ATM TESTER
TPI 750
OPERATING MANUAL

Issue 6B - Firmware 3.21

TTC - TPI Division
221 S. YORKSHIRE ST., SALEM, VA 24153
1-540-375-0500

Manufactured under and NSAI Registered
ISO 9001 Quality System

Dear TTC Customer,

Thank you for selecting a TTC product from our extensive family of communications test solutions. We appreciate your business and look forward to a continuing relationship with you as your network grows and your networking needs change.

For more than two decades, TTC has designed, manufactured, and marketed industry-leading test products that improve our customers' network performance.

TTC's mission is to develop the most technologically advanced, easy-to-use instruments, systems, and software for improved network installation and maintenance.

We stand behind our family of products. To support our products throughout the world, we provide a comprehensive program of full technical support, technology and product training, and professional services. We offer network consulting services, on-site applications assistance, software customization, test procedure development, network management services, technical product support, and much more.

Our team of professionals is ready to assist you with your new product so that it fully meets your network testing demands. Contact us today at one of the numbers found on the attached TTC Contact List or visit our Website at www.ttc.com to learn more about how we may serve you.

Thank you again for choosing a TTC product.

Sincerely,

John Peeler

John Peeler
President and CEO

TTC Worldwide Contacts

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WELCOME

TTC - TPI Division manufactures a broad range of portable test equipment for the telecommunications industry - services testing for ISDN, DDS, Frame Relay, ATM, EBS, and Caller ID.

This Operating Manual for the TPI 750 ATM Tester provides information and descriptions about the 750 ATM Tester, performing tests using the 750, accessories and options available, maintenance and warranty information, general information on ATM technology, and a glossary of terms.

Customer satisfaction is our first priority. Product innovation is a continuing commitment. We welcome your comments.

Tele-Path Instruments
221 S. Yorkshire St.
Salem, VA 24153
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CONVENTIONS USED IN THIS MANUAL

NOTE: *Indicates points of interest or marks a statement which describes or identifies regulatory information concerning the use of the test set.*

CAUTION: *Indicates a procedure that, if not followed, could result in loss of data, faulty test results or damage to the test set or other property.*

WARNING

Marks a statement, which describes or identifies a situation or practice that could result in personal injury or loss of life.

WARNING SYMBOL
Indicates a General Danger.

WARNING SYMBOL
Indicates Electric Shock/Electrocution Hazard.

WARNING SYMBOL
Indicates Burn Hazard.

WARNING SYMBOL
Indicates Fire Hazard.

WARNING SYMBOL
Indicates Explosion Hazard.

WARNING SYMBOL
Indicates a Laser.

MANDATORY ACTION SYMBOL
Consult Operating Manual.

Directs the reader to important information in the Operating Manual. This information can include ***CAUTIONS*** or ***WARNINGS***. In the convention used in this manual, and by markings on the "Consult Operating Manual" MANDATORY ACTION SYMBOL will be followed by a reference to a particular location in the Operating Manual. This reference consists of the paragraph number, enclosed by parenthesis ( ).

For example:

 (1.3.5)

directs the reader to the Laser ***WARNING*** and related information which constitutes paragraph 1.3.5.

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SECTION I

SAFETY INFORMATION

Telecommunications providers employ all reasonable protective measures to limit electrical surges on lines. However, absolute protection from lightning, or from accidental connection to electrical power sources, is impossible.

Because an absolutely safe design is impossible, the user must be responsible for his own safety and employ proper TNV safety procedures to minimize the risk of electrical shock. Comprehensive training in TNV safety procedures is beyond the scope of this Operating Manual. Even so, the user should read and understand all Safety Information within, before using the TPI 750 Test Set.

1.1 TPI 750 Safety Considerations

The TPI 750 Test Set is a professional instrument, designed and tested for connection to various lines that employ the ATM protocol. All such lines supported by the TPI 750 have the EN 60 950 / IEC 950 / UL 1950 safety classification of Safety Extra Low Voltage (SELV), Ref. clause 2.3. The table below shows the safety classification and the normal, or working, voltage of each available TPI 750 port.

Port Designation	Safety Classification	Working Voltage
DTE, software configured as: V.10, X.26, RS-423A V.11, X.27, RS-422A V.28, RS-232E	 SELV SELV SELV	 +/- 9 VDC +/- 6 V differential +/- 15 VDC
DATA (V.28, RS-232E)	SELV	+/- 15 VDC
POWER (input)	SELV	13.5 VDC
HANDSET	SELV	+/- 5 VDC
DS1/E1 (120 Ohm)	SELV	+/- 6 V (balanced)
DS3 (High Power) / E3	SELV	.8 V, 0 to peak
OC-3c / STM-1	LED or Class 1 Laser	Not Applicable (optical)
STM-1 EL / STS3c	SELV	1.0 V, 0 to peak
ATM-25	SELV	+/- 3.75 V (balanced)

1.1.1  Telecommunications Network Voltage

WARNING

Hazardous voltages caused by lightning strikes or accidental connection to power circuits may be present at times on lines that run outdoors. Such lines are classified as Telecommunications Network Voltage (TNV). Only trained Telecommunications Technicians, who can recognize when such hazards may be present and who practice proper procedures for dealing with them should use this test set. Care must be taken to assure that TNV lines are not connected to SELV ports. DO NOT directly connect a line that has been routed outdoors to ANY SELV PORT. If you need to access a line that runs outdoors, you must do so through an interface device that is certified to provide a SELV connection point.

1.2 General Telecommunications Safety

Do not work on telephone equipment if you have not been trained to do so. Serious injury could result if you do not understand the hazards of Telecommunications Network Voltages (TNV), especially the hazards of lightning strikes and accidental connection to power circuits.

Do not work on telephone equipment if there is a threat of lightning.

Do not touch or otherwise come in contact with telephone conductors that could be exposed to lightning or accidental connection to power circuits without first isolating them from the telephone network.

Do not install telephone equipment or termination (jacks) in wet locations unless the equipment or termination are specifically designed for wet locations.

Do not cause or allow telephone circuits to come in contact with power circuits (Mains).

Do not use telephone equipment in the vicinity of a gas leak or in any place where there might be an explosive atmosphere. This test set and most other telephone equipment could in normal operation generate a spark strong enough to ignite a fire or explosion.

Avoid the use of telephone equipment (other than cordless) during a lightning storm. There is a remote possibility of a nearby lightning strike which, because of its **closeness**, could **exceed** the capacity of the telephone network's protective devices and harm you.

Do not use the AC Adapter/Charger outdoors or in wet or damp locations.

Be sure the AC Adapter/Charger is connected to the correct mains voltage as indicated on its label.

Be sure to use only the AC Adapter/Charger supplied with the **test set**.

1.3 Other Safety Information

1.3.1  Adapter/Charger

WARNING

The AC Adapter/Charger is intended for use in dry, indoor locations only. Use outdoors or in wet or damp locations increases the risk of electrical shock and damage to the adapter.

Be sure the AC Adapter/Charger is connected to the correct mains voltage as indicated on its label.

Be sure to use only the AC Adapter/Charger supplied with the test set or offered by TPI as an option for the test set.

1.3.2    Battery

WARNING

This Test Unit uses a Lead-Acid Battery. There is danger of extreme heat, fire, or explosion if the battery is incorrectly replaced or if it is tampered with.

Replace only with TPI part number 836789 or TPI recommended equivalent.

Always dispose of used batteries safely, in a way that will not harm the environment.

DO NOT place in a fire. The battery cells are sealed and the heat could cause them to explode, resulting in injury and the release of chemicals that are hazardous and harmful to the environment.

DO NOT puncture or otherwise damage the sealed battery cells. Lead-Acid cells contain chemicals that are hazardous and harmful to the environment.

DO NOT cause, or allow, the battery to be short-circuited. The heat generated could cause the cells to rupture or explode, resulting in injury and the release of chemicals that are hazardous and harmful to the environment.

DO NOT discard batteries in a trash receptacle whose contents are likely to end up in a landfill. Lead-Acid cells contain chemicals that are hazardous and harmful to the environment.

DO dispose of the battery according to local codes or regulations.

DO deliver the battery to a service facility that will recycle it or otherwise be sure that battery chemicals are not allowed to contaminate the environment. An example of a service facility would be a local vehicle service/ maintenance facility which customarily disposes of used automotive batteries (Lead Acid Batteries), or if a local facility is not available, ship the battery to TTC - TPI Division who will forward it to a recovery/recycle service.

1.3.3  Battery Replacement

WARNING

Notice that the battery terminals are exposed. DO NOT cause or allow anything to short the battery terminals together. Personal injury and damage to the battery coulc result.

1.3.4 Battery Replacement

CAUTION: *Do not pull on the wires when disconnecting the battery assembly. Pull on the body of the connector - only - to prevent separating the wires from the connector.*

1.3.5  Laser

WARNING

This test set may contain a Class I Laser.
Use of controls, adjustments, or procedures other than those specified herein may result in hazardous laser light exposure.

The TPI 750 may contain a Class 1 Laser Device. Though a Class I Laser is considered safe, you should avoid looking directly into the TPI 750 Optical connectors. It is also recommended that you do not look directly into the optical output of any optical cable connected to the instrument. When a connector or cable is not terminated, place the protective cap on the open connector to prevent inadvertent exposure to the laser output and to protect the connection from contamination and damage.

1.3.6  Battery Replacement

WARNING

DO NOT REVERSE POLARITY OF BATTERY CONNECTIONS!

Reversed polarity could cause personal injury and damage to the batteries and test set. Before removing the original batteries notice how they are oriented and install the replacements the same way. The Red marked (+) wire must connect to the Red (+) battery terminal only. The Black marked (-) wire must connect to the Black (-) battery terminal only.

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SECTION II

INTRODUCTION TO THE 750

2.1 General Information

The TPI 750 ATM Tester is a portable, battery powered ATM services provisioning and troubleshooting tool. With DS1/E1, DS3/E3, ATM25, STM1/STS3c electrical, and STM1/OC3c optical interfaces, the TPI 750 provides the needed access in a single integrated unit. The test set supports a thorough layer one testing capability for each interface, enabling technicians to verify the physical layer in both turn-up and troubleshooting applications. The TPI 750 supports Permanent Virtual Path (PVP), Permanent Virtual Circuit (PVC), Switched Virtual Path (SVP), half duplex Monitor, and Switched Virtual Circuit (SVC) testing. ATM modes of operation include a Terminate Mode, permitting emulation of the CSU/DSU, half duplex Monitor, and an optional full duplex Monitor mode for troubleshooting. The Terminate mode features both Continuous (CBR), Variable (VBR), and Unassigned (UBR) bit rate generation of single or multiple cell streams. Extensive Quality of Service measurements and statistics are standard (Terminate mode).

The TPI 750 capabilities also include:

SERVICE TESTING:

Provisioning:

- Support for Quality of Service (QoS) measurements necessary to verify dependability, accuracy, and speed of service.
- Selectable header data includes Virtual Path Identifier (VPI), Virtual Channel Identifier (VCI), Generic Flow Control (GFC), Cell Loss Priority (CLP), Congestion (CNGST), and Service Data Unit (SDU) field manipulation.
- Selectable test cells consistent with ITU O.191 (4/97) and compatible with TTC's T-BERD 310 and FIREBERD 6000 test sets.
- Configurable for generation of Continuous Bit Rate (CBR), Variable Bit Rate real time (VRB-rt), Variable Bit Rate non-real time (VBR-nrt), and Unassigned Bit Rate (UBR) cell streams at full line speeds.
- User selectable cell stream parameters, including Peak Cell Rate (PCR), Sustained Cell Rate (SCR), Maximum Burst Size (MBS), and Cell Delay Variation Tolerance (CDVt).
- Support for up to eight SVC/SVP, or twelve PVC/PVP simultaneous and independently configured user defined cell streams with dual processors, or up to four SVC, four SVP, six PVC, or six PVP cell streams with a single processor.

Troubleshooting:

- Auto-Detection of the thirty-two most recently active VPI/VCI combinations on the physical link. Extensive statistics, including cell throughput, Peak Cell Rate (PCR), and CLP cell count on up to eight SVC/SVP, twelve PVC/PVP specified cell streams with dual processors, or up to four SVC/SVP, or six PVC/PVP cell streams with a single processor.
- Generation of correctable (single) and uncorrectable (multiple) errors within the header, verifying the switch's ability to detect and correct single errors and discard cells with multiple errors.
- Generation of uncorrectable header errors across consecutive cells to verify a switch's ability to re-achieve cell delineation.
- Operations and Maintenance (OAM) support and analysis for loopback, continuity check, Alarm Indication Signal (AIS) and Remote Defect Indication (RDI), and performance management cells (future).
- Optional second processor capability allows for full duplex monitoring and simultaneous analysis of cell streams being carried over different media.

PHYSICAL LAYER TESTING:

- Signal loss, frame loss, yellow alarm, and Alarm Indication Signal (AIS) displayed via LEDs
- Thorough layer one statistics including frame, far-end block errors (FEBE), and BIP errors.
- Bit Error Rate Testing (BERT) utilizing 2^{23}-1, 2^{20}-1 (ITU O.151), 2^{20}-1E (ITU O.153), 2^{15}-1, All Ones, All Zeros, 1010, 1100, and 3 in 24 patterns, and displays G.821 results.

2.2 Physical Description

The TPI 750 ATM Tester illustrated below consists of circuit boards and a battery pack, housed in an aluminum case. The basic configuration weighs approximately 14.3 pounds and has external dimensions of 7" high, 10" wide, and 9" deep.

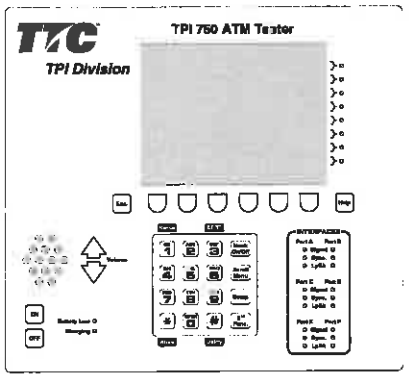

Figure 2.1 Front View of TPI 750

The internal battery is a rechargeable sealed lead acid battery that can be externally charged via the TPI 750-ACC-CHGR A/C Adapter Charger. A fully charged battery will operate the test set for up to 8 hours, depending on configuration. When the **Battery Low** LED illuminates, there are approximately 10 minutes of operating time left before complete shutdown. At that time, the internal battery needs to be recharged.

The right side of the case houses a **POWER** connector for the TPI 750-ACC-CHGR A/C Adapter Charger.

An aluminum hinged cover is attached to the unit to protect the control panel when the unit is being transported. The cover is secured by a latch that snaps loose and unhooks. The hinged cover houses a lid Menu Flow label that details unit operation. The front side houses the firmware module access panel to allow field firmware updates.

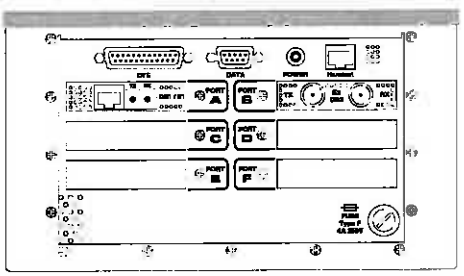

Figure 2.2 Interface panel

Connector interfaces are located on the right side of the unit, under a weather sealed cover. For more information on the interface panel, see section 2.2.2.

2.2.1 Controls and Indicators

The front panel contains a color LCD with soft keys and definable LEDs, a keypad, function keys to configure the unit or conduct a test, and interface status LEDs.

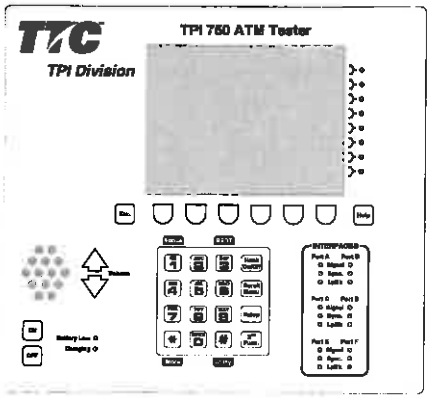

Figure 2.3 Front Panel of TPI 750 ATM Tester

LCD SCREEN AND SOFT KEYS

The color LCD and front panel control keys (soft keys) are used to:

- Configure the test set for access to ATM services
- Select the desired configuration
- Select BERT test parameters (Layer 1)
- Establish loopbacks
- Conduct turn-up and troubleshooting activities

The LCD is controlled using the 6 soft keys below the LCD display and the function keys on the keypad.

NOTE: *This manual is written to reflect the latest firmware and hardware, including the color LCD. Depending on hardware and firmware versions, the screens shown in the manual may not match the ones displayed on the unit.*

KEYPAD

The **Hook On/Off** key is used to initiate a call (SVC service).

The **Scroll Menu** key is used to move through the menu selections on the display and moves a cursor from top to bottom on specific menus.

The **Setup** key moves the display to the initial setup menu screen from any point in the menu tree.

The **2nd Func.** key is used to activate the "second functions" associated with the four labeled keys: 1/Status, 3/BERT, */Store, and #/Utility. It is also used to access alternative assignments for the soft menu keys, e.g., Print. Additionally, when used in conjunction with the **Scroll Menu** key, it allows the user to scroll backwards.

INTERFACES LEDs

The **Signal** LED, when illuminated green, indicates that the appropriate (DS1, DS3, OC3c, etc.) carrier signal has been detected.

The **Sync.** LED, when illuminated green, indicates that the test set has been able to gain frame synchronization with the received carrier signal (DS1, DS3, OC3c, etc.).

The **LpBk** LED will illuminate amber when the unit is in a looped state, i.e., the unit has responded to a loop command from the network or the user has initiated a loopback. The following table outlines the network loopbacks available:

Loopback		Respond	Initiate
DS1	ESF CSU EOC	X	X
	SF CSU Inband	X	X
	SF Facility Inband	X	X
E1	FAS/FAS+CRC SA6		X
DS3	C-bit FEAC	X	X

POWER

The power switch is used to turn the 750 ATM Tester **ON** and **OFF**. If there is no activity (test running or keystroke) for 10 minutes, the TPI 750 may turn itself off to conserve battery life. The **Utility** menu can be accessed to disable this feature.

The **Charging** LED lights green when the A/C Adapter Charger is plugged into the unit and the battery is being charged; or will light red when the A/C Adapter Charger is plugged into the unit, and the battery is not being charged (i.e., Adapter plugged into unit but not into power outlet). The **Charging** LED goes out when the battery is fully charged.

Recharge time is 12 to 14 hours (overnight).

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Up to 8 hours of continuous use is possible from a fully charged battery.

When the **Battery Low** LED lights, there is approximately 10 minutes of operating time left before complete shutdown.

> ***CAUTION:*** *The 10 minute low battery warning is only approximate, and will depend on several factors. To insure proper operation throughout the testing procedures, we recommend that you recharge the battery as soon as the **Battery Low** LED lights.*

2.2.2 Interface Panel

The right side of the unit houses connections, under the weather sealed cover (two quarter-turn fasteners), to the DS1/E1, DS3/E3, ATM25, STM1/STS3c electrical, and STM1/OC3c optical interfaces, a DTE connector used to connect to a CSU/DSU and emulate DTE (future), and a Data connector for output of test statistics or Remote Control access. Auxiliary ports (C-F) are available for optional interfaces.

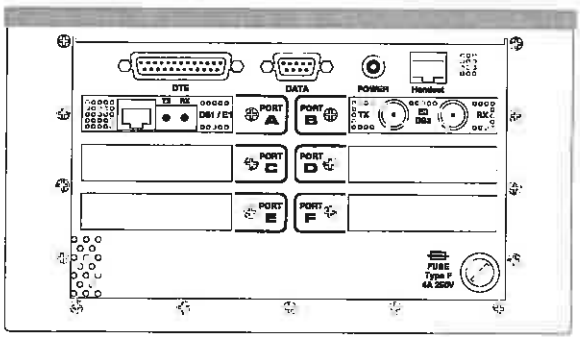

Figure 2.3 Standard Interface Panel

A fully optioned unit will have a second processor with additional ATM25 or DS1/E1, and DS3/E3 interfaces (ports E and F). The unit will also have two optional OC3c or STM1/STS3c interfaces (ports C and D).

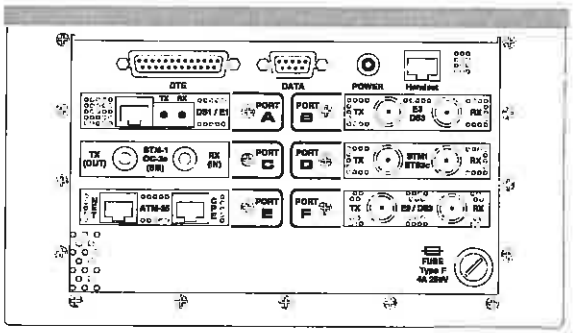

Figure 2.4 Fully Optioned Interface Panel

NOTE: *The drawing above illustrates a single mode optical interface (port C) with FC connectors. OC3c interfaces are available in single mode or multimode with either SC or FC connectors.*

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- Keep protective cap on the connector when not in use. When the TPI 750 is not being used, screw the protective cap on the connector bulkhead to keep the optical connection clean and to minimize damage to the fiber.
- Always use compatible connectors. When making optical connections, use compatible connector types. DO NOT ATTEMPT TO MATE INCOMPATIBLE CONNECTORS. Connector ends are fragile and become unusable when damaged.
- Clean fiber optic connectors before use. Keep fiber optic connectors free of dust and debris by cleaning them before each use. (See "Cleaning Optical Connectors" section in Appendix B - Maintenance) Fiber optic connectors are delicate and can be damaged easily by small debris on the end of the connector. Once a fiber optic connector internal to the TPI 750 is damaged, it must be replaced at the factory.

STANDARD INTERFACES

DTE connector (future)

Reserved for future use.

DATA connector

The **DATA** interface is a DB9/RS-232 connector for printing and output of test statistics. Selecting the **PRINT** soft key sends the current screen out the RS-232 connector to a computer or printer. Output is 8 data bits, no parity, and 1 stop bit. Baud rate is selectable in the Utility menu. This connector is also used for Remote Control of the unit.

POWER jack

This barrel jack is used to connect the A/C Adapter Charger.

Handset jack (future)

Reserved for future use.

DS3/E3 connectors

The **DS3/E3** TX (Transmit) and RX (Receive) BNC connectors are used to connect to the DS3/E3 interface. This connection is software selectable between the DS3/E3 line speeds.

and one of the following:

DS1/E1 modular and bantam jacks

The **DS1/E1** 8-pin modular and mini-bantam jacks provide two options for connection to the DS1/E1 interface. The two connectors are wired in parallel.

or

ATM25 modular jacks

The **ATM25** 8-pin modular jacks provide connections to the ATM interface. The two connectors are wired toward CPE and Network.

OPTIONAL CONFIGURATIONS

Base

In this configuration, the base unit comes equipped with one processor (on ports A and B). The choices are: DS1/E1 and DS3/E3 interfaces or ATM25 and DS3/E3 interfaces.

Options available for the base unit are:

Option	*Description*
750-COPROA Coproccessor Option	This option provides a second processor with additional DS1, E1, DS3, and E3 interfaces, which allows full duplex monitoring at these interfaces. The second processor also allows simultaneous analysis of virtual circuits on different physical interfaces. This capability enables the TPI 750 to "wrap" ATM devices, e.g., transmit cells into a device over a DS1 interface and receive the cells via a device over a DS3 interface.
750-COPROAE Coproccessor Option	This option provides a second processor with additional ATM25, DS3, and E3 interfaces, which allows full duplex monitoring at these interfaces. The second processor also allows simultaneous analysis of virtual circuits on different physical interfaces. This capability enables the TPI 750 to "wrap" ATM devices, e.g., transmit cells into a device over an ATM25 interface and receive the cells via a device over an E3 interface.
750-OC3c1 First OC3c Interface (STM1)	This option allows the TPI 750 to analyze ATM cell streams transported via an OC3c/STM1 optical interface running at full line rate. Both singlemode and multimode options are available with either SC or FC connectors, which must be specified when placing an order.
750-OC3c2 Second OC3c Interface (STM1)	This option provides a second OC3c/STM1 interface. When this option is combined with the coprocessor option (750-COPRO), full duplex monitoring can be done on an OC3c/STM1 optical interface. Both singlemode and multimode options are available with either SC or FC connectors, which must be specified when placing an order.
750-STM-COAX	This option allows the TPI 750 to analyze ATM cell streams transported via an STM1/STS3c electrical interface running at full line rate.
750-F/W Firmware Enhancement Agreement	This option provides a 3 year agreement for firmware enhancements that may become available during the 3 year period. "Cost Options" are not included in this agreement. Existing units can be updated in the field with replacement Firmware Modules.
750-UPD Update	This option provides for the firmware update of existing ATM sets not covered by a Firmware Enhancement Agreement. Existing units can be updated in the field with replacement firmware modules.

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SECTION III

GETTING STARTED

3.1 Power Up

Press the power **ON** key. This will turn the TPI 750 on, and will start the self test routine. The fan and all LEDs (except **Charging**) come on for a short evaluation period before the test set is initialized.

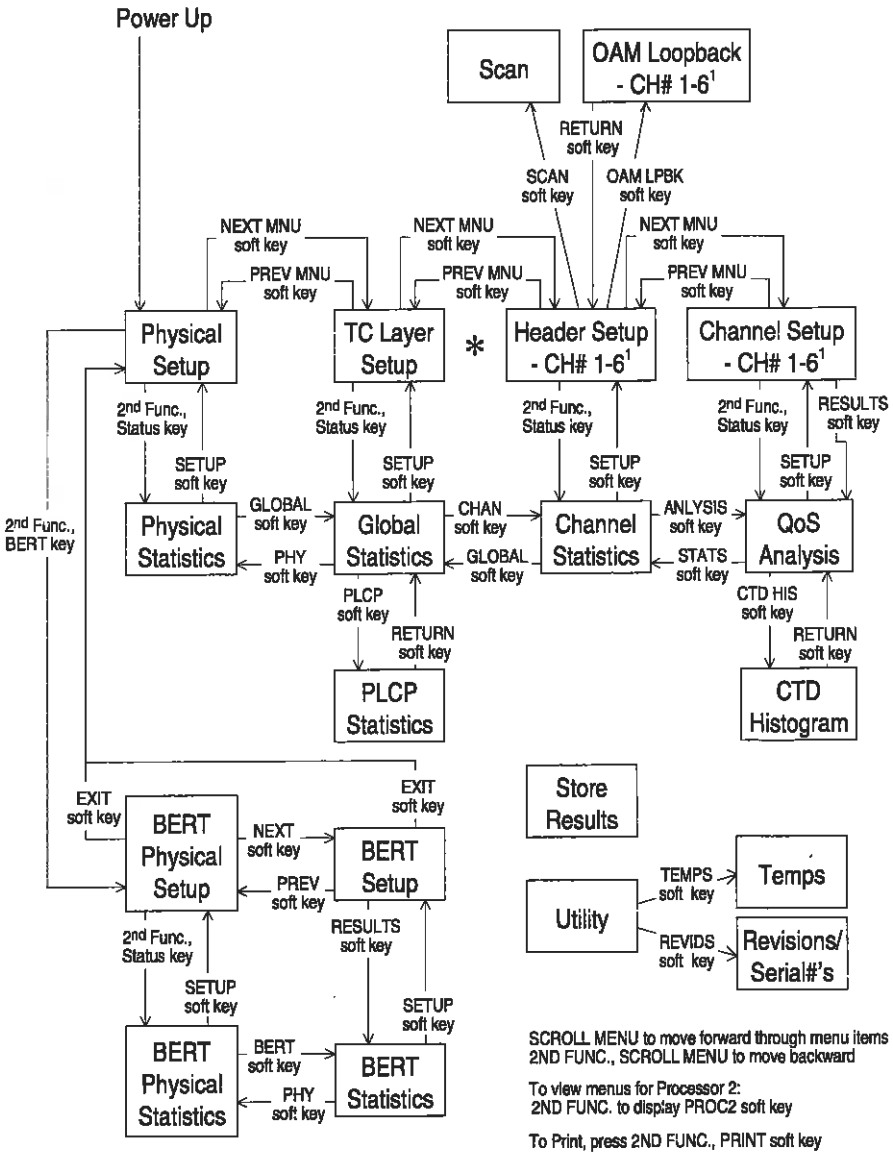
When the self test has concluded, a message will appear on the LCD screen (briefly) with the current software version and a message reporting the results of the Self Test:

If this unit is optioned with the second processor, "PROC2 PASS" may also be displayed, just below "PROC1". (The second processor will be only be initialized if the last Physical Setup type was set to DUPLEX or DUAL.)

NOTE: *If the self test should fail, please contact TTC-TPI Division at 221 S. Yorkshire St., Salem, VA 24153, phone (540) 375-0500, fax (540) 375-0505.*

Upon completion of the self test, the "PHYSICAL SETUP" screen will be displayed. The "PHYSICAL SETUP" screen is the first of several setup screens.

3.2 Menu Tree



3.3 Modes of Operation

The TPI 750 allows users to perform out-of-service (terminate mode) and in-service (monitor and in-line modes) testing for ATM25, DS1, E1, DS3, E3, STM1/STS3c electrical, and STM1/OC3c optical ATM interfaces. A second processor (coprocessor) option greatly enhances all operating modes found in the basic test set.

Terminate Mode

In terminate mode, the 750 acts as the Customer Premise Equipment (CPE) to generate and receive cell streams. This is the primary means to ensure service quality. The 750 enables the user to configure up to four Switched Virtual Circuit (SVC), Switched Virtual Path (SVP), Permanent Virtual Circuit (PVC), or Permanent Virtual Path (PVP) cell streams simultaneously per active interface when signaling is active. When signaling is not active, up to six PVC or PVP cell streams can be simultaneously configured per active interface. Each stream may be independently configured for service type (Constant Bit Rate, Variable Bit Rate, Unassigned Bit Rate), applicable service parameters (Peak Cell Rate, Maximum Burst Size, etc.), and test cell type (TTC Type 1, TTC Type 4, and ITU O.191) to thoroughly exercise the ATM service.

The 750 in terminate mode also provides Quality of Service (QoS) measurements as defined in the User-Network Interface (UNI) ATM service standard for all cell streams. Comprehensive statistics, including lost cells, Header Error Control (HEC) and Payload errors, Peak Cell Rate (PCR), total cells, etc. are also available for each of the receive cell streams. The 750's multi-channel capability permits the user to simultaneously analyze up to four SVC, four SVP, six PVC, or six PVP virtual channels [Virtual Path Identifier (VPI)/Virtual Channel Identifier (VCI) pairs] or virtual paths (unspecified VCIs) per active interface. Available statistics include total cells, Peak Cell Rate (PCR), average throughput, mis-inserted cells, header field statistics, etc.

A 750 equipped with an optional second processor (coprocessor) can simultaneously support a second active interface independent from the first active interface. The second active interface may be the same physical interface type as the first active interface (duplex) or a different physical interface type from the first active interface (dual). This capability allows the 750 to "wrap" ATM devices, e.g., generate cells into a device over a DS3 interface and receive them on the other side via an OC3c interface, and vice-versa. Up to four additional SVC, SVP, PVC, or PVP cell streams can be generated and received on the second interface when signaling is active. When signaling is not active, up to six additional PVC or PVP cell steams can be generated and received on the second interface. Each stream controlled by the coprocessor may also be independently configured for service type, applicable service parameters, and test cell type to exercise ATM service on the second interface. QoS measurements are also provided for all cell streams on the second interface.

Monitor Mode

Monitor mode allows the 750 to non-intrusively gather statistics on customer traffic on an active ATM circuit. Connection to the circuit is via monitor jacks. In a single processor configuration, the 750's monitor mode collects global statistics and statistics on six virtual circuits (SVC, SVP, PVC, or PVP) for the direction being monitored. A 750 equipped with an optional second processor (coprocessor) can collect the same statistics for both directions of the circuit (full-duplex monitoring), or one direction of a second circuit.

Since VPIs and VCIs can change from switch to switch, the 750 includes a scan feature. This feature analyzes the link and provides a list of the 32 most recently active VPI/VCI pairs, which can be automatically assigned to a specific channel for detailed statistical analysis.

In-line Mode

In-line mode enables the 750 to be placed in-line between Network Node Interfaces (NNI) or a switch's User Network Interface (UNI) and the customer's equipment (CPE) when monitor jacks are not available. Customer ATM traffic on an active circuit can be captured, analyzed, or regenerated. In a single processor configuration, the 750 can monitor one direction of the circuit. A 750 equipped with an optional second processor (coprocessor) can monitor both directions of the circuit. In-line mode gathers the same global statistics and SVC/SVP/PVC/PVP statistics as Monitor mode. The scan feature can also be used in in-line mode.

3.4 BER Testing

In addition to its extensive ATM service testing capabilities, the standard TPI 750 also provides physical layer testing features. BER testing of the underlying layer one transport provides confirmation of the physical layer service. The BERT mode allows the 750 to generate nine different patterns. The test set can also automatically detect which of nine patterns is being received. The test set also permits the injection of physical layer errors either individually or at a predefined rate. Finally, the 750 collects extensive statistics for layer one events such as loss of signal and frame synchronization, alarm conditions, line code violations, parity errors, etc., allowing users to identify non-ATM service problems. (These statistics are collected in all modes of operation).

TTC
TPI Division

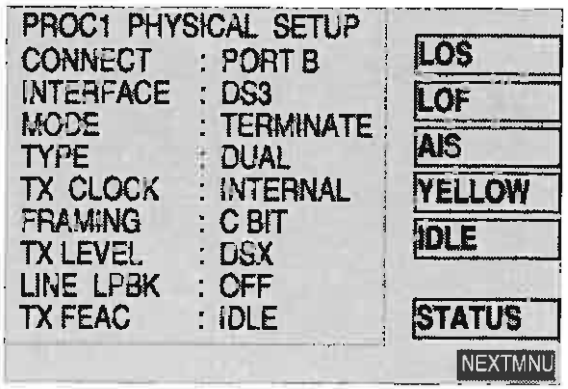
SECTION IV

INSTRUMENT SETUP

4.1 Instrument Setup - General

This section is designed to enable the user to configure the TPI 750 to begin physical layer, OAM and ATM testing. The test procedures are covered in Section V.

Following the Power Up Self Test, the Physical Setup menu will be displayed. For example:



Depending on the last setup used, the actual screen displayed may vary. The "PROC1" or "DUPLX" in the upper left corner indicates the following:

PROC1 = only one processor is active or two processors are active and configured differently and this is the setup for Processor 1.

DUPLX = two processors are active and configured the same.

To view the screen for PROCESSOR 2, press **2nd Func.** then the **PROC2** soft key (only available if "TYPE" is set to DUAL).

If neither appear the instrument is only equipped with one processor.

The **NEXTMNU** soft key is used to move to the next screen.

The following interfaces are available in the 750:

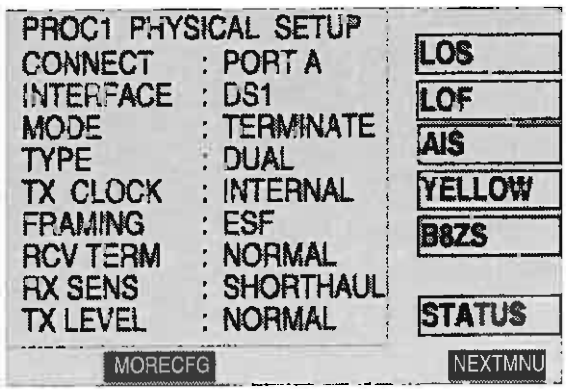
DS1	*- see Section 4.1.1*
E1	*- see Section 4.1.2*
ATM25	*- see Section 4.1.3*
DS3	*- see Section 4.1.4*
E3	*- see Section 4.1.5*
OC3c/STM1	*- see Section 4.1.6*
STM1/STS3c	*- see Section 4.1.7*

NOTE: *This manual is written to reflect the latest firmware and hardware, including the color LCD. Depending on hardware and firmware versions, the screens shown in the manual may not match the ones displayed on the unit.*

4.1.1 DS1 Setup

The following paragraphs provide information on the DS1 interface.

4.1.1.1 DS1 Physical Layer Menu



Soft LED Definitions:

LOS - Loss of Signal - Red indicates that the 750 has currently lost the received signal.

LOF - Loss of Frame - Red indicates that the 750 has lost framing delineation.

AIS - Alarm Indication Signal - Red indicates that an error condition has been detected by a device in the transmission path.

YELLOW - Red indicates a Yellow Alarm is being received.

B8ZS - Green indicates a B8ZS sequence has been received.

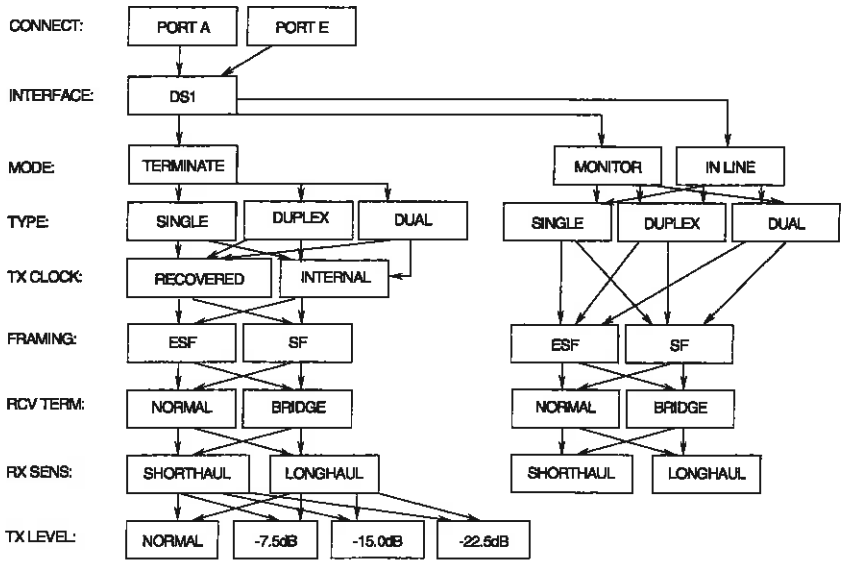
STATUS - Red indicates errors are being detected in the physical layer. Green indicates physical layer is operating properly. Amber indicates the physical layer is currently okay, but experienced errors in the past. The amber color can be changed to green by pressing **2nd. Func., Status** then the **CLEAR** soft key.

Soft key Definitions:

MORECFG - Moves to an additional Setup configuration screen.

NEXTMNU - Moves to the TC Layer Setup menu.

DS1 Physical Setup Menu Tree



Definitions:

Interface: DS1 - Allows the 750 to interface at the rate of 1.544 Mbps.

Mode: Terminate - This mode enables the 750 to terminate the ATM circuit and act as CPE. This mode is used for out of service tests.

Mode: Monitor - This mode enables the 750 to acquire statistics on an active ATM circuit. It is used for in service tests. With the coprocessor option installed, it will enable the 750 to be used for full duplex monitoring of the line under test.

Mode: In-Line - This mode enables the 750 to be placed in-line between the network interface and the customer's equipment.

NOTE: *The **LpBk** LED on active interface(s) will light when In-Line mode is selected. This is normal.*

Type: Single - Activates processor 1 only.

Type: Duplex - Activates both processors and duplicates the physical and TC layer setup for both processors.

Type: Dual - Activates both processors but enables each to be configured differently.

Tx Clock: Recovered - Recovers the network clock for purposes of synchronization.

Tx Clock: Internal - Uses the 750's internal clock for purposes of synchronization.

Framing: ESF - Enables the 750 to operate with ESF framing.

Framing: SF - Enables the 750 to operate with SF framing.

Rcv Term: Normal - Places a normal (100 Ohm) termination on the received signal.

Rcv Term: Bridge - No termination is placed on the received signal.

Rx Sens: Shorthaul - Receiver Sensitivity: 0 to -6dB.

Rx Sens: Longhaul - Receiver Sensitivity: -6 to -34 dB.

NOTE: *Using the 750 with the sensitivity set to "Longhaul" on a circuit with a strong signal (0 to -6dB - "Shorthaul" sensitivity), will overdrive the receiver and cause errors to occur.*

Tx Level: Normal - Meets ANSI T1.403 Power Level specification. No attenuation is inserted in the transmitted signal.

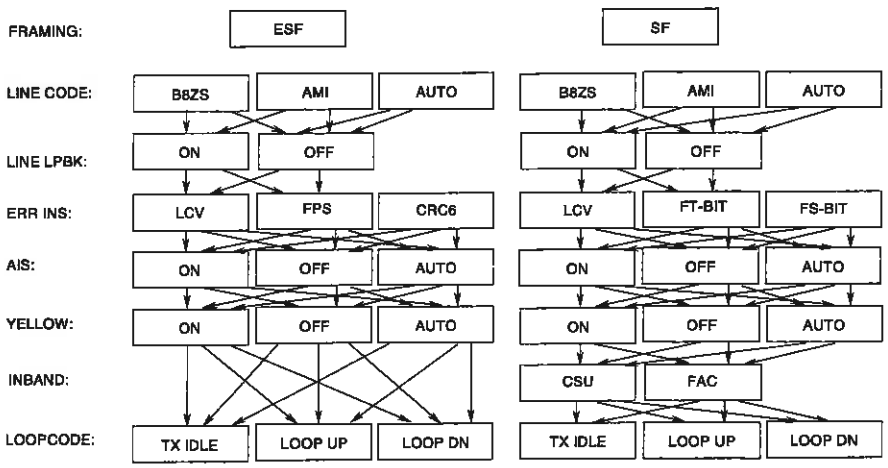
Tx Level: -7.5 dB - Meets ANSI T1.403 Power Level specification. 7.5 dB of attenuation is inserted into the transmitted signal.

Tx Level: -15.0 dB - Meets ANSI T1.403 Power Level specification. 15.0 dB of attenuation is inserted into the transmitted signal.

Tx Level: -22.5 dB - Meets ANSI T1.403 Power Level specification. 22.5 dB of attenuation is inserted into the transmitted signal.

Select the **MORECFG** soft key to continue the Setup.

DS1 Physical Setup MORECFG Menu Tree



Definitions:

Line Code: B8ZS - Uses B8SZ line coding.

Line Code: AMI - Uses AMI line coding.

Line Code: Auto - Auto detects the line coding.

Line LPBK: On - Enables a local line loopback.

Line LPBK: Off - Disables a local line loopback.

Err Ins: LCV - Selects LCV (Line Code Violations) errors to be used when inserting errors on the "PHYSICAL STATISTICS" screen.

Err Ins: FPS - Selects FPS (Framing Pattern Sequence) errors to be used when inserting errors on the "PHYSICAL STATISTICS" screen.

Err Ins: CRC6 - Selects CRC6 errors to be used when inserting errors on the "PHYSICAL STATISTICS" screen.

Err Ins: FT-Bit - Selects FT-Bit (Terminal Framing Bit) errors to be used when inserting errors on the "PHYSICAL STATISTICS" screen.

Err Ins: FS-Bit - Selects FS-Bit (Signal Framing Bit) errors to be used when inserting errors on the "PHYSICAL STATISTICS" screen.

AIS: On - Transmits a constant Alarm Indication Signal, regardless of line conditions.

AIS: Off - Does not respond to or transmit AIS, regardless of line conditions.

AIS: Auto - When LOS or LOF (Loss of Signal or Loss of Framing) are received, an AIS will be sent.

Yellow: On - Transmits a constant Yellow Alarm, regardless of line conditions.

Yellow: Off - Does not respond to or transmit Yellow Alarms, regardless of line conditions.

Yellow: Auto - When a LOS or LOF (Loss of Signal or Loss of Framing) are received, a Yellow Alarm will be sent.

Inband: CSU - Enables an Inband CSU loopback (initiated with the Loop Up/Loop Dn "Loopcode" selection).

Inband: FAC - Enables an Inband Facility loopback (initiated with the Loop Up/Loop Dn "Loopcode" selection)

Loopcode: TX IDLE - Transmits no loop codes.

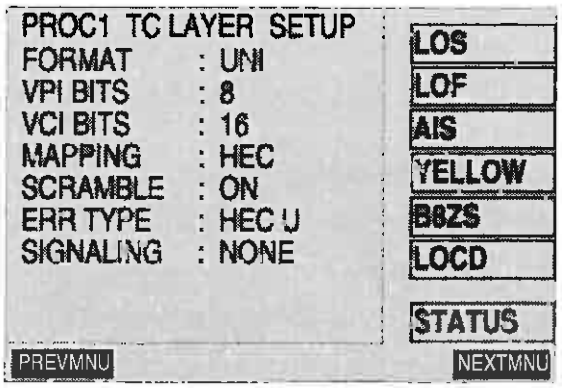
Loopcode: Loop Up - Transmits a loop up command.

