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3270 TIP ERS

For NAM/CCP

By

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3270 TIPs are currently available via the Special Products Library for NOS/BE - INTERCOM 5 - CCI and NOS-NAM R4 - CCP3.1.

The TIPs are designed for use with the IBM 3270 Information Display System, using IBM's Binary Synchronous Communications (BSC) protocol.

The NOS/BE - INTERCOM 5 TIP is available and is being used in production at Rockwell International in Seal Beach, California. The INTERCOM 5 TIP has also been sold to SGIO in Australia, SUN LIFE in London and the Danish Post and Telegraph.

The NOS-NAM variant of the 3270 TIP is in development with completion expected in June or July (August delivery can be committed to customers). The NOS-NAM 3270 TIP has been sold to FERNINAL in Chicago, BPS in France, and the Korean Oil Company.

Following are the major features of the 3270 TIPs:

- **Supported 3270 Control Units and Devices/Stations**
  - 3271 Control Unit, Models 1, 2
  - 3274 Control Unit, Model 1C
  - 3275 Display Station, Models 1, 2 (without Dial feature)
  - 3276 Control Unit/Display Station, Models 1, 2, 3, 4
  - 3277 Display Station, Models 1, 2
  - 3278 Display Station, Models 1, 2, 3, 4
  - (NOS/BE only) 3284, 3286, 3288 printers
  - (NOS/NAM only) card reader support (magnetic - id card) is implicitly available in transparent mode
Configuration

- The TIPs will support multiple 3270 display devices connected to a 3270 Control Unit and multiple 3270 Control Units on one communication line. The addressing scheme of the 3270 allows up to 32 Control Units on a multi-point line and up to 32 devices per Control Unit. The NOS-XAM TIP will not impose any additional limitation on the configuration. NOS/BE - INTERCOM 5 limits support to 12 Control Units on a line where each may have a maximum of 11 consoles and 8 line printers.

Line types

- Basically 3 line types (synchronous) line types are supported by the TIP:
  - Dial-up, with the restriction of the 3270 point-to-point (dial) feature because that is a different protocol (no polling/selecting!).
  - Dedicated, controlled carrier. The TIP will raise and drop the carrier with every transmission (the Control Unit can run with either controlled or constant carrier).
  - Dedicated, constant carrier. The TIP will keep the carrier up (the Control Unit can run with either controlled or constant carrier).

Line speeds

- The TIP will not impose a limit on the transmission line speeds, except with respect to timing out the largest possible block sent to the terminal, a lower limit is assumed of:
  - 600 BPS for screensize up to 480 characters
  - 1200 BPS for screensize up to 960 characters
  - 2000 BPS for screensizes over 960 characters

The upper limit depends on the capacity of the 255x (at least 19.2 KBPS).

Use of General Polls

- Input will be solicited by the TIP through issuing General Polls to each of the configured Control Units. Output will be sent to a display device after the TIP has successfully selected the device.
Code Set, Protocol

The TIP will support the EBCDIC versions of the 3270.

Display Support

The TIPs will allow the 3270 terminal user to have CYBER applications interact with the terminal as follows:

- **NOS/DE - INTERCOM 5**
  - Interactive (line) mode - 96 char ASCII

- **NOS - NAM**
  - Virtual, through use of IVT
  - Transparent. This mode allows the user to make use of the special 3270 Data-Protect features.

The recommended sell price for the 3270 TIP is $12,500 per copy. For additional information, please contact either

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1.0 BSC MULTIPONT TIP FOR 3270

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This section describes a TIP for use with the IBM 3270 Information Display System when remotely attached to a 2550. The protocol used is IBM's Binary Synchronous Communications (BSC) operating as multipoint data links.

FEATURES

- 3271 Control Unit, Models 1, 2
- 3274 Control Unit, Model 1C
- 3275 Display Station, Models 1, 2 (without Dial-feature)
- 3276 Control Unit/Display Station Models 1, 2, 3, 4
- 3277 Display Station, Model 1, 2
- 3278 Display Station, Models 1, 2, 3, 4
- EBCDIC code set
BSC protocol

- up to 32 controllers (clusters) on a line where each cluster may have a maximum of 32 Display Stations (devices)

- data protect is supported in transparent mode (IVT)

- card reader support (magnetic-id card) is implicitly available in transparent mode

- line printers are not supported

- auto recognition not performed

LINE CONTROL

The TIP commences to service a line as soon as the line is enabled.

