NO. 1 PACKET SWITCHING SYSTEM PACKET SWITCH MEASUREMENTS

DESCRIPTION

LOCAL AREA DATA TRANSPORT NETWORK

NETWORK ADMINISTRATION

CONTENTS PAGE

CONTENTS	PAGE

Figures

Tables

CONTENTS	PAGE

1. GENERAL

1.01 The purpose of this section is to provide Network Administration with the measurements that are available for use in the administration of the No. 1 Packet Switching System (No. 1 PSS) packet switch within the Local Area Data Transport (LADT) network. Included in this section is a listing of the measurement variables and a description of the method of data collection, as well as report availability.

1.02 Whenever this section is reissued, the reason(s) for reissue will be listed in this paragraph.

1.03 The title for each figure includes a number(s) in parentheses which identifies the paragraph(s) in which each figure is referenced.

1.04 In addition to specific information related to the measurements available, this section also includes a brief description of the packet switch and the packet switching technology used in the LADT network. This description is provided for a better understanding of the actual measurement definitions.

1.05 The terms and specifications provided in this document are relative to LADT Generic 1, Release 1A. It should be noted that components for service offerings similar to LADT may have different names, but may perform like functions. Any references to the No. 1 PSS packet switch relate to Version 2.0, Release 2.0.

2. PACKET SWITCHING OVERVIEW

TECHNOLOGY

2.01 The No. 1 PSS packet switch uses packet switching as a method of routing data packets to their various destinations. The technique used in this type of switching is to store and forward. The outgoing packets remain in a buffer at the sending node until the next node in the connection acknowledges the error-free reception of the data packet. In this way the packet is held in memory until there is a confirmation of satisfactory reception at the destination. The sending node then discards the data packet.

2.02 A data packet is defined as a fixed maximum length unit of data and control information that is sent from the source to the destination. The configuration of a single data packet is based on a standard set of communication rules identified as the X.25 communications protocol. (Refer to Part 3 of this section for further information on packet switch communications.) Because of the size limitation and required control information, a data packet may be one of a series or may be fully self-contained. These data packets are transported over preestablished paths called virtual circuits.

2.03 There is no physical facility usage or reservation with the establishment of a virtual circuit. Instead, a virtual path is established in the system logic. Physical facilities such as circuits, buffers, and memory are only assigned when actually required to perform a function. In this way, many virtual circuits may establish logical paths over the same physical facility, e.g., access line.

2.04 The No. 1 PSS packet switch is not, in general, sensitive to circuit holding times. The overall capacity of the packet switch is stated in terms of throughput. Throughput is defined as the rate at which the packet switch can switch packets within a specified delay parameter. The key indicator is **delay** and **not blocking**. The more traffic or load there is on the packet switch, the more delay. It is essentially a nonblocking system, although deadlocks and overloads can occur. The effects of a deadlock situation or an overload condition are that little or no effective work is accomplished within the network, and packets are discarded, causing packet retransmissions.

2.05 The packet switch is also relatively insensitive to the length of the data packet, in terms of switching ability. Full or long data packets switch at about the same rate as short packets, which equates to about 500 packets per second. However, the transfer of a given amount of data using shorter packets could eventually degrade the system performance. This is due to both the requirement of a larger amount of data packets to be switched and the requirement for a greater amount of overhead packets for system control and acknowledgement.

PACKET SWITCH DESCRIPTION

2.06 Packet switches are basically stored program devices. To implement the packet switch, special software and communications are added to the basic processor.

2.07 The No. 1 PSS packet switch consists of a duplex 3B20D processor, standard peripherals, and facility interface processors (FIPs). The 3B20D processor is made up of duplicated 3B control units (CUs). Each CU consists of a central processing unit, its memory, a direct memory access (DMA) controller, and input/output (I/O) channels. During normal operation, only one CU is active while the other is in the standby mode.

2.08 The 3B20D processor arrangement interconnects the FIPs, provides access to off-line storage for the packet switch, and provides a centralized interface to the operations peripherals.

2.09 The standard peripherals of the packet switch include moving head disks to provide mass storage for program text and data, and a magnetic tape for the output of traffic and usage data, as well as for field updates. The 3B20D processor also supports the interface to the craft peripherals, including display terminals, printers, and alarm devices.

2.10 The FIP is a processor that has been custom designed for specific use as the front-end processor for the packet switch. The four major components of the FIP are: the central processor unit, memory, a 3B20D interface, and the Digital Data System (DDS) facility interface. The purpose of the DDS interface is to provide access for the DDS user access lines or trunks. Figure 1 provides a sample configuration of the access line or trunk to the 3B20D processor, by way of the FIP.

PACKET SWITCH FUNCTIONS

2.11 In order to meet the needs of its data users, the packet switch must perform four basic functions:

- Data Transport
- Call Control
- Delivery Confirmation
- Error Correction.

2.12 The primary function of the packet switch is to transport data packets efficiently to their destinations. This is accomplished by means of a destination address. The destination of the call is identified by the appearance of the destination address as part of the call. Destination addresses are referred to as data terminal numbers (DTNs) or logical network addresses (LNAs). In addition to this basic function, the packet switch invokes many other processes to prevent or manage network congestion, recover from facility failures, control network access, and to protect the integrity of the data transported.

2.13 Call request and call acceptance packets precede the actual data transfer mode. In addition to the calling and called addresses, these packets may also contain optional protocol information. These options are supported by the X.25 communications interface, are allocated at service provisioning of the access line(s), and are negotiated at call setup. One such option is the transmission rate at which the data is to be transferred. For a complete listing of the available options, refer to Section 255-025-023.

2.14 Delivery confirmation requires that the destination confirm reception of the data packets. This is accomplished by the return of an acknowledgement packet prior to actual data transfer.

2.15 Error correction requires that buffers are not cleared until packet delivery is acknowledged by the destination user. Error checking processes allow each component to validate packet integrity and request retransmission of packets, if errors are detected.

3. PACKET SWITCH COMMUNICATIONS

3.01 Packet switch communications employ virtual circuit services to establish logical channels. Calls are transmitted over the network via the logical channels established in conjunction with the X.25 communications protocol.

VIRTUAL CIRCUIT SERVICES

3.02 A virtual circuit provides a connection-oriented service similar to that of circuit switching, but with the advantages of statistical multiplexing. An end-to-end communication path is established through the logical allocation of packet switch resources. Once the logical path is established, the data packets are transferred between connected ends as desired. These packets are then interleaved or multiplexed with different packets between other pairs of communication users. The logical channel may be provided on one of two types of virtual circuit services:

- Virtual Call (VC)
- Permanent Virtual Circuit (PVC).

3.03 The logical path for a VC is a temporary one. The path is established only when a request for the service has been made. The logical path for a PVC is, by name, a permanent one. This type of circuit is readily available at any given time for user access.

3.04 The type of virtual circuit service required by the user is allocated at the time of service provisioning. Several subscription options available to the user are provided on a VC or PVC basis (refer to Section 255-025-023). These options include the allocation of 1-way outgoing logical channels, and are supported by the X.25 interface.

LOGICAL CHANNELS

3.05 Logical channels are allocated and assigned to each access line at the time of service provisioning. These channels enable a host computer, e.g., a service vendor, to hold simultaneous communications with more than one distant subscriber. This is achieved by allocating a number of logical channels over the access line. A virtual circuit (either a dialed VC or a PVC) can be established on each logical channel. There are three different categories of logical channels:

- Permanent Virtual Circuits

- 2-Way Logical Channels
- 1-Way Outgoing Logical Channels.

3.06 The PVCs are automatically reserved by the No. 1 PSS packet switch during the assignment process of the service subscription. The first channel number to be assigned if this option were requested would be channel number 1. This is because, although channel number 0 does exist, it is used by the X.25 communications protocol for restart and diagnostics and is not available for subscriber use.

3.07 Two-way logical channels provide the user with the ability to originate as well as receive data transmissions. This allows for unrestricted traffic in either direction.

3.08 The VCs can be established on 1-way outgoing logical channels. These types of channels are restricted in that they allow only originating or outgoing data transmission; no incoming calls can be received over these channels.

THE X.25 COMMUNICATIONS PROTOCOL

3.09 The X.25 communications protocol is an international set of rules that are used in the communications process between the packet switch and its users. The protocol is structured into three identifiable levels that are termed the physical level, the link level, and the packet level. Each level is responsible for its own portion of call processing, as specified in paragraphs 5.05 through 5.08.

4. PACKET SWITCH APPLICATION IN LADT

4.01 The LADT network uses packet switching technology to provide the access and routing of communications from local subscribers and data base service vendors. The significant distinction between the LADT users and specific users as acknowledged by the packet switch is based on direct access to the packet switch.

4.02 Figure 2 depicts a basic configuration of the Generic 1, Release 1A LADT network. From this figure it can be seen that the packet switch is the center of communications between the local subscribers of the network (via a Data Subscriber Interface [DSI]) and the service vendors, as well as the Administrative Processor (AP). Both the local subscribers and the service vendors are considered users of the LADT network. Local subscribers are those residence and business subscribers who access the network via 1.2 kb/s dial-up or 4.8 kb/s direct access facilities. Although these subscribers use the packet switch for communication to the service vendors, there is no direct connection to the packet switch; their only access to the network is by way of the DSI(s). The service vendors are also users of the LADT network. These users cannot, with Generic 1, Release 1A, initiate a call on the network, but have a direct linkage to the packet switch for the purpose of responding to data inquiries.

4.03 The packet switch considers the DSIs, the AP, and the service vendors as its users. The DSI to packet switch data link is provided via a 56 kb/s access line. The AP is provided with a direct data link to the packet switch via a 9.6 kb/s facility. Service vendors may be provided with either 9.6 or 56 kb/s direct access lines to the packet switch. Communications for all three types of packet switch users are supported by the X.25 communications protocol.

5. NETWORK OPERATION

CALL ORIGINATION

5.01 When a local subscriber requests LADT service via the customer terminal, a VC setup from the DSI to the No. 1 PSS packet switch is required. When a DSI detects a bid for service, it returns a prompt to the originating terminal requesting the destination address. If the address or DTN is valid, the call control within the DSI places a request to the X.25 protocol level 3 (packet level) to initiate a call request packet to the packet switch.

5.02 When the packet switch receives a call request packet, it is responsible to return a call connect packet, via the X.25 communications protocol. If a call connect packet is received from the packet switch, a successful indication is passed to the DSI call control along with the actual call connect packet. It is at this point that the X.25 negotiable parameters, such as the size of the data packet, are verified as acceptable or not. If the parameters are acceptable, a message is sent to the subscriber terminal indicating that a VC connection is established. Once this VC from the DSI to the packet switch has been set up, the transmission of actual messages may begin.

5.03 The X.25 communications protocol plays a vital role in the overall communications within the LADT network. It is used not only for the initial VC setup from the subscriber to the packet switch via the DSI, but also supports all communications between the subscriber and the service vendor. A detailed view of the X.25 protocol is, therefore, imperative in the understanding of call processing in the LADT network.

THE X.25 INTERFACE

5.04 The X.25 communications interface is a specifically designed set of rules that provide for the virtual circuit services communication of the packet switch. This interface provides standard link access procedures (LAPB) that are used in communications between the users. There are three identifiable levels of protocol in the X.25 interface as shown in Fig. 3:

- Physical Level (level 1)
- Link Level (level 2)
- Packet Level (level 3).

A. Physical Level

5.05 The physical level of the X.25 interface is the simplest level of communications. This level provides a set of basic functions that activate, maintain, and deactivate the physical link between the packet switch and the users.

B. Link Level

5.06 The link level protocol is responsible for the transfer of data packets from level 3 to the physical level for actual transmission over the physical access link. The link level, which is software only, provides the control functions such as link initialization, link flow control, link assurance, and link error control. These are accomplished in a step-by-step handling of the data packet received from the packet level (level 3):

(1) When a data packet is to be transmitted over the network, the level 3 protocol transfers the data packet(s) to the level 2 protocol.

(2) The level 2 system software converts the data packet to a frame by attaching an address and a control field in front of the data packet stream. The address field identifies the frame as either a command or a response. The control field contains transmit and receive sequence numbers, which are used by the level 2 to ensure that the frames cross the interface error free. This control field also contains an identifier which defines each frame as one of the following:

- Numbered information (I) frame
- Numbered supervisory (S) frame
- Unnumbered (U) control frame.

(3) A flag byte is then added at the beginning of the frame. This byte identifies where the frame begins.

(4) The XPC chip in the FIP main processor adds a cyclic redundancy check (CRC) word to the end of the frame for error detection purposes.

(5) Another flag byte is added to the end of the frame to identify where the frame ends. If more than one frame is being sent at the same time, only one flag byte will be placed between the two frames; there will not be a beginning and an ending flag.

(6) The frame is then passed to level 1 for actual transmission.

