Technical Report
TR-005

ADSL Network Element Management

March 1998

ABSTRACT:

This project describes parameters or elements of ADSL modem operation that are subject to network management. It does not describe the protocol(s) by which they are managed or the protocol(s) by which control and management message signals pass from an ATU-C to an ATU-R.

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1 Introduction

This document describes various network management elements required for proper management of ADSL physical layer resources where elements refer to parameters or functions within an ADSL modem pair, either collectively or at an individual end.

These elements have been defined without reference to a specific ADSL line code or means of communication between ATU-C and ATU-R.

The network management framework will be covered in Section 3 and SNMP specific implementation will be covered in Section 5.

2 Reference Model

Figure 1 below shows the system reference model adopted by the ADSL Forum. The network management elements covered by this project exist within ATU-C and ATU-R, and are access across the V interfaces. By intention, no network management element shall be accessible via the T interface (that is, by the customer). Glossary contains definitions of each interface in Figure 1.

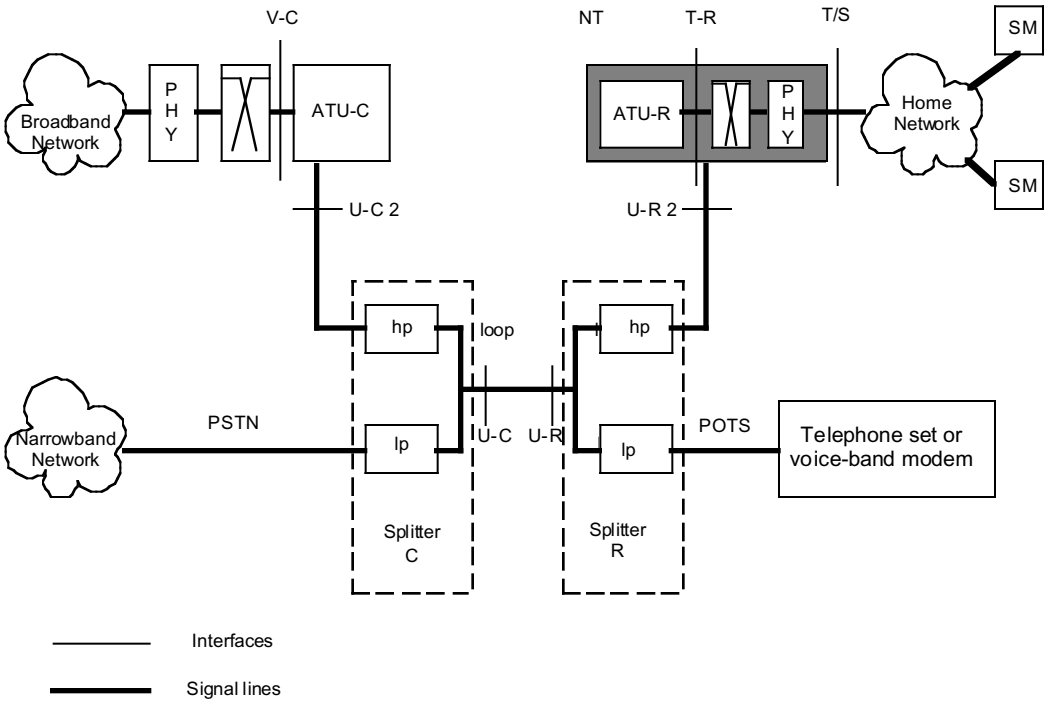

Figure 1 ADSL Forum System Reference Model

3 Network Management Framework

A network management framework consists of at least four components:

1. One or more managed nodes, each containing an agent. The managed node could be a router, bridge, switch, ADSL modem, or other.

2. At least one NMS (Network Management System), which is often called the manager. The manager monitors and controls managed nodes and is usually based on a popular computer.

3. A network management protocol, which is used by the manager and agents to exchange management information.

4. Management information. The unit of management information is an object. A collection of related objects is defined as a Management Information Base (MIB).

The MIB definition assumes the Agent is located at the ATU-C and acts as a proxy for the ATU-R.

To allow for potential expansion, the MIB will be defined to accommodate the aggregation, so an agent can be located in either a single ATU-C or Common Equipment to handle multiple ATU-Cs. Indexing scheme is used to accommodate this. The profile concept for configuration parameters will be used as an option to facilitate parameter management by the NMS. In case the use of the individual parameters is preferred, a profile can be created for each ATU-C.