Loopcode: Loop Dn - Transmits a loop down command.

Select the **RETURN** soft key to return to the main Physical Setup menu. Once the physical layer is set up, the TC Sublayer must be set up. Select the **NEXTMNU** soft key to access the TC sublayer setup menu.

4.1.1.2 DS1 Interface TC Sublayer Menu

The TC Sublayer menu will appear in two different configurations. The configuration seen is based on the selection of the "MAPPING" menu item on the TC Sublayer menu. Following is the DS1 TC Sublayer Setup menu with HEC mapping selected:



Soft LED Definitions:

LOS - Loss of Signal - Red indicates that the 750 has currently lost the received signal.

LOF - Loss of Frame - Red indicates that the 750 has lost framing delineation.

AIS - Alarm Indication Signal - Red indicates that an error condition has been detected by a device in the transmission path.

YELLOW - Red indicates a Yellow Alarm is being received.

B8ZS - Green indicates a B8ZS sequence has been received.

LOCD - Loss of Cell Delineation - Indicates that the 750 has sensed LOCD.

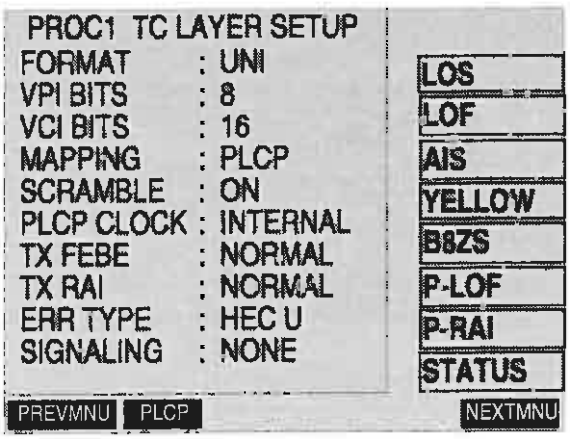
STATUS - Red indicates errors are being detected in the physical layer. Green indicates physical layer is operating properly. Amber indicates the physical layer is currently okay, but experienced errors in the past. The amber color can be changed to green by pressing **2nd. Func., Status** then the **CLEAR** soft key.

Soft key Definitions:

PREVMNU - Moves back to the Physical Setup menu.

NEXTMNU - Moves to the Header Setup menu (PVC and PVP testing) or Link Setup menu (SVC and SVP testing).

Following is the DS1 TC Sublayer setup menu with PLCP mapping selected.



Soft LED Definitions:

LOS - Loss of Signal - Red indicates that the 750 has currently lost the received signal.

LOF - Loss of Frame - Red indicates that the 750 has lost framing delineation.

AIS - Alarm Indication Signal - Red indicates that an error condition has been detected by a device in the transmission path.

YELLOW - Red indicates a Yellow Alarm is being received.

B8ZS - Green indicates a B8ZS sequence has been received.

P-LOF - Red indicates PATH - Loss of Frame is being received (PLCP only).

P-RAI - Red indicates PATH - Remote Alarm Indication is being received (PLCP only).

STATUS - Red indicates errors are being detected in the physical layer. Green indicates physical layer is operating properly. Amber indicates the physical layer is currently okay, but experienced errors in the past. The amber color can be changed to green by pressing **2nd. Func., Status** then the **CLEAR** soft key.

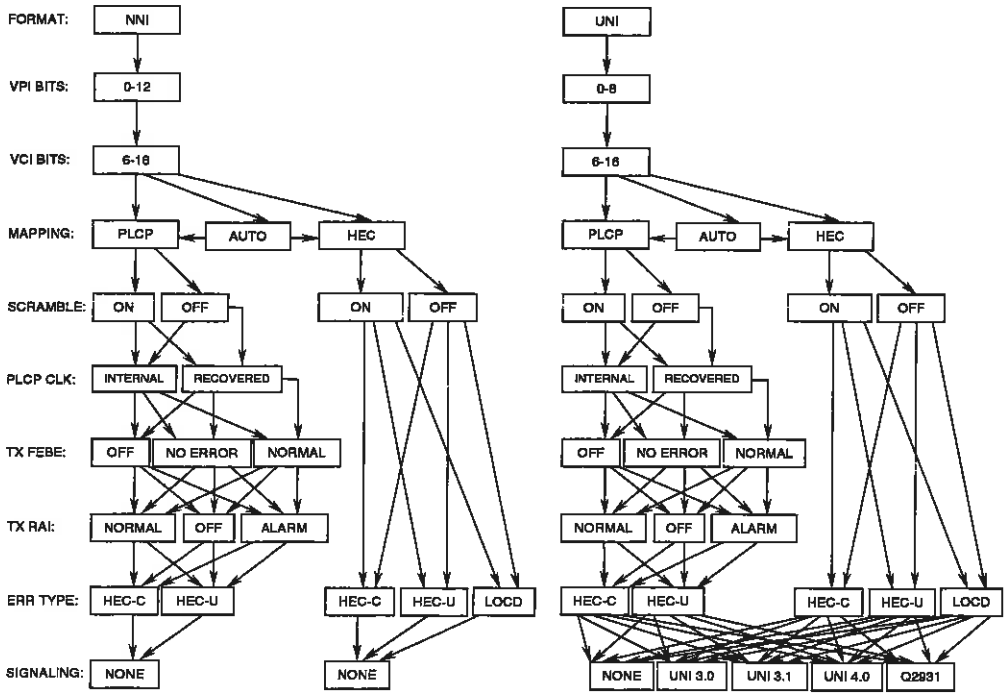
Soft key Definitions:

PREVMNU - Moves back to the Physical Setup menu.

PLCP - Moves to the Global PLCP Statistics screen.

NEXTMNU - Moves to the Header Setup menu (PVC and PVP testing) or Link Setup menu (SVC and SVP testing).

DS1 Interface TC Sublayer Setup Menu Tree:



Definitions:

Format: NNI - Network to Network Interface.

Format: UNI - User to Network Interface.

VPI Bits - Designates the number of bits in the virtual path identifier addressing section of the ATM cell header. This may vary from 0 to 8 bits in the UNI format and 0 to 12 in the NNI format.

VCI Bits - Designates the number of bits in the virtual channel identifier addressing section of the ATM cell header. This number varies from 6 to16 for both UNI and NNI formats.

Mapping: PLCP - Maps ATM cells to the DS1 signal using Physical Layer Convergence Protocol (PLCP) frames. PLCP is defined by IEEE 802.6.

Mapping: HEC - Used for cell delineation in lieu of PLCP mapping.

Mapping: Auto - Auto detects the mapping selection.

Scramble: On - Enables scrambling of the ATM cell payload.

Scramble: Off - Disables scrambling of the ATM cell payload.

PLCP CLK: Internal - PLCP clock is obtained from within the 750.

PLCP CLK: Recovered - PLCP clock is derived from the received signal.

Tx FEBE: Off - The Far End Block Error (FEBE) reporting mechanism is not implemented.

Tx FEBE: No Error - FEBEs are always reported as 0, regardless of the number of Bit Interleaved Parity (BIP) errors received.

Tx FEBE: Normal - One FEBE is transmitted for each BIP error received.

Tx RAI: Normal - Remote Alarm Indication (RAI) is automatically transmitted to the other end when the appropriate condition is met.

Tx RAI: Off - RAI is not transmitted back to the other end.

Tx RAI: Alarm - Transmits a constant RAI regardless of the line condition.

Err Type: HEC-C - Enables the 750 to send a correctable HEC error.

Err Type: HEC-U - Enables the 750 to send an uncorrectable HEC error.

Err Type: LOCD - Enables the 750 to send enough consecutive cell errors (6) to force the network to sense Loss of Cell Delineation (LOCD). (HEC mapping only.) (NOTE: Channel must use 100% of the Interface bandwidth.)

Signaling: None - Enables the 750 to operate in Permanent Virtual Circuit (PVC) or Permanent Virtual Path (PVP) mode. See Section 4.2 for PVC and Section 4.3 for PVP.

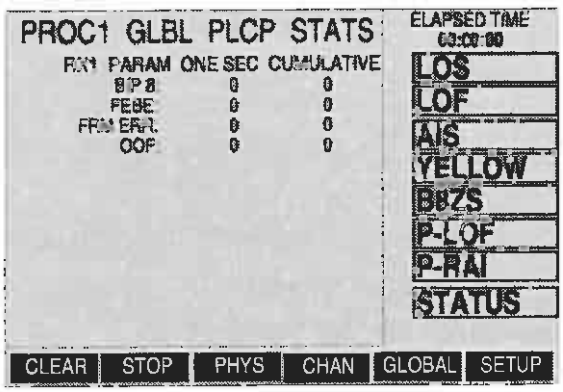
Signaling: UNI 3.0 - Enables the 750 to operate in either PVC, PVP, or Switched Virtual Circuit (SVC) mode or all simultaneously. The SVC mode will use UNI 3.0 signaling. See Section 4.2 for PVC, Section 4.3 for PVP and Section 4.4 for SVC.

Signaling: UNI 3.1 - Enables the 750 to operate in either PVC, PVP, or SVC mode or all simultaneously. The SVC mode will use UNI 3.1 signaling. See Section 4.2 for PVC, Section 4.3 for PVP, and Section 4.4 for SVC.

Signaling: UNI 4.0 - Enables the 750 to operate in either PVC, PVP, SVC, or Switched Virtual Path (SVP) mode or all simultaneously. The SVC and SVP modes will use UNI 4.0 signaling. See Section 4.2 for PVC, Section 4.3 for PVP, Section 4.4 for SVC, and Section 4.5 for SVP.

Signaling: Q2931 - Enables the 750 to operate in either PVC, PVP, or SVC mode or all simultaneously. The SVC mode will use ITU Q2931 signaling. See Section 4.2 for PVC, Section 4.3 for PVP, and Section 4.4 for SVC.

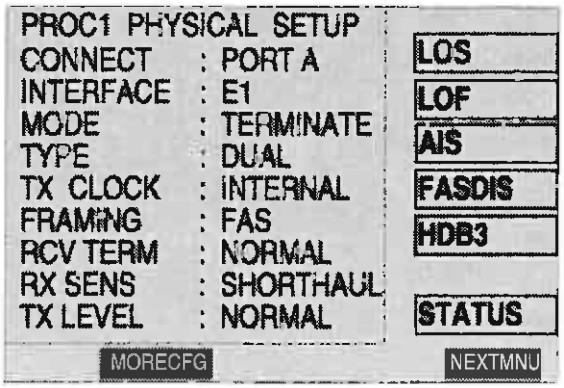
If the **PLCP** soft key is pressed, the following menu appears:



4.1.2 E1 Setup

The following paragraphs provide information on the E1 interface.

4.1.2.1 E1 Physical Layer Menu



Soft LED Definitions:

LOS - Loss of Signal - Red indicates that the 750 has currently lost the received signal.

LOF - Loss of Frame - Red indicates that the 750 has lost framing delineation.

AIS - Alarm Indication Signal - Red indicates that an error condition has been detected by a device in the transmission path.

FASDIS - Red indicates a Distant Frame Alignment Alarm is being received.

HDB3 - Green indicates an HDB3 sequence has been received.

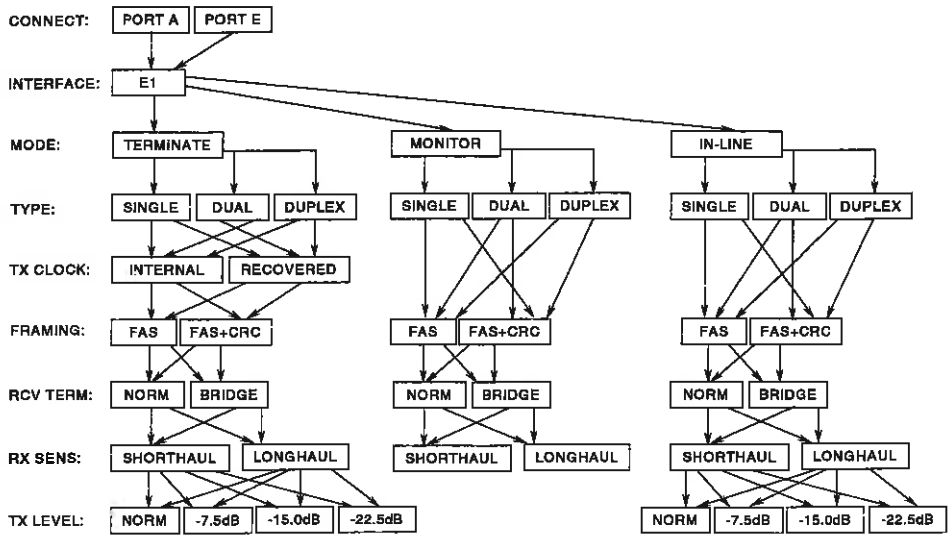
STATUS - Red indicates errors are being detected in the physical layer. Green indicates physical layer is operating properly. Amber indicates the physical layer is currently okay, but experienced errors in the past. The amber color can be changed to green by pressing **2nd. Func., Status** then the **CLEAR** soft key.

Soft key Definitions:

MORECFG - Moves to an additional Setup configuration screen.

NEXTMNU - Moves to the TC Layer Setup menu.

E1 Physical Setup Menu Tree



Definitions:

Interface: E1 - Allows the 750 to interface at the rate of 2.048 Mbps.

Mode: Terminate - This mode enables the 750 to terminate the ATM circuit and act as CPE. This mode is used for out of service tests.

Mode: Monitor - This mode enables the 750 to acquire statistics on an active ATM circuit. It is used for in service tests. With the coprocessor option installed, it will enable the 750 to be used for full duplex monitoring of the line under test.

Mode: In-Line - This mode enables the 750 to be placed in-line between the network interface and the customer's equipment.

NOTE: *The **LpBk** LED on active interface(s) will light when In-Line mode is selected. This is normal.*

Type: Single - Activates processor 1 only.

Type: Duplex - Activates both processors and duplicates the physical and TC layer setup for both processors.

Type: Dual - Activates both processors but enables each to be configured differently.

Tx Clock: Internal - Uses the 750's internal clock for purposes of synchronization.

Tx Clock: Recovered - Recovers the network clock for purposes of synchronization.

Framing: FAS - Enables the 750 to operate with FAS framing.

Framing: FAS+CRC - Enables the 750 to operate with FAS+CRC framing.

Rcv Term: Normal - Places a normal (120 Ohm) termination on the received signal. 75 Ohm termination can be achieved with an adapter (750-CABLE-BNC2).

Rcv Term: Bridge - No termination is placed on the received signal.

Rx Sens: Shorthaul - Receiver Sensitivity: 0 to -6dB.

Rx Sens: Longhaul - Receiver Sensitivity: -6 to -34 dB.

NOTE: *Using the 750 with the sensitivity set to "Longhaul" on a circuit with a strong signal (0 to -6dB - "Shorthaul" sensitivity), will overdrive the receiver and cause errors to occur.*

Tx Level: Normal - Meets ITU G.703 Power Level specification. No attenuation is inserted in the transmitted signal.

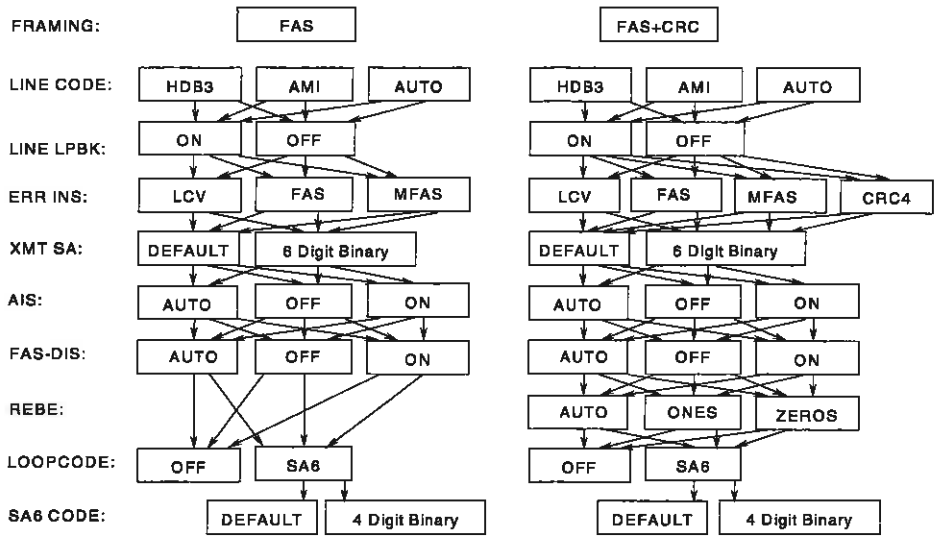
Tx Level: -7.5 dB - Meets ITU G.703 Power Level specification. 7.5 dB of attenuation is inserted into the transmitted signal.

Tx Level: -15.0 dB - Meets ITU G.703 Power Level specification. 15.0 dB of attenuation is inserted into the transmitted signal.

Tx Level: -22.5 dB - Meets ITU G.703 Power Level specification. 22.5 dB of attenuation is inserted into the transmitted signal.

Select the **MORECFG** soft key to continue the Setup.

E1 Physical Setup MORECFG Menu Tree



Definitions:

Line Code: HDB3 - Uses HDB3 line coding.

Line Code: AMI - Uses AMI line coding.

Line Code: Auto - Auto detects the line coding.

Line LPBK: On - Enables a local line loopback.

Line LPBK: Off - Disables a local line loopback.

Err Ins: LCV - Selects LCV (Line Code Violations) errors to be used when inserting errors on the "PHYSICAL STATISTICS" screen.

Err Ins: FAS - Selects FAS (Frame Alignment Sequence) errors to be used when inserting errors on the "PHYSICAL STATISTICS" screen.

Err Ins: MFAS - Selects MFAS (Multi-Frame Alignment Sequence) errors to be used when inserting errors on the "PHYSICAL STATISTICS" screen.

Err Ins: CRC4 -Selects CRC4 (4-bit CRC) errors to be used when inserting errors on the "PHYSICAL STATISTICS" screen.

XMT SA: Default - The 750 transmits a default value (11111) for the SA byte.

XMT SA: Change - The transmitted SA byte can be entered by the user.

AIS: On - Transmits a constant Alarm Indication Signal, regardless of line conditions.

AIS: Off - Does not respond to or transmit AIS, regardless of line conditions.

AIS: Auto - When LOS or LOF (Loss of Signal or Loss of Framing) are received, an AIS will be sent.

FAS-DIS: On - Transmits a constant FAS-DIS Signal, regardless of line conditions.

FAS-DIS: Off - Does not respond to or transmit FAS-DIS, regardless of line conditions.

FAS-DIS: Auto - When LOS or LOF (Loss of Signal or Loss of Framing) are received, an FAS-DIS will be sent.

REBE: Ones - Selects the type of Remote End Bit Error to send - All ones.

REBE: Zeros - Selects the type of Remote End Bit Error to send - All zeros.

REBE: Auto - Selects the type of Remote End Bit Error to send - Whatever was received.

Loop Code: Off - Disables loop code.

Loop Code: SA6 - Enables the SA6 loop code.

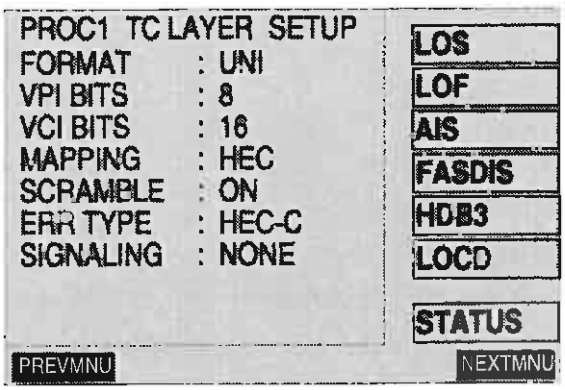
SA6 Code: Default - Sets a default value (1111) for the SA6 loop code.

SA6 Code: Change - The SA6 loop code can be entered by the user.

Once the physical layer is set up, the TC Sublayer must be set up. Select the **NEXTMNU** soft key to access the TC sublayer setup menu.

4.1.2.2 E1 Interface TC Sublayer Menu

The TC Sublayer menu will appear in two different configurations. The configuration seen is based on the selection of the "MAPPING" menu item on the TC Sublayer menu. Following is the E1 TC Sublayer Setup menu with HEC mapping selected:



Soft LED Definitions:

LOS - Loss of Signal - Red indicates that the 750 has currently lost the received signal.

LOF - Loss of Frame - Red indicates that the 750 has lost framing delineation.

AIS - Alarm Indication Signal - Red indicates that an error condition has been detected by a device in the transmission path.

FASDIS - Red indicates that a FAS-DIS is being received.

HDB3 - Green indicates an HDB3 sequence has been received.

LOCD - Loss of Cell Delineation - Indicates that the 750 has sensed LOCD.

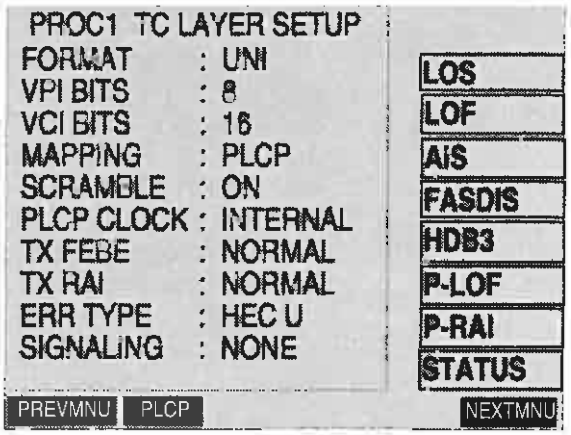
STATUS - Red indicates errors are being detected in the physical layer. Green indicates physical layer is operating properly. Amber indicates the physical layer is currently okay, but experienced errors in the past. The amber color can be changed to green by pressing **2nd. Func., Status** then the **CLEAR** soft key.

Soft key Definitions:

PREVMNU - Moves back to the Physical Setup menu.

NEXTMNU - Moves to the Header Setup menu (PVC and PVP testing) or Link Setup menu (SVC and SVP testing).

Following is the E1 TC Sublayer setup menu with PLCP mapping selected.



Soft LED Definitions:

LOS - Loss of Signal - Red indicates that the 750 has currently lost the received signal.

LOF - Loss of Frame - Red indicates that the 750 has lost framing delineation.

AIS - Alarm Indication Signal - Red indicates that an error condition has been detected by a device in the transmission path.

FASDIS - Red indicates that a FAS-DIS is being received.

HDB3 - Green indicates an HDB3 sequence has been received.

P-LOF - Red indicates PATH - Loss of Frame is being received (PLCP only).

P-RAI - Red indicates PATH - Remote Alarm Indication is being received (PLCP only).

STATUS - Red indicates errors are being detected in the physical layer. Green indicates physical layer is operating properly. Amber indicates the physical layer is currently okay, but experienced errors in the past. The amber color can be changed to green by pressing **2nd. Func., Status** then the **CLEAR** soft key.

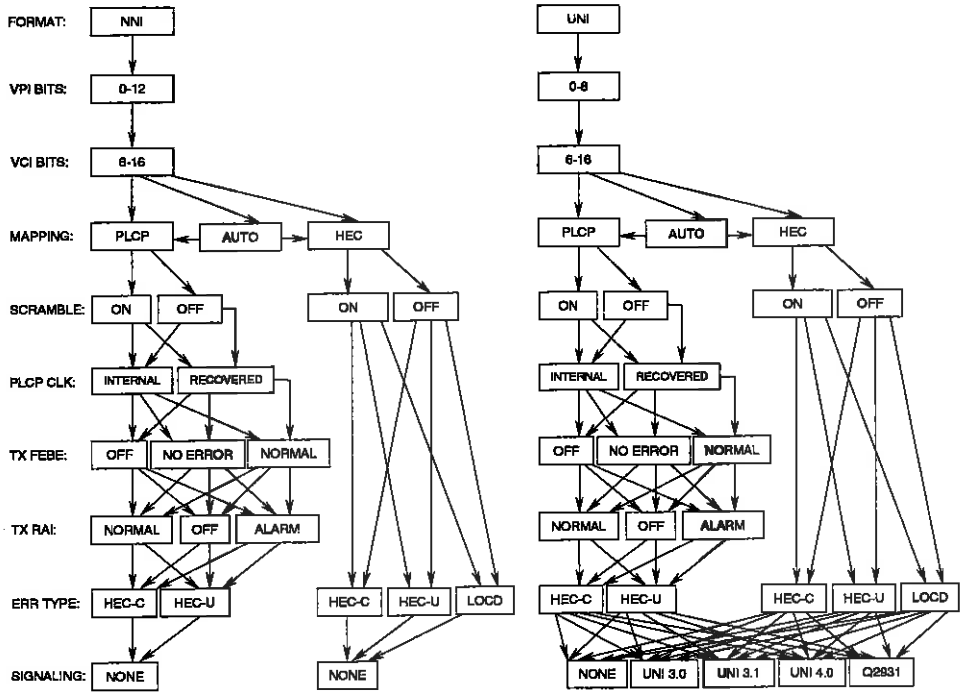
Soft key Definitions:

PREVMNU - Moves back to the Physical Setup menu.

PLCP - Moves to the Global PLCP Statistics screen.

NEXTMNU - Moves to the Header Setup menu (PVC and PVP testing) or Link Setup menu (SVC and SVP testing).

E1 Interface TC Sublayer Setup Menu Tree:



Definitions:

Format: NNI - Network to Network Interface.

Format: UNI - User to Network Interface

VPI Bits - Designates the number of bits in the virtual path identifier addressing section of the ATM cell header. This may vary from 0 to 8 bits in the UNI format and 0 to 12 in the NNI format.

VCI Bits - Designates the number of bits in the virtual channel identifier addressing section of the ATM cell header. This number varies from 6 to16 for both UNI and NNI formats.

Mapping: PLCP - Maps ATM cells to the E1 signal using Physical Layer Convergence Protocol (PLCP) frames.

Mapping: HEC - Used for cell delineation in lieu of PLCP mapping.

Mapping: Auto - Auto detects the mapping selection.

Scramble: On - Enables scrambling of the cell payload.

Scramble: Off - Disables scrambling of the ATM cell payload.

PLCP CLK: Internal - PLCP clock is obtained from within the 750.

PLCP CLK: Recovered - PLCP clock is derived from the received signal.

Tx FEBE: Off - The Far End Block Error (FEBE) reporting mechanism is not implemented.

Tx FEBE: No Error - FEBEs are always reported as 0, regardless of the number of Bit Interleaved Parity (BIP) errors received.

Tx FEBE: Normal - One FEBE is transmitted for each BIP error received.

Tx RAI: Normal - Remote Alarm Indication (RAI) is automatically transmitted to the other end when the appropriate conditions exit.

Tx RAI: Off - RAI is not transmitted back to the other end.

Tx RAI: Alarm - Transmits a constant RAI regardless of line conditions.

Err Type: HEC-C - Enables the 750 to send a correctable HEC error.

Err Type: HEC-U - Enables the 750 to send an uncorrectable HEC error.

Err Type: LOCD - Enables the 750 to send enough consecutive cell errors (6) to force the network to sense Loss of Cell Delineation (LOCD). (HEC only.)

Signaling: None - Enables the 750 to operate in Permanent Virtual Circuit (PVC) or Permanent Virtual Path (PVP) mode. See Section 4.2 for PVC and Section 4.3 for PVP.

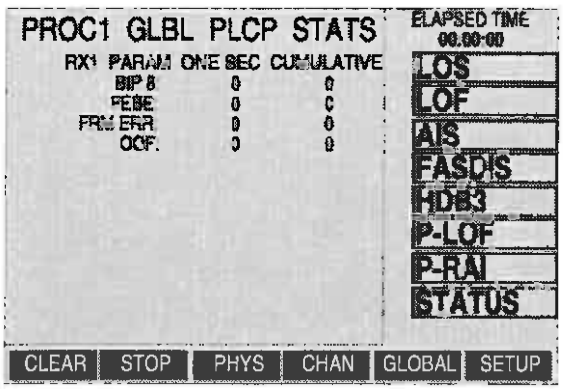
Signaling: UNI 3.0 - Enables the 750 to operate in either PVC, PVP, or Switched Virtual Circuit (SVC) mode or all simultaneously. The SVC mode will use UNI 3.0 signaling. See Section 4.2 for PVC, Section 4.3 for PVP and Section 4.4 for SVC.

Signaling: UNI 3.1 - Enables the 750 to operate in either PVC, PVP, or SVC mode or all simultaneously. The SVC mode will use UNI 3.1 signaling. See Section 4.2 for PVC, Section 4.3 for PVP, and Section 4.4 for SVC.

Signaling: UNI 4.0 - Enables the 750 to operate in either PVC, PVP, SVC, or Switched Virtual Path (SVP) mode or all simultaneously. The SVC and SVP modes will use UNI 4.0 signaling. See Section 4.2 for PVC, Section 4.3 for PVP, Section 4.4 for SVC, and Section 4.5 for SVP.

Signaling: Q2931 - Enables the 750 to operate in either PVC, PVP, or SVC mode or all simultaneously. The SVC mode will use ITU Q2931 signaling. See Section 4.2 for PVC, Section 4.3 for PVP, and Section 4.4 for SVC.

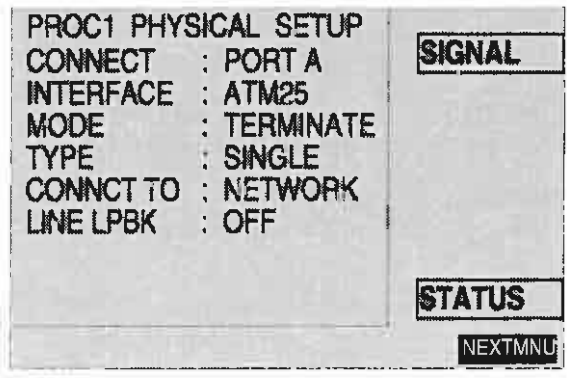
If the **PLCP** soft key is pressed, the following menu appears:



4.1.3 ATM25 Setup

The following paragraphs provide information on the ATM25 interface.

4.1.3.1 ATM25 Physical Layer Menu



Soft LED Definitions:

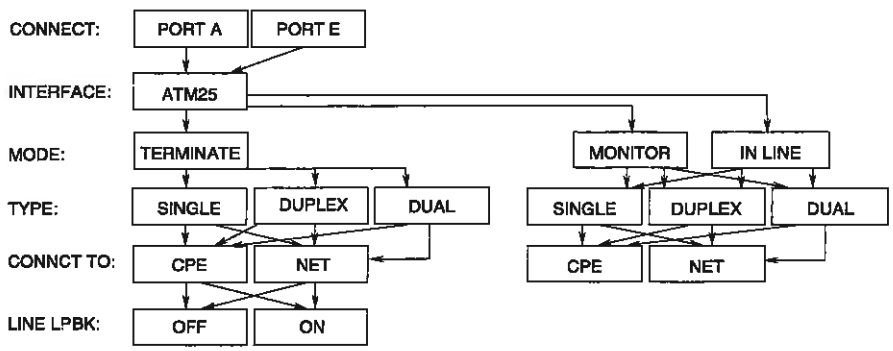
SIGNAL - Red indicates that the 750 has currently lost the received signal. Green indicates an ATM25 signal is being received.

STATUS - Red indicates errors are being detected in the physical layer. Green indicates physical layer is operating properly. Amber indicates the physical layer is currently okay, but experienced errors in the past. The amber color can be changed to green by pressing **2nd Func., Status** then the **CLEAR** soft key.

Soft key Definitions:

NEXTMNU - Moves to the TC Layer Setup menu.

ATM 25 Physical Setup Menu Tree



Definitions:

ATM 25 - This interface meets the specification of the ATM forum AF-PHY-0040.000

Terminate - This mode enables the 750 to terminate the ATM circuit and act as CPE. This mode is used for out of service tests.

Monitor - This mode enables the 750 to acquire statistics on an active ATM circuit. It is used for in service tests. With the coprocessor option installed, it will enable the 750 to be used for full duplex monitoring of the line under test.

In-Line - This mode will enable the 750 to be placed in line between the customer's CPE and the ATM25 line.

NOTE: *The **LpBk** LED on active interface(s) will light when In-Line mode is selected. This is normal.*

Type: Single - Activates processor 1 only.

Type: Duplex - Activates both processors and duplicates the physical and TC layer setup for both processors.

Type: Dual - Activates both processors but enables both to be configured differently.

Connect to: CPE - Configures the 750 as UNI-U and activates the Network connector.

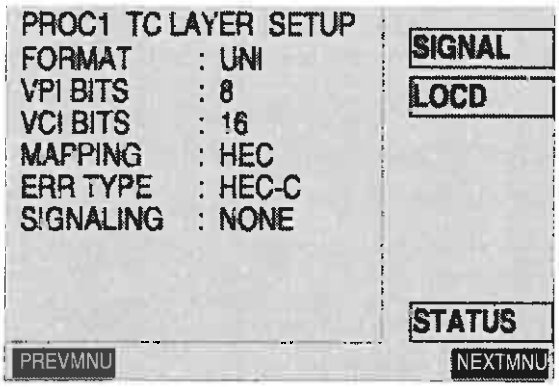
Connect to: NET - Configures the 750 as UNI-N and activates the CPE connector.

Line LPBK: On - Enables a local line loopback.

Line LPBK: Off - Disables a local line loopback.

Once the physical layer is set up the TC sublayer must be addressed. Select the **NEXTMNU** soft key to move to the TC Sublayer setup menu.

4.1.3.2 ATM25 Interface TC Sublayer Menu



Soft LED Definitions:

SIGNAL - Red indicates that the 750 has currently lost the received signal. Green indicates an ATM25 signal is being received.

LOCD - Loss of Cell Delineation - Indicates that the network has sensed LOCD.

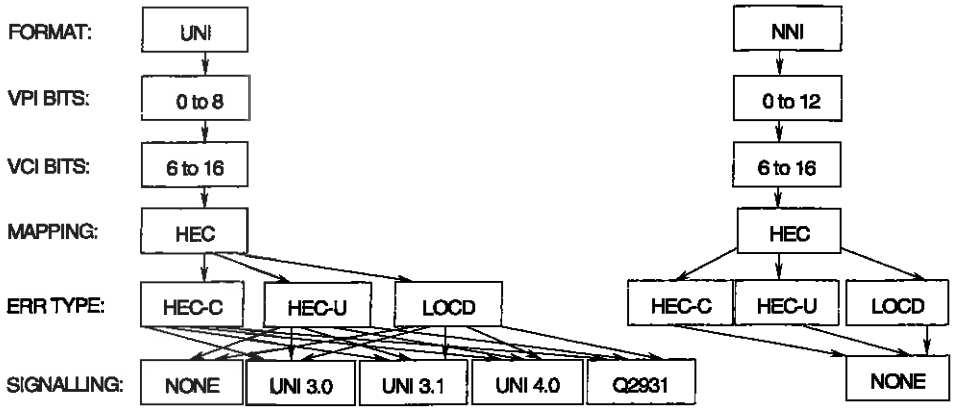
STATUS - Red indicates errors are being detected in the physical layer. Green indicates physical layer is operating properly. Amber indicates the physical layer is currently okay, but experienced errors in the past. The amber color can be changed to green by pressing **2nd Func., Status** then the **CLEAR** soft key.

Soft key Definitions:

PREVMNU - Moves back to the Physical Setup menu.

NEXTMNU - Moves to the Header Setup menu (PVC and PVP testing) or Link Setup menu (SVC and SVP testing).

ATM25 Interface TC Sublayer Setup Menu Tree:



Definitions:

Format: UNI - User to Network Interface.

Format: NNI - Network to Network Interface.

VPI Bits - Designates the number of bits in the Virtual Path Identifier addressing section of the ATM cell header. This may vary from 0 to 8 bits in the UNI format and 0 to 12 bits in the NNI format.

VCI Bits - Designates the number of bits in the Virtual Channel Identifier addressing section of the ATM cell header. This number varies from 6 to 16 bits for both UNI and NNI formats.

Mapping: HEC - This is the only selection available for the ATM 25 interface.

Err Type: HEC-C - Enables the 750 to send a correctable HEC error.

Err Type: HEC-U - Enables the 750 to send an uncorrectable HEC error.

Err Type: LOCD - Enables the 750 to send enough consecutive cell errors (6) to force the network to sense Loss of Delineation (LOCD).

Signaling: None - Enables the 750 to operate in Permanent Virtual Circuit (PVC) or Permanent Virtual Path (PVP) mode. See Section 4.2 for PVC and Section 4.3 for PVP.

Signaling: UNI 3.0 - Enables the 750 to operate in either PVC, PVP, or Switched Virtual Circuit (SVC) mode or all simultaneously. The SVC mode will use UNI 3.0 signaling. See Section 4.2 for PVC, Section 4.3 for PVP and Section 4.4 for SVC.

Signaling: UNI 3.1 - Enables the 750 to operate in either PVC, PVP, or SVC mode or all simultaneously. The SVC mode will use UNI 3.1 signaling. See Section 4.2 for PVC, Section 4.3 for PVP, and Section 4.4 for SVC.

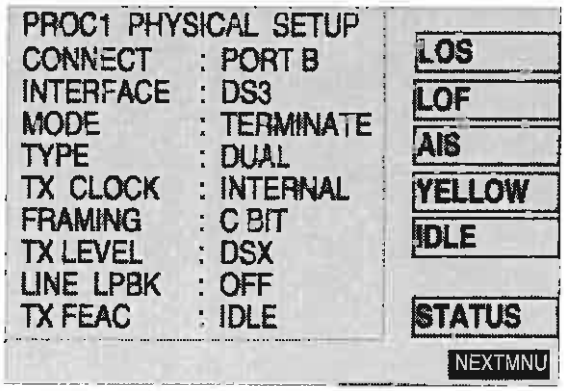
Signaling: UNI 4.0 - Enables the 750 to operate in either PVC, PVP, SVC, or Switched Virtual Path (SVP) mode or all simultaneously. The SVC and SVP modes will use UNI 4.0 signaling. See Section 4.2 for PVC, Section 4.3 for PVP, Section 4.4 for SVC, and Section 4.5 for SVP.

Signaling: Q2931 - Enables the 750 to operate in either PVC, PVP, or SVC mode or all simultaneously. The SVC mode will use ITU Q2931 signaling. See Section 4.2 for PVC, Section 4.3 for PVP, and Section 4.4 for SVC.

4.1.4 DS3 Setup

The following paragraphs provide information on the DS3 interface.

4.1.4.1 DS3 Physical Layer Menu



Soft LED Definitions:

LOS - Loss of Signal - Red indicates that the 750 has currently lost the received signal.

LOF - Loss of Frame - Red indicates that the 750 has lost framing delineation.

AIS - Alarm Indication Signal - Red indicates that an error condition has been detected by a device in the transmission path.

YELLOW - Red indicates a Yellow Alarm is being received.

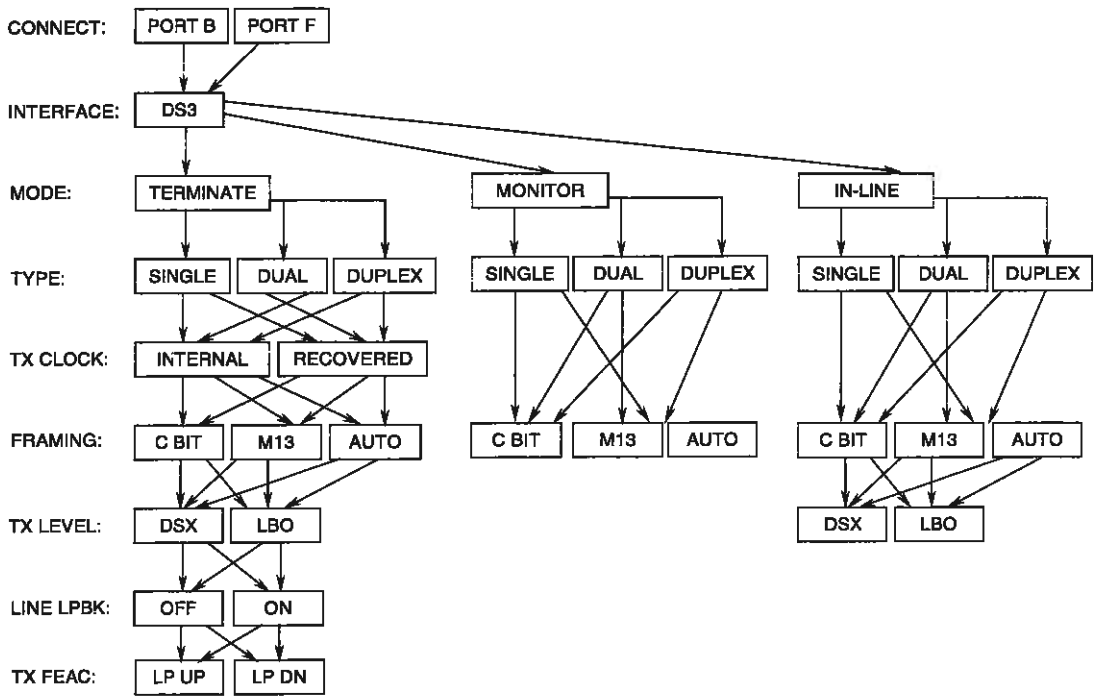
IDLE - Red indicates an Idle alarm is being received.

STATUS - Red indicates errors are being detected in the physical layer. Green indicates physical layer is operating properly. Amber indicates the physical layer is currently okay, but experienced errors in the past. The amber color can be changed to green by pressing **2nd Func., Status** then the **CLEAR** soft key.

Soft key Definitions:

NEXTMNU - Moves to the TC Layer Setup menu.

DS3 Physical Setup Menu Tree:



Definitions:

Interface: DS3 - Enables the 750 to interface at the rate of 45 Mbps. Meets requirements of ANSI specification TI.404-1989.

Mode: Terminate - This mode enables the 750 to terminate the ATM circuit and act as CPE. This mode is used for out of service tests.

Mode: Monitor - This mode enables the 750 to acquire statistics on an active ATM circuit. It is used for in service tests. With the coprocessor option installed, it will enable the 750 to be used for full duplex monitoring of the line under test.

Mode: In-Line - This mode enables the 750 to be placed in-line between the network interface and the customer's equipment.

NOTE: *The **LpBk** LED on active interface(s) will light when In-Line mode is selected. This is normal.*

Type: Single - Activates processor 1 only.

Type: Duplex - Activates both processors and duplicates the physical and TC layer setup for both processors.

Type: Dual - Activates both processors but enables each to be configured differently.

Tx Clock: Internal - Uses the 750's internal clock for purposes of synchronization.

Tx Clock: Recovered - Recovers the network clock for purposes of synchronization.

Framing: C Bit - Enables the 750 to operate with C Bit framing.

Framing: M13 - Enables the 750 to operate with M13 framing.

Framing: Auto - Enables the 750 to automatically determine the framing of the line to be tested and auto configure for that framing.

Tx Level: DSX - Transmits the signal at + 5 dBm.

Tx Level LBO - Transmits the signal at + 3.2 dBm.

Line LPBK: On - Enables a local line loopback.

Line LPBK: Off - Disables a local line loopback.

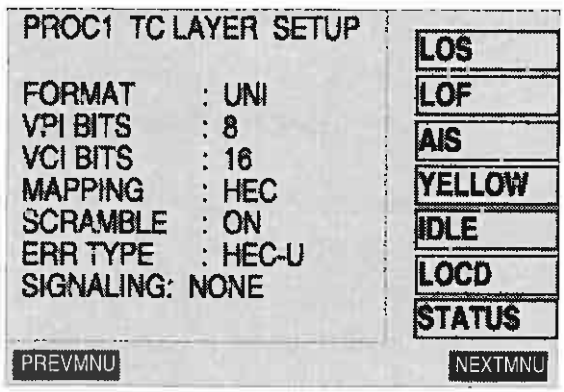
Tx FEAC: Loop Up - Transmits a C Bit FEAC loop up code.

Tx FEAC: Loop Down - Transmits a C Bit FEAC loop down code.

Once the physical layer is set up the TC Sublayer must be set up. Select the **NEXTMNU** soft key to access the TC sublayer setup menu.

4.1.4.2 DS3 TC Sublayer Menu

The TC sublayer menu will appear in two different configurations. The configuration seen is based on the selection of the "MAPPING" menu item on the TC Sublayer menu. Following is the DS3 TC Sublayer Setup menu with HEC mapping selected.



Soft LED Definitions:

LOS - Loss of Signal - Red indicates that the 750 has currently lost the received signal.

LOF - Loss of Frame - Red indicates that the 750 has lost framing delineation.

AIS - Alarm Indication Signal - Red indicates that an error condition has been detected by a device in the transmission path.

YELLOW - Red indicates a Yellow Alarm is being received.

