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Report No. 4135

Pluribus TIP Users' Guide

N.W. Mimno and E. Wm. Hiscox

January 1981

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1. Introduction

The Terminal Interface Message Processor, or TIP, provides the necessary hardware and software to allow a user at a terminal access to Hosts on the ARPANET. The Pluribus TIP Users' Guide provides scenarios for using the TIP, describes available commands and features, and discusses some general issues and background. The Guide may be read through or simply used as a reference. Users familiar with the 316 TIP may wish to take note of the section "Differences Between the 316 and Pluribus TIPs" (5.3).

1.1 A Brief Overview of the ARPANET

The ARPANET Computer Network is a distributed, store-and-forward, packet-switching network. Switching nodes, called Interface Message Processors (IMPs), are interconnected by high speed (typically 50Kbps) leased circuits. IMPs are implemented on a variety of types of hardware including the Honeywell DDP516, the Honeywell H316, the BBN Pluribus (a multiprocessor system), and the BBN C/30 (a microprogrammable machine). Application computers are attached to the subnetwork and are called Host computers or simply Hosts. The IMPs provide a communication capability for these attached Host computers. The ARPANET Network Operations Center (NOC) is responsible for operating and maintaining the communications subnetwork of IMPs, TIPS, and common-carrier circuits. The NOC is manned around the clock by a staff of network controllers, supported by hardware engineers and programmers.

Because a terminal may be attached to one Host and communicate with another Host across the country, a distinction is made between Server and User Host functions. As the terms suggest, a Server Host provides services one generally associates with a computer (file system, editors, assemblers, mail service, and so on) while a User Host provides only the minimum necessary to connect a user (typically a human being at a terminal) to other Server Hosts through the network. Many Hosts provide both functions.

Initially, all user access to the ARPANET was via terminals connected through Hosts. Very early in the network's operation, it was seen to be desirable to have a method of user access to the network which did not require the presence of a separate Host. This led to the development of the Terminal IMP (TIP) which provides a special purpose User Host running as an independent program in the same machine as an IMP, thus allowing direct network access for certain classes of terminals. The original TIP was implemented on the Honeywell 316 hardware; there are over 25 of these 316 TIPS on the ARPANET. The Pluribus TIP is implemented on BBN Pluribus hardware. The basic functions of both versions of TIP are the same though differences exist in internal organization, number of terminals potentially supported, and some special features.

1.2 The Concept of Protocols

A basic concept in the ARPANET is that of a set of communication conventions (or protocols) which allow diverse computers and terminals to understand one another.

Programs running in two possibly dissimilar Hosts must have some agreement as to the method of initiating communication, the interpretation of transmitted data, and so forth. Although it would be possible for such agreements to be reached by each pair of Hosts interested in communication, a more general arrangement is desirable in order to minimize the amount of implementation necessary for network-wide communication.

The ARPANET adopted a "layered" approach to the specification of Communications protocols, wherein the higher layers of protocol use the services of lower layers, but the functions are cleanly separated. The lowest layer is the IMP/Host protocol which specifies the physical and logical message transfer between a Host and its IMP. The next layer, called the Host/Host layer, specifies methods of establishing communications paths between Hosts, managing buffer space at each end of a communications path, etc. Next, the Initial Connection Protocol or ICP specifies a standard way for a remote user (or process) to attract the attention of a network Host, preparatory

to using the Host.* The ICP provides the analog of the user pressing the attention button at a local terminal on a Host. In the next layer is the Telecommunications Network or Telnet protocol which was designed to support terminal access to remote Hosts. Telnet is a specification for a network standard terminal and the protocol for communicating between this standard terminal and a Host. The next logical protocol layer consists of function oriented protocols; two examples are File Transfer Protocol (FTP) and Remote Job Entry protocol (RJE). Finally, at any point in the layering process, it is possible to superimpose ad hoc protocols.

The TIP implements the IMP/Host protocol and NCP version of Host/Host protocol, as well as the User Host versions of both the ICP and Telnet protocols. The pluribus TIP does not support the DOD standard Transmission Control Protocol (TCP) or Internet Protocol (IP).

* This is not theoretically a protocol layer, but thinking of it as one is adequate for the purpose of the Guide.

2. Scenarios for Using the TIP

The following sections describe typical sequences of commands and actions that a TIP user may pursue. The style is discursive and provides background explanations and discussion of related issues. For a quick tutorial, ignore the discussion sections. Each scenario also references more detailed explanation in other sections.

In the normal course of things, a user will go through several more or less distinct stages as the TIP is used. Initially, the user will be concerned with hardware, power, dialing in, establishing device rates, etc. Next, the user will instruct the TIP to open a connection to a remote Host, and later, when done, request the TIP to close the connection. Once the connection is open, the user will mostly ignore the TIP and use the remote Host. The user may also establish a dialogue with the TIP to get a comfortable set of parameters for the session of TIP use, either before or after a connection opens; users are advised to accept the TIP's default characteristics unless problems arise. The following sections will describe these stages in more detail.

2.1 Connecting to the TIP

The hardware stage is described in detail in Section 4, "Connection of Terminals to the TIP". The present section

describes only the final step of this stage, when the user has dialed up the TIP or turned on a directly connected terminal and the TIP detects the terminal on one of its previously idle lines.

Type <control-Q>

TIP prints "<sitename> Pluribus TIP <version #> <MLC>/<port>"
or TIP prints garbled message or none at all

An intelligible message from the TIP indicates that the port is correctly set to the terminal's rate. If this is satisfactory, the user may simply proceed to open a connection. Occasionally, the user may wish a different rate setting; procedures for changing the rate are described below.

A garbled response from the TIP or no response at all means that the port and terminal have mismatched rate settings. Many TIP ports may be in "hunt" mode; that is, ready to recognize the terminal's speed from the first character typed to it. In this case try hunting as described below. If hunting is also unsuccessful, the user may need assistance from the NOC; see the section on "Dealing with the NOC" (5.1). Some TIP ports are already preset to known rates. (The TIP liaison is in charge of such assignments; see Section 5.2, "Site Tailoring and Default Values.") In this case try changing the rate of the terminal to the appropriate setting, or call the NOC for assistance. Even if a port is preset, one may wish to change the rate, for instance

to get faster output. This may be done via the @DEVICE RATE N M command described in Section 3.3.1, "Terminal Characteristics," and also discussed below. It should be noted, however, that ports with preset rates may be protected from change; this policy assures that such protected ports, especially dial-ins, remain predictably set up for all users with access to them.