5.07 A sample of the data packet to frame transition is provided in Fig. 4. Figure 5 provides the overall structure of a level 2 frame.

C. Packet Level

5.08 The level 3 protocol is the most complex protocol level. This level supports virtual call service (VC and PVC) features by the association and connection of logical channels on access lines. It also transfers the user data from these access lines to and from the level 2 protocol into uniform blocks of data call packets, and provides flow control for the transfer of the data. When an LADT subscriber requests a message to be sent to the service vendor (via the DSI), the message is stored in one of the main memory buffers within the DSI. The level 3 protocol performs the following procedures in order to support its network responsibilities:

(1) The level 3 determines the number of words that are to be transmitted in the message and identifies the address of the main memory buffer which contains the data.

(2) Routines within the packet level packetize the data by attaching a packet descriptor word and two packet header words in front of the packet. The packet descriptor word contains the number of bytes that are to be included in this packet and also contains a flag field which identifies the packet as either

a data or a control packet. The packet header words provide logical channel and sequence information. The first word contain the logical channel group number (LCGN) and a general format identifier (GFI). The second word of the packet header contains the logical channel number, two sequence numbers, and two bits. The sequence numbers support the flow control function of level 3 by identifying two distinct events (these numbers are not the same as the sequence number in the level 2 protocol):

- A packet receive [P(R)] sequence number for the next expected data packet
- A packet send [P(S)] sequence number for the current packet being transmitted.

An M bit is provided as an indication of whether or not the packet being sent is the last packet. The M bit for the first and all intermediate packets is set to 1. The last packet of the message has an M bit that is set to zero. All packets with an M bit of 1 must use up all 256 bytes of each packet; these packets must be complete. The last packet, or if the message is fully contained in only one packet, may be less than 256 bytes in length. A sample of the basic packet header is provided in Fig. 6.

(3) Flow control procedures are provided separately for each direction of data transmission. These procedures use the packet sequence numbers (rolling digits 0 through 7) contained in the packet header and a predefined number which specifies the number of packets authorized to be transmitted or received at one time. Together this information is called the transmission window. The standard window size for a VC is two packets for each direction of transmission.

(4) Each time a packet is received at level 3, the P(R) sequence number is incremented by one, and inserted into the next packet that is to be transmitted. This number informs the far end that all packets up to but not including this number have been received. For example, when the first packet is received, the P(R) number is moved up to one, indicating that only one packet, packet 0, has been received. When a second data packet is received, the P(R) number is moved up to two, indicating that only packets 0 and 1 have been received.

(5) At the beginning of the transmission sequence, the standard window size will contain two packets. Because these packets are in the transmission window, they may be transmitted. Each time a packet is transmitted, the P(S) sequence number will also be incremented by one, and the next packet in line for transmission will move into the transmission window. The first packet sent will have a P(S) number of zero. The second packet sent will have a P(S) number of 1. Any packet that is not in the transmission window is not available for transmission. Additionally, if a P(S) number in a received packet does not contain a valid P(R) number (a difference of 1 value), a procedure error will occur, and error recovery procedures are initiated.

PACKET ROUTING AND DELIVERY

5.09 Once the packet switch has accepted the call request packet from the originator, it consults its routing algorithms for the destination and forwards the request packet to the destination host computer over a logical channel on its access line. Once the route is selected on the 3B20D processor, the information is made known to the FIP to use on all other packets associated with the virtual circuit. The 3B20D processor does not keep a record of the individual virtual circuits; each packet contains the address of its destination. The 3B20D processor then switches each packet to its destination based on the available path.

5.10 If the receiving host agrees with the request, an acceptance packet is returned through the network on the virtual circuit established when the request packet was sent. Once the acceptance packet is received, the initiating terminal enters the data transfer mode. The message to be transmitted is segmented into blocks of bits with a maximum length of 128 or 256 bytes. The X.25 packet level protocol information is added to each packet, and the originating terminal begins to transmit the packet stream over the logical channel.

5.11 The data packets are delivered to the destination in their original form. At the destination, the packets are stripped of all information other than the original message content, and the message is delivered to the address for which it was intended. When the destination computer receives a valid packet, it must subsequently notify the packet switch of an acknowledgement. The acknowledgement indicates to the packet switch that it must no longer store the acknowledged packets. Failure to receive an acknowledgement causes the packet switch to retransmit the unacknowledged packets. Retransmission may also occur upon request from the receiver, if an error was detected or an incomplete packet received.

5.12 Data transmission continues until such time as it is no longer needed. Once the virtual circuit is not required, the originator signals the LADT network and the logical facilities used in the connection are made available for other virtual circuit connections.

6. DATA COLLECTION

6.01 Raw data on traffic and performance are taken both at the FIPs and at the 3B20D processor of the packet switch. Through the collection of raw data samples, additional measurements can be calculated. It is this final set of processed measurements that is used by the packet switch to generate the various reports. These processed measurements are also kept in the 3B20D files for later output to a tape, if desired.

FIP DATA COLLECTION

6.02 The FIPs are scanning for measurement collection every 10 seconds. Data are collected by both the firmware in the XPC chip (X.25 communications protocol level 2) and the software in the FIP's main processor.

A. Measurements Collected by the XPC Chip

6.03 The XPC chip has a group of counters that maintain data on the basic events that occur when a call is processed. These counters are incremented each time an actual event occurs. For example, any time a bad frame check sequence occurs, the counter associated with this event scores.

6.04 The XPC chip is also responsible to collect data for counts that occur less frequently than basic call processing events, but are more serious in nature. In this case, the XPC generates an interrupt to the FIP's main processor each time the event occurs. If the data for this type of event is to be maintained, the FIP forwards an interrupt transaction to the packet switch 3B20D processor. The count is actually scored or incremented at the 3B20D. An example of this type of data is the receipt of a disconnect frame.

B. FIP Software Measurements

6.05 The FIP main processor software also collects measurements on the FIP activity. These data basically relate to the utilization of FIP resources and the X.25 level 3 protocol traffic measurements.

6.06 In the case of software measurements, the data is still collected at 10-second intervals, but is forwarded to the 3B20D processor at 1-minute intervals. Once each minute, all raw data taken at the FIP is packetized and sent to the measurements control process (MCP) of the 3B20D processor for retention and further processing.

THE 3B20D PROCESSOR DATA COLLECTION

6.07 The packet switch 3B20D processor (identified as the Central Controller Computer [CCC] in data collection) plays a vital role in the overall collection and administration of packet switching data. It receives packetized raw measurements from the FIPs and accumulates its own raw measurements. The 3B20D processor also collates all raw data into the appropriate files, generates reports automatically and on a demand basis, monitors a group of measurements for threshold violations, and samples another subset of measurements to provide the processed output for certain reports.

A. FIP Measurements

6.08 The automatic recovery (AUTOR) process in the 3B20D processor receives the transactions containing event interrupts from the FIPs. These event interrupts are transmitted from the FIPs at the time serious events (such as the receipt of a disconnect frame) occur. The AUTOR then scores the counter(s) related to the event, if the data is to be retained.

6.09 At 1-minute intervals, the MCP in the 3B20D processor receives the raw data from the FIPs for those normal call handling events. Additionally, the MCP also takes FIP data samples itself. Some of the raw 1-minute data may cause a maintenance or traffic alarm. An alarm is triggered when the MCP, by monitoring the data, determines that any or some combination of data has exceeded a specified threshold. A message indicating that the threshold has been violated will print at the craft terminal, identifying both the threshold involved and the data value observed.

B. CCC Measurements

6.10 Measurements taken by the CCC on an event basis are similar to those taken by the FIP. Raw data are accumulated as a normal call processing event occurs, and/or may be incremented on an interrupt basis for those events that are considered to be serious system problems. Measurements are sampled by both the MCP as well as other processes in the CCC.

6.11 The MCP also observes threshold violation for certain raw 30-second data. These raw measurements or some combination of them are compared on a 30-second basis. If any raw data or a combination exceeds a threshold, then a maintenance or traffic alarm occurs.

7. MEASUREMENTS

SCOPE

7.01 Users of the No. 1 PSS packet switch measurements are separated by the operations work force application. These applications include network management, maintenance, engineering and administration, customer assistance, billing, and network design.

7.02 Certain measurements are not taken by the Release 2.0 packet switch. Three categories of measurements that will not be observed at this time are:

(1) *Point-to-point usage:* The CCS between components (lines or trunks, FIPs, and the CCC) is not currently an engineering issue. Component loads are stated in terms of component utilization, such as the number of packets in and out for each line or trunk, and the number of call setup attempts per CCC.

(2) *Per virtual circuit data:* The collection of per VC or per PVC usage could increase the total network traffic load by a considerable amount. Billing usage data and other measurements are, therefore, collected on a per access line or trunk basis as opposed to on a per virtual circuit (or logical channel).

(3) *Verification of certain network design performance objectives:* It is not planned that the internal measurements be used to directly verify that all design performance objectives are being met. Performance event counts are already available for service measurements and are currently being accumulated and reported by the system. For example, the number of network-generated resets is a service performance measurement. These internal measurements are intended to provide the field with guidelines of the design performance objectives. They are also intended to indicate when external actions may be required. Therefore, qualitative performance problems will usually be apparent from the existing internal measurements without providing additional data manipulations strictly for network design.

MEASUREMENT VARIABLES

A. Raw Measurements

7.03 Raw measurements are a super set of the processed measurements and are typically more detailed. These measurements are collected in counters whose values are retained only for the duration of the current periodic interval (usually 30 minutes).

7.04 Table A provides a listing of all of the raw measurement variables collected for the No. 1 PSS packet switch. This table is subdivided into three columns. The first column provides an alphabetical listing of the raw measurement mnemonics. The fact that these codes appear in lower case type is indicative of raw measurements, as opposed to those that are processed or derived. The second column of the table provides a description of each of the measurements. The third column provides the traffic measurement acronym(s) associated with the raw measurement. The raw measurement may be equal to the traffic measurement or may be part of the formula used to derive the traffic measurement value. (Refer to paragraph 7.09 for further details on traffic measurements.)

7.05 For clarification of the labels, the first letter of each measurement indicates the facility for which the measurement is taken. Those variables beginning with a "c" are taken on a per CCC basis. All variables beginning with an "f" are taken on a per FIP basis. The measurement variables that begin with an "l" are taken on a per access line basis, while those beginning with a "t" are taken on a per trunk basis.

7.06 The raw measurement variable taken on a per "x" basis is not necessarily an indication of where the data is initially collected. As previously stated measurements can be taken by the FIPs, by the CCC, by the MCP, and by AUTOR. Tables B through E provide alphabetical listings of these raw measurements as follows:

- FIP Measurements (Table B)
- CCC Measurements (Table C)
- MCP Measurements (Table D)
- AUTOR Measurements (Table E).

B. Processed and Derived Measurements

7.07 Measurements saved in the 30-minute disk file at the packet switch are called processed measurements. These measurements are a summary of the raw measurements over a 5-minute or 30-minute intervals. The processed measurements are those measurements that appear in the automatic and/or requested traffic measurement reports. They include both raw measurements and formulated data.

7.08 Derived measurements are formulae for events that are not measured directly. These measurements can be determined or closely approximated by a mathematical function of the processed measurements data.

7.09 Table F provides an alphabetical listing and definitions of the processed and derived measurements that appear in the automatic or requested traffic reports. All of these measurements are located in the 30-minute file, and are readily identifiable, since the acronyms are specified in all capital letters. The table is divided into three columns as follows:

(a) The first column specifies the measurement label or acronym.

(b) The second column of Table F identifies the raw measurement label(s) and/or formula(s) used to determine the specific measurement value. The specification of "md." or "fmd." prefixing the raw measurement label indicates that the value of the raw variable is located in the md (CCC) or the fmd (FIP) section of shared memory. Some formulae specify constants of NUMFSAMP or NUMCSAMP to be used in the calculation. These constants are used to dictate the number of samples taken at the FIP or at the CCC, respectively. The NUMFSAMP is currently defined as six, while the NUMCSAMP is currently defined as two.

(c) The third column provides the definition of the measurement label identified in the first column. Also included as part of the definition is the amount of time over which the measurement value is accumulated. This interval (5 and/or 30 minutes) is also used in some of the formulae. For example, AV-CYCLES is:

$$\frac{\text{fmd.fcycles}}{\text{interval}}$$

In this case, the definition states that the interval is only for a 30-minute period. The calculation for AV-CYCLES is, then, the raw value for fcycles divided by the interval of 30 minutes.

8. MEASUREMENT OUTPUT

RAW MEASUREMENT DUMPS

8.01 Raw measurements are stored in various data storage areas. These memory areas are cleared by the MCP every 30 minutes, on the hour and on the half hour. However, the current contents of a specified measurement data buffer can be dumped by using the Transport Network (TNET) **DUMP:MEAS** command.