IDLE - Red indicates an Idle alarm is being received.

LOCD - Loss of Cell Delineation - Indicates that the 750 has sensed LOCD.

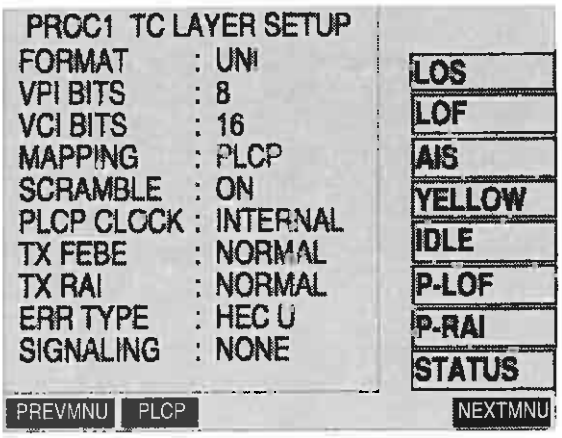
STATUS - Red indicates errors are being detected in the physical layer. Green indicates physical layer is operating properly. Amber indicates the physical layer is currently okay, but experienced errors in the past. The amber color can be changed to green by pressing **2nd. Func., Status** then the **CLEAR** soft key.

Soft key Definitions:

PREVMNU - Moves back to the Physical Setup menu.

NEXTMNU - Moves to the Header Setup menu (PVC and PVP testing) or Link Setup menu (SVC and SVP testing).

Following is the DS3 TC Sublayer setup menu with PLCP mapping selected.



Soft LED Definitions:

LOS - Loss of Signal - Red indicates that the 750 has currently lost the received signal.

LOF - Loss of Frame - Red indicates that the 750 has lost framing delineation.

AIS - Alarm Indication Signal - Red indicates that an error condition has been detected by a device in the transmission path.

YELLOW - Red indicates a Yellow Alarm is being received.

IDLE - Red indicates an Idle Alarm is being received.

P-LOF - Red indicates PATH - Loss of Frame is being received (PLCP only).

P-RAI - Red indicates PATH - Remote Alarm Indication is being received (PLCP only).

STATUS - Red indicates errors are being detected in the physical layer. Green indicates physical layer is operating properly. Amber indicates the physical layer is currently okay, but experienced errors in the past. The amber color can be changed to green by pressing **2nd. Func., Status** then the **CLEAR** soft key.

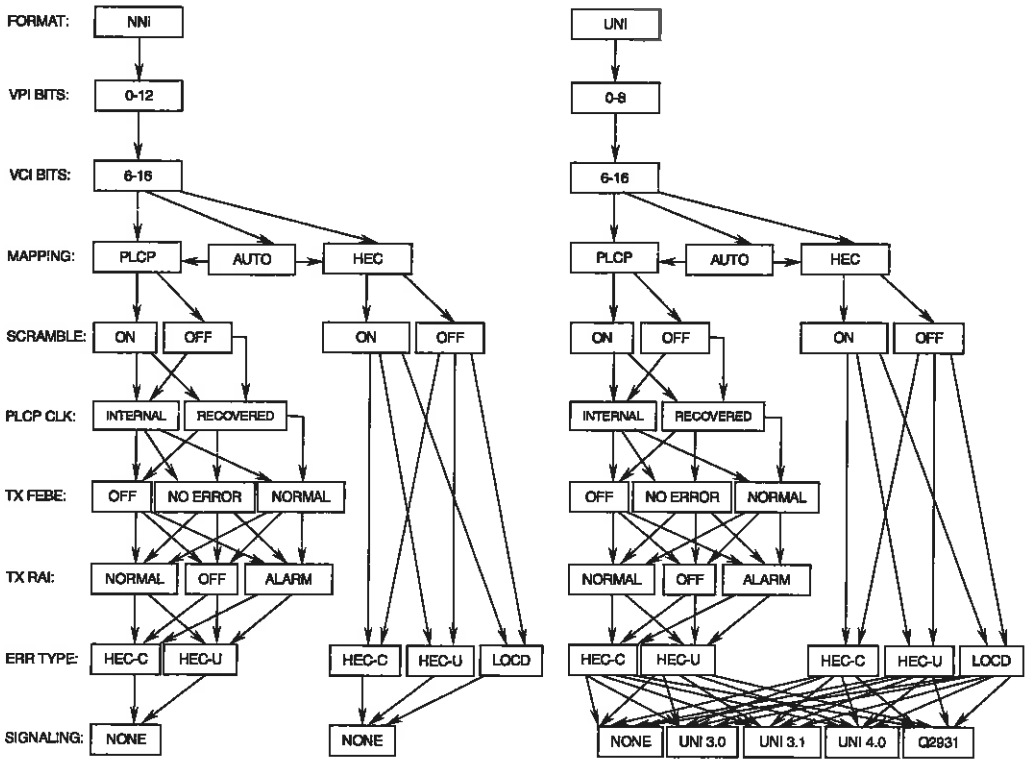
Soft key Definitions:

PREVMNU - Moves back to the Physical Setup menu.

PLCP - Moves to the Global PLCP Statistics screen.

NEXTMNU - Moves to the Header Setup menu (PVC and PVP testing) or Link Setup menu (SVC and SVP testing).

DS3 TC Sublayer Setup Menu Tree:



Definitions:

Format: NNI - Network to Network Interface.

Format: UNI - User to Network Interface.

VPI Bits - Designates the number of bits in the virtual path identifier addressing section of the ATM cell header. This may vary from 0 to 8 bits in the UNI format and 0 to 12 in the NNI format.

VCI Bits - Designates the number of bits in the virtual channel identifier addressing section of the ATM cell header. This number varies from 6 to16 for both UNI and NNI formats.

Mapping: PLCP - Maps ATM cells to the DS3 signal using Physical Layer Convergence Protocol (PLCP) frames. PLCP is defined by IEEE 802.6.

Mapping: HEC - Used for cell delineation in lieu of PLCP mapping.

Mapping: Auto - Auto detects the mapping selection.

Scramble: On - Enables scrambling of the ATM cell payload.

Scramble: Off - Disables scrambling of the ATM cell payload.

PLCP CLK: Internal - PLCP clock is obtained from within the 750.

PLCP CLOCK: Recovered - PLCP clock is derived from the received signal.

Tx FEBE: Off - The Far End Block Error (FEBE) reporting mechanism is not implemented.

Tx FEBE: No Error - FEBEs are always reported as 0, regardless of the number of Bit Interleave Parity (BIP) errors received.

Tx FEBE: Normal - One FEBE is transmitted for each BIP error received.

Tx RAI: Normal - Remote Alarm Indication (RAI) is automatically transmitted to the other end when the appropriate condition is met.

Tx RAI: Off - RAI is not transmitted to the other end.

Tx RAI: Alarm - Transmits a constant RAI regardless of line conditions.

Err Type: HEC-C - Enables the 750 to send a correctable HEC error.

Err Type: HEC-C - Enables the 750 to send a correctable HEC error.

Err Type: HEC-U - Enables the 750 to send an uncorrectable HEC error.

Err Type: LOCD - Enables the 750 to send enough consecutive cell errors (6) to force the network to sense Loss of Cell Delineation (LOCD). (HEC only.)

Signaling: None - Enables the 750 to operate in Permanent Virtual Circuit (PVC) or Permanent Virtual Path (PVP) mode. See Section 4.2 for PVC and Section 4.3 for PVP.

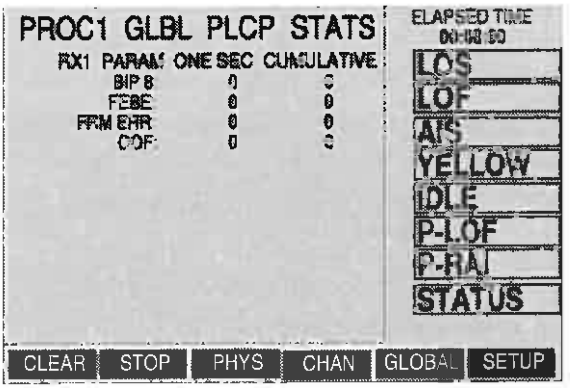
Signaling: UNI 3.0 - Enables the 750 to operate in either PVC, PVP, or Switched Virtual Circuit (SVC) mode or all simultaneously. The SVC mode will use UNI 3.0 signaling. See Section 4.2 for PVC, Section 4.3 for PVP and Section 4.4 for SVC.

Signaling: UNI 3.1 - Enables the 750 to operate in either PVC, PVP, or SVC mode or all simultaneously. The SVC mode will use UNI 3.1 signaling. See Section 4.2 for PVC, Section 4.3 for PVP, and Section 4.4 for SVC.

Signaling: UNI 4.0 - Enables the 750 to operate in either PVC, PVP, SVC, or Switched Virtual Path (SVP) mode or all simultaneously. The SVC and SVP modes will use UNI 4.0 signaling. See Section 4.2 for PVC, Section 4.3 for PVP, Section 4.4 for SVC, and Section 4.5 for SVP.

Signaling: Q2931 - Enables the 750 to operate in either PVC, PVP, or SVC mode or all simultaneously. The SVC mode will use ITU Q2931 signaling. See Section 4.2 for PVC, Section 4.3 for PVP, and Section 4.4 for SVC.

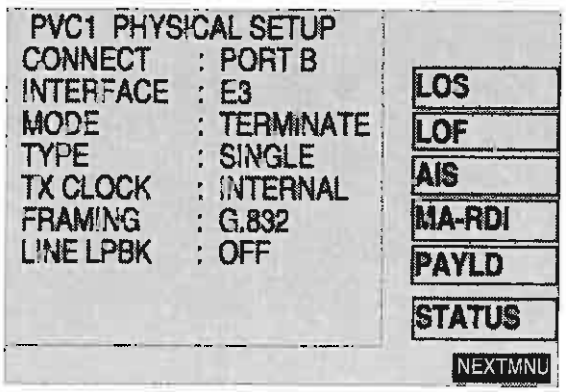
If the **PLCP** soft key is pressed, the following menu appears:



4.1.5 E3 Setup

The following paragraphs provide information on the E3 interface.

4.1.5.1 E3 Physical Layer Menu



Soft LED Definitions:

LOS - Loss of Signal - Red indicates that the 750E has currently lost the received signal.

LOF - Loss of Frame - Red indicates that the 750E has lost framing delineation.

AIS - Alarm Indication Signal - Red indicates that an error condition has been detected by a device in the transmission path.

YELLOW - (G.751) (Not shown) - Red indicates that a yellow alarm is being received.

MA-RDI - (G.832) Red indicates Maintenance and Adaptation Remote Defect Indication.

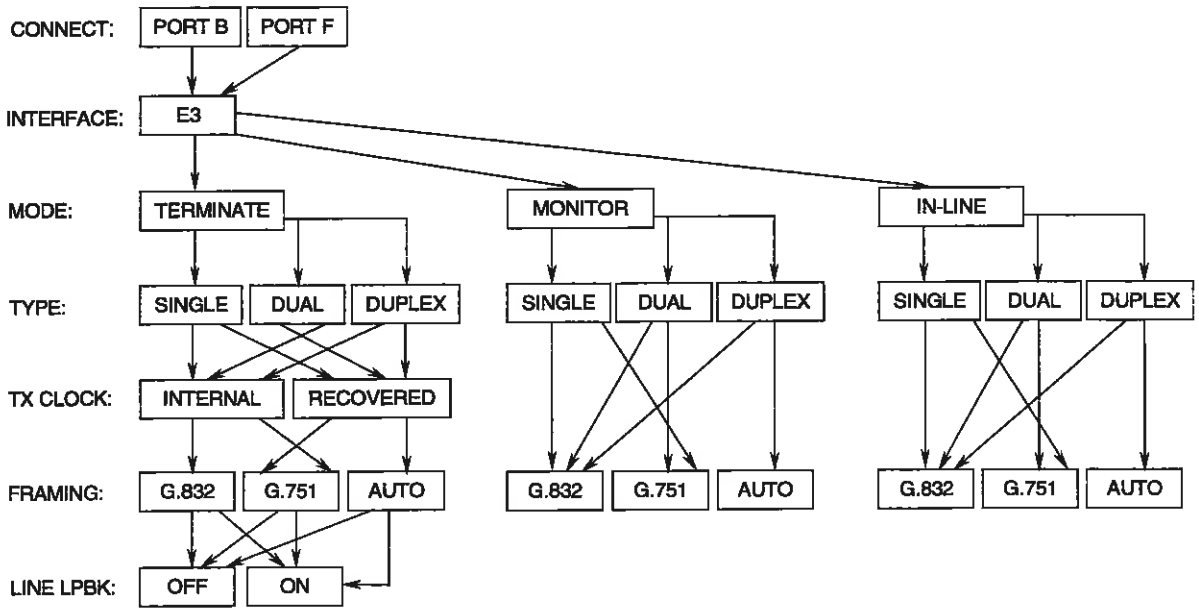
PAYLD - (G.832) Red indicates Payload Mismatch.

STATUS - Red indicates errors are being detected in the physical layer. Green indicates physical layer is operating properly. Amber indicates the physical layer is currently okay, but experienced errors in the past. The amber color can be changed to green by pressing **2nd Func., Status** then the **CLEAR** soft key.

Soft key Definitions:

NEXTMNU - Moves to the TC Layer Setup menu.

E3 Physical Setup Menu Tree:



Definitions:

Interface: E3 - Interface at the rate of 34 Mbps that meets the requirements of ITU-T specifications G.704, G.751, G.804 and 1.432.

Mode: Terminate - This mode enables the 750 to terminate the ATM circuit and act as CPE. This mode is used for out of service tests.

Mode: Monitor - This mode enables the 750 to acquire statistics on an active ATM circuit. It is used for in service tests. With the coprocessor option installed, it will enable the 750 to be used for full duplex monitoring of the line under test.

Mode: In Line - This mode enables the 750 to be placed in-line between the network interface and the customer's equipment.

NOTE: *The **LpBk** LED on active interface(s) will light when In-Line mode is selected. This is normal.*

Type: Single - Activates processor 1 only.

Type: Duplex - Activates both processors and duplicates the physical and TC layer setup for both processors.

Type: Dual - Activates both processors but enables each to be configured differently.

TX Clock: Recovered - Recovers the network clock for purposes of synchronization.

TX Clock: Internal - Uses 750's internal clock for purposes of synchronization.

Framing: G.832 - Configures the 750 interface to conform to ITU-T recommendation G.832. The international standard equivalent of HEC.

Framing: G.751 - Configures the 750 interface to conform to ITU-T recommendation G.751. The international standard equivalent of PLCP.

Framing: Auto - Enables the 750 to automatically determine the framing of the line to be tested and auto-configure for that framing.

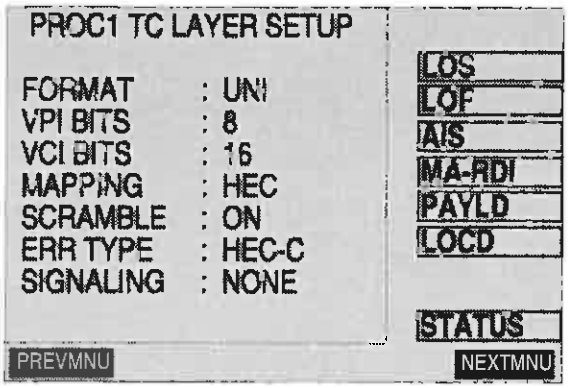
Line LPBK: On - Enables a local line loopback.

Line LPBK: Off - Disables a local line loopback.

Once the physical layer is set up the TC Sublayer must be addressed. Select the **NEXTMNU** soft key to move to the TC layer setup screen.

4.1.5.2 E3 TC Sublayer Menu - G.832 Framing

The TC Sublayer menu will appear in two different configurations. The configuration seen is based on the selection of the "FRAMING" menu item on the Physical Setup menu. Following is the E3 TC Sublayer Setup menu with G.832 framing selected.



Soft LED Definitions:

LOS - Loss of Signal - Red indicates that the 750 has currently lost the received signal.

LOF - Loss of Frame - Red indicates that the 750 has lost framing delineation.

AIS - Alarm Indication Signal - Red indicates that an error condition has been detected by a device in the transmission path.

MA-RDI - Red indicates Maintenance and Adaptation Remote Defect Indication.

PAYLD - Red indicates Payload Mismatch.

LOCD - Loss of Cell Delineation - Indicates that the 750 has sensed LOCD.

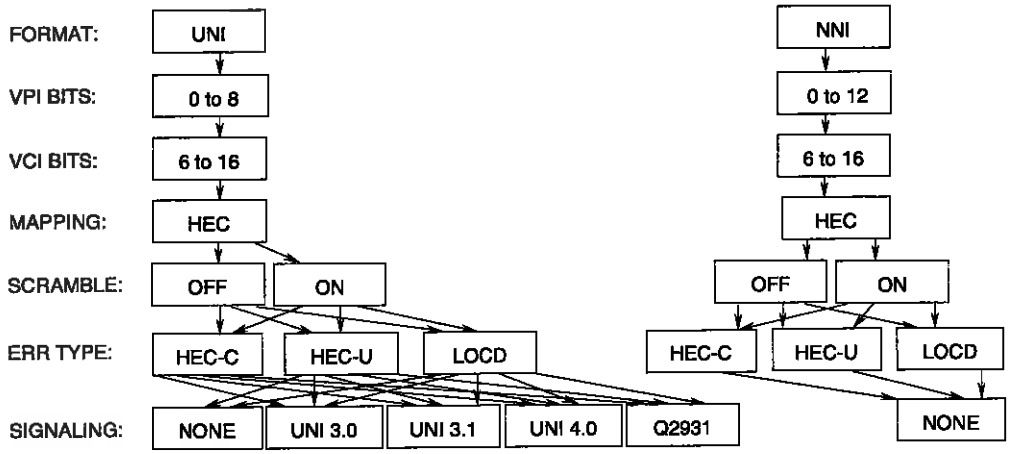
STATUS - Red indicates errors are being detected in the physical layer. Green indicates physical layer is operating properly. Amber indicates the physical layer is currently okay, but experienced errors in the past. The amber color can be changed to green by pressing **2nd Func., Status** then the **CLEAR** soft key.

Soft key Definitions:

PREVMNU - Moves back to the Physical Setup menu.

NEXTMNU - Moves to the Header Setup menu (PVC and PVP testing) or Link Setup menu (SVC and SVP testing).

E3 Interface with G.832 Framing TC Sublayer Setup Menu Tree:



Definitions:

Format: UNI - User to Network Interface.

Format: NNI - Network to Network Interface.

VPI Bits - Designates the number of bits in the virtual path identifier addressing section of the ATM cell header. This may vary from 0 to 8 bits in the UNI format and 0 to 12 in the NNI format.

VCI Bits - Designates the number of bits in the virtual channel identifier addressing section of the ATM cell header. This number varies from 6 to16 for both UNI and NNI formats.

Mapping: HEC - Header Error Control mapping per ITU G.832.

Scramble: On - Enables scrambling of the cell payload.

Scramble: Off - Disables scrambling of the ATM cell payload.

Err Type: HEC-C - Enables the 750 to send a correctable HEC error.

Err Type: HEC-U - Enables the 750 to send an uncorrectable HEC error.

Err Type: LOCD - Enables the 750 to send enough consecutive cell errors (6) to force the network to sense Loss of Cell Delineation (LOCD).

Signaling: None - Enables the 750 to operate in Permanent Virtual Circuit (PVC) or Permanent Virtual Path (PVP) mode. See Section 4.2 for PVC and Section 4.3 for PVP.

Signaling: UNI 3.0 - Enables the 750 to operate in either PVC, PVP, or Switched Virtual Circuit (SVC) mode or all simultaneously. The SVC mode will use UNI 3.0 signaling. See Section 4.2 for PVC, Section 4.3 for PVP and Section 4.4 for SVC.

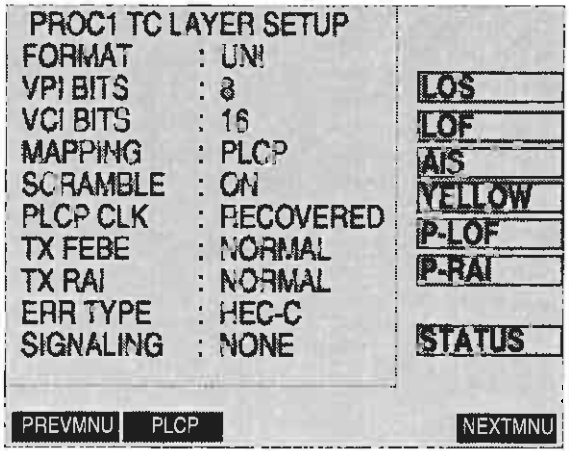
Signaling: UNI 3.1 - Enables the 750 to operate in either PVC, PVP, or SVC mode or all simultaneously. The SVC mode will use UNI 3.1 signaling. See Section 4.2 for PVC, Section 4.3 for PVP, and Section 4.4 for SVC.

Signaling: UNI 4.0 - Enables the 750 to operate in either PVC, PVP, SVC, or Switched Virtual Path (SVP) mode or all simultaneously. The SVC and SVP modes will use UNI 4.0 signaling. See Section 4.2 for PVC, Section 4.3 for PVP, Section 4.4 for SVC, and Section 4.5 for SVP.

Signaling: Q2931 - Enables the 750 to operate in either PVC, PVP, or SVC mode or all simultaneously. The SVC mode will use ITU Q2931 signaling. See Section 4.2 for PVC, Section 4.3 for PVP, and Section 4.4 for SVC.

4.1.5.3 E3 TC Sublayer Menu - G.751 Framing

Following is the E3 TC Sublayer menu with G.751 framing selected.



Soft LED Definitions:

LOS - Loss of Signal - Red indicates that the 750 has currently lost the received signal.

LOF - Loss of Frame - Red indicates that the 750 has lost framing delineation.

AIS - Alarm Indication Signal - Red indicates that an error condition has been detected by a device in the transmission path.

YELLOW - Red indicates a Yellow Alarm is being received.

P-LOF - Red indicates PLCP Loss of Framing is being received.

P-RAI - Red indicates PLCP Remote Alarm Indication is being received.

STATUS - Red indicates errors are being detected in the physical layer. Green indicates physical layer **is** operating properly. Amber indicates the physical layer is currently okay, but experienced errors in the past. The amber color can be changed to green by pressing **2nd Func., Status** then the **CLEAR** soft **key.**

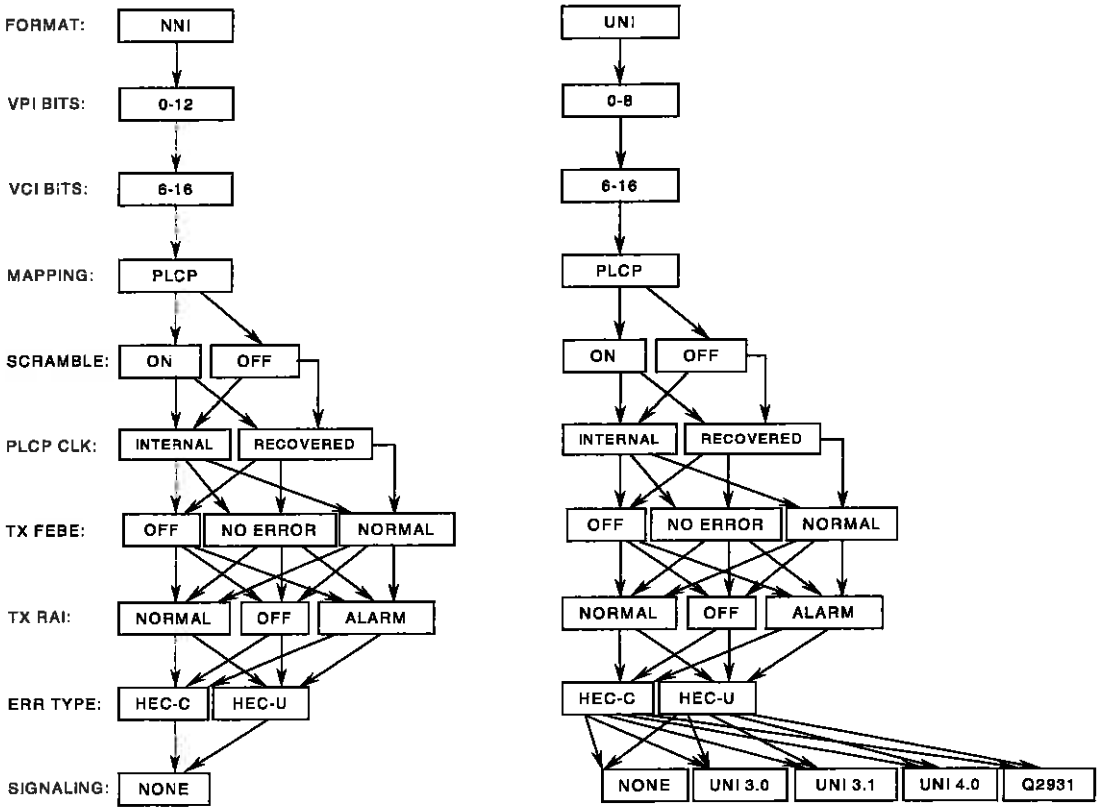
Soft key Definitions:

PREVMNU - Moves back to the Physical Setup menu.

PLCP - Moves to the Global PLCP Statistics screen.

NEXTMNU - Moves to the Header Setup menu (PVC and PVP testing) or Link Setup menu (SVC and SVP testing).

E3 Interface with G.751 framing TC Sublayer Setup Menu Tree:



Definitions:

Format: UNI - User to Network Interface.

Format: NNI - Network to Network Interface.

VPI Bits - Designates the number of bits in the virtual path identifier addressing section of the ATM cell header. This may vary from 0 to 8 bits in the UNI format and 0 to 12 in the NNI format.

VCI Bits - Designates the number of bits in the virtual channel identifier addressing section of the ATM cell header. This number varies from 6 to16 for both UNI and NNI formats.

Mapping: PLCP - Maps ATM cells to the E3 signal using Physical Layer Convergence Protocol (PLCP) frames. PLCP is defined by the ATM Forum UNI 3.1.

PLCP Clock: Internal - PLCP clock is obtained from within the 750.

PLCP Clock: Recovered - PLCP clock is derived from the received signal.

Tx FEBE: Off - The Far End Block Error (FEBE) reporting mechanism is not implemented. Received block error processing is not affected.

Tx FEBE: No Error - FEBEs are always reported as 0, regardless of the number of Bit Interleaved Parity (BIP) errors received.

Tx FEBE: Normal - One FEBE is transmitted for each BIP error received.

Tx RAI: Normal - Remote Alarm Indication (RAI) is automatically transmitted to the other end when appropriate line condition is met.

Tx RAI: Off - RAI is not transmitted to the other end.

Tx RAI: Alarm - Transmits a constant RAI regardless of line conditions.

Err Type: HEC-C - Enables the 750 to send a correctable HEC error.

Err Type: HEC-U - Enables the 750 to send an uncorrectable HEC error.

Signaling: None - Enables the 750 to operate in Permanent Virtual Circuit (PVC) or Permanent Virtual Path (PVP) mode. See Section 4.2 for PVC and Section 4.3 for PVP.

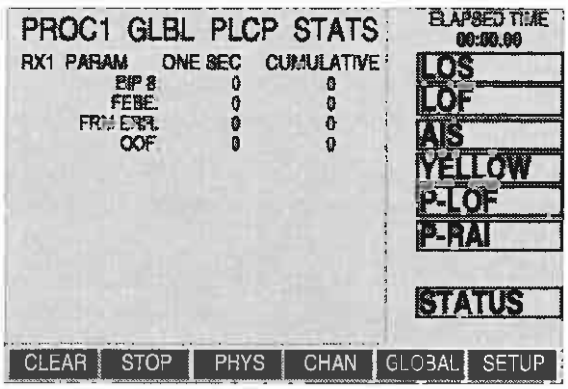
Signaling: UNI 3.0 - Enables the 750 to operate in either PVC, PVP, or Switched Virtual Circuit (SVC) mode or all simultaneously. The SVC mode will use UNI 3.0 signaling. See Section 4.2 for PVC, Section 4.3 for PVP and Section 4.4 for SVC.

Signaling: UNI 3.1 - Enables the 750 to operate in either PVC, PVP, or SVC mode or all simultaneously. The SVC mode will use UNI 3.1 signaling. See Section 4.2 for PVC, Section 4.3 for PVP, and Section 4.4 for SVC.

Signaling: UNI 4.0 - Enables the 750 to operate in either PVC, PVP, SVC, or Switched Virtual Path (SVP) mode or all simultaneously. The SVC and SVP modes will use UNI 4.0 signaling. See Section 4.2 for PVC, Section 4.3 for PVP, Section 4.4 for SVC, and Section 4.5 for SVP.

Signaling: Q2931 - Enables the 750 to operate in either PVC, PVP, or SVC mode or all simultaneously. The SVC mode will use ITU Q2931 signaling. See Section 4.2 for PVC, Section 4.3 for PVP, and Section 4.4 for SVC.

If the **PLCP** soft key is pressed, the following menu appears:

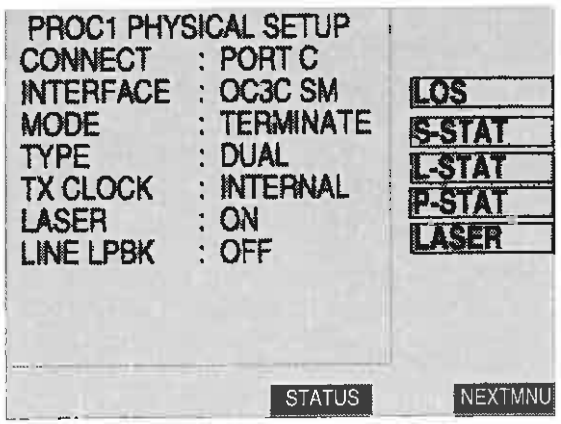


4.1.6 OC3c/STM1 Setup

The following paragraphs provide information on the OC3c/STM1 optical interface.

4.1.6.1 OC3c/STM1 Physical Layer Menu

NOTE: *The OC3c/STM1 Physical Setup uses the same procedure for Single Mode or Multi Mode fiber except that multi mode doesn't use a laser so there is no Laser On/Off menu item.*



Soft LED Definitions:

LOS - Loss of Signal - Red indicates that the 750 has currently lost the received signal.

S-STAT - Section Layer Status - Red indicates errors are being detected; amber indicates errors were detected since beginning the test, but are not present now; green indicates that errors have not been detected.

L-STAT - Line Layer Status - Red indicates errors are being detected; amber indicates errors were detected since beginning the test, but are not present now; green indicates that errors have not been detected.

P-STAT - Path Layer Status - Red indicates errors are being detected; amber indicates errors were detected since beginning the test, but are not present now; green indicates that errors have not been detected.

LASER - Green indicates laser is on, red indicates laser is off. (Single mode only)

Status - Section Layer will show the following additional ***Soft LEDs:***

LOF - Loss of Frame - Red indicates that the 750 has lost framing delineation.

S-BIP - Red indicates section BIP 8 errors are being detected.

Status - Line Layer will show the following additional ***Soft LEDs:***

L-AIS - Alarm Indication Signal - Red indicates that an error condition has been detected by a device in the transmission line.

L-RDI - Red indicates Line Remote Defect Identification alarm has been received.

L-BIP - Red indicates Line BIP 8 errors are being detected.

L-REI - Red indicates Line Remote Error Indicator (REI) is being received.

LOP - Loss of Pointer - Red indicates the receiving equipment has lost the pointer to start of cell in the payload.

L-RDI - Red indicates Line Defect Identification alarm has been received.

Status - Path Layer will show the following additional ***Soft LEDs:***

P-AIS - Red indicates Remote Alarm Indicator Signal has been received.

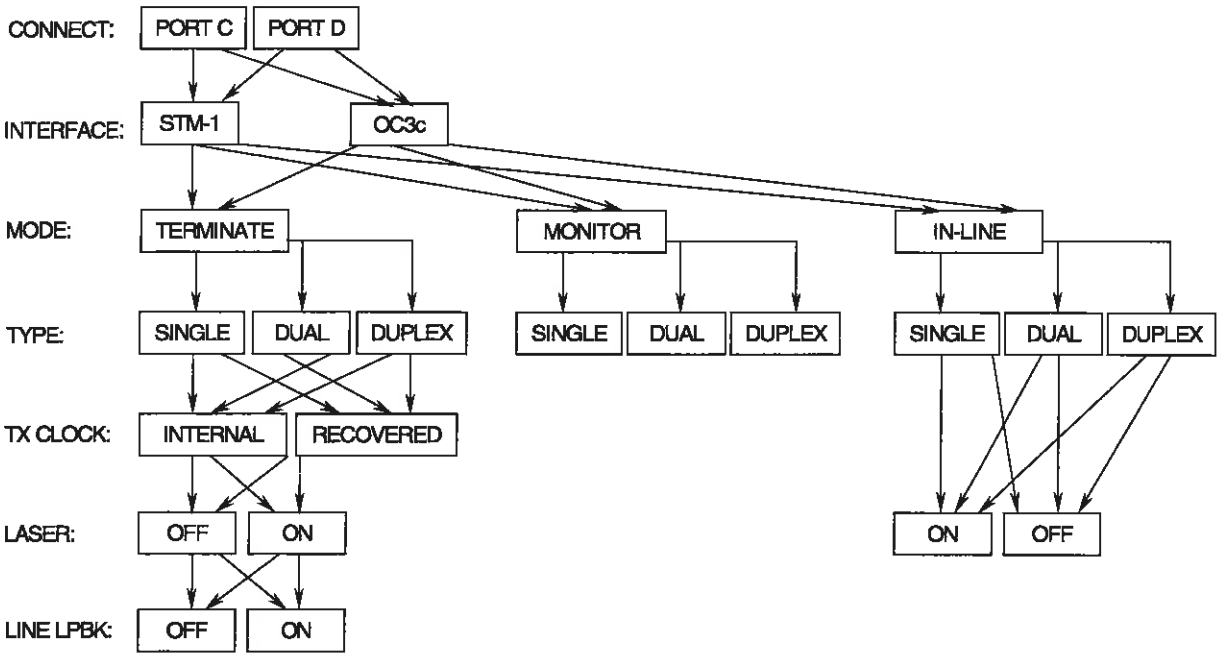
P-RDI - Red indicates Path Remote Defect Identification alarm has been received.

P-BIP - Red indicates Path BIP 8 or BIP 2 errors are being detected.

P-REI - Red indicates Remote Error Indication (REI) is being received.

Label (Signal Label) - Red indicates Signal Label is not designated for ATM.

OC3c/STM1 Physical Setup Menu:



Definitions:

Interface: OC3c/STM1 - Enables the 750 interface to operate at an optical line speed of 155 Mbps.

Mode: Terminate - This mode enables the 750 to terminate the ATM circuit and act as CPE. This mode is used for out of service tests.

Mode: Monitor - This mode enables the 750 to acquire statistics on an active ATM circuit. It is used for in service tests. With the coprocessor option installed, it will enable the 750 to be used for full duplex monitoring of the line under test.

Mode: In-Line - This mode enables the 750 to be placed in-line between the network interface and the customer's equipment.

NOTE: *The **LpBk** LED on active interface(s) will light when In-Line mode is selected. This is normal.*

Type: Single - Activates processor 1 only.

Type: Duplex - Activates both processors and duplicates the physical and TC layer setup for both processors.

Type: Dual - Activates both processors but enables each to be configured differently.

Tx Clock: Internal - Uses the 750's internal clock for purposes of synchronization.

Tx Clock: Recovered - Recovers the network clock for purposes of synchronization.

Laser: On - When displayed, the optical laser is enabled. (Single mode only).

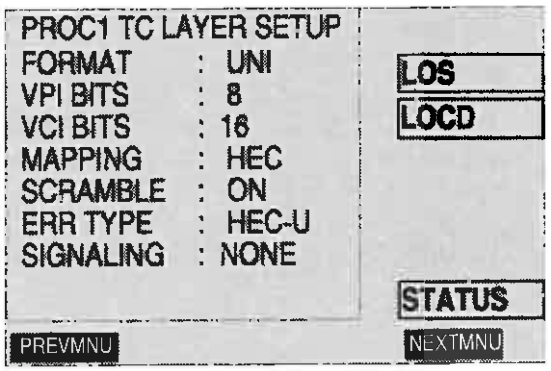
Laser: Off - When displayed, the optical laser is disabled. (Single mode only).

Line LPBK: On - Enables a local line loopback.

Line LPBK: Off - Disables a local line loopback.

Once the Physical Layer is set up, the TC Sublayer must be addressed. Press the **NEXTMNU** soft key to move to the TC Layer Setup menu.

4.1.6.2 OC3c/STM1 Interface TC Sublayer Menu



Soft LED Definitions:

LOS - Loss of Signal - Red indicates that the 750 has currently lost the received signal.

LOCD - Loss of Cell Delineation - Indicates that the 750 has sensed LOCD.

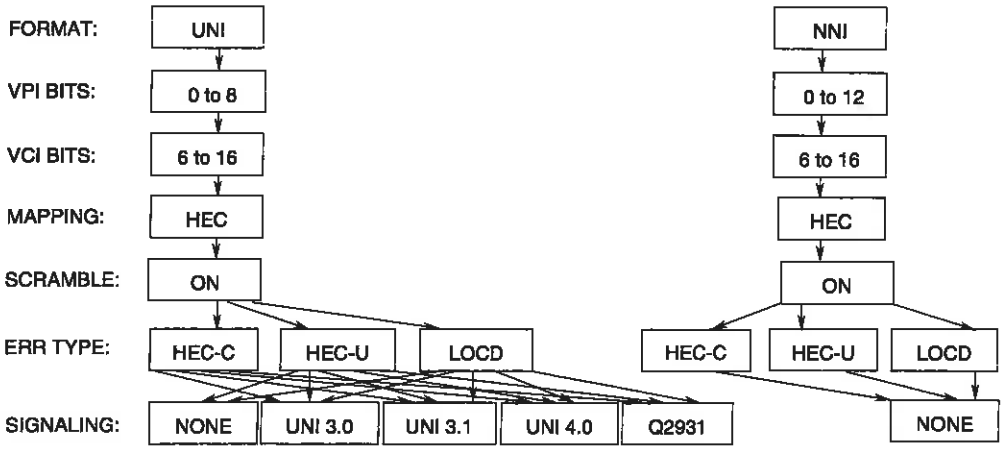
STATUS - Red indicates errors are being detected in the physical layer. Green indicates physical layer is operating properly. Amber indicates the physical layer is currently okay, but experienced errors in the past. The amber color can be changed to green by pressing **2nd Func., Status** then the **CLEAR** soft key.

Soft key Definitions:

PREVMNU - Moves back to the Physical Setup menu.

NEXTMNU - Moves to the Header Setup menu (PVC and PVP testing) or Link Setup menu (SVC and SVP testing).

OC3c/STM1 Interface TC Sublayer Setup Menu Tree:



Definitions:

Format: NNI - Network to Network Interface.

Format: UNI - User to Network Interface.

VPI BITS - Designates the number of bits in the virtual path identifier addressing section of the ATM cell header. This may vary from 0 to 8 bits in the UNI format and 0 to 12 in the NNI format.

VCI BITS - Designates the number of bits in the virtual channel identifier addressing section of the ATM cell header. This number varies from 6 to16 for both UNI and NNI formats.

Mapping: HEC - Used for cell delineation, at OC3c/STM1 interface rates. This setting is not changeable at OC3c/STM1 interface rates.

Scramble: On - Enables scrambling of the cell payload. This setting is not changeable at OC3c/STM1 interface rates.

Err Type: HEC-C - Enables the 750 to send a correctable HEC error.

Err Type: HEC-U - Enables the 750 to send an uncorrectable HEC error.

Err Type: LOCD - Enables the 750 to send enough consecutive cell errors (6) to force the network to sense Loss of Cell Delineation (LOCD). (NOTE: This will only work if the channel bandwidth is large enough to prevent any other correct or idle cells from being received.)

Signaling: None - Enables the 750 to operate in Permanent Virtual Circuit (PVC) or Permanent Virtual Path (PVP) mode. See Section 4.2 for PVC and Section 4.3 for PVP.

Signaling: UNI 3.0 - Enables the 750 to operate in either PVC, PVP, or Switched Virtual Circuit (SVC) mode or all simultaneously. The SVC mode will use UNI 3.0 signaling. See Section 4.2 for PVC, Section 4.3 for PVP and Section 4.4 for SVC.

Signaling: UNI 3.1 - Enables the 750 to operate in either PVC, PVP, or SVC mode or all simultaneously. The SVC mode will use UNI 3.1 signaling. See Section 4.2 for PVC, Section 4.3 for PVP, and Section 4.4 for SVC.

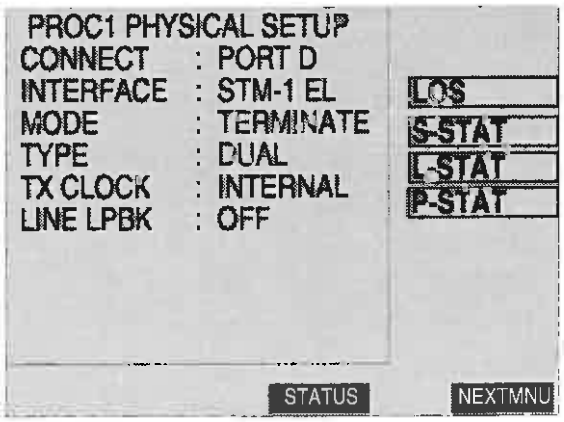
Signaling: UNI 4.0 - Enables the 750 to operate in either PVC, PVP, SVC, or Switched Virtual Path (SVP) mode or all simultaneously. The SVC and SVP modes will use UNI 4.0 signaling. See Section 4.2 for PVC, Section 4.3 for PVP, Section 4.4 for SVC, and Section 4.5 for SVP.

Signaling: Q2931 - Enables the 750 to operate in either PVC, PVP, or SVC mode or all simultaneously. The SVC mode will use ITU Q2931 signaling. See Section 4.2 for PVC, Section 4.3 for PVP, and Section 4.4 for SVC.

4.1.7 STM-1 EL/STS3c Setup

The following paragraphs provide information on the STM1/STS3c electrical interface.

4.1.7.1 STM-1 EL/STS3c Physical Layer Menu



Soft LED Definitions:

LOS - Loss of Signal - Red indicates that the 750 has currently lost the received signal.

S-STAT - Section Layer Status - Red indicates errors are being detected; amber indicates errors were detected since beginning the test, but are not present now; green indicates that errors have not been detected.

***L-STAT - Line Layer* Status** - Red indicates errors are being detected; amber indicates errors were detected since beginning the test, but are not present now; green indicates that errors have not been detected.

P-STAT - Path Layer Status - Red indicates errors are being detected; amber indicates errors were detected since beginning the test, but are not present now; green indicates that errors have not been detected.

Status - Section Layer will show the following additional ***Soft LEDs:***

LOF - Loss of Frame - Red indicates that the 750 has lost framing delineation.

S-BIP - Red indicates Section BIP 8 errors are being detected.

Status - Line Layer will show the following additional ***Soft LEDs:***

L-AIS - Alarm Indication Signal - Red indicates that an error condition has been detected by a device in the transmission line.

L-RDI - Red indicates Line Remote Defect Identification alarm has been received.

L-BIP - Red indicates Line BIP 8 errors are being detected.

L-REI - Red indicates Line Remote Error Indicator (REI) is being received.

LOP - Loss of Pointer - Red indicates the receiving equipment has lost the pointer to start of cell in the payload.

L-RDI - Red indicates Line Defect Identification alarm has been received.

Status - Path Layer will show the following additional ***Soft LEDs:***

P-AIS - Red indicates Remote Alarm Indicator Signal has been received.