Hunting

Set the terminal to desired input/output rate (must initially be the same; for split rates and output greater than 2400 baud, see further discussion).

Type <break>

Type <control-Q>

TIP prints "<sitename> Pluribus TIP <version #> <MLC>/<port>"

Typing a "break" will insure that a hunting port is in hunting mode. If problems arise at any time, <break> will return the port to this initial state (unless there is an open connection, in which case the TIP sends a Telnet "break" to the Host). The TIP uses a single character, <control-Q> (ASCII DC1, octal 021) to deduce the terminal rate.* The TIP can hunt to any standard output rate from 110 to 9600 baud, and input rates up to 2400 according to the following scheme. The initial <control-Q> will set input and output rate equal to the output rate deduced for the terminal. For many cases, this is sufficient; the TIP types

* Experience has shown <control-A> may work better at 4800 baud.

the Herald message and the user moves on to the next stage. Sometimes, however, the user may desire a split rate, that is, input rate different from output rate: a typical example is 300 baud input, 9600 baud output. There are two different schemes possible to achieve this effect, described below. (Both require switching the terminal's rates; consult manufacturer's documentation for proper procedures.)

"Double" Hunting

For output > 2400 baud set the physical terminal rate in and out to the desired rate for output

type <break>

type <control-Q>

TIP prints "Set input rate, then type control-Q."

Set the physical terminal input rate to desired value (2400 baud or less), leaving output rate as it was

Type <control-Q>

TIP prints "<sitename> Pluribus TIP <version #> <MLC>/<port>"

The TIP can deduce rates from the input character control-Q that it cannot actually handle for data. This feature allows one to hunt to high rates for output and then adjust the input rate back to an acceptable value. The TIP effectively "hunts" a second time for input rate only. Note that <break> is not typed again; if so, the port will return to the initial hunting state.

The Device Rate Command

Set the physical terminal rate for the input and output to some value ≤ 2400 baud

Type <break>

Type <control-Q>

TIP prints "<sitename> Pluribus TIP <version #> <MLC>/<port>"

Type @Device Rate n m <carriage-return>
(or abbreviate to @D R n m <carriage-return>) where n is output baud rate and m is input baud rate, or some special character as described below and in section 3.3.1, "Terminal Characteristics")

Change the physical terminal rate for input and or output

The Device Rate command allows one to set a port to any of the following rates: for input 75, 110, 134.5, 150, 300, 600, 1200, 1800, 2400; for output, the above plus 4800 and 9600 baud. The parameters of the command, n and m, may be given in these baud rates, for example @D R 300 300 <carriage-return> sets input and output rates to 300 baud. Additionally, some special characters are defined as follows: <*> means leave the rate the same; <H> means rehunt.

2.2 Giving a TIP Command

(Section 3, The TIP Command Language, provides more detail on commands and command format.)

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

@OPEN 1/5 <carriage-return>

Such a command always starts with the "@" character, called the escape character, and ends with either a carriage-return character or a rubout character, 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 <carriage-return> there will typically be one or more words to identify the command, perhaps followed by one or more parameters. 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 1/5 <carriage-return>

Commands often consist of several command words; for example,

@SEND INTERRUPT PROCESS <carriage-return>

Such commands may be abbreviated; for example

@S I P <carriage-return>

The spaces are required: @SIP <carriage-return> is not a legal command.

Normally, any parameter can be changed at any time by the user at his terminal; when exceptions occur, the TIP will usually inform the user by printing a message.

2.3 Opening a Connection

User types @OPEN n/m <carriage-return>

TIP prints "Trying"

TIP prints one of the following within a minute or so:

"Connection Open"

Destination Host agrees to connect and user may continue.

"Host cannot be reached."

Destination Host cannot be reached due to some kind of trouble in the network.

"Host not responding."

Destination Host not up from the network's point of view, or Host did not answer TIP's request within the timeout period (of about five minutes).

"Host is down until <day> at <hour>:<minutes> <timezone>."

Destination Host not up from the network's point of view. The day and time when service was most recently estimated to resume is indicated.

"Host Rejected connection."

The remote Host rejected the attempt to establish a connection.

"Host does not support new leaders"

Destination Host cannot communicate with high numbered (>63) IMPs; user's TIP has a high number.

"Host did not complete ICP"

Destination Host started to connect but did not finish within the timeout period (of about three minutes).

@CLOSE <carriage-return> typed at any time should abort the open attempt.

A "connection" is defined by several protocols and consists of a data path in each direction between the TIP and the remote host. When the TIP prints "Open", both directions of the connection are complete. A port (or terminal) may only have one open connection at a time. The @Open command specifically starts a process inside the TIP to initiate a connection to the specified host.

2.4 Closing a Connection

The TIP does not know how to log a user out of the remote Host. The user must do this before closing the connection, following whatever procedure the Host requires. Then, to start the shut-down procedure between the TIP and Host,

type @CLOSE <carriage-return>

TIP prints "Connection Closed"

The TIP message is printed when the process is finished, indicating that the Host has agreed to end both directions of the connection. The "Closed" message should come promptly; occasionally the Host does not respond, but the TIP will time out and shut down the connection on its own (in about one minute).

Once the connection is closed, the user may proceed to open a new connection. When through, please remember to hang up a data set or otherwise free up resources so that others may use them.

2.5 Sending and Receiving Data, TIP Parameters

Sending data across the network is very straightforward. The TIP saves 7-bit characters in an input buffer, transmitting these in messages to the Host at appropriate intervals. Several commands exist to change the frequency of transmitting characters; these are described in the section on "Transmission Characteristics" (3.3.2).

The TIP performs no code translation with the single exception that (according to Telnet protocol) a <carriage-return> is expanded automatically either to <carriage-return linefeed> or <carriage-return nul>. The default is <carriage-return linefeed> although some TIP ports may be pre-set to <carriage-return nul>. Commands exist to allow change; they are described in the section on "Terminal Characteristics" (3.3.1).

Recalling that the TIP interprets <@> to be the command escape character, to send an <@> to the Host one must type <@@>. If this procedure is unacceptable for some reason, the escape character may sometimes be changed, as described in the section called "Escape Character Changes" (3.3.4).

Telnet protocol defines several standard representations for control functions such as "break" or "interrupt process"; these are intended to be a convenience to persons who use several different systems and thus do not need to learn the conventions of each Host. The TIP provides several commands to insert these standard function codes into the data stream. These are fully described in the section on "Telnet Standard Control Functions" (3.3.7).