8.02 Because of the size of the storage areas, only selected sections of memory may be dumped using the dump command. These sections are defined as:

- CCC (all per packet switch measurements)
- FIP (all FIP measurements for a given FIP)
- LN (all access line measurements for a given line)
- TRK (all trunk measurements for a given trunk).

8.03 The dump output is formatted in arrays (blocks) of 100 measurements, with 10 rows and 10 columns. Each block of data is separated by a blank line. The first block of data is labeled 0, and the elements within it are labeled 0-99. Thus, block 1 defines elements 100-199, and block 3 defines elements 300-399.

8.04 Each raw measurement for each section (CCC, FIP, etc.) is given a value that corresponds to its position in the dump. The following tables provide listings of the measurement variables and their respective positions in the dump output:

TABLE	SECTION
G	CCC
H	FIP
I	LN (Line)
J	TRK (Trunk)

As can be seen from the tables, all measurements are currently located in the first block of 100 data elements for their respective sections. For example, element 9 in the CCC section (Table G) is identified as "osmpr3", while the same element number, number 9, in the FIP section (Table H) is identified as "fcycles". Table A can then be reviewed for a definition of each of these variables.

8.05 Since memory areas are cleared every 30 minutes, a single dump of the current contents would not provide very much meaningful information. It is, therefore, recommended that at least two dumps be taken within the same half hour when there is a desire to compare raw measurement values. The first dump can then provide a reference point to determine the usage over the specified interval.

TRAFFIC REPORTS

A. Report Classifications

8.06 Traffic reports are provided for two basic time intervals, i.e., 5 minutes and 30 minutes. Reports for each of these intervals may be manipulated in terms of when or if they are printed. In addition, when a report output is demanded for a specific interval, it may be demanded for a specific measurement type, or for all of the facilities reported on the output. The measurement types available for both the 5-minute and the standard 30-minute reports are:

- ALL (for all measurement types)
- CCC (for measurements on a system or per packet switch basis).
- FIP (for FIPs)
- LN (or access lines)
- TRK (for trunks).

Each measurement type only provides certain processed or derived measurements.

8.07 Five-minute reports may be conditionally or unconditionally allowed to print. If the unconditional (UCL) option is not specified during the **report allowing** process, then a single 5-minute measurement report will be printed only after a traffic alarm indication. Table K provides a listing of the various measurements, by measurement type, that are associated with the 5-minute report. A sample of the 5-minute report output format is provided in Fig. 7. Since the 12 latest 5-minute measurement reports are stored, these reports can also be requested on a demand basis. All or selected sections of the rolling 60-minute data can be demanded.

8.08 There are two categories of 30-minute reports that may be allowed to print:

(a) The first category is the standard 30-minute report, which provides only certain measurements for the various measurement types. Table L provides a listing of these measurements by their respective measurement types. Figure 8 provides a sample of the format the 30-minute standard traffic report.

(b) The second category of 30-minute reports provides detailed measurements. The amount of data appearing on the Detail Measurement Reports can be manipulated by the network administrator. When the detailed 30-minute reports are allowed to print, any or all measurements identified in Table M, by measurement type, may be reported. The measurement types provided for the detailed reports are different than those provided for the standard reports, and include:

- CCC Measurements
- FIP Measurements
- Line Traffic Measurements
- Line Error Measurements
- Trunk Traffic Measurements
- Trunk Error Measurements.

8.09 A sample Detail Measurement Report is provided in Fig. 9. Paragraphs 8.11 through 8.18 provide additional details relating to the manipulation of the report format.

8.10 The 30-minute measurements data are stored for the previous 24 hours in 48 data files. Every 30 minutes new 30-minute measurements are written over the oldest (24 hours) 30-minute data. The saving of these data files provides Network Administration with the capability of demanding any and all sections of the 30-minute reports for the time intervals that are saved.

B. Detail Report Measurement Settings

8.11 The TNET input command **SET:MEAS** is used to select a section of the Detail Measurement Report and to set up the automatic and/or demand reporting of the measurements desired within each section, as defined in paragraph 8.08. The section formats that are input are accumulated in a script file or a group of script files. An optional field is provided within the **SET:MEAS** command in order to allow the user to specify a name for any or all of the maximum of 15 script files provided. When script file names are specified, the user has the flexibility of grouping measurements for up to 15 different detail report formats. The name of each file is restricted to a maximum of 12 alphanumeric characters. If a script file name is not specified when the selected measurements are being set for a particular format, a default file is used. Since the effects of the **SET:MEAS** command are cumulative, a command **(CLR:MEAS)** is also provided to clear sections of the report and/or facilities to be reported on.

8.12 The measurements on which data are to be reported are set up in the script file(s) by specifying the appropriate measurement setting for all or any combination of the measurements available for a given section of the report. The measurement setting for a section is specified using a hexadecimal number, where a bit represents a particular measurement. In order to set up the Detail Measurement Report, the network administrator must:

(1) Determine which measurements, per section, are desired to be reported.

(2) Identify the bit position of each desired measurement, by section.

(3) Identify the hexadecimal equivalent for each bit position (measurement), by section.

(4) Add the hexadecimal equivalents together, per section, to derive a single measurement setting value for each section.

(5) Input the measurement setting for each section, using the **SET:MEAS** command.

8.13 Table M provides a listing of the various measurements that are available for each section of the Detail Measurement Report. Also included in this table is a numeric value that represents the bit position of each measurement. As can be seen from the table, the line traffic measurements section has the most measurements available. It should be noted that although numerals 0 through 29 reoccur as the bit position designations for all sections, the measurement for a particular bit may not be the same for two different sections. For example, bit 0 in the CCC Measurements section is PKT-RCV, while the same bit (bit 0) in the FIP section is PKT-FROM-CCC. (Refer to Table F for definitions of these measurements.)

8.14 Once the required measurements per section have been selected from Table M, the bit position for desired measurement must be identified and converted into hexadecimal. Table N provides the hexadecimal equivalent for each of the bit positions. The first column of Table N is a listing of all 32 (numbered 0 through 31) bit positions. (Data measurements for bits 30 and 31 are not available.) Beginning with the least significant bit (LSB), bit 0, the bits are separated into eight groups, with each group containing four bit positions. The group number, as indicated in the second column, represents the 1 through 8 places of the hexadecimal number. The hexadecimal number is right-justified, where the first place or least significant group of bits begins at the right, and the most significant bit (MSB) ends at the left. Therefore, leading zeroes are not required for hexadecimal numbers. However, trailing zeroes are required since they are the place designators for those bits that are not desired.

8.15 The third column of Table N provides the single digit value for each bit. The values of 1, 2, 4, and 8 are repeated for each group of four bits. It is their placement within the 1 through 8 positions of the hexadecimal number that determines the actual bit value. The final column of Table N provides the full 8-digit hexadecimal number, with both leading and the required trailing zeroes.

8.16 In order to derive a hexadecimal number that equates to the measurement setting for a given section of the report, the hexadecimal numbers for each selected bit must be added together. The measurement setting will be no greater than eight alphanumeric characters, but may be less as leading zeroes are not required. The addition of hexadecimal numbers is different from that of decimal numbers. The sum of each column (1 through 8) of the hexadecimal number remains within the same position; there are no 2-digit numbers, i.e., 10, 11, 12, 13, 14, and 15. The values that are used for hexadecimal are 1 through 9 and A through F, where:

DECIMAL	HEXADECIMAL
1 =	1
2 =	2
3 =	3
4 =	4
5 =	5
6 =	6
7 =	7
8 =	8
9 =	9
10 =	A
11 =	B
12 =	C
13 =	D
14 =	E
15 =	F

8.17 The following are examples of hexadecimal addition. In each, sample measurements are reflected by their designated bit positions. A specific section of the Detail Measurement Report is not identified in these examples, since the hexadecimal values relate to the bit positions, and the method used for addition is the same for all sections. Leading zeroes are provided as place indicators for the 1 through 8 positions of the hexadecimal number.

Example 1

SELECTED	HEXADECIMAL
0	00000001
5	00000020
6	00000040
8	00000100
10	+ 0000400
--	---
SUM =	00000561

Example 2

SELECTED	HEXADECIMAL
3	00000008
10	00000400
11	00000800
13	00002000
15	00008000
20	00100000
21	00200000
22	00400000
23	00800000
24	+01000000
--	------
SUM =	01F0AC08

8.18 The hexadecimal sum for each section is the measurement setting value that is used to format the Detail Measurement Report. This value is input into the packet switch software via the TNET **SET:MEAS** command. For Example 1, the input value is actually 561, as the leading zeroes are not required. The input value for Example 2 is 1F0AC08. Refer to the TNET I/O Manual for a complete description of the format and the various arguments available with this command.

C. System Thresholds

8.19 The No. 1 PSS provides for a fixed set of thresholds for certain measurements. These thresholds are always automatically compared at specific intervals, i.e., 30 seconds and 2 minutes. The measurement value that is compared to the threshold has a fixed formula, where the value is equal to a raw data value, or a group of raw data values that have been used in an equation. When a threshold is violated, a message may be printed, an alarm may accompany the threshold, and a traffic indicator may be triggered.

8.20 Each measurement threshold has a specified default values. These values are preset with the generic, but may be changed through use of the TNET **SET:THV** command. A single threshold or a list of up to four thresholds may be set each time the command is used. However, there is no limitation to the number of default values that may be changed; given repetitive use of the command, all threshold values may be set, if desired. The threshold value for each measurement can be set to any number within a specified range of values, or may be set to default to the predefined system value.

8.21 Table O provides a listing of the measurement threshold labels, along with the fixed formula and a definition of each. The raw measurement labels used in the formulae are defined in Table A. Some formulae also use the number of CCC or FIP samples, as dictated by the appearance of NUMCSAMP or NUMFSAMP in the calculation. It should be noted that the measurement referred to as MINFRMTH is not a threshold, but is a settable minimum number of frames received or sent. Since some of the values calculated as ratios are not consistent during light traffic conditions, the MCP handles these conditions by checking for the minimum number of frames received or sent before calculating the values for comparison to the thresholds. The calculation and comparison will not take place unless at least the number of frames specified has been received or sent on the facility.

8.22 Table P provides a listing of the same measurement thresholds identified in Table O, but also provides their default values and the range of acceptable threshold values. Each of these values have been multiplied by 1000, for ease of computation. For example, the default value for CCPUUSG is expressed as 750. The actual value of 0.75 or 75 percent has been multiplied by 1000 for reporting and threshold setting purposes. Therefore, when setting a desired threshold value, the value should also be multiplied by 1000 and coincide with the minimum/maximum range as shown in Table P. In addition, Table P also identifies the type of report and the severity with which the measurements will be reported, if the threshold value is crossed.

8.23 As threshold values are changed, there may periodically be a need to review the current threshold values. The TNET output command **OP:THV** is available to generate a formatted output of the measurement threshold values. This output provides the threshold identification or label, the current threshold value, and the default, minimum, and maximum values as identified in Table P. A sample output is provided in Fig. 10.

9. ABBREVIATIONS AND ACRONYMS

9.01 Abbreviations and acronyms used in this section are defined in the following list:

TERM	DEFINITION
AP	Administrative Processor
AUTOR	Automatic Recovery (process)
CCC	Central Controller Computer
CRC	Cyclic Redundancy Check (word)
CU	Control Unit
DDS	Digital Data System
DMA	Direct Memory Access
DSI	Data Subscriber Interface
DTN	Data Terminal Number
FIP	Facility Interface Processor
GFI	General Format Identifier
LADT	Local Area Data Transport
LAPB	Link Access Procedure B
LCGN	Logical Channel Group Number
LNA	Logical Network Address
LSB	Least Significant Bit
MCP	Measurements Control Process

TERM	DEFINITION
MINFRMTH	Minimum Number of Frames Received or Sent
MSB	Most Significant Bit
NUMCSAMP	Number of CCC Samples
NUMFSAMP	Number of FIP Samples
PSS	Packet Switching System
PVC	Permanent Virtual Circuit
TNET	Transport Network
VC	Virtual Call.