Line code (DMT/CAP) specific objects will be defined in separate MIBs.

4 Network Management Elements

4.1 General

Network management refers to parameter, operations, and protocols for the following functions:

a. Configuration Management: configuring an ADSL modem pair and maintaining inventory information
b. Fault Management: discovering and correcting faults
c. Performance Management: reporting operating conditions and history

Management includes five elements within the ADSL reference model:

a. Management communications protocol across the Network Management sub-interface of the V interface.
b. Management communications protocol across the U interface (i.e., between modems)
c. Parameters and operations within the ATU-C
d. Parameters and operations within the ATU-R
e. ATU-R side of the T interface.

Note that issues presented here do not address management of POTS or metallic line testing, the T interface beyond the ATU-R (i.e., the premises distribution network or any interconnected CPE), or protocols above the physical layer. This Working Text does not cover protocols on the U interface. Standards groups ANSI T1E1.4 and ETSI TM6 are responsible for any standardized protocols at the U interface.

Network Management System as used in this document will refer specifically to any information or procedure that can be controlled or instituted via the V interface operations port, without prejudice to the nature of this port (which can be separated and embedded).

Management of all ATU-R parameters specified in this document may only be performed by an NMS via the ÒVÓ interface (Figure 1).

4.2 Element List

Table 1 lists the required set of elements for an ADSL system, divided into three categories: configuration, fault, and performance management. The ATU-C/ATU-R/ADSL Line column indicates for each element whether or not it should be managed at the ATU-C only, ATU-C & ATU-R, or ADSL Line. The Physical / Fast/Interleave column indicates for each element whether

or not it is a physical layer element or a channelized element. The Read/Write column indicates for each element whether or not it is read only or read/write. N/A means not applicable. Please note that the location of the elements is not specified here.

The following terms used in Table 1 are described a little more to make it clear:

- ADSL Line - ADSL transmission facility, including the two ADSL Transmission Units — ATU-C/R
- ATU-C — Central Office ADSL Modem
- ATU-R — Remote ADSL Modem
- Physical — The ADSL facility physical transmission medium
- Fast — The ADSL Fast transmission Channel as per ANSI T1.413
- Interleaved — The ADSL Interleaved Channel as per ANSI T1.413

Table 1 Network Management Elements

Category	*Element*	*ATU-C / ATU-R / ADSL Line*	*Physical / Fast/Interleave*	*Read/Write*
Configuration				
	ADSL Line Type	ADSL Line	N/A	Read only
	ADSL Line Coding	ADSL Line	N/A	Read only
	Target Noise Margin	ATU-C & ATU-R	Physical	Read/Write
	Maximum Noise Margin	ATU-C & ATU-R	Physical	Read/Write
	Minimum Noise Margin	ATU-C & ATU-R	Physical	Read/Write
	Rate Adaptation Mode	ATU-C & ATU-R	Physical	Read/Write
	Upshift Noise Margin	ATU-C & ATU-R	Physical	Read/Write
	Minimum Time Interval for Upshift Rate Adaptation	ATU-C & ATU-R	Physical	Read/Write
	Downshift Noise Margin	ATU-C & ATU-R	Physical	Read/Write
	Minimum Time Interval for Downshift Rate Adaptation	ATU-C & ATU-R	Physical	Read/Write
	Desired Maximum Rate	ATU-C & ATU-R	Fast/Interleave	Read/Write
	Desired Minimum Rate	ATU-C & ATU-R	Fast/Interleave	Read/Write
	Rate Adaptation Ratio	ATU-C & ATU-R	Physical	Read/Write
	Maximum Interleave Delay	ATU-C & ATU-R	Interleave	Read/Write
	Alarm (Event) Thresholds:			
	15 minute count threshold on			
	Loss of Signal	ATU-C & ATU-R	Physical	Read/Write
	Loss of Frame	ATU-C & ATU-R	Physical	Read/Write
	Loss of Power	ATU-C & ATU-R	Physical	Read/Write
	Loss of Link	ATU-C only	Physical	Read/Write
	Errored Seconds	ATU-C & ATU-R	Physical	Read/Write
	Rate Up Threshold	ATU-C & ATU-R	Fast/Interleave	Read/Write
	Rate Down Threshold	ATU-C & ATU-R	Fast/Interleave	Read/Write
	Vendor ID	ATU-C & ATU-R	Physical	Read only