Echoing is a difficult problem: who should echo and when? The user is advised to accept the TIP settings unless problems arise. If necessary, echo mode can be adjusted by the echo commands described in Section 3.3.6, "Connection Options: Binary and Echo."

Receiving data from the network is equally straightforward: the TIP receives characters and sends them to the terminal without translation. To provide for different terminal needs, various filling and parity schemes are implemented. Again, the user is advised to accept the TIP settings unless problems arise. The section on "Terminal Characteristics" (3.3.1) describes ways to change these settings.

Complete transparency on input and/or output (all eight bits, no escape character, parity or fill characters) is sometimes required. The TIP allows binary mode if the Host

agrees. The section on "Connection Options" (3.3.6) describes binary modes more fully.

2.6 Trouble, Abnormal Conditions

Ideally, once a connection is open, the TIP (and the network) provides an invisible link to the remote Host, as if the terminal were directly connected to that Host. In reality, this network communications link sometimes intrudes into one's consciousness as slow response, pauses, or even a broken connection. Some of the most common problems are described in the following paragraphs.

user gets slow response

Slow response has many causes, but is usually transient. Often, there is a particularly heavy load for a short while on some part of the sub-network, the Host, or the TIP; perhaps a line or an IMP has gone down, loading alternate routes. Commonly, the problem is with the Host itself, for some reason short of some resource. Very poor response for a long time, if not obviously caused by Host loading, may be reported to the NOC; see the section on "Dealing with the NOC" (5.1).

TIP rings "bells" when user types input

If its buffers are full when a character is typed, the TIP discards the character and echoes back a <bel> (ASCII 007 octal).

The TIPS buffers will normally be full only if congestion in the network or in the destination Host prevents the TIP from sending buffered characters. If this persists for several minutes, one might try the @FLUSH and/or @SEND SYNCH commands to "clear the pipe"; see the sections called "Clear Input Buffer" (3.3.3) and "Telnet Standard Control Functions" (3.3.7).

TIP prints one of the following:

"Host Reset Connection
Connection Reset"

Indicating that the Host sent a Host-Host protocol Reset message, or crashed; connection has closed.

"TIP going down for <reason> in <minutes> for <minutes>"
The TIP is going down in the number of minutes indicated; quickly stop what you are doing and stop using the TIP. (The reason why the TIP will be down and the approximate duration of the outage is indicated.)

"<sitename> Pluribus TIP <version #> <mlc#>/<port#>"
TIP has restarted; connection has been reset.

The TIP tries to inform the user of what is happening. The above messages all indicate something relatively serious has happened. The user should try to reopen the connection in "a while"; the new attempt will either succeed or provide more information, such as that the Host is down.

3. TIP Commands and Messages to the User

This section contains detailed explanations of the commands the user may give the TIP and the various messages the TIP may at times print out to the user. Much of this material has been covered in section 2; this section is primarily for reference. These commands and messages are local to the user and the TIP and should not be confused with interactions with the Host.

3.1 The TIP Command Language

All TIP commands begin with an escape character: this is `<@>` by default but can be changed by the "intercept" commands to some other character if desired. See the section on "Escape Character Changes" (3.3.4).

The command text itself follows with words separated by spaces. Only the first character of each word is recognized; in fact, other characters are ignored, so one may type abbreviated commands. Upper and lower case letters may be freely intermixed.

Some commands include one or more parameters, such as device rate. These follow the command text and are decimal numbers by default. Octal or hexadecimal may be used by preceding the number with `<up-arrow><O>` or `<up-arrow><H>` respectively. Decimal values may also be explicitly marked by preceding the number with `<up-arrow><D>`.

All legal commands terminate with a carriage-return character. In addition, commands may be aborted with a rubout character or by typing something illegal. The TIP will print "Aborted" or "Illegal TIP command" or "Illegal TIP command argument," respectively.

Termination of a command will result in some indication to the user, either a message or perhaps only a carriage-return and linefeed.

Most commands may be given at any time whether a connection is open or not. Further, since command recognition depends only on the escape character, the command may begin anywhere on a line.

If the escape character is doubled (i.e., the user types @@ or two of whatever the escape character has been set to), it is treated as one normal text character and buffered for transmission to the remote Host.

If transparency mode is desired, the user should request binary input mode; when in effect, the TIP will not intercept any escape character.

3.2 COMMAND SUMMARY (alphabetic list)

BINARY INPUT END

Leave (or reject) 8-bit binary input mode

BINARY INPUT START

Request 8-bit binary input mode

BINARY OUTPUT END

Leave (or reject) 8-bit binary output mode

BINARY OUTPUT START

Request 8-bit binary output mode

CLEAR DEVICE WILD

Set device to be unwild; take device out of wild mode.

CLEAR INSERT LINEFEED

Stop inserting <linefeed> after <carriage-return>; insert <nul> after <carriage-return>

CLOSE

Close all outstanding connections, or abort current Host login attempt

CONTROL PORT m n

Start entering commands for device n on MLC m; use restricted by NOC

CONTROL PORT CLEAR

Stop entering commands for another device; use restricted by NOC

DEVICE FILL LINEPRINTER

Establish padding for a line printer

DEVICE FILL NONE

Stop performing padding on output

DEVICE FILL SLOW-CARRIAGE-RETURN

Establish padding for a terminal with slow carriage-return

DEVICE PARITY NONE

No parity on output

DEVICE PARITY CLEAR

Set high-order (eighth) bit of output to 0

DEVICE PARITY EVEN
Set high order bit of output for even parity

DEVICE PARITY MARK
Set high order bit of output to 1

DEVICE PARITY ODD
Set high order bit of output for odd parity

DEVICE RATE n m
Set output baud rate to n and input baud rate to m

ECHO HALFDUPLEX
Terminal-generated echo -- TIP echoes nothing
(except the TIP inserted linefeed character)

ECHO LOCAL
Local TIP-generated echo -- TIP echoes everything

ECHO REMOTE
Request Remote Host generated echo for data -- TIP
still echoes local TIP commands

FLOWCONTROL INPUT END
Disable XON-XOFF flowcontrol for the terminal to
TIP direction

FLOWCONTROL INPUT START
Enable XON-XOFF flowcontrol for the terminal to
TIP direction

FLOWCONTROL OUTPUT END
Disable XON-XOFF flowcontrol for the TIP to
terminal direction

FLOWCONTROL OUTPUT START
Enable XON-XOFF flowcontrol for the TIP to
terminal direction