The TIP reports line operational if the modem and CLA signals are present, otherwise, line inoperative. If during normal operation the line becomes inoperative, the TIP will suspend activity on the line and report line inoperative.
Under normal conditions the TIP will issue one general poll per second to each cluster and then, if needed, issue specific polls to all devices on that cluster.

The input process will terminate when the cluster controller indicates it has no more traffic.

A device will be selected as soon as output is available and the device is ready to receive data.

The invitation to input or output will rotate around all the cluster controllers on the line.

\[\text{FUNCTIONAL OVERVIEW}\]

The TIP will control activity on a 3270 by polling for input and selecting for delivery of output.

The 3270 station is under control of the TIP in either of two modes:

- control mode
- text mode
In control mode, the station is maintained in a valid poll/select sequence. When detected, the station enters the text mode. In text mode, the station is either the master or slave station with the TIP assuming the opposite role.

When the entry into text mode is the result of a poll, the station is the master, the TIP is the slave. When transition is caused by a select, the roles are reversed.

In text mode, blocks of data are transferred from master to slave, one at a time with a positive acknowledgement being required for each block prior to delivery of the next. The master normally determines the end of transfer and uses the "EOT" sequence to cause return to the control mode.

The 3270 generates this information to assist in the correct functioning of its devices. The status will be processed by the TIP.
The code set is EBCDIC. EBCDIC will be translated to ASCII prior to delivery to the host. All downline data received from the host is also in ASCII, the TIP will translate to EBCDIC before delivery.

EBCDIC requires standard BSC CRC.

CRC polynomial is: \( X^{16}+X^{15}+X^{2}+1 \)

7.0 TRANSMISSION BLOCKS

7.1 INPUT

```
+------------------+-+-+------------------+-
! P ! S ! S ! S ! C ! D ! TEXT ! ETB ! ! P !
! A ! Y ! Y ! T ! U ! A ! ! or ! ! A !
! D ! N ! N ! X ! ! ! ! ETX ! ! D !
+------------------+-+-+------------------+-
```

CU = cluster unit poll address
DA = device address
PAD = x'55' at start of block and x'7E' at end block. The leading PAD (x'55') is required start the clock of some older 3270 Controllers. TIP does not require to receive the leading PAD, it only looks for 2 SYNC's.
periodic "SYN" insertion will be necessary for output blocks whose transmission time exceeds one second.

8.0 INTERNAL_BLOCKS

8.0.1 General_Poll/Poll_Sequence

first 5 characters clear any cluster controller from text mode (the EDT-sequence).

GP = general poll code in place of DA for general polls (x in EBCDIC).

'7F'
8.0.1.1 General Poll/Poll Responses

- Device Response

Any device having an input requirement may be internally selected by the 3270 cluster controller. The response may be an input message, a test request message or device status information.

The cluster controller will start at random a device and input all device messages, sequentially, as long as "ACK"s are received to blocks until all devices have been serviced. The first 2 characters of the first block of each input message identify the responding device.

The TIP will send blocks terminated by "ETB"s as "BLK" blocks; terminated by "ETX" as "MSG" blocks to the host.

- No Traffic/End Traffic Response

The cluster controller may respond with an "EOT". The tip moves on to its next phase of line service.
N number of retries will be attempted. After \( N \) retries the device or cluster will be declared inoperative by the TIP. If the cluster is declared inoperative, then by default, all the devices on the cluster will be declared inoperative.

8.0.2 Select.Sequence

8.0.2.1 Response to Selection

ACKO

The device has entered the text mode and is ready to receive the message.

WACK

The device is busy. Output will not be attempted until the device indicates end of busy.
The device has pending status or is unavailable. The TIP terminates the select sequence and specifically polls the device to obtain status.

Timeout or Bad Response

Action is the same as for polls.

9.0 DATA_TRANSFER_PHASE

9.1 MASTER

The TIP enters the data transfer phase in the master role after a successful select sequence. All messages in the queue are delivered to the terminal. Each text message is prepared for output with the appropriate communications envelope and a redundancy checking CRC. The anticipated response to the first message delivered is ACK1 and for subsequent messages, the acknowledgement alternates between ACK0 and ACK1. When the last message is successfully delivered, the TIP returns the selected terminal to the control mode by use of the "EOT" sequence. The TIP limits the number of transmissions blocks sent to the terminal during one selection sequence to 4.
ACKO/ACK1

Alternating acknowledgements to correctly received messages. Action is to prepare and deliver the next message, if any, or return the device to the control mode.