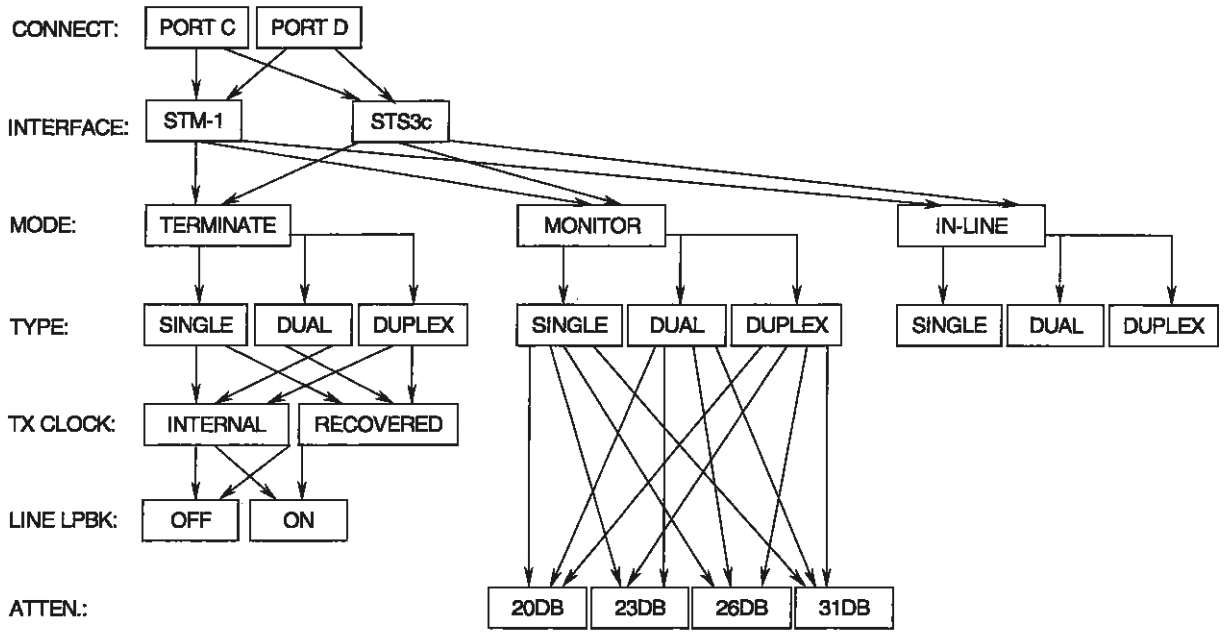
P-RDI - Red indicates Path Remote Defect Identification alarm has been received.

P-BIP - Red indicates Path BIP 8 or BIP 2 errors are being detected.

P-REI - Red indicates Remote Error Indication (REI) is being received.

Label (Signal Label) - Red indicates Signal Label is not designated for ATM.

STM1/STS3c Physical Setup Menu:



Definitions:

Interface: STM-1 EL/STS3c - Enables the 750 interface to operate at an electrical line speed of 155 Mbps.

Mode: Terminate - This mode enables the 750 to terminate the ATM circuit and act as CPE. This mode is used for out of service tests.

Mode: Monitor - This mode enables the 750 to acquire statistics on an active ATM circuit. It is used for in service tests. With the coprocessor option installed, it will enable the 750 to be used for full duplex monitoring of the line under test.

Mode: In-Line - This mode enables the 750 to be placed in-line between the network interface and the customer's equipment.

NOTE: *The **LpBk** LED on active interface(s) will light when In-Line mode is selected. This is normal.*

Type: Single - Activates processor 1 only.

Type: Duplex - Activates both processors and duplicates the physical and TC layer setup for both processors.

Type: Dual - Activates both processors but enables each to be configured differently.

Tx Clock: Internal - Uses the 750's internal clock for purposes of synchronization.

Tx Clock: Recovered - Recovers the network clock for purposes of synchronization

Line LPBK: On - Enables a local line loopback.

Line LPBK: Off - Disables a local line loopback.

Atten: 20 dB - Enables the 750 to monitor a signal down to -20 dBm.

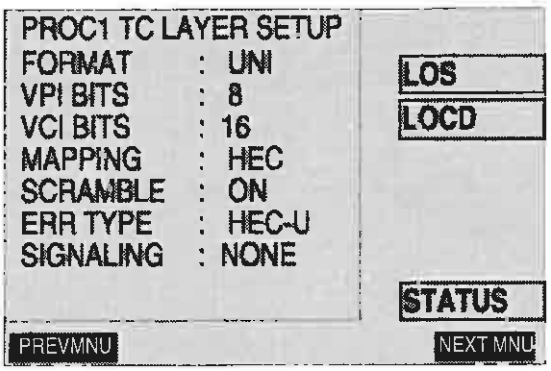
Atten: 23 dB - Enables the 750 to monitor a signal down to -23 dBm.

Atten: 26 dB - Enables the 750 to monitor a signal down to -26 dBm.

Atten: 31 dB - Enables the 750 to monitor a signal down to -31 dBm.

Once the Physical Layer is set up, the TC Sublayer must be addressed. Select the **NEXTMNU** soft key to move to the TC Layer Setup menu.

4.1.7.2 STM1/STS3c Interface TC Sublayer Menu



Soft LED Definitions:

LOS - Loss of Signal - Red indicates that the 750 has currently lost the received signal.

LOCD - Loss of Cell Delineation - Indicates that the 750 has sensed LOCD.

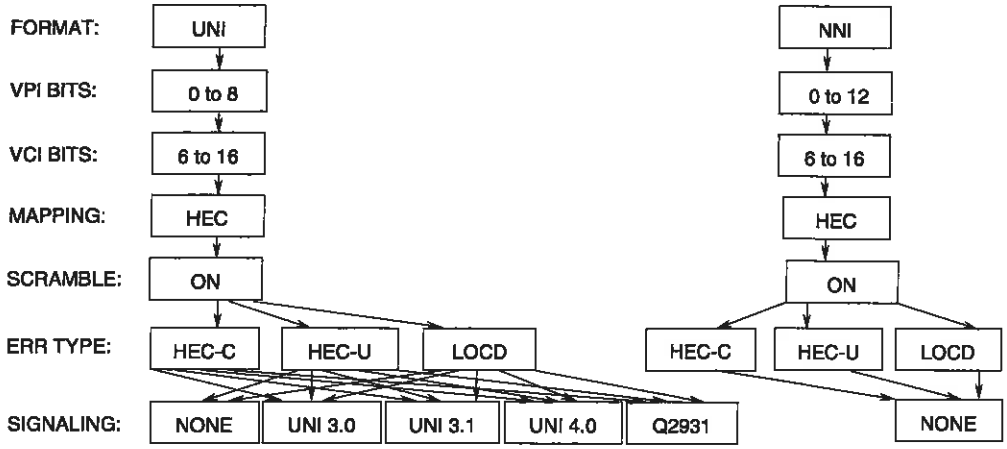
STATUS - Red indicates errors are being detected in the physical layer. Green indicates physical layer is operating properly. Amber indicates the physical layer is currently okay, but experienced errors in the past. The amber color can be changed to green by pressing **2nd Func., Status** then the **CLEAR** soft key.

Soft key Definitions:

PREVMNU - Moves back to the Physical Setup menu.

NEXTMNU - Moves to the Header Setup menu (PVC and PVP testing) or Link Setup menu (SVC and SVP testing).

STM1/STS3c Interface TC Sublayer Setup Menu Tree:



Definitions:

Format: NNI - Network to Network Interface.

Format: UNI - User to Network Interface.

VPI Bits - Designates the number of bits in the virtual path identifier addressing section of the ATM cell header. This may vary from 0 to 8 bits in the UNI format and 0 to 12 in the NNI format.

VCI Bits - Designates the number of bits in the virtual channel identifier addressing section of the ATM cell header. This number varies from 6 to16 for both UNI and NNI formats.

Mapping: HEC - Used for cell delineation for STM1/STS3c interface rates. This setting is not changeable at STM1/STS3c interface rates.

Scramble: On - Enables scrambling of the cell payload. This setting is not changeable at STM1/STS3c interface rates.

Err Type: HEC-C - Enables the 750 to send a correctable HEC error.

Err Type: HEC-U - Enables the 750 to send an uncorrectable HEC error.

Err Type: LOCD - Enables the 750 to send enough consecutive cell errors (6) to force the network to sense Loss of Cell Delineation (LOCD).

Signaling: None - Enables the 750 to operate in Permanent Virtual Circuit (PVC) or Permanent Virtual Path (PVP) mode. See Section 4.2 for PVC and Section 4.3 for PVP.

Signaling: UNI 3.0 - Enables the 750 to operate in either PVC, PVP, or Switched Virtual Circuit (SVC) mode or all simultaneously. The SVC mode will use UNI 3.0 signaling. See Section 4.2 for PVC, Section 4.3 for PVP and Section 4.4 for SVC.

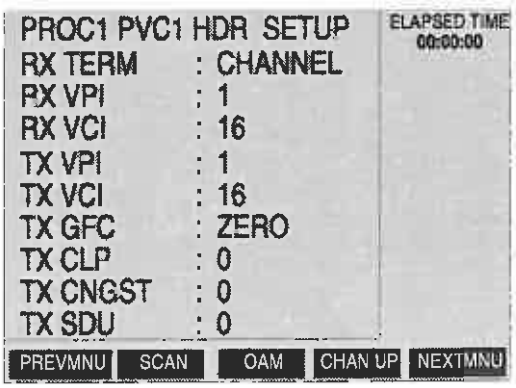
Signaling: UNI 3.1 - Enables the 750 to operate in either PVC, PVP, or SVC mode or all simultaneously. The SVC mode will use UNI 3.1 signaling. See Section 4.2 for PVC, Section 4.3 for PVP, and Section 4.4 for SVC.

Signaling: UNI 4.0 - Enables the 750 to operate in either PVC, PVP, SVC, or Switched Virtual Path (SVP) mode or all simultaneously. The SVC and SVP modes will use UNI 4.0 signaling. See Section 4.2 for PVC, Section 4.3 for PVP, Section 4.4 for SVC, and Section 4.5 for SVP.

Signaling: Q2931 - Enables the 750 to operate in either PVC, PVP, or SVC mode or all simultaneously. The SVC mode will use ITU Q2931 signaling. See Section 4.2 for PVC, Section 4.3 for PVP, and Section 4.4 for SVC.

4.2 PVC Setup

If "SIGNALING: NONE" is selected in the TC Layer setup, the next menu is associated with configuring a 750 to perform ATM testing on up to six Permanent Virtual Circuits (PVC). Each of these Test Channels will be identified as PVC1, PVC2, PVC3, etc.



This menu is used to set up the 5 byte ATM cell header for the designated test cell stream. Each test channel header setup may be accessed by pressing the **CHAN UP** soft key or channel numbers on the keypad.

Definitions:

RX TERM - Selecting "CHANNEL" enables PVC testing.

RX VPI - Virtual Path Identifier to be analyzed as the receive path for this PVC.

RX VCI - Virtual Channel Identifier to be analyzed as the receive path for this PVC.

TX VPI - Virtual Path Identifier that will be used to transmit ATM test cells over a a PVC. The range is 0 to 255.

TX VCI - Virtual Channel Identifier that will be used to transmit ATM test cells over a PVC. The range is 16 to 65535.

TX GFC - Enables the Generic Flow Control bit to be set to 0 or Non-Zero in the ATM test stream.

TX CLP - Enables the Cell Loss Priority bit to be set to 0 or 1 in the ATM test stream.

TX CNGST - Enables the Congestion Indicator bit to be set to 0 or 1 in the ATM test stream.

TX SDU - Enables the Service Data Unit bit to be set to 0 or 1 in the ATM test stream.

Soft key Definitions:

PREVMNU - Displays the previous menu - TC Layer setup.

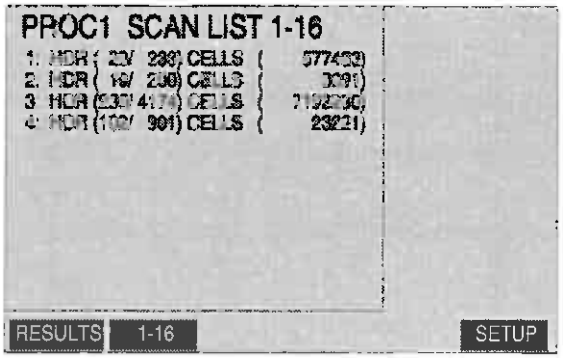
SCAN - This selection enables the 750 to scan the entire link and provide a list of the 32 most recently active VPI/VCI pairs.

OAM - Enables the 750 to send and receive OAM messages. This procedure is covered in Section 5.3 OAM Testing.

CHAN UP - Displays the PVC header setup for the next channel.

NEXTMNU - Displays the next menu - TST setup.

If the **SCAN** soft key is pressed the following menu will be displayed:



NOTE: *There can be up to 16 VPI/VCIs shown on each of two scan menus. If there is more than 16 VPI/VCIs, a 17-32 soft key will appear.*

Soft key Definitions:

RESULTS - Displays up to 16 active VPI/VCI streams and the number of cells scanned.

1-16 - Displays the first 16 VPI/VCIs.

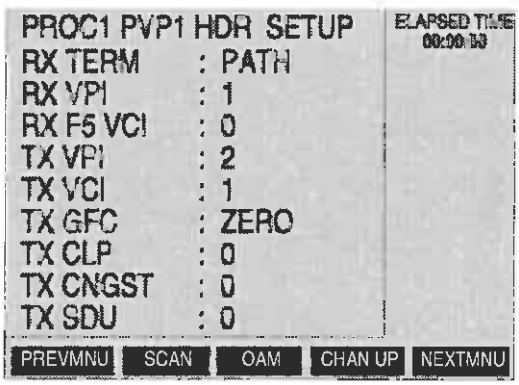
SETUP - Returns the user to the HDR Setup screen.

Once the PVC Header is set up the **NEXT MNU** soft key will display the "TST SETUP" screen. See section 4.5.

4.3 PVP Setup

Permanent Virtual Path (PVP) test support is available in units equipped with 3.20 firmware. It enables the user to generate and analyze ATM traffic and OAM cells and alarms over a designated PVP. The process to setup PVPs is virtually the same as discussed in the previous section for PVCs.

The 750 supports testing on up to 6 PVPs . Each test cell stream will be identified as PVP1, PVP2, PVP3, etc.



Definitions:

RX TERM - Selecting "PATH" enables PVP testing.

RX VPI - Virtual Path Identifier to be analyzed as the receive path.

RX F5 VCI - Virtual Channel Identifier that will be designated as the F5 OAM cell channel.

NOTE: *The 750 will ignore the VCI address for QoS testing and analyze all cells received on the selected VPI.*

TX VPI - Virtual Path Identifier that will be used to transmit ATM cells over a PVP. The range is 0 to 255.

TX VCI - Virtual Channel Identifier that will be used to transmit ATM cells over the PVP. The range is 16 to 65535.

TX GFC - Enables the Generic Flow control bit to be set to 0 or Non-Zero in the ATM test stream.

TX CLP - Enables the Cell Loss Priority bit to be set to 0 or 1 in the ATM test stream.

TX CNGST - Enables the Congestion Indicator bit to be set to 0 or 1 in the ATM test stream.

TX SDU - Enables the Service Data Unit bit to be set to 0 or 1 in the ATM test stream.

Soft key Definitions:

PREVMNU - Displays the previous menu - TC Layer setup.

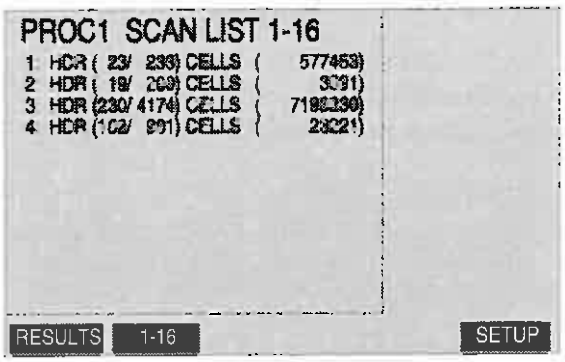
SCAN - This selection enables the 750 to scan the entire link and provide a list of the 32 most recently active VPI/VCI pairs.

OAM - Enables the 750 to send and receive F4 or F5 OAM messages. This procedure is covered in Section 5.3 OAM Testing.

CHAN UP - Displays the PVC header setup for the next channel.

NEXTMNU - Displays the next menu - TST setup.

If the **SCAN** soft key is pressed the following menu will be displayed:



NOTE: *There can be up to 16 VPI/VCIs shown on each of two scan menus. If there is more than 16 VPI/VCIs, a 17-32 soft key will appear at bottom menu.*

Soft key Definitions:

RESULTS - Displays up to 16 active VPI/VCI streams and the number of cells scanned.

1-16 - Displays the first 16 VPI/VCIs.

SETUP - Returns the user to the HDR setup screen.

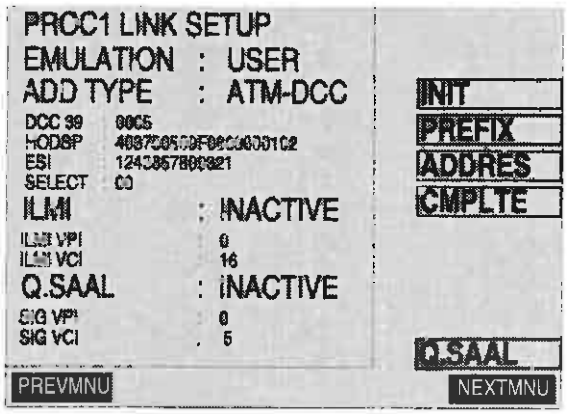
Once the PVP Header is setup the **NEXT MNU** soft key will display the "TST SETUP" screen. See section 4.5.

4.4 Switched Virtual Circuit Setup (SVC)

At the TC Layer Setup menu, the last menu item is "SIGNALING." The soft keys display the available selections. If "NONE" is selected, the unit is placed in PVC/PVP mode. Any other selection will place the unit in SVC mode. When the unit is in SVC mode there are three SVC-related menus to be configured. The first menu is the Link Setup menu.

4.4.1 SVC Link Setup Menu

In this menu, the signaling channels are established. The signaling channels are the Interim Local Management Interface (ILMI) and the Signaling ATM Adaptation Layer (Q.SAAL) channels. The first item on this menu is "EMULATION." This may be set to either "USER" or "NETWORK." This selection determines if the 750 will act as the user or the network in the proposed test scenario. The second menu selection is "ADDR TYPE." The selection options at this menu item are "ATM164", "ATM-DCC", "ATM-ICD," "ATM PNP", or "ISDN164." There are two main groupings of these selections; "ISDN164" and everything else.



Soft LED Definitions:

INIT - Initialization.

PREFIX - Address prefix registration.

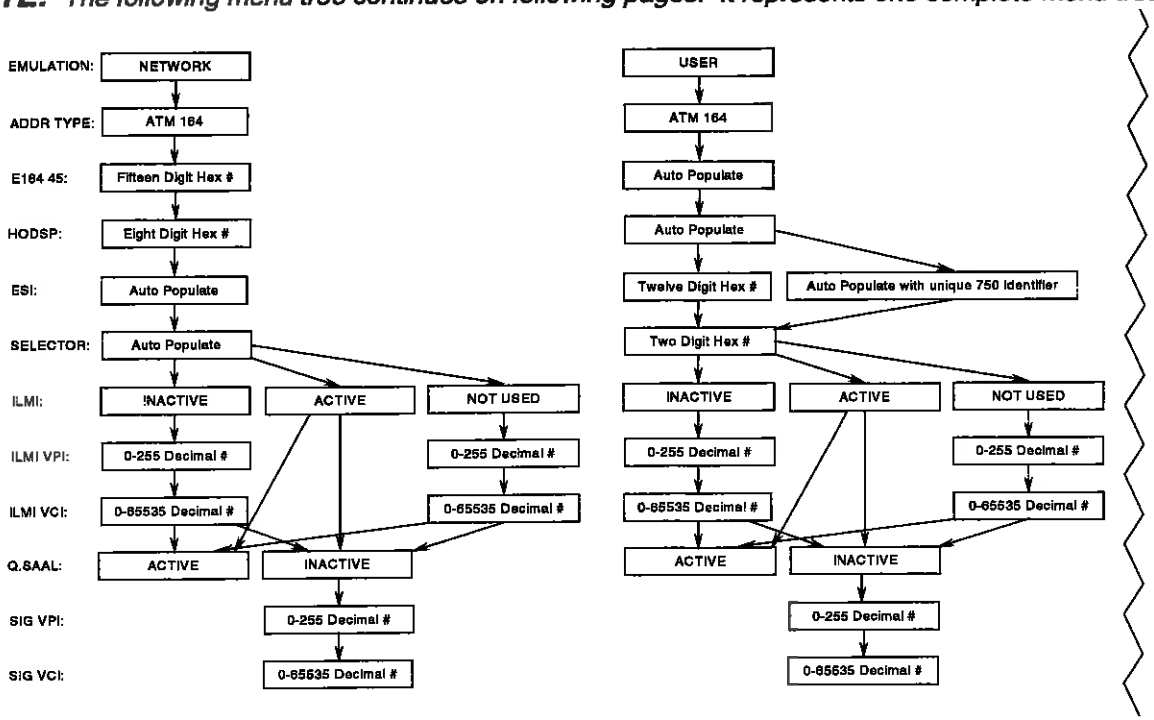
ADDRES - Address exchanged.

CMPLTE - Address registration completed.

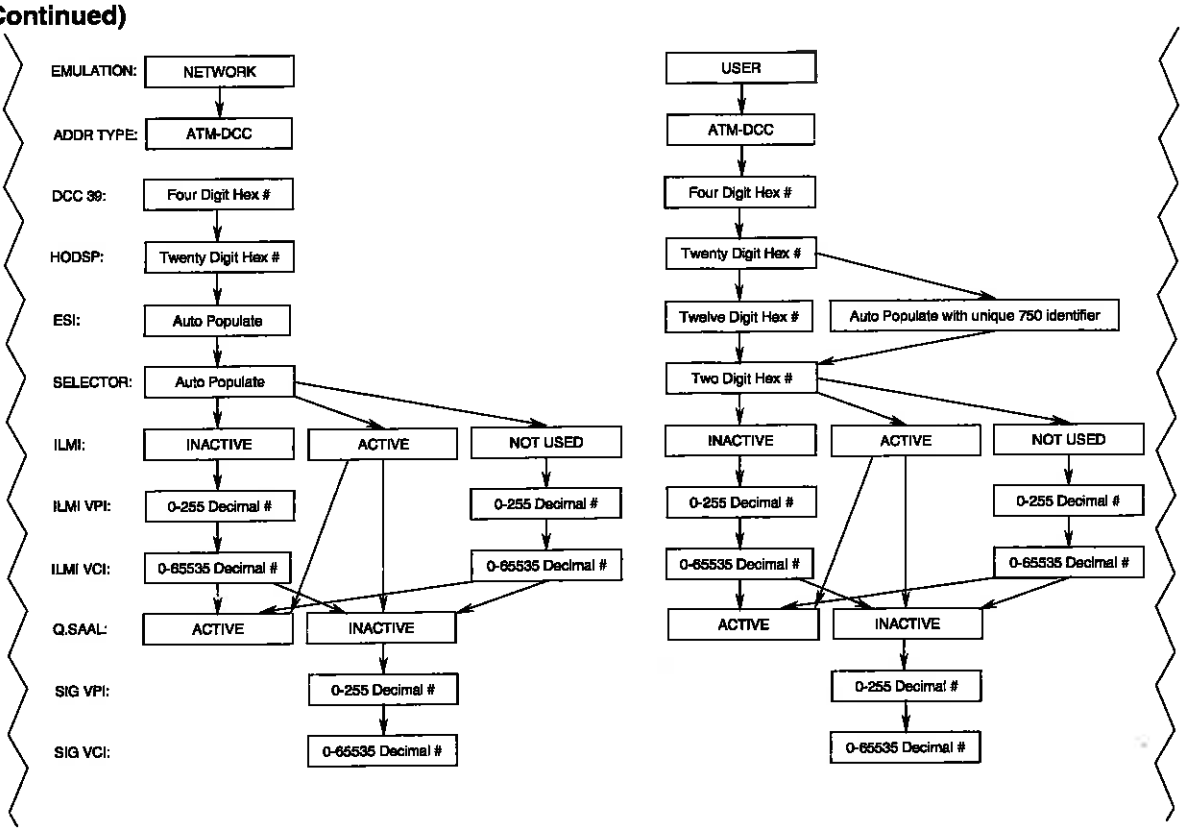
Q.SAAL - Signaling channel.

SVC Link Setup Menu Tree:

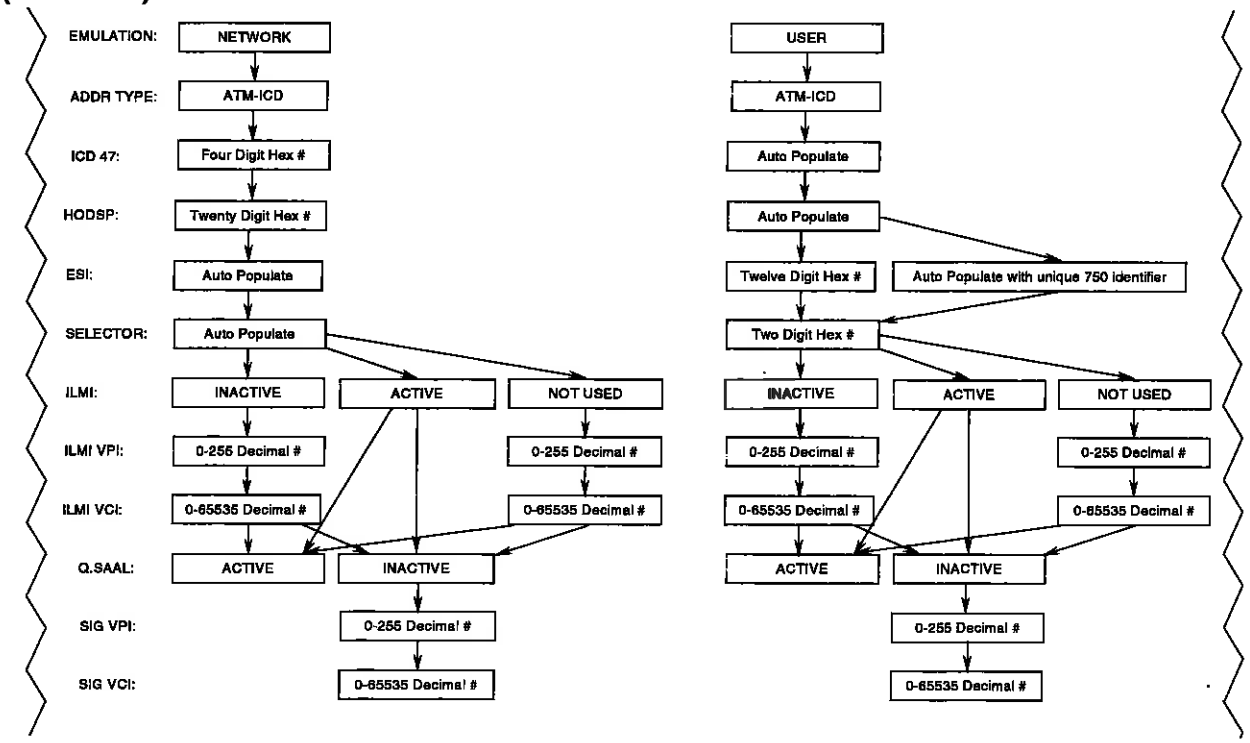
NOTE: *The following menu tree continues on following pages. It represents one complete menu tree.*



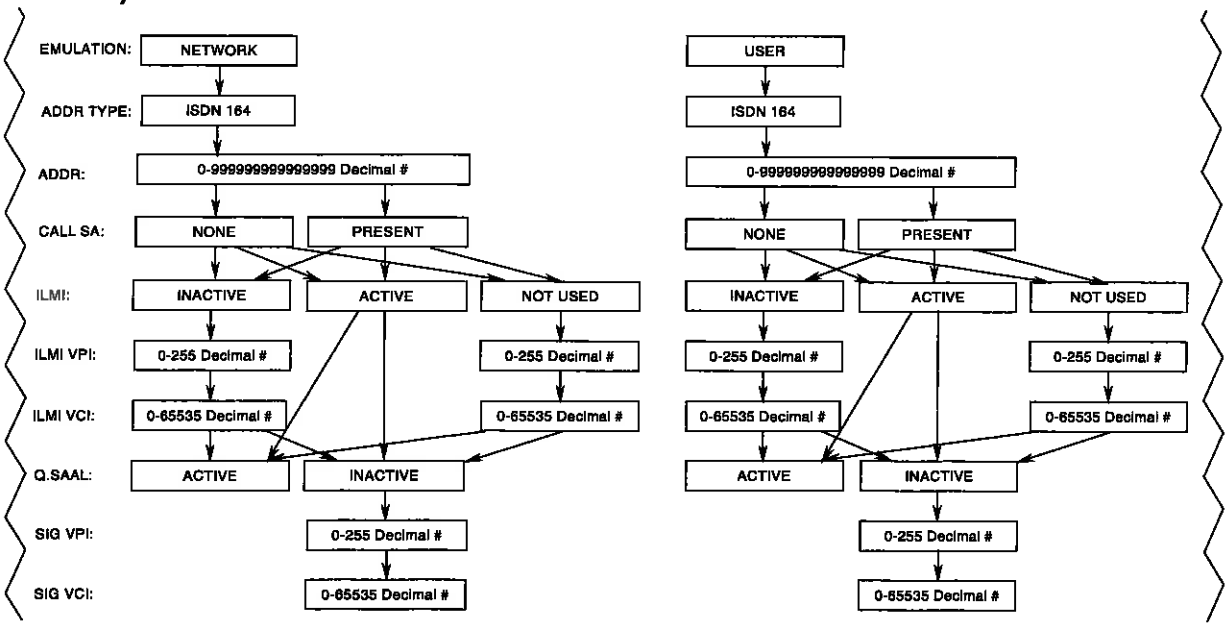
(Continued)



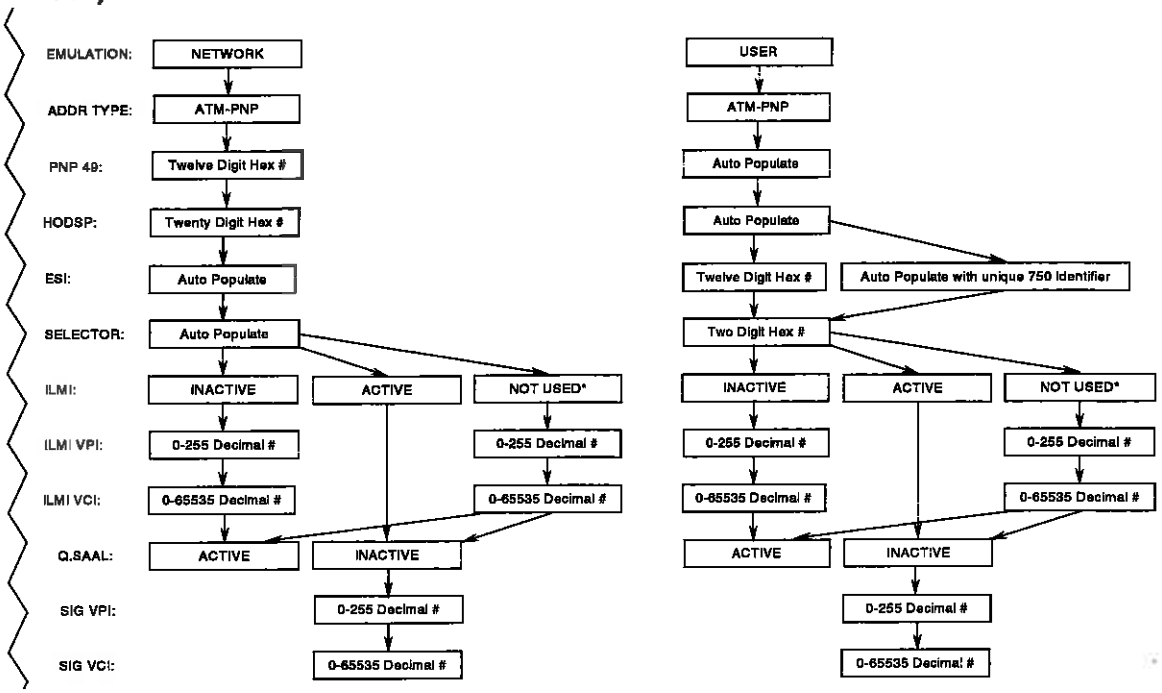
(Continued)



(Continued)



(Continued)



4.4.2 SVC Link Setup in User Emulation Mode

If **ATM164**, **ATM-DCC**, **ATM-ICD**, or **ATM-PNP** is selected as the address type, the "ESI" (End System Identifier) menu item must be manually entered or the **UNIQUE** soft key can be selected to auto populate the ESI with a unique 750 identifier. Also, you must enter the Selector Bits at the "SELECTOR" menu item. When the "ILMI" menu item is set to **ACTIVE** the network will automatically populate the "HO-DSP" (High Order Domain Specific Part) menu item and depending on the address type selected, the "DCC", "ICD", or "E164" menu items will also be automatically populated. If ILMI is not enabled, all of the above fields must be completed by the user.

If **ISDN164** is selected, the next menu item is "ADDR." The 15-digit ISDN phone number of the UNI to which the unit is connected should be entered here. Alternatively, ILMI can be activated and allow the "ADDR" menu item to be populated automatically by the switch.

The remaining menu items ("ILMI VPI", ILMI VCI", "SIG VPI", and "SIG VPI") specify the VPI/VCIs for the ILMI and Q.SAAL signaling channels respectively. The default selections of 0, 16 / 0, 5 are the UNI standards. However, these defaults may be changed if needed.

When ILMI is activated, the **INIT**, **PREFIX**, **ADDRESS**, and **COMPLETE** soft LEDs should all turn green indicating that address registration has taken place. If they do not turn green, address registration has not taken place or ILMI signaling is not active.

To establish the Q.SAAL channel, select the **ACTIVE** soft key for the "Q.SAAL" menu item. The **Q.SAAL** soft LED will illuminate green indicating that Q.SAAL signaling is established.

4.4.3 SVC Link Setup in Network Emulation Mode

If **ATM164**, **ATM-DCC**, **ATM-ICD**, or **ATM-PNP** is selected as the address type, the "ESI" (End System Identifier) menu item and the Selector Bits at the "SELECTOR" menu item **cannot** be entered. However, the "HODSP" menu item **must be** manually entered and depending on the address type selected, the "DCC", "ICD", or "E164" menu items **must be** manually entered as well.

If **ISDN164** is selected, the next menu item is "ADDR." At the "ADDR" item, you **must** enter the 15-digit ISDN phone number.

The remaining menu items ("ILMI VPI", ILMI VCI", "SIG VPI", and "SIG VPI") specify the VPI/VCIs for the ILMI and Q.SAAL signaling channels respectively. The default selections of 0 16 0 5 are the UNI standards. However, these defaults may be changed if needed.

When ILMI is activated, the **INIT**, **PREFIX**, **ADDRESS**, and **COMPLETE** soft LEDs should all turn green indicating that address registration has taken place. If they do not turn green, address registration has not taken place or ILMI signaling is not active.

To establish the Q.SAAL channel, select the **ACTIVE** soft key for the "Q.SAAL" menu item. The **Q.SAAL** soft LED will illuminate green indicating that Q.SAAL signaling is established.

Definitions:

Emulation: Network - Enables the 750 to emulate the network in an SVC environment.

Emulation: User - Enables the 750 to emulate CPE in an SVC environment.

Addr Type: ATM164 - An NSAP addressing scheme

Addr Type: ATM-DCC - An NSAP addressing scheme

Addr Type: ATM-ICD - An NSAP addressing scheme

Addr Type: ISDN164 - ISDN addressing scheme

Addr Type: ATM PNP - An NSAP addressing scheme

E164 45 - Authority and format identifier (AFI)

DCC 39 - Authority and format identifier (AFI)

ICD 47 - Authority and format identifier (AFI)

ADDR - ISDN164 phone number

CALL SA - An ISDN 164 sub-address

HODSP - High Order Domain Specific Part, contains routing information

ESI - End System Identifier (CPE address)

Selector - Selector Bits, further specifies CPE addressing information

ILMI: Active - Initiates ILMI

ILMI: Inactive - Disables ILMI and serves to indicate ILMI is inactive

ILMI: Not Used - Forces all ILMI related information to be manually configured by the user.

ILMI VPI - Specifies the VPI for ILMI. The default selection is 0 and is the UNI standard. However, the default may be changed if needed.

ILMI VCI - Specifies the VCI for ILMI. The default selection is 16 and is the UNI standard. However, the default may be changed if needed.

Q.SAAL: Active - Initiates Q.SAAL

Q.SAAL: Inactive - Disables Q.SAAL

SIG VPI - Specifies the VPI for signaling. The default selection is 0 and is the UNI standard. However, the default may be changed if needed.

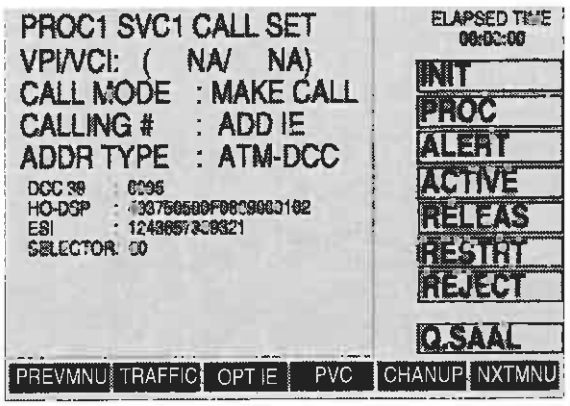
SIG VCI - Specifies the VCI for signaling. The default selection is 5 and is the UNI standard. However, the default may be changed if needed.

When this menu is completed, the **NEXTMNU** soft key can be pressed. The SVC Call Setup menu will then be displayed.

4.4.4 SVC Call Setup Menu

NOTE: *Signaling (i.e., Q.SAAL) must be enabled at the SVC Link Setup menu before the SVC Call Setup menu can be used. Depending on the equipment through which the SVC is made ILMI may have to be enabled as well.*

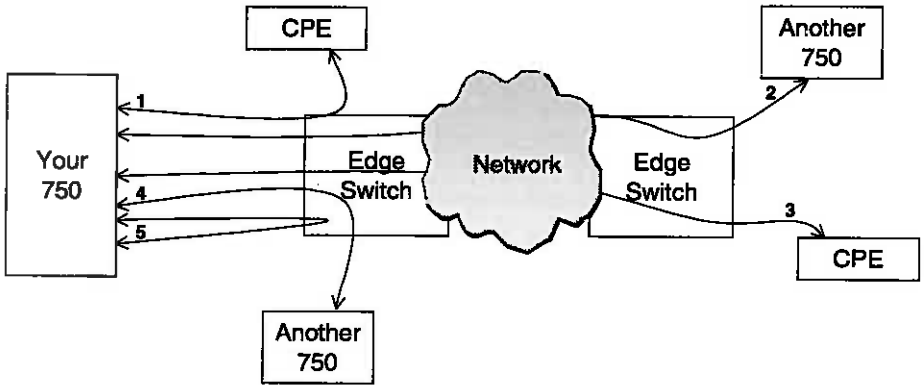
In the SVC Call Setup menu the actual SVC is established. Note that the SVC Call Setup menu is labeled with a number, "SVC n" where "n" is 1-4. Up to four simultaneous SVCs may be supported, 5 if ILMI is not used. The **CHANUP** soft key may be used to select the SVC to be configured.



The SVC is established by either making or taking a call.

A call can be made or taken five ways:

1) CPE through the edge switch.
2) Another 750 through the network.
3) CPE through the edge switch and the network.
4) Another 750 through the edge switch.
5) Processor 1 or 2 of the same 750 via edge switch.



If the intent is to set up the 750 to take a call (number 1, 2, 3, or 4 from the above list) at the second menu item, "CALL MODE", select **TAKE**. When the call is taken, the applicable soft LEDs will turn green and the first menu item, "VPI/VCI." will be populated with the incoming call VPI/VCI.

If the intent is to set up the 750 to make a call, (number 1, 2, 3, or 4 from the above list) at the second menu item, "CALL MODE", select **MAKE**.

If the intent is to call yourself either on processor 1 or 2 (number 5 from the list on the previous page), at the second menu item "CALL MODE" select **PROC1** or **PROC2** as applicable. You must set up one SVC channel to place the call and one SVC channel to receive the call.

If the intent is to call one processor to another, (e.g., call Processor 2 from Processor 1) at Processor 1 SVC Call Setup menu, enter **PROC 2** at the "CALL MODE" menu item. Next, go to processor 2 and enter **TAKE** at the "CALL MODE" menu item on "PROC2 SVC CALL SET" (call setup) menu.

Next, the menu items "CALLING #", "ADDR TYPE", and the variable addressing numeric value items must be entered. Once these items have been correctly entered, the traffic parameters need to be established in the Traffic menu.

Soft LED Definitions:

INIT - Initial call request

PROC - Proceeding (receipt of all information needed for call setup).

ALERT - Incoming call.

ACTIVE - Call established.

RELEAS - Call released.

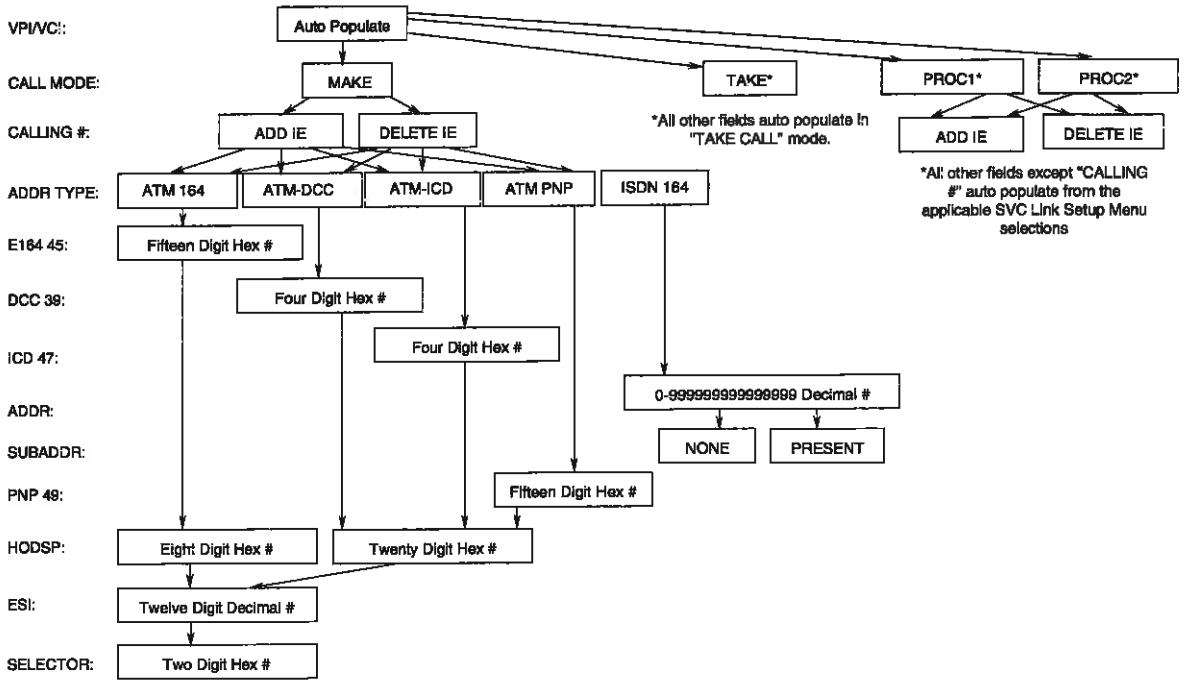
RESTRT - Restart call.

REJECT - Call failed.

Q.SAAL - Signaling channel.

SVC Call Setup Menu Tree:

NOTE: *The following menu tree is valid only when "Signaling" (Q.SAAL) has been enabled in the previous (SVC Link Setup) menu.*



Definitions:

VPI/VCI - Virtual Path Identifier/Virtual Circuit Identifier

Call Mode - Make Call

Call Mode - Take Call

Call Mode - PROC1

Call Mode - PROC2

Calling #: ADD IE

Calling #: DELETE IE

Addr Type: ATM164 - An NSAP addressing scheme.

Addr Type: ATM-DCC - An NSAP addressing scheme.

Addr Type: ATM-ICD - An NSAP addressing scheme.

Addr Type: ISDN164 - ISDN addressing scheme.

Addr Type: ATM PNP - An NSAP addressing scheme.

E164 45 - Authority and format identifiers.

DCC 39 - Authority and format identifiers.

ICD 47 - Authority and format identifiers.

ADDR - ISDN164 phone number

SUBADDR - The ISDN sub-address, if used.

PNP 49 - Authority and format identifiers.