FLUSH
Delete all characters in input buffer

HERALD
TIP prints "<sitename> Pluribus TIP <version#>
<MLC>/<port>"; an additional short message is
printed if the custom herald facility has been set
up by the NOC

INSERT LINEFEED

Insert <linefeed> after <carriage-return>

INTERCEPT SYMBOL S

Use the character <S> as TIP command escape character; not all characters are legal

INTERCEPT VALUE n

Use the character with ASCII value n as TIP command escape character; not all characters are legal

OPEN m.n

Open a bi-directional connection to the IMP.Host address specified

OPEN n/m

Open a bi-directional connection to the Host/IMP address specified

OPEN n/m,s

Open a bi-directional connection to the Host/IMP, socket address specified

RESET

Reset current TIP port parameters and close connection

RESET PORT

hang-up data set; only legal on data-set ports

SEND ABORT OUTPUT

Send the Telnet "AO" command

SEND ARE YOU THERE

Send the Telnet "AYT" command

SEND BREAK

Send the Telnet "BRK" command

SEND ERASE CHARACTER

Send the Telnet "EC" command

SEND ERASE LINE

Send the Telnet "EL" command

SEND INTERRUPT PROCESS

Send the Telnet "IP" command followed by the SYNC sequence

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

SET DEVICE WILD
Accept a connection from any host

TRANSMIT EVERY n
Attempt to send characters to host at least every
nth character; n equal 0 is interpreted as 1

TRANSMIT NOW
Send input buffer now

TRANSMIT ON LINEFEED
Send input buffer every time a <linefeed> is
encountered

TRANSMIT ON MESSAGE-END
Send input buffer every time <control-S> is
encountered

3.3 Detailed Command Descriptions

The following provides detailed discussions of each command with some general comments to provide context. The "command class" breakdown is a logical one intended for ease of understanding; there is no technical distinction among classes. Commands are legal at any time unless otherwise specified; some commands cannot be given while the connection is open (or closed).

3.3.1 Terminal Characteristics

Several commands allow the user to control the way the TIP handles data coming from or sent to the terminal.

Rate Legal values are: for input, 75, 110, 134.5, 150, 300, 600, 1200, 1800, 2400; for output, 4800 and 9600 in addition to input rates. Externally clocked rates (terminal provides clock) are also supported. Rate may be pre-specified in the site parameters file, and may also be specified as permanent, that is, not changeable by user command; see the section on "Site Tailoring and Default Values" (5.1).

DEVICE RATE n m

sets the output rate to value n and the input rate to m. Both rates are usually given as decimal baud rate. In addition, some special characters are allowed: <*> means leave as is; <H> means rehunt both rates.

Fill The TIP allows several optional schemes for filling, or padding, output to the terminal. These may be pre-specified by the site parameters file; see the section on "Site Tailoring and Default Values" (5.2). The default is no padding if no scheme has been specified by the user or site parameters. Binary output mode will suppress padding. The padding schemes are mutually exclusive.

DEVICE FILL NONE

commands the TIP to do no padding on output; disables any prior padding.

DEVICE FILL SLOW-CARRIAGE-RETURN

commands the TIP to pad with nuls after a <carriage-return> sent to the terminal; the number of nuls depends on the output rate, the faster rate requiring more nuls.

DEVICE FILL LINEPRINTER

commands the TIP to pad for lineprinters which require full lines; lines are padded with rubouts to be 83

characters long before a vertical format effector is sent to the terminal (lf, cr, vt, ff).

Parity The TIP provides five choices for setting the parity bit (high order, eighth bit) of characters output to the terminal. Parity type may be pre-specified in the site parameter file. The default if no parity mode is specified will be none. When binary output mode is in effect, parity will be suppressed and the eighth bit will be passed as received from the Host. The bit will be treated as follows:

DEVICE PARITY NONE
 ignored

DEVICE PARITY CLEAR
 set to 0 always

DEVICE PARITY MARK
 set to 1 always

DEVICE PARITY EVEN
 set to even parity

DEVICE PARITY ODD
 set to odd parity

Linefeed Insertion As required by Telnet protocol, the TIP will automatically follow a <carriage-return> input from the terminal with either a <linefeed> or <nul> character. The default is insert <linefeed>. This insertion is suppressed when binary input mode is in effect. The character desired may be pre-set in the site parameters file or changed at any time by the following commands:

INSERT LINEFEED

insert <linefeed> after <carriage-return> input from terminal

CLEAR INSERT LINEFEED

insert <nul> after <carriage-return> input from terminal; do not insert <linefeed>

3.3.2 Transmission Characteristics

Once a connection to a remote Host is established, the TIP will accept data input from the terminal and periodically send it to the Host. Typically, the TIP will send every character, which is the default, but this need not be so. Some Hosts prefer to receive data in chunks such as a line at a time. Several commands specify when data should be sent to the Host. It should be noted, however, that the TIP may send data spontaneously (for instance if buffer space is low) and cannot guarantee any particular scheme all the time. The following should therefore be considered guidelines; in practice they are maximum values.

TRANSMIT NOW

requests immediate transmission of all characters currently stored in input buffers.

TRANSMIT EVERY n

requests the TIP to attempt transmission every nth character; n equals one is the default.

TRANSMIT ON LINEFEED

requests transmission whenever a <linefeed> character is encountered, including the one automatically inserted after <carriage-return>.

TRANSMIT ON MESSAGE-END

requests transmission whenever a <control-S> character is encountered.

3.3.3 Clear Input Buffer

FLUSH

causes the TIP to discard any unsent characters in the input buffer.

3.3.4 Escape Character Changes

The TIP usually allows the user to change the local command escape character from the default <@> to some alternate character. Note that some ports may be pre-set with a permanent escape character which the user cannot change. Legal values are the following set:

! " # \$ % & ' () *
+ , - . / : ; < = >
? @ { _ } ~ ^Y ^P

The TIP will print a message informing the user of the new escape character (especially useful if the character was mis-typed).

INTERCEPT SYMBOL S

changes the escape character to character <S> if S is legal.

INTERCEPT VALUE n

has the same effect as above, merely allowing the user to express the new escape character as an octal, decimal, or hex number for the ASCII character desired.

3.3.5 Connection Control: Open and Close

These commands allow a user to open and close connections. The TIP will print messages indicating success or failure, giving

the reason. See also the scenarios in Section 2. The ARPANET directory contains a list of Host addresses.

