# TERMINAL INTERFACE MESSAGE PROCESSOR: USER'S GUIDE TO THE TERMINAL IMP

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# 1. INTRODUCTION

This report describes the use of a terminal connected to a Terminal IMP (TIP) in the ARPA Network. The report assumes that the user knows how to operate a server Host system somewhere on the network once he becomes connected to that system, and the report defines the procedures and options the user has available to establish that connection.

The ARPA Network, IMPs and TIPs, hardware maintenance, TIP operation, and formats and protocols are not described here. The bibliography (Appendix C) lists the relevant documents.

At the time of this writing we at Bolt Beranek and Newman Inc. (BBN) have operated the TIP extensively with the following terminal types:

KSR-33 Teletype
KSR-37 Teletype
IBM-2741 (Correspondence)*
IBM-2741 (P.T.T.C.)*
DATA 100 (at 110, 150, 300, 600, and 1200 bps)
EXECUPORT (at 110, 150, and 300 bps)
INFOTON VISTAR I (at 110, 150, 300, 600, 1200,
1800, 2400, and 9600 bps)
IMLAC PDS-1 (at 1800, 9600 bps, and synchronous)
ODEC 132 LINE PRINTER
TELETYPE INKTRONICS (Line printer)
TI 733
DATA PRODUCTS LINE PRINTER MODEL 2410 or 2411

Where possible, all these devices have been operated with direct connections to the TIP and also over a 103A dial-up modem.

We have also briefly operated the TIP or heard of the TIP being operated with a variety of other types of terminals. These are listed in Appendix D. For your own safety, before you purchase any terminal listed in Appendix D or any other terminal for use with the TIP, you should check with BBN and try it with a TIP.

The TIP can also be configured with a magnetic tape drive as discussed in Section 8.

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*For a 2741 to operate with the TIP, the 2741 must have the transmit interrupt option and receive option.

## 2. THE NETWORK VIRTUAL TERMINAL

A key concept in the use of the network is the notion of the virtual terminal. Instead of asking each Host system to cope with every terminal type at every other Host in the network, we ask the Host to cope with a single (imaginary) terminal called the Network Virtual Terminal. Your TIP will translate the data you type to make it look like virtual terminal code, and translate the remote system's response back into your terminal's code. While we will often pretend that this translation does not exist, it is, in fact, always present and of crucial importance to the user.

It is probable that the manual describing the use of the remote system is written in terms of a user at the virtual terminal, most likely as a system description based on local terminals plus an add-on piece telling how to use the virtual terminal as a local terminal. Virtual terminal code may include symbols which do not exist on your own keyboard. Combinations of your available characters are used in such cases. You may even find that the translation makes your terminal different from a local terminal of the same make. We have tried to minimize this problem.

The Network Virtual Terminal has 128 keys, often in upper case/lower case pairs. These keys correspond to the full ASCII set. In addition, there are a few control keys, like the "BREAK" key. The terminal is capable of full and half duplex operation, under control of a user-oriented switch. The meaning of the control keys and the way to enter the full 128 keys from each of the terminal types which the TIP supports is described in Section 6 of this report.

The user talks to the TIP after the code conversion has been made; that is, the TIP expects virtual terminal characters. The descriptions below are in terms of virtual terminal codes.

## 3. THE TIP COMMAND FORMAT

The user at a terminal will at various times be talking directly to his TIP instead of to the remote Host. A typical message of this sort might look like:

@ OPEN 15

Such a command always starts with symbol @ and ends with either a linefeed* or a rubout, depending on whether the user is satisfied with the command or wishes to abort it. The only exception to this rule is the specific command

@@

which inserts an @ in the data stream to the Host. Commands may occur anywhere, and need not start on a new line. Upper and lower case may be freely intermixed in the command.

Between the @ and the linefeed there will typically be one or more words to identify the command, perhaps followed by a single parameter. The TIP is not very sophisticated, and thinks the only important thing about a word is its first letter. This permits the user to abbreviate a bit; the more usual rendering of the first example might be:

@O 15

Once the user has started typing the parameter of a command the old value of the command will have been destroyed, and cannot be recovered by aborting the command.

Almost without exception the effect of a TIP command is to set a parameter or mode for the terminal. Even apparently direct commands like

@ OPEN 15

(which initiates an elaborate exchange of messages resulting in a connection to the remote Host system) actually set a mode flag to request the appropriate action when the TIP is free to undertake it. To understand the TIP behavior is really to understand the complete set of parameters and the commands to change them. Normally, any parameter can be changed at any time by the user at his terminal. Exceptions occur when the user tries to change connection parameters

---

*On 2741 terminals the return key transmits carriage-return/ linefeed to the TIP and ASCII terminals are normally operated in a mode where typing a carriage-return is interpreted as carriage-return/linefeed; both can be used to terminate TIP commands in addition to a linefeed alone.

on an open connection. An @OPEN 13 executed while talking to Host 15 would generate the error message "Can't" (the connection to Host 15 must be closed before a connection can be opened to Host 13).

Commands often consist of several command words; for example,

@ DEVICE CODE ASCII

Such commands may be abbreviated; for example

@ D C A

The spaces are required: @ DCA is not a legal command. Upper and lower case letters may be freely intermixed.

An unusual variation in command format is to place a number between the @ and the first word of the command. In this case, the command is not meant for the terminal typing but for the terminal attached to the port of that number on the same TIP as the user. This feature is described in some detail in the section on unusual uses of the TIP, section 5.

# 4. TYPICAL USE OF THE TIP

In the normal course of things, a user will go through four more or less distinct stages in typing into the net. First, he will be concerned with hardware-power, dialing in, etc. Then he will establish a dialogue with the TIP to get a comfortable set of parameters for this usage. Next, he will instruct the TIP to open a connection to a remote Host; and finally, he will mostly ignore the TIP as he talks to the remote Host. The following sections will describe these stages in more detail.

A. Hardware Stage

The hardware stage is primarily described in Section 9. This section describes only the final step of this stage, when the TIP detects a terminal on one of its previously idle lines. At that point the TIP normally goes into a "hunt" mode. In this mode it expects the very first character it sees to describe the terminal, according to the following scheme

ASCII Terminals at 110, 150, or 300 baud type E. (Note that this must be upper case.)

2741 Correspondence Terminals type j, 4, o, or 1 depending on the element used with the terminal -- see Table 4-A.

2741 PTTC Terminals type:

6 for model* 938, 939, 961, 962, or 997
o for model 942 or 943
w for model 947 or 948
f for model 963, 996, or 998

ASCII Terminals transmitting at 110 but receiving at 1200 baud type D. (Again, upper case)

The TIP will deduce terminal rate, character size, and code conversion based on the character typed. When the TIP makes its decision it types out TIP's name in the terminal's own language followed by the version number of the TIP software system and the octal port number. Then it is ready to go. If no TIP name appears, or if garbage appears, hang up your data set and redial. For direct connections Power Off is usually equivalent to hanging up.

Some terminals need special delays at the end of their lines in order not to lose characters when running at high speed. The TIP currently knows how to do this timing for the ODEC line printer and several other devices. The two commands

```
@ DEVICE CODE EXTRA-PADDING
@ DEVICE CODE OTHER-PADDING
```

will instruct the TIP to insert these delays. One device we know of, a Model 37 Teletype, requires a special parity computation to be able to print correctly. The command

```
@ DEVICE CODE 37
```

---

*The model name and number is stamped on the top of the element. If you can't find it, trial and error works. Try "f" first.

instructs the TIP to insert the proper parity; when not in this mode the TIP sets the parity bit to zero for all output characters. Echoed characters are echoed without parity calculation. These commands are discussed more fully in section 5.

On all terminals which hunt to 300 baud, Device Code Extra-padding (@ D C E) automatically will be in effect. On all terminals which hunt to 150 baud, Device Code 37 (@ D C 3) automatically will be in effect. These effects can be canceled with the command @DEVICE CODE ASCII (@ D C A).

TABLE 4-A

Hunt Character to be Used for IBM 2741 Correspondence Type Elements

| NUMBER | NAME | HUNT CHARACTER |
|---|---|---|
| 001 | Scribe | 4 |
| 005 | Letter Gothic | 4 |
| 006 | Manifold 72 | j |
| 007 | Elite 72 * | 4 |
| 008 | Pica 72 * | 4 |
| 010 | Manifold 72 | j |
| 012 | Prestige Elite * | 4 |
| 014 | Light Italic | j |
| 015 | Courier 72 * | 4 |
| 019 | Manifold 72 | j |
| 020 | Dual Gothic | 4 |
| 021 | Dual Gothic | o |
| 025 | Scribe | o |
| 026 | Elite 72 * | o |
| 027 | Pica 72 * | o |
| 028 | Manifold 72 | o |
| 029 | Courier 72 * | o |
| 030 | Adjutant | 4 |
| 031 | Adjutant | o |
| 032 | Light Italic | o |
| 033 | Prestige Elite * | o |
| 034 | Script | o |
| 035 | Delegate | o |
| 036 | Advocate | o |
| 039 | Letter Gothic | o |
| 043 | ASCII | 1 |
| 050 | Advocate | 4 |
| 053 | Artisan 12-72 | 4 |
| 055 | Artisan 12-72 | o |
| 059 | Orator | j |
| 060 | Orator | o |
| 067 | Courier 12 | 4 |
| 068 | Courier 12 | o |
| 070 | Delegate | 4 |
| 085 | Courier 72 | 4 |
| 086 | Courier 12 Italic | o |
| 090 | Script | j |
| 123 | Prestige Pica | o |
| 129 | Adjutant | o |
| 130 | Advocate | o |
| 131 | Artisan 12-72 | |
| 132 | Courier | |
| 133 | Courier 12 Italic | o |

* These type elements can be customized for you. Contact your local IBM office for information.

| | | |
|---|---|---|
| 134 | Courier 72 | o |
| 135 | Delegate | o |
| 136 | Dual Gothic | o |
| 137 | Elite 72 | o |
| 138 | Letter Gothic | o |
| 139 | Light Italic | o |
| 140 | Manifold 72 | o |
| 141 | Orator | o |
| 142 | Pica 72 | o |
| 143 | Prestige Elite 72 | o |
| 144 | Scribe | o |
| 145 | Script | o |
| 154 | ASCII | 1 |
| 158 | Bookface Academic 72 | o |
| 161 | Large Elite 72 | o |

B. Establishing Parameters

In stage two, the user is concerned with initializing parameters. The naive user should skip stage two and accept the TIP's default parameters until an obvious problem arises. The following questions are answered in stage two:

1. When shall the TIP send off messages to the remote Host? Here there are several options. (The TIP is initialized to send on every character, which is simple but inefficient.)