Version Number	ATU-C & ATU-R	Physical	Read only
Serial Number	ATU-C & ATU-R	Physical	Read only

Category	*Element*	*ATU-C/ATU-R ADSL Line*	*Physical / Fast/Interleave*	*Read/Write*
Fault — Indication				
	ADSL Line Status	ATU-C & ATU-R	Physical	Read only
	Exceed 15 minute count threshold of			
	Loss of Signal	ATU-C & ATU-R	Physical	N/A
	Loss of Frame	ATU-C & ATU-R	Physical	N/A
	Loss of Power	ATU-C & ATU-R	Physical	N/A
	Loss of Link	ATU-C only	Physical	N/A
	Errored seconds	ATU-C & ATU-R	Physical	N/A
	Unable to initialize ATU-R	ATU-C only	Physical	N/A
	Rate Change	ATU-C & ATU-R	Fast/Interleave	N/A
Fault — Diagnostics				
	Self test	ATU-C & ATU-R	N/A	N/A
Performance				
	Line Attenuation (current)	ATU-C & ATU-R	Physical	Read only
	Noise Margin (current)	ATU-C & ATU-R	Physical	Read only
	Total Output Power	ATU-C & ATU-R	Physical	Read only
	Maximum Attainable Rate	ATU-C & ATU-R	Physical	Read only
	Current Rate	ATU-C & ATU-R	Fast/Interleave	Read only
	Previous Rate	ATU-C & ATU-R	Fast/Interleave	Read only
	Channel Data Block Length	ATU-C & ATU-R	Fast/Interleave	Read only
	Interleave Delay	ATU-C & ATU-R	Interleave	Read only
	15 minute/1 day counters of current & previous values on			
	Loss of Signal	ATU-C & ATU-R	Physical	Read only
	Loss of Frame	ATU-C & ATU-R	Physical	Read only
	Loss of Power	ATU-C & ATU-R	Physical	Read only
	Loss of Link	ATU-C only	Physical	Read only
	Errored Seconds	ATU-C & ATU-R	Physical	Read only
	Transmit Blocks	ATU-C & ATU-R	Fast/Interleave	Read only
	Receive Blocks	ATU-C & ATU-R	Fast/Interleave	Read only
	Corrected Blocks	ATU-C & ATU-R	Fast/Interleave	Read only
	Uncorrectable Blocks	ATU-C & ATU-R	Fast/Interleave	Read only

4.3 Configuration Management

4.3.1 Paragraphs below describe each element for configuration management.

All elements can be used for fast channel and / or interleaved channel except physical layer elements. Interleaving adds delay but provides greater immunity to impulse noise.

4.3.2 ADSL Line Type

This parameter defines the type of ADSL physical line. Five (5) ADSL line types are defined as follows:

- No channels exist
- Fast channel exists only
- Interleaved channel exists only
- Either fast or interleaved channels can exist, but only one at any time
- Both fast and interleaved channels exist

4.3.3 ADSL Line Coding

This parameter defines the ADSL coding type used on this line.

4.3.4 Noise Margin parameters

The following parameters are defined to control the Noise Margin in the transmit direction in the ATU-C & ATU-R. NOTE: The Noise Margin should be controlled to ensure a BER (Bit Error Rate of 10^{-7} or better). Figure 2 shows the relationship between these parameters. They will be described in detail in the following paragraphs.