OPEN n/m

OPEN m.n

requests the TIP to open a connection to the specified Host (or specifically, to begin the Initial Connection Protocol). The TIP accepts a two-number Host address in either of the following formats:

<Host #n on the IMP>/<IMP #m>

<IMP #m>.<Host #n on the IMP>

Leading zeroes should be used: for example, @OPEN 0/44, rather than @OPEN /44.

OPEN n/m,s

requests the TIP to open a connection to the specified socket "s" on <Host #n on the IMP>/<IMP #m>. The socket "s" is a 32 bit number which identifies a specific process in the Host.

OPEN p

Historical Note: A Host may additionally be specified by a single number; in the above example, @OPEN 44 may be used. A single number address was the original format on the ARPANET with the address being the obscure decimal equivalent of an eight bit field (two high order bits for Host, low order six for IMP). Expansion of the ARPANET has outstripped the field and the two-number formats represent both expanded capacity and increased clarity; they should be used in preference to the single number format, which will be phased out.

CLOSE

requests the TIP to close the connection by initiating the close connection protocol.

3.3.6 Connection Options: Binary and Echo

Telnet protocol provides a procedure for the User (TIP) and Server Hosts to negotiate for transmission characteristics, defines a minimal default set of parameters, and then allows each side to negotiate for non-standard options. No Host is required to accept an undesirable state; in fact, a Host can simply refuse to do "whatever the other side requested" without even understanding what it has just refused. This protocol should allow sophisticated Hosts to define complex options without burdening simpler Hosts. The TIP handles two options at the request of the user; these are Binary (input and output) and Remote Echo. It is necessary to understand that these options cannot be in effect unless a connection is open and the Host and TIP are in agreement. So, unlike Parity type, for instance, the request to the TIP does not guarantee the function. The TIP will print a message informing the user that the option request was refused. If no such message occurs, the requested mode should be in effect.

Binary Input and Output Options

Binary input and/or output are available. The commands are:

BINARY INPUT START
requests binary input mode

BINARY INPUT END
ends binary input mode

BINARY OUTPUT START
requests binary output mode

BINARY OUTPUT END
ends binary output mode

The TIP sets an internal flag for the mode the user wishes, and attempts to get the remote Host to agree. This feature is not automatic: the TIP will not send a request unless the connection is open at the time of the command, but the TIP will passively accept a request for binary mode from a remote Host until the user ends binary mode. The TIP will accept a Host request for Binary input and/or output modes as the default unless explicitly disabled. When Binary mode(s) are in effect the TIP passes all eight bits of data transparently to and/or from the Host: in binary output mode there is no padding or parity added to output; in binary input mode there is no <linefeed> or <nul> inserted after <carriage-return>, and there is no escape character and local commands cannot be given.

While binary input and output modes are independent in the TIP, some Hosts only negotiate both together. Since binary mode can only be in effect on an open connection, closing the connection causes a return to non-binary and local command interpretation.

Echoing Options

Who shall echo and when? Echoing is a complex problem, without any neat solution. Basically, echoing can occur at the terminal hardware (ECHO HALFDUPLEX), in the TIP (ECHO LOCAL), or in the remote Host (ECHO REMOTE). The TIP does not provide the Remote Controlled Transmission and Echoing (RCTE) option.

Each of the echo commands sets the internal state of the TIP to the correct mode, and in addition sends the appropriate TELNET command to the Host if the connection is open when the command is given, or automatically whenever a new connection opens. Halfduplex and Local echoing are available directly from the TIP; Remote Echo mode requires an open connection to a cooperating Host. The default state is Local Echo as described below.

ECHO HALFDUPLEX

instructs the TIP to assume that the terminal is physically providing its own echoing of characters. The TIP will not echo characters input from the terminal and will also refuse to allow the remote Host to echo. The TIP will, however, send out to the terminal any characters it inserts in the data, notably <linefeed> after <carriage-return>. This mode can be used by special purpose devices attached to the TIP to eliminate almost all echoing as well as by real, physical halfduplex terminals.

ECHO LOCAL

instructs the TIP to echo all characters input from the terminal.

ECHO REMOTE

instructs the TIP to request the Host to echo if the connection is open, and to send such a request automatically whenever a new connection opens. Once in this 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 LOCAL (or @ ECHO HALF) modes so when a connection is not open, or if Host refuses to echo, the TIP will resume local echoing.

3.3.7 Telnet Standard Control Functions

The primary goal of the Telnet protocol is the provision of a standard interfacing of terminal devices and terminal-oriented processes through the network. Early experiences with this type of interconnection have shown that certain functions are implemented by most server Hosts but that the methods of invoking these functions differ widely. For a human user who interacts with several server systems, these differences are highly frustrating. Telnet, therefore, defines a standard representation for several of these functions, as described below. These standard representations have standard, but not required, meanings; that is, a system which does not provide the function to local users need not provide it to network users and may treat the standard representation for the function as a no-operation. However, a system which does provide the function to local users is obliged to provide the same function to a network user who transmits the standard representation for the function. Persons may of course continue to use the Host-defined

method of invoking the function. The TIP commands simply send the appropriate Telnet function codes to the Host if a connection is open (or opening).

SEND ABORT OUTPUT

(AO) - Many systems provide a function which allows a process, which is generating output, to run to completion (or to reach the same stopping point it would reach if running to completion) but without sending the output to the user's terminal. Further, this function typically clears any output already produced but not yet actually printed (or displayed) on the user's terminal. AO is the standard representation for invoking this function. The Server should allow the current process to (appear to) run to completion, but not send its output to the user, and also send a SYNC to the user.

SEND ARE YOU THERE

(AYT) - Many systems provide a function which gives the user some visible (e.g., printable) evidence that the system is still up and running. This function may be invoked by the user when the system is unexpectedly "silent" for a long time, because of an unanticipated (by the user) length of a computation or an unusually heavy system load, etc. AYT is the standard representation for invoking this function. The server should send back to the NVT some visible (i.e., printable) or audible evidence that the AYT was received.

SEND BREAK

(BRK) - This interpretation of the break is entirely up to the Host - many ignore it. This code is provided because it is a signal outside the ASCII set which is currently given local meaning within many systems. It is intended to indicate that the Break Key or the Attention Key was hit. Note, however, that this is intended to provide a 129th code for systems which require it, not as a synonym for the IP standard representation.

SEND ERASE CHARACTER

(EC) - The Server may provide a function which deletes the last preceding undeleted character from the stream of data being supplied by the user. This function is typically used to edit keyboard input when typing

mistakes are made. EC is the standard representation for invoking this function.