@ TRANSMIT NOW
@ TRANSMIT ON MESSAGE-END
@ TRANSMIT ON LINEFEED
@ TRANSMIT EVERY #

TRANSMIT NOW causes the message currently being accumulated to be sent as soon as possible. TRANSMIT ON MESSAGE-END causes a message to be sent as soon as possible after an ASCII DC3 (control-S) is encountered. TRANSMIT ON LINEFEED causes a message to be sent as soon as possible after a linefeed is encountered. Additionally, both TRANSMIT ON MESSAGE-END and TRANSMIT ON LINEFEED cause characters to be accumulated in the message buffer until it is almost full. TRANSMIT EVERY # causes a message to be sent as near as possible to every #th character. The command TRANSMIT EVERY 0 will reset the TIP to its initial state, transmitting every character. If the parameter to TRANSMIT EVERY is a large number (e.g., 250) the TIP will save up as many characters as it can before sending a message, but does not offer any guarantee that the total number specified can be buffered.

2. Who shall echo, and when? Echoing is a complex problem, without any neat solution. We have chosen to give the user the means to tell us how he wants it done, since it is hard to guess correctly in advance. Basically, echoing can occur at the terminal hardware, in the TIP, or in the remote Host. The corresponding TIP commands are:

| | |
|---|---|
| @ ECHO HALFDUPLEX | (Echo at terminal) |
| @ ECHO ALL | (Echo at TIP) |
| @ ECHO NONE | (Echo at remote Host) |
| @ ECHO REMOTE | (Send TELNET "remote echo" and perform internal @ E N) |
| @ ECHO LOCAL | (Send TELNET "local echo" and perform internal @ E A) |

In the ECHO NONE mode, although characters for the remote Host are not echoed, the TIP will echo commands. Network protocol specifies that echoing shall start out in the @ ECHO ALL or @ ECHO HALF modes. The TIP will try to guess from the terminal type which of the two is appropriate. The goal of echoing strategy is to avoid the unreadable alternatives of the blank page and the doubling of every character. The naive user is advised to accept

the TIP's default parameters until trouble of this sort arises. A 2741 is incapable of changing echo mode; it is always echo halfduplex.

To allow more complex echoing conventions, the TELNET protocol provides a mechanism whereby the remote terminal user may instruct the serving Host whether or not to echo characters. The ECHO REMOTE and ECHO LOCAL commands at the TIP allow TIP users to use this mechanism after the connection is made.

Finally, many Hosts which provide service request the TIP to allow them to do the echoing. The TIP always grants this request (even for 2741 terminals). The user, if he does not desire this mode, must cancel it AFTER the connection to the Host is established.

C. Connection to Remote Sites

In stage three, the user is concerned with establishing a connection to a remote site.

@ OPEN 15

This amounts to "set the Host number parameter" and "add the user to the queue of users waiting for the TIP's connection mechanism". Appendix A lists the Host numbers of all the sites currently in the network.

Connecting to a Host requires establishing a bi-directional link, so that the terminal can send characters to the Host and vice versa. The request to connect to a Host is thus really a request to establish both transmit and receive sections.

When the user reaches the head of the queue waiting for the TIP's "connection" mechanism, the TIP will type "Trying...".

Following the message "Trying", the user will receive some of the following messages:

| | |
|---|---|
| Open | success* |
| Net Trouble | remote site cannot be reached |
| Refused | remote site up but refusing |
| Host Scheduled | Down Until Sat. at 1850 GMT<br>Host will be back up at time and date indicated |
| Host Unscheduled | Down Until Sat. at 1850 GMT<br>Host will back up at time and date indicated |
| Host not responding | Remote site not up, unknown when up service will resume |
| ICP Interfered With | The Host has not performed the ICP correctly and the TIP has refused to open a connection. |

The connection mechanism will run continuously until a state described above occurs. This can be annoying when the remote site is obviously not going to respond. The command

@ CLOSE

---

*"Open" indicates both halves of the TELNET connection have been opened simultaneously. Sometimes "Open R" followed by "Open T" (or vice versa) will be printed; this too indicates both halves of the connection have been opened, but not simultaneously. If only "Open R" or "Open T" is printed, then the server Host has failed to open one half of the TELNET connection.

will abort the current connection attempt. The user is then free to reattempt to open the connection or to attempt to open a connection to some other Host.

The TIP's connection mechanism has caused users some problems. Perhaps a discussion of what the connection mechanism is doing and how it works will alleviate some of the grief.

First of all, users attempting to connect to different Hosts will never interfere with each other, although users simultaneously attempting to connect to the same Host will be serviced serially.

For the user, opening proceeds in three phases. In the first, the user is queued up waiting to "get" the TIP's connection mechanism. In the second, the user has gotten the TIP's connection mechanism and is beginning the connection sequence. In the third, the user has completed the connection sequence and is waiting for the Host to open up the actual data connections. Many of the problems stem from the fact that only one user may be proceeding through phase 2 at a given time to a given Host. Hence the the TIP types out "Trying" when you get off the queue and the connection mechanism begins trying to open your connections. Thus the "Trying" message signifies the transition from phase 1 to phase 2.

D. Use of Remote Sites

In stage four, the user is normally talking to the Host without concern for the TIP. All the TIP commands are still available.

One command that will eventually be of interest here is

@ CLOSE

This command starts the shut-down procedure. The TIP will echo "Closed"* when the process is finished. The TIP does not know how to log you out of the remote Host. You must do this yourself before closing the connection.

The virtual terminal has a key labeled "BREAK". Some real terminals have a break key, and some Host systems expect to see breaks. Those terminals with a break key (but not the 2741 ATTN key) may simply use it. Others must type the command

@ SEND BREAK

The interpretation of the break is entirely up to the receiving Host -- many Hosts ignore it.

The virtual terminal also has a key labeled "SYNC". No real terminals have such a key, and the function is unique to network use. The "SYNC" key is a clue to the remote Host that there is an important message which seems to be buffered in an "inaccessible" place. The TIP and the Host go to some trouble to get the SYNC indication over a different channel which bypasses the normal buffering conventions. The command to send a SYNC is

@ SEND SYNC

Typical usage of these commands might be @ S B followed by @ S S.

As stated earlier, the TIP nominally treats a carriage-return typed by a user as a carriage-return/linefeed. The user may cause the TIP to treat carriage-return as only carriage-return by executing the command

@CLEAR INSERT LINEFEED

---

*"Closed" indicates that the server Host agreed to close both halves of the TELNET connection simultaneously. If the halves of the connection are closed one after another, "Closed R" followed by "Closed T" (or vice versa) will be printed. If only one of "Closed T" or "Closed R" is printed, wait a minute and the TIP will force the other half of the connection to be closed.

To return to the nominal mode of carriage-return/linefeed, the command

```
@INSERT LINEFEED
```

should be executed.

If at any given time the user types characters faster than a server Host will take them from the TIP, the TIP discards characters it can not buffer and echos them with an ASCII BEL (on a 2741, the type element is wiggled).

The user may sometimes use a server Host with which it is desirable not to have @ be a TIP reserved character. The user can change the character which introduces TIP commands using the command

```
@INTERCEPT #
```

By typing @INTERCEPT followed by a decimal number representing an ASCII character, the user changes the TIP command character for his device to the ASCII character represented by the number. The INTERCEPT ESC command resets the TIP command character to at-sign (@). Thus,

```
@INTERCEPT 42
*INTERCEPT ESC
```

changes the TIP command character to asterisk (*) and back to at-sign (@) assuming the device was in the nominal mode (@) before the first command was executed.

If the user attempts to change the intercept character but fails to type a valid decimal number (or a character string beginning with E) the TIP will type the diagnostic "Num" and will set the intercept character to at-sign.

L. Connection Loss and Restoration

Starting with TENEX Hosts* running Software Version 1.32, if TENEX halts, the TIP will notify users connected to it of this fact by typing "Connection Suspended". At this point the users are free to do one of two things. First, they can wait till TENEX restores service, in which case the TIP will type out "Connection Restored" (or if after the the service interruption the connection could not be restored, the TIP will type out "Host broke the connection"). Alternatively, the user is free to open a connection to any other Host, in which case the TIP will invisibly close the TENEX connection. It is also important to point out that if a user just leaves his terminal unattended across a TENEX service outage without releasing the connection (any network related command such as @H, @O, @N, @C will do the job) his job, directory, etc., are left at the mercy of anyone who acquires that terminal.

---

Other Hosts may also implement the mechanisms which will allow the suspension and restoration of connections.

F. TIP News and User Feedback

There is frequently information which the group developing and debugging the TIP system wishes to convey to TIP users. For instance, when a bug is detected, we may wish to warn users not to use a certain feature until the bug is fixed. When a minor improvement is made, we may wish to notify users. Further, there is frequently news about the state of the network or the state of a particular Host which should be conveyed to TIP users. Finally, TIP users may wish to communicate with the TIP development staff or the Network Control Center staff about problems or suggested improvements for the TIP or the network. Consequently, we have constructed a mechanism which we hope will provide for communication in all the above directions. This mechanism is the Network Virtual TIP Executive.* To activate this mechanism, the TIP user may give the TIP command @N. This command causes the TIP to perform the necessary protocol to make a connection to the Network Virtual TIP Executive which resides on several of the network TENEX systems. Once the Network Virtual TIP Executive has been activated, we think its operation is self-explanatory. Presently available features within the Network Virtual TIP Executive are a Network News feature, a Host Status feature, and a "Gripe" feature. The latter provides users with a mechanism for sending messages to the TIP development or NCC staffs. We recommend that TIP users get the network news at the beginning of every TIP session.