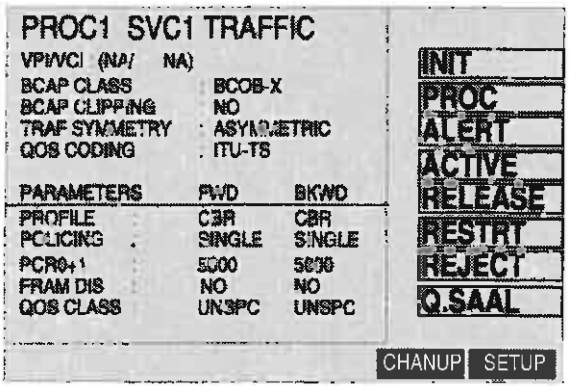
HODSP - High Order Domain Specific Part, contains routing information

ESI - End System Identifier (CPE address)

Selector - Selector Bits, further specifies CPE addressing information

4.4.5 SVC Traffic Menu Setup

To access the Traffic menu, press the **TRAFFIC** soft key on the SVC Call Setup menu. Press the **SETUP** soft key to return to the SVC Call Setup menu. There are thousands of possible permutations relating to the traffic menu setup. It is impossible to provide detailed specifics as to which selections should be made. Depending on the configuration of the applicable ATM device, appropriate traffic parameters should be entered in the Traffic menu.



One of the more difficult areas of establishing an SVC is finding a supported combination of Broadband Bearer Capabilities, Traffic Parameters and Quality of service settings. While the User-Network Interface (UNI) specification does define a set of guidelines which combinations are actually supported are highly dependent on the manufacturer and how the network administrator has configured the device.

The 750 does implement a limited expert system to help in SVC Traffic configuration. When in the Traffic menu certain options will change or be precluded depending upon previous selections. However because of the large number of combinations and the fact that the 750 is designed as a test unit it is possible to setup illegal combinations. What follows are some informal definitions of the various selections and suggested configurations. They appear in this order (top to bottom) in the traffic menu.

Definitions:

BCAP CLASS - refers to the Broadband Bearer Capability class. The class determines what services, if any, a network must provide beyond ATM only service. BCAP Clipping determines whether the cells susceptible to clipping.

TRAF SYMMETRY - whether the same set of traffic parameters will be requested for both forward and backward (transmit and receive) cell streams.

QOS CODING - specifies if the Quality of Service is encoded with values from and ITU standard or a private standard defined for the network.

PROFILE - is the various categories traffic, constant bit rate (CBR), variable bit rate (VBR) or unspecified (UNSPC).

POLICING - determines how and where cells exceeding the traffic contract are tagged and/or discarded.

PCR/SCR/MBS - are different types of traffic parameters. PCR is Peak Cell Rate, SCR Sustainable Cell Rate and MBS Maximum Burst Size. The '01' is shorthand notation for CLP=0+1 (both non-clipped and clipped traffic).

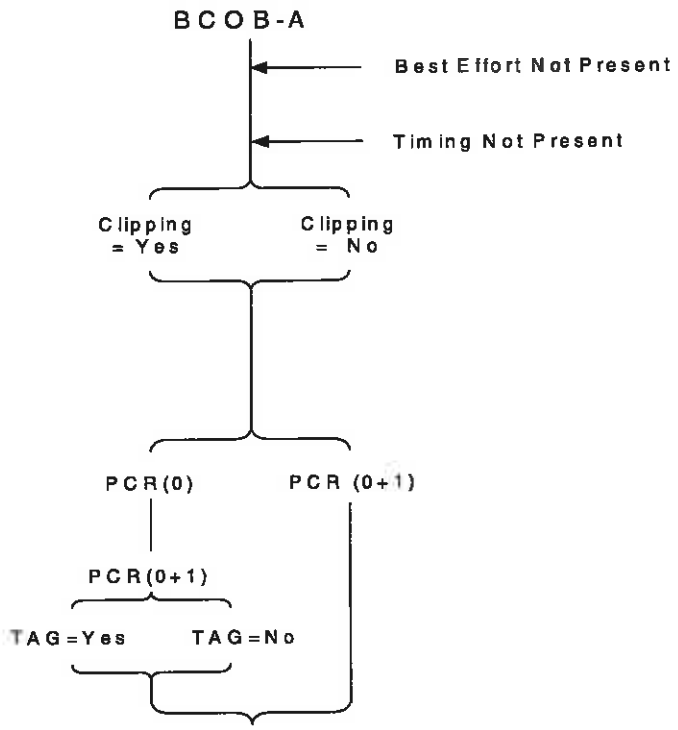
QOS CLASS - a Quality of Service Class is a set of performance parameters defined by a network to provide reasonable service for different categories of traffic. For example variable bit rate audio and video traffic (VBR) falls into class 2.

The follow are some suggestions around the traffic menu. They are suggestions only and cannot be guaranteed to be accepted by the network peer.

The easiest and least complex of the BCAP CLASS's is BCOB-A.

BCAP CLASS	:	BCOB-A	
BCAP CLIPPING	:	NO	
TRAF SYMMETRY	:	SYM	
QOS CODING	:	NET	
PARAMETERS		FWD	BKWD
PROFILE	:	CBR	CBR
POLICING	:	SINGLE	SINGLE
PCR01	:	200	200
QOS CLASS	:	UNSPEC	UNSPEC

Refer to the following logic diagram to see the relationship of traffic parameters for BCOB-A:

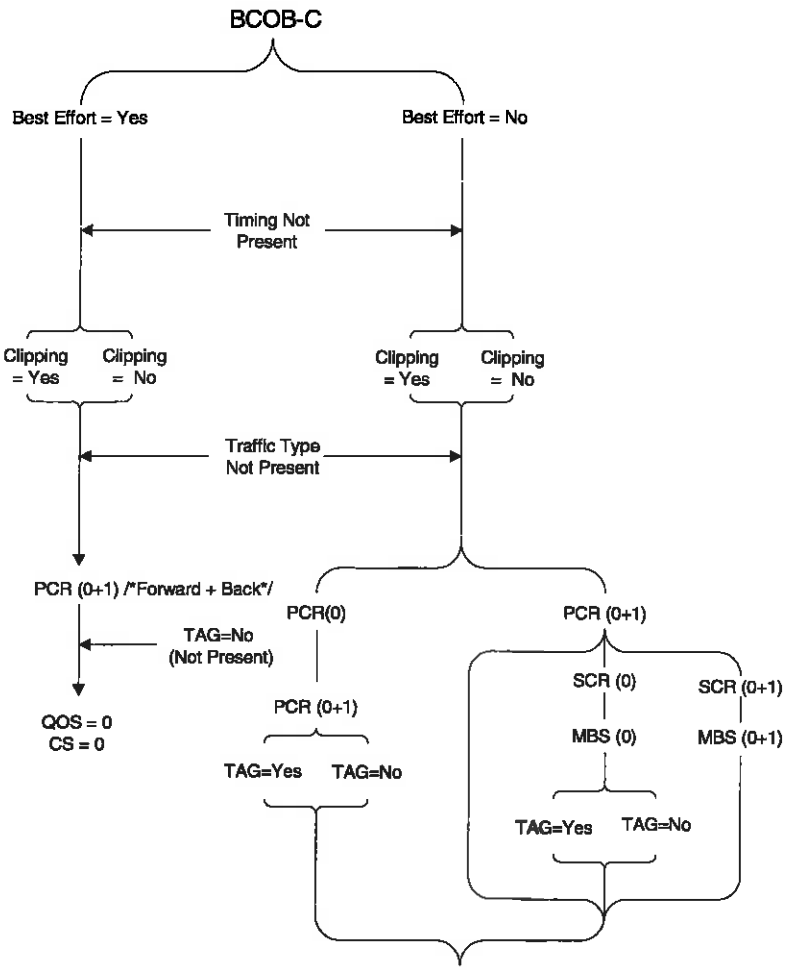


When establishing a SVC for the first time it's worthwhile keeping the traffic menu configuration simple and expand to more complex setups when any destination and connection problems have been resolved.

BCOB-C has a medium level of complexity and seems to do well for VBR type traffic.

BCAP CLASS	:	BCOB-C	
BEST EFFORT	:	OFF	
BCAP CLIPPING	:	NO	
TRAF SYMMETRY	:	SYM	
QOS CODING	:	NET	
PARAMETERS		FWD	BKWD
PROFILE	:	VBR	VBR
POLICING	:	SINGLE	SINGLE
PCR01	:	1000	1000
SCR01	:	1000	1000
MBS01	:	100	100
QOS CLASS	:	UBR	UBR

Refer to the following logic diagram to see the relationship of traffic parameters for BCOB-C below.



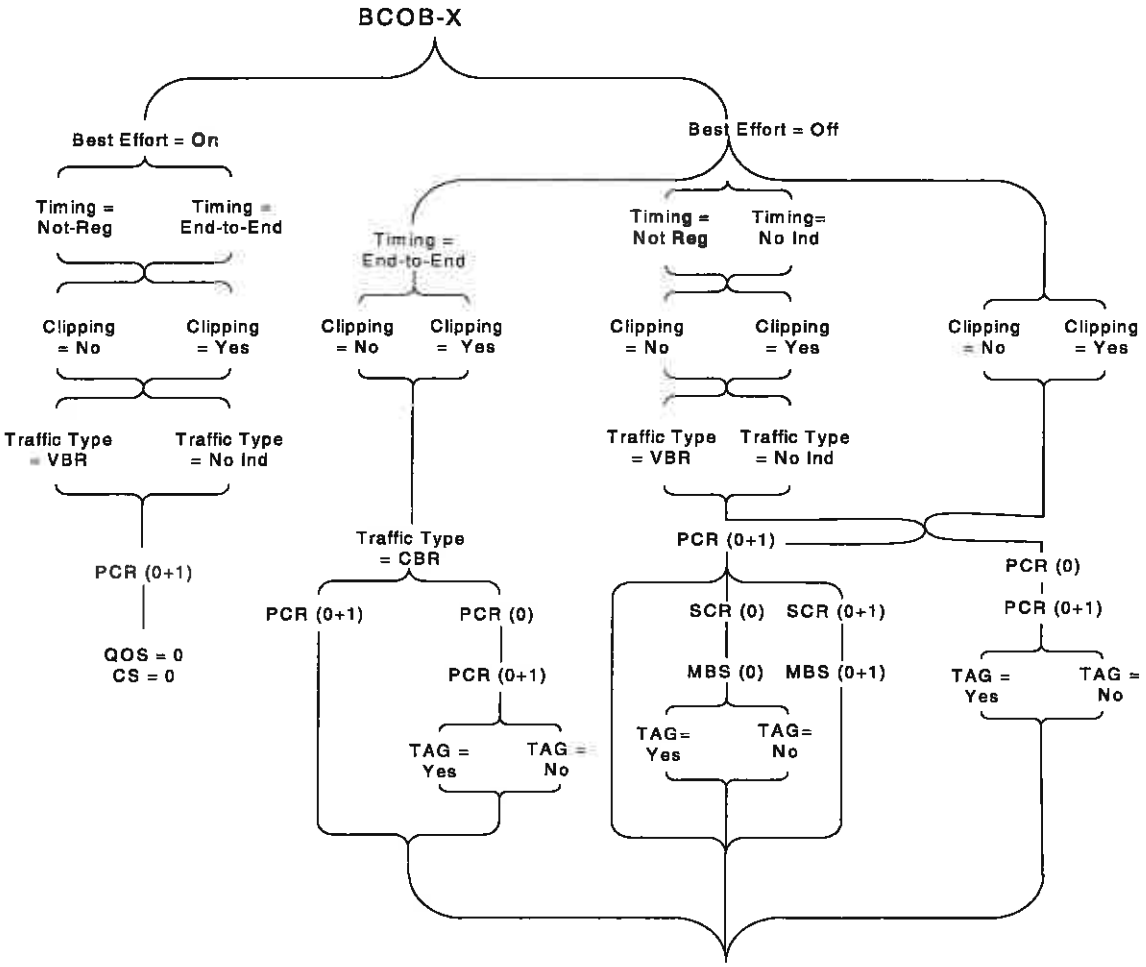
BCOB-X has the largest number of potential combinations. However, because it makes no service demands on a network, beyond ATM service, it is very popular among network administrators. If a setting of BCAP TIMING of END-TO-END is needed set the PROFILE to CBR.

BCAP CLASS	:	BCOB-X	
BEST EFFORT	:	OFF	
BCAP TIMING	:	END-TO-END	
BCAP CLIPPING	:	YES	
TRAF SYMMETRY	:	SYM	
QOS CODING	:	NET	
PARAMETERS		FWD	BKWD
PROFILE	:	CBR	CBR
POLICING	:	SINGLE	SINGLE
PCR01	:	500	500
QOS CLASS	:	UBR	UBR

Otherwise it really depends on the device's setup/configuration. This example seems to be fairly widely accepted.

BCAP CLASS	:	BCOB-X	
BEST EFFORT	:	OFF	
BCAP TIMING	:	NO-IND	
BCAP CLIPPING	:	NO	
TRAF SYMMETRY	:	SYM	
QOS CODING	:	NET	
PARAMETERS		FWD	BKWD
PROFILE	:	VBR	VBR
POLICING	:	SINGLE	
PCR01	:	500	
SCR0	:	100	
MBS0	:	20	
QOS CLASS	:	RT-VBR	

Refer to the following logic diagram to see the relationship of traffic parameters for BCOB-X below:



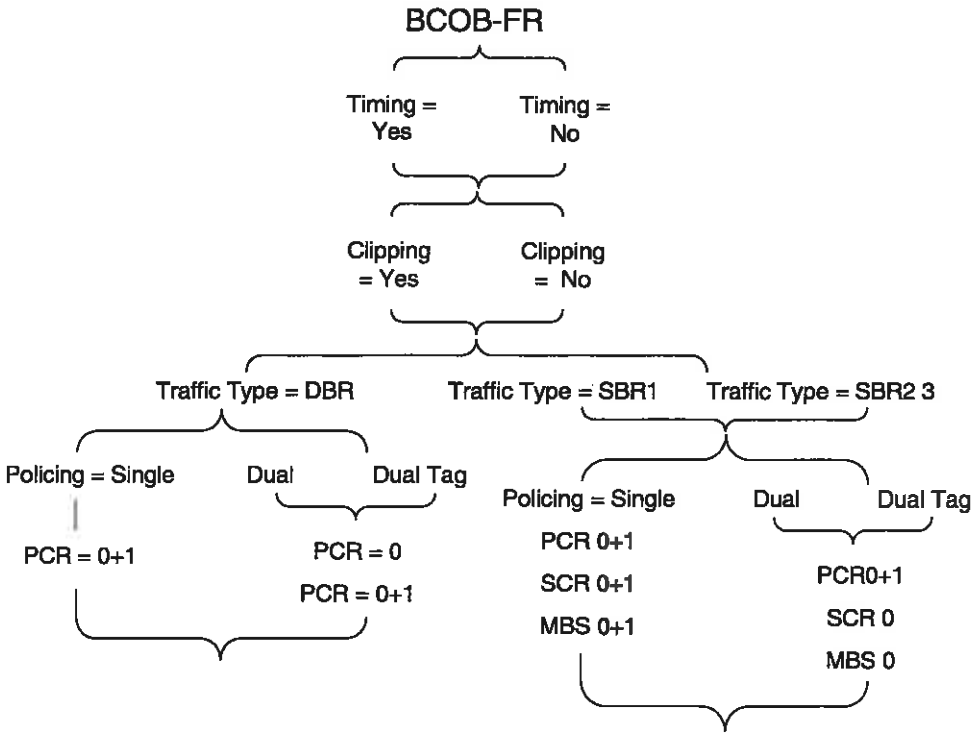
BCOB-FR is available with Q2931 signalling. It uses Frame Relay Bearer Service.

BCAP CLASS	:	BCOB-FR	
BCAP TIMING	:	NO	
BCAP CLIPPING	:	NO	
TRAF SYMMETRY	:	SYMMETRIC	
QOS CODING	:	ITU-TS	
PARAMETERS		FWD	BKWD
PROFILE	:	DBR	EBR
POLICING	:	SINGLE	SINGLE
PCR01	:	1000	1000
QOS CLASS	:	UNSPEC	UNSPEC

Otherwise it really depends on the device's setup/configuration. This example seems to be fairly widely accepted.

BCAP CLASS	:	BCOB-FR	
BCAP TIMING	:	NO-IND	
BCAP CLIPPING	:	NO	
TRAF SYMMETRY	:	SYMETRIC	
QOS CODING	:	ITU-TS	
PARAMETERS		FWD	BKWD
PROFILE	:	SBRI	SBRI
POLICING	:	SINGLE	
PCR+11	:	1000	
SCR+1	:	100	
MBS0+1	:	10	
QOS CLASS	:	UNSPEC	

Refer to the following logic diagram to see the relationship of traffic parameters for BCOB-FR below:

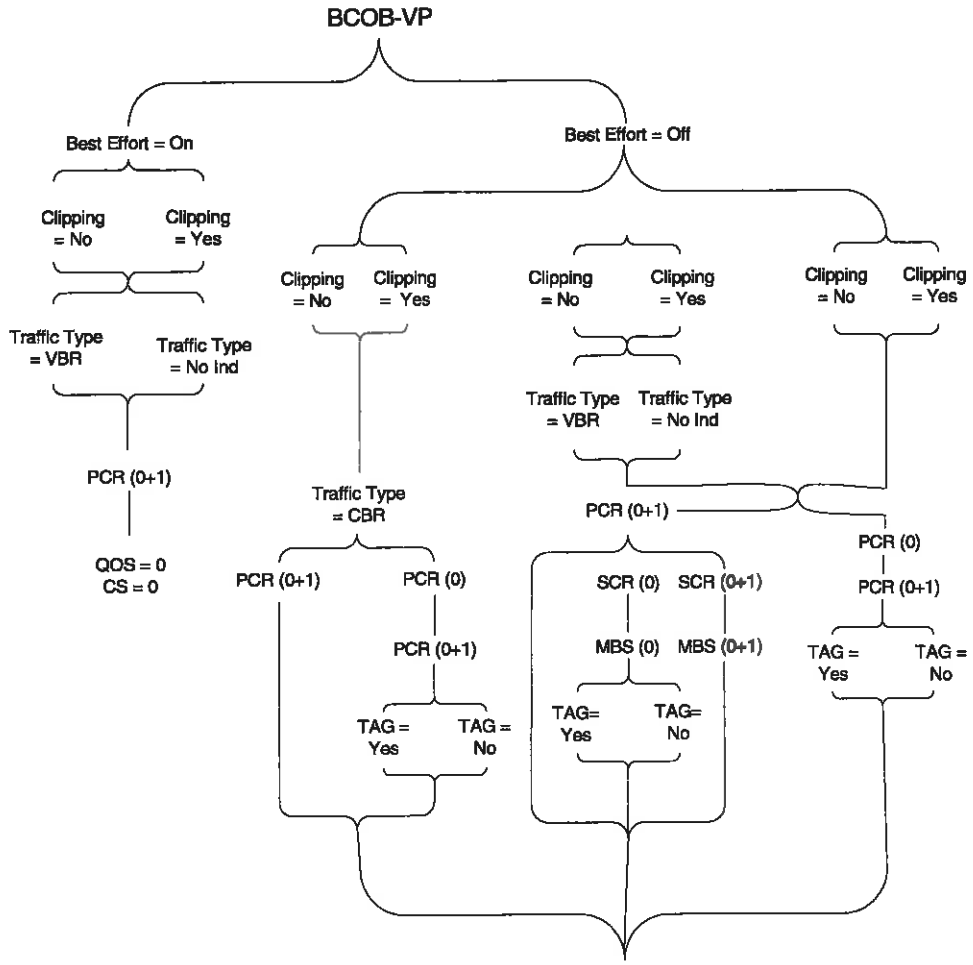


BCOB-VP is available with UNI 4.0 signalling only.

BCOB-VP enables the 750 to establish a SVP test stream. A VCI is assigned to view OAM F5 cells but traffic is routed through the network via the VPI.

BCAP CLASS	: BCOB-VP	
BEST EFFORT	: OFF	
BCAP TIMING	: END-TO-END	
BCAP CLIPPING	: YES	
TRAF SYMMETRY	: SYM	
QOS CODING	: NETWORK	
PARAMETERS	FWD	BKWD
PROFILE	: RTVBR	RTVBR
POLICING	: SINGLE	SINGLE
PCR0+1	: 1000	1000
SCR0+1	: 1000	1000
MBS0+1	: 100	100
FRAME DIS	: NO	NO
QOS CLASS	: RTVBR	RTVBR

Refer to the following logic diagram to see the relationship of traffic parameters for BCOB-VP below:

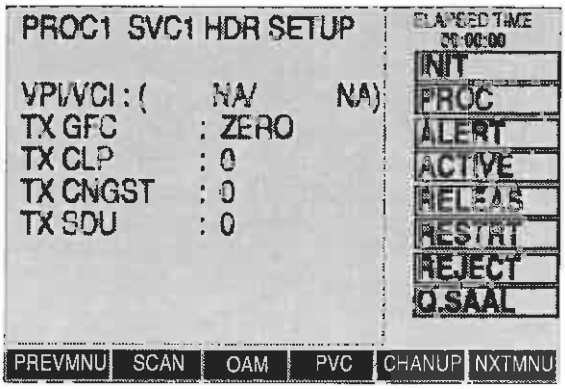


One other note on Traffic Parameters (PCR0, PCR01, MBS0 etc.), it's better to start with values in the hundreds rather than thousands. Avoid setting a parameter to zero. If using both PCR0 and PCR01, set PCR01 greater than PCR0.

Once the Traffic menu is properly configured, the **Hook On/Off** soft key on the 750 keypad can be pressed to initiate the call. As the call progresses, the applicable soft LEDs will turn green and the first menu item "VPI/VCI" will be populated with the network provided VPI/VCI. The **Hook On/Off** key is active from the Traffic, Call Setup, and Header Setup menus and can be used to terminate an active call whether the unit originated of accepted the call. When a call is terminated, the **RELEAS** soft LED will illuminate green. Once the VPI/VCI values are assigned, ATM traffic will begin to flow. This constitutes an ATM connectivity test. For reference, see section 5.4

4.4.6 SVC Header Setup

The next menu is associated with configuring a 750 to perform ATM testing on up to four (five if not using ILMI) Switched Virtual Circuits (SVC). Each of these Test channels will be identified as SVC1, SVC2, SVC 3, etc.



This menu is used to set up the 5 byte ATM cell header for the designated test cell stream. Each test channel header setup may be accessed by pressing the **CHANUP** soft key or channel numbers on the keypad.

Definitions:

VPI/VCI - Virtual Circuit Identifier that will be used to transmit ATM test cells over SVCx. This identifier is assigned by the ATM switch.

TX GFC - Enables the Generic Flow control bit to be set to 0 or Non-Zero in the ATM test stream.

TX CLP - Enables the Cell Loss Priority bit to be set to 0 or 1 in the ATM test stream.

TX CNGST - Enables the Congestion Indicator bit to be set to 0 or 1 in the ATM test stream.

TX SDV - Enables the Service Data Unit bit to be set to 0 or 1 in the ATM test stream.

Soft key Definitions:

PREVMNU - Displays the previous menu - TC Layer setup.

SCAN - This selection enables the 750 to scan the entire link and provide a list of the 32 most recently active VPI/VCI pairs.

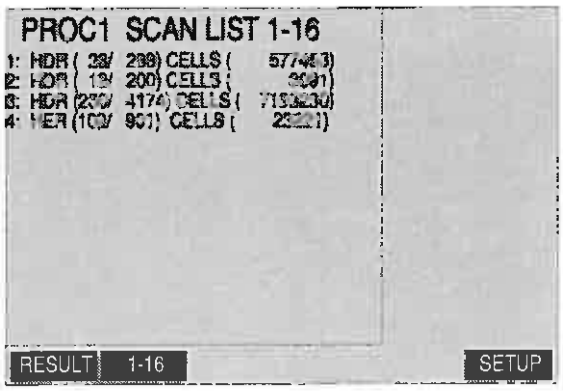
OAM - Enables the 750 to send and receive F5 OAM messages. This procedure is covered in Section 5.3 OAM Testing.

PVC - Changes the cell stream to a PVC and will display the "PROC1 PVC HDR SETUP" screen.

CHANUP - Displays the PVC header setup for the next channel.

NEXTMNU - Displays the next menu - TST setup.

The following screen is displayed:



Soft key Definitions:

RESULTS - Displays up to 16 active VPI/VCI streams and the number of cells scanned.

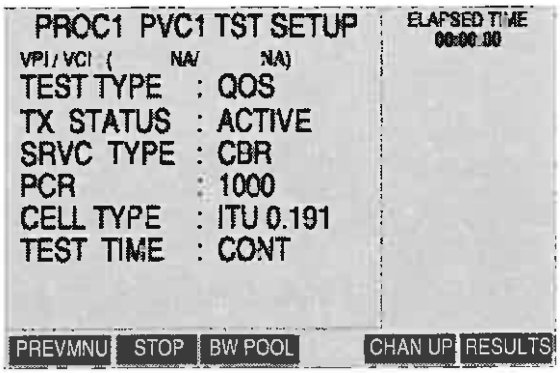
1-16 - Displays the first 16 VPI/VCIs.

SETUP - Returns the user to the HDR setup screen.

Once the SVC Header is setup the **NEXT MNU** soft key will display the TST setup screen.

4.5 ATM Test Setup

Once the Header has been setup the ATM parameters must be entered for each cell stream. This is done from the following screen and is virtually the same for PVCs and SVCs.



Definitions:

VPI/VCI - Virtual Circuit Identifier that will be used to transmit ATM test cells over SVCx. This identifier is assigned by the ATM switch.

RXx HDR - Address for the receive path of the ATM call stream that will be analyzed as channel x (PVP or PVC).

TXx HDR - Address that will be used by the transmitter to send ATM cells to the far end (PVP or PVC).

Test Type: QOS - Enables the 750 to perform a Quality of Service analysis and test cell stream. See Section 5.4 through 5.7.

Test Type: Capture - Enables the 750 to capture up to 6000 ATM cells on the Receive VPI/VCI. These captured cells may be downloaded to a protocol analyzer for troubleshooting. This procedure is covered in Section 5.12

Test Type: Echo - Enables the 750 to send back the cells received (e.g. a "soft" loopback).

Tx Status: ACTIVE - The 750 is transmitting on the test channel.

Tx Status: INACTIVE - The 750 is not transmitting on the test channel.

Srvc Type: CBR - Enables the 750 to generate Constant Bit Rate traffic on this test channel.

Srvc Type: VBR - Enables the 750 to generate Variable Bit Rate traffic on this test channel.

PCR: XXXX - The number of cells that will be generated as the Peak Cell Rate on this channel.

SCR: XXXX - (VBR only) The number of cells that will be generated as the Sustained Cell Rate on this channel.

Burst: XXXX - (VBR only) The number of cells that will be sent as a "burst" to generate the SCR.

Cell Type: TTC1 - The 750 will generate a type of test cell used in TTC test instruments i.e., T-BERD.

Cell Type: TTC4 - The 750 will generate a type of test cell that is compatible with TTC's FIREBERD 6000 family of products.

Cell Type: 0.191- The 750 will generate ATM cells that conform to ITU-T specification 0.191.

Tx Status - The status of the transmitted signal - active or inactive.

Soft key Definitions

PREVMNU - Displays the previous menu - Header setup.

STOP - Ends the ATM test.

BW POOL - Used to verify that the requested PCR is within the bandwidth limits of the interface.

CHANUP - Displays the PVC header setup for the next channel.

RESULTS - Displays the QoS menu.

NOTE: *The **RESULTS** soft key will only be displayed if **QOS** is selected as the "Test Type"*

Once this screen has been provisioned, the 750 will begin testing ATM service. See Section V.

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SECTION V

SPECIFIC TEST APPLICATIONS

5.1 Layer One Test

5.1.1 Description

Reliable ATM service requires proper functioning of the physical layer.

Circuits used for ATM service may span several miles and use many pieces of circuit switched equipment (i.e., cross-connects, repeaters, fiber optic terminal systems, etc.). Circuit impairments (e.g., line code violations, parity errors, loss of sync, etc.) will result in errored and lost cells. These conditions will result in timing problems between the devices for CBR service (voice and video applications). Similarly, for VBR service (data applications), impairments will force end devices to retransmit information, leading to network bottlenecks and delay.

Verification that a circuit has been properly provisioned is an important initial step in provisioning and troubleshooting ATM service.

5.1.2 Test Setup

(1.1.1)

Configure the test set for the appropriate interface, then connect it to the network (for example, if on a DS3 interface, select DS3 interface on the "PHYSICAL SETUP" menu and connect to the **DS3/E3** connector on the interface panel). Refer to Figure 5.1, below.

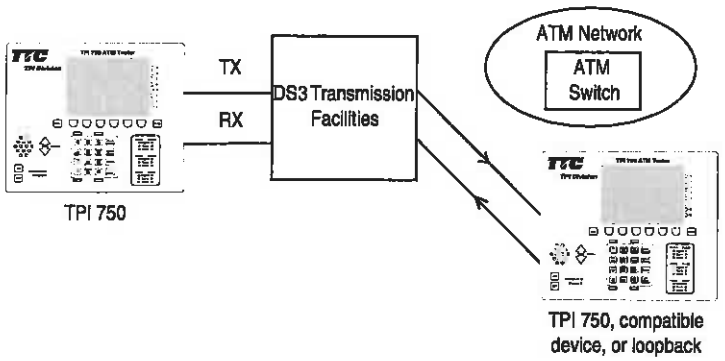


Figure 5.1 Circuit Verification Setup

The interface and definable LEDs will provide physical layer status. Additionally, physical layer statistics will automatically begin registering and can be quickly accessed from the setup screen by pressing **2nd Func.** then **Status**. See Section 6 for BER Testing instructions.

NOTE: *If the test has been stopped, the Status LEDs will not update.*

Once Layer One testing is complete, press the **NEXTMNU** soft key to proceed to the "TC LAYER SETUP" screen for connectivity testing.

5.2 TC Sublayer (Local) Connectivity Test

5.2.1 Description

While the previous test verifies circuit integrity between the premise and the edge switch, it does not ensure the service is correctly interfaced to the switch. The following test verifies ATM connectivity between the premise and the edge switch, configuration of the ATM switch port, and operation of the TC sublayer (i.e., local connectivity).

5.2.2 Test Setup


(1.1.1)

Configure the test set for the appropriate interface, then connect it to the network. Refer to figure 5.2, below.

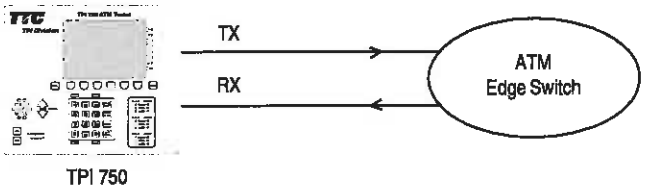


Figure 5.2 TC Sublayer Connection Testing Setup

After circuit verification, the TPI 750 offers quick verification of the TC sublayer directly from the sublayer setup screen. Once the user makes a mapping selection, the TPI 750 automatically defines additional LEDs in accordance with the selection. For PLCP mapping, Loss Of Frame (P-LOF) and Remote Alarm Indication (P-RAI) LEDs appear below the physical layer LEDs. HEC mapping adds a Loss-Of-Cell Delineation (LOCD) LED.

More detailed information is readily available from the "GLOBAL STATS" screen by pressing **2nd Func.** then **Status**. TC Sublayer connectivity is verified in the "GLOBAL STATS" screen once Idle/Unassigned cells are being counted.

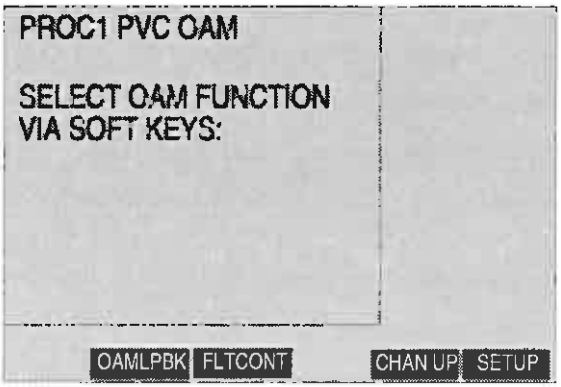
Counts of PLCP events (BIP 8, FEBE, FRM ERR, and OOF) can be displayed by pressing the **PLCP** soft key from either the "TC LAYER SETUP" OR "GLOBAL STATS" screens.

Once TC Sublayer connectivity testing is complete, press the **NEXTMNU** soft key to proceed to the Header Setup Menu. For assistance with Header Setups, see Section 4.2 for PVC, 4.3 for PVP, and 4.4 for SVC.

After assigning values in the XVCX Header Setup menu, the user will be able to perform an OAM or ATM connectivity test. OAM testing is accessed via the **OAM** soft key (section 5.3) and ATM testing is accessed via the **NEXTMNU** soft key (section 5.4).

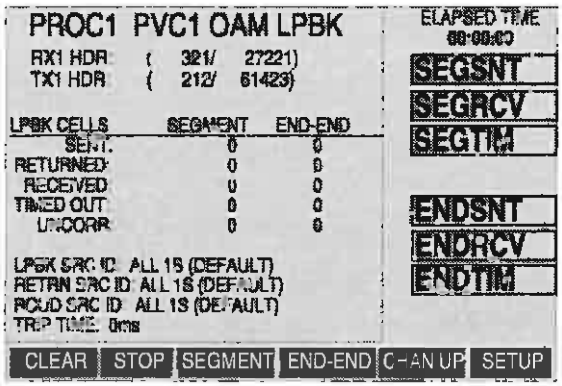
5.3 OAM Testing

OAM - This soft key, found in the Header Setup screen, enables the 750 to provide Operation, Administration and Maintenance cells. The following menu will be displayed:



NOTE: *VPI/VCI header address must be assigned to a Test Channel to perform the OAM tests.*

OAM LPBK will display the OAM LpBk screen:



This menu enables the 750 to send and receive Segment and End to End loopback cells. This feature enables the user to verify segment and end to end continuity of a VCC. It does this by sending a single cell to the designated ATM device. This device returns the cell to the test set.

Soft LED Definitions:

SEGSNT - OAM segment loopback cell sent.

SEGRCV - OAM segment loopback cell received.

SEGTIM - OAM segment loopback cell timed out. This will turn red if the cell is sent and not received within 3 seconds.

ENDSNT- OAM End to End loopback cell sent.

ENDRCV - OAM End to End loopback cell received.

ENDTIM - OAM End to End loopback cell timed out. This will occur if the cell is sent out and not received within 3 seconds.

Definitions:

RXX HDR - VPI/VCI address of received cells.

TXX HDR - VPI/VCI address that is used to transmit OAM loopback cells.

LPBK CELLS - Loopback cells analyzed segment or end to end.

SENT- Indicates the number of cells sent from the 750.

RETURNED - Indicates the number of cells sent to the far end in response to an OAM loopback cell.

RECEIVED - Indicates the number of cells received from the far end in response to the cell sent from this 750.

TIMED OUT - Indicates that an OAM loopback cell was sent to the far end and not received back within 3 seconds.

UNCORR - Message was received with uncorrected errors.

LPBK SRC ID: - Enables the user to change the identifier.

RTRN SRC ID: - Reflects the OAM cell identifer that has been returned to sender.

RCVD SRC ID: - Reflects the OAM cell identifer that has been received by this 750.

TRIP TIME - Round trip time in milliseconds.

NOTE: *This measurement is not the same as the QoS parameter CTD and should not be used for QoS measurements.*

Soft key Definitions:

CLEAR - Returns counters to zero.

STOP - Ends the test.

START - Returns counters and elapsed time to zero and starts the test.

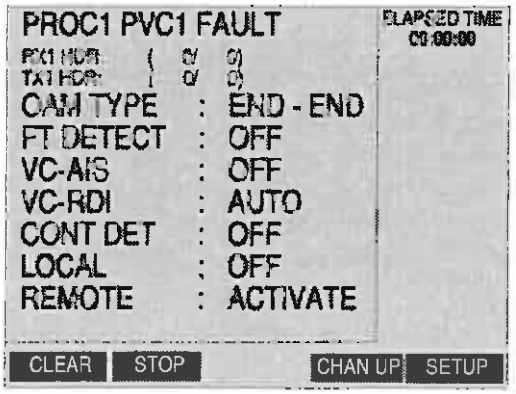
SEGMENT - Transmits a single segment loopback cell.

END-END - Transmits a single end to end loopback cell.

CHANUP - Displays OAM LPBK screen for the next channel.

SETUP - Returns the 750 to the OAM screen.

The OAM **FLTCONT** soft key from the OAM function select screen is used to display the following:



OAM FLTCONT, Fault and Continuity Detection, enables the 750 to detect failure conditions on a segment or an end to end connection via the OAM F4 or F5 flow. The 750 has the ability to transmit AIS and RDI alarms, and continuity check cells.

Definitions:

RXX HDR - VPI/VCI address of received cells.

TXX HDR - VPI/VCI address used to transmit failure conditions and continuity check cells.

OAM TYPE - End to End or Segment conditions/continuity cells.

FLT CONT- Fault and Continuity Detection.

FT DETECT- Enables or Disables the 750 to detect fault condition alarms.

VC-AIS - Transmit an Alarm Indication Signal (AIS) message once per second.

VC-RDI - Transmit a Remote Defect Identification (RDI) message once per second when **ON**. When set to **AUTO**, an RDI message is only sent when an AIS message is received.

CONT DET - Enable or Disable the 750s ability to detect continuity check cells.

LOCAL - Transmit continuity cells.

REMOTE - Activate/Deactivate far end transmitter to send continuity cells.

SETUP - Returns the 750 to the OAM selection screen.

Soft LED Definitions:

FX-AIS - Red indicates Alarm Indication Signal received from End to End or Segment.

FX-RDI - Red indicates Remote Defect Identification received from End to End or Segment.

NOTE: *FX-AIS and FX-RDI soft LEDs only appear when FT DETECT is **ON**.*

FX-CON - Red indicates continuity cells are not being received.

NOTE: *FX-CON soft LED only appears when CONT DET is **ON**.*

5.4 ATM Connectivity Test - End to End

5.4.1 Description

In order to verify that two end users have an operational ATM connection, test cells using assigned VPI/VCI pairs must be transmitted successfully across the network. The TPI 750 accomplishes this by controlling the transmission of test cells and successfully receiving each of these cells. This test verifies that the ATM connection has been provisioned in the switch and that ATM connectivity across the network exists. If this is not the case, the TPI 750 enables the user to identify the problem and provides insight into possible causes.

5.4.2 Test Setup - SVC

Refer to Section 4.4 and follow the procedure to set up an SVC connectivity test.

5.4.3 Test Setup - PVC

(1.1.1)

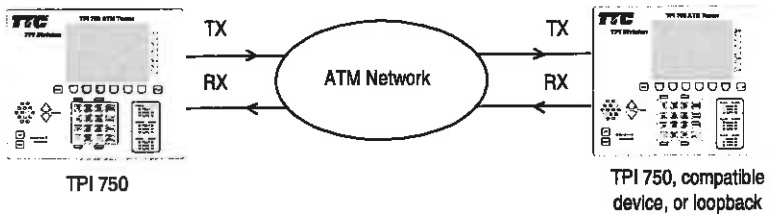


Figure 5.3 End-to-End Test Setup

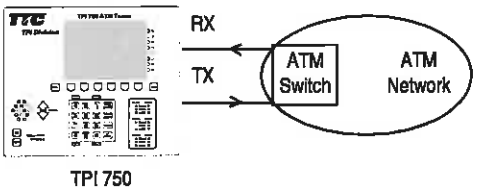


Figure 5.4 Connectivity test with a looped Edge Switch

The TPI 750 allows the user to configure the header and service parameters for up to six independent test streams. Only one test stream should be used for this test. All header fields for the transmitted stream and the VPI/VCI pair for the receive stream are set in the "HEADER SETUP" screen. Because VPI/VCI pairs only have local significance, the user at the receiving TPI 750 in Figure 5.3 may not know the appropriate pair to look for at their end. Using the **SCAN** soft key, the user can view all of the active connections on the link. The VPI/VCI pair that corresponds to the traffic load selected at the transmit end can then be identified and entered into the receiving 750.

The "TST (TEST) SETUP" screen enables the user to select the traffic type (CBR recommended for this test) and the parameters needed to characterize the traffic (peak cell rate and cell type). A PCR of ~5% of the bandwidth and TTC type 4 or O.191 test cells are recommended for this test.

The goal of this test is to verify connectivity (all cells are received with no errors). Once complete, tests 5.5, 5.6, or 5.9 can be run to stress the connection to the contract or full bandwidth rate.

NOTE: *Firmware version 3.20 sets the default values to CBR, PCR = 1000, CDVt = 50 µs, and O.191 test cells. TX Status must be set to ACTIVE to initiate the test. Select* ***RESULTS*** *to view QoS Analysis screen.*

5.4.4 Troubleshooting

TPI 750 Result	Interpretation
Total Cells - Both the one second and cumulative counters should be incrementing on the "Global", "Channel", & " QoS Analysis" menus.	Verifies test cells from the transmitting TPI 750 are being received. If not, verify that the selected receive and transmit headers are configured correctly and check the service order mapping data.
Bandwidth Utilization - TX & RX % should be nearly the same on the "Global" and "Channel" menus.	Confirms the receive TPI 750 is receiving all of the test traffic. If not, see Lost Cell below.
HEC (Correctable & Uncorrectable Errors) - Should be zero on "Global Statistics" menu.	Verifies there are no header errors in the cell stream. If incrementing rapidly, make sure that the scramble settings for each TPI 750 are set correctly (i.e., both On or both Off). If still incrementing, transmission impairments are most likely causing bit errors leading to HEC errors. The user should repeat Test 5.1 to verify the circuit.
Cell Loss Priority 1, Congested, & OAM Counters - Should be zero on "Channel Statistics" menu.	If the Cell Loss Priority 1 or Congested counters are incrementing, check the "HEADER SETUP" screen to make sure they are set to zero.
Cell Error count - Should be zero on "QoS Analysis" menu.	Verifies the integrity of the 48 byte payload of each test cell is error free. If incrementing rapidly, make sure that the scramble settings for each TPI 750 are set correctly (i.e., both On or both Off). If still incrementing, transmission impairments are most likely causing bit errors leading to cell errors. The user should repeat test 5.1 to verify the circuit.
Lost Cells - Should be zero on "QoS Analysis" menu.	Confirms cells are not being dropped. If incrementing, cells are most likely being discarded due to uncorrectable HEC errors (transmission impairments). Although it is unlikely that the network is 'policing' this level of traffic, lower the rate of the transmitting TPI 750 to 1%. If the lost cell counter still increments, check HEC results.
Mis-Inserted Cells on "QoS" Analysis" menu.	Verifies that there are no mis-inserted cells. If not zero, the most likely influence would be undetected/miscorrected errors in the cell header, which in turn is primarily a function of the transmission error rate. The user should repeat test 5.1 to verify the circuit.
Cell Error Rate (CER) - Should be zero or very near zero on "QoS Analysis" menu.	Confirms that the cell error rate is zero. If not zero, check the cell error counter and follow the procedures noted above.

5.5 ATM CBR Service Connection Quality of Service Test

5.5.1 Description

To test CBR service, the user should increase the traffic load up to the contracted PCR and monitor Quality of Service (QoS) and other pertinent results. It is important that QoS be assessed under heavy loading conditions. Doing so provides confidence that the ATM connection is capable of reliably delivering user cells under the anticipated traffic loading conditions. Since making this type of assessment is nearly impossible when end-user applications are up and running, it is important to perform this test before CPE turn-up.

5.5.2 Test Setup - SVC

Refer to section 4.3.5.

5.5.3 Test Setup - PVC

Refer to Figures 5.2, 5.3, and 5.4 for the functional test setup.

The TPI 750 allows the user to configure the header and service parameters for multiple independent test streams. This is done in the HDR Setup screen. All header fields for the transmitted stream and the VPI/VCI pair for the receive stream may be set in the Header Setup screen. Because VPI/VCI pairs only have local significance, the user at the receiving TPI 750 in Figure 5.3 may not know the appropriate pair to look for at their end. Using the **SCAN** soft key, the user can view the 32 most recently active connections on the link. The VPI/VCI pair that corresponds to the traffic load selected at the transmit end can then be identified and entered into the receiving 750.

The "TST (TEST) SETUP" screen enables the user to select the type of test (QoS, Capture, or Echo), traffic type (CBR for this test), and parameters needed to characterize the traffic (peak cell rate and cell type). The PCR should be set to the assigned rate. TTC type 4 or O.191 test cells are recommended for this test. The CDVt (Cell Transfer Delay Tolerance) parameter should be set at the assigned value (default is 50 µs).

The rate of the transmitting TPI 750 can be increased above the PCR value assigned to the connection, causing the lost cell count to increment, as the network enforces usage parameter control (UPC). Most networks perform UPC using the generic cell rate algorithm or "leaky bucket" algorithm. Most "buckets" assigned to CBR service will overflow if PCR is exceeded, leading to discarded cells.

The **BW POOL** soft key verifies that the requested PCR is within the bandwidth limits of the interface.

