for i_DirRec */
struct cdfs_xar i_XarStorage;     /* Static storage for i_Xar */
struct cdfs_rrip i_RripStorage;   /* Static storage for i_Rrip */
struct vnode  i_VnodeStorage;     /* Static storage for i_Vnode */
```

REFERENCES

cdfs-specific dir(4), cdfs-specific fs(4)
inode(4)  (S5)

NAME
inode (s5) – format of an s5 i-node

SYNOPSIS
#include <sys/types.h>
#include <sys/fs/s5ino.h>

DESCRIPTION
An i-node for a plain file or directory in an s5 file system has the following structure defined by sys/fs/s5ino.h.

/* Inode structure as it appears on a disk block. */

struct1dinode1 1
{
    o_mode_t di_mode; /* mode and type of file */
    o_nlink_t di_nlink; /* number of links to file */
    o_uid_t di_uid; /* owner’s user id */
    o_gid_t di_gid; /* owner’s group id */
    off_t di_size; /* number of bytes in file */
    char di_addr[39]; /* disk block addresses */
    unsigned char di_gen; /* file generation number */
    time_t di_atime; /* time last accessed */
    time_t di_mtime; /* time last modified */
    time_t di_ctime; /* time status last changed */
};

/*
 * Of the 40 address bytes:
 * 39 are used as disk addresses
 * 13 addresses of 3 bytes each
 * and the 40th is used as a
 * file generation number
 */

For the meaning of the defined types off_t and time_t see types(5).

SEE ALSO
s5-specific fs(4), stat(2), l3tol(3C), types(5)
NAME
inode (sfs) – format of a sfs inode

SYNOPSIS
#include <sys/param.h>
#include <sys/types.h>
#include <sys/vnode.h>
#include <sys/fs/sfs_inode.h>

DESCRIPTION
The inode is the focus of all local file activity in UNIX. There is a unique inode allo­
cated for each active file, each current directory, each mounted-on file, each map­
ping, and the root of the file system. An inode is ‘named’ by its device/inumber
pair. Data in icommon and isecdata (see below) is read into memory from the per­
manent inode on the actual volume. Data is also written to disk from the inode in
memory (the incore inode) when appropriate.

The structure inode represents the incore inode, and contains copies of two disk
inodes, whose formats are the structures icommon and i_secure (structure
i_secure is referenced from structure inode).

The data in icommon and i_secure is common to the incore and disk inodes. Other
information is also stored in the incore inode as shown below.

struct inode {
    /* Filesystem independent view of this inode. */
    struct inode *i_forw; /* hash chain, forward */
    struct inode *i_back; /* hash chain, back */
    struct inode *i_freef; /* free chain, forward */
    struct inode *i_freeb; /* free chain, back */
    struct vnode *i_vp; /* ptr to vnode */
    struct idata *i_data; /* pointer to the pool data */

    /* Filesystem dependent view of this inode. */
    union i_secure *i_secp; /* extra memory for security data */
    struct vnode *i_vnode; /* vnode for this inode */

    struct vnode *i_devvp; /* vnode for block I/O */
    u_short i_flag;
    dev_t i_dev; /* device where inode resides */
    ino_t i_number; /* i number, 1-to-1 with device address */
    off_t i_diroff; /* offset in dir, where we
                      found last entry */
    struct fs *i_fs; /* file sys associated with this inode */
    struct dquot *i_dquot; /* quota structure controlling
                             this file */
    short i_owner; /* proc index of process locking inode */
    short i_count; /* number of inode locks for i_owner */
    daddr_t i_nextr; /* next byte read offset (read-ahead) */
    ulong i_vcode; /* version code attribute */
    long i_mapcnt; /* mappings to file pages */

89
inode(4)

(SFS)

int *i_map;  /* block list for the corresponding file */
int i_opencnt;  /* count of opens for this inode */
lid_t i_dirofflid;  /* last proc changing i_diroff w/o
write access */
clock_t i_stamp  /*time when inode was modified but not
copied to the buffer cache*/
struct icommon i_ic;

struct icommon {
    o_mode_t ic_smode;  /* 0: mode and type of file */
    short ic_nlink;  /* 2: number of links to file */
    o_uid_t ic_suuid;  /* 4: owner's user id */
    o_gid_t ic_sgdid;  /* 6: owner's group id */
    quad ic_size;  /* 8: number of bytes in file */
    time_t ic_atime;  /* 16: time last accessed */
    long ic_atspare;
    time_t ic_mtime;  /* 24: time last modified */
    long ic_mtspare;
    time_t ic_ctime;  /* 32: last time inode changed */
    long ic_ctspare;
    daddr_t ic_db[NADDR];  /* 40: disk block addresses */
    daddr_t ic_ib[NIADDR];  /* 88: indirect blocks */
    long ic_flags;  /* 100: status, currently unused */
    long ic_blocks;  /* 104: blocks actually held */
    long ic_gen;  /* 108: generation number */
    mode_t ic_mode;  /* 112: EFT version of mode*/
    uid_t ic_uid;  /* 116: EFT version of uid */
    gid_t ic_gid;  /* 120: EFT version of gid */
    ulong ic_eftflag;  /* 124: indicate EFT version*/
};

union i_secure {
    struct icommon is_com;
    struct isecdata {
        struct icommon is_com;
        struct isecdata {
            lid_t isd_lid;  /* Level IDentifier */
            long isd_sflags;  /* flags */
            long isd_aclcnt;  /* ACL count */
            long isd_daclcnt;  /* default ACL count */
            daddr_t isd_aclblk;  /* extended ACL disk blk */
            struct acl isd_acl[NACL];  /* ACL entries */
            lid_t isd_cmwlid;  /* Level IDentifier for
file CMW */
            char isd_filler[8];  /* reserved */
        } is_secdata;
        char is_size[128];
    } is_secddata;
};
The structure `dinode` represents the disk inode; it is 128 bytes long and is the same as the `ufs` inode, except that there are two 128-byte inodes allocated on disk for each directory entry.

```
struct dinode {
    union {
        struct icommon di_icom;
        struct isecdata di_secdta;
        char di_size[128];
    } di_un;
};
```

This "alternate inode" scheme makes it look like only the even-numbered inodes on disk are used. The first inode (the even-numbered inode) is identical to the `ufs` inode, and contains all the information in the structure `icomon`.

The second inode (the "alternate", odd-numbered inode) contains the security information in the structure `isecdata`, shown below.

SEE ALSO

`sfs-specific fs(4)`
NAME
inode (ufs) - format of a ufs inode

SYNOPSIS
#include <sys/param.h>
#include <sys/types.h>
#include <sys/vnode.h>
#include <sys/fs/ufs_inode.h>

DESCRIPTION
The inode is the focus of all local file activity in UNIX. There is a unique inode allocated for each active file, each current directory, each mounted-on file, each mapping, and the root. An inode is 'named' by its dev/inumber pair. Data in icommon is read in from permanent inode on the actual volume.

struct inode {
    /* Filesystem independent view of this inode. */
    struct inode *i_forw; /* hash chain, forward */
    struct inode *i_back; /* hash chain, back */
    struct inode *i_Ifree; /* free chain, forward */
    struct inode *i_freeb; /* free chain, back */
    struct vnode *i_vp; /* ptr to vnode */
    struct idata *i_data; /* pointer to the pool data */

    /* Filesystem dependent view of this inode. */
    union i_secure
        *i_secp;
        vnode i_vnode; /* vnode for this inode */
    struct u_short
        i_flag; /* inode flags (see below) */
    dev_t i_dev; /* device where inode resides */
    ino_t i_number; /* i number, 1-to-1 with device address */
    off_t i_diroff; /* offset in dir, where we found last entry */
    struct dev *i_dfs; /* file sys associated with this inode */
    struct dquot *i_dquot; /* quota structure controlling this file */
    short i_owner; /* proc index of process locking inode */
    short i_count; /* number of inode locks for i_owner */
    daddr_t i_nextr; /* next byte read offset (read-ahead) */
    ulong i_vcode; /* version code attribute */
    long i_mapcnt; /* mappings to file pages */
    int *i_map; /* block list for the corresponding file */
    int i_opencnt; /* count of opens for this inode */
    lid_t i_dirofflid; /* last proc changing i_diroff w/o write access */
    clock_t i_stamp; /* time when inode was modified but not copied */
    struct icommon i_ic;
};

struct icommon {
    o_mode_t ic_smode; /* 0: mode and type of file */
    short ic_nlink; /* 2: number of links to file */
    o_uid_t ic_suid; /* 4: owner's user id */
    o_gid_t ic_sgid; /* 6: owner's group id */
    quad ic_size; /* 8: number of bytes in file */

#ifdef _KERNEL

(UFS)  
inode(4)

struct timeval ic_atime; /* 16: time last accessed */
struct timeval ic_mtime; /* 24: time last modified */
struct timeval ic_ctime; /* 32: last time inode changed */
#endif

time_t              ic_atime;    /* 16: time last accessed */
long                ic_atspare;
time_t              ic_mtime;    /* 24: time last modified */
long                ic_mtspare;
time_t              ic_ctime;    /* 32: last time inode changed */
long                ic_ctspare;
#endif

daddr_t             ic_db[NDADDR]; /* 40: disk block addresses */
daddr_t             ic_ib[NIADDR];  /* 88: indirect blocks */
long                ic_flags;     /* 100: status, currently unused */
long                ic_blocks;    /* 104: blocks actually held */
long                ic_gen;       /* 108: generation number */
mode_t              ic_mode;      /* 112: EFT version of mode */
uid_t               ic_uid;       /* 116: EFT version of uid */
gid_t               ic_gid;       /* 120: EFT version of gid */
ulong               ic_eftflag;   /* 124: indicate EFT version */
};

SEE ALSO
ufs-specific fs(4)
NAME
inode (vxfs) – format of a vxfs inode

SYNOPSIS
#include <sys/types.h>
#include <sys/fs/inode.h>

DESCRIPTION
The inode list consists of fs_inopau inode entries in each allocation unit. An inode entry has the following format:

- **i_mode**: The mode and type of file.
- **i_nlink**: The number of links to the file.
- **i_uid**: The inode owner.
- **i_gid**: The inode group.
- **i_size**: The size in bytes of the file. Eight bytes have been allocated. Only four bytes are used in the first implementation.
- **i_atime**: Time of last access, in timestruc_t format.
- **i_mtime**: Time of last modification, in timestruc_t format.
- **i_ctime**: Time of last inode change, in timestruc_t format.
- **i_aflags**: These flags are used to control the allocation and extension of files.
  - VX_AP_IFBAD: If this flag is set, the inode is invalid in some way. It should be cleared when fsck is run.
  - VX_AP_NOEXTEND: If this flag is set, the file may not be extended once the current reservation is exceeded. The reservation may be increased by the VX_SETEXT ioctl, but the file will not be automatically extended.
  - VX_AP_NOGROW: If this flag is set, the file may not be extended once the current reservation is exceeded. It should be cleared on truncation or when setext is run. This flag is usually set because an I/O error occurs while extending a file.
  - VX_AP_ALIGN: If this flag is set, the file must be allocated in extents of a fixed size and alignment. If an extent of i_fixextsize blocks aligned on an i_fixextsize boundary cannot
be found, then the allocation will fail. The alignment is relative to the beginning of the allocation unit.

**i_orgtype**

Mapping type. Indicates how the inode mapping area is to be interpreted. Currently there are two mapping types supported:

- **IORG_EXT4**
  
  Mapping area consists of an array of 32-bit extent block addresses and sizes.

- **IORG_IMMED**
  
  Mapping area itself is a data block. This mapping is referred to as Immediate Inode Data.

**i_eopflags**

Extended inode operation flag area.

**i_eopdata**

Extended inode operation data area.

**i_ftarea**

This is a union. The contents are determined by file type.

For devices, the following fields are supported:

- **i_rdev**
  
  The device number of a block or character special device.

For directories, the following fields are supported:

- **i_dotdot**
  
  The parent directory inode inumber if the inode is a directory. This replaces the standard ".." entry in the first directory block. The **vxfs** file system does not have explicit "." and ".." entries.

For regular files, the following fields are supported:

- **i_reserve**
  
  The number of data blocks reserved for exclusive use by the file (preallocation). A preallocation may be requested using ioctl. [See **vxfsio**(7).]

- **i_fixextsize**
  
  Set when the inode has a fixed extent size. The default is to have a variable extent size allocation policy. A fixed extent size may be specified using ioctl. [See **vxfsio**(7).]

- **i_blocks**
  
  The number of blocks currently allocated to the file, including any blocks allocated for indirect address extents.

- **i_gen**
  
  The generation number. A serial number which is incremented whenever the inode is freed and reallocated. It is designed to provide a "handle" for stateless servers such as NFS.
i_serial
A count of the number of times the inode metadata has been modified. This field is a 64-bit number.

ic_org
The mapping area. This field is a union based on the value of i_orgtype and the file system type.

For the vxfs IORG_IMMED organization type, the following structure is used:

i_immed
The Immediate Inode data area, NIMMED_N (currently 96) bytes in length (see fs_immedlen). Any directory or symbolic link which is <= 96 bytes in length will be stored directly in the inode.

For the vxfs IORG_EXT4 organization type, the following structure is used:

i_spare
Four bytes of padding, not used.

i_ies Indirect extent size. This is the size in blocks of the indirect data extents in the file.

i_ie Array of indirect address extents. There are NIADDR (currently 2) indirect address extents. The indirect address extents are 8192 bytes long. Each indirect address extent may contain up to 2048 extent addresses. The first indirect address extent is used for single indirection. With single indirection, each entry in the indirect address extent indicates the starting block number of a data extent. The second indirect address extent is a double indirect address extent. With double indirection, each entry in the indirect address extent indicates the starting block number of a single indirect address extent.

i_dext
An array of structures containing the direct extent addresses and sizes. Up to NDADDR_N (currently ten) direct extents are supported. Since a variable length extent allocation policy is used, each direct extent may have a different size. Each structure contains the following elements:

i_de Direct extent address.

i_des Direct extent size.

reserved
There are 80 bytes reserved for future use.

SEE ALSO
vxfs-specific fs(4), stat(2), types(5)
NAME

interface – Internet network interface configuration parameters

SYNOPSIS

/etc/confnet.d/inet/interface

DESCRIPTION

The /etc/confnet.d/inet/interface file is used to store network interface parameters used at boot time. Each line of data in the interface file contains enough information to configure an IP transport provider. This information is passed on to the slink [see slink(1M)] and ifconfig [see ifconfig(1M)] programs at boot time by /etc/confnet.d/inet/config.boot.sh. The /etc/confnet.d/inet/interface file can be maintained by running /etc/confnet.d/configure -i [see configure(1M)] in interactive mode, which will call /etc/confnet.d/inet/configure -i [see INET-specific configure(1M)].

The format of the /etc/confnet.d/inet/interface line is a collection of colon (:) separated fields.

prefix: unit#: address: device: ifconfig_opts: slink_opts

Each field and its defaults (if any) are defined below.

prefix is an identifier for a driver's netstat [see netstat(1M)] statistics. Traditionally this value corresponds to the common name used for a particular device. This field can not be null and it has no default.

unit# is the index per prefix type in the IP internal netstat array, where zero is the first element's index. This field should consist of only 0-9. This field can not be null and it has no default.

address is used by ifconfig to initialize the transport provider. This may be the internet name from /etc/hosts [see hosts(4)] or an address in Internet standard dot notation. Null is expanded to the system nodename, obtained by searching /etc/hosts for the /usr/bin/uname -n entry. Note the system nodename should be used for only one interface line.

device is the device node name of the transport provider. It is allocated from available network devices listed in /etc/confnet.d/netdrivers [see netdrivers(4)] through the /etc/confnet.d/configure script. This field can not be null and it has no default.

ifconfig_opts is used to customize the ifconfig options used at boot time and may contain any options defined for ifconfig on ifconfig(1M). The constructed command line will take the form:

ifconfig PrefixUnit# Converted_Address ifconfig_opts up

where PrefixUnit# is the result of concatenating prefix and unit#. PrefixUnit# result may be used as the interface parameter given to ifconfig and netstat. Converted_Address is the /etc/hosts value for the address field. ifconfig_opts can be null and has no default, but it is traditionally populated with -trailers (needed by SVR4 transport providers). See ifconfig(1M) and INET-specific configure(1M).
A case where \texttt{ifconfig\_opts} is null is when the transport provider is \texttt{lo}, (localhost in \texttt{/etc/hosts}). localhost requires no additional \texttt{ifconfig} options at boot time.

\texttt{slink\_opts} and the \texttt{/etc/strcf} file [see \texttt{strcf(4)}] is used by \texttt{slink} to initialize the \texttt{device} into the TCP/IP protocol stack. \texttt{slink\_opts} defines the \texttt{strcf} function and its first arguments (it is not limited to one word). \texttt{add\_interface} is the default \texttt{slink\_opts} value. Additional arguments will be appended to \texttt{slink\_opts} to make the final form of the \texttt{slink} operation:

\begin{verbatim}
slink\_opts ip device PrefixUnit
\end{verbatim}

where \texttt{ip} will be an open file descriptor to \texttt{/dev/ip}. \texttt{device} and \texttt{PrefixUnit} are defined in the current interface entry. For a standard Ethernet board, \texttt{slink\_opts} may be null; the defaults will take care of all arguments.

\textbf{Files}
\begin{itemize}
  \item \texttt{/dev/ip}
  \item \texttt{/etc/confnet.d/configure}
  \item \texttt{/etc/confnet.d/inet/config.boot.sh}
  \item \texttt{/etc/confnet.d/inet/configure}
  \item \texttt{/etc/confnet.d/inet/interface}
  \item \texttt{/etc/confnet.d/netdrivers}
  \item \texttt{/etc/hosts}
  \item \texttt{/usr/bin/uname}
\end{itemize}

\textbf{USAGE}

\textbf{Examples}

The entry:

\begin{verbatim}
lo:0:localhost:/dev/loop:netmask 0xff000000:add_loop
\end{verbatim}

from \texttt{/etc/confnet.d/inet/interface} will generate the following line to be used by \texttt{slink}:

\begin{verbatim}
slink\_opts ip device PrefixUnit
\end{verbatim}

The following ifconfig command would also be generated for boot time:

\begin{verbatim}
ifconfig lo0 127.0.0.1 netmask 0xff000000 up
\end{verbatim}

Note that the netmask arguments are present only for the purpose of this example.

\textbf{REFERENCES}

generic \texttt{configure(1M)}, INET-specific \texttt{configure(1M)}, \texttt{hosts(4)}, \texttt{ifconfig(1M)}, \texttt{netdrivers(4)}, \texttt{netinfo(1M)}, \texttt{slink(1M)}, \texttt{strcf(4)}
NAME

\texttt{issue} – issue identification file

DESCRIPTION

The file \texttt{/etc/issue} contains the issue or project identification to be printed as a login prompt. \texttt{issue} is an ASCII file that is read by program \texttt{getty} and then written to any terminal spawned or respawned from the \texttt{lines} file.

FILES

\texttt{/etc/issue}

SEE ALSO

\texttt{login(1)}
lid_and_priv(4)

NAME

lid_and_priv – distributed file system security database

DESCRIPTION

lid_and_priv is the distributed file system (DFS) security database, located in /etc/dfs. The lid_and_priv database acts as a mechanism that allows network administrators to control access to RFS and NFS resources on a server.

File entries have the format

domainname hostname level_name priv_list

where

domainname indicates the name of an RFS client’s domain. A dash (-) in the field indicates that the domain is the same as the server’s local domain. The domainname field is ignored by NFS.

hostname indicates the client’s machine name.

level_name indicates the security label, or its alias, assigned to requests from a client. A dash (-) in the level_name field indicates the default behavior.

priv_list is a comma-separated list of privileges that the server will accept from the client. If the network administrator wants to accept the same privileges assigned to the process on the client side, then the field should contain the entry allprivs. See the intro(2) manual page for a complete list of privileges and their meanings.

The special character * can be used in a file entry to set up new default values. By specifying * in the domainname and hostname fields, the network administrator indicates that the values in the level_name and priv_list fields in that same entry are to be used as defaults, overriding the system-defined defaults.

The special character - is a placeholder. It can be used in a file entry in either or both of the fields level_name and priv_list to indicate that the label and/or privileges assigned to the client are the same as the defaults.

The contents of lid_and_priv must be loaded into the kernel whenever changes are made to the file. A network administrator loads the contents of the file into the kernel by running the lidload(1M) command. When lidload in run, all changes in the database immediately affect all NFS resources. All RFS resources are affected immediately as well, with the exception of those with open files, which are affected once the files are closed and re-opened.

SEE ALSO

intro(2), lidload(1M)

NOTES

It is possible for the same RFS client to have more than one entry in lid_and_priv, with a different domain indicated in each entry. NFS clients should have only one entry each. If an NFS client has two entries in the file, a warning message is printed and NFS acts on the information in the first entry.
limits(4)

NAME
limits — header file for implementation-specific constants

SYNOPSIS
#include <limits.h>

DESCRIPTION
The header file limits.h is a list of minimal magnitude limitations imposed by a specific implementation of the operating system.

<table>
<thead>
<tr>
<th>NAME</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>ARG_MAX</td>
<td>5120 /* max length of arguments to exec */</td>
</tr>
<tr>
<td>CHAR_BIT</td>
<td>8 /* max # of bits in a &quot;char&quot; */</td>
</tr>
<tr>
<td>CHAR_MAX</td>
<td>127 /* max value of a &quot;char&quot; */</td>
</tr>
<tr>
<td>CHAR_MIN</td>
<td>-128 /* min value of a &quot;char&quot; */</td>
</tr>
<tr>
<td>CHILD_MAX</td>
<td>25 /* max # of processes per user id */</td>
</tr>
<tr>
<td>CLK_TCK</td>
<td>_sysconf(3) /* clock ticks per second */</td>
</tr>
<tr>
<td>DBL_DIG</td>
<td>15 /* digits of precision of a &quot;double&quot; */</td>
</tr>
<tr>
<td>DBL_MAX</td>
<td>1.7976931348623157E+308 /* max decimal value of a &quot;double&quot; */</td>
</tr>
<tr>
<td>DBL_MIN</td>
<td>2.2250738585072014E-308 /* min decimal value of a &quot;double&quot; */</td>
</tr>
<tr>
<td>FCHR_MAX</td>
<td>1048576 /* max size of a file in bytes */</td>
</tr>
<tr>
<td>FLT_DIG</td>
<td>6 /* digits of precision of a &quot;float&quot; */</td>
</tr>
<tr>
<td>FLT_MAX</td>
<td>3.40282347e+38F /* max decimal value of a &quot;float&quot; */</td>
</tr>
<tr>
<td>FLT_MIN</td>
<td>1.17549435E-38F /* min decimal value of a &quot;float&quot; */</td>
</tr>
<tr>
<td>INT_MAX</td>
<td>2147483647 /* max value of an &quot;int&quot; */</td>
</tr>
<tr>
<td>INT_MIN</td>
<td>(-2147483647-1) /* min value of an &quot;int&quot; */</td>
</tr>
<tr>
<td>LINK_MAX</td>
<td>1000 /* max # of links to a single file */</td>
</tr>
<tr>
<td>LOGNAME_MAX</td>
<td>8 /* max # of characters in a login name */</td>
</tr>
<tr>
<td>LONG_BIT</td>
<td>32 /* # of bits in a &quot;long&quot; */</td>
</tr>
<tr>
<td>LONG_MAX</td>
<td>2147483647 /* max value of a &quot;long int&quot; */</td>
</tr>
<tr>
<td>LONG_MIN</td>
<td>(-2147483647-1) /* min value of a &quot;long int&quot; */</td>
</tr>
<tr>
<td>MAX_CANON</td>
<td>256 /* max bytes in a line for canonical processing */</td>
</tr>
<tr>
<td>MAX_INPUT</td>
<td>512 /* max size of a char input buffer */</td>
</tr>
<tr>
<td>MB_LEN_MAX</td>
<td>5 /* max # of bytes in a multibyte character */</td>
</tr>
<tr>
<td>NAME_MAX</td>
<td>14 /* max # of characters in a file name */</td>
</tr>
<tr>
<td>NGROUPS_MAX</td>
<td>16 /* max # of groups for a user */</td>
</tr>
<tr>
<td>NL_ARGMAX</td>
<td>9 /* max value of &quot;digit&quot; in calls to the NLS printf() and scanf() */</td>
</tr>
<tr>
<td>NL_LANGMAX</td>
<td>14 /* max # of bytes in a LANG name */</td>
</tr>
<tr>
<td>NL_MSGMAX</td>
<td>32767 /* max message number */</td>
</tr>
<tr>
<td>NL_NMAX</td>
<td>1 /* max # of bytes in N-to-1 mapping characters */</td>
</tr>
<tr>
<td>NL_SETMAX</td>
<td>255 /* max set number */</td>
</tr>
<tr>
<td>NL_TEXTMAX</td>
<td>255 /* max # of bytes in a message string */</td>
</tr>
<tr>
<td>NZERO</td>
<td>20 /* default process priority */</td>
</tr>
<tr>
<td>OPEN_MAX</td>
<td>60 /* max # of files a process can have open */</td>
</tr>
<tr>
<td>PASS_MAX</td>
<td>8 /* max # of characters in a password */</td>
</tr>
</tbody>
</table>
### limits (4)

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PATH_MAX</td>
<td>1024</td>
<td>/* max # of characters in a path name */</td>
</tr>
<tr>
<td>PID_MAX</td>
<td>30000</td>
<td>/* max value for a process ID */</td>
</tr>
<tr>
<td>PIPE_BUF</td>
<td>5120</td>
<td>/* max # bytes atomic in write to a pipe */</td>
</tr>
<tr>
<td>PIPE_MAX</td>
<td>5120</td>
<td>/* max # bytes written to a pipe in a write */</td>
</tr>
<tr>
<td>SCHAR_MAX</td>
<td>127</td>
<td>/* max value of a &quot;signed char&quot; */</td>
</tr>
<tr>
<td>SCHAR_MIN</td>
<td>-128</td>
<td>/* min value of a &quot;signed char&quot; */</td>
</tr>
<tr>
<td>SHRT_MAX</td>
<td>32767</td>
<td>/* max value of a &quot;short int&quot; */</td>
</tr>
<tr>
<td>SHRT_MIN</td>
<td>-32768</td>
<td>/* min value of a &quot;short int&quot; */</td>
</tr>
<tr>
<td>SSIZE_MAX</td>
<td>INT_MAX</td>
<td>/* max value of an &quot;int&quot; */</td>
</tr>
<tr>
<td>STD_BLK</td>
<td>1024</td>
<td>/* # bytes in a physical I/O block */</td>
</tr>
<tr>
<td>SYS_NMLN</td>
<td>257</td>
<td>/* 4.0 size of utxname elements */</td>
</tr>
<tr>
<td>SYSNID_MAX</td>
<td>1</td>
<td>/* max pid of system processes */</td>
</tr>
<tr>
<td>TMP_MAX</td>
<td>17576</td>
<td>/* max # of unique names generated by tmpnam */</td>
</tr>
<tr>
<td>UCHAR_MAX</td>
<td>255</td>
<td>/* max value of an &quot;unsigned char&quot; */</td>
</tr>
<tr>
<td>UID_MAX</td>
<td>60000</td>
<td>/* max value for a user or group ID */</td>
</tr>
<tr>
<td>UINT_MAX</td>
<td>4294967295</td>
<td>/* max value of an &quot;unsigned int&quot; */</td>
</tr>
<tr>
<td>ULONG_MAX</td>
<td>4294967295</td>
<td>/* max value of an &quot;unsigned long int&quot; */</td>
</tr>
<tr>
<td>USHRT_MAX</td>
<td>65535</td>
<td>/* max value of an &quot;unsigned short int&quot; */</td>
</tr>
<tr>
<td>USI_MAX</td>
<td>4294967295</td>
<td>/* max decimal value of an &quot;unsigned&quot; */</td>
</tr>
<tr>
<td>WORD_BIT</td>
<td>32</td>
<td>/* # of bits in a &quot;word&quot; or &quot;int&quot; */</td>
</tr>
<tr>
<td>_POSIX_ARG_MAX</td>
<td>4096</td>
<td>/* max length of arguments to exec */</td>
</tr>
<tr>
<td>_POSIX_CHILD_MAX</td>
<td>6</td>
<td>/* max # of processes per user ID */</td>
</tr>
<tr>
<td>_POSIX_LINK_MAX</td>
<td>8</td>
<td>/* max # of links to a single file */</td>
</tr>
<tr>
<td>_POSIX_MAX_CANON</td>
<td>255</td>
<td>/* max # of bytes in a line of input */</td>
</tr>
<tr>
<td>_POSIX_MAX_INPUT</td>
<td>255</td>
<td>/* max # of bytes in terminal input queue */</td>
</tr>
<tr>
<td>_POSIX_NAME_MAX</td>
<td>14</td>
<td>/* # of bytes in a filename */</td>
</tr>
<tr>
<td>_POSIX_NGROUPS_MAX</td>
<td>0</td>
<td>/* max # of groups in a process */</td>
</tr>
<tr>
<td>_POSIX_OPEN_MAX</td>
<td>16</td>
<td>/* max # of files a process can have open */</td>
</tr>
<tr>
<td>_POSIX_PATH_MAX</td>
<td>255</td>
<td>/* max # of characters in a pathname */</td>
</tr>
<tr>
<td>_POSIX_PIPE_BUF</td>
<td>512</td>
<td>/* max # of bytes atomic in write to a pipe */</td>
</tr>
<tr>
<td>_POSIX_SSIZE_MAX</td>
<td>32767</td>
<td>/* min value stored in object of type ssize_t */</td>
</tr>
<tr>
<td>_POSIX_STREAM_MAX</td>
<td>8</td>
<td>/* min number of streams (stdio) that one process can have open at a time */</td>
</tr>
<tr>
<td>_POSIX_TZNAME_MAX</td>
<td>3</td>
<td>/* max number of bytes supported for name of a timezone (not the TZ variable) */</td>
</tr>
</tbody>
</table>

The following POSIX definitions are the most restrictive values to be used by a POSIX conformant application. Conforming implementations shall provide values at least this large.

- _POSIX_ARG_MAX 4096 /* max length of arguments to exec */
- _POSIX_CHILD_MAX 6 /* max # of processes per user ID */
- _POSIX_LINK_MAX 8 /* max # of links to a single file */
- _POSIX_MAX_CANON 255 /* max # of bytes in a line of input */
- _POSIX_MAX_INPUT 255 /* max # of bytes in terminal input queue */
- _POSIX_NAME_MAX 14 /* # of bytes in a filename */
- _POSIX_NGROUPS_MAX 0 /* max # of groups in a process */
- _POSIX_OPEN_MAX 16 /* max # of files a process can have open */
- _POSIX_PATH_MAX 255 /* max # of characters in a pathname */
- _POSIX_PIPE_BUF 512 /* max # of bytes atomic in write to a pipe */
- _POSIX_SSIZE_MAX 32767 /* min value stored in object of type ssize_t */
- _POSIX_STREAM_MAX 8 /* min number of streams (stdio) that one process can have open at a time */
- _POSIX_TZNAME_MAX 3 /* max number of bytes supported for name of a timezone (not the TZ variable) */
NAME

login – login default file

DESCRIPTION

Options for the login program can be set or changed with keywords in /etc/default/login. The following keywords are recognized by login.

CONSOLE If set, a privileged user may log in only on the terminal defined by the CONSOLE keyword. For example,

   CONSOLE=/dev/console

means the privileged user may log in only on the integral display device attached to /dev/console. If CONSOLE is not in /etc/default/login, a privileged user may log in on any terminal.

ALTSHHELL If the user’s shell is defined in /etc/passwd and this keyword is set to YES, the SHELL environment variable is set to the user’s shell. If set to NO, the names of nonstandard shells are not put in the SHELL environment variable. The default value of this keyword is NO. For increased security, set it to YES.

PASSREQ If set to YES, all users must have a password. Any user without a password is asked for one at the first opportunity permitted by the password aging set for that user. (That is, users without passwords may not change their NULL passwords if password aging is enabled for them and the minimum time before a password can be changed has not elapsed.)

MANDPASS When set to YES, this keyword makes passwords mandatory for all logins (overriding PASSREQ).

TIMEZONE This keyword sets the TZ variable in the environment of the user. It must match the format of the timezone set in /etc/TIMEZONE.

HZ This keyword sets the environment variable HZ, the rate of the system clock, for the user logging in. The default is 100.

PATH This keyword sets a default path for an unprivileged user. The default is /usr/bin.

SUPATH This keyword sets the default path for the privileged user logging in. Another default path for the privileged user is in /etc/default/su, which is set for privileged users who did not log in as such. The default is /sbin:/usr/sbin:/usr/bin:/etc.

ULIMIT This keyword sets the maximum file size for a user. It is in units of 512-byte blocks.

UMASK This keyword is the default umask for users. The default is 077.

IDLEWEEKS This keyword is the number of weeks an account may remain idle before its login is disabled.

TIMEOUT This keyword is the length of time, in seconds, that login waits for a password after receiving a user name. The default is 60.
login(4)

**MAXTRYS**  This keyword sets the maximum number of login attempts permitted. The default is 5.

**LOGFAILURES**  This keyword sets the number of failed login attempts permitted before a record is made. The default is 5. [See loginlog(4).]

**DISABLETIME**  This keyword sets the number of seconds to sleep after MAXTRYS or LOGFAILURES failed logins. The default is 20.

**SLEEPTIME**  This keyword sets the number of seconds to sleep before printing an error message. The default is 1.

**OPT_FPM**  This keyword is the pathname of a regular, non-executable file containing a site-specific message to a user without a password, asking that user to pick a password. The default message is Choose one.

**DELA YEDEXIT**  This keyword is used to delay the exit from the login process, for the specified number of seconds, so the user logging in has time to read messages before the screen is cleared. Its value can be set to any number between 0 and 10; the default value is 0. (If you try to assign a value greater than the default—10—the value will be set to 10.)

**FILES**

/etc/default/login

**SEE ALSO**

defadm(1M), loginlog(4)
NAME

loginlog – log of failed login attempts

DESCRIPTION

After LOGFAILURES unsuccessful login attempts, where LOGFAILURES is 5 if not
defined in /etc/default/login, all the attempts are logged in the file
/var/adm/loginlog. This file contains one record for each failed attempt. Each
record contains the login name, tty specification, and time.

This is an ASCII file. Each entry is separated from the next by a new-line. Within
each entry, each field is separated from the next by a colon.

By default, loginlog does not exist, so no logging is done. To enable logging, the
log file must be created with read and write permission for owner only. The owner
must be root; the group, sys.

FILES

/var/adm/loginlog
/etc/default/login

SEE ALSO

defadm(1M), login(1), login(4), passwd(1)
**mailcnfg(4)**

**NAME**
mailcnfg – initialization information for mail and rmail

**DESCRIPTION**
The /etc/mail/mailcnfg file contains initialization information for the mail and rmail commands. This file must be created initially by the administrator. Each entry in mailcnfg consists of a line of the form

```
Keyword = Value
```

Leading whitespace, whitespace surrounding the equal sign, and trailing whitespace is ignored. Keyword may not contain embedded whitespace, but whitespace may appear within Value. Undefined keywords or badly formed entries are silently ignored. Lines beginning with “#” are ignored.

The mailcnfg file must be world readable.

**Keyword Definitions**

**ADD_DATE**
If a message which originated on the local machine does not have a Date: header, and ADD_DATE has a value, one will be added.

**ADD_FROM**
If a message which originated on the local machine does not have a From: header, and ADD_FROM has a value, one will be added.

**ADD_RECEIVED**
If a message is received which has no Received: header, and ADD_RECEIVED has a value, one will be added.

**DEBUG**
Takes the same values as the -x invocation option of mail. This provides a way of setting a system-wide debug/tracing level. Typically DEBUG is set to a value of 2, which provides minimal diagnostics useful for debugging mail and rmail failures. The value of the -x mail invocation option will override any specification of DEBUG in mailcnfg.

**CLUSTER**
To identify a closely coupled set of systems by one name to all other systems, set Value to the cluster name. This string is used in place of the rather than the local system nodename returned by uname(2), such as in the surrogate file processing or for supplying the From UNIX postmark header line.

**RENAMEFROM**
This string may be set in the event that you wish to use a slightly different string in the remote from... information on the From header line UNIX postmark header line than either the cluster name or system name.

**FAILSAFE**
In the event that the /var/mail directory is accessed via RFS or NFS within a cluster (see CLUSTER above), provisions must be made to allow for the directory not being available when local mail is to be delivered (remote system crash, RFS or NFS problems, etc.). Value is a string that indicates where to forward the current message for delivery. Typically this is the remote system that actually owns /var/mail. In this way, the message is queued for delivery to that system when
it becomes available. For example, assume a cluster of systems (sysa, sysb, sysc) where /var/mail is physically mounted on sysc and made available to the other machines via RFS or NFS. If sysc were to crash, the RFS/NFS-accessible /var/mail would become unavailable and local deliveries of mail would go to /var/mail on the local system. When /var/mail is re-mounted via RFS/NFS, all messages deposited in the local directory would be hidden and essentially lost. To prevent this, if FAILSAFE is defined in mailcnfg, mail and rmail check for the existence of /var/mail/:saved, a required subdirectory. If this subdirectory does not exist, mail assumes that the RFS/NFS-accessible /var/mail is not available and invokes the failsafe mechanism of automatically forwarding the message to Value. In this example Value would be sysc!%n. The %n keyword is expanded to be the recipient name [see mail(1) for details] and thus the message would be forwarded to sysc!recipient_name. Because sysc is not available, the message remains on the local system until sysc is available, and then sent there for delivery.

DEL_EMPTY_MFILE
If not specified, the default action of mail and rmail is to delete empty mailfiles if the permissions are 0660 and to retain empty mailfiles if the permissions are anything else. If Value is yes, empty mailfiles are always deleted, regardless of file permissions. If Value is no, empty mailfiles are never deleted.

DOMAIN
This string is used to supply the system domain name in place of the domain name returned by sysinfo(2).

SMARTERHOST
This string may be set to a smarter host which may be referenced within the mail surrogate file via %X.

ARG_MAX
The maximum size of the argument list and environment to be used for surrogate commands. This overrides the kernel-settable ARG_MAX parameter. On most systems, the maximum size will be 5120 bytes.

SURREXPORT
A comma separated list of environment variables to be passed through to surrogate commands.

CNFGEXPORT
A comma separated list of mail configuration variables to be passed through to surrogate commands as environment variables.

NOCOMPILEDSURRFILE
Normally, mail will create a compiled version of the surrogate file, named /etc/mail/Cmailsurr, whenever the surrogate file or configuration file changes, and then subsequently use the compiled version. If this variable is set to any value, mail will ignore the compiled surrogate file.
As described in `mailsurr(4)`, certain pre-defined single letter keywords are textually substituted in surrogate command fields before they are executed. While none of the predefined keyletters may be changed in meaning, new ones may be defined to provide a shorthand notation for long strings (such as `/usr/lib/mail/surrcmd`) which may appear repeatedly within the `mailsurr` file. Upper case letters are reserved for future use and will be ignored if encountered here.

FILES

/etc/mail/mailcnfg
/etc/mail/mailsurr
/etc/mail/Cmailsurr
/var/mail/:saved
/usr/lib/mail/surrcmd

SEE ALSO

mail(1), mailsurr(4), sysconf(3C), sysinfo(2), uname(2)

NOTES

If `/var/mail` is accessed via RFS or NFS and the subdirectory `/var/mail/:saved` is not removed from the local system, the FAILSAFE mechanism will be subverted.
mailsurr (4)

NAME
mailsurr — surrogate commands for routing and transport of mail

DESCRIPTION
The mailsurr file contains routing and transport surrogate commands used by the mail command. Each entry in mailsurr has three (or four) whitespace-separated, single quote delimited fields:

'sender'  'recipient'  'command' ['batch']

or a line that begins with either of

Defaults:
Translate-Defaults:

Entries and fields may span multiple lines, but leading whitespace on field continuation lines is ignored. Fields must be less than 1024 characters long after expansion (see below). Case is always ignored for making comparisons.

The sender and recipient fields are regular expressions. If the sender and recipient fields match those of the message currently being processed, the associated command is invoked.

The command field may have one of the following forms:

A[accept]
D[eny] [message]
L[ocal]
T[ranslate] [B=...;S=...;F=...;T=...;L=...;] R=[\ ]string
< [B=...;S=...;C=...;F=...;] command
> [B=...;W=...;] command
E[rrors] [B=...;W=...;] command

The mailsurr file must be world readable. If a batching specification (B=...) is given, then the batch field must also be given; this fourth field is discussed in the “Batching” section.

Regular Expressions
The sender and recipient fields are composed of regular expressions (REs) which are digested by the regexp(5) compile and advance procedures in the C library. The regular expressions matched are those from ed(1), with simple parentheses () playing the role of \ and the addition of the +, ? and | operators from egrep(1). Any single quotes embedded within the REs must be escaped by prepending them with a backslash or the RE is not interpreted properly.

The mail command prepends a circumflex (^) to the start and appends a dollar sign ($) to the end of each RE so that it matches the entire string. Therefore it would be an error to use ^RE$ in the sender and recipient fields. To provide case insensitivity, all REs are converted to lower case before compilation, and all sender and recipient information is converted to lower case before comparison. This conversion is done only for the purposes of RE pattern matching; the information contained within the message's header is not modified.
mailsurr (4)

The sub-expression pattern matching capabilities of regexp may be used in the command field, that is, \n, where 1 \< n \< 9. Any occurrences of \n in the replacement string are themselves replaced by the corresponding parenthesized ( . . . ) substring in the matched pattern. The sub-expression fields from both the sender and recipient fields are accessible, with the fields numbered 1 to 9 from left to right.

Accept and Deny Commands
Accept instructs rmail to continue its processing with the mailsurr file, but to ignore any subsequent matching Deny. That is, unconditionally accept this message for delivery processing. Deny instructs rmail to stop processing the mailsurr file and to send a negative delivery notification, along with the optional message, to the originator of the message. Whichever is encountered first takes precedence.

< Delivery command
The intent of a < command is that it is invoked as part of the transport and delivery mechanism, with the ready-for-delivery message available to the command at its standard input. As such, there are three conditions possible when the command exits:

Success The command successfully delivered the message. What actually constitutes successful delivery may be different within the context of different surrogates. The rmail process assumes that no more processing is required for the message for the current recipient.

Continue The command performed some function (logging remote message traffic, for example) but did not do what would be considered message delivery. The rmail process continues to scan the mailsurr file looking for some other delivery mechanism.

Failure The command encountered some catastrophic failure. The rmail process stops processing the message and sends to the originator of the message a non-delivery notification that includes any stdout and stderr output generated by the command.

The semantics of the < command field in the mailsurr file allow the specification of exit codes that constitute success, continue, and failure for each surrogate command individually. See the section below on “Exit State Specifications” for details.

Surrogate commands are executed by rmail directly. If any shell syntax is required (metacharacters, redirection, and so on), then the surrogate command must be of the form:

```
sh -c "shell command line . . ."
```

Special care must be taken to properly escape any embedded backslashes and other characters special to the shell as stated in the “Translate” section above.

If there are no matching < commands, or all matching < commands exit with a continue indication, rmail attempts to deliver the message itself by assuming that the recipient is local and delivering the message to /var/mail/recipient.

Translate Command
Translate allows optional on-the-fly translation of recipient address information. The recipient replacement string is specified as R=string.
For example, given a command line of the form

```
'.+‘ ‘([^-]+)+@(\.+)/.EUO/\ATT\.com’ ‘Translate R=attmail!\2!\1’
```

and a recipient address of `rob@sysa.EUO.ATT.COM` the resulting recipient address
would be `attmail!sysa!rob`.

Should the first character after the equal sign be a ‘|’, the remainder of the string is
taken as a command line to be directly executed by `rmail`. If any `sh(1)` syntax is
required (metacharacters, redirection, and so on), then the surrogate command
must be of the form:

```
sh -c "shell command line. ."
```

Special care must be taken to escape properly any embedded back-slashes and sin­
gle or double quotes, since `rmail` uses double quoting to group whitespace delim­
ited fields that are meant to be considered as a single argument to `exec1()` [See
`exec(2)`]. As stated above, any occurrences of `\n` are replaced by the appropriate
substring before the command is executed.

It is assumed that the executed command will write one or more replacement
strings on `stdout`. The exit code of the command is examined to determine the
outcome of the translation:

**Success**  The command successfully translated the address. If the invoked com­
mand does not return at least one replacement string (no output or just a
newline), the original address is not modified. If the original address
itself is returned as one of the translations, the translations are added to
the list of addresses and the original address is not modified.

**Failure**  The command encountered some catastrophic failure. Any translations
read from `stdout` will be used, but the `rmail` process will send to the
originator of the message a non-delivery notification that includes any
`stderr` output generated by the command.

The semantics of the `Translate` command field in the `mailsurr` file allow the
specification of exit codes that constitute success and failure for each surrogate com­
mand individually. See the section below on “Exit State Specifications” for details.

The output of the translation command consists of one or more lines of output con­
taining the new addresses, one or more per line, separated by white space. If batch­
ing is enabled (see the section on “Batching” below), the output of the translation
command consists of the new addresses, but each line of output must begin with
the address for which that line of output is the translation.

This mechanism is useful for mailing list expansions. For example, the command
line

```
'.+‘ ‘(.+)’ ‘Translate R=\findpath \1’
```

allows local routing decisions to be made.

If the recipient address string is modified, `mailsurr` is rescanned from the begin­
ing with the new address(es), and any prior determination of `Accept` (see above)
is discarded.
When a recipient has been translated, the new recipient may again be passed through the translation command for further translation. (Recursive mailing lists are thus possible.) Some translation commands can guarantee that their output is fully translated and cannot be further translated. For these commands, the state specification $T=1;\$ should be given. (If the resulting address should not be processed further within the surrogate file, the state specification $L=1;\$ should be given. Local delivery to $/var/mail/recipient$ will then be attempted.)

If a recipient address translates into a recipient address previously seen, it will not be placed onto the recipient list again unless the name was translated recursively back to itself.

If the returned recipient address begins with an exclamation point "!" and $E=1;\$ is given, then all leading exclamation points will be stripped. Because the default surrogate file treats leading exclamation points as special, careful consideration should be given as to whether stripping should be performed. If a recipient address is passed in to the translate command with a leading exclamation point, the exclamation point should not be stripped.

**Local Command**

**Local** instructs *rmail* to stop processing this address within the surrogate file and attempt local delivery to $/var/mail/recipient$. It is equivalent to a **Translate** command with the state specification $L=1;\$ and a null translation string.

**Exit State Specifications**

The syntax of the exit state specification is:

\[
[state\_id=ec[,ec[,...]];][state\_id=ec[,ec[,...]];[...]]]
\]

Whitespace may precede the exit state specification, but must follow. state\_ids can be specified in any order. exit\_state\_id can have the value $S$, $C$, or $F$, and are used on Delivery < and Translation commands. The special state\_id of $T$ may be used in Translation commands, and is described in that section. The special state\_id of $W$ may be used in Postprocessing, > and Errors, commands, and is described in those sections. The special state\_id of $B$ may be used to specify batched processing and is described in the section "Batching".

$ec$ can be:

- any integer $0 \leq n \leq 255$ [Negative exit values are not possible. See exit(2) and wait(2).]
- a range of integers of the form $lower\_limit-upper\_limit$ where the limits are $\geq 0$ and $\leq 255$, and
- $\ast$, which implies anything

For example, a command field of the form:

\['< S=1-5,99;C=10,12;F=\ast;\quad command \%R'\]

indicates that exit values of 1 through 5, and 99, are to be considered success, values of 0 (zero) and 12 indicate continue, and that anything else implies failure.

It may be possible for ambiguous entries to exist if two exit states have the same value, for example, $S=12,23;C=\ast;F=23,52;\text{or } S=\ast;C=9;F=\ast;\text{. To account for this, }rmail$ looks for explicit exit values (that is, not "\ast") in order of success, continue, failure. Not finding an explicit match, *rmail* then scans for "\ast" in the same order.
It is possible to eliminate an exit state completely by covering all possible values with a different default or setting a state’s value to an impossible number. (Since exit values must be between 0 and 255 (inclusive), a value of 256 is a good one to use.) For example, if you had a surrogate command that was to log all message traffic, a `mailsurr` entry of

```
'(.*).' '('.*).' '<C=*; logger \1 \2'
```

could never indicate success or failure.

**Defaults:** and **Translate-Defaults:** Lines

If not explicitly supplied, default exit code settings are `S=0;C=*;` for `<` commands and `S=0;F=*;` for `Translate` commands. The default exit code settings for delivery and translation commands may be redefined by creating a separate line in the `mailsurr` file of one of these forms:

```
 Defaults: [S=...;][C=...;][F=...;]
 Translate-Defaults: [S=...;][F=...;]
```

Defaults: lines are honored and the indicated default values redefined when the line is encountered during the normal processing of the `mailsurr` file. Therefore, to redefine the defaults globally, the Defaults: line should be the first line in the file. It is possible to have multiple Defaults: lines in the `mailsurr` file, where each subsequent line overrides the previous one.

**Postdelivery command**

The intent of a `>` command is that it is invoked after a successful delivery to do any post-delivery processing that may be required. Matching `>` commands are executed only if some `<` command indicates a successful delivery (see the previous section) or local delivery processing is successful. The `mailsurr` file is rescanned and all matching `>` commands, not just those following the successful `<` command, are executed in order. The exit status of an `>` command is ignored.

Some commands exit quickly, while others may take a while. The `mail` command normally waits for the `>` command to exit before continuing its processing. If it is better not to wait for a particular command, the state specification `W=1;` should be given.

**Errors command**

The intent of an `Errors` command is that it is invoked after an unsuccessful delivery to do any post-delivery processing that may be required. Matching `Errors` commands are executed only if some `<` or `Translate` command indicates a failed delivery, or local delivery processing is unsuccessful. The `mailsurr` file is rescanned and all matching `Errors` commands, not just those following the failed `<` or `Translate` command, are executed in order. The exit status of an `Errors` command is ignored. The state specification `W=1;` may be used just as for the `>` command.

**Batching**

Some commands may be combined together for multiple recipients. For example, the delivery commands
mailsurr(4)

```
  uux - sysa!rmail (tony)
  uux - sysa!rmail (rob)
```

may be combined together into the single delivery command

```
  uux - sysa!rmail (tony) (rob)
```

Note that there are essentially two parts to each of the above commands, the non-varying left-hand part, and the varying right-hand part. Combining two delivery lines going to a common system just requires the use of the non-varying left-hand side paired with all the remaining right-hand sides. Combining the commands together allows for the more efficient delivery of mail.

Note also that there are two possible limitations to be imposed on such commands: the maximum size of the command line as limited by the UNIX system, and the maximum size of buffers used within the command. The first limitation is an administerable kernel parameter, usually 5120 bytes, for the combination of the parameters and environment (the command-line length limitation); the second limitation is a function of the command being used and varies from command to command. For example, the internal buffers of most versions of uux limit the command line to 1024 bytes. (Note also that there are limitations on both sides of the network; even if the limit for uux were raised on the local side, the limit must remain at 1024 to be portable.)

To specify that a surrogate command is to be batched, the batching specification of `B=number` is given along with any exit code specifications. The `number` is the maximum size of the command line to be used. It may also be specified as `*`, in which case the system command-line limitations are used. (The system command-line limitations may be overridden by using the `mailcnfg` variable `ARG_MAX`.)

If batching is specified, then in addition to the `command` field, a fourth `batch` field must also be specified. The `command` field specifies the non-varying left-hand part, and the `batch` field specifies the varying right-hand part. For example, a specification for uux might be:

```
  .+ '([!@]+)!(.+)’ < B=1024; uux - \1!rmail’ ‘(\2)'
```

All surrogate commands which permit a UNIX command to be executed may be batched.

**Surrogate Command Keyletter Replacement.**

Certain special sequences are textually-substituted in surrogate commands before they are invoked:

- `%c` value of the `Content-Type:` header line if present.
- `%C` "text" or "binary", depending on an actual scan of the content. This is independent of the value of any `Content-Type` header line encountered (useful when calling `ckbinarsys`.)
- `%d` the local domain name. This will be either `DOMAIN` from `mailcnfg`, or the value returned by `sysinfo(2)`.
- `%h` the size of the message header in bytes.
- `%l` the local system name. This will be either `CLUSTER` from `mailcnfg` or the value returned by `uname`.
The sequences %L, %U, %D, and %keyletters are permitted within the sender and recipient fields as well as in the command fields.

Mail Surrogate Examples

Some examples of mail surrogates include the distribution of message-waiting notifications to LAN-based recipients and lighting Message-Waiting Lamps, the ability to mail output to printers, and the logging of all mail requests between remote systems (messages passing through the local system). The following is a sample mail.surr file:

```plaintext
# Some common remote mail surrogates follow. To activate any
# or all of them, remove the '#' (comment indicators) from
# the beginning of the appropriate lines. Remember that they
# will be tried in the order they are encountered in the file,
# so put preferred surrogates first.

# Prevent all shell meta-characters
'.'+ '.*[;\&\^<>()].*' 'Deny'

# Map all names of the form local-machine!user -> user
'.'+ '%L!(.+)' 'Translate R=\l'

# Map all names of the form uname!user -> user
# Must be turned on when using mail in a cluster environment.
#'+ '%U!(.+)' 'Translate R=\l'

# Map all names of the form user@host -> host!user
'.'+ '([^@]+)@(.+)' 'Translate R=\2!\1'

# Map all names of the form host.uucp!user -> host!user
'.'+ '([^@]+)\.uucp!(.+)' 'Translate R=\1!\2'

# Map all names of the form host.local-domain!user -> host!user
# DOMAIN= within /etc/mail/mailcnfg will override sysinfo(2).
'.'+ '([^@]+)%D!(.+)' 'Translate R=\1!\2'
```
mailsurr(4)

# Allow access to 'attmail' from remote system 'sysa'
'sysa!.*' 'attmail!.' Accept'

# Deny access to 'attmail' from all other remote systems
'.+!' 'attmail!.' 'Deny No access to AT&T Mail'

# Send mail for 'laser' to attached laser printer
# Make certain that failures are reported via return mail.
'.+' 'laser' '< S=0;F=*; lp -dlaser'

# Run all local names through the mail alias processor
'.+' [^@]+' 'Translate B=*=; R=mailalias' '%n'

# If you wish to support a user name space of user@local-domain in
# addition to user@host.local-domain, then add the following translation,
# where DOMAIN is the local domain, and HOST.DOMAIN is where to send the
# mail. Note that %D contains a leading dot, so it cannot be used in the
# first regular expression.
'.+' !DOMAIN!(.+)' 'Translate R=!HOST%D!\1'

# For remote mail via nusend
'.+' [^@]+!'(.+)' ' nusend -d \1 -s -e !"rmail \2" -'

# For remote mail via usend
'.+' [^@]+!'(.+)' '< usend -s -d\1 -uNoLogin !"rmail \2" -'

# For remote mail via uucp
'.+' [^@]+!'(.+)' '< uucp \1!rmail (\2)'

# For remote mail via smtp
'.+' [^@]+!'(.+)' '< smtpqer %R \1 \2'

# If none of the above work, then let a router change the address.
'.+' .!*[@]*' 'Translate R=mail -A %n'

# If none of the above work, then ship remote mail off to a smarter host.
# Make certain that SMARTERHOST= is defined within /etc/mail/mailcnfg.
'.+' .!*[@]*' 'Translate R=%X!%n'

# If you have a flat name space across multiple machines, but user-names only
# exist on disjoint machines, this entry will forward any name not known
# locally off to the given host.
'.+' .!*[@]*' 'Translate T=1; R=localmail -p -S HOST.DOMAIN' '%n'

# Log successful message deliveries
'.+)' (.+)' '> logger \1 \2'
mailsurr (4)

Note that invoking mail to read mail does not involve the mailsurr file or any surrogate processing.

Security
Surrogate commands execute with the permissions of rmail (user ID of the invoker, group ID of mail). This allows surrogate commands to validate themselves, checking that their effective group ID was mail at invocation time. This requires that all additions to mailsurr be scrutinized before insertion to prevent any unauthorized access to users’ mail files. (Note that some versions of the shell turn off the effective group ID. If the surrogate command is a shell script and it requires group mail permissions, the shell may be explicitly invoked in the surrogate command with the -p option: sh -p shell.script.) All surrogate commands are executed with the path /usr/lib/mail/surrcmd:/usr/bin, and an environment consisting of the SHELL=/usr/bin/sh, HOME, TZ and LOGNAME variables. Other environment variables may be passed by listing them in the mailcnfg variable SURR_EXPORT as a comma-separated list (e.g. SURR_EXPORT=TERM,LINES,COLUMNS).

Debugging New mailsurr Entries
To debug mailsurr files, use the -T option of the mail command. The -T option requires an argument that is taken as the pathname of a test mailsurr file. If null (as in -T ""), the system mailsurr file is used. Enter

```
mail -T test_file recipient
```

The result of using the -T option is displayed on standard output and shows the inputs and resulting transformations as mailsurr is processed by the mail command for the indicated recipient.

Mail messages will never be sent or delivered when using the -T option.

The -d and -# option may also be used to debug the system surrogate files.

FILES
/etc/mail/mailsurr
/usr/lib/mail/surrcmd/* surrogate commands
/etc/mail/mailcnfg initialization information for mail

SEE ALSO
ckbinarsys(1M), ed(1), egrep(1), exec(2), exit(2), mail(1), mail(1), mailalias(1), mailcnfg(4), popen(3S), regexp(5), sh(1), smtpqer(1M), sysinfo(2), uname(1), uux(1C), wait(2)

NOTES
It would be unwise to install new entries into the system mailsurr file without verifying at least their syntactical correctness via ‘mail -T . . ’ as described above.
mapchan (4)

NAME
mapchan – format of tty device mapping files

DESCRIPTION
mapchan configures the mapping of information input and output of UNIX.

Each unique channel map requires a 2048-byte buffer for mapping the input and
output of characters. No buffers are required if no channels are mapped.

A method of sharing maps is implemented for channels that have the same map in
place. Each additional, unique map allocates an additional buffer. The maximum
number of map buffers available on a system is configured in the kernel, and is
adjustable via the link kit NEMAP parameter. Buffers of maps no longer in use are
returned for use by other maps.

EXAMPLES OF A MAP FILE
The internal character set used by UNIX System V/386 is defined by the right
column of the input map, and the first column of the output map in place on that
line. The default internal character set is the 8-bit ISO 8859/1 character set, which is
also known as dpANS X3.4.2 and ISO/TC97/SC2. It supports the Latin alphabet
and can represent most European languages.

Any character value not given is assumed to be a straight mapping. Only the differ­
ences are shown in the mapfile [see mapchan(1M)]. The left hand column must be
unique. More than one occurrence of any entry is an error. Right hand column
characters can appear more than once. This is many to one mapping. Nulls can be
produced with compose sequences or as part of an output string.

It is recommended that no mapping be enabled on the channel used to create or
modify the mapping files. This prevents any confusion of the actual values being
entered due to mapping. It is also recommended that numeric rather than character
representations be used in most cases, as these are not likely to be subject to map­
ning. Use comments to identify the characters represented. Refer to the ascii(5)
manual page and hardware reference manual of the device being mapped for the
values to assign.

#                        #sound bell when errors occur
#sharp/pound/cross-hatched is the comment character
#however, a quoted # ('#') is 0x23, not a comment
#
#beep, input, output, dead, compose and control
#are special keywords and should appear as shown.
#
#beep
input
a b
ab
dead p
q r
# p followed by q yields r.
s t
# p followed by s yields t.
dead u
v w
# u followed by v yields w.
mapchan(4)

compose x  # x is the compose key (only one allowed).
yza  # x followed by B and C yields D.
BCD

output
ef  # e is mapped to f.
ghi j  # g is mapped to hij-one to many.
klnno  # k is mapped lmnno

control  # The control must be last

input
E1  # The character E is followed by 1 or more unmapped character

output
FG2  # The characters FG are followed by 2 more unmapped characters

All of the single letters above preceding the control section must be in one of these formats:

56  # decimal
045  # octal
0xfa  # hexadecimal
'b'  # quoted char
'\076'  # quoted octal
'\x4a'  # quoted hex

All of the above formats are translated to a single byte values.

The control sections (which must be the last in the file) contain specifications of character sequences which should be passed through to or from the terminal device without going through the normal mapchan processing. These specifications consist of two parts: a fixed sequence of one or more defined characters indicating the start of a no-map sequence, followed by a number of characters of which the actual values are unspecified.

To illustrate this, consider a cursor-control sequence which should be passed directly to the terminal without being mapped. Such a sequence would typically begin with a fixed escape sequence instructing the terminal to interpret the following two characters as a cursor position; the values of the following two characters are variable, and depend on the cursor position requested. Such a control sequence would be specified as:

E= 2  # Cursor control: escape = <x> <y>

There are two subsections under the control section: the input section, which is used to filter data sent from the terminal to UNIX System V/386, and the output section, which is used to filter data sent from UNIX System V/386 to the terminal. The two fields in each control sequence are separated by white space, that is the SPACE or TAB characters. Also the # (HASH) character introduces a comment, causing the remainder of the line to be ignored. Therefore, if any of these three characters are required in the specification itself, they should be entered using one of alternative means of entering characters, as follows:
mapchan (4)

^x The character produced by the terminal on pressing the CONTROL and x keys together.
E or \ The ESCAPE character, octal 033.
\c Where c is one of b, f, l, n, r or t, produces BACKSPACE, FORMFEED, LINEFEED, NEWLINE, CARRIAGE RETURN or TAB characters, respectively.
\0 Since the NULL character can not be represented, this sequence is not stored as the character with octal value 0200, which behaves as a NULL on most terminals.
\0 or \0n Specifies the octal value of the character directly.
Followed by any any other character is interpreted as that character. This can be used to enter SPACE, TAB, or HASH characters.

DIAGNOSTICS
mapchan performs these error checks when processing the mapfile:

more than one compose key
characters mapped to more than one thing
syntax errors in the byte values
missing input or output keywords
dead or compose keys also occurring in the input section
extra information on a line
mapping a character to null
starting an output control sequence with a character that is already mapped

If characters are displayed as the 7-bit value instead of the 8-bit value, use stty \-a [see stty(1)] to verify that -strip is set. Make sure input is mapping to the 8859 character set. Dead and compose sequences are input mapping and should be going to 8859.

FILES
/etc/default/mapchan
/usr/lib/mapchan/*

NOTES
Some non-U.S keyboards and display devices do not support characters commonly used by UNIX command shells and the C programming language. Do not attempt to use such devices for system administration tasks.

Not all terminals or printers can display all the characters that can be represented using this utility. Refer to the device's hardware manual for information on the capabilities of the peripheral device.

Use of mapping files that specify a different internal character set per-channel, or a set other than the 8-bit ISO 8859 set supplied by default can cause strange side effects. It is especially important to retain the 7-bit ASCII portion of the character set [see ascii(5)] UNIX System V/386 utilities and applications assume these values. Media transported between machines with different internal code set mappings may not be portable as no mapping is performed on block devices, such as tape and floppy drives. trchan can be used to translate from one internal character set to another.
mapchan(4)

Do not set `ISTRIP` [see `stty(1)`] on channels that have mapping that includes eight bit character set.

SEE ALSO
ascii(5), keyboard(7), lp(7), mapchan(1M), mapkey(1M), stty(1), trchan(1), tty(7)
Master (4)

NAME

Master – generic configuration information for a kernel module

SYNOPSIS

Master

DESCRIPTION

One of the ID/TP kernel configuration files, a Master file describes a kernel module that can potentially be configured into the system. Configuration information for the individual kernel modules that are actually to be included in the next system to be built is described in the System file [see System(4)].

When the Master component of a module’s Driver Software Package (DSP) is installed, idinstall(1M) stores the module’s Master file information in /etc/conf/mdevice.d/module-name, where the file module-name is the name of the module being installed. Package scripts should never access /etc/conf/mdevice.d files directly; only the idinstall and idcheck(1M) commands should be used.

Master files contain lines of the form:

$version version-number
$entry entry-point-list
$depend module-name-list
$modtype loadable-module-type-name
module-name prefix characteristics order bmaj cmaj

Blank lines and lines beginning with ‘#’ or ‘*’ are considered comments and are ignored.

The first four types of lines are as follows:

$version If present in the file, this line must appear as the first non-comment line. The line specifies the version number of the Master file format. The Master file format being described here is version 1. If this line is omitted, version 0 (the old Master file format) is assumed.

$entry Specifies the names of the entry point routines included in the module. One or more $entry lines may be used to specify the entry point names. If a single $entry line specifies more than one entry point name, the multiple names must be separated by white space.

The function names are constructed by appending the entry point name to the module’s prefix. Only functions explicitly listed on $entry lines will be called directly by the kernel. The following entry points are supported (note that some of the supported entry points apply only to certain module types):

_init chpoll close core exec halt init intr ioctl
kenter kexit mmap msgio open poll print read segmap
size start strategy write
$depend

Used for dynamically loadable kernel modules only, the line specifies the names of the loadable modules (if any) that contain symbols referenced by this loadable module. One or more $depend lines may be used to specify the module names. If a single $depend line specifies more than one module name, the multiple names must be separated by white space.

$modtype

This line is used for dynamically loadable kernel modules only. The line specifies the character string (maximum of 40 characters, including white space characters) to be used to identify the type of this module in error messages.

The last line of the Master file contains the following six fields. Each field must be separated by white space and specify a value.

module-name Specifies the internal name of the module (maximum of 14 characters). The first character must be alphabetic; the remaining characters may be letters, digits or underscores.

prefix Specifies the character string prepended to all entry-point routines and variable names associated with this module (maximum of 8 characters). During the kernel build process, an all uppercase version of this string will also be used to construct the #define symbolic constants accessible to the module's Space.c file [see idbuild(1M)].

If the module has no entry-points or special variables, this field may contain a dash; in this case, no #define symbols will be generated.

characteristics Defines a set of flags that indicate the characteristics of the module. If none of the characteristics listed below apply to the module, the characteristics field must contain a dash. Valid field values are:

b The module is a 'block' device driver.
c The module is a (STREAMS or non-STREAMS) character device driver.
d The module is a dispatcher class module.
e The module is an exec object-specific module.
h The module controls hardware, but is not a device driver; that is, the module requires hardware I/O resources (for example, interrupts or bus addresses), but does not require switch table entries.
k Keep majors flag. This flag is intended for device drivers supplied with the base system only. It indicates that idinstall should use the major numbers specified by the bmaj and/or cmaj fields in the module's Master file, instead of automatically assigning major numbers to the module. These reserved major numbers must also be specified in the res_major file [see res_major(4)].
Master (4)

m  The module is a STREAMS module.

o  The module may have only one System file entry.

r  The module is required in all configurations of the kernel. This flag is intended for device drivers supplied with the base system only. Note that, once made, a required module's device nodes (special files in the /dev directory) are not removed [see idmod(1M)].

t  The module is a non-STREAMS tty driver.

u  The module is a device driver which requires identical block major numbers and character major numbers. Note that both the b and c flags must also be set when using this flag; if they are not set, the u flag is ignored.

D  The module is a hardware module which can share its DMA channel(s) with other drivers.

F  The module is a VFS file system module.

O  The IOA range of this device may overlap that of another device.

S  The module is a STREAMS driver and/or STREAMS module.

order  Specifies a decimal numeric value used to control the order by which the module's init and start routines are called, and the order of execsw entries. Higher-numbered values come first. For most modules, the order is unimportant, and this field should be 0.

bmaj  Specifies the block major number(s) for this module. This field should contain either a single decimal number, or two numbers separated by a dash to indicate an inclusive range of values ("multiple majors"). The (first) value should normally be zero prior to installation with idinstall(1M). For example, to request four major numbers, this field would be initialized to "0-3" in the DSP Master file.

If the b flag is set—and the k flag is not set—in the characteristics field, idinstall will automatically assign block major numbers for the device. If the b flag and the k flags are both set, the bmaj field value will be used.

cmaj  Specifies the character major number(s) for this module. This field should contain either a single decimal number, or two numbers separated by a dash to indicate an inclusive range of values ("multiple majors"). The (first) value should normally be zero prior to installation with idinstall(1M). For example, to request four major numbers, this field would be initialized to "0-3" in the DSP Master file.
If the c flag is set—and the k flag is not set—in the characteristics field, idinstall will automatically assign character major numbers for the device. If the c flag and the k flags are both set, the cmaj field value will be used.

NOTES

Specifying STREAMS Devices and Modules

STREAMS modules and drivers are treated in a slightly different way from other drivers, and their configuration reflects this difference. To specify a STREAMS device driver, its Master file should specify both an S and a c flag in the characteristics field. This indicates that it is a STREAMS driver and that it requires an entry in the cdevsw table, where STREAMS drivers are normally configured into the system.

A STREAMS module that is not a device driver, such as a line discipline module, requires both an S and an m flag in the characteristics field of its Master file; it should not specify a c flag, as a device driver does.

In cases where a module contains both a STREAMS module and a STREAMS driver, the S, c and m flags should all be specified.

Compatibility Considerations

For compatibility with existing add-on DSP packages, idinstall also accepts the old (version 0) mdevice file format, which had a single non-comment line that contained the following nine fields:

name funcs characteristics prefix bmaj cmaj min_unit max_unit dmachan

When presented with a version 0 mdevice file, idinstall converts the file to version 1 Master file format. During mdevice file conversion:

The funcs field is converted into $entry lines

The following characteristics flags are ignored as obsolete: a, i, n, s, G, H, M, N, R (the f flag in the version 0 mdevice file will still be recognized, but should not be used in a version 1 Master file)

The min_unit and max_unit fields are ignored as obsolete

The dmachan field is moved to the System file

Because cross-dependencies exist in the version 0 mdevice and sdevice files for exec modules, idinstall cannot convert these files to version 1 files. They must be converted manually before using idinstall.

Note that idinstall also accepts obsolete mfsys files and converts them to version 1 Master file format.

SEE ALSO

idbuild(1M), idcheck(1M), idinstall(1M), Master(4), modadmin(1M), res_major(4), Space.c(4), System(4)
NAME

menu - form description file for menu(1) command

DESCRIPTION

menu is a menu and form generator that creates file-driven, full-screen forms and menus for accepting user input and displaying information. The form or menu to be displayed is specified in a form description file that allows text, lists, input fields, contents of files, and output from commands to be displayed.

The form description file consists of a number of keywords, each denoting the start of a new section of the form description. Each section of the form description corresponds to a different part of the menu described. For example, there is a keyword .top which specifies that the text that follows will be placed at the top of the screen. The text in each section of the form description file can be hard-coded in the form description file, or it may be redirected from a file or command.

I/O Redirection

In the form description file, text may be included from another file. This is handled by specifying a less than (<) character in the first column of the form description file, followed by the name of a file to include. The text included from the file will be included verbatim; that is, no keywords will be processed, and no I/O redirection or command substitution will be performed on the input redirected from a file.

Command Substitution

In the form description file, text may be the output from a shell command. This is handled by enclosing a command to be executed in backquotes. Note that no more than one command will be parsed per input line of the form description file, and no command may span more than one line of the form description file. Again, the text included from the output of the command will be included verbatim; that is, no keywords will be processed, and no I/O redirection or command substitution will be performed on the input given by the output of a command.

Comments

The form description file may contain comments, which will be ignored. Comment lines are specified by placing a pound sign (#) in the first column.

SEE ALSO

menu(1), menu_colors.sh(1)
NAME

mkdev – file format for the pdimkdev utility

DESCRIPTION

The pdimkdev utility is executed when the system transitions from single-user to multi-user mode to create special device file entries for any newly configured PDI peripheral hardware. The pdimkdev utility allows for provision of special device file naming conventions by the application.

The naming convention for a PDI peripheral device is described in a mkdev template file. Additional mkdev template files may be provided for new device types that require a different naming convention than the one already being used.

Template File Overview

Each device type has a corresponding template file that is, by convention, placed in the directory /etc/scsi/mkdev.d. The template file allows for special device files to be created in up to four directories. These are the character and block special directories and the corresponding simple administration directories. The permissions of the special device files may also be specified.

Device Naming Template Syntax

The following tables show the syntax for the mkdev template files. The lines up to the separator “DATA” are for user messages that may be device specific.

<table>
<thead>
<tr>
<th>STRING</th>
<th>MEANING</th>
</tr>
</thead>
<tbody>
<tr>
<td>QUERY</td>
<td>If the QUERY string in the template file is a string other than “-”, then the query will be issued to the user under low inode conditions. The set of device files to be created will be determined based on the response. The only currently known application for this feature is to determine whether a disk device is a boot device.</td>
</tr>
<tr>
<td>POSTMSG</td>
<td>The POSTMSG string is printed after the naming of a new device. For SCSI tape devices, this message is “-”, which mkdev ignores. For disk devices, the message instructs the user to use sysadm partitioning if necessary.</td>
</tr>
</tbody>
</table>

The next line provides the directory names for the block and character devices as well as the simple administration equivalents for these. On the remaining lines the first three fields provide the key, minor number and mode. The fourth and fifth fields provide, respectively, the block and character device files. The sixth and seventh fields provide the block and character simple administration names, which are linked to the files in fields four and five, respectively. Below is a key showing the use and meaning of characters and keywords in the templates that follow.
mkdev(4)

<table>
<thead>
<tr>
<th>KEY</th>
<th>The key field is a single character from the set &quot;-&quot;, &quot;M&quot;, or &quot;Y&quot;. The meanings are explained below.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y</td>
<td>Under low inode conditions (less than 200 available in the root filesystem) these device files will be created if answer to QUERY is &quot;yes&quot;. For disks, this will denote Logical Unit (LU) is bootable and files must be created for a bootable LU.</td>
</tr>
<tr>
<td>M</td>
<td>Device file is mandatory and is created in low inode conditions.</td>
</tr>
<tr>
<td>-</td>
<td>Special device file is to be created under normal situations (that is, more than 200 available inodes on the root filesystem).</td>
</tr>
</tbody>
</table>

**Minor Number Calculation**

The information available to the pdimkdev utility about each device is host adaptor slot number (C), target controller number (T), Logical Unit number (L), and major number. A formula, using the information available to the pdimkdev utility, is provided in the template file and is used to generate the minor number. The major and minor number are used in calls to mknod(2) to create the special device file.

<table>
<thead>
<tr>
<th>STRING</th>
<th>MEANING</th>
</tr>
</thead>
<tbody>
<tr>
<td>MINOR : [constant</td>
<td>C</td>
</tr>
<tr>
<td>C</td>
<td>Host adaptor slot number.</td>
</tr>
<tr>
<td>T</td>
<td>Target controller SCSI ID.</td>
</tr>
<tr>
<td>L</td>
<td>Logical Unit number.</td>
</tr>
</tbody>
</table>

**REFERENCES**

pdimkdev(1M)
mnttab(4)

NAME
mnttab - mounted file system table

SYNOPSIS
#include <sys/mnttab.h>

DESCRIPTION
The file /etc/mnttab contains information about devices that have been mounted by the mount command. The information is in the following structure, defined in sys/mnttab.h:

    struct mnttab {
        char *mnt_special;
        char *mnt_mountp;
        char *mnt_fstype;
        char *mnt_mntopts;
        char *mnt_time;
    };

The fields in the mount table are space-separated and show the block special device, the mount point, the file system type of the mounted file system, the mount options, and the time at which the file system was mounted.

NOTES
Do not store information in the mnttab file other than the fields described above; fields may be added to this file in future releases and are reserved for future use.

SEE ALSO
getmntent(3C), mount(1M), setmnt(1M)
Mtune (4)

NAME
Mtune – tunable parameter definitions

SYNOPSIS
Mtune

DESCRIPTION
One of the ID/TP kernel configuration files, an Mtune file contains definitions of tunable parameters, including default values, for a kernel module type. System-specific tunable values are stored in stune. When the Mtune component of a module’s Driver Software Package (DSP) is installed, idinstall(lM) stores the module’s Mtune file information in /etc/conf/mtune.d/module-name, where the file module-name is the name of the module being installed. Package scripts should never access /etc/conf/mtune.d files directly; only the idinstall and idtune commands should be used.

Each tunable parameter is specified on a separate line of the form:

    parameter-name default-value minimum-value maximum-value

All fields are positional and must be separated by white space. Blank lines and lines beginning with ‘#’ or ‘*’ are considered comments and are ignored.

The Mtune file fields are:

- **parameter-name**: A string (maximum of 20 characters) used to construct the preprocessor #defines that pass the value for this parameter to the system when the system is built [see Space.c(4)].
- **default-value**: Specifies the default value for this tunable parameter. If the value is not overridden by the stune(4) file, this value will be used when the system is built.
- **minimum-value**: Specifies the minimum allowable value for this tunable parameter. If the parameter is set in the stune(4) file, the configuration tools will check that the value specified in the stune file is equal to or greater than this value.
- **maximum-value**: Specifies the maximum allowable value for this tunable parameter. If the parameter is set in the stune(4) file, the configuration tools will check that the value specified in the stune file is equal to or less than this value.

For detailed information on Mtune parameters, refer to the advanced features sections on tunable parameters in your system administration documentation.

NOTES

Compatibility Considerations
For compatibility with existing add-on DSP packages, idbuild(lM) maintains a flat file, /etc/conf/cf.d/mtune, which contains all of the tunable parameters. Packages may read this file to find existing values, and may add new tunables to the file. This mechanism is discouraged, however; new packages should use the idinstall and idtune commands.
SEE ALSO

idbuild(1M), idinstall(1M), idtune(1M), Space.c(4), stune(4)
NAME
netconfig — network configuration database

SYNOPSIS
#include <netconfig.h>

DESCRIPTION
The network configuration database, /etc/netconfig, is a system file used to store information about networks connected to the system and available for use. The netconfig database and the routines that access it [see getnetconfig(3N)] are part of the UNIX System V Network Selection component. The Network Selection component also includes the environment variable NETPATH and a group of routines that access the netconfig database using NETPATH components as links to the netconfig entries. NETPATH is described in sh(1); the NETPATH access routines are discussed in getnetpath(3N).

netconfig contains an entry for each network available on the system. Entries are separated by newlines. Fields are separated by whitespace and occur in the order in which they are described below. Whitespace can be embedded as "\blank" or "\tab." Backslashes may be embedded as "\". Each field corresponds to an element in the struct netconfig structure. struct netconfig and the identifiers described on this manual page are defined in /usr/include/netconfig.h.

network ID
A string used to uniquely identify a network. network ID consists of non-null characters, and has a length of at least 1. No maximum length is specified. This namespace is locally significant and the local system administrator is the naming authority. All network IDs on a system must be unique.

semantics
The semantics field is a string identifying the "semantics" of the network, that is, the set of services it supports, by identifying the service interface it provides. The semantics field is mandatory. The following semantics are recognized.

| tpi_clts | Transport Provider Interface, connectionless |
| tpi_cots | Transport Provider Interface, connection oriented |
| tpi_cots_ord | Transport Provider Interface, connection oriented, supports orderly release |
| tpi_raw | Transport Provider Interface, raw |

flag
The flag field records certain two-valued ("true" and "false") attributes of networks. flag is a string composed of a combination of characters, each of which indicates the value of the corresponding attribute. If the character is present, the attribute is "true." If the character is absent, the attribute is "false." "-" indicates that none of the attributes is present. Two characters are currently recognized:

| v | Visible ("default") network. Used when the environment variable NETPATH is unset |
b Enable RPC broadcast.

**protocol family**

The *protocol family* and *protocol name* fields are provided for protocol-specific applications.

The *protocol family* field contains a string that identifies a protocol family. The *protocol family* identifier follows the same rules as those for *network IDs*, that is, the string consists of non-null characters; it has a length of at least 1; and there is no maximum length specified. A "-" in the *protocol family* field indicates that no protocol family identifier applies, that is, the network is experimental. The following are examples:

- **loopback** Loopback (local to host).
- **inet** Internetwork: UDP, TCP, and so on
- **implink** ARPANET imp addresses
- **pup** PUP protocols: for example, BSP
- **chaos** MIT CHAOS protocols
- **ns** XEROX NS protocols
- **nbs** NBS protocols
- **ecma** European Computer Manufacturers Association
- **datanet** DATANET protocols
- **ccitt** CCITT protocols, X.25, and so on
- **sna** IBM SNA
- **deernet** DECENT
- **dli** Direct data link interface
- **lat** LAT
- **hylink** NSC Hyperchannel
- **appleTalk** Apple Talk
- **nit** Network Interface Tap
- **ieee802** IEEE 802.2; also ISO 8802
- **osi** Umbrella for all families used by OSI (for example, protosw lookup)
- **x25** CCITT X.25 in particular
- **osinet** AFI = 47, IDI = 4
- **gosip** U.S. Government OSI

**protocol name**

The *protocol name* field contains a string that identifies a protocol. The *protocol name* identifier follows the same rules as those for *network IDs*, that is, the string consists of non-NULL characters; it has a length of at least 1; and there is no maximum length specified. The following protocol names are recognized. A "-" indicates that none of the names listed applies.

- **tcp** Transmission Control Protocol
- **udp** User Datagram Protocol
- **icmp** Internet Control Message Protocol

**network device**

The *network device* is the full pathname of the device used to connect to the transport provider. Typically, this device will be in the /dev directory. The *network device* must be specified.
netconfig(4)

**directory lookup libraries**

The directory lookup libraries support a "directory service" (a name-to-address mapping service) for the network. This service is implemented by the UNIX System V Name-to-Address Mapping feature. If a network is not provided with such a library, the netdir feature will not work. A "-" in this field indicates the absence of any lookup libraries, in which case name-to-address mapping for the network is non-functional. The directory lookup library field consists of a comma-separated list of full pathnames to dynamically linked libraries. Commas may be embedded as "\,\"; backslashes as "\\".

Lines in /etc/netconfig that begin with a sharp sign (#) in column 1 are treated as comments.

The struct netconfig structure includes the following members corresponding to the fields in in the netconfig database entries:

- `char * nc_netid` Network ID, including NULL terminator
- `unsigned long nc_semantics` Semantics
- `unsigned long nc_flag` Flags
- `char * nc_protofmly` Protocol family
- `char * nc_proto` Protocol name
- `char * nc_device` Full pathname of the network device
- `unsigned long nc_nlookups` Number of directory lookup libraries
- `char ** nc_lookups` Full pathnames of the directory lookup libraries themselves
- `unsigned long nc_unused[9]` Reserved for future expansion (not advertised to user level)

The nc_semantics field takes the following values, corresponding to the semantics identified above:

- `NC_TPI_CLTS`
- `NC_TPI_COTS`
- `NC_TPI_COTS_ORD`
- `NC_TPI_RAW`

The nc_flag field is a bitfield. The following bit, corresponding to the attribute identified above, is currently recognized: `NC_NOFLAG` indicates the absence of any attributes.

- `NC_VISIBLE`

**FILES**

/etc/netconfig
/usr/include/netconfig.h

**SEE ALSO**

getnetconfig(3N), getnetpath(3N), icmp(7), ip(7), netconfig(4),
netdir_getbynameO [see netdir(3N)]
NAME
netdrivers – data file for networking boards to protocols mappings

SYNOPSIS
/etc/confnet.d/netdrivers

DESCRIPTION
The netdrivers file contains a list of hardware devices installed on the system and
the protocols mapped to each board. The format of the file is:
<device><whitespace><protocol>

where <device> is the name of the device in /dev and <protocol> is a string matching
the directory name in /etc/confnet.d where the configure script for the proto­
col can be found. Multiple lines will exist for any board that is being used for mul­
tiple protocols. Lines starting with "#" will be ignored.
Manipulation of the netdrivers file should be via the netinfo command.

Files
/etc/confnet.d/netdrivers

REFERENCES
generic configure(1M), INET-specific configure(1M), protocol-specific
configure(1M), interface(4), netdrivers(4), netinfo(1M)
netmasks (4)

NAME

netmasks – network mask data base

DESCRIPTION

The netmasks file contains network masks used to implement IP standard subnetting. For each network that is subnetworked, a single line should exist in this file with the network number, any number of SPACE or TAB characters, and the network mask to use on that network. Network numbers and masks may be specified in the conventional IP '\.' notation (like IP host addresses, but with zeroes for the host part). For example,

128.32.0.0 255.255.255.0

can be used to specify that the Class B network 128.32.0.0 should have eight bits of subnet field and eight bits of host field, in addition to the standard sixteen bits in the network field.

SEE ALSO

ifconfig(1M)
NAME

netrc – file for ftp remote login data

DESCRIPTION

The .netrc file contains data for logging in to a remote host over the network for file transfers by ftp(1). This file resides in the user’s home directory on the machine initiating the file transfer. Its permissions should be set to disallow read access by group and others [see chmod(1)].

The following tokens are recognized; they may be separated by SPACE, TAB, or NEWLINE characters:

machine name

Identify a remote machine name. The auto-login process searches the .netrc file for a machine token that matches the remote machine specified on the ftp command line or as an open command argument. Once a match is made, the subsequent .netrc tokens are processed, stopping when the EOF is reached or another machine token is encountered.

login name

Identify a user on the remote machine. If this token is present, the auto-login process will initiate a login using the specified name.

password string

Supply a password. If this token is present, the auto-login process will supply the specified string if the remote server requires a password as part of the login process. Note: if this token is present in the .netrc file, ftp will abort the auto-login process if the .netrc is readable by anyone besides the user.

account string

Supply an additional account password. If this token is present, the auto-login process will supply the specified string if the remote server requires an additional account password, or the auto-login process will initiate an ACCT command if it does not.

macdef name

Define a macro. This token functions as the ftp macdef command functions. A macro is defined with the specified name; its contents begin with the next .netrc line and continue until a NULL line (consecutive NEWLINE characters) is encountered. If a macro named init is defined, it is automatically executed as the last step in the auto-login process.

EXAMPLE

A .netrc file containing the following line:

    machine ray login demo password mypassword

allows an autologin to the machine ray using the login name demo with password mypassword.

FILES

"~/.netrc"
netrc(4)

SEE ALSO
    chmod(1), ftp(1), ftpd(1M)
networks (4)

NAME

networks – network name data base

DESCRIPTION

The networks file contains information regarding the known networks which comprise the DARPA Internet. For each network a single line should be present with the following information:

   official-network-name network-number aliases

Items are separated by any number of SPACE and/or TAB characters. A ‘#’ indicates the beginning of a comment; characters up to the end of the line are not interpreted by routines which search the file. This file is normally created from the official network data base maintained at the Network Information Control Center (NIC), though local changes may be required to bring it up to date regarding unofficial aliases and/or unknown networks.

Network number may be specified in the conventional ‘.’ notation (for example, 193.4.56.0) using the inet_network routine from the Internet address manipulation library, inet(7). Network names may contain any printable character other than a field delimiter, NEWLINE, or comment character.

The networks file allows the usage of symbolic names instead of an IP address in the output of networking commands (for example, netstat -r).

FILES

/etc/networks

SEE ALSO

getnetent(3N), inet(7), netstat(1M)

NOTES

A name server should be used instead of a static file. A binary indexed file format should be available for fast access.
NAME

Node – device node definitions for a device driver

SYNOPSIS

Node

DESCRIPTION

One of the kernel configuration files, a Node file contains definitions used by the
idmknod(1M) command to create the device nodes (block and character special
files) associated with a device driver module. When the Node component of a
module’s Driver Software Package (DSP) is installed, idinstall(1M) stores the
driver’s Node file information in /etc/conf/node.d/module-name, where module-
name is the name of the driver being installed. Package scripts should never access
/etc/conf/node.d files directly; the idinstall command should be used instead.

Each device node for the driver is specified on a separate line of the form:

module-name node-name type minor user group permissions

All fields are positional and must be separated by white space. The first four fields
are required; the last three fields are optional. Blank lines and lines beginning with
‘#’ or ‘*’ are considered comments and are ignored.

The node file fields are:

module-name

Identifies the device to which this node applies. The name must
match the name specified for the device in the module-name field
of the Master(4) file. The device must be defined as a block
and/or character device (Master file characteristics flag set to b or
c). When the device node is created, the Master file bmaj or cmaj
field values will be used as the major number for the created
node.

node-name

Specifies the name of the Node file to be created, relative to /dev.
If this field specifies a pathname containing subdirectories, idmk-
nod will automatically create these subdirectories.

type

Identifies the type of node to be created. The character b indicates that the node is a block device; the character c indicates character device. The value for this field must match one of the
flags specified for the device in the mdevice file characteristics
field.

In cases where a device has multiple major numbers, the Node file
type field must provide additional information used to identify
which device nodes belong to which major. To do this, you
specify a value of the form:

type:offset

where type is the type of node (b or c) and offset gives the offset to
this particular device within the range of major numbers specified
for this device type in the Master file. For example, the value
“c:2” refers to a character major offset 2, which, given a major
device type specification of “15-18”, would translate to a charac-
ter major number of 17.
Node(4)

**minor**

Specifies the minor device number. This field can be coded in one of three ways:

- If this field specifies a (decimal) numeric value, the value is used as the minor device number for the created node.
- If this field specifies a non-numeric value, the value is assumed to be a request for a clone node, and the minor number will be set to the major number of the device whose `module-name` is the value of the field.
- If this field specifies a non-numeric value and the `Node` file `type` field specifies an offset value, the offset will be applied to the minor number instead of the major number when the node is created.

**user**

This field is optional. If used, it specifies the user ID of the user that will own the node to be created. The user ID must be specified as decimal integer value.

**group**

This field is optional. If used, it specifies the group ID of the group that will own the node to be created. The group ID must be specified as decimal integer value.

**permissions**

This field is optional. If used, it specifies, in octal form, the permissions for the node to be created, as given to the `chmod(1)` command (example: 0777).

**USAGE**

**Examples**

The following sample `Node` file entries are provided as coding examples:

- **easy**
  - `tty00 c 0`
  - Makes `/dev/tty00` for character device `asy` using minor device 0.

- **clone**
  - `net/nau/clone c nau`
  - Makes `/dev/net/nau/clone` for character device `clone`. The minor device number is set to the major device number of device `nau`.

- **clone**
  - `imx586_1 c:1 imx586`
  - Makes `/dev/imx586_1` for character device `clone`. The minor device number is set to the major device number of device `imx586` plus 1.

**SEE ALSO**

`idinstall(1M), idmknod(1M)"
OllcValues (4)

NAME

OllcValues – Input Context attribute names and value pairs

SYNOPSIS

#include <Xol/OpenLook.h>

typedef OlICValues *OlICValuesList;

typedef void (*OlImProc)();

typedef void *OlImValue;

DESCRIPTION

OlICValuesList contains a list of Input Context attribute names and value pairs. It is used for getting and setting various Input Context attributes.

The OlICValues structure includes the following members:

    char *attr_name;
    void *attr_value;

The OlImCallback structure includes the following members:

    OlImValues    client_data;
    OlImProc      callback;

The supported Input Context attributes are shown in the table below. The end of the list is indicated by a NULL value in the attribute name.

<table>
<thead>
<tr>
<th>Input Context Attributes</th>
<th>Attribute Name</th>
<th>Attribute Value Type</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OlNclientWindow</td>
<td>Window*</td>
</tr>
<tr>
<td></td>
<td>OlNClientArea</td>
<td>XRectangle*</td>
</tr>
<tr>
<td></td>
<td>OlNinputStyle</td>
<td>OlImStyle*</td>
</tr>
<tr>
<td></td>
<td>OlNfocusWindow</td>
<td>Window*</td>
</tr>
<tr>
<td></td>
<td>OlNpreeditArea</td>
<td>XRectangle*</td>
</tr>
<tr>
<td></td>
<td>OlNstatusArea</td>
<td>XRectangle*</td>
</tr>
<tr>
<td></td>
<td>OlNspotLocation</td>
<td>XPoint*</td>
</tr>
<tr>
<td></td>
<td>OlNresourceDatabase</td>
<td>XrmDatabase*</td>
</tr>
<tr>
<td></td>
<td>OlNpreeditAttributes</td>
<td>OlICWindowAttr*</td>
</tr>
<tr>
<td></td>
<td>OlNstatusAttributes</td>
<td>OlICWindowAttr*</td>
</tr>
</tbody>
</table>
OllcValues (4)

<table>
<thead>
<tr>
<th>Attribute Name</th>
<th>Attribute Value Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>OllNcolormap</td>
<td>Colormap</td>
</tr>
<tr>
<td>OllNstdColormap</td>
<td>Colormap</td>
</tr>
<tr>
<td>OllNbackground</td>
<td>Pixel</td>
</tr>
<tr>
<td>OllNforeground</td>
<td>Pixel</td>
</tr>
<tr>
<td>OllNbackgroundPixmap</td>
<td>Pixmap</td>
</tr>
<tr>
<td>OllNfontset</td>
<td>OlFontList</td>
</tr>
<tr>
<td>OllNlinesSpacing</td>
<td>int</td>
</tr>
<tr>
<td>OllNcursor</td>
<td>Cursor</td>
</tr>
<tr>
<td>Callbacks</td>
<td>OlImCallback</td>
</tr>
</tbody>
</table>

OllNclientWindow
specifies the client window in which the Input Method may display data or create subwindows. Dynamic changes of client window are not supported; this argument must be set at the Input Context creation time and cannot be changed later. It is a static attribute required by OllCreateIC. The value is a pointer to a window.

OllNclientArea
specifies the client area in which the Input Method may display data or create subwindows. The Input Method will establish its own pre-edit and status geometry accordingly. When this attribute is left unspecified, The Input Method will default usable client area to actual client window geometry. This is a dynamic attribute that can be modified via calls to OllSetICValues. The value is a pointer to an XRectangle.

OllNinputStyle
specifies the input style to be used. The value of this argument must be one of the supported styles returned by the OllGetICValues function, otherwise OllCreateIC will fail. If this attribute is unspecified, the Input Method uses an implementation defined default style. MooLIT does not support Dynamic changes of Input Method style. This argument must be set at the Input Context creation time and cannot be changed later. The value is a pointer to OllImStyle.

OllNfocusWindow
specifies to the Input Method the window XID of the focus window. The input method may affect that window: select events on it, send events to it, modify its properties, and grab the keyboard within that window.

When this attribute is unspecified, the Input Method will default from the focus window to the client window. Explicitly setting this attribute from a non NULL value to NULL, forces the Input Method to clear any displayed data in the status area corresponding to the focus window. This is a dynamic attribute that can be modified via calls to OllSetICValues. The value is a pointer to a window.
OlcValues (4)

OlNpreeditArea

the area where pre-edit data should be displayed. The value of this argument is a pointer to XRectangle, relative to the client window. The Input Method may create a preedit window in this area, using the specified geometry, as a child of a client window.

When OlNpreeditArea is unspecified, the Input Method will default from the preedit area to an implementation defined area. This area is contained within the client area.

If you specify this attribute for root or XimPreEditCallbacks Input Method, it is ignored.

If you specify this attribute for an XimPreEditArea Input Method, the width and height determine the size of the area within the "over-the-spot" window now available for pre-edit.

OlNstatusArea

specifies to the Input Method the usable area to display Input Context state information. The value of this argument is a pointer to XRectangle, relative to the client window.

The Input Method may or not create a status window in this area, using the specified geometry, as a child of the client window.

When OlNstatusArea is unspecified, the Input Method defaults to the status area defined by the Input Method implementation. The status area is contained within the client area. This is a dynamic attribute that can be modified via calls to OlSetIcValues.

Note that if a client leaves all areas unspecified, the Input Method may not be able to run properly. Some implementations will generate errors if none of the focus window, focus area, client area, preedit area, and status area are defined. At best, it may behave randomly using any area in the client window, possibly clearing the whole window or erasing any region.

OlNspotLocation

specifies the coordinates of the "spot" (the current cursor position in the text insertion window), to be used by the "over-the-spot" or "on-the-spot" Input Methods. The type is a pointer to Xpoint. The x coordinate specifies the position where the next character would be inserted. The y coordinate is the position of the baseline used by current text line in the focus window.

SEE ALSO

OlCreateIc(3Olit), OlDestroyIc(3Olit), OlGetIcValues(3Olit), OlImOfIc(3Olit), OlImValues(4), OlSetIcFocus(3Olit), OlSetIcValues(3Olit), OlUnsetIcFocus(3Olit), OlResetIc(3Olit)
NAME
OlImValues – a list of IM attributes

SYNOPSIS
#include <Xol/OpenLook.h>

DESCRIPTION
OlImValues contains a list of Input Method values or attributes returned by the OlImStyles structure. The OlImStyles structure includes the following members:

    unsigned short count_styles; /* the number of input styles supported */ OlImStyle *supported_styles;

count_styles is also the size of the array in the supported_styles field. Each element in the array represents a different input style supported by this Input Method. It is a bitmask in which the Input Method indicates its requirements, should this style be selected. These requirements fall into the following categories:

OlImPreEditArea require the client to provide some area values for preediting. Refer to the Input Context attribute OlNpreeditArea.

OlIMPreeditPosition require the client to provide positional values. Refer to Input Context attributes OlNspotLocation and OlNFocusWindow.

OlImPreeditCallbacks require the client to define the set of preedit callbacks. Refer to Input Context attributes OlNPreeditStartCallback, OlNPreeditDoneCallback, OlNPreeditDrawCallback, and OlNPreeditCaretCallback.

OlImNeedNothing function without any preedit values.

OlImStatusArea require the client to provide some area values for status feedback. Refer to OlNArea and OlNAreaNeeded.

OlImStatusCallbacks require the client to define the set of status callbacks.

SEE ALSO
OlCreateIC(3Olit), OlDestroyIC(3Olit), OlGetICValues(3Olit), OlICValues(4), OlICOfIC(3Olit), OlSetICFocus(3Olit), OlSetICValues(3Olit), OlUnsetICFocus(3Olit), OlResetIC(3Olit)
NAME
.ott - FACE object architecture information

DESCRIPTION
The FACE object architecture stores information about object-types in an ASCII file named .ott (object type table) that is contained in each directory. This file describes all of the objects in that directory. Each line of the .ott file contains information about one object in pipe-separated fields. The fields are (in order):

- **name**: the name of the actual UNIX System file.
- **dname**: the name that should be displayed to the user, or a dot if it is the same as the name of the file.
- **description**: the description of the object, or a dot if the description is the default (the same as object-type).
- **object-type**: the FACE internal object type name.
- **flags**: object specific flags.
- **mod time**: the time that FACE last modified the object. The time is given as number of seconds since 1/1/1970, and is in hexadecimal notation.
- **object information**: an optional field, contains a set of semi-colon separated name=value fields that can be used by FACE to store any other information necessary to describe this object.

FILES
.ott is created in any directory opened by FACE.
passwd(4)

NAME
 passwd – password file

SYNOPSIS
 /etc/passwd

DESCRIPTION
 /etc/passwd is an ASCII file that contains basic information about each user’s account. This file contains a one-line entry, for each authorized user, of the form:

   login_name : password : uid : gid : comment : home_dir : login_shell

where:

login_name  is the name specified by the user when logging in. This field contains no uppercase characters, should not be more than eight characters long, and should begin with a non-numeric character (that is, any alphabetic or special character except colon).

password  contains the character x. This field remains only for compatibility reasons. Password information is contained in the file /etc/shadow [see shadow(4)].

uid  is the user’s numerical ID for the system, which should be unique.

gid  is the numerical ID of the group to which the user belongs.

comment  is any information you think might be useful to a user of this file which is not included elsewhere in the file.

home_dir  is the pathname of the directory in which the user is initially positioned upon logging in.

login_shell  is the user’s initial shell program. If this field is empty, the default shell is /usr/bin/sh.

Fields are separated by a colon; entries, by a new-line. Comment lines (lines preceded by the # (pound) character) are not allowed in the /etc/passwd file.

/etc/passwd has general read permission on all systems, and can be used by routines that map numerical user IDs to names.

FILES
 /etc/passwd
 /etc/shadow
 /usr/lib/locale/locale/LC_MESSAGES/uxcore.abi
     language-specific message file [See LANG on environ(5).]

SEE ALSO
 getpwent(3C), group(4), login(1), passwd(1), putpwent(3C), pwconv(1M), shadow(4), unistd(4), useradd(1M), userdel(1M), usermod(1M)
The pathalias files contain lines of the form alias=path where path can be one or more colon-separated directories. Whenever a FACE user references a path not beginning with a "/" this file is checked. If the first component of the pathname matches the left-hand side of the equals sign, the right-hand side is searched much like \$PATH variable in the UNIX System. This allows users to reference the folder \$HOME/FILECABINET by typing filecabinet.

There is a system-wide pathalias file called \$VMSYS/pathalias, and each user can also have local alias file called \$HOME/pref/pathalias. Settings in the user alias file override settings in the system-wide file. The system-wide file is shipped with several standard FACE aliases, such as filecabinet, wastebasket, preferences, other_users, and so on.

Unlike command keywords, partial matching of a path alias is not permitted, however, path aliases are case insensitive. The name of an alias should be alphabetic, and in no case can it contain special characters like "/" or "." There is no particular limit on the number of aliases allowed. Alias files are read once, at login, and are held in core until logout. Thus, if an alias file is modified during a session, the change will not take effect until the next session.

FILES
\$HOME/pref/pathalias
\$VMSYS/pathalias
NAME
pkginfo – package characteristics file

DESCRIPTION
pkginfo is an ASCII file that describes the characteristics of the package along with information that helps control the flow of installation. It is created by the software packag developer.

Each entry in the pkginfo file is a line that establishes the value of a parameter in the following form:

\[ PARAM="value" \]

There is no required order in which the parameters must be specified within the file. Each parameter is described below. Only fields marked with an asterisk are mandatory.

PKG*

PKG is the parameter to which you assign an abbreviation for the name of the package being installed. The abbreviation must be a short string (no more than nine characters long) and it must conform to file naming rules. All characters in the abbreviation must be alphanumeric and the first may not be numeric. install, new, and all are reserved abbreviations.

NAME*

Text that specifies the package name (maximum length of 256 ASCII characters).

ARCH

A comma-separated list of alphanumeric tokens that indicate the architecture (for example, ARCH=m68k, i386) associated with the package. The pkgmk tool may be used to create or modify this value when actually building the package. The maximum length of a token is 16 characters and it cannot include a comma. ARCH is not a mandatory field. Therefore, if it is not specified or if it is specified as NULL, it is ignored.

VERSION*

Text that specifies the current version associated with the software package. The maximum length is 256 ASCII characters and the first character cannot be a left parenthesis. The pkgmk tool may be used to create or modify this value when actually building the package.

CATEGORY*

A comma-separated list of categories under which a package may be displayed. There are six categories: “application”, “graphics”, “system”, “utilities”, “set”, and “patch.” If you choose, you can also assign a package to one or more categories that you define. Categories are case-insensitive and may contain only alphanumericics. Each category is limited in length to 16 characters.

For a Set Installation Package (SIP), this field must have the value “set”. A SIP is a special purpose package that controls the installation of a set of packages.
pkginfo(4)

DESC  Text that describes the package (maximum length of 256 ASCII characters).

VENDOR  Used to identify the vendor that holds the software copyright (maximum length of 256 ASCII characters).

HOTLINE  Phone number and/or mailing address where further information may be received or bugs may be reported (maximum length of 256 ASCII characters).

EMAIL  An electronic address where further information is available or bugs may be reported (maximum length of 256 ASCII characters).

VSTOCK  The vendor stock number, if any, that identifies this product (maximum length of 256 ASCII characters).

CLASSES  A space-separated list of classes defined for a package. The order of the list determines the order in which the classes are installed. Classes listed first will be installed first (on a medium-by-medium basis). This parameter may be modified by the request script. In this way, the request script may be used to select which classes in the package get installed on the system.

ISTATES  A list of allowable run states for package installation (for example, "S s 1").

RSTATES  A list of allowable run states for package removal (for example, "S s 1").

BASEDIR  The pathname to a default directory where "relocatable" files may be installed. If BASEDIR is not specified and basedir in the admin(4) file (/var/sadm/install/admin/default) is set to default, then BASEDIR is set to / by default. An administrator can override the value of BASEDIR by setting basedir in the admin file.

ULIMIT  If set, this parameter is passed as an argument to the ulimit command, which establishes the maximum size of a file during installation.

ORDER  A list of classes defining the order in which they should be put on the medium. Used by pkgmk in creating the package. Classes not defined in this field are placed on the medium using the standard ordering procedures.

MAXINST  The maximum number of package instances that should be allowed on a machine at the same time. By default, only one instance of a package is allowed. This parameter must be set in order to have multiple instances of a package.

PSTAMP  Production stamp used to mark the pkgmap file on the output volumes. Provides a means for distinguishing between production copies of a version if more than one is in use at a time. If PSTAMP is not defined, the default is used. The default consists of the UNIX system machine name followed by the string "YYMMDDHHmm" (year, month, date, hour, minutes).
pkginfo(4)

INTONLY Indicates that the package should be installed interactively only when set to any non-NULL value.

PREDEPEND Used to maintain compatibility with dependency checking on packages delivered earlier than System V Release 4. Pre-Release 4 dependency checks were based on whether or not the name file for the required package existed in the /usr/options directory. This directory is not maintained for Release 4 and later packages because the depend file is used for checking dependencies. However, entries can be created in this directory to maintain compatibility. This is done automatically by pkgmk. This field is to be assigned the package instance name of the package.

SERIALNUM A serial number, if any, that uniquely identifies this copy of the package (maximum length of 256 ASCII characters).

EXAMPLES
Here is a sample pkginfo file:

```
PKG="oam"
NAME="OAM Installation Utilities"
VERSION="3"
VENDOR="AT&T"
HOTLINE="1-800-ATT-BUGS"
EMAIL="attunix!olsen"
VSTOCK="0122c3f5566"
CATEGORY="system.essential"
ISTATES="S 2"
RSTATES="S 2"
```

NOTES
Developers may define their own installation parameters by adding a definition to this file. A developer-defined parameter should begin with a capital letter.

SEE ALSO
admin(4), pkgmk(1)
NAME
pkgmap – package contents description file

DESCRIPTION
pkgmap is an ASCII file that provides a complete listing of the package contents. It is automatically generated by pkgmk(1) using the information in the prototype file.

Each entry in pkgmap describes a single "deliverable object file." A deliverable object file includes shell scripts, executable objects, data files, directories, and so on. The entry consists of several fields of information, each field separated by a space. The fields are described below and must appear in the order shown.

part
A field designating the part number in which the object resides. A part is a collection of files, and is the atomic unit by which a package is processed. A developer can choose the criteria for grouping files into a part (for example, based on class). If no value is defined in this field, part 1 is assumed.

ftype
A one-character field that indicates the file type. Valid values are:

- f  a standard executable or data file
- e  a file to be edited upon installation or removal
- v  volatile file (one whose contents are expected to change)
- d  directory
- x  an exclusive directory (See NOTES)
- l  linked file
- p  named pipe
- c  character special device
- b  block special device
- i  installation script or information file
- s  symbolic link

Once a file has the file type attribute v, it will always be volatile. For example, if a file being installed already exists and has the file type attribute v, then even if the version of the file being installed is not specified as volatile, the file type attribute will remain volatile.

class
The installation class to which the file belongs. This name must contain only alphanumeric characters and be no longer than 12 characters. It is not specified if the ftype is i (information file).

pathname
The pathname where the object will reside on the target machine, such as /usr/bin/mail. Relative pathnames (those that do not begin with a slash) indicate that the file is relocatable.

For linked files (ftype is either l or s), pathname must be in the form of path1=path2, with path1 specifying the destination of the link and path2 specifying the source of the link.

For symbolically linked files, when path2 is a relative pathname starting with ./. or ../., path2 is not considered relocatable. For example, if you enter a line such as

s /foo/bar/etc/mount=../usr/sbin/mount

path1 (/foo/bar/etc/mount) will be a symbolic link to ../usr/sbin/mount.
**pkgmap (4)**

`pathname` may contain variables which support relocation of the file. A `$parameter` may be embedded in the pathname structure. `$BASEDIR` can be used to identify the parent directories of the path hierarchy, making the entire package easily relocatable. Default values for `parameter` and `BASEDIR` must be supplied in the `pkginfo` file and may be overridden at installation.

Special characters, such as an equal sign (=), are included in pathnames by surrounding the entire pathname in single quotes (as in, for example, `/usr/lib/`).

`major` The major device number. The field is only specified for block or character special devices.

`minor` The minor device number. The field is only specified for block or character special devices.

`mode` The octal mode of the file (for example, 0664). A question mark (?) indicates that the mode will be left unchanged, implying that the file already exists on the target machine. This field is not used for linked files, packaging information files or non-installable files.

`owner` The owner of the file (for example, `bin` or `root`). The field is limited to 14 characters in length. A question mark (?) indicates that the owner will be left unchanged, implying that the file already exists on the target machine. This field is not used for linked files or non-installable files. It is used optionally with a package information file. If used, it indicates with what owner an installation script will be executed.

Can be a variable specification in the form of `$[A-Z]`. Will be resolved at installation time (see NOTES).

`group` The group to which the file belongs (for example, "bin" or "sys"). The field is limited to 14 characters in length. A question mark (?) indicates that the group will be left unchanged, implying that the file already exists on the target machine. This field is not used for linked files or non-installable files. It is used optionally with a package information file. If used, it indicates with what group an installation script will be executed.

Can be a variable assignment in the form of `$[A-Z]`. Will be resolved at installation time (see NOTES).

`size` The actual size of the file in bytes. This field is not specified for named pipes, special devices, directories or linked files.

`cksum` The checksum of the file contents. This field is not specified for named pipes, special devices, directories or linked files.

`modtime` The time of last modification, as reported by the `stat(2)` function call. This field is not specified for named pipes, special devices, directories or linked files.
pkgmap(4)

Each pkgmap must have one line that provides information about the number and maximum size (in 512-byte blocks) of parts that make up the package. This line is in the following format:

: number_of_parts maximum_part_size

Lines that begin with "#" are comment lines and are ignored.

When files are saved during installation before they are overwritten, they are normally just copied to a temporary pathname. However, for files whose mode includes execute permission (but which are not editable), the existing version is linked to a temporary pathname and the original file is removed. This allows processes which are executing during installation to be overwritten.

EXAMPLES

The following is an example of a pkgmap file.

:2 500
1 i pkginfo 237 1179 541296672
1 b class1 /dev/diskette 17 134 0644 root other
1 c class1 /dev/rdiskette 17 134 0644 root other
1 d none bin 0755 root bin
1 f none bin/INSTALL 0755 root bin 11103 17954 541295535
1 f none bin/REMOVE 0755 root bin 3214 50237 541295541
1 l none bin/UNINSTALL=bin/REMOVE
1 f none bin/cmda 0755 root bin 3580 60325 541295567
1 f none bin/cmdb 0755 root bin 49107 51255 541438368
1 f class1 bin/cmdc 0755 root bin 45599 26048 541295599
1 f class1 bin/cmdd 0755 root bin 4648 8473 541461238
1 f none bin/cmde 0755 root bin 40501 1264 541295622
1 f class2 bin/cmdf 0755 root bin 2345 35889 541295574
1 f none bin/cmdg 0755 root bin 41185 47653 541461242
2 d class2 data 0755 root bin
2 p class1 data/apipe 0755 root other
2 d none log 0755 root bin 1 NULL NULL
2 v none log/logfile 0755 root bin 41815 47563 541461333
2 d none save 0755 root bin
2 d none spool 0755 root bin
2 d none tmp 0755 root bin

NOTES

The pkgmap file may contain only one entry per unique pathname.

An exclusive directory type (file) type x specifies directories that are constrained to contain only files that appear in the installation software database (/var/sadm/install/contents). If there are other files in the directory, they will be removed by pkgchk -fx as described on the pkgchk(1M) manual page.

Variable specifications for the owner and group fields are defined in the pkginfo file. For example, owner could be $OWNER in the pkgmap file; if OWNER is defined as root in the pkginfo file, $OWNER will get the value root when the file is installed.
NAME
pnch – file format for card images

DESCRIPTION
The PNCH format is a convenient representation for files consisting of card images in an arbitrary code.

A PNCH file is a simple concatenation of card records. A card record consists of a single control byte followed by a variable number of data bytes. The control byte specifies the number (which must lie in the range 0–80) of data bytes that follow. The data bytes are 8-bit codes that constitute the card image. If there are fewer than 80 data bytes, it is understood that the remainder of the card image consists of trailing blanks.
priv(4)

NAME
priv – privilege data file

DESCRIPTION
A privilege data file entry has the following format:

```
dev: fid: valid: %fixed privs: pathname
```

Each field in the entry is separated by a colon (:) character. The dev (see stat(2)) and fid are, respectively, the ID of the device containing a directory entry for this file, and a unique file identification number for this file. These are stored as decimal strings. The valid field is the last file status change time (see stat(2)) contained in the inode of the named file and stored as a decimal string. The fixed privileges field begins with a (%) delimiter and contains character strings which have comma (,) separated privilege names for each field. The pathname is the absolute path name of the privileged file.

The privilege data file is /etc/security/tcb/privs.

SEE ALSO
filepriv(1M), initprivs(1M), intro(2), stat(2)
PrivTable (4)

NAME

PrivTable - privilege table

DESCRIPTION

PrivTable is a list of permissions that can be granted users through the desktop User_Setup client. Each entry includes a list of commands a user with permission will be able to execute with privilege, along with specific granted privileges. These privileges are granted the user using TFM (Trusted Facilities Management).

The privilege table contains lines of the format:

[CatalogFile: Index:] CheckboxString<TAB>EntryList<TAB>HelpFile

CheckboxString

label to use for the checkbox in User_Setup. If the checkbox is checked, EntryList will be registered with TFM

[CatalogFile: Index:] translate CheckboxString. CatalogFile is the file of locale specific translations. index is the line number of the translation.

EntryList

comma seperated list of entries. This takes the form

entryname1:fullpath:priv1:priv2:...,entryname2...

HelpFile

help file to use with this privilege checkbox. This may be a full path name or a locale-specific file in /usr/X/lib/locale/locale/help/LoginMgr.

Files

/etc/security/tfm/users/user
/usr/X/desktop/LoginMgr/PrivTable

SEE ALSO

dtprivilege(1M), make-owner(1M), tfadmin(1M)
proc(4)

NAME
proc – process file system

DESCRIPTION
/proc is a file system that provides access to the image of each active process in the system. The name of each entry in the /proc directory is a decimal number corresponding to the process ID. The owner of each "file" is determined by the process's user-ID.

Standard system call interfaces are used to access /proc files: open, close, read, write, and ioctl. An open for reading and writing enables process control; a read-only open allows inspection but not control. As with ordinary files, more than one process can open the same /proc file at the same time. Exclusive open is provided to allow controlling processes to avoid collisions: an open for writing that specifies O_EXCL fails if the file is already open for writing; if such an exclusive open succeeds, subsequent attempts to open the file for writing, with or without the O_EXCL flag, fail until the exclusively-opened file descriptor is closed. (Exception: a super-user open that does not specify O_EXCL succeeds even if the file is exclusively opened.) There can be any number of read-only opens, even when an exclusive write open is in effect on the file.

Data may be transferred from or to any locations in the traced process's address space by applying lseek to position the file at the virtual address of interest followed by read or write. The PIOCMAP operation can be applied to determine the accessible areas (mappings) of the address space. A contiguous area of the address space may appear as multiple mappings due to varying read/write/execute permissions. I/O transfers may span contiguous mappings. An I/O request extending into an unmapped area is truncated at the boundary.

Information and control operations are provided through ioctl. These have the form:

```c
#include <sys/types.h>
#include <sys/signal.h>
#include <sys/fault.h>
#include <sys/syscall.h>
#include <sys/procfs.h>
void *p;
retval = ioctl(fildes, code, p);
```

The argument p is a generic pointer whose type depends on the specific ioctl code. Where not specifically mentioned below, its value should be zero. sys/procfs.h contains definitions of ioctl codes and data structures used by the operations. Certain operations can be performed only if the process file is open for writing; these include all operations that affect process control.

Process information and control operations involve the use of sets of flags. The set types sigset_t, f1tset_t, and sysset_t correspond, respectively, to signal, fault, and system call enumerations defined in sys/signal.h, sys/fault.h, and sys/syscall.h. Each set type is large enough to hold flags for its own enumeration. Although they are of different sizes, they have a common structure and can be manipulated by these macros:
One of `prfillset` or `premptyset` must be used to initialize set before it is used in any other operation. `flag` must be a member of the enumeration corresponding to `set`.

The allowable `ioctl` codes follow. Those requiring write access are marked with an asterisk (*). Except where noted, an `ioctl` to a process that has terminated elicits the error `ENOENT`.

**PIOCSTATUS**

This returns status information for the process; `p` is a pointer to a `prstatus` structure:

```c
typedef struct prstatus {
    long pr_flags;    /* Process flags */
    short pr_why;     /* Reason for process stop (if stopped) */
    short pr_what;    /* More detailed reason */
    struct siginfo pr_info; /* Info associated with signal or fault */
    short pr_cursig;  /* Current signal */
    sigset_t pr_sigpend; /* Set of other pending signals */
    sigset_t pr_sighold; /* Set of held signals */
    struct sigaltstack pr_altstack; /* Alternate signal stack info */
    struct sigaction pr_action; /* Signal action for current signal */
    pid_t pr_pid;     /* Process id */
    pid_t pr_ppid;    /* Parent process id */
    pid_t pr_pgrp;    /* Process group id */
    pid_t pr_sid;     /* Session id */
    timestruc_t pr_utime; /* Process user cpu time */
    timestruc_t pr_stime; /* Process system cpu time */
    timestruc_t pr_cutime; /* Sum of children’s user times */
    timestruc_t pr_cstime; /* Sum of children’s system times */
    char pr_clname[8]; /* Scheduling class name */
    long pr_filler[20];/* Filler area for future expansion */
    long pr_instr;    /* Current instruction */
    gregset_t pr_reg;  /* General registers */
} prstatus_t;
```

`pr_flags` is a bit-mask holding these flags:

- **PR_STOPPED** process is stopped
- **PR_ISTOP** process is stopped on an event of interest (see `PIOCSTOP`)
- **PR_DSTOP** process has a stop directive in effect (see `PIOCSTOP`)
- **PR_ASLLEEP** process is in an interruptible sleep within a system call
- **PR_FORK** process has its inherit-on-fork flag set (see `PIOCSFORK`)
- **PR_RLC** process has its run-on-last-close flag set (see `PIOCSRLC`)

159
pr_why and pr_what together describe, for a stopped process, the reason that the process is stopped. Possible values of pr_why are:

- **PR_REQUESTED** indicates that the process stopped because PIOCSTOP was applied; pr_what is unused in this case.
- **PR_SIGNALLED** indicates that the process stopped on receipt of a signal (see PIOCSTRACE); pr_what holds the signal number that caused the stop (for a newly-stopped process, the same value is in pr_cursig).
- **PR_FAULTED** indicates that the process stopped on incurring a hardware fault (see PIOCSFAULT); pr_what holds the fault number that caused the stop.
- **PR_SYSENTRY** and **PR_SYSEXIT** indicate a stop on entry to or exit from a system call (see PIOCSENTRY and PIOCSEXIT); pr_what holds the system call number.
- **PR_JOBCONTROL** indicates that the process stopped due to the default action of a job control stop signal (see sigaction); pr_what holds the stopping signal number.

pr_info, when the process is in a **PR_SIGNALLED** or **PR_FAULTED** stop, contains additional information pertinent to the particular signal or fault (see sys/siginfo.h).

pr_cursig names the current signal—that is, the next signal to be delivered to the process. pr_sigpend identifies any other pending signals. pr_sighold identifies those signals whose delivery is being delayed if sent to the process.

pr_altstack contains the alternate signal stack information for the process (see sigaltstack). pr_action contains the signal action information pertaining to the current signal (see sigaction); it is undefined if pr_cursig is zero.

pr_pid, pr_ppid, pr_pgrp, and pr_sid are, respectively, the process ID, the ID of the process’s parent, the process’s process group ID, and the process’s session ID.

pr_utime, pr_stime, pr_cutime, and pr_cstime are, respectively, the user CPU and system CPU time consumed by the process, and the cumulative user CPU and system CPU time consumed by the process’s children, in seconds and nanoseconds.

pr_cname contains the name of the process’s scheduling class.

The pr_filler area is reserved for future use.

pr_instr contains the machine instruction to which the program counter refers. The amount of data retrieved from the process is machine-dependent. In general, the size is that of the machine’s smallest instruction. If the program counter refers to an invalid address, PR_PCINVAL is set and pr_instr is undefined.

pr_reg is an array holding the contents of the general registers. The constants defined in sys/regset.h can be used as indices to refer to the general registers.
PIOCSTOP*, PIOCWSTOP

PIOCSTOP directs the process to stop and waits until it has stopped; PIOCWSTOP simply waits for the process to stop. These operations complete when the process stops on an event of interest, immediately if already so stopped. If \( p \) is non-zero it points to an instance of `prstatus_t` to be filled with status information for the stopped process.

An "event of interest" is either a PR_REQUESTED stop or a stop that has been specified in the process’s tracing flags (set by PIOCSTRACE, PIOCSFAULT, PIOCSENTRY, and PIOCSEXIT). A PR_JOBCONTROL stop is specifically not an event of interest. (A process may stop twice due to a stop signal, first showing PR_SIGNALLED if the signal is traced and again showing PR_JOBCONTROL if the process is set running without clearing the signal.) If the process is controlled by `ptrace`, it comes to a PR_SIGNALLED stop on receipt of any signal; this is an event of interest only if the signal is in the traced signal set. If PIOCSTOP is applied to a process that is stopped, but not on an event of interest, the stop directive takes effect when the process is restarted by the competing mechanism; at that time the process enters a PR_REQUESTED stop before executing any user-level code.

`ioctl`s are interruptible by signals so that, for example, an `alarm` can be set to avoid waiting forever for a process that may never stop on an event of interest. If PIOCSTOP is interrupted, the stop directive remains in effect even though the `ioctl` returns an error.

A system process (indicated by the PR_ISSYS flag) never executes at user level, has no user-level address space visible through `/proc`, and cannot be stopped. Applying PIOCSTOP or PIOCWSTOP to a system process elicits the error EBUSY.

PIOCRUN*

The traced process is made runnable again after a stop. If \( p \) is non-zero it points to a `prrun` structure describing additional actions to be performed:

```c
typedef struct prrun {
    long pr_flags; /* Flags */
    sigset_t pr_trace; /* Set of signals to be traced */
    sigset_t pr_sighold; /* Set of signals to be held */
    fltset_t pr_fault; /* Set of faults to be traced */
    caddr_t pr_vaddr; /* Virtual address at which to resume */
    long pr_filler[8]; /* Filler area for future expansion */
} prrun_t;
```

`pr_flags` is a bit-mask describing optional actions; the remainder of the entries are meaningful only if the appropriate bits are set in `pr_flags`. `pr_filler` is reserved for future use; this area must be filled with zeros by the user’s program.

Flag definitions:

- **PRCSIG** clears the current signal, if any (see PIOCSSIG).
- **PRCFAULT** clears the current fault, if any (see PIOCCFAULT).
- **PRSTRACE** sets the traced signal set to `pr_trace` (see PIOCSTRACE).
PRSHOLD sets the held signal set to pr_sighold (see PIOCSHOLD).

PRSFAltT sets the traced fault set to pr_fault (see PIOCSFAULT).

PRSVADDR sets the address at which execution resumes to pr_vaddr.

PRSTEP directs the process to single-step—i.e., to run and to execute a single machine instruction. On completion of the instruction, a hardware trace trap occurs. If FLTTRACE is being traced, the process stops, otherwise it is sent SIGTRAP; if SIGTRAP is being traced and not held, the process stops. This operation requires hardware support and may not be implemented on all processors.

PRSABORT is meaningful only if the process is in a PR_SYSENTRY stop or is marked PR_ASLEEP; it instructs the process to abort execution of the system call (see PIOCSENTRY, PIOCSEXIT).

PRSTOP directs the process to stop again as soon as possible after resuming execution (see PIOCSTOP). In particular if the process is stopped on PR_SIGNALLED or PR_FAULTED, the next stop will show PR_REQUESTED, no other stop will have intervened, and the process will not have executed any user-level code.

PIOCRUN fails (EBUSY) if applied to a process that is not stopped on an event of interest. Once PIOCRUN has been applied, the process is no longer stopped on an event of interest even if, due to a competing mechanism, it remains stopped.

PIOCSTRACE* This defines a set of signals to be traced: the receipt of one of these signals causes the traced process to stop. The set of signals is defined via an instance of sigset_t addressed by p. Receipt of SIGKILL cannot be traced.

If a signal that is included in the held signal set is sent to the traced process, the signal is not received and does not cause a process stop until it is removed from the held signal set, either by the process itself or by setting the held signal set with PIOCSHOLD or the PRSHOLD option of PIOCRUN.

PIOCGTRACE The current traced signal set is returned in an instance of sigset_t addressed by p.

PIOCSSIG* The current signal and its associated signal information are set according to the contents of the siginfo structure addressed by p (see sys/siginfo.h). If the specified signal number is zero or if p is zero, the current signal is cleared. The semantics of this operation are different from those of kill or PIOCKILL in that the signal is delivered to the process immediately after execution is resumed (even if it is being held) and an additional PR_SIGNALLED stop does not intervene even if the signal is traced. Setting the current signal to SIGKILL terminates the process immediately, even if it is stopped.

PIOCKILL* A signal is sent to the process with semantics identical to those of kill; p points to an int naming the signal. Sending SIGKILL terminates the process immediately.
A signal is deleted, i.e. it is removed from the set of pending signals; the current signal (if any) is unaffected. \( p \) points to an \texttt{int} naming the signal. It is an error to attempt to delete \texttt{SIGKILL}.

**PIOCGHOLD, PIOCSHOLD**

\texttt{PIOCGHOLD} returns the set of held signals (signals whose delivery will be delayed if sent to the process) in an instance of \texttt{sigset_t} addressed by \( p \). \texttt{PIOCSHOLD} correspondingly sets the held signal set but does not allow \texttt{SIGKILL} or \texttt{SIGSTOP} to be held.

**PIOCMAXSIG, PIOCACTION**

These operations provide information about the signal actions associated with the traced process (see \texttt{sigaction}). \texttt{PIOCMAXSIG} returns, in the \texttt{int} addressed by \( p \), the maximum signal number understood by the system. This can be used to allocate storage for use with the \texttt{PIOCACTION} operation, which returns the traced process's signal actions in an array of \texttt{sigaction} structures addressed by \( p \). Signal numbers are displaced by 1 from array indices, so that the action for signal number \( n \) appears in position \( n-1 \) of the array.

**PIOCSFAULT**

This defines a set of hardware faults to be traced: on incurring one of these faults the traced process stops. The set is defined via an instance of \texttt{fltset_t} addressed by \( p \). Fault names are defined in \texttt{sys/fault.h} and include the following. Some of these may not occur on all processors; there may be processor-specific faults in addition to these.

\begin{itemize}
  \item \texttt{FLTILL} \quad \text{illegal instruction}
  \item \texttt{FLT_PRIV} \quad \text{privileged instruction}
  \item \texttt{FLT_BT} \quad \text{breakpoint trap}
  \item \texttt{FLT_TR} \quad \text{trace trap}
  \item \texttt{FLT_ACCESS} \quad \text{memory access fault}
  \item \texttt{FLT_BOUNDS} \quad \text{memory bounds violation}
  \item \texttt{FLT_IOV} \quad \text{integer overflow}
  \item \texttt{FLT_DIV} \quad \text{integer zero divide}
  \item \texttt{FLT_FP} \quad \text{floating-point exception}
  \item \texttt{FLT_STACK} \quad \text{unrecoverable stack fault}
  \item \texttt{FLT_PAGE} \quad \text{recoverable page fault}
\end{itemize}

When not traced, a fault normally results in the posting of a signal to the process that incurred the fault. If the process stops on a fault, the signal is posted to the process when execution is resumed unless the fault is cleared by \texttt{PIOCFAULT} or by the \texttt{PRCFAULT} option of \texttt{PIOCRUN}. \texttt{FLT_PAGE} is an exception; no signal is posted. There may be additional processor-specific faults like this. \texttt{pr_info} in the \texttt{prstatus} structure identifies the signal to be sent and contains machine-specific information about the fault.

**PIOCGFAULT**

The current traced fault set is returned in an instance of \texttt{fltset_t} addressed by \( p \).
PIOCCFAULT*
The current fault (if any) is cleared; the associated signal is not sent to the process.

PIOCSENTRY*, PIOCSEXIT*
These operations instruct the process to stop on entry to or exit from specified system calls. The set of syscalls to be traced is defined via an instance of `sysset_t` addressed by `p`.

When entry to a system call is being traced, the traced process stops after having begun the call to the system but before the system call arguments have been fetched from the process. When exit from a system call is being traced, the traced process stops on completion of the system call just prior to checking for signals and returning to user level. At this point all return values have been stored into the traced process's saved registers.

If the traced process is stopped on entry to a system call (PR_SYSENTRY) or when sleeping in an interruptible system call (PR_ASLEEP is set), it may be instructed to go directly to system call exit by specifying the PRSABORT flag in a PIOCRUN request. Unless exit from the system call is being traced the process returns to user level showing error EINTR.

PIOCGENTRY, PIOCGEXIT
These return the current traced system call entry or exit set in an instance of `sysset_t` addressed by `p`.

PIOCSFORK*, PIOCRFORK*
PIOCSFORK sets the inherit-on-fork flag in the traced process: the process’s tracing flags are inherited by the child of a fork. PIOCRFORK turns this flag off: child processes start with all tracing flags cleared.

PIOCSRLC*, PIOCRRLC*
PIOCSRLC sets the run-on-last-close flag in the traced process: when the last writable /proc file descriptor referring to the traced process is closed, all of the process’s tracing flags are cleared, any outstanding stop directive is canceled, and if the process is stopped, it is set running as though PIOCRUN had been applied to it. PIOCRRLC turns this flag off: the process’s tracing flags are retained and the process is not set running when the process file is closed.

PIOCGREG, PIOCSREG*
These operations respectively get and set the saved process registers into or out of an array addressed by `p`; the array has type `gregset_t`. Register contents are accessible using a set of predefined indices (see PIOCSTATUS). For security, certain bits of the processor-status word cannot be modified by PIOCSREG. There may be other privileged registers that cannot be modified at all. PIOCSREG fails (EBUSY) if applied to a process that is not stopped on an event of interest.

PIOCGFPREG, PIOCSFPREG*
These operations respectively get and set the saved process floating-point registers into or out of a structure addressed by `p`; the structure has type `fregset_t`. An error (EINVAL) is returned if there is no floating-point hardware on the machine. PIOCSFPREG fails (EBUSY) if applied to a process that is not stopped on an event of interest.
The traced process's nice priority is incremented by the amount contained in the int addressed by p. Only the super-user may better a process's priority in this way, but any user may make the priority worse.

This returns miscellaneous process information such as that reported by ps(1). p is a pointer to a prpsinfo structure containing at least the following fields:

```c
typedef struct prpsinfo {
    char pr_state; /* numeric process state (see pr_sname) */
    char pr_sname; /* printable character representing pr_state */
    char pr_zomb; /* !=0: process terminated but not waited for */
    char pr_nice; /* nice for cpu usage */
    u_long pr_flag; /* process flags */
    uid_t pr_uid; /* real user id */
    gid_t pr_gid; /* real group id */
    pid_t pr_pid; /* unique process id */
    pid_t pr_ppid; /* process id of parent */
    pid_t pr_pgrp; /* pid of process group leader */
    pid_t pr_sid; /* session id */
    caddr_t pr_addr; /* physical address of process */
    long pr_size; /* size of process image in pages */
    long pr_rssize; /* resident set size in pages */
    caddr_t pr_wchan; /* wait addr for sleeping process */
    timestruc_t pr_start; /* process start time, sec+nsec since epoch */
    timestruc_t pr_time; /* usr+sys cpu time for this process */
    long pr_pri; /* priority, high value is high priority */
    char pr_oldpri; /* pre-SVR4, low value is high priority */
    char pr_cpu; /* pre-SVR4, cpu usage for scheduling */
    dev_t pr_ttydev; /* controlling tty device (PRNODEV if none) */
    char pr_cname[8]; /* Scheduling class name */
    char pr_fname[16]; /* last component of execed pathname */
    char pr_psargs[PRARGSZ]; /* initial characters of arg list */
    long pr_filler[20]; /* for future expansion */
} prpsinfo_t;
```

Some of the entries in prpsinfo, such as pr_state and pr_flag, are systemspecific and should not be expected to retain their meanings across different versions of the operating system. pr_addr is a vestige of the past and has no real meaning in current systems.

PIOCPSINFO can be applied to a zombie process (one that has terminated but whose parent has not yet performed a wait on it).

PIOCNMAP, PIOCMAP

These operations provide information about the memory mappings (virtual address ranges) associated with the traced process. PIOCNMAP returns, in the int addressed by p, the number of mappings that are currently active. This can be used to allocate storage for use with the PIOCMAP operation, which returns the list of currently active mappings. For PIOCMAP, p addresses an array of elements of type prmap_t; one array element (one structure) is returned for each mapping, plus an additional
element containing all zeros to mark the end of the list.

typedef struct prmap {
    caddr_t pr_vaddr;     /* Virtual address base */
    u_long pr_size;       /* Size of mapping in bytes */
    off_t pr_off;         /* Offset into mapped object, if any */
    long pr_mflags;       /* Protection and attribute flags */
    long pr_filler[4];    /* Filler for future expansion */
} prmap_t;

pr_vaddr is the virtual address base (the lower limit) of the mapping within the
traced process and pr_size is its size in bytes. pr_off is the offset within the
mapped object (if any) to which the address base is mapped.

pr_mflags is a bit-mask of protection and attribute flags:

    MA_READ mapping is readable by the traced process
    MA_WRITE mapping is writable by the traced process
    MA_EXEC mapping is executable by the traced process
    MA_SHARED mapping changes are shared by the mapped object
    MA_BREAK mapping is grown by the brk system call
    MA_STACK mapping is grown automatically on stack faults

PIOCOPENM
The return value retval provides a read-only file descriptor for a mapped object
associated with the traced process. If p is zero the traced process’s execed file (its
a.out file) is found. This enables a debugger to find the object file symbol table
without having to know the path name of the executable file. If p is non-zero it
points to a caddr_t containing a virtual address within the traced process and the
mapped object, if any, associated with that address is found; this can be used to get
a file descriptor for a shared library that is attached to the process. On error
(invalid address or no mapped object for the designated address), -1 is returned.

PIOCCRED
Fetch the set of credentials associated with the process. p points to an instance of
prcred_t, which is filled by the operation:

typedef struct prcred {
    uid_t pr_euid;     /* Effective user id */
    uid_t pr_ruid;     /* Real user id */
    uid_t pr_suid;     /* Saved user id (from exec) */
    uid_t pr_egid;     /* Effective group id */
    uid_t pr_rgid;     /* Real group id */
    uid_t pr_sgid;     /* Saved group id (from exec) */
    u_int pr_ngroups;  /* Number of supplementary groups */
} prcred_t;

PIOCGROUPS
Fetch the set of supplementary group IDs associated with the process. p points to
an array of elements of type uid_t, which will be filled by the operation. PIOCCRED
can be applied beforehand to determine the number of groups (pr_ngroups) that
will be returned and the amount of storage that should be allocated to hold them.
PIOCGETPR, PIOCGETU

These operations copy, respectively, the traced process’s proc structure and user area into the buffer addressed by \( p \). They are provided for completeness but it should be unnecessary to access either of these structures directly since relevant status information is available through other control operations. Their use is discouraged because a program making use of them is tied to a particular version of the operating system.

PIOCGETPR can be applied to a zombie process (see PIOCPINFO).

NOTES

Each operation (ioctl or I/O) is guaranteed to be atomic with respect to the traced process, except when applied to a system process.

For security reasons, except for the super-user, an open of a /proc file fails unless both the user-ID and group-ID of the caller match those of the traced process and the process’s object file is readable by the caller. Files corresponding to setuid and setgid processes can be opened only by the super-user. Even if held by the super-user, an open process file descriptor becomes invalid if the traced process performs an exec of a setuid/setgid object file or an object file that it cannot read. Any operation performed on an invalid file descriptor, except close, fails with EAGAIN. In this situation, if any tracing flags are set and the process file is open for writing, the process will have been directed to stop and its run-on-last-close flag will have been set (see PIOCSRLC). This enables a controlling process (if it has permission) to reopen the process file to get a new valid file descriptor, close the invalid file descriptor, and proceed. Just closing the invalid file descriptor causes the traced process to resume execution with no tracing flags set. Any process not currently open for writing via /proc but that has left-over tracing flags from a previous open and that execs a setuid/setgid or unreadable object file will not be stopped but will have all its tracing flags cleared.

For reasons of symmetry and efficiency there are more control operations than strictly necessary.

FILES

/proc directory (list of active processes)
/proc/nnnnn process image

SEE ALSO

open(2), ptrace(2), sigaction(2), signal(2)

DIAGNOSTICS

Errors that can occur in addition to the errors normally associated with file system access:

ENOENT The traced process has exited after being opened.
EIO I/O was attempted at an illegal address in the traced process.
EBADF An I/O or ioctl operation requiring write access was attempted on a file descriptor not open for writing.
EBUSY PIOCSTOP or PIOCWSTOP was applied to a system process; an exclusive open was attempted on a process file already already open for writing; an open for writing was attempted and an exclusive open is in effect on the process file; PIOCRUN, PIOCSREG or PIOCSFPREG was
applied to a process not stopped on an event of interest; an attempt was made to mount /proc when it is already mounted.

**EPERM** Someone other than the super-user attempted to better a process’s priority by issuing PIOCNICE.

**ENOSYS** An attempt was made to perform an unsupported operation (such as create, remove, link, or unlink) on an entry in /proc.

**EFAULT** An I/O or ioctl request referred to an invalid address in the controlling process.

**EINVAL** In general this means that some invalid argument was supplied to a system call. The list of conditions eliciting this error includes: the ioctl code is undefined; an ioctl operation was issued on a file descriptor referring to the /proc directory; an out-of-range signal number was specified with PIOCSSIG, PIOCKILL, or PIOPUNKILL; SIGKILL was specified with PIOPUNKILL; an illegal virtual address was specified in a PIOCOPENM request; PIOCGPPREG or PIOCSFPREG was issued on a machine without floating-point hardware.

**EINTR** A signal was received by the controlling process while waiting for the traced process to stop via PIOCSTOP or PIOCWSTOP.

**EAGAIN** The traced process has performed an exec of a setuid/setgid object file or of an object file that it cannot read; all further operations on the process file descriptor (except close) elicit this error.
NAME
profile – setting up an environment at login time

SYNOPSIS
/etc/profile
$HOME/.profile

DESCRIPTION
All users who have the shell, sh(1), as their login command have the commands in
these files executed as part of their login sequence.

/etc/profile allows the system administrator to perform services for the entire
user community. Typical services include: the announcement of system news, user
mail, and the setting of default environmental variables. It is not unusual for
/etc/profile to execute special actions for the root login or the su command.
Computers running outside the U.S. Eastern time zone should have the line

   . /etc/TIMEZONE

included early in /etc/profile [see timezone(4)].

The file $HOME/.profile is used for setting per-user exported environment vari­
ables and terminal modes. The following example is typical (except for the com­
ments):

   # Make some environment variables global
   export MAIL PATH TERM
   # Set file creation mask
   umask 022
   # Tell me when new mail comes in
   MAIL=/var/mail/$LOGNAME
   # Add my bin directory to the shell search sequence
   PATH=$PATH:$HOME/bin
   # Set terminal type
   TERM=($L0:-u/n/k/n/o/w/n)
   while :
     do
       if [ -f ${TERMINFO:-/usr/share/lib/terminfo}/?/$TERM ]
         then break
       elif [ -f /usr/share/lib/terminfo/?/$TERM ]
         then break
       else echo "invalid term $TERM" 1>&2
         fi
       echo "terminal: \c"
       read TERM
     done
   # Set the erase character to backspace
   stty erase '``H' echo
profile (4)

FILES

/etc/TIMEZONE  timezone environment
$HOME/.profile  user-specific environment
/etc/profile    system-wide environment

SEE ALSO

env(1), environ(5), login(1), mail(1), sh(1), stty(1), su(1M), term(5),
terinfo(4), timezone(4), tput(1)

NOTES

Care must be taken in providing system-wide services in /etc/profile. Personal
.profile files are better for serving all but the most global needs.
NAME
protocols – protocol name data base

SYNOPSIS
/etc/protocols

DESCRIPTION
The protocols file contains information regarding the known protocols used in the
DARPA Internet. For each protocol a single line should be present with the follow­
ing information:

  official-protocol-name protocol-number   aliases

Items are separated by any number of blanks and/or TAB characters. A ‘#’ indi­
cates the beginning of a comment; characters up to the end of the line are not inter­
preted by routines which search the file.

Protocol names may contain any printable character other than a field delimiter,
NEWLINE, or comment character.

The protocols file is used to initialize commands and protocols with these
reserved values.

EXAMPLE
The following is a sample database:

#
# Internet (IP) protocols
#

ip     0     IP     # internet protocol, pseudo protocol number
icmp   1     ICMP    # internet control message protocol
ggp    3     GGP     # gateway-gateway protocol
tcp    6     TCP     # transmission control protocol
pup    12    PUP     # PARC universal packet protocol
udp    17    UDP     # user datagram protocol

FILES
/etc/protocols

SEE ALSO
getprotoent(3N)

NOTES
A name server should be used instead of a static file. A binary indexed file format
should be available for fast access.
prototype (4)

NAME

prototype – package information file

DESCRIPTION

prototype is an ASCII file used to specify package information. Each entry in the file describes a single deliverable object. An object may be a data file, directory, source file, executable object, etc. This file is generated by the package developer.

Entries in a prototype file consist of several fields of information separated by white space. Comment lines begin with a “#” and are ignored. The fields are described below and must appear in the order shown.

part An optional field designating the part number in which the object resides. A part is a collection of files, and is the atomic unit by which a package is processed. A developer can choose criteria for grouping files into a part (for example, based on class). If this field is not used, part 1 is assumed.

ftype A one-character field which indicates the file type. Valid values are:

- f a standard executable or data file
- e a file to be edited upon installation or removal
- v volatile file (one whose contents are expected to change)
- d directory
- x an exclusive directory (See NOTES)
- l linked file
- p named pipe
- c character special device
- b block special device
- i installation script or information file
- s symbolic link

Once a file has the file type attribute v, it will always be volatile. For example, if a file being installed already exists and has the file type attribute v, then even if the version of the file being installed is not specified as volatile, the file type attribute will remain volatile.

class The installation class to which the file belongs. This name must contain only alphanumeric characters and be no longer than 12 characters. The field is not specified for installation scripts. (admin and all classes beginning with capital letters are reserved class names.)

pathname The pathname where the file will reside on the target machine, for example, /usr/bin/mail or bin/ras_proc. Relative pathnames (those that do not begin with a slash) indicate that the file is relocatable. The form path1=path2 may be used for two purposes: to define a link and to define local pathnames.

For linked files, path1 indicates the destination of the link and path2 indicates the source file. (This format is mandatory for linked files.)

For symbolically linked files, when path2 is a relative pathname starting with ./ or ./, path2 is not considered relocatable. For example, if you enter a line such as

s /foo/bar/etc/mount=../usr/sbin/mount
prototype(4)

`path1` (/foo/bar/etc/mount) will be a symbolic link to `../usr/sbin/mount`.

For local pathnames, `path1` indicates the pathname an object should have on
the machine where the entry is to be installed and `path2` indicates either a relative or fixed pathname to a file on the host machine which contains the actual contents.

A pathname may contain a variable specification, which will be resolved at the time of installation. This specification should have the form `$[A-Z]` (see NOTES).

Special characters, such as an equal sign (=), are included in pathnames by surrounding the entire pathname in single quotes (as in, for example, `'usr/lib/~='`).

**major**
The major device number. The field is only specified for block or character special devices.

**minor**
The minor device number. The field is only specified for block or character special devices.

**mode**
The octal mode of the file (for example, 0664). A question mark (?) indicates that the mode will be left unchanged, implying that the file already exists on the target machine. If the directory doesn’t exist, the default is 0755. If it’s a file, the default is 0644. This field is not used for linked files or packaging information files.

**owner**
The owner of the file (for example, bin or root). The field is limited to 14 characters in length. A question mark (?) indicates that the owner will be left unchanged, implying that the file already exists on the target machine. If it doesn’t exist, owner defaults to root. This field is not used for linked files or packaging information files.

Can be a variable specification in the form of `$[A-Z]` (see NOTES). Will be resolved at installation time.

**group**
The group to which the file belongs (for example, bin or sys). The field is limited to 14 characters in length. A question mark (?) indicates that the group will be left unchanged, implying that the file already exists on the target machine. If it doesn’t exist, group defaults to other. This field is not used for linked files or packaging information files.

Can be a variable specification in the form of `$[A-Z]` (see NOTES). Will be resolved at installation time.

An exclamation point (!) at the beginning of a line indicates that the line contains a command. These commands are used to incorporate files in other directories, to locate objects on a host machine, and to set permanent defaults. The following commands are available:

**search**
Specifies a list of directories (separated by white space) to search for when looking for file contents on the host machine. The basename of the `path` field is appended to each directory in the ordered list until the file is located. This command should not be
prototype(4)

specified in prototype files for packages that are to be compressed.

include Specifies a pathname which points to another prototype file to include. Note that search requests do not span include files.

default Specifies a list of attributes (mode, owner, group, mac, fixed, and inherited) to be used by default if attribute information is not provided for prototype entries which require the information. If either the mode, owner, or group attribute is supplied, all three of these attributes must be supplied.

The defaults do not apply to entries in include prototype files.

param=value Places the indicated parameter in the current environment.

The above commands may have variable substitutions embedded within them, as demonstrated in the two example prototype files below.

Before files are overwritten during installation, they are copied to a temporary pathname. The exception to this rule is files whose mode includes execute permission, unless the file is editable (that is, ftype is e). For files which meet this exception, the existing version is linked to a temporary pathname, and the original file is removed. This allows processes which are executing during installation to be overwritten.

EXAMPLES

Example 1:

```
!PROJDIR=/usr/proj
!BIN=$PROJDIR/bin
!CFG=$PROJDIR/cfg
!LIB=$PROJDIR/lib
!HDRS=$PROJDIR/hdrs
!search /usr/myname/usr/bin /usr/myname/src /usr/myname/hdrs
i pkginfo=/usr/myname/wrap/pkginfo
i depend=/usr/myname/wrap/depend
i version=/usr/myname/wrap/version
d none /usr/wrap 0755 root bin
search $BIN
f none /usr/wrap/bin/INSTALL 0755 root bin
f none /usr/wrap/bin/REMOVE 0755 root bin
f none /usr/wrap/bin/addpkg 0755 root bin
! default 755 root bin
f none /usr/wrap/bin/audit
f none /usr/wrap/bin/listpkg
f none /usr/wrap/bin/pkgmk
# The logfile starts as a zero length file, since the source
# file has zero length. Later, the size of logfile grows.
v none /usr/wrap/logfile=/usr/wrap/log/zero_length 0644 root bin
# the following specifies a link (dest=src)
l none /usr/wrap/src/addpkg=/usr/wrap/bin/rmpkg
! search $SRC
```
prototype(4)

!default 644 root other
f src /usr/wrap/src/INSTALL.sh
f src /usr/wrap/src/REMOVE.sh
f src /usr/wrap/src/addpkg.c
f src /usr/wrap/src/audit.c
f src /usr/wrap/src/listpkg.c
f src /usr/wrap/src/pkngmk.c
d none /usr/wrap/data 0755 root bin
d none /usr/wrap/save 0755 root bin
d none /usr/wrap/spool 0755 root bin
d none /usr/wrap/tmp 0755 root bin
d src /usr/wrap/src/0755 root bin

Example 2:

# this prototype is generated by 'pkgproto' to refer
# to all prototypes in my src directory
!PROJDIR=/usr/dew/projx
!include $PROJDIR/src/cmd/prototype
!include $PROJDIR/src/cmd/audmerg/prototype
!include $PROJDIR/src/lib/proto

SEE ALSO
pkginfo(4), pkngmk(1)

NOTES

Normally, if a file is defined in the prototype file but does not exist, that file is created at the time of package installation. However, if the file pathname includes a directory that does not exist, the file will not be created. For example, if the prototype file has the following entry:

f none /usr/dev/bin/command

and that file does not exist, it will be created if the directory /usr/dev/bin already exists or if the prototype also has an entry defining the directory:

d none /usr/dev/bin

An exclusive directory type ([file] type x) specifies directories that are constrained to contain only files that appear in the software installation database (/var/sadm/install/contents). If there are other files in the directory, they will be removed by pkgchk -fx as described on the pkgchk(1M) man page.

Variable specifications for the pathname, owner, and group fields are defined in the pkginfo file. For example, owner could be $OWNER in the pkgmap file; if OWNER is defined as root in the pkginfo file, $OWNER will get the value root when the file gets installed.
publickey (4)

NAME
publickey – public key database

SYNOPSIS
/etc/publickey

DESCRIPTION
/etc/publickey is the public key database used for secure RPC. Each entry in the
database consists of a network user name (which may either refer to a user or a
hostname), followed by the user's public key (in hex notation), a colon, and then the
user's secret key encrypted with a password (also in hex notation).

This file is altered either by the user through the chkey(1) command or by the sys­
tem administrator through the newkey(1M) command.

SEE ALSO
chkey(1), newkey(1M), publickey(3N)
NAME
Rc – system startup script

SYNOPSIS
Rc

DESCRIPTION
One of the kernel configuration files, an Rc file is an optional file that executes when the system is booted to initialize an installed kernel module. [Normally, this is a shell script (see sh(1)].

When the Rc component of a module’s Driver Software Package (DSP) is installed, idinstall(1M) stores the module’s Rc file in /etc/conf/rc.d/module-name, where module-name is the name of the module being installed. Package scripts should never access /etc/conf/rc.d files directly; the idinstall command should be used instead.

The contents of the /etc/conf/rc.d directory are linked to /etc/idrc.d whenever a new configuration of the kernel is first booted. On this initial reboot, and on all subsequent reboots, the module’s Rc file is invoked upon entering init level 2 [see init(1M)].

SEE ALSO
idinstall(1M), init(1M), Sd(4)
NAME
res_major – reserved major numbers for base system device drivers

SYNOPSIS
res_major

DESCRIPTION
One of the ID/TP kernel configuration files, the res_major file defines the major
numbers that are reserved for use by device drivers supplied with the base system.
When the idinstall(1M) command allocates major numbers for an add-on driver, it
examines the contents of the file /etc/conf/cf.d/res_major to make sure the
major number it intends to allocate to the add-on driver is not already reserved for
allocation to a base system driver. This file should not be used by add-on drivers.

Any base system driver that sets a k (keep majors) flag in the characteristics field of
its Master(4) file must add its major numbers to the res_major file. Each
res_major file entry provides information about one type of base system driver,
specified on a line of the form:

device-type major-number module-name

All fields are positional and must be separated by tabs.

The res_major file fields are:

device-type Identifies the type of base system device driver. The character b
indicates that the driver is a block device driver; the character c
indicates that the driver is a character device driver. If the driver
is both a block device driver and a character device driver, the
driver must define two separate res_major entries, with one
entry for each device type.

major-number Specifies the major number(s) reserved by the base system device
driver. If the device has multiple major numbers, this field
should be specified as two numbers separated by a dash to indi­
cate an inclusive range of reserved values. The value for this field
must match the value specified in the bmaj or cmaj field in the
driver’s Master file.

module-name Identifies the base system device driver for which the major
number(s) are reserved. The name must match the name
specified for the driver in the module-name field of the Master file.

SEE ALSO
idinstall(1M), Master(4)
resolv.conf (4)

NAME
cssolv.conf – configuration file for name server routines

DESCRIPTION
The resolver configuration file contains information that is read by the resolver routines the first time they are invoked in a process. The file is designed to be human readable and contains a list of keyword-value pairs that provide various types of resolver information.

  keyword   value

The different configuration options are:

cssnameserver address  The Internet address (in dot notation) of a name server that the resolver should query. At least one name server should be listed. Up to `MAXNS` (currently 3) name servers may be listed, in that case the resolver library queries tries them in the order listed. The algorithm used is to try a name server, and if the query times out, try the next, until out of name servers, then repeat trying all the name servers until a maximum number of retries are made.

csadomain name        The default domain to append to names that do not have a dot in them.

cscaddress address     An Internet address (in dot notation) of any preferred networks. The list of addresses returned by the resolver will be sorted to put any addresses on this network before any others.

The keyword-value pair must appear on a single line, and the keyword (for instance, `nameserver`) must start the line. The value follows the keyword, separated by white space.

FILES

/etc/resolv.conf

SEE ALSO

gethostent(3N), named(1M), resolver(3N)

rfmaster (4)

NAME
rfmaster – Remote File Sharing name server master file

DESCRIPTION
Each transport provider used by Remote File Sharing has an associated rfmaster file that identifies the primary and secondary name servers for that transport provider. The rfmaster file ASCII contains a series of records, each terminated by a newline; a record may be extended over more than one line by escaping the newline character with a backslash ("\"). The fields in each record are separated by one or more tabs or spaces. Each record has three fields:

name type data

The type field, which defines the meaning of the name and data fields, has three possible values. These values can appear in upper case or lower case:

p The p type defines the primary domain name server. For this type, name is the domain name and data is the full host name of the machine that is the primary name server. The full host name is specified as domain.nodename. There can be only one primary name server per domain.

s The s type defines a secondary name server for a domain. name and data are the same as for the p type. The order of the s entries in the rfmaster file determines the order in which secondary name servers take over when the current domain name server fails.

a The a type defines a network address for a machine. name is the full domain name for the machine and data is the network address of the machine. The network address can be in plain ASCII text or it can be preceded by a \x or \X to be interpreted as hexadecimal notation. (See the documentation for the particular network you are using to determine the network addresses you need.)

If a line in the rfmaster file begins with a # character, the entire line is treated as a comment.

There are at least two lines in the rfmaster file per domain name server: one p and one a line, to define the primary and its network address.

This file is created and maintained on the primary domain name server. When a machine other than the primary tries to start Remote File Sharing, this file is read to determine the address of the primary. If the associated rfmaster for a transport provider is missing, use

rfstart -p primary_name_server_address

to identify the primary name server’s address for that transport provider. After that, a copy of the primary’s rfmaster file is automatically placed on the machine.

Domains not served by the primary can also be listed in the rfmaster file. By adding primary, secondary, and address information for other domains on a network, machines served by the primary will be able to share resources with machines in other domains.
rfmaster (4)

A primary name server may be a primary for more than one domain. However, the secondaries must then also be the same for each domain served by the primary. There is an rfmaster file for each transport provider.

Files
/etc/rfs/<transport>/rfmaster

USAGE
Examples
An example of an rfmaster file, using TCP/IP addresses, is shown below. (The network address shown are for illustration purposes only. Do not use these in your rfmaster file.)

```
ccs p ccs.comp1
ccs s ccs.comp2
ccs.comp2 a \x00020ACEAE026E380000000000000000
ccs.comp1 a \x00020ACEAE026E480000000000000000
```

REFERENCES
rfstart(1M)
NAME
routing - system supporting for packet network routing

DESCRIPTION
The network facilities provide general packet routing. Routing table maintenance may be implemented in applications processes.

A simple set of data structures compose a routing table used in selecting the appropriate network interface when transmitting packets. This table contains a single entry for each route to a specific network or host. The routing table was designed to support routing for the Internet Protocol (IP), but its implementation is protocol independent and thus it may serve other protocols as well. User programs may manipulate this data base with the aid of two ioctl(2) commands, SIOCADDRT and SIOCDELRRT. These commands allow the addition and deletion of a single routing table entry, respectively. Routing table manipulations may only be carried out by privileged user.

A routing table entry has the following form, as defined in /usr/include/net/route.h:

```c
struct rtentry {
    u_long rt_hash; /* to speed lookups */
    struct sockaddr rt_dst; /* key */
    struct sockaddr rt_gateway; /* value */
    short rt_flags; /* up/down?, host/net */
    short rt_refcnt; /* # held references */
    u_long rt_use; /* raw # packets forwarded */
#define RTF_UP 0x1 /* route usable */
#define RTF_GATEWAY 0x2 /* destination is a gateway */
#define RTF_HOST 0x4 /* host entry (net otherwise) */
};
```

Routing table entries come in three flavors: for a specific host, for all hosts on a specific network, for any destination not matched by entries of the first two types (a wildcard route). Each network interface installs a routing table entry when it it is initialized. Normally the interface specifies the route through it is a direct connection to the destination host or network. If the route is direct, the transport layer of a protocol family usually requests the packet be sent to the same host specified in the packet. Otherwise, the interface may be requested to address the packet to an entity different from the eventual recipient (that is, the packet is forwarded).

Routing table entries installed by a user process may not specify the hash, reference count, use, or interface fields; these are filled in by the routing routines. If a route is in use when it is deleted (rt_refcnt is non-zero), the resources associated with it will not be reclaimed until all references to it are removed.
User processes read the routing tables through the `/dev/kmem` device.

The `rt_use` field contains the number of packets sent along the route. This value is used to select among multiple routes to the same destination. When multiple routes to the same destination exist, the least used route is selected.

A wildcard routing entry is specified with a zero destination address value. Wildcard routes are used only when the system fails to find a route to the destination host and network. The combination of wildcard routes and routing redirects can provide an economical mechanism for routing traffic.

**FILES**

`/dev/kmem`

**SEE ALSO**

`ioctl(2), route(1M), routed(1M)`

**DIAGNOSTICS**

- `EEXIST` A request was made to duplicate an existing entry.
- `ESRCH` A request was made to delete a non-existent entry.
- `ENOBUFFS` Insufficient resources were available to install a new route.
**NAME**

rpc – rpc program number data base

**SYNOPSIS**

rpc

**DESCRIPTION**

The **rpc** program number database contains user readable names that can be used in place of RPC program numbers. Each line has the following information:

- name of server for the RPC program
- RPC program number
- aliases

Items are separated by any number of blanks and/or tab characters. A # indicates the beginning of a comment; characters up to the end of the line are not interpreted by routines which search the file.

Below is an example of an RPC database:

```
#
# rpc
#

rpcbind 100000 portmap sunrpc portmapper
rusersd 100002 rusers
nfs 100003 nfsprog
mountd 100005 mount showmount
walld 100008 rwall shutdown
sprayd 100012 spray
llockmgr 100020
nlockmgr 100021
status 100024
bootparam 100026
keyserv 100029 keyserver
```
NAME

rt_dptbl – real-time dispatcher parameter table

DESCRIPTION

The process scheduler (or dispatcher) is the portion of the kernel that controls alloca-
tion of the CPU to processes. The scheduler supports the notion of scheduling classes where each class defines a scheduling policy, used to schedule processes within that class. Associated with each scheduling class is a set of priority queues on which ready to run processes are linked. These priority queues are mapped by the system configuration into a set of global scheduling priorities which are available to processes within the class. (The dispatcher always selects for execution the process with the highest global scheduling priority in the system.) The priority queues associated with a given class are viewed by that class as a contiguous set of priority levels numbered from 0 (lowest priority) to \( n \) (highest priority—a configuration dependent value). The set of global scheduling priorities that the queues for a given class are mapped into might not start at zero and might not be contiguous (depending on the configuration).

The real-time class maintains an in-core table, with an entry for each priority level, giving the properties of that level. This table is called the real-time dispatcher parameter table (rt_dptbl). The rt_dptbl consists of an array of parameter structures (struct rt_dpent), one for each of the \( n \) priority levels. The properties of a given priority level \( i \) are specified by the \( i \)th parameter structure in this array (rt_dptbl).

A parameter structure consists of the following members. These are also described in the /usr/include/sys/rt.h header file.

- **rt_globpri**: The global scheduling priority associated with this priority level. The mapping between real-time priority levels and global scheduling priorities is determined at boot time by the system configuration. The rt_globpri values cannot be changed with dispadmin(1M).

- **rt_quantum**: The length of the time quantum allocated to processes at this level in ticks (HZ). The time quantum value is only a default or starting value for processes at a particular level as the time quantum of a real-time process can be changed by the user with the priocntl command or the priocntl system call.

An administrator can affect the behavior of the real-time portion of the scheduler by reconfiguring the rt_dptbl. There are two methods available for doing this.

DISPADMIN CONFIGURATION FILE

The rt_quantum values in the rt_dptbl can be examined and modified on a running system using the dispadmin(1M) command. Invoking dispadmin for the real-time class allows the administrator to retrieve the current rt_dptbl configuration from the kernel’s in-core table, or overwrite the in-core table with values from a configuration file. The configuration file used for input to dispadmin must conform to the specific format described below.
Blank lines are ignored and any part of a line to the right of a # symbol is treated as a comment. The first non-blank, non-comment line must indicate the resolution to be used for interpreting the time quantum values. The resolution is specified as

```
RES=RES
```

where res is a positive integer between 1 and 1,000,000,000 inclusive and the resolution used is the reciprocal of res in seconds. (For example, RES=1000 specifies millisecond resolution.) Although very fine (nanosecond) resolution may be specified, the time quantum lengths are rounded up to the next integral multiple of the system clock’s resolution. The system clock’s resolution is hardware-dependent; this resolution can be calculated from the value of HZ, which is defined in the file /usr/include/sys/param.h. HZ gives the number of clock ticks per second of the system clock. For example, an HZ of 100 specifies 100 clock ticks per second, or one tick every 10 milliseconds (that is, this system clock has a resolution of 10 milliseconds). If the -t and -r options are used to specify a time quantum of 34 milliseconds, it is rounded up to 4 ticks (40 milliseconds) on a machine with an HZ of 100.

The remaining lines in the file are used to specify the rt_quantum values for each of the real-time priority levels. The first line specifies the quantum for real-time level 0, the second line specifies the quantum for real-time level 1, etc. There must be exactly one line for each configured real-time priority level. Each rt_quantum entry must be either a positive integer specifying the desired time quantum (in the resolution given by res), or the symbol RT_TQINF indicating an infinite time quantum for that level.

**EXAMPLE**

The following excerpt from a dispadmin configuration file illustrates the format. Note that for each line specifying a time quantum there is a comment indicating the corresponding priority level. These level numbers indicate priority within the real-time class, and the mapping between these real-time priorities and the corresponding global scheduling priorities is determined by the configuration specified in the rt master file. The level numbers are strictly for the convenience of the administrator reading the file and, as with any comment, they are ignored by dispadmin on input. dispadmin assumes that the lines in the file are ordered by consecutive, increasing priority level (from 0 to the maximum configured real-time priority). The level numbers in the comments should normally agree with this ordering; if for some reason they don’t, however, dispadmin is unaffected.
# Real-Time Dispatcher Configuration File
RES=1000

<table>
<thead>
<tr>
<th>TIME QUANTUM (rt_quantum)</th>
<th>PRIORITY LEVEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td># 0</td>
</tr>
<tr>
<td>100</td>
<td># 1</td>
</tr>
<tr>
<td>100</td>
<td># 2</td>
</tr>
<tr>
<td>100</td>
<td># 3</td>
</tr>
<tr>
<td>100</td>
<td># 4</td>
</tr>
<tr>
<td>100</td>
<td># 5</td>
</tr>
<tr>
<td>90</td>
<td># 6</td>
</tr>
<tr>
<td>90</td>
<td># 7</td>
</tr>
<tr>
<td>.</td>
<td>. .</td>
</tr>
<tr>
<td>.</td>
<td>. .</td>
</tr>
<tr>
<td>.</td>
<td>. .</td>
</tr>
<tr>
<td>10</td>
<td># 58</td>
</tr>
<tr>
<td>10</td>
<td># 59</td>
</tr>
</tbody>
</table>

FILES
/usr/include/sys/rt.h

SEE ALSO
dispadmin(1M), priocntl(1), priocntl(2)
**Sassign (4)**

**NAME**

*Sassign* – configurable device variables

**SYNOPSIS**

*Sassign*

**DESCRIPTION**

One of the kernel configuration files, the *Sassign* file gives system administrators the ability to assign specific actual devices to logical device names used by the kernel. One example is *rootdev*, which is the device that contains the root file system. At present, the *Sassign* file only supports block devices.

If the system administrator wants to assign a different actual device to perform a function, the administrator remaps the logical device name for that function to specify another configured device in the *Sassign* file. Note that the kernel must be rebuilt and rebooted for the new assignment to take affect.

Each logical device name in the *Sassign* file is specified (in /etc/conf/sassign.d) on a separate line of the form:

```
device-variable-prefix device-module-name minor node-name
```

All fields are positional and must be separated by white space. Blank lines and lines beginning with ‘#’ or ‘*’ are considered comments and are ignored.

The *Sassign* file fields are:

- **device-variable-prefix**
  Specifies a prefix identifier to be used to construct the logical name by which the device is known. When the kernel is rebuilt, the suffix *dev* will be appended to this identifier to form the full logical device name.

  The logical device name will be used to create a global variable of type *dev_t* during the kernel rebuild process. Any module that needs to reference the logical device should include an `extern dev_t` declaration for the logical device name variable.

- **device-module-name**
  Identifies the name of actual device that is to perform the function associated with this logical device name. The name must match the name defined for the device in the *module-name* field of its *Master*(*4*) file.

- **minor**
  Specifies the minor device number which is to be assigned to this logical device name. The major number for the logical device is the major number defined for the device identified in the *device-module-name* field.

- **node-name**
  This field is used for the *swap* device only. The field specifies the full pathname of the block special file for the *swap* device.

**NOTES**

To create a variable which is intended to always refer to the same device, define it as a variable in the device’s *Space.c* file, using the `PRFX_BMAJOR_X` symbol from /etc/conf/cf.d/config.h, instead of using an *Sassign* file.
SEE ALSO
   idbuild(1M), Master(4), Space.c(4)
NAME
sccsfile – format of SCCS file

DESCRIPTION
An SCCS (Source Code Control System) file is an ASCII file. It consists of six logical parts: the checksum, the delta table (contains information about each delta), user names (contains login names and/or numerical group IDs of users who may add deltas), flags (contains definitions of internal keywords), comments (contains arbitrary descriptive information about the file), and the body (contains the actual text lines intermixed with control lines).

Throughout an SCCS file there are lines which begin with the ASCII SOH (start of heading) character (octal 001). This character is hereafter referred to as the control character and will be represented graphically as @. Any line described below that is not depicted as beginning with the control character is prevented from beginning with the control character.

Entries of the form DDDD represent a five-digit string (a number between 00000 and 99999).

Each logical part of an SCCS file is described in detail below.

Checksum
The checksum is the first line of an SCCS file. The form of the line is:

@hDDDDD

The value of the checksum is the sum of all characters, except those of the first line. The @h provides a magic number of (octal) 064001, depending on byte order.

Delta Table
The delta table consists of a variable number of entries of one of the following forms:

@n DDDDD/DDDDD/DDDDD
@d <type> <SCCS ID> yr/mo/da hr:mi:se <pgmr> DDDDD DDDDD
@l DDDDD ...
@x DDDDD ...
@g DDDDD ...
@m <MR number>
@c <comments> ...
...
@e

The first line (@n) contains the number of lines inserted/deleted/unchanged, respectively. The second line (@d) contains the type of the delta (normal: D or removed: R), the SCCS ID of the delta, the date and time of creation of the delta, the login name corresponding to the real user ID at the time the delta was created, and the serial numbers of the delta and its predecessor, respectively.

The @l, @x, and @g lines contain the serial numbers of deltas included, excluded, and ignored, respectively. These lines are optional.
The @m lines (optional) each contain one MR number associated with the delta; the @c lines contain comments associated with the delta. The @e line ends the delta table entry.

**User Names**

The list of login names and/or numerical group IDs of users who may add deltas to the file, separated by new-lines. The lines containing these login names and/or numerical group IDs are surrounded by the bracketing lines @u and @u. An empty list allows anyone to make a delta. Any line starting with a ! prohibits the succeeding group or user from making deltas.

**Flags**

Keywords used internally. See admin(1) for more information on their use. Each flag line takes the form:

\[ @f <flag> <optional text> \]

The following flags are defined:

- `@f t <type of program>`
- `@f v <program name>`
- `@f i <keyword string>`
- `@f b`
- `@f m <module name>`
- `@f f <floor>`
- `@f c <ceiling>`
- `@f d <default-sid>`
- `@f n`
- `@f j`
- `@f l <lock-releases>`
- `@f q <user defined>`
- `@f z <reserved for use in interfaces>`

The `t` flag defines the replacement for the `%Y%-f` identification keyword. The `v` flag controls prompting for MR numbers in addition to comments; if the optional text is present it defines an MR number validity checking program. The `i` flag controls the warning/error aspect of the "No id keywords" message. When the `i` flag is not present, this message is only a warning; when the `i` flag is present, this message causes a fatal error (the file will not be "gotten", or the delta will not be made). When the `b` flag is present the `-b keyletter` may be used on the `get` command to cause a branch in the delta tree. The `m` flag defines the first choice for the replacement text of the `%Y%-identification keyword. The `f` flag defines the floor release; the release below which no deltas may be added. The `c` flag defines the ceiling release; the release above which no deltas may be added. The `d` flag defines the default SID to be used when none is specified on a `get` command. The `n` flag causes `delta` to insert a null delta (a delta that applies no changes) in those releases that are skipped when a delta is made in a new release (for example, when delta 5.1 is made after delta 2.7, releases 3 and 4 are skipped). The absence of the `n` flag causes skipped releases to be completely empty. The `j` flag causes `get` to allow concurrent edits of the same base SID. The `l` flag defines a list of releases that are locked against editing. The `q` flag defines the replacement
sccsfile(4)

for the %Q% identification keyword. The z flag is used in specialized interface pro-
grams.

Comments
Arbitrary text is surrounded by the bracketing lines @t and @T. The comments sec-
tion typically will contain a description of the file’s purpose.

Body
The body consists of text lines and control lines. Text lines do not begin with the
control character, control lines do. There are three kinds of control lines: insert,
delete, and end, represented by:

@IDDDDD
@DDDDDD
@EDDDDD

respectively. The digit string is the serial number corresponding to the delta for the
control line.

SEE ALSO
admin(1), delta(1), get(1), prs(1)
NAME

sd – kernel module system shutdown script

SYNOPSIS

sd

DESCRIPTION

One of the kernel configuration files, a sd file is an optional file that executes when the system is shut down to perform any cleanup required for an installed kernel module. Normally, this is a shell script [see sh(1)].

When the sd component of a module’s Driver Software Package (DSP) is installed, idinstall(1M) stores the driver’s sd file information in /etc/conf/sd.d/module-name, where module-name is the name of the module being installed. Package scripts should never access /etc/conf/sd.d files directly; only the idinstall command should be used.

The contents of the /etc/conf/sd.d directory are linked to /etc/idsd.d whenever a new configuration of the kernel is first booted. On the next system shutdown—and all subsequent system shutdowns—the module’s sd file is executed upon entering init level 0, 5, or 6 [see init(1M)].

SEE ALSO

idinstall(1M), init(1M), shutdown(1M), Rc(4)
services(4)

NAME
services – Internet services and aliases

DESCRIPTION
The services file contains an entry for each service available through the DARPA Internet. Each entry consists of a line of the form:

```
  service-name  port / protocol  aliases
```

*service-name*  This is the official Internet service name.

*port / protocol*  This field is composed of the port number and protocol through which the service is provided (for instance, 512/tcp).

*aliases*  This is a list of alternate names by which the service might be requested.

Fields can be separated by any number of SPACE and/or TAB characters. A ‘#’ (pound-sign) indicates the beginning of a comment; characters up to the end of the line are not interpreted by routines which search the file.

Service names may contain any printable character other than a field delimiter, NEWLINE, or comment character.

The services file is used to initialize commands and protocols with these traditional and reserved values.

FILES
/etc/services

SEE ALSO
getservent(3N), inetd.conf(4), RFC 1060
NAME

setinfo – set characteristics file

DESCRIPTION

setinfo is an ASCII file that describes the characteristics of the set along with information that helps control the flow of installation. It is created by the software set developer and is included in the Set Installation Package (SIP). A SIP is a special purpose package that controls the installation and removal of a set of packages.

Each entry in the setinfo file is a line that consists of predefined fields. Each entry corresponds to a package belonging to the set and must contain the following <tab>-separated fields:

1. Package Abbr
   This field contains the abbreviated name of the package. The abbreviation must be a short string (no more than nine characters long) and must conform to the file naming rules. All characters in the abbreviation must be alphanumeric and the first character cannot be numeric. 
   install, new, and all are reserved.
   This abbreviated name must be the same as the one used in pkginfo(4).

2. Parts
   This field specifies the number of parts this package consists of.

3. Default
   This field contains the character ‘y’ indicating that the package is to be installed as a default. Conversely, an ‘n’ indicates that the package will not be installed.

4. Category
   The category under which the package belongs. Release 4 defines four categories: “application,” “graphics,” “system” and “utilities.” All packages must be assigned to one of these categories. If you choose, you can also assign a package to a category you defined. Categories are case-insensitive and may contain only alphanumerics. Each category is limited to 16 characters.

5. Package Full-Name
   Text that specifies the package name (maximum length of 256 ASCII characters). This field must be the same as NAME in pkginfo(4).

EXAMPLES

setinfo file for set admin:

```bash
#ident "@(#)set:cmn/set/admin/setinfo 1.2"
#ident "$Header:$"

# Format for the setinfo file. Field separator is: <tab>
# pkg parts default category pkg full-name
# abbr y/n

oam 4  y  application  OA&M
bkrs 1  y  system  Extended Backup and Restore
face 1  y  application  FACE
```

195
setinfo (4)

NOTES
The order of the packages listed in the setinfo file must reflect any package dependencies (if any) and must represent the order in which the packages will occur on the media (in the case of datastream). Any package for which there exists a dependency must be listed prior to the package(s) that depends on it.

SEE ALSO
pkginfo(4)
NAME

setsize - disk space requirements file

DESCRIPTION

This set information file defines disk space requirements for the target environment. It contains information about all of the packages in the set. This file describes the disk space taken up by installed files as well as extra space needed for dynamically created files, as described in each package’s space(4) file.

The generic format of a line in this file is:

pathname blocks inodes

Definitions for each field are as follows:

pkg

The short, or abbreviated, name of a package in the set. This name describes which package of the set requires the amount of space described by the rest of the data on this line in the setsize file.

pathname

Names a directory in which there are objects that will be installed or that will require additional space. The name may be the mountpoint for a filesystem. Names that do not begin with a slash (/) indicate relocatable directories.

blocks

Defines the number of 512 byte disk blocks required for installation of the files and directory entries contained in the pathname. (Do not include filesystem-dependent disk usage).

inodes

Defines the number of inodes required for the installation of the files and directory entries contained in the pathname.

At installation time, the set installation calls setsizecvt(1), which reduces the setsize file for a set to a space(4) file containing entries for only the packages that are selected. It is this resulting space(4) file against which space checking for the set is performed.

EXAMPLE

# space required by packages in the Networking Set
inet:/usr/adm 46 2
nfs:/etc 197 17

SEE ALSO

setsizecvt(1), space(4)
shadow (4)

NAME

shadow – shadow password file

DESCRIPTION

/etc/shadow is an access-restricted ASCII system file that contains an entry for each user on the system. The fields within each entry are separated by colons; each entry is separated from the next by a new-line. Unlike the /etc/passwd file, /etc/shadow does not have general read permission.

Here are the fields in /etc/shadow:

- **login_name** The name by which a user identifies himself or herself when logging in.
- **password** A 13-character encrypted password for the user, a lock string to indicate the login is not accessible, or no string to show that there is no password for the login.
- **lastchanged** The number of days between January 1, 1970, and the date that the password was last modified.
- **minimum** The minimum number of days required between password changes.
- **maximum** The maximum number of days the password is valid.
- **warn** The number of days before password expires that the user is warned.
- **inactive** The number of days of inactivity allowed for that user.
- **expire** An absolute date specifying when the login may no longer be used.
- **flag** A character identifying a password generator.

The encrypted password consists of 13 characters chosen from a 64-character alphabet (., /, 0-9, A-Z, a-z).

To update this file, use the passwd, useradd, usermod, or userdel command.

FILES

/etc/shadow

SEE ALSO

getspent(3C), login(1), passwd(1), passwd(4), putspent(3C), useradd(1M), userdel(1M), usermod(1M)
NAME
sharetab – shared file system table

DESCRIPTION
sharetab resides in directory /etc/dfs and contains a table of local resources shared by the share command.

Each line of the file consists of the following fields:

pathname resource fstype specific_options description

where

pathname Indicates the pathname of the shared resource.
resource Indicates the symbolic name by which remote systems can access the resource.
fstype Indicates the file system type of the shared resource.
specific_options Indicates file-system-type-specific options that were given to the share command when the resource was shared.
description Is a description of the shared resource provided by the system administrator when the resource was shared.

SEE ALSO
share(1M)
space (4)

NAME
space – disk space requirement file

DESCRIPTION
space is an ASCII file that gives information about disk space requirements for the target environment. It defines space needed beyond that which is used by objects defined in the prototype file—for example, files which will be installed with the installf command. It should define the maximum amount of additional space which a package will require.

The generic format of a line in this file is:

   pathname  blocks  inodes

Definitions for the fields are as follows:

   pathname  Specifies a directory name which may or may not be the mount point for a filesystem. Names that do not begin with a slash (/) indicate relocatable directories.
   blocks    Defines the number of disk blocks required for installation of the files and directory entries contained in the pathname (using a 512-byte block size).
   inodes    Defines the number of inodes required for installation of the files and directory entries contained in the pathname.

EXAMPLE

   # extra space required by config data which is
data           # dynamically loaded onto the system
   data 500 1

SEE ALSO
installf(1M), prototype(4)
Space.c(4)

NAME
Space.c - configuration-dependent kernel module data structure initializations

SYNOPSIS
Space.c

DESCRIPTION
One of the kernel configuration files, the Space.c file contains storage allocations and initializations for data structures associated with a kernel module, when the size or initial value of the data structures depend on configurable parameters, such as the number of subdevices configured for a particular device or a tunable parameter. For example, the Space.c file gives a driver the ability to allocate storage only for the subdevices actually being configured, by referencing symbolic constants defined in the config.h file.

When the Space.c component of a module's Driver Software Package (DSP) is installed, idinstall(1M) stores the module's Space.c file information in /etc/conf/pack.d/module-name/space.c, where module-name is the name of the module being installed.

Package scripts should never access Space.c files directly; only the idinstall command should be used.

The config.h file is a temporary file created in /etc/conf/cf.d during the system reconfiguration process. The file contains #define statements that can be used to specify the following information about the module:

Per module #defines:

```
#define PRFX Set to 1 if module is configured
#define PRFX_CNTLS Number of configured entries in System file
#define PRFX_UNITS Number of subdevices (sum of unit fields)
#define PRFX_CMAJORS Number of character major numbers supported
#define PRFX_CMAJOR_0 Character major numbers supported; the first major is PRFX_CMAJOR_0, the second PRFX_CMAJOR_1, and so forth
```

Per instance #defines (PRFX_0 represents the first configured instance, followed by PRFX_1, and so on if more than one instance is configured):

```
#define PRFX_0 Unit field value
#define PRFX_0_VECT Interrupt vector used
#define PRFX_0_TYPE Interrupt vector type
#define PRFX_0_IPL Interrupt priority level
#define PRFX_0_SIOA Starting input/output address
#define PRFX_0_EIOA Ending input/output address
#define PRFX_0_SCMA Starting controller memory address
#define PRFX_0_ECMAC Ending controller memory address
#define PRFX_0_CHAN DMA channel used (-1 if none)
```
**Space.c(4)**

Since the module is installed as an object file, the module itself can not reference the `#defines` for the configurable device parameters in `config.h`. However, the module’s `Space.c` is a C language source file, and as such, can define variables which can take on the values of the `#defines` in `config.h`. When the next system configuration is built, the `idbuild(1M)` command uses the list of arguments to `cc(1)` defined in `/etc/conf/cf.d/deflist` to compile the module’s `Space.c` file before linking the module to the kernel.

**NOTES**

The following two `#defines` are generated for the `Space.c` file only if their values are identical for all instances:

```c
#define PRFX_CHAN DMA channel used (-1 if none)
#define PRFX_TYPE Interrupt vector type used
```

**SEE ALSO**

`idbuild(1M)`, `Master(4)`, `System(4)`

**EXAMPLES**

```c
#include <config.h>

...
...

struct strtty lp_tty[LP_CNTLS]; /* tty structs for each device */
struct lpcfg lpcfg[LP_CNTLS]; /* output char watchdog timeout */
...
...

struct lpcfg lpcfg[LP_CNTLS] = {
  0, /* state */
  LP_0_SIOA+0, /* data register port address */
  LP_0_SIOA+1, /* status register port address */
  LP_0_SIOA+2, /* control register port address */
  LP_0_VECT /* interrupt vector */
  #ifdef LP_1
    , /* next structure */
      0, /* state */
      LP_1_SIOA+0, /* data register port address */
      LP_1_SIOA+1, /* status register port address */
      LP_1_SIOA+2, /* control register port address */
      LP_1_VECT /* interrupt vector */
    #endif /* LP_1 */
  #ifdef LP_2
    , /* next structure */
      0, /* state */
      LP_2_SIOA+0, /* data register port address */
      LP_2_SIOA+1, /* status register port address */
      LP_2_SIOA+2, /* control register port address */
      LP_2_VECT /* interrupt vector */
    #endif /* LP_2 */

...
/* next structure */

0,
LP_2_SIOA+0,
LP_2_SIOA+1,
LP_2_SIOA+2,
LP_2_VECT
}
#endif  /* LP_2 */
};
NAME
stat – (XENIX) data returned by stat system call

SYNOPSIS
#include <sys/types.h>
#include <sys/stat.h>

DESCRIPTION
The system calls stat, lstat and fstat return data in a stat structure, which is defined in stat.h:

```c
struct stat
{
    dev_t st_dev;
    ino_t st_ino;
    mode_t st_mode;
    nlink_t st_nlink;
    uid_t st_uid;
    gid_t st_gid;
    dev_t st_rdev;
    off_t st_size;
    time_t st_atime;
    time_t st_mtime;
    time_t st_ctime;
};
```

The constants used in the st_mode field are also defined in this file:

```c
#define S_IFMT 0xF000  /* type of file */
#define S_IAMTH 0x1FF   /* access mode bits */
#define S_IFIFO 0x1000  /* fifo */
#define S_IFCHR 0x2000  /* character special */
#define S_IFDIR 0x4000  /* directory */
#define S_IFNAM 0x5000  /* XENIX special named file */
#define S_INSEM 0x1     /* XENIX semaphore subtype of IFNAM */
#define S_INSEM 0x2     /* XENIX shared data subtype of IFNAM */
#define S_IFBLK 0x6000  /* block special */
#define S_IFREG 0x8000  /* regular */
#define S_IFLNK 0xA000  /* symbolic link */
#define S_ISUID 0x4000  /* set user id on execution */
#define S_ISGID 0x2000  /* set group id on execution */
#define S_ISVTX 0x1000  /* save swapped text even after use */
#define S_IRREAD 0x0400 /* read permission, owner */
#define S_IWWRITE 0x0200 /* write permission, owner */
#define S_IXEXEC 0x0100 /* execute/search permission, owner */
#define S_ENFMT S_ISGID /* record locking enforcement flag */
#define S_IRWXU 0x0700 /* read, write, execute: owner */
#define S_IRUSR 0x0400 /* read permission: owner */
#define S_IWUSR 0x0200 /* write permission: owner */
#define S_IXUSR 0x0100 /* execute permission: owner */
```
(XENIX System Compatibility)

#define S_IRWXG  00070 /* read, write, execute: group */
#define S_IRGRP  00040 /* read permission: group */
#define S_IWGRP  00020 /* write permission: group */
#define S_IXGRP  00010 /* execute permission: group */
#define S_IRWXO  00007 /* read, write, execute: other */
#define S_IROTH  00004 /* read permission: other */
#define S_IWOTH  00002 /* write permission: other */
#define S_IXOTH  00001 /* execute permission: other */

SEE ALSO
stat(2), types(5)
NAME
strcf - STREAMS Configuration File for STREAMS TCP/IP

DESCRIPTION
/etc/strcf contains the script that is executed by slink(1M) to perform the
STREAMS configuration operations required for STREAMS TCP/IP.

The standard /etc/strcf file contains several functions that perform various
configuration operations, along with a sample boot function. Normally, only the
boot function must be modified to customize the configuration for a given install­
ation. In some cases, however, it may be necessary to change existing functions or
add new functions.

The following functions perform basic linking operations:

The tp function is used to set up the link between a transport provider, such as TCP,
and IP.

```
# tp - configure transport provider (that is, tcp, udp, icmp)
# usage: tp devname
#
tp {
  p = open $1
  ip = open /dev/ip
  link p ip
}
```

The linkint function links the specified streams and does a sifname operation
with the given name.

```
# linkint - link interface to ip or arp
# usage: linkint top bottom ifname
#
linkint {
  x = link $1 $2
  sifname $1 x $3
}
```

The aplinkint function performs the same function as linkint for an interface
that uses the app module.

```
# aplinkint - like linkint, but app is pushed on dev
# usage: aplinkint top bottom ifname
#
aplinkint {
  push $2 app
  linkint $1 $2 $3
}
```
The following functions are used to configure different types of Ethernet interfaces:

The uenet function is used to configure an Ethernet interface for a cloning device driver that uses the \textit{unit select} ioctl to select the desired interface. The interface name is constructed by concatenating the supplied prefix and the unit number.

```c
# uenet - configure ethernet-type interface for cloning driver using
# unit select
# usage: uenet ip-fd devname ifprefix unit
#
uenet {
    ifname = strcat $3 $4
    dev = open $2
    unitsel dev $4
    aplinkint $1 dev ifname
    dev = open $2
    unitsel dev $4
    arp = open /dev/arp
    linkint arp dev ifname
}
```

The denet function performs the same function as uenet, except that \texttt{DL\_ATTACH} is used instead of \textit{unit select}.

```c
# denet - configure ethernet-type interface for cloning driver using
# DL\_ATTACH
# usage: denet ip-fd devname ifprefix unit
#
denet {
    ifname = strcat $3 $4
    dev = open $2
    dlattach dev $4
    aplinkint $1 dev ifname
    dev = open $2
    dlattach dev $4
    arp = open /dev/arp
    linkint arp dev ifname
}
```

The cenet function is used to configure an Ethernet interface for a cloning device driver that uses a different major number for each interface. The device name is formed by concatenating the supplied device name prefix and the unit number. The interface name is formed in a similar manner using the interface name prefix.

```c
# cenet - configure ethernet-type interface for cloning driver with
# one major per interface
# usage: cenet ip-fd devprefix ifprefix unit
#
cenet {
    devname = strcat $2 $4
```
The `senet` function is used to configure an Ethernet interface for a non-cloning device driver. Two different device nodes must be specified for IP and ARP.

```c
ifname = strcat $3 $4
dev = open devname
aplinkint $1 dev ifname
dev = open devname
arp = open /dev/arp
linkint arp dev ifname
```

The `senetc` function is like `senet`, except that it allows the specification of a convergence module to be used with the Ethernet driver (such as, for the 3B2 emd driver).

```c
ifname = strcat $3 $4
dev = open $2
aplinkint $1 dev $4
dev = open $3
arp = open /dev/arp
linkint arp dev $4
```

The `loopback` function is used to configure the loopback interface.

```c
ifname = strcat $3 $4
dev = open $2
aplinkint $1 dev $4
dev = open $3
arp = open /dev/arp
linkint arp dev $4
```

The `loopback` function is used to configure the loopback interface.

```c
ifname = strcat $3 $4
dev = open /dev/loop
linkint $1 dev lo0
```
The `slip` function is used to configure a SLIP interface. This function is not normally executed at boot time.

```
# slip - configure slip interface
# usage: slip unit
#
slip {
ip = open /dev/ip
s = open /dev/slip
ifname = strcat sl $1
unitsel s $1
linkint ip s ifname
}
```

The `boot` function is called by default when `slink` is executed. Normally, only the `interfaces` section and possibly the `queue params` section will have to be customized for a given installation. Examples are provided for the various Ethernet driver types.

```
#
# boot - boot time configuration
#
boot {
#
# queue params
#
# initqp /dev/udp rq 8192 40960
# initqp /dev/ip muxrq 8192 40960 rq 8192 40960
#
# transport
#
tp /dev/tcp
tp /dev/udp
tp /dev/icmp
tp /dev/rawip
}
```

FILES

/etc/strcf

SEE ALSO

`slink(1M)"
NAME
strftime – language-specific strings

DESCRIPTION
There can exist one printable file per locale to specify its date and time formatting
information. These files must be kept in the directory
/usr/lib/locale/<locale>/LC_TIME. The contents of these files are:
1. abbreviated month names (in order)
2. month names (in order)
3. abbreviated weekday names (in order)
4. weekday names (in order)
5. default strings that specify formats for locale time (%X) and locale date (%x)
6. default format for cftime, if the argument for cftime is zero or null
7. ante meridian string
8. post meridian string
9. default format for date command output
Each string is on a line by itself. All white space is significant. The order of the
strings in the above list is the same order in which they must appear in the file.

EXAMPLE
Here are the contents of /usr/lib/locale/C/LC_TIME:

Jan
Feb ...
January
February ...
Sun
Mon ...
Sunday
Monday ...
%H:%M:%S
%m/%d/%y
%a %b %d %T %Z %Y
AM
PM
%a %b %d %T %Z %Y

FILES
/usr/lib/locale/<locale>/LC_TIME

SEE ALSO
ctime(3C), setlocale(3C), strftime(3C)
NAME
Stubs.c - stubs for kernel module symbols

SYNOPSIS
Stubs.c

DESCRIPTION
One of the kernel configuration files, a Stubs.c file is an optional C language
source file that can be installed and compiled into the system as a "place holder"
for a kernel module that will not be installed in the system. Its purpose is to enable
the kernel to resolve references to the absent module’s symbols.

When the Stubs.c component of a module’s Driver Software Package (DSP) is
installed, idinstall(1M) stores the module’s Stubs.c file information in
/etc/conf/pack.d/module-name/stubs.c where module-name is the name of the
module being installed. Package scripts should never access Stubs.c files directly;
only the idinstall command should be used.

A module’s Stubs.c file contains function name and variable definition stubs for
symbols defined in the module that can be referenced by other kernel modules
being configured into the system. At compile time, the definitions in the Stubs.c
file give the kernel the ability to resolve references made to the absent module’s
symbols.

SEE ALSO
idinstall(1M)
NAME

stune – local system settings for tunable parameters

SYNOPSIS

stune
stune.current

DESCRIPTION

The /etc/conf/cf.d/stune file contains tunable parameters for the kernel modules to be configured into the next system to be built [see idbuild(1M)]. The parameter settings in the stune file are used to override the default values specified in the Mtune file.

The contents of the stune file will only affect the next kernel rebuild. Once the new kernel has been installed to /stand and booted, the stune file is copied to stune.current. Any change made to the stune.current file using the idtune(1M) command with the -c option will affect all the loadable kernel modules subsequently configured into the running system.

Package scripts should never access /etc/conf/cf.d/stune or /etc/conf/cf.d/stune.current files directly; only the idtune(1M) command should be used.

The stune and stune.current files contain one line for each parameter to be set. Each line contains two positional fields separated by white space:

  parameter-name new-value

Blank lines and lines beginning with ‘#’ or ‘*’ are considered comments and are ignored.

The stune and stune.current fields are:

- parameter-name: The name of the tunable parameter, as defined in the Mtune file.
- new-value: Specifies the new value to be used to override the default value specified for this tunable parameter in the Mtune file. This value must fall within the valid range of values specified for this parameter in the Mtune file.

For detailed information on stune parameters, refer to the advanced features sections on tunable parameters in your system administration documentation.

SEE ALSO

idbuild(1M), idtune(1M), Mtune(4)
NAME

su – su options file

DESCRIPTION

Options for the su command [see su(1M)] can be set or changed with keywords in /etc/default/su. The following keywords are recognized by su:

SULOG=filename
Log (in filename) successful and unsuccessful attempts to execute su.

CONSOLE=device
If a user executes su to become a privileged user on a device other than device, a printed message will appear on device to inform the administrator of that fact.

PATH=path_list
When a user executes su to become an unprivileged user, the user’s path will be set to path_list. The default is /usr/bin:/usr/ccs/bin.

SUPATH=path_list
When a user executes su to become a privileged user, the user’s path will be set to path_list. The default is /sbin:/usr/sbin:/usr/bin:/etc:/usr/ccs/bin.

PROMPT:
If this parameter exists and is set to No, the su command does not prompt for a password (even if one is defined for login_name). The invoking user, however, must still have appropriate privilege to execute su successfully. If this parameter does not exist, or is set to anything other than No (including NULL), su prompts for a password when invoked and validates the password (if one is defined for login_name).

FILES

/etc/default/su

SEE ALSO

su(1M)
syslog.conf (4)  (BSD System Compatibility)

NAME
syslog.conf – (BSD) configuration file for syslogd system log daemon

SYNOPSIS
/etc/syslog.conf

DESCRIPTION
The file /etc/syslog.conf contains information used by the system log daemon, syslogd(1M), to forward a system message to appropriate log files and/or users. syslog preprocesses this file through m4(1) to obtain the correct information for certain log files.

A configuration entry is composed of two TAB-separated fields:

"selector  action"

The selector field contains a semicolon-separated list of priority specifications of the form:

facility . level [ ; facility . level ]

where facility is a system facility, or comma-separated list of facilities, and level is an indication of the severity of the condition being logged. Recognized values for facility include:

user Messages generated by user processes. This is the default priority for messages from programs or facilities not listed in this file.

kern Messages generated by the kernel.

mail The mail system.

daemon System daemons, such as ftpd(1M), routed(1M), and so on.

auth The authorization system: login(1), su(1M), getty(1M), and so on.

lpr The line printer spooling system: lpr(1), lpc(1M), and so on.

news Reserved for the USENET network news system.

uucp Reserved for the UUCP system; it does not currently use the syslog mechanism.

cron The cron/at facility; crontab(1), at(1), cron(1M), and so on.

local0-7 Reserved for local use.

mark For timestamp messages produced internally by syslogd.

* An asterisk indicates all facilities except for the mark facility.

Recognized values for level are (in descending order of severity):

emerg For panic conditions that would normally be broadcast to all users.

alert For conditions that should be corrected immediately, such as a corrupted system database.

crit For warnings about critical conditions, such as hard device errors.

err For other errors.
warning For warning messages.
notice For conditions that are not error conditions, but may require special handling.
info Informational messages.
debug For messages that are normally used only when debugging a program.
none Do not send messages from the indicated facility to the selected file. For example, a selector of
   
   *.debug;mail.none

   will send all messages except mail messages to the selected file.

The action field indicates where to forward the message. Values for this field can have one of four forms:

A filename, beginning with a leading slash, which indicates that messages specified by the selector are to be written to the specified file. The file will be opened in append mode.

The name of a remote host, prefixed with an @, as with: @server, which indicates that messages specified by the selector are to be forwarded to the syslogd on the named host.

A comma-separated list of usernames, which indicates that messages specified by the selector are to be written to the named users if they are logged in.

An asterisk, which indicates that messages specified by the selector are to be written to all logged-in users.

Blank lines are ignored. Lines for which the first nonwhite character is a '#' are treated as comments.

EXAMPLE
With the following configuration file:

<table>
<thead>
<tr>
<th>selector</th>
<th>action</th>
</tr>
</thead>
<tbody>
<tr>
<td>*.notice;mail.info</td>
<td>/var/log/notice</td>
</tr>
<tr>
<td>*.crit</td>
<td>/var/log/critical</td>
</tr>
<tr>
<td>kern, mark.debug</td>
<td>/dev/console</td>
</tr>
<tr>
<td>kern.err</td>
<td>@server</td>
</tr>
<tr>
<td>*.emerg</td>
<td>*</td>
</tr>
<tr>
<td>*.alert</td>
<td>root, operator</td>
</tr>
<tr>
<td>*.alert;auth.warning</td>
<td>/var/log/auth</td>
</tr>
</tbody>
</table>

syslogd will log all mail system messages except debug messages and all notice (or higher) messages into a file named /var/log/notice. It logs all critical messages into /var/log/critical, and all kernel messages and 20-minute marks onto the system console.

Kernel messages of err (error) severity or higher are forwarded to the machine named server. Emergency messages are forwarded to all users. The users root and operator are informed of any alert messages. All messages from the authorization system of warning level or higher are logged in the file /var/log/auth.
syslog.conf(4) (BSD System Compatibility)

FILES
/etc/syslog.conf

SEE ALSO
at(1), cron(1M), crontab(1), getty(1M), login(1), lp(1), m4(1), syslog(3), syslogd(1M), su(1M)
NAME
System – system-specific configuration information for a kernel module

SYNOPSIS
System

DESCRIPTION
One of the ID/TP kernel configuration files, a System file contains information needed to incorporate a particular kernel module into the next system configuration. General configuration information about the module type is described in the Master file. When the System component of a module’s Driver Software Package (DSP) is installed, idinstall(1M) stores the module’s System file information in /etc/conf/sdevice.d/module-name, where the file module-name is the name of the module being installed. Package scripts should never access System files directly; only the idinstall and idcheck(1M) commands should be used.

System files typically contain data in the following format:

$version version-number
$loadable module-name
 module-name configure unit ipl itype ivec sioa eioa scma ecma dmachan

Blank lines and lines beginning with ‘#’ or ‘*’ are considered comments and are ignored.
The first two entries are described as follows:

$version
If present in the file, this line must appear as the first non-comment line. The line specifies the version number of the System file format. The System file format being described here is version 1. If this line is omitted, version 0 (the old sdevice file format) is assumed.

$loadable
Indicates that the module is to be configured as a loadable module [see modadmin(1M)].
This line is used for dynamically loadable kernel modules only. When the line is present in the file:

  The module-name specified on the $loadable line must match the module-name specified in the first field of each instance line of this file.

  At least one instance of the module must specify the value “y” in the configure field.

  The module must be coded in loadable form (requires creation of special initialization "wrapper" code for loadable modules).

To statically link a loadable module to the base kernel, the module’s $loadable line should be commented out by inserting the character # in column one.
The third type of entry in the System file contains configuration information for each instance of the module. For example, if two instances of a device were to be configured, the device would require two lines of System file definitions.

The third entry type contains the following 11 fields. Each field must be delimited by white space and specify a value. Note that, except for the first two fields (module-name and configure), the remaining fields on this line are used for hardware-related modules only. That is, these fields apply to modules that have b, c, or h characteristics flags set in their Master files (one exception to this is exec modules, described below). In cases where a field does not apply to the module—regardless of the module type—the unused field must contain the value 0 (an unused dmachan field must contain the value -1).

**module-name**
Identifies the internal name of the module. The field value must match the module name specified in the module’s Master file.

**configure**
Indicates (Y or N) whether idbuild(1M) should configure this instance of the module into the system. Note that this field can be used to configure statically linked modules or to configure dynamically loadable modules.

**unit**
This field can be used to encode an arbitrary, module-dependent numeric value. The field is typically used to specify the number of subdevices attached to a controller or pseudo device. If this field is not used it should contain the value 0.

**ipl**
This field specifies the interrupt priority level for the device controlled by this module, and the priority at which the module’s interrupt handler will run. Valid values are 1 (lowest priority) to 7 (highest priority); priority 8 is reserved for the clock tick interrupt. If the module is not a hardware module or does not have an interrupt handler, this field should contain the value 0.

**itype**
Indicates the type of interrupt sharing (if any) this hardware module supports. Note that if a module supports a number of interrupt schemes, it will require multiple system lines, with each line specifying a different itype field value.

Valid values are:

0  This instance of the device does not use interrupts.
1  This instance of the device uses an interrupt vector which cannot be shared, not even with another instance of the same module.
2  This instance of the device uses an interrupt vector which can be shared with another instance of the same module, but can not be shared with other modules.
3  This instance of the device uses an interrupt vector which can be shared with any instance of any hardware modules.
System (4)

This instance of the device uses an EISA level-sensitive interrupt vector which can be shared with any instance of any hardware module.

If this field is not used it should contain the value 0.

**vector**

Specifies the interrupt vector number used by this instance of the device. Valid values are a decimal number from 0 through the value of the highest interrupt vector number supported by the system. If the itype field specifies 0 (no interrupts used), this field should also specify 0.

Note that more than one device can share an interrupt vector number if the devices use the same itype interrupt, and that interrupt is of a type that can be shared. Note also that every instance of every module that shares an interrupt vector number must specify the same ipl values. If this field is not used it should contain the value 0.

**sioa**

The start I/O address field. Specifies the lowest I/O port address through which the device communicates. Valid values are a hexadecimal number from 0 through FFFF. For non-hardware modules or devices without I/O ports, this field should contain the value 0.

**eioa**

The end I/O address field. Specifies the highest (inclusive) I/O port address through which the device communicates. Valid values are a hexadecimal number from 1 through FFFF. Note that the value of the eioa field must be greater than or equal to the value of the sioa field. For non-hardware modules or devices without I/O ports, this field should contain the value 0.

**scma**

The start memory controller address field. Specifies the lowest address in memory through which the device communicates. Valid values are a hexadecimal number from 10000 through FFFFFFFF. For non-hardware drivers or devices without controller memory, this field should contain the value 0.

**ecma**

The end memory controller address field. Specifies the highest (inclusive) address in memory through which the device communicates. Valid values are a hexadecimal number from 10000 through FFFFFFFF. Note that the value of the ecma field must be greater than or equal to the value of the scma field. For non-hardware modules or devices without controller memory, this field should contain the value 0.

**dmachan**

For hardware modules that use DMA channels, this field specifies the DMA channel number. Valid values are a decimal number from 0 through 7. For non-hardware modules or devices that don’t use DMA, this field should contain the value -1.
NOTES

Specifying exec Modules

For exec object-specific modules used to support various executable file formats (modules with e characteristic flags set in their Master files, two System file fields have special meanings:

The unit field specifies the number of magic numbers supported by the module. Magic numbers are the first two bytes of an executable file, which are used to dispatch to the appropriate exec module. The module is responsible for defining an array of type short to hold the magic numbers. This array must be called xxxmagic, where xxx is the module's prefix, as defined in the Master(4) file. All of the execsw entries are processed in order, according to the order field of the Master file, calling the appropriate handlers if the magic number matches, until one returns 0 for success or an error other than ENOEXEC.

The itype field controls whether a wild card execsw entry should be generated for the module. If itype is non-zero, an additional entry will be generated for the module, following the entries for the explicit magic numbers. This additional entry will have a NULL magic number pointer. This tells the system to call the handler no matter what the magic number is.

Compatibility Considerations

For compatibility with existing add-on DSP packages, idinstall also accepts the old (version 0) sdevice file format, which it converts to version 1 format before installing the file in /etc/conf/sdevice.d. Since the version 1 System file format now includes the dmachan field that formerly appeared in the version 0 mdevice file, version 0 sdevice files and version 0 mdevice files must be installed together, using a single invocation of the idinstall command. This allows idinstall to move the dmachan field from the module's mdevice file to its System file during conversion.

Because cross-dependencies exist in the version 0 mdevice and sdevice files for exec modules, idinstall cannot convert these files to version 1 files. They must be converted manually before using idinstall.

Note that idinstall also accepts obsolete sfsys files and converts them to version 1 System file format.

SEE ALSO

idbuild(1M), idcheck(1M), idinstall(1M), Master(4)
NAME
tc.index – configuration index file for mass-storage devices

DESCRIPTION
The tc.index file provides the correlation between device-specific inquiry strings and the files used by pdimkdev, pdimkdtab, and disksetup to control their execution. If no matching inquiry string is found in tc.index, generic entries found at the end of the file are used.

The generic entries should be sufficient for most types of mass-storage devices. Before spending time to generate a device-specific entry for a new mass-storage device, you should try the existing generic entry. If the generic entry works, no device-specific entry is required.

File Format
tc.index is a plain-text file consisting of keywords/value pairs. Keywords start in column 1. The value of a keyword is the rest of the text line after the keyword and any white space. A keyword/value pair must be separated by white space, either spaces or tabs. By convention, the value is separated from the keyword by a single tab. The device-specific entries in this file must be first, before any generic entries.

Keywords
The following keywords are recognized in tc.index:

TCINQ Marks the beginning of a device-specific entry in the tc.index file. The remainder of this entry consists of the lines in the file after this keyword, up to the next TCINQ or GENERIC keyword.

The inquiry string for the device in question must be duplicated character-by-character as the value of this keyword. Embedded spaces, special characters and the case of letters are all significant. The first 8 characters of the inquiry string represent the vendor identification string. The next 16 characters represent the product name. Taken together, these 24 characters are considered the inquiry string.

MKDEV Used by pdimkdev and pdimkdtab, the name of the template file to use to create device nodes and device table entries for this device.

FORMAT Used by disksetup and diskformat, the name of the format specification file to use when preparing this device for use by the system.

GENERIC Marks the beginning of an entry that will be used for a given type of device if no device-specific entry is found. Generic entries are currently provided for random, sequential, CD-ROM and WORM devices. The keyword values for each of these device types are, respectively, RANDOM, TAPE, ROM, and WORM. This remainder of this entry consists of the lines in the file after this keyword up to the next GENERIC keyword or until the end-of-file.

# Used to imbed comments in the tc.index file.
REFERENCES
   diskadd(1M), disksetup(1M), pdimkdev(1M), pdimkdtab(1M)
NAME
term – format of compiled term file

SYNOPSIS
/usr/lib/share/terminfo

DESCRIPTION
Compiled terminfo(4) descriptions are placed under the directory
/usr/share/lib/terminfo. In order to avoid a linear search of a huge UNIX sys­

The format has been chosen so that it is the same on all hardware. An 8-bit byte is
assumed, but no assumptions about byte ordering or sign extension are made. Thus, these binary terminfo files can be transported to other hardware with 8-bit bytes.

Short integers are stored in two 8-bit bytes. The first byte contains the least significant 8 bits of the value, and the second byte contains the most significant 8 bits. (Thus, the value represented is 256*second+first.) The value -1 is represented by 0377,0377, and the value -2 is represented by 0376,0377; other negative values are invalid. The -1 generally means that a capability is missing from this terminal. The -2 means that the capability has been canceled in the terminfo source and also is to be considered missing.

The compiled file is created from the source file descriptions of the terminals (see the -I option of infocmp) by using the terminfo compiler, tic, and read by the routine setupterm [see curses(3curses).] The file is divided into six parts in the following order: the header, terminal names, boolean flags, numbers, strings, and string table.

The header section begins the file. This section contains six short integers in the for­
magic number (octal 0432); (2) the size, in bytes, of the names section; (3) the number of bytes in the boolean section; (4) the number of short integers in the numbers section; (5) the number of offsets (short integers) in the strings section; (6) the size, in bytes, of the string table.

The terminal names section comes next. It contains the first line of the terminfo description, listing the various names for the terminal, separated by the bar (|) character (see term(5)). The section is terminated with an ASCII NUL character.

The boolean flags have one byte for each flag. This byte is either 0 or 1 as the flag is present or absent. The value of 2 means that the flag has been canceled. The capa­
bilities are in the same order as the file <term.h>.

Between the boolean section and the number section, a null byte is inserted, if necessary, to ensure that the number section begins on an even byte offset. All short integers are aligned on a short word boundary.
The numbers section is similar to the boolean flags section. Each capability takes up two bytes, and is stored as a short integer. If the value represented is -1 or -2, the capability is taken to be missing.

The strings section is also similar. Each capability is stored as a short integer, in the format above. A value of -1 or -2 means the capability is missing. Otherwise, the value is taken as an offset from the beginning of the string table. Special characters in `^X` or `\c` notation are stored in their interpreted form, not the printing representation. Padding information (`$<nn>`), and parameter information (`%x`) are stored intact in uninterpreted form.

The final section is the string table. It contains all the values of string capabilities referenced in the string section. Each string is null terminated.

Note that it is possible for setupterm to expect a different set of capabilities than are actually present in the file. Either the database may have been updated since setupterm has been recompiled (resulting in extra unrecognized entries in the file) or the program may have been recompiled more recently than the database was updated (resulting in missing entries). The routine setupterm must be prepared for both possibilities—this is why the numbers and sizes are included. Also, new capabilities must always be added at the end of the lists of boolean, number, and string capabilities.

As an example, here is terminal information on the AT&T Model 37 KSR terminal as output by the `infocmp -I tty37` command:

```
37|tty37|AT&T model 37 teletype,
bk, os, xon,
bel=`G, cr=`r, cubl=`b, cudl=`n, cuul=`E7, hd=`E9,
hu=`E8, ind=`n,
```

And here is an octal dump of the term file, produced by the `od -c /usr/share/lib/terminfo/t/tty37` command:

```
000000 032 001 \0 032 \0 013 \0 021 001 3 \0 3 7 \t
0000020 t y 3 7 \AT&T model 1
0000040 3 7 \tea l e t y p e \0 \0 \0 \0 \0 \0 \0 \0
0000060 \0 \0 \0 \001 \0 \0 \0 \0 \0 \0 \0 \0 \0 \0
0000100 \001 \0 \0 \0 \0 \0 \0 377 377 377 377 377 377 377 377 377 377
0000140 \0 377 377 377 377 377 377 377 377 377 377 377 377 377 377 377 377 377 377 377
0000160 377 377 " \0 377 377 377 377 ( \0 377 377 377 377 377 377 377 377 377 377 377 377 377 377 377 377 377 377 377
0000200 377 377 0 \0 377 377 377 377 377 377 377 377 377 377 377 377 377 377 377 377
* 224
Some limitations: total compiled entries cannot exceed 4096 bytes; all entries in the name field cannot exceed 128 bytes.

SEE ALSO

    curses(3curses), info~(1M), term(5), terminfo(4)
terminfo (4)

NAME
terminfo – terminal capability data base

SYNOPSIS
/usr/share/lib/terminfo/*

DESCRIPTION

terminfo is a database produced by tic that describes the capabilities of devices such as terminals and printers. Devices are described in terminfo source files by specifying a set of capabilities, by quantifying certain aspects of the device, and by specifying character sequences that effect particular results. This database is often used by screen oriented applications such as vi and curses programs, as well as by some UNIX system commands such as ls and more. This usage allows them to work with a variety of devices without changes to the programs.

terminfo source files consist of one or more device descriptions. Each description consists of a header (beginning in column 1) and one or more lines that list the features for that particular device. Every line in a terminfo source file must end in a comma (,). Every line in a terminfo source file except the header must be indented with one or more white spaces (either spaces or tabs).

Entries in terminfo source files consist of a number of comma-separated fields. White space after each comma is ignored. Embedded commas must be escaped by using a backslash. The following example shows the format of a terminfo source file.