The TIP will normally prompt the user to consider reading the news by typing the message:

Latest net news DATE
Use "@N<cr>" followed by "netnews<cr>"

at some point(s) during the user's session. The point chosen is at the time of terminal recognition for "hunting" terminals (see Section 4.A), or at each time a connection is closed for "non-hunting" terminals (see Section 5.A).

When a user issues an @N command, the TIP requests support from all cooperating servers. Thus, the user should be able to reach a news facility, somewhere, almost all of the time. However, in the event that no cooperating server is available the TIP will time out the @N command in about thirty seconds. An @C command will abort an @N immediately.

---

*A version of the Resource Sharing Executive being developed by the BBN TENEX Group.

Of course, TIP users with an immediate need for communication with the NCC or TIP development staffs should telephone (collect) the Network Control Center (617-661-0100). Users with general questions about network usage (How do I find out if Host X is ever going to be up again? What's happening with a Host/Host protocol for graphics?) may also call the NCC.

# 5. UNUSUAL USES OF THE TIP

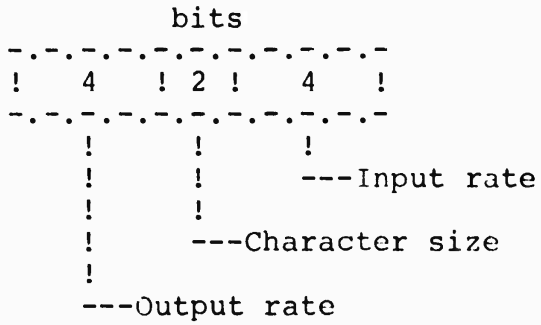
The "usual" use of a TIP is to connect one of the terminals which the TIP supports to a remote Host. We have tried to make this operation as easy and natural as possible for the user. "Unusual" uses of the TIP are such things as connecting a non-standard terminal, talking terminal-to-terminal, or using unusual protocols. Such uses are possible, but within the constraints of the TIP's size it has not always been feasible to make them easy.

## A. Device Parameters

The TIP uses a Hunt algorithm to determine device parameters. On standard low speed terminals it works well and easily. If something more complicated is desired, like establishing a rate over 300 bps, the user must set these parameters himself.

The @DEVICE RATE command does not affect the hunt-bit. Therefore, the only way to change a port to, or from, being hunting is to have the TIP site liaison call the NCC and have it done.

The TIP stores device parameters in a 10-bit field as shown below:




where character size is 5 less than the number of bits per character and the 16 rates are zero, 75, 110, 134.5, 150, 300, 600, 1200, 1800, 2400, 4800, 9600, 19200, unused, unused, and external clock. The 4800, 9600 and 19.2K rates are available only for output.

The user can change device parameters with the command

@ DEVICE RATE #

where # is the decimal equivalent of the 10-bit field the user wishes to establish. The command will often be executed from another terminal (see Section 5-D below).

Some examples follow:

| @D R | bps | |
|---|---|---|
| 178 | 110 | ASCII in and out |
| 308 | 150 | |
| 373 | 300 | |
| 438 | 600 | |
| 503 | 1200 | |
| 568 | 1800 | |
| 633 | 2400 | |
| 754 | 110 in 9600 out | |
| 243 | 134.5 | 2741 in and out |

The user can set device code conversion with the commands

```
@ DEVICE CODE ASCII
@ DEVICE CODE EXTRA-PADDING
@ DEVICE CODE OTHER-PADDING
@ DEVICE CODE 37
```

EXTRA-PADDING is ASCII with a slow carriage-return. This mode has been found to be useful with EXECUPORT, T.I., AND DATAPOINT 3300. DEVICE CODE OTHER-PADDING is ASCII for a line-printer which requires special timing for a slow linefeed as well as a slow carriage-return and also requires a minimum number of characters per line of output. Two line-printers are currently handled via the DEVICE CODE OTHER-PADDING option. These are the ODEC printer and the MEMOREX printer. A given TIP can be configured so that DEVICE CODE OTHER-PADDING refers to either the ODEC or the MEMOREX printer but not both.

Often the device code commands will be executed by one terminal for another terminal, as described in Section 5-D below. Sometimes they are executed as the last step before changing a terminal's rate. The code sets ASCII, EXTRA-PADDING, and OTHER-PADDING are similar enough so that a terminal shifting from one to another will still be able to talk to the TIP. All are basically ASCII with different timing for the end of line. DEVICE CODE ASCII clears the effect of the other three DEVICE CODE commands. The command

```
@DEVICE CODE 37
```

can be used to set up the TIP to correctly handle a Model 37 Teletype, namely to compute even-parity for output characters (echoed characters have the parity they had when sent from the terminal to the TIP).

B. Talking to Another TIP

One can talk to a device on another TIP (or your own TIP) using the TIP as a fancy telephone connection. This is not particularly easy, especially since the only label a TIP knows for a device is its hardware port number, which neither user may happen to know. Supposing the port numbers are known, one must establish a pair of connections between the two ports. The protocol for making connections specifies that each end of each connection will be labeled by a 32-bit socket number. The TIP puts the port number in the high order 16 bits of the socket number, and 2 (or 3) in the low order bits for the receiving (or sending) socket. The user must tell the TIP the Host number (in decimal) and socket number (in octal) for the foreign end of both the transmit and receive connections, for example, the commands

```
@ SEND TO HOST 158
@ RECEIVE FROM HOST 158
@ SEND TO SOCKET 1600002
@ RECEIVE FROM SOCKET 1600003
```

Simultaneously the far end must establish the corresponding parameters for his half of the connection. Then one side or the other must initiate the connections using the two commands

```
@ PROTOCOL TO TRANSMIT
@ PROTOCOL TO RECEIVE
```

This will open the full duplex connection. In the example above the connection is to Port 7 at Host 158. Alternately, a shorter sequence of commands may be used, namely

```
@ HOST 158
@ SEND TO SOCKET 1600002
@ RECEIVE FROM SOCKET 1600003
@ PROTOCOL BOTH
```

If the terminals are full duplex, it will probably be necessary for each terminal to use ECHO ALL mode.

A problem in making TIP-to-TIP connections is ascertaining the port numbers of the TIP ports between which communication is desired. The greeting message typed by the TIP on a hunting port includes the octal port number. The @RESET command on non-hunting ports also provides this information (although it also logs out a logged-in user). In addition, the The Network Virtual TIP Executive (@N) offers aid in this area through its TRMINF command. The socket number printed by the TRMINF command is the octal port number of the TIP terminal executing the TRMINF command via the @N command.

In the future, we will make available via the Network Virtual TIP Executive a capability to link and send messages to users on

other TIPs and TIP ports by name. The capability already exists in the Network Virtual TIP Executive for linking to users of some server Hosts.

C. Binary Mode

Seven-bit binary is possible using the regular TELNET Protocol. It is necessary to turn on and off command interpretation to allow the TIP input routines to pass along all 128 possible input characters. There are two commands to do this,

```
@ INTERCEPT ESC
@ INTERCEPT NONE
```

The first command puts the TIP in its normal mode, the second in 7-bit binary mode.

Eight-bit binary mode is possible using the commands

```
@ BINARY INPUT START
@ BINARY INPUT END
@ BINARY OUTPUT START
@ BINARY OUTPUT END
```

When a TIP is in binary output mode, all eight bits of characters coming from the network are sent to the terminal. This may result in strange things being printed on a printer. It would probably make more sense to send 8-bit binary output to devices such as paper tape punches. When a TIP is in binary input mode, all eight bits of characters entered at the terminal are sent to the network.

Since commands from a terminal in binary input mode or INTERCEPT NONE mode can no longer be recognized, removing a terminal from these modes must be done with a command from another terminal as described immediately below. As the TIP's default mode is INSERT LINEFEED, the user will probably desire to CLEAR INSERT LINEFEED (@C I L) before using 8-bit binary mode; perhaps also for 7-bit binary mode.

D. Setting Another Terminal's Parameters

Any command may be preceded by a number, in which case it is meant for a device other than your own. The device port number must be in octal. For example,

@ 16 DEVICE RATE 633

would set the characteristics for device 16 to ASCII code, 2400 baud input and output. In this case we speak of "capturing" device 16.

Such a mechanism needs some form of protection: the TIP remembers the number of the capturing device and does not allow a second device also to capture until the first device explicitly gives up control with the command

@ 16 GIVE BACK

If a device chooses to capture himself by preceding any command by his own device number he is then invulnerable to tampering from another device.

This format is usually used in conjunction with the DEVICE RATE command to initialize some non-standard device, like a printer or a high-speed CRT terminal.

E. The DIVERT OUTPUT Command

It is possible (with some care) to divert the output intended for one terminal to another terminal. Presumably the second terminal has a desired feature, like hard copy or high speed. The command

@ 16 DIVERT OUTPUT

will cause all remotely generated output to be diverted from the terminal on which the command was typed to Terminal 16. This state will continue until any other command is executed at the diverting terminal. (Executing another command does not do a Give Back.) Local-echoing will not be diverted, and input may proceed at the diverting terminal.

This mechanism is not natural to the structure of the program. In particular, the buffer allocation structure becomes confused if the diversion aborts while output is in progress. Chained diversion will also confuse the TIP. Please don't try these things: all that will happen is that one or both terminals involved will stop responding. In fact, in general, we discourage use of the DIVERT OUTPUT command and suggest printing to TIP devices other than the user's own terminal by programs such as the TIPCOPY program which runs on many network TENEXs.