5.5.4 CBR Connection Troubleshooting

TPI 750 Result	Interpretation
Total Cells - The cumulative counter on the "Global", "Channel", and "QoS Analysis" menus should be incrementing, and the one second count should approximate the rate cells being transmitted (PCR).	Confirms test cells from the transmitting TPI 750 are being received. If the cumulative counter is not incrementing, verify that the selected RX and TX headers are configured correctly. If that fails, see Lost Cell & Cell Loss Rate below.
Bandwidth Utilization - TX & RX % should be nearly the same on the "Global" and "Channel Statistics" menus, only if cells are being sent to VPI/VCI of current channel.	Verifies the receive TPI 750 is receiving all of the test traffic. If not, see Lost Cell and Cell Loss Rate below.
Lost Cell Counter and Cell Loss Ratio - Should be zero or near zero (e.g., 1E-09) on "QoS Analysis" menu.	If both results are zero, confirms cells are not being dropped. Non-zero results may still be acceptable. Cell Loss Ratio (CLR) should match (or better) the QoS CLR assigned to the connection. If the lost cell counter is incrementing rapidly, cells are most likely being discarded due to UPC enforcement by the network. Another indication of this would be if the one second total cell counter is more than the agreed PCR value.
Cell Errors & Cell Error Ratio (CER) - Should be zero or near zero (e.g., 1E-09) on "QoS Analysis" menu.	If both results are zero, verifies bit errors are not corrupting cell payloads. If not zero, this may be acceptable. The Cell Error Ratio (CER) should match (or better) the QoS CER level assigned to the connection. If incrementing rapidly, make sure that the scramble settings for each TPI 750 are set correctly (i.e., both On or both Off). If still incrementing, transmission impairments are most likely causing bit errors leading to cell errors. The user should repeat test 5.1 to verify the circuit.
HEC (Correctable & Uncorrectable Errors - Should be zero on "Global Statistics" menu.	Confirms there are no header errors in the cell stream. If incrementing rapidly, make sure that the scramble settings for each TPI 750 are set correctly (i.e., both On or both Off). If still incrementing, transmission impairments are most likely causing bit errors leading to HEC errors. The user should repeat Test 5.1 to verify the circuit.
Cell Loss Priority 1, Congested, & OAM Counters - Should be zero on "Channel Statistics" menu.	If the Cell Loss Priority 1 or Congested counters are incrementing, check the "HEADER SETUP" screen to make sure they are set to zero.
Mis-Inserted Cells - Should be zero on "QoS Analysis" menu.	Verifies that cells from other traffic sources are not mistakenly being received by the TPI 750. If not zero, the most likely influence would be undetected/miscorrected errors in the cell header on another traffic stream.
Cell Delay Variation should correspond to the anticipated CDV on "QoS Analysis" menu.	If testing the output of the device, then compare this result to the device specification. If testing the network output (cells on their way to the receiving device), compare to the QoS assigned value.

5.6 ATM VBR Service Connection Test

5.6.1 Description

The traffic that pushes the UPC thresholds of the VBR service is transmitted while QoS and other results are monitored.

5.6.2 Test Setup - SVC

Refer to section 4.3.5.

5.6.3 Test Setup - PVC

Refer to Figures 5.2, 5.3, and 5.4 for the functional test setup.

Since there are multiple service characteristics that influence VBR performance (SCR, PCR, CDVt, and MBS), three separate tests are used to verify VBR service. Once these parameters have been verified, the third step is to configure a VBR stream with the assigned service characteristics and then monitor its QoS results. This procedure is valid for VBRrt and VBRnrt service.

STAGE 1

Channel one should be configured for VBR (rt or nrt) service with its PCR, CDVt, and SCR parameters set to the assigned SCR and CDVt for the VBR service and the MBS set to the SCR as well. This creates a constant stream of traffic at the SCR, ensuring that the connection can support the service's SCR. Additionally, it allows the user to verify that all of the QoS parameters can be met by the connection.

STAGE 2

Using channel two, which will also be set for VBR, the user will set the PCR, CDVt, and SCR parameters to their assigned values, and the MBS to *twice* its assigned value. The purpose of this test is to verify that the network "tags" excess cells appropriately.

STAGE 3

For the third stage of the test, channel three is configured for VBR and the traffic parameters are set to values assigned to the VBR service under test. This test will allow the user to verify the connection performance under actual service conditions.

Use of the TPI 750's support for multiple test streams allows the user to configure each stage up front, avoiding the need to reconfigure a "primary" stream for each test. The only action necessary is to ensure that the appropriate channels are active/inactive.

5.6.4 VBR Connection Troubleshooting

Stage 1:

TPI 750 Result	Interpretation
Total Cells - Both the one second and cumulative counters should be incrementing on the "Global", "Channel", and "QoS Analysis" menus.	Confirms test cells from the transmitting TPI 750 are being received. If not, verify that the selected RX and TX headers are configured correctly.
Lost Cell Counter and Cell Loss Ratio - Should be zero or near zero (e.g., 1E-09) on "QoS Analysis" menu.	As long as the TPI 750 is transmitting at a fixed rate below the PCR, cells should not be discarded by the network. If the fixed rate is increased above the PCR, the lost cell counter should increment.
Cell Loss Priority 1, - Should be zero on "Channel Statistics" menu.	As long as the TPI 750 is transmitting at a fixed rate below the assigned SCR, cells should not be "tagged". If the fixed rate is increased above the SCR, the CLP 1 counter should increment. Cells with the CLP value set to "1" are the first to be discarded when entering a congested ATM switch.

Stage 2:

TPI 750 Result	Interpretation
Total Cells - Both the one second and cumulative counters should be incrementing on the "Global", "Channel", and "QoS Analysis" menus.	Confirms cells from the transmitting TPI 750 are being received. If not, verify that the selected RX and TX headers are configured correctly.
Lost Cell Counter and Cell Loss Ratio - Should be zero or near zero (e.g., 1E-09) on "QoS Analysis" menu.	Since the TPI 750 is transmitting below the PCR, cells should not be discarded by the network. If the rate is increased above the PCR, the lost cell counter should increment.
Cell Loss Priority 1, - Should be incrementing rapidly on "Channel Statistics" menu.	The transmit traffic of the TPI 750 is exceeding the SCR assigned to the service, which should result in "tagged cells". Because the MBS is twice the assigned value, approximately half the total cells should be "tagged".

Stage 3:

TPI 750 Result	Interpretation
Total Cells - Both the one second and cumulative counters should be incrementing on the "Global", "Channel", and "QoS Analysis" menus.	Confirms cells from the transmitting TPI 750 are being received. If not, verify that the selected RX and TX headers are configured correctly.
Lost Cells - Should be zero on "QoS Analysis" menu.	As long as the TPI 750's PCR parameter is at or below the assigned PCR, very few cells should be discarded. If cells are being discarded at a high rate, lower the PCR parameter on the TX stream until the counter stops incrementing (or the CLR approaches the QoS value). The user should compare this value to the assigned value and determine if the difference is acceptable.
Cell Loss Priority 1, - Should be zero on "Channel Statistics" menu.	As long as the TPI 750's SCR parameter is at or below the assigned SCR, cells should not be "tagged". If cells are being "tagged", lower the SCR value on the TX stream until the CLP counter stops incrementing. The user should compare this SCR value to the assigned value and determine if the difference is acceptable.

5.7 Quality of Service Measurements

5.7.1 Description

Quality of Service measurements are used to measure the accuracy (cell error ratio, mis-inserted cell count & errored cell count), dependability (cell loss ratio), and speed (cell transfer delay & cell delay variation) of ATM service. These measures are also used as benchmarks within contracts between providers and end users. Provisioning service requires testing to the contract/assigned parameters. They can also provide insight into problems occurring on live traffic. Verification of contract parameters is an essential part of ATM service provisioning and can be a useful step in identifying network problems in a troubleshooting application.

5.7.2 Test Setup

Refer to Figures 5.2, 5.3, and 5.4 for the functional test setup.

For correct results, the appropriate service parameters must be entered in the "HEADER" and "TEST SETUP" menus. With SVC, the correct parameters must be entered in the Traffic menu. See Section 4.4.5.

5.7.3 QoS Troubleshooting

TPI 750 Result	Interpretation
Cell Transfer Delay time on "QoS Analysis" menu.	CTD is a Quality of Service parameter that measures network latency caused by propagation delay, queuing, routing, and switching delays. Most providers have established service objectives/contractual guarantees for different levels of CTD. The TPI 750 shows the round-trip delay divided by two. The measured result should be compared to the assigned value for the specific ATM service. For troubleshooting, the permissible CTD will vary with the application being supported. As such, the user will need insight into the delay tolerance of the application/CPE when interpreting this result.
Cell Delay Variation on the "QoS Analysis" menu.	Another Quality of Service parameter that describes how much cells "clump" or "gap" as they traverse the network, i.e., Cell Jitter. Because of CBR's strict timing requirements, CDV is an essential measure for this type of service. Too much clumping overflows receiving end buffers leading to discarded cells and gaps lead to empty buffers and loss of synchronization in circuit emulation applications. As such, measuring CDV is required to turn-up CBR service.
Cell Delay Peak- Peak on "QoS Analysis" menu.	Defined as CDV max-CDV min. When coupled with CDV, this measure can give users a feel for the range of CDV changes over time.
Cell Loss Ratio on "Qos Analysis" menu.	A Quality of Service parameter used to measure the dependability of the link. The CLR is influenced by errors in the cell header, buffer overflows, and non-ideal traffic management. This test is standard for service provisioning.
Cell Error Ratio on "QoS Analysis" menu.	CER is a Quality of Service measure for the accuracy of the network connection. Included in most turn-up procedures, CER aids in identifying physical media and buffer overflow problems.
Mis-Insertion Rate on "QoS Analysis" menu.	A Quality of Service parameter defined as the number of cells on the wrong link over a given time period. MIR is most likely caused by undetected or miscorrected errors in the cell header, leading to the cell being misassigned to a valid VPI/VCI. These occurrences are related to transmission errors and the number of valid VPI/VCIs in a given network. This is more likely to happen in larger public networks than in private networks.

5.8 In-Line Monitor

5.8.1 Description

The in-line monitor mode allows the TPI 750 to be placed in-line between the network and the CPE and capture ATM traffic for analysis then regenerate it, allowing delivery in both directions. (A second processor must be installed to monitor both directions.) The TPI 750 provides physical layer, TC sublayer (PLCP) and ATM layer (on both global and per-channel basis) statistics for the purpose of isolating service problems. Often network related problems can be isolated without a protocol analyzer. Additionally the TPI 750 can differentiate between physical, TC, and ATM related problems.

5.8.2 Test Setup


(1.1.1)

Configure the test set for the appropriate interface(s) and select the In-Line Monitor mode on the Physical Setup screen (Section 4). Once the physical layer is correctly set up, all data received will be regenerated and transmitted back out the same interface. Refer to Figure 5.5, below.

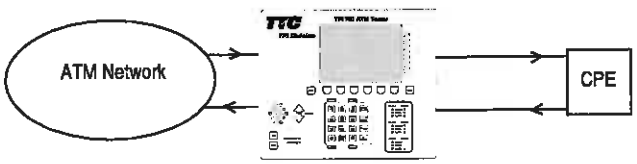


Figure 5.5 In-Line Monitoring Setup

NOTE: *When In-Line mode is selected, the* ***LpBk*** *LED(s) will light for the interface(s) being set up.*

Set up the TC Sublayer, Header, and ATM Test menus for the logical connection(s) to be monitored. Refer to Figure 5.6 below:

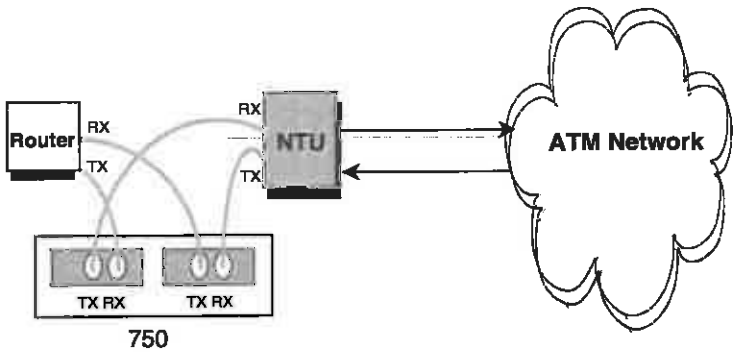


Figure 5.6 In-Line Full Duplex Monitoring Cable Connections

As in terminate mode, the user may look at a specific VPI/VCI or the entire interface. If a specific VPI/VCI is to be examined, the user must assign the VCC to a test channel. This is done by entering the VPI/VCI address in the PVCX Header Setup screen. The PVCX test setup is either QoS or Capture and the test time is determined by the user. The **RESULTS** soft key is used to display the QoS Analysis screen as described earlier. All statistics and QoS measurements are valid except for CTD measurements.

Results at each of the different levels needs to be monitored, using the "Physical", "Global", "Channel", and "Analysis" menus. This test requires the use of many results covered in previous tests. Refer to those sections for specific details.

5.9 In-Service Monitoring

5.9.1 Description

In-service monitoring is often used to troubleshoot potential network problems without taking customers out of service. The TPI 750 provides physical layer, TC sublayer (PLCP) and ATM layer (on both global and per-channel basis) statistics for the purpose of isolating service problems. Often network related problems can be isolated without a protocol analyzer. Additionally the TPI 750 can differentiate between physical, TC, and ATM related problems.

5.9.2 Test Setup


(1.1.1)

Configure the test set for the appropriate interface and select Monitor mode on the Physical Setup screen (Section 4). Set up the Physical, TC Sublayer, Header, and ATM Test menus for the logical connection(s) to be monitored. Refer to Figure 5.7 below.

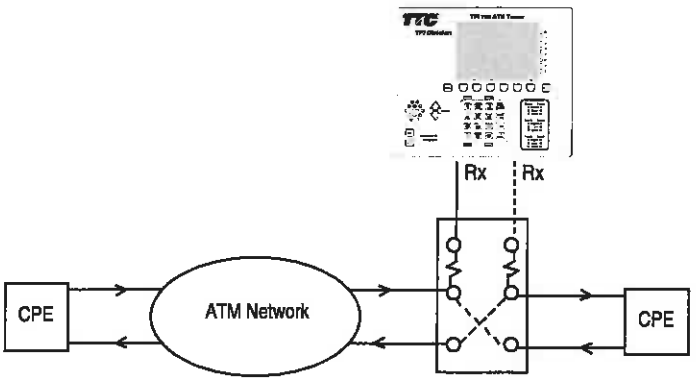


Figure 5.7 In-Service Monitoring Setup

Connection to the circuit is normally via monitor jacks. In a single processor configuration, the 750's monitor mode collects global statistics and statistics on six virtual circuits (SVC or PVC) for the direction being monitored. A 750 equipped with an optional second processor (coprocessor) can collect the same statistics for both directions of the circuit (full-duplex monitoring), or one direction of a second circuit. Refer to Figure 5.8 below.

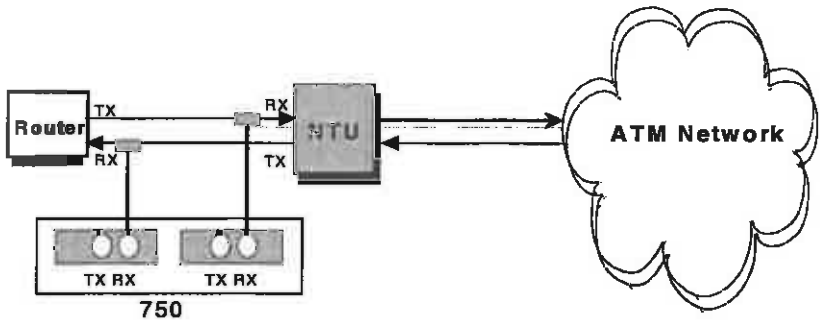


Figure 5.8 Full Duplex Monitoring Cable Connections

Results at each of the different levels needs to be monitored, using the "Physical", "Global", "Channel", and "Analysis" menus. This test requires the use of many results covered in previous tests. Refer to those sections for specific details. However, a Test Channel must be set up to look at a specific VCC. The procedure is the same as discussed in Section 5.8.2 (In-Line Monitor).

5.10 ATM Device Testing (Wrap) Application

5.10.1 Description

The ATM Device Testing Application can be used to "wrap around the switch". In this mode, two interfaces are used (can be same speed interfaces or two different speed interfaces): one interface OUT of the TPI 750 and IN to the switch, and another interface OUT of the switch and IN to the TPI 750.

The TPI 750 provides physical layer, TC sublayer (PLCP), and ATM layer (on both global and per-channel basis) statistics for the purpose of isolating service problems. Switch-related performance can be verified (address routing, congestion management, etc.).

5.10.2 Test Setup



(1.1.1)

On the "Physical Setup" menu, the "Type" selection should be "Dual" to operate with two different interface setups ("Duplex" would be used if operating with the same speed interface, DS3 to DS3 for example). See Section 4.

Connect the TX and RX connectors to the applicable interface. This will verify inbound and outbound service.

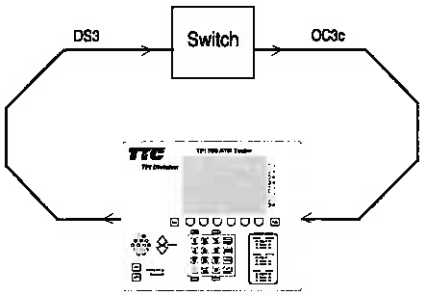


Figure 5.7 ATM Device Testing (Wrap) Setup

Enter the "Setup" selections ("Physical Setup", "TC Layer Setup", etc.) for the first interface (DS3 in the example above).

Press the **2nd Func.** key to display the **PROC2** soft key. Select the **PROC2** soft key. This will display the "Setup" menus for the second processor, or second interface (OC3c in the example above).

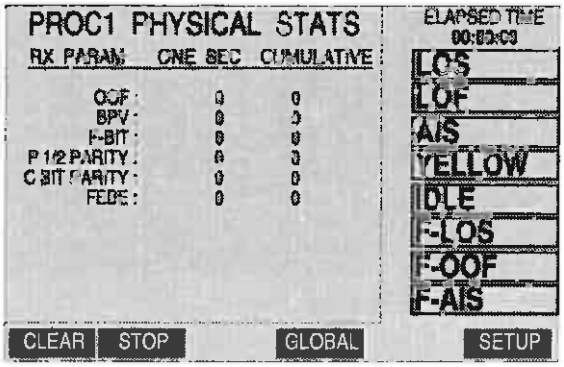
Cells can be generated on one interface (i.e., DS3) and received on the other interface (i.e., OC3c).

Results at each of the different levels needs to be monitored, using the "Physical", "Global", "Channel", and "Analysis" menus. This test requires the use of many results covered in previous tests. Refer to those sections for specific details.

5.11 Status Reports

Pressing "**2nd Func.**, **Status**" from any of the "Setup" menus displays a "Status" menu.

From the "Physical Setup" menu, pressing "**2nd Func.**, **Status**" will display the following menu, assuming that DS3 was selected as the interface:

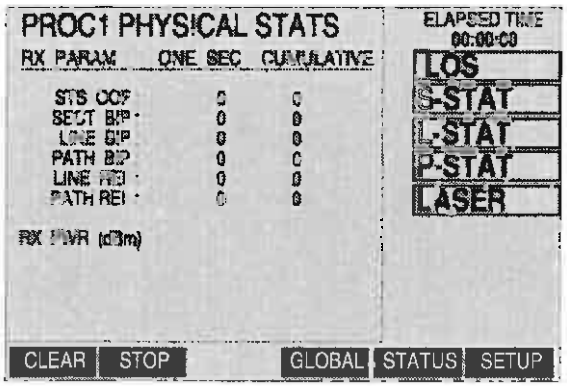


The actual screen displayed may vary depending on the interface (the screen above is the DS3 screen). Pressing the **CLEAR** soft key will return the elapsed time and the error counters to zero. The **STOP** soft key ends the test. Selecting **SETUP** returns to the "PHYSICAL SETUP" screen.

If lit, the definable LED's (to the right of the menu) display Loss of Signal (**LOS**), Loss of Framing (**LOF**), Alarm Indication Signal (**AIS**), Yellow Alarm (**YELLOW**), **IDLE**, Far end Loss of Signal (**F-LOS**), Far end Out of Frame (**F-OOF**), and Far end Alarm Indication Signal (**F-AIS**)

If M13 framing was selected in setup (DS3 interface), the "C BIT PARITY" and "FEBE" lines will not be displayed, the "F-XXX" LED's will not be displayed, and a **STATUS** LED will appear to report any difference between the current and previous statistics: green=no detected errors at this layer; amber=errors detected in the past, but not currently being detected on this layer; red=currently detecting errors at this layer. If the LED is red or amber, errors can be cleared by pressing the **CLEAR** soft key.

If OC3c interface was selected in Setup, pressing "**2nd Func.**, **Status**" will display the following menu:

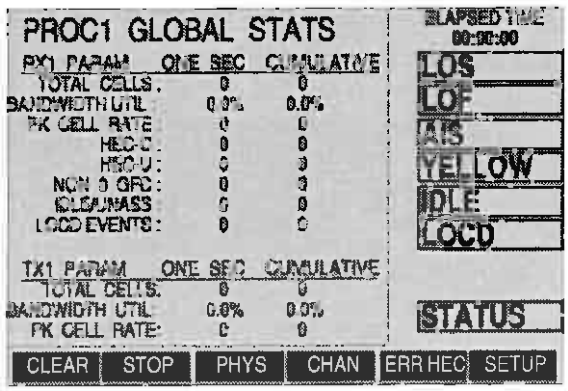


Pressing the **CLEAR** soft key will return the elapsed time and the error counters to zero. The **STOP** soft key ends the test. Selecting **SETUP** will return to the "PHYSICAL SETUP" screen. The "RX PWR (dBm)" line indicates the received optical signal level, from 0 dBm to -30 dBm ±1 dBm. (Note: Receiver Power is also available on the DS1 and E1 interfaces. The signal level is measured to -3dB if 3.20 hardware is installed.)

If lit, the definable LED's (to the right of the menu) and the applicable text label on the color LCD screen display Loss of Signal (**LOS**), Section Status (**S-STAT**), Line Status (**L-STAT**), Path Status (**P-STAT**), and **LASER** on/off.

Selecting the **STATUS** soft key displays more status LED labels (right side of the screen).

Selecting the **GLOBAL** soft key will display the following menu, assuming that DS3 was selected as the interface:



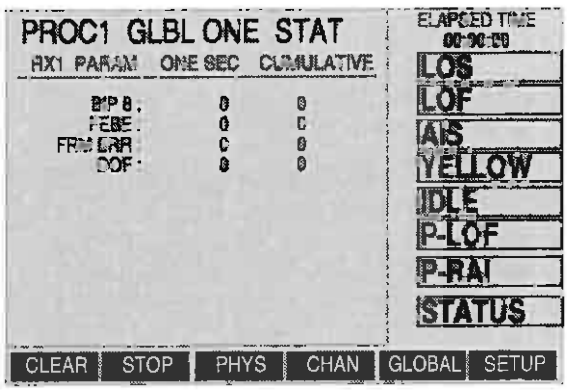
NOTE: *The "LOCD EVENTS" line will only be displayed if HEC Mapping was selected on the TC SUBLAYER SETUP menu.*

Pressing the **CLEAR** soft key will return the elapsed time and the error counters to zero. The **STOP** soft key ends the test. Pressing the **CHAN** soft key views the "CHANNEL STATISTICS". Selecting **PHYS** will return to the "PHYSICAL STATISTICS" screen. The **ERR HEC** soft key is used for HEC error insertion, based on the "ERR TYPE" selection in the "TC LAYER SETUP" menu. Selecting **SETUP** will return to the "TC LAYER SETUP" screen.

If lit, the definable LED's (to the right of the menu) and the applicable text label on the color LCD screen display Loss of Signal (**LOS**), Loss of Framing (**LOF**), Alarm Indication Signal (**AIS**), Yellow Alarm (**YELLOW**), **IDLE**, and Loss of Cell Delineation (**LOCD**).

If PLCP mapping was selected on the TC LAYER SETUP screen, a **PLCP** soft key will be displayed and the **LOCD** LED will become PLCP Loss of Framing (**P-LOF**), and a PLCP Remote Alarm Indication (**P-RAI**) LED will be displayed.

Pressing the **PLCP** soft key displays the PLCP statistics:



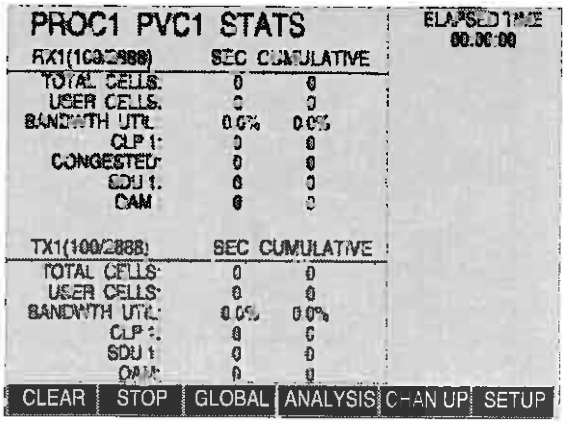
NOTE: *This menu will only be available if PLCP mapping was selected on the "TC LAYER SETUP" screen.*

Pressing the **CLEAR** soft key will return the elapsed time and the error counters to zero. The **STOP** soft key ends the test. Selecting **GLOBAL** will return to the "GLOBAL STATISTICS" screen. Selecting **SETUP** will return to the "TC LAYER SETUP" screen.

If lit, the definable LED's (to the right of the menu) display Loss of Signal (**LOS**), Loss of Framing (**LOF**), Alarm Indication Signal (**AIS**), Yellow Alarm (**YELLOW**), **IDLE**, PLCP Loss of Framing (**P-LOF**), PLCP Remote Alarm Indication (**P-RAI**), and **STATUS**.

The **STATUS** LED indicates a difference between the current statistics and the previous statistics: green=no detected errors at this layer; amber=errors detected in the past, but not currently being detected on this layer; red=currently detecting errors at this layer. If the LED and the applicable text label on the color LCD screen is red or amber, the errors can be cleared by pressing the **CLEAR** soft key.

Selecting the **CHAN** soft key will display the following menu:

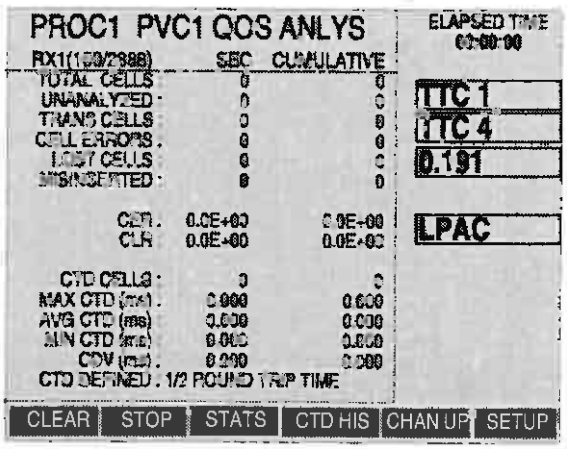


Pressing the **CLEAR** soft key will return the elapsed time and the error counters to zero. The **STOP** soft key ends the test. Selecting **GLOBAL** will return to the "GLOBAL STATISTICS" screen. Pressing **CHAN UP** displays the channel statistics for the next channel. Selecting **SETUP** will return to the "HEADER SETUP" screen.

"SDU 1" is the count of user cells of any type having the SDU bit set.

"OAM" is a total count of all types of OAM cells (messages).

Pressing **ANALYSIS** will display the following menu:

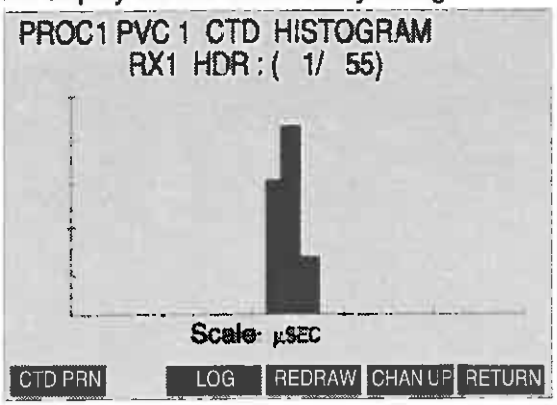


This menu can also be reached from the **Setup** menus by selecting the **RESULTS** soft key on the Test Setup screen.

Pressing the **CLEAR** soft key will return the counters and the elapsed time to zero. Selecting **STOP** will stop the counters and the elapsed time. The **STATS** soft key can be pressed to display the "CHANNEL STATISTICS" menu. The **CHANUP** soft key will display the analysis screen for the next channel. The **SETUP** soft key returns to the "TST SETUP" screen.

The Loss of Performance Analysis Capability (**LPAC**) LED, if lit amber, indicates Loss of Performance Assessment Capability since the **CLEAR** soft key was last pressed; if lit red, indicates current Loss of Performance Assessment Capability condition. Return to the **Setup** screen to verify stream configuration (Active, paramenters, etc.)

Selecting the **CTD HIS** soft key will display the cell transit delay histogram for the current virtual circuit.



The histogram gives a visual "spread" of the cell transfer delay. For more information on Quality of Service parameters, refer to the "Quality of Service" section of Appendix C.

The table on the following page provides tolerance data for common higher layer applications.

Type	Category	Bandwidth	CBR/VBR	Burst Length	Error/Loss Tolerance	Delay Tolerance
Voice	PCM Voice	64K	CBR	N/A	10E-4 to 10E-6	10 to 150 ms
Voice	ADPCM Voice	32K	CBR	N/A	10E-4 to 10E-7	10 to 150 ms
Voice	Predictive Coding	16K	VBR	2 to 3K	10E-6 to 10E-8	10 to 150 ms
Voice	Voice Mail	16 to 64K	CBRV BR	N/A	10E-6	500 ms to 5 sec
Voice	CD-Quality	1.4M	CBR	N/A	10E-6	500 ms to 25 sec
Voice	Video Tel/Voice Part	64 to 192K	CBR	N/A	10E-7 to 10E-9	10 to 150 ms
Data	LAN Interconnect	1.5 to 100M	VBR	100 to 1000B	10E-12	10 to 100 ms
Data	Host-host File Transfer	64K to 1.5M	VBR	12K to 10M	10E-12	1 to 500 sec
Data	PC File Transfer	9.6 to 64K	VBR	1K to 1M	10E-9	10 to 100 sec
Data	Client/Server System	10 to 100M	VBR	1 to 500K	10E-9	10 to 500 ms
Data	Remote Data Base Access	1 to 10M	VBR	100B to 100K	10E-9	1 to 10 sec
Data	Workstation CAD/CAM	64K to 1.5M	VBR	40 to 100K	10E-9	1 to 10 sec
Data	Transaction Processing	64K to 5M	VBR	100 to 300B	10E-9	1 to 3 sec
Video	Video Telephony	64K to 2M	CBR VBR	2 to 10K	10E-9	150 to 350 ms
Video	Video conferencing	128K to 14M	CBR VBR	1.6 to 40K	10E-9	150 to 350 ms
Video	NTSC TV	15 to 44M	VBR	500K to 1.3M	10E-10	40 ms
Video	HDTV	150M	VBR	5 to 14M	10E-12	40 ms
Video	G4 Fax 400x400	64K	CBR	256 to 640K	10E-8	4 to 10 sec
Video	X-Ray 14x17 in	1.5 to 10 M	CBR VBR	5 to 8 M	10E-12	2 sec
Video	Medical MRI/CAT scan	10 to 200 M	CBR VBR	250K to 3M	10E-12	2 sec
Video	High Resolution Graphics	100 M to 10G	VBR	1 to 100 M	10E-12	10 to 500 ms

Qos Performance Needs for Various Applications

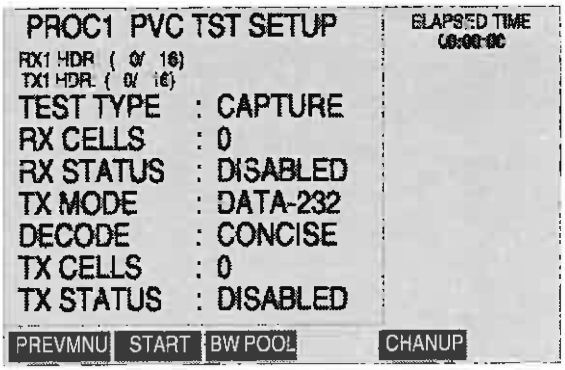
Source: ISDN & Broadband ISDN w/Frame Relay & ATM, William Stallings, 1995

5.12 Cell Capture

The TPI 750 has the ability to capture cells and store them in a buffer for remote retrieval through the port used to capture them or the RS-232 **Data** port.

To enable the capture function, press the **Setup** key then the **NEXTMNU** soft key until the "TEST SETUP" menu is displayed. Press **Scroll Menu** to highlight the "TEST TYPE" menu item. The selections, QOS ECHO, and CAPTURE, are displayed as soft keys. Select **CAPTURE.**

The following menu will be displayed:



"RX STATUS" enables or disables capturing cells; "TX STATUS" enables or disables retransmitting of the captured cells. The "TX MODE" selects which way to retransmit the cells: out the same physical interface (PHY), or out the RS-232 connector (DATA-232).

"RX CELLS" counts the number of cells that are in the capture buffer, (i.e., 1 - 6144). "TX CELLS" counts the number of captured cells that are re-transmitted (i.e., 1 - 6144).

"TX FILTER" is available in the PHY TX Mode only. It enables all the stored cells to be re-transmitted, or only cells for a particular VP, or a particular VCC.

"TIMESCALE" is available in the PHY TX mode only. It enables the stored cells to be re-transmitted at lower rates than the one at which they were received. For example, by using X128, a 155 Mbps cell capture could be re-transmitted out the E1 port.

"DECODE" is available in the DATA TX mode only. The decode choices are "Summary", "Header", "Concise", and "Verbose." Examples of each are:

Summary

```
12.280,949,36     :: chan[1] :: HEADER: 0x00000100
                  ::::::::::::::::::::::::::::::::
 12.281,777,72    :: chan[1] :: HEADER: 0x00000100
                  ::::::::::::::::::::::::::::::::
 12.282,881,96    :: chan[1] :: HEADER: 0x00000100
                  ::::::::::::::::::::::::::::::::
 12.283,709,68    :: chan[1] :: HEADER: 0x00000100
                  ::::::::::::::::::::::::::::::::
 12.284,813,96    :: chan[1] :: HEADER: 0x00000100
                  ::::::::::::::::::::::::::::::::
```

Header

```
12.272,944,20      :: chan[1] :: HEADER: 0x00000100
                   :: GFC VPI -VCI- CLP PTI-----------------------------
                   ::   0   0    16  0  USER DATA, SDU=0, NO CONGESTION
                   ::::::::::::::::::::::::::::::::::
 12.273,772,56     :: chan[1] :: HEADER: 0x00000100
                   :: GFC VPI -VCI- CLP PTI-----------------------------
                   ::   0   0    16  0  USER DATA, SDU=0, NO CONGESTION
                   ::::::::::::::::::::::::::::::::::
 12.274,876,80     :: chan[1] :: HEADER: 0x00000100
                   :: GFC VPI -VCI- CLP PTI-----------------------------
                   ::   0   0    16  0  USER DATA, SDU=0, NO CONGESTION
                   ::::::::::::::::::::::::::::::::::
 12.275,704,56     :: chan[1] :: HEADER: 0x00000100
                   :: GFC VPI -VCI- CLP PTI-----------------------------
```

Concise

```
12.272,944,20      :: chan[1] :: HEADER: 0x00000100
                   :: 0x913e6f4d   0x83f83984   0xe5586f4d   0xc8a15a7e
                   :: 0xc92df935   0x33018ca3   0x4bfa2c75   0x9678fba0
                   :: 0xd6dd82d7   0xd540a579   0x77039d27   0xaea2d9b6
                   ::      BIP-16: 0x602b      CRC Residual: 0x0078
                   ::::::::::::::::::::::::::::::::::
 12.273,772,56     :: chan[1] :: HEADER: 0x00000100
                   :: 0x922729da   0x77a15167   0x8fba0d6d   0xd82d7d54
                   :: 0x0a579770   0x39d27aea   0x243385ed   0x9a1de1ff
                   :: 0x07be2e64   0x129da3cf   0x9b15238d   0xab898b34
                   ::      BIP-16: 0xbe1b      CRC Residual: 0x0377
                   ::::::::::::::::::::::::::::::::::
 12.274,876,80     :: chan[1] :: HEADER: 0x00000100
                   :: 0x932feba8   0xdb981da7   0xec92df93   0x533018ca
                   :: 0x34bfa2c7   0x59678fba   0x0d6dd82d   0x7d540a57
                   :: 0x977039d2   0x7aea2433   0x85ed9a1d   0xe1ffe473
                   ::      BIP-16: 0xcea2      CRC Residual: 0x011a
                   ::::::::::::::::::::::::::::::::::
 12.275,704,56     :: chan[1] :: HEADER: 0x00000100
                   :: 0x9c53b760   0xfea0ce22   0x0108c272   0xac37a6e4
                   :: 0x50ad3f64   0x96fc9a99   0x80c651a5   0xfd163acb
                   :: 0x3c7dd06b   0x6ec16bea   0xa052bcbb   0x81ce2ad9
                   ::      BIP-16: 0xf9c9      CRC Residual: 0x01cd

                   ::::::::::::::::::::::::::::::::::
```

Verbose

```
12.283,709,68     :: chan[1] :: HEADER: 0x00000100
                  :: GFC VPI -VCI- CLP PTI----------------------------
                  ::   0   0    16  0  USER DATA, SDU=0, NO CONGESTION
                  :: CELL PAYLOAD -----------------------------------
                  :: 0xa581cd8a   0xda8ff4bb   0x81ce93d7   0x51219c2f
                  :: 0x6cd0ef0f   0xf83df173   0x2094ed1e   0x7cd8a91c
                  :: 0x6d5c4c44   0x021184e5   0x586f4dc8   0xa15a456c
                  ::      BIP-16: 0x5d8a      CRC Residual: 0x01f7
                  ::::::::::::::::::::::::::::::::::
 12.284,813,96    :: chan[1] :: HEADER: 0x00000100
                  :: GFC VPI -VCI- CLP PTI----------------------------
                  ::   0   0    16  0  USER DATA, SDU=0, NO CONGESTION
                  :: CELL PAYLOAD -----------------------------------
                  :: 0xa4890ff8   0x76b6bd61   0xbd372285   0x69fb24b7
                  :: 0xe4d4cc06   0x328d2fe8   0xb1d659e3   0xee835b76
                  :: 0x0b5f5502   0x95e5dc0e   0x749eba89   0x0ce1b2fc
                  ::      BIP-16: 0xbd93      CRC Residual: 0x0371
                  ::::::::::::::::::::::::::::::::::
 12.285,918,24    :: chan[1] :: HEADER: 0x00000100
                  :: GFC VPI -VCI- CLP PTI----------------------------
                  ::   0   0    16  0  USER DATA, SDU=0, NO CONGESTION
                  :: CELL PAYLOAD -----------------------------------
                  :: 0xa790496f   0x82efd0b9   0x904a768f   0x3e6c548e
                  :: 0x36ae2622   0x0108c272   0xac37a6e4   0x50ad3f64
                  :: 0x96fc9a99   0x80c651a5   0xfd163acb   0x3c7dfc67
                  ::      BIP-16: 0x5ca3      CRC Residual: 0x0108
                  ::::::::::::::::::::::::::::::::::
```

5.13 Echo

The TPI 750 has the ability to configure a PCV with a "soft" loopback. This type of test mode is accessible from the TST Setup screen. When enabled, the 750 will receive cells on a designated VPI/VCI and retransmit those cells out the designated VPI/VCI.

This test mode will enable the 750 to interact with any other type of test set.

No reports or statistics are available on the designated channel when in this mode, with the exception of the BW POOL report.

The Echo test is performed by selecting TEST TYPE: ECHO and setting ECHO STAT: ENABLED.

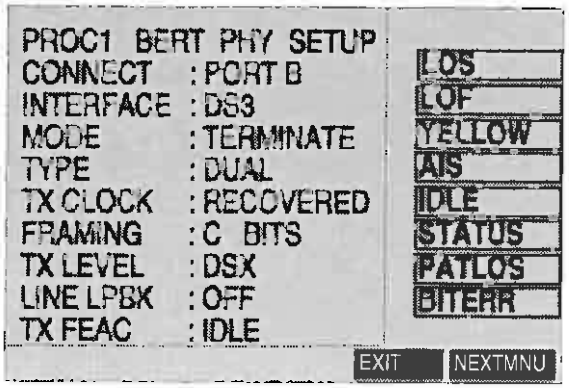
TTC
TPI Division

SECTION VI

BER TESTING

6.1 BERT Physical Layer Setup

Pressing **2nd Func., BERT** from the Physical Setup menu will enter BERT mode. The following menu will be displayed:



This screen reflects a DS3 setup. The display will vary depending on the interface selected. For example, if using the single mode optical interfaces, the "TX Level" line is not displayed and "Framing" will be replaced with "Laser". This screen is the same Physical Setup screen as seen in ATM test mode. For details on the Physical Setup see Section 4.1.

The TPI 750 is capable of sending network loopback codes in many of the available interfaces. The following table outlines the network loopbacks available:

Loopback		Respond	Initiate
DS1	ESF CSU EOC	X	X
	SF CSU Inband	X	X
	SF Facility Inband	X	X
E1	FAS/FAS+CRC SA6		X
DS3	C-bit FEAC	X	X

Soft key Definitions:

EXIT - Terminates the BERT testing mode and returns the 750 to the ATM testing mode.

NEXTMNU - Displays the BERT setup screen.

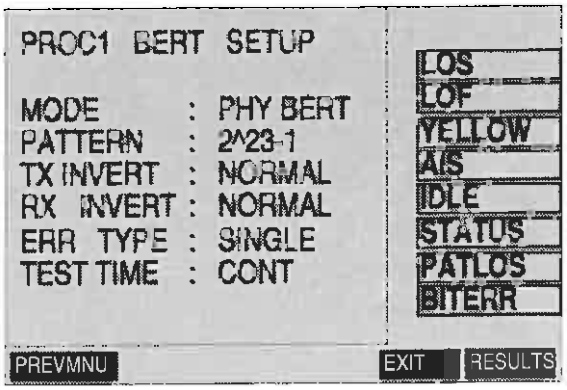
Soft LED Definitions:

PATLOS - Red indicates pattern loss, Green indicates pattern synchronization, Amber shows that there had been pattern loss in the past but the pattern is currently synchronized.

BITERR - Red indicates that errors are present, Green indicates that there are no errors, Amber shows that errors have been received, but are not currently being received.

6.1.1 BERT Setup

The following menu enables the 750 to be configured for BERT testing:



Soft key Definitions:

PREVMNU - Returns the unit to the BERT Physical Setup screen.

EXIT - Exits the BER test mode and returns the unit to the ATM test mode.

RESULTS - Displays the BERT Statistics screen.

Definitions:

MODE: PHY BERT - Enables the 750 to perform a BER test on the line.

MODE: 750 BERT - Same as PHY BERT (framed pseudorandom pattern), except HEC's are calculated and injected into the data stream (overwrites every 53rd byte). Allows early versions of the 750 to sync on the received BERT pattern.

PATTERN - Configures the pattern to be used in the BER test. The available choices are: 2^{23}-1, 2^{20}-1 (ITU O.151), 2^{20}-1E (ITU O.153), All Ones, All Zeros, 1010, 1100, and 3 in 24. The **AUTO** soft key will examine an incoming pattern from the receiver and select the pattern to be used in the BER test.

NOTE: *Auto pattern detection may not work if physical alarms (e.g., LOS, LOF, etc.) are present.*

TX INVERT: NORMAL - The BERT pattern is transmitted as normal.

TX INVERT: INVERT - The BERT pattern is transmitted inverted.

RX INVERT: NORMAL - The received BERT pattern is analyzed as normal.

RX INVERT: INVERT - The received BERT pattern is analyzed as inverted.

ERR TYPE - Enables the 750 to inject errors into the pattern. The choices are:

Single - inject a single error.
6 ERR - injects six consecutive errors.
10^{-3} - injects errors at the rate of 10^{-3}.
10^{-6} - injects errors at the rate of 10^{-6}.

TEST TIME - Enables the BER test to continue for 30 minutes, 60 minutes, until stopped, or for a User Defined length of time.

Pressing **2nd Func.** displays additional soft keys:

PRINT - Enables a "Screen Print" through the RS-232 **DATA** port.

ERR INS - Inserts errors at the predetermined rate.