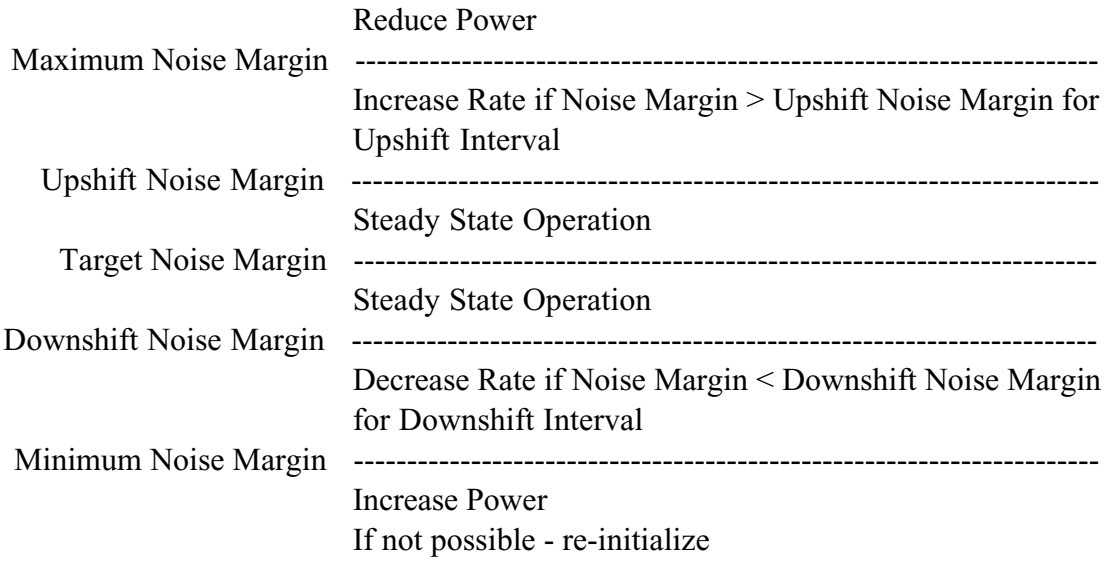

Figure 2 Noise Margins

NOTE:

1. Upshift Noise Margin, and Downshift Noise Margin are only supported for Rate Adaptive Mode.
2. Minimum Noise Margin <= Downshift Noise Margin <= Target Noise Margin <= Upshift Noise Margin <= Maximum Noise Margin

4.3.4.1 Target Noise Margin

This is the Noise Margin the modem (transmit from ATU-C and ATU-R) must achieve with a BER of 10^{-7} or better to successfully complete initialization.

4.3.4.2 Maximum Noise Margin

This is the maximum Noise Margin a modem (transmit from ATU-C and ATU-R) should try to sustain. If the Noise Margin is above this, the modem should attempt to reduce its power output to optimize its operation.

4.3.4.3 Minimum Noise Margin

This is the minimum Noise Margin the modem (transmit from ATU-C and ATU-R) should tolerate. If the noise margin falls below this level, the modem should attempt to increase its power output. If that is not possible, the modem will attempt to re-initialize.

4.3.5 Dynamic Rate Adaptation parameters

The following parameters are defined to manage the Rate-Adaptive behavior in the transmit direction for both ATU-C and ATU-R.

4.3.5.1 Rate Adaptation Mode

This parameter specifies the mode of operation of a rate-adaptive modem (transmit from ATU-C and ATU-R). (If this functionality is supported)

- Mode 1: MANUAL - Rate changed manually.

At startup:

The Desired Minimum Rate parameter specifies the bit rate the modem must support, with a noise margin which is at least as large as the specified Target Noise Margin, and a BER of better than $10^{-7.}$ If it fails to achieve the bit rate the modem will fail, and NMS will be notified. Although the modem might be able to support a higher bit rate, it will not provide more than what is requested.

When the noise margin for the selected transport configuration is higher than the Maximum Noise Margin, then the modem shall reduce its power to get a noise margin below this limit. (If this functionality is supported)

At showtime:

The modem shall maintain the specified Desired Minimum Rate. When the current noise margin falls below the Minimum Noise Margin then the modem will fail, and NMS will be notified.

When the current noise margin rises above Maximum Noise Margin, then the power shall be reduced to get the noise margin below this limit. (If this functionality is supported)

- Mode 2: AT_INIT- Rate automatically selected at startup only and does not change after that.

At startup:

The Desired Minimum Rate parameter specifies the minimum bit rate the modem must support, with a noise margin which is at least as large as the specified Target Noise Margin, and a BER of better than $10^{-7.}$ If it fails to achieve the bit rate the modem will fail, and NMS will be notified. If the modem is able to support a higher bit rate for that direction at initialization, the excess bit rate will be distributed amongst the fast and interleaved latency path according to the ratio (0 to 100%) specified by the Rate Adaptation Ratio parameter. The ratio is defined as Fast / (Fast + Interleave) bit rate x 100%. A ratio of 30% means that 30% of the excess bit rate should be assigned to the fast latency path, and 70% to the interleaved latency path. When the Desired Maximum Rate is achieved in one of the latency paths, then the remaining excess bit rate is assigned to the other latency path, until it also reaches its Desired Maximum Rate. A ratio of 100% will assign all excess bit rate first to the fast latency path, and only when the Desired Maximum Rate of Fast channel is obtained, the remaining excess bit rate will be assigned

to the interleaved latency path, a ratio of 0% will give priority to the interleaved latency path.