WACK

Acknowledges the output message but indicates the device is now busy. The TIP issues an "EOT" causing the device to return to control mode. Some time later, the TIP will again select the device.

EOT

Device is unable to perform the operation requested by the transaction. The TIP issues a specific poll to obtain the device status.
The previous message was received in error. After N "NAK"s, the TIP will terminate the selection with an "EOT" sequence and declare the device inoperative.

Timeout or Invalid Sequence

Action is the same as for polls.

9.2 SLAVE

The TIP enters this phase as a result of a successful poll.

The 3270 cluster starts a search at some random device and scans all devices in n. Each device which has data pending (including err's) will input. The TIP will acknowledge each block received, with alternating ACKO/ACK1.

The first block of each message identifies the responding terminal by containing the CU and the DA. These characters immediately follow the STX. Status and test request messages carry SDH and two id bytes prior to the STX.
Data Blocks

The TIP performs the appropriate redundancy check on each data block. For the first block successfully received after a role reversal or poll, an ACK1 is returned. For each succeeding block, the ACK is alternated. Status messages are identified by the characters "XR", immediately following the "SOH."

Data Block Ending in ENQ

The 3270 terminates a data block abnormally with an "ENQ" character upon detection of internal errors.

The TIP "NAK" the block. The 3270 is expected to respond with "EOT". The TIP performs a specific poll to obtain status. The status will be such that the device is declared inoperative.

EOT

The 3270 sends an "EOT" sequence to end a normal data transfer sequence. The TIP enters control mode and performs the next task in turn for the line.
Bad Blocks

The TIP "NAK"s bad blocks. The 3270 does not count "NAK"s. The TIP will count "NAK"s, send out and allow the 3270 for N retries.

Timeout

The TIP must timeout a 3270 when operating in the slave mode during data transfers. If the 3270 does not continue a data transfer sequence, the TIP must regain control of the line in order to continue servicing other 3270 lines. The TIP must commence a timeout after each response to a data block.

If the 3270 does not continue the transfer within the time T, the TIP must abort the transfer with an EOT sequence. Action at this point is the same as for EOT sequences.

T = 1 second for the data to get started and 3 seconds during transfer of the data.
**UNUSED_BSC_FEATURES**

- TTD
- Forward Abort
- Conversational Mode
- 3275 dial-feature

**EXCEPTION_HANDLING**

The 3270 has self diagnostic capabilities. This results in presentation of status messages from cluster controllers with devices experiencing abnormal conditions. Some information in such messages requires action by the TIP to modify the communications activity of the terminal, e.g., device busy, rc busy, inoperative, operative, etc.

**1.1 STATUS MESSAGE FORMAT**

```
+----------------------------------------+--------+
! S ! % ! R ! S ! C ! D ! S ! S ! E ! C !
! H ! ! ! X ! ! ! ! 1 ! X ! C !
+----------------------------------------+--------+
```

- % after "SOH" signifies status message
The status message is returned for a device under the following conditions:

- general poll
  for all conditions other than device busy or unavailable

- specific poll
  all conditions

If error conditions occur during a data transfer phase, status is returned.

The TIP will be forced into performing a specific poll to obtain status in the following cases:

- "RVI" in response to a selection

- "EDT" in response to output of data

- input block terminated by "ENG".
During normal operation of the line, BSC will detect various fault conditions, all of which (if they persist) will result in the cluster controller being declared inoperative.

Detection of failure of individual devices on a cluster is only possible by examination of status messages.

The busy condition is signified by a "WACK" response to a select, followed by a status message indicating busy response to a specific poll or more normally, a "WACK" response to an output message. In both of these conditions, further output must not be attempted until device end (non-busy) status is received in response to the normal general poll/poll sequences.

Since any declaration of a terminal inoperative requires corresponding method of detecting a return to the operational state, the actions by the TIP are limited to positive failure cases.
- detect terminal I/O malfunctions

- monitor device available/unavailable, ready/not ready, busy/not busy

The TIP will not output to a device which is not ready, not available or busy.