10. REFERENCES

10.01 The following sections should be used as references for additional information:

SECTION	TITLE
255-025-005	LADT General Description
255-025-020	LADT System Administration
255-025-021	Data Subscriber Interface
255-025-022	Data Terminal Numbers
255-025-023	Packet Switch Assignments
255-025-040	Administrative Processor Measurements
255-093-010	Feature Document — No. 1 Packet Switching System Description
255-093-510	Feature Document — Data Subscriber Interface — LADT Network

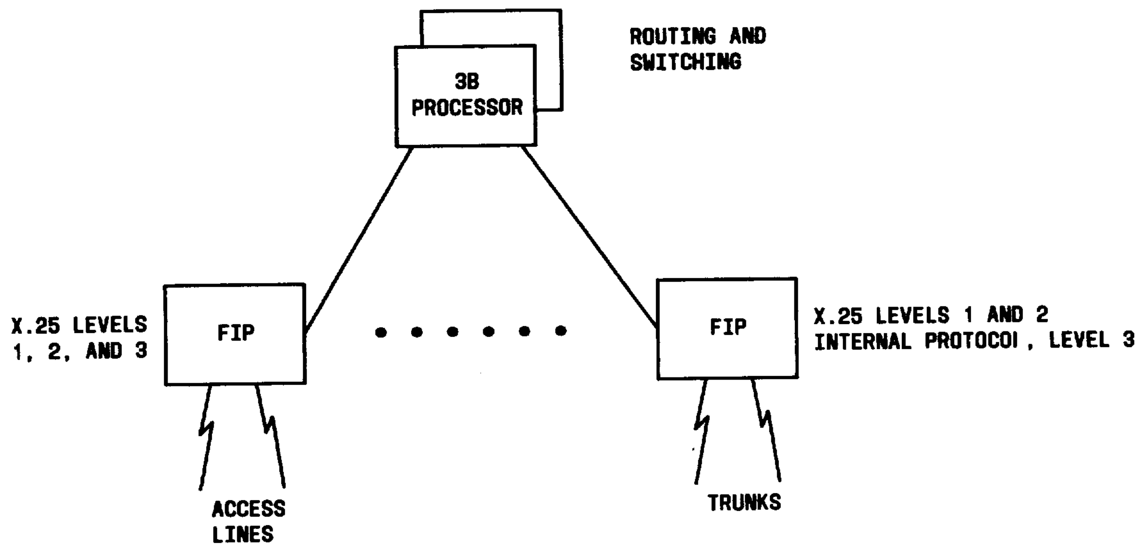
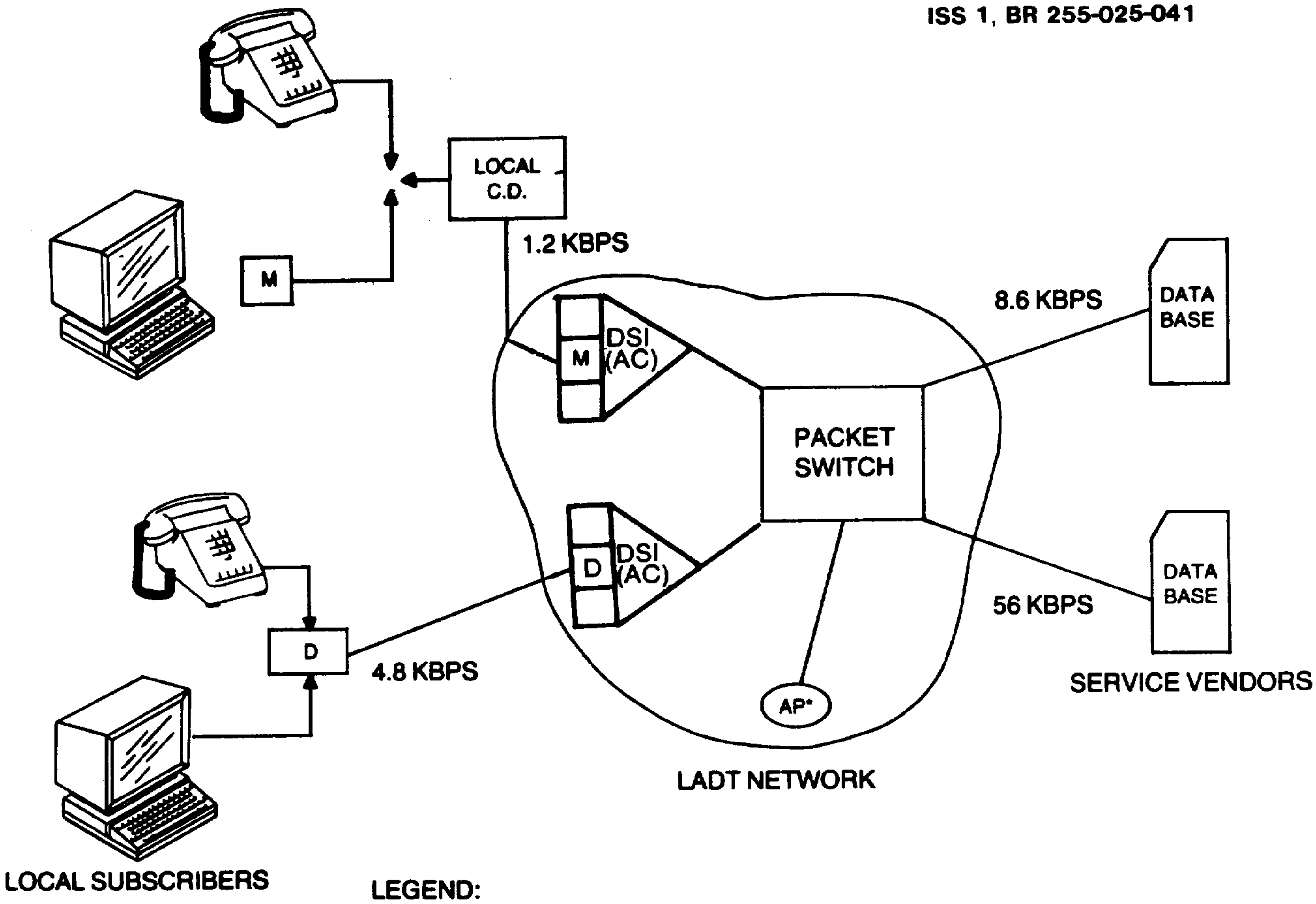


Fig. 1—Access Lines/Trunks to 3B20D Processor (2.10)



LEGEND:
M = MODEM
D = DATA SLC CARRIER SYSTEM DEVICE
* = FLORIDA APPLICATIONS ONLY

Fig. 2—LADT Network (4.02)

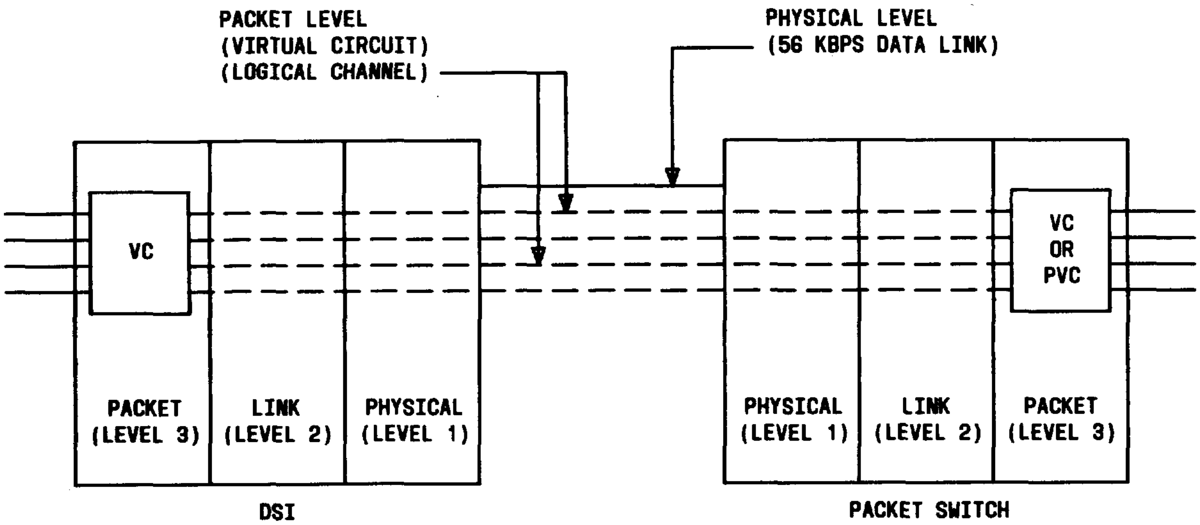


Fig. 3—X.25 Interface Levels (5.04)

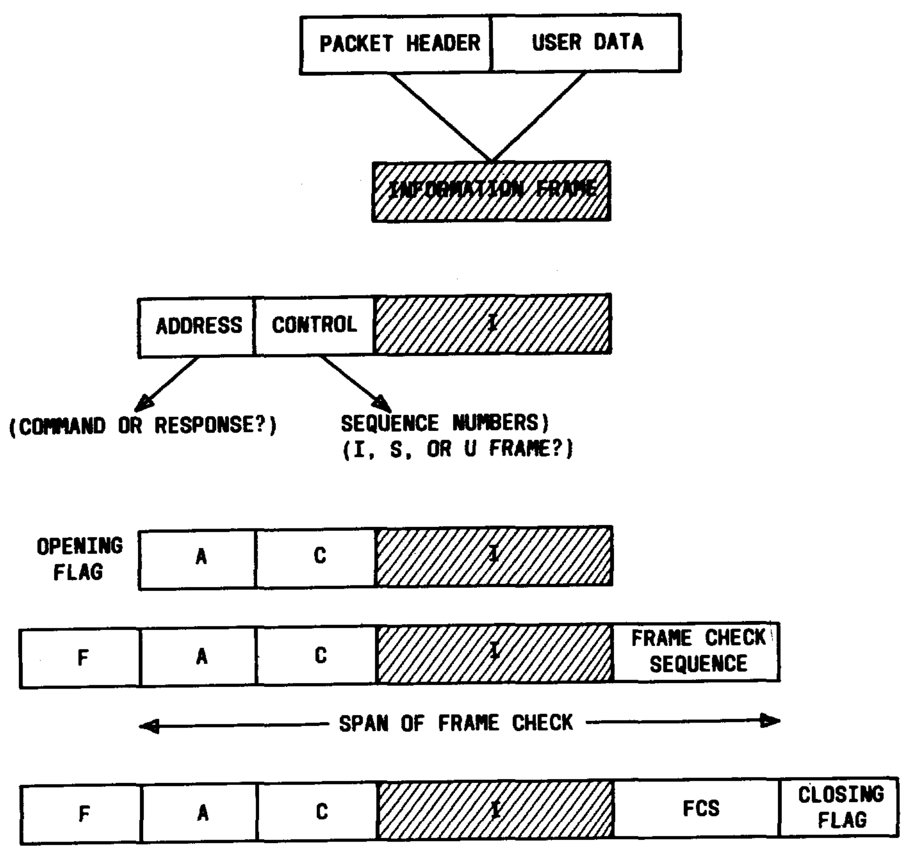


Fig. 4—Data Packet to Frame Transition (5.07)

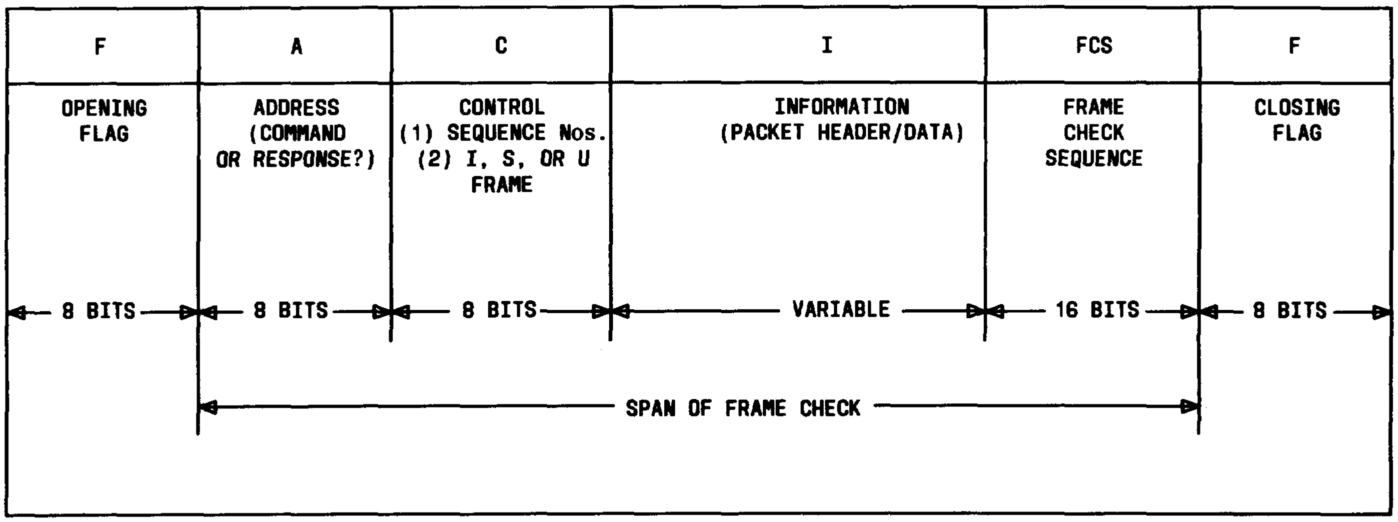


Fig. 5—Overall Frame Structure (5.07)