When the noise margin for the selected transport configuration is higher than the Maximum Noise Margin, then the modem shall reduce its power to get a noise margin below this limit. Note: This can happen only when Desired Maximum Rates are reached for both latencies, since bit rate increase has priority over power reduction. (if this functionality is supported)

At showtime:

During showtime, no rate adaptation is allowed. The bit rate which has been settled during initialization shall be maintained. When the current noise margin falls below the Minimum Noise Margin then the modem will fail, and NMS will be notified.

When the current noise margin rises above Maximum Noise Margin, then the power shall be reduced to get the noise margin below this limit. (If this functionality is supported)

- Mode 3: DYNAMIC- Rate is automatically selected at startup and is continuously adapted during operation (showtime).

At startup:

In Mode 3, the modem shall start up as in Mode 2.

At showtime:

During showtime, rate adaptation is allowed with respect to the Ratio Adaptation Ratio for distributing the excess bit rate amongst the interleaved and fast latency path (see Mode 2), and assuring that the Desired Minimum Rate remains available at a BER of 10^{-7} or better. The bit rate can vary between the Desired Minimum Rate , and the Desired Maximum Rate. Rate Adaptation is performed when the conditions specified for Upshift Noise Margin and Upshift Interval - or for Downshift Noise Margin and Downshift Interval - are satisfied. This means:

For an Upshift action: allowed when the current noise margin is above Upshift Noise Margin during Minimum Time Interval for Upshift Rate Adaptation.

For a Downshift action: allowed when the current noise margin is below Downshift Noise Margin during Minimum Time Interval for Downshift Rate Adaptation.

When the current noise margin falls below the Minimum Noise Margin then the modem will fail, and NMS will be notified.

When Desired Maximum Rates have been reached in both latency paths, and when the current noise margin rises above Maximum Noise Margin, then the power shall be reduced to get the noise margin below this limit.

4.3.5.2 Upshift Noise Margin

If the Noise Margin is above the Upshift Noise Margin and stays above that for more than the time specified by the Minimum Upshift Rate Adaptation Interval, the modem should increase its data rate (transmit from ATU-C and ATU-R).

4.3.5.3 Minimum Time Interval for Upshift Rate Adaptation

This parameter defines the interval of time the Noise Margin should stay above the Upshift Noise Margin before the modem will attempt to increase data rate (transmit from ATU-C and ATU-R).

4.3.5.4 Downshift Noise Margin

If the Noise Margin is below the Downshift Noise Margin and stays below that for more than the time specified by the Minimum Downshift Rate Adaptation Interval, the modem should decrease its data rate (transmit from ATU-C and ATU-R).

4.3.5.5 Minimum Time Interval for Downshift Rate Adaptation

This parameter defines the interval of time the Noise Margin should stay below the Downshift Noise Margin before the modem will attempt to decrease data rate (transmit from ATU-C and ATU-R).

4.3.6 Bit Rate Parameters

These bit rate parameters refer to the transmit direction for both ATU-C and ATU-R. The two desired bit rate parameters define the desired bit rate as specified by the operator of the system (the operator of the ATU-C). It is assumed that ATU-C and ATU-R will interpret the value set by the operator as appropriate for the specific implementation of ADSL between the ATU-C and ATU-R in setting the line rates. This model defined in this interface makes no assumptions about the possible range of these attributes. The Management System used by the operator to manage the ATU-R and ATU-C may implement its own limits on the allowed values for the desired bit rate parameters based on the particulars of the system managed. The definition of such a system is outside the scope of this model.

4.3.6.1 Desired Maximum Rate

These parameters specify the desired maximum rates (transmit from the ATU-R and ATU-C) as desired by the operator of the system.

4.3.6.2 Desired Minimum Rate

These parameters specify the desired minimum rates (transmit from the ATU-R and ATU-C) as desired by the operator of the system.