A device will be reported as inoperative if

- it malfunctions

- it goes not ready or not available and this has not yet been reported.

A device will be reported as operational if it goes from not ready or not available to ready and available, or when input is received for an inoperative device.
A controller or line failure will be detected by one of the following methods:

- invalid or no response to N successive polls.
- invalid or no response to N successive selects.
- "NAK" response to N successive block retransmissions.
- Timeout of input data phase.

Each of these conditions will result in the cluster controller, or the device which was currently being actioned, being declared inoperative.

The controller will be set to the slow poll mode. In the slow poll mode, a controller is polled once per 10 seconds. Only one attempt is made to establish contact with the controller during the slow poll mode. If the controller responds with a valid sequence other than EOT, the device that responded is declared operational; the TIP and normal polling of the cluster controller is resumed.
can only be obtained through a specific poll can be received by the TIP.

A controller becomes operational as soon as a device on that controller becomes operational. A device can become operational by correctly sending data or status (good status).

As soon as the first device on a controller becomes operational, the TIP will assume normal general-polling (one per second).

2.1 RETRIES

The TIP will attempt the following retries in case of consecutive errors:

- 15 on NAK's or CRC-errors received.
- 7 on ENG's, Time-outs or Bad-responses.
- 3 on Text-terminated-by-ENG or ACK0/ACK1 out-of-sequence.

In case of mix consecutive errors the TIP has a retry limit of 31.
NORMAL INTERACTIVE MODE

In this mode all the standard IVT features (page-wait, auto-input, line-folding, CR/LF in text, format-effectors) are supported by the TIP. In addition, the TIP will after having sent all the available output to the terminal, send a blank line to the screen. This line will unlock the keyboard and give the terminal-user space to enter a next line of input.

13.1.1 Page-wait

The TIP will declare a terminal in page-wait as soon as a screen-full output is sent to a terminal without any reception of input inbetween. Any input received afterwards will take the terminal out of page-wait and output transmission will continue.

The TIP will display a message (OVER...) at the bottom of the screen, indicating the page-wait condition and the fact that more output is available.
by hitting the CLEAR key. This will cause the screen to clear and the next line of output to start at the top-of-screen.

13.1.2 Auto-input

After a block of auto-input is sent to the terminal, the TIP will upon reception of a text-block from the terminal, send the first 20 characters of output and the received text as one block to the host-application that requested this auto-input.

13.1.3 IVT Commands

The TIP allows the following IVT commands to be sent by the host-application to the terminal-user:

- PW Page width (default - 80, range 20-255)
- PL Page length (default - 24, range 12-255)
- PG Paging on/off (default - ON range ON, OFF)
Control character (default - %)

Terminal class (must enter % TC = 2B)

User breaks are supported but not as special alterable input-characters. The TIP interprets the Program-attention keys as breaks. (PA1 = User-break 1, PA2 = User-break 2).

The TIP does not support the Cancel, because the terminal allows the user to locally cancel text before hitting the ENTER (send) key.

13.1.4 Format-effectors

The - allows all valid Format-effectors with the exception of the NO-ACTION which is treated as Present-one.

Home-cursor and Clear-Screen format-effectors will force the terminal into page-wait unless the last interaction with the terminal was input.

A Post-print FE will be given an additional pre-print-one after input is received, such that output will not overwrite the input on the screen.
The TIP replaces a CR/LF or LF/CR sequence logically by a Format-effector, Pre-Print-One. CR/LF sequences can force the terminal into page-wait in the middle of a logical line.

3.1.6 Line-Folding

If downline logical-lines are larger than the page-width, the TIP will perform line-folding. Folded lines will not force the TIP into page-wait. More than 3 folded lines out of one logical line can cause the TIP to overwrite text on the screen not yet seen by the user.

3.1.7 Cursor-control

In the non-transparent mode, the TIP supplies all cursor-addresses for output. The terminal-user has control over where the next line of output goes after input. After a line of input, the TIP will start output on the screen one line from where the user left the cursor (normally this will be the next line after input).
13.2 **TRANSPARENT MODE**

In this mode, all the data-protect features of the 3270 display are available to the application.