SEND ERASE LINE

(EL) - The Server may provide a function which deletes characters from the data stream back to, but not including, the last <carriage-return linefeed> sequence sent over the Telnet connection. This function is typically used to edit keyboard input. EL is the standard representation for invoking this function.

SEND INTERRUPT PROCESS

(IP) - The Server may provide a function which suspends, interrupts, aborts, or terminates the operation of a user process. This function is frequently used when a user believes his process is in an unending loop, or when an unwanted process was inadvertently activated. IP is the standard representation for invoking this function. The TIP automatically follows IP with a SYNC.

SEND SYNC

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. Typical usage of this command might be @ S B followed by @ S S.

3.3.8 Reset Commands

The reset commands cause a return to a known, initial state.

RESET PORT

hangs up a data set; it is applicable only to dial-in ports.

RESET

shuts down any open connection, initializes terminal parameters to any preset values, and prints the TIP Herald message; this command does not hang up a data set or put a port back into hunt mode.

3.3.9 Flowcontrol Commands

Certain devices such as line printers may need flowcontrol to prevent their internal buffers from overflowing if they are connected to a TIP port. Likewise, the TIP may need flowcontrol to prevent its buffers from overflowing if it is receiving data at a high rate from a connected device such as a bubble memory terminal. The TIP provides XON-XOFF flowcontrol for the input (terminal to TIP) and output (TIP to terminal) directions. The XOFF flowcontrol character is <control-S> (ASCII DC3, octal 023) and the XON flowcontrol character is <control-Q> (ASCII DC1, octal 021).

The commands for input are:

```
@FLOWCONTROL INPUT START
```

```
@FLOWCONTROL INPUT END
```

and for output are:

```
@FLOWCONTROL OUTPUT START
```

```
@FLOWCONTROL OUTPUT END
```

When a port has Output Flowcontrol enabled, the TIP will do the following: when an XOFF has been received from the port, the TIP will stop sending characters to the port; the TIP will resume sending characters to the port after the TIP has received an XON.

When a port has Input Flowcontrol enabled, the TIP will do the following: when the TIP's input buffer for the port is about 80% full, the TIP will send the port an XOFF to signal that the port should stop sending input; after the utilization of the TIP's input buffer for the port has dropped to 60%, the TIP will send the port an XON character to signal that the port may resume sending input.

Certain TIP options will cause deadlocks or undesirable states if they are set while flowcontrol is on. Therefore, the following TIP options cannot be enabled at the same time - Input and Output Flowcontrol, Input Flowcontrol and Binary Output, Output Flowcontrol and Binary Input, and Output Flowcontrol and Transmit on EOM (control-S). Furthermore, when Input Flowcontrol is enabled, the TIP will not output the characters control-S or control-Q which a host sends the port.

A port can have flowcontrol permanently enabled by setting the FLOWCONTROL option in the site-specific file. If flowcontrol is not in the site file then hanging up a dataset will clear any flowcontrol mode which has been set. Resetting or closing a connection on a terminal port (i.e., not a dataset) will not clear the flowcontrol mode.

3.3.10 "Wild" mode commands

In most cases, TIP connections to remote Hosts are initiated by a person at a terminal. Occasionally, it is useful to have the remote Host open a connection to a passive device on a TIP, most often a line printer or tape punch. Normally, a TIP port will refuse such an "unsolicited" request for connection; a port for which the TIP honors such requests is called "wild". Wildness may be turned on and off by user commands or may be preset in the site parameters file, as described in the section called "Site Tailoring and Default Values" (5.2). To make the connection, the remote Host must know the precise location of the wild port, that is, its socket and Host numbers. A typical example is a spooling process on a Host which queues listing requests, then automatically opens connections to a line printer and sends the files.

```
SET DEVICE WILD
    puts the port into "wild" mode.
```

```
CLEAR DEVICE WILD
    removes the port from "wild" mode.
```

3.3.11 Control Port commands

Normally a user gives TIP commands only to the port being used. Sometimes, though, it is useful to give commands for one terminal from another, for example in the case of a terminal in a hung state, or one simply unable to produce input such as a line

printer. The liaison for each TIP will designate certain ports to have Control Port privileges.

CONTROL PORT n m

puts the user's terminal in control of port m on MLC n; the TIP indicates success and prompts with a double escape character; user enters commands which apply to controlled port; no data is allowed.

CONTROL PORT CLEAR

ends control port mode; normal mode resumes.

3.4 TIP Messages to the Terminal User

The following is an alphabetic summary listing of messages the TIP may print to the user.

<sitename> Pluribus TIP <version #> <mlc#>/<device #>

The TIP heard the user dial in and establish rate. The <version #> is the TIP software system version number. It is followed by the decimal port number given as an MLC number followed by a device number within that MLC.

<carriage-return-linefeed>

Indicates a general TIP response such as completion of a command.

@@

Prompt when in Control Port mode.

Aborted

TIP has aborted current procedure, as requested by the user.

Binary Input request rejected

Host has refused Telnet Negotiation for Binary Input Mode.

Binary Output request rejected

Host has refused Telnet negotiation for Binary Output mode.

Can't - A connection is still open

Indicates ICP attempt (@Open command) has failed; connection is already open, in process of opening, or closing.

Connection Open
Connection Closed
Connection Reset

Indicate a change in the state of the connection.

Controlled Port is busy - Try again later
Control Port resources are currently being used; try again later.

Controlling MLC <n> on Port <m>
Control Port request is successful for the indicated port.

Echo request rejected
Host has refused Telnet negotiation for Remote Echo mode.

Flowcontrol is not allowed with current TIP options enabled
A TIP option is already set which prevents flowcontrol from being started.

Host broke the connection
Destination Host has discarded an open connection without sending the proper close protocol message.

Host cannot be reached
Destination Host cannot be reached due to some kind of trouble in the network.

Host closed connection
Destination Host has closed the connection.

Host did not complete ICP
Destination Host started to connect but did not finish within the timeout period (of about three minutes).

Host does not support new leaders
Destination Host cannot communicate with high numbered (>63) IMPs; user's TIP has a high number.

Host not responding
Destination Host is not up from the network's point of view, or Host did not answer TIP's request within the timeout period (of about five minutes).

Host is down until <day> at <hours:minutes> <timezone>
Destination Host is not up from the network's point of view. The time and day when service was most recently estimated to resume is indicated.