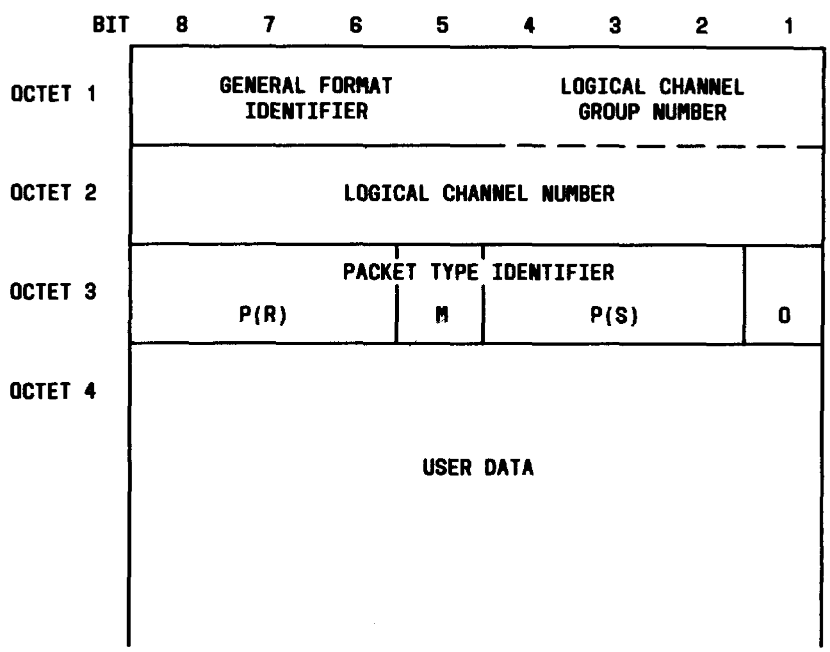


Fig. 6—Basic packet Header (5.08)

5 MIN MEASUREMENT REPORT

PKT–RCV	____	AV–FREE–BUF	____	TSP–CPU–USE	____

	FIP a0	FIP a1	FIP a2	FIP a3	FIP a4	FIP a5
AV–CTG–OUTQ	____	____	____	____	____	____
DISCARD–CTF	____	____	____	____	____	____
PKT–FROM–CCC	____	____	____	____	____	____

•
•
•

	FIP a(n–5)		FIP an
AV–CTG–OUTQ	____		____
DISCARD–CTF	____	• • •	____
PKT–FROM–CCC	____		____

	LINE b0	LINE b1	LINE b2	LINE b3	LINE b4	LINE b5
PKT–IN	____	____	____	____	____	____
PKT–OUT	____	____	____	____	____	____
DISCARD–PKT	____	____	____	____	____	____
AV–PKT–BUF	____	____	____	____	____	____

•
•
•

	LINE b(n–5)		LINE bn
PKT–IN	____		____
PKT–OUT	____	• • •	____
DISCARD–PKT	____		____
AV–PKT–BUF	____		____

	TRUNK c0	TRUNK c1	TRUNK c2	TRUNK c3	TRUNK c4	TRUNK c5
PKT–IN	____	____	____	____	____	____
PKT–OUT	____	____	____	____	____	____
DISCARD–PKT	____	____	____	____	____	____
AV–PKT–BUF	____	____	____	____	____	____

•
•
•

	TRUNK c(n–5)		TRUNK cn
PKT–IN	____		____
PKT–OUT	____	• • •	____
DISCARD–PKT	____		____
AV–PKT–BUF	____		____

Fig. 7—5-Minute Measurement Report (8.07)

30 MIN MEASUREMENT REPORT

PKT-RCV	________	TSP-CPU-USE	________	BAD-SETUP-NTWK	________
SETUP-ATMPT	________	DISCON-NTWK	________	RESET-NTWK	________
DISCARD-PK	________	UN-DISCARD-PKT	________	DISCARD-PKT-CC	________

	FIB a0	FIP al	FIP a2	FIP a3	FIP a4	FIP a5
PKT-FROM-CCC	________	________	________	________	________	________
AV-CYCLES	________	________	________	________	________	________
RETRANS-L3	________	________	________	________	________	________

•
•
•

	FIP a(n-5)		FIP an
PKT-FROM-CCC	________	• • •	________
AV-CYCLES	________		________
RETRANS-L3	________		________

	LINE b0	LINE b1	LINE b2	LINE b3	LINE b4	LINE b5
PKT-IN	________	________	________	________	________	________
PKT-OUT	________	________	________	________	________	________
ACT-VC-IN-USE	________	________	________	________	________	________

•
•
•

	LINE b (n-5)		LINE bn
PKT-IN	________	• • •	________
PKT-OUT	________		________
ACT-VC-IN-USE	________		________

	TRUNK c0	TRUNK cl	TRUNK c2	TRUNK c3	TRUNK c4	TRUNK c5
I-FLD-BYTE-RCV	________	________	________	________	________	________
I-FLD-BYTE-XMT	________	________	________	________	________	________
	________	________	________	________	________	________
	________	________	________	________	________	________

•
•
•

	TRUNK c(n-5)		TRUNK cn
I-FLD-BYTE-RCV	________	• • •	________
I-FLD-BYTE-XMT	________		________

Fig. 8—30-Minute Measurement Report (8.08)

DETAIL MEASUREMENT REPORT

CCC MEASUREMENTS:

PKT-PCV	________	PKT-XMT	________	AV-FREE-BUF	________
TSP-CPU-USE	________	BAD-SETUP-NTWK	________	SETUP-ATMPT	________
DISCON-NTWK	________	RESET-NTWK	________	DISCARD-PKT	________
UN-DISCARD-PKT	________	DISCARD-PKT-CC	________	OPRN-CPU-USE	________
DMERT-CPUT-USE	________	PKT-RTPAD	________	IDLE-TIME	________
FREE-BUF-BL-TH	________	TSP-AB-TH	________	RETRAN-TRPAD	________
CCC-SETUPS	________				

FIP MEASURMENTS

	FIP a0	FIP al		FIP an
PKT-FROM-CCC	________	________		________
PKT-TO-CCC	________	________		________
AV-CYCLES	________	________		________
AV-FTC-OUTQ	________	________	• • •	________
AV-CTF-OUTQ	________	________		________
DISCARD CTF	________	________		________
FTC-OUTQ-AB-TH	________	________		________
CYCLES-BL-TH	________	________		________
RETRANS-L3	________	________		________
DISCARD-AB-TH	________	________		________

LINE TRAFFIC MEASUREMENTS

	LINE b0	LINE b1		LINE bn
PKT-IN	________	________		________
PKT-OUT	________	________		________
BILL-PKT	________	________		________
ACT-VC-IN-USE	________	________		________
ORIG-SETUP	________	________		________
TERM-SETUP	________	________		________
BAD-SETUP-NTWK	________	________		________
FLOW-CNTRL-T1	________	________		________
DISCHARD-PKT	________	________		________
UN-DISCARD-PKT	________	________		________
RESET-CUST	________	________	• • •	________
RESET-NTWK	________	________		________
DISCON-NTWK	________	________		________
AV-PKT-BUT	________	________		________
I-FLT-BYTE-RCV	________	________		________
I-FLT-BYTE-XMT	________	________		________
PKT-IN-AB-TH	________	________		________
PKT-OUT-AB-TH	________	________		________
PKT-BUF-AB-TH	________	________		________
CNTL-FRM-RCV	________	________		________
AV-HLD-BUF	________	________		________

Fig. 9—Detail Measurement Report (8.09) (Sheet 1 of 2)

LINE ERROR MEASUREMENTS

	LINE b0	LINE b1		LINE bn
RETRANS-L2				
RESET-CUST				
RESET-NTWK				
DISCON-NTWK			• • •	
BAD-FCS-FRMS				
RNR-RCV-L2				
FRMR-RCV				
FRMR-XMT				
DM-RCV				
UA-RCV				
SABM-RCV				
DIAG-PKT				

TRUNK TRAFFIC MEASUREMENTS:

	TRUNK c0	TRUNK cl		TRUNK cn
PKT-IN				
PKT-OUT				
DISCARD-PKT				
RETRANS-L2				
AV-PKT-BUF			• • •	
DISCARD CTF				
I-FLD-BYTE-RCV				
I-FLD-BYTE-XMT				
PKT-IN-AB-TH				
PKT-OUT-AB-TH				
PKT-BUF-AB-TH				
CNTL-FRM-RCV				

TRUNK ERROR MEASUREMENTS:

	TRUNK c0	TRUNK c1		TRUNK cn
RETRANS-L2				
BAD-FCS-FRMS				
RNR-RCV-L2				
FRMR-RCV				
FRMR-XMT			• • •	
DM-RCV				
UA-RCV				
SABM-RCV				

Fig. 9—Detail Measurement Report (8.09) (Sheet 2 of 2)

THRHLD ID	THRHLD VALUE	DFLT VALUE	MIN VALUE	MAX VALUE
thid	thval	dfval	lval	hval
thid	thval	dfval	lval	hval
thid	thval	dfval	lval	hval
•	•	•	•	•
•	•	•	•	•
•	•	•	•	•
•	•	•	•	•
thid	thval	dfval	lval	hval

Fig. 10—Threshold Values Output (8.23)

TABLE A

RAW MEASUREMENT VARIABLES

MEASUREMENT LABEL	DEFINITION	USED IN TRAFFIC MEASUREMENT FORMULA FOR:
ccpuabvt	Number of times the CCC transport process CPU usage went above threshold CCPUUSG.	TSP-AB-TH
cfpbbelt	Number of times average number of free packet buffers available at the CCC (cfpbufs) went below the threshold CFPBUF.	FREE-BUF-BL-TH
cfpbufs	Sum of samples of the number of free packet buffers available at the CCC.	AV-FREE-BUF
ccsetups	Total number of setup attempts (originating and terminating) recorded at the CCC.	CCC-SETUPS
ctvce	Number of terminating interpacket switch virtual call setup attempts.	SETUP-ATMPT
fcycbelt	Number of time FIP cycles (fcycles) went below threshold FCYCLES.	CYCLES-BL-TH
fcycles	Number of cycles by the FIP Executive, per FIP.	AV-CYCLES
fcycsq	Square of the number of cycles by the FIP Executive, per FIP (reserved for future use).	
fdscabvt	Number of times the CCC discard rate went above the threshold FCDSCDR, per FIP.	DISCARD-AB-TH
fdscotf	Number of (recoverable) packets discarded by CSIH due to output table full, per FIP.	DISCARD-CTF DISCARD-PKT-CC
fl3rexmt	Number of packets retransmitted from an access line, level 3, per FIP.	RETRANS-L3
fmpktrev	Number of times measurements processed from the FIP.	
fnoprcv	Number of transport packets received from the FIP, per FIP.	PKT-RCV PKT-TO-CCC

TABLE A (Contd)

RAW MEASUREMENT VARIABLES

MEASUREMENT LABEL	DEFINITION	USED IN TRAFFIC MEASUREMENT FORMULA FOR:
fnopxmt	Total number of packets sent to the FIP, per FIP.	PKT-FROM-CCC PKT-XMT
foutabvt	Number of times the FIP to CCC output queue and table (fsoutccc) went above threshold FTCOUTQ.	FTC-OUTQ-AB-TH
fsihots	Sum of samples of numbers of packets in the CSIH output table and queue to the FIP, per FIP.	AV-CTF-OUTQ
fspvtccc	Sum of samples of number of packets waiting to be sent to the CCC (sum of the number of packets in LSIH output table and LSIH output queue), per FIP.	AV-FTC-OUTQ
lbadfcs	Number of frames received with bad FCS, per line, level 2.	BAD-FCS-FRMS
lbyterr	Number of byte mode error link interrupts, per line, level 2.	
lcfrrcv	Number of control frames received (includes only good ones), per line, level 2.	CNTL-FRM-RCV
lclxmtn	Number of network generated clear packets on existing calls (does not include confirmations), where the decision to clear was made by this FIP (does not include restarts), per line, level 3.	DISCON-NTWK
ldgnclr	Number of diagnostic packets sent to the DTE and the number of clears transmitted on line that were on a channel with no call up, per line, level 3.	DIAG-PKT
ldmrcv	Number of times a SABM transmitted in response to a DM received per line, level 2.	DM-RCV
ldscnrec	Number of packets discarded that were not recoverable (includes) due to facility going out of service, per line.	UN-DISCARD-PKT
lsaxewx	Number of packets discarded that were recoverable (includes due to lack of buffers), per line.	DISCARD-PKT
lfrmrr	Number of FRMR (frame reject) frames received and SABM sent, per line.	FRMR-RCV

TABLE A (Contd)