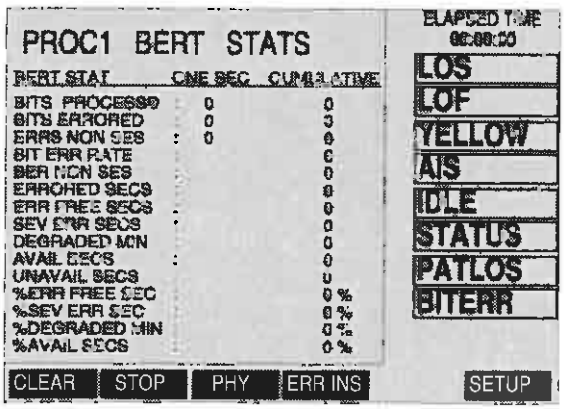
PROCx - Shifts to the other processor, if applicable.

LAS ON - Turns on the laser, if using an optical interface.

NOTE: *If operating in STM1/OC3c SM (Duplex Mode) with both processors, selecting **LAS ON** will turn on both lasers.*

6.2 Test Description

Once Setup is complete, press the **RESULTS** soft key. The following statistics screen will be displayed:



The statistics are calculated per G.821.

Soft key Definitions:

CLEAR - Resets the counters and starts a new test.

STOP - Ends the test (BER Test starts when BERT mode is entered).

PHY - Displays the Physical Statistics for the interface.

ERR INS - Inserts errors.

SETUP - Returns to the BERT Setup menu.

NOTE: *BERT mode can only be exited from the BERT Setup and BERT Physical Setup menus.*

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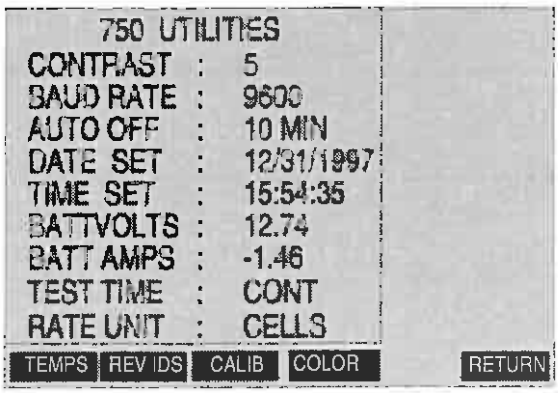
SECTION VII

UTILITIES

7.1 Utility

Pressing **2nd Func., Utility** (Utility is the "#" key on the keypad) will display the following menu:



Definitions:

Contrast - Control LCD Contrast Up or Down (0-9).

Baud Rate - Select speed of the **DATA** RS-232 connector.

Auto Off - Select Auto Power Down 10 Min/Disable.
Press **DISABLE** to disable this feature. Selecting **10 MIN** will power down the unit after 10 minutes of inactivity to conserve battery life. The **SMART** mode enables the unit "to know" whether a timed test is running or if AC power is present, and if so, the unit will not power down.

Date Set - MM/DD/YYYY.

Time Set - HH:MM:SS (24-hour clock).

Battery Volts - Report battery voltage.

Battery Amps - Report battery amps.

Test Time - Select duration of ATM test (BERT duration set under BERT).

Rate Unit - Select the unit used for the PCR, SCR, and MBS unit used in the Test Setup menu. Selections are **CELLS** (cells per second), **BITRATE** (bits per second), or **PERCENT** (percentage of bandwidth). If set to **BITRATE**, a specific number can be entered, or enter a number then select K or M. One K bit = 1024 bits, one M bit = 1048566 bits. If set to **PERCENT**, it can be set to two decimal places (**star** ["*"] = decimal). The percentage can only be set to 100% if the CDVT (Cell Delay Variation Tolerance) = 1.

Press the **Scroll Menu** key to move to the next line item.

Soft key Definitions:

TEMPS - Checks the temperature of the internal components.

REV IDS - View the revision levels of the internal components.

CALIB - Used to calibrate the optical lasers.

NOTE: *The **CALIB** soft key will only be displayed if the unit is setup to use an optical interface.*

COLOR - Sets the colors on the LCD.

RETURN - Goes back to the last menu.

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APPENDIX A

ACCESSORIES AND OPTIONS

Standard Accessories

TPI 750 Base Unit includes:	
PART #	*DESCRIPTION*
750 (836516)	Mainframe ATM Test Unit with
Must Choose One Processor Type:	
750-PRO1 (836541)	ATM25/E3/DS3 Processor
750-PRO2 (836529)	E1/DS1/E3/DS3 Processor
750-ACC-PACK (837196)	Soft Pack Carry Case
750-CABLE-8PIN (834016)	8-Pin Mod to 8-Pin Mod Cable
750-CABLE-BNC (834034)	2 Meter Shielded BNC Cable
750-CABLE-BNC2 (836699)	8-Pin Mod to BNC
750-CABLE-BNC3 (861050)	120 Ω to 75 Ω (G.703) Adapter
750-ACC-CHGR (860026)	Battery Charger/AC Adapter [13.5VDC, 2.8A]

Optional Accessories

TPI 750 Optional Features:	
PART #	*DESCRIPTION*
750-COPROA (836529)	Coprocessor with E1/DS1/E3/DS3 Interfaces
750-COPROAE (836541)	Coprocessor with ATM25 and E3/DS3 Interfaces (Coprocessors enable full duplex monitoring, through, and wrap modes.)

NOTE: *Only One Coprocessor will be supported in a single unit.*

750-OC3c1-	1st 155Mbps Optical Interface (RX and TX), (*Must select one*):
SM-FC (836524)	-STM1/OC3c Single Mode with FC connections
SM-SC (836506)	-STM1/OC3c Single Mode with SC connections
MM-FC (836526)	-STM1/OC3c Multi-Mode with FC connections
MM-SC (836527)	-STM1/OC3c Multi-Mode with FC connections

For example: 750-OC3c1-SM-FC = First 155Mbps Optical Interface Equipped with Single Mode FC Connectors and Fiber Optic Patch Cords

750-OC3c2-	2nd 155Mbps Optical Interface (RX and TX), (*Must select one*):
SM-FC (836524)	-STM1/OC3c Single Mode with FC connections
SM-SC (836506)	-STM1/OC3c Single Mode with SC connections
MM-FC (836526)	-STM1/OC3c Multi-Mode with FC connections
MM-SC (836527)	-STM1/OC3c Multi-Mode with FC connections

For example: 750-OC3c2-SM-FC = Second 155Mbps Optical Interface Equipped with Single Mode FC Connectors and Fiber Optic Patch Cords

NOTE: *The 155Mbps Optical Interfaces Support Both STM1 and OC3c Framing.*

750-STM-COAX (836494)	STM1/STS3c Coax Interface (TX/RX) (155Mbps Electrical Interface with Coax Connectors. Supports both STM1 and STS3c)

NOTE: *The 750 will support up to TWO 155Mbps Interfaces.*

TPI 750 Optional Accessories:	
PART #	*DESCRIPTION*
750-CABLE-3-PIN (836698)	6 Ft. Siemens 3 Pin Cable
750-CABLE-8-PIN (834003)	8-Pin Mod to 8-Pin Mod Cable
750-CABLE-BNC (834034)	6 Ft. Shielded BNC Cable
750-CABLE-BNC2 (861050)	120 Ω to 75 Ω (G.703) Adapter
750-ViTL (tpivitl)	Virtual Test Link Software
750-F/W	3-year Firmware Enhancement Agreement

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APPENDIX B

MAINTENANCE

Unit Maintenance

The only replaceable parts on the TPI 750 ATM Tester are the firmware module (front of unit, near the handle), batteries, and external cords. The LED indicators and displays are soldered into the unit and are not field replaceable.

If the TPI 750 operation should become suspect, the unit can be "reset" by pressing the asterisk (*) key on power up. The unit also may be checked for proper operation by performing a SELF TEST. This is done by turning the power off, then on again, which will initiate a Power-Up Self Test. If this procedure does not operate successfully, contact the factory Customer Service department at 1-540-375-0500.

Battery Life / Recharge

The unit can operate on battery power for up to 8 hours, depending on which interfaces are in use.

Recharge time is 12 to 14 hours (overnight).

Lead Acid batteries self discharge over time. Leaving them in a discharged condition for extended periods tends to shorten their life. To extend battery life, TPI recommends that the battery be fully recharged at least once every two (2) months. The charging circuit is designed so that the AC Adapter/Charger can be connected indefinitely, without overcharging or damaging the battery.



(1.3.1)





(1.3.2)

If the unit does not have a fuse in the connector panel, the battery cannot be replaced in the field. If this is the case, contact the TTC - TPI Division Customer Service Department at the number listed in the front of this manual. If the unit has a fuse in the connector panel, the battery can be replaced in the field using the following procedure:

 (1.3.2)

1.) *Turn Power OFF and unplug the AC Adapter, if used.*
2.) *Remove the fuse using a small screwdriver. Press inward firmly and turn 1/4 turn to the left (counter-clockwise).*
3.) *Turn unit over, resting on the lid.*
4.) *Locate the battery access panel. Remove the eight (8) screws using a #1 Philips screwdriver. Remove the panel from the back of the unit*

 (1.3.3)

5.) *Locate the battery farthest away from the connector panel. This is the rear battery.*
6.) *Lift the battery using the pull tabs and stand it upright in the battery compartment.*

 (1.3.4)

7.) *Disconnect the black (-) lead of the rear battery and leave the red (+) lead connected for now.*
8.) *Lift the front battery (closest to the connector panel) using the pull tabs and stand it upright in the battery compartment*
9.) *Disconnect the red (+) and black (-) leads from the front battery.*

 (1.3.6)

10.) *Replace the battery.*
11.) *Re-connect the red (+) and black (-) leads to the front battery, pressing each connector all the way in to be sure that it is seated fully.*
12.) *Carefully return the battery to its original flat position, being careful not to pinch the wires.*

 (1.3.6)

13.) *Return to the rear battery and disconnect the red (+) lead.*

14.) Replace the battery.

15.) Re-connect the red (+) lead to the rear battery, pressing the connector all the way in to be sure that it is seated fully. Then, re-connect the black (-) lead.

16.) Feed the wires back behind the battery bracket as you lower the battery into place, being careful not to pinch the wires.

17.) Inspect the wires for both batteries to be sure that the wires are not pinched or can be pinched when the access panel is replaced.

18.) Place the battery access panel in place, with the tab inserted toward the connector panel.

19.) Fold the battery pull tabs inward while lowering the access cover.

20.) Re-install the eight (8) screws in the battery access panel.

21.) Re-install the fuse using a small screwdriver and turning 1/4 turn to the right (clockwise).

22.) Charge the batteries overnight before using.


(1.3.1)

Recharge time is 12 to 14 hours (overnight). Lead Acid batteries self-discharge over time. Leaving them in a discharged condition for extended periods tends to shorten their life. To maximize battery life, TPI recommends that the battery be recharged at least every two months. The TPI 750 charging system will not overcharge the battery, even if left charging indefinitely.

23.) Dispose of the old batteries properly.

Always dispose of used batteries safely, in a way that will not harm the environment.

DO NOT place in a fire. The battery cells are sealed and the heat could cause them to explode, resulting in injury and the release of chemicals that are hazardous and harmful to the environment.

DO NOT puncture or otherwise damage the sealed battery cells. Lead-Acid cells contain chemicals that are hazardous and harmful to the environment.

DO NOT cause, or allow, the battery to be short-circuited. The heat generated could cause the cells to rupture or explode, resulting in injury and the release of chemicals that are hazardous and harmful to the environment.

DO NOT discard batteries in a trash receptacle whose contents are likely to end up in a landfill. Lead-Acid cells contain chemicals that are hazardous and harmful to the environment.

DO dispose of the battery according to local codes or regulations.

DO deliver the battery to a service facility that will recycle it or otherwise be sure that battery chemicals are not allowed to contaminate the environment. An example of a service facility would be a local vehicle service/ maintenance facility which customarily disposes of used automotive batteries (Lead Acid Batteries), or if a local facility is not available, ship the battery to TTC - TPI Division who will forward it to a recovery/recycle service.

Cleaning Optical Connectors


(1.3.5)

A clean fiber optic surface is essential for accurate test results and to protect fiber optic surfaces from abrasive dirt particles.

> ***CAUTION:*** Fiber optic connectors are delicate and can be damaged easily. Once damaged, the TPI 750 internal connector must be replaced at the factory. Therefore, clean the connector and the mating connectors often.

When the TPI 750 is used in a low-dust environment, minimal amounts of dirt and debris are expected on the connectors. Therefore, the following procedure is sufficient to maintain the connectors contamination free and protect the fiber from damage.

1.) *TRANSMIT or RECEIVE optical connections: Remove the protective cap from the fiber optic connector.*
2.) *Clean fiber optic surfaces: Carefully clean the fiber optic connector and cable ends with a cotton swab dipped in alcohol or an alcohol wipe.*
3.) *Dry fiber optic surfaces: Wipe the fiber optic connector and cable ends with a clean, dry swab.*
4.) *Repeat as necessary: Repeat approximately every tenth usage or more if the TPI 750 is operated in a dusty environment. Replace protective cap after each test.*

Firmware Module

The firmware module, located on the front side of the unit, may be removed and updated. Replacement is accomplished through the following steps:

1.) *Turn power OFF and unplug AC Adapter, if used.*
2.) *With a static discharge wrist strap on, remove the (2) screws from the "EPROM Firmware Door" on the front side of the unit.*
3.) *Remove the door.*
4.) *Push the corner tabs toward the outside.*
5.) *Gently pull out the EPROM circuit board.*
6.) *Insert the new board assembly and firmly press the board into place to secure it.*
7.) *Replace the (2) screws in the EPROM door.*
8.) *Depress and hold the */Store key when powering up the TPI 750 until the LCD screen reports "UNIT RESET DETECTED", then verify that the SELF TEST passes.*
9.) *Return the replaced EPROM module(s) to TTC - TPI Division Customer Service, with the unit serial number noted.*

Technical Assistance

If the operation of the TPI 750 is in question, please contact "Technical Assistance" at one of the following numbers:

TTC = 1-800-638-2049

Factory (TPI) = 1-540-375-0500

Warranty

The TPI 750 ATM Tester has a 3-year equipment warranty.

TTC - TPI Division warrants that this product will be free from defects in materials and workmanship for a period of three (3) years from the date of shipment. If any such product proves defective during this warranty period, TTC - TPI Division, at its option, either will repair the defective product without charge for parts and labor, or will provide a replacement in exchange of the defective product.

This warranty shall not apply to any defect, failure, or damage caused by improper use or improper or inadequate maintenance and care. TTC - TPI Division shall not be obligated to furnish service under this warranty a) to repair damage resulting from attempts by personnel other than TTC - TPI Division representatives to install, repair, or service this product; b) to repair damage resulting from improper use or connection to incompatible equipment; or c) to service a product that has been modified or integrated with other products when the effect of such modification or integration increases the time or difficulty of servicing the product.

THIS WARRANTY IS GIVEN BY TTC - TPI DIVISION WITH RESPECT TO THIS PRODUCT IN LIEU OF ANY OTHER WARRANTIES, EXPRESSED OR IMPLIED. TTC - TPI DIVISION DISCLAIMS ANY IMPLIED WARRANTIES OF MERCHANT ABILITY OR FITNESS FOR A PARTICULAR PURPOSE. TTC - TPI DIVISION'S RESPONSIBILITY TO REPAIR OR REPLACE DEFECTIVE PRODUCT IS THE SOLE AND EXCLUSIVE REMEDY PROVIDED TO THE CUSTOMER FOR BREACH OF THIS WARRANTY. TTC - TPI DIVISION WILL NOT BE LIABLE FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES IRRESPECTIVE OF WHETHER TTC - TPI DIVISION HAS ADVANCE NOTICE OF THE POSSIBILITY OF SUCH DAMAGES.

Service

In-Warranty Service

In-warranty equipment must be returned to the factory with shipping prepaid. The equipment should be packed and shipped in accordance with the instructions contained in the "Return Instructions" section below. Defective units will be repaired or replaced (at our option) depending on severity of defect. Before returning any equipment, the customer must obtain a Return Authorization (RA) number by contacting the TTC - TPI Division Customer Service Department. The RA number should then appear on all paperwork and be clearly marked on the outside of the equipment container. Customer Service may be reached at:

TTC = 1-800-638-2049
Factory (TPI) = 1-540-375-0500

After equipment is repaired by TTC - TPI Division, it will be tested to applicable specifications, operated for at least 24 hours, retested, and returned to the customer with shipping prepaid. A description of the work performed will be provided on the "Customer Service Tracking Form" furnished with the returned equipment.

Out-of-Warranty Service

The procedure for repairing out-of-warranty equipment is the same as that used for equipment still in warranty. However, a minimum charge will be applied to each request for out-of-warranty service in order to recycle the product through the production test operation. Contact the TTC - TPI Division Customer Service Department for specific information on the minimum out-of-warranty repair charge.

The customer will also be required to furnish a purchase order number before repair work can be started, and a hard copy of the purchase order must be received by TTC - TPI Division before the repaired equipment will be shipped to the customer. A description of the work performed will be provided on the "Customer Service Tracking Form" furnished with the returned equipment.

Return Instructions

The customer should attach a tag to all equipment returned for repair that includes the following information:

1.) *Owner's name and address*

2.) *A list of the equipment being returned and the applicable serial number(s)*

3.) *A detailed description of the problem or service requested.*

4.) *The name and telephone number of the person to contact regarding questions about the repair.*

5.) *The Return Authorization (RA) number.*

6.) *It is recommended that all switches be left in the positions they were in when the problem occurred.*

If possible, the customer should return the equipment, including all accessories and cables, using the original shipping container and material. If the original container is not available, the unit should be carefully packed so that it will not be damaged in transit. TTC - TPI Division is not liable for any damage that may occur during shipping. The customer should clearly mark the RA number (issued by TTC - TPI Division) on the outside of the package and ship it prepaid and insured to TTC - TPI Division.

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APPENDIX C

TECHNOLOGY OVERVIEW

ATM Technology

Asynchronous Transfer Mode (ATM) is a scaleable technology designed for interconnecting very high speed services. Its primary benefit is the provision of high bandwidth with low-delay, via a packet-like switching and multiplexing technique. Additionally, this technique allows service providers to offer bandwidth on demand, improving network efficiency and lowering costs. These are achieved by segmenting the usable capacity into fixed segments, known as cells. The fixed cell length enables transmission equipment to process the traffic with less overhead, leading to very high transmission rates.

Conventional networks carry data in a synchronous manner. Because empty slots are circulating even when the link is not needed, network capacity is wasted. ATM automatically adjusts the network capacity to meet the system needs and can handle data, voice, video, and television signals. These are transferred in a sequence of 53-byte cells. Common standards definitions are provided for both private and public networks so that ATM systems can be interfaced to either or both. ATM is therefore a wideband, low delay, packet-like switching and multiplexing concept that allows flexible use of the transmission bandwidth.

Each cell consists of 5 bytes of header field plus 48 bytes of user data. The header contains data that identifies with the related cell, a logical address that identifies the routing, header error correction (HEC) bits, plus a bit for priority handling and network management functions. HEC applies only to the header as it is assumed that the network medium will not degrade the error rate below an acceptable level.

All the cells of a virtual connection (VC) follow the same path through the network that was determined during call set-up. There are no fixed time slots in the system so that any user can access the transmission medium whenever an empty call is available. ATM is capable of operating at bit rates of 155.52 and 622.08 Mbps and the call stream is continuous and without gaps. The position of the cells associated with a particular VC is random and depends upon the activity of the network. Cells produced by different streams to the ATM multiplex are stored in queues awaiting cell assignment. Since a call is only accepted when the necessary bandwidth is available, there is a probability of queue overflow. Cell loss due to thus forms one ATM impairment. However, this can be minimized through the use of statistical multiplexers. Bit errors in the header which are beyond the HEC capability can lead to misrouting.

The network guarantees that cells are delivered in sequence to the destination. There aren't too many more restrictions on the network line or on the services. The cells themselves may be nearly continuous (Continuous Bit Rate), or they may very with time (Variable Bit Rate), or they may be clumped in packet-like bursts. It doesn't matter at the ATM layer, where the job is simply to deliver those cells through the network. The figure below shows how a longer data packet is split into cells. Each cell has a header used to expedite processing.

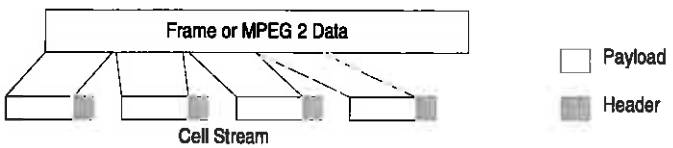

Figure C.1 Frame divided into cells

Packet or stream data is split into cells for transport over ATM. Each cell contains a header telling the network how to follow the Virtual Connection to the destination.

This process of splitting information streams up into cells can work with non-packet data just as well as packets. One common service is Circuit Emulation, where leased lines (e.g., DS-1 or DS-3) are transparently carried over ATM cell streams. Another service is Unswitched Digital Video, where the ATM cell stream establishes a transparent pipe between the video coder and decoder. Thus an ATM cell stream is scaleable, meaning that it provides the bandwidth needed by the specific service. This enables users to subscribe for their exact bandwidth needs, instead of having to pay for an entire DS-3 when only 8 Mbps is required.

While the 48 byte payload carries the important user data, the 5 byte header contains all of the information necessary to accurately deliver the payload. The figure below details the components of the header.

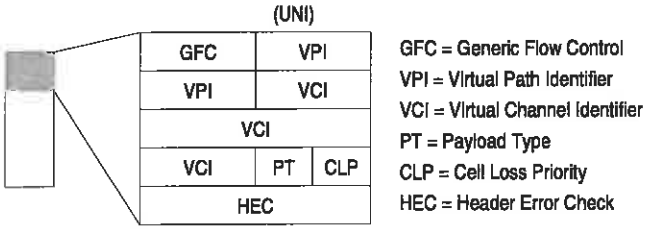

Figure C.2 Components of ATM Header

The concept of a Virtual Connection is fundamental to ATM. Among other things, this means that each switch in an ATM network has a table entry associated with each data flow. The header of each cell doesn't need to contain all the information needed for proper handling, just a pair of identifiers which the switches can use to look up local processing like local connection destination, priority, accounting records, and any special handling.

The header of an ATM cell is defined slightly differently at two places in the network. The figure above shows the most common interface, the User-Network Interface (UNI). There is also an interface defined between network switches, called the Network-Network Interface (NNI), where the GFC field is not used and its bits are added to the Virtual Path Identifier field.

The UNI allocates 8 bits for the VPI and 16 for the VCI, which allows for 256 virtual paths per active UNI and 65535 virtual connections per virtual path. The additional four bits for the VPI field at an NNI interface allow for 4096 virtual paths per active NNI, enabling more multiplexing deep within the network.

The Generic Flow Control field is historically tied to FDDI networks and has little use on other networks. There are two levels of identifiers present within the header, the Virtual Path Identifier (VPI) and the Virtual Connection Identifier (VCI). These are similar in definition and handling, the main differences are set by service offering. Generally, VPs are like leased lines and VCs are like TCP connections.

The other bits within the header are used to indicate whether the cell contains user or network data, or if the cell is the last within a packet formed by the next higher protocol layer. This special context information is transmitted just once to the carrying switches, and retrieved from the lookup tables using the VCI or VPI as an index. The header bits are primarily used to convey information that changes during the life of the connection. Because errors in the header may result in the loss of the 48 byte payload, the header is protected by an 8 bit CRC.

For most network elements, ATM processing involves little more than moving cells through the network. It is irrelevant whether the cells were generated in a steady stream, a varying stream, or in packet-like bursts. However, for some parts of the network particularly the interworking and endpoint processing elements, this information is important. ATM provides this information via a set of associated protocols to help these elements adapt to the raw cell flow. These helping protocols are known as ATM Adaptation layers (AAL).

Their most important function is called Segmentation and Reassembly - managing the process of breaking the data stream up into cells which can be reliably reassembled at the far end. There are three AALs defined today, each of which is designed to meet the needs of specific types of higher layer services.

AAL1	Unstructured Constant Bit Rate, e.g., DS1, DS3, Circuit Emulation
AAL3/4	Variable Bit Rate, e.g., Data services like SMDS
AAL5	Packet Data, no Muxing, e.g. IP, MPEG2, etc.

AAL1

Support for legacy systems will be an important service provided by ATM. Consolidating a mix of DS1 and DS3 leased lines onto a single ATM interface running at 155 Mbps, is a prime example of these types of services. These leased lines have very tight timing needs, which are met with AAL1 by using one of the payload bytes to carry timing information. To protect against cell loss causing equipment to lose synchronization, AAL1 allows for service-specific replacement of the lost cell. The figure below illustrates the cell structure for AAL1.

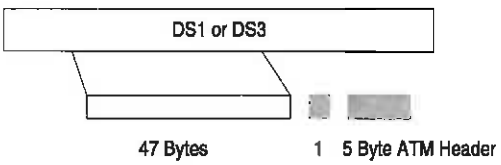

Figure C.3 Cell Structure for AAL1

AAL 3/4

The AAL3/4 format allows multiple terminals on a single access line to interleave long packets on a single virtual connection. By giving up 4 bytes of the payload, up to 1000 64 Kbyte packets can be muxed together on a single connection. Two of the bytes are used by AAL3/4 for a header and two for a trailer that contains a CRC. The figure below shows the details of AAL3/4.

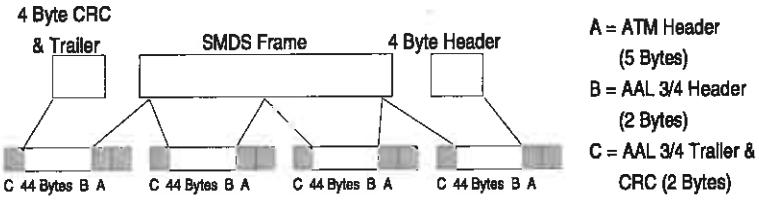

Figure C.4 Details of AAL3/4

AAL5

AAL5 is the simplest AAL with very few additional overhead bits taken from the payload. Packets of up to 65535 bytes can be segmented into cells that are protected by a 32 bit CRC. The end of the higher layer packet is identified using the Payload Type bits in the ATM header of the cells. The CRC protection is provided by using the last 4 bytes of payload from the last cell containing data for the higher layer packet. This process is shown in the figure below.

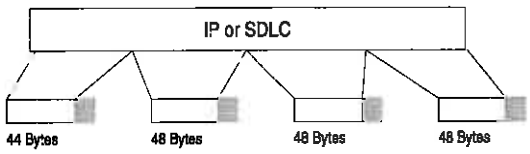

Figure C.5 AAL 5

Quality Of Service

Quality of Service (QoS) refers to the ATM User-Network Interface (UNI) defined parameters designed to measure the accuracy, dependability, and speed of the ATM link. The parameters are as follows:

Cell Error Ratio	Accuracy
Cell Misinsertion Rate	Accuracy
Cell Loss Ratio	Dependability
Cell Transfer Delay	Speed
Cell Delay Variation	Speed

Cell Error Ratio

The Cell Error Ratio is defined as follows:

$$\frac{\text{Errored Cells}}{\text{Successfully Transferred Cells + Errored Cells}}$$

Successfully Transferred and Errored cells contained in Severely-Errored Blocks are not included in the above calculation.While the network will detect errors within the 5-byte header, correcting single errors and discarding cells with multiple header errors, it does not check the payload for errors. Errored Cells are defined as those with errors in the 48-byte payload. Counting Errored Cells requires a separate error detection mechanism for the cell's payload, which necessitates that this test be conducted out of service. The TPI 750 uses a test cell that contains a Cyclic Redundancy Check or CRC test to detect errored cells.

The Cell Error Rate tolerance varies depending on the higher layer application (Voice, Data, or Video). Generally, the higher the data rate required to support an application, the less tolerant the application. Cell Error Rates in excess of an application's tolerance can result in data retransmissions increasing network congestion and lowering quality. Table 1 at the end of this Application Note provides tolerance data for common higher layer applications.

Cell Errors are primarily related to the error characteristics of the physical media.

If the observed Cell Error count is incrementing rapidly, it may be caused by a mismatch in the cell scramble settings across the link. Both ends must be set to either "On" or "Off". Changing the scramble setting (via the TC Sublayer Setup menu in the TPI 750) at one end may eliminate the mismatch and the resulting errors. If that fails, the next step is to look at the performance statistics for the physical layer (found in the Physical Statistics screen in the TPI 750). Excessive numbers of BPVs, Framing Errors, Parity Errors, etc., would indicate a problem at the physical layer. A Bit Error Rate Test (BERT) with the appropriate pattern for the given physical interface can help isolate the problem.

Cell Loss Ratio

The Cell Loss Ratio is defined by the following relationship:

$$\frac{\text{Lost Cells}}{\text{Total Transmitted Cells}}$$

Lost Cells are those that are not delivered, including those that are rejected for multiple header errors or discarded due to congestion.

The Cell Loss Ratio tolerance varies depending on the higher layer application (Voice, Data, or Video). Generally, the higher the data rate required to support an application, the less tolerant the application. Cell Loss Ratio in excess of an application's tolerance can result in data retransmissions and lower quality. The problem tends to be more pronounced in wide area networks (WAN) than local area networks (LAN). The loss of a higher layer packet is detected more quickly on LANs than on WANs. This allows the higher layer application to initiate a retransmission more quickly in the LAN environment, limiting the overall impact of the lost cell on the higher layer application.

The Cell Loss Ratio is influenced by errors in the cell header, non-optimal Usage Parameter Control (UPC) activity , and buffer overflows. Because Constant Bit Rate (CBR) traffic has a higher service priority than Variable Bit Rate (VBR) traffic, VBR cell streams are more likely to experience CLR problems than CBR streams.

As long as the link is operating within the contracted parameters (Peak Cell Rate, Sustained Cell Rate, and Maximum Burst Size), header errors are the most likely cause of excessive Cell Loss. The first step is to look at the link statistics (found in the Global Statistics screen in the TPI 750). If there are excessive uncorrectable header errors, the next step is to look at the performance statistics for the physical layer (found in the Physical Statistics screen in the TPI 750). Excessive numbers of BPVs, Framing Errors, Parity Errors, etc., indicate a problem at the physical layer, which may be overwhelming the network's ability to properly correct them when they occur in the 5-byte header. A Bit Error Rate Test (BERT) with the appropriate pattern for the given physical interface can help isolate the problem within the network.

Non-Optimal UPC enforcement can be implied by examining the number of cells with their Cell Loss Priority (CLP) bit set to one and comparing the traffic contracted for the link with the traffic actually being carried by the link. Generally, if the carried traffic is less than the contracted traffic and a large number of cells have their CLP bit set to one, the UPC enforcement is set too tightly, leading the network to drop cells that should not be dropped. Buffering overflow related Cell Loss is closely correlated to the number of nodes between the source and destination. The more nodes, the greater the possibility that a cell will encounter a node that is overflowing.Lost and transmitted cells occurring in Severely Errored Cell Blocks are not included in this calculation.

Cell Misinsertion Rate

The Cell Misinsertion Rate is defined as:

$$\frac{\text{Misinserted Cells}}{\text{Time Interval}}$$

Misinserted Cells are the number of cells that are delivered over the wrong link. As a practical matter, most ATM links are expected to experience fewer than five misinserted cells per day (regardless of link rate). Because of this low rate, the TPI 750 reports the Misinserted Cell count instead of the rate.

Given their expected low frequency, Misinserted Cells are not likely to have drastic affects on higher layer applications. However, excessive Misinserted Cells are a symptom of network troubles, and may be an early indicator of greater problems to come.

Misinserted Cells are most likely caused by undetected or miscorrected errors in the cell header, leading to the cell being misassigned to a valid VPI/VCI. Misinserted Cell events are related to both physical layer errors and the number of valid VPI/VCI pairs in a given network. Since the number of valid VPI/VCI pairs is likely to be less for a private network than a public one, misinserted cells are less likely to occur on private networks.

Because header errors are correlated to physical layer errors, the first step is to look at the performance statistics for the physical layer (found in the Physical Statistics screen in the TPI 750). Excessive numbers of BPVs, Framing Errors, Parity Errors, etc., indicate a problem at the physical layer, which may be overwhelming the network's ability to properly correct them when they occur in the 5-byte header. A Bit Error Rate Test (BERT) with the appropriate pattern for the given physical interface can help isolate the problem within the network.This calculation excludes cells that occur in Severely Errored Cell Blocks. The most common cause of Misinserted Cells is an undetected error in the header of a cell, causing it to be transmitted over the wrong connection.

Cell Transfer Delay

Cell Transfer Delay (CTD) is defined as the time it takes a cell to travel from its origination point to its destination for a particular connection. A true measure of CTD requires perfectly synchronized test sets at both the cell source and destination. Besides being costly, this arrangement is also not practical. Instead, using a loopback at one end and a test set at the other allows a single technician to measure a cell's round-trip delay. Under the assumption that delay is likely to be symmetrical, dividing the round-trip delay by two yields an accurate "estimate" of CTD. The TPI 750 uses this method to calculate CTD.

With its strict timing requirements, CBR traffic is more susceptible to CTD than VBR connections. Table 1 at the end of this Application Note provides tolerance data for common higher layer applications.

Network design factors such as propagation delay, queuing, routing, and switching delay affect CTD. Generally, the more active devices that a cell encounters on its path, the greater its CTD. Thus CTD is more likely to be a problem in large WANs or very large LANs than in other types of networks.

It is important to remember that CTD is measured on a cell by cell basis, meaning each cell may experience a different CTD. While it may be convenient to simply report the average CTD over the entire testing period, an average within tolerance does not mean that the higher layer application will function properly. For example, if PCM Voice service is being carried over an ATM network, the maximum CTD it can tolerate is between 10 and 150 ms. If half the cells experience 100 ms of CTD and the other half 180 ms, the average of 140 ms appears to be fine. In reality half of the cells are out of bounds, probably leading to an unusable voice circuit. The TPI 750 displays the average, maximum, and minimum CTD for both the current second and the entire test.

In addition to the tabular display, the TPI 750 also features a histogram for each channel under analysis. The histogram gives users quick visual verification of the "spread" in CTD measurements. It also provides insight into the effects of multiple traffic streams on the same physical link.

When two or more virtual channels (VCs) share the same physical link, both the length of and variability in the cell transfer time increases. The differences between Figure C.6 and Figure C.7 illustrate this point. Figure C.6 displays the transfer characteristics of a single CBR cell stream operating over the physical link. Transit time varies from 55ms to 73ms, and is centered around 66ms. Figure C.7 shows the same VC at a time after a second VC has been activated on the physical link. Transit time now varies from 53ms to 82ms, and averages close to 73ms. Besides the increases in variability and transit time, the asymmetrical distribution of cells (the two peaks in the histogram) strongly points to interference from a newly activated VC.

As a general rule, the average CTD should be on the order of tens of microseconds for local and metro area networks to tens of milliseconds for national and international area networks. (Satellite links will add hundreds of milliseconds to the CTD)

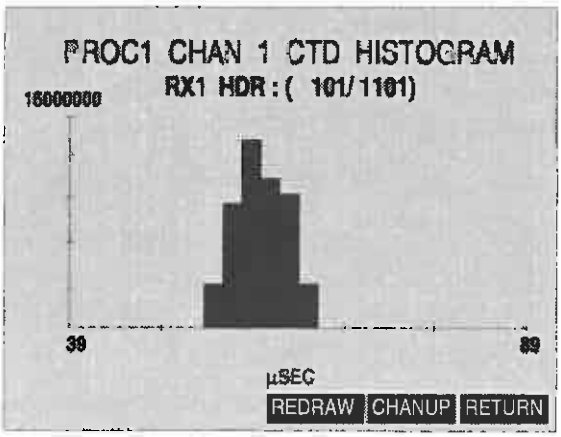

Figure C.6 CTD Histogram with Single Channel Running.

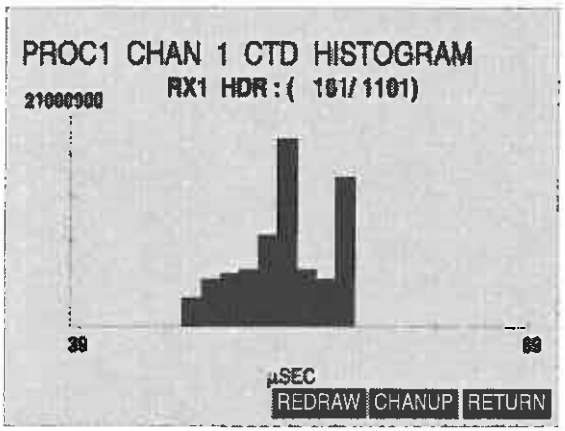

Figure C.7 CTD Histogram with Second Channel Activated.

Cell Delay Variation

Cell Delay Variation describes the variability in the pattern of cell arrivals at a given reference point. The TPI 750 calculation method is known as Cell Delay Variation Peak-to- Peak. This parameter measures the difference between the smallest and largest single point Cell Delay Variations over a given period of time. The larger the number, the more variability there is in cell delay.

Cell Delay Variation (CDV) measures the variability of the CTD experienced over the same virtual circuit.

Within CBR applications, CDV creates timing problems very similar to bit slips for a DS3 circuit. To avoid affecting the higher layer application, each node in a CBR service must provide buffering sufficient to absorb the maximum CDV. Without enough buffering the higher layer application will likely experience an out-of-frame event, resulting in significant data loss while framing is reestablished.

Variability in propagation delay, queuing, routing, and switching delays between cells creates CTD. A common cause of variability is network congestion, which can lead to changes in each of these attributes.

Large CDV values create the greatest problems for CBR service because the higher layer applications riding over CBR service typically have stringent timing requirements. Because of VBR service's bursty nature, the CDV measure is not as important for VBR traffic.

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APPENDIX D

SPECIFICATIONS

Physical

LINE INTERFACES

ATM25
E1
DS1
E3
DS3
STM1 (coax)
STM1 (optical)
STS3c
OC3c
DTE per V.35 - future

POWER

Internal 7AH Lead Acid rechargeable battery

Battery Charger/AC Adapter (13.8VDC, 2.1A)

Battery Life = 2 to 6 hours of continuous use from fully charged battery state, depending on mode and battery option.

Battery Recharge = 12 to 14 hours (overnight)
At least once every 2 months

WEIGHT

10 - 16 lbs, depending on options

DIMENSIONS

10 $^{1}/_{2}$" wide, 9 $^{3}/_{4}$" high, 7" deep

Environmental

Operating Temperature = 32° - 113° F (0° - 45° C)
Operating Humidity = 10% - 90%, non-condensing
Storage Temperature = -20° - 150° F (-29° - 66° C)
Storage Humidity = 5% - 95%, non-condensing

Operational

MODES

Terminate (CPE Emulation)
Monitor
In-Line

OPTICAL LASER

Single Mode: Intermediate reach laser at 1310 nm
Multi-Mode: LED, 1310 nm

CCITT Q.933 Annex A

DATA CONNECTOR (DB-9, RS-232)

Selectable speed
8 data bits, 1 stop bit
No Parity

ATM25 CONNECTORS

8-pin modular

E1/DS1 CONNECTORS

8-pin modular/mini bantam TX, RX

E3/DS3

BNC TX, RX

STM1/STS3c (electrical)

Coax TX, RX

STM1/OC3c (optical)

SC connectors TX, RX
FC connectors TX, RX

Measurements

Continuous Bit Rate (CBR) and Unassigned Bit Rate (UBR) testing:

Peak Cell Rate (PCR) selectable
Cell Delay Variation Tolerance (CDVt) selectable

Variable Bit Rate Real Time (VBRrt) and Non Real Time (VBRnrt) testing:

PCR selectable
CDVt selectable
Sustained Cell Rate (SCR) selectable
Maximum Burst Size (MBS) selectable
PDU rate

Quality of Service Testing:

Cell Transfer Delay (CTD): Maximum, Average, Minimum
Cell Delay Variation Peak-to-Peak (CDV)
Cell Loss Ration
Cell Error Ratio
Mis-inserted cells

Monitor/In-Line Mode:

Total Cells
PCR
Average thruput cells/second
HEC Errors
Mis-inserted Cells
CLP Cell Count
CDV
PT Counts
Minimum, Maximum Cell Gaps

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GLOSSARY

AAL *ATM Adaptation Layer* - A set of internationally standardized protocols and formats that define support for circuit emulation (AAL1), packet video and audio (AAL5), and connection-oriented and connectionless data services (AAL3/4).

AAL-1 *ATM Adaptation Layer Type 1* - AAL functions in support of constant bit rate, time-dependent traffic such as voice and video.

AAL-2 *ATM Adaptation Layer Type 2* - This AAL is still undefined by the International Standards bodies. It is a place holder for variable bit rate video transmission.

AAL-3/4 *ATM Adaptation Layer Type 3/4* - AAL functions in support of variable bit rate, delay-tolerant data traffic requiring some sequencing and/or error detection support. Originally two AAL types, i.e. connection-oriented and connectionless, which have been combined.

AAL-5 *ATM Adaptation Layer Type 5* - AAL functions in support of variable bit rate, delay-tolerant connection-oriented data traffic requiring minimal sequencing or error detection support.

ABR *Available Bit Rate* - ABR is an ATM layer service category for which the limiting ATM layer transfer characteristics provided by the network may change subsequent to connection establishment. A flow control mechanism is specified which supports several types of feedback to control the source rate in response to changing ATM layer transfer characteristics. It is expected that an end-system that adapts its traffic in accordance with the feedback will experience a low cell loss ratio and obtain a fair share of the available bandwidth according to a network specific allocation policy. Cell delay variation is not controlled in this service, although admitted cells are not delayed unnecessarily.

ACM *Address Complete Message*

ACR *Allowed Cell Rate* - An ABR service parameter, ACR is the current rate in cells/sec at which a source is allowed to send.

ACT *Activity Bit*

ADM *Add/Drop Multiplexer*

ADPCM *Adaptive Differential Pulse Code Modulation*

Ai - Signaling ID assigned by Exchange A

AIM *ATM Inverse Multiplexer*

AIR *Additive Increase Rate*

AIS *Alarm Indication Signal* - An all ones signal sent down or up stream by a device when it detects an error condition or receives an error condition or receives an error notification from another unit in the transmission path. VP-AIS and VC-AIS alarms are generated by the defect detecting node to alert the downstream nodes that a defect has been detected upstream; the fault management OAM cells with AIS function type are used to communicate these alarms.

AIS-E *Alarm Indication Signal* - External

AMI *Alternate Mark Inversion* - A line coding format used on T1 facilities that transmits ones by alternate positive and negative pulses.

ANI *Automatic Number Identification*

ANM *Answer Message*

ANSI *American National Standards Institute* - A U.S. standards body.

APD *Avalanche Photo-diode*

API *Application Programming Interface*

API Connection - Native ATM Application Program Interface Connection. API_connection is a relationship between an API_endpoint and other ATM devices that has the following characteristics:

- Data communication may occur between the API_endpoint and the other ATM devices comprising the API_connection.
- Each API_connection may occur over a duration of time only once; the same set of communicating ATM devices may form a new connection after a prior connection is released.
- The API_connection may be presently active (able to transfer data), or merely anticipated for the future.

APPN *Advanced Peer to Peer Network*

APS *Automatic Protecting Switching*

ARE *All Routes Explorer*

ARP *Address Resolution Protocol* - The procedures and messages in a communications protocol which determines which physical network address (MAC) corresponds to the IP address in the packet.

ARQ *Automated Repeat reQuest*

ASCII *American national Standard Code for Information Interchange*

ASE *Application Service Element*

ASIC *Application Specific Integrated Circuit*

ASN *Abstract Syntax Notation*

ASP *Abstract Service Primitive*

ATD *Asynchronous Time Division*

ATM *Asynchronous Transfer Mode* - A transfer mode in which the information is organized into cells. It is asynchronous in the sense that the recurrence of cells containing information from an individual user is not necessarily periodic.

ATM Address - Defined in the UNI Specification as 3 formats, each having 20 bytes in length including country, area and end-system identifiers.

ATM Edge Switch - A piece of equipment which accepts many different types of traffic (i.e., frame relay, T1 bit stream, etc.), converts the traffic to ATM cells through the appropriate AAL process, assigns VPI/VCI to each cell stream, and sends the cells out the appropriate ports.

ATM Layer Link - A section of an ATM Layer connection between two adjacent active ATM Layer entities (ATM-entities).

ATM Link - A virtual path link (VPL) or a virtual channel link (VCL).

ATM Multiplexer - A piece of equipment which accepts many different types of traffic (i.e., frame relay, T1 bit stream, etc.), converts the traffic to ATM cells through the appropriate AAL process, assigns VPI/VCI to each cell stream, and sends the cells out on one ATM line; the cells are dispersed on the line depending on priority of the service type.

ATM Peer-to-Peer Connection - A virtual channel connection (VCC) or a virtual path connection (VPC).