Host rejected connection

The remote Host rejected the attempt to establish connections.

Host reset connection

Indicates the Host sent a Host/Host protocol Reset message, or crashed; connections are closed.

Illegal TIP command

The TIP does not recognize the command.

Illegal TIP command argument

The command contains an inappropriate parameter value.

Intercept character is <X>

Confirms that the escape character was changed to <X>.

Intercept Character is permanent for this port

TIP will not change the escape character for this port.

Network buffer is full - Try again later

The TIP lacks buffer space to open a connection.

No more host connections available

An attempt was made to open a connection to a new Host while the TIP is already supporting connections to ten other Hosts.

Port is being controlled

An attempt was made to execute a command at a port that is being controlled.

Port is not a data set - TIP command aborted

A command was given which is inappropriate for this port.

Rates are permanent for this port

An attempt was made to change the rates on a port which has fixed rates.

Set input rate, then type control-Q

TIP hunted to a rate acceptable for output but too fast for input; user must hunt a second time after setting the terminal to an input rate no more than 2400 baud.

Terminal does not have control port privileges

Terminal is not authorized to control other ports.

Terminal is already in control port mode
The port specified in a Control Port command is already controlled by someone else.

Terminal is not a hunting terminal
Command given was inappropriate for this port.

Terminal not in control mode - TIP command aborted
The Control Port Clear command was given but the port was not in Control Mode.

Terminal does not have an open connection
Command is inappropriate unless a connection exists.

TIP Command is not implemented
Command given is not supported in the current version of the TIP but may work someday.

TIP going down for <reason> in <minutes> for <minutes>
The TIP is going down in the number of minutes indicated -- quickly stop what you are doing and stop using the TIP. The reason why the TIP will be down and the approximate duration of the outage are indicated.

TIP option is not allowed when flowcontrol is enabled
An attempt was made to enable a TIP option that is disallowed while flowcontrol is on.

Trying
The TIP is now servicing the user's OPEN request.

In addition to these messages, the TIP is able to send a custom herald message to users. When a user closes a connection, hunts a port, or issues a HERALD command, a short message can be printed on the user's terminal along with the normal TIP site herald. If this feature is desired, please contact the NOC for details.

4. Connection of Terminals to the TIP

4.1 General Comments

The Pluribus TIP allows a wide variety of terminals to connect to the TIP. The TIP supports terminals and modems that conform to the EIA RS232 specification as well as terminals that communicate using either 20 or 60 milliamperes current loops. This section describes the physical connection considerations for the above protocols. Unless specified, "terminal" means Terminal or Modem.

4.2 RS232 Terminal or Modem Connection

Basically, RS232 defines bipolar data and control signals, impedance characteristics, and control signal use. A data line is marking or logical one between -3 and -25 volts. A space, logical zero, is a voltage between +3 and +25 volts. The resistive component is defined as not less than 3000 ohms. The reactive component shall not be inductive and the capacitance shall not exceed 2500 pfd measured at the interface connector. For further information, an EIA RS232 manual is recommended. Most terminals and modems adhere well to the voltage specifications, but the control line usage varies from manufacturer to manufacturer.

The TIP will work with modems on either dedicated or dial up lines. A number of modems are supported, and basically the TIP will handle any modem that is similar to the Bell 103; Bell 202S and T modems have been used as have Vadic 3400 series. Given the large number of modem manufacturers, it would be advisable to check with the NOC about new modems; the NOC can assist a potential user in deciding whether a particular modem will work.

4.2.1 Double Connection Line Interface Unit

The Double connection Line Interface Unit supports two terminals per card; it is called an ELIU. There are two 20-pin connectors on each card which are connected to BBN-supplied cables. The cables are terminated at the customer end with DB25P or DB25S connectors as requested by the customer.

There are four cables, two for connection to modems and two for connection to terminals. The following table should provide enough information to order a cable.

CABLE	CONNECTOR	CONNECTS	-X	FEET
DLCM-X	male	modem	-A	3
DLCF-X	female	modem		
DLTM-X	male	terminal	-B	10
DLTF-X	female	terminal	-C	20

4.2.2 Terminal and Modem Cable Connections

TERMINAL CABLES

(DLT (M/F) -X)

PIN	USE
1	PROTECTIVE GROUND (AA).
2	RECEIVED DATA (BB). Data going from the terminal to the TIP.
3	TRANSMITTED DATA (BA). Data going from the TIP to the terminal.
4	REQUEST TO SEND (CA). From the terminal MSTAT0 on the MLC console. The ELI jumpers this to MSTAT2 on the MLC console which is DATA TERMINAL READY (CD) pin 20 on the 25 pin RS232 connector.
5	CLEAR TO SEND (CB). MCBIN0 on the MLC console. Held on by the TIP.
6	DATA SET READY (CC). MCBIN2 on the MLC console. Held on by the TIP.
7	SIGNAL GROUND (AB).
8	RECEIVED LINE SIGNAL DETECTOR (CF). MCBIN3 on the MLC console. Held on by the TIP.
12	SECONDARY RECEIVED LINE SIGNAL DETECTOR (SCF). MSTAT3 on the MLC console. Not used by TIP software.
16	SECONDARY RECEIVED DATA (SBB). MCBIN1 on the MLC console.
19	SECONDARY REQUEST TO SEND (SCA). MSTAT1 on the MLC console.
20	DATA TERMINAL READY (CD). MSTAT2 on the MLC console. MSTAT2 is jumpered from MSTAT0 on the ELI.

MODEM CABLES
(DLC (M/F) -X)

- 1 PROTECTIVE GROUND (AA).
- 2 TRANSMITTED DATA (BA). Data going from the TIP to the modem.
- 3 RECEIVED DATA (BB). Data going from the modem to the TIP.
- 4 REQUEST TO SEND (CA). MCBIN0 on the MLC console. Held on by the TIP.
- 5 CLEAR TO SEND (CB). MSTAT0 on the MLC console.
- 6 DATA SET READY (CC). MSTAT1 on the MLC console. MSTAT1 is used in conjunction with MSTAT2 to determine if a legitimate data call has been made.
- 7 SIGNAL GROUND (AB).
- 8 RECEIVED LINE SIGNAL DETECTOR (CF). MSTAT2 on the MLC console. MSTAT2 is used in conjunction with MSTAT1, DATA SET READY, to determine if a legitimate data call has been made.
- 12 SECONDARY RECEIVED LINE SIGNAL DETECTOR (SCF). MSTAT3 on the MLC console. MSTAT3 is jumpered to MSTAT1 on the ELI.
- 14 SECONDARY TRANSMITTED DATA (SBA). MCBIN1 on the MLC console. Held on by TIP software.
- 19 SECONDARY REQUEST TO SEND (SCA). MCBIN2 on the MLC console.
- 20 DATA TERMINAL READY (CD). MCBIN3 on the MLC console. Held on by TIP software except for about 1.2 seconds after DATA SET READY is turned off.