RAW MEASUREMENT VARIABLES

MEASUREMENT LABEL	DEFINITION	USED IN TRAFFIC MEASUREMENT FORMULA FOR:
lfrmrt	Number of FRMR (frame reject) frames transmitted (in response to certain bad frames received), level 2, per line. (Does not include received F=1, but did not sent P=1.)	FRMR-XMT
lifrabt	Number of times the number of information frames received on a line (lifrrcv) went above threshold LIFRRCV.	PKT-IN-AB-TH
lifrrcv	Number of information frames received (includes only good frames), per line.	PKT-IN
lifrretr	Number of information frames retransmitted, level 2, per line.	RETRANS-L2
lifrxmt	Number of information frames transmitted (does not include level 2 retransmissions), per line.	PKT-OUT
lifsrcv	Sum of the number of bytes in information fields received (includes only good frames), per line.	I-FLD-BYTE-RCV
lifsxmt	Sum of the number of bytes in information fields transmitted (does not include retransmissions), per line.	I-FLD-BYTE-XMT
lifxabt	Number of times the number of information frames transmitted on a line (lifrxmt) went above threshold LIFRXMT.	PKT-OUT-AB-TH
llnkrcv	Number of SABMs received, level 2, per line.	SABM-RCV
llpbsms	Sum of samples of number of long holding time packet buffers used for speed matching (level 3 flow control), per line.	AV-HLD-BUF
ln2exc	Number of times a SABM transmitted, in response to counter N2, was exceeded per line, level 2.	
lobpe	Number of interstate billable packets received from or sent to DTE on VCs or PVCs originating at DTE, per line. Billable packets and data, reset, and interrupt packets.	BILL-PKT
lobpi	Number of intrastate billable packets received from or sent to DTE on VCs or PVCs originating at DTE, per line.	BILL-PKT

TABLE A (Contd)

RAW MEASUREMENT VARIABLES

MEASUREMENT LABEL	DEFINITION	USED IN TRAFFIC MEASUREMENT FORMULA FOR:
lovcbe	Number of originating interstate VC setup attempts that will be billed, per line.	ORIG-SETUP SETUP-ATMPT
lovcbi	Number of originating intrastate VC setup attempts that will be billed, per line.	ORIG-SETUP SETUP-ATMPT
lpbufabt	Number of times the number of FIP packet buffers in use per line (lpbufs) went above the threshold LFBPBUF.	PKT-BUF-AB-TH
lpbufs	Sum of samples of number of packet buffers in use, per line. Samples are taken every 10 seconds.	AV-PKT-BUF
lrcvovr	Number of receiver overrun link interrupts, per line, level 2.	
lrecfl	Number of times a FRMR frame transmitted in response to receiving F=1 but did not send P= per line, level 2.	
lrnrfr	Number of RNR (receiver-not-ready) frames received, per line, level 2.	RNR-RCV-L2
lrsrcv	Number of level 3 reset request packets received from DTE, per line.	RESET-CUST
lrsxmtn	Number of network generated reset packets sent to DTE where due to network failures, per line. This is pegged only at the FIP where the reset is initiated.	RESET-NTWK
lsoavce	Sum of samples of the number of originating interstate active VCs per time interval, per line.	ACT-VC-IN-USE
lsoavci	Sum of samples of the number of originating intrastate active VCs per time interval, per line.	ACT-VC-IN-USE
lstavce	Sum of samples of the number of terminating interstate active VCs per time interval, per line.	ACT-VC-IN-USE
lstavci	Sum of samples of the number of terminating intrastate active VCs per time interval, per line.	ACT-VC-IN-USE
ltlctrl	Number of times T2 flow control was put into effect, per line.	FLOW-CNTL-T1

TABLE A (Contd)

RAW MEASUREMENT VARIABLES

MEASUREMENT LABEL	DEFINITION	USED IN TRAFFIC MEASUREMENT FORMULA FOR:
ltbpe	Number of interstate billable packets received from or sent to DTE on VCs or PVCs terminating at DTE, per line.	BILL-PKT
ltbpi	Number of intrastate billable packets received from or sent to DTE on VCs or PVCs terminating at DTE, per line.	BILL-PKT
ltvcbe	Number of terminating interstate VCs setup attempts that will be billed (successful and unsuccessful), per line.	TERM-SETUP
ltvcbi	Number of terminating intrastate VCs setup attempts that will be billed (successful and unsuccessful) per line.	TERM-SETUP
luarcv	Number of times a SABM transmitted in response to UA received per line, level 2.	UA-RCV
lxundr	Number of transmitter underrun link interrupts, per line, level 2.	
lvcunb	Number of unsuccessful VC call setup attempts that cannot be billed/includes due to code block and network causes), per line.	BAD-SETUP-NTWK
osmpr0	Number of samples taken at sampling rate 0.	
osmpr1	Number of samples taken at sampling rate 1.	
osmpr2	Number of samples taken at sampling rate 2.	
osmpr3	Number of samples taken at sampling rate 3. (reserved for future use).	
oterrpt	Number of TNET CCC errors reported.	
ropkxmt	Number of nontransport packets sent to (through) all FIPs by the Remote Transaction Packet Assembler/Disassembler.	PKT-RTPAD
rtpncp	Number of times a retransmission of a remote transaction was not attempted because the number of retransmissions allowed was exceeded (to the sending Remote Transaction Packet Assembler/Disassembler, the transaction was not completed).	RETRAN-RTPAD

TABLE A (Contd)

RAW MEASUREMENT VARIABLES

MEASUREMENT LABEL	DEFINITION	USED IN TRAFFIC MEASUREMENT FORMULA FOR:
tbadfcs	Number of frames received with bad FCS, per trunk.	BAD-FCS-FRMS
tbyterr	Number of byte mode error link interrupts, per trunk, level 2.	
tcfrrcv	Number of control frames received (includes only good ones), per trunk, level 2.	CNTL-FRM-RCV
tdmrcv	Number of times a SABM transmitted in response to DM received, per trunk, level 2.	DM-RCV
tdscrec	Number of packets discarded that were recoverable (includes due to lack of buffers), per trunk.	DISCARD-PKT
tfrmrr	Number of FRMR (frame reject) frames received and a SABM transmitter, per trunk.	FRMR-RCV
tfrmrt	Number of FRMR (frame reject) frames transmitted (in response to certain bad frames received), per trunk. (Does not include received F=1, but did not send P=1.)	FRMR-XMT
tifrabt	Number of times the number of information frames received on a trunk (tifrrcv) went above threshold TIFRRCV.	PKT-IN-AB-TH
tifrrcv	Number of information frames received (includes only good frames), per trunk.	PKT-IN
tifrretr	Number of information frames retransmitted, level 2, per trunk.	RETRANS-L2
tifrxmt	Number of information frames transmitted (does not include level 2 retransmissions), per trunk	PKT-OUT
tifsrcv	Sum of the number of bytes in information fields received (includes only good frames), per trunk.	I-FLD-BYTE-RCV
tifsxmt	Sum of the number of bytes in information fields transmitted (does not include retransmissions), per trunk.	I-FLD-BYTE-RCV
tifxabt	Number of times the number of information frames transmitted on a trunk (tifrxmt) went above the threshold TIFRXMT.	PKT-OUT-AB-TH

TABLE A (Contd)

RAW MEASUREMENT VARIABLES

MEASUREMENT LABEL	DEFINITION	USED IN TRAFFIC MEASUREMENT FORMULA FOR:
tlnkrcv	Number of SAMBs received, level 2, per trunk.	SABM-RCV
tn2exc	Number of times a SABM transmitted in response to counter N2 exceeded per trunk, level 2.	
tpbufabt	Number of times the number of FIP packet buffers in use per trunk (tpbufs) went above threshold TFBPBUF.	PKT-BUF-AB-TH
tpbufs	Sum of samples of number of packet buffers in use, per trunk.	AV-PKT-BUF
trcvovr	Number of receiver overrun link interrupts, per trunk, level 2.	
trecf1	Number of times a FRMR frame transmitted in response to receiving F=1 but didn't send P=1 per trunk, level 2.	
trnrfr	Number of RNR (receiver-not-ready) frames received, per trunk level 2.	RNR-RCV-L2
tuarcv	Number of times a SABM transmitted in response to UA received per trunk level 2.	UA-RCV
txundr	Number of transmitter underrun link interrupts, per trunk, level 2.	

TABLE B

RAW MEASUREMENTS TAKEN BY THE FIP

MEASUREMENT LABEL (NOTE1)	TYPE (NOTE 2)	BYTES REQD.	AVAILABILITY PER LINE	PER TRUNK	PER FIP
?badfcs	M	1	X	X	
?cfrrcv	M	2	X	X	
?dscrec	ND	1	X	X	
?dscnrec	ND,NN	2	X	X	
?ifrrcv	EA,M,NM	2	X	X	
?ifrretr	M	1	X	X	
?ifrxmt	EA,M,NM	2	X	X	
?ifsrcv	EA,ND	2	X	X	
?ifsxmt	EA,ND	2	X	X	
?pbufs	EA,ND,NM	1	X	X	
?rnrfr	M	1	X	X	
lclxmtn	EA,M,ND	1	X		
ldgnclr	M	1	X		
llpbsms	ND	1	X		
lobpe	B,EA,ND	2	X		
lobpi	B,EA,ND	2	X		
lovcbe	B,EA,ND	2	X		
lovcbi	B,EA,ND	2	X		
lrsrsv	M	1	X		
lrsxmtn	EA,M,ND	1	X		
lsoavc	B,M	2	X		
lsoavci	B,M	2	X		
lstavce	B,M	2	X		
lstavci	B,M	2	X		
ltlctrl	ND	1	X		
ltbpe	B,EA,ND	2	X		
ltbpi	B,EA,ND	2	X		
ltvcbe	B,EA,ND	2	X		
ltvcbi	B,EA,ND	2	X		
lvcunb	EA,ND	1	X		
fsoutccc	EA,ND	1			X
fcycles	EA,ND	2			X
fl3rexmt	ND	2			X

Note 1: The first character (?) is to be replaced with an "l" for line and a "t" for trunks.

Note 2:
B = Billing
EA = Engineering and Administration
M = Maintenance
ND = Network Design
NM = Network Management

TABLE C

MEASUREMENTS HANDLED BY CCC

MEASUREMENT LABEL	TYPE (NOTE 1)	CATEGORY		AVAILABILITY	
		RAW	OTHER	PER CCC	PER FIP
cdmertcp	EA		(Note 2)	X	
cfpbufs	NM	X		X	
cidlecpu	EA		(Note 2)	X	
copnscpu	EA		(Note 2)	X	
ctspcpu	EA,NM		(Note 2)	X	
ctvce	EA	X		X	
ropkxmt	ND	X		X	
rtpncp	ND	X		X	
fdscotf	NM	X			X
fnoprcv	EA,ND	X			X
fnopxmt	ND,NM	X			X
fsihots	NM	X			X

Note 1: EA = Engineering and Administration
ND = Network Design
NM = Network Management

Note 2: These measurements relate to the fraction of CPU processing time used by DMERT, time that is idle, time used by operations processes, and time used by TSP. Refer to the following traffic measurements (Table F):

DMERT-CPU-USE
IDLE-TIME
OPRN-CPU-USE
TSP-CPU-USE

TABLE D

MEASUREMENTS HANDLED BY MCP

MEASUREMENT LABEL (NOTE)	AVAILABILITY			
	PER LINE	PER TRUNK	PER FIP	PER CCC
?ifrabt	X	X		
?ifxabt	X	X		
lpbufabt	X			
fcycbelt			X	
foutabvt			X	
fdscabvt				X
ccpuabvt				X
cfpbbelt				X

Note: The first character (?) is to be replaced with an "l" for lines and a "t" for trunks.