4.3.6.3 Rate Adaptation Ratio

These parameters (expressed in %) specify the ratio that should be taken into account for distributing the bit rate considered for rate adaptation amongst the fast and interleaved channels in case of excess bit rate. The ratio is defined as: [Fast / (Fast + Interleaved)]*100. Following this rule a ratio of 20% means that 20% of the additional bit rate (in excess of the fast minimum plus the interleaved minimum bit rate) will be assigned to the fast channel, and 80% to the interleaved channel.

4.3.7 Maximum Interleave Delay

The transmission delay is introduced by the interleaving process. The delay is defined as per ANSI T1.413, and is (S x d) / 4 milli-seconds, where ÔSÕ is the S-factor, and ÔdÓ is the ÒInterleaving DepthÓ

4.3.8 Alarm (Event) Thresholds

Each ATU maintains current 15 minute interval counts. Each count may trigger an alarm (event) if it reaches or exceeds a preset threshold. Those thresholds shown in Table 1 will be set individually.

4.3.9 Rate Threshold

These parameters provide rate up and down thresholds which trigger a rate change alarm (event) when they are reached or crossed.

4.3.10 Inventory Information

Each ATU-R and ATU-C shall make accessible through the NMS port the following information: Vendor ID, Version Number and Serial Number. The hardware, software and firmware version are vendor specific fields and should be placed in an enterprise specific equipment MIB for SNMP implementation.

4.3.10.1 Vendor ID

The vendor ID is assigned by T1E1.4 according to T1.413 Appendix D, which contains a procedure for applying for numbers. The numbers are consecutively assigned, starting with 002.

4.3.10.2 Version Number

The version number is for version control and is vendor specific information.

4.3.10.3 Serial Number

The serial number is vendor specific and should be no longer than 32 bytes. Note that the combination of vendor ID and serial number creates a unique number for each ADSL unit.

4.4 Fault Management

4.4.1 Fault management applies to the process of the identifying the existence of a fault condition, determining its cause, and taking corrective action. For purposes here, faults will be notified by alarms (events) presented over the NMS port from the ATU-C. Network management systems may also determine faults, such as line deterioration, by examining performance reports. However, current telephone company practices favor alarm (event) driven fault management. For this reason the number of alarm (event) conditions, and range of configurability, is rather large. Note that some alarms (events) may not represent faults as such, but require operations notice because they interrupt service or represent sources for service calls. Unpowered ATU-Rs and unpowered connected CPE are examples.

4.4.2 ADSL Line Status

ADSL Line Status shows the current state of the line. The possible states are defined as follows:

- Operational
- Loss of Frame
- Loss of Signal
- Loss of Power
- Loss of Link (ATU-C only)
  A Loss of Link condition is declared at the ATU-C if a Loss of Signal is not proceeded by a 'dying-gasp' message from the ATU-R
- Loss of Signal Quality
- Initialization failure due to Data Error (ATU-C only)
- Initialization failure due to Configuration Error (ATU-C only)
- Initialization failure due to Protocol Error (ATU-C only)
- Initialization failure due to no Peer ATU present (ATU-C only)

4.4.3 Alarms (Events)

4.4.3.1 There is no distinction between major and minor alarms (events). To generate alarm (event) on Loss of Signal, Loss of Frame, Loss of Power, Loss of Link, Error Seconds depends on the value of the counter reaching or exceeding the threshold value in a single 15 minute interval. The threshold value is configurable. When those alarms (events) clear, it will not report a trap to show the status change. The reason is if the alarm (event) condition persists in

next 15 minutes, it will generate another alarm. If no alarm (event) is generated in next 15 minutes, the NMS knows the alarm (event) clears.

Unable to initialize ATU-R from ATU-C will generate an alarm (event). When ATU-C is able to initialize the ATU-R, a clear alarm (event) will be generated.

Rate change will generate an alarm (event) consisting of configurable rate up and down thresholds on upstream and downstream rates, respectively.

All alarms (events) can be enabled/disabled. The default is disabled. Please refer to ANSI T1.413 for more detailed definitions of alarms (events).

Loss of Signal at ATU-R
Loss of Signal at ATU-C
Loss of Frame at ATU-R
Loss of Frame at ATU-C
Loss of Power at ATU-R
Loss of Power at ATU-C
Loss of Link at ATU-R for ATU-C
Error Seconds at ATU-R
Error Seconds at ATU-C
Unable to initialize with ATU-R (implies knowledge that power is on at ATU-R)
Rate change at ATU-R
Rate change at ATU-C

4.4.4 Fault Isolation

4.4.4.1 Fault isolation falls more to operations strategy and practices than anything necessarily inherent in the modems and may need to be coordinated with other forms of testing, such as MLT. However, modem tests and test sequences can be helpful in isolating faults to a particular element in a link, comprising an ATU-C, its POTS splitter, the line, the ATU-R POTS splitter, the ATU-R, and equipment attached at the T interface.