F. Editing

At the moment the only editing command available is

@ FLUSH

which deletes all the characters in the TIP's input buffer. In current practice this command is used to clear out any odd characters stuck in a TIP prior to giving an OPEN command. (The TIP accumulates characters typed in during periods of non-connection and sends them as the first data over a new connection.)

To abort a command, type a rubout or merely make something about the command illegal; for example,

@O X

The "X" aborts the OPEN command.

G. Wild

Setting a device wild allows the device to receive any connection from a designated Host or to receive any connection from any Host. TIP ports cannot be set permanently wild from other TIP ports, they must be set wild by the NCC. The command to set a port wild is

```
@SET DEVICE WILD
```

This instructs the TIP to accept an attempt to connect from any Host using any sockets. This command can be cancelled by the command

```
@CLEAR DEVICE WILD
```

If a user desires to accept an attempt to connect from a particular Host using any sockets the set of commands

```
@HOST #
@SEND TO WILD
@RECEIVE FROM WILD
```

should be used. This instructs the TIP to accept any attempt to connect from the Host whose decimal address is specified in the Host command.

## H. Low Level Protocol Commands

Several low level TIP commands exist which allow the user to manually do Host/Host protocol. These commands are

```
@ INITIAL CONNECTION PROTOCOL
@ PROTOCOL BOTH
@ CLOSE
@ PROTOCOL TO TRANSMIT
@ PROTOCOL TO RECEIVE
@ RECEIVE FROM HOST #
@ SEND TO HOST #
@ HOST #
@ SEND TO SOCKET #
@ RECEIVE FROM SOCKET #
```

Examples of the use of some of these commands are given below.

```
@H 69       /"logging in" to a socket
@R F S 13   /other than socket 1
@I C P      /on a server Host


@C          /attempt to close both halves of
            /an open connection
Closed R    /closed R side of connection
Closed T    /closed T side of connection
```

The rest of the low level protocol commands listed above were used in the example of section 5-B.

There is one other low level protocol command, a command to reset the NCP in the Host specified in a @ SEND TO HOST command. Since this command resets all connections between the TIP and the specified Host, it should only be used as a last resort. A responsible person at the TIP site should contact the NCC if the need arises.

## I. Commands from the Network

When a TIP terminal receives the character 207 (octal) in the input stream from the network, the characters following the 207 up to the next linefeed are treated as a command typed on the terminal keyboard. (The 207 takes the place of the @; the @ should not be sent through the network.) In this way Hosts can remotely control the TIP terminals. For example, a Host might send a command to the TIP which causes maximum size messages to be sent from the TIP terminal to the Host. The TIPs themselves can send commands to other TIP terminals by using the command

@ SEND COMMAND

which inserts the 207 character in the output stream to the network. This feature is evolving, so we do not recommend its use at the present time.

J. The RESET Device Command

The reset device command (@RESET) will restore a port to its initial state. Implicit in this command is the concept of a "permanent device." Currently, "permanent" is the same as "non-hunting" (see section 5-A), but this will not always be so. Permanent devices are those requiring a particular set of parameters that is not expected to change or perhaps for which the TIP cannot hunt. Examples are the IMLAC (no high speed hunt) and a line printer (no input possible). Everything is reset as follows:

a. All network connections and attempts to open connections are cleared;
b. If this device is captured by any other device, that state is cleared and if this device is capturing any other devices, that state is cleared;
c. Input buffers are initialized;
d. "Connection" parameters are reset to a default state* (i.e., echoing all, terminate every character, no insert linefeed, no device wild, intercept all);
e. The code, rate, and size are set to the hunting state.
f. The port's data set is hung-up.

For permanent devices the RESET command does only a, b, c, and f above and prints "TIP NAME" followed by the TIP version number and the octal port number.

---

*The default state for "binary" mode (Section 5.C) is rather complicated and is being somewhat revised. For current information, contact the NCC.

## K. TIP Configuration and Device Pre-initialization

The set of terminals and uses of these terminals typically varies from TIP site to TIP site. Therefore, the TIP software system has been constructed in a way which is somewhat modular to permit varying configurations of the TIP software at different sites. For instance, with line printers, it is possible for a given TIP system to contain code to handle an ODEC line printer or a MEMOREX line printer or neither (not both). As another example, it is possible to distribute the available space for device buffers among all sixty-three TIP ports or to allocate the available space to only a few ports (thus effectively disabling the remaining ports). Finally, it is possible to configure the TIP so certain ports are automatically set up to have pre-determined parameters at TIP initialization time, thus relieving TIP site personnel or users of the burden of manually setting up these device parameters.

The complete list of presently available options is given below:

1. TIP configured with ODEC code or MEMOREX code or neither.

2. TIP configured with EXTRA-PADDING code or without it.

3. TIP port pre-initialization

    a. Input buffer size
    b. Output buffer size
    c. Input rate
    d. Output rate
    e. No hunt or hunt (see section A)
    f. Extra-padding (D C E) or not
    g. Other-padding (D C O) or not
    h. Wild (S D W) or not
    i. No insert linefeed (C I L) or not
    j. Half duplex (E H) or not
    k. No intercept character (I N) or any intercept character
    l. Echo none (E N) or not
    m. Compute 37 parity (D C 3) or not

Of the above, f and g are mutually exclusive, j and l are mutually exclusive, and f through m depend on e being set to no hunt.

Some configuration must be specified for each TIP. If nothing is specified by the TIP site personnel, the TIP will be configured in an arbitrary (but hopefully reasonable) manner. Requests for specific TIP configurations should be made by the designated representative of the TIP site to the Network Control Center.

# 6. MAPPING THE VARIOUS DEVICES INTO THE NETWORK VIRTUAL TERMINAL

## A. TTY and TTY-like Devices (ASCII)

At the moment this conversion follows the simple rule that if the terminal can generate and/or print the code it will be sent and/or received. Otherwise there is no way to use the code. For example, there is no way to enter lower case characters from a Model 33 Teletype.

## B. 2741 and 2741-like Devices (transmit interrupt and receive interrupt options required)

The rule for these devices is if the terminal has the ASCII graphic it will translate directly to that graphic. Otherwise a number of equivalences are defined, most of which consist of the character double-quote followed by some other character. For each of the eight variations of 2741 that we have considered there is at least one way to type in the desired ASCII graphic. To actually type in the character double quote, two double quotes must be struck in succession. On output, ASCII characters which print on a Model 37 Teletype but have no representation on a 2741 are printed as the equivalents used to type in the character, with some exceptions. ASCII characters which do not print on a Model 37 Teletype do not print on a 2741. A double quote is not printed as two double quotes; thus, on output the user must sometimes determine what was printed from the context as there is no unambiguous representation of all the ASCII characters.

The ATTN key is used to interrupt output. It signals the TIP to hold off output for the duration of one TIP command; it is not seen by the remote Host. If used during input it is taken as a request to send all the accumulated characters to the remote Host (like @TRANSMIT NOW).

## C. ASCII/2741 Conversion Table

If this table is printed on-line, it is meant to be printed on a printer possessing the full ASCII character set. Except where noted, on input, any of the alternate 2741 representations of the ASCII character which it is possible to type on the given 2741 may be used. On output, the single character representation is chosen when possible. In the "Symbol" column of the table, ↑ is used to indicate control; e.g., ↑R means control-R. Not all ASCII terminals have a left arrow -- some have an underbar instead. Likewise, some ASCII terminals have a caret where others have an uparrow.

| Octal | Decimal | ASCII Name | ASCII Symbol | 2741 Representation |
|---|---|---|---|---|
| 0 | 0 | NUL | ↑@ | "p (no output) |
| 1 | 1 | SOH | ↑A | "a (no output) |
| 2 | 2 | STX | ↑B | "b (no output) |
| 3 | 3 | ETX | ↑C | "c (no output) |
| 4 | 4 | EOT | ↑D | "d (no output) |
| 5 | 5 | ENQ | ↑E | "e (no output) |
| 6 | 6 | ACK | ↑F | "f (no output) |
| 7 | 7 | BEL | ↑G | "g |
| 10 | 8 | BS | ↑H | "h or BS (output only) |
| 11 | 9 | HT | ↑I | "i or HT (output only) |
| 12 | 10 | LF | ↑J | "j or LF (output only) |
| 13 | 11 | VT | ↑K | "k (no output) |
| 14 | 12 | FF | ↑L | "l (no output) |
| 15 | 13 | CR | ↑M | "m or NL (output only) |
| 16 | 14 | SO | ↑N | "n (no output) |
| 17 | 15 | SI | ↑O | "o (no output) |
| 20 | 16 | DLE | ↑P | "p (no output) |
| 21 | 17 | DC1 | ↑Q | "q (no output) |
| 22 | 18 | DC2 | ↑R | "r (no output) |
| 23 | 19 | DC3 | ↑S | "s (no output) |
| 24 | 20 | DC4 | ↑T | "t (no output) |
| 25 | 21 | NAK | ↑U | "u (no output) |
| 26 | 22 | SYN | ↑V | "v (no output) |
| 27 | 23 | ETB | ↑W | "w (no output) |
| 30 | 24 | CAN | ↑X | "x (no output) |
| 31 | 25 | EM | ↑Y | "y (no output) |
| 32 | 26 | SUB | ↑Z | "z (no output) |
| 33 | 27 | ESC | ↑[ | "K or ¢ (no output)* |
| 34 | 28 | FS | ↑\ | "L (no output) |
| 35 | 29 | GS | ↑] | "M (no output) |
| 36 | 30 | RS | ↑↑ | "N (no output) |
| 37 | 31 | US | ↑← | "O (no output) |

---

*A cent-sign will print if the 2741 has one, otherwise there will be no output.