TABLE E

RAW MEASUREMENTS PEGGED BY AUTOR

MEASUREMENT LABEL	PER LINE	PER TRUNK
ldmrcv	X	
lfrmrr	X	
lfrmrt	X	
llnkrcv	X	
ln23xc	X	
luarcv	X	
tdmrcv		X
tfrmrr		X
tfrmrt		X
tlnkrcv		X
tn2exc		X
trecfl		X
tuarcv		X

TABLE F

TRAFFIC REPORTS MEASUREMENTS

MSMT LABEL	RAW MEASUREMENT OR FORMULA	DEFINITION
ACT-VC-IN-USE	(fmd.lsoavce + fmd.lsoavci + fmd.lstavce + fmd.lstavci) ---------------------- (NUMFSAMP x interval)	Average number of active VCs simultaneously in use for a line over the interval (30 minutes).
AV-CTF-OUTQ	md.fsihots -------------------- (NUMCSAMP x interval)	Average number of packets in the queue and output table from the CCC to FIP over the interval (5 or 30 minutes).
AV-CYCLES	fmd.fcycles ------------ interval	Average number of cycles of the FIP (per minute) over the interval (30 minutes).
AV-FREE-BUF	md.cfpbufs ------------ (NUMCSAMP x interval)	Average number of free packet buffers available at the CCC over theintervals (5 or 30 minutes).
AV-FTC-OUTQ	fmd.fsoutccc -------------- (NUMCSAMP x interval)	Average number of packets in the FIP to CCC output queue over the interval (5 or 30 minutes).
AV-HLD-BUF	fmd.llpbsms ---------------- (NUMFSAMP x interval)	Average number of holding buffers in use.
AV-PKT-BUF	For Lines: fmd.lpbufs ------------ (NUMFSAMP x interval) For Trunks: fmd/tpbufs ------------ (NUMFSAMP x interval)	Average number of packet buffers in use for a line (or trunk) over theinterval (5 or 30 minutes).
BAD-FCS-FRMS	For Lines: md.lbadfcs For Trunks: md.tbadfcs	Number of frames received with bad FSS

TABLE F (Contd)

TRAFFIC REPORTS MEASUREMENTS

MSMT LABEL	RAW MEASUREMENT OR FORMULA	DEFINITION
BAD-SETUP-NTWK	fmd.lvcunb	Total number of unsuccessful VC setup attempts due to a network fault.
BILL-PKT	fmd.lobpe + fmd.lobpi + fmd.ltbpe + fmd.ltbpl	Number of billable packets for the access line.
CCC-SETUPS	md.ccsetups	Total number of setup attempts (originating and terminating) recorded at the CCC.
CNTL-FRM-RCV	For Lines: fmd.lcfrrcv For trunks: fmd.tcfrrcv	Number of control frames received.
CYCLES-BL-TH	md.fcycbelt	Number of times the DIP cycles went below a threshold.
DIAG-PKT	fmd.ldgnclr	Number of diagnostic packets sent to DTE on a line.
DISCARD-AB-TH	md.fdscabvt	Number of times the discard rate went above the threshold for a FIP.
DISCARD-PKT	For Lines: fmd.ldscrec For Trunk: fmd.tdscrec	Total number of recoverable packets discarded for an access line (or trunk) by the FIP.
DISCARD-PKT-CC	md.fdscotf over all FIPs	Total number of packets discardedby the CCC.
DISCON-NTWK	fmd.lclxmtn	Total number of network generated VC disconnects.
DM-RCV	For Lines: md.ldmrcv For Trunks: md.tdmrcv	Number of DM frames received for a line (or trunk).

TABLE F (Contd)

TRAFFIC REPORTS MEASUREMENTS

MSMT LABEL	RAW MEASUREMENT OR FORMULA	DEFINITION
DMERT-CPU-USE	DMERT spy routines used	Percentage of CPU time used by DMERT. Includes OST for permanent application processes plus time spend in selected DMERT kernel went above the threshold for a level processes. Does not include any temporary DMERT processes.
FLOW-CNTL-T1	fmd.ltlctrl	Number of times that T1 buffer control was put into effect.
FREE-BUF-BL-TH	md.cfpbbelt	Number of times that free CCC buffers went below the threshold.
FRMR-RCV	For Lines: md.lfrmrr For trunks: md.trmrr	Number of FRMR frames received for line (or trunk).
FRMR-XMT	For Lines: md.lfrmrt For Trunks: md.tfrmt	Number of FRMR frames transmitted over a line (or trunk).
FTC-OUTQ-AB-TH	md.foutabvt	Number of times the FIP to CCC output queue went above a threshold.
IDLE-TIME	DMERT spy routines used	Percentage of CPU time that the system was idle.

TABLE F (Contd)

TRAFFIC REPORTS MEASUREMENTS

MSMT LABEL	RAW MEASUREMENT OR FORMULA	DEFINITION
I-FLD-BYTE-RCV	For Lines: fmd.lifsrcv For Trunks: fmd.tifsrcv	Total number of bytes in all I-fields received from a line (or trunk).
I-FLD-BYTE-XMT	For Lines: fmd.lifsxmt For Trunks fmd.tifsxmt	Total number of bytes in all I-fields transmitted over a line (or trunk) not including retransmissions.
OPRN-CPU-USE	DMERT spy routines used	Percentage of CPU time spent in nondeferrable operations processes. Does not include craft CEPS or DMERT overhead.
ORIG-SETUP	fmd.lovcbe + fmd.lovcbi	Total number of setup attempts originating at the access line.
PKT-BUF-AB-TH	For Lines: md.lpbufabt For Trunks: md.tpbufabt	Number of times that the packet buffers on a line (or trunk) was above a threshold.
PKT-IN	For Lines: fmd.lifrrcv For Trunks: fmd.tifrrcv	Number of packets received by an access line (or trunk).
PKT-IN-AB-TH	For Lines: fmd.lifrabt For Trunks: fmd.tifrabt	Number of times that packets received was above the threshold.
PKT-OUT	For Lines: fmd.lifrxmt For Trunks: fmd.tifrmt	Number of packets transmitted on an access line (or trunk).
PKT-OUT-AB-TH	For Lines: fmd.lifxabt For Trunks: fmd.tifxabt	Number of times that packets transmitted was above the threshold.
PKT-RCV	md.fnoprcv over all FIPs	Total number of packets received from the FIPs.
PKT-FROM-CCC	md.fnopxmt	Total number of packets received by the FIP from the CCC.
PKT-RTPAD	md.ropkxmt	Number of packets sent by RTPAD at the CCC.

TABLE F (Contd)

TRAFFIC REPORTS MEASUREMENTS

MSMT LABEL	RAW MEASUREMENT OR FORMULA	DEFINITION
PKT-XMT	md.fnopxmt over all FIPS	Total number of packets transmitted to the FIPs.
PKT-TO-CCC	md.fnoprcv	Total number of packets sent to the CCC by the FIP.
RESET-CUST	fmd.lrsrcv	Total number of level 3 resets caused by DTE.
RESET-NTWK	fmd.lrsxmtn	Total number of network generated resets.
RETRAN-RTPAD	md.rtpncp	Number of times a retransmission of a remote transaction was not attempted because the number of retransmissions allowed was exceeded.
TSP-CPU-USE	DMERT spy routines used	Percentage of CPU time spent in the TSP process. Time spend does not include DMERT overhead.
UN-DISCARD-PKT	fmd.ldscnrec	Total number of unrecoverable packets discarded by the FIP for an access line.
UA-RCV	For Lines: md.luarcv For Trunks: md.tuarcv	Number of UA frames received for a line (or trunk).

TABLE F (Contd)

TRAFFIC REPORTS MEASUREMENTS

MSMT LABEL	RAW MEASUREMENT OR FORMULA	DEFINITION
RETRANS-L2	For Lines: fmd.lifrretr For Trunks: fmd.tifrretr	Total number of information frames transmitted over a line (or trunk).
RETRANS-L3	fmd.fl3rexmt	Total number of packet retransmissions.
RNR-RCV-L3	For Lines: fmd.lrnrfr For Trunks fmd.trnrfr	Total number of RNR packets received at level 2 over a line (or trunk).
SABM-RCV	For Lines: md.llnkrev For Trunks: md.tlnkrcv	Number of SABMs received over a line (or trunk).
SETUP-ATMPT	fmd.lovcbe + fmd.lovcbi over all lines + md.ctvce	Total number of setup attempts.
TERM-SETUP	fmd.ltvcbe + fmd.ltvcbi	Total number of setup attempts that terminated on the access line.
TSP-AB-TH	md.ccpuabvt	Number of times that the TSP usage went above the threshold.

TABLE G

CCC RAW MEASUREMENTS DUMP

ELEMENT NO.	0	1	2	3	4	5	6	7	8	9
0	ccpuabvt	cfpbufs	cfpbbelt	ctvce	ropkxmt	rtpncp	osmpr0	osmpr1	osmpr2	osmpr3
1	oterrpt	ccsetups								
2										
3										
4										
5										
6										
7										
8										
9										

TABLE H

FIP RAW MEASUREMENTS DUMP

ELEMENT NO.	0	1	2	3	4	5	6	7	8	9
0	fdscotf	fnoprcv	fnopxmt	fsihots	fcycbelt	fcycsq	fdscabvt	foutabvt	fmpktrcv	fcycles
1	fl3rexmt	fsoutccc	numfsamp							
2										
3										
4										
5										
6										
7										
8										
9										

TABLE I

LINE RAW MEASUREMENTS DUMP

ELEMENT NO.	0	1	2	3	4	5	6	7	8	9
0	ldmrcv	lfrmrr	lfrmrt	llnkrcv	ln2exc	lrecfl	luarcv	lrcvovr	lxundr	lbyterr
1	lifrabt	lifxabt	lpbufabt	lactvc	losetup	ltsetup	lbillpkt	lsumint	lcfrrcv	lrnrfr
2	lifrretr	lbadfcs	lifrrcv	lifsrcv	lifrxmt	lifsxmt	ldscrec	lpbufs	ldscnrec	lvcunb
3	ldgnclr	lrsrcv	lrsxmtn	lclxmtn	lt1ctrl	llpbsms	lsoavce	lsoavci	lstavce	lstavci
4	lobpe	lobpi	ltbpe	ltbpi	lovcbe	lovcbi	ltvcbe	ltvcbi		
5										
6										
7										
8										
9										

TABLE J

TRUNK RAW MEASUREMENTS DUMP

ELEMENT NO.	0	1	2	3	4	5	6	7	8	9
0	tdmrcv	tfrmrr	tfrmrt	tlnkrcv	tn2exc	trecfl	tuarcv	trcvovr	txundr	tbyterr
1	tifrabt	tifxabt	tpbufabt	tcfrrcv	trnrfr	tifrretr	tbadfcs	tifrrcv	tifsrcv	tifrxmt
2	tifsxmt	tdscrec	tpbufs							
3										
4										
5										
6										
7										
8										
9										

TABLE K

5-MINUTE REPORT MEASUREMENTS

REPORT TYPE	MEASUREMENT LABEL	ASSOCIATED TRAFFIC ALARM
CCC	AV-FREE-BUF	YES
	PKT-RCV	NO
	TSP-CPU-USE	YES
FIP	AV-CTF-OUTQ	NO
	DISCARD-CTF	YES
	PKT-FROM-CCC	NO
LINE	AV-PKT-BUF	YES
	DISCARD-PKT	YES
	PKT-IN	NO
	PKT-OUT	NO
TRUNK	AV-PKT-BUF	YES
	DISCARD-PKT	YES
	PKT-IN	NO
	PKT-OUT	NO

TABLE L

30-MINUTE SUMMARY REPORT MEASUREMENTS

REPORT TYPE	MEASUREMENT LABEL
CCC	BAD-SETUP-NTWK DISCARD-PKT DISCARD-PKT-CC DISCON-NTWK PKT-RCV RESET-NTWK SETUP-ATMPT TSP-CPU-USE UN-DISCARD-PKT
FIP	AV-CYCLES PKT-FROM-CCC RETRANS-L3
LINE	AV-VC-IN-USE PKT-IN PKT-OUT
TRUNK	I-FLD-BYTE-RCV I-FLD-BYTE-XMT

TABLE M

DETAIL REPORT AVAILABLE MEASUREMENTS AND BIT POSITIONS

REPORT SECTION	BIT POSITION	MEASUREMENT LABEL
CCC MEASUREMENTS	0	PKT-RCV
	1	PKT-XMT
	2	AV-FREE-BUF
	3	TSP-CPU-USE
	4	BAD-SETUP-NTWK
	5	SETUP-ATMPT
	6	DISCON-NTWK
	7	RESET-NTWK
	8	DISCARD-PKT
	9	UN-DISCARD-PKT
	10	DISCARD-PKT-CC
	11	OPRN-CPU-USE
	12	DMERT-CPU-USE
	13	PKT-RTPAD
	14	IDLE-TIME
	15	FREE-BUF-BL-TH
	16	TSP-AB-TH
	17	RETRAN-RTPAD
	18	CCC-SETUPS
FIP MEASUREMENTS	0	PKT-FROM-CCC
	1	PKT-TO-CCC
	2	AV-CYCLES
	3	AV-FTC-OUTQ
	4	AV-CTF-OUTQ
	5	DISCARD-CTF
	6	FTC-OUTQ-AB-TH
	7	CYCLES-BL-TH
	8	RETRANS-L3
	9	DISCARD-AB-TH
LINE TRAFFIC MEASUREMENTS	0	PKT-IN
	1	PKT-OUT
	2	BILL-PKT
	3	ACT-VC-IN-USE
	4	ORIG-SETUP
	5	TERM-SETUP
	6	BAD-SETUP-NTWK
	7	FLOW-CNTL-T1
	8	DISCARD-PKT
	9	UN-DISCARD-PKT
	10	RETRANS-L2

TABLE M (Contd)