13.2.1 **Downline**

The application will have to construct a screen-full of protected/unprotected fields and supply all the desired attribute-characters and screen-buffer-addresses for the fields. The first character of a downline block must be a valid (allowed) command-code (such as clear-screen, etc.). The TIP remains responsible for preceding the block of output by SYNC-characters, Start-of-text, and Escape-char, and attaches ETX, CRC, PAD at the end. The TIP will also translate all downline data ASCII to EBCDIC and perform SYNC-fill.

Allowed Command-codes are:

- Normal-write \( x'31' \)
- Erase-write \( x'35' \)
Invalid Command-codes are replaced by an x'31' (normal write).

A typical start of a field would be:

- SBA  Set-buffer-address x'11'
- BA1  Buffer-address-1
- BA2  Buffer-address-2
- ATT  Attribute-char.

See 3270 manuals, all in ASCII.

The attribute-character determines the characteristics of the field:

- protected
- unprotected
- intensified
- numeric shift
- etc.
Invalid Command-codes are replaced by an x'31' (normal write).

A typical start of a field would be:

- **SBA** Set-buffer-address x'11'
- **BA1** Buffer-address-1 See 3270 manuals.
- **BA2** Buffer-address-2 all in ASCII.
- **ATT** Attribute-char.

The attribute-character determines the characteristics of the field:

- protected
- unprotected
- intensified
- numeric shift
- etc.
REMOTE STATUS AND SENSE BYTE DEFINITION

Bit No. | Bit Definition
---|---
S/S Byte 0; Not Used
0,1 | Reserved.
2 | Reserved.
3 | Device Busy (DB) - This bit indicates that the addressed device is busy executing an operation or that a busy detection was previously made by a command or a print operation, accepting data from the Operator Identification Card Reader, or performing various keyboard operations (Erase Input, Backtab, and Clear).

This bit is set with Operation Check when a Copy command is received which specifies a "busy" device with its "from" address.
This bit is set with **Unit Specify** when a command is addressed to a busy device. This can occur by chaining a command to a Write, Erase/Write, or Copy command which started a Printer or by chaining a command to a Specific Poll addressed to a busy device.

**Unit Specify (US)** - This bit is set if any S/S bit is set as a result of a device-detected error, if a command is addressed to a busy device.

**Device End (DE)** - This bit indicates that the addressed device has changed from unavailable to available and not ready to ready, or busy to not busy. This bit is included during a Specific or General Poll but is not considered pending status by a Selection Addressing sequence.

If a Selection Addressing sequence detects that the addressed device has pending status and also detects one of the above status changes that warrants a Device End, then the Device End bit is set and preserved along with the other pending status, and an RVI response is made.

**Transmission Check** - Not used by the 3271. This bit is set when the 3275 detects a BCC error on the TCU transmission.
S/S Byte 1:

0,1  Not Used.

2  Command Reject (CR) - This bit is set upon receipt of an invalid 3270 command (or Copy command if this feature is not installed).

3  Intervention Required (IR) - This bit is set if:

- A Copy command contains a "from" address in its data stream which specifies an unavailable device.

A command attempted to start a printer but found it not ready. The printout is suppressed.

Intervention Required (IR) - This bit is set if:

- The 3271 receives a Selection Addressing sequence or a Specific Poll sequence for a device which is unavailable or which became not ready. A general Poll sequence does not respond to the unavailable/not ready indication and proceeds to determine the state of the next device.
The 3271 receives a command for a device which the
3271 has logged as unavailable or not ready.

Equipment Check (EC) - This bit indicates 3271 detected
bad parity from the device.

Data Check (DC) - This bit indicates the detection of a
parity or Cursor check in either the 3271 or a device
buffer or in the 3275 buffer, or 3271 detected bad parity
from the device.

Control Check (CC) - This bit is set with Control Check,
Intervention, Data Check, Device Busy, or Data Check with
Unit Specify to indicate that the errors that set these
sense bits were detected while the 3271 was executing an
operation with the 'from' device during a Copy command.
This bit is set with Unit Specify to indicate that the
'from' address in a Copy command specified a device with a
'locked' buffer (the device data is secure).
The TIP will receive input in transparent mode as long as the applications sends downline transparent data. So the first transparent output will signal to the TIP to receive input in transparent mode and vice versa. Note the TIP command to interpret input in transparent mode is supported by the TIP (but it does not seem to be useful).