| | | | | |
|---|---|---|---|---|
| 40 | 32 | SP | space | space |
| 41 | 33 | | ! | ! or ± |
| 42 | 34 | | " | "" (input) and " (output) |
| 43 | 35 | | # | # or "= |
| 44 | 36 | | $ | $ or "& |
| 45 | 37 | | % | % or "? |
| 46 | 38 | | & | & or "$ |
| 47 | 39 | | ' | ' or ", |
| 50 | 40 | | ( | ( or "< |
| 51 | 41 | | ) | ) or "> |
| 52 | 42 | | * | * |
| 53 | 43 | | + | + or ~~+++~~ |
| 54 | 44 | | , | , |
| 55 | 45 | | - | - |
| 56 | 46 | | . | . |
| 57 | 47 | | / | / |
| 60 | 48 | | 0 | 0 |
| 61 | 49 | | 1 | 1 or ° or □ |
| 62 | 50 | | 2 | 2 |
| 63 | 51 | | 3 | 3 |
| 64 | 52 | | 4 | 4 |
| 65 | 53 | | 5 | 5 |
| 66 | 54 | | 6 | 6 |
| 67 | 55 | | 7 | 7 |
| 70 | 56 | | 8 | 8 |
| 71 | 57 | | 9 | 9 |
| 72 | 58 | | : | : |
| 73 | 59 | | ; | ; |
| 74 | 60 | | < | < or "( |
| 75 | 61 | | = | = or Δ |
| 76 | 62 | | > | > or ") |
| 77 | 63 | | ? | ? |

| | | | |
|---|---|---|---|
| 100 | 64 | @ | @ or "+ |
| 101 | 65 | A | A |
| 102 | 66 | B | B |
| 103 | 67 | C | C |
| 104 | 68 | D | D |
| 105 | 69 | E | E |
| 106 | 70 | F | F |
| 107 | 71 | G | g |
| 110 | 72 | H | H |
| 111 | 73 | I | I |
| 112 | 74 | J | J |
| 113 | 75 | K | K |
| 114 | 76 | L | L |
| 115 | 77 | M | M |
| 116 | 78 | N | N |
| 117 | 79 | O | O |
| 120 | 80 | P | P |
| 121 | 81 | Q | Q |
| 122 | 82 | R | R |
| 123 | 83 | S | S |
| 124 | 84 | T | T |
| 125 | 85 | U | U |
| 126 | 86 | V | V |
| 127 | 87 | W | W |
| 130 | 88 | X | X |
| 131 | 89 | Y | Y |
| 132 | 90 | Z | Z |
| 133 | 91 | [ | [ or "B |
| 134 | 92 | \ | \ or "/ |
| 135 | 93 | ] | ] or "E |
| 136 | 94 | ↑ | ^ or ↑ or "! or "± |
| 137 | 95 | ← | _ or ← |

| | | | | |
|---|---|---|---|---|
| 140 | 96 | | ` | "* |
| 141 | 97 | | a | a |
| 142 | 98 | | b | b |
| 143 | 99 | | c | c |
| 144 | 100 | | d | d |
| 145 | 101 | | e | e |
| 146 | 102 | | f | f |
| 147 | 103 | | g | g |
| 150 | 104 | | h | h |
| 151 | 105 | | i | i |
| 152 | 106 | | j | j |
| 153 | 107 | | k | k |
| 154 | 108 | | l | l |
| 155 | 109 | | m | m |
| 156 | 110 | | n | n |
| 157 | 111 | | o | o |
| 160 | 112 | | p | p |
| 161 | 113 | | q | q |
| 162 | 114 | | r | r |
| 163 | 115 | | s | s |
| 164 | 116 | | t | t |
| 165 | 117 | | u | u |
| 166 | 118 | | v | v |
| 167 | 119 | | w | w |
| 170 | 120 | | x | x |
| 171 | 121 | | y | y |
| 172 | 122 | | z | z |
| 173 | 123 | | { | "6 |
| 174 | 124 | | \| | \| or "V |
| 175 | 125 | | } | "9 |
| 176 | 126 | tilde | ~ | ¬ or "- |
| 177 | 127 | DEL | rubout | "D (no output) |

# 7. TIP MESSAGES TO THE TERMINAL USER

BAD — The TIP doesn't recognize the command

Closed — Connection closed, usually by server Host

Connection Restored
Destination Host has restored the connection as it was before the Host halted.

Connection Suspended
Destination Host has halted operation.

Host broke the connection
The Destination Host's service is restored but all network connection tables have been reset.

Host not responding
Destination Host not up from the network's point of view. It is not known when service will resume.

Host Scheduled Down Until ...
Destination Host is scheduled down until the date and time indicated.

Host Unscheduled Down Until ...
Destination Host is unscheduled down until the date and time indicated.

ICP Interferred With
The Host has not performed the ICP correctly and the TIP has refused to open a connection.

Latest Net news...
Use "@N<cr>" followhd by "netnews<cr>"
The TIP is conveying to the user the date the latest news item for TIP users was generated.

Net Trouble — Destination IMP cannot be reached due to some kind of trouble in the network.

NO — Parameters may not be set for specified terminal.

Num — The TIP expected a number -- command terminated.

Open — Connection opened by server Host.

R — Refers to the Receive side of a connection.

Refused — The remote Host rejected the attempt to establish connections.

| | |
|---|---|
| T | Refers to the Transmit side of a connection. |
| TIP GOING DOWN | The TIP is going down in the number of minutes indicated -- quickly stop what you are doing and stop using the TIP. |
| TIP NAME | The TIP heard the user dial in and establish rate. The number following NAME is the TIP software system version number. It is followed by the octal port number. |
| Trying | The TIP is now servicing the user's OPEN request. |
| Wait | The TIP is attempting to contact an RSEXEC Server. |

# 8. TIP MAGNETIC TAPE OPTION

As one method of increasing the usefulness of the Terminal IMP, we have developed a magnetic tape transfer capability as a TIP option. The first such option was delivered to the field during the first quarter of 1972. In order to ease the problems of interfacing such a specialized terminal type, we chose to specify the attachment of a standard Honeywell peripheral unit rather than attempting to solve the problem of tape drive attachment in a more generalized way. The unit chosen is the Honeywell 316-4021 option which consists of a tape drive controller and one drive unit (the controller itself is capable of handling up to seven additional 316-4022 drives). The characteristics of the tape drive include:

- Read/write speed of 26 inches per second
- Seven-track tapes
- Even or odd parity (program selectable)
- Industry compatible 200, 556, or 800 bpi

In addition to the tape drive and controller, the problem of programming for the controller and the buffering of tape records dictated the addition of a separate 4K memory bank to TIPs equipped with this option.

The most immediate pressure for the addition of a magnetic tape option to the TIP was the desire to enable a pair of TIP users to copy tapes over the network from one TIP to another, rather than shipping physical tapes by mail.

The magnetic tape system communicates with the network through the TIP, although in many cases it bypasses the usual TIP code, substituting its own procedures to allow for the special nature and relatively high data rate of a magnetic tape terminal. In most respects, however, the tape unit appears as a standard terminal, arbitrarily designated number 77. On a TIP equipped with magnetic tape, line 77 cannot be used as an external terminal.

An additional terminal is required to issue commands to the tape and receive status information and error comments. This may be of any type and may be connected to any line. Its use as the tape-controlling terminal can be concurrent with its normal usage.

The specific hardware design of the magnetic tape units used dictates some constraints. Tape format is 7-track using either odd or even parity. In memory, tape frames are stored two to a word occupying the high order twelve bits of each word. Frames can only be written in pairs; reading a record with an odd number of frames causes the control unit to append an extra null frame to the record in memory.

The maximum record length is 2400 characters (frames). This limit is based on the amount of TIP core available for buffering. If all maximum length records are used, this results in an 80% utilization of tape space at 800 bpi (the remainder is inter-record gaps).

The commands relating to magnetic tapes are of a less general form than other TIP commands. Neither multiple spaces nor word completion are presently permitted, and numbers are used to distinguish different commands. The format is @ M #1 #2, where #1 and #2 are the command number and its argument respectively. The commands, their numbers and arguments are:

| | | |
|---|---|---|
| Rewind | 1 | decimal-count |
| Forward Space Record | 2 | decimal-count |
| Forward Space File | 3 | decimal-count |
| Backward Space Record | 4 | decimal-count |
| Backward Space File | 5 | decimal-count |
| Read Record | 6 | decimal-count |
| Read File | 7 | decimal-count |
| Write Record | 8 | decimal-count |
| Write File | 9 | decimal-count |
| Transfer Files | 10 | decimal-count |
| Setup TIP-TIP Copy | 11 | foreign-TIP-number |
| Abort and Initialize | 12 | parity (i.e. even or odd) |
| Write File Mark | 13 | decimal-count |
| Set Parity | 14 | even-or-odd |

A file mark is treated by the hardware as a record and must thus be accounted for when spacing or reading by the RECORD commands. The SETUP COPY command is used in the establishment of a connection between TIPs, described below.

There are some important things to note about magnetic tape commands. All regular TIP commands given for the tape, e.g., those specifying Host or socket parameters, must be preceded by 77. This, of course, captures the tape drive for the terminal giving the commands. All special tape commands (those beginning with M), implicitly capture device 77 in the same way. Thus once any terminal issues a command for device 77 or any MAG command, it has captured the magnetic tape; no one else is permitted to control it until the owning terminal has issued the @77 GIVE BACK command.

A network connection must exist before information may be transferred. A typical sequence of TIP commands which might establish a connection between two magnetic tapes follows: at each TIP, the operator would issue a Setup Copy command to the Host number of the other TIP. This command establishes socket numbers for the "standard" TIP-to-TIP magnetic tape connection. Status information about this connection such as Open, Closed, etc. will be followed by MTR and MTT rather than the usual R and T to differentiate magnetic tape activity from other activity of the

controlling terminal. Then the write side would give a Transfer Files command which would close MTT and MTR if necessary, and open MTT. When MTT opens, a request is sent to the other TIP, and MTT is closed. The request prompts the other TIP to open MTR (his MTT), rewind his tape, read and send the requested number of files, rewind his tape, and close the connection. The writing TIP also rewinds its tape after writing the last file.