```
alias1 | alias2 | ... | alias_n | longname,
<white space> am, lines #24,
<white space> home=\Eeh,
```

The first line, commonly referred to as the header line, must begin in column one and must contain at least two aliases separated by vertical bars. The last field in the header line must be the long name of the device and it may contain any string. Alias names must be unique in the terminfo database and they must conform to UNIX system file naming conventions [see tic(1M)]; they cannot, for example, contain white space or slashes.

Every device must be assigned a name, such as "vt100". Device names (except the long name) should be chosen using the following conventions. The name should not contain hyphens because hyphens are reserved for use when adding suffixes that indicate special modes.

These special modes may be modes that the hardware can be in, or user preferences. To assign a special mode to a particular device, append a suffix consisting of a hyphen and an indicator of the mode to the device name. For example, the \w suffix means "wide mode"; when specified, it allows for a width of 132 columns instead of the standard 80 columns. Therefore, if you want to use a vt100 device set to wide mode, name the device "vt100-w." Use the following suffixes where possible.
The terminfo reference manual page is organized in two sections: "DEVICE CAPABILITIES" and "PRINTER CAPABILITIES."

PART 1: DEVICE CAPABILITIES
Capabilities in terminfo are of three types: Boolean capabilities (which show that a device has or does not have a particular feature), numeric capabilities (which quantify particular features of a device), and string capabilities (which provide sequences that can be used to perform particular operations on devices).

In the following table, a Variable is the name by which a C programmer accesses a capability (at the terminfo level). A Capname is the short name for a capability specified in the terminfo source file. It is used by a person updating the source file and by the tput command. A Termcap Code is a two-letter sequence that corresponds to the termcap capability name. (Note that termcap is no longer supported.)

Capability names have no real length limit, but an informal limit of five characters has been adopted to keep them short. Whenever possible, capability names are chosen to be the same as or similar to those specified by the ANSI X3.64-1979 standard. Semantics are also intended to match those of the ANSI standard.

All string capabilities listed below may have padding specified, with the exception of those used for input. Input capabilities, listed under the Strings section in the following tables, have names beginning with key_. The #i symbol in the description field of the following tables refers to the ith parameter.

### Booleans

<table>
<thead>
<tr>
<th>Variable</th>
<th>Cap-name</th>
<th>Termcap Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>auto_left_margin</td>
<td>bw</td>
<td>bw</td>
<td>cub1 wraps from column 0 to last column</td>
</tr>
<tr>
<td>auto_right_margin</td>
<td>am</td>
<td>am</td>
<td>Terminal has automatic margins</td>
</tr>
<tr>
<td>back_color_erase</td>
<td>bce</td>
<td>be</td>
<td>Screen erased with background color</td>
</tr>
<tr>
<td>can_change</td>
<td>ccc</td>
<td>cc</td>
<td>Terminal can re-define existing color</td>
</tr>
<tr>
<td>csel_standout_glitch</td>
<td>xhp</td>
<td>xs</td>
<td>Standout not erased by overwriting (hp)</td>
</tr>
<tr>
<td>col_addr_glitch</td>
<td>xhp a</td>
<td>YA</td>
<td>Only positive motion for hpa/mhpa caps</td>
</tr>
<tr>
<td>cpi_changes_res</td>
<td>cpi</td>
<td>YF</td>
<td>Changing character pitch changes resolution</td>
</tr>
<tr>
<td>cr_cancels_micro_mode</td>
<td>crxm</td>
<td>YB</td>
<td>Using cr turns off micro mode</td>
</tr>
</tbody>
</table>
### terinfo (4)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Cap-name</th>
<th>Termcap</th>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>eat_newline_glitch</td>
<td>xn1</td>
<td>xn</td>
<td></td>
<td>Newline ignored after 80 columns (Concept)</td>
</tr>
<tr>
<td>erase_overstrike</td>
<td>eo</td>
<td>eo</td>
<td></td>
<td>Can erase overstrikes with a blank</td>
</tr>
<tr>
<td>generic_type</td>
<td>gn</td>
<td>gn</td>
<td></td>
<td>Generic line type (e.g., dialup, switch)</td>
</tr>
<tr>
<td>hard_copy</td>
<td>hc</td>
<td>hc</td>
<td></td>
<td>Hardcopy terminal</td>
</tr>
<tr>
<td>hard_cursor</td>
<td>chts</td>
<td>HC</td>
<td></td>
<td>Cursor is hard to see</td>
</tr>
<tr>
<td>has_meta_key</td>
<td>km</td>
<td>km</td>
<td></td>
<td>Has a meta key (shift, sets parity bit)</td>
</tr>
<tr>
<td>has_print_wheel</td>
<td>daisy</td>
<td>YC</td>
<td></td>
<td>Printer needs operator to change character set</td>
</tr>
<tr>
<td>has_status_line</td>
<td>hs</td>
<td>hs</td>
<td></td>
<td>Has extra &quot;status line&quot;</td>
</tr>
<tr>
<td>hue_lightness_saturation</td>
<td>hls</td>
<td>hI</td>
<td></td>
<td>Terminal uses only HLS color notation (Tektronix)</td>
</tr>
<tr>
<td>insert_null_glitch</td>
<td>in</td>
<td>in</td>
<td></td>
<td>Insert mode distinguishes nulls</td>
</tr>
<tr>
<td>lpi_changes_res</td>
<td>lpix</td>
<td>YG</td>
<td></td>
<td>Changing line pitch changes resolution</td>
</tr>
<tr>
<td>memory_above</td>
<td>da</td>
<td>da</td>
<td></td>
<td>Display may be retained above the screen</td>
</tr>
<tr>
<td>memory_below</td>
<td>db</td>
<td>db</td>
<td></td>
<td>Display may be retained below the screen</td>
</tr>
<tr>
<td>move_insert_mode</td>
<td>mir</td>
<td>mi</td>
<td></td>
<td>Safe to move while in insert mode</td>
</tr>
<tr>
<td>move_standout_mode</td>
<td>msgr</td>
<td>ms</td>
<td></td>
<td>Safe to move in standout modes</td>
</tr>
<tr>
<td>needs_xon_xoff</td>
<td>nxon</td>
<td>nx</td>
<td></td>
<td>Padding won’t work, xon/xoff required</td>
</tr>
<tr>
<td>no_esc_ctlc</td>
<td>xab</td>
<td>xb</td>
<td></td>
<td>Beehive (f1=escape, f2=ctrl C)</td>
</tr>
<tr>
<td>non_rev_rmcup</td>
<td>nrmc</td>
<td>NR</td>
<td></td>
<td>smcup does not reverse rmcup</td>
</tr>
<tr>
<td>no_pad_char</td>
<td>ncp</td>
<td>NP</td>
<td></td>
<td>Pad character doesn’t exist</td>
</tr>
<tr>
<td>over_strike</td>
<td>os</td>
<td>os</td>
<td></td>
<td>Terminal overstrikes on hard-copy terminal</td>
</tr>
<tr>
<td>prtr_silent</td>
<td>mc5i</td>
<td>5i</td>
<td></td>
<td>Printer won’t echo on screen</td>
</tr>
<tr>
<td>row_addr</td>
<td>xvpa</td>
<td>YD</td>
<td></td>
<td>Only positive motion for vpa/mvpa caps</td>
</tr>
<tr>
<td>semi_auto_right_margin</td>
<td>sem</td>
<td>YE</td>
<td></td>
<td>Printing in last column causes cr</td>
</tr>
<tr>
<td>status_line_esc_ok</td>
<td>eslok</td>
<td>es</td>
<td></td>
<td>Escape can be used on the status line</td>
</tr>
<tr>
<td>dest_tabs_magic_smao</td>
<td>xt</td>
<td>xt</td>
<td></td>
<td>Destructive tabs, magic smao char (11061)</td>
</tr>
<tr>
<td>tilde_glitch</td>
<td>hz</td>
<td>hz</td>
<td></td>
<td>Hazeltine; can’t print tilde (’)</td>
</tr>
<tr>
<td>transparent_underline</td>
<td>ul</td>
<td>ul</td>
<td></td>
<td>Underline character overstrikes</td>
</tr>
<tr>
<td>xon_xoff</td>
<td>xon</td>
<td>xo</td>
<td></td>
<td>Terminal uses xon/xoff handshaking</td>
</tr>
</tbody>
</table>

### Numbers

<table>
<thead>
<tr>
<th>Variable</th>
<th>Cap-name</th>
<th>Termcap</th>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>buffer_capacity</td>
<td>bufsz</td>
<td>ya</td>
<td></td>
<td>Number of bytes buffered before printing</td>
</tr>
<tr>
<td>buttons</td>
<td>bts</td>
<td>BT</td>
<td></td>
<td>Number of buttons on the mouse</td>
</tr>
<tr>
<td>columns</td>
<td>cols</td>
<td>co</td>
<td></td>
<td>Number of columns in a line</td>
</tr>
<tr>
<td>dot_vert_spacing</td>
<td>spinv</td>
<td>Yb</td>
<td></td>
<td>Spacing of pins vertically in pins per inch</td>
</tr>
<tr>
<td>dot_horz_spacing</td>
<td>spinh</td>
<td>Yc</td>
<td></td>
<td>Spacing of dots horizontally in dots per inch</td>
</tr>
<tr>
<td>init_tabs</td>
<td>it</td>
<td>it</td>
<td></td>
<td>Tabs initially every # spaces</td>
</tr>
<tr>
<td>label_height</td>
<td>lh</td>
<td>lh</td>
<td></td>
<td>Number of rows in each label</td>
</tr>
<tr>
<td>label_width</td>
<td>lw</td>
<td>lw</td>
<td></td>
<td>Number of columns in each label</td>
</tr>
</tbody>
</table>

228
### Variable

<table>
<thead>
<tr>
<th>Variable</th>
<th>Cap-name</th>
<th>Termcap Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>lines</td>
<td>lines</td>
<td>li</td>
<td>Number of lines on a screen or a page</td>
</tr>
<tr>
<td>lines_of_memory</td>
<td>lm</td>
<td>lm</td>
<td>Lines of memory if &gt; lines; 0 means varies</td>
</tr>
<tr>
<td>magic_cookie_glitch</td>
<td>xmc</td>
<td>sg</td>
<td>Number of blank characters left by smso or rmso</td>
</tr>
<tr>
<td>max_colors</td>
<td>colors</td>
<td>Co</td>
<td>Maximum number of colors on the screen</td>
</tr>
<tr>
<td>max_micro_address</td>
<td>maddr</td>
<td>Yd</td>
<td>Maximum value in micro...address</td>
</tr>
<tr>
<td>max_micro_jump</td>
<td>mjump</td>
<td>Ye</td>
<td>Maximum value in parm...micro</td>
</tr>
<tr>
<td>max_pairs</td>
<td>pairs</td>
<td>pa</td>
<td>Maximum number of color-pairs on the screen</td>
</tr>
<tr>
<td>micro_col_size</td>
<td>mcs</td>
<td>Yf</td>
<td>Character step size when in micro mode</td>
</tr>
<tr>
<td>micro_line_size</td>
<td>mls</td>
<td>Yg</td>
<td>Line step size when in micro mode</td>
</tr>
<tr>
<td>no_color_video</td>
<td>ncv</td>
<td>NC</td>
<td>Video attributes that can’t be used with colors</td>
</tr>
<tr>
<td>number_of_pins</td>
<td>npins</td>
<td>Yh</td>
<td>Number of pins in print-head</td>
</tr>
<tr>
<td>num_labels</td>
<td>nlab</td>
<td>Nl</td>
<td>Number of labels on screen (start at 1)</td>
</tr>
<tr>
<td>output_res_char</td>
<td>orc</td>
<td>Yi</td>
<td>Horizontal resolution in units per character</td>
</tr>
<tr>
<td>output_res_line</td>
<td>orl</td>
<td>Yj</td>
<td>Vertical resolution in units per line</td>
</tr>
<tr>
<td>output_res_horz_inch</td>
<td>orhi</td>
<td>Yk</td>
<td>Horizontal resolution in units per inch</td>
</tr>
<tr>
<td>output_res_vert_inch</td>
<td>orvi</td>
<td>Yl</td>
<td>Vertical resolution in units per inch</td>
</tr>
<tr>
<td>padding_baud_rate</td>
<td>pb</td>
<td>pb</td>
<td>Lowest baud rate where padding needed</td>
</tr>
<tr>
<td>virtual_terminal</td>
<td>vt</td>
<td>vt</td>
<td>Virtual terminal number (UNIX system)</td>
</tr>
<tr>
<td>wide_char_size</td>
<td>widcs</td>
<td>Yn</td>
<td>Character step size when in double wide mode</td>
</tr>
<tr>
<td>width_status_line</td>
<td>wsl</td>
<td>ws</td>
<td>Number of columns in status line</td>
</tr>
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</table>

### Strings

<table>
<thead>
<tr>
<th>Variable</th>
<th>Cap-name</th>
<th>Termcap Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>acs_chars</td>
<td>acsc</td>
<td>ac</td>
<td>Graphic charset pairs aAbBcC</td>
</tr>
<tr>
<td>alt_scancode_esc</td>
<td>scesca</td>
<td>S8</td>
<td>Alternate escape for scancode emulation (default is for vt100)</td>
</tr>
<tr>
<td>back_tab</td>
<td>cbt</td>
<td>bt</td>
<td>Back tab</td>
</tr>
<tr>
<td>bell</td>
<td>bel</td>
<td>bl</td>
<td>Audible signal (bell)</td>
</tr>
<tr>
<td>bit_image_repeat</td>
<td>birep</td>
<td>Zy</td>
<td>Repeat bit-image cell #1 #2 times (use tparm)</td>
</tr>
<tr>
<td>bit_image_newline</td>
<td>binel</td>
<td>Zs</td>
<td>Move to next row of the bit image (use tparm)</td>
</tr>
<tr>
<td>bit_image_carriage_return</td>
<td>birc</td>
<td>Yr</td>
<td>Move to beginning of same row (use tparm)</td>
</tr>
<tr>
<td>carriage_return</td>
<td>cr</td>
<td>cr</td>
<td>Carriage return</td>
</tr>
<tr>
<td>change_char_pitch</td>
<td>cpl</td>
<td>ZA</td>
<td>Change number of characters per inch</td>
</tr>
<tr>
<td>change_line_pitch</td>
<td>lpi</td>
<td>ZB</td>
<td>Change number of lines per inch</td>
</tr>
<tr>
<td>change_res_horz</td>
<td>chr</td>
<td>ZC</td>
<td>Change horizontal resolution</td>
</tr>
<tr>
<td>change_res_vert</td>
<td>cvr</td>
<td>ZD</td>
<td>Change vertical resolution</td>
</tr>
<tr>
<td>change_scroll_region</td>
<td>csr</td>
<td>cs</td>
<td>Change to lines #1 through #2 (vt100)</td>
</tr>
<tr>
<td>char_padding</td>
<td>rmp</td>
<td>rP</td>
<td>Like ip but when in replace mode</td>
</tr>
<tr>
<td>char_set_names</td>
<td>csnm</td>
<td>ZY</td>
<td>List of character set names</td>
</tr>
<tr>
<td>Variable</td>
<td>Cap-name</td>
<td>Termcap Code</td>
<td>Description</td>
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<tr>
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<td>----------</td>
<td>--------------</td>
<td>-------------------------------------------------</td>
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<td>clear_all_tabs</td>
<td>tbc</td>
<td>ct</td>
<td>Clear all tab stops</td>
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<tr>
<td>clearMargins</td>
<td>mgc</td>
<td>MC</td>
<td>Clear all margins (top, bottom, and sides)</td>
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<tr>
<td>clear_screen</td>
<td>clear</td>
<td>cl</td>
<td>Clear screen and home cursor</td>
</tr>
<tr>
<td>clr_bol</td>
<td>el</td>
<td>cb</td>
<td>Clear to beginning of line, inclusive</td>
</tr>
<tr>
<td>clr_eol</td>
<td>el</td>
<td>ce</td>
<td>Clear to end of line</td>
</tr>
<tr>
<td>clr_eos</td>
<td>ed</td>
<td>cd</td>
<td>Clear to end of display</td>
</tr>
<tr>
<td>code_set_init</td>
<td>csin</td>
<td>ci</td>
<td>Init sequence for multiple codesets</td>
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<tr>
<td>color_names</td>
<td>colornm</td>
<td>Yw</td>
<td>Give name for color #1</td>
</tr>
<tr>
<td>column_address</td>
<td>hpa</td>
<td>ch</td>
<td>Horizontal position absolute</td>
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<tr>
<td>command_character</td>
<td>cmdch</td>
<td>CC</td>
<td>Terminal settable cmd character in prototype</td>
</tr>
<tr>
<td>cursor_address</td>
<td>cup</td>
<td>cm</td>
<td>Move to row #1 col #2</td>
</tr>
<tr>
<td>cursor_down</td>
<td>cud1</td>
<td>do</td>
<td>Down one line</td>
</tr>
<tr>
<td>cursor_home</td>
<td>home</td>
<td>ho</td>
<td>Home cursor (if no cup)</td>
</tr>
<tr>
<td>cursor_invisible</td>
<td>civis</td>
<td>vi</td>
<td>Make cursor invisible</td>
</tr>
<tr>
<td>cursor_left</td>
<td>cub1</td>
<td>le</td>
<td>Move left one space.</td>
</tr>
<tr>
<td>cursor_mem_address</td>
<td>mrcup</td>
<td>CM</td>
<td>Memory relative cursor addressing</td>
</tr>
<tr>
<td>cursor_normal</td>
<td>cnorm</td>
<td>vs</td>
<td>Make cursor appear normal (undo vs/vi)</td>
</tr>
<tr>
<td>cursor_right</td>
<td>cufl1</td>
<td>ni</td>
<td>Non-destructive space (cursor or carriage right)</td>
</tr>
<tr>
<td>cursor_to_ll</td>
<td>ll</td>
<td>ll</td>
<td>Last line, first column (if no cup)</td>
</tr>
<tr>
<td>cursor_up</td>
<td>cuul</td>
<td>up</td>
<td>Upline (cursor up)</td>
</tr>
<tr>
<td>cursor_visible</td>
<td>cvvis</td>
<td>vs</td>
<td>Make cursor very visible</td>
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<tr>
<td>define_bit_image_region</td>
<td>defbi</td>
<td>Yx</td>
<td>Define rectangular bit-image region (use tparm)</td>
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<tr>
<td>define_char</td>
<td>defc</td>
<td>ZE</td>
<td>Define a character in a character set †</td>
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<tr>
<td>delete_character</td>
<td>dch1</td>
<td>dc</td>
<td>Delete character</td>
</tr>
<tr>
<td>delete_line</td>
<td>d1</td>
<td>dl</td>
<td>Delete line</td>
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<tr>
<td>device_type</td>
<td>devt</td>
<td>dv</td>
<td>Indicate language/codeset support</td>
</tr>
<tr>
<td>disable_status_line</td>
<td>ds1</td>
<td>ds</td>
<td>Disable status line</td>
</tr>
<tr>
<td>display_pc_char</td>
<td>dispch</td>
<td>SI</td>
<td>Display PC character</td>
</tr>
<tr>
<td>down_half_line</td>
<td>hd</td>
<td>hd</td>
<td>Half-line down (forward 1/2 linefeed)</td>
</tr>
<tr>
<td>end_bit_image_region</td>
<td>endbi</td>
<td>Yy</td>
<td>End a bit-image region (use tparm)</td>
</tr>
<tr>
<td>enter_alt_charset_mode</td>
<td>smacs</td>
<td>AS</td>
<td>Start alternate character set</td>
</tr>
<tr>
<td>enter_am_mode</td>
<td>smam</td>
<td>SA</td>
<td>Turn on automatic margins</td>
</tr>
<tr>
<td>enter_blink_mode</td>
<td>blink</td>
<td>mb</td>
<td>Turn on blinking</td>
</tr>
<tr>
<td>enter_bold_mode</td>
<td>bold</td>
<td>md</td>
<td>Turn on bold (extra bright) mode</td>
</tr>
<tr>
<td>enter_ca_mode</td>
<td>smcup</td>
<td>ti</td>
<td>String to begin programs that use cup</td>
</tr>
<tr>
<td>enter_delete_mode</td>
<td>smdc</td>
<td>dm</td>
<td>Delete mode (enter)</td>
</tr>
<tr>
<td>enter_dim_mode</td>
<td>dim</td>
<td>mh</td>
<td>Turn on half-bright mode</td>
</tr>
<tr>
<td>enter_doublewide_mode</td>
<td>swidm</td>
<td>ZF</td>
<td>Enable double wide printing</td>
</tr>
<tr>
<td>enter_draft_quality</td>
<td>sdrfq</td>
<td>ZG</td>
<td>Set draft quality print</td>
</tr>
</tbody>
</table>
## terminfo (4)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Cap-name</th>
<th>Termcap Code</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>enter_insert_mode</td>
<td>smir</td>
<td>im</td>
<td>Insert mode (enter)</td>
</tr>
<tr>
<td>enter_italics_mode</td>
<td>sitm</td>
<td>2h</td>
<td>Enable italics</td>
</tr>
<tr>
<td>enter_leftward_mode</td>
<td>slm</td>
<td>2i</td>
<td>Enable leftward carriage motion</td>
</tr>
<tr>
<td>enter_micro_mode</td>
<td>smicm</td>
<td>2j</td>
<td>Enable micro motion capabilities</td>
</tr>
<tr>
<td>enter_near_letter_quality</td>
<td>snlq</td>
<td>2k</td>
<td>Set near-letter quality print</td>
</tr>
<tr>
<td>enter_normal_quality</td>
<td>snrmq</td>
<td>2l</td>
<td>Set normal quality print</td>
</tr>
<tr>
<td>enter_pc_charset_mode</td>
<td>smpch</td>
<td>S2</td>
<td>Enter PC character display mode</td>
</tr>
<tr>
<td>enter_protected_mode</td>
<td>prot</td>
<td>mp</td>
<td>Turn on protected mode</td>
</tr>
<tr>
<td>enter_reverse_mode</td>
<td>rev</td>
<td>mR</td>
<td>Turn on reverse video mode</td>
</tr>
<tr>
<td>enter_scancode_mode</td>
<td>smsc</td>
<td>S4</td>
<td>Enter PC scancode mode</td>
</tr>
<tr>
<td>enter_secure_mode</td>
<td>invs</td>
<td>mk</td>
<td>Turn on blank mode (characters invisible)</td>
</tr>
<tr>
<td>enter_shadow_mode</td>
<td>ssbm</td>
<td>2M</td>
<td>Enable shadow printing</td>
</tr>
<tr>
<td>enter_standout_mode</td>
<td>ssao</td>
<td>so</td>
<td>Begin standout mode</td>
</tr>
<tr>
<td>enter_subscript_mode</td>
<td>ssbhm</td>
<td>2n</td>
<td>Enable subscript printing</td>
</tr>
<tr>
<td>enter_superscript_mode</td>
<td>ssbpm</td>
<td>ZO</td>
<td>Enable superscript printing</td>
</tr>
<tr>
<td>enter_underline_mode</td>
<td>ssml</td>
<td>us</td>
<td>Start underscore mode</td>
</tr>
<tr>
<td>enter_upward_mode</td>
<td>sum</td>
<td>ZP</td>
<td>Enable upward carriage motion</td>
</tr>
<tr>
<td>erase_chars</td>
<td>ech</td>
<td>ec</td>
<td>Erase #1 characters</td>
</tr>
<tr>
<td>exit_alt_charset_mode</td>
<td>rmacs</td>
<td>ae</td>
<td>End alternate character set</td>
</tr>
<tr>
<td>exit_am_mode</td>
<td>rmm</td>
<td>RA</td>
<td>Turn off automatic margins</td>
</tr>
<tr>
<td>exit_attribute_mode</td>
<td>sgr0</td>
<td>me</td>
<td>Turn off all attributes</td>
</tr>
<tr>
<td>exit_ca_mode</td>
<td>rmcup</td>
<td>te</td>
<td>String to end programs that use cup</td>
</tr>
<tr>
<td>exit_delete_mode</td>
<td>rmde</td>
<td>ed</td>
<td>End delete mode</td>
</tr>
<tr>
<td>exit_doublewide_mode</td>
<td>rwidm</td>
<td>ZQ</td>
<td>Disable double wide printing</td>
</tr>
<tr>
<td>exit_insert_mode</td>
<td>rmir</td>
<td>ei</td>
<td>End insert mode</td>
</tr>
<tr>
<td>exit_italics_mode</td>
<td>ritm</td>
<td>ZR</td>
<td>Disable italics</td>
</tr>
<tr>
<td>exit_leftward_mode</td>
<td>rlm</td>
<td>ZS</td>
<td>Enable rightward (normal) carriage motion</td>
</tr>
<tr>
<td>exit_micro_mode</td>
<td>rmicm</td>
<td>ZT</td>
<td>Disable micro motion capabilities</td>
</tr>
<tr>
<td>exit_pc_charset_mode</td>
<td>rmpch</td>
<td>S3</td>
<td>Disable PC character display mode</td>
</tr>
<tr>
<td>exit_scancode_mode</td>
<td>rmsc</td>
<td>S5</td>
<td>Disable PC scancode mode</td>
</tr>
<tr>
<td>exit_shadow_mode</td>
<td>rshm</td>
<td>ZU</td>
<td>Disable shadow printing</td>
</tr>
<tr>
<td>exit_standout_mode</td>
<td>rsmo</td>
<td>se</td>
<td>End standout mode</td>
</tr>
<tr>
<td>exit_subscript_mode</td>
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<td>ZV</td>
<td>Disable subscript printing</td>
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<tr>
<td>exit_superscript_mode</td>
<td>rsubm</td>
<td>Zw</td>
<td>Disable superscript printing</td>
</tr>
<tr>
<td>exit_underline_mode</td>
<td>rmu1</td>
<td>ue</td>
<td>End underscore mode</td>
</tr>
<tr>
<td>exit_upward_mode</td>
<td>rum</td>
<td>ZX</td>
<td>Enable downward (normal) carriage motion</td>
</tr>
<tr>
<td>exit_xon_mode</td>
<td>rmxon</td>
<td>RX</td>
<td>Turn off xon/xoff handshaking</td>
</tr>
<tr>
<td>flash_screen</td>
<td>flash</td>
<td>vb</td>
<td>Visible bell (may not move cursor)</td>
</tr>
<tr>
<td>form_feed</td>
<td>ff</td>
<td>ff</td>
<td>Hardcopy terminal page eject</td>
</tr>
<tr>
<td>from_status_line</td>
<td>fsl</td>
<td>fs</td>
<td>Return from status line</td>
</tr>
<tr>
<td>get_mouse</td>
<td>getm</td>
<td>Gm</td>
<td>Curses should get button events</td>
</tr>
</tbody>
</table>
The "key_" strings are sent by specific keys. The "key_" descriptions include the macro, defined in curses.h, for the code returned by the curses routine getch when the key is pressed [see curses_getch(3curses)].
<table>
<thead>
<tr>
<th>Variable</th>
<th>Cap-name</th>
<th>Termcap Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>key_exit</td>
<td>kext</td>
<td>09</td>
<td>KEY_EXIT, sent by exit key</td>
</tr>
<tr>
<td>key_f0</td>
<td>kf0</td>
<td>k0</td>
<td>KEY_F(0), sent by function key f0</td>
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<td>key_f1</td>
<td>kf1</td>
<td>k1</td>
<td>KEY_F(1), sent by function key f1</td>
</tr>
<tr>
<td>key_f2</td>
<td>kf2</td>
<td>k2</td>
<td>KEY_F(2), sent by function key f2</td>
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<tr>
<td>key_f3</td>
<td>kf3</td>
<td>k3</td>
<td>KEY_F(3), sent by function key f3</td>
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<tr>
<td>key_f4</td>
<td>kf4</td>
<td>k4</td>
<td>KEY_F(4), sent by function key f4</td>
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<td>KEY_F(7), sent by function key f7</td>
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<td>k8</td>
<td>KEY_F(8), sent by function key f8</td>
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<td>KEY_F(9), sent by function key f9</td>
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<td>k1</td>
<td>KEY_F(10), sent by function key f10</td>
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<td>f1</td>
<td>KEY_F(11), sent by function key f11</td>
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<td>kf12</td>
<td>f2</td>
<td>KEY_F(12), sent by function key f12</td>
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<td>key_f13</td>
<td>kf13</td>
<td>f3</td>
<td>KEY_F(13), sent by function key f13</td>
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<td>f4</td>
<td>KEY_F(14), sent by function key f14</td>
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<td>KEY_F(15), sent by function key f15</td>
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<td>f6</td>
<td>KEY_F(16), sent by function key f16</td>
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<td>KEY_F(17), sent by function key f17</td>
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<td>KEY_F(18), sent by function key f18</td>
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<td>kf19</td>
<td>f9</td>
<td>KEY_F(19), sent by function key f19</td>
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<td>kf20</td>
<td>fA</td>
<td>KEY_F(20), sent by function key f20</td>
</tr>
<tr>
<td>key_f21</td>
<td>kf21</td>
<td>fB</td>
<td>KEY_F(21), sent by function key f21</td>
</tr>
<tr>
<td>key_f22</td>
<td>kf22</td>
<td>fC</td>
<td>KEY_F(22), sent by function key f22</td>
</tr>
<tr>
<td>key_f23</td>
<td>kf23</td>
<td>fD</td>
<td>KEY_F(23), sent by function key f23</td>
</tr>
<tr>
<td>key_f24</td>
<td>kf24</td>
<td>fE</td>
<td>KEY_F(24), sent by function key f24</td>
</tr>
<tr>
<td>key_f25</td>
<td>kf25</td>
<td>fF</td>
<td>KEY_F(25), sent by function key f25</td>
</tr>
<tr>
<td>key_f26</td>
<td>kf26</td>
<td>fG</td>
<td>KEY_F(26), sent by function key f26</td>
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<td>key_f27</td>
<td>kf27</td>
<td>fH</td>
<td>KEY_F(27), sent by function key f27</td>
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<td>key_f28</td>
<td>kf28</td>
<td>fI</td>
<td>KEY_F(28), sent by function key f28</td>
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<td>kf29</td>
<td>fJ</td>
<td>KEY_F(29), sent by function key f29</td>
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<td>key_f30</td>
<td>kf30</td>
<td>fK</td>
<td>KEY_F(30), sent by function key f30</td>
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<tr>
<td>key_f31</td>
<td>kf31</td>
<td>fL</td>
<td>KEY_F(31), sent by function key f31</td>
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<td>key_f32</td>
<td>kf32</td>
<td>fM</td>
<td>KEY_F(32), sent by function key f32</td>
</tr>
<tr>
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<td>kf33</td>
<td>fN</td>
<td>KEY_F(33), sent by function key f33</td>
</tr>
<tr>
<td>key_f34</td>
<td>kf34</td>
<td>fO</td>
<td>KEY_F(34), sent by function key f34</td>
</tr>
<tr>
<td>key_f35</td>
<td>kf35</td>
<td>fP</td>
<td>KEY_F(35), sent by function key f35</td>
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<td>key_f36</td>
<td>kf36</td>
<td>fQ</td>
<td>KEY_F(36), sent by function key f36</td>
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<td>kf37</td>
<td>fR</td>
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<td>key_f38</td>
<td>kf38</td>
<td>fS</td>
<td>KEY_F(38), sent by function key f38</td>
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<tr>
<td>key_f39</td>
<td>kf39</td>
<td>fT</td>
<td>KEY_F(39), sent by function key f39</td>
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<tr>
<td>key_f40</td>
<td>kf40</td>
<td>fU</td>
<td>KEY_F(40), sent by function key f40</td>
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<td>key_f41</td>
<td>kf41</td>
<td>fV</td>
<td>KEY_F(41), sent by function key f41</td>
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<td>key_f42</td>
<td>kf42</td>
<td>fW</td>
<td>KEY_F(42), sent by function key f42</td>
</tr>
<tr>
<td>key_f43</td>
<td>kf43</td>
<td>fX</td>
<td>KEY_F(43), sent by function key f43</td>
</tr>
</tbody>
</table>
### Variable | Cap-name | Termcap | Description
--- | --- | --- | ---
key_f44 | kf44 | FY | $\text{KEY}\_F(44)$, sent by function key f44
key_f45 | kf45 | FZ | $\text{KEY}\_F(45)$, sent by function key f45
key_f46 | kf46 | Fa | $\text{KEY}\_F(46)$, sent by function key f46
key_f47 | kf47 | Fb | $\text{KEY}\_F(47)$, sent by function key f47
key_f48 | kf48 | Fc | $\text{KEY}\_F(48)$, sent by function key f48
key_f49 | kf49 |Fd | $\text{KEY}\_F(49)$, sent by function key f49
key_f50 | kf50 | Fe | $\text{KEY}\_F(50)$, sent by function key f50
key_f51 | kf51 | Ff | $\text{KEY}\_F(51)$, sent by function key f51
key_f52 | kf52 | Fg | $\text{KEY}\_F(52)$, sent by function key f52
key_f53 | kf53 | Fh | $\text{KEY}\_F(53)$, sent by function key f53
key_f54 | kf54 | Fl | $\text{KEY}\_F(54)$, sent by function key f54
key_f55 | kf55 | Fj | $\text{KEY}\_F(55)$, sent by function key f55
key_f56 | kf56 | Fk | $\text{KEY}\_F(56)$, sent by function key f56
key_f57 | kf57 | Fl | $\text{KEY}\_F(57)$, sent by function key f57
key_f58 | kf58 | Fm | $\text{KEY}\_F(58)$, sent by function key f58
key_f59 | kf59 | Fn | $\text{KEY}\_F(59)$, sent by function key f59
key_f60 | kf60 | Fo | $\text{KEY}\_F(60)$, sent by function key f60
key_f61 | kf61 | Pp | $\text{KEY}\_F(61)$, sent by function key f61
key_f62 | kf62 | Fq | $\text{KEY}\_F(62)$, sent by function key f62
key_f63 | kf63 | Fr | $\text{KEY}\_F(63)$, sent by function key f63
key_find | kfnd | @O | $\text{KEY\_FIND}$, sent by find key
key_help | khlp | %1 | $\text{KEY\_HELP}$, sent by help key
key_home | khome | kh | $\text{KEY\_HOME}$, sent by home key
key_ic | kich1 | kI | $\text{KEY\_IC}$, sent by ins-char/enter ins-mode key
key_left | kleft | kl | $\text{KEY\_LEFT}$, sent by terminal left-arrow key
key_message | kmsg | %3 | $\text{KEY\_MESSAGE}$, sent by message key
key_mouse | kmous | Rm | Mouse event has occurred
key_move | kmov | %4 | $\text{KEY\_MOVE}$, sent by move key
key_next | knxt | %5 | $\text{KEY\_NEXT}$, sent by next-object key
key_npage | knp | kN | $\text{KEY\_NPAGE}$, sent by next-page key
key_open | kopn | k6 | $\text{KEY\_OPEN}$, sent by open key
key_options | kopt | %7 | $\text{KEY\_OPTIONS}$, sent by options key
key_page | kpp | kP | $\text{KEY\_PAGE}$, sent by previous-page key
key_previous | kprv | %8 | $\text{KEY\_PREVIOUS}$, sent by previous-object key
key_print | kprt | %9 | $\text{KEY\_PRINT}$, sent by print or copy key
key_redo | kredo | %0 | $\text{KEY\_REDO}$, sent by redo key
key_replace | krpl | %3 | $\text{KEY\_REPLACE}$, sent by replace key

<table>
<thead>
<tr>
<th>Variable</th>
<th>Cap-name</th>
<th>Termcap Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>key_restart</td>
<td>krst</td>
<td>&amp;4</td>
<td>KEY_RESTART, sent by restart key</td>
</tr>
<tr>
<td>key_resume</td>
<td>kres</td>
<td>&amp;5</td>
<td>KEY_RESUME, sent by resume key</td>
</tr>
<tr>
<td>key_right</td>
<td>kcufl</td>
<td>kr</td>
<td>KEY_RIGHT, sent by terminal right-arrow key</td>
</tr>
<tr>
<td>key_save</td>
<td>ksav</td>
<td>&amp;6</td>
<td>KEY_SAVE, sent by save key</td>
</tr>
<tr>
<td>key_abeg</td>
<td>kBEGIN</td>
<td>&amp;9</td>
<td>KEY_ABEG, sent by shifted beginning key</td>
</tr>
<tr>
<td>key_scancel</td>
<td>kCANCEL</td>
<td>&amp;0</td>
<td>KEY_SCANCEL, sent by shifted cancel key</td>
</tr>
<tr>
<td>key_scommand</td>
<td>kCMD</td>
<td>*1</td>
<td>KEY_SCOMMAND, sent by shifted command key</td>
</tr>
<tr>
<td>key_scopy</td>
<td>kCPY</td>
<td>*2</td>
<td>KEY_SCPY, sent by shifted copy key</td>
</tr>
<tr>
<td>key_screate</td>
<td>kCRT</td>
<td>*3</td>
<td>KEY_SCREATE, sent by shifted create key</td>
</tr>
<tr>
<td>key_sdc</td>
<td>kDC</td>
<td>*4</td>
<td>KEY_SDC, sent by shifted delete-char key</td>
</tr>
<tr>
<td>key_sdl</td>
<td>kDL</td>
<td>*5</td>
<td>KEY_SDL, sent by shifted delete-line key</td>
</tr>
<tr>
<td>key_select</td>
<td>kSELECT</td>
<td>*6</td>
<td>KEY_SELECT, sent by select key</td>
</tr>
<tr>
<td>key_send</td>
<td>kSEND</td>
<td>*7</td>
<td>KEY_SEND, sent by shifted end key</td>
</tr>
<tr>
<td>key_seol</td>
<td>kSOL</td>
<td>*8</td>
<td>KEY_SEOL, sent by shifted clear-line key</td>
</tr>
<tr>
<td>key_sexit</td>
<td>kEXIT</td>
<td>*9</td>
<td>KEY_SEXIT, sent by shifted exit key</td>
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<tr>
<td>key_sf</td>
<td>kSF</td>
<td></td>
<td>KEY_SF, sent by scroll-forward/down key</td>
</tr>
<tr>
<td>key_sfind</td>
<td>kFIND</td>
<td>*0</td>
<td>KEY_SFIN, sent by shifted find key</td>
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<tr>
<td>key_shelp</td>
<td>kHELP</td>
<td>#1</td>
<td>KEY_SHHELP, sent by shifted help key</td>
</tr>
<tr>
<td>key_shome</td>
<td>kHOME</td>
<td>#2</td>
<td>KEY_SHOME, sent by shifted home key</td>
</tr>
<tr>
<td>key_sic</td>
<td>kIC</td>
<td>#3</td>
<td>KEY_SIC, sent by shifted input key</td>
</tr>
<tr>
<td>key_sleft</td>
<td>kLEFT</td>
<td>#4</td>
<td>KEY_SLEFT, sent by shifted left-arrow key</td>
</tr>
<tr>
<td>key_smessage</td>
<td>kMESSAGE</td>
<td>%a</td>
<td>KEY_SMMESSAGE, sent by shifted message key</td>
</tr>
<tr>
<td>key_smove</td>
<td>kMOVE</td>
<td>%b</td>
<td>KEY_SMOVE, sent by shifted move key</td>
</tr>
<tr>
<td>key_snext</td>
<td>kNEXT</td>
<td>%c</td>
<td>KEY_SNEXT, sent by shifted next key</td>
</tr>
<tr>
<td>key_soptions</td>
<td>kOPT</td>
<td>%d</td>
<td>KEY_SOPTIONS, sent by shifted options key</td>
</tr>
<tr>
<td>key_spprevious</td>
<td>kPREV</td>
<td>%e</td>
<td>KEY_SPREVIOUS, sent by shifted prev key</td>
</tr>
<tr>
<td>key_sprint</td>
<td>kPRINT</td>
<td>%f</td>
<td>KEY_SPRINT, sent by shifted print key</td>
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<tr>
<td>key_se</td>
<td>hR</td>
<td></td>
<td>KEY_SE, sent by scroll-backward/up key</td>
</tr>
<tr>
<td>key_sredo</td>
<td>kREDO</td>
<td>%g</td>
<td>KEY_SREDO, sent by shifted redo key</td>
</tr>
<tr>
<td>key_sreplace</td>
<td>kRPL</td>
<td>%h</td>
<td>KEY_SRPLACE, sent by shifted replace key</td>
</tr>
<tr>
<td>key_sright</td>
<td>kRIGHT</td>
<td>%i</td>
<td>KEY_SRIGHT, sent by shifted right-arrow key</td>
</tr>
<tr>
<td>key_sresume</td>
<td>kRES</td>
<td>%j</td>
<td>KEY_SRESUME, sent by shifted resume key</td>
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<tr>
<td>key_ssav</td>
<td>kSAV</td>
<td>!1</td>
<td>KEY_SSSAVE, sent by shifted save key</td>
</tr>
<tr>
<td>key_ssuspend</td>
<td>kSPD</td>
<td>!2</td>
<td>KEY_SSUSPEND, sent by shifted suspend</td>
</tr>
</tbody>
</table>

235
### terminfo (4)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Cap-name</th>
<th>Termcap Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>key_stab</td>
<td>khts</td>
<td>kT</td>
<td><strong>KEY_STAB</strong>, sent by set-tab key</td>
</tr>
<tr>
<td>key_sundo</td>
<td>kUND</td>
<td>13</td>
<td><strong>KEY_SUNDO</strong>, sent by shifted undo key</td>
</tr>
<tr>
<td>key_suspend</td>
<td>kspd</td>
<td>67</td>
<td><strong>KEY_SUSPEND</strong>, sent by suspend key</td>
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<tr>
<td>key_undo</td>
<td>kund</td>
<td>68</td>
<td><strong>KEY_UNDO</strong>, sent by undo key</td>
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<tr>
<td>key_up</td>
<td>kcuu1</td>
<td>ku</td>
<td><strong>KEY_UP</strong>, sent by terminal up-arrow key</td>
</tr>
<tr>
<td>keypad_local</td>
<td>rmbx</td>
<td>ke</td>
<td>Out of &quot;keypad-transmit&quot; mode</td>
</tr>
<tr>
<td>keypad_xmit</td>
<td>smbx</td>
<td>ks</td>
<td>Put terminal in &quot;keypad-transmit&quot; mode</td>
</tr>
<tr>
<td>lab_f0</td>
<td>lf0</td>
<td>10</td>
<td>Labels on function key f0 if not f0</td>
</tr>
<tr>
<td>lab_f1</td>
<td>lf1</td>
<td>11</td>
<td>Labels on function key f1 if not f1</td>
</tr>
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<td>lab_f2</td>
<td>lf2</td>
<td>12</td>
<td>Labels on function key f2 if not f2</td>
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<td>lab_f3</td>
<td>lf3</td>
<td>13</td>
<td>Labels on function key f3 if not f3</td>
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<td>Labels on function key f4 if not f4</td>
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<td>lab_f5</td>
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<td>Labels on function key f5 if not f5</td>
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<td>Labels on function key f6 if not f6</td>
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<td>Labels on function key f7 if not f7</td>
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<td>Labels on function key f9 if not f9</td>
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<td>lab_f10</td>
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<td>la</td>
<td>Labels on function key f10 if not f10</td>
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<tr>
<td>label_off</td>
<td>rmln</td>
<td>LF</td>
<td>Turn off soft labels</td>
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<tr>
<td>label_on</td>
<td>smln</td>
<td>LO</td>
<td>Turn on soft labels</td>
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<tr>
<td>meta_off</td>
<td>rmn</td>
<td>mo</td>
<td>Turn off &quot;meta mode&quot;</td>
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<td>meta_on</td>
<td>smm</td>
<td>mm</td>
<td>Turn on &quot;meta mode&quot; (8th bit)</td>
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<td>micro_column_address</td>
<td>shpa</td>
<td>ZY</td>
<td>Like <strong>column_address</strong> for micro adjustment</td>
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<tr>
<td>micro_down</td>
<td>mcud1</td>
<td>ZZ</td>
<td>Like <strong>cursor_down</strong> for micro adjustment</td>
</tr>
<tr>
<td>micro_left</td>
<td>mcub1</td>
<td>Za</td>
<td>Like <strong>cursor_left</strong> for micro adjustment</td>
</tr>
<tr>
<td>micro_right</td>
<td>mcuf1</td>
<td>Zb</td>
<td>Like <strong>cursor_right</strong> for micro adjustment</td>
</tr>
<tr>
<td>micro_row_address</td>
<td>mvpa</td>
<td>Zc</td>
<td>Like <strong>row_address</strong> for micro adjustment</td>
</tr>
<tr>
<td>micro_up</td>
<td>mcuul</td>
<td>Zd</td>
<td>Like <strong>cursor_up</strong> for micro adjustment</td>
</tr>
<tr>
<td>mouse_info</td>
<td>minfo</td>
<td>Mi</td>
<td>Mouse status information</td>
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<tr>
<td>newline</td>
<td>nel</td>
<td>nw</td>
<td>Newline (behaves like cr followed by lf)</td>
</tr>
<tr>
<td>order_of_pins</td>
<td>porder</td>
<td>Ze</td>
<td>Matches software bits to print-head pins</td>
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<tr>
<td>orig_colors</td>
<td>oc</td>
<td>oc</td>
<td>Set all color(-pair)s to the original ones</td>
</tr>
<tr>
<td>orig_pair</td>
<td>op</td>
<td>op</td>
<td>Set default color-pair to the original one</td>
</tr>
<tr>
<td>pad_char</td>
<td>pad</td>
<td>pc</td>
<td>Pad character (rather than null)</td>
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<tr>
<td>parm_dch</td>
<td>dch</td>
<td>DC</td>
<td>Delete #1 chars</td>
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<tr>
<td>parm_delete_line</td>
<td>dl</td>
<td>DL</td>
<td>Delete #1 lines</td>
</tr>
<tr>
<td>parm_down_cursor</td>
<td>cud</td>
<td>DO</td>
<td>Move down #1 lines.</td>
</tr>
<tr>
<td>parm_down_micro</td>
<td>mcud</td>
<td>Zf</td>
<td>Like <strong>parm_down_cursor</strong> for micro adjust.</td>
</tr>
<tr>
<td>parm_ich</td>
<td>ich</td>
<td>IC</td>
<td>Insert #1 blank chars</td>
</tr>
<tr>
<td>Variable</td>
<td>Cap-name</td>
<td>Termcap</td>
<td>Description</td>
</tr>
<tr>
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<td>----------------------------------------------</td>
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<tr>
<td>parm_index</td>
<td>indn</td>
<td>SF</td>
<td>Scroll forward #1 lines.</td>
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<tr>
<td>parm_insert_line</td>
<td>il</td>
<td>AL</td>
<td>Add #1 new blank lines</td>
</tr>
<tr>
<td>parm_left_cursor</td>
<td>cub</td>
<td>LS</td>
<td>Move cursor left #1 spaces</td>
</tr>
<tr>
<td>parm_left_micro</td>
<td>mcub</td>
<td>Zg</td>
<td>Like parm_left_cursor for micro adjust.</td>
</tr>
<tr>
<td>parm_right_cursor</td>
<td>cuf</td>
<td>RI</td>
<td>Move right #1 spaces.</td>
</tr>
<tr>
<td>parm_right_micro</td>
<td>mcuf</td>
<td>Zh</td>
<td>Like parm_right_cursor for micro adjust.</td>
</tr>
<tr>
<td>parm_index</td>
<td>rin</td>
<td>SR</td>
<td>Scroll backward #1 lines</td>
</tr>
<tr>
<td>parm_up_cursor</td>
<td>cuu</td>
<td>UP</td>
<td>Move cursor up #1 lines</td>
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<td>Zl</td>
<td>Like parm_up_cursor for micro adjust.</td>
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<td>S6</td>
<td>PC terminal options</td>
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<tr>
<td>pkey_key</td>
<td>pfkey</td>
<td>pk</td>
<td>Prog funct key #1 to type string #2</td>
</tr>
<tr>
<td>pkey_local</td>
<td>pfloc</td>
<td>pl</td>
<td>Prog funct key #1 to execute string #2</td>
</tr>
<tr>
<td>pkey_plab</td>
<td>pfxl</td>
<td>xl</td>
<td>Prog key #1 to xmit string #2 and show string #3</td>
</tr>
<tr>
<td>pkey_xmit</td>
<td>pfx</td>
<td>px</td>
<td>Prog funct key #1 to xmit string #2</td>
</tr>
<tr>
<td>plab_norm</td>
<td>pln</td>
<td>pn</td>
<td>Prog label #1 to show string #2</td>
</tr>
<tr>
<td>print_screen</td>
<td>mc0c</td>
<td>pa</td>
<td>Print contents of the screen</td>
</tr>
<tr>
<td>prtr_non</td>
<td>mc4p</td>
<td>po</td>
<td>Turn on the printer for #1 bytes</td>
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<tr>
<td>prtr_off</td>
<td>mc5c</td>
<td>pf</td>
<td>Turn off the printer</td>
</tr>
<tr>
<td>prtr_on</td>
<td>mc5c</td>
<td>po</td>
<td>Turn on the printer</td>
</tr>
<tr>
<td>repeat_char</td>
<td>rep</td>
<td>rp</td>
<td>Repeat char #1 #2 times</td>
</tr>
<tr>
<td>req_for_input</td>
<td>rfi</td>
<td>RF</td>
<td>Send next input char (for ptys)</td>
</tr>
<tr>
<td>req_mouse_pos</td>
<td>reqmp</td>
<td>RQ</td>
<td>Request mouse position report</td>
</tr>
<tr>
<td>reset_1string</td>
<td>rs1c</td>
<td>ri</td>
<td>Reset terminal completely to sane modes</td>
</tr>
<tr>
<td>reset_2string</td>
<td>rs2c</td>
<td>r2</td>
<td>Reset terminal completely to sane modes</td>
</tr>
<tr>
<td>reset_3string</td>
<td>rs3c</td>
<td>r3</td>
<td>Reset terminal completely to sane modes</td>
</tr>
<tr>
<td>reset_file</td>
<td>rcf</td>
<td>rf</td>
<td>Name of file containing reset string</td>
</tr>
<tr>
<td>restore_cursor</td>
<td>rcv</td>
<td>rc</td>
<td>Restore cursor to position of last sc</td>
</tr>
<tr>
<td>row_address</td>
<td>vpa</td>
<td>cv</td>
<td>Vertical position absolute</td>
</tr>
<tr>
<td>save_cursor</td>
<td>scc</td>
<td>sc</td>
<td>Save cursor position</td>
</tr>
<tr>
<td>scancode_escape</td>
<td>scesc</td>
<td>S7</td>
<td>Escape for scancode emulation</td>
</tr>
<tr>
<td>scroll_forward</td>
<td>indf</td>
<td>sf</td>
<td>Scroll text up</td>
</tr>
<tr>
<td>scroll_reverse</td>
<td>ri</td>
<td>sr</td>
<td>Scroll text down</td>
</tr>
<tr>
<td>select_char_set</td>
<td>sccs</td>
<td>Zj</td>
<td>Select character set</td>
</tr>
<tr>
<td>set0_des_seq</td>
<td>s0ds</td>
<td>s0</td>
<td>Shift into codeset 0 (EUC set 0, ASCII)</td>
</tr>
<tr>
<td>set1_des_seq</td>
<td>s1ds</td>
<td>s1</td>
<td>Shift into codeset 1</td>
</tr>
<tr>
<td>set2_des_seq</td>
<td>s2ds</td>
<td>s2</td>
<td>Shift into codeset 2</td>
</tr>
<tr>
<td>set3_des_seq</td>
<td>s3ds</td>
<td>s3</td>
<td>Shift into codeset 3</td>
</tr>
<tr>
<td>set_a_background</td>
<td>setab</td>
<td>AB</td>
<td>Set background color using ANSI escape</td>
</tr>
<tr>
<td>set_a_foreground</td>
<td>setaf</td>
<td>AF</td>
<td>Set foreground color using ANSI escape</td>
</tr>
<tr>
<td>set_attributes</td>
<td>sgr</td>
<td>sa</td>
<td>Define the video attributes #1-#9</td>
</tr>
<tr>
<td>set_background</td>
<td>setb</td>
<td>Sb</td>
<td>Set current background color</td>
</tr>
<tr>
<td>set_bottom_margin</td>
<td>smgkb</td>
<td>Zk</td>
<td>Set bottom margin at current line</td>
</tr>
<tr>
<td>set_bottom_margin_parm</td>
<td>smgbkp</td>
<td>Zl</td>
<td>Set bottom margin at line #1 or #2</td>
</tr>
</tbody>
</table>
Sample Entry

The following entry, which describes the AT&T 610 terminal, is among the more complex entries in the terminfo file as of this writing.

```
610 | 610bct | ATT610 | att610 | AT&T610; 80 column; 98key keyboard
am, eslok, hs, mir, msgr, xenl, xon, cols#80, it#8, lh#2, lines#24, lw#8, nlab#8, wsl#80,
acsc='aaffggjjkkllmmnnooppqrrrsstttuvvwwxxxxzz{11}~~, bel="G", blink=\E[5m, bold=\E[1m, cdt=\E[2,
civs=\E[?25l, clear=\E[H\E[J, cnorm=\E[25h\E[?12l, cr=r, csr=\E[\%p1%d;\%p2%dr, cub=\E[\%p1%dD, cubl=\b, cu=\E[\%p1%dB, cudl=\E[B, cufr=\E[\%p1%dC, cufl=\E[C, cup=\E[\%p1%d;\%p2%dh, cuu=\E[\%p1%dA, cuul=\E[A, cvvis=\E[?12;25h, dch=\E[\%p1%dp, dchl=\E[P, dim=\E[2m, dl=\E[\%p1%dM, dl1=\E[M, ed=\E[J, el=\E[K, el1=\E[1K, flash=\E[?5h$<200>\E[?51, fsl=\E8, home=\E[H, ht=t,
```

238
The sample entry shows the formats for the three types of `terminfo` capabilities listed: Boolean, numeric, and string. All capabilities specified in the `terminfo` source file must be followed by commas, including the last capability in the source file. In `terminfo` source files, capabilities are referenced by their capability names (as shown in the previous tables).

Boolean capabilities are specified simply by their comma separated cap names.

Numeric capabilities are followed by the character `'#'` and then a positive integer value. Thus, in the sample, `cols` (which shows the number of columns available on a device) is assigned the value `80` for the AT&T 610. (Values for numeric capabilities may be specified in decimal, octal, or hexadecimal, using normal C programming language conventions.)

Finally, string-valued capabilities such as `el` (clear to end of line sequence) are listed by a two- to five-character capname, an `='`, and a string ended by the next occurrence of a comma. A delay in milliseconds may appear anywhere in such a capability, preceded by `$` and enclosed in angle brackets, as in `el=$<3>`. Padding characters are supplied by `tput`. The delay can be any of the following: a number, a number followed by an asterisk, such as `5*`, a number followed by a slash, such as `5/`, or a number followed by both, such as `5*/`. A `'*'` shows that the padding required is proportional to the number of lines affected by the operation, and the amount given is the per-affected-unit padding required. (In the case of insert characters, the factor is still the number of lines affected. This is always 1 unless the device has `in` and the software uses it.) When a `'*'` is specified, it is sometimes useful to give a delay of the form `3.5` to specify a delay per unit to tenths of milliseconds. (Only one decimal place is allowed.)
A '/' indicates that the padding is mandatory. If a device has `xon` defined, the padding information is advisory and will only be used for cost estimates or when the device is in raw mode. Mandatory padding will be transmitted regardless of the setting of `xon`. If padding (whether advisory or mandatory) is specified for `bel` or `flash`, however, it will always be used, regardless of whether `xon` is specified.

`terminfo` offers notation for encoding special characters. Both `\E` and `\e` map to an ESCAPE character, `\x` maps to a control `x` for any appropriate `x`, and the sequences `\n`, `\l`, `\x`, `\t`, `\b`, `\f`, and `\s` give a newline, linefeed, return, tab, backspace, formfeed, and space, respectively. Other escapes include: `\^` for caret (`\`); `\` for backslash (`\`); `,` for comma (,); `:` for colon (:) and `\0` for null. (`\0` will actually produce `\200`, which does not terminate a string but behaves as a null character on most devices, providing CS7 is specified. [See `stty(1)`.] Finally, characters may be given as three octal digits after a backslash (for example, `\123`).

Sometimes individual capabilities must be commented out. To do this, put a period before the capability name. For example, see the second `ind` in the example above. Note that capabilities are defined in a left-to-right order and, therefore, a prior definition will override a later definition.

Preparing Descriptions

The most effective way to prepare a device description is by imitating the description of a similar device in `terminfo` and building up a description gradually, using partial descriptions with `vi` to check that they are correct. Be aware that a very unusual device may expose deficiencies in the ability of the `terminfo` file to describe it or the inability of `vi` to work with that device. To test a new device description, set the environment variable `TERMINFO` to the pathname of a directory containing the compiled description you are working on and programs will look there rather than in `/usr/share/lib/terminfo`. To get the padding for insert-line correct (if the device manufacturer did not document it) a severe test is to comment out `xon`, edit a large file at 9600 baud with `vi`, delete 16 or so lines from the middle of the screen, and then press the `u` key several times quickly. If the display is corrupted, more padding is usually needed. A similar test can be used for insert-character.

Section 1-1: Basic Capabilities

The number of columns on each line for the device is given by the `cols` numeric capability. If the device has a screen, then the number of lines on the screen is given by the `lines` capability. If the device wraps around to the beginning of the next line when it reaches the right margin, then it should have the `am` capability. If the terminal can clear its screen, leaving the cursor in the home position, then this is given by the `clear` string capability. If the terminal overstrikes (rather than clearing a position when a character is struck over) then it should have the `os` capability. If the device is a printing terminal, with no soft copy unit, specify both `hc` and `os`. If there is a way to move the cursor to the left edge of the current row, specify this as `cr`. (Normally this will be carriage return, control M.) If there is a way to produce an audible signal (such as a bell or a beep), specify it as `bel`. If, like most devices, the device uses the xon-xoff flow-control protocol, specify `xon`. 
If there is a way to move the cursor one position to the left (such as backspace), that capability should be given as \texttt{cu\textbackslash left}. Similarly, sequences to move to the right, up, and down should be given as \texttt{cu\textbackslash right}, \texttt{cu\textbackslash up}, and \texttt{cu\textbackslash down}, respectively. These local cursor motions must not alter the text they pass over; for example, you would not normally use \texttt{cu\textbackslash left=\textbackslash s} because the space would erase the character moved over.

A very important point here is that the local cursor motions encoded in \texttt{terminfo} are undefined at the left and top edges of a screen terminal. Programs should never attempt to backspace around the left edge, unless \texttt{bw} is specified, and should never attempt to go up locally off the top. To scroll text up, a program goes to the bottom left corner of the screen and sends the \texttt{ind} (index) string.

To scroll text down, a program goes to the top left corner of the screen and sends the \texttt{ri} (reverse index) string. The strings \texttt{ind} and \texttt{ri} are undefined when not on their respective corners of the screen.

Parameterized versions of the scrolling sequences are \texttt{ind\textbackslash n} and \texttt{rin\textbackslash n}. These versions have the same semantics as \texttt{ind} and \texttt{ri}, except that they take one parameter and scroll the number of lines specified by that parameter. They are also undefined except at the appropriate edge of the screen.

The \texttt{am} capability tells whether the cursor sticks at the right edge of the screen when text is output, but this does not necessarily apply to a \texttt{cu\textbackslash left} from the last column. Backward motion from the left edge of the screen is possible only when \texttt{bw} is specified. In this case, \texttt{cu\textbackslash left} will move to the right edge of the previous row. If \texttt{bw} is not given, the effect is undefined. This is useful for drawing a box around the edge of the screen, for example. If the device has switch selectable automatic margins, \texttt{am} should be specified in the \texttt{terminfo} source file. In this case, initialization strings should turn on this option, if possible. If the device has a command that moves to the first column of the next line, that command can be given as \texttt{nel} (newline). It does not matter if the command clears the remainder of the current line, so if the device has no \texttt{cr} and \texttt{1f} it may still be possible to craft a working \texttt{nel} out of one or both of them.

These capabilities suffice to describe hardcopy and screen terminals. Thus the AT&T 5320 hardcopy terminal is described as follows:

\begin{verbatim}
5320|att5320|AT&T 5320 hardcopy terminal,
    am, hc, os,
    cols#132,
    bel=^G, cr=\textbackslash r, cubl=\textbackslash b, cndl=\textbackslash n,
    dch1=\texttt{\textbackslash E[}P, dll=\texttt{\textbackslash E[M},
    ind=\textbackslash n,
\end{verbatim}

while the Lear Siegler ADM-3 is described as

\begin{verbatim}
adm3 |lsi adm3,
    am, bel=^G, clear=^Z, cols#80, cr=^M, cubl=^H,
    cudl=^J, ind=^J, lines#24,
\end{verbatim}

\textbf{Section 1-2: Parameterized Strings}

Cursor addressing and other strings requiring parameters are described by a parameterized string capability, with \texttt{printf}-like escapes (\%x) in it. For example, to address the cursor, the \texttt{cup} capability is given, using two parameters: the row and column to address to. (Rows and columns are numbered from zero and refer to the
physical screen visible to the user, not to any unseen memory.) If the terminal has memory relative cursor addressing, that can be indicated by \texttt{mrcup}.

The parameter mechanism uses a stack and special \% codes to manipulate the stack in the manner of Reverse Polish Notation (postfix). Typically a sequence will push one of the parameters onto the stack and then print it in some format. Often more complex operations are necessary. Operations are in postfix form with the operands in the usual order. That is, to subtract 5 from the first parameter, one would use \%p1(\texttt{5})\%-.

The \% encodings have the following meanings:

\%
  outputs \'%\'
\%[[:flags]]\{width[.precision]\}[doxXs]
    as in \texttt{printf}, flags are \{-+\#\} and space
\%c
  print pop gives \%c
\%p[1-9]
  push ith parm
\%P[a-z]
  set dynamic variable \{a-z\} to pop
\%g[a-z]
  get dynamic variable \{a-z\} and push it
\%P[A-Z]
  set static variable \{a-z\} to pop
\%g[A-Z]
  get static variable \{a-z\} and push it
\%c
  push char constant \texttt{c}
\%{\texttt{nn}}
  push decimal constant \texttt{nn}
\%1
  push strlen(pop)
\%+ \%- \%^ \%*/ \%m
  arithmetic (\%m is mod): push(pop integer\texttt{2} op pop integer\texttt{1}) where integer\texttt{1} is the top of the stack
\%& \%1 \%A \%0 \%!
  bit operations: push(pop integer\texttt{2} op pop integer\texttt{1})
\%= \%> \%<
  logical operations: push(pop integer\texttt{2} op pop integer\texttt{1})
\%A \%0
  logical operations: and, or
\%1 \%~
  unary operations: push(op pop)
\%t (for ANSI terminals) add 1 to first parm, if one parm present, or first two parms, if more than one parm present
\%?
  \texttt{expr} \%t \texttt{thenpart} \%e \texttt{elsepart} \%t;
  if-then-else, \%e \texttt{elsepart} is optional; else-if's are possible ala Algol 68: \%? \texttt{c}_1 \%t \texttt{b}_1 \%e \texttt{c}_2 \%t \texttt{b}_2 \%e \texttt{c}_3 \%t \texttt{b}_3 \%e \texttt{c}_4 \%t \texttt{b}_4 \%e \texttt{b}_5 \%t;
  \texttt{c}_i\texttt{s} are conditions, \texttt{b}_i\texttt{s} are bodies.
If the "-" flag is used with "%-doXXs", then a colon (:) must be placed between the "%" and the "-" to differentiate the flag from the binary "%-" operator, for example, "%-:16.16s".

Consider the Hewlett-Packard 2645, which, to get to row 3 and column 12, needs to be sent \E&a12c03Y padded for 6 milliseconds. Note that the order of the rows and columns is inverted here, and that the row and column are zero-padded as two digits. Thus its cup capability is:

\[ \text{cup} = \text{\Ea p2\#2.2dC p1\#2.2dY}$<6> \]

The Micro-Term ACT-IV needs the current row and column sent preceded by a ^T, with the row and column simply encoded in binary, "cup=^T%p1\#c%p2\#c". Devices that use "%c" need to be able to backspace the cursor (cubl), and to move the cursor up one line on the screen (cnu1). This is necessary because it is not always safe to transmit \n, ^D, and \r, as the system may change or discard them. (The library routines dealing with terminfo set tty modes so that tabs are never expanded, so \t is safe to send. This turns out to be essential for the Ann Arbor 4080.)

A final example is the LSI ADM-3a, which uses row and column offset by a blank character, thus "cup=\E%=p1\#s\#e+p2\#s\#e". After sending "\E=", this pushes the first parameter, pushes the ASCII value for a space (32), adds them (pushing the sum on the stack in place of the two previous values), and outputs that value as a character. Then the same is done for the second parameter. More complex arithmetic is possible using the stack.

Section 1-3: Cursor Motions

If the terminal has a fast way to home the cursor (to very upper left corner of screen) then this can be given as home; similarly a fast way of getting to the lower left-hand corner can be given as 11; this may involve going up with cuul from the home position, but a program should never do this itself (unless 11 does) because it may make no assumption about the effect of moving up from the home position. Note that the home position is the same as addressing to (0,0): to the top left corner of the screen, not of memory. (Thus, the \EH sequence on Hewlett-Packard terminals cannot be used for home without losing some of the other features on the terminal.)

If the device has row or column absolute-cursor addressing, these can be given as single parameter capabilities hpa (horizontal position absolute) and vpa (vertical position absolute). Sometimes these are shorter than the more general two-parameter sequence (as with the Hewlett-Packard 2645) and can be used in preference to cup. If there are parameterized local motions (for example, move \pi spaces to the right) these can be given as cud, cub, cuf, and cuu with a single parameter indicating how many spaces to move. These are primarily useful if the device does not have cup, such as the Tektronix 4025.

If the device needs to be in a special mode when running a program that uses these capabilities, the codes to enter and exit this mode can be given as smcup and rmcup. This arises, for example, from terminals, such as the Concept, with more than one page of memory. If the device has only memory relative cursor addressing and not screen relative cursor addressing, a one screen-sized window must be fixed into the device for cursor addressing to work properly. This is also used for the Tektronix
Section 1-4: Area Clears
If the terminal can clear from the current position to the end of the line, leaving the
cursor where it is, this should be given as el. If the terminal can clear from
the beginning of the line to the current position inclusive, leaving the cursor where it is,
this should be given as e11. If the terminal can clear from the current position to
the end of the display, then this should be given as ed. ed is only defined from the
first column of a line. (Thus, it can be simulated by a request to delete a large
number of lines, if a true ed is not available.)

Section 1-5: Insert/Delete Line
If the terminal can open a new blank line before the line where the cursor is, this
should be given as ill; this is done only from the first position of a line. The cursor
must then appear on the newly blank line. If the terminal can delete the line which
the cursor is on, then this should be given as d11; this is done only from the first
position on the line to be deleted. Versions of ill and d11 which take a single
parameter and insert or delete that many lines can be given as il and dl.

If the terminal has a settable destructive scrolling region (like the VT100) the com­
mmand to set this can be described with the csrc capability, which takes two param­
ters: the top and bottom lines of the scrolling region. The cursor position is, alas,
undefined after using this command. It is possible to get the effect of insert or
delete line using this command — the sc and rc (save and restore cursor) com­
mmands are also useful. Inserting lines at the top or bottom of the screen can also be
done using ri or ind on many terminals without a true insert/delete line, and is
often faster even on terminals with those features.

To determine whether a terminal has destructive scrolling regions or non­
destructive scrolling regions, create a scrolling region in the middle of the screen,
place data on the bottom line of the scrolling region, move the cursor to the top line
of the scrolling region, and do a reverse index (ri) followed by a delete line (d11) or
index (ind). If the data that was originally on the bottom line of the scrolling region
was restored into the scrolling region by the d11 or ind, then the terminal has non­
destructive scrolling regions. Otherwise, it has destructive scrolling regions. Do
not specify csrc if the terminal has non-destructive scrolling regions, unless ind, ri,
indn, rin, dl, and d11 all simulate destructive scrolling.

If the terminal has the ability to define a window as part of memory, which all com­
mands affect, it should be given as the parameterized string wind. The four param­
ters are the starting and ending lines in memory and the starting and ending
columns in memory, in that order.

If the terminal can retain display memory above, then the da capability should be
given; if display memory can be retained below, then db should be given. These
indicate that deleting a line or scrolling a full screen may bring non-blank lines up
from below or that scrolling back with ri may bring down non-blank lines.
Section 1-6: Insert/Delete Character

There are two basic kinds of intelligent terminals with respect to insert/delete character operations which can be described using terminfo. The most common insert/delete character operations affect only the characters on the current line and shift characters off the end of the line rigidly. Other terminals, such as the Concept 100 and the Perkin Elmer Owl, make a distinction between typed and untyped blanks on the screen, shifting upon an insert or delete only to an untyped blank on the screen which is either eliminated, or expanded to two untyped blanks. You can determine the kind of terminal you have by clearing the screen and then typing text separated by cursor motions. Type "abc def" using local cursor motions (not spaces) between the abc and the def. Then position the cursor before the abc and put the terminal in insert mode. If typing characters causes the rest of the line to shift rigidly and characters to fall off the end, then your terminal does not distinguish between blanks and untyped positions. If the abc shifts over to the def which then move together around the end of the current line and onto the next as you insert, you have the second type of terminal, and should give the capability in, which stands for "insert null." While these are two logically separate attributes (one line versus multiline insert mode, and special treatment of untyped spaces) we have seen no terminals whose insert mode cannot be described with the single attribute.

terminfo can describe both terminals that have an insert mode and terminals which send a simple sequence to open a blank position on the current line. Give as smir the sequence to get into insert mode. Give as rmir the sequence to leave insert mode. Now give as ichl any sequence needed to be sent just before sending the character to be inserted. Most terminals with a true insert mode will not give ichl; terminals that send a sequence to open a screen position should give it here. (If your terminal has both, insert mode is usually preferable to ichl. Do not give both unless the terminal actually requires both to be used in combination.) If post-insert padding is needed, give this as a number of milliseconds padding in ip (a string option). Any other sequence which may need to be sent after an insert of a single character may also be given in ip. If your terminal needs both to be placed into an 'insert mode' and a special code to precede each inserted character, then both smir/rmir and ichl can be given, and both will be used. The ich capability, with one parameter, n, will insert n blanks.

If padding is necessary between characters typed while not in insert mode, give this as a number of milliseconds padding in nmp.

It is occasionally necessary to move around while in insert mode to delete characters on the same line (for example, if there is a tab after the insertion position). If your terminal allows motion while in insert mode you can give the capability mir to speed up inserting in this case. Omitting mir will affect only speed. Some terminals (notably Datamedia's) must not have mir because of the way their insert mode works.

Finally, you can specify dchl to delete a single character, dch with one parameter, n, to delete n characters, and delete mode by giving smdc and rmdc to enter and exit delete mode (any mode the terminal needs to be placed in for dchl to work).
A command to erase \( n \) characters (equivalent to outputting \( n \) blanks without moving the cursor) can be given as `ech` with one parameter.

**Section 1-7: Highlighting, Underlining, and Visible Bells**

Your device may have one or more kinds of display attributes that allow you to highlight selected characters when they appear on the screen. The following display modes (shown with the names by which they are set) may be available: a blinking screen (`blink`), bold or extra-bright characters (`bold`), dim or half-bright characters (`dim`), blanking or invisible text (`invis`), protected text (`prot`), a reverse-video screen (`rev`), and an alternate character set (`smacs` to enter this mode and `rmacs` to exit it). (If a command is necessary before you can enter alternate character set mode, give the sequence in `enacs` or "enable alternate-character-set" mode.) Turning on any of these modes singly may or may not turn off other modes.

`sgr0` should be used to turn off all video enhancement capabilities. It should always be specified because it represents the only way to turn off some capabilities, such as `dim` or `blink`.

You should choose one display method as *standout mode* [see `curses(3curses)`] and use it to highlight error messages and other kinds of text to which you want to draw attention. Choose a form of display that provides strong contrast but that is easy on the eyes. (We recommend reverse-video plus half-bright or reverse-video alone.) The sequences to enter and exit standout mode are given as `smso` and `rmso`, respectively. If the code to change into or out of standout mode leaves one or even two blank spaces on the screen, as the TVI 912 and Teleray 1061 do, then `xmc` should be given to tell how many spaces are left.

Sequences to begin underlining and end underlining can be specified as `smul` and `rmul`, respectively. If the device has a sequence to underline the current character and to move the cursor one space to the right (such as the Micro-Term MIME), this sequence can be specified as `uc`.

Terminals with the "magic cookie" glitch (`xmc`) deposit special "cookies" when they receive mode-setting sequences, which affect the display algorithm rather than having extra bits for each character. Some terminals, such as the Hewlett-Packard 2621, automatically leave standout mode when they move to a new line or the cursor is addressed. Programs using standout mode should exit standout mode before moving the cursor or sending a newline, unless the `msgr` capability, asserting that it is safe to move in standout mode, is present.

If the terminal has a way of flashing the screen to indicate an error quietly (a bell replacement), then this can be given as `flash`; it must not move the cursor. A good flash can be done by changing the screen into reverse video, pad for 200 ms, then return the screen to normal video.

If the cursor needs to be made more visible than normal when it is not on the bottom line (to make, for example, a non-blinking underline into an easier to find block or blinking underline) give this sequence as `cvvis`. The boolean `chts` should also be given. If there is a way to make the cursor completely invisible, give that as `civis`. The capability `cnorm` should be given which undoes the effects of either of these modes.
If your terminal generates underlined characters by using the underline character (with no special sequences needed) even though it does not otherwise overstrike characters, then you should specify the capability ul. For devices on which a character overstriking another leaves both characters on the screen, specify the capability os. If overstrikes are erasable with a blank, then this should be indicated by specifying eo.

If there is a sequence to set arbitrary combinations of modes, this should be given as sgr (set attributes), taking nine parameters. Each parameter is either 0 or non-zero, as the corresponding attribute is on or off. The nine parameters are, in order: standout, underline, reverse, blink, dim, bold, blank, protect, alternate character set. Not all modes need to be supported by sgr; only those for which corresponding separate attribute commands exist should be supported. For example, let’s assume that the terminal in question needs the following escape sequences to turn on various modes.

<table>
<thead>
<tr>
<th>tparm</th>
<th>attribute</th>
<th>escape sequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>none</td>
<td></td>
<td>\E[0m</td>
</tr>
<tr>
<td>p1</td>
<td>standout</td>
<td>\E[0;4;7m</td>
</tr>
<tr>
<td>p2</td>
<td>underline</td>
<td>\E[0;3m</td>
</tr>
<tr>
<td>p3</td>
<td>reverse</td>
<td>\E[0;4m</td>
</tr>
<tr>
<td>p4</td>
<td>blink</td>
<td>\E[0;5m</td>
</tr>
<tr>
<td>p5</td>
<td>dim</td>
<td>\E[0;7m</td>
</tr>
<tr>
<td>p6</td>
<td>bold</td>
<td>\E[0;3;4m</td>
</tr>
<tr>
<td>p7</td>
<td>invis</td>
<td>\E[0;8m</td>
</tr>
<tr>
<td>p8</td>
<td>protect</td>
<td>not available</td>
</tr>
<tr>
<td>p9</td>
<td>altcharset</td>
<td>^(off) &amp;N (on)</td>
</tr>
</tbody>
</table>

Note that each escape sequence requires a 0 to turn off other modes before turning on its own mode. Also note that, as suggested above, standout is set up to be the combination of reverse and dim. Also, because this terminal has no bold mode, bold is set up as the combination of reverse and underline. In addition, to allow combinations, such as underline-blink, the sequence to use would be \E[0;3;5m. The terminal doesn’t have protect mode, either, but that cannot be simulated in any way, so p8 is ignored. The altcharset mode is different in that it is either \^O or \^N, depending on whether it is off or on. If all modes were to be turned on, the sequence would be \E[0;3;4;5;7;8m\&N.

Now look at when different sequences are output. For example, ; 3 is output when either p2 or p6 is true, that is, if either underline or bold modes are turned on. Writing out the above sequences, along with their dependencies, gives the following:

<table>
<thead>
<tr>
<th>sequence</th>
<th>when to output</th>
<th>terminfo translation</th>
</tr>
</thead>
<tbody>
<tr>
<td>\E[0</td>
<td>always</td>
<td>\E[0</td>
</tr>
<tr>
<td>; 3</td>
<td>if p2 or p6</td>
<td>%?p2%p6%\t;3%;</td>
</tr>
<tr>
<td>; 4</td>
<td>if p1 or p3 or p6</td>
<td>%?p1%p3%p6%\t;4%;</td>
</tr>
<tr>
<td>; 5</td>
<td>if p4</td>
<td>%?p4%\t;5%;</td>
</tr>
<tr>
<td>; 7</td>
<td>if p1 or p5</td>
<td>%?p1%p5%\t;7%;</td>
</tr>
</tbody>
</table>
Putting this all together into the sgr sequence gives:

\[ \text{sgr} = \text{\vphantom{E[0]}E[0]%p2%p6|}%t;3%;%p1%p3|]%p6|\vphantom{]%t;4%;}%p5%t;5%;%p1%p5|\vphantom{%}t;7%;%p7%t;8%;m;%p9%t.{N}e{"}O; \]

Remember that \text{sgr} and \text{sgr0} must always be specified.

Section 1-8: Keypad

If the device has a keypad that transmits sequences when the keys are pressed, this information can also be specified. Note that it is not possible to handle devices where the keypad only works in local (this applies, for example, to the unshifted Hewlett-Packard 2621 keys). If the keypad can be set to transmit or not transmit, specify these sequences as \text{smkx} and \text{nnkx}. Otherwise the keypad is assumed to always transmit.

The sequences sent by the left arrow, right arrow, up arrow, down arrow, and home keys can be given as \text{kcufl}, \text{kcuul}, \text{kcupl}, \text{kcudl}, and \text{khome}, respectively. If there are function keys such as \text{f0}, \text{f1}, ..., \text{f63}, the sequences they send can be specified as \text{kf0}, \text{kf1}, ..., \text{kf63}. If the first 11 keys have labels other than the default \text{f0} through \text{f10}, the labels can be given as \text{lf0}, \text{lf1}, ..., \text{lf10}. The codes transmitted by certain other special keys can be given: \text{kl1} (home down), \text{kbs} (backspace), \text{kbc} (clear all tabs), \text{kctab} (clear the tab stop in this column), \text{kclr} (clear screen or erase key), \text{kdcpl} (delete character), \text{kdl1} (delete line), \text{krmi} (exit insert mode), \text{kel} (clear to end of line), \text{kdd} (clear to end of screen), \text{kim} (insert character or enter insert mode), \text{kil1} (insert line), \text{knp} (next page), \text{kpp} (previous page), \text{kht} (scroll forward/down), \text{kri} (scroll backward/up), \text{khts} (set a tab stop in this column). In addition, if the keypad has a 3 by 3 array of keys including the four arrow keys, the other five keys can be given as \text{kal}, \text{kbl}, \text{kcl}, \text{kcr}, \text{kct}, and \text{kck}. These keys are useful when the effects of a 3 by 3 directional pad are needed. Further keys are defined above in the capabilities list.

Strings to program function keys can be specified as \text{pfkey}, \text{pfloc}, and \text{pfx}. A string to program screen labels should be specified as \text{pln}. Each of these strings takes two parameters: a function key identifier and a string to program it with. \text{pfkey} causes pressing the given key to be the same as the user typing the given string; \text{pfloc} causes the string to be executed by the terminal in local mode; and \text{pfx} causes the string to be transmitted to the computer. The capabilities \text{nlab}, \text{lw} and \text{lh} define the number of programmable screen labels and their width and height. If there are commands to turn the labels on and off, give them in \text{smln} and \text{rmln}. \text{smln} is normally output after one or more \text{pln} sequences to make sure that the change becomes visible.

Section 1-9: Tabs and Initialization

If the device has hardware tabs, the command to advance to the next tab stop can be given as \text{ht} (usually control l). A "backtab" command that moves leftward to the next tab stop can be given as \text{cbt}. By convention, if tty modes show that tabs are being expanded by the computer rather than being sent to the device, programs should not use \text{ht} or \text{cbt} (even if they are present) because the user may not have
the tab stops properly set. If the device has hardware tabs that are initially set every \( n \) spaces when the device is powered up, the numeric parameter \( n \) is given, showing the number of spaces the tabs are set to. This is normally used by `tput init` [see `tput(1)`] to determine whether to set the mode for hardware tab expansion and whether to set the tab stops. If the device has tab stops that can be saved in nonvolatile memory, the `terminfo` description can assume that they are properly set. If there are commands to set and clear tab stops, they can be given as `tbc` (clear all tab stops) and `hts` (set a tab stop in the current column of every row).

Other capabilities include: `is1`, `is2`, and `is3`, initialization strings for the device; `iprog`, the path name of a program to be run to initialize the device; and `if`, the name of a file containing long initialization strings. These strings are expected to set the device into modes consistent with the rest of the `terminfo` description. They must be sent to the device each time the user logs in and be output in the following order: run the program `iprog`; output `is1`; output `is2`; set the margins using `mge`, `smgl` and `smgr`; set the tabs using `tbc` and `hts`; print the file `if`; and finally output `is3`. This is usually done using the `init` option of `tput`.

Most initialization is done with `is2`. Special device modes can be set up without duplicating strings by putting the common sequences in `is2` and special cases in `is1` and `is3`. Sequences that do a reset from a totally unknown state can be given as `rs1`, `rs2`, `rf`, and `rs3`, analogous to `is1`, `is2`, `is3`, and `if`. (The method using files, `if` and `rf`, is used for a few terminals, from `/usr/share/lib/tabset/*`; however, the recommended method is to use the initialization and reset strings.) These strings are output by `tput reset`, which is used when the terminal gets into a wedged state. Commands are normally placed in `rs1`, `rs2`, `rs3`, and `rf` only if they produce annoying effects on the screen and are not necessary when logging in. For example, the command to set a terminal into 80-column mode would normally be part of `is2`, but on some terminals it causes an annoying glitch on the screen and is not normally needed because the terminal is usually already in 80-column mode.

If a more complex sequence is needed to set the tabs than can be described by using `tbc` and `hts`, the sequence can be placed in `is2` or `if`.

Any margin can be cleared with `mge`. (For instructions on how to specify commands to set and clear margins, see "Margins" below under "PRINTER CAPABILITIES."

### Section 1-10: Delays

Certain capabilities control padding in the `tty` driver. These are primarily needed by hard-copy terminals, and are used by `tput init` to set `tty` modes appropriately. Delays embedded in the capabilities `cr`, `ind`, `cubi`, `ff`, and `tab` can be used to set the appropriate delay bits to be set in the `tty` driver. If `pb` (padding baud rate) is given, these values can be ignored at baud rates below the value of `pb`.

### Section 1-11: Status Lines

If the terminal has an extra "status line" that is not normally used by software, this fact can be indicated. If the status line is viewed as an extra line below the bottom line, into which one can cursor address normally (such as the Heathkit h19's 25th line, or the 24th line of a VT100 which is set to a 23-line scrolling region), the capability `hs` should be given. Special strings that go to a given column of the status line and return from the status line can be given as `ts1` and `fs1`. (`fs1` must leave the cursor position in the same place it was before `ts1`. If necessary, the `sc` and `rc`
strings can be included in `tsl` and `fsl` to get this effect.) The capability `tsl` takes one parameter, which is the column number of the status line the cursor is to be moved to.

If escape sequences and other special commands, such as `tab`, work while in the status line, the flag `eslok` can be given. A string which turns off the status line (or otherwise erases its contents) should be given as `dsl`. If the terminal has commands to save and restore the position of the cursor, give them as `sc` and `rc`. The status line is normally assumed to be the same width as the rest of the screen, for example, `cols`. If the status line is a different width (possibly because the terminal does not allow an entire line to be loaded) the width, in columns, can be indicated with the numeric parameter `wsl`.

### Section 1-12: Line Graphics

If the device has a line drawing alternate character set, the mapping of glyph to character would be given in `acsc`. The definition of this string is based on the alternate character set used in the DEC VT100 terminal, extended slightly with some characters from the AT&T 4410v1 terminal.

<table>
<thead>
<tr>
<th>glyph name</th>
<th>vt100+ character</th>
</tr>
</thead>
<tbody>
<tr>
<td>arrow pointing right</td>
<td>+</td>
</tr>
<tr>
<td>arrow pointing left</td>
<td>,</td>
</tr>
<tr>
<td>arrow pointing down</td>
<td>.</td>
</tr>
<tr>
<td>solid square block</td>
<td>0</td>
</tr>
<tr>
<td>lantern symbol</td>
<td>I</td>
</tr>
<tr>
<td>arrow pointing up</td>
<td>-</td>
</tr>
<tr>
<td>diamond</td>
<td>'</td>
</tr>
<tr>
<td>checker board (stipple)</td>
<td>a</td>
</tr>
<tr>
<td>degree symbol</td>
<td>f</td>
</tr>
<tr>
<td>plus/minus</td>
<td>g</td>
</tr>
<tr>
<td>board of squares</td>
<td>h</td>
</tr>
<tr>
<td>lower right corner</td>
<td>j</td>
</tr>
<tr>
<td>upper right corner</td>
<td>k</td>
</tr>
<tr>
<td>upper left corner</td>
<td>l</td>
</tr>
<tr>
<td>lower left corner</td>
<td>m</td>
</tr>
<tr>
<td>plus</td>
<td>n</td>
</tr>
<tr>
<td>scan line 1</td>
<td>o</td>
</tr>
<tr>
<td>horizontal line</td>
<td>q</td>
</tr>
<tr>
<td>scan line 9</td>
<td>s</td>
</tr>
<tr>
<td>left tee (←)</td>
<td>t</td>
</tr>
<tr>
<td>right tee (→)</td>
<td>u</td>
</tr>
<tr>
<td>bottom tee (└)</td>
<td>v</td>
</tr>
<tr>
<td>top tee (┘)</td>
<td>w</td>
</tr>
<tr>
<td>vertical line</td>
<td>x</td>
</tr>
<tr>
<td>bullet</td>
<td>~</td>
</tr>
</tbody>
</table>

The best way to describe a new device’s line graphics set is to add a third column to the above table with the characters for the new device that produce the appropriate glyph when the device is in the alternate character set mode. For example,
terminfo (4)

<table>
<thead>
<tr>
<th>glyph name</th>
<th>vt100+ char</th>
<th>new tty char</th>
</tr>
</thead>
<tbody>
<tr>
<td>upper left corner</td>
<td>l</td>
<td>R</td>
</tr>
<tr>
<td>lower left corner</td>
<td>m</td>
<td>F</td>
</tr>
<tr>
<td>upper right corner</td>
<td>k</td>
<td>T</td>
</tr>
<tr>
<td>lower right corner</td>
<td>j</td>
<td>G</td>
</tr>
<tr>
<td>horizontal line</td>
<td>q</td>
<td></td>
</tr>
<tr>
<td>vertical line</td>
<td>x</td>
<td></td>
</tr>
</tbody>
</table>

Now write down the characters left to right, as in “acsc=IRmFkTjGq\,x.”.

In addition, terminfo allows you to define multiple character sets. See Section 2-5 for details.

Section 1-13: Color Manipulation

Let us define two methods of color manipulation: the Tektronix method and the HP method. The Tektronix method uses a set of N predefined colors (usually 8) from which a user can select "current" foreground and background colors. Thus a terminal can support up to N colors mixed into N*N color-pairs to be displayed on the screen at the same time. When using an HP method the user cannot define the foreground independently of the background, or vice-versa. Instead, the user must define an entire color-pair at once. Up to M color-pairs, made from 2*M different colors, can be defined this way. Most existing color terminals belong to one of these two classes of terminals.

The numeric variables colors and pairs define the number of colors and color-pairs that can be displayed on the screen at the same time. If a terminal can change the definition of a color (for example, the Tektronix 4100 and 4200 series terminals), this should be specified with ccc (can change color). To change the definition of a color (Tektronix 4200 method), use initc (initialize color). It requires four arguments: color number (ranging from 0 to colors-1) and three RGB (red, green, and blue) values or three HLS colors (Hue, Lightness, Saturation). Ranges of RGB and HLS values are terminal dependent.

Tektronix 4100 series terminals only use HLS color notation. For such terminals (or dual-mode terminals to be operated in HLS mode) one must define a boolean variable hls; that would instruct the curses init_color routine to convert its RGB arguments to HLS before sending them to the terminal. The last three arguments to the initc string would then be HLS values.

If a terminal can change the definitions of colors, but uses a color notation different from RGB and HLS, a mapping to either RGB or HLS must be developed.

To set current foreground or background to a given color, use setaf (set ANSI foreground) and setab (set ANSI background). They require one parameter: the number of the color. To initialize a color-pair (HP method), use initp (initialize pair). It requires seven parameters: the number of a color-pair (range=0 to pairs-1), and six RGB values: three for the foreground followed by three for the background. (Each of these groups of three should be in the order RGB.) When initc or initp are used, RGB or HLS arguments should be in the order "red, green, blue" or "hue, lightness, saturation"), respectively. To make a color-pair current, use scp (set color-pair). It takes one parameter, the number of a color-pair.
Some terminals (for example, most color terminal emulators for PCs) erase areas of the screen with current background color. In such cases, bce (background color erase) should be defined. The variable op (original pair) contains a sequence for setting the foreground and the background colors to what they were at the terminal start-up time. Similarly, oc (original colors) contains a control sequence for setting all colors (for the Tektronix method) or color-pairs (for the HP method) to the values they had at the terminal start-up time.

Some color terminals substitute color for video attributes. Such video attributes should not be combined with colors. Information about these video attributes should be packed into the ncv (no color video) variable. There is a one-to-one correspondence between the nine least significant bits of that variable and the video attributes. The following table depicts this correspondence.

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Bit Position</th>
<th>Decimal Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>A_STANDOUT</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>A_UNDERLINE</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>A_REVERSE</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>A_BLINK</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>A_DIM</td>
<td>4</td>
<td>16</td>
</tr>
<tr>
<td>A_BOLD</td>
<td>5</td>
<td>32</td>
</tr>
<tr>
<td>A_INVIS</td>
<td>6</td>
<td>64</td>
</tr>
<tr>
<td>A_PROTECT</td>
<td>7</td>
<td>128</td>
</tr>
<tr>
<td>A_ALTCHARSET</td>
<td>8</td>
<td>256</td>
</tr>
</tbody>
</table>

When a particular video attribute should not be used with colors, the corresponding ncv bit should be set to 1; otherwise it should be set to zero. To determine the information to pack into the ncv variable, you must add together the decimal values corresponding to those attributes that cannot coexist with colors. For example, if the terminal uses colors to simulate reverse video (bit number 2 and decimal value 4) and bold (bit number 5 and decimal value 32), the resulting value for ncv will be 36 (4 + 32).

Section 1-14: Miscellaneous

If the terminal requires other than a null (zero) character as a pad, then this can be given as pad. Only the first character of the pad string is used. If the terminal does not have a pad character, specify npc.

If the terminal can move up or down half a line, this can be indicated with hu (half-line up) and hd (half-line down). This is primarily useful for superscripts and subscripts on hardcopy terminals. If a hardcopy terminal can eject to the next page (form feed), give this as ff (usually control L).

If there is a command to repeat a given character a given number of times (to save time transmitting a large number of identical characters) this can be indicated with the parameterized string rep. The first parameter is the character to be repeated and the second is the number of times to repeat it. Thus, tparm(repeat_char, 'x', 10) is the same as xxxxxxxxxx.
If the terminal has a settable command character, such as the Tektronix 4025, this can be indicated with `cmdch`. A prototype command character is chosen which is used in all capabilities. This character is given in the `cmdch` capability to identify it. The following convention is supported on some UNIX systems: If the environment variable `CC` exists, all occurrences of the prototype character are replaced with the character in `CC`.

Terminal descriptions that do not represent a specific kind of known terminal, such as `switch`, `dialup`, `patch`, and `network`, should include the `gn` (generic) capability so that programs can complain that they do not know how to talk to the terminal. (This capability does not apply to virtual terminal descriptions for which the escape sequences are known.) If the terminal is one of those supported by the UNIX system virtual terminal protocol, the terminal number can be given as `vt`. A line-turnaround sequence to be transmitted before doing reads should be specified in `rfi`.

If the device uses `xon/xoff` handshaking for flow control, give `xon`. Padding information should still be included so that routines can make better decisions about costs, but actual pad characters will not be transmitted. Sequences to turn on and off `xon/xoff` handshaking may be given in `smaxon` and `rmaxon`. If the `xon` and `xoff` characters used for handshaking are not `~S` and `~Q`, they may be specified with `xonc` and `xoffc`.

If the terminal has a "meta key" which acts as a shift key, setting the 8th bit of any character transmitted, this fact can be indicated with `km`. Otherwise, software will assume that the 8th bit is parity and it will usually be cleared. If strings exist to turn this "meta mode" on and off, they can be given as `smm` and `rmm`.

If the terminal has more lines of memory than will fit on the screen at once, the number of lines of memory can be indicated with `lm`. A value of `lm#0` indicates that the number of lines is not fixed, but that there is still more memory than fits on the screen.

Media copy strings which control an auxiliary printer connected to the terminal can be given as `mc0`: print the contents of the screen, `mc4`: turn off the printer, and `mc5`: turn on the printer. When the printer is on, all text sent to the terminal will be sent to the printer. A variation, `mc5p`, takes one parameter, and leaves the printer on for as many characters as the value of the parameter, then turns the printer off. The parameter should not exceed 255. If the text is not displayed on the terminal screen when the printer is on, specify `mc5i` (silent printer). All text, including `mc4`, is transparently passed to the printer while an `mc5p` is in effect.

**Section 1-15: Special Cases**

The working model used by `terminfo` fits most terminals reasonably well. However, some terminals do not completely match that model, requiring special support by `terminfo`. These are not meant to be construed as deficiencies in the terminals; they are just differences between the working model and the actual hardware. They may be unusual devices or, for some reason, do not have all the features of the `terminfo` model implemented.

Terminals that cannot display tilde (`~`) characters, such as certain Hazeltine terminals, should indicate `hz`. 

253
Terminals that ignore a linefeed immediately after an am wrap, such as the Concept 100, should indicate xenl. Those terminals whose cursor remains on the right-most column until another character has been received, rather than wrapping immediately upon receiving the right-most character, such as the VT100, should also indicate xenl.

If el is required to get rid of standout (instead of writing normal text on top of it), xhp should be given.

Those Teleray terminals whose tabs turn all characters moved over to blanks, should indicate xt (destructive tabs). This capability is also taken to mean that it is not possible to position the cursor on top of a “magic cookie.” Therefore, to erase standout mode, it is necessary, instead, to use delete and insert line.

Those Beehive Superbee terminals which do not transmit the escape or control-C characters, should specify xsb, indicating that the f1 key is to be used for escape and the f2 key for control C.

Section 1-16: Similar Terminals

If there are two very similar terminals, one can be defined as being just like the other with certain exceptions. The string capability use can be given with the name of the similar terminal. The capabilities given before use override those in the terminal type invoked by use. A capability can be canceled by placing xx@ to the left of the capability definition, where xx is the capability. For example, the entry

```
att4424-2|Teletype 4424 in display function group ii,
rev@, sgr@, smul@, use=att4424,
```

defines an AT&T 4424 terminal that does not have the rev, sgr, and smul capabilities, and hence cannot do highlighting. This is useful for different modes for a terminal, or for different user preferences. More than one use capability may be given.

PART 2: PRINTER CAPABILITIES

The terminfo database allows you to define capabilities of printers as well as terminals. To find out what capabilities are available for printers as well as for terminals, see the two lists under "DEVICE CAPABILITIES" that list capabilities by variable and by capability name.

Section 2-1: Rounding Values

Because parameterized string capabilities work only with integer values, we recommend that terminfo designers create strings that expect numeric values that have been rounded. Application designers should note this and should always round values to the nearest integer before using them with a parameterized string capability.

Section 2-2: Printer Resolution

A printer’s resolution is defined to be the smallest spacing of characters it can achieve. In general printers have independent resolution horizontally and vertically. Thus the vertical resolution of a printer can be determined by measuring the smallest achievable distance between consecutive printing baselines, while the horizontal resolution can be determined by measuring the smallest achievable distance between the left-most edges of consecutive printed, identical, characters.
All printers are assumed to be capable of printing with a uniform horizontal and vertical resolution. The view of printing that terminfo currently presents is one of printing inside a uniform matrix: All characters are printed at fixed positions relative to each “cell” in the matrix; furthermore, each cell has the same size given by the smallest horizontal and vertical step sizes dictated by the resolution. (The cell size can be changed as will be seen later.)

Many printers are capable of “proportional printing,” where the horizontal spacing depends on the size of the character last printed. terminfo does not make use of this capability, although it does provide enough capability definitions to allow an application to simulate proportional printing.

A printer must not only be able to print characters as close together as the horizontal and vertical resolutions suggest, but also of “moving” to a position an integral multiple of the smallest distance away from a previous position. Thus printed characters can be spaced apart a distance that is an integral multiple of the smallest distance, up to the length or width of a single page.

Some printers can have different resolutions depending on different “modes.” In “normal mode,” the existing terminfo capabilities are assumed to work on columns and lines, just like a video terminal. Thus the old lines capability would give the length of a page in lines, and the cols capability would give the width of a page in columns. In “micro mode,” many terminfo capabilities work on increments of lines and columns. With some printers the micro mode may be concomitant with normal mode, so that all the capabilities work at the same time.

Section 2-3: Specifying Printer Resolution

The printing resolution of a printer is given in several ways. Each specifies the resolution as the number of smallest steps per distance:

<table>
<thead>
<tr>
<th>Specification of Printer Resolution</th>
<th>Characteristic Number of Smallest Steps</th>
</tr>
</thead>
<tbody>
<tr>
<td>orhi</td>
<td>Steps per inch horizontally</td>
</tr>
<tr>
<td>orvi</td>
<td>Steps per inch vertically</td>
</tr>
<tr>
<td>orc</td>
<td>Steps per column</td>
</tr>
<tr>
<td>orl</td>
<td>Steps per line</td>
</tr>
</tbody>
</table>

When printing in normal mode, each character printed causes movement to the next column, except in special cases described later; the distance moved is the same as the per-column resolution. Some printers cause an automatic movement to the next line when a character is printed in the rightmost position; the distance moved vertically is the same as the per-line resolution. When printing in micro mode, these distances can be different, and may be zero for some printers.

<table>
<thead>
<tr>
<th>Specification of Printer Resolution</th>
<th>Automatic Motion after Printing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal Mode:</td>
<td></td>
</tr>
<tr>
<td>orc</td>
<td>Steps moved horizontally</td>
</tr>
<tr>
<td>orl</td>
<td>Steps moved vertically</td>
</tr>
</tbody>
</table>
Some printers are capable of printing wide characters. The distance moved when a wide character is printed in normal mode may be different from when a regular width character is printed. The distance moved when a wide character is printed in micro mode may also be different from when a regular character is printed in micro mode, but the differences are assumed to be related: If the distance moved for a regular character is the same whether in normal mode or micro mode (mcs = orc), then the distance moved for a wide character is also the same whether in normal mode or micro mode. This doesn’t mean the normal character distance is necessarily the same as the wide character distance, just that the distances don’t change with a change in normal to micro mode. However, if the distance moved for a regular character is different in micro mode from the distance moved in normal mode (mcs < orc), the micro mode distance is assumed to be the same for a wide character printed in micro mode, as the table below shows.

### Specification of Printer Resolution

**Automatic Motion after Printing Wide Character**

<table>
<thead>
<tr>
<th>Normal Mode or Micro Mode (mcs = orc):</th>
<th>widcs</th>
<th>Steps moved horizontally</th>
</tr>
</thead>
<tbody>
<tr>
<td>Micro Mode (mcs &lt; orc):</td>
<td></td>
<td></td>
</tr>
<tr>
<td>mcs</td>
<td></td>
<td>Steps moved horizontally</td>
</tr>
</tbody>
</table>

There may be control sequences to change the number of columns per inch (the character pitch) and to change the number of lines per inch (the line pitch). If these are used, the resolution of the printer changes, but the type of change depends on the printer:

### Specification of Printer Resolution

**Changing the Character/Line Pitches**

| cpi | Change character pitch                     |
| cpi | If set, cpi changes orhi, otherwise changes orc |
| lpi | Change line pitch                          |
| lpi | If set, lpi changes orvi, otherwise changes orl |
| chr | Change steps per column                    |
| cvr | Change steps per line                      |

The cpi and lpi string capabilities are each used with a single argument, the pitch in columns (or characters) and lines per inch, respectively. The chr and cvr string capabilities are each used with a single argument, the number of steps per column and line, respectively.

Using any of the control sequences in these strings will imply a change in some of the values of orc, orhi, orl, and orvi. Also, the distance moved when a wide character is printed, widcs, changes in relation to orc. The distance moved when a character is printed in micro mode, mcs, changes similarly, with one exception: if
the distance is 0 or 1, then no change is assumed (see items marked with † in the following table).

Programs that use \texttt{cpi, lpi, chr,} or \texttt{cvr} should recalculate the printer resolution (and should recalculate other values see "Effect of Changing Printing Resolution" under "Dot-Mapped Graphics").

### Specification of Printer Resolution

#### Effects of Changing the Character/Line Pitches

<table>
<thead>
<tr>
<th>Before</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>Using \texttt{cpi} with \texttt{cpi}x clear:</td>
<td></td>
</tr>
<tr>
<td>\texttt{orhi}'</td>
<td>\texttt{orhi}</td>
</tr>
<tr>
<td>\texttt{orc}'</td>
<td>\texttt{orc} = \texttt{orhi} / V_{cpi}</td>
</tr>
<tr>
<td>Using \texttt{cpi} with \texttt{cpi}x set:</td>
<td></td>
</tr>
<tr>
<td>\texttt{orhi}'</td>
<td>\texttt{orhi} = \texttt{orc} \cdot V_{cpi}</td>
</tr>
<tr>
<td>\texttt{orc}'</td>
<td>\texttt{orc}</td>
</tr>
<tr>
<td>Using \texttt{lpi} with \texttt{lpi}x clear:</td>
<td></td>
</tr>
<tr>
<td>\texttt{orvi}'</td>
<td>\texttt{orvi}</td>
</tr>
<tr>
<td>\texttt{orl}'</td>
<td>\texttt{orl} = \texttt{orvi} / V_{lpi}</td>
</tr>
<tr>
<td>Using \texttt{lpi} with \texttt{lpi}x set:</td>
<td></td>
</tr>
<tr>
<td>\texttt{orvi}'</td>
<td>\texttt{orvi} = \texttt{orl} \cdot V_{lpi}</td>
</tr>
<tr>
<td>\texttt{orl}'</td>
<td>\texttt{orl}</td>
</tr>
<tr>
<td>Using \texttt{chr}:</td>
<td></td>
</tr>
<tr>
<td>\texttt{orhi}'</td>
<td>\texttt{orhi}</td>
</tr>
<tr>
<td>\texttt{orc}'</td>
<td>V_{chr}</td>
</tr>
<tr>
<td>Using \texttt{cvr}:</td>
<td></td>
</tr>
<tr>
<td>\texttt{orvi}'</td>
<td>\texttt{orvi}</td>
</tr>
<tr>
<td>\texttt{orl}'</td>
<td>V_{cvr}</td>
</tr>
<tr>
<td>Using \texttt{cpi} or \texttt{chr}:</td>
<td></td>
</tr>
<tr>
<td>\texttt{wids}'</td>
<td>\texttt{wids} = \texttt{wids} \cdot \texttt{orc} / \texttt{orc}'</td>
</tr>
<tr>
<td>\texttt{mcs}'</td>
<td>\texttt{mcs} = \texttt{mcs} \cdot \texttt{orc} / \texttt{orc}'</td>
</tr>
</tbody>
</table>

$V_{cpi}$, $V_{lpi}$, $V_{chr}$, and $V_{cvr}$ are the arguments used with \texttt{cpi, lpi, chr,} and \texttt{cvr,} respectively. The prime marks (') indicate the old values.

### Section 2-4: Capabilities that Cause Movement

In the following descriptions, "movement" refers to the motion of the "current position." With video terminals this would be the cursor; with some printers this is the carriage position. Other printers have different equivalents. In general, the current position is where a character would be displayed if printed.
**terminfo (4)**

*terminfo* has string capabilities for control sequences that cause movement a number of full columns or lines. It also has equivalent string capabilities for control sequences that cause movement a number of smallest steps.

<table>
<thead>
<tr>
<th>String Capabilities for Motion</th>
</tr>
</thead>
<tbody>
<tr>
<td>mcubl</td>
</tr>
<tr>
<td>mcuf1</td>
</tr>
<tr>
<td>mcuul</td>
</tr>
<tr>
<td>mcudl</td>
</tr>
<tr>
<td>mcub</td>
</tr>
<tr>
<td>mcuf</td>
</tr>
<tr>
<td>mcuu</td>
</tr>
<tr>
<td>mcud</td>
</tr>
<tr>
<td>mhpa</td>
</tr>
<tr>
<td>mvpa</td>
</tr>
</tbody>
</table>

The latter six strings are each used with a single argument, *N*.

Sometimes the motion is limited to less than the width or length of a page. Also, some printers don’t accept absolute motion to the left of the current position. *terminfo* has capabilities for specifying these limits.

<table>
<thead>
<tr>
<th>Limits to Motion</th>
</tr>
</thead>
<tbody>
<tr>
<td>njump</td>
</tr>
<tr>
<td>maddr</td>
</tr>
<tr>
<td>xhpa</td>
</tr>
<tr>
<td>xvpa</td>
</tr>
</tbody>
</table>

If a printer needs to be in a “micro mode” for the motion capabilities described above to work, there are string capabilities defined to contain the control sequence to enter and exit this mode. A boolean is available for those printers where using a carriage return causes an automatic return to normal mode.

<table>
<thead>
<tr>
<th>Entering/Exiting Micro Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>smicm</td>
</tr>
<tr>
<td>rmicm</td>
</tr>
<tr>
<td>crxm</td>
</tr>
</tbody>
</table>

The movement made when a character is printed in the rightmost position varies among printers. Some make no movement, some move to the beginning of the next line, others move to the beginning of the same line. *terminfo* has boolean capabilities for describing all three cases.
Some printers can be put in a mode where the normal direction of motion is reversed. This mode can be especially useful when there are no capabilities for leftward or upward motion, because those capabilities can be built from the motion reversal capability and the rightward or downward motion capabilities. It is best to leave it up to an application to build the leftward or upward capabilities, though, and not enter them in the terminfo database. This allows several reverse motions to be strung together without intervening wasted steps that leave and reenter reverse mode.

The reverse motion modes should not affect the mvpa and mhpa absolute motion capabilities. The reverse vertical motion mode should, however, also reverse the action of the line “wrapping” that occurs when a character is printed in the rightmost position. Thus printers that have the standard terminfo capability am defined should experience motion to the beginning of the previous line when a character is printed in the right-most position under reverse vertical motion mode.

The action when any other motion capabilities are used in reverse motion modes is not defined; thus, programs must exit reverse motion modes before using other motion capabilities.
Two miscellaneous capabilities complete the list of new motion capabilities. One of these is needed for printers that move the current position to the beginning of a line when certain control characters, such as "line-feed" or "form-feed," are used. The other is used for the capability of suspending the motion that normally occurs after printing a character.

Miscellaneous Motion Strings

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>do.cr</td>
<td>List of control characters causing cr zero</td>
</tr>
<tr>
<td>zerom</td>
<td>Prevent auto motion after printing next single character</td>
</tr>
</tbody>
</table>

Margins

terminfo provides two strings for setting margins on terminals: one for the left and one for the right margin. Printers, however, have two additional margins, for the top and bottom margins of each page. Furthermore, some printers require not using motion strings to move the current position to a margin and then fixing the margin there, but require the specification of where a margin should be regardless of the current position. Therefore terminfo offers six additional strings for defining margins with printers.

Setting Margins

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>sm.gl</td>
<td>Set left margin at current column</td>
</tr>
<tr>
<td>sm.gr</td>
<td>Set right margin at current column</td>
</tr>
<tr>
<td>sm.gb</td>
<td>Set bottom margin at current line</td>
</tr>
<tr>
<td>sm.gt</td>
<td>Set top margin at current line</td>
</tr>
<tr>
<td>sm.gb.p</td>
<td>Set bottom margin at line N</td>
</tr>
<tr>
<td>sm.gl.p</td>
<td>Set left margin at column N</td>
</tr>
<tr>
<td>sm.gr.p</td>
<td>Set right margin at column N</td>
</tr>
<tr>
<td>sm.g.t.p</td>
<td>Set top margin at line N</td>
</tr>
</tbody>
</table>

The last four strings are used with one or more arguments that give the position of the margin or margins to set. If both of sm.gl.p and sm.gr.p are set, each is used with a single argument, N, that gives the column number of the left and right margin, respectively. If both of sm.g.t.p and sm.gb.p are set, each is used to set the top and bottom margin, respectively: sm.g.t.p is used with a single argument, N, the line number of the top margin; however, sm.gb.p is used with two arguments, N and M, that give the line number of the bottom margin, the first counting from the top of the page and the second counting from the bottom. This accommodates the two styles of specifying the bottom margin in different manufacturers' printers. When coding a terminfo entry for a printer that has a settable bottom margin, only the first or second parameter should be used, depending on the printer. When writing an application that uses sm.gb.p to set the bottom margin, both arguments must be given.

If only one of sm.gl.p and sm.gr.p is set, then it is used with two arguments, the column number of the left and right margins, in that order. Likewise, if only one of sm.g.t.p and sm.gb.p is set, then it is used with two arguments that give the top and bottom margins, in that order, counting from the top of the page. Thus when coding a terminfo entry for a printer that requires setting both left and right or top and bottom margins simultaneously, only one of sm.gl.p and sm.gr.p or sm.g.t.p and sm.gb.p should be defined; the other should be left blank. When writing an
application that uses these string capabilities, the pairs should be first checked to see if each in the pair is set or only one is set, and should then be used accordingly.

In counting lines or columns, line zero is the top line and column zero is the leftmost column. A zero value for the second argument with \texttt{smgbp} means the bottom line of the page.

All margins can be cleared with \texttt{mgc}.

**Shadows, Italics, Wide Characters, Superscripts, Subscripts**

Five new sets of strings are used to describe the capabilities printers have of enhancing printed text.

<table>
<thead>
<tr>
<th>Enhanced Printing</th>
</tr>
</thead>
<tbody>
<tr>
<td>\texttt{sshm}</td>
</tr>
<tr>
<td>\texttt{rshm}</td>
</tr>
<tr>
<td>\texttt{sitm}</td>
</tr>
<tr>
<td>\texttt{ritm}</td>
</tr>
<tr>
<td>\texttt{swidm}</td>
</tr>
<tr>
<td>\texttt{rwidm}</td>
</tr>
<tr>
<td>\texttt{ssupm}</td>
</tr>
<tr>
<td>\texttt{rsupm}</td>
</tr>
<tr>
<td>\texttt{supcs}</td>
</tr>
<tr>
<td>\texttt{ssubm}</td>
</tr>
<tr>
<td>\texttt{rsubm}</td>
</tr>
<tr>
<td>\texttt{subcs}</td>
</tr>
</tbody>
</table>

If a printer requires the \texttt{sshm} control sequence before every character to be shadow-printed, the \texttt{rshm} string is left blank. Thus programs that find a control sequence in \texttt{sshm} but none in \texttt{rshm} should use the \texttt{sshm} control sequence before every character to be shadow-printed; otherwise, the \texttt{sshm} control sequence should be used once before the set of characters to be shadow-printed, followed by \texttt{rshm}. The same is also true of each of the \texttt{sitm}/\texttt{ritm}, \texttt{swidm}/\texttt{rwidm}, \texttt{ssupm}/\texttt{rsupm}, and \texttt{ssubm}/\texttt{rsubm} pairs.

Note that \texttt{terminfo} also has a capability for printing emboldened text (bold). While shadow printing and emboldened printing are similar in that they “darken” the text, many printers produce these two types of print in slightly different ways. Generally, emboldened printing is done by overstriking the same character one or more times. Shadow printing likewise usually involves overstriking, but with a slight movement up and/or to the side so that the character is “fatter.”

It is assumed that enhanced printing modes are independent modes, so that it would be possible, for instance, to shadow print italicized subscripts.

As mentioned earlier, the amount of motion automatically made after printing a wide character should be given in \texttt{widcs}.

If only a subset of the printable ASCII characters can be printed as superscripts or subscripts, they should be listed in \texttt{supcs} or \texttt{subcs} strings, respectively. If the \texttt{ssupm} or \texttt{ssubm} strings contain control sequences, but the corresponding \texttt{supcs} or
**terminfo (4)**

subesc strings are empty, it is assumed that all printable ASCII characters are available as superscripts or subscripts.

Automatic motion made after printing a superscript or subscript is assumed to be the same as for regular characters. Thus, for example, printing any of the following three examples will result in equivalent motion:

\[
\text{Bi} \quad \text{B}^i
\]

Note that the existing `msgr` boolean capability describes whether motion control sequences can be used while in "standout mode." This capability is extended to cover the enhanced printing modes added here. `msgr` should be set for those printers that accept any motion control sequences without affecting shadow, italicized, widened, superscript, or subscript printing. Conversely, if `msgr` is not set, a program should end these modes before attempting any motion.

**Section 2-5: Alternate Character Sets**

In addition to allowing you to define line graphics (described in Section 1-12), terminfo lets you define alternate character sets. The following capabilities cover printers and terminals with multiple selectable or definable character sets.

<table>
<thead>
<tr>
<th>Alternate Character Sets</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>scs</code></td>
</tr>
<tr>
<td><code>scsd</code></td>
</tr>
<tr>
<td><code>defc</code></td>
</tr>
<tr>
<td><code>rcsd</code></td>
</tr>
<tr>
<td><code>csnm</code></td>
</tr>
<tr>
<td><code>daisy</code></td>
</tr>
</tbody>
</table>

The `scs`, `rcsd`, and `csnm` strings are used with a single argument, \(N\), a number from 0 to 63 that identifies the character set. The `scsd` string is also used with the argument \(N\) and another, \(M\), that gives the number of characters in the set. The `defc` string is used with three arguments: \(A\) gives the ASCII code representation for the character, \(B\) gives the width of the character in dots, and \(D\) is zero or one depending on whether the character is a "descender" or not. The `defc` string is also followed by a string of "image-data" bytes that describe how the character looks (see below).

Character set 0 is the default character set present after the printer has been initialized. Not every printer has 64 character sets, of course; using `scs` with an argument that doesn’t select an available character set should cause a null result from `tparm`.

If a character set has to be defined before it can be used, the `scsd` control sequence is to be used before defining the character set, and the `rcsd` is to be used after. They should also cause a null result from `tparm` when used with an argument \(N\) that doesn’t apply. If a character set still has to be selected after being defined, the `scs` control sequence should follow the `rcsd` control sequence. By examining the results of using each of the `scs`, `scsd`, and `rcsd` strings with a character set number in a call to `tparm`, a program can determine which of the three are needed.
Between use of the `scsd` and `rscsd` strings, the `defc` string should be used to define each character. To print any character on printers covered by `terminfo`, the ASCII code is sent to the printer. This is true for characters in an alternate set as well as “normal” characters. Thus the definition of a character includes the ASCII code that represents it. In addition, the width of the character in dots is given, along with an indication of whether the character should descend below the print line (such as the lower case letter “g” in most character sets). The width of the character in dots also indicates the number of image-data bytes that will follow the `defc` string. These image-data bytes indicate where in a dot-matrix pattern ink should be applied to “draw” the character; the number of these bytes and their form are defined below under “Dot-Mapped Graphics.”

It’s easiest for the creator of `terminfo` entries to refer to each character set by number; however, these numbers will be meaningless to the application developer. The `csnm` string alleviates this problem by providing names for each number.

When used with a character set number in a call to `tparm`, the `csnm` string will produce the equivalent name. These names should be used as a reference only. No naming convention is implied, although anyone who creates a `terminfo` entry for a printer should use names consistent with the names found in user documents for the printer. Application developers should allow a user to specify a character set by number (leaving it up to the user to examine the `csnm` string to determine the correct number), or by name, where the application examines the `csnm` string to determine the corresponding character set number.

These capabilities are likely to be used only with dot-matrix printers. If they are not available, the strings should not be defined. For printers that have manually changed print-wheels or font cartridges, the boolean `daisy` is set.

**Section 2-6: Dot-Matrix Graphics**

Dot-matrix printers typically have the capability of reproducing “raster-graphics” images. Three new numeric capabilities and three new string capabilities can help a program draw raster-graphics images independent of the type of dot-matrix printer or the number of pins or dots the printer can handle at one time.

<table>
<thead>
<tr>
<th>Dot-Matrix Graphics</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>npins</td>
<td>Number of pins, ( N ), in print-head</td>
</tr>
<tr>
<td>spinv</td>
<td>Spacing of pins vertically in pins per inch</td>
</tr>
<tr>
<td>spinh</td>
<td>Spacing of dots horizontally in dots per inch</td>
</tr>
<tr>
<td>porder</td>
<td>Matches software bits to print-head pins</td>
</tr>
<tr>
<td>sbim</td>
<td>Start printing bit image graphics, ( B ) bits wide</td>
</tr>
<tr>
<td>rbim</td>
<td>End printing bit image graphics</td>
</tr>
</tbody>
</table>

The `sbim` string is used with a single argument, \( B \), the width of the image in dots.

The model of dot-matrix or raster-graphics that `terminfo` presents is similar to the technique used for most dot-matrix printers: each pass of the printer’s print-head is assumed to produce a dot-matrix that is \( N \) dots high and \( B \) dots wide. This is typically a wide, squat, rectangle of dots. The height of this rectangle in dots will vary from one printer to the next; this is given in the `npins` numeric capability. The size of the rectangle in fractions of an inch will also vary; it can be deduced from the `spinv` and `spinh` numeric capabilities. With these three values an application can
divide a complete raster-graphics image into several horizontal strips, perhaps interpolating to account for different dot spacing vertically and horizontally.

The `sbim` and `rbim` strings are used to start and end a dot-matrix image, respectively. The `sbim` string is used with a single argument that gives the width of the dot-matrix in dots. A sequence of "image-data bytes" are sent to the printer after the `sbim` string and before the `rbim` string. The number of bytes is a integral multiple of the width of the dot-matrix; the multiple and the form of each byte is determined by the `porder` string as described below.

The `porder` string is a comma separated list of pin numbers optionally followed by an numerical offset. The offset, if given, is separated from the list with a semicolon. The position of each pin number in the list corresponds to a bit in an 8-bit data byte. The pins are numbered consecutively from 1 to `npins`, with 1 being the top pin. Note that the term "pin" is used loosely here; "ink-jet" dot-matrix printers don’t have pins, but can be considered to have an equivalent method of applying a single dot of ink to paper. The bit positions in `porder` are in groups of 8, with the first position in each group the most significant bit and the last position the least significant bit. An application produces 8-bit bytes in the order of the groups in `porder`.

An application computes the "image-data bytes" from the internal image, mapping vertical dot positions in each print-head pass into 8-bit bytes, using a 1 bit where ink should be applied and 0 where no ink should be applied. This can be reversed (0 bit for ink, 1 bit for no ink) by giving a negative pin number. If a position is skipped in `porder`, a 0 bit is used. If a position has a lower case ‘x’ instead of a pin number, a 1 bit is used in the skipped position. For consistency, a lower case ‘0’ can be used to represent a 0 filled, skipped bit. There must be a multiple of 8 bit positions used or skipped in `porder`; if not, 0 bits are used to fill the last byte in the least significant bits. The offset, if given, is added to each data byte; the offset can be negative.

Some examples may help clarify the use of the `porder` string. The AT&T 470, AT&T 475 and C.Itoh 8510 printers provide eight pins for graphics. The pins are identified top to bottom by the 8 bits in a byte, from least significant to most. The `porder` strings for these printers would be `8, 7, 6, 5, 4, 3, 2, 1`. The AT&T 478 and AT&T 479 printers also provide eight pins for graphics. However, the pins are identified in the reverse order. The `porder` strings for these printers would be `1, 2, 3, 4, 5, 6, 7, 8`. The AT&T 5310, AT&T 5320, DEC LA100, and DEC LN03 printers provide six pins for graphics. The pins are identified top to bottom by the decimal values 1, 2, 4, 8, 16 and 32. These correspond to the low six bits in an 8-bit byte, although the decimal values are further offset by the value 63. The `porder` string for these printers would be `6, 5, 4, 3, 2, 1; 63`, or alternately `0, 0, 6, 5, 4, 3, 2, 1; 63`.

**Section 2-7: Effect of Changing Printing Resolution**

If the control sequences to change the character pitch or the line pitch are used, the pin or dot spacing may change:
Dot-Matrix Graphics
Changing the Character/Line Pitches

- **cpi**: Change character pitch
- **cpi**x: If set, **cpi** changes **spinh**
- **lpi**: Change line pitch
- **lpi**x: If set, **lpi** changes **spinv**

Programs that use **cpi** or **lpi** should recalculate the dot spacing:

<table>
<thead>
<tr>
<th>Before</th>
<th>After</th>
</tr>
</thead>
<tbody>
<tr>
<td>Using <strong>cpi</strong> with <strong>cpi</strong>x clear:</td>
<td></td>
</tr>
<tr>
<td><strong>spinh</strong>'</td>
<td><strong>spinh</strong></td>
</tr>
<tr>
<td>Using <strong>cpi</strong> with <strong>cpi</strong>x set:</td>
<td></td>
</tr>
<tr>
<td><strong>spinh</strong>'</td>
<td><strong>spinh</strong> = <strong>spinh</strong>'. ( \frac{\text{orhi}}{\text{orhi}} )</td>
</tr>
<tr>
<td>Using <strong>lpi</strong> with <strong>lpi</strong>x clear:</td>
<td></td>
</tr>
<tr>
<td><strong>spinv</strong>'</td>
<td><strong>spinv</strong></td>
</tr>
<tr>
<td>Using <strong>lpi</strong> with <strong>lpi</strong>x set:</td>
<td></td>
</tr>
<tr>
<td><strong>spinv</strong>'</td>
<td><strong>spinv</strong> = <strong>spinv</strong>'. ( \frac{\text{orhi}}{\text{orhi}} )</td>
</tr>
<tr>
<td>Using <strong>chr</strong>:</td>
<td></td>
</tr>
<tr>
<td><strong>spinh</strong>'</td>
<td><strong>spinh</strong></td>
</tr>
<tr>
<td>Using <strong>cvr</strong>:</td>
<td></td>
</tr>
<tr>
<td><strong>spinv</strong>'</td>
<td><strong>spinv</strong></td>
</tr>
</tbody>
</table>

**orhi**' and **orhi** are the values of the horizontal resolution in steps per inch, before using **cpi** and after using **cpi**, respectively. Likewise, **orvi**' and **orvi** are the values of the vertical resolution in steps per inch, before using **lpi** and after using **lpi**, respectively. Thus, the changes in the dots per inch for dot-matrix graphics follow the changes in steps per inch for printer resolution.

**Section 2-8: Print Quality**
Many dot-matrix printers can alter the dot spacing of printed text to produce near "letter quality" printing or "draft quality" printing. Usually it is important to be able to choose one or the other because the rate of printing generally falls off as the quality improves. There are three new strings used to describe these capabilities.
### Print Quality

- **snlq**: Set near-letter quality print
- **snrmq**: Set normal quality print
- **sdrfq**: Set draft quality print

The capabilities are listed in decreasing levels of quality. If a printer doesn’t have all three levels, one or two of the strings should be left blank as appropriate.

### Section 2-9: Printing Rate and Buffer Size

Because there is no standard protocol that can be used to keep a program synchronized with a printer, and because modern printers can buffer data before printing it, a program generally cannot determine at any time what has been printed. Two new numeric capabilities can help a program estimate what has been printed.

<table>
<thead>
<tr>
<th>Print Rate/Buffer Size</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>cps</strong></td>
<td>Nominal print rate in characters per second</td>
</tr>
<tr>
<td><strong>bufsz</strong></td>
<td>Buffer capacity in characters</td>
</tr>
</tbody>
</table>

**cps** is the nominal or average rate at which the printer prints characters; if this value is not given, the rate should be estimated at one-tenth the prevailing baud rate. **bufsz** is the maximum number of subsequent characters buffered before the guaranteed printing of an earlier character, assuming proper flow control has been used. If this value is not given it is assumed that the printer does not buffer characters, but prints them as they are received.

As an example, if a printer has a 1000-character buffer, then sending the letter “a” followed by 1000 additional characters is guaranteed to cause the letter “a” to print. If the same printer prints at the rate of 100 characters per second, then it should take 10 seconds to print all the characters in the buffer, less if the buffer is not full. By keeping track of the characters sent to a printer, and knowing the print rate and buffer size, a program can synchronize itself with the printer.

Note that most printer manufacturers advertise the maximum print rate, not the nominal print rate. A good way to get a value to put in for **cps** is to generate a few pages of text, count the number of printable characters, and then see how long it takes to print the text.

Applications that use these values should recognize the variability in the print rate. Straight text, in short lines, with no embedded control sequences will probably print at close to the advertised print rate and probably faster than the rate in **cps**. Graphics data with a lot of control sequences, or very long lines of text, will print at well below the advertised rate and below the rate in **cps**. If the application is using **cps** to decide how long it should take a printer to print a block of text, the application should pad the estimate. If the application is using **cps** to decide how much text has already been printed, it should shrink the estimate. The application will thus err in favor of the user, who wants, above all, to see all the output in its correct place.
TERMINFODNFO

FILES

/usr/share/lib/terminfo/?/*   compiled terminal description database
/usr/share/lib/tabset/*      tab settings for some terminals, in a format
                              appropriate to be output to the terminal
                              (escape sequences that set margins and tabs)

SEE ALSO

curses(3curses), ls(1), pg(1), printf(3S), stty(1), tic(1M), tput(1), tty(1), vi(1)

NOTES

The most effective way to prepare a terminal description is by imitating the description of a similar terminal in terminfo and to build up a description gradually, using partial descriptions with a screen oriented editor, such as vi, to check that they are correct. To easily test a new terminal description the environment variable TERMINFO can be set to the pathname of a directory containing the compiled description, and programs will look there rather than in /usr/share/lib/terminfo.
timezone(4)

NAME
timezone – set default system time zone

SYNOPSIS
/etc/TIMEZONE

DESCRIPTION
This file sets and exports the time zone environmental variable TZ.
This file is “dotted” into other files that must know the time zone.

EXAMPLES
/etc/TIMEZONE for the United States east coast:

    #  Time Zone
    TZ=EST5EDT
    export TZ

SEE ALSO
cftime(3C), environ(5), profile(4), rc2(1M)
NAME
ts_dptbl – time-sharing dispatcher parameter table

DESCRIPTION
The process scheduler (or dispatcher) is the portion of the kernel that controls allocation of the CPU to processes. The scheduler supports the notion of scheduling classes where each class defines a scheduling policy, used to schedule processes within that class. Associated with each scheduling class is a set of priority queues on which ready to run processes are linked. These priority queues are mapped by the system configuration into a set of global scheduling priorities which are available to processes within the class. (The dispatcher always selects for execution the process with the highest global scheduling priority in the system.) The priority queues associated with a given class are viewed by that class as a contiguous set of priority levels numbered from 0 (lowest priority) to \( n \) (highest priority—a configuration-dependent value). The set of global scheduling priorities that the queues for a given class are mapped into might not start at zero and might not be contiguous (depending on the configuration).

Processes in the time-sharing class which are running in user mode (or in kernel mode before going to sleep) are scheduled according to the parameters in a time-sharing dispatcher parameter table (ts_dptbl). (Time-sharing processes running in kernel mode after sleeping are run within a special range of priorities reserved for such processes and are not affected by the parameters in the ts_dptbl until they return to user mode.) The ts_dptbl consists of an array of parameter structures (struct ts_dpent), one for each of the \( n \) priority levels used by time-sharing processes in user mode. The properties of a given priority level \( i \) are specified by the \( i \)th parameter structure in this array (ts_dptbl).

A parameter structure consists of the following members. These are also described in the /usr/include/sys/ts.h header file.

- **ts_globpri**: The global scheduling priority associated with this priority level. The mapping between time-sharing priority levels and global scheduling priorities is determined at boot time by the system configuration. ts_globpri is the only member of the ts_dptbl which cannot be changed with dispadmin(1M).

- **ts_quantum**: The length of the time quantum allocated to processes at this level in ticks (HZ).

- **ts_tqexp**: Priority level of the new queue on which to place a process running at the current level if it exceeds its time quantum. Normally this field links to a lower priority time-sharing level that has a larger quantum.

- **ts_slpret**: Priority level of the new queue on which to place a process, that was previously in user mode at this level, when it returns to user mode after sleeping. Normally this field links to a higher priority level that has a smaller quantum.

- **ts_maxwait**: A per process counter, tsDispwait is initialized to zero each time a time-sharing process is placed back on the dispatcher queue after its time quantum has expired or when it is awakened (tsDispwait is not reset to zero when a process is preempted.
by a higher priority process). This counter is incremented once per second for each process on the dispatcher queue. If a process’s ts_dispwait value exceeds the ts_maxwait value for its level, the process’s priority is changed to that indicated by ts_lwait. The purpose of this field is to prevent starvation.

**ts_lwait**  
Move a process to this new priority level if ts_dispwait is greater than ts_maxwait.

An administrator can affect the behavior of the time-sharing portion of the scheduler by reconfiguring the ts_dptbl. There are two methods available for doing this.

**DISPADMIN CONFIGURATION FILE**

With the exception of ts_globpri all of the members of the ts_dptbl can be examined and modified on a running system using the dispadmin(lM) command. Invoking dispadmin for the time-sharing class allows the administrator to retrieve the current ts_dptbl configuration from the kernel’s in-core table, or overwrite the in-core table with values from a configuration file. The configuration file used for input to dispadmin must conform to the specific format described below.

Blank lines are ignored and any part of a line to the right of a # symbol is treated as a comment. The first non-blank, non-comment line must indicate the resolution to be used for interpreting the ts_quantum time quantum values. The resolution is specified as

RES=res

where res is a positive integer between 1 and 1,000,000,000 inclusive and the resolution used is the reciprocal of res in seconds (for example, RES=1000 specifies millisecond resolution). Although very fine (nanosecond) resolution may be specified, the time quantum lengths are rounded up to the next integral multiple of the system clock’s resolution. The system clock’s resolution is hardware-dependent; this resolution can be calculated from the value of HZ, which is defined in the file /usr/include/sys/param.h. HZ gives the number of clock ticks per second of the system clock. For example, an HZ of 100 specifies 100 clock ticks per second, or one tick every 10 milliseconds (that is, this system clock has a resolution of 10 milliseconds). If the -t and -r options are used to specify a time quantum of 34 milliseconds, it is rounded up to 4 ticks (40 milliseconds) on a machine with an HZ of 100.

The remaining lines in the file are used to specify the parameter values for each of the time-sharing priority levels. The first line specifies the parameters for time-sharing level 0, the second line specifies the parameters for time-sharing level 1, etc. There must be exactly one line for each configured time-sharing priority level.

**EXAMPLE**

The following excerpt from a dispadmin configuration file illustrates the format. Note that for each line specifying a set of parameters there is a comment indicating the corresponding priority level. These level numbers indicate priority within the time-sharing class, and the mapping between these time-sharing priorities and the corresponding global scheduling priorities is determined by the configuration specified in the ts master file. The level numbers are strictly for the convenience of the administrator reading the file and, as with any comment, they are ignored by
**Dispadmin** dispadmin assumes that the lines in the file are ordered by consecutive, increasing priority level (from 0 to the maximum configured time-sharing priority). The level numbers in the comments should normally agree with this ordering; if for some reason they don’t, however, dispadmin is unaffected.

```
# Time-Sharing Dispatcher Configuration File
RES=1000

# ts_quantum ts_tqexp ts_slpret ts_maxwait ts_lwait PRIORITY LEVEL
500 0 10 5 10 # 0
500 0 11 5 11 # 1
500 1 12 5 12 # 2
500 1 13 5 13 # 3
500 2 14 5 14 # 4
500 2 15 5 15 # 5
450 3 16 5 16 # 6
450 3 17 5 17 # 7
. . . . . . . .
. . . . . . . .
. . . . . . . .
50 48 59 5 59 # 58
50 49 59 5 59 # 59
```

**FILES**

/usr/include/sys/ts.h

**SEE ALSO**

dispadmin(1M), priocntl(1), priocntl(2)

**NOTES**

dispadmin does some limited sanity checking on the values supplied in the configuration file. The sanity checking is intended to ensure that the new ts_dptbl values do not cause the system to panic. The sanity checking does not attempt to analyze the effect that the new values will have on the performance of the system. Unusual ts_dptbl configurations may have a dramatic negative impact on the performance of the system.

No sanity checking is done on the ts_dptbl values specified in the ts master file. Specifying an inconsistent or nonsensical ts_dptbl configuration through the ts master file could cause serious performance problems and/or cause the system to panic.
ttydefs(4)

NAME

ttydefs – file contains terminal line settings information for ttymon

DESCRIPTION

/etc/ttydefs is an administrative file that contains information used by ttymon to set up the speed and terminal settings for a TTY port.

The ttydefs file contains the following fields:

ttylabel The string ttymon tries to match against the TTY port’s ttylabel field in the port monitor administrative file. It often describes the speed at which the terminal is supposed to run, for example, 1200.

initial-flags Contains the initial termio(7) settings to which the terminal is to be set. For example, the system administrator will be able to specify what the default erase and kill characters will be. initial-flags must be specified in the syntax recognized by the stty command.

final-flags final-flags must be specified in the same format as initial-flags. ttymon sets these final settings after a connection request has been made and immediately prior to invoking a port’s service.

autobaud If the autobaud field contains the character ‘A’, autobaud will be enabled. Otherwise, autobaud will be disabled. ttymon determines what line speed to set the TTY port to by analyzing the carriage returns entered. If autobaud has been disabled, the hunt sequence is used for baud rate determination.

nextlabel If the user indicates that the current terminal setting is not appropriate by sending a BREAK, ttymon searches for a ttydefs entry whose ttylabel field matches the nextlabel field. A series of speeds is often linked together in this way into a closed set called a hunt sequence. For example, 4800 may be linked to 1200, which in turn is linked to 2400, which is finally linked to 4800.

SEE ALSO

sttydefs(1M), ttymon(1M)
ttysrch(4)

NAME

ttysrch – directory search list for ttymap and ttyname

DESCRIPTION

TTYSRCH is an optional file used by the ttymap(1M) administrative command. The
TTYMAP command creates a map file, /var/tmp/ttymap, used by ttyname(3C) for
fast lookups of terminal device names.

The ttysrch file lists the names of directories in /dev that contain terminal and
terminal-related device files, as well as the names of directories that contain no such
files. The purpose of this file is to improve the performance of ttyname by identifying
subdirectories in /dev to be searched first and subdirectories to be ignored.
These subdirectory names must appear on separate lines and must begin with /dev.
Those path names that do not begin with /dev are ignored and a warning is sent to
the console. Blank lines (lines containing only white space) and lines beginning
with the comment character “#” are ignored. ttymap writes entries into the mapfile
/var/tmp/ttymap in the order in which they occur in the ttysrch file. Subdirectories
to be ignored are also specified as such in the mapfile. With the exception of
/dev, entries in the ttysrch file are used recursively to identify a directory
sub-tree.

When ttyname searches for device files, it tries to find a file whose major/minor
device number, file system identifier, and inode number match those of the file
descriptor it was given as an argument. If it does not find a match, it settles for a
match of just major/minor device and file system identifier, if one can be found.
However, if the file descriptor is associated with a cloned device [see clone(7)], this
algorithm does not work efficiently because the inode number of the device file
associated with a clonable device never matches the inode number of the file
descriptor that was returned by the open of that clonable device. To help with
these situations, entries can be put into the /etc/ttysrch file to improve perfor­
mance when cloned devices are used as terminals on a system (for remote login, for
example). However, this is useful only if the minor devices related to a cloned
device are put into a subdirectory. (It is important to note that device files need not
exist for cloned devices; if they do, ttyname fails.) For example, if /dev/starlan
is a cloned device, there could be a subdirectory /dev/starlan that contains files 0, 1, 2, . .
that correspond to the minor devices of the starlan driver.

An optional second field is used in the /etc/ttysrch file to indicate the matching
criteria. This field is separated from the first field by whitespace (any combination
of blanks or tabs). The field is made up of a combination of the following letters:

M major/minor device number
F file system identifier
I inode number
X ignore this directory completely

If this field is not specified for an entry, the default is MFI, which means try to
match on all three. For cloned devices the field should be MF, which indicates that it
is not necessary to match on the inode number.
ttysrch (4)

Without the /etc/ttysrch file, ttymap maps the /dev directory by first looking in
the directories /dev/term, /dev/pts, and /dev/xt, and by ignoring /dev/dsk and
/dev/rdsk. If a system has terminal devices installed in directories other than
these, it may help performance if the ttysrch file is created and contains that list of
directories.

EXAMPLE

A sample /etc/ttysrch file follows:

```
/dev/term       MFI
/dev/pts        MFI
/dev/xt         MFI
/dev/slan       MF
/dev/dsk        X
/dev/rdsk       X
```

This file tells ttyname that it should first search through those directories listed,
that when searching through the /dev/slan directory, if a file is encountered
whose major/minor devices and file system identifier match those of the file
descriptor argument to ttyname, this device name should be considered a match,
and that neither /dev/dsk nor /dev/rdsk need be searched.

FILES

/etc/ttysrch

SEE ALSO

clone(7), ttymap(1M), ttyname(3C)
NAME
unistd – header file for symbolic constants

SYNOPSIS
#include <unistd.h>

DESCRIPTION
The unistd.h header file defines the symbolic constants and structures not already
defined or declared in some other header file. The contents of this file are shown
below.

The following symbolic constants are defined for the access function [see
access(2)]:

   R_OK Test for read permission.
   W_OK Test for write permission.
   X_OK Test for execute (search) permission.
   F_OK Test for existence of file.

The constants F_OK, R_OK, W_OK and X_OK and the expressions R_OK | W_OK,
R_OK | X_OK and R_OK | W_OK | X_OK all have distinct values.

Declares the constant

   NULL null pointer

The following symbolic constants are defined for the lockf function [see
lockf(3C)]:

   F_ULOCK Unlock a previously locked region.
   F_LOCK Lock a region for exclusive use.
   F_TLOCK Test and lock a region for exclusive use.
   F_TEST Test a region for other processes locks.

The following symbolic constants are defined for the lseek [see lseek(2)] and
fcntl [see fcntl(2)] functions (they have distinct values):

   SEEK_SET Set file offset to offset.
   SEEK_CUR Set file offset to current plus offset.
   SEEK_END Set file offset to EOF plus offset.

The following symbolic constants are defined (with fixed values):

   _POSIX_VERSION Integer value indicating version of the POSIX
                        standard.
   _XOPEN_VERSION Integer value indicating version of the XPG to
                        which system is compliant.

The following symbolic constants are defined to indicate that the option is present:

   _POSIX_JOB_CONTROL Implementation supports job control.
   _POSIX_SAVED_IDS The exec functions [see exec(2)] save the effective
                        user and group.
   _POSIX_VDISABLE Terminal special characters defined in
                        termios.h [see termio(7)] can be disabled using
                        this character.
The following symbolic constants are defined for `sysconf` [see `sysconf(3C)`]:

- `_SC_ARG_MAX`
- `_SC_CHILD_MAX`
- `_SC_CLK_TCK`
- `_SC_JOB_CONTROL`
- `_SC_LOGNAME_MAX`
- `_SC_NGROUPS_MAX`
- `_SC_OPEN_MAX`
- `_SC_PAGESIZE`
- `_SC_PASS_MAX`
- `_SC_SAVED_IDS`
- `_SC_VERSION`
- `_SC_XOPEN_VERSION`

The following symbolic constants are defined for `pathconf` [see `fpathconf(2)`]:

- `_PC_CHOWN_RESTRICTED`
- `_PC_LINK_MAX`
- `_PC_MAX_CANON`
- `_PC_MAX_INPUT`
- `_PC_NAME_MAX`
- `_PC_NO_TRUNC`
- `_PC_PATH_MAX`
- `_PC_PIPE_BUF`
- `_PC_VDISABLE`

The following symbolic constants are defined for file streams:

- `STDIN_FILENO` File number of `stdin`. It is 0.
- `STDOUT_FILENO` File number of `stdout`. It is 1.
- `STDERR_FILENO` File number of `stderr`. It is 2.

The following pathnames are defined:

- `GF_PATH` Pathname of the group file.
- `PF_PATH` Pathname of the `passwd` file.

**SEE ALSO**

`access(2), exec(2), fcntl(2), fpathconf(2), group(4), lseek(2), passwd(4),
sysconf(3C), termios(7), termios(2)`

**NOTES**

The following values for constants are defined for this release of System V:

- `_POSIX_VERSION` 198808L
- `_XOPEN_VERSION` 3
NAME
updaters – configuration file for Network Information Service (NIS) updating

SYNOPSIS
/var/yp/updaters

DESCRIPTION
The file /var/yp/updaters is a makefile [see make(1)] which is used for updating
NIS databases. Databases can only be updated in a secure network, that is, one that
has a publickey(4) database. Each entry in the file is a make target for a particular
NIS database. For example, if there is a NIS database named publickeybyname
that can be updated, there should be a make target named publickeybyname in
the updaters file with the command to update the file.
The information necessary to make the update is passed to the update command
through standard input. The information passed is described below (all items are
followed by a NEWLINE, except for the actual bytes of key and actual bytes of date).

  network name of client wishing to make the update (a string)
  kind of update (an integer)
  number of bytes in key (an integer)
  actual bytes of key
  number of bytes in data (an integer)
  actual bytes of data

After getting this information through standard input, the command to update the
particular database should decide whether the user is allowed to make the change.
If not, it should exit with the status YPERR_ACCESS. If the user is allowed to make
the change, the command should make the change and exit with a status of zero. If
there are any errors that may prevent the updater from making the change, it
should exit with the status that matches a valid NIS error code described in
<rpcsvc/ypclnt.h>.

FILES
/var/yp/updaters

SEE ALSO
make(1), publickey(4), ypupdate(3N), ypupdated(1M)
utmp(4)

NAME
utmp, wtmp — utmp and wtmp entry formats

SYNOPSIS
#include <utmp.h>

DESCRIPTION
These files, which hold user and accounting information for such commands as who, write, and login, have the following structure, defined in utmp.h:

#define UTMP_FILE "/var/adm/utmp"
#define WTMP_FILE "/var/adm/wtmp"
#define ut_name ut_user

The utmp structure includes the following members:

char ut_user[8]; /* user login name */
char ut_id[4]; /* /etc/inittab id (created by */
char ut_line[12]; /* device name (console, lnxx) */
short ut_pid; /* process id */
short ut_type; /* type of entry */
struct exit_status {
    short e_termination; /* process termination status */
    short e_exit; /* process exit status */
} ut_exit;

time_t ut_time; /* time entry was made */

/* Definitions for ut_type */
#define EMPTY 0
#define RUN_LVL 1
#define BOOT_TIME 2
#define OLD_TIME 3
#define NEW_TIME 4
#define INIT_PROCESS 5 /* process spawned by "init" */
#define LOGIN_PROCESS 6 /* a "getty" process waiting for login */
#define USER_PROCESS 7 /* a user process */
#define DEAD_PROCESS 8
#define ACCOUNTING 9
#define UTMAXTYPE ACCOUNTING /* max legal value of ut_type */

/* Below are special strings or formats used in the "ut_line" */
/* field when accounting for something other than a process. */
/* No string for the ut_line field should be no more than 11 chars + */
/* a null character in length. */
#define RUNLVL_MSG "run-level %e"
#define BOOT_MSG "system boot"
#define OTIME_MSG "old time"
#define NTIME_MSG "new time"
FILES
/var/adm/utmp
/var/adm/wtmp

SEE ALSO
getut(3C), login(1), utmpx(4), who(1), write(1)
utmpx(4)

NAME
utmpx, wtmpx – utmpx and wtmpx entry formats

SYNOPSIS
#include <utmpx.h>

DESCRIPTION
utmpx(4) is an extended version of utmp(4).
These files, which hold user and accounting information for such commands as who,
write, and login, have the following structure as defined by utmpx.h:

#define UTMPX_FILE "/var/adm/utmpx"
#define WTMPX_FILE "/var/adm/wtmpx"
#define ut_name ut_user
#define ut_xtime ut_tv.tv_sec

The utmpx structure includes the following members:

char ut_user[32]; /* user login name */
char ut_id[4]; /* inittab id */
char ut_line[32]; /* device name (console, lnxx) */
pid_t ut_pid; /* process id */
short ut_type; /* type of entry */
struct exit_status {
  short e_termination; /* termination status */
  short e_exit; /* exit status */
} ut_exit; /* process termination/exit status */
struct timeval {
  long tv_sec; /* seconds */
  long tv_usec; /* and microseconds */
  ut_tv; /* time entry was made */
  long ut_session; /* session ID, used for windowing */
  long pad[5]; /* reserved for future use */
  short ut_syslen; /* significant length of ut_host */
  /* including terminating null */
  char ut_host[257]; /* remote host name */

/* Definitions for ut_type */

#define EMPTY 0
#define RUN_LVL 1
#define BOOT_TIME 2
#define OLD_TIME 3
#define NEW_TIME 4
#define INIT_PROCESS 5 /* Process spawned by "init" */
#define LOGIN_PROCESS 6 /* A "getty" process waiting for login */
#define USER_PROCESS 7 /* A user process */
#define DEAD_PROCESS 8
#define ACCOUNTING 9
#define UTMAXTYPE ACCOUNTING /* Largest legal value of ut_type */
utmpx(4)

/* Below are special strings or formats used in the "ut_line" */
/* field when accounting for something other than a process. */
/* No string for the ut_line field should be more than 31 chars + */
/* a null character in length. */
#define RUNLVL_MSG  "run-level %c"
#define BOOT_MSG    "system boot"
#define OTIME_MSG   "old time"
#define NTIME_MSG   "new time"
#define MOD_WIN     10

FILES
/var/adm/utmpx
/var/adm/wtmpx

SEE ALSO
getutx(3C), login(1), utmp(4), who(1), write(1)
NAME
uuencode – format of an encoded uuencode file

DESCRIPTION
Files output by uuencode consist of a header line, followed by a number of body
lines, and a trailer line. uudecode ignores any lines preceding the header or
following the trailer. Lines preceding a header must not, of course, look like a
header.

The header line is distinguished by having the first 6 characters begin (the word
begin followed by a space). begin is followed by a mode (in octal), and a string
which names the remote file. Spaces separate the three items in the header line.

The body consists of a number of lines, each at most 62 characters long (including
the trailing NEWLINE). These consist of a character count, followed by encoded
characters, followed by a NEWLINE. The character count is a single printing char­
acter, and represents an integer, the number of bytes the rest of the line represents.
Such integers are always in the range from 0 to 63 and can be determined by sub­
tracting the character space (octal 40) from the character.

Groups of 3 bytes are stored in 4 characters, 6 bits per character. All are offset by a
space to make the characters printing. The last line may be shorter than the normal
45 bytes. If the size is not a multiple of 3, this fact can be determined by the value of
the count on the last line. Extra characters will be included to make the character
count a multiple of 4. The body is terminated by a line with a count of zero. This
line consists of one ASCII space.

The trailer line consists of end on a line by itself.

SEE ALSO
mail(1), uucp(1C), uuencode(1C)
vfstab (4)

NAME
vfstab – table of file system defaults

SYNOPSIS
#include <sys/fstyp.h>
#include <sys/param.h>
#include <sys/vfstab.h>

DESCRIPTION
The file /etc/vfstab describes defaults for each file system. The information is in the following structure, defined in sys/vfstab.h:

```c
struct vfstab {
    char *vfs_special;
    char *vfs_fsckdev;
    char *vfs_mountp;
    char *vfs_fstype;
    char *vfs_fsckpass;
    char *vfs_automnt;
    char *vfs_mntopts;
    char *vfs_macceiling;
};
```

The fields in the table are space-separated and show the block special or resource name, the raw device to `fsck`, the default mount directory, the name of the file system type, the number used by `fsck` to decide whether to check the file system automatically, whether the file system should be mounted automatically by `mountall`, the mount options, and the default file system level ceiling. If Enhanced Security is not installed, the field that displays the default file system level ceiling is not used. A '-' is used to indicate no entry in a field.

The `getvfsent(3C)` family of routines are used to read and write to /etc/vfstab.

NOTES
Do not store information in the `vfstab` file other than the fields described above; fields may be added to this file in future releases and are reserved for future use.

SEE ALSO
`fsck(1M), getvfsent(3C), mount(1M), setmnt(1M)`
**Xwinmaps (4)**

**NAME**

`Xwinmaps` - XWIN color map file

**DESCRIPTION**

The server reads the `/usr/X/defaults/Xwinmaps` file to fill up the static color map. Each line has `R`, `G`, and `B` values. There are several colormaps in the default `Xwinmaps` file, but custom colormaps can be created and added to this file. The server takes the first uncommented colormap (without `#` in the first column) as the valid colormap data.

The format of the colormap data is:

```
colormap type screen num num colors
RED_VAL, BLUE_VAL, GREEN_VAL,
RED_VAL, BLUE_VAL, GREEN_VAL,
```

Where

- `colormap` key word. This is the same for all entries.
- `type` type of colormap. This can be `PseudoColor`, `StaticColor`, or `GrayScale`.
- `screen_num` screen number
- `num_colors` number of colors
- `RED_VAL` red value
- `GREEN_VAL` green value
- `BLUE_VAL` blue value

The number of `RED_VAL`, `BLUE_VAL`, `GREEN_VAL`, lines should be the same as `num_colors`.

**USAGE**

To use the colormap of your choice, add a `#` to the current definition and remove the `#` sign in front of the new definition line, for example,

```
colormap StaticColor 0.0 16
```

To use a private copy of your color map, either of the following commands can be used.