There is an older version of the ELIU card which implements a subset of the available control and status signals. The DATASET READY status signal (CC) is jumpered to the SECONDARY

RECEIVED LINE SIGNAL DETECTOR (SCF) signal, and the RECEIVED LINE SIGNAL DETECTOR (CF) status signal is jumpered to the REQUEST TO SEND (CA) signal. The DATA TERMINAL READY (CD) control signal is held on in the corresponding modem cable.

4.3 Current Loop

The BBN Current Loop Line Interface Unit, ILIU, supports two current loop terminals. Both 20 and 60 milliamperes current loops are supported, and the current can be supplied by the ILIU or the terminal. A connector compatible with the 3M 3429 connector must be used. One such connector is the CANNON 121-7326-113. Pin numbering is shown in figure 1.

.....
! 26 25 !
! 24 23 !
! 22 21 !
! 20 19 !
! 18 17 !
! 16 15 !
! 14 13 !
! 12 11 !
! 10 9 !
! 8 7 !
! 6 5 !
! 4 3 !
! 2 1 !
.....

Figure 1

If the terminals being used are on a ground system that is independent of the Pluribus TIP, or have other ground problems, the ILIU can work with an external supply. The external supply

must be bipolar and referenced to a common ground. The external supply cannot be greater than +15 or -15, and the maximum interground potential is ± 2500 volts. Connection of the external supply is described below.

EXTERNAL POWER SUPPLY

Connect	To
PIN 3	PIN 5
PIN 7	PIN 9
PIN 11	PIN 13
PIN 6	external minus supply
pin 10	external ground
PIN 14	external plus supply.

If the internal ± 12 volt supplies are to be used, make the following connections.

INTERNAL POWER SUPPLY

Connect	To
PIN 3	PIN 4
PIN 7	PIN 8
PIN 11	PIN 12

Data going from the ILIU to the terminal, TRANSMIT or PRINTER, comes from pins 1, TRANSMIT +, and 2, TRANSMIT-. Data coming from the terminal to the ILIU, RECEIVER or KEY-BOARD, comes into the ILIU on pins 25, RECEIVER-, and 26, RECEIVER+. Polarity must be observed in both cases.

Selection of the 20 or 60 milliamper mode is described below.

Report No. 4135

Bolt Beranek and Newman Inc.

TRANSMIT

20 Milliampere as above

60 milliampere

Connect

To

PIN 21
PIN 17

PIN 22
PIN 18

RECEIVE

as above

Connect

To

PIN 23
PIN 15

PIN 24
PIN 16

5. Special Operational Issues

5.1 Dealing with the Network Operations Center (NOC)

The Network Operations Center is located at and run by Bolt Beranek and Newman Inc. in Cambridge, Massachusetts. It is manned 24 hours a day, seven days a week. When problems occur that the user is unable to fix locally or diagnose accurately, the NOC can assist in a number of ways: by directly fixing TIP problems or port settings; by helping to diagnose a problem as a TIP, Host, subnet, phone line, or terminal problem; by answering questions and explaining situations.

The NOC values user feedback as an aid in maintaining service and as a way to identify low level problem areas. Suggestions are also welcome; difficulties sometimes go unrecognized until a user asks. We request that when communicating with the NOC, the user be as specific as possible. For TIP problems, it is very useful to know which port on which TIP and MLC is affected; time of day is often useful in relating a problem to other network events.

There are two ways to reach the NOC: for immediate needs, telephone 617-661-0100; otherwise send network mail to the address CONTROL@BBNC.

5.2 Site Tailoring and Default Values

Each TIP site has a special site-specific file which is included whenever the TIP is reloaded by the NOC. This file contains the name of the site, its configuration (such as how many MLCs there are and how many terminals on each MLC) and other general information needed by the TIP program. In addition, the file allows a limited number of individual TIP ports to be tailored for particular devices. The feature has proved to be a great convenience where usage of TIP ports is known, for instance, for lineprinters, special devices, high speed dial-up lines, and terminals directly and permanently connected to a TIP.

A liaison at each TIP site is responsible for coordinating this information and all requests for changes to the site-specific file must be channeled through the site liaison. The NOC can provide the name of a site liaison for any site upon request.

The specific parameters which may be tailored are:

- input and/or output rate
- permanent rates (default is changeable rate settings)
- insert <linefeed> or <nul> after <carriage-return> (default is <linefeed>)
- fill type (default is none)
- control port capability (default is none)

- flowcontrol mode (default is no flowcontrol)
- parity type (default is none)
- binary mode (default is accept binary in and out)
- echo mode (default is local echo)
- wild mode (default is not wild)
- intercept character (default is <@>)
- permanent intercept character
(default is changeable intercept character
assignment)
- transmission frequency (default is every character)

5.3 Differences Between the 316 and Pluribus TIPS

Persons with previous experience on the 316 TIP may at times be confused, or merely curious, about differences between the two systems. This section briefly lists some of these.

- The Pluribus TIP uses a different scheme for hunting and can hunt to higher rates.
- Messages printed to the user are expanded and more informative in the Pluribus TIP.
- The Pluribus TIP buffers command parameters as they are typed and does not destroy the current values until the command is legally ended; thus aborting a command has no bad effect.
- Parameters to commands are better human engineered, notably device rates, which may be given as baud rates.
- The Pluribus TIP restricts the set of legal escape characters where the 316 did not.
- Pluribus TIP commands terminate with a <carriage-return> instead of the <linefeed> used by the 316 TIP.
- The Control Port commands on the Pluribus are a rationalized version of commanding another terminal in the 316 by preceding the 316 command with a device #.
- Pluribus TIP does not implement the Old Telnet protocol, which included the "commands from the net" capability and allowed <carriage-return> to be sent by itself, not followed by either <linefeed> or <nul>.
- The Pluribus TIP does not implement the Telnet RCTE option.
- The Pluribus TIP does not support the IBM 2741 terminal or the magnetic tape option.
- The Pluribus TIP does not implement divert output, low level protocol commands, "capturing".

DATE
ILME