Errors and abnormal status conditions are detected and messages are typed out on the controlling terminal. Errors which will be of significance to the operator include:

| | |
|---|---|
| UNREC ERR | Unrecoverable read or write errors after 20 retries -- a bad spot in the tape or tape drive hardware problems. The results of the 20th try are used. |
| TIMEOUT | The tape controller remains busy or no network activity occurs for too long. The command is aborted. |
| OFFLINE | The mag tape unit is somehow not operational (power off, no tape mounted, vacuum off, wrong unit number, etc.). The command is aborted. |
| EOT | The tape has moved past the end-of-tape marker. The command is aborted. |

The error messages may be followed by MTR or MTT to denote which side of the connection originated the message. At the request of the TIP sites with magnetic tape option, records read in error presently are reread many times and then transmitted anyway after printing an error message. If aborted by an error condition, the Transfer Files command will attempt to restart the transfer requesting the other TIP to rewind its tape, skip over as many files as have already been written and send the remaining files.

# 9. CONNECTION OF TERMINALS TO THE TIP

## A. General Comments

The TIP allows the connection of most terminals that conform to the EIA RS232 standard. The TIP is built such that it appears to a terminal to be a modem and appears to a modem as a terminal. If a terminal has a 25 pin connector (DB25P, several manufacturers) and works with a 103 modem or equivalent, it will probably work when plugged into an LIU card marked "T". Appendix D lists terminals that have been used.

This section specifies the interface between a terminal and the TIP. See Section 4 for connections involving modems. It is hoped that by examining this section, an engineer will be able to determine whether he has met the conditions necessary for proper operation of a terminal connected to the TIP.

To a large extent, the TIP follows EIA Standard RS-232C. Familiarity with that document is recommended. The pin allocations specified by that standard are given inside the front cover.

In order to connect a terminal to the TIP without modems, each must look like a modem to the other. Input and output connections are therefore cross-connected at the LIU pads, as shown in Table 9-1.

Expansions to this specification are planned in the future (particularly as this relates to control signals). It is therefore very important that this section be kept up-to-date as revisions are provided.

Connector - The connector from the terminal should be equivalent to a Cinch DB-25P. It is recommended that extension cords for terminals provide for all 25 pins in order to allow for future changes.

Signal Levels - All signals are represented by bipolar low voltage levels. All signals are measured with respect to signal ground. The source of a signal shall deliver a voltage of magnitude between 5 and 25 volts into a load of not less than 3000 ohms. The reactive component of the load shall not be inductive, and the capacitance shall not exceed 2500 pfd. measured at the interface connector. The signals shall be interpreted in this way:

Data Signals

-25<Vd<-3 is marking or logical one
+3<Vd<+25 is spacing or logical zero

Control and Timing Signals

-25<Vc<-3 is considered OFF
+3<Vc<+25 is is considered ON

Signal Use - The TIP software handles the signals as shown in Table 9-1.

Character Code - The TIP software accepts ASCII 8-bit code. Parity is ignored on input, and undefined on output. IBM 2741 and 2741-like devices are specially handled. See Appendix C.

Carriage Return Speed - Carriage return speed is known to be reasonably compensated for Teletypes 33, 35, and 37; and, separately, for Execuport-like devices. A line printer (ODEC) with a small (256-character) buffer is also reasonably compensated This compensation is set by the TIP program.

Terminals Which Provide Their Own Clock - Terminals which provide their own clocks for transferring data can be connected to the TIP provided they meet the previous specifications. The clocks should be routed to LIU pads E15 and E17. The data lines should change on the positive edges of the clocks, and should be sampled on the negative edges. (This is not to be interpreted as an indication that the TIP works with synchronus modems or devices. Characters must still be formatted with stop-start bits since the actual operating mode is basically character-asychronus.)

B. Direct Terminal Connection

Table 9-1 lists how the TIP uses RS232 signals for terminal connections.

TABLE 9-1 TIP SIGNAL ALLOCATION FOR TERMINALS*

| EIA PIN | LIU PAD | DESIGNATION (FROM THE POINT OF VIEW OF THE TERMINAL) |
|---|---|---|
| 1 | E1 | PROTECTIVE GROUND (AA) - Used. |
| 2 | E3 | TRANSMITTED DATA (BA) - Used for data going from the terminal to the TIP. |
| 3 | E2 | RECEIVED DATA (BB) - Used for data going from the TIP to the terminal. |
| 7 | E7 | SIGNAL GROUND (AB) - Used. |
| 8 | E20 | RECEIVED LINE SIGNAL DETECTOR (CF) - Modem control bit 3. Held ON by the TIP, except for a short (approximately 1/2 sec.) period following an ON to OFF transition of DATA TERMINAL READY, during which it goes off. |
| 20 | E3 | DATA TERMINAL READY (CD) - Modem status bit 2. THIS SIGNAL IS USED BY THE TIP to determine that the terminal is connected to the TIP. If "hunt" mode is enabled for this device, an ON to OFF transition of this signal initiates "hunt" mode. |
| | | The following control signals are held on by the TIP software: |
| 5 | E4 | CLEAR TO SEND (CB) - Modem control bit 0. Held ON by the TIP. |
| 6 | E19 | DATA SET READY (CC) - Modem control bit 2. Held ON by the TIP. |
| 16 | E14 | SECONDARY RECEIVED DATA (SBB) - Modem control bit 1. Held ON by the TIP. |
| | | The following status signals are ignored by the TIP software: |
| 4 | E5 | REQUEST TO SEND (CA) - Modem status bit 0. Ignored by the TIP. |
| 12 | E12 | SECONDARY RECEIVED LINE SIGNAL DETECTOR (SCF) - Modem status bit 3. Ignored by the TIP. |
| 13 | E13 | SECONDARY CLEAR TO SEND (SCB) - Modem status bit 4. Ignored by the TIP. |
| 14 | E16 | SECONDARY TRANSMITTED DATA (SBA) - Modem status bit 5. Ignored by the TIP. |
| 19 | E6 | SECONDARY REQUEST TO SEND (SCA) - Modem status bit 1. Ignored by the TIP. |

*This configuration makes the LIU look approximately like a 103 modem to the terminal.

## C. Modems

It is desired that the TIP be able to operate with terminals over private or leased lines, or over the switched telephone network. This requires the use of a pair of modems between the terminal and the TIP. The TIP basically supports the Bell 103 class of modems. An extension is the Vadic 3400 which is 1200 baud full duplex with 103 protocol. A 202 equivalent modem is being used in Simplex mode to drive a remote line printer.

It may be that a group desiring to use another type of modem could coax that modem to work within the available software and hardware structure. For that purpose, this section will try to describe the difficulties in using half-duplex modems, the use of synchronous modems, and the manner in which the 103 modem is supported.

### Half-Duplex Modems

Half-duplex modems are modems in which data on the primary data channel can flow in only one direction at a time. Data cannot flow both ways at the same time. There may or may not be a "secondary" or "supervisory" channel which points in the direction opposite the primary channel. The essential problem involved in half-duplex operation is control of the direction of data flow on the primary channel. Significant questions are:

- What protocol should be adopted for turning the line around -- special control characters, or use of a secondary channel?
- Which end (if either) is in control of the channel?
- If the terminal is receiving a large listing, how can the user terminate the output when the channel is pointing the wrong way?
- Who should do the echoing and when?

These problems are clearly a matter of convention. Unfortunately, EIA Standard RS-232, which many modems follow, does not define a convention which would answer these questions. It is very helpful if a request to BBN for a modem on the TIP includes a statement of what terminals are to be connected to the other end, and what convention they follow.

### Synchronous Modems

The TIP should be able to use synchronous modems provided that the characters are framed by start and stop bits, and that the synchronous modem is similar enough to a modem which is

supported by the software. The device rate must be set to external clock mode through the use of a TIP command such as:

@ DEVICE RATE 1023

103 Modems

Description:

The Bell Telephone 103 modem is a low-speed (up to 300 baud), asynchronous, full-duplex modem for use on private leased lines or the switched telephone network.

Connection:

See Table 9-2 for the pin connection on the LIU card, and for a description of the TIP's use of the signals.

Operation:

In use, the modem at the TIP end is usually left in the AUTO-ANSWER mode. When a user wishes to connect his terminal, he dials the number of the modem at the TIP. After the ring is answered and a data carrier is heard, the user depresses the DATA button. The user is then connected as if his terminal were connected directly to the TIP. He types the characteristic character for his terminal, receives the header message, and proceeds to use the network as desired.

Simplex Modem Connections

A simplex modem connection is defined as a modem connected to an LIU card with data flowing in one direction only. Its primary use is to connect a line printer at a remote site to a TIP. A 1200 baud asynchronous modem (with supervisory reverse channel) is usually used. Any modem will probably work including half duplex types. Since the half duplex protocol is to have the called modem transmit first, simplex should work quite well.

The LIU will hold EIA pins 3 and 11 at ground. There are normally not enough pads on the pin 3 patch panel, so a minor change to the LIU card and a jumper must be prepared. If this connection is desired, call the NCC for further information and assistance.

TABLE 9-2
TIP SIGNAL ALLOCATION FOR 103 MODEM

| EIA PIN | LIU PAD | |
|---|---|---|
| 1 | E1 | PROTECTIVE GROUND (AA) - Used. |
| 2 | E2 | TRANSMITTED DATA (BA) - Used for data going from the TIP to the MODEM. |
| 3 | E3 | RECEIVED DATA (BB) - Used for data going from the MODEM to the TIP. |
| 5 | E5 | CLEAR TO SEND (CB) - Modem status bit 0. Ignored by the TIP. |
| 6 | E6 | DATA SET READY (CC) - Modem status bit 1. Used in conjunction with CF to determine whether a legitimate data call has been made or whether the connection should be terminated. |
| 7 | E7 | SIGNAL GROUND (AB) - Used. |
| 8 | E8 | RECEIVED LINE SIGNAL DETECTOR (CF) = modem status bit 2. This signal is used by the TIP to determine that a connection has been made. If "hunt" mode is enabled for this device, an ON to OFF transition initiates "hunt" mode. |
| 20 | E20 | DATA TERMINAL READY (CD) - Modem control bit 3. Held ON by the TIP, except for a short (approximately 1/2 sec.) period after TIP software decides whether a legitimate data call has been made or whether the connection should be terminated. |

All other signals are connected as shown in Appendix A but are not used by the 103 modem.