```
olinit -- -cmap $HOME/mycmap
X -cmap $HOME/mycmap &
```
## EXAMPLES

The following is equivalent to the default colormap on the XWIN server.

<table>
<thead>
<tr>
<th>colormap</th>
<th>StaticColor</th>
<th>0.0</th>
<th>16</th>
</tr>
</thead>
<tbody>
<tr>
<td>0x0000,</td>
<td>0x0000,</td>
<td>0x0000,</td>
<td></td>
</tr>
<tr>
<td>0xFFFF,</td>
<td>0xFFFF,</td>
<td>0xFFFF,</td>
<td></td>
</tr>
<tr>
<td>0xAAAA,</td>
<td>0xAAAA,</td>
<td>0xAAAA,</td>
<td></td>
</tr>
<tr>
<td>0x0000,</td>
<td>0x0000,</td>
<td>0x0000,</td>
<td></td>
</tr>
<tr>
<td>0x0000,</td>
<td>0x0000,</td>
<td>0xFFFF,</td>
<td></td>
</tr>
<tr>
<td>0x0000,</td>
<td>0xAAAA,</td>
<td>0xFFFF,</td>
<td></td>
</tr>
<tr>
<td>0x0000,</td>
<td>0xAAAA,</td>
<td>0xAAAA,</td>
<td></td>
</tr>
</tbody>
</table>

# colormap  | StaticColor | 0.0 | 16 |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>0xFFFF,</td>
<td>0xFFFF,</td>
<td>0xFFFF,</td>
<td></td>
</tr>
<tr>
<td>0xA699,</td>
<td>0xA699,</td>
<td>0xA699, # a bit darker than openlook gray</td>
<td></td>
</tr>
<tr>
<td>0x0000,</td>
<td>0x0000,</td>
<td>0x0000, # navy</td>
<td></td>
</tr>
<tr>
<td>0x0000,</td>
<td>0x0000,</td>
<td>0x0000, # a bit less saturated than blue</td>
<td></td>
</tr>
<tr>
<td>0x0000,</td>
<td>0x5144,</td>
<td>0xffff, # sky blue</td>
<td></td>
</tr>
<tr>
<td>0x0000,</td>
<td>0xe79d,</td>
<td>0x0000, # a bit darker than openlook cyan</td>
<td></td>
</tr>
<tr>
<td>0x0000,</td>
<td>0x0000,</td>
<td>0x0000, # lime green (openlook forestgreen)</td>
<td></td>
</tr>
<tr>
<td>0x0000,</td>
<td>0xdf7d,</td>
<td>0x0000, # a bit darker than green</td>
<td></td>
</tr>
<tr>
<td>0x2081,</td>
<td>0xe8e8,</td>
<td>0x0000, # sea green</td>
<td></td>
</tr>
<tr>
<td>0xaaaa,</td>
<td>0x5555,</td>
<td>0x0000, # brown</td>
<td></td>
</tr>
<tr>
<td>0xf3ce,</td>
<td>0x9e97,</td>
<td>0x0000, # a bit darker than openlook orange</td>
<td></td>
</tr>
<tr>
<td>0xffff,</td>
<td>0xffff,</td>
<td>0x0000, # yellow</td>
<td></td>
</tr>
<tr>
<td>0xaaaa,</td>
<td>0x0000,</td>
<td>0xaaaa, # violet</td>
<td></td>
</tr>
<tr>
<td>0x9248,</td>
<td>0xc8b2b,</td>
<td>0x9248, # wheat-like color</td>
<td></td>
</tr>
<tr>
<td>0xffff,</td>
<td>0x0000,</td>
<td>0x0000, # red</td>
<td></td>
</tr>
</tbody>
</table>

## NOTES

- **PseudoColor** is not recommended for 16 colors.

## SEE ALSO

- Xwinconfig(4)
**Xwinconfig (4)**

**NAME**

`Xwinconfig` - XWIN configuration file

**DESCRIPTION**

The server reads the first uncommented line in the `Xwinconfig` file for information about the display, colormap, and the information needed by the display driver. All the required data is on one line.

To change the current configuration, use the `setvgamode` command. To change modes manually, see the section “Editing the Xwinconfig File” below. In either case, the user must have appropriate privileges.

The format of the data of the first line in `Xwinconfig` file is:

```
  display class cmap "INFO for SDD" scr_num tty display_lib
```

Where

- **display** device
- **class** display class, for example, VGA16, VGA256, EGA, 8514, XGA, and so on.
- **cmap** type of colormap, for example, StaticColor or PseudoColor
- **INFO for SDD** information passed to SDD, for example, info passed to `libvga16.so`. See **USAGE** for a detailed description of this field.
- **scr_num** screen number
- **tty** tty, for example, `/dev/console`
- **display_lib** display library to link at run time, for example, `libvga16.so` or `libvga256.so`

**USAGE**

The following two sample entries in the `Xwinconfig` file illustrate the file format. Each line has been split in two (with a \ at the end of the first line) for display here, in the `Xwinconfig` file, each is one line.

```
display VGA16 StaticColor "VGA STDVGA 640x480 16 9.75x7.32" \ 
  0 /dev/console /usr/X/lib/libvga16.so

display VGA256 StaticColor "ET4000 MULTISYNC 1024x768 9.75x7.32" \ 
  0 /dev/console /usr/X/lib/libvga16.so
```

Description of the various fields:

1st field type of device (currently, always `display`)

2nd field video class (for example, VGA16, VGA256, EGA, 8514, XGA, and so on)

3rd field color class (always StaticColor for VGA16, PseudoColor for 256 and other high performance boards, and GrayScale for monochrome)
4th field information passed to the "display driver" which is linked at run time. The format of this string is dependent on the display driver and varies for different display boards. Entries for both 16 and 256 colors can reside in the same configuration file. For example:

"ET4000 MULTISYNC 800x600 16 10.0x9.0"

ET4000 vendor or chipset identification.
MULTISYNC type of monitor
800x600 resolution (width x height) in pixels
16 number of colors. For a 256 color driver, this field is omitted, because it supports only 256 colors. For a 16 color driver, this field may be 2, 4, or 16. For monochrome, this field must be 2.
10.0x9.0 monitor size (width x height) in inches

5th field display number
6th field the actual device (in most cases /dev/console)
7th field the display driver

Editing the Xwinconfig file
For the advance user, editing the Xwinconfig file manually may be more flexible. The first uncommented line (without a # in the first column) is treated as a valid entry in the file.

To use a private copy of a configuration file, either of the following commands can be used:

```
olinit - - -config $HOME/mycfg
X -config $HOME/mycfg &
```

To return to the default mode (640x480, 16 colors), run the `setvgamode` command with the `-default` option.

Examples
This example illustrates how to manually set up files for a particular mode. The display is a Tseng Labs ET4000 based board and the mode is 1024x768 mode with 256 colors.

```
cp /usr/X/lib/vgainit/et4k_256i.so /usr/X/lib/libv256i.so.1
cp /usr/X/lib/vgainit/et4k.256cfg /usr/X/defaults/xwinconfig
```

Edit the `/usr/X/defaults/Xwinconfig` file and remove the # sign in the first column of the line that has the 1024x768 entry. Make sure that all lines in the file before this entry are commented, as the first line without a # in the 1st column is treated as the active entry.
Xwinconfig (4)

The procedure is the same for 16 modes. (that is, copy the et4k_16i.so and et4k.16cfg files).

The following example demonstrates creating a private copy of the config files, (avoids editing the system Xwinconfig file):

    cp /usr/X/lib/vgainit/et4k.16cfg $HOME/cfg16
    cp /usr/X/lib/vgainit/et4k.256cfg $HOME/cfg256

Now to run the server, either command can be used.

    X -config $HOME/cfg16
    X -config $HOME/cfg256

The standard VGA 640x480 mode is supported by all the 16 color SDDs. To find out the various entries provided by a particular SDD, follow the instructions above and give an invalid entry for the first field of the SDD information (for example, foo rather than ET4000). The following example prints out all the modes supported by that SDD.

    display VGA16 StaticColor "foo STDVGA 640x480 16 10.0x9.0" \
        0 /dev/console /usr/X/lib/libvga16.so

Files

/usr/X/adm/setvgamode
/usr/X/defaults/Xwinconfig
/usr/X/defaults/Xwinconfig.ini

SEE ALSO

    setvgamode(1M), xwinconfig(4)
NAME

Xwinfont — XWIN font configuration and defaults file (scalable and bitmapped)

SYNOPSIS

/usr/X/defaults/Xwinfont

DESCRIPTION

The Xwinfont file specifies options concerning font rendering to the X server and allows several different font renders, both bitmapped and scalable, to be used. For example, it contains font configuration information showing the library to use for a renderer, the filename suffix for the renderer’s font files, and the default pointsize to use for a scalable font if none is specified by an application.

The design of the font interface in XWIN provides the flexibility to add renderers to the X server without any code changes if the renderer uses the interface described in the document Porting the XWIN Server; this is done using dynamic shared libraries. This configuration file contains the information needed to use any such renderer—no changes to the server are required.

This file can also be used to tune font rendering in the server by allowing certain runtime combinations to be easily changed—for example, tuning for memory versus speed tradeoffs.

The format of the entries in the Xwinfont file is a simple keyword-value pair, with each element separated by an =. This is the same format as the X11R5 Font Server configuration file. The following types of values are supported:

cardinal a non-negative number; generally used for specifying sizes

boolean 1, y, or t shows a feature present, 0, n, or f shows a feature absent; used for yes/no or true/false possibilities.

string an ASCII string

list a list of cardinals or strings separated by commas

Comments can be inserted in the file with lines that start with a #. Invalid options are logged to stderr ($HOME/.oliniterr) and are skipped. Some options are general options and affect all renderers; others are renderer-specific.

Renderer-specific options begin with a line containing startrenderer=suffix, followed by a variable number of lines containing information specific to that renderer, and ended by either another line containing startrenderer=suffix or the end of the file. Suffix is the font filename suffix the renderer uses to recognize files that it can render. Valid suffixes and their meanings are bitmap distribution format (bdf), server natural format (snf), portable compiled format (pcf), PostScript™ Type 1 format (pfa and pfb), Bitstream Speedo format (spd), and Folio (TypeScaler™) F3 format (f3b).

If several suffixes are valid for a renderer, as when the font files might have several valid styles of names, multiple startrenderer lines should be supplied, each with a valid suffix; the same options can be defined for each suffix. For example, the Type 1 outline font files for use with the Adobe Type Manager™ renderer can have, among others, suffixes of pfa or pfb.
The snf format is the default supported bitmap renderer and need not be explicitly defined. Its shared library is libbitmap.so in /usr/X/lib.

**General Font Configuration Options**

The options that apply to all renderers or to the X server appear first in the file, before the renderer-specific options.

**fontpath=listofstring**

The X server’s default font path. This is a list of font path elements that the server will use in resolving OpenFont and ListFonts requests. It contains a comma separated list of string entries. If a full pathname is not given, the server will check the XWINHOME environment variable for the location of the default installed tree, and will prepend that path to each partial path. Font server names for fontpaths contain a colon separating the font server name from the path within the font server. The environment variable XWINFONTPATH or a server command line option (-fp) will override this option.

**cachesize=cardinal**

The cachesize option is the maximum value that the font cache can grow to without causing a font to be freed from the cache before inserting a new font. This value is expressed in K bytes and defaults to 800; it cannot be set lower than 256. The space is not preallocated for the cache. The cache will be allowed to grow to this value; if the maximum value is never reached, the freeing of fonts from the cache will not take place. Fonts are freed from the cache when they have been closed by all processes and users that had them open, or when a font is selected by the cache free routines to keep the maximum cache allocated for fonts within a maximum size. This maximum size can temporarily be exceeded if a font is open and more space is needed for the font glyphs; however, the space will be reduced to below the maximum cachesize at the first available opportunity. The font that caused the cache to overflow its maximum value will be chosen to free first, provided it is not the current font in use.

**mincachesize=cardinal**

This value is the low water mark for the cache. The value is expressed in units of K bytes. The cache starts allocating in non-pagesize chunks when the low water mark is reached. The default value is 90% of cachesize. The options

```
cachesize=500
mincachesize=450
```

would set a maximum font cache size of 500K bytes of memory and a low-water mark of 450K bytes of memory.

**derived-instance-pointsizes=list**

Applications may already exist that do not use scalable names, yet use the ListFonts protocol request with some pattern and expect to receive a list of fonts that specify a collection of point and pixel sizes. It was strongly encouraged by the X Logical Font Description Conventions that server vendors provide a mechanism for including in each scalable
name a list of specific derived instance names for use by these applica-
tions. (A derived instance is the result of replacing scalable fields with
values to yield a font name that could actually be produced from the
font source.)

This option contains a list of cardinal values for point sizes that should
be generated for scalable fonts to satisfy such requests. There is no
default value if this is not specified in the file; the value placed in the file
when outline fonts are installed is 10, 12, 14. This option is not used
directly by the X server; its value can be specified as the value of the
DERIVED_INSTANCE_PS environment variable of the mkfontscale pro-
gram, which creates the XLFD names in the fonts.scale in directories
containing outline fonts (one XLFD name is created for each specified
size, as well as for size 0, which indicates a scalable name). The Font
Setup application of the UNIX Desktop runs the mkfontscale program,
with the environment variable thus set, when the Actions / Integrity
Check button menu item is chosen. The mkfontdir program creates the
fonts.dir file from the fonts.scale file (this is also run by the
Integrity Check menu button menu item); the X server reads the fonts.dir
file to determine what fonts and derived instances are available.

Renderer-Specific Configuration Options

A renderer-specific configuration option is an option that only applies to the
renderer used for font files who suffix was named in the most recent start-
trenderer option. All renderer-specific options must be specified in the entries
that follow a startrenderer=suffix. Duplicate entries, for the same suffix, later in
the file will override any previous entries; only the last set of renderer options in a
file for any given named renderer are set. All options for a given renderer are
grouped together between the start renderer and the next startrenderer in the
file (or the end of the file).

There are both public and private renderer options allowed. Renderer public
options are defined below. Renderer private options are options that are unique to
a specific renderer that might be added to the X server by OEMs and are defined
and checked by the rendering library. Any unrecognized renderer options are
assumed to be private options and are not parsed directly by the configuration file
initialization routines (other than to set a flag to the renderer that private options
were encountered). The renderer must check this flag for possible private options
and for parsing these options. An example of an option that might be useful and
private to a given renderer would be a list of glyphs to preallocate or prerender for
a given font or for all fonts. How to specify the list would be renderer-specific.

startrenderer=suffix
Start defining renderer-specific options for a renderer whose font files
have the file name suffix suffix.

use-renderer=boolean
The use-renderer option shows if this particular renderer should be
used by the X server. The default, if the renderer is specified, and the
use-renderer field is missing, is to include the rendering library. The
server command line option -renderer +suffix or -renderer -suffix
will override this option.
Xwinfont (4)

**font-type=string**

The *font-type* option denotes the type of rendering supported by this renderer. Valid values are *bitmap*, *scalable* and *both*. If both *bitmap* and *scalable* are valid, then the value *both* should be used. The default type is *scalable*.

**sharedlib-filename=string**

Contains the name and location of the font rendering library to load for this font format type. If the name is not a complete pathname, then the library will be searched for using the *lib* directory of the `XWINHOME` environment variable. This field will be used when the rendering library needs to be loaded. If the library is not found, an error will be returned when a font from that library is needed. This is a **mandatory** field. It is required since a renderer could be added after the Desktop product is released, and a full library specification in this field will enable the server to handle new font rendering libraries that conform to the specification outlined in Porting the XWIN Server. If more than one suffix applies to a single library, then multiple startrenderer entries and sharedlib-filename entries should be used.

**defaultpoint=cardinal**

Contains the default point size to be used in resolving scalable names that do not specify a point size or a pixel size in the request. This will be used to generate a derived instance of the font, if no other derived instance point sizes are given. If not specified, a compiled in default point size will be used (12).

**preallocate-glyphs=cardinal**

Rendering all the glyphs at open time requires that space be allocated at open as well. This will have a longer initialization time for the font as the glyphs are scaled. The other approach scales the character the first time it is accessed for display.

If glyphs are preallocated but not prerendered, this ensures enough space exists to render the entire font, and reserves it even though some glyphs may never get rendered.

A renderer-specific configuration option (**preallocate-glyphs=string**), determines how much space for the glyphs in a font should be preallocated. Value should be a *cardinal* value that specifies a number reflecting a percentage of the entire font to preallocate (that is, 10 for 10%). If the value is 0, no glyphs should be preallocated. If the value is 100, all the glyphs in each font should be preallocated; otherwise a value can be given that will represent the percentage of the total font glyph size that should be preallocated. The default for bitmap fonts, if not specified, is to preallocate the space for all the glyphs when the font is read.

**prerender-glyphs=boolean**

Another option (**prerender-glyphs=boolean**) specifies whether all the glyphs in the font should be rendered at open time (y), or as each glyph is used in a blitting routine (n). The default for bitmap fonts is they are already rendered. The default for scalable fonts is not to render the
glyph until it is needed, unless some renderer-specific private option overrides this. (For Adobe Type Manager, when it is installed, this option is set in the file to y, as this has proven to more efficient, given the information that the X server must get from the font for each character when just a single character is rendered.)

Other Options

Additional renderer-specific options are available. However, they should not be changed by a user or the owner of the machine, just an expert administrator or OEM developer who is monitoring font-related server performance.

**preload-renderer=boolean**

This option will determine when the rendering library should be opened and the symbols resolved. If **preload-renderer** is set to false, the loading of the font renderer's library will be deferred until a font is needed. This will conserve the memory required by the library until it is needed, and will be the default for scalable renderers. If **preload-renderer** is true, the library will be loaded at server start up. This is the default for the bitmap based library containing the default cursor and text fonts.

**free-renderer=boolean**

This option will determine when the rendering library will be closed and consequently when the memory used by the library is released. If set to true, the library will be closed when the last font is closed. This will free the space, but if another font from the library is opened later, it might cause a delay to reload the library. This is a performance/memory tradeoff option and will be helpful in doing internal performance evaluations. The default is set to false.

**alloc-units=cardinal**

Indicates the minimum pagesize chunks that should be allocated for this renderer when allocating space for font glyphs. The default value is one pagesize chunk.

The **alloc-units** are saved in the font structure. This will allow renderers who wish to supply **alloc-units** by using renderer private options to override any general value.

**download-glyphs=string**

Indicates if glyphs of this renderer should be downloaded to device dependent code. Possible values are **none, fixed** or **all**. The value **fixed** indicates only fixed width fonts should be downloaded. If **download-glyphs** is **none**, fonts for this renderer will not be downloaded. If set to **all**, then all fonts for this renderer will be downloaded.

**download-height=cardinal**

This is the maximum height for glyphs in fonts that can be downloaded. Fonts containing any glyphs larger than height will not be downloaded.

**download-width=cardinal**

This is the maximum width for glyphs in fonts that can be downloaded. Fonts containing any glyphs wider than width will not be downloaded.
Xwinfont(4)

**download-maxchars**=*cardinal*

If fonts are downloadable, then this is the maximum number of glyphs in fonts that can be downloaded. Fonts containing more characters than **download-maxchars** will not be downloaded.

**EXAMPLES**

The following options allow the Adobe Type Manager renderer to be used:

```bash
derived-instance-pointsizes=10,12,14
# fontpath= lib/fonts/misc,,lib/fonts/Xol,,lib/fonts/75dpi,, \ lib/fonts/100dpi,lib/fonts/type1,lib/fonts/mitType1
# startrenderer=pfa
prender-glyphs=t
sharedlib-filename=libatm.so
# startrenderer=pfb
use-renderer=t
prender-glyphs=t
sharedlib-filename=libatm.so
```

The \ at the end of the font path line is just notation showing this line is longer than can be printed here; the \ is not parsed.

**NOTES**

Partial names that contain a colon are reserved for future font server names.

**SEE ALSO**

mkfontscale(1), mkfontdir(1)
NAME

ypfiles – the Network Information Service (NIS) database and directory structure

DESCRIPTION

The NIS network lookup service uses a distributed, replicated database of dbm files contained in the /var/yp directory hierarchy on each NIS server. A dbm database consists of two files, one has the filename extension .pag and the other has the filename extension .dir. For instance, the database named publickey, is implemented by the pair of files publickey.pag and publickey.dir.

A dbm database served by the NIS is called a NIS map. A NIS ypdomain is a subdirectory of /var/yp containing a set of NIS maps. Any number of NIS domains can exist. Each may contain any number of maps.

No maps are required by the NIS lookup service itself, although they may be required for the normal operation of other parts of the system. There is no list of maps which NIS serves — if the map exists in a given domain, and a client asks about it, the NIS will serve it. For a map to be accessible consistently, it must exist on all NIS servers that serve the domain. To provide data consistency between the replicated maps, an entry to run ypxfr periodically should be made in the privileged user’s crontab file on each server. More information on this topic is in ypxfr(1M).

NIS maps should contain two distinguished key-value pairs. The first is the key YP_LAST_MODIFIED, having as a value a ten-character ASCII order number. The order number should be the system time in seconds when the map was built. The second key is YP_MASTER_NAME, with the name of the NIS master server as a value. makedbm(1M) generates both key-value pairs automatically. A map that does not contain both key-value pairs can be served by the NIS, but the ypserv process will not be able to return values for “Get order number” or “Get master name” requests. See ypserv(1M). In addition, values of these two keys are used by ypxfr when it transfers a map from a master NIS server to a slave. If ypxfr cannot figure out where to get the map, or if it is unable to determine whether the local copy is more recent than the copy at the master, extra command line switches must be set when it is run.

NIS maps must be generated and modified only at the master server. They are copied to the slaves using ypxfr(1M) to avoid potential byte-ordering problems among NIS servers running on machines with different architectures, and to minimize the amount of disk space required for the dbm files. The NIS database can be initially set up for both masters and slaves by using ypinit(1M).

All NIS maps have entries in /var/yp/aliases. Each entry includes the map name and map nickname. The map name and nickname may be the same depending on the filesystem limitation of the length of filenames.

After the server databases are set up, it is probable that the contents of some maps will change. In general, some ASCII source version of the database exists on the master, and it is changed with a standard text editor. The update is incorporated into the NIS map and is propagated from the master to the slaves by running /var/yp/Makefile, see ypmake(1M). All Sun-supplied maps have entries in /var/yp/Makefile; if a NIS map is added, edit this file to support the new map. The makefile uses makedbm(1M) to generate the NIS map on the master, and
ypfiles (4)

`yppush(1M)` to propagate the changed map to the slaves. `yppush` is a client of the map `ypservers`, which lists all the NIS servers. For more information on this topic, see `yppush(1M)`.

 FILES

```
/var/yp
/var/yp/aliases
/var/yp/Makefile
```

 SEE ALSO

```
dbm(3), makedbm(1M), publickey(4), ypinit(1M), yppoll(1M), yppush(1M), ypserve(1M), ypfr(1M)
```
NAME
  intro – introduction to miscellany

DESCRIPTION
  This section describes miscellaneous facilities such as macro packages, character set tables, and so forth.
NAME

ascii – map of ASCII character set

DESCRIPTION

This is a map of the ASCII character set, giving both octal and hexadecimal equivalents of each character.

```
<table>
<thead>
<tr>
<th>000</th>
<th>nul</th>
<th>001</th>
<th>sch</th>
<th>002</th>
<th>stx</th>
<th>003</th>
<th>etx</th>
<th>004</th>
<th>eot</th>
<th>005</th>
<th>enq</th>
<th>006</th>
<th>ack</th>
<th>007</th>
<th>bel</th>
</tr>
</thead>
<tbody>
<tr>
<td>010</td>
<td>bs</td>
<td>011</td>
<td>ht</td>
<td>012</td>
<td>nl</td>
<td>013</td>
<td>vt</td>
<td>014</td>
<td>np</td>
<td>015</td>
<td>cr</td>
<td>016</td>
<td>so</td>
<td>017</td>
<td>si</td>
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<td>022</td>
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<td>023</td>
<td>dc3</td>
<td>024</td>
<td>dc4</td>
<td>025</td>
<td>nak</td>
<td>026</td>
<td>syn</td>
<td>027</td>
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<td>031</td>
<td>em</td>
<td>032</td>
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<td>sp</td>
<td>041</td>
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<td>042</td>
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<td>043</td>
<td>#</td>
<td>044</td>
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<td>045</td>
<td>%</td>
<td>046</td>
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<td>(</td>
<td>051</td>
<td>)</td>
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<td>*</td>
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</tr>
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<td>h</td>
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<td>-</td>
<td>0F6</td>
<td>°</td>
<td>0F7</td>
</tr>
</tbody>
</table>
```
NAME

environ – user environment

DESCRIPTION

When a process begins execution, exec routines make available an array of strings called the environment [see exec(2)]. By convention, these strings have the form `variable=value`, for example, `PATH=/sbin:/usr/sbin`. These environmental variables provide a way to make information about a program’s environment available to programs. The following environmental variables can be used by applications and are expected to be set in the target runtime environment.

HOME

The name of the user’s login directory, set by `login(1)` from the password file [see `passwd(4)`].

LANG

The program’s locale. Locales consist of files that describe the conventions appropriate to some nationality, culture, and language. Generally, users determine which files are selected by manipulating the environment variables described below. For background, see `setlocale(3C)`.

Locales are partitioned into categories LC_COLLATE, LC_CTYPE, LC_MESSAGES, LC_MONETARY, LC_NUMERIC, and LC_TIME (see below for what the categories control). Each category has a corresponding environment variable that the user can set to specify that category’s locale:

```
LC_CTYPE=fr[ançais]
```

The LANG environment variable is searched if the environment variable for a category is unset or empty:

```
LANG=fr
LC_COLLATE=de[utsche]
```

sets all the categories but LC_COLLATE to French. If LANG is unset or empty, the default C locale is used.

**LC_COLLATE**

specifies the collation order used. The information for this category is stored in a database created by the `colltab(1M)` command. This environment variable affects `sort(1)`, `strcoll(3C)`, and `strxfrm(3C)`.

**LC_CTYPE**

specifies character classification, character conversion, and widths of multibyte characters. The information for this category is stored in a database created by the `chrtbl(1M)` or `wchartbl(1M)` commands. The default C locale uses the 7-bit US ASCII character set. This environment variable affects many commands and functions, among them, `cat(1)`, `ed(1)`, `ls(1)`, `vi(1)`, `ctype(3C)`, and `mbchar(3C)`.

**LC_MESSAGES**

specifies the message database used. A command or application may have French and German message databases, for example. Message databases are created by the `mkmsgs(1)` or `gencat(1)` commands. This environment variable affects `gettext(1)`,
environ(5)

srchtxt(1), catgets(3C), and gettext(3C), and every command that generates locale-specific output messages.

**LC_MONETARY** specifies the monetary symbols and delimiters used. The information for this category is stored in a database created by the month(1M) command. This environment variable affects localeconv(3C).

**LC_NUMERIC** specifies the decimal and thousands delimiters. The information for this category is stored in a database created by the chrtbl(1M) or wchar tbl(1M) commands. The default C locale uses a period (.) as the decimal delimiter and no thousands delimiter. This environment variable affects localeconv(3C), printf(3S), scanf(3S), and strtod(3C).

**LC_TIME** specifies date and time formats. The information for this category is stored in a database specified in strftime(4). The default C locale uses US date and time formats. This environment variable affects many commands and functions, among them, at(1), calendar(1), date(1), getdate(3C), and strftime(3C).

**MSGVERB** Controls which standard format message components fmtmsg selects when messages are displayed to stderr [see fmtmsg(1) and fmtmsg(3C)].

**SEV_LEVEL** Defines severity levels and associates and prints strings with them in standard format error messages [see addseverity(3C), fmtmsg(1), and fmtmsg(3C)].

**NETPATH** A colon-separated list of network identifiers. A network identifier is a character string used by the Network Selection component of the system to provide application-specific default network search paths. A network identifier must consist of non-NULL characters and must have a length of at least 1. No maximum length is specified. Network identifiers are normally chosen by the system administrator. A network identifier is also the first field in any /etc/netconfig file entry. NETPATH thus provides a link into the /etc/netconfig file and the information about a network contained in that network’s entry. /etc/netconfig is maintained by the system administrator. The library routines described in getnetpath(3N) access the NETPATH environment variable.

**NLSPATH** Contains a sequence of templates which catopen(3C) uses when attempting to locate message catalogs. Each template consists of an optional prefix, one or more substitution fields, a filename, and an optional suffix.
For example:

```
NLSPATH="/system/nlslib/%N.cat"
```

defines that `catopen` should look for all message catalogs in the directory `/system/nlslib`, where the catalog name should be constructed from the `name` parameter passed to `catopen`, `%N`, with the suffix `.cat`.

Substitution fields consist of a `%` symbol, followed by a single-letter keyword. The following keywords are currently defined:

- `%N` The value of the `name` parameter passed to `catopen`.
- `%L` The value of `LANG`.
- `%l` The language element from `LANG`.
- `%t` The territory element from `LANG`.
- `%c` The codeset element from `LANG`.
- `%%` A single `%` character.

An empty string is substituted if the specified value is not currently defined. The separators "_" and "." are not included in `%t` and `%c` substitutions.

Templates defined in `NLSPATH` are separated by colons (:). A leading colon or two adjacent colons (: :) is equivalent to specifying `%N`.

For example:

```
NLSPATH=":%N.cat:/nlslib/%L/%N.cat"
```

indicates to `catopen` that it should look for the requested message catalog in `name, name.cat`, and `/nlslib/$LANG/name.cat`.

**PATH**
The sequence of directory prefixes that `sh(1)`, `time(1)`, `nice(1)`, `nohup(1)`, and so on apply in searching for a file known by an incomplete path name. The prefixes are separated by colons (:). `login(1)` sets `PATH=/usr/bin`. [For more detail, see `sh(1)`.]

**SHELL**
When the shell is invoked, it scans the environment for this name. If it is found and `rsh` is the filename part of its value, the shell becomes a restricted shell. The value of this variable should be specified with an absolute pathname. The variable is used by `make(1)`, `ksh(1)`, `sh(1)`, and `vi(1)`, among other commands.

**TERM**
The kind of terminal for which output is to be prepared. This information is used by commands, such as `vi(1)`, which may exploit special capabilities of that terminal.

**TZ**
Time zone information. The contents of the environment variable named `TZ` are used by the functions `ctime(3C)`, `localtime` [see `ctime(3C)`], `strftime(3C)`, and `mktime(3C)` to override the default time zone. If the first character of `TZ` is a colon (:), the behavior is implementation-defined, otherwise `TZ` has the form:

```
std offset [ dst [ offset ], [ start [/time] ], end [/time] ]
```
**environ (5)**

**std and dst**
Three or more bytes that are the designation for the standard (std) and daylight savings time (dst) time zones. Only std is required, if dst is missing, then daylight savings time does not apply in this locale. Upper- and lowercase letters are allowed. Any characters except a leading colon (:), digits, a comma (,), a minus (-), or a plus (+) are allowed.

**offset** Indicates the value one must add to the local time to arrive at Coordinated Universal Time. The offset has the form:

```
    hh [ : mm [ : ss ] ]
```

The minutes (mm) and seconds (ss) are optional. The hour (hh) is required and may be a single digit. The offset following std is required. If no offset follows dst, daylight savings time is assumed to be one hour ahead of standard time. One or more digits may be used; the value is always interpreted as a decimal number. The hour must be between 0 and 24, and the minutes (and seconds) if present between 0 and 59. Out of range values may cause unpredictable behavior. If preceded by a "-", the time zone is east of the Prime Meridian; otherwise it is west (which may be indicated by an optional preceding "+") sign).

**start/time, end/time**
Indicates when to change to and back from daylight savings time, where start/time describes when the change from standard time to daylight savings time occurs, and end/time describes when the change back happens. Each time field describes when, in current local time, the change is made.

The formats of start and end are one of the following:

- **Jn** The Julian day n (1 ≤ n ≤ 365). Leap days are not counted. That is, in all years, February 28 is day 59 and March 1 is day 60. It is impossible to refer to the occasional February 29.

- **n** The zero-based Julian day (0 ≤ n ≤ 365). Leap days are counted, and it is possible to refer to February 29.

- **Mon.n.d** The d\(^{th}\) day, (0 ≤ d ≤ 6) of week n of month m of the year (1 ≤ n ≤ 5, 1 ≤ m ≤ 12), where week 5 means "the last d-day in month m" which may occur in either the fourth or the fifth week). Week 1 is the first week in which the d\(^{th}\) day occurs. Day zero is Sunday.

Implementation-specific defaults are used for start and end if these optional fields are not given.

The time has the same format as offset except that no leading sign ('-' or '+') is allowed. The default, if time is not given is 02:00:00.
Further names may be placed in the environment by the `export` command and `name=value` arguments in `sh(1)`, or by `exec(2)`. It is unwise to conflict with certain shell variables that are frequently exported by `.profile` files: `MAIL`, `PS1`, `PS2`, `IFS` [see `profile(4)`].

SEE ALSO

`addseverity(3C)`, `cat(1)`, `catgets(3C)`, `catopen(3C)`, `chrtabl(1M)`, `colltabl(1M)`, `ctime(3C)`, `ctype(3C)`, `date(1)`, `ed(1)`, `exec(2)`, `fmtmsg(1)`, `fmtmsg(3C)`, `gencat(1)`, `getdate(3C)`, `getnetpath(3N)`, `gettext(1)`, `gettext(3C)`, `localeconv(3C)`, `login(1)`, `ls(1)`, `mbchar(3C)`, `mkmsgs(1)`, `mktime(3C)`, `month(1M)`, `netconfig(4)`, `nice(1)`, `nohup(1)`, `passwd(4)`, `printf(3S)`, `profile(4)`, `scanf(3S)`, `setlocale(3C)`, `sh(1)`, `sort(1)`, `srcrtext(1)`, `strcoll(3C)`, `strftime(3C)`, `strftime(4)`, `strtod(3C)`, `strxfrm(3C)`, `time(1)`, `timezone(4)`, `vi(1)`, `wchrtabl(1M)`
eqnchar(5)  (BSD System Compatibility)

NAME
eqnchar – (BSD) special character definitions for eqn

SYNOPSIS
  eqn /usr/ucblib/pub/eqnchar [file] | troff [options]
  neqn /usr/ucblib/pub/eqnchar [file] | nroff [options]

DESCRIPTION
  The eqnchar command contains troff(1) and nroff(1) character definitions for
  constructing characters that are not available on the Graphic Systems typesetter.
  These definitions are primarily intended for use with eqn(1) and neqn. It contains
  definitions for the following characters:

  | ciplus  | ⊕ | || | || | square | □ |
  | citimes | ⊗ | langle | \ | circle | ○ |
  | wig     | ~ | rangle | \ | blot | □ |
  | -wig    | = | hbar    | h | bullet | • |
  | >wig    | ≥ | ppd     | ↓ | prop   | ∞ |
  | <wig    | ≤ | <>      | ↔ | empty  | Ø |
  | =wig    | ≡ | <=>     | ⇔ | member | ∈ |
  | star    | * | <|      | † | nomem  | ∈ |
  | bigstar | * | ||>     | † | cup    | ⊙ |
  | =dot    | ⊥ | ang     | ⊥ | cap    | ⊥ |
  | orsign  | ∨ | rang    | ⊥ | incl   | ⊥ |
  | andsign | ∧ | 3dot    | : | subset | ⊂ |
  | =del    | ≡ | thf     | : | supset | ⊃ |
  | oppA    | ∀ | quarter | ¥ | !subset | ⊈ |
  | oppE    | ∃ | 3quarter | ¥ | !supset | ⊉ |
  | angstrom| Å | degree  | ° |

FILES
  /usr/ucblib/pub/eqnchar

SEE ALSO
  eqn(1), nroff(1), troff(1)
NAME
eucioctl - generic interface to EUC handling tty drivers and modules

SYNOPSIS
#include <sys/eucioctl.h>

ioctl(int fd, I_STR, struct strioctl *sb);

DESCRIPTION
This interface is implemented in tty drivers and pushable STREAMS modules that
handle EUC codes. It is intended as a generic interface for EUC handling, to elim­
inate an explosion of module-specific ioctl calls that would otherwise be neces­
sary, and to provide uniformity in dealing with EUC code sets in the tty subsystem.

Several calls are defined. The first two calls take an argument, which is expected to
be a pointer to an eucioc structure, defined in the header file sys/eucioctl.h:

struct eucioc {
    unsigned char eucw[4];
    unsigned char scrw[4];
};
typedef struct eucioc eucioc_t;

In all cases, these calls return non-zero on failure. Failure should be usually taken
as an indication that the current driver, or line discipline module, does not support
EUC, in which case errno will be set to EINVAL. For the EUC_WSET or EUC_WGET
calls, errno will be set to EPROTO if struct eucioc argument is invalid.

EUC_WSET
This call takes a pointer to an eucioc structure, and uses it to
set the EUC line discipline's local definition for the code set
widths to be used for subsequent operations. Within the
stream, the line discipline may optionally notify other modules
of this setting via M_CTL messages.

EUC_WGET
This call takes a pointer to an eucioc structure, and returns in
it the EUC code set widths currently in use by the EUC line dis­
cipline. It needs to be recognized only by line discipline
modules.

The following calls take no arguments. They should only fail if the driver (at the
bottom of the tty stream) does not recognize EUC codes. Drivers that support EUC,
whether the stream contains modules that respond to the calls or not, will recognize
the calls and acknowledge them. These calls are normally only interpreted by
modules that have modes other than ASCII, and/or do some form of I/O conversion
that normally prevents a program from receiving non-EUC characters in its byte
stream. All of these calls, when received by modules, are passed down the tty
stream, to be ultimately acknowledged by the tty driver.

EUC_MSAVE
This call has no effect on modules that are currently in ASCII
mode. Otherwise (i.e., for modules not in ASCII mode), the fol­
lowing actions are taken by all modules that recognize this call:
(1) the current mode status is saved, (2) the mode is changed to
ASCII mode immediately.
eucioctl (5)

**EUC_MREST** If a mode was saved via a previous EUC_MSAVE call, the saved mode is restored, and the saved state flag is cleared. If the mode was not previously saved, this call has no effect. (The exact semantics are somewhat dependent on the module, since some modules may respond to specific user requests to switch modes, even while a mode is being saved via EUC_MSAVE.)

**EUC_IXLOFF** If a module is currently in a state where input conversion is being performed on the incoming byte stream, then input conversion is turned off, and the module’s mode status is saved. If no input conversion is being performed, there is no effect on the module. The purpose of this call is to provide a way of insuring a pure byte stream to the program. The byte stream while input conversion is off is, of course, not guaranteed to be a stream of EUC characters. Turning off input conversion is roughly equivalent to the old concept of raw mode, if used in conjunction with ICANON off. It should normally not be used by applications.

**EUC_IXLON** If a module previously saved its state and turned off input conversion, then input conversion is restored (i.e., turned back on); otherwise, there is no effect.

**EUC_OXLOFF** In a manner similar to EUC_IXLOFF, any output conversion is turned off and the current mode status saved.

**EUC_OXLON** In a manner similar to EUC_IXLON, any saved output conversion status is restored (i.e., output conversion is turned back on if previously turned off via EUC_OXLOFF).

**FILES**

/usr/include/sys/eucioctl.h

**NOTES**

Drivers and modules that support EUC should all respond appropriately to these calls, depending on their type. Line disciplines must respond to EUC_WSET and EUC_WGET, changing their current code set sizes to match EUC_WSET requests. All tty STREAMS modules that do any input or output conversion should recognize the other calls; modules that do no code set conversion are not required to recognize the calls, but must pass them through. Drivers that support EUC tty streams must all acknowledge the ON/OFF calls, whether the drivers themselves are affected or not, since these calls are purposely not acknowledged by modules which receive them; they are intended to be made available for affecting all modules in the whole stream.

Adherence to this protocol for all EUC handling modules is strongly encouraged in order to increase portability and language-independence of applications. These calls are intended as a small set of primitives to help reduce an anticipated plethora of module- and language-dependent operations.
NAME
  fcntl – file control options

SYNOPSIS
  #include <sys/fcntl.h>

DESCRIPTION
  The fcntl.h header defines the following requests and arguments for use by the
  functions fcntl [see fcntl(2)] and open [see open(2)].

  Values for cmd used by fcntl (the following values are unique):
  F_DUPFD    Duplicate file descriptor
  F_GETFD    Get file descriptor flags
  F_SETFD    Set file descriptor flags
  F_GETFL    Get file status flags
  F_SETFL    Set file status flags
  F_GETLK    Get record locking information
  F_SETLK    Set record locking information
  F_SETLKW   Set record locking information;
              wait if blocked

  File descriptor flags used for fcntl:
  FD_CLOEXEC Close the file descriptor upon
              execution of an exec function [see exec(2)]

  Values for l_type used for record locking with fcntl
  (the following values are unique):
  F_RDLCK    Shared or read lock
  F_UNLCK    Unlock
  F_WRLCK    Exclusive or write lock

  The following three sets of values are bitwise distinct:

  Values for oflag used by open:
  O_CREAT    Create file if it does not exist
  O_EXCL     Exclusive use flag
  O_NOCTTY   Do not assign controlling tty
  O_TRUNC    Truncate flag

  File status flags used for open and fcntl:
  O_APPEND   Set append mode
  O_NDELAY   Non-blocking mode
  O_NONBLOCK Non-blocking mode (POSIX)
  O_SYNC     Synchronous writes

  Mask for use with file access modes:
  O_ACCMODE  Mask for file access modes

  File access modes used for open and fcntl:
  O_RDONLY   Open for reading only
  O_RDWR      Open for reading and writing
  O_WRONLY    Open for writing only
The structure `flock` describes a file lock. It includes the following members:

```c
short  l_type;     /* Type of lock */
short  l_whence;  /* Flag for starting offset */
off_t  l_start;   /* Relative offset in bytes */
off_t  l_len;     /* Size; if 0 then until EOF */
long   l_sysid;   /* Returned with F_GETLK */
pid_t  l_pid;     /* Returned with F_GETLK */
long   l_pad;     /* reserve area */
```

SEE ALSO
`creat(2), exec(2), fcntl(2), open(2)`
NAME
font – font description files for troff and dpost

SYNOPSIS
troff -T ptty ...

DESCRIPTION
For each typesetter or printer type supported by troff(1) and available on this system, there is a directory containing files describing the device and its fonts. This directory is named /usr/lib/font/devptty where ptty is the abbreviated name of the typesetter or printer type. Currently supported devices are aps for the Auto logic APS-5, post for PostScript printers, and il10 for the Imagen Imprint 10 laser printer.

For a particular phototypesetter, ptty, the ASCII file DESC in the directory /usr/lib/font/devptty describes its characteristics. Each line starts with a word identifying the characteristic which is followed by appropriate specifiers. Blank lines and lines beginning with a # are ignored.

The legal lines for DESC are:

res num resolution of device in basic increments per inch
hor num smallest unit of horizontal motion
vert num smallest unit of vertical motion
unitwidth num pointsize in which widths are specified
sizescale num scaling for fractional pointsizes
paperwidth num width of paper in basic increments
paperlength num length of paper in basic increments
biggestfont num maximum size of a font
spare2 num available for use
sizes num num ... list of pointsizes available on typesetter
fonts num name ... number of initial fonts followed by the names of the fonts. For example:

fonts 4 R I B S

charset this always comes last in the file and is on a line by itself. Following it is the list of special character names for this device. Names are separated by a space or a newline. The list can be as long as necessary. Names not in this list are not allowed in the font description files.

res is the basic resolution of the device in increments per inch. hor and vert describe the relationships between motions in the horizontal and vertical directions. If the device is capable of moving in single basic increments in both directions, both hor and vert would have values of 1. If the vertical motions only take place in multiples of two basic units while the horizontal motions take place in the basic increments, then hor would be 1, while vert would be 2. The unitwidth is the pointsize in which all width tables in the font description files are given. troff
automatically scales the widths from the unitwidth size to the pointsize it is working with. Sizescale is not currently used and is 1. paperwidth is the width of the paper in basic increments. The APS-5 is 6120 increments wide. paperlength is the length of a sheet of paper in the basic increments. biggestfont is the maximum number of characters on a font.

For each font supported by the phototypesetter, there is also an ASCII file with the same name as the font (e.g., R, I4). The format for a font description file is:

```
name name  name of the font, such as R or 4
internalname name internal name of font
special sets flag indicating that the font is special
ligatures name ... 0
   Sets flag indicating font has ligatures. The list of ligatures follows and is terminated by a zero. Accepted ligatures are: ff fi fl ffi ffl.
sparel available for use
spacewidth num width of space if something other than 1/3 of — is desired as a space.
charset The character set must come at the end. Each line following the word charset describes one character in the font. Each line has one of two formats:
   name width kerning code
   name"
where name is either a single ASCII character or a special character name from the list found in DESC. The width is in basic increments. The kerning information is 1 if the character descends below the line, 2 if it rises above the letter 'a', and 3 if it both rises and descends. The kerning information for special characters is not used and so may be 0. The code is the number sent to the typesetter to produce the character. The second format is used to indicate that the character has more than one name. The double quote indicates that this name has the same values as the preceding line. The kerning and code fields are not used if the width field is a double quote character. The total number of different characters in this list should not be greater than the value of biggestfont in the DESC file (see above).
```

troff and its postprocessors like dpost read this information from binary files produced from the ASCII files by a program distributed with troff called makedev. For those with a need to know, a description of the format of these files follows:

The file DESC.out starts with the dev structure, defined by dev.h:
/*
dev.h: characteristics of a typesetter
*/

struct dev {
  unsigned short filesize; /* number of bytes in file, */
    /* excluding dev part */
  short res; /* basic resolution in goobies/inch */
  short hor; /* goobies horizontally */
  short vert;
  short unitwidth; /* size at which widths are given*/
  short nfonts; /* number fonts physically available */
  short nsizes; /* number of pointsizes */
  short sizescale; /* scaling for fractional pointsizes */
  short paperwidth; /* max line length in units */
  short paperlength; /* max paper length in units */
  short nchtab; /* number of funny names in chtab */
  short lchname; /* length of chname table */
  short biggestfont; /* max # of chars in a font */
  short spare2;
};

Filesize is just the size of everything in DESC.out excluding the dev structure. Nfonts is the number of different font positions available. Nsizes is the number of different pointsizes supported by this typesetter. Nchtab is the number of special character names. Lchname is the total number of characters, including nulls, needed to list all the special character names. At the end of the structure are two spares for later expansions.

Immediately following the dev structure are a number of tables. First is the sizes table, which contains nsizes + 1 shorts(a null at the end), describing the pointsizes of text available on this device. The second table is the funny_char_index_table. It contains indices into the table which follows it, the funny_char_strings. The indices point to the beginning of each special character name which is stored in the funny_char_strings table. The funny_char_strings table is lchname characters long, while the funny_char_index_table is nchtab shorts long.

Following the dev structure will occur nfonts [font].out files, which are used to initialize the font positions. These [font].out files, which also exist as separate files, begin with a font structure and then are followed by four character arrays:

  struct font { /* characteristics of a font */
    char nwfont; /* number of width entries */
    char specfont; /* 1 == special font */
    char ligfont; /* 1 == ligatures exist on this font */
    char spare1; /* unused for now */
    char namefont[10]; /* name of this font, e.g., R */
    char intname[10]; /* internal name of font, in ASCII */
  };

font(5)
font(5)

The font structure tells how many defined characters there are in the font, whether the font is a "special" font and if it contains ligatures. It also has the ASCII name of the font, which should match the name of the file it appears in, and the internal name of the font on the typesetting device (innname). The internal name is independent of the font position and name that troff knows about. For example, you might say mount R in position 4, but when asking the typesetter to actually produce a character from the R font, the postprocessor which instructs the typesetter would use innname.

The first three character arrays are specific for the font and run in parallel. The first array, widths, contains the width of each character relative to unitwidth. unitwidth is defined in DESC. The second array, kerning, contains kerning information. If a character rises above the letter 'a', 02 is set. If it descends below the line, 01 is set. The third array, codes, contains the code that is sent to the typesetter to produce the character.

The fourth array is defined by the device description in DESC. It is the font_index_table. This table contains indices into the width, kerning, and code tables for each character. The order that characters appear in these three tables is arbitrary and changes from one font to the next. In order for troff to be able to translate from ASCII and the special character names to these arbitrary tables, the font_index_table is created with an order which is constant for each device. The number of entries in this table is 96 plus the number of special character names for this device. The value 96 is 128 - 32, the number of printable characters in the ASCII alphabet. To determine whether a normal ASCII character exists, troff takes the ASCII value of the character, subtracts 32, and looks in the font_index_table. If it finds a 0, the character is not defined in this font. If it finds anything else, that is the index into widths, kerning, and codes that describe that character.

To look up a special character name, for example \( p1 \), the mathematical plus sign, and determine whether it appears in a particular font or not, the following procedure is followed. A counter is set to 0 and an index to a special character name is picked out of the counter' th position in the funny_char_index_table. A string comparison is performed between funny_char_strings[funny_char_index_table[counter]] and the special character name, in our example p1, and if it matches, then troff refers to this character as \( 96 + \text{counter} \). When it wants to determine whether a specific font supports this character, it looks in font_index_table(96+counter), (see below), to see whether there is a 0, meaning the character does not appear in this font, or a number, which is the index into the widths, kerning, and codes tables.

Notice that since a value of 0 in the font_index_table indicates that a character does not exist, the 0th element of the width, kerning, and codes arrays are not used. For this reason the 0th element of the width array can be used for a special purpose, defining the width of a space for a font. Normally a space is defined by troff to be 1/3 of the width of the \( \text{em} \) character, but if the 0th element of the width array is non-zero, then that value is used for the width of a space.

SEE ALSO
dpost(1), troff(1), troff(5)
FILES

/usr/lib/font/devX/DESC.out  description file for phototypesetter X
/usr/lib/font/devX/font.out  font description files for phototypesetter X
NAME
iconv – code set conversion tables

DESCRIPTION
The following code set conversions are supported:

<table>
<thead>
<tr>
<th>Code Set Conversions Supported</th>
</tr>
</thead>
<tbody>
<tr>
<td>Code</td>
</tr>
<tr>
<td>-------</td>
</tr>
<tr>
<td>ISO 646</td>
</tr>
<tr>
<td>ISO 646de</td>
</tr>
<tr>
<td>ISO 646da</td>
</tr>
<tr>
<td>ISO 646en</td>
</tr>
<tr>
<td>ISO 646es</td>
</tr>
<tr>
<td>ISO 646fr</td>
</tr>
<tr>
<td>ISO 646it</td>
</tr>
<tr>
<td>ISO 646sv</td>
</tr>
<tr>
<td>ISO 8859-1</td>
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<tr>
<td>ISO 8859-1</td>
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<tr>
<td>ISO 8859-1</td>
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<tr>
<td>ISO 8859-1</td>
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<tr>
<td>ISO 8859-1</td>
</tr>
</tbody>
</table>

The conversions are performed according to the tables following. All values in the tables are given in octal.

ISO 646 (US ASCII) to ISO 8859-1
For the conversion of ISO 646 to ISO 8859-1 all characters in ISO 646 can be mapped unchanged to ISO 8859-1.

ISO 646de (GERMAN) to ISO 8859-1
For the conversion of ISO 646de to ISO 8859-1 all characters not in the following table are mapped unchanged.

<table>
<thead>
<tr>
<th>Conversions Performed</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISO 646de</td>
</tr>
<tr>
<td>100</td>
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<tr>
<td>133</td>
</tr>
<tr>
<td>134</td>
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<tr>
<td>135</td>
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<tr>
<td>173</td>
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<td>174</td>
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<tr>
<td>175</td>
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<tr>
<td>176</td>
</tr>
</tbody>
</table>
ISO 646da (DANISH) to ISO 8859-1
For the conversion of ISO 646da to ISO 8859-1 all characters not in the following table are mapped unchanged.

<table>
<thead>
<tr>
<th>Conversions Performed</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISO 646da</td>
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<td>133</td>
</tr>
<tr>
<td>134</td>
</tr>
<tr>
<td>135</td>
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<tr>
<td>173</td>
</tr>
<tr>
<td>174</td>
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<tr>
<td>175</td>
</tr>
</tbody>
</table>

ISO 646en (ENGLISH ASCII) to ISO 8859-1
For the conversion of ISO 646en to ISO 8859-1 all characters not in the following table are mapped unchanged.

<table>
<thead>
<tr>
<th>Conversions Performed</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISO 646en</td>
</tr>
<tr>
<td>043</td>
</tr>
</tbody>
</table>

ISO 646fr (FRENCH) to ISO 8859-1
For the conversion of ISO 646fr to ISO 8859-1 all characters not in the following table are mapped unchanged.

<table>
<thead>
<tr>
<th>Conversions Performed</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISO 646fr</td>
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<td>043</td>
</tr>
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<tr>
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<tr>
<td>134</td>
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<tr>
<td>135</td>
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<tr>
<td>173</td>
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<tr>
<td>174</td>
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<tr>
<td>175</td>
</tr>
<tr>
<td>176</td>
</tr>
</tbody>
</table>
**iconv (5)**

**ISO 646it (ITALIAN) to ISO 8859-1**
For the conversion of ISO 646it to ISO 8859-1 all characters not in the following table are mapped unchanged.

<table>
<thead>
<tr>
<th>Conversions Performed</th>
<th>ISO 646it</th>
<th>ISO 8859-1</th>
</tr>
</thead>
<tbody>
<tr>
<td>043</td>
<td>243</td>
<td></td>
</tr>
<tr>
<td>100</td>
<td>247</td>
<td></td>
</tr>
<tr>
<td>133</td>
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<td></td>
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<tr>
<td>135</td>
<td>351</td>
<td></td>
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<tr>
<td>140</td>
<td>371</td>
<td></td>
</tr>
<tr>
<td>173</td>
<td>340</td>
<td></td>
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<tr>
<td>174</td>
<td>362</td>
<td></td>
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<td>175</td>
<td>350</td>
<td></td>
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<tr>
<td>176</td>
<td>354</td>
<td></td>
</tr>
</tbody>
</table>

**ISO 646es (SPANISH) to ISO 8859-1**
For the conversion of ISO 646es to ISO 8859-1 all characters not in the following table are mapped unchanged.

<table>
<thead>
<tr>
<th>Conversions Performed</th>
<th>ISO 646es</th>
<th>ISO 8859-1</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>247</td>
<td></td>
</tr>
<tr>
<td>133</td>
<td>241</td>
<td></td>
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<tr>
<td>134</td>
<td>321</td>
<td></td>
</tr>
<tr>
<td>135</td>
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<tr>
<td>173</td>
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<td></td>
</tr>
<tr>
<td>174</td>
<td>361</td>
<td></td>
</tr>
<tr>
<td>175</td>
<td>347</td>
<td></td>
</tr>
</tbody>
</table>
ISO 646sv (SWEDISH) to ISO 8859-1

For the conversion of ISO 646sv to ISO 8859-1 all characters not in the following table are mapped unchanged.

<table>
<thead>
<tr>
<th>Conversions Performed</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISO 646sv</td>
</tr>
<tr>
<td>100</td>
</tr>
<tr>
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<tr>
<td>134</td>
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<td>135</td>
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<td>136</td>
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<tr>
<td>173</td>
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<tr>
<td>174</td>
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<tr>
<td>175</td>
</tr>
<tr>
<td>176</td>
</tr>
</tbody>
</table>

ISO 8859-1 to ISO 646 (ASCII)

For the conversion of ISO 8859-1 to ISO 646 all characters not in the following table are mapped unchanged.

<table>
<thead>
<tr>
<th>Converted to Underscore ' ' (137)</th>
</tr>
</thead>
<tbody>
<tr>
<td>200 201 202 203 204 205 206 207</td>
</tr>
<tr>
<td>220 221 222 223 224 225 226 227</td>
</tr>
<tr>
<td>240 241 242 243 244 245 246 247</td>
</tr>
<tr>
<td>260 261 262 263 264 265 266 267</td>
</tr>
<tr>
<td>300 301 302 303 304 305 306 307</td>
</tr>
<tr>
<td>320 321 322 323 324 325 326 327</td>
</tr>
<tr>
<td>340 341 342 343 344 345 346 347</td>
</tr>
<tr>
<td>360 361 362 363 364 365 366 367</td>
</tr>
</tbody>
</table>
For the conversion of ISO 8859-1 to ISO 646de all characters not in the following tables are mapped unchanged.

<table>
<thead>
<tr>
<th>Conversions Performed</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISO 8859-1</td>
</tr>
<tr>
<td>247</td>
</tr>
<tr>
<td>304</td>
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<tr>
<td>326</td>
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<td>344</td>
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<tr>
<td>366</td>
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<tr>
<td>374</td>
</tr>
</tbody>
</table>

 Converted to Underscore ' ' (137)

<table>
<thead>
<tr>
<th>100</th>
<th>133</th>
<th>134</th>
<th>135</th>
<th>173</th>
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</thead>
<tbody>
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<td>372</td>
<td>373</td>
<td>375</td>
<td>376</td>
<td>377</td>
<td></td>
</tr>
</tbody>
</table>
ISO 8859-1 to ISO 646da (DANISH)

For the conversion of ISO 8859-1 to ISO 646da all characters not in the following tables are mapped unchanged.

<table>
<thead>
<tr>
<th>Conversions Performed</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISO 8859-1</td>
</tr>
<tr>
<td>305</td>
</tr>
<tr>
<td>306</td>
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<tr>
<td>330</td>
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<tr>
<td>345</td>
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<tr>
<td>346</td>
</tr>
<tr>
<td>370</td>
</tr>
</tbody>
</table>

Converted to Underscore "_" (137)

<table>
<thead>
<tr>
<th></th>
<th>133</th>
<th>134</th>
<th>135</th>
<th>173</th>
<th>174</th>
<th>175</th>
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<tbody>
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</table>
iconv (5)

ISO 8859-1 to ISO 646en (ENGLISH ASCII)
For the conversion of ISO 8859-1 to ISO 646en all characters not in the following tables are mapped unchanged.

<table>
<thead>
<tr>
<th>Conversions Performed</th>
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<td>ISO 8859-1</td>
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<td>243</td>
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Converted to Underscore ‘ ’ (137)

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<td>200 201 202 203 204 205 206 207</td>
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ISO 8859-1 to ISO 646fr (FRENCH)

For the conversion of ISO 8859-1 to ISO 646fr all characters not in the following tables are mapped unchanged.

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Converted to Underscore `'` (137)

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<td>240 241 242 244 245 246</td>
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<td>340 341 342 343 344 345 346</td>
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<td>350 351 352 353 354 355 356 357</td>
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<td>360 361 362 363 364 365 366 367</td>
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<tr>
<td>370 371 372 373 374 375 376 377</td>
</tr>
</tbody>
</table>
ISO 8859-1 to ISO 646it (ITALIAN)
For the conversion of ISO 8859-1 to ISO 646it all characters not in the following tables are mapped unchanged.

<table>
<thead>
<tr>
<th>Conversions Performed</th>
</tr>
</thead>
<tbody>
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<td>ISO 8859-1</td>
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Converted to Underscore `'` (137)

<table>
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<tr>
<th></th>
<th>043</th>
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ISO 8859-1 to ISO 646es (SPANISH)

For the conversion of ISO 8859-1 to ISO 646es all characters not in the following tables are mapped unchanged.

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<thead>
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<th>Conversions Performed</th>
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<td>361</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Converted to Underscore ‘ ’ (137)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 133 134 135 173 174 175</td>
</tr>
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<td>200 201 202 203 204 205 206 207</td>
</tr>
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<td>210 211 212 213 214 215 216 217</td>
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<tr>
<td>360 362 363 364 365 366 367</td>
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<tr>
<td>370 371 372 373 374 375 376 377</td>
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ISO 8859-1 to ISO 646sv (SWEDISH)

For the conversion of ISO 8859-1 to ISO 646sv all characters not in the following tables are mapped unchanged.

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Converted to Underscore ‘ ’ (137)

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<td></td>
</tr>
</tbody>
</table>
FILES
/usr/lib/iconv/iconv_data lists the conversions supported
/usr/lib/iconv/* conversion tables
/usr/lib/locale/locale/LC_MESSAGES/uxmsg language-specific message file [See LANG on
environ(5).]

SEE ALSO
iconv(1)
langinfo(5)

NAME
langinfo – language information constants

SYNOPSIS
#include <langinfo.h>

DESCRIPTION
This header file contains the constants used to identify items of langinfo data. The mode of items is given in nl_types(5).

DAY_1  Locale’s equivalent of “sunday”
DAY_2  Locale’s equivalent of “monday”
DAY_3  Locale’s equivalent of “tuesday”
DAY_4  Locale’s equivalent of “wednesday”
DAY_5  Locale’s equivalent of “thursday”
DAY_6  Locale’s equivalent of “friday”
DAY_7  Locale’s equivalent of “saturday”
ABDAY_1 Locale’s equivalent of “sun”
ABDAY_2 Locale’s equivalent of “mon”
ABDAY_3 Locale’s equivalent of “tue”
ABDAY_4 Locale’s equivalent of “wed”
ABDAY_5 Locale’s equivalent of “thur”
ABDAY_6 Locale’s equivalent of “fri”
ABDAY_7 Locale’s equivalent of “sat”
MON_1  Locale’s equivalent of “january”
MON_2  Locale’s equivalent of “february”
MON_3  Locale’s equivalent of “march”
MON_4  Locale’s equivalent of “april”
MON_5  Locale’s equivalent of “may”
MON_6  Locale’s equivalent of “june”
MON_7  Locale’s equivalent of “july”
MON_8  Locale’s equivalent of “august”
MON_9  Locale’s equivalent of “september”
MON_10 Locale’s equivalent of “october”
MON_11 Locale’s equivalent of “november”
MON_12 Locale’s equivalent of “december”
ABMON_1 Locale’s equivalent of “jan”
This information is retrieved by \texttt{nl\_langinfo(3C)}.

The items \texttt{CRNCYSTR}, \texttt{RADIXCHAR}, and \texttt{THOUSEP} are extracted from the fields \texttt{currency\_symbol}, \texttt{decimal\_point}, and \texttt{thousands\_sep} in the structure returned by \texttt{localeconv(3C)}.

The items \texttt{T\_FMT}, \texttt{D\_FMT}, \texttt{D\_T\_FMT}, \texttt{YESSTR}, and \texttt{NOSTR} are retrieved from a special message catalog named \texttt{Xopen\_info} which should be generated for each locale supported and installed in the appropriate directory [see \texttt{mkmsgs(1)} and \texttt{gettext(3C)}]. This catalog should have the messages in the order \texttt{T\_FMT}, \texttt{D\_FMT}, \texttt{D\_T\_FMT}, \texttt{YESSTR}, and \texttt{NOSTR}.

All other items are as returned by \texttt{strftime(3C)}.

\textbf{SEE ALSO}
\texttt{cftime(3C)}, \texttt{gettext(3C)}, \texttt{localeconv(3C)}, \texttt{mkmsgs(1)}, \texttt{nl\_langinfo(3C)}, \texttt{nl\_types(5)}, \texttt{strftime(3C)}
**SYNOPSIS**

```
nroff -man filename...
troff -man filename...
```

**DESCRIPTION**

These macros are used to lay out the reference pages in this manual. Note: if `filename` contains format input for a preprocessor, the commands shown above must be piped through the appropriate preprocessor. This is handled automatically by `man(1)`. See the "Conventions" section.

Any text argument `t` may be zero to six words. Quotes may be used to include `SPACE` characters in a word. If `text` is empty, the special treatment is applied to the next input line with text to be printed. In this way `.` may be used to italicize a whole line, or `.SB` may be used to make small bold letters.

A prevailing indent distance is remembered between successive indented paragraphs, and is reset to default value upon reaching a non-indented paragraph. Default units for indents `i` are `ens`.

Type font and size are reset to default values before each paragraph, and after processing font and size setting macros.

These strings are predefined by `-man`:

```\*R '®', '(Reg)' in nroff.
\*S Change to default type size.
```

**Requests**

* `n.t.l.` = next text line; `p.i.` = prevailing indent

<table>
<thead>
<tr>
<th>Request</th>
<th>Cause Break</th>
<th>If no Argument</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>.B <code>t</code></td>
<td>no</td>
<td><code>t=n.t.l.*</code></td>
<td>Text is in bold font.</td>
</tr>
<tr>
<td>.BI <code>t</code></td>
<td>no</td>
<td><code>t=n.t.l.</code></td>
<td>Join words, alternating bold and italic.</td>
</tr>
<tr>
<td>.BR <code>t</code></td>
<td>no</td>
<td><code>t=n.t.l.</code></td>
<td>Join words, alternating bold and roman.</td>
</tr>
<tr>
<td>.DT <code>i</code></td>
<td>yes</td>
<td><code>i=p.i.*</code></td>
<td>Begin paragraph with hanging indent. Set prevailing indent to <code>i</code>.</td>
</tr>
<tr>
<td>.I <code>t</code></td>
<td>no</td>
<td><code>t=n.t.l.</code></td>
<td>Text is italic.</td>
</tr>
<tr>
<td>.IB <code>t</code></td>
<td>no</td>
<td><code>t=n.t.l.</code></td>
<td>Join words, alternating italic and bold.</td>
</tr>
<tr>
<td>.IP <code>x i</code></td>
<td>yes</td>
<td><code>x=&quot;&quot;</code></td>
<td>Same as .TP with tag <code>x</code>.</td>
</tr>
<tr>
<td>.IR <code>t</code></td>
<td>no</td>
<td><code>t=n.t.l.</code></td>
<td>Join words, alternating italic and roman.</td>
</tr>
<tr>
<td>.IX <code>t</code></td>
<td>no</td>
<td>-</td>
<td>Index macro.</td>
</tr>
<tr>
<td>.LP</td>
<td>yes</td>
<td>-</td>
<td>Begin left-aligned paragraph. Set prevailing indent to <code>.5i</code>.</td>
</tr>
<tr>
<td>.PD <code>d</code></td>
<td>no</td>
<td><code>d=.4v</code></td>
<td>Set vertical distance between paragraphs.</td>
</tr>
<tr>
<td>.PP</td>
<td>yes</td>
<td>-</td>
<td>Same as .LP.</td>
</tr>
</tbody>
</table>
(BSD System Compatibility) man(5)

<table>
<thead>
<tr>
<th>Request</th>
<th>Cause Break</th>
<th>If no Argument</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>.RE</td>
<td>yes</td>
<td>-</td>
<td>End of relative indent. Restores prevailing indent.</td>
</tr>
<tr>
<td>.RB t</td>
<td>no</td>
<td>t=n.t.l.</td>
<td>Join words, alternating roman and bold.</td>
</tr>
<tr>
<td>.RI t</td>
<td>no</td>
<td>t=n.t.l.</td>
<td>Join words, alternating roman and italic.</td>
</tr>
<tr>
<td>.RS i</td>
<td>yes</td>
<td>i=p.i.</td>
<td>Start relative indent, increase indent by i. Sets prevailing indent to .5i for nested indents.</td>
</tr>
<tr>
<td>.SB t</td>
<td>no</td>
<td>-</td>
<td>Reduce size of text by 1 point, make text bold.</td>
</tr>
<tr>
<td>.SH t</td>
<td>yes</td>
<td>-</td>
<td>Section Heading.</td>
</tr>
<tr>
<td>.SM t</td>
<td>no</td>
<td>t=n.t.l.</td>
<td>Reduce size of text by 1 point.</td>
</tr>
<tr>
<td>.SS t</td>
<td>yes</td>
<td>t=n.t.l.</td>
<td>Section Subheading.</td>
</tr>
<tr>
<td>.TH n s d f m</td>
<td>yes</td>
<td>-</td>
<td>Begin reference page n, of of section s; d is the date of the most recent change. If present, f is the left page footer; m is the main page (center) header. Sets prevailing indent and tabs to .5i.</td>
</tr>
<tr>
<td>.TP i</td>
<td>yes</td>
<td>i=p.i.</td>
<td>Begin indented paragraph, with the tag given on the next text line. Set prevailing indent to i.</td>
</tr>
</tbody>
</table>

Conventions

When formatting a manual page, man examines the first line to determine whether it requires special processing. For example a first line consisting of:

'" t

indicates that the manual page must be run through the tbl(1) preprocessor.

A typical manual page for a command or function is laid out as follows:

.TH title [1-8]

The name of the command or function, which serves as the title of the manual page. This is followed by the number of the section in which it appears.

.SH NAME

The name, or list of names, by which the command is called, followed by a dash and then a one-line summary of the action performed. All in roman font, this section contains no troff(1) commands or escapes, and no macro requests. It is used to generate the whatis(1) database.

.SH SYNOPSIS

Commands:

The syntax of the command and its arguments, as typed on the command line. When in boldface, a word must be typed exactly as printed. When in italics, a word can be replaced with an argument that you supply. References to bold or italicized items are not capitalized in other sections, even when they begin a sentence.
Syntactic symbols appear in roman face:

[] An argument, when surrounded by brackets is optional.

| Arguments separated by a vertical bar are exclusive. You can supply only one item from such a list.

... Arguments followed by an ellipsis can be repeated. When an ellipsis follows a bracketed set, the expression within the brackets can be repeated.

Functions:
If required, the data declaration, or \texttt{#include} directive, is shown first, followed by the function declaration. Otherwise, the function declaration is shown.

\texttt{.SH DESCRIPTION}
A narrative overview of the command or function's external behavior. This includes how it interacts with files or data, and how it handles the standard input, standard output and standard error. Internals and implementation details are normally omitted. This section attempts to provide a succinct overview in answer to the question, "what does it do?"

Literal text from the synopsis appears in constant width, as do literal filenames and references to items that appear elsewhere in the reference manuals. Arguments are italicized.

If a command interprets either subcommands or an input grammar, its command interface or input grammar is normally described in a \texttt{USAGE} section, which follows the \texttt{OPTIONS} section. The \texttt{DESCRIPTION} section only describes the behavior of the command, not that of subcommands.

\texttt{.SH OPTIONS}
The list of options along with a description of how each affects the command's operation.

\texttt{.SH FILES}
A list of files associated with the command or function.

\texttt{.SH SEE ALSO}
A comma-separated list of related manual pages, followed by references to other published materials.

\texttt{.SH DIAGNOSTICS}
A list of diagnostic messages and an explanation of each.

\texttt{.SH NOTES}
A description of limitations, known defects, and possible problems associated with the command or function.

\texttt{FILES}
/usr/ucblib/doctools/tmac/an

\texttt{SEE ALSO}
man(1), nroff(1), troff(1), whatis(1)
NAME
math – math functions and constants

SYNOPSIS
#include <math.h>

DESCRIPTION
This file contains declarations of all the functions in the Math Library (described in Section 3M), as well as various functions in the C Library (Section 3C) that return floating-point values.

It defines the structure and constants used by the matherr(3M) error-handling mechanisms, including the following constant used as a error-return value:

HUGE The maximum value of a single-precision floating-point number.

The following mathematical constants are defined for user convenience:

M_E The base of natural logarithms (e).
M_LOG2E The base-2 logarithm of e.
M_LOG10E The base-10 logarithm of e.
M_LN2 The natural logarithm of 2.
M_LN10 The natural logarithm of 10.
M_PI π, the ratio of the circumference of a circle to its diameter.
M_PI_2 π/2.
M_PI_4 π/4.
M_1_PI 1/π.
M_2_PI 2/π.
M_2_SQRTPI 2/√π.
M_SQRT2 The positive square root of 2.
M_SQRT1_2 The positive square root of 1/2.

The following mathematical constants are also defined in this header file:

MAXFLOAT The maximum value of a non-infinite single-precision floating point number.
HUGE_VAL positive infinity.

For the definitions of various machine-dependent constants, see values(5).

SEE ALSO
intro(3), matherr(3M), values(5)
NAME

me - (BSD) macros for formatting papers

SYNOPSIS

nroff -me [options] file...
troff -me [options] file...

DESCRIPTION

This package of nroff and troff macro definitions provides a canned formatting facility for technical papers in various formats. When producing 2-column output on a terminal, filter the output through col(1).

The macro requests are defined below. Many nroff and troff requests are unsafe in conjunction with this package, however, these requests may be used with impunity after the first .pp:

- .bp begin new page
- .br break output line here
- .sp n insert n spacing lines
- .ls n (line spacing) n=1 single, n=2 double space
- .na no alignment of right margin
- .ce n center next n lines
- .ul n underline next n lines
- .sz +n add n to point size

Output of the eqn, neqn, refer, and tbl(1) preprocessors for equations and tables is acceptable as input.

Requests

In the following list, initialization refers to the first .pp, .lp, .lp, .np, .sh, or .uh macro. This list is incomplete.

<table>
<thead>
<tr>
<th>Request</th>
<th>Initial</th>
<th>Cause Break</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>.(c)</td>
<td>-</td>
<td>yes</td>
<td>Begin centered block</td>
</tr>
<tr>
<td>.(d)</td>
<td>-</td>
<td>no</td>
<td>Begin delayed text</td>
</tr>
<tr>
<td>.(f)</td>
<td>-</td>
<td>no</td>
<td>Begin footnote</td>
</tr>
<tr>
<td>.(l)</td>
<td>-</td>
<td>yes</td>
<td>Begin list</td>
</tr>
<tr>
<td>.(q)</td>
<td>-</td>
<td>yes</td>
<td>Begin major quote</td>
</tr>
<tr>
<td>.(xx)</td>
<td>-</td>
<td>no</td>
<td>Begin indexed item in index x</td>
</tr>
<tr>
<td>.(z)</td>
<td>-</td>
<td>no</td>
<td>Begin floating keep</td>
</tr>
<tr>
<td>.(c)</td>
<td>-</td>
<td>yes</td>
<td>End centered block</td>
</tr>
<tr>
<td>.(d)</td>
<td>-</td>
<td>yes</td>
<td>End delayed text</td>
</tr>
<tr>
<td>.(f)</td>
<td>-</td>
<td>yes</td>
<td>End footnote</td>
</tr>
<tr>
<td>.(l)</td>
<td>-</td>
<td>yes</td>
<td>End list</td>
</tr>
<tr>
<td>.(q)</td>
<td>-</td>
<td>yes</td>
<td>End major quote</td>
</tr>
<tr>
<td>.(x)</td>
<td>-</td>
<td>yes</td>
<td>End index item</td>
</tr>
<tr>
<td>.(z)</td>
<td>-</td>
<td>yes</td>
<td>End floating keep</td>
</tr>
<tr>
<td>Request</td>
<td>Initial Value</td>
<td>Cause Break</td>
<td>Explanation</td>
</tr>
<tr>
<td>---------</td>
<td>---------------</td>
<td>-------------</td>
<td>-------------</td>
</tr>
<tr>
<td>.++ m H</td>
<td>-</td>
<td>no</td>
<td>Define paper section. ( m ) defines the part of the paper, and can be C (chapter), A (appendix), P (preliminary, for instance, table of contents, and so on), B (bibliography), RC (chapters renumbered from page one each chapter), or RA (appendix renumbered from page one).</td>
</tr>
<tr>
<td>.+c T</td>
<td>-</td>
<td>yes</td>
<td>Begin chapter (or appendix, and so on, as set by .++.). ( T ) is the chapter title.</td>
</tr>
<tr>
<td>.lc</td>
<td>1</td>
<td>yes</td>
<td>One column format on a new page.</td>
</tr>
<tr>
<td>.2c</td>
<td>1</td>
<td>yes</td>
<td>Two column format.</td>
</tr>
<tr>
<td>.EN</td>
<td>-</td>
<td>yes</td>
<td>Space after equation produced by eqn or meqn.</td>
</tr>
<tr>
<td>.EQ x y</td>
<td>-</td>
<td>yes</td>
<td>Precede equation; break out and add space. Equation number is ( y ). The optional argument ( x ) may be ( I ) to indent equation (default), ( L ) to left-adjust the equation, or ( C ) to center the equation.</td>
</tr>
<tr>
<td>.TE</td>
<td>-</td>
<td>yes</td>
<td>End table.</td>
</tr>
<tr>
<td>.TH</td>
<td>-</td>
<td>yes</td>
<td>End heading section of table.</td>
</tr>
<tr>
<td>.TS x</td>
<td>-</td>
<td>yes</td>
<td>Begin table; if ( x ) is ( H ) table has repeated heading.</td>
</tr>
<tr>
<td>.ac A N</td>
<td>-</td>
<td>no</td>
<td>Set up for ACM style output. ( A ) is the Author’s name(s), ( N ) is the total number of pages. Must be given before the first initialization.</td>
</tr>
<tr>
<td>.bx</td>
<td>no</td>
<td>no</td>
<td>Print ( x ) in boldface; if no argument switch to boldface.</td>
</tr>
<tr>
<td>.ba +n</td>
<td>0</td>
<td>yes</td>
<td>Augments the base indent by ( n ). This indent is used to set the indent on regular text (like paragraphs).</td>
</tr>
<tr>
<td>.bc</td>
<td>no</td>
<td>yes</td>
<td>Begin new column</td>
</tr>
<tr>
<td>.bi x</td>
<td>no</td>
<td>no</td>
<td>Print ( x ) in bold italics (nofill only)</td>
</tr>
<tr>
<td>.bx x</td>
<td>no</td>
<td>no</td>
<td>Print ( x ) in a box (nofill only).</td>
</tr>
<tr>
<td>.ef 'x'y'z</td>
<td>'....'</td>
<td>no</td>
<td>Set even footer to ( x y z )</td>
</tr>
<tr>
<td>.eh 'x'y'z</td>
<td>'....'</td>
<td>no</td>
<td>Set even header to ( x y z )</td>
</tr>
<tr>
<td>.fo 'x'y'z</td>
<td>'....'</td>
<td>no</td>
<td>Set footer to ( x y z )</td>
</tr>
<tr>
<td>.hx</td>
<td>-</td>
<td>no</td>
<td>Suppress headers and footers on next page.</td>
</tr>
<tr>
<td>.he 'x'y'z</td>
<td>'....'</td>
<td>no</td>
<td>Set header to ( x y z )</td>
</tr>
<tr>
<td>.hl</td>
<td>-</td>
<td>yes</td>
<td>Draw a horizontal line</td>
</tr>
<tr>
<td>.i x</td>
<td>no</td>
<td>no</td>
<td>Italicize ( x ); if ( x ) missing, italic text follows.</td>
</tr>
</tbody>
</table>
me(5)  (BSD System Compatibility)

<table>
<thead>
<tr>
<th>Request</th>
<th>Initial Value</th>
<th>Cause Break</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>.ip x y</td>
<td>no</td>
<td>yes</td>
<td>Start indented paragraph, with hanging tag x. Indentation is y ens (default 5).</td>
</tr>
<tr>
<td>.lp</td>
<td>yes</td>
<td>yes</td>
<td>Start left-blocked paragraph.</td>
</tr>
<tr>
<td>.lo</td>
<td>-</td>
<td>no</td>
<td>Read in a file of local macros of the form .'x. Must be given before initialization.</td>
</tr>
<tr>
<td>.np</td>
<td>1</td>
<td>yes</td>
<td>Start numbered paragraph.</td>
</tr>
<tr>
<td>.of .x'y'z</td>
<td>, , , ,</td>
<td>no</td>
<td>Set odd footer to x y z</td>
</tr>
<tr>
<td>.oh .x'y'z</td>
<td>, , , ,</td>
<td>no</td>
<td>Set odd header to x y z</td>
</tr>
<tr>
<td>.pd</td>
<td>-</td>
<td>yes</td>
<td>Print delayed text.</td>
</tr>
<tr>
<td>.pp</td>
<td>no</td>
<td>yes</td>
<td>Begin paragraph. First line indented.</td>
</tr>
<tr>
<td>.r</td>
<td>yes</td>
<td>no</td>
<td>Roman text follows.</td>
</tr>
<tr>
<td>.re</td>
<td>-</td>
<td>no</td>
<td>Reset tabs to default values.</td>
</tr>
<tr>
<td>.sc</td>
<td>no</td>
<td>no</td>
<td>Read in a file of special characters and diacritical marks. Must be given before initialization.</td>
</tr>
<tr>
<td>.sh n x</td>
<td>-</td>
<td>yes</td>
<td>Section head follows, font automatically bold. n is level of section, x is title of section.</td>
</tr>
<tr>
<td>.sk</td>
<td>no</td>
<td>no</td>
<td>Leave the next page blank. Only one page is remembered ahead.</td>
</tr>
<tr>
<td>.sz +n</td>
<td>10p</td>
<td>no</td>
<td>Augment the point size by n points.</td>
</tr>
<tr>
<td>.th</td>
<td>no</td>
<td>no</td>
<td>Produce the paper in thesis format. Must be given before initialization.</td>
</tr>
<tr>
<td>.tp</td>
<td>no</td>
<td>yes</td>
<td>Begin title page.</td>
</tr>
<tr>
<td>.uh x</td>
<td>-</td>
<td>no</td>
<td>Underline argument (even in troff). (Nofill only).</td>
</tr>
<tr>
<td>.xp x</td>
<td>-</td>
<td>yes</td>
<td>Like .sh but unnumbered.</td>
</tr>
</tbody>
</table>

FILES
/usr/ucblib/doctools/tmac/e
/usr/ucblib/doctools/tmac/*me

SEE ALSO
col(1), eqn(1), nroff(1), troff(1), refer(1), tbl(1)
NAME
ms - (BSD) text formatting macros

SYNOPSIS
nroff -ms [options] file...
troff -ms [options] file...

DESCRIPTION
This package of nroff(1) and troff(1) macro definitions provides a formatting facility for various styles of articles, theses, and books. When producing 2-column output on a terminal or lineprinter, or when reverse line motions are needed, filter the output through col(1). All external -ms macros are defined below.

Many nroff and troff requests are unsafe in conjunction with this package. However, the first four requests below may be used with impunity after initialization, and the last two may be used even before initialization:

- .bp begin new page
- .br break output line
- .sp n insert n spacing lines
- .ce n center next n lines
- .ls n line spacing: n=1 single, n=2 double space
- .na no alignment of right margin

Font and point size changes with \f and \s are also allowed; for example, \fIword\fR will italicize word. Output of the tbl(1), eqn(1) and refer(1) preprocessors for equations, tables, and references is acceptable as input.

Requests

<table>
<thead>
<tr>
<th>Macro Name</th>
<th>Initial Value</th>
<th>Break?</th>
<th>Reset?</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>.AB x</td>
<td>-</td>
<td>y</td>
<td>y</td>
<td>begin abstract; if x=no do not label abstract</td>
</tr>
<tr>
<td>.AE</td>
<td>-</td>
<td>y</td>
<td>y</td>
<td>end abstract</td>
</tr>
<tr>
<td>.AI</td>
<td>-</td>
<td>y</td>
<td></td>
<td>author's institution</td>
</tr>
<tr>
<td>.AM</td>
<td>-</td>
<td>n</td>
<td></td>
<td>better accent mark definitions</td>
</tr>
<tr>
<td>.AU</td>
<td>-</td>
<td>y</td>
<td></td>
<td>author's name</td>
</tr>
<tr>
<td>.B x</td>
<td>-</td>
<td>n</td>
<td></td>
<td>embolden x; if no x, switch to boldface</td>
</tr>
<tr>
<td>.B1</td>
<td>-</td>
<td>y</td>
<td></td>
<td>begin text to be enclosed in a box</td>
</tr>
<tr>
<td>.B2</td>
<td>-</td>
<td>y</td>
<td></td>
<td>end boxed text and print it</td>
</tr>
<tr>
<td>.BD</td>
<td>-</td>
<td>y</td>
<td></td>
<td>block display; center entire block</td>
</tr>
<tr>
<td>.BT</td>
<td>date</td>
<td>n</td>
<td></td>
<td>bottom title, printed at foot of page</td>
</tr>
<tr>
<td>.BX x</td>
<td>-</td>
<td>n</td>
<td></td>
<td>print word x in a box</td>
</tr>
<tr>
<td>.CD</td>
<td>-</td>
<td>y</td>
<td></td>
<td>centered display with no keep</td>
</tr>
<tr>
<td>.CM</td>
<td>if t</td>
<td>n</td>
<td></td>
<td>cut mark between pages</td>
</tr>
<tr>
<td>.CT</td>
<td>-</td>
<td>y,y</td>
<td></td>
<td>chapter title: page number moved to CF (TM only)</td>
</tr>
<tr>
<td>.DA x</td>
<td>if n</td>
<td>n</td>
<td></td>
<td>force date x at bottom of page; today if no x</td>
</tr>
<tr>
<td>.DE</td>
<td>-</td>
<td>y</td>
<td></td>
<td>end display (unfilled text) of any kind</td>
</tr>
<tr>
<td>.DS x y</td>
<td>I</td>
<td>y</td>
<td></td>
<td>begin display with keep; x=I, L, C, B; y=indent</td>
</tr>
</tbody>
</table>
## Macro Initial Break? Explanation

<table>
<thead>
<tr>
<th>Macro Name</th>
<th>Initial Value</th>
<th>Break?</th>
<th>Reset?</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>.EF x</td>
<td>-</td>
<td>n</td>
<td></td>
<td>even page footer x (3 part as for .t1)</td>
</tr>
<tr>
<td>.EH x</td>
<td>-</td>
<td>n</td>
<td></td>
<td>even page header x (3 part as for .t1)</td>
</tr>
<tr>
<td>.EN</td>
<td>y</td>
<td></td>
<td></td>
<td>end displayed equation produced by eqn</td>
</tr>
<tr>
<td>.EQ xy</td>
<td>-</td>
<td>y</td>
<td></td>
<td>break out equation; x=L,I,C; y=equation number</td>
</tr>
<tr>
<td>.FE</td>
<td>n</td>
<td></td>
<td></td>
<td>end footnote to be placed at bottom of page</td>
</tr>
<tr>
<td>.FP</td>
<td>n</td>
<td></td>
<td></td>
<td>numbered footnote paragraph; may be redefined</td>
</tr>
<tr>
<td>.FS x</td>
<td>-</td>
<td>n</td>
<td></td>
<td>start footnote; x is optional footnote label</td>
</tr>
<tr>
<td>.HD</td>
<td>undef</td>
<td>n</td>
<td></td>
<td>optional page header below header margin</td>
</tr>
<tr>
<td>.I x</td>
<td>-</td>
<td>n</td>
<td></td>
<td>italicize x; if no x, switch to italics</td>
</tr>
<tr>
<td>.ID y</td>
<td>8n,.5i</td>
<td>y</td>
<td></td>
<td>indented display with no keep; y=indent</td>
</tr>
<tr>
<td>.IP xy</td>
<td>-</td>
<td>y,y</td>
<td></td>
<td>indented paragraph, with hanging tag x; y=indent</td>
</tr>
<tr>
<td>.IX xy</td>
<td>-</td>
<td>y</td>
<td></td>
<td>index words x y and so on (up to 5 levels)</td>
</tr>
<tr>
<td>.KE</td>
<td>-</td>
<td>n</td>
<td></td>
<td>end keep of any kind</td>
</tr>
<tr>
<td>.KF</td>
<td>n</td>
<td></td>
<td></td>
<td>begin floating keep; text fills remainder of page</td>
</tr>
<tr>
<td>.KS</td>
<td>y</td>
<td></td>
<td></td>
<td>begin keep; unit kept together on a single page</td>
</tr>
<tr>
<td>.LD</td>
<td>-</td>
<td>y</td>
<td></td>
<td>left display with no keep</td>
</tr>
<tr>
<td>.LG</td>
<td>n</td>
<td></td>
<td></td>
<td>larger; increase point size by 2</td>
</tr>
<tr>
<td>.LP</td>
<td>y,y</td>
<td></td>
<td></td>
<td>left (block) paragraph.</td>
</tr>
<tr>
<td>.MC x</td>
<td>-</td>
<td>y,y</td>
<td></td>
<td>multiple columns; x=column width</td>
</tr>
<tr>
<td>.ND x</td>
<td>if t</td>
<td>n</td>
<td></td>
<td>no date in page footer; x is date on cover</td>
</tr>
<tr>
<td>.NH xy</td>
<td>-</td>
<td>y,y</td>
<td></td>
<td>numbered header; x=level, x=0 resets, x=S sets to y</td>
</tr>
<tr>
<td>.NL</td>
<td>10p</td>
<td>n</td>
<td></td>
<td>set point size back to normal</td>
</tr>
<tr>
<td>.OF x</td>
<td>-</td>
<td>n</td>
<td></td>
<td>odd page footer x (3 part as for .t1)</td>
</tr>
<tr>
<td>.OH x</td>
<td>-</td>
<td>n</td>
<td></td>
<td>odd page header x (3 part as for .t1)</td>
</tr>
<tr>
<td>.PI</td>
<td>if TM</td>
<td>n</td>
<td></td>
<td>print header on first page</td>
</tr>
<tr>
<td>.PP</td>
<td>y,y</td>
<td></td>
<td></td>
<td>paragraph with first line indented</td>
</tr>
<tr>
<td>.PT</td>
<td>- % -</td>
<td>n</td>
<td></td>
<td>page title, printed at head of page</td>
</tr>
<tr>
<td>.PX x</td>
<td>-</td>
<td>y</td>
<td></td>
<td>print index (table of contents); x=no suppresses title</td>
</tr>
<tr>
<td>.QP</td>
<td>-</td>
<td>y,y</td>
<td></td>
<td>quote paragraph (indented and shorter)</td>
</tr>
<tr>
<td>.R</td>
<td>on</td>
<td>n</td>
<td></td>
<td>return to Roman font</td>
</tr>
<tr>
<td>.RE</td>
<td>5n</td>
<td>y,y</td>
<td></td>
<td>retreat; end level of relative indentation</td>
</tr>
<tr>
<td>.RP x</td>
<td>-</td>
<td>n</td>
<td></td>
<td>released paper format; x=no stops title on first page</td>
</tr>
<tr>
<td>.RS</td>
<td>5n</td>
<td>y,y</td>
<td></td>
<td>right shift; start level of relative indentation</td>
</tr>
<tr>
<td>.SH</td>
<td>-</td>
<td>y,y</td>
<td></td>
<td>section header, in boldface</td>
</tr>
<tr>
<td>.SM</td>
<td>-</td>
<td>n</td>
<td></td>
<td>smaller; decrease point size by 2</td>
</tr>
<tr>
<td>.TA</td>
<td>8n,5n</td>
<td>n</td>
<td></td>
<td>set TAB characters to 8n 16n ... (nroff) 5n 10n ... (troff)</td>
</tr>
<tr>
<td>.TC x</td>
<td>-</td>
<td>y</td>
<td></td>
<td>print table of contents at end; x=no suppresses title</td>
</tr>
<tr>
<td>.TE</td>
<td>-</td>
<td>y</td>
<td></td>
<td>end of table processed by tbl</td>
</tr>
<tr>
<td>.TH</td>
<td>-</td>
<td>y</td>
<td></td>
<td>end multi-page header of table</td>
</tr>
<tr>
<td>.TL</td>
<td>-</td>
<td>y</td>
<td></td>
<td>title in boldface and two points larger</td>
</tr>
<tr>
<td>.TM</td>
<td>off</td>
<td>n</td>
<td></td>
<td>thesis mode</td>
</tr>
<tr>
<td>.TS x</td>
<td>-</td>
<td>y,y</td>
<td></td>
<td>begin table; if x=H table has multi-page header</td>
</tr>
<tr>
<td>.UL x</td>
<td>-</td>
<td>n</td>
<td></td>
<td>underline x, even in troff</td>
</tr>
</tbody>
</table>
(BSD System Compatibility)

<table>
<thead>
<tr>
<th>Macro Name</th>
<th>Initial Value</th>
<th>Break?</th>
<th>Reset?</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>.UX x</td>
<td>–</td>
<td>n</td>
<td></td>
<td>UNIX; trademark message first time; x appended</td>
</tr>
<tr>
<td>.XA x y</td>
<td>– y</td>
<td>n</td>
<td>y</td>
<td>another index entry; x=page or no for none; y=indent</td>
</tr>
<tr>
<td>.XE</td>
<td>– y</td>
<td>y</td>
<td></td>
<td>end index entry (or series of .IX entries)</td>
</tr>
<tr>
<td>.XP</td>
<td>– y,y</td>
<td></td>
<td></td>
<td>paragraph with second and subsequent lines indented</td>
</tr>
<tr>
<td>.XS x y</td>
<td>– y</td>
<td></td>
<td>y</td>
<td>begin index entry; x=page or no for none; y=indent</td>
</tr>
<tr>
<td>.1C</td>
<td>on</td>
<td></td>
<td>y,y</td>
<td>one column format, on a new page</td>
</tr>
<tr>
<td>.2C</td>
<td>–</td>
<td>y,y</td>
<td></td>
<td>begin two column format</td>
</tr>
<tr>
<td>.}</td>
<td>–</td>
<td>n</td>
<td></td>
<td>beginning of refer reference</td>
</tr>
<tr>
<td>.[ 0</td>
<td>–</td>
<td>n</td>
<td></td>
<td>end of unclassifiable type of reference</td>
</tr>
</tbody>
</table>

**Registers**

Formatting distances can be controlled in -ms by means of built-in number registers. For example, this sets the line length to 6.5 inches:

```
.nr LL 6.5i
```

Here is a table of number registers and their default values:

<table>
<thead>
<tr>
<th>Name</th>
<th>Register Controls</th>
<th>Takes Effect</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>PS</td>
<td>point size</td>
<td>paragraph</td>
<td>10</td>
</tr>
<tr>
<td>VS</td>
<td>vertical spacing</td>
<td>paragraph</td>
<td>12</td>
</tr>
<tr>
<td>LL</td>
<td>line length</td>
<td>paragraph</td>
<td>6i</td>
</tr>
<tr>
<td>LT</td>
<td>title length</td>
<td>next page</td>
<td>same as LL</td>
</tr>
<tr>
<td>FL</td>
<td>footnote length</td>
<td>next .PS</td>
<td>5.5i</td>
</tr>
<tr>
<td>PD</td>
<td>paragraph distance</td>
<td>paragraph</td>
<td>1v (if n), .3v (if t)</td>
</tr>
<tr>
<td>DD</td>
<td>display distance</td>
<td>displays</td>
<td>1v (if n), .5v (if t)</td>
</tr>
<tr>
<td>PI</td>
<td>paragraph indent</td>
<td>paragraph</td>
<td>5n</td>
</tr>
<tr>
<td>QI</td>
<td>quote indent</td>
<td>next .QP</td>
<td>5n</td>
</tr>
<tr>
<td>FI</td>
<td>footnote indent</td>
<td>next .PS</td>
<td>2n</td>
</tr>
<tr>
<td>PO</td>
<td>page offset</td>
<td>next page</td>
<td>0 (if n), -1i (if t)</td>
</tr>
<tr>
<td>HM</td>
<td>header margin</td>
<td>next page</td>
<td>1i</td>
</tr>
<tr>
<td>FM</td>
<td>footer margin</td>
<td>next page</td>
<td>1i</td>
</tr>
<tr>
<td>FF</td>
<td>footnote format</td>
<td>next .PS</td>
<td>0 (1, 2, 3 available)</td>
</tr>
</tbody>
</table>

When resetting these values, make sure to specify the appropriate units. Setting the line length to 7, for example, will result in output with one character per line. Setting FF to 1 suppresses footnote superscripting; setting it to 2 also suppresses indentation of the first line; and setting it to 3 produces an .IP-like footnote paragraph.

Here is a list of string registers available in -ms; they may be used anywhere in the text:
ms (5)

(BSD System Compatibility)

<table>
<thead>
<tr>
<th>Name</th>
<th>String’s Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>*Q</td>
<td>quote (&quot; in nroff, ‘’ in troff )</td>
</tr>
<tr>
<td>*U</td>
<td>unquote (&quot; in nroff, ‘’ in troff )</td>
</tr>
<tr>
<td>*-</td>
<td>dash (-- in nroff, – in troff )</td>
</tr>
<tr>
<td>*(MO</td>
<td>month (month of the year)</td>
</tr>
<tr>
<td>*(DY</td>
<td>day (current date)</td>
</tr>
<tr>
<td>**</td>
<td>automatically numbered footnote</td>
</tr>
<tr>
<td>*‘</td>
<td>acute accent (before letter)</td>
</tr>
<tr>
<td>*’</td>
<td>grave accent (before letter)</td>
</tr>
<tr>
<td>*,</td>
<td>circumflex (before letter)</td>
</tr>
<tr>
<td>*,c</td>
<td>cedilla (before letter)</td>
</tr>
<tr>
<td>*:u</td>
<td>umlaut (before letter)</td>
</tr>
<tr>
<td>*:t</td>
<td>tild (before letter)</td>
</tr>
</tbody>
</table>

When using the extended accent mark definitions available with .AM, these strings should come after, rather than before, the letter to be accented.

FILES
/usr/ucb/lib/doctools/tmac/s
/usr/ucb/lib/doctools/tmac/ms.???

SEE ALSO
col(1), eqn(1), nroff(1), refer(1), tbl(1), troff(1)

NOTES
Floating keeps and regular keeps are diverted to the same space, so they cannot be mixed together with predictable results.
NAME

nl_types - native language data types

SYNOPSIS

#include <nl_types.h>

DESCRIPTION

This header file contains the following definitions:

nl_catd used by the message catalog functions catopen, catgets and catclose to identify a catalog

nl_item used by nl_langinfo to identify items of langinfo data. Values for objects of type nl_item are defined in langinfo.h

NL_SETD used by gencat when no $set directive is specified in a message text source file. This constant can be used in subsequent calls to catgets as the value of the set identifier parameter.

NL_MGSMAX maximum number of messages per set

NL_SETMAX maximum number of sets per catalog

NL_TEXTMAX maximum size of a message

DEF_NLSPATH the default search path for locating catalogs

SEE ALSO

catgets(3C), catopen(3C), gencat(1), langinfo(5), nl_langinfo(3C)
**NAME**

`priv` – include file for user-level privilege definitions

**SYNOPSIS**

```c
#include <priv.h>
```

**DESCRIPTION**

This header file is used by all user-level privilege commands.

```c
#ifndef
#define _PRIV_H
#define _PRIV_H

/***************************************************************************/
/* * Header file used by the user-level privilege commands. */
/* * Contains several macros used by user-level programs. The * external (user-level) privilege representation consists of: */
/* * */
/* * type | privilege */
/* * and is defined in <sys/privilege.h>. */
/* */
/* Also contained in <sys/privilege.h> are the definitions */
/* for the privilege position names used by user-level macros */
/* `pm_work()`, `pm_max()`, `pm_fixed()`, and `pm_inher()` below. */
/* */
/* The syntax for privileges are as follows: */
/* */
/* `pname` ::= <A-Z><0-9> */
/* privilege position ::= P_<pname> */
/* string name of privilege ::= lowercase(<pname>) */
/* */
/* It also contains macro definitions for the command arguments */
/* to the `filepriv()`, `procpriv()`, `procprivl()`, and `procprivc()` */
/* calls in addition to the typedef for the user-level definition */
/* of a privilege type and privilege set. */
/* */
/***************************************************************************/
#include <sys/privilege.h>

/***************************************************************************/
/* The following macros are used to specify which privilege sets */
/* are updated with the specified privilege. */
/* */
/***************************************************************************/
#define pm_work(p) (priv_t)((p) & PS_TYPE) ? -1 : ((p) | PS_WKG))
#define pm_max(p) (priv_t)((p) & PS_TYPE) ? -1 : ((p) | PS_MAX))
#define pm_fixed(p) (priv_t)((p) & PS_TYPE) ? -1 : ((p) | PS_FIX))
```
The following macros are used to simplify the procprivl(3C) and procprivr(3C) calls for setting/clearing process privileges.

```c
#define OWNER_W pm_work(P_OWNER)
#define AUDIT_W pm_work(P_AUDIT)
#define COMPAT_W pm_work(P_COMPAT)
#define DACREAD_W pm_work(P_DACREAD)
#define DACWRITE_W pm_work(P_DACWRITE)
#define DEV_W pm_work(P_DEV)
#define FILESYS_W pm_work(P_FIESYS)
#define MACREAD_W pm_work(P_MACREAD)
#define MACWRITE_W pm_work(P_MACWRITE)
#define MOUNT_W pm_work(P_MOUNT)
#define MULTIDIR_W pm_work(P_MULTIDIR)
#define SETFLEVEL_W pm_work(P_SETFLEVEL)
#define SETLEVEL_W pm_work(P_SETLEVEL)
#define SETSPRIV_W pm_work(P_SETSPRIV)
#define SETUID_W pm_work(P_SETUID)
#define SYOPS_W pm_work(P_SYOPS)
#define SETUPRIV_W pm_work(P_SETUPRIV)
#define DRIVER_W pm_work(P_DRIVER)
#define RTIME_W pm_work(P_RTIME)
#define MACUPGRADE_W pm_work(P_MACUPGRADE)
#define FSYSRANGE_W pm_work(P_FSYSRANGE)
#define AUDITWR_W pm_work(P_AUDITWR)
#define TSHAR_W pm_work(P_TSHAR)
#define FLOCK_W pm_work(P_FLOCK)
#define ALLPRIVS_W pm_work(P_ALLPRIVS)
#define READ_W DACREAD_W,MACREAD_W
#define WRITE_W DACWRITE_W,MACWRITE_W
#define ACCESS_W READ_W,WRITE_W
#define PRIVS_W ACCESS_W,SETSPRIV_W,FSYSRANGE_W
```

The following are the definitions for the privilege functions.

```c
# define priv (p) (priv_t) (((p) & PS_TYPE) ? -1 : ((p) | PS_INH))

extern int filepriv(const char *, int, priv_t *, int);
```
extern int procpriv(int, priv_t *, int);
extern int procprivl(int, ...);
extern int procprivc(int, ...);

#else
extern int filepriv();
extern int procpriv();
extern int procprivl();
extern int procprivc();

#endif /* _STDC */

#endif /* _PRIV_H */

SEE ALSO
filepriv(2), procpriv(2), privilege(5)
privilege(5)

NAME
privilege – include file for privilege mechanism definitions

SYNOPSIS
#include <sys/privilege.h>

DESCRIPTION
This header file is used by all privilege mechanisms. All privileges are defined here, as well as certain operations that are necessary for privilege operations.

#ifndef
#define _ACC_PRIV_PRIVILEGE_H /* wrapper symbol for kernel use */
#define _ACC_PRIV_PRIVILEGE_H /* subject to change without notice */
#endif

#ifndef
#define _KERNEL_HEADERS
#endif
#ifndef _UTIL_TYPES_H
#include <util/types.h> /* REQUIRED */
#endif /* _UTIL_TYPES_H */

# ifdef _KERNEL_HEADERS
#elif defined(_KERNEL)
#include <sys/types.h> /* REQUIRED */
#endif /* _KERNEL_HEADERS */

/**********************************************************
* The following is the typedef for the user-level privilege
* definition. It is here because kernel routines also need
* to know about this particular type.
* **********************************************************/
typedef unsigned long priv_t;

/**********************************************************
* The following are the known privilege sets.
* **********************************************************/
#define PS_FIX 0x66000000
#define PS_INH 0x69000000
#define PS_MAX 0x6d000000
#define PS_WKG 0x77000000
#define PS_TYPE 0xff000000
privilege(5)

/* *************************************************************************/
* The following are the supported object types for privilege mechanisms.
*
***************************************************************************/

#define PS_FILE_OTYPE 0x0
#define PS_PROC_OTYPE 0x1

/* *************************************************************************/
* The following is the set of all known privileges. The define NPRIVS is the
* number of privileges currently in use. It should be modified whenever a
* privilege is added or deleted. Further description of each privilege can be found in intro(2).
*
***************************************************************************/

#define NPRIVS 26
#define P_OWNER 0x00000000
#define P_AUDIT 0x00000001
#define P_COMPAT 0x00000002
#define P_DACREAD 0x00000003
#define P_DACWRITE 0x00000004
#define P_DEV 0x00000005
#define P_FILESYS 0x00000006
#define P_MACREAD 0x00000007
#define P_MACWRITE 0x00000008
#define P_MOUNT 0x00000009
#define P_MULTIDIR 0x0000000a
#define P_SETLEVEL 0x0000000b
#define P_SETSPRIV 0x0000000c
#define P_SETUID 0x0000000d
#define P_SYSOPS 0x0000000e
#define P_SETUPRIV 0x0000000f
#define P_DRIVER 0x00000010
#define P_RTMA 0x00000011
#define P_MACUPGRADE 0x00000012
#define P_FSYSRANGE 0x00000013
#define P_SETLEVEL 0x00000014
#define P_AUDITWR 0x00000015
#define P_TSHAR 0x00000016
#define P_PLOCK 0x00000017
#define P_CORE 0x00000018
#define P_LOADMOD 0x00000019
#define P_ALLPRIVS 0x000000ff
The following defines are recognized by the privilege mechanisms. They are returned in the argument value of the secsys() system call in the form of flags when the command is ES_PRVINFO.

```c
#define PM_UIDBASE 0x00000001
#define PM_ULVLINIT 0x00000002
#define PM_PRVMODE 0x00000004
```

The following are the CMOS recognized by the procpriv() and filepriv() system calls.

```c
#define SETPRV 0x0
#define CLRPRV 0x1
#define PUTPRV 0x2
#define GETPRV 0x3
#define CNTPRV 0x4
```

Structure definition for the privilege sets supported by individual privilege servers. Also some defines that are used at user-level related to the privilege mechanisms.

```c
#define PRVAMSIZ 32
#define PRVMAXSETS 256
typedef struct pm_setdef {
   priv_t sd_mask; /* masked type for this privilege set */
   uint sd_setcnt; /* number of privileges in this set */
   char sd_name[PRVAMSIZ]; /* name of this privilege set */
   ulong_t sd_objtype; /* object type of this privilege set */
} setdef_t;
```

The following macros are used by the different privilege servers to manipulate privilege bits.