4.4.4.2 To assist fault isolation the modem systems shall provide the following diagnostics under control of commands transmitted across an NMS port:

4.4.4.2.1 ATU-C self test

See T1.413 for details

4.4.4.2.2 ATU-R self test

See T1.413 for details

4.5 Performance Management

Each ATU-R and ATU-C shall make accessible through the NMS port the following performance/status related information:

4.5.1 Status

4.5.1.1 Line attenuation

This is the measured difference in the total power transmitted by the peer ATU and the total power received by this ATU in dB.

4.5.1.2 Noise Margin

This is the Noise Margin as seen by this ATU with respect to its received signal in dB.

4.5.1.3 Total Output Power

This is to show total output power from the modem.

4.5.1.4 Maximum Attainable Rate

This is to indicate the maximum currently attainable data rate by the modem.

4.5.1.5 Current Rate

These parameters report the current rate (transmit from the ATU-R and ATU-C) to which the ATU-C or ATU-R is adapted. It can be read by the operator of the system.

4.5.1.6 Previous Rate

These parameters report the rate (transmit from the ATU-R and ATU-C) to which the previous "rate change" event occurred.

4.5.1.7 Channel Data Block Length

This per channel parameter indicates the size of the data block subject to CRC check. This includes the number of redundant check bytes and the number of message bytes over which these check bytes provide protection. This value may be different for the fast and interleaved channel as the number of check bytes for each channel is individually negotiated and the number of bytes per symbol depends upon the rate of each channel. It will be read only information.

4.5.1.8 Interleave Delay

The transmission delay is introduced by the interleaving process. The delay is defined as per ANSI T1.413, and is (S x d) / 4 milli-seconds, where ÒSÓ is the S-factor, and ÒdÓ is the ÒInterleaving DepthÓ

4.5.2 Performance Monitoring

The following raw counters (counters that begin at 0 when the device is started and continue forever wrapping at the maximum count) shall be kept for both the ATU-C and ATU-R:

Loss of Signal Failure
Loss of Frame Failure
Loss of Power Failure
Loss of Link Failure
Errored Seconds
: This is a count of one second intervals containing one or more uncorrectable block errors in either the fast or interleaved channel, or one or more los or sef defects.

Transmitted Blocks
: This counter is available per channel and indicates the number of blocks that have been transmitted by this ATU. This counter should only be incremented when there is a reasonable expectation of end-to-end communication (e.g. showtime).

Received Blocks
: This per channel counter indicates the number of blocks received by this ATU. This counter should only be incremented when valid framing is detected.

Corrected Blocks
: This is the count of received blocks which were errored when received but corrected by the built-in forward error correction.

Uncorrectable Blocks
: This is the count of the received blocks which were unable to be corrected by the forward error correction mechanism.

Note: Since the counting of corrected and uncorrected errors is based on the forward error correction block this is the definition which must also be used for counting transmitted and received blocks.

The following seconds counters should be available for the current and previous day and current and from 1 to 96 previous 15-minute intervals. A seconds counter is incremented when one or more of the relevant events occurred or the condition persisted throughout that second. The counts should be kept for each of the following items with respect to both the ATU-C and ATU-R:

Loss of Signal Seconds
Loss of Frame Seconds

Loss of Power Seconds
Loss of Link Seconds
Errored Second Seconds
Transmit Blocks
Receive Blocks
Corrected Blocks
Uncorrectable Blocks

5 SNMP Specific Implementation

Please refer to ADSL Forum TR-006 ÒSNMP-based ADSL LINE MIBÓ for SNMP-specific implementations.

Appendix A Features for Future Consideration

This appendix lists features which have been identified for future consideration.

Single tone echo test
Transmission of a single tone that is echoed back from the ATU-R after frequency translation (assuming FDM). The most robust implementation of this would use analog circuits independent of DSPs.