Table 9-3

LIU Patch Panel Configurations

| EIA PIN | 103 MODEM | STD TERMINAL | MDL37 TTY | SIMPLEX MODEM* | 202 MODEM |
|---|---|---|---|---|---|
| 1 | 1 | 1 | 1 | 1 | 1 |
| 2 | 2 | 3 | 3 | 2 | 2 |
| 3 | 3 | 2 | 2 | OPEN | 3 |
| 4 | 4 | 5 | 5 | 4 | 4 |
| 5 | 5 | 4 | 4 | 5 | 5 |
| 6 | 6 | 19 | 8 | 6 | 6 |
| 7 | 7 | 7 | 7 | 7,3 | 7 |
| 8 | 8 | 20 | 20 | 12 | 8 |
| 9 | - | - | - | - | - |
| 10 | - | - | - | - | - |
| 11 | 11 | 11 | 11 | 7 | 14 |
| 12 | 12 | 12 | 12 | 8 | 16 |
| 13 | 13 | 13 | 13 | 13 | 13 |
| 14 | 14 | 16 | 16 | 14 | 12 |
| 15 | 15 | 17 | 17 | 15 | 15 |
| 16 | 16 | 14 | 14 | 16 | 11 |
| 17 | 17 | 15 | 15 | 17 | 17 |
| 18 | - | - | - | - | - |
| 19 | 19 | 6 | 6 | 19 | 19 |
| 20 | 20 | 8 | 8 | 20 | 20 |
| 21 | - | - | - | - | - |
| 22 | - | | | | |
| 23 | - | - | - | - | - |
| 24 | 24 | 25 | 25 | 24 | 24 |
| 25 | 25 | 24 | 24 | 25 | 25 |
| Labels | (M,103, or None) | (T) | (37) | (SM) | (202) |

*A jumper and a minor change to the LIU card is needed for this configuration.

APPENDIX A HOST ADDRESSES

The following is a table of Hosts on the Network at the time this update was published. The columns (from left to right) are: Octal Host address, Decimal Host address, Host name, (Interface computer, if any, and) computer type, Status of the system and type of operating system.

| Host Address Octal | Decimal | Hostname | (Interface)-> Computer | Status/ System |
|---|---|---|---|---|
| 156 | 110 | ADR | (VDH)-> PDP-11 | User ELF |
| 260 | 176 | AFWL-TIP | | TIP |
| 244 | 164 | ALOHA-TIP | | TIP |
| 320 | 208 | AMES-11 | (PDP-11/45)-> CDC 7600 | User |
| 020 | 16 | AMES-67 | IBM 360/67 | Server TSS/360 |
| 220 | 144 | AMES-TIP | | TIP |
| 067 | 55 | ANL | (VARIAN-73)-> IBM 370/195 | Server OS-MVT |
| 002 | 2 | ARC-RD | PDP-11/40 | User ELF |
| 034 | 28 | ARPA-DMS | PDP-15 | Limited Server Keydata DMS |
| 234 | 156 | ARPA-TIP | | TIP |
| 160 | 112 | ASL | (VDH)-> PDP-11/10 | User ELF |
| 350 | 232 | BBN-1D | PDP-1 | User |
| 261 | 177 | BBN10X-TIP | | TIP |
| 105 | 69 | BBN-11X | PDP-11 | Server ELF |
| 205 | 133 | BBN-11XB | PDP-11 | User ELF |
| 050 | 40 | BBN-NCC | H-316 | User |
| 161 | 113 | BBN-SAT | (VDH)-> PDP-11/40 | User ELF, RT-11 |

| | | | | |
|---|---|---|---|---|
| 062 | 50 | BBN-SPEECH-11 | (PDP-11/40)-> SPS-41 | Summer '75 ELF |
| 361 | 241 | BBN-TENEX | PDP-10 | Server TENEX |
| 305 | 197 | BBN-TENEXA | PDP-10 | limited Server TENEX |
| 061 | 49 | BBN-TENEXB | PDP-10 | limited Server TENEX |
| 162 | 114 | BBN-TENEXD | PDP-10 | limited Server TENEX |
| 236 | 158 | BBN-TESTIP | | TIP |
| 033 | 27 | BELVOIR | (PDP-11)-> CDC 6600 | User (ANTS) Scope |
| 035 | 29 | BRL | PDP-11/40 | User ANTS |
| 337 | 223 | CCA-SIP | PDP-11/40 | User ELF |
| 037 | 31 | CCA-TENEX | (PDP-10)-> Datacomputer | dedicated Server TENEX,Datacomputer |
| 237 | 159 | CCA-TIP | | TIP |
| 203 | 131 | CHII | (VDH)-> Signal-1 | Server |
| 116 | 78 | CMU-10A | PDP-10 | limited Server DEC 10/50 |
| 016 | 14 | CMU-10B | PDP-10 | Server DEC 10/50 |
| 216 | 142 | CMU-11 | C.mmp | Summer '75 Hydra |
| 316 | 206 | CMU-CC | (PDP-11)-> IBM 360/67 + UNIVAC 1108 | Summer '75 |
| 231 | 153 | DOCB-TIP | | TIP |
| 065 | 53 | EGLIN | CDC 6600 | User SCOPE |

| | | | | |
|---|---|---|---|---|
| 024 | 20 | ETAC | (PDP-11/45)-> CDC-6600 | Summer '75 (ANTS) |
| 224 | 148 | ETAC-TIP | | TIP |
| 041 | 33 | FNWC | (CDC 3200)-> CDC 6500 | Not Active SCOPE |
| 241 | 161 | FNWC-TIP | | TIP |
| 015 | 13 | GUNTER | (PDP-11/35)-> B4700 | User (ELF) MCPV |
| 230 | 152 | GWC-TIP | | TIP |
| 111 | 73 | HARV-1 | PDP-1 | User |
| 011 | 9 | HARV-10 | PDP-10 | limited Server DEC 10/50 |
| 311 | 201 | HASKINS | (VDH)-> PDP-11/45 | User ELF, RSX-11D |
| 344 | 228 | HAWAII-500 | (PDP-11)-> BCC 500 | limited Server (ELF) BKY OpSys |
| 044 | 36 | HAWAII-ALOHA | HP 2100 | User Menehune |
| 117 | 79 | I4-ELF | (PDP-11)-> ILLIAC IV | Server (ELF) |
| 017 | 15 | I4A-TENEX | (PDP-10)-> ILLIAC IV + B6700 | Server (TENEX) |
| 217 | 143 | I4B-TENEX | (PDP-10)-> ILLIAC IV | limited Server (TENEX) |
| 014 | 12 | ILL-CAC | PDP-11/20 | User ANTS |
| 114 | 76 | ILL-NTS | PDP-11/50 | User UNIX |
| 026 | 22 | ISI-SPEECH11 | (PDP-11/45)-> SPS-41 | User ELF, DOS |
| 264 | 180 | ISI-TIP | | TIP |
| 326 | 214 | ISI-XGP11 | PDP-11/40 | User ELF |
| 042 | 34 | LBL | (CDC 6600)-> CDC 7600 | Server (Sesame) BKY |

| | | | | |
|---|---|---|---|---|
| 052 | 42 | LONDON | (PDP-9)->IBM 360/195 | limited Server OS/MVT ? |
| 252 | 170 | LONDON-TIP | | TIP |
| 152 | 106 | LONDON-VDH | (VDH)->(PDP-9)->ATLAS II | User CMAS |
| 012 | 10 | LL | IBM 370/168 | limited Server VM-370 |
| 312 | 202 | LL-11 | (PDP-11/45)->SPS-41 | User ELF, RSX-11M |
| 137 | 95 | LL-ASG | (VDH)->PDP-11/50 | User ELF |
| 212 | 138 | LL-TSP | TSP | User |
| 025 | 21 | LLL-RISOS | PDP-11/45 | limited Server RATS |
| 206 | 134 | MIT-AI | PDP-10 | limited Server ITS |
| 006 | 6 | MIT-DEVMULTICS | H-68/80 | User Multics |
| 106 | 70 | MIT-DMS | PDP-10 | Server ITS |
| 306 | 198 | MIT-ML | PDP-10 | Server ITS |
| 054 | 44 | MIT-MULTICS | H-6180 | Server Multics |
| 221 | 145 | MITRE-TIP | | TIP |
| 023 | 19 | NBS-ICST | PDP-11/45 + PDP-10 Not Active. | |
| 223 | 147 | NBS-TIP | | TIP |
| 250 | 168 | NCC-TIP | | TIP |
| 351 | 233 | NORSAR-40A | IBM 360/40 | Fall '75 DOS/360 |
| 051 | 41 | NORSAR-40B | IBM 360/40 | Fall '75 DOS/360 |
| 251 | 169 | NORSAR-TIP | | TIP |