```c
#if defined(_KERNEL) || defined(_KMEMUSER)
```

```c
```
privilege (5)

/* Turn on significant bits within kernel privilege vector. */
#define pm_allon ((1 << NPRIVS) - 1)

/* Mask off type field within privilege descriptor and returns */
/* the privilege */
#define pm_pos(p) (pvec_t)((p) & ~PS_TYPE)

/* Mask off the privilege field and return the privilege type */
#define pm_type(p) (pvec_t)((p) & PS_TYPE)

/* Convert privilege type to ASCII character */
#define pm_pridc(p) (pvec_t)((p) >> 24)

/* Turn on privilege passed within vector passed */
#define pm_setbits(p, v) (v = ((p) == P_ALLPRIVS) ? pm_allon : (1 << pm_pos(p)));

/* Check the credential(a) passed, */
/* to determine if privilege(b) is on within the working privilege set */
#define pm_privon(a, b) ((a)->cr_wkgpriv & (b))

/* Check both credentials(a,b) passed, */
/* to determine if the maximum privilege set of (b) is a subset of (a) */
#define pm_subset(a, b) (((a)->cr_maxpriv & (b)->cr_maxpriv) == (b)->cr_maxpriv)

/* If the maximum privileges in the credentials passed are non-zero */
/* then the process is privileged. */
#define pm_privileged(a) ((a)->cr_maxpriv)

/*****************************************************************************/
/* Structure definitions for the kernel privilege table */
/* data types. Used by any privilege mechanism that stores */
/* the information in the kernel. */
/*****************************************************************************/
privilege (5)

/* least privilege file table */
typedef struct lpftab {
    struct lpftab *lpf_next; /* ptr to next file in list */
    ino_t lpf_nodeid; /* node id */
    pvec_t lpf_fixpriv; /* fixed privileges */
    pvec_t lpf_inhpriv; /* inheritable privileges */
    time_t lpf_validity; /* validity info for integrity */
} lpftab_t;

/* least privilege file system id table */
typedef struct lpdtab {
    struct lpdtab *lpd_next; /* ptr to next file system in list */
    lpftab_t *lpd_list; /* ptr to a privileged file on */
    /* this particular file system */
    dev_t lpd_fsid; /* the id number for this file system */
} lpdtab_t;

/* least privilege device per file system table */
typedef struct lpktab {
    struct lpktab *lpk_next; /* ptr to next device in list */
    lpdtab_t *lpk_list; /* ptr to a file system on */
    /* this particular device */
    dev_t lpk_dev; /* the id number for this device */
} lpktab_t;

#endif /* _KERNEL || _KMEMUSER */

#endif /* _ACC_PRIV_PRIVILEGE_H */

SEE ALSO
filepriv(2), procpriv(2), priv(4)
prof(5)

NAME
prof – profile within a function

SYNOPSIS
#define MARK
#include <prof.h>
void MARK(name);

DESCRIPTION
MARK introduces a mark called name that is treated the same as a function entry point. Execution of the mark adds to a counter for that mark, and program-counter time spent is accounted to the immediately preceding mark or to the function if there are no preceding marks within the active function.

name may be any combination of letters, numbers, or underscores. Each name in a single compilation must be unique, but may be the same as any ordinary program symbol.

For marks to be effective, the symbol MARK must be defined before the header file prof.h is included, either by a preprocessor directive as in the synopsis, or by a command line argument:

cc -p -DMARK foo.c

If MARK is not defined, the MARK(name) statements may be left in the source files containing them and are ignored. prof -g must be used to get information on all labels.

EXAMPLE
In this example, marks can be used to determine how much time is spent in each loop. Unless this example is compiled with MARK defined on the command line, the marks are ignored.

#include <prof.h>
foo() {
  int i, j;
  ...
  MARK(loop1);
  for (i = 0; i < 2000; i++) {
    ...
  }
  MARK(loop2);
  for (j = 0; j < 2000; j++) {
    ...
  }
}

SEE ALSO
  monitor(3C) prof(1), profil(2)
NAME
regexp: compile, step, advance – regular expression compile and match routines

SYNOPSIS
#define INIT declarations
#define GETC (void) getc code
#define PEEKC (void) peekc code
#define UNGETC (void) ungetc code
#define RETURN(ptr) return code
#define ERROR(val) error code
#include <regexp.h>
char *compile(char *instring, char *expbuf, char *endbuf, int eof);
int step(char *string, char *expbuf);
int advance(char *string, char *expbuf);
extern char *loc1, *loc2, *locs;

DESCRIPTION
These functions are general purpose regular expression matching routines to be
used in programs that perform regular expression matching. These functions are
defined by the regexp.h header file.

The functions step and advance do pattern matching given a character string and a
compiled regular expression as input.

The function compile takes as input a regular expression as defined below and pro­
duces a compiled expression that can be used with step or advance.

A regular expression specifies a set of character strings. A member of this set of
strings is said to be matched by the regular expression. Some characters have spe­
cial meaning when used in a regular expression; other characters stand for them­
selves.

The regular expressions available for use with the regexp functions are constructed
as follows:

<table>
<thead>
<tr>
<th>Expression</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>c</td>
<td>the character c where c is not a special character.</td>
</tr>
<tr>
<td>\c</td>
<td>the character c where c is any character, except a digit in the range 1–9.</td>
</tr>
<tr>
<td>^</td>
<td>the beginning of the line being compared.</td>
</tr>
<tr>
<td>$</td>
<td>the end of the line being compared.</td>
</tr>
<tr>
<td>.</td>
<td>any character in the input.</td>
</tr>
</tbody>
</table>
| [s]        | any character in the set s, where s is a sequence of characters and/or a
             | range of characters, for example, [c–e]. |
| [^s]       | any character not in the set s, where s is defined as above. |
regexp (5)

\( r^* \) zero or more successive occurrences of the regular expression \( r \). The longest leftmost match is chosen.

\( rx \) the occurrence of regular expression \( r \) followed by the occurrence of regular expression \( x \). (Concatenation)

\( r\{m,n\} \) any number of \( m \) through \( n \) successive occurrences of the regular expression \( r \). The regular expression \( r\{m\} \) matches exactly \( m \) occurrences; \( r\{m,\} \) matches at least \( m \) occurrences.

\( (r) \) the regular expression \( r \). When \( \n \) (where \( n \) is a number greater than zero) appears in a constructed regular expression, it stands for the regular expression \( x \) where \( x \) is the \( n^{th} \) regular expression enclosed in \( ( \) and \( ) \) that appeared earlier in the constructed regular expression. For example, \( (r)x(y)z\n \) is the concatenation of regular expressions \( rxyz \).

Characters that have special meaning except when they appear within square brackets (([])) or are preceded by \( \) are: ., *, [, \. Other special characters, such as $ have special meaning in more restricted contexts.

The character ~ at the beginning of an expression permits a successful match only immediately after a newline, and the character $ at the end of an expression requires a trailing newline.

Two characters have special meaning only when used within square brackets. The character – denotes a range, [c–c], unless it is just after the open bracket or before the closing bracket, [-c] or [c–] in which case it has no special meaning. When used within brackets, the character ^ has the meaning complement of if it immediately follows the open bracket (example: [^c]); elsewhere between brackets (example: [c^]) it stands for the ordinary character ^.

The special meaning of the \ operator can be escaped only by preceding it with another \, for example, \n.

Programs must have the following five macros declared before the #include regexp.h statement. These macros are used by the compile routine. The macros GETC, PEEKC, and UNGETC operate on the regular expression given as input to compile.

GETC This macro returns the value of the next character (byte) in the regular expression pattern. Successive calls to GETC should return successive characters of the regular expression.

PEEK C This macro returns the next character (byte) in the regular expression. Immediately successive calls to PEEK C should return the same character, which should also be the next character returned by GETC.

UNGET C This macro causes the argument c to be returned by the next call to GETC and PEEKC. No more than one character of pushback is ever needed and this character is guaranteed to be the last character read by GETC. The return value of the macro UNGETC(c) is always ignored.
RETURN(ptr) This macro is used on normal exit of the compile routine. The value of the argument ptr is a pointer to the character after the last character of the compiled regular expression. This is useful to programs which have memory allocation to manage.

ERROR(val) This macro is the abnormal return from the compile routine. The argument val is an error number [see ERRORS below for meanings]. This call should never return.

The syntax of the compile routine is as follows:

```
compile(instring, expbuf, endbuf, eof)
```

The first parameter, instring, is never used explicitly by the compile routine but is useful for programs that pass down different pointers to input characters. It is sometimes used in the INIT declaration (see below). Programs which call functions to input characters or have characters in an external array can pass down a value of (char *)0 for this parameter.

The next parameter, expbuf, is a character pointer. It points to the place where the compiled regular expression will be placed.

The parameter endbuf is one more than the highest address where the compiled regular expression may be placed. If the compiled expression cannot fit in (endbuf-expbuf) bytes, a call to ERROR(SO) is made.

The parameter eof is the character which marks the end of the regular expression. This character is usually a /.

Each program that includes the regexp.h header file must have a #define statement for INIT. It is used for dependent declarations and initializations. Most often it is used to set a register variable to point to the beginning of the regular expression so that this register variable can be used in the declarations for GETC, PEEKC, and UNGETC. Otherwise it can be used to declare external variables that might be used by GETC, PEEKC and UNGETC. [See EXAMPLE below.]

The first parameter to the step and advance functions is a pointer to a string of characters to be checked for a match. This string should be null terminated.

The second parameter, expbuf, is the compiled regular expression which was obtained by a call to the function compile.

The function step returns non-zero if some substring of string matches the regular expression in expbuf and zero if there is no match. If there is a match, two external character pointers are set as a side effect to the call to step. The variable loc1 points to the first character that matched the regular expression; the variable loc2 points to the character after the last character that matches the regular expression. Thus if the regular expression matches the entire input string, loc1 will point to the first character of string and loc2 will point to the null at the end of string.

The function advance returns non-zero if the initial substring of string matches the regular expression in expbuf. If there is a match, an external character pointer, loc2, is set as a side effect. The variable loc2 points to the next character in string after the last character that matched.
When `advance` encounters a `*` or `{ \}` sequence in the regular expression, it will advance its pointer to the string to be matched as far as possible and will recursively call itself trying to match the rest of the string to the rest of the regular expression. As long as there is no match, `advance` will back up along the string until it finds a match or reaches the point in the string that initially matched the `*` or `{ \}`. It is sometimes desirable to stop this backing up before the initial point in the string is reached. If the external character pointer `loca` is equal to the point in the string at sometime during the backing up process, `advance` will break out of the loop that backs up and will return zero.

The external variables `circf`, `sed`, and `nbra` are reserved.

**DIAGNOSTICS**

The function `compile` uses the macro `RETURN` on success and the macro `ERROR` on failure (see above). The functions `step` and `advance` return non-zero on a successful match and zero if there is no match. Errors are:

- 11 range endpoint too large.
- 16 bad number.
- 25 \ digit out of range.
- 36 invalid or missing delimiter.
- 41 no remembered search string.
- 42 \( \) imbalance.
- 43 too many \(.
- 44 more than 2 numbers given in \( \).
- 45 \) expected after \.
- 46 first number exceeds second in \( \).
- 49 \] imbalance.
- 50 regular expression overflow.

**EXAMPLES**

The following is an example of how the regular expression macros and calls might be defined by an application program:

```c
#include <regexp.h>
register char *sp = instring;
(*sp++)
(*sp)
(--sp)
returns;
regerr

(void) compile(*argv, expbuf, &expbuf[ESIZE], '0');
if (step(linebuf, expbuf))
succeed;
```

**SEE ALSO**

`regexp(3G)`
NAME

siginfo – signal generation information

SYNOPSIS

#include <siginfo.h>

DESCRIPTION

If a process is catching a signal, it may request information that tells why the system generated that signal [see sigaction(2)]. If a process is monitoring its children, it may receive information that tells why a child changed state [see waitid(2)]. In either case, the system returns the information in a structure of type siginfo_t, which includes the following information:

```c
int si_signo    /* signal number */
int si_errno    /* error number */
int si_code     /* signal code */
```

si_signo contains the system-generated signal number. (For the waitid(2) function, si_signo is always SIGCHLD.)

If si_errno is non-zero, it contains an error number associated with this signal, as defined in errno.h.

si_code contains a code identifying the cause of the signal. If the value of si_code is less than or equal to 0, then the signal was generated by a user process [see kill(2) and sigsend(2)] and the siginfo structure contains the following additional information:

```c
pid_t si_pid    /* sending process ID */
uid_t si_uid    /* sending user ID */
```

Otherwise, si_code contains a signal-specific reason why the signal was generated, as follows:

<table>
<thead>
<tr>
<th>Signal</th>
<th>Code</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIGILL</td>
<td>ILL_ILLOPC</td>
<td>illegal opcode</td>
</tr>
<tr>
<td></td>
<td>ILL_ILLOPN</td>
<td>illegal operand</td>
</tr>
<tr>
<td></td>
<td>ILL_ILLADR</td>
<td>illegal addressing mode</td>
</tr>
<tr>
<td></td>
<td>ILL_ILLTRP</td>
<td>illegal trap</td>
</tr>
<tr>
<td></td>
<td>ILL_PRVOPC</td>
<td>privileged opcode</td>
</tr>
<tr>
<td></td>
<td>ILL_PRVREG</td>
<td>privileged register</td>
</tr>
<tr>
<td></td>
<td>ILL_COPROC</td>
<td>co-processor error</td>
</tr>
<tr>
<td></td>
<td>ILL_BADSTK</td>
<td>internal stack error</td>
</tr>
<tr>
<td>SIGFPE</td>
<td>FPE_INTDIV</td>
<td>integer divide by zero</td>
</tr>
<tr>
<td></td>
<td>FPE_INTOVF</td>
<td>integer overflow</td>
</tr>
<tr>
<td></td>
<td>FPE_FLTDIV</td>
<td>floating point divide by zero</td>
</tr>
<tr>
<td></td>
<td>FPE_FTOVF</td>
<td>floating point overflow</td>
</tr>
<tr>
<td></td>
<td>FPE_FLTUND</td>
<td>floating point underflow</td>
</tr>
<tr>
<td></td>
<td>FPE_FLTRES</td>
<td>floating point inexact result</td>
</tr>
<tr>
<td></td>
<td>FPE_FLTINV</td>
<td>invalid floating point operation</td>
</tr>
<tr>
<td></td>
<td>FPE_FLTSUB</td>
<td>subscript out of range</td>
</tr>
</tbody>
</table>
siginfo(5)

<table>
<thead>
<tr>
<th>Signal</th>
<th>Code</th>
<th>Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIGSEGV</td>
<td>SEGV_MAPERR</td>
<td>address not mapped to object</td>
</tr>
<tr>
<td></td>
<td>SEGV_ACCERR</td>
<td>invalid permissions for mapped object</td>
</tr>
<tr>
<td>SIGBUS</td>
<td>BUS_ADRALN</td>
<td>invalid address alignment</td>
</tr>
<tr>
<td></td>
<td>BUS_ADRERR</td>
<td>non-existent physical address</td>
</tr>
<tr>
<td></td>
<td>BUS_OBJERR</td>
<td>object specific hardware error</td>
</tr>
<tr>
<td>SIGTRAP</td>
<td>TRAP_BRKPT</td>
<td>process breakpoint</td>
</tr>
<tr>
<td></td>
<td>TRAP_TRACE</td>
<td>process trace trap</td>
</tr>
<tr>
<td>SIGCHLD</td>
<td>CLD_EXITED</td>
<td>child has exited</td>
</tr>
<tr>
<td></td>
<td>CLD_KILLED</td>
<td>child was killed</td>
</tr>
<tr>
<td></td>
<td>CLD_DUMPED</td>
<td>child terminated abnormally</td>
</tr>
<tr>
<td></td>
<td>CLD_TRAPPED</td>
<td>traced child has trapped</td>
</tr>
<tr>
<td></td>
<td>CLD_STOPPED</td>
<td>child has stopped</td>
</tr>
<tr>
<td></td>
<td>CLD_CONTINUED</td>
<td>stopped child had continued</td>
</tr>
<tr>
<td>SIGPOLL</td>
<td>POLL_IN</td>
<td>data input available</td>
</tr>
<tr>
<td></td>
<td>POLL_OUT</td>
<td>output buffers available</td>
</tr>
<tr>
<td></td>
<td>POLL_MSG</td>
<td>input message available</td>
</tr>
<tr>
<td></td>
<td>POLL_ERR</td>
<td>I/O error</td>
</tr>
<tr>
<td></td>
<td>POLL_PRI</td>
<td>high priority input available</td>
</tr>
<tr>
<td></td>
<td>POLL_HUP</td>
<td>device disconnected</td>
</tr>
</tbody>
</table>

In addition, the following signal-dependent information is available for kernel-generated signals:

<table>
<thead>
<tr>
<th>Signal</th>
<th>Field</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIGILL</td>
<td>caddr_t si_addr</td>
<td>address of faulting instruction</td>
</tr>
<tr>
<td>SIGFPE</td>
<td>caddr_t si_addr</td>
<td>address of faulting memory reference</td>
</tr>
<tr>
<td>SIGSEGV</td>
<td>caddr_t si_addr</td>
<td>address of faulting memory reference</td>
</tr>
<tr>
<td>SIGBUS</td>
<td>pid_t si_pid</td>
<td>child process ID</td>
</tr>
<tr>
<td></td>
<td>int si_status</td>
<td>exit value or signal</td>
</tr>
<tr>
<td>SIGPOLL</td>
<td>long si_band</td>
<td>band event for POLL_IN, POLL_OUT, or POLL_MSG</td>
</tr>
</tbody>
</table>

SEE ALSO
sigaction(2), signal(5), waitid(2)

NOTES
For SIGCHLD signals, if si_code is equal to CLD_EXITED, then si_status is equal to the exit value of the process; otherwise, it is equal to the signal that caused the process to change state. For some implementations, the exact value of si_addr may not be available; in that case, si_addr is guaranteed to be on the same page as the faulting instruction or memory reference.
NAME

signal – base signals

SYNOPSIS

#include <signal.h>

DESCRIPTION

A signal is an asynchronous notification of an event. A signal is said to be generated for (or sent to) a process when the event associated with that signal first occurs. Examples of such events include hardware faults, timer expiration and terminal activity, as well as the invocation of the kill or sigsend system calls. In some circumstances, the same event generates signals for multiple processes. A process may request a detailed notification of the source of the signal and the reason why it was generated [see siginfo(5)].

Each process may specify a system action to be taken in response to each signal sent to it, called the signal’s disposition. The set of system signal actions for a process is initialized from that of its parent. Once an action is installed for a specific signal, it usually remains installed until another disposition is explicitly requested by a call to either sigaction, signal or sigset, or until the process execs [see sigaction(2) and signal(2)]. When a process execs, all signals whose disposition has been set to catch the signal will be set to SIG_DFL. Alternatively, a process may request that the system automatically reset the disposition of a signal to SIG_DFL after it has been caught [see sigaction(2) and signal(2)].

A signal is said to be delivered to a process when the appropriate action for the process and signal is taken. During the time between the generation of a signal and its delivery, the signal is said to be pending [see sigpending(2)]. Ordinarily, this interval cannot be detected by an application. However, a signal can be blocked from delivery to a process [see signal(2) and sigprocmask(2)]. If the action associated with a blocked signal is anything other than to ignore the signal, and if that signal is generated for the process, the signal remains pending until either it is unblocked or the signal’s disposition requests that the signal be ignored. If the signal disposition of a blocked signal requests that the signal be ignored, and if that signal is generated for the process, the signal is discarded immediately upon generation.

Each process has a signal mask that defines the set of signals currently blocked from delivery to it [see sigprocmask(2)]. The signal mask for a process is initialized from that of its parent.

The determination of which action is taken in response to a signal is made at the time the signal is delivered, allowing for any changes since the time of generation. This determination is independent of the means by which the signal was originally generated.

The signals currently defined in sys/signal.h are as follows:
### signal (5)

<table>
<thead>
<tr>
<th>Name</th>
<th>Value</th>
<th>Default</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIGHUP</td>
<td>1</td>
<td>Exit</td>
<td>Hangup [see termio(7)]</td>
</tr>
<tr>
<td>SIGINT</td>
<td>2</td>
<td>Exit</td>
<td>Interrupt [see termio(7)]</td>
</tr>
<tr>
<td>SIGQUIT</td>
<td>3</td>
<td>Core</td>
<td>Quit [see termio(7)]</td>
</tr>
<tr>
<td>SIGILL</td>
<td>4</td>
<td>Core</td>
<td>Illegal Instruction</td>
</tr>
<tr>
<td>SIGTRAP</td>
<td>5</td>
<td>Core</td>
<td>Trace/Breakpoint Trap</td>
</tr>
<tr>
<td>SIGABRT</td>
<td>6</td>
<td>Core</td>
<td>Abort</td>
</tr>
<tr>
<td>SIGEMT</td>
<td>7</td>
<td>Core</td>
<td>Emulation Trap</td>
</tr>
<tr>
<td>SIGFPE</td>
<td>8</td>
<td>Core</td>
<td>Arithmetic Exception</td>
</tr>
<tr>
<td>SIGKILL</td>
<td>9</td>
<td>Exit</td>
<td>Killed</td>
</tr>
<tr>
<td>SIGBUS</td>
<td>10</td>
<td>Core</td>
<td>Bus Error</td>
</tr>
<tr>
<td>SIGSEGV</td>
<td>11</td>
<td>Core</td>
<td>Segmentation Fault</td>
</tr>
<tr>
<td>SIGSYS</td>
<td>12</td>
<td>Core</td>
<td>Bad System Call</td>
</tr>
<tr>
<td>SIGPIPE</td>
<td>13</td>
<td>Exit</td>
<td>Broken Pipe</td>
</tr>
<tr>
<td>SIGALRM</td>
<td>14</td>
<td>Exit</td>
<td>Alarm Clock</td>
</tr>
<tr>
<td>SIGTERM</td>
<td>15</td>
<td>Exit</td>
<td>Terminated</td>
</tr>
<tr>
<td>SIGUSR1</td>
<td>16</td>
<td>Exit</td>
<td>User Signal 1</td>
</tr>
<tr>
<td>SIGUSR2</td>
<td>17</td>
<td>Exit</td>
<td>User Signal 2</td>
</tr>
<tr>
<td>SIGCHLD</td>
<td>18</td>
<td>Ignore</td>
<td>Child Status</td>
</tr>
<tr>
<td>SIGPWR</td>
<td>19</td>
<td>Ignore</td>
<td>Power Fail/Restart</td>
</tr>
<tr>
<td>SIGWINCH</td>
<td>20</td>
<td>Ignore</td>
<td>Window Size Change</td>
</tr>
<tr>
<td>SIGURG</td>
<td>21</td>
<td>Ignore</td>
<td>Urgent Socket Condition</td>
</tr>
<tr>
<td>SIGPOLL</td>
<td>22</td>
<td>Ignore</td>
<td>Socket I/O Possible</td>
</tr>
<tr>
<td>SIGSTOP</td>
<td>23</td>
<td>Stop</td>
<td>Stopped (signal)</td>
</tr>
<tr>
<td>SIGSTTP</td>
<td>24</td>
<td>Stop</td>
<td>Stopped (user) [see termio(7)]</td>
</tr>
<tr>
<td>SIGCONT</td>
<td>25</td>
<td>Ignore</td>
<td>Continued</td>
</tr>
<tr>
<td>SIGTTIN</td>
<td>26</td>
<td>Stop</td>
<td>Stopped (tty input) [see termio(7)]</td>
</tr>
<tr>
<td>SIGTTOU</td>
<td>27</td>
<td>Stop</td>
<td>Stopped (tty output) [see termio(7)]</td>
</tr>
<tr>
<td>SIGVTALRM</td>
<td>28</td>
<td>Exit</td>
<td>Virtual Timer Expired</td>
</tr>
<tr>
<td>SIGPROF</td>
<td>29</td>
<td>Exit</td>
<td>Profiling Timer Expired</td>
</tr>
<tr>
<td>SIGXCPU</td>
<td>30</td>
<td>Core</td>
<td>CPU time limit exceeded [see getrlimit(2)]</td>
</tr>
<tr>
<td>SIGXFSZ</td>
<td>31</td>
<td>Core</td>
<td>File size limit exceeded [see getrlimit(2)]</td>
</tr>
</tbody>
</table>

Using the `signal`, `sigset` or `sigaction` system call, a process may specify one of three dispositions for a signal: take the default action for the signal, ignore the signal, or catch the signal.

**Default Action: SIG_DFL**

A disposition of `SIG_DFL` specifies the default action. The default action for each signal is listed in the table above and is selected from the following:

- **Exit** When it gets the signal, the receiving process is to be terminated with all the consequences outlined in `exit(2)`.
- **Core** When it gets the signal, the receiving process is to be terminated with all the consequences outlined in `exit(2)`. In addition, a "core image" of the process is constructed in the current working directory.
- **Stop** When it gets the signal, the receiving process is to stop.
Signal

Ignore When it gets the signal, the receiving process is to ignore it. This is identical to setting the disposition to `SIG_IGN`.

Ignore Signal: `SIG_IGN`
A disposition of `SIG_IGN` specifies that the signal is to be ignored.

Catch Signal: `function address`
A disposition that is a function address specifies that, when it gets the signal, the receiving process is to execute the signal handler at the specified address. Normally, the signal handler is passed the signal number as its only argument; if the disposition was set with the `sigaction` function however, additional arguments may be requested [see `sigaction(2)`]. When the signal handler returns, the receiving process resumes execution at the point it was interrupted, unless the signal handler makes other arrangements. If an invalid function address is specified, results are undefined.

If the disposition has been set with the `sigset` or `sigaction` function, the signal is automatically blocked by the system while the signal catcher is executing. If a `longjmp` [see `setjmp(3C)`] is used to leave the signal catcher, then the signal must be explicitly unblocked by the user [see `signal(2)` and `sigprocmask(2)`].

If execution of the signal handler interrupts a blocked system call, the handler is executed and the interrupted system call returns a `-1` to the calling process with `errno` set to `EINTR`. However, if the `SA_RESTART` flag is set the system call will be transparently restarted.

Notes
The dispositions of the `SIGKILL` and `SIGSTOP` signals cannot be altered from their default values. The system generates an error if this is attempted.

The `SIGKILL` and `SIGSTOP` signals cannot be blocked. The system silently enforces this restriction.

Whenever a process receives a `SIGSTOP`, `SIGTSTP`, `SIGTTIN`, or `SIGTTOU` signal, regardless of its disposition, any pending `SIGCONT` signal is discarded. A process stopped by the above four signals is said to be in a job control stop.

Whenever a process receives a `SIGCONT` signal, regardless of its disposition, any pending `SIGSTOP`, `SIGTSTP`, `SIGTTIN`, and `SIGTTOU` signals are discarded. In addition, if the process was stopped, it is continued.

`SIGPOLL` is issued when a file descriptor corresponding to a STREAMS [see `intro(2)`] file has a “selectable” event pending. A process must specifically request that this signal be sent using the `I_SETSIG ioctl` call. Otherwise, the process will never receive `SIGPOLL`.

If the disposition of the `SIGCHLD` signal has been set with `signal` or `sigset`, or with `sigaction` and the `SA_NOCLDSTOP` flag has been specified, it will only be sent to the calling process when its children exit; otherwise, it will also be sent when the calling process’s children are stopped or continued due to job control.

For backward compatibility, the names `SIGCLD`, `SIGIOT`, and `SIGIO` are defined in this header file. `SIGCLD` identifies the same signal as `SIGCHLD`. `SIGIOT` identifies the same signal as `SIGABRT`, and `SIGIO` identifies the same signal as `SIGPOLL`. However, new applications should use `SIGCHLD`, `SIGABRT`, and `SIGPOLL`.

357
The disposition of signals that are inherited as SIG_IGN should not be changed.

SEE ALSO
exit(2), getrlimit(2), intro(2), kill(2), pause(2), sigaction(2),
sigaltstack(2), siginfo(5), signal(2), sigprocmask(2), sigsend(2),
sigsetops(3C), sigsuspend(2), ucontext(5), wait(2)
NAME

stat – data returned by stat system call

SYNOPSIS

```c
#include <sys/types.h>
#include <sys/stat.h>
```

DESCRIPTION

The system calls stat, lstat and fstat return data in a stat structure, which is
defined in std.h and includes the following members:

```c
dev_t st_dev;
ino_t st_ino;
mode_t st_mode;
nlink_t st_nlink;
uid_t st_uid;
gid_t st_gid;
dev_t st_rdev;
off_t st_size;
time_t st_atime;
time_t st_mtime;
time_t st_ctime;
long st_blksize;
long st_blocks;
char st_fstype[ST_FSTYPESZ];
```

The following members are only valid if Enhanced Security is installed:

```c
int st_aclcnt;
level_t st_level;
ulong_t st_flags; /* general purpose flag */
```

The constants used in the st_mode field are also defined in this file:

```c
#define S_IFMT /* type of file */
#define S_IAMB /* access mode bits */
#define S_IFIFO /* fifo */
#define S_IFCHR /* character special */
#define S_IPDIR /* directory */
#define S_IFNAM /* XENIX special named file */
#define S_INSEM /* XENIX semaphore subtype of IFNAM */
#define S_INSHD /* XENIX shared data subtype of IFNAM */
#define S_IFBLK /* block special */
#define S_IPREG /* regular */
#define S_IPLNK /* symbolic link */
#define S_ISUID /* set user id on execution */
#define S_ISGID /* set group id on execution */
#define S_ISVTX /* save swapped text even after use */
```
#define S_IREAD /* read permission, owner */
#define S_IWRITE /* write permission, owner */
#define S_IEXEC /* execute/search permission, owner */
#define S_ENFMT /* record locking enforcement flag */
#define S_IREAD /* read permission: owner */
#define S_IWRITE /* write permission: owner */
#define S_IXUSR /* execute permission: owner */
#define S_IREADX /* read, write, execute: owner */
#define S_IRUSR /* read permission: group */
#define S_IWUSR /* write permission: group */
#define S_IXGRP /* execute permission: group */
#define S_IEXEC /* record locking enforcement flag */
#define S_IRWXU /* read, write, execute: owner */
#define S_IRUSR /* read, write, execute: group */
#define S_IWUSR /* read, write, execute: other */
#define S_IXUSR /* read, write, execute: other */
#define S_IXOTH /* execute permission: other */
#define S_IRGRP /* read permission: other */
#define S_IWOTH /* write permission: other */
#define S_IXOTH /* execute permission: other */

The following macros are for POSIX conformance:

#define S_ISBLK(mode) block special file
#define S_ISCHR(mode) character special file
#define S_ISDIR(mode) directory file
#define S_ISFIFO(mode) pipe or fifo file
#define S_ISREG(mode) regular file

One constant used in the st_flags field is also defined in this file:

#define S_ISMLD /* indicates multilevel directory */

Multilevel directories are only supported if the Enhanced Security Utilities are installed.

SEE ALSO
stat(2), types(5)
NAME

stdarg - handle variable argument list

SYNOPSIS

#include <stdarg.h>

va_list pvar;

void va_start(va_list pvar, parmN);

type va_arg(va_list pvar, type);

void va_end(va_list pvar);

DESCRIPTION

This set of macros allows portable procedures that accept variable numbers of arguments of variable types to be written. Routines that have variable argument lists (such as printf) but do not use stdarg are inherently non-portable, as different machines use different argument-passing conventions.

va_list is a type defined for the variable used to traverse the list.

The va_start macro is invoked before any access to the unnamed arguments and initializes pvar for subsequent use by va_arg and va_end. The parameter parmN is the identifier of the rightmost parameter in the variable parameter list in the function definition (the one just before the , ...). If this parameter is declared with the register storage class or with a function or array type, or with a type that is not compatible with the type that results after application of the default argument promotions, the behavior is undefined.

The parameter parmN is required under strict ANSI C compilation. In other compilation modes, parmN need not be supplied and the second parameter to the va_start macro can be left empty [e.g., va_start(pvar, )];. This allows for routines that contain no parameters before the ... in the variable parameter list.

The va_arg macro expands to an expression that has the type and value of the next argument in the call. The parameter pvar should have been previously initialized by va_start. Each invocation of va_arg modifies pvar so that the values of successive arguments are returned in turn. The parameter type is the type name of the next argument to be returned. The type name must be specified in such a way so that the type of a pointer to an object that has the specified type can be obtained simply by postfixing a * to type. If there is no actual next argument, or if type is not compatible with the type of the actual next argument (as promoted according to the default argument promotions), the behavior is undefined.

The va_end macro is used to clean up.

Multiple traversals, each bracketed by va_start and va_end, are possible.

EXAMPLE

This example gathers into an array a list of arguments that are pointers to strings (but not more than MAXARGS arguments) with function f1, then passes the array as a single argument to function f2. The number of pointers is specified by the first argument to f1.
#include <stdarg.h>
define MAXARGS 31

void f1(int n_ptrs, ...) {
    va_list ap;
    char *array[MAXARGS];
    int ptr_no = 0;

    if (n_ptrs > MAXARGS)
        n_ptrs = MAXARGS;
    va_start(ap, n_ptrs);
    while (ptr_no < n_ptrs)
        array[ptr_no++] = va_arg(ap, char*);
    va_end(ap);
    f2(n_ptrs, array);
}

Each call to f1 shall have visible the definition of the function or a declaration such as

    void f1(int, ...)

SEE ALSO
vprintf(3S)

NOTES
It is up to the calling routine to specify in some manner how many arguments there are, since it is not always possible to determine the number of arguments from the stack frame. For example, exec1 is passed a zero pointer to signal the end of the list. printf can tell how many arguments there are by the format. It is non-portable to specify a second argument of char, short, or float to va_arg, because arguments seen by the called function are not char, short, or float. C converts char and short arguments to int and converts float arguments to double before passing them to a function.
NAME
term – conventional names for terminals

DESCRIPTION
Terminal names are maintained as part of the shell environment in the environment variable TERM [see sh(1), profile(4), and environ(5)]. These names are used by certain commands [for example, tabs, tput, and vi] and certain functions [for example, see curses(3curses)].

Files under /usr/share/lib/terminfo are used to name terminals and describe their capabilities. These files are in the format described in terminfo(4). Entries in terminfo source files consist of a number of comma-separated fields. To print a description of a terminal term, use the command infocnrp -I term [see infocnp(lM)]. White space after each comma is ignored. The first line of each terminal description in the terminfo database gives the names by which terminfo knows the terminal, separated by bar (|) characters. The first name given is the most common abbreviation for the terminal [this is the one to use to set the environment variable TERMINFO in $HOME/.profile; see profile(4)], the last name given should be a long name fully identifying the terminal, and all others are understood as synonyms for the terminal name. All names but the last should contain no blanks and must be unique in the first 14 characters; the last name may contain blanks for readability.

Terminal names (except for the last, verbose entry) should be chosen using the following conventions. The particular piece of hardware making up the terminal should have a root name chosen, for example, for the AT&T 4425 terminal, att4425. This name should not contain hyphens, except that synonyms may be chosen that do not conflict with other names. Up to 8 characters, chosen from the set a through z and 0 through 9, make up a basic terminal name. Names should generally be based on original vendors rather than local distributors. A terminal acquired from one vendor should not have more than one distinct basic name. Terminal sub-models, operational modes that the hardware can be in, or user preferences should be indicated by appending a hyphen and an indicator of the mode. Thus, an AT&T 4425 terminal in 132 column mode is att4425-w. The following suffixes should be used where possible:

<table>
<thead>
<tr>
<th>Suffix</th>
<th>Meaning</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>-w</td>
<td>Wide mode (more than 80 columns)</td>
<td>att4425-w</td>
</tr>
<tr>
<td>-am</td>
<td>With auto. margins (usually default)</td>
<td>vt100-am</td>
</tr>
<tr>
<td>-nam</td>
<td>Without automatic margins</td>
<td>vt100-nam</td>
</tr>
<tr>
<td>-n</td>
<td>Number of lines on the screen</td>
<td>aaa-60</td>
</tr>
<tr>
<td>-na</td>
<td>No arrow keys (leave them in local)</td>
<td>c100-na</td>
</tr>
<tr>
<td>-np</td>
<td>Number of pages of memory</td>
<td>c100-4p</td>
</tr>
<tr>
<td>-rv</td>
<td>Reverse video</td>
<td>att4415-rv</td>
</tr>
</tbody>
</table>

To avoid conflicts with the naming conventions used in describing the different modes of a terminal (for example, -w), it is recommended that a terminal's root name not contain hyphens. Further, it is good practice to make all terminal names used in the terminfo(4) database unique. Terminal entries that are present only for inclusion in other entries via the use= facilities should have a '+' in their name, as in 4415+n1.
Here are some of the known terminal names: (For a complete list, enter the command `1s -C /usr/share/lib/terminfo/?`.)

- **2621, hp2621**: Hewlett-Packard 2621 series
- **2631**: Hewlett-Packard 2631 line printer
- **2631-c**: Hewlett-Packard 2631 line printer, compressed mode
- **2631-e**: Hewlett-Packard 2631 line printer, expanded mode
- **2640, hp2640**: Hewlett-Packard 2640 series
- **2645, hp2645**: Hewlett-Packard 2645 series
- **3270**: IBM Model 3270
- **33, tty33**: AT&T Teletype Model 33 KSR
- **35, tty35**: AT&T Teletype Model 35 KSR
- **37, tty37**: AT&T Teletype Model 37 KSR
- **4000a**: Trendata 4000a
- **4014, tek4014**: TEKTRONIX 4014
- **40, tty40**: AT&T Teletype Dataspeed 40/2
- **43, tty43**: AT&T Teletype Model 43 KSR
- **4410, 5410**: AT&T 4410/5410 in 80-column mode, version 2
- **4410-nfk, 5410-nfk**: AT&T 4410/5410 without function keys, version 1
- **4410-nsl, 5410-nsl**: AT&T 4410/5410 without pIn defined
- **4410-w, 5410-w**: AT&T 4410/5410 in 132-column mode
- **4410v1, 5410v1**: AT&T 4410/5410 in 80-column mode, version 1
- **4410v1-w, 5410v1-w**: AT&T 4410/5410 in 132-column mode, version 1
- **4418, 5418**: AT&T 5418 in 80-column mode
- **4418-w, 5418-w**: AT&T 5418 in 132-column mode
- **4420**: AT&T Teletype Model 4420
- **4424**: AT&T Teletype Model 4424
- **4424-2**: AT&T Teletype Model 4424 in display function group ii
- **4425, 5425**: AT&T 4425/5425
- **4425-fk, 5425-fk**: AT&T 4425/5425 without function keys
- **4425-nl, 5425-nl**: AT&T 4425/5425 without changing labels in 80-column mode
- **4425-w, 5425-w**: AT&T 4425/5425 in 132-column mode
- **4425-w-fk, 5425-w-fk**: AT&T 4425/5425 without function keys in 132-column mode
- **4425-nl-w, 5425-nl-w**: AT&T 4425/5425 without changing labels in 132-column mode
- **4426**: AT&T Teletype Model 4426S
<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>450</td>
<td>DASI 450 (same as Diablo 1620)</td>
</tr>
<tr>
<td>450-12</td>
<td>DASI 450 in 12-pitch mode</td>
</tr>
<tr>
<td>500,att500</td>
<td>AT&amp;T-IS 500 terminal</td>
</tr>
<tr>
<td>510,510a</td>
<td>AT&amp;T 510/510a in 80-column mode</td>
</tr>
<tr>
<td>513bct,att513</td>
<td>AT&amp;T 513 bct terminal</td>
</tr>
<tr>
<td>5320</td>
<td>AT&amp;T 5320 hardcopy terminal</td>
</tr>
<tr>
<td>5420_2</td>
<td>AT&amp;T 5420 model 2 in 80-column mode</td>
</tr>
<tr>
<td>5420_2-w</td>
<td>AT&amp;T 5420 model 2 in 132-column mode</td>
</tr>
<tr>
<td>610,610bct</td>
<td>AT&amp;T 610 bct terminal in 80-column mode</td>
</tr>
<tr>
<td>610-w,610bct-w</td>
<td>AT&amp;T 610 bct terminal in 132-column mode</td>
</tr>
<tr>
<td>630,630MTG</td>
<td>AT&amp;T 630 Multi-Tasking Graphics terminal</td>
</tr>
<tr>
<td>735,ti</td>
<td>Texas Instruments TI735 and TI725</td>
</tr>
<tr>
<td>745</td>
<td>Texas Instruments TI745</td>
</tr>
<tr>
<td>dumb</td>
<td>generic name for terminals that lack reverse line feed and other special escape sequences</td>
</tr>
<tr>
<td>hp</td>
<td>Hewlett-Packard (same as 2645)</td>
</tr>
<tr>
<td>lp</td>
<td>generic name for a line printer</td>
</tr>
<tr>
<td>pt505</td>
<td>AT&amp;T Personal Terminal 505 (22 lines)</td>
</tr>
<tr>
<td>pt505-24</td>
<td>AT&amp;T Personal Terminal 505 (24-line mode)</td>
</tr>
<tr>
<td>sync</td>
<td>generic name for synchronous Teletype Model 4540-compatible terminals</td>
</tr>
</tbody>
</table>

Commands whose behavior depends on the type of terminal should accept arguments of the form `-Tterm` where `term` is one of the names given above; if no such argument is present, such commands should obtain the terminal type from the environment variable `TERM`, which, in turn, should contain `term`.

**FILES**

`/usr/share/lib/terminfo/*` compiled terminal description database

**SEE ALSO**

`curses(3curses), environ(5), infocmp(1M), profile(4), sh(1), stty(1), tabs(1), terminfo(4), tput(1), vi(1)`
types(5)

NAME

types – primitive system data types

SYNOPSIS

#include <sys/types.h>

DESCRIPTION

The data types defined in types.h are used in UNIX system code. Some data of
these types are accessible to user code:

typedef struct { int r[1]; } *physadr;
typedef long clock_t;
typedef long daddr_t;
typedef char * caddr_t;
typedef unsigned char unchar;
typedef unsigned short ushort;
typedef unsigned int uint;
typedef unsigned long ulong;
typedef unsigned long ino_t;
typedef long uid_t;
typedef long gid_t;
typedef ulong nlink_t;
typedef ulong mode_t;
typedef short cnt_t;
typedef long time_t;
typedef int label_t[10];
typedef ulong dev_t;
typedef long off_t;
typedef long pid_t;
typedef ulong paddr_t;
typedef int key_t;
typedef unsigned char use_t;
typedef short sysid_t;
typedef short index_t;
typedef short lock_t;
typedef unsigned int size_t;
typedef long clock_t;
typedef long pid_t;
typedef int ssize_t;

The form daddr_t is used for disk addresses except in an i-node on disk, see fs(4).
Times are encoded in seconds since 00:00:00 UTC, January 1, 1970. The major and
minor parts of a device code specify kind and unit number of a device and are
installation-dependent. Offsets are measured in bytes from the beginning of a file.
The label_t variables are used to save the processor state while another process is
running.
NAME
ucontext – user context

SYNOPSIS
#include <ucontext.h>

DESCRIPTION
The ucontext structure defines the context of a thread of control within an executing process.

This structure includes at least the following members:

- `ucontext_t *uc_link`
- `sigset_t uc_sigmask`
- `stack_t uc_stack`
- `mcontext_t uc_mcontext`

uc_link is a pointer to the context that is to be resumed when this context returns. If uc_link is equal to 0, then this context is the main context, and the process exits when this context returns. The uc_link field is only meaningful for contexts created using makecontext.

uc_sigmask defines the set of Signals that are blocked when this context is active [see sigprocmask(2)].

uc_stack defines the stack used by this context [see sigaltstack(2)].

uc_mcontext contains the saved set of machine registers and any implementation specific context data. Portable applications should not modify or access uc_mcontext.

SEE ALSO
getcontext(2), makecontext(3C), sigaction(2), sigaltstack(2), sigprocmask(2)
values(5)

NAME
values – machine-dependent values

SYNOPSIS
#include <values.h>

DESCRIPTION
This file contains a set of manifest constants, conditionally defined for particular
processor architectures.
The model assumed for integers is binary representation (one’s or two’s complement),
where the sign is represented by the value of the high-order bit.

BITS(type) The number of bits in a specified type (for example, int).

HIBITS The value of a short integer with only the high-order bit set.

HIBITL The value of a long integer with only the high-order bit set.

HIBITI The value of a regular integer with only the high-order bit set.

MAXSHORT The maximum value of a signed short integer.

MAXLONG The maximum value of a signed long integer.

MAXINT The maximum value of a signed regular integer.

MAXFLOAT, LN_MAXFLOAT
The maximum value of a single-precision floating-point number, and its natural logarithm.

MAXDOUBLE, LN_MAXDOUBLE
The maximum value of a double-precision floating-point number, and its natural logarithm.

MAXLONDDOUBLE, LN_MAXLONDDOUBLE
The maximum value of a quad-precision floating-point number, and its natural logarithm.

MINFLOAT, LN_MINFLOAT
The minimum positive value of a single-precision floating-point number, and its natural logarithm.

MINDOUBLE, LN_MINDOUBLE
The minimum positive value of a double-precision floating-point number, and its natural logarithm.

MINLONDDOUBLE, LN_MINLONDDOUBLE
The minimum value of a quad-precision floating-point number, and its natural logarithm.

FSIGNIF The number of significant bits in the mantissa of a single-precision floating-point number.

DSIGNIF The number of significant bits in the mantissa of a double-precision floating-point number.

LDSIGNIF The number of significant bits in the mantissa of a quad-precision floating-point number.
SEE ALSO
intro(3), math(5)
NAME

varargs – handle variable argument list

SYNOPSIS

#include <varargs.h>
va_alist
va_dcl
va_list pvar;
void va_start(va_list pvar);
type va_arg(va_list pvar, type);
void va_end(va_list pvar);

DESCRIPTION

This set of macros allows portable procedures that accept variable argument lists to be written. Routines that have variable argument lists [such as printf(3S)] but do not use varargs are inherently non-portable, as different machines use different argument-passing conventions.

va_alist is used as the parameter list in a function header.

va_dcl is a declaration for va_alist. No semicolon should follow va_dcl.

va_list is a type defined for the variable used to traverse the list.

va_start is called to initialize pvar to the beginning of the list.

va_arg will return the next argument in the list pointed to by pvar. type is the type the argument is expected to be. Different types can be mixed, but it is up to the routine to know what type of argument is expected, as it cannot be determined at runtime.

va_end is used to clean up.

Multiple traversals, each bracketed by va_start and va_end, are possible.

EXAMPLE

This example is a possible implementation of exec1 [see exec(2)].

#include <unistd.h>
#include <varargs.h>
#define MAXARGS 100
/* exec1 is called by
     exec1(file, arg1, arg2, ... , (char *)0);
*/
exec1(va_alist)
va_dcl
{
    va_list ap;
    char *file;
    char *args[MAXARGS]; /* assumed big enough*/
    int argno = 0;
    va_start(ap);
file = va_arg(ap, char *);
while (((args[argno++] = va_arg(ap, char *)) != 0)
        ;
va_end(ap);
return execv(file, args);
}

SEE ALSO
exec(2), printf(3S), stdarg(5), vprintf(3S)

NOTES
It is up to the calling routine to specify in some manner how many arguments there are, since it is not always possible to determine the number of arguments from the stack frame. For example, exec1 is passed a zero pointer to signal the end of the list. printf can tell how many arguments are there by the format.

It is non-portable to specify a second argument of char, short, or float to va_arg, since arguments seen by the called function are not char, short, or float. C converts char and short arguments to int and converts float arguments to double before passing them to a function.

stdarg is the preferred interface.
NAME
wstat – wait status

SYNOPSIS
#include <sys/wait.h>

DESCRIPTION
When a process waits for status from its children via either the wait or waitpid
function, the status returned may be evaluated with the following macros, defined
in sys/wait.h. These macros evaluate to integral expressions. The stat argument
to these macros is the integer value returned from wait or waitpid.

WIFEXITED(stat) Evaluates to a non-zero value if status was returned for a
child process that terminated normally.

WEXITSTATUS(stat) If the value of WIFEXITED(stat) is non-zero, this macro
evaluates to the exit code that the child process passed to
_exit or exit, or the value that the child process returned
from main.

WIFSIGNALED(stat) Evaluates to a non-zero value if status was returned for a
child process that terminated due to the receipt of a signal.

WTERMSIG(stat) If the value of WIFSIGNALED(stat) is non-zero, this macro
evaluates to the number of the signal that caused the termi-
nation of the child process.

WIFSTOPPED(stat) Evaluates to a non-zero value if status was returned for a
child process that is currently stopped.

WSTOPSIG(stat) If the value of WIFSTOPPED(stat) is non-zero, this macro
evaluates to the number of the signal that caused the child
process to stop.

WIFCONTINUED(stat) Evaluates to a non-zero value if status was returned for a
child process that has continued.

WCOREDUMP(stat) If the value of WIFSIGNALED(stat) is non-zero, this macro
evaluates to a non-zero value if a core image of the ter-
minated child was created.

SEE ALSO
exit(2), wait(2), waitpid(2)
NAME

**intro** – introduction to special files

DESCRIPTION

This section describes various special files that refer to specific hardware peripherals, and UNIX system device drivers. STREAMS [see intro(2)] software drivers, modules and the STREAMS-generic set of ioctl(2) system calls are also described.

For hardware related files, the names of the entries are generally derived from names for the hardware, as opposed to the names of the special files themselves. Characteristics of both the hardware device and the corresponding UNIX system device driver are discussed where applicable.

Disk device file names are in the following format:

```
/dev/{r}dsk/{1.0}s#  For integral disks
/dev/{r}dsk/{c#t#d#s#}  For SCSI disks
```

where **r** indicates a raw interface to the disk, the **c#** indicates the SCSI host adapter number, **t#** indicates the SCSI target ID of the device, **d#** indicates the device attached to the controller and **s#** indicates the section number of the partitioned device.
adsc(7)

NAME
adsc - Adaptec 1542A SCSI host adapter subsystem

DESCRIPTION
The Adaptec 1542A host adapter subsystem enables SCSI target drivers (such as sd01, st01, and so on) to communicate on the SCSI bus with target controllers and logical units. This driver implements the Portable Device Interface (PDI) for such PDI target drivers.

It is also possible to access the SCSI-bus subsystem directly by using the driver’s pass-through interface. This allows you to issue sb control blocks directly to the target controller. To find the appropriate pass-through device to use, while any device is being accessed through the target driver (for example, sd01), use the B_GETDEV ioctl to get the major and minor numbers of the pass-through node. This node may be created and opened for pass-through use (SDI_SEND ioctl).

ioctl Calls
The following ioctl(2) commands are supported by this driver:

SDI_SEND
Sends a pass-through command (SCSI control block) to a target controller, bypassing the associated target driver.

SDI_BRESET
Resets the SCSI bus.

B_REDT
Reads the extended Equipped Device Table (EDT) data structure that is stored in the adsc driver’s internal data structure.

B_GETTYPE
Returns the bus name (for example, SCSI) and device driver name of a specific device.

Files
/usr/include/sys/ad1542.h
/usr/include/sys/scsi.h
/usr/include/sys/sdi.h
/usr/include/sys/sdi_edt.h
/etc/conf/pack.d/adsc/space.c

NOTICES
Adaptec SCSI controllers cannot be used reliably with Emulex SCSI/ESDI bridge controllers (also known as AT&T DCM/4E). In the future, a hardware and/or software fix may be implemented.

REFERENCES
dpt(7), ioctl(2), mcis(7), sc01(7), sd01(7), st01(7), sw01(7), wd7000(7)
NAME
alp – algorithm pool management module

DESCRIPTION
The STREAMS module alp maintains a pool of algorithms (in the form of STREAMS-
compatible subroutines) that may be used for processing STREAMS data messages.
Interfaces are defined allowing modules to request and initiate processing by any of
the algorithms maintained in the pool. It is expected to help centralize and stand-
ardize the interfaces to algorithms that now represent a proliferation of similar-but-different STREAMS modules. Its major use is envisioned as a central registry of
available code set conversion algorithms or other types of common data-
manipulating routines.

An algorithm pool is a registry (or pool) of available functions; in this case, routines
for performing transformations on STREAMS data messages. Registered functions
may keep information on attached users, which means that algorithms need not be
stateless, but may maintain extensive state information related to each connection.
An algorithm from the pool is called by another in-kernel module with arguments
that are a STREAMS data message and a unique identifier. If a message is passed
back to the caller, it is the algorithm’s output, otherwise the algorithm may store
partially convertible input until enough input is received to give back output on a
subsequent call.

This pool is one means for providing a consistent and flexible interface for code set
conversion within STREAMS modules, especially kbd, but it may also be used to pro-
vide other services that are commonly duplicated by several modules.

The alp module contains some subroutines dealing with its (minor) role as a
module, a data definition for an algorithm list, connection and disconnection rou-
tines, and a search routine for finding registered items. The module interface incor-
porated into alp serves the purpose of providing an ioctl interface, so that users
can find out what algorithms are registered [see alpq(l)].

The programmer of a function for use with alp provides a simple module with a
simple specified interface. The module must have an initialization routine
(xxxinit) which is called at system startup time to register itself with alp, an open
routine, and an interface routine (which actually implements the algorithm).

The registry method of dynamically building the list of available functions obviates
the need for recompiling modules or otherwise updating a list or reconfiguring
other parts of the system to accommodate additions or deletions. To install a new
function module, one merely links it with the kernel in whatever manner is stan-
dard for that system; there is no need for updating or re-configuring any other parts
of the kernel (including alp itself). The remainder of this discussion concerns the
in-kernel operation and use of the module.

Calling Sequence
An algorithm is called from the pool by first requesting a connection via the alp
connection interface. The alp module returns the function address of an interface
routine, and fills in a unique identifier (id) for the connection. The returned func-
tion address is NULL on failure (and id is undefined). This is a sample of making a
connection to a function managed by alp:

```
```
Once the connection has been made, the interface routine can be called directly by the connecting module to process messages:

```c
mblk_t *inp, *outp;
mblk_t *(*func)();
...
outp = (*func)(mp, id);
mp = NULL; /* mp cannot be re-used! */
if (outp)
  regular processing;
else
  error processing;
```

If the interface routine processed the entire message, then `outp` is a valid pointer to the algorithm’s output message. If, however, the routine needs more information, or is buffering something, `outp` will be a null pointer. In either case, the original message (`mp`) may not be subsequently accessed by the caller. The interface routine takes charge of the message `mp`, and may free it or otherwise dispose of it (it may even return the same message). The caller may pass a null message pointer to an interface routine to cause a flush of any data being held by the routine; this is useful for end-of-file conditions to insure that all data have been passed through. (Interface routines must thus recognize a null message pointer and deal with it.)

Synchronization between input and output messages is not guaranteed for all items in the pool. If one message of input does not produce one message of output, this fact should be documented for that particular module. Many multibyte code set conversion algorithms, to cite one instance, buffer partial sequences, so that if a multibyte character happens to be spread across more than one message, it may take two or more output messages to complete translation; in this case, it is only possible to synchronize when input message boundaries coincide with character boundaries.

### Building an Algorithm for the Pool

As mentioned, the modules managed by `alp` are implemented as simple modules—not STREAMS modules—each with an initialization routine, an open routine, and a user-interface routine. The initialization routine is called when the system is booted and prior to nearly everything else that happens at boot-time. The routine takes no arguments and its sole purpose is to register the algorithm with the `alp` module, so that it may subsequently accessed. Any other required initialization may also be performed at that time. A generic initialization routine for a module called `GEN`, with prefix `gen` is as follows:
The registration routine, `alp_register` takes three arguments and returns zero if successful. The arguments are (1) a pointer to the algorithm's entry point (in this case, the function `genfunc`), (2) a pointer to its name, and (3) a pointer to a character string containing a brief explanation. The name should be limited to under 16 bytes, and the explanation to under 60 bytes, as shown in the following example. Neither the name nor the explanation need include a newline.

```c
i = alp_register(sjisfunc, "stou",
    "Shift-JIS to UJIS converter");
```

It is possible for a single module to contain several different, related algorithms, which can each be registered separately by a single `init` routine.

A module's open routine is called by `alp_con` when a connection is first requested by a user (that is, a module that wishes to use it). The open routine takes two arguments. The first argument is an integer; if it is non-zero, the request is an open request, and the second argument is unused. The function should allocate a unique identifier and return it as a generic address pointer. If the first argument is zero, the request is a close request, and the second argument is the unique identifier that was returned by a previous open request, indicating which of (potentially several) connections is to be closed. The routine does any necessary clean-up and closes the connection; thereafter, any normal interface requests on that identifier will fail. This use of unique identifiers allows these modules to keep state information relating to each open connection; no format is imposed upon the unique identifier, so it may contain any arbitrary type of information, equivalent in size to a core address; `alp` and most callers will treat it as being of type `caddr_t`, in a manner similar to the private data held by each instantiation of a STREAMS module.

A skeleton for the `gen` module's open routine is:

```c
genopen(arg, id)
    int arg;
    caddr_t id;
{
    if ( arg ) {
        open processing;
        return( unique-id );
    }
    close processing for id;
    return(0);
}
```
Once a connection has been made, users may proceed as in the example in the previous section. When the connection is to be closed (for example, the connecting module is being popped), a call is made to `alp_discon`, passing the unique id and the name:

```c
    caddr_t id;
    char *name;
    mblk_t *alp_discon(), *mp;
    ...
    mp = alp_discon(name, id);
    if (mp)
        process "left-over" data;
```

If the disconnect request returns a valid message pointer (mp) then there was unprocessed or partially processed data left in an internal buffer, and it should be dealt with by the caller (for example, by flushing it or sending it to the neighboring module).

**The ioctl and Query Interfaces**

A kernel-level query interface is provided in addition to the query interface supported by the `alpq` command. The routine `alp_query` takes a single argument, a pointer to a `name`. If the name matches a registered function, `alp_query` returns a pointer to the function’s `explanation` string, otherwise it returns a null pointer. A calling example is:

```c
    unsigned char *alp_query(), *name, *expl;
    ...
    if (expl = alp_query(name))
        regular processing;
    else
        error processing;
```

The `ioctl` interface provides calls for querying registered functions (for which the `explanation` discussed above is necessary); this is supported by the `alpq` command, which may be used whenever user-level programs need the associated information.

**Uses**

The `alp` module can be used to replace various kernel-resident code set conversion functions in international or multi-language environments. The KBD subsystem (which supplies code set conversion and keyboard mapping) supports the use of `alp` algorithms as processing elements.

Since state information may be maintained, functions may also implement processing on larger or more structured data elements, such as transaction records and network packets. Currently, STREAMS CPU priority is assumed by `alp` or should be set individually by interface and open routines.

**EXAMPLES**

```c
/*
 * This is a SAMPLE module that registers with ALP and
 * performs a one-message delay.
 */
#include <sys/types.h>
#include <sys/stream.h>
```
```c
#include <sys/stropts.h>
#include <sys/kmem.h>
#include <sys/alp.h>

static mblk_t *dely();
caddr_t delyopen();

/*
 * Our state structure. Keeps its own address and a pointer.
 */
struct dstruct {
    caddr_t d_unique;
    mblk_t *d_mp;
};

/*
 * The name is "Dely". It has an open routine "delyopen"
 * and an interface "dely".
 */
static struct algo delyalgo =
{ 0, (queue_t *) 0, (queue_t *) 0, dely, delyopen,
    (unsigned char *) "Dely",
    (unsigned char *) "One Message Delay Buffer",
    (struct algo *) 0
};

/*
 * This is the sysinit routine, called when the system is
 * being brought up. It registers "Dely" with ALP.
 */
delyinit()
{
    if (alp_register(&delyalgo)) /* then register with ALP */
        printf("DELY: register failed\n");
}

/*
 * This is the interface routine itself.
 * Holds onto "mp" and returns whatever it had before.
 */
static mblk_t *
dely(mblk_t *mp, caddr_t id)
{
    register mblk_t *rp;
    register struct dstruct *d;

    d = (struct dstruct *) id; /* clarify the situation */
```
alp(7)

rp = d->d_mp;
d->d_mp = mp;
return(rp); /* return the previous message */
}

/*
 * The open (and close) routine. Use kmem_alloc() to get
 * a private structure for saving state info.
 */
caddr_t
delyopen(arg, id)
int arg; /* 1 = open, 0 = close */
caddr_t id; /* ignored on open; unique id on close */
{
    register struct dstruct *d;
    register mblk_t *rp;

    if (! arg) { /* close processing */
        d = (struct dstruct *) id;
        d->d_unique = (caddr_t) -1;
        rp = d->d_mp;
        kmem_free(d, sizeof(struct dstruct));
        return((caddr_t) rp);
    }
    /* otherwise, open processing */
    d = (struct dstruct *) kmem_zalloc(sizeof(struct dstruct),
                                      KM_NOSLEEP);
    d->d_unique = (caddr_t) &d;
    return((caddr_t) d);
}

SEE ALSO
    alpq(1), kbd(7)
ARP(7)

NAME
ARP – Address Resolution Protocol

SYNOPSIS
#include <sys/socket.h>
#include <net/if_arp.h>
#include <netinet/in.h>

s = socket(AF_INET, SOCK_DGRAM, 0);
d = open("/dev/arp", O_RDWR);

DESCRIPTION
ARP is a protocol used to map dynamically between Internet Protocol (IP) and
10Mb/s Ethernet addresses. It is used by all the 10Mb/s Ethernet data link provid­
ers (interface drivers). It is not specific to the Internet Protocol or to the 10Mb/s
Ethernet, but this implementation currently supports only that combination. The
STREAMS device /dev/arp is not a Transport Level Interface (TLI) transport pro­
vider and may not be used with the TLI interface.

ARP caches IP-to-Ethernet address mappings. When an interface requests a map­
ingen for an address not in the cache, ARP queues the message that requires the map­
ping and broadcasts a message on the associated network requesting the address
mapping. If a response is provided, the new mapping is cached and any pending
message is transmitted. ARP will queue at most one packet while waiting for a
mapping request to be responded to; only the most recently transmitted packet is
kept.

To facilitate communications with systems which do not use ARP, ioctl requests
are provided to enter and delete entries in the IP-to-Ethernet tables.

USAGE
#include <sys/sockio.h>
#include <sys/socket.h>
#include <net/if.h>
#include <net/if_arp.h>

struct arpreq arpreq;

ioctl(s, SIOCSARP, (caddr_t)&arpreq);
ioctl(s, SIOCGARP, (caddr_t)&arpreq);
ioctl(s, SIOCDARP, (caddr_t)&arpreq);

Each ioctl request takes the same structure as an argument. SIOCSARP sets an ARP
entry, SIOCGARP gets an ARP entry, and SIOCDARP deletes an ARP entry. These
ioctl requests may be applied to any Internet family socket descriptor s, or to a
descriptor for the ARP device, but only by the privileged user. The arpreq struc­
ture contains:

/*
* ARP ioctl request
*/

struct arpreq {
    struct sockaddr arpa;     /* protocol address */
    struct sockaddr arpha;    /* hardware address */
    int arflags;              /* flags */
}
The address family for the **arp_pa** sockaddr must be **AF_INET**; for the **arp_ha** sockaddr it must be **AF_UNSPEC**. The only flag bits that may be written are **ATF_PERM**, **ATF_PUBL** and **ATF_USETRAILERS**. **ATF_PERM** makes the entry permanent if the ioctl request succeeds. The peculiar nature of the ARP tables may cause the ioctl request to fail if too many permanent IP addresses hash to the same slot. **ATF_PUBL** specifies that the ARP code should respond to ARP requests for the indicated host coming from other machines. This allows a host to act as an ARP server, which may be useful in convincing an ARP-only machine to talk to a non-ARP machine.

ARP is also used to negotiate the use of trailer IP encapsulations; trailers are an alternate encapsulation used to allow efficient packet alignment for large packets despite variable-sized headers. Hosts that wish to receive trailer encapsulations so indicate by sending gratuitous ARP translation replies along with replies to IP requests; they are also sent in reply to IP translation replies. The negotiation is thus fully symmetrical, in that either or both hosts may request trailers. The **ATF_USETRAILERS** flag is used to record the receipt of such a reply, and enables the transmission of trailer packets to that host.

ARP watches passively for hosts impersonating the local host (that is, a host which responds to an ARP mapping request for the local host's address).

**SEE ALSO**

arp(1M), if(7), ifconfig(1M), inet(7)


NAME

asyc – asynchronous serial port

DESCRIPTION

The asyc driver supports both the system board serial port and an additional serial adapter simultaneously. Up to two serial ports are supported. If an adapter for a port is not installed, an attempt to open it will fail. Depending on your system processor type and UART, the port can be programmed for speed (50–38400 baud), character length, and parity. Output speed is always the same as input speed. The port behaves as described in termio(7).

The asynchronous port is a character-at-a-time device for both input and output. This characteristic both limits the bandwidth that can be achieved over a line, and increases the interrupt loading on the central processor. File transfer programs such as uucp(1C) may be able to function well at speeds greater than 9600 baud, depending on your system processor type and UART.

The baud rates of the serial adapter programmable baud-rate generator do not correspond exactly with system baud rates. In particular, setting B0 will cause a disconnect, setting EXTA will set 19200 baud, and setting EBTB will set 38400 baud. It is not possible to directly set 2000, 3600, or 7200 baud. The asynchronous ports driver supports line signal (hardware) flow control when the device node /dev/tty0?h is used. The /dev/tty0?s ports are software flow control nodes as are the /dev/tty0? nodes.

FILES

/dev/tty* /dev/term/*

SEE ALSO

signal(2), termio(7)
**clone(7)**

**NAME**

`clone` – open any major/minor device pair on a STREAMS driver

**DESCRIPTION**

`clone` is a STREAMS software driver that finds and opens an unused major/minor device on another STREAMS driver. The major device number passed to `clone` during open corresponds to the `clone` driver and the minor device number corresponds to the target driver. Each open results in a separate stream to a previously unused major/minor device.

The `clone` driver consists solely of an open function. This open function performs all of the necessary work so that subsequent system calls [including `close(2)`] require no further involvement of `clone`.

`clone` will generate an `ENXIO` error, without opening the device, if the major/minor device number provided does not correspond to a valid major/minor device, or if the driver indicated is not a STREAMS driver.

**NOTICES**

Multiple opens of the same major/minor device cannot be done through the `clone` interface. Executing `stat(2)` on the file system node for a cloned device yields a different result from executing `fstat` using a file descriptor obtained from opening the node.

**REFERENCES**

`log(7)`
NAME
connld – line discipline for unique stream connections

DESCRIPTION
connld is a STREAMS-based module that provides unique connections between server and client processes. It can only be pushed [see streamio(7)] onto one end of a STREAMS-based pipe that may subsequently be attached to a name in the file system name space. After the pipe end is attached, a new pipe is created internally when an originating process attempts to open(2) or creat(2) the file system name. A file descriptor for one end of the new pipe is packaged into a message identical to that for the ioctl I_SENDFD [see streamio(7)] and is transmitted along the stream to the server process on the other end. The originating process is blocked until the server responds.

The server responds to the I_SENDFD request by accepting the file descriptor through the I_RECVFD ioctl message. When this happens, the file descriptor associated with the other end of the new pipe is transmitted to the originating process as the file descriptor returned from open(2) or creat(2).

If the server does not respond to the I_SENDFD request, the stream that the connld module is pushed on becomes uni-directional because the server will not be able to retrieve any data off the stream until the I_RECVFD request is issued. If the server process exits before issuing the I_RECVFD request, the open(2) or the creat(2) system calls will fail and return -1 to the originating process.

When the connld module is pushed onto a pipe, messages going back and forth through the pipe are ignored by connld.

On success, an open of connld returns 0. On failure, errno is set to the following values:

- EINVAL: A stream onto which connld is being pushed is not a pipe or the pipe does not have a write queue pointer pointing to a stream head read queue.
- EINVAL: The other end of the pipe onto which connld is being pushed is linked under a multiplexor.
- EPIPE: connld is being pushed onto a pipe end whose other end is no longer there.
- ENOMEM: An internal pipe could not be created.
- ENXIO: An M_HANGUP message is at the stream head of the pipe onto which connld is being pushed.
- EAGAIN: Internal data structures could not be allocated.
- ENFILE: A file table entry could not be allocated.

SEE ALSO
streamio(7)
console(7)

NAME
console – STREAMS-based console interface

DESCRIPTION
The file /dev/console is the system console and refers to an asynchronous serial
data line originating from the system board.

The file /dev/contty refers to a second asynchronous serial data line originating
from the system board.

Both /dev/console and /dev/contty access the STREAMS-based console driver,
which when used in conjunction with the STREAMS line discipline module ldterm,
supports the termio(7) and termios(2) processing.

FILES
/dev/console
/dev/contty

SEE ALSO
crash(1M), ldterm(7), termio(7), termios(2)
NAME
  cram – CMOS RAM interface

DESCRIPTION
  The cram driver provides an interface to the 64 bytes of battery backed-up RAM.
  This memory contains information such as diagnostics and configuration informa-
  tion.

ioctl Calls
  CMOSREAD
    This call is used to read the contents of one of the CMOS RAM locations. The
    argument to the ioctl is the address of a buffer of two unsigned characters,
    the first of which is the address to be read. The ioctl will fill in the second
    byte with the data. An address less than 0 or greater than 63 will result in an
    error, with errno set to ENXIO.

  CMOSWRITE
    This call is used to write a value into one of the CMOS RAM locations. The
    argument to the ioctl is the address of a buffer of two unsigned characters,
    the first of which is the address and the second of which is the value to write
    at that address. An address less than 0 or greater than 63 will result in an
    error, with errno set to ENXIO. Note that only the super-user may open the
    CMOS RAM device for writing, and that the CMOSWRITE ioctl will fail for
    any other than the super-user.

Files
  /dev/cram
NAME
DCD – Direct-Coupled Disk host adapter Subsystem

DESCRIPTION
The DCD subsystem consists of at least one DCD Host Controller card which has at least one logical unit attached to it.

The DCD subsystem adds support for non-SCSI devices under SDI for use with related target drivers. This subsystem is accessed indirectly by opening an appropriate target driver to access a target device that is on a DCD controller.

It is also possible to access this subsystem via the pass-through driver. To find the appropriate device to use, while the device is being accessed through the target driver, use the `B_GETDEV ioctl` to get the major and minor numbers of the pass-through node. This node may either be created and/or open for use.

There are four groups of `ioctl(2)` commands supported by DCD. The first group contains the `ioctl` commands used by the DCD driver itself.

- **SDI_SEND**: Used to send a pass through command to a target controller bypassing the associated target driver.
- **SDI_RESET**: Used to reset the bus.
- **HA_VER**: For a 80386-based computer, used to determine the Driver Interface Version supported by the driver. It returns the structure `ver_no` defined in `sdi.h`.

The second group is used by the driver and all target drivers that use the SCSI Driver Interface protocol to communicate with their associated target controllers.

- **B_GETTYPE**: Return the bus name (DCD) and device driver name of a specific device.

The third group should be used by all the target drivers that use the SCSI Driver Interface protocol to communicate with their associated target controllers. This `ioctl` is not supported by the DCD driver.

- **B_GETDEV**: Return the pass through major and minor numbers to the calling utility to allow creation of a pass through the special device file.

The fourth group should be used to get and set device geometry. These return or accept the structure `disk_geom` defined in `sdi.h`.

- **HA_GETPARMS**: Return Host adapters idea of the device geometry. This is what the system uses during the boot sequence. This is used by certain target drivers.
- **HA_SETPARMS**: Set the Host adapters idea of the device geometry. Note that some Host adapters do not support this `ioctl` and will result in an error.
- **HA_GETPPARMS**: Return the actual device geometry. This is the actual as opposed to virtual device geometry.
The DCD driver has a halt routine that is executed during shutdown, which allows the controller enough time to flush the disk cache (if present) to disk. Although two seconds are allowed for this flush, the actual timeout value is an external variable in the DCD space.c file. You can modify this variable if a specific controller needs more time to clear the cache.

Files
/usr/include/sys/sdi.h
/usr/include/sys/sdi_edt.h

REFERENCES
ioctl(2)
display (7)

NAME

display – system console display

SYNOPSIS

#include <sys/console.h>
#include <sys/kd.h>
#include <sys/vt.h>

DESCRIPTION

The system console (and user's terminal) is composed of two separate pieces: the keyboard [see keyboard (7)] and the display. Because of their complexity, and because there are three possible display interfaces (monochrome, color graphics, and enhanced graphics adapters), they are discussed in separate manual entries.

The display normally consists of 25 lines of 80 columns each; 40-column lines are also supported by the color/graphics adapter, and 43 lines of 80-columns each are supported by the enhanced graphics adapter. When characters are written to the console or one of its virtual screens (/dev/console or /dev/vtxx), the output depends on the specific characters. All characters written to /dev/console are first processed by the terminal interface [see termio (7)]. For example, mapping newline characters to carriage return plus new-line, and expanding tabs to spaces, will be done before the following processing:

x Where x is not one of the following, displays x.
BEL Generates a bell (audible tone, no modulation).
CR Places the cursor at column 1 of the current line.
LF, VT Places the cursor at the same column of the next line (scrolls if the current line is line 25).
FF Clears the screen and places the cursor at line 1, column 1.
BS If the cursor is not at column 1, it is moved to the left one position on the same line. If the cursor is at column 1 but not line 1, it is moved to column 79 of the previous line. Finally, if the cursor is at column 1, line 1, it is not moved.

The display can be controlled by using specific sequences of characters that are ANSI X3.64 escape sequences preceded by the ASCII character ESC. The escape sequences, which work on either the monochrome, color graphics, or enhanced graphics adapter, are the following:

ESC c Clears the screen and places the cursor at line 1, column 1.

ESC Q n 'string'
Defines the function key n with string. The string delimiter ' may be any character not in string. Function keys are numbered 0 through 11 (F1 = 0, F2 = 1, and so on.)

ESC[ n @ Insert character—inserts n blanks at the current cursor position.

ESC[ n \ Horizontal Position Absolute—moves active position to column given by n.
Cursor up—moves the cursor up \( n \) lines (default: \( n=1 \)).

\[ \text{ESC} [ \ n \ A \] \]

Horizontal Position Relative—moves active position \( n \) characters to the right (default: \( n=1 \)).

\[ \text{ESC} [ \ n \ a \] \]

Cursor down—moves the cursor down \( n \) lines (default: \( n=1 \)).

\[ \text{ESC} [ \ n \ B \] \]

Cursor right—moves the cursor right \( n \) columns (default: \( n=1 \)).

\[ \text{ESC} [ \ n \ C \] \]

Set Cursor Type—where \( n \) is 0 (underline cursor), 1(blockcursor), or 2(no cursor). 0 is the default value for \( n \).

\[ \text{ESC} [ \ n \ D \] \]

Cursor left—moves the cursor left \( n \) columns (default: \( n=1 \)).

\[ \text{ESC} [ \ n \ d \] \]

Vertical Position Absolute—moves active position to line given by \( n \).

\[ \text{ESC} [ \ n \ E \] \]

Cursor next line—moves the cursor to column 1 of the next line, then down \( n-1 \) lines (default: \( n=1 \)).

\[ \text{ESC} [ \ n \ e \] \]

Vertical Position Relative—moves the active position down \( n \) lines (default: \( n=1 \)).

\[ \text{ESC} [ \ n \ F \] \]

Cursor previous line—moves the cursor to column 1 of the current line, then up \( n \) lines (default: \( n=1 \)).

\[ \text{ESC} [ \ n \ G \] \]

Cursor horizontal position—moves the cursor to column \( n \) of the current line (default: \( n=1 \)).

\[ \text{ESC} [ \ n \ ; \ m \ H \] \]

Position cursor—moves the cursor to column \( m \) of line \( n \) (default: \( n=1 \), \( m=1 \)).

\[ \text{ESC} [ \ n \ ; \ m \ f \] \]

Erase window—erases from the current cursor position to the end of the window if \( n=0 \), from the beginning of the window to the current cursor position if \( n=1 \), and the entire window if \( n=2 \) (default: \( n=0 \)).

\[ \text{ESC} [ \ n \ J \] \]

Erase line—erases from the current cursor position to the end of the line if \( n=0 \), from the beginning of the line to the current cursor position if \( n=1 \), and the entire line if \( n=2 \) (default: \( n=0 \)).

\[ \text{ESC} [ \ n \ K \] \]

Insert line—inserts \( n \) lines at the current cursor position (default: \( n=1 \)).

\[ \text{ESC} [ \ n \ L \] \]

Delete line—deletes \( n \) lines starting at the current cursor position (default: \( n=1 \)).

\[ \text{ESC} [ \ n \ M \] \]

Delete character—deletes \( n \) characters from a line starting at the current cursor position (default: \( n=1 \)).

\[ \text{ESC} [ \ n \ P \] \]

Scroll up—scrolls the characters in the current window up \( n \) lines. The bottom \( n \) lines are cleared to blanks (default: \( n=1 \)).

\[ \text{ESC} [ \ n \ S \] \]

Scroll down—scrolls the characters in the current window down \( n \) lines. The top \( n \) lines are cleared to blanks (default: \( n=1 \)).

\[ \text{ESC} [ \ n \ T \] \]

Erase character—erases \( n \) character positions starting at the current cursor position (default: \( n=1 \)).

\[ \text{ESC} [ \ n \ X \] \]
display (7)

ESC[ n Z  Cursor Backward Tabulation—moves active position back n tab stops.

ESC[ 2 h  Locks the keyboard and ignores keyboard input until unlocked. Characters are not saved.

ESC[ 2 i  Sends the screen to the host. The current screen display is sent to the application.

ESC[ 2 l  Unlocks the keyboard. Re-enables keyboard input.

ESC[ Ps ; Ps ; m  Character attributes—each Ps is a value in the table below; multiple characters are separated by semicolons. These parameters apply to successive characters being displayed, in an additive way (for example, both bold and underscoring can be selected). Only the parameters through 7 apply to the monochrome adapter; all parameters apply to the color or graphics adapter and the enhanced graphics adapter. (Default: Ps=0).

<table>
<thead>
<tr>
<th>Ps</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>all attributes off (normal display)</td>
</tr>
<tr>
<td>1</td>
<td>bold intensity</td>
</tr>
<tr>
<td>4</td>
<td>underscore on</td>
</tr>
<tr>
<td>5</td>
<td>blink on</td>
</tr>
<tr>
<td>6</td>
<td>VGA only: if blink (5) is on, turn blink off and background color to its light equivalent (that is, brown to yellow).</td>
</tr>
<tr>
<td>7</td>
<td>reverse video</td>
</tr>
<tr>
<td>30</td>
<td>black (gray) foreground</td>
</tr>
<tr>
<td>31</td>
<td>red (light red) foreground</td>
</tr>
<tr>
<td>32</td>
<td>green (light green) foreground</td>
</tr>
<tr>
<td>33</td>
<td>brown (yellow) foreground</td>
</tr>
<tr>
<td>34</td>
<td>blue (light blue) foreground</td>
</tr>
<tr>
<td>35</td>
<td>magenta (light magenta) foreground</td>
</tr>
<tr>
<td>36</td>
<td>cyan (light cyan) foreground</td>
</tr>
<tr>
<td>37</td>
<td>white (bright white) foreground</td>
</tr>
<tr>
<td>40</td>
<td>black (gray) background</td>
</tr>
<tr>
<td>41</td>
<td>red (light red) background</td>
</tr>
<tr>
<td>42</td>
<td>green (light green) background</td>
</tr>
<tr>
<td>43</td>
<td>brown (yellow) background</td>
</tr>
<tr>
<td>44</td>
<td>blue (light blue) background</td>
</tr>
<tr>
<td>45</td>
<td>magenta (light magenta) background</td>
</tr>
<tr>
<td>46</td>
<td>cyan (light cyan) background</td>
</tr>
<tr>
<td>47</td>
<td>white (bright white) background</td>
</tr>
</tbody>
</table>

Note that for character attributes 30–37, the color selected for foreground will depend on whether the bold intensity attribute (1) is currently on. If not, the first color listed will result; otherwise the second color listed will result.
Similarly, for character attributes 40–47, the color selected for background will depend on whether the blink attribute (5) is currently on and bright background (6) has been turned on. If blink is not turned on or bright background has not been selected, the first listed color will result. Otherwise, the second color listed will result.

\[\text{ESC} \,[ \, 8 \, m \,] \quad \text{sets blank (non-display)}\]

\[\text{ESC} \,[ \, 10 \, m \,] \quad \text{selects the primary font}\]

\[\text{ESC} \,[ \, 11 \, m \,] \quad \text{selects the first alternate font; lets ASCII characters less than 32 be displayed as ROM characters}\]

\[\text{ESC} \,[ \, 12 \, m \,] \quad \text{selects a second alternate font; toggles high bit of extended ASCII code before displaying as ROM characters}\]

\[\text{ESC} \,[ \, 38 \, m \,] \quad \text{enables underline option; white foreground with white underscore (see the NOTES section)}\]

\[\text{ESC} \,[ \, 39 \, m \,] \quad \text{disables underline option (see the NOTES section)}\]

The following non-ANSI X3.64 escape sequences are supplied:

\[\text{ESC} \,[ \, = \, a \,] \quad \text{Sets overscan color.}\]

\[\text{ESC} \,[ \, = \, p \, ; \, d \, B \,] \quad \text{Sets bell parameters (where } p \text{ is the pitch in Hz and } d \text{ is the duration in milliseconds)}\]

\[\text{ESC} \,[ \, = \, s \, ; \, c \, C \,] \quad \text{Sets cursor parameters (where } s \text{ is the starting and } e \text{ is the ending scanlines of the cursor).}\]

\[\text{ESC} \,[ \, = \, x \, D \,] \quad \text{Enables/disables intensity of background color (where } x \text{ is 0 for enable and 1 for disable).}\]

\[\text{ESC} \,[ \, = \, x \, E \,] \quad \text{Sets/clears blink versus bold background (where } x \text{ is 0 for set and 1 for clear).}\]

\[\text{ESC} \,[ \, = \, c \, F \,] \quad \text{Sets normal foreground color. See GIO_ATTR for the valid values for } c.\]

\[\text{ESC} \,[ \, = \, c \, G \,] \quad \text{Sets normal background color. See GIO_ATTR for the valid values for } c.\]

\[\text{ESC} \,[ \, = \, n \, g \,] \quad \text{Displays graphic character } n.\]

\[\text{ESC} \,[ \, = \, c \, H \,] \quad \text{Sets reverse foreground color. See GIO_ATTR for the valid values for } c.\]

\[\text{ESC} \,[ \, = \, c \, I \,] \quad \text{Sets reverse background color. See GIO_ATTR for the valid values for } c.\]

\[\text{ESC} \,[ \, = \, c \, J \,] \quad \text{Sets graphic foreground color. See GIO_ATTR for the valid values for } c.\]

\[\text{ESC} \,[ \, = \, c \, K \,] \quad \text{Sets graphic background color. See GIO_ATTR for the valid values for } c.\]

\[\text{ESC} \,[ \, n \, z \,] \quad \text{Makes virtual terminal number } n \text{ active.}\]

\[\text{ESC} \, 7 \quad \text{Saves cursor position.}\]
display(7)

ESC 8  Restores cursor position to saved value.
ESC[ 0 k  Disables the key-click feature (the default).
ESC[ 1 k  Enables the key-click feature. A tone is produced for each key press.

ioctl Calls

The following ioctl calls may be used to change the display used for the video monitor. If the virtual terminal has not been put in process mode (see the VT_SETMODE ioctl), setting the display mode to a non-text mode will turn off VT switching. VT switches will be re-enabled after the display mode has been reset to a text mode.

Note: All the following ioctls are performed on either a file descriptor to the virtual terminals or to the special file /dev/video. ioctls to /dev/video are indicated with an asterisk (*). For the ioctls to /dev/video to work, the controlling tty for the process must be the virtual terminal on which the operation is to be performed. If the tty is not a virtual terminal, the return value will be -1 and errno will be set to EINVAL.

**SWAPMONO** (*)
This call selects the monochrome adapter as the output device for the system console.

**SWAPCGA** (*)
This call selects the color/graphics adapter as the output device for the system console.

**SWAPEGA** (*)
This call selects the enhanced graphics adapter as the output device for the system console.

**SWAPVGA** (*)
This call selects the video graphics array as the output device for the system console.

The following ioctl call may be used to obtain more information about the display adapter currently attached to the video monitor:

**CONS_CURRENT** (*)
This call returns the display adapter type currently attached to the video monitor. The return value can be one of: MONO, CGA, or EGA.

The following ioctl calls may be used to switch display modes on the various video adapters:

**SW_B40x25** (*)
This call selects 40x25 (40 columns by 25 rows) black and white text display mode. It is valid only for CGA and EGA devices.

**SW_C40x25** (*)
This call selects 40x25 (40 columns by 25 rows) color text display mode. It is valid only for CGA and EGA devices.

**SW_B80x25** (*)
This call selects 80x25 (80 columns by 25 rows) black and white text display mode. It is valid only for CGA and EGA devices.
display (7)

SW_C80x25 (*)
This call selects 80x25 (80 columns by 25 rows) color text display mode. It is valid only for CGA and EGA devices.

SW_BG320 (*)
This call selects 320x200 black and white graphics display mode. It is valid only for CGA and EGA devices.

SW_CG320 (*)
This call selects 320x200 color graphics display mode. It is valid only for CGA and EGA devices.

SW_BG640 (*)
This call selects 640x200 black and white graphics display mode. It is valid only for CGA and EGA devices.

SW_CG320_D (*)
This call selects EGA support for 320x200 graphics display mode (EGA mode D). It is valid only for EGA devices.

SW_CG640_B (*)
This call selects EGA support for 640x200 graphics display mode (EGA mode E). It is valid only for EGA devices.

SW_EGAMONOAPA (*)
This call selects EGA support for 640x350 graphics display mode (EGA mode F). It is valid only for EGA devices.

SW_ENH_MONOAPA2 (*)
This call selects EGA support for 640x350 graphics display mode with extended memory (EGA mode F*). It is valid only for EGA devices.

SW_CG640x350 (*)
This call selects EGA support for 640x350 graphics display mode (EGA mode 10). It is valid only for EGA devices.

SW_ENH_CG640 (*)
This call selects EGA support for 640x350 graphics display mode with extended memory (EGA mode 16). It is valid only for EGA devices.

SW_EGAMON080x25 (*)
This call selects EGA monochrome text display mode (EGA mode 7), which emulates support provided by the monochrome adapter. It is valid only for EGA devices.

SW_ENHB40x25 (*)
This call selects enhanced 40x25 black and white text display mode. It is valid only for EGA devices.

SW_ENHBC40x25 (*)
This call selects enhanced 40x25 color text display mode. It is valid only for EGA devices.

SW_ENHB80x25 (*)
This call selects enhanced 80x25 black and white display mode. It is valid only for EGA devices.
display (7)

SW_ENHC80x25 (*)
This call selects enhanced 80x25 color text display mode. It is valid only for EGA devices.

SW_ENH80x43 (*)
This call selects enhanced 80x43 black and white text display mode. It is valid only for EGA devices.

SW_ENH80x43 (*)
This call selects enhanced 80x43 color text display mode. It is valid only for EGA devices.

SW_MCAMODE (*)
This call reinitializes the monochrome adapter. It is valid only for monochrome adapters.

SW_ATT640 (*)
This call selects 640x400 16 color mode, when an AT&T Super-Vu video controller is attached.

Switching to an invalid display mode for a display device will result in an error.

The following ioctl s may be used to obtain information about the current display modes:

CONS_GET (*)
This call returns the current display mode setting for whatever display adapter is being used. Possible return values include:
- M_B40x25 (0), black and white 40 columns. CGA and EGA only.
- M_C40x25 (1), color 40 columns. CGA and EGA only.
- M_B80x25 (2), black and white 80 columns. CGA and EGA only.
- M_C80x25 (3), color 80 columns. CGA and EGA only.
- M_BG320 (4), black and white graphics 320 by 200. CGA and EGA only.
- M_CG320 (5), color graphics 320 by 200. CGA and EGA only.
- M_BG640 (6), black and white graphics 640 by 200 high-resolution. CGA and EGA only.
- M_EGAMONO80x25 (7), EGA-mono 80 by 25. EGA only.
- M_CG320_D (13), EGA mode D.
- M_CG640_E (14), EGA mode E.
- M_EFAMONOAPA (15), EGA mode F.
- M_CG640x350 (16), EGA mode 10.
- M_ENHMONOAPA2 (17), EGA mode F with extended memory.
- M_ENH_CG640 (18), EGA mode 16.
M_ENH_B40x25 (19), EGA enhanced black and white 40 columns.
M_ENH_C40x25 (20), EGA enhanced color 40 columns.
M_ENH_B80x25 (21), EGA enhanced black and white 80 columns.
M_ENH_C80x25 (22), EGA enhanced color 80 columns.
M_ENH_B80x43 (0x70), EGA black and white 80 by 43.
M_ENH_C80x43 (0x71), EGA color 80 by 43.
M_MCA_MODE (0xff), monochrome adapter mode.

MCA_GET (*) This call returns the current display mode setting of the monochrome adapter. See CONS_GET for a list of return values. If the monochrome adapter is not installed, the call will fail and errno will be set to 22 (EINVAL).

CGA_GET (*) This call returns the current display mode setting of the color/graphics adapter. See CONS_GET for a list of return values. If the color graphics adapter is not installed, the call will fail and errno will be set to 22 (EINVAL).

EGA_GET (*) This call returns the current display mode setting of the enhanced graphics adapter. See CONS_GET for a list of return values. If the enhanced graphics adapter is not installed, the call will fail and errno will be set to 22 (EINVAL).

The following ioctl calls may be used to map the video adapter’s memory into the user’s data space.

MAPCONS (*) This call maps the display memory of the adapter currently being used into the user’s data space.

MAPMONO (*) This call maps the monochrome adapter’s display memory into the user’s data space.

MAPCGA (*) This call maps the color/graphics adapter’s display memory into the user’s data space.

MAPEGA (*) This call maps the enhanced graphics adapter’s display memory into the user’s data space.

MAPVGA (*) This call maps the video graphics array’s display memory into the user’s data space.

You can use ioctl calls to input a byte from the graphics adapter port or to output a byte to the graphics adapter port. The argument to the ioctl uses the port_io_arg data structure:

```c
struct port_io_arg {
    struct port_io_struc_args[4];
};
```

The previous example shows that the port_io_arg structure points to an array of four port_io_struc data structures. The port_io_struc has the following format:
You can specify one, two, three, or four of the port_io_struc structures in the array for one ioctl call. The value of dir can be either IN_ON_PORT (to specify a byte being input from the graphics adapter port) or OUT_ON_PORT (to specify a byte being output to the graphics adapter port). Port is an integer specifying the port address of the desired graphics adapter port. Data is the byte of data being input or output as specified by the call. If you are not using any of the port_io_struc structures, load the port with 0, and leave the unused structures at the end of the array. Refer to your hardware manuals for port addresses and functions for the various adapters.

The following ioctl calls may be used to input or output bytes on the graphics adapter port:

**MCAIO** (*) This call inputs or outputs a byte on the monochrome adapter port as specified.

**CGAIO** (*) This call inputs or outputs a byte on the color/graphics adapter port as specified.

**EGAIO** (*) This call inputs or outputs a byte on the enhanced graphics adapter port as specified.

**VGAIO** (*) This call inputs or outputs a byte on the video graphics array port as specified.

To input a byte on any of the graphics adapter ports, load dir with IN_ON_PORT and load port with the port address of the graphics adapter. The byte input from the graphics adapter port will be returned in data.

To output a byte, load dir with OUT_ON_PORT, load port with the port address of the graphics adapter, and load data with the byte you want to output to the graphics adapter port.

The following ioctl's may be used with either the monochrome, color graphics, or enhanced graphics adapters:

**GIO_FONT8x8** (*) This call gets the current 8x8 font in use.

**GIO_FONT8x14** (*) This call gets the current 8x14 font in use.

**GIO_FONT8x16** (*) This call gets the current 8x16 font in use.

**KDDISPTYPE** (*) This call returns display information to the user. The argument expected is the buffer address of a structure of type kd_disparam into which display information is returned to the user. The kd_disparam structure is defined as follows:
struct kd_dispam {  
  long type;  /*display type*/  
  char *addr;  /*display memory address*/  
  ushort ioaddr[MKDIOADDR];  /*valid I/O addresses*/  
}

Possible values for the type field include:
KD_MONO (0x01), for the IBM monochrome display adapter.
KD_HERCULES (0x02), for the Hercules monochrome graphics adapter.
KD_CGA (0x03), for the IBM color graphics adapter.
KD_EGA (0x04), for the IBM enhanced graphics adapter.

KIOCSOUND (*)
Start sound generation. Turn on sound. The "arg" is the frequency desired. A frequency of 0 turns off the sound.

KDGETLED Get keyboard LED status. The argument is a pointer to a character. The character will be filled with a boolean combination of the following values:

- LED_SCR 0x01 (flag bit for scroll lock)
- LED_CAP 0x04 (flag bit for caps lock)
- LED_NUM 0x02 (flag bit for num lock)

KDSETLED Set keyboard LED status. The argument is a character whose value is the boolean combination of the values listed under KDGETLED.

KDMKTONE (*)
Generate a fixed length tone. The argument is a 32 bit value, with the lower 16 bits set to the frequency and the upper 16 bits set to the duration (in milliseconds).

KDGBKTYPE Get keyboard type. The argument is a pointer to a character type. The character will be returned with one of the following values:

- KB_84 0x01 (84 key keyboard)
- KB_101 0x02 (101 key keyboard)
- KB_OTHER 0x03

KDADDIO (*)
Add I/O port address to list of valid video adaptor addresses. Argument is an unsigned short type that should contain a valid port address for the installed video adaptor.

KDELETE (*)
Delete I/O port address from list of valid video adaptor addresses. Argument is an unsigned short type that should contain a valid port address for the installed video adaptor.

KDENABIO (*)
Enable in's and out's to video adaptor ports. No argument.
display (7)

KDDISABIO (*)
Disable in’s and out’s to video adaptor ports. No argument.

KDQUEMODE (*)
Enable/Disable special queue mode. Queue mode is used by AT&T’s X-Windows software to establish a shared queue for access to keyboard and mouse event information. The argument is a pointer to a structure "kd_quemode." If a NULL pointer is sent as an argument, the queue will be closed and the mode disabled. The structure "kd_quemode" is as follows:

```c
struct kd_quemode {
    int qsize; /* desired # of elements in queue */
    int signo; /* signal number to send when queue goes non-empty */
    void char *qaddr; /* user virtual address of queue (set by driver) */
};
```

KDSBORDER (*)
Set screen color border in EGA text mode. The argument is of type character. Each bit position corresponds to a color selection. From bit position 0 to bit position 6, the color selections are respectively; blue, green, red, secondary blue, secondary green, and secondary red. Setting the bit position to a logic one will select the desired color or colors. See the NOTES section.

KDSETMODE (*)
Set console in text or graphics mode. The argument is of type integer, which should contain one of the following values:

- KD_TEXT 0x00 (sets console to text mode)
- KD_GRAPHICS 0x01 (sets console in graphics mode)

If the mode is set to KD_GRAPHICS and the Virtual Terminal is not in process mode (see the VT_SETMODE ioctl), no virtual terminal switches will be possible until the mode is reset to KD_TEXT, KD_TEXT0, or KD_TEXT1.

Note, the user is responsible for programming the color/graphics adaptor registers for the appropriate graphical state.

KDGETMODE (*)
Get current mode of console. Returns integer argument containing either KD_TEXT or KD_GRAPHICS as defined in the KDSETMODE ioctl description.

KDMAPDISP (*)
Maps display memory into user process address space. Argument is a pointer to structure type "kd_memloc." Structure definition is as follows:
display (7)

struct kd_memloc {
    char *vaddr; /* virtual address to map to */
    char *physaddr; /* physical address to map from */
    long length; /* size in bytes to map */
    long ioflg; /* enable i/o addresses if set */
}

KDUNMAPDISP (*)
Unmap display memory from user process address space. No argument required.

KDVDCTYPE
This call returns VDC controller/display information.

PIO_FONT8x8 (*)
This call uses the user supplied 8x8 font.

PIO_FONT8x14 (*)
This call uses the user supplied 8x14 font.

PIO_FONT8x16 (*)
This call uses the user supplied 8x16 font.

VT_OPENQRY
Inquires if this virtual terminal is already open. Find an available virtual terminal. The argument is a pointer to a long. The long will be filled with the number of the first available "VT" that no other process has open or -1 if none is available.

VT_GETMODE (*)
Determine what mode the active virtual terminal is currently in, either VT_AUTO or VT_PROCESS. The argument to the ioctl is the address of the following type of structure:

struct vt_mode {
    char mode; /* VT mode */
    char waitv; /* if set, hang on writes when not active */
    short relsig; /* signal to use for release request */
    short acqsig; /* signal to use for display acquired */
    short frsig; /* not used set to 0 */
}

#define VT_AUTO 0x00 /* automatic VT switching */
#define VT_PROCESS 0x01 /* process controls switching */

The "vt mode" structure will be filled in with the current value for each field.

VT_GETSTATE (*)
The VT_GETSTATE ioctl returns global virtual terminal state information. It returns the active virtual terminal in the v_active field, and the number of active virtual terminals and a bit mask of the global state in the v_state field, where bit x is the state of vt x (1 indicates that the virtual terminal is open).
VT_SETMODE (*)
Set the virtual terminal mode (Auto or Proced). The argument is a pointer to a "vt_mode" structure, as defined above.

VT_SENDSIG (*)
The VT_SENDSIG ioctl specifies a signal (in v_signal) to be sent to a bit mask of virtual terminals (in v_state).

The data structure used by the VT_GETSTATE and VT_SENDSIG ioctl's is:

```c
struct vt_stat {
    ushort v_active;  /* active vt*/
    ushort v_signal;  /* signal to send (VT_SENDSIG) */
    ushort v_state;   /* vt bit mask (VT_SENDSIG and VT_GETSTATE)*/
};
```
and is defined in /usr/include/sys/vt.h.

VT_RELDISP (*)
Used to tell the virtual terminal manager that the display has or has not been released by the process. A zero value indicates refusal to release the display. A value of VT_ACKACQ indicates an acquisition of a device. EINVAL is returned if a non-zero value that is not equal to VT_ACKACQ is received and the virtual terminal has not yet been acquired. Otherwise, the virtual terminal will be released.

VT_ACTIVATE (*)
Makes the virtual terminal number specified in the argument the active "VT." The "VT" manager will cause a switch to occur in the same way as if a hotkey sequence had been typed at the keyboard. If the specified "VT" is not open or does not exist, the call will fail and errno will be set to ENXIO.

KIOCINFO This call tells the user what the device is.

GIO_SCRNMAP (*)
This call gets the screen mapping table from the kernel.

GIO_ATTR This call returns the current screen attribute. The bits are interpreted as follows:

Bit 0 determines underlining for black and white monitors (1=underlining on).

Bits 0-2, for color monitors only, select the foreground color. The following list indicates what colors are selected by the given value:

- The value 0 selects black.
- The value 1 selects red.
- The value 2 selects green.
- The value 3 selects brown.
- The value 4 selects blue.
- The value 5 selects magenta.
- The value 6 selects cyan.
- The value 7 selects white.
Bit 3 is the intensity bit (1=blink on).

Bits 4-6, for color monitors only, select the background color. For a list of colors and their values, see the list under foreground colors.

Bit 7 is the blink bit (1=blink on).

**GIO_COLOR** (*

This call returns a non-zero value if the current display is a color display, otherwise, it returns a zero.

**PIO_SCMNMAP**

This call puts the screen mapping table in the kernel.

The screen mapping table maps extended ASCII (8-bit) characters to ROM characters. It is an array [256] of char (typedef scrnmap t) and is indexed by extended ASCII values. The value of the elements of the array are the ROM character to display.

**FILES**

/dev/console
/dev/tty00-n
/dev/video
/usr/include/sys/kd.h

**SEE ALSO**

console(7), ioctl(2), keyboard(7), stty(1), termio(7)

**NOTES**

Although it is possible to write character sequences that set arbitrary bits on the screen in any of the three graphics modes, this mode of operation is not currently supported.

Monochrome adaptors support underscore option as the default. EGA and VGA adaptors require the use of the **ESC[38m** and **ESC[39m** escape sequences to enable/disable the underscore option respectively. After the underscore option has been enabled on a EGA or VGA adaptor by using the **ESC[38m** sequence and until the underline option has been disabled by using the **ESC[39m** sequence, characters that have blue foreground attributes will be displayed in cyan foreground and characters that have blue background attributes will be displayed in white background attributes.

It is currently not possible to access the 6845 start address registers. Thus, it is impossible to determine the beginning of the color monitor’s screen memory.

The alternate/background color bit (bit 4) of the color select register does not appear to affect background colors in alphanumeric modes.

**KDSBORDER ioctl** calls will not work with AT&T’s Super-Vu enhanced color/graphics video adaptor. It will however, work with the IBM EGA card and other EGA compatible video adaptors.

The low-resolution graphics mode appears to be 80 across by 100 down.
dpt(7)

NAME
  dpt – DPT PM2012 SCSI host adapter subsystem

DESCRIPTION
  The dpt host adapter subsystem enables SCSI target drivers (such as sd01, st01, and so on) to communicate on the SCSI bus with target controllers and logical units. This driver implements the Portable Device Interface (PDI) for such PDI target drivers.

  It is also possible to access this subsystem directly using the pass-through driver interface. This allows you to issue sb control blocks directly to the target controller. To find the appropriate device to use, while any device is being accessed through the target driver (for example, sd01), use the B_GETDEV ioctl to get the major and minor numbers of the pass-through node. This node may be created and opened for pass-through use (SDI_SEND ioctl).

ioctl Calls
  The following ioctl(2) commands are supported by dpt:

  SDI_SEND
    Sends a pass-through command (SCSI control block) to a target controller, bypassing the associated target driver.

  SDI_BRESET
    Resets the SCSI bus.

  B_REDT
    Reads the extended Equipped Device Table (EDT) data structure that is stored in the dpt driver’s internal data structure.

  B_GETTYPE
    Returns the bus name (for example, SCSI) and device driver name of a specific device.

NOTICES
  The DPT SCSI adapter will not work reliably with the Emulex SCSI/ESDI bridge controller (also known as the AT&T DCM/4E). In the future, a hardware or software solution may be implemented.

Files
  /usr/include/sys/dpt.h
  /usr/include/sys/scsi.h
  /usr/include/sys/sdi.h
  /usr/include/sys/sdi_edt.h
  /etc/conf/pack.d/dpt/space.c

REFERENCES
  adsc(7), ioctl(2), mcis(7), sc01(7), sd01(7), st01(7), sw01(7), wd7000(7)
NAME
    ee16 - EtherExpress 16 Ethernet Adapter Driver

SYNOPSIS
    #include <sys/dlpi.h>
    #include <sys/dlpi_ether.h>
    #include <sys/ee16.h>

    fd = open("/dev/ee16_0", O_RDWR)

DESCRIPTION
    The ee16 driver provides a data link interface to the EtherExpress 16 Ethernet adapter from Intel. It is a STREAMS-based driver that is compatible with the Data Link Provider Interface (DLPI) and Logical Link Interface (LLI) software interfaces.

    It supports DL_ETHER and DL_CSMACD for MAC type, DL_CL_ETHER for service mode, and DL_STYLE1 for provider style. The ee16 driver can operate as a cloned or non-cloned device.

    A process must issue a DL_BIND_REQ primitive to receive frames from the network. The process must specify the dl_sap field of the dl_bind_req_t structure. The type field of an incoming frame is compared to the dl_sap value. If the values are equal, it is placed on the STREAMS read queue of the process. A privileged process may set the dl_sap field to PROMISCUOUS_SAP. The PROMISCUOUS_SAP matches all incoming frames.

    A privileged process may also bind to a SAP already bound by another process. In cases where a frame qualifies to be sent to more than one process, independent copies of the frame will be made and placed on the STREAMS read queue of each process.

    Received frames are delivered in dl_unitdata_ind_t structures. The source and destination address each contain a 6-byte Ethernet address, followed by a 2-byte type value.

USAGE
    ioctl Calls
    The following ioctls are supported:

    DLIOCGMI

        Returns the DL_mib_t structure, which contains the Management Information Base (MIB). The MIB holds the Ethernet statistics kept in the driver.

            /*
            *  Ether statistics structure.
            */
            typedef struct {
                ulong_t etherAlignErrors;    /* Frame alignment errors */
                ulong_t etherCRCerrors;      /* CRC errors */
                ulong_t etherMissedPkts;     /* Packet overflow or missed inter */
                ulong_t etherOverrunErrors;  /* Overrun errors */
                ulong_t etherUnderrunErrors; /* Underrun errors */
                ulong_t etherCollisions;     /* Total collisions */
                ulong_t etherAbortErrors;    /* Transmits aborted at interface */
                ulong_t etherCarrierLost;    /* Carrier sense signal lost */
            } DL_MIB;
typedef struct {
    int ifIndex; /* ranges between 1 and ifNumber */
    int ifDescrLen; /* len of desc. following this struct */
    int ifType; /* type of interface */
    int ifMtu; /* datagram size that can be sent/rcv */
    ulong_t ifSpeed; /* estimate of bandwidth in bits PS */
    uchar_t ifPhyAddress[DL_MAC_ADDR_LEN]; /* Ethernet Address */
    int ifAdminStatus; /* desired state of the interface */
    int ifOperStatus; /* current state of the interface */
    ulong_t ifLastChange; /* sysUpTime when state was entered */
    ulong_t ifInOctets; /* octets received on interface */
    ulong_t ifInUcastPkts; /* unicast packets delivered */
    ulong_t ifInNUcastPkts; /* non-unicast packets delivered */
    ulong_t ifInDiscards; /* good packets received but dropped */
    ulong_t ifInErrors; /* packets received with errors */
    ulong_t ifInUnknownProtos; /* packets recv’d to unbound proto */
    ulong_t ifOutOctets; /* octets transmitted on interface */
    ulong_t ifOutUcastPkts; /* unicast packets transmitted */
    ulong_t ifOutNUcastPkts; /* non-unicast packets transmitted */
    ulong_t ifOutDiscards; /* good outbound packets dropped */
    ulong_t ifOutErrors; /* number of transmit errors */
    ulong_t ifOutQlen; /* length of output queue */
    DL_etherstat_t ifSpecific; /* ethernet specific stats */
} DL_mib_t;

The values in the MIB are compatible with those needed by the SNMP protocol.
The ifDescrLen field indicates the length of the null terminated description string that immediately follows the DL_mib_t structure.

There are three fields in the MIB that are specific to the ee16 driver. The ifSpecific.etherDependent1 field tracks the number of times the transceiver failed to transmit a collision signal after transmission of a packet. The ifSpecific.etherDependent2 field contains the number of collisions that occurred after a slot time (out of window collisions). The ifSpecific.etherDependent3 field tracks the number of times a transmit interrupt timeout condition occurred.
DLIOCSMIG
Allows a privileged process to initialize the values in the MIB (that is, the DL_mib_t structure). A process cannot use this ioctl to change the ifPhyAddress, the ifDescrLen, or the text of the description fields.

DLIOCGENADDR
Returns the Ethernet address in network order.

DLIOCGLPCFLG
Returns the state of the local packet copy flag in the ioc_rval of the iocblk structure. The local copy flag determines if packets looped back by the driver should also be sent to the network. A non-zero value indicates that frames should also be sent to the network after being looped back. The default value of this flag is zero.

DLIOCSLPCFLG
Allows a privileged process to set the local packet copy flag, causing all packets looped back by the driver to be sent to the network as well.

DLIOCSPROMISC
Returns the value of the promiscuous flag in the ioc_rval of the iocblk structure. A non-zero value indicates that the Ethernet interface will receive all frames on the network. The default value of this flag is zero.

DLIOCSPROMISC
Allows a privileged process to toggle the current state of the promiscuous flag. When the flag is set, the driver captures all frames from the network. Processes that are bound to a promiscuous SAP, or to a SAP that matches the type field of the received frame, receive a copy of the frame.

DLIOCGMULTI
Returns a list of multicast addresses (if it exists).

DLIOCADDMULTI
Allows a privileged process to add a new multicast address and enable its reception. A 6-byte buffer pointing to the multicast address must be passed as the parameter.

DLIOCDDELMULTI
Allows a privileged process to delete a multicast address by passing a 6-byte multicast address as the parameter.

Installation
You must select the interrupt level and the base I/O address for the EtherExpress card at package installation time. Refer to the User's Guide that came with your adaptor for more information.

You can also set these parameters in the /etc/conf/sdevice.d/ee16 file.

If there is one EtherExpress 16 card in the system, it is configured automatically to the parameters specified at installation each time the system is initialized. During initialization, the system determines the current base I/O address of the card, and then programs the card to its new configuration. If the system doesn't find an EtherExpress 16 card, it displays an error message. Because of the way the system searches for an EtherExpress 16 card, reads to I/O addresses without EtherExpress 16 cards may occur during the automatic configuration process.
Automatic configuration occurs only when one EtherExpress 16 card is installed in the system. If you want to install more than one card, use the following procedure:

When you install the ee16 package, specify the interrupt level and the base I/O address for one EtherExpress 16 card, install the card in the system, reboot the system, and use the automatic configuration process to assign those parameters to the card.

Then, for each additional card, edit the /etc/conf/sdevice.d/ee16 file and specify the interrupt level and base I/O address for the next EtherExpress 16 card (being careful not to use an interrupt level or base I/O address that are being used by any other board in the system), shut down the system, remove the EtherExpress 16 card that's in the system, replace it with the next EtherExpress 16 card, and reboot the system. The automatic configuration process will assign the parameters in /etc/conf/sdevice.d/ee16 to the new card.

When you have programmed the parameters for all the cards, shut down and turn off the system, and install all the cards. The configuration files need to reflect the fact that multiple cards are in use. When you boot the system it recognizes that there are multiple EtherExpress 16 cards installed and does not try to autoconfigure them.

Configuration

The ee16 driver has four configurable parameters in the /etc/conf/pack.d/ee16/space.c file. Any changes to this file must be followed by a rebuild of the kernel and a reboot of the system for the changes to take effect.

The configurable parameters are:

N_SAPS
Defines the number of SAPs that can be bound at any one time. This value should be only slightly larger than anticipated SAP usage. A typical TCP/IP system requires two SAPs (0x800 and 0x806). A large value will degrade performance and increase memory usage.

CABLE_TYPE
Defines the type of Ethernet cable attached to the Ethernet controller card. A value of 0 specifies a thin Ethernet cable with a BNC connector. A value of 1 specifies a thick Ethernet cable with an AUI connector.

STREAMS_LOG
Defines whether the driver should log debugging messages to the STREAMS logger for the strace(1M) utility to display. The module ID used with strace is 2101. A value of 0 indicates that no STREAMS debug messages should be generated. A value of 1 will cause messages to be generated. You can temporarily set the driver to log messages by changing the value of ee16strlog (a 4-byte integer) to 1 using the kernel debugger. STREAMS tracing should only be performed when debugging a network problem. It can cause a severe performance degradation if you use full ee16 STREAMS logging.
IFNAME
This parameter is important only in a TCP/IP networking environment. It
defines the string used in displaying network statistics. This string should
match the logical interface name assigned in /etc/confnet.d/inet/interfaces file and with ifconfig(1M)
commands used in /etc/inet/rc.inet configuration script.

Errors
The ee16 driver can return the following error codes:
ENXIO Invalid major number or board is not installed.
ECHRNG No minor devices left if configured as a cloned device. Increase N_SAP value in /etc/conf/pack.d/ee16/space.c Invalid minor device number if configured as a non-cloned device.
EPERM An ioctl was made without the appropriate privilege.
EINVAL An ioctl was made that did not supply a required input and/or output buffer.
DL_NOTSUPPORTED Requested service primitive is not supported.
DL_BADPRIM Unknown service primitive was requested.
DL_OUTSTATE DL_BIND_REQ was issued when the Stream was bound, or DL_UNBIND_REQ or DL_UNITDATA_REQ was issued when the Stream was unbound.
DL_ACCESS An attempt was made to bind to PROMISCUOUS_SAP with insufficient privilege.
DL_BOUND The requested SAP is already bound. A privileged process may bind to an already bound SAP.
DL_NOTINIT DL_UNITDATA_REQ was made on an Ethernet board that has gone offline due to an error.
DL_BADDATA DL_UNITDATA_REQ was made with a data size that was either larger than the SPDU maximum or smaller than the SPDU minimum.

Files
/dev/ee16*
/etc/conf/pack.d/ee16/space.c
/etc/conf/sdevice.d/ee16

REFERENCES
getmsg(2), ioctl(2), open(2), putmsg(2)
NAME
e1l6 - EtherLink 16 Ethernet Adapter Driver

SYNOPSIS
#include <sys/dlpi.h>
#include <sys/dlpi_ether.h>
#include <sys/e1l6.h>

fd = open("/dev/e1l6_0", O_RDWR)

DESCRIPTION
The e1l6 driver provides a data link interface to the EtherLink 16 and
Etherlink/MC adapters from 3Com. It is a STREAMS-based driver compatible with
the Data Link Provider Interface (DLPI) and Logical Link Interface (LLI) software
interfaces.

It supports DL_ETHER and DL_CSMACD for MAC type, DL_CLDLS for service mode,
and DL_STYLE1 for provider style. The e1l6 driver can operate as a cloned or
non-cloned device.

A process must issue a DL_BIND_REQ primitive to receive frames from the network.
The process must specify the dl_sap field of the dl_bind_req_t structure. The type
field of an incoming frame is compared to the dl_sap value. If the values are equal,
it is placed on the STREAMS read queue of the process. A privileged process may
set the dl_sap field to PROMISCUOUS_SAP. The PROMISCUOUS_SAP matches all incom­
ing frames.

A privileged process may also bind to a SAP already bound by another process. In
cases where a frame qualifies to be sent to more than one process, independent
copies of the frame are created and placed on the STREAMS read queue of each
process.

Received frames are delivered in dl_unitdata_ind_t structures. The source and
destination address each contain contain a 6-byte Ethernet address, followed by a
2-byte type value.

USAGE
ioctl Calls
The following ioctls are supported:

DLIOCGMIB

Returns the DL_mib_t structure, which contains the Management Information
Base (MIB). The MIB holds the Ethernet statistics kept in the driver.

typedef struct {
    ulong_t etherAlignErrors; /* Frame alignment errors */
    ulong_t etherCRCerrors; /* CRC errors */
    ulong_t etherMissedPktss; /* Packet overflow or missed inter */
    ulong_t etherOverrunErrors; /* Overrun errors */
    ulong_t etherUnderrunErrors; /* Underrun errors */
    ulong_t etherCollisions; /* Total collisions */
}
ulong_t etherAbortErrors;  /* Transmits aborted at interface */
ulong_t etherCarrierLost;  /* Carrier sense signal lost */
ulong_t etherReadqFull;  /* STREAMS read queue full */
ulong_t etherRcvResources;  /* Receive resource alloc failure */
ulong_t etherDependent1;  /* Device dependent statistic */
ulong_t etherDependent2;  /* Device dependent statistic */
ulong_t etherDependent3;  /* Device dependent statistic */
ulong_t etherDependent4;  /* Device dependent statistic */
ulong_t etherDependent5;  /* Device dependent statistic */

/* Interface statistics compatible with MIB II SNMP requirements. */
typedef struct {
  int ifIndex;  /* ranges between 1 and ifNumber */
  int ifDescrLen;  /* len of desc. following this struct */
  int ifType;  /* type of interface */
  int ifMtu;  /* datagram size that can be sent/rcv */
  ulong_t ifSpeed;  /* estimate of bandwidth in bits PS */
  uchar_t ifPhyAddress[DL_MAC_ADDR_LEN];  /* Ethernet Address */
  int ifAdminStatus;  /* desired state of the interface */
  int ifOperStatus;  /* current state of the interface */
  ulong_t ifLastChange;  /* sysUpTime when state was entered */
  ulong_t ifInOctets;  /* octets received on interface */
  ulong_t ifInUcastPkts;  /* unicast packets delivered */
  ulong_t ifInNUcastPkts;  /* non-unicast packets delivered */
  ulong_t ifInDiscards;  /* good packets received but dropped */
  ulong_t ifInErrors;  /* packets received with errors */
  ulong_t ifInUnknownProtos;  /* packets recv'd to unbound proto */
  ulong_t ifOutOctets;  /* octets transmitted on interface */
  ulong_t ifOutUcastPkts;  /* unicast packets transmitted */
  ulong_t ifOutNUcastPkts;  /* non-unicast packets transmitted */
  ulong_t ifOutDiscards;  /* good outbound packets dropped */
  ulong_t ifOutErrors;  /* number of transmit errors */
  ulong_t ifOutQlen;  /* length of output queue */
  DL_etherstat_t ifSpecific;  /* ethernet specific stats */
} DL_mib_t;

The values in the MIB are compatible with those needed by the SNMP protocol.
The ifDescrLen field indicates the length of the null terminated description string that immediately follows the DL_mib_t structure.

There are three fields in the MIB that are specific to the e116 driver. The ifSpecific.etherDependent1 field tracks the number of times the transceiver failed to transmit a collision signal after transmission of a packet. The ifSpecific.etherDependent2 field contains the number of collisions that occurred after a slot time (out of window collisions). The
IfSpecific.etherDependent3 field tracks the number of times a transmit interrupt timeout condition occurred.

DLIOCSMIB
Allows a privileged process to initialize the values in the MIB (that is, the DL_mib_t structure). A process cannot use this ioctl to change the ifPhyAddress, the ifDescrLen, or the text of the description fields.

DLIOCGENADDR
Returns the Ethernet address in network order.

DLIOCGLPCFLG
Returns the state of the local packet copy flag in the ioc_rval of the iocblk structure. The local copy flag determines if packets looped back by the driver should also be sent to the network. A non-zero value indicates that frames should also be sent to the network after being looped back. The default value of this flag is zero.

DLIOSLPCFLG
Allows a privileged process to set the local packet copy flag, causing all packets looped back by the driver to be sent to the network as well.

DLIOCGPROMISC
Returns the value of the promiscuous flag in the ioc_rval of the iocblk structure. A non-zero value indicates that the Ethernet interface will receive all frames on the network. The default value of this flag is zero.

DLIOCSPROMISC
Allows a privileged process to toggle the current state of the promiscuous flag. When the flag is set, the driver captures all frames from the network. Processes that are bound to a promiscuous SAP, or to a SAP that matches the type field of the received frame, receive a copy of the frame.

DLIOCGETMULTI
Retries the current list of multicast addresses (if it exists).

DLIOCADDMULTI
Allows a privileged process to add a new multicast address and enable its reception. A 6-byte buffer pointing to the multicast address must be passed as the parameter.

DLIOCDELMULTI
Allows a privileged process to delete a multicast address by passing a 6-byte multicast address as the parameter.

Installation
You can select the interrupt vector, the base I/O address, and the base RAM address for the EtherLink 16 adaptor at package installation time. Consult the User’s Manual that came with your adaptor for more information.

You can also set these parameters in the /etc/conf/sdevice.d/el16 file.

In addition, zero-wait-state operation of memory can be enabled or disabled at installation time.
If there is one EtherLink 16 card in the system, it is configured automatically to the parameters specified at installation when the system is initialized. During initialization, the system determines the current base I/O address of the card, and then programs the card to its new configuration. If the system doesn’t find an EtherLink 16 card, it displays an error message.

Automatic configuration occurs only when one EtherLink 16 card is installed in the system. If more than one EtherLink 16 card needs to be present in the system, the cards are assumed to have been configured already (the cards may be configured using the configuration software that comes with the card).

**Configuration**

The `el16` driver has six configurable parameters in the `/etc/conf/pack.d/el16/space.c` file. Any changes to this file must be followed by a rebuild of the kernel and a reboot of the system for the changes to take effect.

The configurable parameters are:

**N_SAPS**

This defines the number of SAPs that can be bound at any one time. This value should be only slightly larger than anticipated SAP usage. A typical TCP/IP system would require two SAPs (0x800 and 0x806). A large value will degrade system performance and increase memory usage.

**CABLE_TYPE**

Defines the type of ethernet cable attached to the Ethernet controller card. A value of 0 specifies a thin Ethernet cable with a BNC connector. A value of 1 specifies a thick Ethernet cable with an AUI connector.

**STREAMS_LOG**

Defines whether the driver should log debugging messages to the STREAMS logger for the `strace(1M)` utility to display. The module ID used with `strace` is 2101. A value of 0 indicates that no STREAMS debug messages should be generated. A value of 1 causes messages to be generated. You can temporarily instruct the driver to log messages by changing the value of `el16strlog` (a 4-byte integer) to 1 using the kernel debugger.

STREAMS tracing should only be performed when debugging a network problem. It can cause a severe performance degradation if full `el16` STREAMS logging is performed.

**IFNAME**

This parameter is important only in a TCP/IP networking environment. It defines the string used in displaying network statistics. This string should match the logical interface name assigned in `/etc/confnet.d/inet/interface` file and with `ifconfig(1M)` commands used in `/etc/inet/rc.inet` configuration script.

**ZWS**

Enables or disables zero-wait-state operation of the memory. A value of 0 disables zero-wait-state operation while a value of 1 enables it.

**SAAD**

Enables or disables software address decode in the adapter. In machines which use the VTI chip set, this bit needs to be set.
The `el16` driver can return the following error codes:

- **ENXIO**: Invalid major number or board is not installed.
- **ECHRG**: No minor devices left if configured as a cloned device. Increase `N_SAP` value in `/etc/conf/pack.d/el16/space.c`. Invalid minor device number if configured as a non-cloned device.
- **EPERM**: An `ioctl` was made without the appropriate privilege.
- **EINVAL**: An `ioctl` was made that did not supply a required input and/or output buffer.
- **DL_NOTSUPPORTED**: Requested service primitive is not supported.
- **DL_BADPRIM**: Unknown service primitive was requested.
- **DL_OUTSTATE**: `DL_BIND_REQ` or `DL_UNBIND_REQ` was issued when the Stream was bound, or `DL_UNITDATA_REQ` was issued when the Stream was unbound.
- **DL_ACCESS**: An attempt was made to bind to `PROMISCUOUS_SAP` with insufficient privilege.
- **DL_BOUND**: The requested SAP is already bound. A privileged process may bind to an already bound SAP.
- **DL_NOTINIT**: A `DL_UNITDATA_REQ` was made on an Ethernet board that has gone offline due to an error.
- **DL_BADDATA**: `DL_UNITDATA_REQ` was made with a data size that was either larger than the SPDU maximum or smaller than the SPDU minimum.

**Files**

- `/dev/el16*`
- `/etc/conf/pack.d/el16/space.c`
- `/etc/conf/sdevice.d/el16`

**REFERENCES**

- `open(2)`, `getmsg(2)`, `ioctl(2)`, `putmsg(2)`
NAME
d – diskette (floppy disk)

DESCRIPTION
The diskette driver provides access to diskettes as both block and character devices. Diskettes must be formatted before their use [see \texttt{format(1M)}]. Both 5.25" and 3.50" diskette formats are supported. The driver controls up to two diskette drives. The minor device number specifies the drive number, the format of the diskette and the partition number.

Diskette device file names (which correspond to a specific major and minor device) use the following format:

\texttt{/dev/{r}dsk/f\{0,1\}\{5h,5d9,5d8,5d4,5d16,5q,3h,3d\}\{t,u\}}

where \texttt{r} indicates a raw (character) interface to the diskette, \texttt{dsk} selects the raw device interface and \texttt{dsk} selects the block device interface. \texttt{0} or \texttt{1} selects the drive to be accessed: \texttt{f0} selects floppy drive 0, while \texttt{f1} selects drive 1. The following list describes the format to be interacted with:

- \texttt{5h} 5.25" high density diskette (1.2MB).
- \texttt{5d9} 5.25" double density diskette, 9 sectors per track (360KB).
- \texttt{5d8} 5.25" double density diskette, 8 sectors per track (320KB).
- \texttt{5d4} 5.25" double density diskette, 4 sectors per track (320KB).
- \texttt{5d16} 5.25" double density diskette, 16 sectors per track (320KB).
- \texttt{5q} 5.25" quad density diskette (720KB).
- \texttt{3h} 3.50" high density diskette (1.44MB).
- \texttt{3d} 3.50" double density diskette (720KB).

Format specification is mandatory when opening the device for formatting. However, when accessing a floppy disk for other operations (read and write), the format specification field can be omitted. In this case, the floppy disk driver will automatically determine the format previously established on the diskette and then perform the requested operation (for example, \texttt{cpio -itv /dev/rsdk/f1}).

The last parameter, \texttt{t} or \texttt{u}, selects the partition to be accessed. \texttt{t} represents the whole diskette. Without \texttt{t} or \texttt{u} specified, the whole diskette except cylinder 0 will be selected. \texttt{u} represents the whole diskette except track 0 of cylinder 0 and applies only to the 5d8 type of floppy.

Besides the device file naming convention described above, some of the formats have alias names that correlate to previous releases. The following list describes the formats that have an alias:

<table>
<thead>
<tr>
<th>format</th>
<th>alias</th>
</tr>
</thead>
<tbody>
<tr>
<td>5h</td>
<td>q15d</td>
</tr>
<tr>
<td>5d8</td>
<td>d8d</td>
</tr>
<tr>
<td>5d9</td>
<td>d9d</td>
</tr>
</tbody>
</table>

For example, the device file \texttt{/dev/rds/f0q15dt} is equivalent to \texttt{/dev/rds/f05ht}.
In order to minimize errors when using diskettes, the driver attempts to assure that the diskette is installed when needed, and that the operations requested have been completed before the device close is completed. In particular, the drive is checked for the presence of a diskette each time a read/write request is made to the drive. If this is not true (either the diskette is not physically present or the door is open), the driver retries the request continually, at five-second intervals. The message:

**FD(n): diskette not present - please insert**

appears after each attempt (the n represents the drive number). The INTR and QUIT signals are honored in this case, so that the process accessing the diskette drive in question will receive these signals (unless, of course, the process itself is ignoring them). In particular, if the diskette is removed prematurely, or not inserted soon enough, *no data is lost*, provided the correct diskette is inserted in the drive when the message to do so is displayed.

### ioctl Calls

**V_GETPARMS**

This call is used to get information about the current drive configuration. The argument to the ioctl is the address of one of the following structures, defined in *sys/vtoc.h*, which will be filled in by the ioctl:

```c
struct disk_parms {
    char      dp_type;        /* Disk type (see below) */
    uchar     dp_heads;       /* Number of heads */
    ushort    dp_cyls;        /* Number of cylinders */
    uchar     dp_sectors;     /* Number of sectors/track */
    ushort    dp_secsiz;      /* Number of bytes/sector */
    /* for this partition: */
    ushort    dp_pstartsec;   /* Starting sector number */
    ushort    dp_pnumsec;     /* Number of sectors */
    /* Partition tag (not used) */
    /* Partition flag (not used) */
}
```

For the floppy driver, the disk type will always be DPT_FLOPPY. The unused fields in the disk_parms structure are only applicable to hard disks; however, returning the same structure from both the hard disk driver and the diskette driver allows programs to be written that can understand either one.

**V_FORMAT**

This call is used to format tracks on a diskette. The argument passed to the ioctl is the address of one of the following structures, defined in *sys/vtoc.h*, containing the starting track, number of tracks, and interleave factor:
union io_arg {
  struct {
    ushort start_trk; /* first track */
    ushort num_trks; /* number of tracks to format */
    ushort intlv; /* interleave factor */
  } ia_fmt;
}

Formatting will start at the given track and will continue so that the given number of tracks are formatted, using the given interleave factor.

Note that the file descriptor must refer to the character (raw) special device for the desired drive, and the file must have been opened in exclusive mode (that is, O_EXCL).

Files
/dev/dsk/f0, /dev/rdsk/f0, ...
/dev/dsk/f0t, /dev/rdsk/f0t, ...
/dev/dsk/f05h, /dev/rdsk/f05h, ...
/dev/dsk/f05ht, /dev/rdsk/f05ht, ...
/dev/dsk/f05d9, /dev/rdsk/f05d9, ...
/dev/dsk/f05d9t, /dev/rdsk/f05d9t, ...
/dev/dsk/f0fd8, /dev/rdsk/f0fd8, ...
/dev/dsk/f05d8t, /dev/rdsk/f05d8t, ...
/dev/dsk/f05d4, /dev/rdsk/f05d4, ...
/dev/dsk/f05d4t, /dev/rdsk/f05d4t, ...
/dev/dsk/f05d16, /dev/rdsk/f05d16, ...
/dev/dsk/f05d16t, /dev/rdsk/f05d16t, ...
/dev/dsk/f05q, /dev/rdsk/f05q, ...
/dev/dsk/f05qt, /dev/rdsk/f05qt, ...
/dev/dsk/f03h, /dev/rdsk/f03h, ...
/dev/dsk/f03ht, /dev/rdsk/f03ht, ...
/dev/dsk/f03d, /dev/rdsk/f03d, ...
/dev/dsk/f03dt, /dev/rdsk/f03dt, ...

Errors
The driver will retry failed transfers up to ten times. If the request still has not succeeded, the driver will display an appropriate message. Errors from the diskette controller, other than the above, are displayed as follows:

FD drv n, blk b: drive error message
FD controller controller error message

The first message occurs on an error after a transfer has begun, where n is the drive where the error occurred, and b is the block number that is being read or written. The drive error message is one of the messages appearing in the following list:

Missing data address mark
The diskette may not be formatted properly.
Cylinder marked bad
The accessed cylinder has been marked bad by the formatter.

Seek error (wrong cylinder)
The drive positioned itself at the wrong cylinder when attempting to set up for the requested transfer.

Uncorrectable data read error
A CRC error was detected when attempting to read the requested block from the drive.

Sector marked bad
The accessed sector has been marked bad by the formatter.

Missing header address mark
The diskette may not be formatted properly.

Write protected
A write was attempted to a diskette that is currently write-protected.

Sector not found
The diskette may not be formatted properly.

Data overrun
The system could not keep up with the requested transfer of data. (Should not occur.)

Header read error
The diskette may not be formatted properly.

Illegal sector specified
The driver is confused about the format of the diskette that has been inserted. (Should not occur.)

The second message occurs when there is a controller error during the setup for, or actual transfer of, a block. The controller error message is one of the messages appearing in the following list:

command timeout
The controller failed to complete the requested command in a reasonable length of time.

status timeout
The controller failed to return its status after a command was completed.

busy
During an attempt to access the controller, a timeout occurred.

REFERENCES
format(1M), ioctl(2)
NAME
filesystem – file system organization

SYNOPSIS
/
/usr

DESCRIPTION
The System V file system tree is organized for administrative convenience. Distinct areas within the file system tree are provided for files that are private to one machine, files that can be shared by multiple machines of a common architecture, files that can be shared by all machines, and home directories. This organization allows sharable files to be stored on one machine but accessed by many machines using a remote file access mechanism such as RFS or NFS. Grouping together similar files makes the file system tree easier to upgrade and manage.

The file system tree consists of a root file system and a collection of mountable file systems. The mount(1M) program attaches mountable file systems to the file system tree at mount points (directory entries) in the root file system or other previously mounted file systems. / If /f4/usr is configured as a separate file system, it must be mounted in order to have a completely functional system. The root file system is mounted automatically by the kernel at boot time.

The root file system contains files that are unique to each machine. It contains the following directories:
/dev
Character and block special files. These device files provide hooks into hardware devices or operating system facilities. Typically, device files are built to match the kernel and hardware configuration of the machine.
/dev/term
Terminal devices.
/dev/pts
Pseudo-terminal devices.
/dev/sxt
Shell layers device files used by shl.
/etc
Machine-specific administrative configuration files and system administration databases. /etc may be viewed as the home directory of a machine, the directory that in a sense defines the machine’s identity. Executable programs are no longer kept in /etc.
/home
Root of a subtree for user directories.
/mnt
Temporary mount point for file systems. This is an empty directory on which file systems may be temporarily mounted.
/opt
Root of a subtree for add-on application packages.
/proc
Root of a subtree for the process file system.
/sbin
Essential executables used in the booting process and in manual system recovery. The full complement of utilities is available only after /usr is mounted,
filesystem (7)

/tmp
Temporary files; initialized to empty during the boot operation.

/var
Root of a subtree for varying files. Varying files are files that are unique to a machine but that can grow to an arbitrary (that is, variable) size. An example is a log file.

/var/adm
System logging and accounting files.

/var/cron
cron’s log file.

/var/mail
Where users’ mail is kept.

/var/opt
Top-level directory used by application packages.

/var/preserve
Backup files for vi(1) and ex(1).

/var/spool
Subdirectories for files used in printer spooling, mail delivery, cron(1M), at(1), etc.

/var/tmp
Transitory files; initialized to empty during the boot operation.

Because it is desirable to keep the root file system small and not volatile, on disk-based systems larger file systems are often mounted on /home, /opt, /usr, and /var.

The file system mounted on /usr contains architecture-dependent and architecture-independent sharable files. The subtree rooted at /usr/share contains architecture-independent sharable files; the rest of the /usr tree contains architecture-dependent files. By mounting a common remote file system, a group of machines with a common architecture may share a single /usr file system. A single /usr/share file system can be shared by machines of any architecture. A machine acting as a file server may export many different /usr file systems to support several different architectures and operating system releases. Clients usually mount /usr read-only so that they don’t accidentally change any shared files. The /usr file system contains the following subdirectories:

/usr/bin
Most system utilities.

/usr/sbin
Executables for system administration.

/usr/games
Game binaries and data.

/usr/include
Include header files (for C programs, etc).

/usr/lib
Program libraries, various architecture-dependent databases, and executables not invoked directly by the user (system daemons, etc).

/usr/share
Subtree for architecture-independent sharable files.

/usr/share/man
Subdirectories for on-line reference manual pages (if present).

/usr/share/lib
Architecture-independent databases.

/usr/src
Source code for utilities and libraries.

/usr/ucb
Berkeley compatibility package binaries.
A machine with disks may export root file systems, swap files, and /usr file systems to diskless or partially-disked machines that mount them into the standard file system hierarchy. The standard directory tree for sharing these file systems from a server is:

- `/export` The default root of the exported file system tree.
- `/export/exec/architecture-name` The exported /usr file system supporting `architecture-name` for the current release.
- `/export/exec/architecture-name.release-name` The exported /usr file system supporting `architecture-name` for System V `release-name`.
- `/export/exec/share` The exported common /usr/share directory tree.
- `/export/exec/share.release-name` The exported common /usr/share directory tree for System V `release-name`.
- `/export/root/hostname` The exported root file system for `hostname`.
- `/export/swap/hostname` The exported swap file for `hostname`.
- `/export/var/hostname` The exported /var directory tree for `hostname`.

SEE ALSO
- `at(1)`, `fsck(1M)`, `init(1M)`, `mknod(1M)`, `mount(1M)`, `sh(1)`, `vi(1)`
NAME
i596 – i596 Ethernet Driver

SYNOPSIS
#include <sys/dlpi.h>
#include <sys/dlpi_ether.h>
#include <sys/i596.h>

fd = open("/dev/i596_0", O_RDWR)

DESCRIPTION
The i596 driver provides a data link interface to the 82596 high-performance 32-bit
LAN coprocessor in the LP486/33E system. In this system, the 82596CA resides on
the host bus, sharing address, data, and control lines with the i486 processor. This
driver is a STREAMS-based driver that is compatible with the Data Link Provider
Interface (DLPI) and Logical Link Interface (LLI) software interfaces.

It supports DL_ETHER as MAC type, DL_CL_ETHER for service mode, and
DL_STYLE1 for provider style. The i596 driver can operate as a cloned or non-
cloned device.

A process must issue a DL_BIND_REQ primitive to receive frames from the network.
The process must specify the dl_sap field of the dl_bind_req_t structure. The type
field of an incoming frame is compared to the dl_sap value. If the values are equal,
it is placed on the STREAMS read queue of the process. A privileged process may
set the dl_sap field to PROMISCUOUS_SAP. The PROMISCUOUS_SAP matches all incom­
ing frames.

A privileged process may also bind to a SAP already bound by another process. In
cases where a frame qualifies to be sent to more than one process, independent
copies of the frame are created and placed on the STREAMS read queue of each
process.

Received frames are delivered in dl_unitdata_ind_t structures. The source and
destination address each contain a 6-byte Ethernet address followed by a 2-byte
type value.

USAGE
ioctl Calls
The following ioctls are supported:

DLIOCGMIB
Returns the DL_mib_t structure, which contains the Management Information
Base (MIB). The MIB holds the Ethernet statistics that are kept in the
driver.

/*
 * Ether statistics structure.
 */
typedef struct {
    int etherAlignErrors;  /* Frame alignment errors */
    int etherCRCerrors;    /* CRC errors */
    int etherMissedPkts;   /* Packet overflow or missed inter */
    int etherOverrunErrors; /* Overrun errors */
    int etherUnderrunErrors; /* Underrun errors */
}
The values in the MIB are compatible with those needed by the SNMP protocol.

The ifDescrLen field indicates the length of the null terminated description string that immediately follows the DL_mib_t structure.

There are three fields in the MIB that are specific to the i596 driver: The ifSpecific.etherDependent1 field tracks the number of times the transceiver failed to transmit a collision signal after transmission of a packet. The ifSpecific.etherDependent2 field contains the number of collisions that
occurred after a slot time (out of window collisions). The ifSpecific.etherDependent3 field tracks the number of times a transmit interrupt timeout condition occurred.

DLIOCSMIG
Allows a privileged process to initialize the values in the MIB (that is, the DL_mib_t structure). A process cannot use this ioctl to change the ifPhyAddress, the ifDescrLen, or the text of the description fields.

DLIOCGENADDR
Returns the Ethernet address in network order.

DLIOCGLPCFLG
Returns the state of the local packet copy flag in the ioc_real of the iocblk structure. The local copy flag determines whether packets looped back by the driver should also be sent to the network. A non-zero value indicates that frames should also be sent to the network after being looped back. The default value of this flag is zero.

DLIOCSSLPCFLG
Allows a privileged process to set the local packet copy flag, causing all packets looped back by the driver to be sent to the network as well.

DLIOCSPROMISC
Allows a privileged process to toggle the current state of the promiscuous flag. When the flag is set, the driver captures all frames from the network. Processes that are bound to a promiscuous SAP, or to a SAP that matches the type field of the received frame, receive a copy of the frame.

Installation
You select the interrupt level for the i596 at package installation time. The following interrupts are valid: 9, 10, 11, or 15.

This interrupt should match the "LAN IRQ Level" value configured by the EISA Configuration Utility (ECU). In addition, the "Onboard LAN" must be enabled and the "LAN Media Type" set to either AUI or Twisted Pair, whichever is appropriate.

You can also set the interrupt level in the /etc/conf/sdevice.d/i596 file.

Configuration
The i596 driver has three configurable parameters in the /etc/conf/pack.d/i596/space.c file. Any changes to this file must be followed by a rebuild of the kernel and a reboot of the system for the changes to take effect.

The configurable parameters are:

N_SAPS
Defines the number of SAPs that can be bound at any one time. This value should be only slightly larger than anticipated SAP usage. A typical TCP/IP system would require two SAPs (0x800 and 0x806). A large value will degrade performance and increase memory usage.
STREAMS_LOG
Defines whether the driver should log debugging messages to the
STREAMS logger for the strace(1M) utility to display. The module ID
used with strace is 2101. A value of 0 indicates that STREAMS debug
messages should not be generated. A value of 1 enables STREAMS debug
messages. You can make the driver temporarily log messages by changing
the value of i596strlog (a 4-byte integer) to 1 using the kernel debugger.
STREAMS tracing should only be performed when debugging a network
problem. It can cause a severe performance degradation if you use full i596
STREAMS logging.

IPNAME
This parameter is important only in a TCP/IP networking environment. It
defines the string used in displaying network statistics. This string should
match the logical interface name assigned in /etc/inet/strcf file and
with ifconfig(1M) commands used in /etc/inet/rc.inet configuration
script.

Errors
The i596 driver can return the following error codes:
ENXIO Invalid major number or board is not installed.
ECHRNG No minor devices left if configured as a cloned device. Increase N_SAP value
in /etc/conf/pack.d/i596/space.c Invalid minor device number if
configured as a non-cloned device.
EPERM An ioctl was issued without the appropriate privilege.
EINVAL An ioctl was issued that did not supply a required input and/or output
buffer.
DL_NOTSUPPORTED The requested service primitive is not supported.
DL_BADPRIM An unknown service primitive was requested.
DL_OUTSTATE DL_BIND_REQ was issued when the Stream was bound, or DL_UNBIND_REQ
or DL_UNITDATA_REQ was issued when the Stream was unbound.
DL_ACCESS An attempt was made to bind to PROMISCUOUS_SAP with insufficient
privilege.
DL_BOUND The requested SAP is already bound. A privileged process may bind to an
already bound SAP.
DL_NOTINIT DL_UNITDATA_REQ was issued on an Ethernet board that has gone offline
due to an error.
DL_BADDATA

DL_UNITDATA_REQ was issued with a data size that was either larger than the SPDU maximum or smaller than the SPDU minimum.

Files
/dev/i596_0
/etc/conf/pack.d/i596/space.c
/etc/conf/sdevice.d/i596

REFERENCES
open(2), getmsg(2), ioctl(2), putmsg(2)
NAME
ibmtok – IBM Token Ring Driver

SYNOPSIS
#include <sys/dlpi.h>
#include <sys/ibmtokhw.h>
#include <sys/ibmtok.h>

fd = open("/dev/ibmtok_0", O_RDWR)

DESCRIPTION
The ibmtok driver provides a data link interface to both the 16/4 and the 16/4A
token ring adapters from IBM. It is a STREAMS-based driver that is compatible
with the Data Link Provider Interface (DLPI) and Logical Link Interface (LLI)
software interfaces.

The ibmtok driver can operate as a cloned or non-cloned device.

A process must issue a DL BIND REQ primitive to receive frames from the net­
work. The process must specify the dl_sap field of the dl_bind_req struct.
The type field of an incoming frame is compared to the dl_sap value. If the values
are equal, it is placed on the STREAMS read queue of the process.

Received frames are delivered in dl_unitdata_ind_t structures. The source and
destination address each contain a 6-byte Ethernet address, followed by the 1- or 2-
byte type value.

Any user process that has a Stream bound (using a DL_BIND_REQ) to the token ring
driver should explicitly unbind (using DL_UNBIND_REQ) before closing the Stream.
Any destructive close (closing without unbind) will render the SAP useless until the
board can be closed and opened again.

USAGE
You can select the interrupt level, base I/O address, ROM address and the shared
RAM address for the token ring card at package installation time. While interrupts
2, 3, 6, and 7 are valid for the AT version of the card, 2, 3, 10, and 12 should be used
for the MCA version of the card. The shared RAM is a movable section of memory
and can be 8K, 16K, 32K or 64K. The starting address of the shared RAM is a func­
tion of the size and should fall on appropriate boundaries. For example, the start­
ing address of a 16K RAM should only be on 16K boundaries. Similarly, you can
also choose the starting address of an 8K ROM. The ROM contains adapter
configuration information and is also used to control the adapter.

The base I/O address of the card can be one of the following addresses:
0xA20  0xA23
0xA24  0xA27

You can also set these parameters in the /etc/conf/sdevice.d/ibmtok file.

Configuration
The ibmtok driver has four configurable parameters in the
/etc/conf/pack.d/ibmtok/space.c file. Any changes to this file must be
ibmtok(7)

followed by a rebuild of the kernel and a reboot of the system for the changes to take effect.

The configurable parameters are:

Tok_nbr_rcv_buffers
Defines the number of receive buffers that are minimally required. The receive buffers are allocated in the shared RAM. Though the default value is 20, the adapter can and will allocate all unused memory to the receive buffers.

tok_rcv_buff_size
Defines the size of the receive buffers. The default value is 264.

tok_tx_buff_size
The size of the transmit buffer. The default value is 2048 bytes.

tok_nbr_tx_buffers
The number of transmit buffers. The default value is 1.

ioctl Calls
The following ioctls are supported:

DLGDEVSTAT
Returns the tokstat structure, which contains the information about the number of packets and bytes transmitted and received for that particular SAP.

/*
 * Per sap statistics structure.
 */
typedef struct {
    ulong toks_xpkts;  /*The number of packets transmitted */
    ulong toks_xbytes; /*The number of bytes transmitted */
    ulong toks_rpkm;  /*The number of packets received */
    ulong toks_rbytes; /*The number of bytes received */
} tokdevstat;

DLGADDR
Returns the Ethernet address in network order.

Error Codes
The ibmtok driver can return the following error codes:

ENXIO Invalid major number, board not installed, or a non-functional board.

ECHRNG
No minor devices left, if configured as a cloned device.

EINTR Signal terminating a process sleeping on an event.

EINVAL
An ioctl was issued that did not supply a required input and/or output buffer.
ibmtok (7)

**DL_NOT_SUPPORTED**
Requested service primitive is not supported.

**DL_BADPRIM**
Unknown service primitive was requested.

**DL_OUTSTATE**
- **DL_BIND_REQ** was issued when the stream was bound, or **DL_UNBIND_REQ** or **DL_UNITDATA_REQ** was issued when the stream was unbound.

**DL_BOUND**
The requested SAP is already bound.

**DL_NOTINIT**
A service primitive was issued to a token ring board that has gone offline due to an error.

**DL_BADDATA**
- **DL_UNITDATA_REQ** was issued with a data size that was either larger than the SPDU maximum or smaller than the SPDU minimum.

**Files**
/dev/ibmtok*
/etc/conf/pack.d/ibmtok/space.c
/etc/conf/sdevice.d/ibmtok

**REFERENCES**
getmsg(2), ioctl(2), open(2), putmsg(2)
ICMP(7)

NAME
ICMP – Internet Control Message Protocol

SYNOPSIS
#include <sys/socket.h>
#include <netinet/in.h>
#include <netinet/ip_icmp.h>

s = socket(AF_INET, SOCK_RAW, proto);
t = t_open("/dev/icmp", O_RDWR);

DESCRIPTION
ICMP is the error and control message protocol used by the Internet protocol family. It is used by the kernel to handle and report errors in protocol processing. It may also be accessed by programs using the socket interface or the Transport Level Interface (TLI) for network monitoring and diagnostic functions. When used with the socket interface, a raw socket type is used. The protocol number for ICMP, used in the proto parameter to the socket call, can be obtained from getprotobyname() [see getprotoent(3N)]. ICMP file descriptors and sockets are connectionless, and are normally used with the t_sndudata / t_rcvudata and the sendto() / recvfrom() calls [see send(3N) and recv(3N)].

Outgoing packets automatically have an Internet Protocol (IP) header prepended to them. Incoming packets are provided to the user with the IP header and options intact.

ICMP is a datagram protocol layered above IP. It is used internally by the protocol code for various purposes including routing, fault isolation, and congestion control. Receipt of an ICMP redirect message will add a new entry in the routing table, or modify an existing one. ICMP messages are routinely sent by the protocol code. Received ICMP messages may be reflected back to users of higher-level protocols such as TCP or UDP as error returns from system calls. A copy of all ICMP message received by the system is provided to every holder of an open ICMP socket or TLI descriptor.

SEE ALSO
getprotoent(3N), inet(7), ip(7), recv(3N), routing(4), send(3N), t_rcvudata(3N), t_sndudata(3N)


DIAGNOSTICS
A socket operation may fail with one of the following errors returned:

EISCONN An attempt was made to establish a connection on a socket which already has one, or when trying to send a datagram with the destination address specified and the socket is already connected.

ENOTCONN An attempt was made to send a datagram, but no destination address is specified, and the socket has not been connected.
ENOBUFFS  The system ran out of memory for an internal data structure.
EADDRNOTAVAIL  An attempt was made to create a socket with a network address for which no network interface exists.

NOTES
Replies to ICMP echo messages which are source routed are not sent back using inverted source routes, but rather go back through the normal routing mechanisms.
NAME
ie6 - 3C503 3Com Ethernet Driver

SYNOPSIS
#include <sys/dlpi.h>
#include <sys/dlpi_ether.h>
#include <sys/ie6.h>

fd = open("/dev/ie6_0", O_RDWR)

DESCRIPTION
The ie6 driver provides a data link interface to the 3C503 Ethernet controller from
3Com. It is a STREAMS-based driver, compatible with the Data Link Provider
Interface (DLPI) and Logical Link Interface (LLI) software interfaces.

The ie6 driver supports both DL_ETHER and DL_CSMACD for MAC type,
DL_CL_ETHER for service mode, and DL_STYLE1 for provider style. The driver can
operate as a cloned or non-cloned device.

A process must issue a DL_BIND_REQ primitive to receive frames from the network.
This primitive includes a dl_bind_req_t structure.

The process must specify the dl sap field of the dl_bind_req_t structure in host
order. The type field of an incoming frame is converted to host order and com­
pared to the dl sap value. If the values are equal, the frame is placed on the
STREAMS read queue of the requesting process. A privileged process may set the
dl sap field to PROMISCUOUS_SAP. The PROMISCUOUS_SAP matches all incoming
frames.

A privileged process may bind to an SAP already bound by another process. In
cases where a frame qualifies to be sent to more than one process, independent
copies of the frame are made and placed on the STREAMS read queue of each pro­
cess.

Received frames are delivered in dl_unitdata_ind_t structures. The source and
destination address each contain a 6-byte Ethernet address, followed by the 2-byte
type value, written in network order.

USAGE
ioctl Calls
The following ioctls are supported:

DLIOCGMIB
Returns the DL_mib_t structure, which contains the Management Information
Base (MIB). The MIB holds the Ethernet statistics kept in the driver.

/*
 * Ether statistics structure.
 */
typedef struct {
    ulong_tetherAlignErrors; /* Frame alignment errors */
    ulong_tetherCRCerrors;   /* CRC errors */
    ulong_tetherMissedPkts;  /* Packet overflow or missed inter */
    ulong_tetherOverrunErrors; /* Overrun errors */
    ulong_tetherUnderrunErrors; /* Underrun errors */
    ulong_tetherCollisions; /* Total collisions */
}
ulong_t etherAbortErrors;  /* Transmits aborted at interface */
ulong_tetherCarrierLost;  /* Carrier sense signal lost */
ulong_tetherReadqFull;   /* STREAMS read queue full */
ulong_tetherRcvrResources; /* Receive resource alloc failure */
ulong_tetherDependent1;  /* Device dependent statistic */
ulong_tetherDependent2;  /* Device dependent statistic */
ulong_tetherDependent3;  /* Device dependent statistic */
ulong_tetherDependent4;  /* Device dependent statistic */
ulong_tetherDependent5;  /* Device dependent statistic */

typedef struct {
    int ifIndex;            /* 1 through ifNumber */
    int ifDescrLen;         /* len of desc. following this struct */
    int ifType;             /* type of interface */
    int ifMtu;              /* datagram size that can be sent/rcv */
    ulong_tifSpeed;         /* estimate of bandwidth in bits PS */
    uchar_tifPhyAddress[DL_MAC_ADDR_LEN]; /* Ethernet Address */
    int ifAdminStatus;      /* desired state of the interface */
    int ifOperStatus;       /* current state of the interface */
    ulong_tifLastChange;   /* sysUpTime when state was entered */
    ulong_tifInOctets;      /* octets received on interface */
    ulong_tifInUcastPkts;   /* unicast packets delivered */
    ulong_tifInNcastPkts;   /* non-unicast packets delivered */
    ulong_tifInDiscards;    /* good packets received but dropped */
    ulong_tifInErrors;      /* packets received with errors */
    ulong_tifInUnknownProtos; /* packets recv'd to unbound proto */
    ulong_tifOutOctets;     /* octets transmitted on interface */
    ulong_tifOutUcastPkts;  /* unicast packets transmitted */
    ulong_tifOutNcastPkts;  /* non-unicast packets transmitted */
    ulong_tifOutDiscards;   /* good outbound packets dropped */
    ulong_tifOutErrors;     /* number of transmit errors */
    ulong_tifOutQlen;       /* length of output queue */
} DL_etherstat_t ifSpecific; /* Ethernet specific stats */

} DL_mib_t;

The values in the MIB are compatible with those needed by the SNMP protocol.
The ifDescrLen field indicates the length of the null-terminated description string that immediately follows the DL_mib_t structure.
There are three fields in the MIB that are specific to the ie6 driver: The `ifSpecific.etherDependent1` field tracks the number of times the transceiver failed to transmit a collision signal after transmission of a packet. The `ifSpecific.etherDependent2` field tracks the number of collisions that occurred after a slot time (out-of-window collisions). The `ifSpecific.etherDependent3` field tracks the number of times a transmit interrupt timeout condition occurred.

**DLIOCSMIG**
Allows a privileged process to initialize the values in the MIB (that is, the `DL_mib_t` structure). A process cannot use this `ioctl` to change the `ifPhyAddress`, the `ifDescrLen`, or the text of the description fields.

**DLIOCGENADDR**
Returns the Ethernet address in network order.

**DLIOCGLPCFLG**
Returns the state of the local packet copy flag in the `iocバル` field of the `iocblk` structure. The local copy flag determines if packets looped back by the driver should also be sent to the network. A non-zero value indicates that frames should also be sent to the network after being looped back. The default value of this flag is zero.

**DLIOCSLPCFLG**
Allows a privileged process to set the local packet copy flag, causing all packets looped back by the driver to also be sent to the network.

**DLIOCSPROMISC**
Returns the value of the promiscuous flag in the `iocバル` of the `iocblk` structure. A non-zero value indicates that the Ethernet interface will receive all frames on the network. The default value of this flag is zero.

**DLIOCSPROMISC**
Allows a privileged process to toggle the current state of the promiscuous flag. When the flag is non-zero, the driver captures all frames from the network. Processes that are bound to the promiscuous SAP, or to an SAP that matches the type field of the received frame, receive a copy of the frame.

**DLIOCGETMULTI**
Returns the current list of multicast addresses (if it exists).

**DLIOCADDMULTI**
Allows a privileged process to add a new multicast address and enable its reception. A 6-byte buffer pointing to the multicast address must be passed as the parameter.

**DLIOCDELMULTI**
Allows a privileged process to delete a multicast address by passing a 6-byte multicast address as the parameter.

**Configuration**
The `ie6` driver has four configurable parameters in the `/etc/conf/pack.d/ie6/space.c` file. If you change this file, you must rebuild the kernel and reboot the system for the changes to take effect.
The configurable parameters are:

**N_SAPS**
Defines the number of SAPs that can be bound at any one time. This value should be only slightly larger than anticipated SAP usage. A typical TCP/IP system requires two SAPs (0x800 and 0x806). If you assign too large a value to this parameter, system performance and memory usage may suffer.

**CABLE_TYPE**
Defines the type of Ethernet cable attached to the Ethernet controller card. A value of 0 specifies thin Ethernet cable with a BNC connector. A value of 1 specifies thick Ethernet cable with a AUI connector.

**STREAMS_LOG**
Defines whether the driver should log debugging messages to the STREAMS logger for the strace(1M) utility to display. The module ID used with strace is 2101. A value of 0 indicates that no STREAMS debug messages should be generated. A value of 1 enables STREAMS debug messages to be generated. You can also direct the driver to log messages temporarily by using the kernel debugger to change the value of ie6strlog (a 4-byte integer) to 1.

Use STREAMS tracing only when debugging a network problem, because system performance suffers when full ie6 STREAMS logging is in progress.

**IFNAME**
This parameter is important only in a TCP/IP networking environment. It defines the string used in displaying network statistics. This string should match the logical interface name assigned in the /etc/confnet.d/inet/interfaces file and with ifconfig(1M) commands used in the /etc/inet/rc.inet configuration script.

**Errors**
The ie6 driver can return the following error codes:

- **ENXIO** Invalid major number or board is not installed.
- **ECHRNG** No minor devices left if configured as a cloned device. Increase N_SAP value in /etc/conf/pack.d/ie6/space.c Invalid minor device number if configured as a non-cloned device.
- **EPERM** An ioctl was made without the appropriate privilege.
- **EINVAL** An ioctl was made that did not supply a required input and/or output buffer.
- **DL_NOTSUPPORTED** Requested service primitive is not supported.
- **DL_BADPRIM** Unknown service primitive was requested.
DL_OUTSTATE
   DL_BIND_REQ was issued when the Stream was bound, or DL_UNBIND_REQ
   or DL_UNITDATA_REQ were issued when the Stream was unbound.

DL_ACCESS
   An attempt was made to bind to PROMISCUOUS_SAP with insufficient
   privilege.

DL_BOUND
   The requested SAP is already bound. A privileged process may bind to an
   already bound SAP.

DL_NOTINIT
   DL_UNITDATA_REQ was issued on an Ethernet board that has gone offline
   due to an error.

DL_BADDATA
   DL_UNITDATA_REQ was issued with a data size that was either larger than
   the SPDU maximum or smaller than the SPDU minimum.

Files
   /dev/ie6_*
   /etc/conf/pack.d/ie6/space.c

REFERENCES
   getmsg(2), ifconfig(1M), ioctl(2), open(2), putmsg(2), strace(1M)
if(7)

NAME

if – general properties of Internet Protocol network interfaces

DESCRIPTION

A network interface is a device for sending and receiving packets on a network. A network interface is usually a hardware device, although certain interfaces such as the loopback interface, lo(7), are implemented in software. Network interfaces used by the Internet Protocol (IP) must be STREAMS devices conforming to the Datalink Provider Interface (DLPI).

An interface becomes available to IP when it is linked below the IP STREAMS device with the I_LINK ioctl() call. This may be initiated by the kernel at boot time or by a user program some time after the system is running. Each IP interface must have a name assigned to it with the SIOCSIFNAME ioctl(). This name is used as a unique handle on the interface by all of the other network interface ioctl() calls. Each interface must be assigned an IP address with the SIOCSIFADDR ioctl() before it can be used. On interfaces where the network-to-link layer address mapping is static, only the network number is taken from the ioctl() request; the remainder is found in a hardware specific manner. On interfaces which provide dynamic network-to-link layer address mapping facilities [for example, 10Mb/s Ethernets using arp(7)], the entire address specified in the ioctl() is used. A routing table entry for destinations on the network of the interface is installed automatically when an interface’s address is set.

IOCTLS

The following ioctl() calls may be used to manipulate IP network interfaces. Unless specified otherwise, the request takes an ifreq structure as its parameter. This structure has the form:

/* Interface request structure used for socket ioctl’s. All */
/* interface ioctl’s must have parameter definitions which */
/* begin with ifr_name. The remainder may be interface specific. */

struct ifreq {
    #define IFNAMSIZ 16
    char ifr_name[IFNAMSIZ];  /* if name, for example "emd1" */

    union {
        struct sockaddr ifru_addr;
        struct sockaddr ifru_dstaddr;
        char ifru_oname[IFNAMSIZ]; /* other if name */
        struct sockaddr ifru_broadaddr;
        short ifru_flags;
        int ifru_metric;
        char ifru_data[1];  /* interface dependent data */
        char ifru_enaddr[6]; /* ethernet address */
    } ifr_ifru;

    #define ifr_addr ifr_ifru.ifru_addr /* address */
    #define ifr_dstaddr ifr_ifru.ifru_dstaddr /* other end of p-to-p link */
    #define ifr_oname ifr_ifru.ifru_oname /* other if name */
    #define ifr_broadaddr ifr_ifru.ifru_broadaddr /* broadcast address */
    #define ifr_flags ifr_ifru.ifru_flags /* flags */
    #define ifr_metric ifr_ifru.ifru_metric /* metric */
    #define ifr_data ifr_ifru.ifru_data /* for use by interface */
    #define ifr_enaddr ifr_ifru.ifru_enaddr /* ethernet address */
};
SIOCSIFADDR
Set interface address. Following the address assignment, the initialization routine for the interface is called.

SIOCGIFADDR
Get interface address.

SIOCSIFDSTADDR
Set point to point address for interface.

SIOCGIFDSTADDR
Get point to point address for interface.

SIOCSIFFLAGS
Set interface flags field. If the interface is marked down, any processes currently routing packets through the interface are notified. The interface can be marked up or down by using ifconfig(1M).

SIOCGIFFLAGS
Get interface flags.

SIOCGIFCONF
Get interface configuration list. This request takes an ifconf structure (see below) as a value-result parameter. The ifc_len field should be initially set to the size of the buffer pointed to by ifc_buf. On return it will contain the length, in bytes, of the configuration list.

The ifconf structure has the form:

```c
/*
 * Structure used in SIOCGIFCONF request.
 * Used to retrieve interface configuration
 * for machine (useful for programs which
 * must know all networks accessible).
 */
struct ifconf {
  int ifc_len; /* size of associated buffer */
  union {
    caddr_t ifcu_buf;
    struct ifreq *ifcu_req;
  } ifc_ifcu;
#define ifc_buf ifc_ifcu.ifcu_buf /* buffer address */
#define ifc_req ifc_ifcu.ifcu_req /* array of structures returned */
};
```

SIOCSIFNAME
Set the name of the interface.

SEE ALSO
arp(7), ip(7), ifconfig(1M), lo(7)
NAME
imx586 – IMXLAN586 Intel Ethernet Driver

SYNOPSIS
#include <sys/dlpi.h>
#include <sys/dlpi_ether.h>
#include <sys/imx586.h>

fd = open ("/dev/imx586_0", O_RDWR)

DESCRIPTION
The imx586 driver provides a data link interface to the iMX-LAN/586 Ethernet controller from Intel. It is a STREAMS-based driver, compatible with the Data Link Provider Interface (DLPI) and Logical Link Interface (LLI) software interfaces.

The imx586 driver supports both DL_ETHER and DL_CSMACD for MAC type, DL_CL_ETHER for service mode, and DL_STYLE1 for provider style. The driver can operate as a cloned or non-cloned device.

A process must issue a DL_BIND_REQ primitive to receive frames from the network. This primitive includes a dl_bind_req_t structure.

The process must specify the dl_sap field of the dl_bind_req_t structure in host order. The type field of an incoming frame is converted to host order and compared to the dl_sap value. If the values are equal, the frame is placed on the STREAMS read queue of the requesting process. A privileged process may set the dl_sap field to PROMISCUOUS_SAP. The PROMISCUOUS_SAP matches all incoming frames.

A privileged process may bind to an SAP already bound by another process. In cases where a frame qualifies to be sent to more than one process, independent copies of the frame are made and placed on the STREAMS read queue of each process.

Received frames are delivered in dl_unitdata_ind_t structures. The source and destination address each contain a 6-byte Ethernet address, followed by a 2-byte type value, written in network order.

USAGE
ioctl Calls
The following ioctls are supported:

DLIOCGMIB
Returns the DL_mib_t structure, which contains the Management Information Base (MIB). The MIB holds the Ethernet statistics kept in the driver.

typedef struct {
    ulong_tetherAlignErrors; /* Frame alignment errors */
    ulong_tetherCRCerrors; /* CRC errors */
    ulong_tetherMissedPkts; /* Packet overflow or missed inter */
    ulong_tetherOverrunErrors; /* Overrun errors */
    ulong_tetherUnderrunErrors; /* Underrun errors */
    ulong_tetherCollisions; /* Total collisions */
}
The values in the MIB are compatible with those needed by the SNMP protocol.

The ifDescrLen field indicates the length of the null-terminated description string that immediately follows the DL_mib_t structure.
There are three fields in the MIB that are specific to the imx586 driver: The ifSpecific.etherDependent1 field tracks the number of times the transceiver failed to transmit a collision signal after transmission of a packet. The ifSpecific.etherDependent2 field tracks the number of collisions that occurred after a slot time (out-of-window collisions). The ifSpecific.etherDependent3 field tracks the number of times a transmit interrupt timeout condition occurred.

**DLIOCSMIG**
Allows a privileged process to initialize the values in the MIB (that is, the DL_mib_t structure). A process cannot use this ioctl to change the ifPhyAddress, the ifDescrLen, or the text of the description fields.

**DLIOCGENADDR**
Returns the Ethernet address in network order.

**DLIOCGLPCFLG**
Returns the state of the local packet copy flag in the ioc rval field of the iocblk structure. The local copy flag determines if packets looped back by the driver should also be sent to the network. A non-zero value indicates that frames should also be be sent to the network after being looped back. The default value of this flag is zero.

**DLIOCSLPCFLG**
Allows a privileged process to set the local packet copy flag, causing all packets looped back by the driver to also be sent to the network.

**DLIOCGRPMISC**
Returns the value of the promiscuous flag in the ioc rval of the iocblk structure. A non-zero value indicates that the Ethernet interface will receive all frames on the network. The default value of this flag is zero.

**DLIOCSPROMISC**
Allows a privileged process to toggle the current state of the promiscuous flag. When the flag is non-zero, the driver capture all frames from the network. Processes that are bound to the promiscuous SAP, or to an SAP that matches the type field of the received frame, receive a copy of the frame.

**DLIOCGETMULTI**
Returns the current list of multicast addresses (if it exists).

**DLIOCADDMULTI**
Allows a privileged process to add a new multicast address and enable its reception. A 6-byte buffer pointing to the multicast address must be passed as the parameter.

**DLIOCDELMULTI**
Allows a privileged process to delete a multicast address by passing a 6-byte multicast address as the parameter.

**Configuration**
The imx586 driver has four configurable parameters in the /etc/conf/pack.d/imx586/space.c file. If you change this file, you must rebuild the kernel and reboot the system for the changes to take effect.
The configurable parameters are:

**N_SAPS**
Defines the number of SAPs that can be bound at any one time. This value should be only slightly larger than anticipated SAP usage. A typical TCP/IP system requires two SAPs (0x800 and 0x806). If you assign too large a value to this parameter, system performance and memory usage may suffer.

**STREAMS_LOG**
Defines whether the driver should log debugging messages to the STREAMS logger for the `strace(1M)` utility to display. The module ID used with `strace` is 2101. A value of 0 indicates that no STREAMS debug messages should be generated. A value of 1 enables STREAMS debug messages to be generated. You can also direct the driver to log messages temporarily by using the kernel debugger to change the value of `imx586strlog` (a 4-byte integer) to 1.

Use STREAMS tracing only when debugging a network problem, because system performance suffers when full imx586 STREAMS logging is in progress.

**IFNAME**
This parameter is important only in a TCP/IP networking environment. It defines the string used in displaying network statistics. This string should match the logical interface name assigned in the `/etc/confnet.d/inet/interfaces` file and with `ifconfig(1M)` commands used in the `/etc/inet/rc.inet` configuration script.

**Errors**
The `imx586` driver can return the following error codes:

**ENXIO** Invalid major number or board is not installed.

**ECHRNG** No minor devices left if configured as a cloned device. Increase `N_SAP` value in `/etc/conf/pack.d/imx586/space.c` Invalid minor device number if configured as a non-cloned device.

**EPERM** An `ioctl` was made without the appropriate privilege.

**EINVAL** An `ioctl` was made that did not supply a required input and/or output buffer.

**DL_NOTSUPPORTED** Requested service primitive is not supported.

**DL_BADPRIM** Unknown service primitive was requested.

**DL_OUTSTATE** `DL_BIND_REQ` was issued when the Stream was bound, or `DL_UNBIND_REQ` or `DL_UNITDATA_REQ` were issued when the Stream was unbound.
**DL_ACCESS**
An attempt was made to bind to `PROMISCUOUS_SAP` with insufficient privilege.

**DL_BOUND**
The requested SAP is already bound. A privileged process may bind to an already bound SAP.

**DL_NOTINIT**
**DL_UNITDATA_REQ** was issued on an Ethernet board that has gone offline due to an error.

**DL_BADDATA**
**DL_UNITDATA_REQ** was issued with a data size that was either larger than the SPDU maximum or smaller than the SPDU minimum.

**Files**
/dev/imxS86_*
/etc/conf/pack.d/imxS86/space.c

**REFERENCES**
getmsg(2), ifconfig(1M), ioctl(2), open(2), putmsg(2), strace(1M)
inet(7)

NAME
inet – Internet protocol family

SYNOPSIS
#include <sys/types.h>
#include <netinet/in.h>

DESCRIPTION
The Internet protocol family implements a collection of protocols which are centered around the Internet Protocol (IP) and which share a common address format. The Internet family protocols can be accessed via the socket interface, where they support the SOCK_STREAM, SOCK_DGRAM, and SOCK_RAW socket types, or the Transport Level Interface (TLI), where they support the connectionless (T_CLTS) and connection oriented (T_COTS_ORD) service types.

PROTOCOLS
The Internet protocol family comprises the Internet Protocol (IP), the Address Resolution Protocol (ARP), the Internet Control Message Protocol (ICMP), the Transmission Control Protocol (TCP), and the User Datagram Protocol (UDP).

TCP supports the socket interface’s SOCK_STREAM abstraction and TLI’s T_COTS_ORD service type. UDP supports the SOCK_DGRAM socket abstraction and the TLI T_CLTS service type. See tcp(7) and udp(7). A direct interface to IP is available via both TLI and the socket interface; See ip(7). ICMP is used by the kernel to handle and report errors in protocol processing. It is also accessible to user programs; see icmp(7). ARP is used to translate 32-bit IP addresses into 48-bit Ethernet addresses; see arp(7).

The 32-bit IP address is divided into network number and host number parts. It is frequency-encoded; The most-significant bit is zero in Class A addresses, in which the high-order 8 bits represent the network number. Class B addresses have their high order two bits set to 10 and use the high-order 16 bits as the network number field. Class C addresses have a 24-bit network number part of which the high order three bits are 110. Rather than using the default class A, B, or C address, a subnet mask can be used for the network interface. See “Setting Up Subnets” in the “Expanding Your TCP/IP Network” chapter in Network Administration for more information on subnet masks. Subnet addressing is enabled and examined by the following ioctl(2) commands; They have the same form as the SIOCSIFADDR command [see if(7)].

SIOCSIFNETMASK Set interface network mask. The network mask defines the network part of the address; If it contains more of the address than the address type would indicate, then subnets are in use.

SIOCGIFNETMASK Get interface network mask.

ADDRESSING
IP addresses are four byte quantities, stored in network byte order. IP addresses should be manipulated using the byte order conversion routines [see byteorder(3N)].
Addresses in the Internet protocol family use the following structure:

```c
struct sockaddr_in {
    short sin_family;
    u_short sin_port;
    struct in_addr sin_addr;
    char sin_zero[8];
};
```

Library routines are provided to manipulate structures of this form; See `inet(3N)`.

The `sin_addr` field of the `sockaddr_in` structure specifies a local or remote IP address. Each network interface has its own unique IP address. The special value `INADDR_ANY` may be used in this field to effect wildcard matching. Given in a `bind(3N)` call, this value leaves the local IP address of the socket unspecified, so that the socket will receive connections or messages directed at any of the valid IP addresses of the system. This can prove useful when a process neither knows nor cares what the local IP address is or when a process wishes to receive requests using all of its network interfaces. The `sockaddr_in` structure given in the `bind(3N)` call must specify an `in_addr` value of either `IPADDR_ANY` or one of the system's valid IP addresses. Requests to bind any other address will elicit the error `EADDRNOTAVAIL`.

When a `connect(3N)` call is made for a socket that has a wildcard local address, the system sets the `sin_addr` field of the socket to the IP address of the network interface that the packets for that connection are routed via.

The `sin_port` field of the `sockaddr_in` structure specifies a port number used by TCP or UDP. The local port address specified in a `bind(3N)` call is restricted to be greater than `IPPORT_RESERVED` (defined in `<netinet/in.h>`) unless the creating process is running as the super-user, providing a space of protected port numbers. In addition, the local port address must not be in use by any socket of same address family and type. Requests to bind sockets to port numbers being used by other sockets return the error `EADDRINUSE`. If the local port address is specified as 0, then the system picks a unique port address greater than `IPPORT_RESERVED`. A unique local port address is also picked when a socket which is not bound is used in a `connect(3N)` or `sendto()` [see `send(3N)`] call. This allows programs which do not care which local port number is used to set up TCP connections by simply calling `socket(3N)` and then `connect(3N)`, and to send UDP datagrams with a `socket(3N)` call followed by a `sendto()` [see `send(3N)`] call.

Although this implementation restricts sockets to unique local port numbers, TCP allows multiple simultaneous connections involving the same local port number so long as the remote IP addresses or port numbers are different for each connection. Programs may explicitly override the socket restriction by setting the `SO_REUSEADDR` socket option with `setsockopt` [see `getsockopt(3N)`].

TLI applies somewhat different semantics to the binding of local port numbers. These semantics apply when Internet family protocols are used via the TLI.

SEE ALSO

`arp(7), bind(3N), byteorder(3N), connect(3N), icmp(7), if(7), ioctl(2), ip(7), gethostent(3N), getnetent(3N), getprotoent(3N), getservent(3N), getsockopt(3N), send(3N), socket(3N), tcp(7), udp(7)`

**NOTES**

The Internet protocol support is subject to change as the Internet protocols develop. Users should not depend on details of the current implementation, but rather the services exported.
NAME
IP - Internet Protocol

SYNOPSIS
#include <sys/socket.h>
#include <netinet/in.h>
s = socket(AF_INET, SOCK_RAW, proto);
t = t_open("/dev/rawip", O_RDWR);
d = open("/dev/ip", O_RDWR);

DESCRIPTION
IP is the internetwork datagram delivery protocol that is central to the Internet protocol family. Programs may use IP through higher-level protocols such as the Transmission Control Protocol (TCP) or the User Datagram Protocol (UDP), or may interface directly to IP. See tcp(7) and udp(7). Direct access may be via the socket interface (using a raw socket) or the Transport Level Interface (TLI). The protocol options defined in the IP specification may be set in outgoing datagrams.

The STREAMS driver /dev/rawip is the TLI transport provider that provides raw access to IP. The device /dev/ip is the multiplexing STREAMS driver that implements the protocol processing of IP. The latter connects below to datalink providers [interface drivers, see if(7)], and above to transport providers such as TCP and UDP.

Raw IP sockets are connectionless and are normally used with the sendto() and recvfrom() calls, [see send(3N) and recv(3N)] although the connect(3N) call may also be used to fix the destination for future datagrams [in which case the read(2) or recv(3N) and write(2) or send(3N) calls may be used]. If proto is zero, the default protocol, IPPROTO_RAW, is used. If proto is non-zero, that protocol number will be set in outgoing datagrams and will be used to filter incoming datagrams. An IP header will be generated and prepended to each outgoing datagram; received datagrams are returned with the IP header and options intact.

A single socket option, IP_OPTIONS, is supported at the IP level. This socket option may be used to set IP options to be included in each outgoing datagram. IP options to be sent are set with setsockopt() [see getsockopt(3N)]. The getsockopt(3N) call returns the IP options set in the last setsockopt() call. IP options on received datagrams are visible to user programs only using raw IP sockets. The format of IP options given in setsockopt() matches those defined in the IP specification with one exception: the list of addresses for the source routing options must include the first-hop gateway at the beginning of the list of gateways. The first-hop gateway address will be extracted from the option list and the size adjusted accordingly before use. IP options may be used with any socket type in the Internet family.

At the socket level, the socket option SO_DONTROUTE may be applied. This option forces datagrams being sent to bypass the routing step in output. Normally, IP selects a network interface to send the datagram, and possibly an intermediate gateway, based on an entry in the routing table. See routing(4). When SO_DONTROUTE is set, the datagram will be sent using the interface whose network number or full IP address matches the destination address. If no interface matches, the error ENETUNRCH will be returned.
Raw IP datagrams can also be sent and received using the TLI connectionless primitives.

Datagrams flow through the IP layer in two directions: from the network up to user processes and from user processes down to the network. Using this orientation, IP is layered above the network interface drivers and below the transport protocols such as UDP and TCP. The Internet Control Message Protocol (ICMP) is logically a part of IP. See icmp(7).

IP provides for a checksum of the header part, but not the data part of the datagram. The checksum value is computed and set in the process of sending datagrams and checked when receiving datagrams. IP header checksumming may be disabled for debugging purposes by patching the kernel variable ipcksum to have the value zero.

IP options in received datagrams are processed in the IP layer according to the protocol specification. Currently recognized IP options include: security, loose source and record route (LSRR), strict source and record route (SSRR), record route, stream identifier, and internet timestamp.

The IP layer will normally forward received datagrams that are not addressed to it. Forwarding is under the control of the kernel variable ipforwarding: if ipforwarding is zero, IP datagrams will not be forwarded; if ipforwarding is one, IP datagrams will be forwarded. ipforwarding is usually set to one only in machines with more than one network interface (internetwork routers). This kernel variable can be patched to enable or disable forwarding.

The IP layer will send an ICMP message back to the source host in many cases when it receives a datagram that can not be handled. A time exceeded ICMP message will be sent if the time to live field in the IP header drops to zero in the process of forwarding a datagram. A destination unreachable message will be sent if a datagram cannot be forwarded because there is no route to the final destination, or if it can not be fragmented. If the datagram is addressed to the local host but is destined for a protocol that is not supported or a port that is not in use, a destination unreachable message will also be sent. The IP layer may send an ICMP source quench message if it is receiving datagrams too quickly. ICMP messages are only sent for the first fragment of a fragmented datagram and are never returned in response to errors in other ICMP messages.

The IP layer supports fragmentation and reassembly. Datagrams are fragmented on output if the datagram is larger than the maximum transmission unit (MTU) of the network interface. Fragments of received datagrams are dropped from the reassembly queues if the complete datagram is not reconstructed within a short time period.

Errors in sending discovered at the network interface driver layer are passed by IP back up to the user process.

SEE ALSO
connect(3N), getsockopt(3N), icmp(7), if(7), inet(7), read(2), recv(3N), routing(4), send(3N), tcp(7), udp(7), write(2)
DIAGNOSTICS

A socket operation may fail with one of the following errors returned:

- **EACCES**: A IP broadcast destination address was specified and the caller was not the privileged user.
- **EISCONN**: An attempt was made to establish a connection on a socket which already had one, or to send a datagram with the destination address specified and the socket was already connected.
- **EMSGSIZE**: An attempt was made to send a datagram that was too large for an interface, but was not allowed to be fragmented (such as broadcasts).
- **ENETUNREACH**: An attempt was made to establish a connection or send a datagram, where there was no matching entry in the routing table, or if an ICMP destination unreachable message was received.
- **ENOTCONN**: A datagram was sent, but no destination address was specified, and the socket had not been connected.
- **ENOBUFFS**: The system ran out of memory for fragmentation buffers or other internal data structures.
- **EADDRNOTAVAIL**: An attempt was made to create a socket with a local address that did not match any network interface, or an IP broadcast destination address was specified and the network interface does not support broadcast.

The following errors may occur when setting or getting IP options:

- **EINVAL**: An unknown socket option name was given.
- **EINVAL**: The IP option field was improperly formed; an option field was shorter than the minimum value or longer than the option buffer provided.

NOTES

Raw sockets should receive ICMP error packets relating to the protocol; currently such packets are simply discarded.

Users of higher-level protocols such as TCP and UDP should be able to see received IP options.
NAME
kbd – generalized string translation module

DESCRIPTION
The STREAMS module kbd is a programmable string translation module. It performs two types of operations on an input stream: the first type is simple byte-swapping via a lookup table, the second is string translation. It is useful for code set conversion and compose-key or dead-key character production on terminals and production of overstriking sequences on printers. It also can be used for minor types of key-rebinding, expansion of abbreviations, and keyboard re-arrangement (an example of the latter would be swapping the positions of the Y and Z keys, required for German keyboards, or providing Dvorak keyboard emulation for QWERTY keyboards). The kbdcomp(1M) manual page discusses table construction, the input language, and contains sample uses. It is intended mainly to aid administrators in configuring the module on a particular system; the user interface to the module is only through the commands kbdload(1M) and kbdset(1).

The kbd module works by changing an input stream according to instructions embodied in tables. It has no built-in default tables. Some tables may be loaded when the system is first brought up by pushing the module and loading standard or often-used tables [see kbdload(1M)] that are retained in main-memory across invocations and made available to all users. These are called public tables. Users may also load private tables at any time; these tables do not remain resident.

With the kbdset command, users may query the module for a list of available and attached tables, attach various tables, and set the optional per-user hotkey, hot-key mode, and verbose string for their particular invocation.

When a user attaches more than one table, the user's hot-key may be used to cycle to the next table in the list. If only one table is specified, the hot-key may be used to toggle translation on and off. When multiple tables are in use, the hot-key may be used to cycle through the list of tables. [See kbdset(1) for a description of the available modes.]

In its initial state, kbd scans input for occurrences of bytes beginning a translation sequence. When receiving such a byte, kbd attempts to match subsequent bytes of the input to programmed sequences. Input is buffered beginning with the byte that caused the state change and is released if a match is not found. When a match fails, the first byte of the invalid sequence is sent upstream, the buffered input is shifted, and the scan begins again with the resulting input sequence. If the current table contains an error entry, its value (one or more bytes) is substituted for the offending input byte. When a sequence is found to be valid, the entire sequence is replaced with the result string specified for it.

The kbd module may be used in either the read or write directions, or both simultaneously. Maps and hot-keys may be specified independently for input and output.

The kbd also supports the use of external kernel-resident functions as if they were tables; once declared and attached (via kbdload and kbdset respectively) they may be used as simple tables or members of composites. To accomplish this, kbd understands the registration functions of the alp module and can access any function registered with that module. Further information on external functions and their
definition is contained in alp(7). External functions are especially useful in supporting multibyte code set conversions that would be difficult or impossible with normal kbd tables.

Limitations
It is not an error to attach multiple tables without defining a hot-key, but the tables will not all be accessible. It is recommended that the user’s hot-key be set before loading and attaching tables to avoid unpleasant side effects when an unfamiliar arrangement is first loaded.

Each user has a limitation on the amount of memory that may be used for private and attached tables. This “quota” is controlled by the kbd_umem variable described below. When a user that is not a privileged user attempts to load a table or create a composite table, the quota is checked, and the load will fail if it would cause the quota to be exceeded. When a composite table is attached, the space for attachment (which requires more space than the composite table itself) is charged against this quota (attachment of simple tables is not charged against the quota). The quota is enforced only when loading new tables. Detaching temporarily from unneeded composite tables may reduce the current allocation enough to load a table that would otherwise fail because of quota enforcement. To minimize chances of failure while loading tables, it is advisable to load all required tables and make all required composite tables before attaching any of them.

Configuration Parameters
The master (or space.c) file contains configurable parameters.

NKBDU is the maximum number of tables that may be attached by a single user. The number should be large enough to cover uncommon cases, and must be at least 2. Default is 6.

ZUMEM, from which the variable kbd_umem is assigned, is the maximum number of bytes that a user (other than a privileged user) may have allocated to private tables (that is, the quota). Default is 4096.

KBDTIME is the default timer value for timeout mode. It is the number of clock ticks allowed before timing out. The value of one clock tick depends on the hardware, but is usually 1/100 or 1/60 of a second. A timeout value of 20 is 1/5 second at 100Hz; with a 60Hz clock, a value of 12 produces a 1/5 second timeout. Values from 5 to 400 inclusive are allowed by the module; if the value set for KBDTIME is outside this range, the module forces it to the nearest limit. (This value is only a default; users may change their particular stream to use a different value depending on their own preferences, terminal baud-rate, and typing speed.)

FILES
/usr/lib/kbd – directory containing system standard table files.
/usr/lib/kbd/*.map – source for some system table files.

SEE ALSO
alp(7), kbdcomp(1M), kbdload(1M), kbdset(1)

NOTES
NULL characters may not be used in result or input strings, because they are used as string delimiters.
keyboard (7)

NAME keyboard – system console keyboard

DESCRIPTION The system console has two separate parts: the keyboard and the display [see display (7)].

The keyboard is used to type data, and send certain control signals to the computer. UNIX system software performs terminal emulation on the console screen and keyboard, and, in doing so, makes use of several particular keys and key combinations. These keys and key combinations have special names that are unique to the UNIX system, and may or may not correspond to the keytop labels on your keyboard.

When you press a key, one of the following happens:

- An ASCII value is entered
- The meaning of another key, or keys, is changed.
- A string is sent to the computer.
- A function is initiated.

When a key is pressed (a keystroke), the keyboard sends a scancode to the computer. This scancode is interpreted by the keyboard driver. The actual code sequence delivered to the terminal input routine [see termio (7)] is defined by a set of internal tables in the driver. These tables can be modified by software (see the discussion of ioctl calls below). In addition, the driver can be instructed not to do translations, delivering the keyboard up and down scan codes directly.

Changing Meanings
The action performed by a key can be changed by using certain keys in combination. For example, the SHIFT key changes the ASCII values of the alphanumeric keys. Holding down the CTRL key while pressing another key sends a control code (such as CTRL-d, CTRL-s, and CTRL-q). Holding down the ALT key also modifies a key’s value. The SHIFT, CTRL, and ALT keys can be used in combination.

Switching Screens
To change screens (virtual terminals), first run the vtlmgr command [see vtlmgr(1)]. Switch the current screen by typing ALT-SYSREQ (also labeled ALT-PRINTSCRN on some systems) followed by a key that identifies the desired screen. Any active screen can be selected by following ALT-SYSREQ with F1, where F1 is one of the function keys. F1 refers to the first virtual terminal screen, F2 refers to the second virtual terminal screen, and so on. ALT-SYSREQ h (home) refers to the main console display (/dev/console). The next active screen can be selected with ALT-SYSREQ n, and the previous screen can be selected with ALT-SYSREQ p.

The default screen switch enable sequence (ALT-SYSREQ) is configurable. The SYSREQ table entry can be changed by software (see discussion of ioctl calls below).

Special Keys
The following table shows which keys on a typical console correspond to UNIX system keys. In this table, a hyphen (-) between keys means you must hold down the first key while pressing the second. The mapping between characters that generate signals and the signal generated is set with stty(1), and may be changed [see stty(1)].
# keyboard (7)

<table>
<thead>
<tr>
<th>Name</th>
<th>Keytop</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>INTR</td>
<td>DEL</td>
<td>Stops current action and returns to the shell. This key is also called the <strong>RUB OUT</strong> or <strong>INTERRUPT</strong> key.</td>
</tr>
<tr>
<td>BACKSPACE</td>
<td>←</td>
<td>Deletes the first character to the left of the cursor. Note that the “cursor left” key also has a left arrow (←) on its keytop, but you cannot backspace using that key.</td>
</tr>
<tr>
<td>CTRL-d</td>
<td>CTRL-D</td>
<td>Signals the end of input from the keyboard; also exits current shell.</td>
</tr>
<tr>
<td>CTRL-h</td>
<td>CTRL-H</td>
<td>Deletes the first character to the left of the cursor. Also called the <strong>ERASE</strong> key.</td>
</tr>
<tr>
<td>CTRL-q</td>
<td>CTRL-Q</td>
<td>Restarts printing after it has been stopped with CTRL-s.</td>
</tr>
<tr>
<td>CTRL-s</td>
<td>CTRL-S</td>
<td>Suspends printing on the screen (does not stop the program).</td>
</tr>
<tr>
<td>CTRL-u</td>
<td>CTRL-U</td>
<td>Deletes all characters on the current line. Also called the <strong>KILL</strong> key.</td>
</tr>
<tr>
<td>CTRL-\</td>
<td>CTRL-\</td>
<td>Quits current command and creates a <strong>core</strong> file, if allowed. (Recommended for debugging only.)</td>
</tr>
<tr>
<td>ESCAPE</td>
<td>ESC</td>
<td>Special code for some programs. For example, changes from insert mode to command mode in the <strong>vi(1)</strong> text editor.</td>
</tr>
<tr>
<td>RETURN</td>
<td>(down-left arrow or ENTER)</td>
<td>Terminates a command line and initiates an action from the shell.</td>
</tr>
<tr>
<td>F$n$</td>
<td>F$n$</td>
<td>Function key $n$. <strong>F1</strong>–<strong>F12</strong> are unshifted, <strong>F13</strong>–<strong>F24</strong> are shifted <strong>F1</strong>–<strong>F12</strong>, <strong>F25</strong>–<strong>F36</strong> are <strong>CTRL</strong>–<strong>F1</strong> through <strong>F12</strong>, and <strong>F37</strong>–<strong>F48</strong> are <strong>CTRL-SHIFT</strong>–<strong>F1</strong> through <strong>F12</strong>. The next <strong>F$n$</strong> keys (<strong>F49</strong>–<strong>F60</strong>) are on the number pad (unshifted):</td>
</tr>
<tr>
<td></td>
<td>F49</td>
<td>’7’</td>
</tr>
<tr>
<td></td>
<td>F50</td>
<td>’8’</td>
</tr>
<tr>
<td></td>
<td>F51</td>
<td>’9’</td>
</tr>
<tr>
<td></td>
<td>F52</td>
<td>‘,’</td>
</tr>
<tr>
<td></td>
<td>F53</td>
<td>‘4’</td>
</tr>
<tr>
<td></td>
<td>F54</td>
<td>‘5’</td>
</tr>
<tr>
<td></td>
<td>F55</td>
<td>’6’</td>
</tr>
<tr>
<td></td>
<td>F56</td>
<td>’+’</td>
</tr>
<tr>
<td></td>
<td>F57</td>
<td>’1’</td>
</tr>
<tr>
<td></td>
<td>F58</td>
<td>’2’</td>
</tr>
<tr>
<td></td>
<td>F59</td>
<td>’3’</td>
</tr>
<tr>
<td></td>
<td>F60</td>
<td>’0’</td>
</tr>
</tbody>
</table>

## Keyboard Map

The keyboard mapping structure is defined in `/usr/include/sys/kd.h`. Each key can have ten states. The first eight states are:

- **BASE** - **CTRL-SHIFT**
- **SHIFT** - **ALT-SHIFT**
- **CTRL** - **ALT-CTRL**
- **ALT** - **ALT-CTRL-SHIFT**
keyboard (7)

The two remaining states are indicated by two special bytes. The first byte is a special state byte whose bits indicate whether the key is special in one or more of the first eight states. The second byte is one of four codes represented by the characters C, N, B, or 0 which indicate how the lock keys affect the particular key.

The following table describes the default keyboard mapping. All values, except for special keywords (which are described later), are ASCII character values.

<table>
<thead>
<tr>
<th>Heading</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCAN CODE</td>
<td>This column contains the scan code generated by the keyboard hardware when a key is pressed. There are no table entries for the scan code generated by releasing a key.</td>
</tr>
<tr>
<td>BASE</td>
<td>This column contains the normal value of a key press.</td>
</tr>
<tr>
<td>SHIFT</td>
<td>This column contains the value of a key press when the SHIFT is also being held down.</td>
</tr>
<tr>
<td>LOCK</td>
<td>This column indicates which lock keys affect that particular key:</td>
</tr>
<tr>
<td></td>
<td>– C indicates CAPSLOCK</td>
</tr>
<tr>
<td></td>
<td>– N indicates NUMLOCK</td>
</tr>
<tr>
<td></td>
<td>– B indicates both</td>
</tr>
<tr>
<td></td>
<td>– 0 indicates locking is off</td>
</tr>
</tbody>
</table>

The remaining columns are the values of key presses when combinations of the CTRL, ALT and SHIFT keys are also held down.

The SRQTAB column entry is included in this table to provide a simple index of the default virtual terminal key selectors to the scan code to which it is assigned. The actual SRQTAB table is a stand-alone table which can be read or written using the KDGKBENT and KDSKBENT ioctl calls.
<table>
<thead>
<tr>
<th>SCAN CODE</th>
<th>BASE</th>
<th>SHIFT</th>
<th>CTRL</th>
<th>CTRL SHIFT</th>
<th>ALT</th>
<th>ALT SHIFT</th>
<th>ALT CTRL</th>
<th>ALT CTRL SHIFT</th>
<th>LOCK</th>
<th>SRQTAB</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>esc</td>
<td>esc</td>
<td>esc</td>
<td>esc</td>
<td>esc</td>
<td>esc</td>
<td>esc</td>
<td>esc</td>
<td>O</td>
<td>nop</td>
</tr>
<tr>
<td>2</td>
<td>'1'</td>
<td>'1'</td>
<td>'1'</td>
<td>'1'</td>
<td>esc</td>
<td>esc</td>
<td>esc</td>
<td>esc</td>
<td>O</td>
<td>nop</td>
</tr>
<tr>
<td>3</td>
<td>'2'</td>
<td>'2'</td>
<td>'2'</td>
<td>'2'</td>
<td>esc</td>
<td>esc</td>
<td>esc</td>
<td>esc</td>
<td>O</td>
<td>nop</td>
</tr>
<tr>
<td>4</td>
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<td>'3'</td>
<td>'3'</td>
<td>'3'</td>
<td>esc</td>
<td>esc</td>
<td>esc</td>
<td>esc</td>
<td>O</td>
<td>nop</td>
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<tr>
<td>5</td>
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<td>'4'</td>
<td>'4'</td>
<td>'4'</td>
<td>esc</td>
<td>esc</td>
<td>esc</td>
<td>esc</td>
<td>O</td>
<td>nop</td>
</tr>
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<td>6</td>
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<td>'5'</td>
<td>'5'</td>
<td>esc</td>
<td>esc</td>
<td>esc</td>
<td>esc</td>
<td>O</td>
<td>nop</td>
</tr>
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<td>'6'</td>
<td>'6'</td>
<td>'6'</td>
<td>esc</td>
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<td>esc</td>
<td>esc</td>
<td>O</td>
<td>nop</td>
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<td>'7'</td>
<td>esc</td>
<td>esc</td>
<td>esc</td>
<td>esc</td>
<td>O</td>
<td>nop</td>
</tr>
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<td>'8'</td>
<td>'8'</td>
<td>esc</td>
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<td>esc</td>
<td>esc</td>
<td>O</td>
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</tr>
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<td>'9'</td>
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<td>esc</td>
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<td>esc</td>
<td>esc</td>
<td>O</td>
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</tr>
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<td>'0'</td>
<td>'0'</td>
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</tr>
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<td>'+'</td>
<td>'+'</td>
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<td>esc</td>
<td>esc</td>
<td>O</td>
<td>nop</td>
</tr>
<tr>
<td>13</td>
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<td>'='</td>
<td>'='</td>
<td>'='</td>
<td>esc</td>
<td>esc</td>
<td>esc</td>
<td>esc</td>
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</tr>
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<td>bs</td>
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<td>nop</td>
</tr>
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<td>O</td>
<td>nop</td>
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<td>etb</td>
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<td>enq</td>
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<td>nop</td>
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<td>'r'</td>
<td>'r'</td>
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<td>dle</td>
<td>C</td>
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<td>'j'</td>
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<td>nop</td>
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<td>nop</td>
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<td>letr</td>
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<td>soh</td>
<td>C</td>
<td>nop</td>
</tr>
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<td>nop</td>
</tr>
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<td>eot</td>
<td>eot</td>
<td>C</td>
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</tr>
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<td>'f'</td>
<td>ack</td>
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<td>ack</td>
<td>ack</td>
<td>C</td>
<td>K_FRCNEXT</td>
</tr>
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<td>bel</td>
<td>bel</td>
<td>C</td>
<td>nop</td>
</tr>
<tr>
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<td>'h'</td>
<td>'h'</td>
<td>bs</td>
<td>bs</td>
<td>bs</td>
<td>bs</td>
<td>C</td>
<td>K_VTF</td>
</tr>
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<td>'j'</td>
<td>'j'</td>
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<td>nl</td>
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<td>nop</td>
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<td>'k'</td>
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<td>vt</td>
<td>vt</td>
<td>C</td>
<td>nop</td>
</tr>
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<td>np</td>
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<td>nop</td>
</tr>
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<td>'/'</td>
<td>'/'</td>
<td>'/'</td>
<td>esc</td>
<td>esc</td>
<td>esc</td>
<td>esc</td>
<td>O</td>
<td>nop</td>
</tr>
<tr>
<td>40</td>
<td>''</td>
<td>''</td>
<td>''</td>
<td>''</td>
<td>esc</td>
<td>esc</td>
<td>esc</td>
<td>esc</td>
<td>O</td>
<td>nop</td>
</tr>
<tr>
<td>41</td>
<td>''</td>
<td>''</td>
<td>''</td>
<td>''</td>
<td>esc</td>
<td>esc</td>
<td>esc</td>
<td>esc</td>
<td>O</td>
<td>nop</td>
</tr>
<tr>
<td>42</td>
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<td>lshift</td>
<td>lshift</td>
<td>lshift</td>
<td>lshift</td>
<td>lshift</td>
<td>lshift</td>
<td>O</td>
<td>nop</td>
</tr>
<tr>
<td>43</td>
<td>'//'</td>
<td>'//'</td>
<td>'//'</td>
<td>'//'</td>
<td>fs</td>
<td>fs</td>
<td>fs</td>
<td>fs</td>
<td>O</td>
<td>nop</td>
</tr>
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<td>'z'</td>
<td>'z'</td>
<td>'z'</td>
<td>sub</td>
<td>sub</td>
<td>sub</td>
<td>sub</td>
<td>C</td>
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<td>111</td>
<td>fkey51</td>
<td>fkey51</td>
<td>fkey51</td>
<td>fkey51</td>
<td>fkey51</td>
<td>fkey51</td>
<td>fkey51</td>
<td>fkey51</td>
<td>O</td>
<td></td>
</tr>
<tr>
<td>112</td>
<td>nop</td>
<td>nop</td>
<td>nop</td>
<td>nop</td>
<td>nop</td>
<td>nop</td>
<td>nop</td>
<td>nop</td>
<td>O</td>
<td>K_NOP</td>
</tr>
<tr>
<td>113</td>
<td>nop</td>
<td>nop</td>
<td>nop</td>
<td>nop</td>
<td>nop</td>
<td>nop</td>
<td>nop</td>
<td>nop</td>
<td>O</td>
<td>K_NOP</td>
</tr>
<tr>
<td>114</td>
<td>ralt</td>
<td>ralt</td>
<td>ralt</td>
<td>ralt</td>
<td>ralt</td>
<td>ralt</td>
<td>ralt</td>
<td>ralt</td>
<td>O</td>
<td>K_NOP</td>
</tr>
<tr>
<td>115</td>
<td>rctrl rctrl rctrl rctrl rctrl rctrl rctrl rctrl rctrl</td>
<td>rctrl</td>
<td>rctrl</td>
<td>rctrl</td>
<td>rctrl</td>
<td>rctrl</td>
<td>O</td>
<td>K_NOP</td>
<td></td>
<td></td>
</tr>
<tr>
<td>116</td>
<td>lock</td>
<td>lock</td>
<td>lock</td>
<td>lock</td>
<td>lock</td>
<td>lock</td>
<td>lock</td>
<td>lock</td>
<td>O</td>
<td>K_NOP</td>
</tr>
<tr>
<td>117</td>
<td>'/'</td>
<td>'/'</td>
<td>nop</td>
<td>nop</td>
<td>escn</td>
<td>escn</td>
<td>nop</td>
<td>escn</td>
<td>O</td>
<td>K_NOP</td>
</tr>
<tr>
<td>118</td>
<td>nop</td>
<td>nop</td>
<td>nop</td>
<td>nop</td>
<td>nop</td>
<td>nop</td>
<td>nop</td>
<td>nop</td>
<td>O</td>
<td>K_NOP</td>
</tr>
<tr>
<td>119</td>
<td>lock</td>
<td>lock</td>
<td>lock</td>
<td>lock</td>
<td>lock</td>
<td>lock</td>
<td>lock</td>
<td>lock</td>
<td>O</td>
<td>K_NOP</td>
</tr>
<tr>
<td>120</td>
<td>fkey50</td>
<td>fkey50</td>
<td>fkey50</td>
<td>fkey50</td>
<td>fkey50</td>
<td>fkey50</td>
<td>fkey50</td>
<td>fkey50</td>
<td>O</td>
<td></td>
</tr>
<tr>
<td>121</td>
<td>del</td>
<td>del</td>
<td>del</td>
<td>del</td>
<td>del</td>
<td>del</td>
<td>del</td>
<td>del</td>
<td>O</td>
<td>K_NOP</td>
</tr>
<tr>
<td>122</td>
<td>fkey57</td>
<td>fkey57</td>
<td>fkey57</td>
<td>fkey57</td>
<td>fkey57</td>
<td>fkey57</td>
<td>fkey57</td>
<td>fkey57</td>
<td>O</td>
<td></td>
</tr>
<tr>
<td>123</td>
<td>fkey60</td>
<td>fkey60</td>
<td>fkey60</td>
<td>fkey60</td>
<td>fkey60</td>
<td>fkey60</td>
<td>fkey60</td>
<td>fkey60</td>
<td>O</td>
<td></td>
</tr>
<tr>
<td>124</td>
<td>nop</td>
<td>nop</td>
<td>nop</td>
<td>nop</td>
<td>nop</td>
<td>nop</td>
<td>nop</td>
<td>nop</td>
<td>O</td>
<td>K_NOP</td>
</tr>
<tr>
<td>125</td>
<td>fkey55</td>
<td>fkey55</td>
<td>fkey55</td>
<td>fkey55</td>
<td>fkey55</td>
<td>fkey55</td>
<td>fkey55</td>
<td>fkey55</td>
<td>O</td>
<td></td>
</tr>
<tr>
<td>126</td>
<td>fkey59</td>
<td>fkey59</td>
<td>fkey59</td>
<td>fkey59</td>
<td>fkey59</td>
<td>fkey59</td>
<td>fkey59</td>
<td>fkey59</td>
<td>O</td>
<td></td>
</tr>
<tr>
<td>127</td>
<td>fkey49</td>
<td>fkey49</td>
<td>fkey49</td>
<td>fkey49</td>
<td>fkey49</td>
<td>fkey49</td>
<td>fkey49</td>
<td>fkey49</td>
<td>O</td>
<td></td>
</tr>
</tbody>
</table>

The following table lists the value of each of the special keywords used in the preceding tables. The keywords are used only in the preceding tables for readability. In the actual keyboard map, a special keyword is represented by its value with the corresponding special state bit being set.
### keyboard (7)

<table>
<thead>
<tr>
<th>Name</th>
<th>Value</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>nop</td>
<td>0</td>
<td>No operation - no action from keypress</td>
</tr>
<tr>
<td>lshift</td>
<td>2</td>
<td>Left-hand shift</td>
</tr>
<tr>
<td>rshift</td>
<td>3</td>
<td>Right-hand shift</td>
</tr>
<tr>
<td>clock</td>
<td>4</td>
<td>Caps lock</td>
</tr>
<tr>
<td>nlock</td>
<td>5</td>
<td>Numeric lock</td>
</tr>
<tr>
<td>slock</td>
<td>6</td>
<td>Scroll lock</td>
</tr>
<tr>
<td>alt</td>
<td>7</td>
<td>Alt key</td>
</tr>
<tr>
<td>btab</td>
<td>8</td>
<td>Back tab key - generates fixed sequence (ESC[ Z)</td>
</tr>
<tr>
<td>ctrl</td>
<td>9</td>
<td>Control key</td>
</tr>
<tr>
<td>lalt</td>
<td>10</td>
<td>Left-hand alt key</td>
</tr>
<tr>
<td>ralt</td>
<td>11</td>
<td>Right-hand alt key</td>
</tr>
<tr>
<td>lctrl</td>
<td>12</td>
<td>Left-hand control key</td>
</tr>
<tr>
<td>rctrl</td>
<td>13</td>
<td>Right-hand control key</td>
</tr>
<tr>
<td>agr</td>
<td>14</td>
<td>ALT-GR key (European keyboards only)</td>
</tr>
<tr>
<td>fkey1</td>
<td>27</td>
<td>Function key #1</td>
</tr>
<tr>
<td>.</td>
<td>.</td>
<td>.</td>
</tr>
<tr>
<td>.</td>
<td>.</td>
<td>.</td>
</tr>
<tr>
<td>fkey96</td>
<td>122</td>
<td>Function key #96</td>
</tr>
<tr>
<td>sysreq</td>
<td>123</td>
<td>System request</td>
</tr>
<tr>
<td>brk</td>
<td>124</td>
<td>Break key</td>
</tr>
<tr>
<td>escn</td>
<td>125</td>
<td>Generate an ESC N x sequence, where x is the un-alt’ed value of the scan code</td>
</tr>
<tr>
<td>esco</td>
<td>126</td>
<td>Generate an ESC O x sequence, where x is the un-alt’ed value of the scan code</td>
</tr>
<tr>
<td>esl</td>
<td>127</td>
<td>Generate an ESC L x sequence, where x is the un-alt’ed value of the scan code</td>
</tr>
<tr>
<td>rboot</td>
<td>128</td>
<td>Reboot system</td>
</tr>
<tr>
<td>debug</td>
<td>129</td>
<td>Invoke kernel debugger</td>
</tr>
<tr>
<td>NEXT</td>
<td>130</td>
<td>Switch to next virtual terminal on queue</td>
</tr>
<tr>
<td>PREV</td>
<td>131</td>
<td>Switch to previous virtual terminal on queue</td>
</tr>
<tr>
<td>FNEXT</td>
<td>132</td>
<td>Forced switch to next virtual terminal on queue</td>
</tr>
<tr>
<td>FPREV</td>
<td>133</td>
<td>Forced switch to previous virtual terminal on queue</td>
</tr>
<tr>
<td>VTF</td>
<td>134</td>
<td>Virtual Terminal First (VT00)</td>
</tr>
<tr>
<td>.</td>
<td>.</td>
<td>.</td>
</tr>
<tr>
<td>.</td>
<td>.</td>
<td>.</td>
</tr>
<tr>
<td>VTL</td>
<td>148</td>
<td>Virtual Terminal Last (VT14)</td>
</tr>
<tr>
<td>MGRF</td>
<td>149</td>
<td>Virtual Terminal Manager First. Allows assigning special significance to key sequence for actions by virtual terminal layer manager. Used in SRQTAB table.</td>
</tr>
<tr>
<td>.</td>
<td>.</td>
<td>.</td>
</tr>
<tr>
<td>.</td>
<td>.</td>
<td>.</td>
</tr>
<tr>
<td>MGRL</td>
<td>179</td>
<td>Virtual Terminal Manager Last. Used in SRQTAB table.</td>
</tr>
</tbody>
</table>
The following table lists names and decimal values for ASCII characters in the preceding table. Names are used in place of numeric constants to make it easier to read the scan code table. Only the decimal values are placed in the ioctl buffer. These values are taken from ascii(5).

<table>
<thead>
<tr>
<th>Name</th>
<th>Value</th>
<th>Name</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>nul</td>
<td>0</td>
<td>dc1</td>
<td>17</td>
</tr>
<tr>
<td>soh</td>
<td>1</td>
<td>dc2</td>
<td>18</td>
</tr>
<tr>
<td>stx</td>
<td>2</td>
<td>dc3</td>
<td>19</td>
</tr>
<tr>
<td>etx</td>
<td>3</td>
<td>dc4</td>
<td>20</td>
</tr>
<tr>
<td>eot</td>
<td>4</td>
<td>nak</td>
<td>21</td>
</tr>
<tr>
<td>enq</td>
<td>5</td>
<td>syn</td>
<td>22</td>
</tr>
<tr>
<td>ack</td>
<td>6</td>
<td>etb</td>
<td>23</td>
</tr>
<tr>
<td>bel</td>
<td>7</td>
<td>can</td>
<td>24</td>
</tr>
<tr>
<td>bs</td>
<td>8</td>
<td>em</td>
<td>25</td>
</tr>
<tr>
<td>ht</td>
<td>9</td>
<td>sub</td>
<td>26</td>
</tr>
<tr>
<td>nl</td>
<td>10</td>
<td>esc</td>
<td>27</td>
</tr>
<tr>
<td>vt</td>
<td>11</td>
<td>fs</td>
<td>28</td>
</tr>
<tr>
<td>np</td>
<td>12</td>
<td>gs</td>
<td>29</td>
</tr>
<tr>
<td>cr</td>
<td>13</td>
<td>rs</td>
<td>30</td>
</tr>
<tr>
<td>so</td>
<td>14</td>
<td>ns</td>
<td>31</td>
</tr>
<tr>
<td>si</td>
<td>15</td>
<td>del</td>
<td>127</td>
</tr>
<tr>
<td>dle</td>
<td>16</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**String Key Mapping**

The string mapping table is an array of 512 bytes (typedef strmap_t) containing null-terminated strings that redefine the function keys. The first null-terminated string is assigned to the first function key, the second string is assigned to the second function key, and so on.

There is no limit to the length of any particular string; however, the whole table can not exceed 512 bytes, including nulls. To make a string a null, add extra null characters. The following table contains default function key values.
# keyboard (7)

## Default Function Key Values

<table>
<thead>
<tr>
<th>Function Key #</th>
<th>Function</th>
<th>Shift Function</th>
<th>Ctrl Function</th>
<th>Ctrl Shift Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>ESC OP</td>
<td>ESC Op</td>
<td>ESC OP</td>
<td>ESC Op</td>
</tr>
<tr>
<td>2</td>
<td>ESC OQ</td>
<td>ESC Oq</td>
<td>ESC OQ</td>
<td>ESC Oq</td>
</tr>
<tr>
<td>3</td>
<td>ESC OR</td>
<td>ESC Or</td>
<td>ESC OR</td>
<td>ESC Or</td>
</tr>
<tr>
<td>4</td>
<td>ESC OS</td>
<td>ESC Os</td>
<td>ESC OS</td>
<td>ESC Os</td>
</tr>
<tr>
<td>5</td>
<td>ESC OT</td>
<td>ESC Ot</td>
<td>ESC OT</td>
<td>ESC Ot</td>
</tr>
<tr>
<td>6</td>
<td>ESC OU</td>
<td>ESC Ou</td>
<td>ESC OU</td>
<td>ESC Ou</td>
</tr>
<tr>
<td>7</td>
<td>ESC OV</td>
<td>ESC Ov</td>
<td>ESC Ov</td>
<td>ESC Ov</td>
</tr>
<tr>
<td>8</td>
<td>ESC OW</td>
<td>ESC Ow</td>
<td>ESC Ow</td>
<td>ESC Ow</td>
</tr>
<tr>
<td>9</td>
<td>ESC OX</td>
<td>ESC Ox</td>
<td>ESC Ox</td>
<td>ESC Ox</td>
</tr>
<tr>
<td>10</td>
<td>ESC OY</td>
<td>ESC Oy</td>
<td>ESC Oy</td>
<td>ESC Oy</td>
</tr>
<tr>
<td>11</td>
<td>ESC OZ</td>
<td>ESC Oz</td>
<td>ESC Oz</td>
<td>ESC Oz</td>
</tr>
<tr>
<td>12</td>
<td>ESC OA</td>
<td>ESC Oa</td>
<td>ESC OA</td>
<td>ESC Oa</td>
</tr>
</tbody>
</table>

## ioctl Calls:

**KDGBKMODE**

This call gets the current keyboard mode. It returns one of the following values, as defined in `/usr/include/sys/kd.h`:

```c
#define K_RAW       0x00 /* Send row scan codes */
#define K_XLATE     0x01 /* Translate to ASCII */
```

**KDSKBMODE**

This call sets the keyboard mode. The argument to the call is either `K_RAW` or `K_XLATE`. By using raw mode, the program can see the raw up and down scan codes from the keyboard. In translate mode, the translation tables are used to generate the appropriate character code.

**KDGBKTYPE**

This call gets the keyboard type. It returns one of the following values, as defined in `/usr/include/sys/kd.h`:

```c
#define KB_84     1 /* 84 key keyboard */
#define KB_101    2 /* 101 key keyboard */
#define KB_OTHER  3 /* Other type keyboard */
```

**KDGBKENT**

This call reads one of the entries in the translation tables. The argument to the call is the address of one of the following structures, defined in `/usr/include/sys/kd.h`, with the first two fields filled in:

```c
struct kbentry {
    uchar kb_table; /* Table to use */
    uchar kb_index; /* Entry in table */
    ushort kb_value; /* Value to get/set */
};
```
Valid values for the `kb_table` field are:

```c
#define K_NORMTAB 0x00 /* Base */
#define K_SHIFTTAB 0x01 /* Shifted */
#define K_ALTTAB 0x02 /* Alt */
#define K_ALTSHIFTTAB 0x03 /* Shifted alt */
#define K_SRQTAB 0x04 /* Select sysreq */
```

The `ioctl` will get the indicated entry from the indicated table and return it in the third field.

The `K_SRQTAB` value for the `kb_table` field allows access to the scancode indexed table which allows assignment of a given virtual terminal selector (`K_VTF-K_VTL`) or the virtual terminal layer manager (`K_MGRF-K_MGRL`) special key assignments.

The virtual terminal selector (`K_VTF`) is normally associated with `/dev/tty00`, on which the user login shell is commonly found. The following terminal selectors also are used to select virtual terminals:

- `K_VTF+1` for the 1st virtual terminal (`/dev/vt01`)
- `K_VTF+2` for the 2nd virtual terminal (`/dev/vt02`)
- ...
- `K_VTF+12` for the 12th virtual terminal (`/dev/vt12`)

KDSKBBNT

This call sets an entry in one of the translation tables. It uses the same structure as the `KDSKBBNT ioctl`, but with the third field filled in with the value that should be placed in the translation table. This can be used to partially or completely remap the keyboard. This ioctl does not work for all keycodes.

The `kd` driver provides support for virtual terminals. The console minor device, `/dev/vtmon`, provides virtual terminal key requests from the `kd` driver to the process that has `/dev/vtmon` open. Two `ioctl`s are provided for virtual terminal support:

VT_GETSTATE

The `VT_GETSTATE ioctl` returns global virtual terminal state information. It returns the active virtual terminal in the `v_active` field, and the number of active virtual terminals and a bit mask of the global state in the `v_state` open field, where bit `x` is the state of `vt x` (1 indicates that the virtual terminal is open).

VT_SENDSIG

The `VT_SENDSIG ioctl` specifies a signal (in `v_signal`) to be sent to a bit mask of virtual terminals (in `v_state`).
The data structure used by the VT_GETSTATE and VT_SENDSIG ioctls is:

```c
struct vt_stat {
    ushort v_active; /* active vt */
    ushort v_signal; /* signal to send (VT_SENDSIG) */
    ushort v_state;  /* vt bit mask (VT_SENDSIG and VT_GETSTATE) */
};
```
and is defined in `/usr/include/sys/vt.h`

**VT_OPENQRY**

The VT_OPENQRY ioctl is used to get the next available virtual terminal. It inquires if this vt is already open. This value is set in the last argument of the ioctl (2) call.

**GIO_KEYMAP**

This call gets the entire keyboard mapping table from the kernel. The structure of the argument is given in `/usr/include/sys/kd.h`

**PIO_KEYMAP**

This call sets the entire keyboard mapping table. The structure of the argument is given in `/usr/include/sys/kd.h`

**GIO_STRMAP**

This call gets the function key string mapping table from the kernel. The structure of the argument is given in `/usr/include/sys/kd.h`

**PIO_STRMAP**

This call sets the function key string mapping table. The structure of the argument is given in `/usr/include/sys/kd.h`

**TIOCKBOF**

Extended character codes are disabled. This is the default mode.

**TIOCKBON**

Allows extended characters to be transmitted to the user program when the extended keys are enabled. Then the keyboard is said to be fully enabled. The extended characters are transmitted as a null byte followed by a second byte containing the character’s extended code. When a true null byte is sent, it is transmitted as two consecutive null bytes.

When the keyboard is fully enabled, an 8-bit character code can be obtained by holding down the ALT key and entering the 3-digit decimal value of the character from the numeric keypad. The character is transmitted when the ALT key is released.

Some keyboard characters have special meaning. Under default operations, pressing the DELETE key generates an interrupt signal that is sent to all processes designated with the associated control terminal. When the keyboard is fully enabled, holding down the ALT key and pressing the 8 key on the home keyboard (not on the numeric keypad) returns a null byte followed by 0x7F. This will produce the same effect as the DELETE key (0x7F) unless you have executed the stty(1) command with the -isig option.
keyboard(7)

KBENABLED
If the keyboard is fully enabled (TIOCKBON), a non-zero value will be returned. If the keyboard is not fully enabled (TIOCKBOF), a value of zero will be returned.

GETFKEY
Obtains the current definition of a function key. The argument to the call is the address of one of the following structures defined in /usr/include/sys/kd.h:

```c
struct fkeyarg {
    unsigned short keynum;
    unchar keydef [MAXFK]; /* Comes from ioctl.h via comcrt.h */
    char flen;
};
```

The function key number must be passed in `keynum` (see arg structure above). The string currently assigned to the key will be returned in `keydef` and the length of the string will be returned in `flen` when the ioctl is performed.

SETFKEY
Assigns a given string to a function key. It uses the same structure as the GETFKEY ioctl. The function key number must be passed in `keynum`, the string must be passed in `keydef`, and the length of the string (number of characters) must be passed in `flen`.

FILES
/dev/console
/dev/vt00-n
/usr/include/sys/kd.h

SEE ALSO
ascii(5), console(7), display(7), ioctl(2), stty(1), termio(7), vtmgr(1)
NAME

kmem – perform I/O on kernel memory based on symbol name

SYNOPSIS

#include <sys/ksym.h>

int ioctl(int kmemfd, MIOC_READKSYM, struct mioc_rksym *rks);
int ioctl(int kmemfd, MIOC_IREADKSYM, struct mioc_rksym *rks);
int ioctl(int kmemfd, MIOC_WRITEKSYM, struct mioc_rksym *rks);

DESCRIPTION

When used with a valid file descriptor for /dev/kmem (kmemfd), these ioctl commands [see ioctl(2)] can be used to read or write kernel memory based on information provided in the mioc_rksym structure, which includes the following members:

- char *mirk_symname; /* symbol at whose address read will start */
- void *mirk_buf; /* buffer into which data will be written */
- size_t mirk_buflen; /* length (in bytes) of read buffer */

The second argument to ioctl determines which I/O operation is being performed:

<table>
<thead>
<tr>
<th>ioctl</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>MIOC_READKSYM</td>
<td>Read buflen bytes of kernel memory starting at the address for symname into buf.</td>
</tr>
<tr>
<td>MIOC_IREADKSYM</td>
<td>Read sizeof(void *) bytes of kernel memory starting at the address for symname and use that as the address from which to read buflen bytes of kernel memory into buf.</td>
</tr>
<tr>
<td>MIOC_WRITEKSYM</td>
<td>Write buflen bytes into kernel memory starting at the address for symname from buf.</td>
</tr>
</tbody>
</table>

DIAGNOSTICS

In addition to the error conditions listed on ioctl(2), these ioctl commands can fail for the following reasons:

- EBADF     kmemfd open for reading and this is MIOC_WRITEKSYM or kmemfd open for writing and this is MIOC_READKSYM
- EFAULT    Value of mirk_buflen results in attempt to read outside kernel virtual address space, or the third argument to ioctl is an invalid pointer, or an invalid pointer is given for the symbol name or buffer in the mioc_rksym structure
- EINVAL    Second argument to ioctl is invalid
- ENAMETOOLONG Symbol name is longer than MAXSYMNMLEN characters
- ENOMATCH   Symbol names not found in the running kernel (including loaded modules)
- ENXIO      kmemfd open on wrong minor device (that is, not /dev/kmem)
SEE ALSO
getksym(2), ioctl(2), nlist(3E)
ldterm (7)

NAME

ldterm – standard STREAMS terminal line discipline module

DESCRIPTION

ldterm is a STREAMS module that provides most of the termio(7) terminal interface. This module does not perform the low-level device control functions specified by flags in the c_cflag word of the termio/termios structure or by the IGNBRK, IGNPAR, PARMRK, or INPCK flags in the c_iflag word of the termio/termios structure; those functions must be performed by the driver or by modules pushed below the ldterm module. All other termio/termios functions are performed by ldterm; some of them, however, require the cooperation of the driver or modules pushed below ldterm and may not be performed in some cases. These include the IXOFF flag in the c_iflag word and the delays specified in the c_oflag word.

ldterm also handles EUC and multi-byte characters.

When ldterm is pushed onto a stream, the open routine initializes the settings of the termio flags. The default settings are:

   c_iflag = BRKINT|ICRNL|IXON|ISTRIP
   c_oflag = OPOST|ONLRC|TAB3
   c_cflag = 0
   c_lflag = ISIG|ICANON|ECHO|ECHOK

The remainder of this section describes the processing of various STREAMS messages on the read- and write-side.

Read-side Behavior

Various types of STREAMS messages are processed as follows:

M_BREAK When this message is received, either an interrupt signal is generated or the message is treated as if it were an M_DATA message containing a single ASCII NUL character, depending on the state of the BRKINT flag.

M_DATA This message is normally processed using the standard termio input processing. If the ICANON flag is set, a single input record ("line") is accumulated in an internal buffer and sent upstream when a line-terminating character is received. If the ICANON flag is not set, other input processing is performed and the processed data are passed upstream.

If output is to be stopped or started as a result of the arrival of characters (usually CNTRL-Q and CNTRL-S), M_STOP and M_START messages are sent downstream. If the IXOFF flag is set and input is to be stopped or started as a result of flow-control considerations, M_STOPI and M_STARTI messages are sent downstream.

M_DATA messages are sent downstream, as necessary, to perform echoing.

If a signal is to be generated, an M_FLUSH message with a flag byte of FLUSHR is placed on the read queue. If the signal is also to flush output, an M_FLUSH message with a flag byte of FLUSHW is sent downstream.
ldterm(7)

M_CTL
If the size of the data buffer associated with the message is the size of
struct iocblk, ldterm will perform functional negotiation to determine where the termio(7) processing is to be done. If the command
field of the iocblk structure (ioc_cmd) is set to MC_NO_CANON, the input
canonical processing normally performed on M_DATA messages is disabled and those messages are passed upstream unmodified; this is for
the use of modules or drivers that perform their own input processing,
such as a pseudo-terminal in TIOCREMOTE mode connected to a program
that performs this processing. If the command is MC_DO_CANON, all input
processing is enabled. If the command is MC_PART_CANON, then an
M_DATA message containing a termios structure is expected to be
attached to the original M_CTL message. The ldterm module will exam­
ine the iflag, oflag, and Iflag fields of the termios structure and
from then on will process only those flags which have not been turned
ON. If none of the above commands are found, the message is ignored;
in any case, the message is passed upstream.

M_FLUSH
The read queue of the module is flushed of all its data messages and all
data in the record being accumulated are also flushed. The message is
passed upstream.

M_IOCACK
The data contained within the message, which is to be returned to the
process, are augmented if necessary, and the message is passed
upstream.

All other messages are passed upstream unchanged.

Write-side Behavior
Various types of STREAMS messages are processed as follows:

M_FLUSH
The write queue of the module is flushed of all its data messages and
the message is passed downstream.

M_IOCTL
The function of this ioctl is performed and the message is passed
downstream in most cases. The TCFLUSH and TCXONC ioctls can be per­
formed entirely in the ldterm module, so the reply is sent upstream and
the message is not passed downstream.

M_DATA
If the OPOST flag is set, or both the XCASE and I_CANON flags are set, output
processing is performed and the processed message is passed
downstream along with any M_DELAY messages generated. Otherwise,
the message is passed downstream without change.

All other messages are passed downstream unchanged.

ioctls
The following ioctls are processed by the ldterm module. All others are passed
downstream. EUC_WSET and EUC_WGET are I_STR ioctl calls whereas other
ioctls listed here are TRANSPARENT ioctls.

TCGETS/TCGETA
The message is passed downstream; if an acknowledgment is seen, the
data provided by the driver and modules downstream are augmented
and the acknowledgement is passed upstream.
Idterm(7)

TCSETS/TCSETSW/TCSETSF/TCSETA/TCSETAW/TCSETAF
The parameters that control the behavior of the Idterm module are changed. If a mode change requires options at the stream head to be changed, an M_SETOPTS message is sent upstream. If the ICANON flag is turned on or off, the read mode at the stream head is changed to message-nondiscard or byte-stream mode, respectively. If the TOSTOP flag is turned on or off, the tostop mode at the stream head is turned on or off, respectively.

TCFLSH
If the argument is 0, an M_FLUSH message with a flag byte of FLUSHR is sent downstream and placed on the read queue. If the argument is 1, the write queue is flushed of all its data messages and an M_FLUSH message with a flag byte of FLUSHW is sent upstream and downstream. If the argument is 2, the write queue is flushed of all its data messages and an M_FLUSH message with a flag byte of FLUSHRW is sent downstream and placed on the read queue.

TCXONC
If the argument is 0 and output is not already stopped, an M_STOP message is sent downstream. If the argument is 1 and output is stopped, an M_START message is sent downstream. If the argument is 2 and input is not already stopped, an M_STOPI message is sent downstream. If the argument is 3 and input is stopped, an M_STARTI message is sent downstream.

TCSBRK
The message is passed downstream, so the driver has a chance to drain the data and then send an M_IOCACK message upstream.

EUC_WSET
This call takes a pointer to an eucioc structure, and uses it to set the EUC line discipline’s local definition for the code set widths to be used for subsequent operations. Within the stream, the line discipline may optionally notify other modules of this setting via M_CTL messages.

EUC_WGET
This call takes a pointer to an eucioc structure, and returns in it the EUC code set widths currently in use by the EUC line discipline.

SEE ALSO
pseudo(1), console(7), termio(7), termios(2)
NAME
   lo – software loopback network interface

SYNOPSIS
   d = open("/dev/loop", O_RDWR);

DESCRIPTION
   The loopback device is a software datalink provider (interface driver) that returns
   all packets it receives to their source without involving any hardware devices. It is
   a STREAMS device conforming to the datalink provider interface (DLPI). See if(7)
   for a general description of network interfaces.

   The loopback interface is used to access Internet services on the local machine.
   Because it is available on all machines, including those with no hardware network
   interfaces, programs can use it for guaranteed access to local servers. A typical
   application is the comsat(1M) server which accepts notification of mail delivery
   from a local client. The loopback interface is also used for performance analysis
   and testing.

   By convention, the name of the loopback interface is lo0, and it is configured with
   Internet address 127.0.0.1. This address may be changed with the
   SIOCSIFADDR ioctl().

SEE ALSO
   comsat(1M), if(7), inet(7)
log(7)

NAME

log – interface to STREAMS error logging and event tracing

SYNOPSIS

#include <sys/stream.h>
#include <sys/log.h>
#include <sys/strlog.h>
#include <sys/syslog.h>

DESCRIPTION

log is a STREAMS software device driver that provides an interface for console logging and for the STREAMS error logging and event tracing processes [strerr(1M), strace(1M)]. log presents two separate interfaces: a function call interface in the kernel through which STREAMS drivers and modules submit log messages; and a subset of ioctl(2) system calls and STREAMS messages for interaction with a user level console logger, an error logger, a trace logger, or processes that need to submit their own log messages.

Kernel Interface

log messages are generated within the kernel by calls to the function strlog:

```
strlog(short mid, short sid, char level, ushort flags,
       char *fmt, unsigned arg1, ... );
```

Required definitions are contained in stream.h, strlog.h, log.h, and syslog.h in /usr/include/sys. mid is the STREAMS module ID number for the module or driver submitting the log message. sid is an internal sub-ID number usually used to identify a particular minor device of a driver. level is a tracing level that allows for selective screening out of low priority messages from the tracer. flags are any combination of SL_ERROR (the message is for the error logger), SL_TRACE (the message is for the tracer), SL_CONSOLE (the message is for the console logger), SL_FATAL (advisory notification of a fatal error), and SL_NOTIFY (request that a copy of the message be mailed to the system administrator). fmt is a printf(3S) style format string, except that %s, %e, %E, %g, and %G conversion specifications are not handled. Up to NLOGARGS (currently 3) numeric or character arguments can be provided.

User Interface

log is opened via the clone interface, /dev/log. Each open of /dev/log obtains a separate stream to log. In order to receive log messages, a process must first notify log whether it is an error logger, trace logger, or console logger via a STREAMS I_STR ioctl call (see below). For the console logger, the I_STR ioctl has an ic_cmd field of I_CONSLOG, with no accompanying data. For the error logger, the I_STR ioctl has an ic_cmd field of I_ERRLOG, with no accompanying data. For the trace logger, the ioctl has an ic_cmd field of I_TRCLOG, and must be accompanied by a data buffer containing an array of one or more struct trace_ids elements. Each trace_ids structure specifies an mid, sid, and level from which message will be accepted. strlog will accept messages whose mid and sid exactly match those in the trace_ids structure, and whose level is less than or equal to the level given in the trace_ids structure. A value of -1 in any of the fields of the trace_ids structure indicates that any value is accepted for that field.
Once the logger process has identified itself via the `ioctl` call, `log` will begin sending up messages subject to the restrictions noted above. These messages are obtained via the `getmsg(2)` system call. The control part of this message contains a `log_ctl` structure, which specifies the `mid`, `sid`, `level`, `flags`, time in ticks since boot that the message was submitted, the corresponding time in seconds since Jan. 1, 1970, a sequence number, and a priority. The time in seconds since 1970 is provided so that the date and time of the message can be easily computed, and the time in ticks since boot is provided so that the relative timing of `log` messages can be determined.

The priority is comprised of a priority code and a facility code, found in `sys/syslog.h`. If `SL_CONSOLE` is set in `flags`, the priority code is set as follows. If `SL_WARN` is set, the priority code is set to `LOG_WARNING`. If `SL_FATAL` is set, the priority code is set to `LOG_CRIT`. If `SL_ERROR` is set, the priority code is set to `LOG_ERR`. If `SL_NOTE` is set, the priority code is set to `LOG_NOTICE`. If `SL_TRACE` is set, the priority code is set to `LOG_DEBUG`. If only `SL_CONSOLE` is set, the priority code is set to `LOG_INFO`. Messages originating from the kernel have the facility code set to `LOG_KERN`. Most messages originating from user processes will have the facility code set to `LOG_USER`.

Different sequence numbers are maintained for the error and trace logging streams, and are provided so that gaps in the sequence of messages can be determined (during times of high message traffic some messages may not be delivered by the logger to avoid hogging system resources). The data part of the message contains the unexpanded text of the format string (null terminated), followed by `NLOGARGS` words for the arguments to the format string, aligned on the first word boundary following the format string.

A process may also send a message of the same structure to `log`, even if it is not an error or trace logger. The only fields of the `log_ctl` structure in the control part of the message that are accepted are the `level`, `flags`, and `pri` fields; all other fields are filled in by `log` before being forwarded to the appropriate logger. The data portion must contain a null terminated format string, and any arguments (up to `NLOGARGS`) must be packed one word each, on the next word boundary following the end of the format string.

`ENXIO` is returned for `I_TRCLOG` `ioctl`s without any `trace_ids` structures, or for any unrecognized `I_STR` `ioctl`s. Incorrectly formatted `log` messages sent to the driver by a user process are silently ignored (no error results).

Processes that wish to write a message to the console logger may direct their output to `/dev/conslog`, using either `write(2)` or `putmsg(2)`.

**EXAMPLES**

Example of `I_ERRLOG` notification:

```c
struct strioctl ioc;

ioc.ic_cmd = I_ERRLOG;

/* default timeout (15 secs.) */

ioctl(log, I_STR, &ioc);
```
Example of `I_TRCLOG` notification:

```c
struct trace_ids tid[2];
tid[0].ti_mid = 2;
tid[0].ti_sid = 0;
tid[0].ti_level = 1;
tid[1].ti_mid = 1002;
tid[1].ti_sid = -1; /* any sub-id will be allowed */
tid[1].ti_level = -1; /* any level will be allowed */

ioc.ic_cmd = I_TRCLOG;
ic.oic_timeout = 0;
ic.oic_len = 2 * sizeof(struct trace_ids);
ic.oic_dp = (char *)tid;

ioctl(log, I_STR, &ioc);
```

Example of submitting a log message (no arguments):

```c
struct strbuf ctl, dat;
struct log_ctl lc;
char *message = "Don’t forget to pick up some milk on the way home";

ctl.len = ctl.maxlen = sizeof(lc);
ctl.buf = (char *)&lc;

dat.len = dat.maxlen = strlen(message);
dat.buf = message;

lc.level = 0;
lc.flags = SL_ERROR|SL_NOTIFY;

putmsg(log, &ctl, &dat, 0);
```

FILES
```
/dev/log
/dev/conslog
```

SEE ALSO
`clone(7), getmsg(2), intro(2), putmsg(2), strace(1M), strerr(1M), write(2)`

NOTES
The `log` driver high and low water marks are tunable via the master file.
NAME

lp – parallel port interface

DESCRIPTION

The parallel port (lp) driver supports both the primary (monochrome) and secondary parallel printer adapters simultaneously. Up to two printers are supported. If an adapter for a printer is not installed, an attempt to open it will fail. The close waits until all output is completed before returning to the user. The lp driver allows only one process at a time to write to the adapter. If it is already busy, an open for writing will return an error. However, the driver allows multiple opens to occur if they are read-only.

The parallel printer adapters are character devices. The minor device number corresponds to the primary or secondary parallel printer adapter. Thus, minor device 0 corresponds to the primary parallel printer adapter, while minor device 1 corresponds to the secondary adapter.

The parallel port behaves as described in termio(7).

FILES

/dev/lp*

SEE ALSO

stty(1), termio(7)
The MCIS host adapter subsystem serves as a means for SCSI target drivers (such as sd01, st01, and so on) to communicate on the SCSI bus with target controllers and logical units. This driver implements the SCSI Driver Interface (SDI) for such SCSI target drivers.

It is also possible to access this subsystem using the pass-through driver interface. To find the appropriate device to use, while any device is being accessed through the target driver, use the B_GETDEV ioctl to get the major and minor numbers of the pass-through node. This node may be created and opened for use.

**ioctl Calls**

There are three groups of ioctl(2) commands supported by mcis. The first group contains the ioctl commands used by the mcis driver itself:

**SDI_SEND**

Sends a pass-through command to a target controller, bypassing the associated target driver.

**SDI_BRESET**

Resets the SCSI bus.

**B_REDT**

Reads the extended edt data structure that is stored in the mcis driver’s internal data structure.

**B_HA_CNT**

Gets the value of the number of host adapters for which the mcis driver is configured.

The second group is used by the mcis driver and all target drivers that use the SDI protocol to communicate with their associated target controllers.

**B_GETTYPE**

Returns the bus name (for example, scsi) and device driver name of a specific device.

The third group should be supported by all target drivers that use the SDI protocol to communicate with their associated target controllers. However, this ioctl is not supported by the mcis driver.

**B_GETDEV**

Returns the pass-through major and minor numbers to the calling utility to allow creation of a pass-through special device file.

**Files**

/usr/include/sys/mcis.h
/usr/include/sys/scsi.h
/usr/include/sys/sdi.h
/usr/include/sys/sdi_edt.h
/etc/conf/pack.d/mcis/space.c
NOTICES
On IBM MCA SCSI systems (for example, Model 57 and Model 90), the SCSI boot disk must be configured to be at SCSI target address (SCSI ID) 6. If you attempt to use a SCSI disk not at SCSI ID 6 as a boot device, it may not work.

REFERENCES
ioctl(2)
mem(7)

NAME

mem, kmem – core memory

DESCRIPTION

The file /dev/mem is a special file that is an image of the core memory of the com­
puter. For example, it may be used to examine and patch the system.

Byte addresses in /dev/mem are interpreted as memory addresses. References to
non-existent locations cause errors to be returned.

Examining and patching device registers is likely to lead to unexpected results
when read-only or write-only bits are present.

The file /dev/kmem is the same as /dev/mem except that kernel virtual memory
rather than physical memory is accessed.

Files

/dev/mem
/dev/kmem

NOTES

Some of /dev/kmem cannot be read because of write-only addresses or unequipped
memory addresses.
NAME

mouse – mouse device driver for bus, serial, and PS/2 mouse devices

DESCRIPTION

The mouse device driver supports several types of mouse devices:

Logitech bus mouse that attaches to a plug-in card and is designed to be used in an eight-bit card slot.

Logitech serial type mouse that plugs directly into a serial port connector.

PS/2 compatible mouse that connects to a PS/2 auxiliary port.

Microsoft bus mouse that attaches to a plug-in card and is designed to be used in an eight-bit card slot.

Microsoft serial type mouse that plugs directly into a serial port connector.

The driver will support multiple mouse applications running in virtual terminal screens, both under the UNIX System and MS-DOS via SimulTask, VP/ix, Merge, or another similar product.

Support for mouse administration is also provided. See mouseadmin(1).

The following ioctl’s are supported:

- **MOUSEIOCMON**  Used exclusively by /usr/lib/mousemgr to receive open and close commands from /dev/mouse driver.

- **MOUSEISOPEN**  Used exclusively by mouseadmin. Returns 16-byte character array indicating which mouse devices are currently open; 1 is open, 0 is not open. The array is in the linear order established by /usr/bin/mouseadmin in building the display and device map pairs.

- **MOUSEIOCCONFIG**  Used exclusively by mouseadmin to configure display and mouse pairs. The mse_cfg data structure is used to pass display and device mapping and map pair count information to the driver:

```c
struct mse_cfg {
    struct mousemap *mapping;
    unsigned count;
}

struct mousemap {
    dev_t disp_dev;
    dev_t mse_dev;
}

int type;
```

- **MOUSEIOCREAD**  Read mouse position and status data. The following data structure is used to return mouse position information to a user application:
mouse(7)

```c
define struct mouseinfo {
    unsigned char status;
    char xmotion;
    char ymotion;
}
```

`MOUSEIOCREAD` will set `errno` to `EFAULT` for failure to return a valid `mouseinfo` structure. The `status` byte contains the button state information according to the following format:

```
0 Mv Lc Mc Rc L M R
```

where:

- **Mv**: is 1 if the mouse has moved since last `MOUSEIOCREAD`
- **Lc**: is 1 if Left button has changed state since last `MOUSEIOCREAD`
- **Mc**: is 1 if Middle button has changed state since last `MOUSEIOCREAD`
- **Rc**: is 1 if Right button has changed state since last `MOUSEIOCREAD`
- **L**: current state of Left button (1 == depressed)
- **M**: current state of Middle button
- **R**: current state of Right button

The `Mv` bit is required because the total x and y delta since the last `MOUSEIOCREAD` ioctl could be 0 yet the mouse may have been moved. The `Lc`, `Mc`, and `Rc` bits are required for a similar reason; if a button had been pushed and released since the last `MOUSEIOCREAD` ioctl, the current state bit would be unchanged but the application would want to know the button had been pushed.

The `xmotion` and `ymotion` fields are signed quantities relative to the previous position in the range -127 to 127. Deltas that would overflow a signed char have been truncated.

Used to send commands and receive responses from the PS/2 compatible mouse devices. Failed `MOUSE320` commands will return `ENXIO` as the `errno` value. The following data structure is used to pass commands, status, and position information between the driver and a user application:

```c
struct cmd_320 {
    int cmd;
    int arg1;
    int arg2;
    int arg3;
}
```

Valid commands for the PS/2 compatible devices are as follows:
mouse (7)

**MSERESET** reset mouse
**MSERESEND** resend last data
**MSESETDEF** set default status
**MSEOFF** disable mouse
**MSEON** enable mouse
**MSESPROMPT** set prompt mode
**MSEECHON** set echo mode
**MSEECHOFF** reset echo mode
**MSESTREAM** set stream mode
**MSESETRES** set resolution (counts per millimeter)
valid arg1 values are as follows:

- 00 = 1 count/mm.
- 01 = 2 count/mm.
- 02 = 4 count/mm.
- 03 = 8 count/mm.

**MSESCALE2** set 2:1 scaling
**MSESCALE1** set 1:1 scaling
**MSECHGMOD** set sampling rate (reports per second)
valid arg1 values are as follows:

- 0A = 10 reports/sec.
- 14 = 20 reports/sec.
- 28 = 40 reports/sec.
- 3C = 60 reports/sec.
- 50 = 80 reports/sec.
- 64 = 100 reports/sec.
- C8 = 200 reports/sec.

**MSEGETDEV** read device type returns a zero (0) for the PS/2 compatible mouse.

**MSEREPOR** read mouse report returns three-byte mouse/button position where bytes two and three are 9-bit 2's complement relative motions with the 9th bit (sign bit) coming from byte 1.

Byte 1
- **b0** - left button (1 == depressed)
- **b1** - right button
- **b2** - middle button
- **b3** - always 1
- **b4** - X data sign (1 == negative)
- **b5** - Y data sign
- **b6** - X data overflow
- **b7** - Y data overflow
mouse (7)

Byte 2
   X axis position data

Byte 3
   Y axis position data

MSESTATREQ status request returns three-byte report with the following format:

Byte 1
   b0 - right button (1 == depressed)
   b1 - middle button
   b2 - left button
   b3 - always 0
   b4 - scaling 1:1 = 0, 2:1 = 1
   b5 - disabled(0)/enabled(1)
   b6 - stream(0)/prompt(1) mode
   b7 - always 0

Byte 2
   b0 - 6 current resolution
   b7 - always 0

Byte 3
   b0 - 7 current sampling rate

NOTE
The mouse also supports queue mode for accessing mouse input, both motion and button events; see display(7) for more information on the KDQUEMODE ioctl.

FILES
/dev/mouse
/usr/lib/mousemgr
/usr/include/sys/mouse.h

SEE ALSO
mouseadmin(1)
NAME
  \texttt{null} – the null file

DESCRIPTION
  Data written on the null special file, \texttt{/dev/null}, is discarded.
  Reads from a null special file always return 0 bytes.

Files
  \texttt{/dev/null}
pckt(7)

NAME
pckt – STREAMS Packet Mode module

DESCRIPTION
pckt is a STREAMS module that may be used with a pseudo terminal to packetize
certain messages. The pckt module should be pushed [see I_PUSH, streamio(7)]
onto the master side of a pseudo terminal.

Packetizing is performed by prefixing a message with an M_PROTO message. The
original message type is stored in the 4 byte data portion of the M_PROTO message.

On the read-side, only the M_PROTO, M_PCPROTO, M_STOP, M_START, M_STOPI,
M_STARTI, M_IOCTL, M_DATA, M_FLUSH, and M_READ messages are packetized. All
other message types are passed upstream unmodified.

Since all unread state information is held in the master's stream head read queue,
flushing of this queue is disabled.

On the write-side, all messages are sent down unmodified.

With this module in place, all reads from the master side of the pseudo terminal
should be performed with the getmsg(2) or getpmsg system call. The control part
of the message contains the message type. The data part contains the actual data
associated with that message type. The onus is on the application to separate the
data into its component parts.

SEE ALSO
crash(1M), getmsg(2), ioctl(2), ldtterm(7), ptem(7), pty(7), streamio(7),
termio(7)
NAME

prf – operating system profiler

DESCRIPTION

The special file /dev/prf provides access to activity information in the operating system. The profiler commands load the measurement facility with text addresses to be monitored. Reading the file returns these addresses and a set of counters indicative of activity between adjacent text addresses.

The recording mechanism is driven by the system clock and samples the program counter at line frequency. Samples that catch the operating system are matched against the stored text addresses and increment corresponding counters for later processing.

The file /dev/prf is a pseudo-device with no associated hardware.

FILES

/dev/prf

NOTES

If the prf device is not configured into the kernel, to turn it on you must edit the /etc/conf/sdevice.d/prf file, change the second field from N to Y, and reconfigure the kernel.

When the profiler is turned on, loadable modules are locked into memory and cannot be unloaded. Subsequently loaded modules will also be locked until profiling is disabled.

SEE ALSO

profiler(1M)
**ptem(7)**

**NAME**

`ptem` - STREAMS pseudo-terminal emulation module

**DESCRIPTION**

`ptem` is a STREAMS module that when used in conjunction with a line discipline and pseudo terminal driver emulates a terminal. See `pseudo(1)`.

The `ptem` module must be pushed [see `I_PUSH, streamio(7)`] onto the slave side of a pseudo terminal STREAM, before the `ldterm` module is pushed.

On the write-side, the `TCSETA`, `TCSETAF`, `TCSETAW`, `TCGETA`, `TCSETS`, `TCSETSW`, `TCSETSF`, `TCGETS`, `TCSBRK`, `JWINSIZE`, `TIOCOWINSZ`, and `TIOCWSWINSZ` `termio ioctl` messages are processed and acknowledged. A hang up (such as stty 0) is converted to a zero length `M_DATA` message and passed downstream. `termio cflags` and window row and column information are stored locally one per stream. `M_DELAY` messages are discarded. All other messages are passed downstream unmodified.

On the read-side all messages are passed upstream unmodified with the following exceptions. All `M_READ` and `M_DELAY` messages are freed in both directions. An `ioctl TCSBRK` is converted to an `M_BREAK` message and passed upstream and an acknowledgement is returned downstream. An `ioctl TIOCSIGNAL` is converted into an `M_PCSIG` message, and passed upstream and an acknowledgement is returned downstream. Finally an `ioctl TIOCREMOTE` is converted into an `M_CTL` message, acknowledged, and passed upstream.

**SEE ALSO**

`crash(1M), ioctl(2), ldterm(7), pckt(7), pseudo(1), pty(7), streamio(7), stty(1), termio(7)`
NAME

pty - STREAMS pseudo-terminal driver

DESCRIPTION

The pseudo-terminal subsystem (pty) supports a pair of STREAMS-based devices called the master device and the slave device. The slave device provides processes with an interface that is identical to the terminal interface. However, whereas all devices that provide the terminal interface have some kind of hardware device behind them, the slave device has another process manipulating it through the master half of the pseudo terminal. Anything written on the master device is given to the slave as input and anything written on the slave device is presented as input on the master side.

The master device, called ptm, is accessed through the clone driver and is the controlling part of the system. The slave device, called pts, works with a line discipline module such as ldterm(7), a hardware emulation module such as ptem(7), and optionally with an ioctl translation module such as ttcompat(7) to provide a terminal interface to the user process. An optional packetizing module called pckt(7) is also provided to support "packet mode" when it is pushed on the master side.

The master device is opened via the open(2) system call with /dev/ptmx as the device to be opened. The clone open finds the next available minor device for that major device; a master device is available only if it and its corresponding slave device are not already open.

When the master device is opened, the corresponding slave device is automatically locked out, and no user may open that device until it is unlocked. A user may invoke grantpt(3C) to change the owner and permissions of the slave device to that of the user who is running the process. Once the permissions have been changed, the device may be unlocked by the user. Only the owner or a privileged user can access the slave device. The user then invokes unlockpt(3C) to unlock the slave device. The user calls ptsname(3C) to get the name of the slave device, and then invokes the open system call with the name that was returned by the function.

After both the master and slave devices have been opened, the user has two file descriptors that provide full-duplex communication using two streams. The two streams are automatically connected. The user may then push modules onto either side of the stream. The user also must push the ptem and ldterm modules onto the slave side to get terminal semantics.

The master and slave devices pass all STREAMS messages to their adjacent queues. Only M_FLUSH needs some processing. Because the read queue of one side is connected to the write queue of the other, the FLUSHR flag is changed to FLUSHW and vice versa.

When the master device is closed, an M_HANGUP message is sent to the slave device, which renders the device unusable. The process on the slave side gets the errno ENXIO when attempting to write on that stream, but it can read any data remaining on the stream head read queue. When all the data have been read, read returns 0, indicating that the stream can no longer be used.
On the last close of the slave device, a zero-length message is sent to the master side. When the master side application issues a read and 0 is returned, the user decides whether to issue a close, which dismantles the pseudo-terminal, or not close the master device so that the pseudo-tty subsystem will be available for another user to open the slave device.

**ioctl**s

The master device supports the **ISPTM** and **UNLKPT** ioctl that are used by the **grantpt**, **unlockpt**, and **ptsname** functions.

The **ioctl** **ISPTM** determines whether the file descriptor is that of an open master device. On success, it returns the major/minor number (type **dev_t**) of the master device, which can be used to determine the name of the corresponding slave device. On failure it returns -1.

The **ioctl** **UNLKPT** unlocks the master and slave devices. It returns 0 on success. On failure, it returns -1 and sets **errno** to **EINVAL**, indicating that the master device is not open.

The format of these commands is:

```c
int ioctl (int fd, int command, int arg);
```

where **command** is either **ISPTM** or **UNLKPT** and **arg** is 0.

The master side application is responsible for detecting an interrupt character and sending an interrupt signal **SIGINT** to the process on the slave side. This can be done as follows:

```c
ioctl (fd, TIOCSIGNAL, SIGINT);
```

where **SIGINT** is defined in the header file **signal.h**.

**FILES**

- **/dev/ptmx** pseudo-terminal master device
- **/dev/pts/*** pseudo-terminal slave devices

**SEE ALSO**

- **grantpt(3C)**, **ldterm(7)**, **pckt(7)**, **pseudo(1)**, **ptem(7)**, **ptsname(3C)**, **ttcompat(7)**, **unlockpt(3C)**
NAME

rtc – real time clock interface

DESCRIPTION

The rtc driver supports the real time clock chip, allowing it to be set with the correct local time and allowing the time to be read from the chip.

ioctl Calls

RTCSTIME

This call is used to set the time into the real time clock chip. The argument to the ioctl is the address of a buffer of RTCNREG unsigned characters (RTCNREG is defined in sys/rtc.h). The ioctl will fill in the buffer with the contents of the chip registers. Currently, RTCNREG is 14, and the meanings of the byte registers are as follows:

<table>
<thead>
<tr>
<th>Register</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Seconds</td>
</tr>
<tr>
<td>1</td>
<td>Second alarm</td>
</tr>
<tr>
<td>2</td>
<td>Minutes</td>
</tr>
<tr>
<td>3</td>
<td>Minute alarm</td>
</tr>
<tr>
<td>4</td>
<td>Hours</td>
</tr>
<tr>
<td>5</td>
<td>Hour alarm</td>
</tr>
<tr>
<td>6</td>
<td>Day of week</td>
</tr>
<tr>
<td>7</td>
<td>Date of month</td>
</tr>
<tr>
<td>8</td>
<td>Month</td>
</tr>
<tr>
<td>9</td>
<td>Year</td>
</tr>
<tr>
<td>A</td>
<td>Status register A</td>
</tr>
<tr>
<td>B</td>
<td>Status register B</td>
</tr>
<tr>
<td>C</td>
<td>Status register C</td>
</tr>
<tr>
<td>D</td>
<td>Status register D</td>
</tr>
</tbody>
</table>

For further information on the functions of these registers, see your hardware technical reference manual.

RTCSTIME

This call is used to set the time into the real time clock chip. The argument to ioctl is the address of a buffer of RTCNREGP unsigned characters (RTCNREGP is defined in sys/rtc.h). These bytes should be the desired chip register contents. Currently, RTCNREGP is 10, representing registers 0–9 as shown above. Note that only the super-user may open the real time clock device for writing and that the RTCSTIME ioctl will fail for any other than the super-user.

FILES

/dev/rtc
The STREAMS Administrative Driver provides an interface for applications to perform administrative operations on STREAMS modules and drivers. The interface is provided through ioctl(2) commands. Privileged operations may access the sad driver via /dev/sad/admin. Unprivileged operations may access the sad driver via /dev/sad/user.

fildes is an open file descriptor that refers to the sad driver. command determines the control function to be performed as described below. arg represents additional information that is needed by this command. The type of arg depends upon the command, but it is generally an integer or a pointer to a command-specific data structure.

Commands
The autopush facility [see autopush(1M)] allows one to configure a list of modules to be automatically pushed on a stream when a driver is first opened. Autopush is controlled by the next commands.

SAD_SAP Allows the administrator to configure the autopush information for the given device. arg points to a strapush structure which contains the following members:

- `uint sap_cmd;`
- `long sap_major;`
- `long sap_minor;`
- `long sap_lastminor;`
- `long sap_npush;`
- `uint sap_list[MAXAPUSH][FMNAMESZ + 1];`

The sap_cmd field indicates the type of configuration being done. It may take on one of the following values:

- **SAP_ONE** Configure one minor device of a driver.
- **SAP_RANGE** Configure a range of minor devices of a driver.
- **SAP_ALL** Configure all minor devices of a driver.
- **SAP_CLEAR** Undo configuration information for a driver.

The sap_major field is the major device number of the device to be configured. The sap_minor field is the minor device number of the device to be configured. The sap_lastminor field is used only with the SAP_RANGE command, with which a range of minor devices between sap_minor and sap_lastminor, inclusive, are to be configured. The minor fields have no meaning for the SAP_ALL
command. The sap_npush field indicates the number of modules to be automatically pushed when the device is opened. It must be less than or equal to MAXAPUSH, defined in sad.h. It must also be less than or equal to NSTRPUSH, the maximum number of modules that can be pushed on a stream, defined in the kernel master file. The field sap_list is an array of module names to be pushed in the order in which they appear in the list.

When using the SAP_CLEAR command, the user sets only sap_major and sap_minor. This will undo the configuration information for any of the other commands. If a previous entry was configured as SAP_ALL, sap_minor should be set to zero. If a previous entry was configured as SAP_RANGE, sap_minor should be set to the lowest minor device number in the range configured.

On failure, errno is set to the following value:

- **EFAULT**  
  arg points outside the allocated address space.

- **EINVAL**  
  The major device number is invalid, the number of modules is invalid, or the list of module names is invalid.

- **ENOSTR**  
  The major device number does not represent a STREAMS driver.

- **EEXIST**  
  The major-minor device pair is already configured.

- **ERANGE**  
  The command is SAP_RANGE and sap_lastminor is not greater than sap_minor, or the command is SAP_CLEAR and sap_minor is not equal to the first minor in the range.

- **ENODEV**  
  The command is SAP_CLEAR and the device is not configured for autopush.

- **ENOSR**  
  An internal autopush data structure cannot be allocated.

### **SAD_GAP**

Allows any user to query the sad driver to get the autopush configuration information for a given device. arg points to a strapush structure as described in the previous command.

The user should set the sap_major and sap_minor fields of the strapush structure to the major and minor device numbers, respectively, of the device in question. On return, the strapush structure will be filled in with the entire information used to configure the device. Unused entries in the module list will be zero-filled.

On failure, errno is set to one of the following values:

- **EFAULT**  
  arg points outside the allocated address space.

- **EINVAL**  
  The major device number is invalid.
sad(7)

ENOSTR  The major device number does not represent a STREAMS driver.
ENODEV  The device is not configured for autopush.

SAD_VML  Allows any user to validate a list of modules (for example, to see if they are installed on the system). arg is a pointer to a str_list structure with the following members:

    int         sl_nmods;
    struct str_mlist  *sl_modlist;

The str_mlist structure has the following member:

    char     l_name[FMNAMESZ+1];

sl_nmods indicates the number of entries the user has allocated in the array and sl_modlist points to the array of module names. The return value is 0 if the list is valid, 1 if the list contains an invalid module name, or -1 on failure. On failure, errno is set to one of the following values:

EFAULT  arg points outside the allocated address space.
EINVAL  The sl_nmods field of the str_list structure is less than or equal to zero.

SEE ALSO  intro(2), ioctl(2), open(2)

DIAGNOSTICS  Unless specified otherwise above, the return value from ioctl is 0 upon success and -1 upon failure with errno set as indicated.
NAME
sc01 – CD-ROM Target Driver

DESCRIPTION
sc01 is a Portable Device Interface (PDI)-compliant CD-ROM target driver that provides access to one or more CD-ROM drives. Each drive must be attached to a SCSI bus controlled by an PDI-compliant host adapter driver [for example, see adsc(7)].

Access to a particular drive is accomplished using the sc01 device files located in /dev/[r]cdrom. Each device file identifies a particular drive based on the SCSI ID assigned to that drive. The binding between a device file and a CD-ROM drive is as follows:

/dev/rcdrom/cd0  CD-ROM drive with lowest SCSI ID
/dev/rcdrom/cd1  CD-ROM drive with next to lowest SCSI ID
and so on.

Most CD-ROM drives can handle CD-ROM disks that contain two types of data: informational data and audio data. The sc01 driver allows access to both types of data.

A CD-ROM disk that contains informational data is treated as a random-access storage device, such as a hard disk. The information on the disk is divided into consecutively numbered, fixed-size (usually 2 Kbytes) sectors that can be accessed in any order. The standard tools for reading data from a random-access device, such as dd(1) or read(2), can be used to read informational data from a CD-ROM. However, all write operations are prohibited.

Audio commands control the operation of the drive’s audio output hardware (usually a headphone jack located on the drive). For example, the C_PLAYAUDIO ioctl causes the audio hardware to decode and convert the audio data to analog at a specific location on the disk, and play the audio on the drive’s audio output hardware. Audio data is not returned to the host system.

All audio data commands are executed through the ioctl interface and often require a parameter structure that identifies the audio data to be acted upon. Unlike informational data, audio data is not referenced by a sector address. The methods used to identify a particular section of audio data should be described in the SCSI interface section of the reference manual supplied with your CD-ROM drive. Audio data cannot be read as if it were informational data, and informational data cannot be played using the drive’s audio hardware.

ioctl Calls
The sc01 driver uses several ioctl(2) commands, listed below. Many of these ioctl(2) commands provide a convenient method for sending one of the preselected SCSI commands directly to the drive. SCSI commands not explicitly supported by the sc01 driver can be sent to the drive using the pass-through facility provided by the SDI host adapter driver. For an example, see adsc(7).

The following ioctls are used to identify a target driver and to get a pass-through major and minor number for a target device.
**B_GETTYPE**

Returns the type of peripheral bus (for example, *scsi*) used and the name of this driver (for example, *sc01*).

**B_GETDEV**

Returns the major and minor number of the pass-through device for the CD-ROM drive. For example, see *adsc(7)* for details.

The following ioctls cause the appropriate Group-0, Group-1, or Group-6 SCSI commands to be sent to the device. These commands are defined by the SCSI bus specification and should also be described in the SCSI Interface section of the reference manual supplied with your CD-ROM drive.

**Group 0**

*C_TESTUNIT*

Sends a Test Unit Ready command to the device.

*C_REZERO*

Sends a Rezero Device command to the device.

*C_SEEK*

Sends a Seek command to the device.

*C_INQUIR*

Sends an Inquiry command to the device and returns the resulting data back to the caller.

*C_STARTUNIT*

Sends a Start Unit command to the device.

*C_STOPUNIT*

Sends a Stop Unit command to the device.

*C_PREVMV*

Sends a Prevent Media Removal command to the device.

*C_ALLOMV*

Sends an Allow Media Removal command to the device.

**Group-1**

*C_READCAPA*

Sends a Read Capacity command to the device and returns the data sent by the drive.

**Group-6**

*C_AUDIOSEARCH*

Sends an Audio Search command to the device.

*C_PLAYAUDIO*

Sends a Play Audio command to the device.

*C_STILL*

Sends a Still command to the device.
C_TRAYOPEN
     Sends a Tray Open command to the device.

C_TRAYCLOSE
     Sends a Tray Close command to the device.

Note: The Group 6 IOCTL's support only the drives that are software compatible with the Toshiba XM-3201B.

The following ioctls are also supported by the sc01 driver.

B_GET_SUBDEVS
     Returns the number of sub-devices supported by this driver (for example, 1).

Files
/usr/include/sys/cd_ioctl.h
/usr/include/sys/cdrom.h
/usr/include/sys/sc01.h
/etc/conf/pack.d/sc01/space.c
/dev/[r]cdrom/cd*
/usr/include/sys/scsi.h
/usr/include/sys/sdi.h
/usr/include/sys/sdi_edt.h

REFERENCES
    adsc(7), dpt(7), ioctl(2), mcis(7), sd01(7), st01(7), sw01(7), wd7000(7)
The `sd01` disk target driver is the device-level driver for both Small Computer System Interface (SCSI) hard disks, SCSI optical disks, and ESDI/ST506/IDE/MFM integral disks. It provides block and character (raw) access to the disk, and I/O controls (`ioctl`) to the disk. `sd01` sets up two levels of organization to the disk, to allow the disk to be shared with other operating systems, and provide efficient sized portions within the UNIX system.

The first level of organization of the disk by `sd01` is the partition table. The partition table divides the disk into pieces (called partitions) which serve as a logical disks. There are a maximum of 4 partitions for each disk. A partition has four characteristics: a start sector, a length, an operating system type (for example, UNIX, DOS, Extended DOS, and so on), and an active flag (which indicates the current bootable partition). A valid partition has at least the first three fields defined. A bootable valid partition has all four fields defined/ on.

The partition table is maintained by the `fdisk(1M)` command. The `sd01` target driver searches the partition table for UNIX partitions. The active flag is used not only to indicate that a partition on the boot disk is bootable, but also indicates whether it is accessible (for example, a UNIX partition on the second disk which isn’t active cannot be accessed).

Within a UNIX partition is the second level of organization of the disk. The UNIX partition is broken into contiguous sections called slices. The slices of a UNIX partition are defined by the Virtual Table Of Contents (VTOC). The VTOC provides the means to break up the UNIX partition in smaller pieces to better manage the space, to differentiate slices for special purposes, and to allow protection of some of the slices. The VTOC allows for a maximum of 16 slices per disk. A slice also has four characteristics: a start sector, a length, a slice type (for example, root, user, swap, stand, and so on), and permissions (valid and mountable/unmountable). A slice can contain a filesystem (for example, VXFS, S5, BFS, and so on), can be used as swap space for paging, or left to be organized by an application such as a database.

Several of the slices have required definitions as follows:

Slice 0  The whole UNIX partition; that is, it has the same start and length as the UNIX partition.

Slice 7  The boot slice which contains UNIX boot code (if it is the boot disk), the VTOC information, and the PDINFO (described later). This slice occupies sector 1 through 34 of UNIX partition.

Slice 8  The alternates slice, containing the table of remapped sectors, sectors which have been remapped, and spare sectors available for remapping.

Slice 9  Used in 4.0 and earlier UNIX releases additionally as the alternate track area. The alternates mechanism was consolidated in SVR4.2 to use one slice.

On the boot disk, there are several other slices which also have required definitions:
Slice 1  The root filesystem
Slice 2  The swap slice
Slice 10  The boot slice which contains the BFS filesystem

Finally, on a boot disk, the optional filesystems are organized as follows:
Slice 3  The /usr filesystem
Slice 4  The /home filesystem
Slice 5  Points to the first DOS partition, if defined
Slice 6  The dump slice (holds memory dumps)
Slice 11  The /var filesystem
Slice 12  The /home2 filesystem
Slice 13  The /tmp filesystem
Slice 14  Points to the second DOS partition, if defined
Slice 15  Points to the third DOS partition, if defined

The slices of a disk are represented by device nodes, which have the major number for sdOl and a minor number pointing to one of slices. Since there are sixteen slices, there are therefore sixteen minors per disk, so minor 0 through 15 are for the first disk, 16 through 31 are for the second disk, 32 through 47 for the third disk and so on. The system supports 256 minors per major number so thus there are 16 sets of disk devices per major number. sdOl supports multiple major numbers, and currently supports 7 major numbers, which allows for up to 112 disks. When the disk device is opened, the partition table and the VTOC are read by sdOl to fill out its tables of partitions and slices.

Mapping of bad blocks is performed dynamically and automatically by the sdOl disk driver, without user intervention and without retaining a fixed bad block log on the disk. The SCSI direct-access controllers reassign the defective blocks to an area on the disk reserved for this purpose. The sdOl disk driver can map both marginal bad blocks (that is, readable with some difficulty) and actual bad blocks (that is, unreadable). The sdOl driver does not map or report a bad block residing in a non-UNIX System (that is, MS-DOS) partition of the disk. In addition, even with dynamic bad block handling, it is possible for damage to occur that cannot be mapped automatically. This means that you may have to restore the file system from the last full backup, if the bad block occurs in a critical area of the disk which cannot tolerate bad sectors.

The sdOl disk driver reports problems with driver error messages. The error numbers in the error messages identify the type of error. For SCSI sense codes, extended sense codes, and command codes, see the file /usr/include/sys/scsi.h. For SDI return codes, see the file
The \texttt{sd01} driver receives command requests from the kernel through the Input/Output (I/O) control call \texttt{ioctl(2)}. The \texttt{sd01} driver generates the requested commands and passes them to the host adapter driver. When command execution is complete, the host adapter driver notifies the \texttt{sd01} driver through an interrupt. After this notification, the \texttt{sd01} driver performs any required error recovery and indicates to the kernel that the I/O request is complete.

The files in the \texttt{/dev/dsk} directory access the disk through the system's normal buffering mechanism, and may be read and written without regard to physical disk records.

There is also a [r] raw interface that provides for direct transmission between the disk and the user's read or write buffer. A single read or write call results in exactly one I/O operation. Therefore, raw I/O is considerably more efficient when many words are transmitted. The names of the raw disk files contain \texttt{/dev/rdsk} and have the same form as the \texttt{/dev/dsk} files.

In raw I/O, the buffer must begin on a \(512\)-byte boundary, and transfer counts must be integral multiples of \(512\) bytes.

The special device file names associated with the \texttt{sd01} disk driver have the form:

\begin{verbatim}
/dev/[r]dsk/c#t#d#s#
\end{verbatim}

The naming convention for the \texttt{sd01} disk special device file name components is as follows:

\begin{itemize}
\item \texttt{[r]}: The optional \texttt{r} in \texttt{/rdsk} denotes a raw (that is, character) device; \texttt{dsk} without the optional \texttt{r} indicates a block device.
\item \texttt{c#}\#: \# is the occurrence of the host adapter board in the system (that is, card number), ranging are from 0-2 (machine dependent).
\item \texttt{t#}\#: \# is the target controller number, ranging are from 0-F hexadecimal.
\item \texttt{d#}\#: \# is the logical unit number of the disk device, ranging are from 0-3, since each target controller currently supports up to four disks.
\item \texttt{s#}\#: \# is the disk slice number or VTOC partition number, ranging are from 0-F hexadecimal.
\end{itemize}

The disk parameters—number of cylinders, heads, and sectors per track—are obtained at driver initialization (init) time. If the disk is an ESDI/ST506/IDE drive, the CMOS contains parameters for the first two disks. For SCSI disks, a read capacity command is issued, and the disk parameters are calculated based on a disk geometry of 32 sectors per track and 64 heads. This geometry is for drives with 512 byte sectors. It is adjusted if the number of bytes per sector changes. The disk parameters are stored in Physical Descriptor Information (PDINFO) structure which is stored in the boot slice of the disk. The PDINFO is kept as a sanity check against those found at driver init time.

When the machine is booted, the primary boot code (BIOS) looks in the \texttt{fdisk} table for the active partition and jumps to sector 0 of that partition to find the first-stage bootstrap. If the first-stage bootstrap is over one sector in length, it is the responsibility of the first-stage bootstrap to understand this. The boot code will read in the VTOC to locate the BFS filesystem. It will then load the kernel and begin executing...
the kernel.

**ioctl Calls**

The ioctl calls used by the sd01 driver to control the reading and writing of data to disk are as follows:

**V_CONFIG**

Used to modify the parameters (cylinders and heads) of a disk device. Its usage is not recommended and it is no longer used in any of the system commands. The argument to the ioctl is the address of one of the following structures, defined in `sys/vtoc.h`, containing the new configuration parameters:

```c
union io_arg {
    struct {
        ushortncyl;/* Number of cylinders */
        uncharnhead;/* Heads/cylinder */
        uncharnsec;/* Sectors/track */
        ushortsecsiz;/* Bytes/sector */
    } ia_cd;
}
```

Note that it is not possible to change the sector size on the hard disk with this ioctl, and that an attempt to do so results in the ioctl failing, with `errno` set to `EINVAL`. This call is provided for backward compatibility with any commands which use it. This call should no longer be used and will be removed in the future.

**V_REMOUNT**

Forces sd01 to re-read the VTOC on the next open operation of the drive. It fails if any slice other than slice 0 is currently open, since the VTOC information cannot be updated while a process is using a slice. This is used by `disksetup` when it changes the VTOC to signal sd01 to update its internal tables.

**V_GETPARMS**

Gets information about the current drive configuration. The argument to the ioctl is the address of the following structure, defined in `sys/vtoc.h`, which are filled in by the ioctl:

```c
struct disk_parms {
    char dp_type;/* Disk type (see below) */
    unchar dp_heads;/* No. of heads */
    ushort dp_cyls;/* No. of cylinders */
    unchar dp_sectors;/* No. of sectors/track */
    ushort dp_secsiz;/* No. of bytes/sector */
    ushort dp_ptag;/* Currently not used */
    ushort dp_pflag;/* Currently not used */
    daddr_t dp_pstartsec;/* Starting abs. sector no. */
    daddr_t dp_pnumsec;/* Currently not used */
}
```

/* Disk types */
#define DPT_NOTDISK0 /* Not a disk device */
#define DPT_WIN1 /* Winchester disk */
#define DPT_FLOPPY2 /* Floppy */
#define DPT_OTHER3 /* Other type of disk */
#define DPT_SCSI_HD4 /* SCSI hard disk */
#define DPT_SCSI_OD5 /* SCSI optical disk */

/* Partition tag */
#define V_BOOT1 /* Bootable partition */
#define V_ROOT2 /* Root filesystem */
#define V_SWAP3 /* Swap slice */
#define V_USR4 /* User filesystem */
#define V_BACKUP5 /* Entire disk */
#define V_ALTS6 /* Alternate sectors (SVR4.0 and earlier) */
#define V_OTHER7 /* Non-UNIX System partition */
#define V_ALTTTRK8 /* Alternate tracks (SVR4.0 and earlier) */
#define V_STAND9 /* Stand (BFS) filesystem */
#define V_VAR0A /* Var filesystem */
#define V_HOME0B /* Home filesystem */
#define V_DUMP0C /* Dump slice */
#define V_ALTSCTR0D /* Alternate sectors (SVR4.2) */

/* Partition flag */
#define V_UNMNT0x001 /* Unmountable partition */
#define V_RONLYOx010 /* Read only partition */
#define V_OPENOx100 /* Partition open */
#define V_VALID0x200 /* Partition valid to use */

For SCSI disks the disk type is DPT_SCSI_HD. For ESDI/ST506/IDE disks the disk type is DPT_WIN1.

V_PDLOC
Returns the logical sector address of the pdinfo structure. The value is returned in pdloc.

unsigned long pdloc;

V_RDABS / V_WRABS
Used as a means for reading/writing any sector on the hard disk. Only users with root privilege can freely access any sector. Users who do not have root privilege can access the partition table (sector 0) or the boot slice (to allow access to the VTOC). The absolute sector address to be written to is placed in abs_sec. The data for the sector is read to or written from abs_buf. The size of abs_buf should be disk_parms.dp_secsize for the current drive. Note that both the first cylinder (containing the fdisk table, first-stage bootstrap and VTOC) and the first track of the active partition (containing the first-stage bootstrap) can only be accessed using partition 0, since these tracks are normally not considered part of any other partition in the VTOC. The absio structure is defined in sys/vtoc.h.
struct absio {
    daddr_tabs_sec;/* Absolute sector no. (from 0) */
    char*abs_buf;/* Sector buffer */
};

V_PREAD/V_PWRITE
Used to read or write any size data block on the disk, regardless of the physical sector size. Only users with root privilege can use these calls. The starting logical sector address to be written to or read from is placed in sectst, the number of bytes to be transferred is placed in datasz, the data to be transferred is placed in memaddr, and the phyio structure is defined in sys/vtoc.h.

struct phyio {
    intretval;/* Return value */
    unsignedlong sectst;/* Sector address */
    unsignedlong memaddr;/* Buffer address */
    unsignedlong datasz;/* Transfer size in bytes */
};

V_PDREAD/V_PDWRITE
Used to read or write the Physical Description sector on the disk, regardless of this sector’s location. Only users with root privilege can use these calls. The starting logical sector address to be written to or read from is assigned by the sd01 driver, the physical sector size of the disk must be placed in datasz, the data to be transferred is placed in memaddr, and the phyio structure is defined in sys/vtoc.h.

SD_PDLOC
Returns the physical sector address of the pdinfo structure. The value is returned in pdloc.

unsignedlongpdloc;

SDI_RESERVE
Reserves a SCSI disk for a processor.

SDI_RELEASE
Releases a SCSI disk from a processor.

SDI_RESTAT
Returns device reservation status.

The following ioctl commands are used to identify a target driver and to get pass-through major and minor numbers for a target device:

B_GETTYPE
Returns the bus name (for example, scsi) and device driver name (for example, sd01) of a specific device.

B_GETDEV
Returns the pass-through major and minor numbers to the calling utility, allowing creation of a pass-through special device file.
sd01(7)

Files
/dev/dsk/*
/dev/rdsk/*
/usr/include/sys/scsi.h
/usr/include/sys/sdi.h
/usr/include/sys/sdi_edt.h
/usr/include/sys/vtoc.h

NOTES
The sd01 driver retries failed transfers up to two times depending on the error type. Certain errors are not retried. sd01 displays an appropriate message upon encountering an error during the transfer.

The VTOC and second-stage bootstrap require that no bad sectors occur in the first 30 sectors of the UNIX System partition on the disk. When a marginal bad block occurs, the driver’s warning indicates that the controller’s error-correction algorithm successfully recovered from an error. This may be a symptom of a sector going bad.

REFERENCES
adsc(7), disksetup(1M), dpt(7), edvtoc(1M), fdisk(1M), fs(4), ioctl(2) mcis(7) mount(1M), prtvtoc(1M), sd01(7), st01(7), sw01(7), wd7000(7)
NAME
sockio - ioctl that operate directly on sockets

SYNOPSIS
#include <sys/sockio.h>

DESCRIPTION
The ioctl listed in this manual page apply directly to sockets, independent of any underlying protocol. The setsockopt call (see getsockopt(3N)) is the primary method for operating on sockets, rather than on the underlying protocol or network interface. ioctl for a specific network interface or protocol are documented in the manual page for that interface or protocol.

SIOCSPGRP
The argument is a pointer to an int. Set the process-group ID that will subsequently receive SIGIO or SIGURG signals for the socket referred to by the descriptor passed to ioctl to the value of that int.

SIOCGPGRP
The argument is a pointer to an int. Set the value of that int to the process-group ID that is receiving SIGIO or SIGURG signals for the socket referred to by the descriptor passed to ioctl.

SIOCCATMARK
The argument is a pointer to an int. Set the value of that int to 1 if the read pointer for the socket referred to by the descriptor passed to ioctl points to a mark in the data stream for an out-of-band message. Set the value of that int to 0 if the read pointer for the socket referred to by the descriptor passed to ioctl does not point to a mark in the data stream for an out-of-band message.

SEE ALSO
ioctl(2) getsockopt(3N),

501
NAME

st01 – Portable Device Interface (PDI) tape target driver

DESCRIPTION

The st01 tape driver receives command requests from the kernel through the read(2), write(2), and ioctl(2) system calls. The st01 driver generates the appropriate commands and passes them through the host adapter driver to the tape device. When command execution is complete, the host adapter driver notifies st01 through an interrupt. After this notification, st01 performs any required error recovery, and indicates to the kernel that the Input/Output (I/O) request is complete. The st01 driver operates independently of the hardware used to communicate with the HBA bus.

I/O requests must be in length a multiple of the tape block length. The default value is 512 bytes.

Only raw character interface files are provided. When opened, the tape is assumed to be positioned as desired. If a retension-on-open special file is opened, the tape is retensioned before any I/O is performed. When a T_RWD, T_RETENSION, T_LOAD, or T_UNLOAD ioctl is requested and the tape has been written, two file marks are written before the ioctl is executed.

The open(2) on a tape device can fail if a tape is not inserted, resulting in the error report EIO. An open(2) can also fail if the tape controller associated with the special file is not detected by the driver. In this case, the error reported is ENXIO.

The following table lists the actions that occur on close, depending on whether the file is designated as rewind or no-rewind, and if the tape was written or read:

<table>
<thead>
<tr>
<th>Rewind on Close?</th>
<th>Tape Read?</th>
<th>Tape Written?</th>
<th>Action on Close</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>Yes</td>
<td>N/A</td>
<td>Rewind tape.</td>
</tr>
<tr>
<td>Yes</td>
<td>N/A</td>
<td>Yes</td>
<td>Write two file marks and rewind tape.</td>
</tr>
<tr>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>Rewind tape</td>
</tr>
<tr>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No tape movement</td>
</tr>
<tr>
<td>No</td>
<td>Yes</td>
<td>N/A</td>
<td>Position tape after next file mark</td>
</tr>
<tr>
<td>No</td>
<td>N/A</td>
<td>Yes</td>
<td>Write one file mark and position tape after this file mark</td>
</tr>
</tbody>
</table>

A read occurring when the tape is positioned immediately before a file mark returns zero(0) bytes, and the tape is positioned after the file mark. As with other raw devices, seeks are ignored. Some tape devices allow both reads and writes to occur between rewinds; the st01 driver supports these devices.

ioctl Calls

The following ioctl calls are used by the st01 driver to control tape positioning:

T_SFF/T_SFB Positions the tape forward or backward arg [see ioctl(2)] number of file marks from the current tape head position toward the End-of-Tape (EOT) or Beginning-of-Tape (BOT). Forward movement of the tape leaves the tape positioned on the EOT side of a file mark or at EOT, and backwards movement leaves the tape positioned on
the BOT side of a file mark or at BOT. A backward positioning operation causes the next read to return 0 bytes unless arg is greater than the number of file marks between the current position and BOT. The value of arg must be a positive integer. A value of 0 is not considered an error, but does not result in any tape movement.

**T_SBF/T_SBB** Positions the tape forward or backward arg number of blocks from the current tape head position toward the EOT or BOT. Upon command completion, the tape head is positioned in the gap between tape blocks. Thus, skipping a block forward advances to the next block, and skipping a block backward retreats to the last block. The value of arg must be a positive integer. Upon any attempt to skip over a file mark, the tape is positioned on the EOT/BOT side of the file mark for forward/backward movement, and the positioning operation ceases. A value of 0 is not considered an error, but does not result in any tape movement.

**T_RWD** Rewinds the tape from the current tape position to the BOT. Two file marks are written before the rewind if the tape has been written. This command does not unload the tape.

**T_WRFILEM** Writes file marks to the tape. The value of arg defines the number of consecutive file marks to be written. If an error occurs while writing file marks, the number of file marks that have been successfully written is indeterminate.

**T_EOD** Positions the tape just beyond the last file mark.

**T_STD** Defines the recording density of the tape media being used. The numeric density code used is as defined in the SCSI-2 draft specification.

**T_PREVMV** Locks the tape in the drive. This prevention may be in the form of a mechanical lock or an LED to indicate the device is in use. **T_PREVMV** is supported only on devices that implement this feature. For example, ICT devices are among those which do not support this ioctl.

**T_ALLOMV** Unlocks the tape in the drive. This command is used to undo the lock created by **T_PREVMV**. **T_ALLOMV** is supported only on devices that implement this feature. For example, ICT devices are among those which do not support this ioctl.

**T_LOAD** Loads the tape media and position the tape BOT.

**T_UNLOAD** Unloads the tape. Most devices rewind the tape before unloading. Devices capable of ejecting the tape will do so in response to this command.

**T_ERASE** Erases the tape, from BOT to EOT. If the tape is not positioned at BOT, the tape is positioned at BOT before performing the erase function.
T_RDBKLEN

Returns the minimum and maximum block lengths supported by the tape device. The value of arg must be a struct blklen. See the file /usr/include/sys/st01.h for more information.

T_WRBLKLEN

Sets the current block length for the tape device. The value of arg must be a struct blklen with both max.blen and min.blen set to the desired block length. See the file /usr/include/sys/st01.h for more information.

T_RETENSION

Retensions the tape in the drive, running the tape at high speed from BOT to EOT, and then back again. The retension operation leaves the tape positioned at BOT.

The following ioctl commands identify a target driver and get a pass-through major and minor number for a target device.

B_GETTYPE

Gets the bus name (for example, scsi) and device driver name (for example, st01) of a specific device.

B_GETDEV

Gets the pass-through major and minor number to the calling utility, allowing creation of a pass-through special device file.

Files

/usr/include/sys/st01_ioctl.h
/usr/include/sys/st01.h
/usr/include/sys/sdi_edt.h

NOTES

Once any drive error is encountered, the driver will not perform any other functions until the file is closed.

The st01 tape driver does not always require block sizes that are in multiples of 512 bytes, but block size is device dependent. You should set the tape driver to use the block size supported by the tape device. Failure to set the block size correctly will result in an error when the driver attempts to write a block of the unsupported size.

The tape driver does not support the use of the sar command.

REFERENCES

adsci(7), close(2), dpt(7), ioctl(2), mcisi(7), read(2), scsi(7), sd01(7), sw01(7), wd7000(7), write(2)
NAME
streamio – STREAMS ioctl commands

SYNOPSIS
#include <sys/types.h>
#include <stropts.h>

int ioctl (int fildes, int command, ... /* arg */);

DESCRIPTION
STREAMS [see intro(2)] ioctl commands are a subset of the ioctl(2) system calls which perform a variety of control functions on streams.

fildes is an open file descriptor that refers to a stream. command determines the control function to be performed as described below. arg represents additional information that is needed by this command. The type of arg depends upon the command, but it is generally an integer or a pointer to a command-specific data structure. The command and arg are interpreted by the stream head. Certain combinations of these arguments may be passed to a module or driver in the stream.

Since these STREAMS commands are a subset of ioctl, they are subject to the errors described there. In addition to those errors, the call will fail with errno set to EINVAL, without processing a control function, if the stream referenced by fildes is linked below a multiplexor, or if command is not a valid value for a stream.

Also, as described in ioctl, STREAMS modules and drivers can detect errors. In this case, the module or driver sends an error message to the stream head containing an error value. This causes subsequent system calls to fail with errno set to this value.

Command Functions
The following ioctl commands, with error values indicated, are applicable to all STREAMS files:

I_PUSH
Pushes the module whose name is pointed to by arg onto the top of the current stream, just below the stream head. If the stream is a pipe, the module will be inserted between the stream heads of both ends of the pipe. It then calls the open routine of the newly-pushed module. On failure, errno is set to one of the following values:

EINVAL
Invalid module name.
EFAULT
arg points outside the allocated address space.
ENXIO
Open routine of new module failed.
ENXIO
Hangup received on fildes.

I_POP
Removes the module just below the stream head of the stream pointed to by fildes. To remove a module from a pipe requires that the module was pushed on the side it is being removed from. arg should be 0 in an I_POP request. On failure, errno is set to one of the following values:

EINVAL
No module present in the stream.
streamio (7)

**I_LOOK**
Retrieves the name of the module just below the stream head of the stream pointed to by *fildes*, and places it in a null terminated character string pointed at by *arg*. The buffer pointed to by *arg* should be at least `FMNAMESZ+1` bytes long. A `#include <sys/conf.h>` declaration is required. On failure, **errno** is set to one of the following values:

- **EFAULT**  
  *arg* points outside the allocated address space.

- **EINVAL**  
  No module present in stream.

**I_FLUSH**
This request flushes all input and/or output queues, depending on the value of *arg*. Valid *arg* values are:

- **FLUSHR**  
  Flush read queues.

- **FLUSHW**  
  Flush write queues.

- **FLUSHRW**  
  Flush read and write queues.

If a pipe or FIFO does not have any modules pushed, the read queue of the stream head on either end is flushed depending on the value of *arg*.

If **FLUSHR** is set and *fildes* is a pipe, the read queue for that end of the pipe is flushed and the write queue for the other end is flushed. If *fildes* is a FIFO, both queues are flushed.

If **FLUSHW** is set and *fildes* is a pipe and the other end of the pipe exists, the read queue for the other end of the pipe is flushed and the write queue for this end is flushed. If *fildes* is a FIFO, both queues of the FIFO are flushed.

If **FLUSHRW** is set, all read queues are flushed, that is, the read queue for the FIFO and the read queue on both ends of the pipe are flushed.

Correct flush handling of a pipe or FIFO with modules pushed is achieved via the `pipemod` module. This module should be the first module pushed onto a pipe so that it is at the midpoint of the pipe itself.

On failure, **errno** is set to one of the following values:

- **ENOSR**  
  Unable to allocate buffers for flush message due to insufficient STREAMS memory resources.

- **EINVAL**  
  Invalid *arg* value.

- **ENXIO**  
  Hangup received on *fildes*.

**I_FLUSHBAND**
Flushes a particular band of messages. *arg* points to a `bandinfo` structure that has the following members:

```c
unsigned char   bi_pri;
int             bi_flag;
```

The **bi_flag** field may be one of **FLUSHR**, **FLUSHW**, or **FLUSHRW** as described earlier.
Informs the stream head that the user wants the kernel to issue the `SIGPOLL` signal [see `signal(2)`] when a particular event has occurred on the stream associated with `fildes`. `I_SETSIG` supports an asynchronous processing capability in STREAMS. The value of `arg` is a bitmask that specifies the events for which the user should be signaled. It is the bitwise-OR of any combination, except where noted, of the following constants:

- **S_INPUT**: Any message other than an `M_PCPROTO` has arrived on a stream head read queue. This event is maintained for compatibility with prior releases. This is set even if the message is of zero length.
- **S_RDNORM**: An ordinary (non-priority) message has arrived on a stream head read queue. This is set even if the message is of zero length.
- **S_RDBAND**: A priority band message (band > 0) has arrived on a stream head read queue. This is set even if the message is of zero length.
- **S_HIPRI**: A high priority message is present on the stream head read queue. This is set even if the message is of zero length.
- **S_OUTPUT**: The write queue just below the stream head is no longer full. This notifies the user that there is room on the queue for sending (or writing) data downstream. This event is the same as `S_OUTPUT`.
- **S_WRNORM**: This event is the same as `S_OUTPUT`.
- **S_WRBAND**: A priority band greater than 0 of a queue downstream exists and is writable. This notifies the user that there is room on the queue for sending (or writing) priority data downstream.
- **S_MSG**: A STREAMS signal message that contains the `SIGPOLL` signal has reached the front of the stream head read queue.
- **S_ERROR**: An `M_ERROR` message has reached the stream head.
- **S_HANGUP**: An `M_HANGUP` message has reached the stream head.
- **S_BANDURG**: When used in conjunction with `S_RDBAND`, `SIGURG` is generated instead of `SIGPOLL` when a priority message reaches the front of the stream head read queue.

A user process may choose to be signaled only of high priority messages by setting the `arg` bitmask to the value `S_HIPRI`.

Processes that want to receive `SIGPOLL` signals must explicitly register to receive them using `I_SETSIG`. If several processes register to receive this signal for the same event on the same stream, each process will be signaled when the event occurs.
streamio (7)

If the value of arg is zero, the calling process will be unregistered and will not receive further SIGPOLL signals. On failure, errno is set to one of the following values:

EINVAL  arg value is invalid or arg is zero and process is not registered to receive the SIGPOLL signal.

EAGAIN   Allocation of a data structure to store the signal request failed.

I_GETSIG  Returns the events for which the calling process is currently registered to be sent a SIGPOLL signal. The events are returned as a bitmask pointed to by arg, where the events are those specified in the description of I_SETSIG above. On failure, errno is set to one of the following values:

EINVAL  Process not registered to receive the SIGPOLL signal.

EFAULT   arg points outside the allocated address space.

I_FIND   Compares the names of all modules currently present in the stream to the name pointed to by arg, and returns 1 if the named module is present in the stream. It returns 0 if the named module is not present. On failure, errno is set to one of the following values:

EFAULT   arg points outside the allocated address space.

EINVAL  arg does not contain a valid module name.

I_PEEK  Allows a user to retrieve the information in the first message on the stream head read queue without taking the message off the queue. I_PEEK is analogous to getmsg(2) except that it does not remove the message from the queue. arg points to a strpeek structure which contains the following members:

```
struct strbuf  ctlbuf;
struct strbuf  databuf;
long           flags;
```

The maxlen field in the ctlbuf and databuf strbuf structures [see getmsg(2)] must be set to the number of bytes of control information and/or data information, respectively, to retrieve. flags may be set to RS_HIPRI or 0. If RS_HIPRI is set, I_PEEK will look for a high priority message on the stream head read queue. Otherwise, I_PEEK will look for the first message on the stream head read queue.

I_PEEK returns 1 if a message was retrieved, and returns 0 if no message was found on the stream head read queue. It does not wait for a message to arrive. On return, ctlbuf specifies information in the control buffer, databuf specifies information in the data buffer, and flags contains the value RS_HIPRI or 0. On failure, errno is set to the following value:

EFAULT   arg points, or the buffer area specified in ctlbuf or databuf is, outside the allocated address space.
streamio (7)

EBADMSG Queued message to be read is not valid for I_PEEK.
EINVAL Invalid value for flags.

I_SRDOPT Sets the read mode [see read(2)] using the value of the argument arg. Valid arg values are:
RNORM Byte-stream mode, the default.
RMSGD Message-discard mode.
RMSGN Message-nondiscard mode.

Setting both RMSGD and RMSGN is an error. RMSGD and RMSGN override RNORM.

In addition, treatment of control messages by the stream head may be changed by setting the following flags in arg:
RPROTNORM Fail read with EBADMSG if a control message is at the front of the stream head read queue. This is the default behavior.
RPROTDAT Deliver the control portion of a message as data when a user issues read.
RPROTDIS Discard the control portion of a message, delivering any data portion, when a user issues a read.

On failure, errno is set to the following value:
EINVAL arg is not one of the above valid values.
EINVAL Both RMSGD and RMSGN are set.

I_GRDOPT Returns the current read mode setting in an int pointed to by the argument arg. Read modes are described in read(2). On failure, errno is set to the following value:
EFAULT arg points outside the allocated address space.

I_NREAD Counts the number of data bytes in data blocks in the first message on the stream head read queue, and places this value in the location pointed to by arg. The return value for the command is the number of messages on the stream head read queue. For example, if zero is returned in arg, but the ioctl return value is greater than zero, this indicates that a zero-length message is next on the queue. On failure, errno is set to the following value:
EFAULT arg points outside the allocated address space.

I_FDISERT Creates a message from user specified buffer(s), adds information about another stream and sends the message downstream. The message contains a control part and an optional data part. The data and control parts to be sent are distinguished by placement in separate buffers, as described below.

arg points to a strfdinsert structure which contains the following members:
streamio (7)

```c
struct strbuf    ctlbuf;
struct strbuf    databuf;
long             flags;
int              fildes;
int              offset;
```

The `len` field in the `ctlbuf` `strbuf` structure [see `putmsg(2)`] must be set to the size of a pointer plus the number of bytes of control information to be sent with the message. `fildes` in the `strfdinsert` structure specifies the file descriptor of the other stream. `offset`, which must be word-aligned, specifies the number of bytes beyond the beginning of the control buffer where `I_FDINSERT` will store a pointer. This pointer will be the address of the read queue structure of the driver for the stream corresponding to `fildes` in the `strfdinsert` structure. The `len` field in the `databuf` `strbuf` structure must be set to the number of bytes of data information to be sent with the message or zero if no data part is to be sent.

`flags` specifies the type of message to be created. An ordinary (non-priority) message is created if `flags` is set to 0, a high priority message is created if `flags` is set to `RS_HIPRI`. For normal messages, `I_FDINSERT` will block if the stream write queue is full due to internal flow control conditions. For high priority messages, `I_FDINSERT` does not block on this condition. For normal messages, `I_FDINSERT` does not block when the write queue is full and `O_NDELAY` or `O_NONBLOCK` is set. Instead, it fails and sets `errno` to `EAGAIN`.

`I_FDINSERT` also blocks, unless prevented by lack of internal resources, waiting for the availability of message blocks, regardless of priority or whether `O_NDELAY` or `O_NONBLOCK` has been specified. No partial message is sent. On failure, `errno` is set to one of the following values:

- **EAGAIN** A non-priority message was specified, the `O_NDELAY` or `O_NONBLOCK` flag is set, and the stream write queue is full due to internal flow control conditions.
- **ENOSR** Buffers could not be allocated for the message that was to be created due to insufficient STREAMS memory resources.
- **EFAULT** `arg` points, or the buffer area specified in `ctlbuf` or `databuf` is, outside the allocated address space.
- **EINVAL** One of the following: `fildes` in the `strfdinsert` structure is not a valid, open stream file descriptor; the size of a pointer plus `offset` is greater than the `len` field for the buffer specified through `ctlptr`; `offset` does not specify a properly-aligned location in the data buffer; an undefined value is stored in `flags`.
ENXIO  Hangup received on fildes of the ioctl call or fildes in the strfdinsert structure.

ERANGE The len field for the buffer specified through databuf does not fall within the range specified by the maximum and minimum packet sizes of the topmost stream module, or the len field for the buffer specified through databuf is larger than the maximum configured size of the data part of a message, or the len field for the buffer specified through ctlbuf is larger than the maximum configured size of the control part of a message.

I_FDINSERT can also fail if an error message was received by the stream head of the stream corresponding to fildes in the strfdinsert structure. In this case, errno will be set to the value in the message.

I_STR

Constructs an internal STREAMS ioctl message from the data pointed to by arg, and sends that message downstream.

This mechanism is provided to send user ioctl requests to downstream modules and drivers. It allows information to be sent with the ioctl, and will return to the user any information sent upstream by the downstream recipient. I_STR blocks until the system responds with either a positive or negative acknowledgement message, or until the request “times out” after some period of time. If the request times out, it fails with errno set to ETIME.

At most, one I_STR can be active on a stream. Further I_STR calls will block until the active I_STR completes at the stream head. The default timeout interval for these requests is 15 seconds. The O_NDELAY and O_NONBLOCK [see open(2)] flags have no effect on this call.

To send requests downstream, arg must point to a strioctl structure which contains the following members:

```c
int   ic_cmd;
int   ic_timeout;
int   ic_len;
char  *ic_dp;
```

ic_cmd is the internal ioctl command intended for a downstream module or driver and ic_timeout is the number of seconds (\(-1 = \) infinite, \(0 = \) use default, \(>0 = \) as specified) an I_STR request will wait for acknowledgement before timing out. The default timeout is infinite. ic_len is the number of bytes in the data argument and ic_dp is a pointer to the data argument. The ic_len field has two uses: on input, it contains the length of the data argument passed in, and on return from the command, it contains the number of bytes being returned to the user (the buffer pointed to by ic_dp should be large enough to contain the maximum amount of data that any module or the driver in the stream can return).
The stream head will convert the information pointed to by the `ioctl` structure to an internal `ioctl` command message and send it downstream. On failure, `errno` is set to one of the following values:

- **ENOSR**  
  Unable to allocate buffers for the `ioctl` message due to insufficient STREAMS memory resources.

- **EFAULT**  
  `arg` points, or the buffer area specified by `ic_dp` and `ic_len` (separately for data sent and data returned) is, outside the allocated address space.

- **EINVAL**  
  `ic_len` is less than 0 or `ic_len` is larger than the maximum configured size of the data part of a message or `ic_timout` is less than -1.

- **ENXIO**  
  Hangup received on `fildes`.

- **ETIME**  
  A downstream `ioctl` timed out before acknowledgement was received.

An `I_STR` can also fail while waiting for an acknowledgement if a message indicating an error or a hangup is received at the stream head. In addition, an error code can be returned in the positive or negative acknowledgement message, in the event the `ioctl` command sent downstream fails. For these cases, `I_STR` will fail with `errno` set to the value in the message.

- **I_SWROPT**  
  Sets the write mode using the value of the argument `arg`. Legal bit settings for `arg` are:

  - **SNDZERO**  
    Send a zero-length message downstream when a write of 0 bytes occurs.

  To not send a zero-length message when a write of 0 bytes occurs, this bit must not be set in `arg`.

  On failure, `errno` may be set to the following value:

  - **EINVAL**  
    `arg` is not the above valid value.

- **I_GWROPT**  
  Returns the current write mode setting, as described above, in the `int` that is pointed to by the argument `arg`.

- **I_SENDFD**  
  Requests the stream associated with `fildes` to send a message, containing a file pointer, to the stream head at the other end of a stream pipe. The file pointer corresponds to `arg`, which must be an open file descriptor.

  `I_SENDFD` converts `arg` into the corresponding system file pointer. It allocates a message block and inserts the file pointer in the block. The user ID and group ID associated with the sending process are also inserted. This message is placed directly on the read queue [see `intro(2)`] of the stream head at the other end of the stream pipe to which it is connected. On failure, `errno` is set to one of the following values:
EAGAIN

The sending stream is unable to allocate a message block to contain the file pointer.

EAGAIN

The read queue of the receiving stream head is full and cannot accept the message sent by I_SENDFD.

EBADF

arg is not a valid, open file descriptor.

EINVAL

fildes is not connected to a stream pipe.

ENXIO

Hangup received on fildes.

I_RECVFD

Retrieves the file descriptor associated with the message sent by an I_SENDFD ioctl over a stream pipe. arg is a pointer to a data buffer large enough to hold an strrecvfd data structure containing the following members:

```c
int fd;
uid_t uid;
gid_t gid;
char fill[8];
```

fd is an integer file descriptor. uid and gid are the user ID and group ID, respectively, of the sending stream.

If O_NDELAY and O_NONBLOCK are clear [see open(2)], I_RECVFD will block until a message is present at the stream head. If O_NDELAY or O_NONBLOCK is set, I_RECVFD will fail with errno set to EAGAIN if no message is present at the stream head.

If the message at the stream head is a message sent by an I_SENDFD, a new user file descriptor is allocated for the file pointer contained in the message. The new file descriptor is placed in the fd field of the strrecvfd structure. The structure is copied into the user data buffer pointed to by arg.

On failure, errno is set to one of the following values:

EAGAIN

A message is not present at the stream head read queue, and the O_NDELAY or O_NONBLOCK flag is set.

EBADMSG

The message at the stream head read queue is not a message containing a passed file descriptor.

EFAULT

arg points outside the allocated address space.

EMFILE

NOFILES file descriptors are currently open.

ENXIO

Hangup received on fildes.

EOVERFLOW

uid or gid is too large to be stored in the structure pointed to by arg.

I_S_RECVFD

Retrieves the file descriptor associated with the message sent by an I_SENDFD ioctl over a stream pipe. arg is a pointer to a data buffer large enough to hold an s_strrecvfd data structure containing the following members:
int fd;
uid_t uid;
gid_t gid;
struct sub_attr s_attrs;

fd is an integer file descriptor. uid and gid are the user ID and group ID, respectively, of the sending stream. sub_attr contains security relevant information. The sub_attr structure is used as an argument for the secadvise(2) system call, which provides advisory access information.

If O_NDELAY and O_NONBLOCK are clear [see open(2)], I_RECVFD will block until a message is present at the stream head. If O_NDELAY or O_NONBLOCK is set, I_RECVFD will fail with errno set to EAGAIN if no message is present at the stream head.

If the message at the stream head is a message sent by an I_SENDFD, a new user file descriptor is allocated for the file pointer contained in the message. The new file descriptor is placed in the fd field of the s_strrecvfd structure. The structure is copied into the user data buffer pointed to by arg.

On failure, errno is set to one of the following values:

ENOMEM The system cannot allocate memory for the s_strrecvfd structure.
EAGAIN A message is not present at the stream head read queue, and the O_NDELAY or O_NONBLOCK flag is set.
EBADMSG The message at the stream head read queue is not a message containing a passed file descriptor.
EFAULT arg points outside the allocated address space.
EMFILE NOFILES file descriptors are currently open.
ENXIO Hangup received on fildes.
EOVERFLOW uid or gid is too large to be stored in the structure pointed to by arg.

I_LIST Allows the user to list all the module names on the stream, up to and including the topmost driver name. If arg is NULL, the return value is the number of modules, including the driver, that are on the stream pointed to by fildes. This allows the user to allocate enough space for the module names. If arg is non-NULL, it should point to an str_list structure that has the following members:

int sl_nmods;
struct str_mlist *sl_modlist;

The str_mlist structure has the following member:

char l_name[FMNAMESZ+1];
streamio (7)

*sl_nmods* indicates the number of entries the user has allocated in the array. On success, the return value is 0, *sl_modlist* contains the list of module names, and *sl_nmods* indicates the number of entries that have been filled in. On failure, *errno* may be set to one of the following values:

- **EINVAL** The *sl_nmods* member is less than 1.
- **EAGAIN** Unable to allocate buffers

**I_ATMARK** Allows the user to see if the current message on the stream head read queue is "marked" by some module downstream. *arg* determines how the checking is done when there may be multiple marked messages on the stream head read queue. It may take the following values:

- **ANYMARK** Check if the message is marked.
- **LASTMARK** Check if the message is the last one marked on the queue.

If both **ANYMARK** and **LASTMARK** are set, **ANYMARK** supersedes **LASTMARK**.

The return value is 1 if the mark condition is satisfied and 0 otherwise. On failure, *errno* may be set to the following value:

- **EINVAL** A value other than (*ANYMARK|LASTMARK*) is set in *arg*.

**I_CKBAND** Check if the message of a given priority band exists on the stream head read queue. This returns 1 if a message of a given priority exists, or -1 on error. *arg* should be an integer containing the value of the priority band in question. On failure, *errno* may be set to the following value:

- **EINVAL** Invalid *arg* value.

**I_GETBAND** Returns the priority band of the first message on the stream head read queue in the integer referenced by *arg*. On failure, *errno* may be set to the following value:

- **ENODATA** No message on the stream head read queue.

**I_CANPUT** Check if a certain band is writable. *arg* is set to the priority band in question. The return value is 0 if the priority band *arg* is flow controlled, 1 if the band is writable, or -1 on error. On failure, *errno* may be set to the following value:

- **EINVAL** Invalid *arg* value.

**I_SETCLTIME** Allows the user to set the time the stream head will delay when a stream is closing and there is data on the write queues. Before closing each module and driver, the stream head will delay for the specified amount of time to allow the data to drain. If, after the delay, data is still present, data will be flushed. *arg* is a pointer to the number of milliseconds to delay, rounded up to the nearest valid
streamio (7)

value on the system. The default is fifteen seconds. On failure, errno may be set to the following value:

EINVAL    Invalid arg value.

I_GETCLTIME

Returns the close time delay in the long pointed by arg.

The following four commands are used for connecting and disconnecting multiplexed STREAMS configurations.

I_LINK

Connects two streams, where fildes is the file descriptor of the stream connected to the multiplexing driver, and arg is the file descriptor of the stream connected to another driver. The stream designated by arg gets connected below the multiplexing driver. I_LINK requires the multiplexing driver to send an acknowledgement message to the stream head regarding the linking operation. This call returns a multiplexor ID number (an identifier used to disconnect the multiplexor, see I_UNLINK) on success, and a -1 on failure. On failure, errno is set to one of the following values:

ENXIO    Hangup received on fildes.
ETIME    Time out before acknowledgement message was received at stream head.
EAGAIN    Temporarily unable to allocate storage to perform the I_LINK.
ENOSR    Unable to allocate storage to perform the I_LINK due to insufficient STREAMS memory resources.
EBADF    arg is not a valid, open file descriptor.
EINVAL    fildes stream does not support multiplexing.
EINVAL    arg is not a stream, or is already linked under a multiplexor.
EINVAL    The specified link operation would cause a "cycle" in the resulting configuration; that is, if a given driver is linked into a multiplexing configuration in more than one place.
EINVAL    fildes is the file descriptor of a pipe or FIFO.

An I_LINK can also fail while waiting for the multiplexing driver to acknowledge the link request, if a message indicating an error or a hangup is received at the stream head of fildes. In addition, an error code can be returned in the positive or negative acknowledgement message. For these cases, I_LINK will fail with errno set to the value in the message.

I_UNLINK

Disconnects the two streams specified by fildes and arg. fildes is the file descriptor of the stream connected to the multiplexing driver. arg is the multiplexor ID number that was returned by the I_LINK. If arg is -1, then all Streams which were linked to fildes are disconnected. As in I_LINK, this command requires the multiplexing
driver to acknowledge the unlink. On failure, **errno** is set to one of the following values:

- **ENXIO**  
  Hangup received on *fildes*.

- **ETIME**  
  Time out before acknowledgement message was received at stream head.

- **ENOSR**  
  Unable to allocate storage to perform the **I_UNLINK** due to insufficient STREAMS memory resources.

- **EINVAL**  
  *arg* is an invalid multiplexor ID number or *fildes* is not the stream on which the **I_LINK** that returned *arg* was performed.

- **EINVAL**  
  *fildes* is the file descriptor of a pipe or FIFO.

An **I_UNLINK** can also fail while waiting for the multiplexing driver to acknowledge the link request, if a message indicating an error or a hangup is received at the stream head of *fildes*. In addition, an error code can be returned in the positive or negative acknowledgement message. For these cases, **I_UNLINK** will fail with **errno** set to the value in the message.

**I_PLENK**  
Connects two streams, where *fildes* is the file descriptor of the stream connected to the multiplexing driver, and *arg* is the file descriptor of the stream connected to another driver. The stream designated by *arg* gets connected via a persistent link below the multiplexing driver. **I_PLENK** requires the multiplexing driver to send an acknowledgement message to the stream head regarding the linking operation. This call creates a persistent link which can exist even if the file descriptor *fildes* associated with the upper stream to the multiplexing driver is closed. This call returns a multiplexor ID number (an identifier that may be used to disconnect the multiplexor, see **I_PUNLINK**) on success, and a -1 on failure. On failure, **errno** may be set to one of the following values:

- **ENXIO**  
  Hangup received on *fildes*.

- **ETIME**  
  Time out before acknowledgement message was received at the stream head.

- **EAGAIN**  
  Unable to allocate STREAMS storage to perform the **I_PLENK**.

- **EBADF**  
  *arg* is not a valid, open file descriptor.

- **EINVAL**  
  *fildes* does not support multiplexing.

- **EINVAL**  
  *arg* is not a stream or is already linked under a multiplexor.

- **EINVAL**  
  The specified link operation would cause a "cycle" in the resulting configuration; that is, if a given stream head is linked into a multiplexing configuration in more than one place.
streamio (7)

EINVAL  

fildes is the file descriptor of a pipe or FIFO.

An I_PLINK can also fail while waiting for the multiplexing driver to acknowledge the link request, if a message indicating an error on a hangup is received at the stream head of fildes. In addition, an error code can be returned in the positive or negative acknowledgement message. For these cases, I_PLINK will fail with errno set to the value in the message.

I_PUNLINK

Disconnects the two streams specified by fildes and arg that are connected with a persistent link. fildes is the file descriptor of the stream connected to the multiplexing driver. arg is the multiplexor ID number that was returned by I_PLINK when a stream was linked below the multiplexing driver. If arg is MUXID_ALL then all streams which are persistent links to fildes are disconnected. As in I_PLINK, this command requires the multiplexing driver to acknowledge the unlink. On failure, errno may be set to one of the following values:

ENXIO  

Hangup received on fildes.

ETIME  

Time out before acknowledgement message was received at the stream head.

EAGAIN  

Unable to allocate buffers for the acknowledgement message.

EINVAL  

Invalid multiplexor ID number.

EINVAL  

fildes is the file descriptor of a pipe or FIFO.

An I_PUNLINK can also fail while waiting for the multiplexing driver to acknowledge the link request if a message indicating an error or a hangup is received at the stream head of fildes. In addition, an error code can be returned in the positive or negative acknowledgement message. For these cases, I_PUNLINK will fail with errno set to the value in the message.

SEE ALSO

close(2), fcntl(2), getmsg(2), intro(2), ioctl(2), open(2), poll(2), putmsg(2), read(2), signal(2), signal(5), write(2)

DIAGNOSTICS

Unless specified otherwise above, ioctl returns 0 on success and -1 on failure and sets errno as indicated.
NAME

swOl – Portable Device Interface (PDI) WORM Target Driver

DESCRIPTION

The swOl driver is a PDI-compliant WORM (Write Once Read Many) target driver that provides access to one or more WORM drives. Each drive must be attached to a SCSI Bus that is controlled by a PDI-compliant host adapter driver.

Access to the particular drive is accomplished through the swOl device nodes located in /dev/[rl]worm.

Each device node identifies a particular drive based on the SCSI ID assigned to that drive. The binding between a device node and a WORM drive is as follows:

- /dev/rworm/worm0  WORM drive with lowest SCSI ID
- /dev/rworm/worm1  WORM drive with next to lowest SCSI ID

and so on.

A WORM drive uses removable media divided into consecutively numbered, fixed-size sectors that may be accessed in any order, similar to a hard disk. Most of the standard tools for reading and writing to and from a hard disk, such as such as dd(1) or read(2), work with a WORM drive. However, keep in mind that for WORM drives, each sector can be written to only once. This characteristic causes problems if a WORM device is mounted [mount(1M)] without using the read-only flag, -r.

ioctl Calls

The swOl driver supports several ioctl functions [see ioctl(2) in the Programmer’s Reference Manual], which are accessed through the ioctl system call. Many of the supported ioctl calls provide a convenient method for sending one of the preselected SCSI commands directly to the drive. SCSI commands not explicitly supported by swOl can be sent to the drive using the pass-through facility provided by the SDI host adapter driver.

The following ioctl calls are defined and required by the SDI interface.

- **B_GETTYPE**  Returns the type of peripheral bus (for example, scsi) used and the name of the driver (for example, swOl) for this specific device
- **B_GETDEV**   Returns the major and minor number of the pass-through device for the WORM drive
- **SDI_reserve** Sends a SCSI Reserve command to the drive
- **SDI_release** Sends a SCSI Release command to the drive

The following ioctl calls send the appropriate Group-0 SCSI command to the device. These commands are defined by the SCSI bus specification and should also be described in the SCSI interface section of the reference manual supplied with your WORM drive.

- **W_TESTUNIT** Sends a Test Unit Ready command to the device
The following ioctl calls send the appropriate Group-1 SCSI command to the device. The Group-1 SCSI commands are defined by the SCSI bus specification and should be described in the SCSI interface section of the reference manual supplied with your WORM drive.

- `W_REZERO` Sends a Rezero Device command to the device
- `W_SEEK` Sends a Seek command to the device
- `W_INQUIRY` Sends an Inquiry command to the device, and returns the resulting data back to the calling process
- `W_STARTUNIT` Sends a Start Unit command to the device
- `W_STOPUNIT` Sends a Stop Unit command to the device
- `W_PREVMV` Sends a Prevent Media Removal command to the device
- `W_ALLOMV` Sends an Allow Media Removal command to the device

The following ioctl calls send the appropriate Group-6 SCSI command to the drive. Group-6 SCSI commands are vendor specific and should be described in the SCSI interface section of the reference manual supplied with your drive. Since the format of these SCSI commands is vendor specific, these ioctl calls are supported only by products compatible with the Toshiba D070 drive.

- `W_READCAPA` Sends a Read Capacity command to the device, and returns the data sent by the drive
- `W_VERIFY` Sends a Verify command to the device

The following ioctl calls send the appropriate Group-7 SCSI command to the drive. Group-7 SCSI commands are vendor specific and should be described in the SCSI interface section of the reference manual supplied with your drive. Since the format of these SCSI commands is vendor specific, these ioctl calls are supported only by products compatible with the Toshiba D070 drive.

- `W_STNCHECK` Sends a Stand-By Check command to the device
- `W_LOADCART` Sends a Load Cartridge command to the device
- `W_UNLOADCART` Sends an Unload Cartridge command to the device
- `W_READCB` Sends a Read Control Block command to the device

The following ioctl calls are also supported by the `sw01` driver.

- `B_GET_SUBDEVS` Returns the number of sub-devices supported by this driver
- `W_ERRMSGON` Enables the `sw01` related system error messages
- `W_ERRMSGOFF` Disables the `sw01` related system error messages

Files

/usr/include/sys/sw01.h
/etc/conf/pack.d/sw01/space.c
/dev/[r]worm/*
sw01(7)

/usr/include/sys/scsi.h
/usr/include/sys/sdi.h
/usr/include/sys/sdi_edt.h

REFERENCES
adsc(7), dpt(7), ioctl(2), mcis(7), mount(1M), sc01(7), sd01(7), st01(7), wd7000(7)
sxt(7)

NAME

sxt – pseudo-device driver

DESCRIPTION

The special file /dev/sxt is a pseudo-device driver that interposes a discipline between the standard tty line disciplines and a real device driver. The standard disciplines manipulate virtual tty structures (channels) declared by the /dev/sxt driver. /dev/sxt acts as a discipline manipulating a real tty structure declared by a real device driver. The /dev/sxt driver is currently only used by the shl(1) command.

Virtual ttys are named by inodes in the subdirectory /dev/sxt and are allocated in groups of up to eight. To allocate a group, a program should exclusively open a file with a name of the form /dev/sxt/??0 (channel 0) and then execute a SXTIOCLINK ioctl call to initiate the multiplexing.

Only one channel, the controlling channel, can receive input from the keyboard at a time; others attempting to read will be blocked.

There are two groups of ioctl(2) commands supported by sxt. The first group contains the standard ioctl commands described in termio(7), with the addition of the following:

TIOCEXCL Set exclusive use mode: no further opens are permitted until the file has been closed.
TIOCNXCL Reset exclusive use mode: further opens are once again permitted.

The second group are commands to sxt itself. Some of these may only be executed on channel 0.

SXTIOCLINK Allocate a channel group and multiplex the virtual ttys onto the real tty. The argument is the number of channels to allocate. This command may only be executed on channel 0. Possible errors include:

EINVAL The argument is out of range.
ENOITY The command was not issued from a real tty.
ENXIO linesw is not configured with sxt.
EBUSY An SXTIOCLINK command has already been issued for this real tty.
ENOMEM There is no system memory available for allocating the virtual tty structures.
EBADF Channel 0 was not opened before this call.

SXTIOSWITCH Set the controlling channel. Possible errors include:

EINVAL An invalid channel number was given.
EPERM The command was not executed from channel 0.
**SXTIOCWF**

Cause a channel to wait until it is the controlling channel. This command will return the error, **EINVAL**, if an invalid channel number is given.

**SXTIOCUBLK**

Turn off the **loblk** control flag in the virtual tty of the indicated channel. The error **EINVAL** will be returned if an invalid number or channel 0 is given.

**SXTIOCSTAT**

Get the status (blocked on input or output) of each channel and store in the **sxtblock** structure referenced by the argument. The error **EFAULT** will be returned if the structure cannot be written.

**SXTIOCTTRACE**

Enable tracing. Tracing information is written to the console. This command has no effect if tracing is not configured.

**SXTIOCNOTRACE**

Disable tracing. This command has no effect if tracing is not configured.

**FILES**

```
/dev/sxt/?? [0-7]    Virtual tty devices
```

**SEE ALSO**

```
ioct1(2), open(2), shl(1), stty(1) termio(7)
```
TCP(7)

NAME
TCP – Internet Transmission Control Protocol

SYNOPSIS
#include <sys/socket.h>
#include <netinet/in.h>
s = socket(AF_INET, SOCK_STREAM, 0);
t = t_open("/dev/tcp", O_RDWR);

DESCRIPTION
TCP is the virtual circuit protocol of the Internet protocol family. It provides reliable, flow-controlled, in order, two-way transmission of data. It is a byte-stream protocol layered above the Internet Protocol (IP), the Internet protocol family’s internetwork datagram delivery protocol.

Programs can access TCP using the socket interface as a SOCK_STREAM socket type, or using the Transport Level Interface (TLI) where it supports the connection-oriented (T_COTS_ORD) service type.

TCP uses IP’s host-level addressing and adds its own per-host collection of port addresses. The endpoints of a TCP connection are identified by the combination of an IP address and a TCP port number. Although other protocols, such as the User Datagram Protocol (UDP), may use the same host and port address format, the port space of these protocols is distinct. See inet(7) for details on the common aspects of addressing in the Internet protocol family.

Sockets utilizing TCP are either active or passive. Active sockets initiate connections to passive sockets. Both types of sockets must have their local IP address and TCP port number bound with the bind(3N) system call after the socket is created. By default, TCP sockets are active. A passive socket is created by calling the listen(3N) system call after binding the socket with bind(). This establishes a queuing parameter for the passive socket. After this, connections to the passive socket can be received with the accept(3N) system call. Active sockets use the connect(3N) call after binding to initiate connections.

By using the special value INADDR_ANY, the local IP address can be left unspecified in the bind() call by either active or passive TCP sockets. This feature is usually used if the local address is either unknown or irrelevant. If left unspecified, the local IP address will be bound at connection time to the address of the network interface used to service the connection.

Once a connection has been established, data can be exchanged using the read(2) and write(2) system calls.

TCP supports one socket option, TCP_NODELAY, which is set with setsockopt() and tested with getsockopt(3N). Under most circumstances, TCP sends data when it is presented. When outstanding data has not yet been acknowledged, it gathers small amounts of output to be sent in a single packet once an acknowledgement is received. For a small number of clients, such as window systems that send a stream of mouse events which receive no replies, this packetization may cause significant delays. Therefore, TCP provides a boolean option, TCP_NODELAY (defined in /usr/include/netinet/tcp.h), to defeat this algorithm. The option level for
the `setsockopt()` call is the protocol number for TCP, available from `getprotobyname()` [see `getprotoent(3N)`].

Options at the IP level may be used with TCP; See `ip(7)`.

TCP provides an urgent data mechanism, which may be invoked using the out-of-band provisions of `send(3N)`. The caller may mark one byte as urgent with the `MSG_OOB` flag to `send(3N)`. This sets an urgent pointer pointing to this byte in the TCP stream. The receiver on the other side of the stream is notified of the urgent data by a `SIGURG` signal. The `SIOCATMARK ioctl()` request returns a value indicating whether the stream is at the urgent mark. Because the system never returns data across the urgent mark in a single `read(2)` call, it is possible to advance to the urgent data in a simple loop which reads data, testing the socket with the `SIOCATMARK ioctl()` request, until it reaches the mark.

Incoming connection requests that include an IP source route option are noted, and the reverse source route is used in responding.

A checksum over all data helps TCP implement reliability. Using a window-based flow control mechanism that makes use of positive acknowledgements, sequence numbers, and a retransmission strategy, TCP can usually recover when datagrams are damaged, delayed, duplicated or delivered out of order by the underlying communication medium.

If the local TCP receives no acknowledgements from its peer for a period of time, as would be the case if the remote machine crashed, the connection is closed and an error is returned to the user. If the remote machine reboots or otherwise loses state information about a TCP connection, the connection is aborted and an error is returned to the user.

**SEE ALSO**

`accept(3N), bind(3N), connect(3N), getprotoent(3N), getsockopt(3N), inet(7), ip(7), listen(3N), read(2), send(3N), write(2)`


**DIAGNOSTICS**

A socket operation may fail if:

- **EISCONN** A `connect()` operation was attempted on a socket on which a `connect()` operation had already been performed.
- **ETIMEDOUT** A connection was dropped due to excessive retransmissions.
- **ECONNREFUSED** The remote peer actively refused connection establishment (usually because no process is listening to the port).
- **EADDRINUSE** A `bind()` operation was attempted on a socket with a network address/port pair that has already been bound to another socket.
TCP(7)

EADDRNOTAVAIL  A `bind()` operation was attempted on a socket with a network address for which no network interface exists.

EACCES         A `bind()` operation was attempted with a reserved port number and the effective user ID of the process was not the privileged user.

ENOBUFFS       The system ran out of memory for internal data structures.
NAME
termio – general terminal interface

SYNOPSIS
#include <termio.h>
ioctl(int fildes, int request, struct termio *arg);
ioctl(int fildes, int request, int arg);

#include <termios.h>
ioctl(int fildes, int request, struct termios *arg);

DESCRIPTION
System V supports a general interface for asynchronous communications ports that is hardware-independent. The user interface to this functionality is via function calls (the preferred interface) described in termios(2) or ioctl commands described in this section. This section also discusses the common features of the terminal subsystem which are relevant with both user interfaces.

When a terminal file is opened, it normally causes the process to wait until a connection is established. In practice, users’ programs seldom open terminal files; they are opened by the system and become a user’s standard input, output, and error files. The very first terminal file opened by the session leader, which is not already associated with a session, becomes the controlling terminal for that session. The controlling terminal plays a special role in handling quit and interrupt signals, as discussed below. The controlling terminal is inherited by a child process during a fork(2). A process can break this association by changing its session using setsid(2).

A terminal associated with one of these files ordinarily operates in full-duplex mode. Characters may be typed at any time, even while output is occurring, and are only lost when the character input buffers of the system become completely full, which is rare (for example, if the number of characters in the line discipline buffer exceeds MAX_CANON and IMAXBEL [see below] is not set), or when the user has accumulated MAX_INPUT number of input characters that have not yet been read by some program. When the input limit is reached, all the characters saved in the buffer up to that point are thrown away without notice.

Session Management (Job Control)
A control terminal will distinguish one of the process groups in the session associated with it to be the foreground process group. All other process groups in the session are designated as background process groups. This foreground process group plays a special role in handling signal-generating input characters, as discussed below. By default, when a controlling terminal is allocated, the controlling process’s process group is assigned as foreground process group.

Background process groups in the controlling process’s session are subject to a job control line discipline when they attempt to access their controlling terminal. Process groups can be sent signals that will cause them to stop, unless they have made other arrangements. An exception is made for members of orphaned process groups. These are process groups which do not have a member with a parent in another process group that is in the same session and therefore shares the same controlling terminal. When a member’s orphaned process group attempts to access its
controlling terminal, errors will be returned. Since there is no process to continue it if it should stop.

If a member of a background process group attempts to read its controlling terminal, its process group will be sent a **SIGTTIN** signal, which will normally cause the members of that process group to stop. If, however, the process is ignoring or holding **SIGTTIN**, or is a member of an orphaned process group, the read will fail with **errno** set to **EIO**, and no signal will be sent.

If a member of a background process group attempts to write its controlling terminal and the **TOSTOP** bit is set in the **c_lflag** field, its process group will be sent a **SIGTTOU** signal, which will normally cause the members of that process group to stop. If, however, the process is ignoring or holding **SIGTTOU**, the write will succeed. If the process is not ignoring or holding **SIGTTOU** and is a member of an orphaned process group, the write will fail with **errno** set to **EIO**, and no signal will be sent.

If **TOSTOP** is set and a member of a background process group attempts to ioctl its controlling terminal, and that ioctl will modify terminal parameters (for example, **TCSETA**, **TCSETAW**, **TCSETAF**, or **TIOCSGPRP**), its process group will be sent a **SIGTTOU** signal, which will normally cause the members of that process group to stop. If, however, the process is ignoring or holding **SIGTTOU**, the ioctl will succeed. If the process is not ignoring or holding **SIGTTOU** and is a member of an orphaned process group, the write will fail with **errno** set to **EIO**, and no signal will be sent.

**Canonical Mode Input Processing**

Normally, terminal input is processed in units of lines. A line is delimited by a newline (ASCII LF) character, an end-of-file (ASCII EOT) character, or an end-of-line character. This means that a program attempting to read will be suspended until an entire line has been typed. Also, no matter how many characters are requested in the read call, at most one line will be returned. It is not necessary, however, to read a whole line at once; any number of characters may be requested in a read, even one, without losing information.

During input, erase and kill processing is normally done. The **ERASE** character (by default, the character #) erases the last character typed. The **WERASE** character (the character control-W) erases the last “word” typed in the current input line (but not any preceding spaces or tabs). A “word” is defined as a sequence of non-blank characters, with tabs counted as blanks. Neither **ERASE** nor **WERASE** will erase beyond the beginning of the line. The **KILL** character (by default, the character @) kills (deletes) the entire input line, and optionally outputs a newline character. All these characters operate on a key stroke basis, independent of any backspacing or tabbing that may have been done. The **REPRINT** character (the character control-R) prints a newline followed by all characters that have not been read. Reprinting also occurs automatically if characters that would normally be erased from the screen are fouled by program output. The characters are reprinted as if they were being echoed; consequently, if **ECHO** is not set, they are not printed.

The **ERASE** and **KILL** characters may be entered literally by preceding them with the escape character (\). In this case, the escape character is not read. The erase and kill characters may be changed.
Non-canonical Mode Input Processing
In non-canonical mode input processing, input characters are not assembled into lines, and erase and kill processing does not occur. The MIN and TIME values are used to determine how to process the characters received.

MIN represents the minimum number of characters that should be received when the read is satisfied (that is, when the characters are returned to the user). TIME is a timer of 0.10-second granularity that is used to timeout bursty and short-term data transmissions. The values for MIN and TIME should be set by the programmer in the termios or termio structure. The four possible values for MIN and TIME and their interactions are described below.

Case A: MIN > 0, TIME > 0
In this case, TIME serves as an intercharacter timer and is activated after the first character is received. Since it is an intercharacter timer, it is reset after a character is received. The interaction between MIN and TIME is as follows: as soon as one character is received, the intercharacter timer is started. If MIN characters are received before the intercharacter timer expires (note that the timer is reset upon receipt of each character), the read is satisfied. If the timer expires before MIN characters are received, the characters received to that point are returned to the user. Note that if TIME expires, at least one character will be returned because the timer would not have been enabled unless a character was received. In this case (MIN > 0, TIME > 0), the read sleeps until the MIN and TIME mechanisms are activated by the receipt of the first character. If the number of characters read is less than the number of characters available, the timer is not reactivated and the subsequent read is satisfied immediately.

Case B: MIN > 0, TIME = 0
In this case, since the value of TIME is zero, the timer plays no role and only MIN is significant. A pending read is not satisfied until MIN characters are received (the pending read sleeps until MIN characters are received). A program that uses this case to read record based terminal I/O may block indefinitely in the read operation.

Case C: MIN = 0, TIME > 0
In this case, since MIN = 0, TIME no longer represents an intercharacter timer: it now serves as a read timer that is activated as soon as a read is done. A read is satisfied as soon as a single character is received or the read timer expires. Note that, in this case, if the timer expires, no character is returned. If the timer does not expire, the only way the read can be satisfied is if a character is received. In this case, the read will not block indefinitely waiting for a character; if no character is received within TIME*.10 seconds after the read is initiated, the read returns with zero characters.

Case D: MIN = 0, TIME = 0
In this case, return is immediate. The minimum of either the number of characters requested or the number of characters currently available is returned without waiting for more characters to be input.

Comparison of the Different Cases of MIN, TIME Interaction
Some points to note about MIN and TIME:
In the following explanations, note that the interactions of MIN and TIME are not symmetric. For example, when \( \text{MIN} > 0 \) and \( \text{TIME} = 0 \), \( \text{TIME} \) has no effect. However, in the opposite case, where \( \text{MIN} = 0 \) and \( \text{TIME} > 0 \), both \( \text{MIN} \) and \( \text{TIME} \) play a role in that \( \text{MIN} \) is satisfied with the receipt of a single character.

Also note that in case A (\( \text{MIN} > 0, \text{TIME} > 0 \)), \( \text{TIME} \) represents an intercharacter timer, whereas in case C (\( \text{TIME} = 0, \text{TIME} > 0 \)), \( \text{TIME} \) represents a read timer.

These two points highlight the dual purpose of the MIN/TIME feature. Cases A and B, where \( \text{MIN} > 0 \), exist to handle burst mode activity (for example, file transfer programs), where a program would like to process at least \( \text{MIN} \) characters at a time. In case A, the intercharacter timer is activated by a user as a safety measure; in case B, the timer is turned off.

Cases C and D exist to handle single character, timed transfers. These cases are readily adaptable to screen-based applications that need to know if a character is present in the input queue before refreshing the screen. In case C, the read is timed, whereas in case D, it is not.

Another important note is that \( \text{MIN} \) is always just a minimum. It does not denote a record length. For example, if a program does a read of 20 bytes, \( \text{MIN} \) is 10, and 25 characters are present, then 20 characters will be returned to the user.

**Writing Characters**

When one or more characters are written, they are transmitted to the terminal as soon as previously written characters have finished typing. Input characters are echoed as they are typed if echoing has been enabled. If a process produces characters more rapidly than they can be typed, it will be suspended when its output queue exceeds some limit. When the queue is drained down to some threshold, the program is resumed.

**Special Characters**

Certain characters have special functions on input. These functions and their default character values are summarized as follows:

- **INTR** (Rubout or ASCII DEL) generates a \texttt{SIGINT} signal. \texttt{SIGINT} is sent to all frequent processes associated with the controlling terminal. Normally, each such process is forced to terminate, but arrangements may be made either to ignore the signal or to receive a trap to an agreed upon location. [See \texttt{signal(5)}].

- **QUIT** (CTRL-I or ASCII FS) generates a \texttt{SIGQUIT} signal. Its treatment is identical to the interrupt signal except that, unless a receiving process has made other arrangements, it will not only be terminated but a core image file (called \texttt{core}) will be created in the current working directory.

- **ERASE** (#) erases the preceding character. It does not erase beyond the start of a line, as delimited by a NL, EOF, EOL, or EOL2 character.

- **WERASE** (CTRL-W or ASCII ETX) erases the preceding “word”. It does not erase beyond the start of a line, as delimited by a NL, EOF, EOL, or EOL2 character.
KILL (\@) deletes the entire line, as delimited by a NL, EOF, EOL, or EOL2 character.

REPRINT (CTRL-R or ASCII DC2) reprints all characters, preceded by a newline, that have not been read.

EOF (CTRL-D or ASCII EOT) may be used to generate an end-of-file from a terminal. When received, all the characters waiting to be read are immediately passed to the program, without waiting for a newline, and the EOF is discarded. Thus, if no characters are waiting (that is, the EOF occurred at the beginning of a line) zero characters are passed back, which is the standard end-of-file indication. The EOF character is not echoed unless it is escaped or ECHOCTL is set. Because EOT is the default EOF character, this prevents terminals that respond to EOT from hanging up.

NL (ASCII LF) is the normal line delimiter. It cannot be changed or escaped.

EOL (ASCII NULL) is an additional line delimiter, like NL. It is not normally used.

EOL2 is another additional line delimiter.

SWITCH (CTRL-Z or ASCII EM) is used only when shllayers is invoked.

SUSP (CTRL-Z or ASCII SUB) generates a SIGTSTP signal. SIGTSTP stops all processes in the foreground process group for that terminal.

DSUSP (CTRL-Y or ASCII EM) It generates a SIGTSTP signal as SUSP does, but the signal is sent when a process in the foreground process group attempts to read the DSUSP character, rather than when it is typed.

STOP (CTRL-S or ASCII DC3) can be used to suspend output temporarily. It is useful with CRT terminals to prevent output from disappearing before it can be read. While output is suspended, STOP characters are ignored and not read.

START (CTRL-Q or ASCII DC1) is used to resume output. Output has been suspended by a STOP character. While output is not suspended, START characters are ignored and not read.

DISCARD (CTRL-O or ASCII SI) causes subsequent output to be discarded. Output is discarded until another DISCARD character is typed, more input arrives, or the condition is cleared by a program.

LNEXT (CTRL-V or ASCII SYN) causes the special meaning of the next character to be ignored. This works for all the special characters mentioned above. It allows characters to be input that would otherwise be interpreted by the system (for example, KILL, QUIT).

The character values for INTR, QUIT, ERASE, WERASE, KILL, REPRINT, EOF, EOL, EOL2, SWITCH, SUSP, DSUSP, STOP, START, DISCARD, and LNEXT may be changed to suit individual tastes. If the value of a special control character is _POSIX_VDISABLE (0), the function of that special control character is disabled. The ERASE, KILL, and EOF characters may be escaped by a preceding \ character, in which case no special function is done. Any of the special characters may be preceded by the LNEXT character, in which case no special function is done.
**Modem Disconnect**

When a modem disconnect is detected, a `SIGHUP` signal is sent to the terminal’s controlling process. Unless other arrangements have been made, these signals cause the process to terminate. If `SIGHUP` is ignored or caught, any subsequent read returns with an end-of-file indication until the terminal is closed.

Processes in background process groups that attempt to access the controlling terminal after modem disconnect while the terminal is still allocated to the session will receive appropriate `SIGTTOU` and `SIGTTIN` signals. Unless other arrangements have been made, this signal causes the processes to stop.

The controlling terminal will remain in this state until it is reinitialized with a successful open by the controlling process, or deallocated by the controlling process.

**Terminal Parameters**

The parameters that control the behavior of devices and modules providing the `termios` interface are specified by the `termios` structure defined by `termios.h`. Several `ioctl(2)` system calls that fetch or change these parameters use this structure that contains the following members:

```c
    tcflag_t c_iflag;     /* input modes */
    tcflag_t c_oflag;     /* output modes */
    tcflag_t c_cflag;     /* control modes */
    tcflag_t c_lflag;     /* local modes */
    cc_t   c_cc[NCCS];    /* control chars */
```

The special control characters are defined by the array `c_cc`. The symbolic name `NCCS` is the size of the control-character array and is also defined by `termios.h`. The relative positions, subscript names, and typical default values for each function are as follows:

<table>
<thead>
<tr>
<th>Subscript</th>
<th>Character</th>
<th>Symbolic Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>VINTR</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>VQUIT</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>VERASE</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>VKILL</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>VEOF</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>VEOL</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>VEOL2</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>VSWITCH</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>VSTRT</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>VSTOP</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>VSUSP</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>VDSUSP</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>VREPRINT</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>VDISCRD</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>VWERASE</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>VLNEXT</td>
<td></td>
</tr>
<tr>
<td>16-19</td>
<td>reserved</td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>DEL</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>FS</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>#</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>@</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>EOT</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>NUL</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>NUL</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>NUL</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>DC1</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>DC3</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>SUB</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>EM</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>DC2</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>SI</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>ETB</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>SYN</td>
<td></td>
</tr>
</tbody>
</table>

For the non-canonical mode the positions of `VEOF` and `VEOL` are shared by `VMIN` and `VTIME`:

<table>
<thead>
<tr>
<th>Subscript</th>
<th>Symbolic Name</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>VMIN</td>
<td>used to set the value of MIN</td>
</tr>
<tr>
<td>5</td>
<td>VTIME</td>
<td>used to set the value of TIME</td>
</tr>
</tbody>
</table>
Input Modes

The **c_iflag** field describes the basic terminal input control:

- **IGNBRK**: Ignore break condition.
- **BRKINT**: Signal interrupt on break.
- **IGNPAR**: Ignore characters with parity errors.
- **PARMRK**: Mark parity errors.
- **INPCK**: Enable input parity check.
- **ISTRIP**: Strip character.
- **INLCR**: Map NL to CR on input.
- **IGNCR**: Ignore CR.
- **ICRNL**: Map CR to NL on input.
- **IUCLC**: Map upper-case to lower-case on input.
- **IXON**: Enable start/stop output control.
- **IXANY**: Enable any character to restart output.
- **IXOFF**: Enable start/stop input control.
- **IMAXBEL**: Echo BEL on input line too long.

If **IGNBRK** is set, a break condition (a character framing error with data all zeros) detected on input is ignored, that is, not put on the input queue and therefore not read by any process. If **IGNBRK** is not set and **BRKINT** is set, the break condition shall flush the input and output queues and if the terminal is the controlling terminal of a foreground process group, the break condition generates a single **SIGINT** signal to that foreground process group. If neither **IGNBRK** nor **BRKINT** is set, a break condition is read as a single ASCII NULL character (`\0`), or if **PARMRK** is set, as `\377`, `\0`, `\0`.

If **IGNPAR** is set, a byte with framing or parity errors (other than break) is ignored. If **PARMRK** is set, and **IGNPAR** is not set, a byte with a framing or parity error (other than break) is given to the application as the three-character sequence: `\377`, `\0`, X, where X is the data of the byte received in error. To avoid ambiguity in this case, if **ISTRIP** is not set, a valid character of `\377` is given to the application as `\377`, `\377`. If neither **IGNPAR** nor **PARMRK** is set, a framing or parity error (other than break) is given to the application as a single ASCII NULL character (`\0`).

If **INPCK** is set, input parity checking is enabled. If **INPCK** is not set, input parity checking is disabled. This allows output parity generation without input parity errors. Note that whether input parity checking is enabled or disabled is independent of whether parity detection is enabled or disabled. If parity detection is enabled but input parity checking is disabled, the hardware to which the terminal is connected will recognize the parity bit, but the terminal special file will not check whether this is set correctly or not.

If **ISTRIP** is set, valid input characters are first stripped to seven bits, otherwise all eight bits are processed.

If **INLCR** is set, a received NL character is translated into a CR character. If **IGNCR** is set, a received CR character is ignored (not read). Otherwise, if **ICRNL** is set, a received CR character is translated into a NL character.
If **IUCLC** is set, a received upper case, alphabetic character is translated into the corresponding lower case character.

If **IXON** is set, start/stop output control is enabled. A received STOP character suspends output and a received START character restarts output. The STOP and START characters will not be read, but will merely perform flow control functions. If **IXANY** is set, any input character restarts output that has been suspended.

If **IXOFF** is set, the system transmits a STOP character when the input queue is nearly full, and a START character when enough input has been read so that the input queue is nearly empty again.

If **IMAXBEL** is set, the ASCII BEL character is echoed if the input stream overflows. Further input is not stored, but any input already present in the input stream is not disturbed. If **IMAXBEL** is not set, no BEL character is echoed, and all input present in the input queue is discarded if the input stream overflows.

The initial input control value is **BRKINT, ICRNL, IXON, ISTRIP**.

**Output Modes**

The `c_oflag` field specifies the system treatment of output:

<table>
<thead>
<tr>
<th>OPOST</th>
<th>Post-process output.</th>
</tr>
</thead>
<tbody>
<tr>
<td>OLCUC</td>
<td>Map lower case to upper on output.</td>
</tr>
<tr>
<td>ONLCR</td>
<td>Map NL to CR-NL on output.</td>
</tr>
<tr>
<td>OCRNL</td>
<td>Map CR to NL on output.</td>
</tr>
<tr>
<td>ONOCR</td>
<td>No CR output at column 0.</td>
</tr>
<tr>
<td>ONLRET</td>
<td>NL performs CR function.</td>
</tr>
<tr>
<td>OFILL</td>
<td>Use fill characters for delay.</td>
</tr>
<tr>
<td>OFDEL</td>
<td>Fill is DEL, else NULL.</td>
</tr>
<tr>
<td>NLDLY</td>
<td>Select newline delays:</td>
</tr>
<tr>
<td>NL0</td>
<td></td>
</tr>
<tr>
<td>NL1</td>
<td></td>
</tr>
<tr>
<td>CRDLY</td>
<td>Select carriage-return delays:</td>
</tr>
<tr>
<td>CR0</td>
<td></td>
</tr>
<tr>
<td>CR1</td>
<td></td>
</tr>
<tr>
<td>CR2</td>
<td></td>
</tr>
<tr>
<td>CR3</td>
<td></td>
</tr>
<tr>
<td>TABDLY</td>
<td>Select horizontal tab delays:</td>
</tr>
<tr>
<td>TAB0</td>
<td>or tab expansion:</td>
</tr>
<tr>
<td>TAB1</td>
<td></td>
</tr>
<tr>
<td>TAB2</td>
<td></td>
</tr>
<tr>
<td>TAB3</td>
<td>Expand tabs to spaces.</td>
</tr>
<tr>
<td>XTABS</td>
<td>Expand tabs to spaces.</td>
</tr>
<tr>
<td>BSDLY</td>
<td>Select backspace delays:</td>
</tr>
<tr>
<td>BS0</td>
<td></td>
</tr>
<tr>
<td>BS1</td>
<td></td>
</tr>
<tr>
<td>VTDLY</td>
<td>Select vertical tab delays:</td>
</tr>
<tr>
<td>VT0</td>
<td></td>
</tr>
<tr>
<td>VT1</td>
<td></td>
</tr>
<tr>
<td>FFDLY</td>
<td>Select form feed delays:</td>
</tr>
<tr>
<td>FF0</td>
<td></td>
</tr>
<tr>
<td>FF1</td>
<td></td>
</tr>
</tbody>
</table>
If **OPOST** is set, output characters are post-processed as indicated by the remaining flags; otherwise, characters are transmitted without change.

If **OLCUC** is set, a lower case alphabetic character is transmitted as the corresponding upper case character. This function is often used in conjunction with **IUCLC**.

If **ONLCR** is set, the NL character is transmitted as the CR-NL character pair. If **OCRNL** is set, the CR character is transmitted as the NL character. If **ONOCR** is set, no CR character is transmitted when at column 0 (first position). If **ONRET** is set, the NL character is assumed to do the carriage-return function; the column pointer is set to 0 and the delays specified for CR are used. Otherwise, the NL character is assumed to do just the line-feed function; the column pointer remains unchanged. The column pointer is also set to 0 if the CR character is actually transmitted.

The delay bits specify how long transmission stops to allow for mechanical or other movement when certain characters are sent to the terminal. In all cases, a value of 0 indicates no delay. If **OFILL** is set, fill characters are transmitted for delay instead of a timed delay. This is useful for high baud rate terminals that need only a minimal delay. If **OFDEL** is set, the fill character is DEL; otherwise it is **NULL**.

If a form-feed or vertical-tab delay is specified, it lasts for about 2 seconds.

Newline delay lasts about 0.10 seconds. If **ONLRET** is set, the carriage-return delays are used instead of the newline delays. If **OFILL** is set, two fill characters are transmitted.

Carriage-return delay type 1 is dependent on the current column position, type 2 is about 0.10 seconds, and type 3 is about 0.15 seconds. If **OFILL** is set, delay type 1 transmits two fill characters, and type 2 transmits four fill characters.

Horizontal-tab delay type 1 is dependent on the current column position. Type 2 is about 0.10 seconds. Type 3 specifies that tabs are to be expanded into spaces. If **OFILL** is set, two fill characters are transmitted for any delay.

Backspace delay lasts about 0.05 seconds. If **OFILL** is set, one fill character is transmitted.

The actual delays depend on line speed and system load.

The initial output control value is **OPOST, ONLCR, TAB3**.

**Control Modes**

The **c_cflag** field describes the hardware control of the terminal:

<table>
<thead>
<tr>
<th>CBAUD</th>
<th>Baud rate:</th>
</tr>
</thead>
<tbody>
<tr>
<td>B0</td>
<td>Hang up</td>
</tr>
<tr>
<td>B50</td>
<td>50 baud</td>
</tr>
<tr>
<td>B75</td>
<td>75 baud</td>
</tr>
<tr>
<td>B110</td>
<td>110 baud</td>
</tr>
<tr>
<td>B134</td>
<td>134 baud</td>
</tr>
<tr>
<td>B150</td>
<td>150 baud</td>
</tr>
<tr>
<td>B200</td>
<td>200 baud</td>
</tr>
<tr>
<td>B300</td>
<td>300 baud</td>
</tr>
<tr>
<td>B600</td>
<td>600 baud</td>
</tr>
<tr>
<td>B1200</td>
<td>1200 baud</td>
</tr>
<tr>
<td>B1800</td>
<td>1800 baud</td>
</tr>
</tbody>
</table>
The **CBAUD** bits specify the baud rate. The zero baud rate, B0, is used to hang up the connection. If B0 is specified, the data-terminal-ready signal is not asserted. Normally, this disconnects the line. If the **CIBAUD** bits are not zero, they specify the input baud rate, with the **CBAUD** bits specifying the output baud rate; otherwise, the output and input baud rates are both specified by the **CBAUD** bits. The values for the **CIBAUD** bits are the same as the values for the **CBAUD** bits, shifted left **IBSHIFT** bits. For any particular hardware, impossible speed changes are ignored.

The **CSIZE** bits specify the character size in bits for both transmission and reception. This size does not include the parity bit, if any. If **CSTOPB** is set, two stop bits are used; otherwise, one stop bit is used. For example, at 110 baud, two stops bits are required.

If **PARENB** is set, parity generation and detection is enabled, and a parity bit is added to each character. If parity is enabled, the **PARODD** flag specifies odd parity if set; otherwise, even parity is used.

If **CREAD** is set, the receiver is enabled. Otherwise, no characters are received.

If **HUPCL** is set, the line is disconnected when the last process with the line open closes it or terminates. That is, the data-terminal-ready signal is not asserted.

If **CLOCAL** is set, the line is assumed to be a local, direct connection with no modem control; otherwise, modem control is assumed.

The initial hardware control value after open is **B300, CS8, CREAD, HUPCL**.

**Local Modes**

The **c_lflag** field of the argument structure is used by the line discipline to control terminal functions. The basic line discipline provides the following:
**termio(7)**

- **ISIG** Enable signals.
- **ICANON** Canonical input (erase and kill processing).
- **XCASE** Canonical upper/lower presentation.
- **ECHO** Enable echo.
- **ECHOE** Echo erase character as BS-SP-BS.
- **ECHOK** Echo NL after kill character.
- **ECHONL** Echo NL.
- **NOFLSH** Disable flush after interrupt or quit.
- **TOSTOP** Send **SIGTTOU** for background output.
- **ECHOCTL** Echo control characters as `char`, delete as `?`.
- **ECHOPRT** Echo erase character as character erased.
- **ECHOKE** BS-SP-BS erase entire line on line kill.
- **FLUSHO** Output is being flushed.
- **PENDIN** Retype pending input at next read or input character.
- **IEXTEN** Enable extended (implementation-defined) functions.

If **ISIG** is set, each input character is checked against the special control characters **INTR**, **QUIT**, **SWITCH**, **SUSP**, **STATUS**, and **DSUSP**. If an input character matches one of these control characters, the function associated with that character is performed. If **ISIG** is not set, no checking is done. Thus, these special input functions are possible only if **ISIG** is set.

If **ICANON** is set, canonical processing is enabled. This enables the erase and kill edit functions, and the assembly of input characters into lines delimited by **NL**, **EOF**, **EOL**, and **EOL2**. If **ICANON** is not set, read requests are satisfied directly from the input queue. A read is not satisfied until at least **MIN** characters have been received or the timeout value **TIME** has expired between characters. This allows fast bursts of input to be read efficiently while still allowing single character input. The time value represents tenths of seconds.

If **XCASE** is set, and if **ICANON** is set, an upper case letter is accepted on input by preceding it with a `\` character, and is output preceded by a `\` character. In this mode, the following escape sequences are generated on output and accepted on input:

```
\n \n
```

For example, **A** is input as `\`, `\n` as `\n`, and `\N` as `\n`.

If **ECHO** is set, characters are echoed as received.

When **ICANON** is set, the following echo functions are possible.

1. If **ECHO** and **ECHOE** are set, and **ECHOPRT** is not set, the **ERASE** and **WERASE** characters are echoed as one or more ASCII BS SP BS, which clears the last character(s) from a CRT screen.
termio(7)

2. If ECHO and ECHOPRT are set, the first ERASE and WERASE character in a sequence echoes as a backslash (\), followed by the characters being erased. Subsequent ERASE and WERASE characters echo the characters being erased, in reverse order. The next non-erase character causes a slash (/) to be typed before it is echoed. ECHOPRT should be used for hard copy terminals.

3. If ECHOKE is set, the kill character is echoed by erasing each character on the line from the screen (using the mechanism selected by ECHOB and ECHOPRT).

4. If ECHOK is set, and ECHOKE is not set, the NL character is echoed after the kill character to emphasize that the line is deleted. Note that an escape character (\) or an LNEXT character preceding the erase or kill character removes any special function.

5. If ECHONL is set, the NL character is echoed even if ECHO is not set. This is useful for terminals set to local echo (so called half-duplex).

If ECHOCtl is set, all control characters (characters with codes between 0 and 37 octal) other than ASCII TAB, ASCII NL, the START character, and the STOP character, ASCII CR, and ASCII BS are echoed as 'X, where X is the character given by adding 100 octal to the code of the control character (so that the character with octal code 1 is echoed as 'A), and the ASCII DEL character, with code 177 octal, is echoed as '?.

If NOFLSH is set, the normal flush of the input and output queues associated with the INTR, QUIT, and SUSP characters is not done. This bit should be set when restarting system calls that read from or write to a terminal [see sigaction(2)].

If TOSTOP is set, the signal SIGTTOU is sent to a process that tries to write to its controlling terminal if it is not in the foreground process group for that terminal. This signal normally stops the process. Otherwise, the output generated by that process is output to the current output stream. Processes that are blocking or ignoring SIGTTOU signals are excepted and allowed to produce output, if any.

If FLUSHO is set, data written to the terminal is discarded. This bit is set when the FLUSH character is typed. A program can cancel the effect of typing the FLUSH character by clearing FLUSHO.

If PENDIN is set, any input that has not yet been read is reprinted when the next character arrives as input.

If IEXTEN is set, the following implementation-defined functions are enabled: special characters (WERASE, REPRINT, DISCARD, and LNEXT) and local flags (TOSTOP, ECHOCtl, ECHOPRT, ECHOKE, FLUSHO, and PENDIN).

The initial line-discipline control value is ISIG, ICANON, ECHO, ECHOK.

Terminal Size
The number of lines and columns on the terminal’s display is specified in the winsize structure defined by sys/termios.h and includes the following members:
unsigned short ws_row; /* rows, in characters */
unsigned short ws_col; /* columns, in characters */
unsigned short ws_xpixel; /* horizontal size, in pixels */
unsigned short ws_ypixel; /* vertical size, in pixels */

**termio Structure**

The System V *termio* structure is used by some *ioctl*S; it is defined by
*sys/termio.h* and includes the following members:

```
unsigned short c_iflag; /* input modes */
unsigned short c_oflag; /* output modes */
unsigned short c_cflag; /* control modes */
unsigned short c_lflag; /* local modes */
char c_line; /* line discipline */
unsigned char c_cc[NCC]; /* control chars */
```

The special control characters are defined by the array *c_cc*. The symbolic name
*NCC* is the size of the control-character array and is also defined by *termio.h*. The
relative positions, subscript names, and typical default values for each function are
as follows:

<table>
<thead>
<tr>
<th>Position</th>
<th>Symbol</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>VINTR</td>
<td>DEL</td>
</tr>
<tr>
<td>1</td>
<td>VQUIT</td>
<td>FS</td>
</tr>
<tr>
<td>2</td>
<td>VERASE</td>
<td>#</td>
</tr>
<tr>
<td>3</td>
<td>VKILL</td>
<td>@</td>
</tr>
<tr>
<td>4</td>
<td>VEOF</td>
<td>EOT</td>
</tr>
<tr>
<td>5</td>
<td>VEOL</td>
<td>NUL</td>
</tr>
<tr>
<td>6</td>
<td>VEOL2</td>
<td>NUL</td>
</tr>
<tr>
<td>7</td>
<td>reserved</td>
<td></td>
</tr>
</tbody>
</table>

For the non-canonical mode the positions of *VEOF* and *VEOL* are shared by *VMIN* and
*VTIME*:

<table>
<thead>
<tr>
<th>Position</th>
<th>Symbol</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>VMIN</td>
<td>used to set the value of MIN</td>
</tr>
<tr>
<td>5</td>
<td>VTIME</td>
<td>used to set the value of TIME</td>
</tr>
</tbody>
</table>

The calls that use the *termio* structure only affect the flags and control characters
that can be stored in the *termio* structure; all other flags and control characters are
unaffected.

**Modem lines**

On special files representing serial ports, the modem control lines supported by the
hardware can be read, and the modem status lines supported by the hardware can
be changed. The following modem control and status lines may be supported by a
device; they are defined by *sys/termios.h*:

```
TIOCM_LE line enable
TIOCM_DTR data terminal ready
TIOCM_RTS request to send
TIOCM_ST secondary transmit
TIOCM_SR secondary receive
TIOCM_CTS clear to send
TIOCM_CAR carrier detect
TIOCM_RNG ring
TIOCM_DSR data set ready
```
TIOCM_CD is a synonym for TIOCM_CAR, and TIOCM_RI is a synonym for TIOCM_RNG. Not all of these are necessarily supported by any particular device; check the manual page for the device in question.

IOCTLS

The ioctl supported by devices and STREAMS modules providing the termios interface are listed below. Some calls may not be supported by all devices or modules. The functionality provided by these calls is also available through the preferred function call interface specified on termios(2).

TCGETS
The argument is a pointer to a termios structure. The current terminal parameters are fetched and stored into that structure.

TCSETS
The argument is a pointer to a termios structure. The current terminal parameters are set from the values stored in that structure. The change is immediate.

TCSETSW
The argument is a pointer to a termios structure. The current terminal parameters are set from the values stored in that structure. The change occurs after all characters queued for output have been transmitted. This form should be used when changing parameters that affect output.

TCSETSF
The argument is a pointer to a termios structure. The current terminal parameters are set from the values stored in that structure. The change occurs after all characters queued for output have been transmitted; all characters queued for input are discarded and then the change occurs.

TCGETA
The argument is a pointer to a termio structure. The current terminal parameters are fetched, and those parameters that can be stored in a termio structure are stored into that structure.

TCSETA
The argument is a pointer to a termio structure. Those terminal parameters that can be stored in a termio structure are set from the values stored in that structure. The change is immediate.

TCSETAW
The argument is a pointer to a termio structure. Those terminal parameters that can be stored in a termio structure are set from the values stored in that structure. The change occurs after all characters queued for output have been transmitted. This form should be used when changing parameters that affect output.

TCSETAF
The argument is a pointer to a termio structure. Those terminal parameters that can be stored in a termio structure are set from the values stored in that structure. The change occurs after all characters queued for output have been transmitted; all characters queued for input are discarded and then the change occurs.

TCSBRK
The argument is an int value. Wait for the output to drain. If the argument is 0, then send a break (zero valued bits for 0.25 seconds).
TCXONC  Start/stop control. The argument is an int value. If the argument is 0, suspend output; if 1, restart suspended output; if 2, suspend input; if 3, restart suspended input.

TCFLSH  The argument is an int value. If the argument is 0, flush the input queue; if 1, flush the output queue; if 2, flush both the input and output queues. On some controllers, if the argument is 0, input flow control characters will be flushed, causing the unflushed output queue to overflow a busy output device.

TIOCGPGRP The argument is a pointer to a pid_t. Set the value of that pid_t to the process group ID of the foreground process group associated with the terminal. See termios(2) for a description or TCGETPGRP.

TIOCSPGRP The argument is a pointer to a pid_t. Associate the process group whose process group ID is specified by the value of that pid_t with the terminal. The new process group value must be in the range of valid process group ID values. Otherwise, the error EPERM is returned. See termios(2) for a description of TCSETPGRP.

TIOCGSID The argument is a pointer to a pid_t. The session ID of the terminal is fetched and stored in the pid_t.

TIOCGWINSZ The argument is a pointer to a winsize structure. The terminal driver’s notion of the terminal size is stored into that structure.

TIOC SWINSZ The argument is a pointer to a winsize structure. The terminal driver’s notion of the terminal size is set from the values specified in that structure. If the new sizes are different from the old sizes, a SIGWINCH signal is set to the process group of the terminal.

TIOCM BIS The argument is a pointer to an int whose value is a mask containing modem control lines to be turned on. The control lines whose bits are set in the argument are turned on; no other control lines are affected.

TIOCM BIC The argument is a pointer to an int whose value is a mask containing modem control lines to be turned off. The control lines whose bits are set in the argument are turned off; no other control lines are affected.

TIOCMGET The argument is a pointer to an int. The current state of the modem status lines is fetched and stored in the int pointed to by the argument.

TIOCMSET The argument is a pointer to an int containing a new set of modem control lines. The modem control lines are turned on or off, depending on whether the bit for that mode is set or clear.

FILES
/dev/*

SEE ALSO
fork(2), ioctl(2), setsid(2), signal(2), streamio(7), termios(2)
The extended general terminal interface supplements the termio(7) general terminal interface by adding support for asynchronous hardware flow control, isochronous flow control and clock modes, and local implementations of additional asynchronous features. Some systems may not support all of these capabilities because of either hardware or software limitations. Other systems may not permit certain functions to be disabled. In these cases the appropriate bits will be ignored. See termiox.h for your system to find out which capabilities are supported.

Hardware Flow Control Modes

Hardware flow control supplements the termio(7) IXON, IXOFF, and IXANY character flow control. Character flow control occurs when one device controls the data transfer of another device by the insertion of control characters in the data stream between devices. Hardware flow control occurs when one device controls the data transfer of another device using electrical control signals on wires (circuits) of the asynchronous interface. Isochronous hardware flow control occurs when one device controls the data transfer of another device by asserting or removing the transmit clock signals of that device. Character flow control and hardware flow control may be simultaneously set.

In asynchronous, full duplex applications, the use of the Electronic Industries Association’s EIA-232-D Request To Send (RTS) and Clear To Send (CTS) circuits is the preferred method of hardware flow control. An interface to other hardware flow control methods is included to provide a standard interface to these existing methods.

The EIA-232-D standard specified only uni-directional hardware flow control - the Data Circuit-terminating Equipment or Data Communications Equipment (DCE) indicates to the Data Terminal Equipment (DTE) to stop transmitting data. The termiox(7) interface allows both uni-directional and bi-directional hardware flow control; when bi-directional flow control is enabled, either the DCE or DTE can indicate to each other to stop transmitting data across the interface. Note: It is assumed that the asynchronous port is configured as a DTE. If the connected device is also a DTE and not a DCE, then DTE to DTE (for example, terminal or printer connected to computer) hardware flow control is possible by using a null modem to interconnect the appropriate data and control circuits.

Clock Modes

Isochronous communication is a variation of asynchronous communication whereby two communicating devices may provide transmit and/or receive clock to each other. Incoming clock signals can be taken from the baud rate generator on the local isochronous port controller, from CCITT V.24 circuit 114, Transmitter Signal Element Timing - DCE source (EIA-232-D pin 15), or from CCITT V.24 circuit 115, Receiver Signal Element Timing - DCE source (EIA-232-D pin 17). Outgoing clock signals can be sent on CCITT V.24 circuit 113, Transmitter Signal Element Timing - DTE source (EIA-232-D pin 24), on CCITT V.24 circuit 128, Receiver Signal Element Timing - DTE source (no EIA-232-D pin), or not sent at all.
In terms of clock modes, traditional asynchronous communication is implemented simply by using the local baud rate generator as the incoming transmit and receive clock source and not outputting any clock signals.

**Terminal Parameters**

The parameters that control the behavior of devices providing the `termiox` interface are specified by the `termiox` structure, defined in the `sys/termiox.h` header file. Several `ioctl(2)` system calls that fetch or change these parameters use this structure:

```c
#define NFF 5
struct termiox {
    unsigned short x_hflag; /* hardware flow control modes */
    unsigned short x_cflag; /* clock modes */
    unsigned short x_rflag[NFF]; /* reserved modes */
    unsigned short x_sflag; /* spare local modes */
};
```

The `x_hflag` field describes hardware flow control modes:

- **RTSXOFF** 0000001 Enable RTS hardware flow control on input.
- **CTSXON** 0000002 Enable CTS hardware flow control on output.
- **DTRXOFF** 0000004 Enable DTR hardware flow control on input.
- **CDXON** 0000010 Enable CD hardware flow control on output.
- **ISXOFF** 0000020 Enable isochronous hardware flow control on input.

The EIA-232-D DTR and CD circuits are used to establish a connection between two systems. The RTS circuit is also used to establish a connection with a modem. Thus, both DTR and RTS are activated when an asynchronous port is opened. If DTR is used for hardware flow control, then RTS must be used for connectivity. If CD is used for hardware flow control, then CTS must be used for connectivity. Thus, RTS and DTR (or CTS and CD) cannot both be used for hardware flow control at the same time. Other mutual exclusions may apply, such as the simultaneous setting of the `termio(7)` HUPCL and the `termiox(7)` DTRXOFF bits, which use the DTE ready line for different functions.

Variations of different hardware flow control methods may be selected by setting the appropriate bits. For example, bi-directional RTS/CTS flow control is selected by setting both the RTSXOFF and CTSXON bits and bi-directional DTR/CTS flow control is selected by setting both the DTRXOFF and CTSXON. Modem control or uni-directional CTS hardware flow control is selected by setting only the CTSXON bit.

As previously mentioned, it is assumed that the local asynchronous port (for example, computer) is configured as a DTE. If the connected device (for example, printer) is also a DTE, it is assumed that the device is connected to the computer's asynchronous port via a null modem that swaps control circuits (typically RTS and CTS). The connected DTE drives RTS and the null modem swaps RTS and CTS so that the remote RTS is received as CTS by the local DTE. In the case that CTSXON is set for hardware flow control, printer's lowering of its RTS would cause CTS seen by the computer to be lowered. Output to the printer is suspended...
until the printer’s raising of its RTS, which would cause CTS seen by the computer to be raised.

If \texttt{RTSXOFF} is set, the Request To Send (RTS) circuit (line) will be raised, and if the asynchronous port needs to have its input stopped, it will lower the Request To Send (RTS) line. If the RTS line is lowered, it is assumed that the connected device will stop its output until RTS is raised.

If \texttt{CTSXON} is set, output will occur only if the Clear To Send (CTS) circuit (line) is raised by the connected device. If the CTS line is lowered by the connected device, output is suspended until CTS is raised.

If \texttt{DTRXOFF} is set, the DTE Ready (DTR) circuit (line) will be raised, and if the asynchronous port needs to have its input stopped, it will lower the DTE Ready (DTR) line. If the DTR line is lowered, it is assumed that the connected device will stop its output until DTR is raised.

If \texttt{CDXON} is set, output will occur only if the Received Line Signal Detector (CD) circuit (line) is raised by the connected device. If the CD line is lowered by the connected device, output is suspended until CD is raised.

If \texttt{ISXOFF} is set, and if the isochronous port needs to have its input stopped, it will stop the outgoing clock signal. It is assumed that the connected device is using this clock signal to create its output. Transit and receive clock sources are programmed using the \texttt{x_cflag} fields. If the port is not programmed for external clock generation, \texttt{ISXOFF} is ignored. Output isochronous flow control is supported by appropriate clock source programming using the \texttt{x_cflag} field and enabled at the remote connected device.

The \texttt{x_cflag} field specifies the system treatment of clock modes.

\begin{verbatim}
<table>
<thead>
<tr>
<th>Field</th>
<th>Mask</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>XMTCLK</td>
<td>000007</td>
<td>Transmit clock source:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Get transmit clock from internal baud rate</td>
</tr>
<tr>
<td></td>
<td></td>
<td>generator.</td>
</tr>
<tr>
<td>XCIBRG</td>
<td>000000</td>
<td>Get transmit clock from transmitter signal</td>
</tr>
<tr>
<td></td>
<td></td>
<td>element timing (DCE source) lead, CCITT</td>
</tr>
<tr>
<td></td>
<td></td>
<td>V.24 circuit 114, EIA-232-D pin 15.</td>
</tr>
<tr>
<td>XCTSET</td>
<td>000001</td>
<td>Get transmit clock from transmitter signal</td>
</tr>
<tr>
<td></td>
<td></td>
<td>element timing (DCE source) lead, CCITT</td>
</tr>
<tr>
<td></td>
<td></td>
<td>V.24 circuit 114, EIA-232-D pin 15.</td>
</tr>
<tr>
<td>XCRSET</td>
<td>000002</td>
<td>Get transmit clock from receiver signal</td>
</tr>
<tr>
<td></td>
<td></td>
<td>element timing (DCE source) lead, CCITT</td>
</tr>
<tr>
<td></td>
<td></td>
<td>V.24 circuit 115, EIA-232-D pin 17.</td>
</tr>
<tr>
<td>RCVCLK</td>
<td>000007</td>
<td>Receive clock source:</td>
</tr>
<tr>
<td>RCIBRG</td>
<td>000000</td>
<td>Get receive clock from internal baud rate</td>
</tr>
<tr>
<td></td>
<td></td>
<td>generator.</td>
</tr>
<tr>
<td>RCTSET</td>
<td>000010</td>
<td>Get receive clock from transmitter signal</td>
</tr>
<tr>
<td></td>
<td></td>
<td>element timing (DCE source) lead, CCITT</td>
</tr>
<tr>
<td></td>
<td></td>
<td>V.24 circuit 114, EIA-232-D pin 15.</td>
</tr>
<tr>
<td>RCRSET</td>
<td>000020</td>
<td>Get receive clock from receiver signal</td>
</tr>
<tr>
<td></td>
<td></td>
<td>element timing (DCE source) lead, CCITT</td>
</tr>
<tr>
<td></td>
<td></td>
<td>V.24 circuit 115, EIA-232-D pin 17.</td>
</tr>
<tr>
<td>TSETCLK</td>
<td>000070</td>
<td>Transmitter signal element timing (DTE source)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>lead, CCITT V.24 circuit 113, EIA-232-D pin 24,</td>
</tr>
<tr>
<td></td>
<td></td>
<td>clock source:</td>
</tr>
<tr>
<td>TSETCOFF</td>
<td>000000</td>
<td>TSET clock not provided.</td>
</tr>
</tbody>
</table>
\end{verbatim}
TSETCRBRG 0000100 Output receive baud rate generator on circuit 113.
TSETCTBRG 0000200 Output transmit baud rate generator on circuit 113.
TSETCTSET 0000300 Output transmitter signal element timing (DCE source) on circuit 113.
TSETCRSET 0000400 Output receiver signal element timing (DCE source) on circuit 113.
RSETCLK 0007000 Receiver signal element timing (DTE source) lead, CCITT V.24 circuit 128, no EIA-232-D pin, clock source:
RSETCOFF 0000000 RSET clock not provided.
RSETCRBRG 0001000 Output receive baud rate generator on circuit 128.
RSETCTBRG 0002000 Output transmit baud rate generator on circuit 128.
RSETCTSET 0003000 Output transmitter signal element timing (DCE source) on circuit 128.
RSETCRSET 0004000 Output receiver signal element timing (DCE) on circuit 128.

If the XMTCLK field has a value of XCIBRG the transmit clock is taken from the hardware internal baud rate generator, as in normal asynchronous transmission. If XMTCLK = XCTSET the transmit clock is taken from the Transmitter Signal Element Timing (DCE source) circuit. If XMTCLK = XCRSET the transmit clock is taken from the Receiver Signal Element Timing (DCE source) circuit.

If the RCVCLK field has a value of RCIBRG the receive clock is taken from the hardware Internal Baud Rate Generator, as in normal asynchronous transmission. If RCVCLK = RCTSET the receive clock is taken from the Transmitter Signal Element Timing (DCE source) circuit. If RCVCLK = RCRSET the receive clock is taken from the Receiver Signal Element Timing (DCE source) circuit.

If the TSETCLK field has a value of TSETCOFF the Transmitter Signal Element Timing (DTE source) circuit is not driven. If TSETCLK = TSETCRBRG the Transmitter Signal Element Timing (DTE source) circuit is driven by the Receive Baud Rate Generator. If TSETCLK = TSETCTBRG the Transmitter Signal Element Timing (DTE source) circuit is driven by the Transmit Baud Rate Generator. If TSETCLK = TSETCTSET the Transmitter Signal Element Timing (DTE source) circuit is driven by the Transmitter Signal Element Timing (DCE source). If TSETCLK = TSETCRBRG the Transmitter Signal Element Timing (DTE source) circuit is driven by the Receiver Signal Element Timing (DCE source).

If the RSETCLK field has a value of RSETCOFF the Receiver Signal Element Timing (DTE source) circuit is not driven. If RSETCLK = RSETCRBRG the Receiver Signal Element Timing (DTE source) circuit is driven by the Receive Baud Rate Generator. If RSETCLK = RSETCTBRG the Receiver Signal Element Timing (DTE source) circuit is driven by the Transmit Baud Rate Generator. If RSETCLK = RSETCTSET the Receiver Signal Element Timing (DTE source) circuit is driven by the Transmitter Signal Element Timing (DCE source). If RSETCLK = RSETCRBRG the Receiver Signal Element Timing (DTE source) circuit is driven by the Receiver Signal Element Timing (DCE source).
termiox(7)

The \texttt{x_rflag} is reserved for future interface definitions and should not be used by any implementations. The \texttt{x_sflag} may be used by local implementations wishing to customize their terminal interface using the \texttt{termiox(7)} ioctl system calls.

\textbf{ioctls}

The \texttt{ioctl(2)} system calls have the form:

\begin{verbatim}
ioctl (int fildes, int command, struct termiox *arg);
\end{verbatim}

The commands using this form are:

- \texttt{TCGETX} The argument is a pointer to a \texttt{termiox} structure. The current terminal parameters are fetched and stored into that structure.

- \texttt{TCSETX} The argument is a pointer to a \texttt{termiox} structure. The current terminal parameters are set from the values stored in that structure. The change is immediate.

- \texttt{TCSETXW} The argument is a pointer to a \texttt{termiox} structure. The current terminal parameters are set from the values stored in that structure. The change occurs after all characters queued for output have been transmitted. This form should be used when changing parameters that will affect output.

- \texttt{TCSETXF} The argument is a pointer to a \texttt{termiox} structure. The current terminal parameters are set from the values stored in that structure. The change occurs after all characters queued for output have been transmitted; all characters queued for input are discarded and then the change occurs.

\textbf{FILES}

\begin{verbatim}
/dev/*
\end{verbatim}

\textbf{SEE ALSO}

\texttt{ioctl(2), stty(1), termio(7)}
NAME
ticlts, ticots, ticotsord - loopback transport providers

SYNOPSIS
#include <ticlts.h>
#include <ticots.h>
#include <ticotsord.h>

DESCRIPTION
The devices known as ticlts, ticots, and ticotsord are "loopback transport providers," that is, stand-alone networks at the transport level. Loopback transport providers are transport providers in every sense except one: only one host (the local machine) is "connected to" a loopback network. Loopback transports present a TPI (STREAMS-level) interface to application processes and are intended to be accessed via the TLI (application-level) interface. They are implemented as clone devices and support address spaces consisting of "flex-addresses," that is, arbitrary sequences of octets, of length > 0, represented by a netbuf structure.

ticlts is a datagram-mode transport provider. It offers (connectionless) service of type T_CLTS. Its default address size is TCL_DEFAULTADDRSZ. ticlts prints the following error messages [see t_rcvuderr(3N)]:

TCL_BADADDR bad address specification
TCL_BADOPT bad option specification
TCL_NOPEER bound
TCL_PEERBADSTATE peer in wrong state

ticots is a virtual circuit-mode transport provider. It offers (connection-oriented) service of type T_COTS. Its default address size is TCO_DEFAULTADDRSZ. ticots prints the following disconnect messages [see t_rcvdis(3N)]:

TCO_NOPEER no listener on destination address
TCO_PEERNOROOMONQ peer has no room on connect queue
TCO_PEERBADSTATE peer in wrong state
TCO_PEERINITIATED peer-initiated disconnect
TCO_PROVIDERINITIATED provider-initiated disconnect

ticotsord is a virtual circuit-mode transport provider, offering service of type T_COTS_ORD (connection-oriented service with orderly release). Its default address size is TCOO_DEFAULTADDRSZ. ticotsord prints the following disconnect messages [see t_rcvdis(3N)]:

TCOO_NOPEER no listener on destination address
TCOO_PEERNOROOMONQ peer has no room on connect queue
TCOO_PEERBADSTATE peer in wrong state
TCOO_PEERINITIATED peer-initiated disconnect
TCOO_PROVIDERINITIATED provider-initiated disconnect

USAGE
Loopback transports support a local IPC mechanism through the TLI interface. Applications implemented in a transport provider-independent manner on a client-server model using this IPC are transparently transportable to networked environments.
**ticlts(7)**

Transport provider-independent applications must not include the header files listed in the synopsis section above. In particular, the options are (like all transport provider options) provider dependent.

**ticlts** and **ticots** support the same service types (**T_CLTS** and **T_COTS**) supported by the OSI transport-level model. The use of **ticlts** and **ticots** is encouraged.

**ticotsord** supports the same service type (**T_COTS_ORD**) supported by the TCP/IP model. The use of **ticotsord** is discouraged except for reasons of compatibility.

**FILES**

/dev/ticlts
/dev/ticots
/dev/ticotsord
NAME

timod – Transport Interface cooperating STREAMS module

DESCRIPTION

timod is a STREAMS module for use with the Transport Interface (TI) functions of the Network Services library. The timod module converts a set of ioctl(2) calls into STREAMS messages that may be consumed by a transport protocol provider which supports the Transport Interface. This allows a user to initiate certain TI functions as atomic operations.

The timod module must be pushed onto only a stream terminated by a transport protocol provider which supports the TI.

All STREAMS messages, with the exception of the message types generated from the ioctl commands described below, will be transparently passed to the neighboring STREAMS module or driver. The messages generated from the following ioctl commands are recognized and processed by the timod module. The format of the ioctl call is:

```c
#include <sys/stropts.h>

struct strioctl strioctl;

strioctl.ic_cmd = cmd;
strioctl.ic_timeout = INFTIM;
strioctl.ic_len = size;
strioctl.ic_dp = (char *)buf
ioctl(fildes, I_STR, &strioctl);
```

Where, on issuance, size is the size of the appropriate TI message to be sent to the transport provider and on return size is the size of the appropriate TI message from the transport provider in response to the issued TI message. buf is a pointer to a buffer large enough to hold the contents of the appropriate TI messages. The TI message types are defined in sys/tihdr.h. The possible values for the cmd field are:

**TI_BIND**

Bind an address to the underlying transport protocol provider. The message issued to the TI_BIND ioctl is equivalent to the TI message type T_BIND_REQ and the message returned by the successful completion of the ioctl is equivalent to the TI message type T_BIND_ACK.

**TI_UNBIND**

Unbind an address from the underlying transport protocol provider. The message issued to the TI_UNBIND ioctl is equivalent to the TI message type T_UNBIND_REQ and the message returned by the successful completion of the ioctl is equivalent to the TI message type T_OK_ACK.

**TI_GETINFO**

Get the TI protocol specific information from the transport protocol provider. The message issued to the TI_GETINFO ioctl is equivalent to the TI message type T_INFO_REQ and the message
timod(7)

returned by the successful completion of the ioctl is equivalent to the TI message type T_INFO_ACK.

TI_OPTMGMT

Get, set or negotiate protocol specific options with the transport protocol provider. The message issued to the TI_OPTMGMT ioctl is equivalent to the TI message type T_OPTMGMT_REQ and the message returned by the successful completion of the ioctl is equivalent to the TI message type T_OPTMGMT_ACK.

FILES

sys/timod.h
sys/tiuser.h
sys/tihdr.h
sys/errno.h

SEE ALSO

tirdwr(7)

DIAGNOSTICS

If the ioctl system call returns with a value greater than 0, the lower 8 bits of the return value will be one of the TI error codes as defined in sys/tiuser.h. If the TI error is of type TSYSERR, then the next 8 bits of the return value will contain an error as defined in sys/errno.h [see intro(2)].
NAME
tirdwr – Transport Interface read/write interface STREAMS module

DESCRIPTION
tirdwr is a STREAMS module that provides an alternate interface to a transport provider which supports the Transport Interface (TI) functions of the Network Services library (see Section 3N). This alternate interface allows a user to communicate with the transport protocol provider using the read(2) and write(2) system calls. The putmsg(2) and getmsg(2) system calls may also be used. However, putmsg and getmsg can only transfer data messages between user and stream.

The tirdwr module must only be pushed [see I_PUSH in streamio(7)] onto a stream terminated by a transport protocol provider which supports the TI. After the tirdwr module has been pushed onto a stream, none of the Transport Interface functions can be used. Subsequent calls to TI functions will cause an error on the stream. Once the error is detected, subsequent system calls on the stream will return an error with errno set to EPROTO.

The following are the actions taken by the tirdwr module when pushed on the stream, popped [see I_POP in streamio(7)] off the stream, or when data passes through it.

push When the module is pushed onto a stream, it will check any existing data destined for the user to ensure that only regular data messages are present. It will ignore any messages on the stream that relate to process management, such as messages that generate signals to the user processes associated with the stream. If any other messages are present, the I_PUSH will return an error with errno set to EPROTO.

write The module will take the following actions on data that originated from a write system call:

All messages with the exception of messages that contain control portions (see the putmsg and getmsg system calls) will be transparently passed onto the module’s downstream neighbor.

Any zero length data messages will be freed by the module and they will not be passed onto the module’s downstream neighbor.

Any messages with control portions will generate an error, and any further system calls associated with the stream will fail with errno set to EPROTO.

read The module will take the following actions on data that originated from the transport protocol provider:

All messages with the exception of those that contain control portions (see the putmsg and getmsg system calls) will be transparently passed onto the module’s upstream neighbor.

The action taken on messages with control portions will be as follows:
Messages that represent expedited data will generate an error. All further system calls associated with the stream will fail with \texttt{errno} set to \texttt{EPROTO}.

Any data messages with control portions will have the control portions removed from the message prior to passing the message on to the upstream neighbor.

Messages that represent an orderly release indication from the transport provider will generate a zero length data message, indicating the end of file, which will be sent to the reader of the stream. The orderly release message itself will be freed by the module.

Messages that represent an abortive disconnect indication from the transport provider will cause all further \texttt{write} and \texttt{putmsg} system calls to fail with \texttt{errno} set to \texttt{ENXIO}. All further \texttt{read} and \texttt{getmsg} system calls will return zero length data (indicating end of file) once all previous data has been read.

With the exception of the above rules, all other messages with control portions will generate an error and all further system calls associated with the stream will fail with \texttt{errno} set to \texttt{EPROTO}.

Any zero length data messages will be freed by the module and they will not be passed onto the module's upstream neighbor.

\textit{pop} \hspace{1cm} When the module is popped off the stream or the stream is closed, the module will take the following action:

If an orderly release indication has been previously received, then an orderly release request will be sent to the remote side of the transport connection.

\textbf{SEE ALSO}
\begin{itemize}
  \item \texttt{getmsg(2)}, \texttt{intro(2)}, \texttt{intro(3)}
  \item \texttt{putmsg(2)}, \texttt{read(2)}, \texttt{streamio(7)}, \texttt{timod(7)}, \texttt{write(2)}
\end{itemize}
NAME
ttcompat – V7, 4BSD and XENIX STREAMS compatibility module

SYNOPSIS
#include <sys/stream.h>
#include <sys/stropts.h>
#include <sys/ttcompat.h>
#include <sys/ttold.h>

ioctl(fd, I_PUSH, "ttcompat");

DESCRIPTION
ttcompat is a STREAMS module that translates the ioctl calls supported by the older Version 7, 4BSD and XENIX terminal drivers into the ioctl calls supported by the termio interface [see termio(7)]. All other messages pass through this module unchanged; the behavior of read and write calls is unchanged, as is the behavior of ioctl calls other than the ones supported by ttcompat.

This module can be automatically pushed onto a stream with the autopush(1M) mechanism when a terminal device is opened; it does not have to be explicitly pushed onto a stream. This module requires that the termios interface be supported by the modules and the application can push the driver downstream. The TGETS, TSETS, and TCSETS ioctl calls must be supported; if any information set or fetched by those ioctl calls is not supported by the modules and driver downstream, some of the V7/4BSD/XENIX functions may not be supported. For example, if the CBAUD bits in the c_cflag field are not supported, the functions provided by the sg_ispeed and sg_ospeed fields of the sgttyb structure (see below) will not be supported. If the TCFLUSH ioctl is not supported, the function provided by the TIOCFLUSH ioctl will not be supported. If the TCXONC ioctl is not supported, the functions provided by the TIOCSTOP and TIOCSTART ioctl calls will not be supported. If the TIOCMBIS and TIOCMBIC ioctl calls are not supported, the functions provided by the TIOCSSTR and TIOCSETDTR ioctl calls will not be supported.

The basic ioctl calls use the sgttyb structure defined by sys/ioctl.h:

struct sgttyb {
    char sg_ispeed;
    char sg_ospeed;
    char sg_erase;
    char sg_killi;
    int sg_flags;
};

The sg_ispeed and sg_ospeed fields describe the input and output speeds of the device, and reflect the values in the c_cflag field of the termios structure. The sg_erase and sg_killi fields of the argument structure specify the erase and kill characters respectively, and reflect the values in the VERASE and VKILL members of the c_cc field of the termios structure.

The sg_flags field of the argument structure contains several flags that determine the system’s treatment of the terminal. They are mapped into flags in fields of the terminal state, represented by the termios structure.
Delay type 0 is always mapped into the equivalent delay type 0 in the `c_oflag` field of the `termios` structure. Other delay mappings are performed as follows:

<table>
<thead>
<tr>
<th>sg_flags</th>
<th>c_oflag</th>
</tr>
</thead>
<tbody>
<tr>
<td>BS1</td>
<td>BS1</td>
</tr>
<tr>
<td>FF1</td>
<td>VT1</td>
</tr>
<tr>
<td>CR1</td>
<td>CR2</td>
</tr>
<tr>
<td>CR2</td>
<td>CR3</td>
</tr>
<tr>
<td>CR3</td>
<td>not supported</td>
</tr>
<tr>
<td>TAB1</td>
<td>TAB1</td>
</tr>
<tr>
<td>TAB2</td>
<td>TAB2</td>
</tr>
<tr>
<td>X TABS</td>
<td>TAB3</td>
</tr>
<tr>
<td>NL1</td>
<td>ONLRET</td>
</tr>
<tr>
<td>NL2</td>
<td>NL2</td>
</tr>
</tbody>
</table>

If previous `TIOCLSET` or `TIOCLBIS` ioctl calls have not selected LITOUT or PASS8 mode, and if RAW mode is not selected, the _ISTRIP_ flag is set in the `c_iflag` field of the `termios` structure, and the _EVENP_ and _ODDP_ flags control the parity of characters sent to the terminal and accepted from the terminal:

- Parity is not to be generated on output or checked on input:
  
  The character size is set to CS8 and the flag is cleared in the `c_cflag` field of the `termios` structure.

- Even parity characters are to be generated on output and accepted on input:
  
  The flag is set in the `c_iflag` field of the `termios` structure, the character size is set to CS7 and the flag is set in the `c_cflag` field of the `termios` structure.

- Odd parity characters are to be generated on output and accepted on input:
  
  The flag is set in the `c_iflag` field, the character size is set to CS7 and the and flags are set in the `c_cflag` field of the `termios` structure.

- Even parity characters are to be generated on output and characters of either parity are to be accepted on input:
  
  The flag is cleared in the `c_iflag` field, the character size is set to CS7 and the flag is set in the `c_cflag` field of the `termios` structure.

The RAW flag disables all output processing (the OPOST flag in the `c_oflag` field, and the XCASE flag in the `c_lflag` field, are cleared in the `termios` structure) and input processing (all flags in the `c_iflag` field other than the IXOFF and IXANY flags are cleared in the `termios` structure). 8 bits of data, with no parity bit, are accepted on input and generated on output; the character size is set to CS8 and the PARENB and PARODD flags are cleared in the `c_cflag` field of the `termios` structure. The signal-generating and line-editing control characters are disabled by clearing the ISIG and ICANON flags in the `c_lflag` field of the `termios` structure.

The CRMOD flag turns input RETURN characters into NEWLINE characters, and output and echoed NEWLINE characters to be output as a RETURN followed by a LINEFEED. The ICRNL flag in the `c_iflag` field, and the OPOST and ONLCR flags in the `c_oflag` field, are set in the `termios` structure.
The `LCASE` flag maps upper-case letters in the ASCII character set to their lower-case equivalents on input (the `IUCLC` flag is set in the `c_iflag` field), and maps lower-case letters in the ASCII character set to their upper-case equivalents on output (the `OLCUC` flag is set in the `c_oflag` field). Escape sequences are accepted on input, and generated on output, to handle certain ASCII characters not supported by older terminals (the `XCASE` flag is set in the `c_iflag` field).

Other flags are directly mapped to flags in the `termios` structure:

```
sg_flags    flags in termios structure
CBREAK      complement of ICANON in c_iflag field
ECHO        ECHO in c_lflag field
TANDEM      IXOFF in c_iflag field
```

Another structure associated with each terminal specifies characters that are special in both the old Version 7 and the newer 4BSD terminal interfaces. The following structure is defined by `sys/ioct1.h`:

```
struct tchars {
    char t_intrc;    /* interrupt */
    char t_quitc;    /* quit */
    char t_startc;   /* start output */
    char t_stopc;    /* stop output */
    char t_eofc;     /* end-of-file */
    char t_brkc;     /* input delimiter (like nl) */
};
```

XENIX defines the `tchar` structure as `tc`. The characters are mapped to members of the `c_cc` field of the `termios` structure as follows:

```
tchars    c_cc index
t_intrc    VINTR
_t_quitc   VQUIT
_t_startc  VSTART
_t_stopc   VSTOP
t_eofc     VEOF
t_brkc     VEOL
```

Also associated with each terminal is a local flag word, specifying flags supported by the new 4BSD terminal interface. Most of these flags are directly mapped to flags in the `termios` structure:

```
local flags flags in termios structure
LCRTBS      not supported
LPRTERA     ECHOPRT in the c_lflag field
LCRTERA     ECHO in the c_lflag field
LTILDE      not supported
LTOSTOP     TOSTOP in the c_lflag field
LFLUSHO     FLUSHO in the c_lflag field
LNOHANG     CLOCAL in the c_cflag field
```
Another structure associated with each terminal is the ltchars structure which defines control characters for the new 4BSD terminal interface. Its structure is:

```c
struct ltchars {
    char t_suspc; /* stop process signal */
    char t_dsuspc; /* delayed stop process signal */
    char t_rprntc; /* reprint line */
    char t_flushc; /* flush output (toggles) */
    char t_werasc; /* word erase */
    char t_lnextc; /* literal next character */
};
```

The characters are mapped to members of the c_cc field of the termios structure as follows:

<table>
<thead>
<tr>
<th>ltchars</th>
<th>c_cc index</th>
</tr>
</thead>
<tbody>
<tr>
<td>t_suspc</td>
<td>VSUSP</td>
</tr>
<tr>
<td>t_dsuspc</td>
<td>VDSUSP</td>
</tr>
<tr>
<td>t_rprntc</td>
<td>VREPRINT</td>
</tr>
<tr>
<td>t_flushc</td>
<td>VDISCARD</td>
</tr>
<tr>
<td>t_werasc</td>
<td>VWERASE</td>
</tr>
<tr>
<td>t_lnextc</td>
<td>VLNEXT</td>
</tr>
</tbody>
</table>

ioctls

**ttcompat** responds to the following ioctl calls. All others are passed to the module below.

- **TIOCGETP**
  The argument is a pointer to an sgttyb structure. The current terminal state is fetched; the appropriate characters in the terminal state are stored in that structure, as are the input and output speeds. The values of the flags in the sg_flags field are derived from the flags in the terminal state and stored in the structure.

- **TIOCSEXCL**
  Set “exclusive-use” mode; no further opens (except by a privileged user) are permitted until the file has been closed.

- **TIOCNXCL**
  Turn off “exclusive-use” mode.

- **TIOCSETP**
  The argument is a pointer to an sgttyb structure. The appropriate characters and input and output speeds in the terminal state are set from the values in that structure, and the flags in the terminal state are set to match the values of the flags in the sg_flags field of that structure. The state is changed with a TCSETSF ioctl so that the interface delays until output is quiescent, then throws away any unread characters, before changing the modes.
The argument is a pointer to an `sgttyb` structure. The terminal state is changed as `TIOCSETP` would change it, but a `TCSETS ioctl` is used, so that the interface neither delays nor discards input.

The argument is ignored. The HUPCL flag is set in the `c_cflag` word of the terminal state.

The argument is a pointer to an `int` variable. If its value is zero, all characters waiting in input or output queues are flushed. Otherwise, the value of the `int` is treated as the logical OR of the `FREAD` and `FWRITE` flags defined by `sys/file.h`; if the `FREAD` bit is set, all characters waiting in input queues are flushed, and if the `FWRITE` bit is set, all characters waiting in output queues are flushed.

The argument is ignored. The break bit is set for the device.

The argument is ignored. The break bit is cleared for the device.

The argument is ignored. The Data Terminal Ready bit is set for the device.

The argument is ignored. The Data Terminal Ready bit is cleared for the device.

The argument is ignored. Output is stopped as if the `STOP` character had been typed.

The argument is ignored. Output is restarted as if the `START` character had been typed.

The argument is a pointer to a `tchars` structure. The current terminal state is fetched, and the appropriate characters in the terminal state are stored in that structure.

The argument is a pointer to a `tchars` structure. The values of the appropriate characters in the terminal state are set from the characters in that structure.

The argument is a pointer to an `int`. The current terminal state is fetched, and the values of the local flags are derived from the flags in the terminal state and stored in the `int` pointed to by the argument.

The argument is a pointer to an `int` whose value is a mask containing flags to be set in the local flags word. The current terminal state is fetched, and the values of the local flags are derived from the flags in the terminal state; the specified flags are set, and the flags in the terminal state are set to match the new value of the local flags word.

The argument is a pointer to an `int` whose value is a mask containing flags to be cleared in the local flags word. The current terminal state is fetched, and the values of the local flags are derived from the flags in the terminal state; the specified flags are cleared, and the flags in the terminal state are set to match the new value of the local flags word.
ttcompat(7)

TIOCLSET The argument is a pointer to an int containing a new set of local flags. The flags in the terminal state are set to match the new value of the local flags word.

TIOCGLTTC The argument is a pointer to an ltchars structure. The values of the appropriate characters in the terminal state are stored in that structure.

TIOCGLTC The argument is a pointer to an ltchars structure. The values of the appropriate characters in the terminal state are set from the characters in that structure.

FIORDCHK FIORDCHK returns the number of immediately readable characters. The argument is ignored.

FIONREAD FIONREAD returns the number of immediately readable characters in the int pointed to by the argument.

LDSMAP Calls the function emsetmap(tp, mp) if the function is configured in the kernel.

LDGMAP Calls the function emgetmap(tp, mp) if the function is configured in the kernel.

LDNMAP Calls the function emummap(tp, mp) if the function is configured in the kernel.

The following ioctls are returned as successful for the sake of compatibility. However, nothing significant is done (that is, the state of the terminal is not changed in any way).

| TIOCSETD | LDOPEN |
| TIOCGETD | LDCLOSE |
| DIOCSETP | LDCHG |
| DIOCSETP | LDSETP |
| DIOGMETP | LDGETT |

SEE ALSO ioctl(2), lterm(7), termio(7), termios(2)

NOTES TIOCBRK and TIOCBBRK should be handled by the driver. FIONREAD and FIORDCHK are handled in the stream head.
NAME
tty – controlling terminal interface

DESCRIPTION
The file `/dev/tty` is, in each process, a synonym for the control terminal associated with the process group of that process, if any. It is useful for programs or shell sequences that wish to be sure of writing messages on the terminal no matter how output has been redirected. It can also be used for programs that demand the name of a file for output, when typed output is desired and it is tiresome to find out what terminal is currently in use.

FILES
`/dev/tty`
`/dev/tty*`

SEE ALSO
`console(7)`
NAME
UDP – Internet User Datagram Protocol

SYNOPSIS
#include <sys/socket.h>
#include <netinet/in.h>
s = socket(AF_INET, SOCK_DGRAM, 0);
t = t_open("/dev/udp", 0_RDWR);

DESCRIPTION
UDP is a simple datagram protocol which is layered directly above the Internet Protocol (IP). Programs may access UDP using the socket interface, where it supports the SOCK_DGRAM socket type, or using the Transport Level Interface (TLI), where it supports the connectionless (T_CLTS) service type.

Within the socket interface, UDP is normally used with the sendto(), sendmsg(), recvfrom(), and recvmsg() calls [see send(3N) and recv(3N)]. If the connect(3N) call is used to fix the destination for future packets, then the recv(3N) or read(2) and send(3N) or write(2) calls may be used.

UDP address formats are identical to those used by the Transmission Control Protocol (TCP). Like TCP, UDP uses a port number along with an IP address to identify the endpoint of communication. The UDP port number space is separate from the TCP port number space (that is, a UDP port may not be connected to a TCP port). The bind(3N) call can be used to set the local address and port number of a UDP socket. The local IP address may be left unspecified in the bind() call by using the special value INADDR_ANY. If the bind() call is not done, a local IP address and port number will be assigned to the endpoint when the first packet is sent. Broadcast packets may be sent (assuming the underlying network supports this) by using a reserved broadcast address. This address is network interface dependent. Broadcasts may only be sent by the privileged user.

Options at the IP level may be used with UDP; see ip(7).

As the RFC allows, there are a variety of ways that a UDP packet can be lost or corrupted, including a failure of the underlying communication mechanism. UDP implements a checksum over the data portion of the packet. If the checksum of a received packet is in error, the packet will be dropped with no indication given to the user. A queue of received packets is provided for each UDP socket. This queue has a limited capacity. Arriving datagrams which will not fit within its high-water capacity are silently discarded.

As the RFC allows, UDP processes Internet Control Message Protocol (ICMP) error messages received in response to UDP packets it has sent. See icmp(7). ICMP source quench messages are ignored. ICMP destination unreachable, time exceeded and parameter problem messages disconnect the socket from its peer so that subsequent attempts to send packets using that socket will return an error. UDP will not guarantee that packets are delivered in the order they were sent. As well, duplicate packets may be generated in the communication process.
SEE ALSO
bind(3N), connect(3N), icmp(7), inet(7), ip(7), read(2), recv(3N), send(3N),
tcp(7), write(2)


DIAGNOSTICS
A socket operation may fail if:

**EISCONN**
A `connect()` operation was attempted on a socket on which a `connect()` operation had already been performed, and the socket could not be successfully disconnected before making the new connection.

**EISCONN**
A `sendto()` or `sendmsg()` operation specifying an address to which the message should be sent was attempted on a socket on which a `connect()` operation had already been performed.

**ENOTCONN**
A `send()` or `write()` operation, or a `sendto()` or `sendmsg()` operation not specifying an address to which the message should be sent, was attempted on a socket on which a `connect()` operation had not already been performed.

**EADDRINUSE**
A `bind()` operation was attempted on a socket with a network address/port pair that has already been bound to another socket.

**EADDRNOTAVAIL**
A `bind()` operation was attempted on a socket with a network address for which no network interface exists.

**EINVAL**
A `sendmsg()` operation with a non-NULL `msg_accrights` was attempted.

**EACCES**
A `bind()` operation was attempted with a reserved port number and the effective user ID of the process was not the privileged user.

**ENOBUFFS**
The system ran out of memory for internal data structures.
NAME
vxfsio - vxfs file system control functions

SYNOPSIS
#include <sys/types.h>
#include <sys/fs/vx_ioctl.h>
int ioctl (int fildes, int cmd, arg);

DESCRIPTION
The vxfs_ioctl(2) enhancements provide for extended control over open files.
The argument fildes is an open file_descriptor.
The data type and value of arg are specific to the type of command specified by cmd.
Unless specified, arg is treated as an int type. The symbolic names for commands
and file status flags are defined by the sys/fs/vx_ioctl.h header file.
The enhancements available are:

VX_SETCACHE
Set caching advisories. These advisories allow an application to indicate to
the file system which forms of caching would be most advantageous.
NOTE: VX_SETCACHE is available with the VxFS Advanced package only.
The values for arg are such that multiple advisories may be set by combining
values with bitwise OR operations. The possible values for arg are:

VX_RANDOM
Indicates that the file is being accessed randomly. Read-ahead
should not be performed.

VX_SEQ
Indicates that the file is being accessed sequentially. Maximum
read-ahead should be performed.

VX_DIRECT
Indicates that data associated with read and write operations is to be
transferred directly to or from the user supplied buffer, without
being cached. When this options is enabled, all I/O operations must
begin on block boundaries and must be a multiple of the block size
in length. The buffer supplied with the I/O operations must be
aligned to a page boundary.

If an I/O request fails to meet alignment criteria, or the file is
currently being accessed for mapped I/O, the I/O request will be
performed as a data synchronous I/O operation.

VX_NOREUSE
Indicates that buffered data does not need to be retained in anticipa-
tion of further use by the application.

VX_DSYNC
Indicates that data synchronous I/O mode is desired. In data syn-
chronous I/O mode, a write operation returns to the caller after the
data has been transferred to external media, but the inode is not updated synchronously if only the times in the inode need to be updated.

Only one of VX_RANDOM, VX_SEQ, or VX_DIRECT may be specified. The VX_NOREUSE and VX_DSYNC options may not be used in conjunction with VX_DIRECT. The caching advisories for a file are maintained on a per-file basis. Changes made to the advisories by a process affect I/O operations by all processes currently accessing the file.

The VX_SETCACHE ioctl returns a 0 if the caching advisories are successfully set. If the operation fails, the return value is -1 and the external variable errno will be a general DIAGNOSTIC.

VX_GETCACHE

Get caching advisories in effect for the file. The argument arg should be a pointer to to an int.

The VX_GETCACHE ioctl returns a 0 if the caching advisories are successfully obtained and the advisories are returned in arg. If the operation fails, the return value is -1 and the external variable errno will be a general DIAGNOSTIC.

VX_SETEXT

Set extent information.

NOTE: VX_SETEXT is available with the VxFS Advanced package only.

The extent information is set according to the parameters specified by arg. The argument arg points to a structure of type vx_ext defined in sys/fs/vx_ioctl.h, which contains the following members:

```
off_t ext_size; /* extent size */
off_t reserve; /* space reservation */
int a_flags; /* allocation flags */
```

The ext_size element is used to request a fixed extent size, in blocks, for the file. If a fixed extent size is not required, zero should be used to allow the default allocation policy to be used. Changes to the fixed extent size made after the file contains indirect blocks have no effect unless all current indirect blocks are freed via file truncation and/or reservation deallocation.

The reserve element is used to set the amount of space preallocated to the file. If the reserve amount is greater than the current reservation, the allocation for the file is increased to match the reserve amount. If the reserve amount is less than the current reservation, the allocation is decreased. The allocation will not be reduced to less than the current file size.

File reservation cannot be increased beyond the ulimit(2) of the requesting process. However, an existing reservation will not be trimmed to the requesting process’s ulimit(2). Reservation of space for existing sparse files will not cause blocks to be allocated to fill in the holes, but will only allocate blocks after the end of the file.
Thus, it’s possible to have a larger reservation for a file than blocks in the file.

The reservation amount is independent of file size since reservation is used to preallocate space for a file. The `a_flags` element is used to indicate the type of reservation required. The choices are:

**VX_NOEXTEND**
The file may not be extended once the current reservation is exceeded. The reservation may be increased if necessary by another invocation of the ioctl, but the file will not be automatically extended.

**VX_TRIM**
The reservation for the file is to be trimmed to the current file size upon last close by all processes that have the file open.

**VX_CONTIGUOUS**
The reservation must be allocated contiguously (as a single extent). `ext_size` will become the fixed extent size for subsequent allocations, but has no affect on this one. The reservation will fail if the file has gone into indirect extents, unless the amount of space requested is the same as the indirect extent size. If the contiguous allocation request is done on an empty file, this will not happen.

**VX_ALIGN**
Align all new extents on an `ext_size` boundary relative to the starting block of an allocation unit. If `VX_CONTIGUOUS` is set, the single extent allocated during this invocation is not subject to the alignment restriction.

**VX_NORESERVE**
The reservation is to be made as a non-persistent allocation to the file. The on-disk inode will not be updated with the reservation information so that the reservation will not survive a system crash. The reservation is associated with the file until the close of the file. The reservation is trimmed to the current file size on close.

**VX_CHGSIZE**
The reservation is to be immediately incorporated into the file. The file’s on-disk inode is updated with the size and block count information that is increased to include the reserved space. Unlike an `fcnt1 F_FREESP` operation which “truncates-up” [see `fcnt1(2)`], the space included in the file is not initialized. This operation is restricted to users with appropriate privileges.

Write permission to a file is required to set extent information, but any process that can open the file can get the extent information. Extent information only applies to regular files. Only one set of extent information is kept per file. Except in those cases noted above
as non-persistent, the extent information becomes part of the on-disk
inode information, and thus persists across reboots.

The **VX_SETTEXT** ioctl returns a 0 if the extent information is successfully set.
If the operation fails, the return value is -1 and the external variable *errno*
will be a general DIAGNOSTIC.

**VX_GETTEXT**
Get extent information. Return the extent information associated with *fildes*.
The argument *arg* points to a structure of type **vx_ext** as defined in
`sys/fs/vx_ioctl.h`.

The **VX_GETTEXT** ioctl returns a 0 if the extent information is successfully
obtained. If the operation fails, the return value is -1 and the external variable *errno* will be a general DIAGNOSTIC.

**VX_GETFSOPT**
Get file system options. The argument *arg* should be a pointer to to an **int**.
This command may be used by any user who can open the root inode on the
file system. The options returned in *arg* are:

*VX_FSO_BLKCLEAR*
Indicates that all newly allocated blocks will be guaranteed to con-
tain all zeros.

*VX_FSO_CACHE_CLOSESYNC*
Indicates that any non-logged changes to the inode or data will be
flushed to disk when the file is closed.

*VX_FSO_CACHE_DIRECT*
Indicates that any non-synchronous I/O will be handled as if the
**VX_DIRECT** cache advisory had been set on the file. Also, any non-
logged changes to the inode or data will be flushed to disk when the
file is closed.

*VX_FSO_CACHE_DSYNC*
Indicates that any writes that don't have either **O_SYNC** or the
**VX_DIRECT** advisory set will be handled as if the **VX_DSYNC** advisory
had been set on the file. Also, any non-logged changes to the inode
or data will be flushed to disk when the file is closed.

*VX_FSO_NODATAINLOG*
Indicates that intent logging of user data for synchronous writes is
disabled.

*VX_FSO_Nolog*
Indicates that intent logging of structural changes to the file system
is disabled.

*VX_FSO_OSYNC_CLOSESYNC*
Indicates that any non-logged changes to the inode or data will be
flushed to disk when a file accessed with **O_SYNC** is closed.

565
**vxfsio(7)**

**VX_FSO_OSYNC_DIRECT**
Indicates that any _O_SYNC_ I/O will be handled as if the _VX_DIRECT_ cache advisory had been set on the file instead. Also, any non-logged changes to the inode or data will be flushed to disk when a file accessed with _O_SYNC_ is closed.

**VX_FSO_OSYNC_DSYNC**
Indicates that any _O_SYNC_ writes will be handled as if the _VX_DSYNC_ cache advisory had been set on the file instead. Also, any non-logged changes to the inode or data will be flushed to disk when a file accessed with _O_SYNC_ is closed.

**VX_FSO_SNAPPED**
Indicates that a snapshot backup is in progress on the file system.

**VX_FSO_SNAPSHOT**
Indicates that this file system is a snapshot backup of another file system.

**VX_FSO_VJFS**
Indicates that this is not the VxFS Advanced package.

The **VX_GETFSOPT** ioctl returns a 0 if the file system options are successfully obtained. If the operation fails, the return value is -1 and the external variable _errno_ will be a general DIAGNOSTIC.

**VX_FREEZE**
Sync then freeze the file system. Once frozen, all further operations against the file system block until a **VX_THAW** operation is received. The argument _arg_ is a timeout value expressed in seconds. If a **VX_THAW** operation is not received within the specified timeout interval, the file system will perform a **VX_THAW** operation automatically.

This command may only be used by a user with appropriate privilege, on the root directory of the file system.

The **VX_FREEZE** ioctl returns a 0 if the file system is successfully frozen. If the operation fails, the return value is -1 and the external variable _errno_ will be a general DIAGNOSTIC.

**VX_THAW**
Unblock a file system that has been frozen by a **VX_FREEZE** operation. The argument _arg_ should be NULL. The process that is to issue a **VX_THAW** operation must have the root directory of the file system open, and must ensure that it does not access the file system after the file system has been frozen, to ensure that the process itself does not block.

This command may only be used by a user with appropriate privilege, on the root directory of the file system.

The **VX_THAW** ioctl returns a 0 if the file system is successfully unfrozen. If the operation fails, the return value is -1 and the external variable _errno_ will be a general DIAGNOSTIC or one of the following:
DIAGNOSTICS

The following values are returned in `errno` upon operation failures:

- **EACCESS** The calling process does not have write access to the file specified by `fildes`.
- **EAGAIN** The file system is not currently frozen.
- **EFBIG** An attempt was made to reserve space larger than the maximum file size limit for this process.
- **EINVAL** The command or argument is invalid.
- **EPERM** The process does not have appropriate privilege.
- **ENODEV** The file specified by `fildes` is not the root directory of a `vxfs` file system.
- **EROFS** The file system is mounted read-only.
- **EIO** An I/O error occurred while attempting to perform the operation.
- **ENOSPC** Requested space could not be obtained.
- **EFAULT** An address specified by an argument is invalid.

SEE ALSO

`getrlimit(2), ioctl(2), ulimit(2)`
wd(7)

NAME
wd – Western Digital WD8003 Ethernet Driver

SYNOPSIS
#include <sys/dlpi.h>
#include <sys/dlpi_ether.h>
#include <sys/wd.h>

fd = open("/dev/wd_0", O_RDWR)

DESCRIPTION
The wd driver provides a data link interface to the WD8003 family of ISA and MCA Ethernet controllers from Western Digital. It is a STREAMS-based driver, compatible with the Data Link Provider Interface (DLPI) and Logical Link Interface (LLI) software interfaces.

The wd driver supports both DL_ETHER and DL_CSMACD for MAC type, DL_CL_ETHER for service mode, and DL_STYLE1 for provider style. The driver can operate as a cloned or non-cloned device.

A process must issue a DL_BIND_REQ primitive to receive frames from the network. This primitive includes a dl_bind_req_t structure.

The process must specify the dl_sap field of the dl_bind_req_t structure in host order. The type field of an incoming frame is converted to host order and compared to the dl_sap value. If the values are equal, the frame is placed on the STREAMS read queue of the requesting process. A privileged process may set the dl_sap field to PROMISCUOUS_SAP. The PROMISCUOUS_SAP matches all incoming frames.

A privileged process may bind to an SAP already bound by another process. In cases where a frame qualifies to be sent to more than one process, independent copies of the frame are made and placed on the STREAMS read queue of each process.

Received frames are delivered in dl_unitdata_ind_t structures. The source and destination address each contain a 6-byte Ethernet address, followed by a 2-byte type value, written in network order.

ioctl Calls
The following ioctls are supported:

DLIOCGMIB
Returns the DL_mib_t structure, which contains the Management Information Base (MIB). The MIB holds the Ethernet statistics kept in the driver.

typedef struct {
    ulong_tetherAlignErrors; /* Frame alignment errors */
    ulong_tetherCRCerrors; /* CRC errors */
    ulong_tetherMissedPkts; /* Packet overflow or missed inter */
    ulong_tetherOverrunErrors; /* Overrun errors */
    ulong_tetherUnderrunErrors; /* Underrun errors */
    ulong_tetherCollisions; /* Total collisions */}
ulong_t etherAbortErrors; /* Transmits aborted at interface */
ulong_t tetherCarrierLost; /* Carrier sense signal lost */
ulong_t tetherReadqFull; /* STREAMS read queue full */
ulong_t tetherRcvResources; /* Receive resource alloc failture */
ulong_t tetherDependent1; /* Device dependent statistic */
ulong_t tetherDependent2; /* Device dependent statistic */
ulong_t tetherDependent3; /* Device dependent statistic */
ulong_t tetherDependent4; /* Device dependent statistic */
ulong_t tetherDependent5; /* Device dependent statistic */
} DL_etherstat_t;

/*
 * Interface statistics compatible with MIB II SNMP requirements.
 */
typedef struct {
    int ifIndex;      /* 1 through ifNumber */
    int ifDescrLen;   /* len of desc. following this struct */
    int ifType;       /* type of interface */
    int ifMtu;        /* datagram size that can be sent/rcv */
    ulong_t ifSpeed;  /* estimate of bandwidth in bits PS */
    uchar_t ifPhyAddress[DL_MAC_ADDR_LEN];  /* Ethernet Address */
    int ifAdminStatus; /* desired state of the interface */
    int ifOperStatus;  /* current state of the interface */
    ulong_t ifLastChange; /* sysUpTime when state was entered */
    ulong_t ifInOctets; /* octets received on interface */
    ulong_t ifInUcastPkts; /* unicast packets delivered */
    ulong_t ifInNUcastPkts; /* non-unicast packets delivered */
    ulong_t ifInDiscards; /* good packets received but dropped */
    ulong_t ifInErrors; /* packets received with errors */
    ulong_t ifInUnknownProtos; /* packets recvd to unbound proto */
    ulong_t ifOutOctets; /* octets transmitted on interface */
    ulong_t ifOutUcastPkts; /* unicast packets transmitted */
    ulong_t ifOutNUcastPkts; /* non-unicast packets transmitted */
    ulong_t ifOutDiscards; /* good outbound packets dropped */
    ulong_t ifOutErrors; /* number of transmit errors */
    ulong_t ifOutQlen; /* length of output queue */
    DL_etherstat_t ifSpecific; /* Ethernet specific stats */
} DL_mib_t;

The values in the MIB are compatible with those needed by the SNMP protocol.
The ifDescrLen field indicates the length of the null-terminated description string that immediately follows the DL_mib_t structure.
There are three fields in the MIB that are specific to the wd driver: The 
\texttt{ifSpecific.etherDependent1} field tracks the number of times the transceiver 
failed to transmit a collision signal after transmission of a packet. The 
\texttt{ifSpecific.etherDependent2} field tracks the number of collisions that occurred 
after a slot time (out-of-window collisions). The \texttt{ifSpecific.etherDependent3} 
field tracks the number of times a transmit interrupt timeout condition 
ocurred.

\textbf{DLIOCSMIG} 
Allows a privileged process to initialize the values in the MIB (that is, the 
\texttt{DL_mib_t} structure). A process cannot use this \texttt{ioctl} to change the 
\texttt{ifPhyAddress}, the \texttt{ifDescrLen}, or the text of the description fields.

\textbf{DLIOCGENADDR} 
Returns the Ethernet address in network order.

\textbf{DLIOCGLPCFLG} 
Returns the state of the local packet copy flag in the \texttt{ioc_rval} field of the 
\texttt{iocblk} structure. The local copy flag determines if packets looped back by 
the driver should also be sent to the network. A non-zero value indicates 
that frames should also be sent to the network after being looped back. The 
default value of this flag is zero.

\textbf{DLIOCSLPCFLG} 
Allows a privileged process to set the local packet copy flag, causing all 
packets looped back by the driver to also be sent to the network.

\textbf{DLIOCGPROMISC} 
Returns the value of the promiscuous flag in the \texttt{ioc_rval} of the \texttt{iocblk} struc-
ture. A non-zero value indicates that the Ethernet interface will receive all 
frames on the network. The default value of this flag is zero.

\textbf{DLIOCS PROM ISC} 
Allows a privileged process to toggle the current state of the promiscuous 
flag. When the flag is non-zero, the driver captures all frames from the net-
work. Processes that are bound to the promiscuous SAP, or to an SAP that 
matches the type field of the received frame, receive a copy of the frame.

\textbf{DLIOCGMULTI} 
Returns the current list of multicast addresses (if it exists).

\textbf{DLIOCADDMULTI} 
Allows a privileged process to add a new multicast address and enable its 
reception. A 6-byte buffer pointing to the multicast address must be passed 
as the parameter.

\textbf{DLIOCDELMULTI} 
Allows a privileged process to delete a multicast address by passing a 6-byte 
multicast address as the parameter.

\textbf{Configuration} 
The \texttt{wd} driver has four configurable parameters in the 
\texttt{/etc/conf/pack.d/wd/space.c} file. If you change this file, you must rebuild the 
kernel and reboot the system for the changes to take effect.
The configurable parameters are:

**N_SAPS**
Defines the number of SAPs that can be bound at any one time. This value should be only slightly larger than anticipated SAP usage. A typical TCP/IP system requires two SAPs (0x800 and 0x806). If you assign too large a value to this parameter, system performance and memory usage may suffer.

**STREAMS_LOG**
Defines whether the driver should log debugging messages to the STREAMS logger for the `strace(1M)` utility to display. The module ID used with `strace` is 2101. A value of 0 indicates that no STREAMS debug messages should be generated. A value of 1 enables STREAMS debug messages to be generated. You can also direct the driver to log messages temporarily by using the kernel debugger to change the value of `wdstrlog` (a 4-byte integer) to 1.

Use STREAMS tracing only when debugging a network problem, because system performance suffers when full wd STREAMS logging is in progress.

**IFNAME**
This parameter is important only in a TCP/IP networking environment. It defines the string used in displaying network statistics. This string should match the logical interface name assigned in the `/etc/confnet.d/inet/interfaces` file and with `ifconfig(1M)` commands used in the `/etc/inet/rc.inet` configuration script.

**Error Codes**
The wd driver can return the following error codes:

ENXIO  Invalid major number or board is not installed.

ECHRING  No minor devices left if configured as a cloned device. Increase N_SAP value in `/etc/conf/pack.d/wd/space.c` Invalid minor device number if configured as a non-cloned device.

EPERM  An ioctl was made without the appropriate privilege.

EINVAL  An ioctl was made that did not supply a required input and/or output buffer.

DL_NOTSUPPORTED  Requested service primitive is not supported.

DL_BADPRIM  Unknown service primitive was requested.

DL_OUTSTATE  DL_BIND_REQ was issued when the Stream was bound, or DL_UNBIND_REQ or DL_UNITDATA_REQ were issued when the Stream was unbound.
An attempt was made to bind to `PROMISCUOUS_SAP` with insufficient privilege.

The requested SAP is already bound. A privileged process may bind to an already bound SAP.

`DL_UNITDATA_REQ` was issued on an Ethernet board that has gone offline due to an error.

`DL_UNITDATA_REQ` was issued with a data size that was either larger than the SPDU maximum or smaller than the SPDU minimum.

```
Files
/dev/wd_*
/etc/conf/pack.d/wd/space.c
```

REFERENCES
`getmsg(2), ifconfig(1M), ioctl(2), open(2), putmsg(2), strace(1M)`
NAME
wd7000 – WD7000 FASST2 host adapter subsystem

DESCRIPTION
The WD7000 FASST2 SCSI host adapter subsystem enables SCSI target drivers (such as sd01, st01, and so on) to communicate on the SCSI bus with target controllers and logical units. This driver implements the Portable Device Interface (PDI) for such PDI target drivers.

It is also possible to access this subsystem directly using the pass-through driver interface. This allows you to issue sb control blocks directly to the target controller. To find the appropriate device to use, while any device is being accessed through the target driver for example sd01), use the B_GETDEV ioctl to get the major and minor numbers of the pass-through node. This node may be created and opened for pass-through use (SDI_SEND ioctl).

ioctl Calls
The following ioctl(2) commands are supported by this driver:

SDI_SEND
Sends a pass-through command (SCSI control block) to a target controller, bypassing the associated target driver.

SDI_BRESET
Resets the SCSI bus.

B_REDT
Reads the extended Equipped Device Table (EDT) data structure that is stored in the SCSI driver’s internal data structure.

B_HA_CNT
gets the value of the number of host adapters for which the SCSI driver is configured.

HA_VER
Determines the Driver Interface Version supported by the driver. It returns the structure ver_no, defined in /usr/include/sys/sdi.h.

B_GETTYPE
Returns the bus name (for example, scsi) and device driver name of a specific device.

Files
/usr/include/sys/wd7000.h
/usr/include/sys/scsi.h
/usr/include/sys/sdi.h
/usr/include/sys/sdi_edt.h
/etc/conf/pack.d/wd7000/space.c/fP

REFERENCES
adsc(7), dpt(7), ioctl(2), mcis(7), sc01(7), sd01(7), st01(7), sw01(7)
zero (7)

NAME
  zero – source of zeroes

DESCRIPTION
  A zero special file is a source of zeroed unnamed memory.
  Reads from a zero special file always return a buffer full of zeroes. The file is of infinite length.
  Writes to a zero special file are always successful, but the data written is ignored.
  Mapping a zero special file creates a zero-initialized unnamed memory object of a length equal to the length of the mapping and rounded up to the nearest page size as returned by `sysconf`. Multiple processes can share such a zero special file object provided a common ancestor mapped the object `MAP_SHARED`.

Files
  /dev/zero

REFERENCES
  `fork(2), mmap(2), sysconf(3C)`
Reference Manual Index

The Permuted Index that follows is a list of keywords, alphabetized in the second of three columns, together with the context in which each keyword is found. The manual page that produced an entry is listed in the right column.

Entries are identified with their section numbers shown in parentheses. This is important because there is considerable duplication of names among the sections, arising principally from commands and functions that exist only to exercise a particular system call.

The index is produced by rotating the NAME section of each manual page to alphabetize each keyword in it. Words that cannot fit in the middle column are rotated into the left column. If the entry is still too long, some words are omitted, and their omission is indicated with a slash ("/").

How the Permuted Index Is Created

Many users find that understanding a few things about how the permuted index is created helps them to read it more effectively and clarifies what kind of information can and cannot be obtained from it.

The basic building block for the index is the one-line description given in the NAME line on the top of each manual page. For example, this is what the top of the mountall(1M) manual page looks like:

```
mountall(1M)

NAME

mountall, umountall – mount, unmount multiple file systems
```

Each NAME line includes:

- the command, file format, system call or other utility for which the manual page is named (this is the primary utility; `mountall` is the primary utility in the example)

- secondary utilities, which are also described on that manual page and do not have a separate manual page of their own (`umountall` is a secondary utility in the example)
a brief description of the utility function(s)

For each manual page NAME line, the indexing software generates several index entries, generally one entry for each keyword in the phrase. The middle column of the index is alphabetized on these keywords.

For:

```
NAME
mountall, umountall – mount, unmount multiple file systems
```

This is generated:

```
mount, unmount multiple systems. mountall, umountall: mount, unmount multiple file systems. /umountall: mount, unmount multiple file systems. mountall, umountall: mount, unmount multiple file systems. multiple file systems. mountall, umountall: mount, unmount multiple file systems. /umountall: mount, unmount multiple file systems. mountall, umountall: mount, unmount multiple file systems.
```

How to Use the Index

Look in the middle column of the index for the word of interest. Then read the complete phrase by starting with the utility name, which may appear in the left or middle column. Utility names are followed by a colon.

The NAME line phrase is contained in the two columns, with long phrases wrapping around to the beginning of the left column. The right column of the index provides the manual page name and section number.

A slash (/) sometimes appears in the index entry to indicate that space limitations were exceeded and one or more words from the phrase were deleted.
## Permuted Index

<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>adsc Adaptec</td>
<td>1542A SCSI host adapter subsystem</td>
<td>adsc(7)</td>
</tr>
<tr>
<td>ee16 EtherExpress</td>
<td>16 Ethernet Adapter Driver</td>
<td>ee(7)</td>
</tr>
<tr>
<td>e16 EtherLink</td>
<td>16 Ethernet Adapter Driver</td>
<td>el(7)</td>
</tr>
<tr>
<td>ie6</td>
<td>3Com Ethernet Driver</td>
<td>i6e(7)</td>
</tr>
<tr>
<td>i6 3C503</td>
<td>4BSD and XENIX STREAMS</td>
<td>ttcompat(7)</td>
</tr>
<tr>
<td>compatibility module</td>
<td>tcompat V7,</td>
<td></td>
</tr>
<tr>
<td>acct per-process</td>
<td>accounting file format</td>
<td>acct(4)</td>
</tr>
<tr>
<td>holidays</td>
<td>accounting file</td>
<td>holidays(4)</td>
</tr>
<tr>
<td>format</td>
<td>acct per-process accounting file</td>
<td>acct(4)</td>
</tr>
<tr>
<td>subsystem adsc</td>
<td>Adaptec 1542A SCSI host adapter subsystem</td>
<td>adsc(7)</td>
</tr>
<tr>
<td>ee16 EtherExpress 16 Ethernet</td>
<td>Adapter Driver</td>
<td>ee(7)</td>
</tr>
<tr>
<td>el16 EtherLink 16 Ethernet</td>
<td>Adapter Driver</td>
<td>el(7)</td>
</tr>
<tr>
<td>mcs MCIS SCSI host</td>
<td>adapter driver</td>
<td>mcs(7)</td>
</tr>
<tr>
<td>adsc Adaptec 1542A SCSI host</td>
<td>adapter subsystem</td>
<td>adsc(7)</td>
</tr>
<tr>
<td>DCD Direct-Coupled Disk host</td>
<td>adapter subsystem</td>
<td>DCD(7)</td>
</tr>
<tr>
<td>dpt DPT PM2012 SCSI host</td>
<td>adapter subsystem</td>
<td>dpt(7)</td>
</tr>
<tr>
<td>wd7000 WD7000 FASST2 host</td>
<td>adapter subsystem</td>
<td>wd7000(7)</td>
</tr>
<tr>
<td>ARP</td>
<td>Address Resolution Protocol</td>
<td>ARP(7)</td>
</tr>
<tr>
<td>domain ethers Ethernet</td>
<td>address to hostname database or</td>
<td>ethers(4)</td>
</tr>
<tr>
<td>aliases, addresses, forward (BSD)</td>
<td>addresses and aliases for sendmail</td>
<td>aliases(4)</td>
</tr>
<tr>
<td>and aliases for sendmail</td>
<td>addresses, forward (BSD) addresses</td>
<td>aliases(4)</td>
</tr>
<tr>
<td>alias file for FACE</td>
<td>admin installation defaults file</td>
<td>admin(4)</td>
</tr>
<tr>
<td>sad STREAMS</td>
<td>Administrative Driver</td>
<td>sad(7)</td>
</tr>
<tr>
<td>adapter subsystem</td>
<td>adsc Adaptec 1542A SCSI host</td>
<td>adsc(7)</td>
</tr>
<tr>
<td>and match/ regexp: compile, step, alp</td>
<td>advance regular expression compile</td>
<td>regexp(5)</td>
</tr>
<tr>
<td>pathalias</td>
<td>algorithm pool management module</td>
<td>alp(7)</td>
</tr>
<tr>
<td>addresses and aliases for sendmail</td>
<td>aliases, addresses, forward (BSD)</td>
<td>aliases(4)</td>
</tr>
<tr>
<td>forward (BSD) addresses and services</td>
<td>aliases for sendmail</td>
<td>aliases(4)</td>
</tr>
<tr>
<td>animation</td>
<td>alp algorithm pool management module</td>
<td>alp(7)</td>
</tr>
<tr>
<td>a.out ELF (Executable and Linking)</td>
<td>a.out(4)</td>
<td>a.out(4)</td>
</tr>
<tr>
<td>ar archive file format</td>
<td>architecture information</td>
<td>ar(4)</td>
</tr>
<tr>
<td>architecture</td>
<td>ar archive file format</td>
<td>ar(4)</td>
</tr>
<tr>
<td>archives device header file</td>
<td>archives(4)</td>
<td>archives(4)</td>
</tr>
<tr>
<td>argument list</td>
<td>argument list</td>
<td>stdarg(5)</td>
</tr>
<tr>
<td>argument list</td>
<td>argument list</td>
<td>varargs(5)</td>
</tr>
<tr>
<td>ascii map of</td>
<td>ASCII character set</td>
<td>ascii(5)</td>
</tr>
<tr>
<td>ascii map of ASCII character set</td>
<td>ascii(5)</td>
<td>ascii(5)</td>
</tr>
<tr>
<td>asyc asynchonous serial port</td>
<td>asyc(7)</td>
<td>asyc(7)</td>
</tr>
<tr>
<td>asynchronous serial port</td>
<td>asyc(7)</td>
<td></td>
</tr>
<tr>
<td>loginlog log of failed login</td>
<td>attempts</td>
<td>loginlog(4)</td>
</tr>
<tr>
<td>OllicValues Input Context</td>
<td>attribute names and value pairs</td>
<td>OllicValues(4)</td>
</tr>
<tr>
<td>OllmValues list of IM</td>
<td>attributes</td>
<td>OllmValues(4)</td>
</tr>
<tr>
<td>bootparams boot parameter data</td>
<td>base</td>
<td>bootparams(4)</td>
</tr>
</tbody>
</table>
hosts host name data                          hosts(4)
netmasks network mask data                 netmasks(4)
networks network name data                 networks(4)
protocols protocol name data              protocols(4)
rpc rpc program number data               rpc(4)
signal                                      signal(5)
/reserved major numbers for              res_major(4)
terminfo terminal capability data         terminfo(4)
kmem perform I/O on kernel memory         kmem(7)
fs (bfs) format of the                    fs(4)
inode                                       inode(4)
volume                                       inode(4)
fs (bfs) format of a                     fs(4)
for the cbinarsys command                fs(4)
and defaults file (scalable and           fs(4)
netdrivers data file for networking       fs(4)
dump                                      dump(4)
boot                                       boot(4)
bootparams                                boot(4)
aliases, addresses, forward               aliases(4)
syslogd system log/ syslog.conf           syslog.conf(4)
me                                          me(5)
for eqn eqnchar                            eqnchar(5)
ms                                          ms(5)
mouse mouse device driver for              mouse(7)
data returned by stat system               stat(4)
stat data returned by stat system          stat(4)
N) terminfo terminal                      terminfo(4)
pnch file format for                      pnch(4)
/(cdfs) format of CD-ROM file system      fs(4)
fs (cdfs) format of a                     fs(4)
inode                                      inode(4)
(cdfs) directory data/ dir                fs(4)
inode (cdfs) format of a                   fs(4)
data/ dir (cdfs) format of sc01            fs(4)
eqnchar (BSD) special                      eqnchar(5)
ascii map of ASCII                        ascii(5)
pkginfo package                           pkginfo(4)
setinfo set                                setinfo(4)
remote system information for the         remote system information for the
rtc real time                              rtc(7)
pair on a STREAMS driver                   cram(7)
cram                                        cramat(7)
file header for common object file         cram(7)
Xwinmaps XWIN                               cram(7)
information for the cbinarsys             cram(7)
form description file for menu(1)          cram(7)
of mail mailsurr surrogate                 cram(7)
dfstab file containing commands for sharing resources
dfstab(4)
streamio STREAMS ioctl
commands ........................................... streamio(7)
filehdr file header for compat
common object file (COFF) ......................... filehdr(4)	tcompat V7, 4BSD and XENIX STREAMS
compatibility module .................................. ttcompat(7)
comper
compatible versions file ................................ compver(4)
ocomp=Y step, advance regular expression
compile and match routines ..................... regexp(5)
expression compile and / regexp:
compile, step, advance regular ...................(5)
term format of compiled term file ...................(4)
 compiled term file .................................. term(4)
Sassign
compver compatible versions file ................. compver(4)
configurable device variables ..................... Sassign(4)
Xwinfont
configuration and defaults file ................... Xwinfont(4)
netconfig database ................................ netconfig(4)
configuration defaults for ....................... disk.cfg(4)
Information Service (NIS) / updaters
configuration file for Network .................... updaters(4)
TCP/IP strcf STREAMS
Configuration File for STREAMS ................. strcf(4)
system log / syslog.conf (BSD)
configuration file for syslogd ................. syslog.conf(4)
Xwinconfig XWIN
configuration file .................................. Xwinconf(4)
mass-storage and SCSI / disk.cfg
configuration index file for ..................... tc.index(4)
routines resolv.conf
configuration information for Master ......... Master(4)
nonconfig network
configuration information for a System .... System(4)
df stab file containing configuration-dependent kernel .......... Space.c(4)
RMMA
queuedefs option files for configuration parameters interface .......... interface(4)
module data structure / Space.c
connections conlnl ............................................................. conlnl(7)
line discipline for unique stream
connection line discipline for unique .......... conlnl(7)
stream connections
console display ............................................ display(7)
display system ............................................ display(7)
console STREAMS-based
console interface ......................................... console(7)
keyboard system
console keyboard ......................................... keyboard(7)
interface
console STREAMS-based console ................. console(7)
langinfo language information
constants limits header .............................. limits(4)
file for implementation-specific constants math functions and
constants limits header .............................. limits(4)
math(5)
unstd header file for symbolic constants
constants ....................................................... unistd(4)
resources dfstab file
containing commands for sharing .......... dfstab(4)
information for / ttydefs file
contains terminal line settings ................ ttydefs(4)
pkgmap package
contents description file ......................... pkgmap(4)
pairs OIICValues Input
Context attribute names and value .......... OIICValues(4)
uncontext user
context ..................................................... uncontext(5)
vxfsio vxfs file system
control functions ..................................... vxfsio(7)
ICMP Internet
Control Message Protocol ....................... ICMP(7)
cntl file
control options ......................................... cntl(5)
TCP Internet Transmission
Control Protocol ....................................... TCP(7)
tty
controlling terminal interface ................. tty(7)
term
conventional names for terminals ................ term(5)
time
iconv code set
conversion tables ...................................... iconv(3)
timod Transport Interface
cooperating STREAMS module ................... timod(7)
core
core image file ......................................... core(4)
mem, kmem
core memory ............................................. mem(7)
cram CMOS RAM interface ...................... cram(7)
crontab and at
cron, queuedefs option files for .......... cron(4)
crontab and at .................................... cron(4)
file for syslogd system log
bootparams boot parameter
hosts host name
netmasks network mask
networks network name
protocols protocol name
rpc rpc program number
N) terminfo terminal capability
protocols mappings netdrivers
priv privilege
netrc file for ftp remote login
stat (XENIX)
stat
CD-ROM file system (cdfs) directory
/kernel module
nl_types native language
types primitive system
/Network Information Service (NIS)
inetd.conf Internet servers
distributed file system security
netconfig network configuration
ethers Ethernet address to hostname
publickey public key
UDP Internet User
adapter Subsystem
timezone set
admin installation
/XWIN font configuration and
devices disk.cfg configuration
vfstab table of file system
Node device node
eqnchar (BSD) special character
Mtune tunable parameter
file for user-level privilege
file for privilege mechanism
depend software
command menu form
pkgmap package contents
dpost font font
fd file
help
PS/2 mouse devices mouse mouse
Node device node definitions for a major numbers for a base system archives
driver st01 Portable
Driver sw01 Portable
mapchan format of tty
device driver Node
close open any major/minor
daemon /BSD) configuration syslog.conf(4)
data base bootparams(4)
data base hosts(4)
data base netmasks(4)
data base networks(4)
data base protocols(4)
data base rpc(4)
data base termininfo(4)
data file netdrivers(4)
data file priv(4)
data file netrc(4)
data file stat(4)
data file stat(5)
data structure /cdfs) format of dir(4)
data structure initialization nl_types(4)
data structure types(5)
database and directory structure ypphiles(4)
database inetd.conf(4)
database lid_and_priv(4)
database netconfig(4)
database ethers(4)
database publickey(4)
Datagram Protocol UDP(7)
DCD Direct-Coupled Disk host DCD(7)
default file login(4)
default file timezone(4)
defaults file admin(4)
defaults file Xwinfont(4)
defaults file(4)
defaults for mass-storage and SCSI disk.cfg(4)
defaults vfstab(4)
definitions for a device driver Node(4)
definitions for eqn eqnchar(5)
definitions priv(5)
definitions privilege include privilege(5)
definitions dependencies files depend(4)
definitions dependencies files depend(4)
description file menu(4)
description file pkgmap(4)
description files for troff and font(5)
description files for troff and font(5)
Desktop help file format help(4)
device driver for bus, serial, and mouse(7)
device driver Node(4)
device drivers res_major reserved res_major(4)
device header file archives(4)
Device Interface (PDI) tape target st0(7)
Device Interface (PDI) WORM Target sw0(7)
device mapping files mapchan(4)
device node definitions for a Node(4)
device pair on a STREAMS driver clone(7)
Sassign configurable defaults for mass-storage and SCSI for bus, serial, and PS/2 mouse.

index file for mass-storage sharing resources.

wd Western system (cdfs) directory data/

Subsystem DCD sockio ioctls that operate

dir (s5) format of s5
dir (ufs) format of ufs

format of CD-ROM file system (cdfs)
dirent file system independent

and ttysrch Service (NIS) database and
directory entry

connections connid line

standard STREAMS terminal line

fd diskette (floppy)

DCD Direct-Coupled

space

setsizemass-storage and SCSI devices

fd

rt_dptbl real-time
ts_dptbl time-sharing
display system console

disktypes file that registers
database lid_and_priv

address to hostname database or
description files for troff and

subsystem

subsystem dpt
device pair on a STREAMS

EtherExpress 16 Ethernet Adapter
e16 EtherLink 16 Ethernet Adapter

mouse devices mouse mouse device

i596 i596 Ethernet

ibmtok IBM Token Ring

ie6 3C503 3Com Ethernet

imx586 IMXLAN586 Intel Ethernet

mcis MCIS SCSI host adapter

node definitions for a device

ptf STREAMS pseudo-termina

sad STREAMS Administrative

sco1 CD-ROM Target

sd01 PDI disk target

Device Interface (PDI) tape target

device variables Sassign(4)
devices disk.cfg configuration disk.cfg(4)
devices mouse mouse device mouse(7)
devices tc.index configuration tc.index(4)
dfstab file containing commands for dfstab(4)

Digital WD8003 Ethernet Driver wd(7)
dir (cdfs) format of CD-ROM dir(4)
dir (s5) format of s5 directories dir(4)
dir (ufs) format of ufs directories dir(4)

Direct-Coupled Disk host adapter DCD(7)
directly on sockets sockio(7)
directories dir(4)
directories dir(4)
directory data structure /cdfs dir(4)
directory entry diren(4)
directory search list for ttyspace ttysrch(4)
directory structure /Information ypfiles(4)
direct file system independent diren(4)
discipline for unique stream connid(7)
discipline module lterm lterm(7)
disk(7)

Disk host adapter Subsystem DCD(7)
disk space requirement file space(4)
disk space requirements file setsizem(4)
disk target driver sd01(7)
disk.cfg configuration defaults for disk.cfg(4)
diskette (floppy disk) fd(7)
dispatcher parameter table rt_dptbl(4)
dispatcher parameter table ts_dptbl(4)
display display(7)
display system console display display(7)
display system console display display(7)
distributed file system packages ftypes(4)
distributed file system security lid_and_priv(4)
domain ethers Ethernet ethers(4)
dpost font font(5)
dpt DPT PM2012 SCSI host adapter dpt(7)
DPT PM2012 SCSI host adapter dpt(7)
driver clone open any major/minor clone(7)

Driver ee16 ee(7)

Driver el7(7)
driver for bus, serial, and PS/2 mouse(7)

Driver i596(7)

Driver ibmtok(7)

Driver ie6(7)

Driver imx586(7)

driver mcis(7)

driver Node device Node(4)

driver pty(7)

Driver sad(7)

Driver sco(7)

driver sd01(7)

driver st01 Portable st0(7)
Device Interface (PDI) WORM Target
sxt pseudo-device
wd Western Digital WD8003 Ethernet
interface to EUC handling tty
numbers for base system device
dump boot
Adapter Driver
driver sw01 Portable ......................................................... sw0(7)
driver ................................................................. sxt(7)
Driver ................................................................. wd(7)
drivers and modules /generic ....................................... eucioctl(5)
drivers res_major reserved major .............................. res_major(4)
dump boot dump timeout file .................................... dump(4)
dump timeout file .................................................... dump(4)
eel6 EtherExpress 16 Ethernet ....................................... ee7(7)
 elf6 EtherLink 16 Ethernet Adapter ................................. el(7)
ELF (Executable and Linking Format) .............................. a.out(4)
emulation module ....................................................... ptem(7)
encoded uenencode file ......................................... uencoder(4)
entries for a kernel module ........................................ Init(4)
entry dirent ............................................................ dirent(4)
entry formats .......................................................... utmp4(4)
entries formats ......................................................... utmp(4)
.environ, .pref, variables ........................................ environ(4)
environ user environment .......................................... environ(5)
environment at login time ........................................ profile(4)
environment ........................................................ envon(5)
eqn eqnchbar (BSD) ................................................ eqnchar(5)
eqnchar (BSD) special character ................................ eqnchar(5)
error logging and event tracing ................................. log(7)
EtherExpress 16 Ethernet Adapter ............................... ee7(7)
EtherLink 16 Ethernet Adapter ...................................... el(7)
Ethernet Adapter Driver .............................................. ee7(7)
Ethernet Adapter Driver .............................................. el(7)
Ethernet address to hostname .................................... ethers(4)
Ethernet Driver ......................................................... i596(7)
Ethernet Driver ......................................................... i6(7)
Ethernet Driver ......................................................... imx586(7)
Ethernet Driver ......................................................... wd7(7)
ethers Ethernet address to hostname .......................... ethers(4)
EUC handling tty drivers and/ ................................. eucioctl(5)
eucioctl generic interface to EUC ................................. eucioctl(5)
event tracing log interface ........................................ log(7)
(Executable and Linking Format) .............................. a.out(4)
expression compile and match/ ................................. regexp(5)
extended general terminal Interface ........................... termio(7)
FACE / .pref, .variables .......................................... environ(4)
FACE object architecture ......................................... ot(4)
FACE ................................................................. pathalias(4)
famify ................................................................. inet(7)
FASST2 host adapter subsystem ................................ wd7000(7)
fcntl file control options ........................................ fcntl(5)
fd diskette (floppy disk) ........................................... fd(7)
fd file descriptor files .............................................. fd(4)
file ................................................................. admin(4)
file ................................................................. archives(4)
file (COFF) filehdr ................................................. filehdr(4)
file ................................................................. compver(4)

582
Permutted Index
sharing resources dfstab
settings information for/ ttydefs
fcntl
copyright copyright information
core core image
fd
dump boot dump timeout
pathalias alias
netrc
constants limits header
tc.index configuration index
menu form description
resolv.conf configuration
Service/ updaters configuration
protocols mappings netdrivers data
definitions privilege include
strcf STREAMS Configuration
unistd header
syslog.conf (BSD) configuration
definitions priv include
acct per-process accounting
ar archive
pncch
utility mkdev
help Desktop help
group group
(COFF) filehdr
holidays accounting
issue issue identification
login login default
null the null
passwd password
pkginfo package characteristics
pkgmap package contents description
priv privilege data
prototype package information
File Sharing name server master
font configuration and defaults
sccsfile format of SCCS
setinfo set characteristics
setsize disk space requirements
shadow shadow password
file rfmaster Remote
space disk space requirement
su su options
dir (cdfs) format of CD-ROM
vxfsio vxfs
vfstab table of
fs (cdfs) format of a cdfs
entry dirent
filesystem
file that registers distributed
<table>
<thead>
<tr>
<th>Proc process</th>
<th>file system security database</th>
<th>proc(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lid_and_priv distributed</td>
<td>file system table</td>
<td>lid_and_priv(4)</td>
</tr>
<tr>
<td>Mnttab mounted</td>
<td>file system table</td>
<td>mnttab(4)</td>
</tr>
<tr>
<td>Sharetab shared</td>
<td>file system table</td>
<td>sharetab(4)</td>
</tr>
<tr>
<td>Fs (BFS) format of the BFS</td>
<td>file system volume</td>
<td>fs(4)</td>
</tr>
<tr>
<td>Fs (S5) format of S5</td>
<td>file system volume</td>
<td>fs(4)</td>
</tr>
<tr>
<td>Fs (SFS) format of SFS</td>
<td>file system volume</td>
<td>fs(4)</td>
</tr>
<tr>
<td>Fs (UFS) format of UFS</td>
<td>file system volume</td>
<td>fs(4)</td>
</tr>
<tr>
<td>Fs (VXFS) format of VXFS</td>
<td>file system volume</td>
<td>fs(4)</td>
</tr>
<tr>
<td>Term format of compiled term</td>
<td>file that registers distributed</td>
<td>term(4)</td>
</tr>
<tr>
<td>File system packages ftypes</td>
<td>file</td>
<td>ftypes(4)</td>
</tr>
<tr>
<td>Format of an encoded uuencode</td>
<td>file</td>
<td>uuencode(4)</td>
</tr>
<tr>
<td>Xwinconfig XWIN configuration</td>
<td>file</td>
<td>Xwinconfig(4)</td>
</tr>
<tr>
<td>Object file (COFF)</td>
<td>filehdr file header for common</td>
<td>filehdr(4)</td>
</tr>
<tr>
<td>ELF (Executable and Linking Format)</td>
<td>files</td>
<td>a.out(4)</td>
</tr>
<tr>
<td>Depend software dependencies</td>
<td>files</td>
<td>depend(4)</td>
</tr>
<tr>
<td>Fd file descriptor</td>
<td>files</td>
<td>fd(4)</td>
</tr>
<tr>
<td>Cron, queuedefs option</td>
<td>files for crontab and at</td>
<td>cron(4)</td>
</tr>
<tr>
<td>User-preference variable</td>
<td>files for /etc/faces /variables</td>
<td>environ(4)</td>
</tr>
<tr>
<td>Font font description</td>
<td>files for troff and dpost</td>
<td>font(5)</td>
</tr>
<tr>
<td>Fspec format specification in text</td>
<td>files</td>
<td>fspec(4)</td>
</tr>
<tr>
<td>Intro introduction to special</td>
<td>files</td>
<td>intro(7)</td>
</tr>
<tr>
<td>Format of tty device mapping</td>
<td>files</td>
<td>mapchan(4)</td>
</tr>
<tr>
<td>Fd diskette</td>
<td>files</td>
<td>fd(7)</td>
</tr>
<tr>
<td>File (scalable and)</td>
<td>Font file configuration and defaults</td>
<td>Xwinfont(4)</td>
</tr>
<tr>
<td>Xwinfont XWIN</td>
<td>font description files for troff</td>
<td>font(5)</td>
</tr>
<tr>
<td>And dpost font</td>
<td>font description files for troff</td>
<td>font(5)</td>
</tr>
<tr>
<td>Troff and dpost</td>
<td>form description file for menu</td>
<td>font(5)</td>
</tr>
<tr>
<td>Command menu</td>
<td>form description file for menu</td>
<td>menu(4)</td>
</tr>
<tr>
<td>Acct per-process accounting file</td>
<td>format</td>
<td>acct(4)</td>
</tr>
<tr>
<td>Ar archive file</td>
<td>format</td>
<td>ar(4)</td>
</tr>
<tr>
<td>A.out ELF (Executable and Linking)</td>
<td>Format files</td>
<td>a.out(4)</td>
</tr>
<tr>
<td>Pnch file</td>
<td>format for card images</td>
<td>pnch(4)</td>
</tr>
<tr>
<td>Mkdev file</td>
<td>format for the pdimkdev utility</td>
<td>mkdev(4)</td>
</tr>
<tr>
<td>Help Desktop help file</td>
<td>format</td>
<td>help(4)</td>
</tr>
<tr>
<td>Inode (BFS)</td>
<td>format of a BFS i-node</td>
<td>inode(4)</td>
</tr>
<tr>
<td>Fs (CDFS)</td>
<td>format of a cdfs file system</td>
<td>fs(4)</td>
</tr>
<tr>
<td>Inode (CDFS)</td>
<td>format of a cdfs inode</td>
<td>inode(4)</td>
</tr>
<tr>
<td>Inode (SFS)</td>
<td>format of a sfs inode</td>
<td>inode(4)</td>
</tr>
<tr>
<td>Inode (UFS)</td>
<td>format of a ufs inode</td>
<td>inode(4)</td>
</tr>
<tr>
<td>Inode (VXFS)</td>
<td>format of a vxfs inode</td>
<td>inode(4)</td>
</tr>
<tr>
<td>Uuencode</td>
<td>format of an encoded uuencode file</td>
<td>uuencode(4)</td>
</tr>
<tr>
<td>Inode (S5)</td>
<td>format of an S5 i-node</td>
<td>inode(4)</td>
</tr>
<tr>
<td>Directory data/</td>
<td>format of CD-ROM file system (cdfs)</td>
<td>dir(4)</td>
</tr>
<tr>
<td>Dir (CDFS)</td>
<td>format of compiled term file</td>
<td>term(4)</td>
</tr>
<tr>
<td>Term</td>
<td>format of compiled term file</td>
<td>term(4)</td>
</tr>
<tr>
<td>Dir (S5)</td>
<td>format of S5 directories</td>
<td>dir(4)</td>
</tr>
<tr>
<td>Fs (S5)</td>
<td>format of S5 file system volume</td>
<td>fs(4)</td>
</tr>
<tr>
<td>Sccsfile</td>
<td>format of SCCS file</td>
<td>sccsfile(4)</td>
</tr>
<tr>
<td>Fs (SFS)</td>
<td>format of SFS file system volume</td>
<td>fs(4)</td>
</tr>
<tr>
<td>Volume fs (BFS)</td>
<td>format of the BFS file system</td>
<td>fs(4)</td>
</tr>
<tr>
<td>Mapchan</td>
<td>format of tty device mapping files</td>
<td>mapchan(4)</td>
</tr>
</tbody>
</table>

**584 Permuted Index**
by system and by user hosts.equiv, .rhosts trusted hosts ......................... hosts.equiv(4)
i596 i596 Ethernet Driver ...................................................... i596(7)
i596 i596 Ethernet Driver ...................................................... i596(7)
i596 i596 Ethernet Driver ...................................................... i596(7)
i596 Ethernet Driver ...................................................... i596(7)
i596 Ethernet Driver ...................................................... i596(7)
i596 Ethernet Driver ...................................................... i596(7)
i596 Ethernet Driver ...................................................... i596(7)
i596 Ethernet Driver ...................................................... i596(7)
i596 Ethernet Driver ...................................................... i596(7)
i596 Ethernet Driver ...................................................... i596(7)
i596 Ethernet Driver ...................................................... i596(7)
i596 Ethernet Driver ...................................................... i596(7)
i596 Ethernet Driver ...................................................... i596(7)
i596 Ethernet Driver ...................................................... i596(7)
i596 Ethernet Driver ...................................................... i596(7)
i596 Ethernet Driver ...................................................... i596(7)
i596 Ethernet Driver ...................................................... i596(7)
i596 Ethernet Driver ...................................................... i596(7)
i596 Ethernet Driver ...................................................... i596(7)
i596 Ethernet Driver ...................................................... i596(7)
i596 Ethernet Driver ...................................................... i596(7)
i596 Ethernet Driver ...................................................... i596(7)
i596 Ethernet Driver ...................................................... i596(7)
i596 Ethernet Driver ...................................................... i596(7)
i596 Ethernet Driver ...................................................... i596(7)
i596 Ethernet Driver ...................................................... i596(7)
i596 Ethernet Driver ...................................................... i596(7)
i596 Ethernet Driver ...................................................... i596(7)
i596 Ethernet Driver ...................................................... i596(7)
i596 Ethernet Driver ...................................................... i596(7)
i596 Ethernet Driver ...................................................... i596(7)
i596 Ethernet Driver ...................................................... i596(7)
i596 Ethernet Driver ...................................................... i596(7)
i596 Ethernet Driver ...................................................... i596(7)
i596 Ethernet Driver ...................................................... i596(7)
i596 Ethernet Driver ...................................................... i596(7)
i596 Ethernet Driver ...................................................... i596(7)
i596 Ethernet Driver ...................................................... i596(7)
i596 Ethernet Driver ...................................................... i596(7)
i596 Ethernet Driver ...................................................... i596(7)
i596 Ethernet Driver ...................................................... i596(7)
i596 Ethernet Driver ...................................................... i596(7)
i596 Ethernet Driver ...................................................... i596(7)
i596 Ethernet Driver ...................................................... i596(7)
i596 Ethernet Driver ...................................................... i596(7)
i596 Ethernet Driver ...................................................... i596(7)
i596 Ethernet Driver ...................................................... i596(7)
i596 Ethernet Driver ...................................................... i596(7)
i596 Ethernet Driver ...................................................... i596(7)
i596 Ethernet Driver ...................................................... i596(7)
i596 Ethernet Driver ...................................................... i596(7)
i596 Ethernet Driver ...................................................... i596(7)
admin
imx586 IMXLAN586
interface Internet network
console STREAMS-based console
module timod Transport
cram CMOS RAM
interface configuration parameters
interface configuration parameters
lo software loopback network
lp parallel port
st01 Portable Device
sw01 Portable Device
STREAMS module tirdwr Transport
rtc real time clock
Transport Interface read/write
termio general terminal
termio extended general terminal
drivers and / eucioctl generic
and event tracing log
tty controlling terminal
of Internet Protocol network
ICMP
configuration parameters interface
inet
IP
if general properties of
inetd.conf
services
Protocol TCP
UDP
intro
introduction to special files
symbol name kmem perform
streamio STREAMS
sockets sockio
ioctls ioctl commands
issue issue identification file
module
kbd generalized string translation
Init inittab entries for a
configuration information for a
Stubs.c stubs for
script Sd
configuration information for a
publickey public
keyboard system console
mem,

based on symbol name

installation defaults file ........................................... admin(4)
Intel Ethernet defaults file ........................................... imx586(7)
interface configuration parameters ................................... interface(4)
interface cooperating STREAMS ...................................... timod(7)
interface ................................................................. cram(7)
Interface (PDI) tape target driver .................................... st0(7)
Interface (PDI) WORM Target Driver ................................ sw0(7)
Interface read/write interface ....................................... tirdwr(7)
interface ................................................................. rtc(7)
interface STREAMS module .......................................... tirdwr(7)
interface ................................................................. termio(7)
interface to EUC handling tty ...................................... eucioctl(5)
interface to STREAMS error logging ................................ log(7)
interface ................................................................. tty(7)
interfaces if general properties ..................................... if(7)
Internet Control Message Protocol ................................. ICMP(7)
Internet protocol family ............................................... interface(4)
Internet Protocol ...................................................... IP(7)
Internet Protocol network/ .......................................... if(7)
Internet servers database .......................................... inetr.conf(4)
Internet services and aliases ....................................... services(4)
Internet Transmission Control ..................................... TCP(7)
Internet User Datagram Protocol ................................... UDP(7)
intro introduction to miscellany .................................... intro(5)
intro introduction to special files .................................. intro(7)
intro introduction to special files .................................. intro(7)
I/O on kernel memory based on symbol name .................... kmem(7)
ioctl commands ......................................................... streamio(7)
sockets that operate directly on ................................... sockio(7)
IP Internet Protocol .................................................... IP(7)
issue issue identification file ...................................... issue(4)
issue issue identification file ...................................... issue(4)
kernel module based on symbol name ............................... kmem(7)
kernel module Master generic ..................................... Master(4)
kernel module symbols .............................................. Stubs.c(4)
kernel module system shutdown .................................... Sd(4)
kernel module /system-specific .................................... System(4)
key database ............................................................. publickey(4)
keyboard ................................................................. keyboard(7)
keyboard system console .......................................... keyboard(7)
kmem core memory ..................................................... kmem(7)
kmem perform I/O on kernel memory ............................... kmem(7)
constants
nl_types native
langinfo
strftime
line discipline module
system security database
implementation-specific constants
connections
connld
ldterm standard STREAMS terminal
line discipline for unique stream
line discipline module
ldterm(7)
line settings information for/
ttydefs(4)
Linking Format) files
list of ttymap and tyyname
ttydefs(4)
list of IM attributes
OImValues a
stdarg handle variable argument
varargs handle variable argument
interface
parameters
stune
file for syslogd system
logging and event tracing
loginterface to STREAMS error
log of failed login attempts
log in and event tracing
login attempts
netrc file for ftp remote
login
data
local system settings for tunable
log daemon /(BSD) configuration
log interface to STREAMS error
log of failed login attempts
log of failed login
login attempt
login default file
login default file
login profile
login failed login attempts
loopback network interface
loopback transport providers
lp parallel port interface
machine-dependent values
macro for formatting papers
macros
macros for formatting papers
macros
mail and rmail
mailcfrg
mail malsurr surrogate commands
mailcfrg initialized information
mailsurr surrogate commands
major numbers for base system
management module
Management module
Manual pages
map file
map of ASCII character set
mapping files
mapping files
mappings
mask data base
mass-storage and SCSI devices
mass-storage devices
master file
rmaster(4)
Master generic configuration
Remote File Sharing name server
information for a kernel module
regular expression compile and math
match routines /step, advance ....................................... regexp(5)
match functions and constants .................................. math(5)
match math functions and constants .......................... math(5)
mcis MCIS SCSI host adapter driver ............................. mcis(7)
MCIS SCSI host adapter driver .................................... mcis(7)
include file for privilege
mechanism definitions privilege ..................................... privilege(5)
memo, kmem core memory ........................................... mem(7)
memory based on symbol name ...................................... kmem(7)
menu(1) command
menu form description file for ...................................... menu(4)
menu(1) command ....................................................... menu(4)
STREAMS pseudo-terminal emulation
ICMP Internet Control
Message Protocol ....................................................... ICMP(7)
intro introduction to
miscellany ................................................................. intro(5)
pckt STREAMS Packet
mkdev file format for the pdmdev ................................. mkdev(4)
alp algorithm pool management
mnttab mounted file system table .................................. mnttab(4)
configuration-dependent kernel
Mode module .............................................................. pckt(7)
module ................................................................. alp(7)
module data structure/ Space.c .................................. Space.c(4)
module ................................................................. Init(4)
module kbd generalized string translation ............................ kbd(7)
STREAMS terminal line discipline
module lterm standard .............................................. lterm(7)
module /generic configuration ...................................... Master(4)
module ................................................................. pckt(7)
stubs for kernel
module symbols ...................................................... Stubs.c(4)
module system shutdown script .................................... Sd(4)
module /configuration ................................................. System(4)
module timod Transport ............................................. timod(7)
module tdirwr Transport Interface ................................. tdirwr(7)
term/ncurses interface definitions and applications
modules eucioctl generic interface ................................. eucioctl(5)
mounted file system table ............................................. mnttab(4)
mouse device driver for bus, ......................................... mouse(7)
mouse devices mouse mouse device ................................. mouse(7)
tsBSD text formatting macros ......................................... ms(5)
Mfs tunable parameter definitions ................................. Mfs(4)
N) terminfo terminal capability ..................................... terminfo(4)
Nmdev file system table ............................................. Nmdev(4)
nterface cooperating STREAMS
modules for serial, and PS/2 mouse mouse devices
mouse device driver for bus, ......................................... mouse(7)
mouse devices mouse mouse device ................................. mouse(7)
modules eucioctl generic interface ................................. eucioctl(5)
mnttab mounted file system table .................................. mnttab(4)
networks network
networks network .......................................................... networks(4)
protocol protocol
name data base ........................................................... protocols(4)
name kmem perform I/O ............................................... kmem(7)
rpmaster Remote File Sharing
name server master file ............................................... rpmaster(7)
resolv.conf configuration file for
name server routines ................................................... resolv.conf(4)
OlIcValues Input Context attribute
directives for serial, and PS/2 mouse devices
network configuration definition................................. netconfig(4)
names and value pairs ............................................... OlIcValues(4)
names for terminals ................................................... term(5)
native language data types .......................................... nl_types(5)
network configuration.................................................. netconfig(4)
data
netdrivers file data for networking ............................... netdrivers(4)
netdrivers file data for networking ............................... netdrivers(4)
netconfig network mask data base ............................... netmask(4)
netconfig network configuration database ................. netconfig(4)

Permuted Index
database and directory / ypfiles the
updaters configuration file for
parameters interface Internet
lo software loopback
properties of Internet Protocol
netmasks networks
system supporting for packet mappings netdrivers data file for
/the Network Information Service
for Network Information Service
driver Node device
device driver
null the
rpc rpc program
drivers res_major reserved major
.ott FACE
filehdr file header for common
names and value pairs
a STREAMS driver clone
sockio ioctl that
prf cron, queuedefs
boot boot
fcntl file control
su su
filesystem file system
information .ott FACE object architecture
pkinfo pkgmap
prototype
registers distributed file system
pckt STREAMS
routing system supporting for
macros to format Reference Manual
clone open any major/minor device
Context attribute names and value
me (BSD) macros for formatting
lp
bootstrap boot
Mtune tunable
rt_dptbl real-time dispatcher
ts_dptbl time-sharing dispatcher
network interface configuration
local system settings for tunable
passwd
shadow shadow

Network Information Service (NIS) ypfiles
Network Information Service (NIS)/ updaters
network interface configuration interface
network interface lo
network interfaces if general if
network mask data base netmasks
network name data base networks
network routing routing	networking boards to protocols netdrivers
networks network name data base networks
(NIS) database and directory ypfiles
(NIS) updating /configuration file updaters
nl_types native language data types nl_types
node definitions for a device Node
Node device node definitions for a
null file null
null the null file
number data base rpc
numbers for base system device res_major
object architecture information .ott
object file (COFF) filehdr
OIlcValues Input Context attribute OIlcValues
OIlmValues a list of IM attributes OIlmValues
open any major/minor device pair on clone
operate directly on sockets sockio
operating system profiler prf
option files for crontab and at cron
options boot
options file su
organization filesystem
package characteristics file pkinfo
package contents description file pkgmap
package information file prototype
packages fstypes file that
Packet Mode module pckt
packet network routing routing
pages man man
pair on a STREAMS driver clone
pairs OIlcValues Input
papers me
parallel port interface lp
parameter data base bootstrap
parameter definitions Mtune
parameter table rt_dptbl
parameter table ts_dptbl
parameters interface Internet interface
parameters stune stune
passwd password file
password file passwd
password file shadow
Permuted Index

591

sd01

st01 Portable Device Interface

sw01 Portable Device Interface

mkdev file format for the

on symbol name kmem

acct

file

file
dpt DPT

alp algorithm

async asynchronous serial

lp parallel
tape target driver st01

WORM Target Driver sw01

user-preference variable/ .environ,

privilege definitions

priv

priv include file for user-level

privilege mechanism definitions

privilege include file for PrivTable

priv include file for user-level

privilege mechanism definitions

privilege include file for PrivTable

privilege data file

privilege data file

privilege definitions

privilege include file for privilege(5)

privilege include file for PrivTable

privilege table

PrivTable

PrivTable privilege table

proc

at login time

prof

prf operating system

rpc rpc

network interfaces if general

ARP Address Resolution

inet Internet

ICMP Internet Control Message

IP Internet

protocols

if general properties of Internet

TCP Internet Transmission Control

UDP Internet User Datagram

data file for networking boards to

ticsords loopback transport
device driver for bus, serial, and

sxt

pty STREAMS

ptem STREAMS

pathalias alias file for FACE ............................................................. pathalias(4)

pkct STREAMS Packet Mode module ........................................... pkct(7)

PDI disk target driver ............................................................. sd0(7)

(PDI) tape target driver ............................................................. st0(7)

(PDI) WORM Target Device ...................................................... sw0(7)

pdimkdev utility ................................................................. mkdev(4)

perform I/O on kernel memory based ........................................ kmem(7)

per-process accounting file format ......................................... acct(4)

pkginfo package characteristics ......................................... pkginfo(4)

pkgmap package contents description .................................... pkgmap(4)

PM2012 SCSI host adapter subsystem ........................................ dpt(7)

pnic file format for card images .............................................. pnic(4)

pool management module ....................................................... alp(7)

port ................................................................. asyc(7)

port interface ............................................................... lp(7)

Porta ble Device Interface (PDI) ............................................. st0(7)

Portable Device Interface (PDI) .............................................. sw0(7)

.pref, .variables ........................................................ environ(4)

primitive system data types ................................................. types(5)

priv include file for user-level ........................................ priv(5)

priv privilege data file ....................................................... priv(4)

privilege data file ............................................................. priv(4)

privilege definitions ......................................................... priv(5)

privilege include file for privilege(5)

privilege include file for PrivTable

privilege table

PrivTable

PrivTable privilege table

proc process file system ..................................................... proc(4)

process file system .......................................................... proc(4)

prof profile within a function ............................................ prof(5)

profile setting up an environment ....................................... profile(4)

profile within a function .................................................. prof(5)

profiler ................................................................. prf(7)

prof operating system ....................................................... prf(7)

program number data base ................................................ rcp(4)

properties of Internet Protocol ....................................... if(7)

Protocol ................................................................. ARP(7)

protocol family ............................................................ inet(7)

Protocol ................................................................. ICMP(7)

Protocol ................................................................. IP(7)

protocol name data base .................................................. protocols(4)

protocol network interfaces ............................................... if(7)

Protocol ................................................................. TCP(7)

Protocol ................................................................. UDP(7)

protocols mappings netdrivers ........................................... netdrivers(4)

protocols protocol name data base ..................................... protocols(4)

prototype package information file ..................................... prototype(4)

providers ticits, ticots, ............................................... ticits(7)

PS/2 mouse devices mouse ................................................. mouse(7)

pseudo-device driver ....................................................... sxt(7)

pseudo-terminal driver ..................................................... pty(7)

pseudo-terminal emulation module .................................... ptem(7)
<table>
<thead>
<tr>
<th><strong>emulation module</strong></th>
<th><strong>ptem STREAMS pseudo-terminal</strong></th>
<th><strong>ptem(7)</strong>*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>publickey</strong></td>
<td><strong>pty STREAMS pseudo-terminal driver</strong></td>
<td><strong>pty(7)</strong></td>
</tr>
<tr>
<td><strong>and at cron,</strong></td>
<td><strong>public key database</strong></td>
<td><strong>publickey(4)</strong></td>
</tr>
<tr>
<td><strong>cram CMOS</strong></td>
<td><strong>public key database</strong></td>
<td><strong>publickey(4)</strong></td>
</tr>
<tr>
<td><strong>tirdwr Transport Interface</strong></td>
<td><strong>queuedefs option files for crontab</strong></td>
<td><strong>cron(4)</strong></td>
</tr>
<tr>
<td><strong>rtc</strong></td>
<td><strong>RAM interface</strong></td>
<td><strong>cram(7)</strong></td>
</tr>
<tr>
<td><strong>table rt_dptbl</strong></td>
<td><strong>read/write interface STREAMS module</strong></td>
<td><strong>tirdwr(7)</strong></td>
</tr>
<tr>
<td><strong>man macros to format</strong></td>
<td><strong>real time clock interface</strong></td>
<td><strong>rtc(7)</strong></td>
</tr>
<tr>
<td><strong>regular expression compile and/</strong>** packages fstypes file that**</td>
<td><strong>real-time dispatcher parameter</strong></td>
<td><strong>rt_dptbl(4)</strong></td>
</tr>
<tr>
<td><strong>regexp: compile, step, advance</strong></td>
<td><strong>Reference Manual pages</strong></td>
<td><strong>man(5)</strong></td>
</tr>
<tr>
<td><strong>master file rfmaster</strong></td>
<td><strong>regexp: compile, step, advance</strong></td>
<td><strong>regexp(5)</strong></td>
</tr>
<tr>
<td><strong>netrc file for ftp</strong></td>
<td><strong>registrers distributed file system</strong></td>
<td><strong>fstypes(4)</strong></td>
</tr>
<tr>
<td><strong>ckbinarsys command binariesys</strong></td>
<td><strong>regular expression compile and/</strong>****</td>
<td><strong>regexp(5)</strong></td>
</tr>
<tr>
<td><strong>space disk space</strong></td>
<td><strong>res_major reserved major numbers</strong></td>
<td><strong>res_major(4)</strong></td>
</tr>
<tr>
<td><strong>setsizes disk space</strong></td>
<td><strong>stat data</strong></td>
<td><strong>stat(5)</strong></td>
</tr>
<tr>
<td><strong>for base system device drivers</strong></td>
<td><strong>server master file</strong></td>
<td><strong>rfmaster(4)</strong></td>
</tr>
<tr>
<td><strong>ARP Address</strong></td>
<td><strong>by user hosts.equiv,</strong></td>
<td><strong>hosts.equiv(4)</strong></td>
</tr>
<tr>
<td><strong>name server routines</strong></td>
<td><strong>ibmtok IBM Token</strong></td>
<td><strong>ibmtok(7)</strong></td>
</tr>
<tr>
<td><strong>containing commands for sharing</strong></td>
<td><strong>information for mail and</strong></td>
<td><strong>mailcnfg(4)</strong></td>
</tr>
<tr>
<td><strong>stat (XENIX) data</strong></td>
<td><strong>expression compile and match</strong></td>
<td><strong>regexp(5)</strong></td>
</tr>
<tr>
<td><strong>statdata</strong></td>
<td><strong>configuration file for name server</strong></td>
<td><strong>stat(4)</strong></td>
</tr>
<tr>
<td><strong>server master file</strong></td>
<td><strong>mailsurr surrogate commands for</strong></td>
<td><strong>mailsurr(4)</strong></td>
</tr>
<tr>
<td><strong>by user hosts.equiv,</strong></td>
<td><strong>supporting for packet network</strong></td>
<td><strong>mailsurr(4)</strong></td>
</tr>
<tr>
<td><strong>ibmtok IBM Token</strong></td>
<td><strong>packet network routing</strong></td>
<td><strong>rfmaster(4)</strong></td>
</tr>
<tr>
<td><strong>information for mail and</strong></td>
<td><strong>packet network routing</strong></td>
<td><strong>rfmaster(4)</strong></td>
</tr>
<tr>
<td><strong>expression compile and match</strong></td>
<td><strong>rpc</strong></td>
<td><strong>rpc(4)</strong></td>
</tr>
<tr>
<td><strong>configuration file for name server</strong></td>
<td><strong>parameter table</strong></td>
<td><strong>parameter table</strong></td>
</tr>
<tr>
<td><strong>mailsurr surrogate commands for</strong></td>
<td><strong>dir (5)</strong> format of**</td>
<td><strong>dir(5)</strong></td>
</tr>
<tr>
<td><strong>supporting for packet network</strong></td>
<td><strong>fs (5)</strong> format of**</td>
<td><strong>fs(5)</strong></td>
</tr>
<tr>
<td><strong>packet network routing</strong></td>
<td><strong>inode (5)</strong> format of an**</td>
<td><strong>inode(5)</strong></td>
</tr>
<tr>
<td><strong>rpc</strong></td>
<td><strong>s5 directorys</strong></td>
<td><strong>dir(4)</strong></td>
</tr>
<tr>
<td><strong>rtc real time clock interface</strong></td>
<td><strong>s5 file system volume</strong></td>
<td><strong>fs(4)</strong></td>
</tr>
<tr>
<td><strong>rt_dptbl real-time dispatcher</strong></td>
<td><strong>s5 format of an s5 i-node</strong></td>
<td><strong>inode(4)</strong></td>
</tr>
<tr>
<td><strong>parameter table</strong></td>
<td><strong>s5 format of s5 directories</strong></td>
<td><strong>dir(4)</strong></td>
</tr>
<tr>
<td><strong>dir (5)</strong> format of**</td>
<td><strong>s5 format of s5 file system</strong></td>
<td><strong>fs(4)</strong></td>
</tr>
<tr>
<td><strong>fs (5)</strong> format of**</td>
<td><strong>s5 i-node</strong></td>
<td><strong>inode(4)</strong></td>
</tr>
<tr>
<td><strong>inode (5)</strong> format of an**</td>
<td><strong>sad STREAMS Administrative Driver</strong></td>
<td><strong>sad(7)</strong></td>
</tr>
<tr>
<td><strong>variables</strong></td>
<td><strong>Sassign configurable device</strong></td>
<td><strong>Sassign(4)</strong></td>
</tr>
<tr>
<td><strong>configuration and defaults file</strong></td>
<td><strong>sc01 CD-ROM Target Driver</strong></td>
<td><strong>sc01(7)</strong></td>
</tr>
<tr>
<td><strong>sccsfile format of</strong></td>
<td><strong>(scalable and bitmapped) /XWIN font</strong></td>
<td><strong>Xwinfont(4)</strong></td>
</tr>
<tr>
<td><strong>inittab</strong></td>
<td><strong>SCCS file</strong></td>
<td><strong>sccsfile(4)</strong></td>
</tr>
<tr>
<td><strong>script for init</strong></td>
<td><strong>sccsfile format of SCCS file</strong></td>
<td><strong>sccsfile(4)</strong></td>
</tr>
<tr>
<td><strong>Rc system startup</strong></td>
<td><strong>script</strong></td>
<td><strong>inittab(4)</strong></td>
</tr>
</tbody>
</table>

---

**Permutted Index**
<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
</tr>
</thead>
</table>
| Sd kernel module system shutdown | shutdown script ..........................................................................................  
| Sd(4)                        | scrypt ........................................................................................................  |
| Sd kernel module data structure/ | script ........................................................................................................  |
| dfstab file containing commands for | Sd kernel module system shutdown .......................................................... Sd(4)  
| Sd(4)                        | scrypt ........................................................................................................  |
| dfstab file containing commands for | Sd kernel module system shutdown .......................................................... Sd(4)  
| Sd(4)                        | scrypt ........................................................................................................  |
| rfmaster Remote File          | server master file ..................................................................................... rfmaster(4)  
| Sd(4)                        | scrypt ........................................................................................................  |
| rfmaster Remote File          | server master file ..................................................................................... rfmaster(4)  
| Sd(4)                        | scrypt ........................................................................................................  |
| Remote File Sharing name      | server master file ..................................................................................... rfmaster(4)  
| configuration file for name   | server master file ..................................................................................... rfmaster(4)  
| inetd.conf Internet           | servers database ........................................................................................ inetd.conf(4)  
| ypfiles the Network Information | Service (NIS) database and/ .................................................................... ypfiles(4)  
| sfs file system volume        | Service (NIS) database and/ .................................................................... ypfiles(4)  
| Sd(4)                        | scrypt ........................................................................................................  |
| Sd(4)                        | scrypt ........................................................................................................  |
| Shadow password file          | shadow password file ................................................................................... shadow(4)  
| Sd(4)                        | scrypt ........................................................................................................  |
| shared file system table      | shared file system table ............................................................................. sharetab(4)  
| Sd(4)                        | scrypt ........................................................................................................  |
| sharetab                     | shared file system table ............................................................................. sharetab(4)  
| Sd(4)                        | scrypt ........................................................................................................  |
| rfmaster Remote File          | Sharing name server master file ................................................................ rfmaster(4)  
| dfstab file containing commands for | Sharing name server master file ................................................................ rfmaster(4)  
| Sd(4)                        | scrypt ........................................................................................................  |
| ioctls that operate directly on | sockets sockio .......................................................................................... sockio(7)  
| on sockets                   | sockets sockio .......................................................................................... sockio(7)  
| Sd(4)                        | scrypt ........................................................................................................  |
| signal base                  | signals ........................................................................................................ signal(5)  
| Sd(4)                        | scrypt ........................................................................................................  |
| Software dependencies files   | software dependencies files ......................................................................... depend(4)  
| Sd(4)                        | scrypt ........................................................................................................  |
| Software loopback network interface | software dependencies files ......................................................................... depend(4)  
| Sd(4)                        | scrypt ........................................................................................................  |
| space disk                   | space disk space requirement file ............................................................. space(4)  
| Sd(4)                        | scrypt ........................................................................................................  |
| space requirements file      | space requirements file ............................................................................. setsizes(4)  
| Sd(4)                        | scrypt ........................................................................................................  |

- **compile and match/** regexp: compile,
- **wd7000 WD7000**
- **dpt DPT**
- **any major/**minor device pair on a Direct-Coupled Disk host adapter Adaptec 1542A
- **STREAMS Configuration File for connld line discipline for unique I/O transport Interface cooperating file system (cdfs) directory data ttcompat V7, 4BSD and XENIX streamio**
- **stat (XENIX) data returned by stat system call**
- **stat data returned by system call**
- **status**
- **wstat wait list**
- **compile and match/** regexp: compile,
- for STREAMS TCP/IP connld line discipline for unique
- **sad**
- **ttcompat V7, 4BSD and XENIX**
- **STREAMS TCP/IP strcf**
- **any major/**minor device pair on a Tracing log interface to streamio**
- **Transport Interface cooperating Interface read/**write interface** pktc**
- **pty**
- **module ptem**
- **STREAMS Configuration File for module ldterm standard console**
- **STREAMS Configuration File**
- **STREAMS TCP/IP strcf**
- **STREAMS terminal line discipline**
- **STREAMS-based console interface**
- **string translation module**
- **strings**
- **structure /cdfs) format of CD-ROM**
- **structure initialization**
- **structure /Information Service**
- **subs for kernel module symbols**
- **stune local system settings for**
- **su options file**
- **su options file**
- **subsystem adsc**
- **Subsystem DCD**
- **Subsystem **
- **supporting for packet network**
- **surrogate commands for routing and**
- **symbol name kmem perform**
- **symbolic constants**
Stubs.c stubs for kernel module
file for syslogd system log daemon
/(BSD) configuration file for
.rhosts trusted hosts by
stat (XENIX) data returned by stat
stat data returned by stat
dir (cdfs) format of CD-ROM file
display
keyboard
vxfstabc vxfstabc file
types primitive
tystab table of file
reserved major numbers for base
fs (cdfs) format of a cdfs file
dirent file
ckbinarsys command binarsys remote
configuration file for syslogd
filesystem file
that registers distributed file
proc process file
prf operating
lid_and_priv distributed file
parameters.stune local
Sd kernel module

Rc
network routing routing
configuration information for a/
mnttab mounted file
sharetab shared file
timezone set default
fs (bfs) format of the bfs file
fs (s5) format of s5 file
fs (sfs) format of sfs file
fs (ufs) format of ufs file
fs (vxfs) format of vxfs file
information for a kernel/
System
mnttab mounted file system
vystab
PrivTable privilege
real-time dispatcher parameter
sharetab shared file system
time-sharing dispatcher parameter
iconv code set conversion
Portable Device Interface (PDI)
sc01 CD-ROM
sd01 PDI disk
Device Interface (PDI) tape
Device Interface (PDI) WORM
for mass-storage devices
Protocol
Configuration File for STREAMS
terminals

symbols .................................................. Stubs.c(4)
syslog.conf (BSD) configuration .......... syslog.conf(4)
syslogd system log daemon .......... syslogd(8)
system and by user hosts.equiv,.......... hosts.equiv(4)
system call ........................................ stat(4)
system call ........................................ stat(5)
system (cdfs) directory data/ ........... dir(4)
system console display ...................... display(7)
system device drivers res_major .......... res_major(4)
system ............................................. fs(4)
system independent directory entry ...... dirent(4)
system information for the .............. binarsys(4)
system log daemon /(BSD) .............. syslogd(8)
system organization ....................... filesystem(7)
system packages fstypes file .......... fstypes(4)
system ............................................. proc(4)
system profiler ............................... prf(7)
system security database .............. lid_and_priv(4)
system settings for tunable ............. stune(4)
system startup script ...................... Sd(4)
system supporting for packet .......... routing(4)
System system-specific .................... System(4)
system table ................................... mnttab(4)
system time zone ......................... timezone(4)
system volume .............................. fs(4)
system volume .............................. fs(4)
system volume .............................. fs(4)
system volume .............................. fs(4)
system volume .............................. fs(4)
system volume .............................. fs(4)
system volume .............................. fs(4)
system-specific configuration .......... System(4)
system ............................................. mnttab(4)
system ............................................. mnttab(4)
system ............................................. PrivTable(4)
system ............................................. rt_dptbl(4)
system ............................................. rt_dptbl(4)
system ............................................. sharetab(4)
system ............................................. ts_dptbl(4)
system ............................................. ts_dptbl(4)
system ............................................. iconv(5)
tape target driver st01 ................... st0(7)
Target Driver ................................. sc0(7)
target driver ................................. sd0(7)
target driver st01 Portable .............. st0(7)
Target Driver sw01 Portable ........... sw0(7)
tc.index configuration index file ........ tc.index(4)
TCP Internet Transmission Control ........ TCP(7)
TCP/IP strcf STREAMS .................. strcf(4)
term conventional names for ........... term(5)
<table>
<thead>
<tr>
<th>term format of compiled N) terminfo</th>
<th>term file</th>
<th>term(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>termio extended general</td>
<td>detailed extended terminal capability data base</td>
<td>term(4)</td>
</tr>
<tr>
<td>tty controlling</td>
<td>terminal interface</td>
<td>termio(7)</td>
</tr>
<tr>
<td>ldterm standard STREAMS for ttymon</td>
<td>terminal interface</td>
<td>termiox(7)</td>
</tr>
<tr>
<td>ttydefs file contains</td>
<td>terminal interface</td>
<td>tty(7)</td>
</tr>
<tr>
<td>gettydefs speed and</td>
<td>terminal line discipline module</td>
<td>ldterm(7)</td>
</tr>
<tr>
<td>term conventional names for</td>
<td>terminal line settings information</td>
<td>ttymon(4)</td>
</tr>
<tr>
<td>base N)</td>
<td>terminal settings used by getty</td>
<td>gettydefs(4)</td>
</tr>
<tr>
<td></td>
<td>terminals</td>
<td>term(5)</td>
</tr>
<tr>
<td></td>
<td>terminfo terminal capability data</td>
<td>terminfo(4)</td>
</tr>
<tr>
<td></td>
<td>termio general terminal interface</td>
<td>termio(7)</td>
</tr>
<tr>
<td></td>
<td>termiox extended general terminal</td>
<td>termiox(7)</td>
</tr>
<tr>
<td></td>
<td>text files</td>
<td>fspec(4)</td>
</tr>
<tr>
<td></td>
<td>text formatting macros</td>
<td>ms(5)</td>
</tr>
<tr>
<td></td>
<td>tictls, ticots, ticotsord loopback</td>
<td>ticots(7)</td>
</tr>
<tr>
<td></td>
<td>ticots, ticotsord loopback</td>
<td>ticots(7)</td>
</tr>
<tr>
<td></td>
<td>ticotsord loopback transport</td>
<td>ticots(7)</td>
</tr>
<tr>
<td></td>
<td>timeout file</td>
<td>dump(4)</td>
</tr>
<tr>
<td></td>
<td>time-sharing dispatcher parameter</td>
<td>ts_dptbl(4)</td>
</tr>
<tr>
<td></td>
<td>timezone set default system time</td>
<td>timezone(4)</td>
</tr>
<tr>
<td></td>
<td>timod Transport Interface</td>
<td>timod(7)</td>
</tr>
<tr>
<td></td>
<td>tirdwr Transport Interface</td>
<td>tirdwr(7)</td>
</tr>
<tr>
<td></td>
<td>Token Ring Driver</td>
<td>ibmtok(7)</td>
</tr>
<tr>
<td></td>
<td>tracing log interface</td>
<td>log(7)</td>
</tr>
<tr>
<td></td>
<td>translation module</td>
<td>kbd(7)</td>
</tr>
<tr>
<td></td>
<td>Transmission Control Protocol</td>
<td>TCP(7)</td>
</tr>
<tr>
<td>TCP Internet</td>
<td>Transport Interface cooperating</td>
<td>timod(7)</td>
</tr>
<tr>
<td>STREAMS module timod</td>
<td>Transport Interface read/write</td>
<td>tirdwr(7)</td>
</tr>
<tr>
<td>interface STREAMS module tirdwr</td>
<td>transport of mail</td>
<td>mailsurr(4)</td>
</tr>
<tr>
<td>cooperating STREAMS module</td>
<td>transport providers</td>
<td>ticots(7)</td>
</tr>
<tr>
<td>read/write interface STREAMS/ibmtokIBM</td>
<td>troff and dpost</td>
<td>font(5)</td>
</tr>
<tr>
<td>to STREAMS error logging and event</td>
<td>trusted hosts by system and by user</td>
<td>hosts.equiv(4)</td>
</tr>
<tr>
<td>kbd generalized string</td>
<td>ts_dptbl time-sharing dispatcher</td>
<td>ts_dptbl(4)</td>
</tr>
<tr>
<td></td>
<td>ttcmap V7, 4BSD and XENIX STREAMS</td>
<td>ttcmap(7)</td>
</tr>
<tr>
<td></td>
<td>tty controlling terminal interface</td>
<td>tty(7)</td>
</tr>
<tr>
<td></td>
<td>tty device mapping files</td>
<td>mapchan(4)</td>
</tr>
<tr>
<td></td>
<td>tty drivers and modules eucioctl</td>
<td>eucioctl(5)</td>
</tr>
<tr>
<td></td>
<td>ttydefs file contains terminal line</td>
<td>ttymon(4)</td>
</tr>
<tr>
<td></td>
<td>ttmmap and ttnname</td>
<td>ttmmap(4)</td>
</tr>
<tr>
<td></td>
<td>ttymon/file contains terminal</td>
<td>ttymon(4)</td>
</tr>
<tr>
<td></td>
<td>ttname ttmrsh directory</td>
<td>ttname(4)</td>
</tr>
<tr>
<td></td>
<td>ttmrsh directory search list for</td>
<td>ttname(4)</td>
</tr>
<tr>
<td></td>
<td>tunable parameter definitions</td>
<td>Mtune(4)</td>
</tr>
<tr>
<td></td>
<td>tunable parameters</td>
<td>stune(4)</td>
</tr>
<tr>
<td></td>
<td>types</td>
<td>nl_types(5)</td>
</tr>
<tr>
<td></td>
<td>types primitive system data types</td>
<td>types(5)</td>
</tr>
<tr>
<td></td>
<td>types</td>
<td>types(5)</td>
</tr>
<tr>
<td></td>
<td>ucontext user context</td>
<td>ucontext(5)</td>
</tr>
<tr>
<td></td>
<td>UDIP Internet User Datagram Protocol</td>
<td>UDIP(7)</td>
</tr>
<tr>
<td></td>
<td>ufs directories</td>
<td>dir(4)</td>
</tr>
<tr>
<td></td>
<td>ufs file system volume</td>
<td>fs(4)</td>
</tr>
</tbody>
</table>

Permutated Index
utmp, wtmp utmp and
utmp, utmp
utmpx, wtmpx utmpx and
utmpx, system call stat
tcompat V7, 4BSD and
Xwinconfig
defaults file (scalable/ Xwinconfig
defaults file (scalable and/
Service (NIS) database and/
zero source of
timezone set default system time

wstat wait status ....................................................... wstat(5)
wtmp entry formats .................................................... utmp(4)
wtmp utmp and wtmp entry formats ............................ utmp(4)
wtmpx entry formats .................................................. utmpx(4)
wtmpx utmpx and wtmpx entry formats ...................... utmpx(4)
(XENIX) data returned by stat .................................. stat(4)
XENIX STREAMS compatibility module ....................... ttcompat(7)
XWIN color map file ................................................. Xwinmaps(4)
XWIN configuration file ........................................... Xwinconfig(4)
XWIN font configuration and ..................................... Xwinfont(4)
Xwinmaps XWIN color map file ................................. Xwinmaps(4)
Xwinconfig XWIN configuration file ........................... Xwinconfig(4)
Xwinfont XWIN font configuration .............................. Xwinfont(4)
yppfiles the Network Information ............................... yppfiles(4)
zero source of zeroes ............................................. zero(7)
zeroes ......................................................................... zero(7)
zezone ......................................................................... timezone(4)

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