ATM Traffic Descriptor - A generic list of traffic parameters that can be used to capture the intrinsic traffic characteristics of a requested ATM connection.

ATM "Transport" - Use of ATM switching and multiplexing techniques at the datalink layer (i.e., the ATM layer) to convey end-user traffic from source to destination within a network.

ATM User-User Connection - An association established by the ATM Layer to support communication between two or more ATM service users (i.e., between tow or more next higher entities or between tow or more ATM-entities). The communications over an ATM Layer connection may be either bi-directional or unidirectional. The same Virtual Channel Identifier (VCI) issued for both directions of a connection at an interface.

ATMARP *ATM Address Resolution Protocol*

ATS *Abstract Test Suite*

ATV *Advanced Television*

AU *Access Unit*

AUU - ATM User-to-user

B3ZS *Bipolar 3rd Zero Substitution*

B8ZS *Bipolar 8th Zero Substitution*

B-ICI *Broadband Inter Carrier Interface*

B-ICI *SAAL B-ICI Signaling ATM Adaptation Layer*

B-ISDN *Broadband ISDN*

B-ISUP *Broadband ISDN User Part*

B-LLI *Broadband Low Layer Information*

B-NT *Broadband Network Termination*

B-TE *Broadband Terminal Equipment*

BBC *Broadband Bearer Capability*

BCBDS *Broadband Connectionless Data Bearer Service*

BCD *Binary Coded Decimal*

BCOB *Broadband Class of Bearer*

BCOB-A *Bearer Class A* - Indicated by ATM end user in SETUP message for connection-oriented, constant bit rate service. The network may perform inter networking based on AAL information element (IE).

BCOB-C *Bearer Class C* - Indicated by ATM end user in SETUP message for connection-oriented, variable bit rate service. The network may perform inter-networking based on AAL information element (IE).

BCOB-X *Bearer Class X* - Indicated by ATM end user in SETUP message for ATM transport service where AAL, traffic type and timing requirements are transparent to the network.

BE *Beginning-End-Tag*

BECN *Backward Explicit Congestion Notification* - A Resource Management (RM) cell type generated by the network or the destination, indicating congestion or approaching congestion for traffic flowing in the direction opposite that of the BECN cell.

BER *Bit Error Rate* - A measure of transmission quality. It is generally shown as a negative exponent (e.g., 10-7 which means 1 out of 107 bits are in error or 1 out of 10,000,000 bits are in error).

BERT *Bit Error Rate Test*

BGP *Border Gateway Protocol*

BGT *Broadcast and Group Translators*

BHLI *Broadband High Layer Information* - This is a Q.2931 information element that identifies an application (or session layer protocol of an application).

Bi *Signaling ID assigned by Exchange B*

BIP *Bit Interleaved Parity* - A method used at the PHY layer to monitor the error performance of the link. A check bit or word is sent in the link overhead covering the previous block or frame. Bit errors in the payload will be detected and may be reported as maintenance information.

BISSI *Broadband Inter Switching System Interface*

BN *Bridge Number*

BN *BECN Cell* - A Resource Management (RM) cell type indicator. A Backwards Explicit Congestion Notification (BECN) RM-cell may be generated by the network or the destination. To do so, BN=1 is set, to indicate the cell is not source-generated, and DIR-1 to indicate the backward flow. Source generated RM-cells are initialized with BN-0.

BOC *Bell Operating Company*

BOM *Beginning of Message*

BOOTP *Bootstrap Protocol*

BPDU *Bridge Protocol Data Unit*

BPP *Bridge Port Pair*

BPS *Bits per second*

BSTS *Broadband Series Test System*

BSVC *Broadcast Switched Virtual Connections*

BT *Burst Tolerance* - BT applies to ATM connections supporting VBR services and is the limit parameter of the GCRA. It is used in conjunction with SCR to determine conformance to the GCRA; maximum burst size (MBS) is the parameter usually known; BT is calculated as follows: BT = (MBS - 1)(1/SCR + 1/PCR).

BTAG *Begin Tag*

Burstiness - Measure of how infrequently a source sends traffic; (peak rate/average rate).

BUS *Broadcast and Unknown Server*

BW *Bandwidth* - A numerical measurement of throughput of a system or network.

CA *Cell Arrival*

CAC *Connection Admission Control* - Software function in a switch which is responsible for determining whether a connection request is admitted or denied.

CAD *Computer Aided Design*

CAM *Computer Aided Manufacturing*

CBDS *Connectionless Broadband Data Service*

CBR *Constant Bit Rate* - An ATM service category which supports a constant or guaranteed rate to transport services such as video or voice as well as circuit emulation which requires timing to be maintained with a low level of cell delay variation (CDV).

CC *Continuity Cell*

CCITT *Consultative Committee on International Telephone and Telegraph* - Now known as ITU

CCR *Current Cell Rate* - The Current Cell Rate is an RM-cell field set by the source to its current ACR when it generates a forward RM-cell. This field may be used to facilitate the calculation of ER, and may not be changed by network elements. CCR is formatted as a rate.

CCS *Common Channel Signaling*

CCSS7 *Common Channel Signaling System 7*

CDDI *Copper Distributed Data Interface*

CDT *Cell Delay Tolerance*

CDV *Cell Delay Variation* - A parameter used to describe how much cell transfer delay varies from cell to cell; CDV impacts delay sensitive applications such as constant bit rate (CBR).

CDVT *Cell Delay Variation Tolerance* - Expressed as number of cells; parameter used to describe the "clumping" of cells that results when cells are multiplexed or switched; cells should be spaced no closer than the spacing that occurs during the peak cell rate; MUXing or switching may reshape the traffic resulting in some cell "clums"; e.g., five user cells in a row have an instantaneous utilization of 100% which may be significantly higher that the PCR; some cell "clumps" are allowed in the network and are controlled by the CDVT parameter.

CEI *Connection Endpoint Identifier*

CENELEC *European Committee for Electrotechnical Standardization (rough translation from the original French)* - The standards organization designated by the European Economic Community to create and maintain electrical standards.

Cell - A unit of transmission in ATM. A fixed-size frame consisting of a 5-octet header and a 48-octet payload.

Cell Concentrating - A process where cells from three incoming ATM lines can be multiplexed to an outgoing line running at 100% provided that the three incoming lines are running at 1/3 their line rate; for example, all three incoming DS3 lines run at 33% while the outgoing line runs close to 100%).

Cell Delineation - Permits the identification of cell boundaries in the payload; SONET overhead provides this; PLCP can be used for DS3 and DS1; HEC alignment (no overhead of cell framing; receiver is capable of delineating cells in a continuous cell stream); "cell synchronization" is declared in six cell times or less.

Cell Rate Decoupling - The process of adding unassigned cells to the assigned cell stream to be transmitted, so that a continuous cell stream matching the line rate of the UNI is provided to the Physical Layer; for example, cells from an incoming DS1 ATM line can be switched/multiplexed to an outgoing DS3 ATM line by interspersing more idle cells on the DS3 line than on the DS1 line.

CEPT *Conference of European Postal & Telecommunication Administration*

CER *Cell Error Ratio* - The ratio of errored cells in a transmission in relation to the total cells sent in a transmission. The measurement is taken over a time interval and is desirable to be measured on an in-service circuit.

CES *Circuit Emulation Service* - The ATM Forum circuit emulation service interoperability specification specifies interoperability agreements for supporting Constant Bit Rate (CBR) traffic over ATM networks that comply with the other ATM Forum interoperability agreements. Specifically, this specification supports emulation of existing TDM circuits over ATM networks.

CI *Congestion Indicator* - This is a field in a RM-cell, and is used to cause the source to decrease its ACR. The source sets CI=0 when it sends an RM-cell. Setting CI=1 is typically how destinations indicate that EFCI has been received on a previous data cell.

CIP *Carrier Identification Parameter*

CIR *Committed Information Rate* - CIR is the information transfer rate which a network offering Frame Relay Services (FRS) is committed to transfer under normal conditions. The rate is averaged over a minimum increment of time.

CL *Connectionless Service*

CLNAP *Connectionless Network Access Protocol*

CLNP *Connectionless Network Protocol*

CLNS *Connectionless Network Service*

CLP *Cell Loss Priority* - This bit in the ATM cell header indicates two levels of priority for ATM cells. CLP=0 cells are higher priority than CLP=1 cells. CLP=1 cells may be discarded during periods of congestion to preserve the CLR of CLP=0 cells.

CLR *Cell Loss Ratio* - CLR is a negotiated QoS parameter and acceptable values are network specific. The objective is to minimize CLR provided the end-system adapts the traffic to the changing ATM layer transfer characteristics. The Cell Loss Ratio is defined for a connection as: Lost Cells/Total Transmitted Cells. The CLR parameter is the value of CLR that the network agrees to offer as an objective over the lifetime of the connection. It is expressed as an order of magnitude, having a range of 10-1 to 10-15 and unspecified.

CLS *Connectionless Server*

CLFS - Connectionless Service Function

CME *Component Management Entity*

CMI *Coded Mark Inversion*

CMIP *Common Management Interface Protocol*

CMR *Cell Mis-insertion Rate* - The ratio of cells received at an endpoint that were not originally transmitted by the source end in relation to the total number of cells properly transmitted.

CN *Copy Network*

CNM *Customer Network Management*

CO *Connection Oriented*

CO(B-ISDN) *Connection Oriented Services*

COD *Connection Oriented Data*

COM *Continuation of Message*

Conforming cells - Cells that do not cause the "leaky bucket" to overflow, when added to the bucket.

Congestion Control - Actions taken by the network to minimize the intensity, spread, and duration of congestion.

CONS *Connection Oriented Network Service*

COS *Class of Service*

CP *Connection Processor*

CPCS *Common Part Convergence Sublayer* - The portion of the convergence sublayer of an AAL that remains the same regardless of the traffic type.

CPCS-SDU *Common Part Convergence Sublayer-Service Data Unit* - Protocol data unit to be delivered to the receiving AAL layer by the destination CP convergence sublayer.

CPE *Customer Premises Equipment*

CPG *Call Progress Message*

CPI *Common Part Indicator*

CPI *Common Part Indicator*

CPN *Customer Premises Network*

CPN *Calling Party Number* - A parameter of the initial address message that identifies the calling number and is sent to the destination carrier.

CRC *Cyclic Redundancy Check* - A mathematical algorithm which detects bit errors caused in data transmission. The algorithm computes a numerical value based on the bits in a block of data. This number is transmitted with the data and the receiver uses this information and the same algorithm to insure the accurate delivery of data by comparing the results of algorithm and the number received. If a mismatch occurs, an error in transmission is presumed.

CRCG *Common Routing Connection Group*

CRF(VC) *Virtual Channel Connection Related Function*

CS *Convergence Sublayer* - The general procedures and functions that convert between ATM and non-ATM formats. This describes the functions of the upper half of the AAL layer. This is also used to describe the conversion functions between non-ATM protocols such as frame relay or SMDS and ATM protocols above the AAL layer.

CS *Carrier Selection*

CS1 *Capability Set One*

CS2 *Capability Set Two*

CSA *Canadian Standards Association*

CSI *Convergence Sublayer Indication*

CSPDN *Circuit Switched Public Data Network*

CSR *Cell Missenquenced Ratio*

CSU *Channel Service Unit* - An interface for digital leased lines which performs loopback testing and line conditioning.

CSU/DSU *Channel Service Unit/Data Service Unit*

CTD *Cell Transfer Delay* - This is defined as the elapsed time between a cell exit event at the measurement point 1 (e.g., at the source UNI) and the corresponding cell entry event at measurement point 2 (e.g., the destination UNI) for a particular connection. The cell transfer delay between two measurement points is the sum of the total inter-ATM node transmission delay and the total ATM node processing delay.

CTV *Cell Tolerance Variation*

CVs *Coding Violations*

DA *Destination Address*

DACS *Digital Access and Cross Connect System*

dB *Decibel*

dBm *Decibel referencing 1 milliwatt*

DCC *Data Communications Channel*

DCE *Data Circuit Terminating Equipment*

DCS *Digital Cross-Connect System*

DD *Depacketization Delay*

DLC *Data Link Control*

DLCI *Data Link Connection Identifier*

DE *Discard Eligible*

DES *Destination End System*

DMDD *Distributed Multiplexing Distributed Demultiplexing*

DN *Distribution Network*

DNA *Digital Network Architecture*

DQDB *Distributed Queue Dual Bus*

DS *Distributed Single Layer Test Method*

DS-0 *Digital Signal, Level 0* - The 64 kbps rate that is the basic building block for both the North American and European digital hierarchies.

DS-1 *Digital Signal, Level 1* - The North American Digital Hierarchy signaling standard for transmission at 1.544 Mbps. This standard supports 24 simultaneous DS-0 signals. The term is often used interchangeably with T1 carrier although DS-1 signals may be exchanged over other transmission systems.

DS1C *Digital Signal, Level 1C*

DS2 *Digital Signal, Level 2*

DS-3 *Digital Signal, Level 3* - The North American Digital Hierarchy signaling standard for transmission at 44.736 Mbps that is used by T3 carrier. DS-3 supports 28 DS-1s plus overhead.

DS-3 PLCP *Physical Layer Convergence Protocol* - An alternate method used by older T carrier equipment to locate ATM cell boundaries. This method has recently been moved to an informative appendix of the ATM DS3 specification and has been replaced by the HEC method.

DS-4 *Digital Signal, Level 4*

DSE *Distributed Single Layer Embedded Test Method*

DSID *Destination Signaling Identifier*

DSP *Digital Signal Processor*

DSS2 *Setup Digital Subscriber Signaling #2*

DSU *Data Service Unit* - Equipment used to attach users' computing equipment to a public network.

DSX *Digital Signal Cross-Connect*

DTE *Data Terminal Equipment* - A generic definition of external networking interface equipment such as a modem.

DTL IE *DTL Information Element*

DTMF *Dual Tone Multi-Frequency*

DXI *Data Exchange Interface* - A variable length frame-based ATM interface between a DTE and a special ATM CSU/DSU. The ATM CSU/DSU converts between the variable-length DXI frames and the fixed length ATM cells.

E1 - Also known as CEPT1, the 2.048 Mbps rate used by European CEPT carrier to transmit 30 64 kbps digital channels for voice or data calls, plus a 64 kbps signaling channel and a 64 kbps channel for framing and maintenance.

E3 - Also known as CEPT3, the 34.368 Mbps rate used by European CEPT carrier to transmit 16 CEPT1s plus overhead.

Edge Device - A physical device which is capable of forwarding packets between legacy interworking interfaces (e.g., Ethernet, Token Ring, etc.) and ATM interfaces based on data-link and network layer information but which does not participate in the running of any network layer routing protocol. An Edge Device obtains forwarding descriptions using the route distribution protocol.

EFCI *Explicit Forward Congestion Indication* - EFCI is an indication in the ATM cell header. A network element in an impending-congested state or a congested state may set EFCI so that this indication may be examined by the destination end-system. For example, the end-system may use this indication to implement a protocol that adaptively lowers the cell rate of the connection during congestion or impending congestion. A network element that is not in a congestion state or an impending congestion state will not modify the value of this indication. Impending congestion is the state when a network equipment is operating around its engineered capacity level.

ELAN *Emulated Local Area Network*

EMI *Electromagnetic Interference*

EN 55 022 - The particular European standard (normative) dealing with electromagnetic emissions.

End-to-End F4 Flow - This OAM flow is used for communicating end-to-end VPC operations information; VCI = 4 is used for identifying OAM cells that make up F4 flow.

End-to-End F5 Flow - PTI value 5 is used to identify OAM cells used for communicating end-to-end VCC operations information.

EOC *Embedded Operations Channel*

EOM *End of Message*

ES *Errored Seconds*

ESF *Extended Superframe* - A DS1 framing format in which 24 DS0 times lots plus a coded framing bit are organized into a frame which is repeated 24 times to form a superframe.

ETAG *End Tag*

ETE *End-to-End*

ETSI *European Telecommunications Standards Institute* - The primary telecommunications standards organization.

EXM *Exit Message*

Fault Management OAM Cells - Cells which are transmitted to indicate failure conditions, such as failed facility or discontinuity at the virtual path or channel level; these cells may also be used to perform various test functions on a virtual connection or connection segment.

FC *Forward Congestion Indicator*

FCS *Fast Circuit Switching*

FCS *Frame Check Sequence* - Any mathematical formula which derives a numeric value based on the bit pattern of a transmitted block of information and uses that value at the receiving end to determine the existence of any transmission errors.

FDDI *Fiber Distributed Data Interface*

FEBE *Far End Block Error* - A maintenance signal transmitted in the PHY overhead that a bit error(s) has been detected at the PHY layer at the far end of the link. This used to monitor bit error performance of the link.

FEAC *Far End Alarm Channel*

FEC *Forward Error Correction* - A technique for detection and correction of errors in a digital data stream.

FECN *Forward Explicit Congestion Notification*

FERF *Far End Receive Failure* - See also RDI

FFOL

FDDI *Follow-On-LAN*

FFS *For Further Study*

FOT *Fiber Optic Terminal*

FR *Frame Relay*

FR-SS *Frame Relay Switching System*

FRS *Frame-Relay Service* - A connection oriented service that is capable of carrying up to 4096 bytes per frame.

FTTC *Fiber-to-the-Curb*

FTTH *Fiber-to-the-Home*

FTI *FractionalTI*

FUNI *Frame User Network Interface*

GAP *Generic Address Parameter*

Gb/s *Gigabits per second*

GCID *Global Call Identifier*

GCID-IE *Global Call Identifier* - Information Element

GCRA *Generic Cell Rate Algorithm* - The GCRA is used to define conformance with respect to the traffic contract of the connection. For each cell arrival the GCRA determines whether the cell conforms to the traffic contract. The UPC function may implement the GCRA, or one or more equivalent algorithms to enforce conformance. The GCRA is defined with two parameters: the Increment (I) and the Limit (L).

GFC *Generic Flow Control* - Four bit field in the ATM UNI header; set to 0000 by CPE and network equipment at the public UNI; has local significance only; can be used to communicate flow control information on the customer site; GFC is not carried end-to-end (i.e., will be overwritten by switching equipment).

GPS *Navstar Global Positioning Satellite*

GRC *Generic Reference Configuration*

GSM *Global System for Mobile Communications*

GW *Gateway*

HDB3 *High Density Bipolar 3*

HDLC *High-level Data Link Control*

HDR *Header*

HDTV *High Definition Television*

HEC *Header Error Control* - One byte field within each ATM cell header; provides error checking across the five byte header (i.e., does not provide error detection across the entire 53 byte cell); capable of correcting one bit error; capable of detecting multiple bit errors (in which the cell is discarded); single bit error correction can be optioned "on" or "off"; HEC field may also be used for cell delineation in the absence of PLCP.

HEL *Header Extension Length*

HIPPI *High Performance Parallel Interface*

HLPI *Higher Layer Protocol Identifier*

HOL *Head of Line*

HSC *Header Check Sequence*

HSSI *High Speed Serial Interface*

Hz *Hertz (Cycles Per Second)*

IAA *Initial Address Acknowledgment*

IAM *Initial Address Message*

IAR *Initial Address Reject*

ICD *International Code Designator*

ICI *Interexchange Carrier Interface*

ICMP *Internal Control Message Protocol*

ICR *Initial Cell Rate*

IDLC *Integrated Digital Loop Carrier*

IDU *Interface Data Unit*

IE *Information Element*

IEC *Inter-exchange Carrier*

IEC *International Electrotechnical Commission* - A private standards organization that creates and maintains the models from which European electrical standards evolve.

IEC 320 - European standard (see **IEC**) for the power connector commonly used for removable power cords on personal computers and AC powered test equipment.

IEEE *Institute of Electrical and Electronic Engineers*

IETF *Internet Engineering Task Force*

ILMI *Interim Link Management Interface* - An ATM Forum defined interim specification for network management functions between an end user and a public or private network and between a public network and a private network. This is based on a limited subset of SNMP capabilities.

IN *Intelligent Network*

IOP *Interoperability*

IP *Internet Protocol*

IP(AIN) *Intelligent Peripheral*

IPng *Internet Protocol Next Generation*

IPX *Novell Internetwork Packet Exchange*

ISDN *Integrated Services Digital Network*

ISI *Intersymbol Interference*

ISSI *Inter-Switching System Interface*

ISO *International Organization for Standardization*

ISUP *ISDN User Part*

ITU *International Telecommunications Union*

IUT *Implementation Under Test*

IWF *Interworking Function*

IWU *Interworking Unit*

JPEG *Joint Photographic Experts Group* - An ISO Standards group that defines how to compress still pictures.

Kb/s *Kilobits per second*

kHz *Kilohertz (Thousands of Cycles per Second)*

LAN *Local Area Network*

LANE *LAN Emulation* - The set of services, functional groups and protocols which provide for the emulation of LANS utilizing ATM as a backbone to allow connectivity among LAN and ATM attached end stations.

LAPB *Link Access Procedure Balanced*

LAPD *Link Access Procedure D*

LAPF *Link Access Procedure F*

LATA *Local Access and Transport Area*

LB *Leaky Bucket*

LD *LAN Destination*

LE *LAN Emulation*

LE_ARP *LAN Emulation Address Resolution Protocol*

Leaky Bucket - An informal term for the Generic Cell Rate Algorithm.

"Leaky Bucket" Algorithm -Algorithm used to define the meaning of conformance checking for an arriving cell stream against the traffic parameters in the traffic contract.

LEC *LAN Emulation Client*

LEC *Local Exchange Carrier*

LECID *LAN Emulation Client Identifier*

LECS *LAN Emulation Configuration Server*

LED *Light Emulating Diode*

LEN *Local Exchange Node*

LES *LAN Emulation Server*

LIJP *Leaf Initiated Join Parameter*

LIV *Link Integrity Verification*

LMI *Local Management Interface*

LLATMI *Lower Layer ATM Interface*

LLC *Logical Link Control*

LLC/SNAP *Logical Link Control/Subnetwork Access Protocol*

LOCD *Loss of Cell Delineation* - A condition at the receiver or a maintenance signal transmitted in the PHY overhead indicating that the receiving equipment has lost cell delineation. Used to monitor the performance of the PHY layer.

LOF *Loss of Frame* - A condition at the receiver or a maintenance signal transmitted in the PHY overhead indicating that the receiving equipment has lost frame delineation. This is used to monitor the performance of the PHY layer.

LOH *Line Overhead*

Loopback cell - Type of OAM fault management cell used to verify the existence of a reported trouble, identify the nature of the trouble, and isolate its cause.

LOP *Loss of Pointer* - A condition at the receiver or a maintenance signal transmitted in the PHY overhead indicating that the receiving equipment has lost the pointer to the start of cell in the payload. This is used to monitor the performance of the PHY layer.

LOS *Loss of Signal* - A condition at the receiver or a maintenance signal transmitted in the PHY overhead indicating that the receiving equipment has lost the received signal. This is used to monitor the performance of the PHY layer.

LPAC *Loss of Performance Analysis Capability*

LSB *Least Significant Bit*

LSR *Leaf Setup Request*

LT *Lower Tester*

LTE *Line Terminating Equipment*

LTH *Length Field*

M13 *Multiplexer DS1 to DS3*

MA *Maintenance and Adaptation*

MAC *Media Access Control*

MAN *Metropolitan Area Network*

Mb/s *Megabits per second*

MBS *Maximum Burst Size* - In the signaling message, the Burst Tolerance (BT) is conveyed through the MBS which is coded as a number of cells. The BT together with the SCR and the GCRA determine the MBS that may be transmitted at the peak rate and still be in conformance with the GCRA.

MCDV *Maximum Cell Delay Variance* - This is the maximum two-point CDV objective across a link or node for the specified service category.

MCLR *Maximum Cell Loss Ratio* - This is the maximum ratio of the number of cells that do not make it across the link or node to the total number of cells arriving at the link or node.

MCR *Minimum Cell Rate* - An ABR service traffic descriptor, in cells/sec, that is the rate at which the source is always allowed to send.

MCTD *Maximum Cell Transfer Delay* - This is the sum of the fixed delay component across the link or node and MCDV.

ME *Mapping Entity*

MFLOPS *Millions of Floating Point Instructions per Second*

MIB *Management Information Base* - A definition of management items for some network component that can be accessed by a network manager. A MIB includes the names of objects it contains and the type of information retained.

MIN *Multistage Interconnection Networks*

MIPS *Millions of Instructions per Second*

MIR *Maximum Information Rate*

MM *Multi Mode*

MMF *Multimode Fiberoptic cable*

Modem *Modulator/Demodulator*

MPEG *Motion Picture Experts Group* - An ISO Standards group dealing with video and audio compression techniques and mechanisms for multiplexing and synchronizing various media streams.

MPOA *Multiprotocol over ATM* - An effort taking place in the ATM Forum to standardize protocols for the purpose of running multiple network layer protocols over ATM.

MRCS *Multi-rate Circuit Switching*

MS *Meta Signaling*

MSAP *Management Service Access Point*

MSB *Most Significant Bit*

MSN *Monitoring Cell Sequence Number*

MSOH *Multiplexer Section Overhead*

MSVC *Meta-signaling Virtual Channel*

MT *Message Type*

MTP *Message Transfer Part*

MTU *Message Transfer Unit*

MUX *Multiplexer*

N-ISDN *Narrowband Integrated Services Digital Network*

NCP *Network Control Point*

NDIS *Network Driver Interface Specification*

NE *Network Element*

NETBIOS *Network Basic Input/Output System*

NHRP *Next Hop Resolution Protocol*

NI *Network Interconnect*

NMS *Network Management System*

NNI *Network-to-Network Interface* - An interface between "nodes" (switches or networks). The format is identical to the UNI format, but the NNI has no Generic Flow Control (GFC) field, and the VPI field is increased from 8 bits to 12 bits.

Non-conforming cells - Cells that cause the "leaky bucket" to overflow when added to the bucket; as a result, these cells are either discarded or tagged where the CLP bit is set to "1", and will make it through the network if they do not run into any congested switches.

NP *Network Performance*

NPC *Network Parameter Control*

NRM *Network Resource Management*

NSAP *Network Service Access Point*

NSP *Network Service Provider*

NSR *Non-Source Routed*

NT *Network Termination* - Network Termination represents the termination point of a Virtual Channel, Virtual Path, or Virtual Path/Virtual Channel at the UNI.

NTIB *Network Termination 1 (Broadband)*

NT1 *Network Termination 1*

NT12 *Network Termination 1 and 2*

NT2 *Network Termination 2*

NTSC *National Television Standards Committee*

OAM *Operations Administration and Maintenance* - A group of network management functions that provide network fault indication, performance information, and data and diagnosis functions.

OC-1 *Optical Carrier Level 1 Signal*

OC-3 *Optical Carrier Level 3 Signal*

OC-12 *Optical Carrier Level 12 Signal*

OC-24 *Optical Carrier Level 24 Signal*

OC-48 *Optical Carrier Level 48 Signal*

OC-N *Optical Carrier Level N Signal*

Octet - An 8-bit-long transmission unit of measure.

ODI *Open Data-Link Interface*

OLI *Originating Line Information*

OOF *Out of Frame* - Refer to LOF.

OPCR *Original Program Clock Reference*

OSI *Open System Interconnection Reference Model*

OSID *Origination Signaling Identifier*

OSPF *Open Shortest Path First*

OUI *Organizationally Unique Identifier* - A three-octet field in the IEEE 802.1a defined SubNetwork Attachment Point (SNAP) header, identifying an organization which administers the meaning of the following two octet Protocol Identifier (PID) field in the SNAP header. Together they identify a distinct routed or bridged protocol.

PAD *Packet Assembler and Disassembler* - A PAD assembles packets of asynchronous data and emits these fuffers in a burst to a packet switch network. The PAD also disassembles packets from the network and emits the data to the non-packet device.

P-NNI *Private Network to Network Interface*

PBX *Private Branch eXchange*

PC *Protocol Control*

PC *Personal Computer*

PCM *Pulse Code Modulation*

PCN *Personal Communications Network*

PCO *Point of Control and Observation*

PCR *Peak Cell Rate* - The cell rate, in cells/sec, which the source may never exceed. For CBR, this is the upper bond at all times; for VBR, this is the upper bond for bursts (average must stay within SCR to avoid tagging).

PCR *Program Clock Reference*

PCVS *Point to Point Switched Virtual Connections*

PD *Packetization Delay*

PDH *Plesiochronous Digital Hierarchy*

PDU *Protocol Data Unit* - A PDU is a message of a given protocol comprising payload and protocol-specific control information, typically contained in a header. PDUs pass over the protocol interfaces which exist between the layers of protocols (per OSI model).

Performance Monitoring - At the SONET level, this refers to monitoring section BIP-8s, line BIP-24s, and path BIP-8s while FEBEs are used to convey detected BIP errors back to the upstream equipment.

PHY - Physical Layer of the OSI model

PLCP *Physical Layer Convergence Protocol* - Part of the Transmission Convergence (TC) sublayer; defined for DS3; maps ATM cells to the DS3 signal using PLCP frames (performs similar function as SONET overhead); reduces the overall ATM throughput on a DS3 line to 40.704 Mbps. The PLCP is defined by the IEEE 802.6. It is used for DS3 transmission of ATM. ATM cells are encapsulated in a 125microsecond frame defined by the PLCP which is defined inside the DS3 M-frame.

PMD *Physical Media Dependent sublayer* - Deals with aspects which are dependent on the transmission medium selected; specifies the physical medium and the transmission (e.g., bit timing, bit framing, line coding) characteristics; does not include PLCP framing and PLCP overhead.

PICS *Protocol Implementation Conformance Statement*

PID *Protocol Identifier*

PIXIT *Protocol Implementation eXtra Information for Testing*

PL *Physical Layer*

PLP *Packet Layer Protocol*

PLL *Phase Locked Loop*

PM *Physical Medium*

PMD *Physical Media Dependent* - This sublayer defines the parameters at the lowest level, such as speed of the bits on the media.

POH *Path Overhead* - A maintenance channel transmitted in the SONET overhead following the path from the beginning multiplexer to the ending demultiplexer. This is not implemented in SONET Lite.

POI *Path Overhead Indicator*

PRI *Primary Rate Interface*

Private User-to-Network Interface (UNI) - Typically used to interconnect ATM user with an ATM switch, all of which is managed by an end user (e.g., workstation with ATM NIC connected to ATM LAN switch).

PRN *Pseudo Random Noise*

PSTN *Public Switched Telephone Network*

PT *Payload Type* - Three bit field in the ATM header; used to indicate whether a cell contains user information or management information; can be used to indicate a network congestion state or for network resource management.

PTE *Path Terminating Equipment*

PTI *Payload Type Indicator* - Payload Type Indicator is the Payload Type field value distinguishing the various management cells and user cells. Example: Resource Management cell has PTI=110, end-to-end OAM F5 Flow cell has PTI=101.

Public UNI - One of the two forms of the ATM UNI; typically used to interconnect an ATM user (ATM CPE such as ATM router, ATM MUX, ATM switch) with an ATM switch (public service providers equipment/network).

PVC *Permanent Virtual Circuit* - A logical dedicated circuit between two user ports in a point-to-point configuration; this type of connection is established by network management or provisioning actions and is left up indefinitely.

PVCC *Permanent Virtual Channel Connection* - A Virtual Channel Connection (VCC) is an ATM connection where switching is performed on the VPI/VCI fields of each cell. A Permanent VCC is one which is provisioned through some network management function and left up indefinitely.

PVPC *Permanent Virtual Path Connection* - A Virtual Path Connection (VPC) is an ATM connection where switching is performed on the VPI field only of each cell. A Permanent VPC is one which is provisioned through some network management function and left up indefinitely.

PXB *Private Branch Exchange*

QD *Queuing Delay*

QoS *Quality of Service* - Pertains to quality of user oriented end-to-end service, not network performance; some examples include cell loss ratio, cell error ratio, cell delay variation, cell transit delay, and cell mis-insertion rate.

QPSX *Queue Packet and Synchronous Circuit Exchange*

RAI *Remote Alarm Indication*

RBOC *Regional Bell Operating Company*

RC *Routing Control*

RD *Route Descriptor*

RDF *Rate Decrease Factor*

RDI *Remote Defect Identification* - VP-RDI and VC-RDI alarms are generated by the node terminating a defective connection to alert the upstream nodes that a defect has been detected downstream; these alarms are communicated using the OAM cells with the RDI function type. See also FERF.

REL *Release Message*

RFC *Request For Comment (Document Series)*

RFI *Radio Frequency Interference*

RI *Routing Information*

RII *Routing Information Indicator*

RIP *Routing Information Protocol*

RISC *Reduced Instruction Set Computing*

RLC *Release Complete*

RM *Resource Management*

RM-Cell *Resource Management Cell* - Information about the state of the network like bandwidth availability, state of congestion, and impending congestion, is conveyed to the source through special control cells called Resource Management Cells (RM-cells).

ROLC *Routing Over Large Clouds*

Router - A physical device that is capable of forwarding packets based on network layer information and that also participates in running one or more network layer routing protocols.

RSOH *Regenerator Section overhead*

RSVP *Resource Reservation Protocol*

RT *Router*

RT *Routing Type*

RTS *Residual Time Stamp*

SA *Source Address*

SAAL *Signaling ATM Adaptation Layer* - This resides between the ATM layer and the Q.2931 function. The SAAL provides reliable transport of Q.2931 function. The SAAL provides reliable transport of Q.2931 messages between Q.2931 entities (e.g., ATM switch and host) over the ATM layer; two sublayers: common part and service specific part.

SAP *Service Access Point*

SAPI *Service Access Point Identifier*

SAR *Segmentation and Reassembly* - Method of breaking up arbitrarily sized packets.

SB *S Interface (Broadband)*

SCI *Subscriber Network Interface*

SCCP *Signaling Connection and Control Part*

SCP *Service Control Point*

SCR *Sustainable Cell Rate* - Upper bound on the possible conforming average rate (cells per second) of an ATM connection (i.e., VP or VC); VBR service allows user cell traffic to move toward the PCR (the absolute ceiling) but run the risk of "tagging" when the SCR (in conjunction with the burst tolerance, BT) is exceeded; not applicable for CBR service.

SDH *Synchronous Digital Hierarchy*

SDU *Service Data Unit* - A unit of interface information whose identity is preserved from one end of a layer connection to the other.

SE *Switching Element*

SEAL *Simple and Efficient Adaptation Layer*

SELV *Safety Extra Low Voltage* - A safety standard term declaring that a person will not be harmed by contact.

Segment F4 Flow - Identifies OAM cells communicated within the bounds of a single virtual path or group of interconnected virtual paths in a single provider's network.

Segment F5 Flow - PTI value 4 is used to identify OAM cells communicated within the bounds of a single VCC link or group of interconnected VCC links in a single provider's network.

SES *Severely Errored Seconds*

SF *Switching Fabric*

SGM *Segmentation Message*

SID *Signaling Identifier*

SIP *SMDS Interface Protocol*

SIR *Sustained Information Rate*

SLC *Subscriber Loop Carrier*

SM *Single Mode*

SMC *Sleep Mode Connection*

SMDS *Switched Multi-Megabit Data Service*

SMDS-SS *SMDS Switching System*

SMF *Single Mode Fiber*

SN *Sequence Number*

SNA *Systems Network Architecture*

SNAP *Subnetwork Access Protocol*

SNMP *Simple Network Management Protocol*

SNI *Subscriber Network Interface*

SOH *Sonet Overhead*

SONET *Synchronous Optical Network* - An ANSI standard for transmitting information over optical fiber. This standard is used or accepted in the United States and Canada and is a variation of the SDH International standard.

SPE SONET *Synchronous Payload Envelope*

SPID *Service Profile Identifier*

SPTS *Single Program Transport Stream*

SR *Source Routing (Bridging)*

SRF *Specifically Routed Frame*

SRT *Source Routing Transparent*

SRTS *Synchronous Residual Time Stamp* - A clock recovery technique in which difference signals between source timing and a network reference timing signal are transmitted to allow reconstruction of the source timing at the destination.

SS7 *Signaling System Number 7*

SSCF *Service Specific Coordination Function*

SSCOP *Service Specific Connection Oriented Protocol*

SSCS *Service Specific Convergence Sublayer*

SSS *Self Synchronization Scrambler*

ST *Segment Type*

STE *Spanning Tree Explorer*

STE SONET *Section Terminating Equipment* - SONET equipment that terminates a section of a link between a transmitter and repeater, repeater and repeater, or repeater and receiver. This is usually implemented in wide area facilities and not implemented by SONET Lite.

STM *Synchronous Transfer Module* - STM is a basic building block used for a synchronous multiplexing hierarchy defined by the CCITT/ITU-T.STM-1 operates at a rate of 155.52 Mbps (same as STS-3).

STM-1 *Synchronous Transport Module 1* - SDH standard for transmission over OC-3 optical fiber at 155.52 Mbps.

STM-n *Synchronous Transport Module "n"* - SDH standards for transmission over optical fiber (OC-'n x 3) by multiplexing "n" STM-1 frames, (e.g., STM-4 at 622.08 Mbps and STM-16 at 2.455 Gbps).

STP *Signaling Transfer Point*

STP *Shielded Twisted Pair*

STS *Synchronous Time Stamps*

STS-1 *Synchronous Transport Signal 1* - SONET standard for transmission over OC-1 optical fiber at 51.84 Mbps.

STS-1c *Synchronous Transport Signal Level 1 Concatenated*

STS-3 *Synchronous Transport Signal Level 3*

STS-3c *Synchronous Transport Signal Level 3 Concatenated*

STS-n *Synchronous Transport Signal "n"* - SONET standards for transmission over OC-n optical fiber by multiplexing "n" (where n is an integer) STS-1 frames, (e.g., STS-3 at 155.52 Mbps STS-12 at 622.08 Mbps and STS-48 at 2.488 Gbps).

SUT *System Under Test*

SVC *Switched Virtual Circuit* - A connection established on a call by call basis via signaling. The user defines the endpoints when the call is initiated.

SVCC *Switched Virtual Channel Connection* - A Switched VCC is one which is established and taken down dynamically through control signaling. A Virtual Channel Connection (VCC) is an ATM connection where switching is performed on the VPI/VCI fields of each cell.

SVCI *Switched Virtual Circuit Identifier*

SVP *Switched Virtual Path*

SWG *Sub-Working Group*

T Carrie *T1 Carrier*

T1(ANSI) *Telephony Committee*

T1S1 *ANSI T1 Subcommittee*

T-Mux *T1 Multiplexer*

Tagged Cells - Cells which have their CLP bit set to "1" indicating that the cell will make it through the network if it does not run into any congested switches; if the cell encounters congested switches, the cell will be dropped immediately.

TB *Transparent Bridging*

TB *T Interface (Broadband)*

TC *Transaction Capabilities*

TC *Transmission Convergence* - The TC sublayer transforms the flow of cells into a steady flow of bit and bytes for transmission over the physical medium. On transmit, the TC sublayer maps the cells to the frame format, generates the Header Error Check (HEC), sends idle cells when the ATM layer has none to send. On reception, the TC sublayer delineates individual cells in the received bit stream, and uses the HEC to detect and correct received errors.

TCAP *Transaction Capabilities Application Part*

TCI *Test Cell Input*

TCO *Test Cell Output*

TCP *Test Coordination Procedure*

TCP *Transmission Control Protocol*

TCP/IP *Transmission Control Program/Internet Protocol*

TCS *Transmission Convergence Sublayer*

TDJ *Transfer Delay Jitter*

TDM *Time Division Multiples*

TE *Terminal Equipment*

TE1 *Terminal Equipment type 1*

TE2 *Terminal Equipment type 2*

TLV *Type/Length/Value*

TM *Traffic Management*

TM SWG *Traffic Management Sub-Working Group*

TMP *Test Management Protocol*

TNS *Transit Network Selection*

TNV *Telecommunications Network Voltage* - A safety standard term declaring that a hazardous overvoltage condition could possibly be present on the Telecommunications Network due to lightning or accidental contact with power circuits.

TPCC *Third Party Call Control*

TR *Token Ring*

Traffic Control - Actions taken by the network in order to avoid congested conditions.

Traffic Parameters - Quantitative or qualitative description of traffic; examples include peak cell rate (PCR), sustainable cell rate (SCR), and burst tolerance (BT).

Transit Delay - The time difference between the instant at which the first bit of a PDU crosses one designated boundary and the instant at which the last bit of the same PDU crosses a second designated boundary.

Transmission Convergence (TC) sublayer - Deals with physical layer aspects that are media independent (e.g., PLCP, HEC generation/verification); deals with any overhead.

TS *Traffic Shaping* - Traffic shaping is a mechanism that alters the traffic characteristics of a stream of cells on a connection to achieve better network efficiency, while meeting the QoS objectives, or to ensure conformance at a subsequent interface. Traffic shaping must maintain cell sequence integrity on a connection. Shaping modifies traffic characteristics of a cell flow with the consequence of increasing the mean Cell Transfer Delay.

TS *Time Stamp*

TS *Transport Stream*

TS *Time Slot*

TSAP *Transport Service Access Point*

UBR *Unspecified Bit Rate* - UBR is an ATM service category which does not specify traffic related service guarantees. Specifically, UBR does not include the notion of a per-connection negotiated bandwidth. No numerical commitments are made with respect to the cell loss ratio experienced by a UBR connection, or as to the cell transfer delay experienced by cells on the connection.

UDP *User Datagram Protocol*

UME *UNI Management Entity*

Unassigned Cells - Used for maintaining continuous cell streams and cell rate decoupling; VPI/VCI equals 000/00000.

UNI *User-Network Interface* - An interface point between ATM end users and a private ATM switch, or between a private ATM switch and the public carrier ATM network; defined by physical and protocol specifications per ATM Forum UNI documents. The standard adopted by the ATM Forum to define connections between users or end stations and local switch.

UPC *Usage Parameter Control* - Usage Parameter Control is defined as the set of actions taken by the network to monitor and control traffic, in terms of traffic offered and validity of the ATM connection, at the end-system access. Its main purpose is to protect network resources from malicious as well as unintentional misbehavior, which can affect the QoS of other already established connections, by detecting violations of negotiated parameters and taking appropriate actions.

UPT *Universal Personal Telecommunications*

UT *Upper Tester*

UTOPIA *Universal Test & Operations Interface for ATM* - Refers to an electrical interface between the TC and PMD sublayers of the PHY layer.

UTP *Unshielded Twisted Pair* - A cable having one or more twisted pairs, but with no shield per pair.

VBR *Variable Bit Rate* - An ATM Forum defined service category which supports variable bit rate data traffic with average and peak traffic parameters. This service type is used primarily for data and compressed video; timing is not as critical for this type of traffic type.

VBR-RT *VBR-Real Time*

VBR+ *VBR-Non Real Time*

VC - A communications channel that provides for the sequential unidirectional transport of ATM cells.

VCC *Virtual Channel Connection* - End-to-end virtual channel where the VPI/VCI values are assigned to each end of the virtual channel; the ATM network switches the cells based on the VPI and VCI information.A concatenation of VCLs that extends between the points where the ATM service users access the ATM layer. The points at which the ATM cell payload is passed to, or received from, the users of the ATM Layer (i.e., a higher layer or ATM-entity) for processing signify the endpoints of a VCC. VCCs are unidirectional.

VCI *Virtual Channel Identifier* - A unique numerical tag as defined by a 16 bit field in the ATM cell header that identifies a virtual channel, over which the cell is to travel.

Virtual circuit - A virtual connection established through the network from origination to destination, where packets, frames, or cells are routed over the same path for the duration of the call; these connections seem like dedicated paths to the users, but are actually network resources shared by all users; bandwidth on a virtual circuit is not allocated until it is used.

VPI/VCI *Virtual Path Identifier/Virtual Channel Identifier* - Fields in the cell header used for cell routing purposes (similar to DLCI used for frame relay).

VLAN *Virtual Local Area Network*

VP *Virtual Path* - A unidirectional logical association or bundle of VCs.

VP/VC *Virtual Path, Virtual Circuit*

VPC *Virtual Path Connection* - End-to-end virtual path where any VCI values can be used because the switch will ignore these VCI values. A concatenation of VPLs between Virtual Path Terminators (VPTs). VPCs are unidirectional.

VPI *Virtual Path Identifier* - An eight bit field in the ATM cell header which indicates the virtual path over which the cell should be routed.

VPN *Virtual Private Network*

VS *Virtual Scheduling*

VT *Virtual Tributary*

VT 1.5 *Virtual Tributary 1.5*

VT 2 *Virtual Tributary 2*

VT 3 *Virtual Tributary 3*

VT 6 *Virtual Tributary 6*

VTG *Virtual Tributary Group*

VTOH *Virtual Tributary Overhead*

WAN *Wide Area Network*

XA-SMDS *Exchange Access SMDS*

XNS *Xerox Network Systems*

XTP *eXpress Transport Protocol*

TTC
TPI Division

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