DETAIL REPORT AVAILABLE MEASUREMENTS AND BIT POSITIONS

REPORT SECTION	BIT POSITION	MEASUREMENT LABEL
LINE TRAFFIC MEASUREMENTS (Contd)	11	RESET-CUST
	12	RESET-NTWK
	13	DISCON-NTWK
	14	AV-PKT-BUF
	15	I-FLD-BYTE-RCV
	16	I-FLD-BYTE-XMT
	17	PKT-IN-AB-TH
	18	PKT-OUT-AB-TH
	19	PKT-BUF-AB-TH
	20	CNTL-FRM-RCV
	21	AV-HLD-BUF
	22	BAD-FCS-FRMS
	23	RNR-RCV-L2
	24	FRMR-RCV
	25	FRMR-XMT
	26	DM-RCV
	27	UA-RCV
	28	SABM-RCV
	29	DIAG-PKT
LINE ERROR MEASUREMENTS	10	RETRANS-L2
	11	RESET CUST
	12	RESET-NTWK
	13	DISCON-NTWK
	22	BAD-FCS-FRMS
	23	RNR-RCV-L2
	24	FRMR-RCV
	25	FRMR-XMT
	26	DM-RCV
	27	UA-RCV
	28	SABM-RCV
	29	DIAG-PKT
TRUNK TRAFFIC MEASUREMENTS	0	PKT-IN
	1	PKT-OUT
	2	DISCARD-PKT
	3	RETRANS-L2
	4	AV-PKT-BUF
	5	I-FLD-BYTE-RCV
	6	I-FLD-BYTE-XMT
	7	PKT-IN-AB-TH
	8	PKT-OUT-AB-TH
	9	PKT-BUF-AB-TH
	10	CNTL-FRM-RCV
	11	BAD-FCS-FRMS

TABLE M (Contd)

DETAIL REPORT AVAILABLE MEASUREMENTS AND BIT POSITIONS

REPORT SECTION	BIT POSITION	MEASUREMENT LABEL
TRUNK TRAFFIC MEASUREMENTS (Contd)	12	RNR-RCV-L2
	13	FRMR-RCV
	14	FRMR-XMT
	15	DM-RCV
	16	UA-RCV
	17	SABM-RCV
TRUNK ERROR MEASUREMENTS	3	RETRANS-L2
	11	BAD-FCS-FRMS
	12	RNR-RCV-L2
	13	FRMR-RCV
	14	FRMR-XMT
	15	DM-RCV
	16	UA-RCV
	17	SABM-RCV

TABLE N

DETAIL MEASUREMENTS HEXADECIMAL EQUIVALENTS

BIT POSITION	HEXADECIMAL GROUPING (NOTE)	VALUE	HEXADECIMAL EQUIVALENT
0	FIRST	1	0000001
1		2	0000002
2		4	0000004
3		8	0000008
4	SECOND	1	00000010
5		2	00000020
6		4	00000040
7		8	00000080
8	THIRD	1	00000100
9		2	00000200
10		4	00000400
11		8	00000800
12	FOURTH	1	00001000
13		2	00002000
14		4	00004000
15		8	00008000
15	FIFTH	1	00010000
17		2	00020000
18		4	00400000
19		8	00080000
20	SIXTH	1	00100000
21		2	00200000
22		4	00400000
23		8	00800000
24	SEVENTH	1	01000000
25		2	02000000
26		4	04000000
27		8	08000000
28	EIGHTH	1	10000000
29		2	20000000
30		4	40000000
31		8	80000000

Note: Where hexadecimal grouping is:

Group No.	8	7	6	5	4	3	2	1
Bit Nos.	31-28	27-24	23-20	19-16	15-12	11-8	7-4	3-0

TABLE O

THRESHOLDED MEASUREMENTS

THRESHOLD LABEL	RAW MEASUREMENT OR FORMULA	DEFINITION
CCPUUSG	Found by taking snapshots of CPU usage by and for the CTSP.	Upper limit for transport service CPU usage at the CCC.
CFPBUF	$\frac{\text{cfpbufs}}{\text{NUMCSAMP}}$	Lower limit for average number of free packet buffers available at the CCC.
CSUCPSR	$\frac{\text{fnopxmt}}{\text{(fnopxmt + fdscotf)}}$	Lower limit for the ratio of the number of packets to be switched that were successfully switched.
FCDSCDR	$\frac{\text{fdscotf}}{\text{fdscotf + fnopxmt)}}$	Upper limit for the ratio of discarded packets at the CCC (in relation to a FIP) to transmitted packets per FIP.
FCTFOUTQ	$\frac{\text{fsihots}}{\text{NUMCSAMP}}$	Upper limit for the average number of packets in the CCC output queue to the FIP.
FCYCLES	fcycles	Lower limit for the number of cycles by the FIP executive.
FDSCDR	$\frac{\text{ldscrec + tdscrec}}{\text{fnopxmt}}$ (for each equipped line/ trunk on FIP)	Upper limit for the ratio of packets discarded at the FIP to transmitted packets per FIP.
FTCOUTQ	$\frac{\text{fsoutccc}}{\text{NUMFSAMP}}$	Upper limit for the average number of packets in a FIP output queue to the CCC.
L3NWRST	lrsxmtn	Upper limit for the number of network caused level 3 resets per line.
LBADFRRC	$\frac{\text{lbadfcs}}{\text{(lbadfcs + lifrrcv + lcfrrcv)}}$	Upper limit for ratio of bad frames received to the total number of frames received per line. (This threshold is compared only if the number of information and control frames received on the line is greater than MINFRMTH.)
LFBPBUF	$\frac{\text{lpbufs}}{\text{NUMFSAMP}}$	Upper limit for the average number of FIP packet buffers in use per line.
LIFRETR	$\frac{\text{lifrretr}}{\text{lifrxmt}}$	Upper limit for the ratio of information frames retransmitted to the total number of information frames transmitted per line. (This threshold is compared only if the number of information frames transmitted on the line is greater than MINFRMTH.)
LIFRRCV	lifrrcv	Upper limit for the number of information frames received from DTE on a line.

TABLE O (Contd)

THRESHOLDED MEASUREMENTS

THRESHOLD LABEL	RAW MEASUREMENT OR FORMULA	DEFINITION
LIFRXMT	lifrxmt	Upper limit for the number of information frames transmitted to DTE on a line.
LLNKRCV	llnkrcv	Upper limit for the number of SABMs received per line.
LLPVI	lfrmrr + ldmrcv	Upper limit for the number of times a local protocol violation was indicated (FRMR received, DM received) per line.
LLTPBUF	$\frac{\text{lpbufs}}{(\text{NUMFSAMP} \times \text{interval})}$	Upper limit for the average number of FIP packet buffers in use per line over a long term.
LRNRRCV	$\frac{\text{lrnrrcv}}{(\text{lifrrcv} + \text{lcfrrcv})}$	Upper limit for the ratio of RNR (Receiver-Not-Ready) frames received to the total number of frames received per line.
LRPVI	luarcv + lrecfl + lfrmrt	Upper limit for the number of times a remote protocol violation was indicated (FRMR sent, UA received) per line.
LRCVOVR	lrcvovr	Upper limit for the number of receiver overun link interrupts on a line.
LXUNDR	lxundr	Upper limit for the number of transmitter underrun link interrupts on a line.
LBYTERR	lbyterr	Upper limit for the number of byte mode error link interrupts on a line.
TBADFRRC	$\frac{\text{tbadfcs}}{(\text{tbadfcs} + \text{tifrrcv} + \text{tcfrrcv})}$	Upper limit for ratio of bad frames received to the total number of frames received per trunk. (This threshold is compared only if the number of information and control frames received on the trunk is greater than MINFRMTH.
TRBPBUF	$\frac{\text{tpbufs}}{\text{NUMFSAMP}}$	Upper limit for the average number of FIP packet buffers in use per trunk.
TIFRETR	$\frac{\text{tifrretr}}{\text{tifrxmt}}$	Upper limit for the ratio of information frames retransmitted to the total number of information frames transmitted per trunk. (This threshold is compared only if the number of information frames transmitted on the trunk is greater than MINFRMTH.

TABLE O (Contd)

THRESHOLDED MEASUREMENTS

THRESHOLD LABEL	RAW MEASUREMENT OR FORMULA	DEFINITION
TIFRRCV	tifrrcv	Upper limit for the number of information frames received on a trunk.
TIFRXMT	tifrxmt	Upper limit for the number of information frames transmitted on a trunk.
TLNKRCV	tlnkrcv	Upper limit for the number of SABMs received per trunk.
TLPVI	tfrmrr + tdmrcv	Upper limit for the number of times a local protocol violation was indicated per trunk (FRMR received, DM received).
TLTPBUF	$\frac{\text{tpbufs}}{(\text{NUMFSAMP} \times \text{interval})}$	Upper limit for the average number of FIP packet buffers in use per trunk over a long term.
TRNRRCV	$\frac{\text{trnrrcv}}{(\text{tifrrcv} + \text{tcfrrcv})}$	Upper limit for the ratio of RNR (Receiver-Not-Ready) frames received to the total number of frames received per trunk.
TRPVI	tuarcv + trecfl + tfrmrt	Upper limit for the number of times a remote protocol violation was indicated per trunk (FRMR sent, UA received).
TRCVOVR	trcvovr	Upper limit for the number of receiver overrun link interrupts on a trunk.
TXUNDR	txundr	Upper limit for the number of transmitter underrun link interrupts on a trunk.
TBYTERR	tbyterr	Upper limit for the number of byte mode error link interrupts on a trunk.
TERRCCC	errpegct: checked on occurrence, cleared every 5 minutes or when threshold exceeded	Upper limit for number of logged errors at the CCC.
TERRFBC	fbcerrct: checked on occurrence, cleared every 5 minutes or when threshold exceeded	Upper limit for number of logged errors per FIP.
TLSTEMSG	losermsg: checked on occurrence, cleared every 5 minutes or when threshold exceeded	Upper limit for number of lost error reports.

TABLE P

THRESHOLD VALUES AND REPORTS

THRESHOLD	DEFAULT	MIN.	MAX.	REPORT TYPE	REPORT SEVERITY
CCPUUSG	750	0	1000	THRHLD EXC.	MINOR ALM(TC)
CFPBUF	30000	0	400000	THRHLD EXC.	MINOR ALM(TC)
CSUCPSR	900	0	1000	THRHLD EXC.	MINOR ALM
FCDSCDR	100	50	200000	THRHLD EXC.	MINOR ALM
FCTFOUTQ	100000	0	200000	THRHLD EXC.	MINOR ALM
FCYCLES	0	0	70000000	THRHLD EXC.	MINOR ALM(TF)
FDSCDR	200	10	1000	THRHLD EXC.	MINOR ALM(TF)
FTCOUTQ	100000	0	200000	THRHLD EXC.	MINOR ALM
L3NWRST	1000	1000	512000	THRHLD EXC.	MINOR ALM
LBADFRRC	50	10	500	THRHLD EXC.	NON-ACTION
LFBPBUF	35000	0	50000	THRHLD EXC.	MINOR ALM(TF)
LIFRETR	100	10	1000	THRHLD EXC.	MINOR ALM
LIFRRCV	3400000	0	10000000	THRHLD EXC.	NON-ACTION
LIFRXMT	3400000	0	10000000	THRHLD EXC.	NON-ACTION
LLNKRCV	5000	1000	60000	THRHLD EXC.	NON-ACTION
LLPVI	50000	0	1000000	THRHLD EXC.	NON-ACTION
LLTPBUF	35000	0	50000	THRHLD EXC.	MINOR ALM
LRNRRCV	500	10	1000	THRHLD EXC.	NON-ACTION
LRPVI	50000	0	1000000	THRHLD EXC.	NON-ACTION
LRCVOVR	1000	0	10000	THRHLD EXC.	NON-ACTION
LXUNDR	1000	0	10000	THRHLD EXC.	NON-ACTION
LBYTERR	1000	0	10000	THRHLD EXC.	NON-ACTION
TBADFRRC	50	10	500	THRHLD EXC.	NON-ACTION
TRBPUBUF	35000	0	50000	THRHLD EXC.	MINOR ALM(TF)
TIFBPBUF	35000	0	50000	THRHLD EXC.	MINOR ALM
TIFRRCV	3400000	0	10000000	THRHLD EXC.	NON-ACTION
TIFRXMT	3400000	0	10000000	THRHLD EXC.	NON-ACTION
TLNKRCV	5000	1000	60000	THRHLD EXC.	NON-ACTION
TLPVI	50000	0	1000000	THRHLD EXC.	NON-ACTION
TLTPBUF	35000	0	50000	THRHLD EXC.	MINOR ALM
TRNRRCV	500	10	10000	THRHLD EXC.	NON-ACTION
TRPVI	50000	0	1000000	THRHLD EXC.	NON-ACTION
TRCVOVR	1000	0	10000	THRHLD EXC.	NON-ACTION
TXUNDR	1000	0	10000	THRHLD EXC.	NON-ACTION
TBYTERR	1000	0	10000	THRHLD EXC.	NON-ACTION
TERRCCC	50000	0	100000	TNET ERROR	MINOR ALM
TERRFBC	50000	0	100000	TNET ERROR	MINOR ALM
TLSTEMSG	50000	0	100000	No Message	—
MINFRMTH	30	0	10000	Not applicable	