| | | | | |
|---|---|---|---|---|
| 071 | 57 | NSA | PDP-10 | Fall '75<br>TENEX |
| 053 | 43 | OFFICE-1 | PDP-10 | dedicated Server<br>TENEX,NLS |
| 040 | 32 | PARC-MAXC | (Nova)->MAXC | limited Server<br>TENEX |
| 140 | 96 | PARC-VTS | Nova 800 | User<br>VTS |
| 046 | 38 | PURDUE | PDP-11/45 | User<br>ANTS |
| 022 | 18 | RADC-MULTICS | H-6180 | User<br>Multics |
| 222 | 146 | RADC-TIP | | TIP |
| 107 | 71 | RAND-ISD | PDP-11/45 | Server<br>UNIX |
| 007 | 7 | RAND-RCC | IBM 370/158 | Server<br>OS-MVT |
| 045 | 37 | RML-7 | Sigma 7 | User<br>BPS |
| 245 | 165 | RML-TIP | | TIP |
| 056 | 46 | RUTGERS-10 | PDP-10/70 | Server<br>TOPS-10 |
| 256 | 174 | RUTGERS-TIP | | TIP |
| 055 | 45 | SCI-TENEX | PDP-10 | limited Server |
| 166 | 118 | SCRL-ELF | (VDH)->PDP-11/45 | User<br>ELF |
| 066 | 54 | SCRL-ELFDEVEL | PDP-11/20 | User<br>ELF |
| 032 | 26 | SDAC-44 | IBM 360/44 | limited Server<br>DOS/360, USC-PS |

| | | | | |
|---|---|---|---|---|
| 332 | 218 | SDAC-CCP | BBN-Pluribus | alternate to #39 decimal |
| 047 | 39 | SDAC-CCP | BBN-Pluribus | User |
| 147 | 103 | SDAC-DP | IBM 360/40 | User DOS/360 |
| 247 | 167 | SDAC-NEP | IBM 360/40 | User DOS/360 |
| 232 | 154 | SDAC-TIP | | TIP |
| 110 | 72 | SDC-CC | IBM 370/158 | Server VS2 |
| 010 | 8 | SDC-LAB | IBM 370/145 | limited Server SDC-VM |
| 102 | 66 | SRI-AI | (PDP-10)-> PDP-15 | limited Server TENEX |
| 202 | 130 | SRI-ARC | PDP-11/40 | User ELF |
| 263 | 179 | SRI-CBC11 | PDP-11/10 | User |
| 163 | 115 | SRI-IA11 | PDP-11/40 | User RSX-11M |
| 063 | 51 | SRI-NSC11 | (PDP-11/40)-> SPS-41 | User ELF, DOS |
| 363 | 243 | SRI-PKT | PDP-11 | Summer '75 |
| 013 | 11 | SU-AI | PDP-10 | Server DEC 10/50 |
| 113 | 75 | SU-DSL | (VDH)-> PDP-11/20 | User ELF |
| 070 | 56 | SUMEX-AIM | PDP-10 | Server TENEX |
| 253 | 171 | TYMSHARE-TIP | | TIP |
| 142 | 98 | UCB | (VDH)-> PDP-11/45 | User ELF, DOS |
| 001 | 1 | UCLA-ATS | PDP-11/45 | User ANTS, ELF |
| 101 | 65 | UCLA-CCN | IBM 360/91 | Server TSO, OS-MVT |

| | | | | |
|---|---|---|---|---|
| 201 | 129 | UCLA-CCBS | (PDP-15)->PDP-10 | limited Server DEC 10/50 |
| 003 | 3 | UCSB-MOD75 | IBM 360/75 | Server OLS, OS-MVT |
| 043 | 35 | UCSD-CC | (Micro 810)->B6700 | Server MCP |
| 214 | 140 | UNIVAC | (VDH)->(UNIVAC 1218)->UNIVAC 1616 | User |
| 027 | 23 | USC-44 | IBM 360/44 | Server USC-PS |
| 327 | 215 | USC-ECL | PDP-10 | Server TENEX |
| 126 | 86 | USC-ISI | PDP-10 | Server TENEX |
| 226 | 150 | USC-ISIB | PDP-10 | limited Server TENEX |
| 364 | 244 | USC-ISIC | PDP-10 | Server TENEX |
| 227 | 151 | USC-TIP | | TIP |
| 004 | 4 | UTAH-10 | PDP-10 | limited Server TENEX |
| 204 | 132 | UTAH-TIP | | TIP |
| 257 | 175 | WPAFB-TIP | | TIP |

# APPENDIX B: COMMAND SUMMARY*

| | Section |
|---|---|
| BINARY INPUT END<br>Leave 8-bit binary input mode | 5-C |
| BINARY INPUT START<br>Enter 8-bit binary input mode | 5-C |
| BINARY OUTPUT END<br>Leave 8-bit binary output mode | 5-C |
| BINARY OUTPUT START<br>Enter 8-bit binary output mode | 5-C |
| CLEAR DEVICE WILD<br>Set device to be unwild | 5-G |
| CLEAR INSERT LINEFEED<br>Stop inserting linefeed after carriage-return | 4-B |
| CLOSE<br>Close all outstanding connections, or abort current Host login | 4-D |
| DEVICE CODE 37<br>Establish parity computation for Model 37 Teletype | 5-A |
| DEVICE CODE ASCII<br>Establish code conversion for an ASCII terminal | 5-A |
| DEVICE CODE EXTRA-PADDING<br>Establish code conversion for a terminal with slow CR | 5-A |
| DEVICE CODE OTHER-PADDING<br>Establish code conversion for a line printer | 5-A |
| DEVICE RATE #<br># is a 10-bit code specifying hardware rate and character size settings | 5-A |
| # DIVERT OUTPUT<br>Capture device # and divert this terminal's output to it. # is an octal number. | 5-F |
| ECHO ALL<br>Local TIP-generated echo -- TIP echoes everything | 4-B |

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* # denotes a decimal number unless otherwise stated

PROTOCOL BOTH
Simultaneous "@P T T" and "@P T R" 5-B

PROTOCOL TO RECEIVE
Manually initiate connection protocol 5-B

PROTOCOL TO TRANSMIT
Manually initiate connection protocol 5-B

RECEIVE FROM HOST #
Establish Host # parameter for manual initialization 5-B

RECEIVE FROM SOCKET #
Establish socket # parameter for manual initialization of connection -- socket # is given in octal 5-B

RECEIVE FROM WILD
Equivalent to "@R F S <any>" 5-G

RESET
Reset current TIP port parameters 5-J

Reset NCP
Resets NCP 5-H

SEND BREAK
Send the Telnet "BREAK" character 4-D

SEND COMMAND
Send the command escape character 5-I

SEND SYNC
Send the Telnet "SYNC" character and an "INTERRUPT SENDER" message 4-D

SEND TO HOST #
Establish Host # parameter for manual initialization of connection 5-B

SEND TO SOCKET #
Establish socket # parameter for manual initialization of connection -- socket # is given in octal 5-B

SEND TO WILD
Equivalent to "@S T S <any>" 5-G

SET DEVICE WILD
Equilvalent to the commands "@R F H <any>", "@S T H <any>", "@S T S <any>", and "@R F S <any>". 5-G

TRANSMIT EVERY #
Send off input buffer at least every #th character where 0<#<256 4-B

TRANSMIT NOW
Send off input buffer now 4-B

TRANSMIT ON LINEFEED
Send input buffer every time a linefeed is encountered 4-B

TRANSMIT ON MESSAGE-END
Send input buffer every time an end-of-message is encountered 4-B

# APPENDIX C: BIBLIOGRAPHY

Most of the following should be available through your Network Information Center Station Agent or the

ARPA Network Information Center
Augmentation Research Center
Stanford Research Institute
333 Ravenswood Avenue
Menlo Park, California 94025

Specifications for the Interconnection of a Host and an IMP, BBN Report No. 1822 (IMP-HOST section of NIC 7104).

IMP Operating Manual, BBN Report No. 1877.

The Interface Message Processor for the ARPA Computer Network, Heart et al, Proceedings AFIPS 1970 Spring Joint Computer Conference (NIC 4655).

The Network Working Group "Request for Comment " Series: A Set of Working Papers on Host Protocol.

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The BBN Terminal Interface Message Processor (Hardware Manual), BBN Report No. 2184.

Specifications for the Interconnection of Terminals and the Terminal IMP, BBN Report 2277.

ARPA Network Current Network Protocols, NIC 7104.

The Terminal IMP for the ARPA Computer Network, Ornstein et al, Proceedings AFIPS 1972 Spring Joint Computer Conference.

Terminal Access to the ARPA Network: Experience and Improvements, Mimno et al, COMPCON 73, Proceedings Seventh Annual IEEE Computer Society International Conference, San Francisco, February 27 - March 1, 1973.

TIP Users Group Notes, a series of informal notes designed to increase communication among the developers of the TIP, TIP users, and Hosts frequently used from TIPs. To be put on the distribution list for these notes, apply to the NIC Station Agent.

# APPENDIX D: TERMINALS USED WITH THE TIP

The following terminals are reputed to have worked with the TIP. See the Introduction (Section 1).

A. B. DICK VIDEOJET 9600 LINE PRINTER (2400 bps)
ANDERSON-JACOBSON (models 630 and 841)
ARDS
KSR-35 Teletype
CALCOMP 565
CDI 1030/ "MULTICS" Terminal
DATA 100 (model 73)
DATAPOINT (models 2200, 3000, and 3300)
DELTA TELTERM 2
DIGITAL EQUIPMENT CORP. (models VT05 and GT40A)
EDT 1200
HAZELTINE 2000
LINEOLEX (model A)
MEMOREX 1240
SUGARMAN (model S-4300)
TECTRAN CASSETTE
TEKTRONICS (models 4010 and 4013)
TELETERM (model 1030)
TELETYPE (MODEL 38)
TERMINET 300
TI Silent 700
TYCOM
TRENDATA (model 1000)
UNIVAC DCT 500
VIDEO SYSTEMS (models 1200 and 5000)

We would be pleased to hear of any other terminals that have operated on a TIP.

At the International Conference on Computer Communications held in Washington, D.C., in October 1972, we had the opportunity to personally test a number of the above terminals with the TIP. As a result of this experience we now hold opinions as to the methods and difficulty of connecting a number of these terminals to the TIP. We suggest you call the Network Control Center to be put in touch with someone about this subject.