Measure line attenuation by frequency

CPE synchronization

T interface cable test

Average S/N ratio on each of the 256 tones

When bit swaps (from one tone to another) are made and number of bit swaps per 15 minutes and per day

Transmit power and change in transmit power

Test related features to support Reset, Loopback (or other out-of-service performance testing TBD), and out-of-service testing

Management functions in the Access Node (AN), for example, ATU-C ports, channel cross-connect, broadband channel allocation etc.

DMT / CAP specific elements

Appendix B Glossary

ATU-C: ADSL Transmission Unit at the Central Office end. The ATU-C may be integrated within an Access Node.

ATU-R: ADSL Transmission Unit at the customer premises end.

Access Node: Concentration point for Broadband and Narrowband data. The Access Node may be located at a Central Office or a remote site. Also, a remote Access Node may subtend from a central access node.

Broadcast: Broadband data input in simplex mode (typically broadcast video).

Broadband Network: Switching system for data rates above 1.5/2.0 Mbps.

hp: high pass

Loop: Twisted-pair copper telephone line.

lp: low pass

Narrowband Network: Switching system for data rates at or below 1.5/2.0 Mbps.

NT: Network Termination

POTS: Plain Old Telephone Service.

PSTN: Public Switched Telephone Network.

Service Module (SM): Performs terminal adaptation functions. Examples are set top boxes, PC interfaces, or LAN router.

Splitter: Filters which separate high frequency (ADSL) and low frequency (POTS) signals at CO end and premises end. The splitter may be integrated into the ATU, physically separated from the ATU, or divided between high pass and low pass, with the low pass function physically separated from the ATU. The provision of POTS splitters and POTS-related functions is optional.

T-R: Interface(s) between ATU-R and Switching layers (e.g., ATM & STM).

T/S: Interface(s) between ANT (ADSL Network Termination) and CI (Customer Installation) or home network.

U-C: Interface between Loop and ATU-C (analog). Defining both ends of the Loop interface separately arises because of the asymmetry of the signals on the line.

U-C2: Interface between POTS splitter and ATU-C.

U-R: Interface between Loop and ATU-R (analog).

U-R2: Interface between POTS splitter and ATU-R.

V-C: Logical interface between ATU-C and a digital network element such as one or more switching systems. A digital carrier facility (e.g., SONET extension) may be interposed at the **V-C** interface when the ATU-C is located at a remote site.

Appendix C Contribution Reference

ADSL Forum 96-034	Telecommunications management network - An overview of TMN
ADSL Forum 96-040	SNMP Management for ADSL
ADSL Forum 96-045	ADSL Data Service Network Management
ADSL Forum 96-047	Variable Bit Rate ADSL Using Carrierless AM/PM (CAP)
ADSL Forum 96-061	Recommended Values of ifType Object for ADSL management with SNMP
ADSL Forum 96-064	Rate Adaptive Packet (RAP) Mode ADSL
ADSL Forum 96-068	More facilities for Configuration Management
ADSL Forum 96-069	SNMP and ADSL
ADSL Forum 96-105	Network Management group - Status Report (9/19/96)
ADSL Forum 96-134	ADSL MIB Definition (from Alcatel)
ADSL Forum 96-143	ADSL MIB draft version (from ADSL Forum Network Management group)
ADSL Forum 97-008	ADSL Line MIB (from editor John Burgess)
ADSL Forum 97-009	Updates on the ADSL MIB definition
ADSL Forum 97-019	Defining the Need for a Very Simple Network Management Protocol for End-To-End management of the ATU-C and ATU-R
ADSL Forum 97-030	A Network Management Approach to dealing with Dynamic Bandwidth
ADSL Forum 97-053	A Common OAM Interface for UNI and FUNI
ADSL Forum 97-054	An Interface to support SNMP over and ADSL OAM flow
ADSL Forum 97-056	GDMO Representation ADSL Function Model & Information Model
ADSL Forum 97-057	ADSL Issue 2 Measurements and Counter
ADSL Forum 97-059	ATM Layer management for the ATM UNI and FUNI
ADSL Forum 97-067	ADSL MIB Performance Monitoring
ADSL Forum 97-073	Proposal for ADSL LINE MIB Conformance Statements
ADSL Forum 97-074	Comments on the ADSL Forum Network Management Text
ADSL Forum 97-082	A Structure Framework for ADSL Operational Design
ADSL Forum 97-121	A ÒContainerÓ MIB for End-to-End Management of ADSL Networks