INTERNATIONAL TELECOMMUNICATION UNION

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

G.997.1

(05/2003)

SERIES G: TRANSMISSION SYSTEMS AND MEDIA, DIGITAL SYSTEMS AND NETWORKS

Digital sections and digital line system – Access networks

Physical layer management for digital subscriber line (DSL) transceivers

ITU-T Recommendation G.997.1

ITU-T G-SERIES RECOMMENDATIONS

TRANSMISSION SYSTEMS AND MEDIA, DIGITAL SYSTEMS AND NETWORKS

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ITU-T Recommendation G.997.1

Physical layer management for digital subscriber line (DSL) transceivers

Summary

This Recommendation specifies the physical layer management for ADSL transmission systems. It specifies means of communication on a transport transmission channel defined in the physical layer Recommendations G.992.1, G.992.2, G.992.3, G.992.4 and G.992.5. It specifies Network Elements content and syntax for Configuration, Fault and Performance Management.

Source

ITU-T Recommendation G.997.1 was approved by ITU-T Study Group 15 (2001-2004) under the ITU-T Recommendation A.8 procedure on 22 May 2003.

FOREWORD

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The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

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In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

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As of the date of approval of this Recommendation, ITU had received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementors are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database.

CONTENTS

ITU-T Recommendation G.997.1

Physical layer management for digital subscriber line (DSL) transceivers

1 Scope

This Recommendation specifies the physical layer management for ADSL transmission systems based on the usage of indicator bits and EOC messages defined in the G.992.x series of ITU-T Recommendations and the clear embedded operation channel defined in this Recommendation.

It specifies Network Management elements content for configuration, fault and performance management.

The mechanisms to provide OAM functions and to generate OAM flows F1, F2 and F3 will depend on the transport mechanism of the physical layer transmission system as well as on the supervision functions contained within the physical layer termination functions of equipment. This Recommendation only specifies flow F3 – transmission path level.

For interrelationships of this Recommendation with other G.99x-series ITU-T Recommendations, see ITU-T Rec. G.995.1.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

[1] IETF RFC 1157 (1999), *A Simple Network Management Protocol (SNMP)*.

[2] ITU-T Recommendation G.992.1 (1999), *Asymmetric digital subscriber line (ADSL) transceivers*.

[3] ITU-T Recommendation G.992.2 (1999), *Splitterless asymmetric digital subscriber line (ADSL) transceivers*.

[4] ITU-T Recommendation G.994.1 (2003), *Handshake procedures for digital subscriber line (DSL) transceivers*.

[5] ITU-T Recommendation I.610 (1999), *B-ISDN operation and maintenance principles and functions*.

[6] ITU-T I.432.x-series Recommendations, *B-ISDN user-network interface – Physical layer specification*.

[7] ITU-T Recommendation T.35 (2000), *Procedure for the allocation of ITU-T defined codes for non-standard facilities*.

[8] ITU-T Recommendation G.992.3 (2002), *Asymmetric digital subscriber line transceivers 2 (ADSL2)*.

[9] ITU-T Recommendation G.992.4 (2002), *Splitterless asymmetric digital subscriber line transceivers 2 (ADSL2)*.

[10] ITU-T Recommendation G.992.5 (2003), *Asymmetric digital subscriber line (ADSL) transceivers – Extended bandwidth ADSL2 (ADSL2+)*.

3 Definitions

This Recommendation defines the following terms:

3.1 clear EOC: An octet oriented data channel multiplexed in the physical layer transmission frame structure.

3.2 anomaly: An anomaly is a discrepancy between the actual and desired characteristics of an item.

The desired characteristic may be expressed in the form of a specification.

An anomaly may or may not affect the ability of an item to perform a required function.

3.3 defect: A defect is a limited interruption in the ability of an item to perform a required function. It may or may not lead to maintenance action depending on the results of additional analysis.

Successive anomalies causing a decrease in the ability of an item to perform a required function are considered as a defect.

3.4 failure: A failure is the termination of the ability of an item to perform a required function.

NOTE – After failure, the item has a fault.

Analysis of successive anomalies or defects affecting the same item can lead to the item being considered as "failed".

3.5 net data rate: Net data rate is defined in the G.992.x-series ITU-T Recommendations.

4 Abbreviations

This Recommendation uses the following abbreviations:

ADSL	Asymmetric Digital Subscriber Line
AME	ADSL Management Entity
AN	Access Node
AS0 to AS3	Downstream simplex bearer channel designators
ATM	Asynchronous Transfer Mode
ATU-C	ADSL Transceiver Unit-Central office end (i.e., network operator)
ATU-R	ADSL Transceiver Unit-Remote terminal end (i.e., CP)
CRC	Cyclic Redundancy Check
CVF-L	Code Violation-Line (Fast path)
CVI-L	Code Violation-Line (Interleaved path)
DMT	Discrete MultiTone
DSL	Digital Subscriber Line
ECF-L	Forward Error Correction Count Line (Fast path)
ECI-L	Forward Error Correction Count Line (Interleaved path)
ECS-L	Forward Error Correction second-Line
EOC	Embedded Operations Channel
ES	Errored Second
ES-L	Errored Second-Line

FEBE-F	Binary indication of Far-End Block Error count-Fast data
FEBE-I	Binary indication of Far-End Block Error count-Interleaved data
FEC	Forward Error Correction
FFEC-F	Binary indication of Far-end Forward Error Correction count-Fast data
FFEC-I	Binary indication of Far-end Forward Error Correction count-Interleaved data
HDLC	High-level Data Link Control
HDSL	High bit rate Digital Subscriber Line
HEC	Header Error Control
ib0-23	Indicator bits
ID code	Vendor identification code
ISDN	Integrated Services Digital Network
kbit/s	kilo bits per second
LCD	Loss of Cell Delineation
LOF	Loss of Frame
LOS	Loss of Signal
LOSS-L	LOS Second-line
LS0-2	DUPLEX bearer channel designators
LSB	Least Significant Bit
MIB	Management Information Base
MSB	Most Significant Bit
NCD	No Cell Delineation
NE	Network Element
NMS	Network Management System
NT	Network Termination
OAM	Operations, Administration and Maintenance
POTS	Plain Old Telephone Service; one of the services using the voiceband; sometimes used as a descriptor for all voiceband services
PSTN	Public Switched Telephone Network
RDI	Remote Defect Indication
RFI	Remote Failure Indication
SEF	Severely Errored Frame
SES-L	Severely Errored Second-line
SNMP	Simple Network Management Protocol
STM	Synchronous Transfer Mode
T/S	Interface(s) between ADSL network termination and Customer Installation or home network
TC	Transmission Convergence (layer)

TCM	Time Compression Multiplex
TE	Terminal Equipment
T-R	Interface(s) between ATU-R and switching layer (ATM or STM)
TR	Threshold Reports
UAS	Unavailable Seconds
U-C	Loop interface-central office end
U-R	Loop interface-remote terminal end
V-C	Logical interface between ATU-C and a digital network element such as one or more switching systems

5 Overview

Figure 5-1 shows the system reference model for this Recommendation.

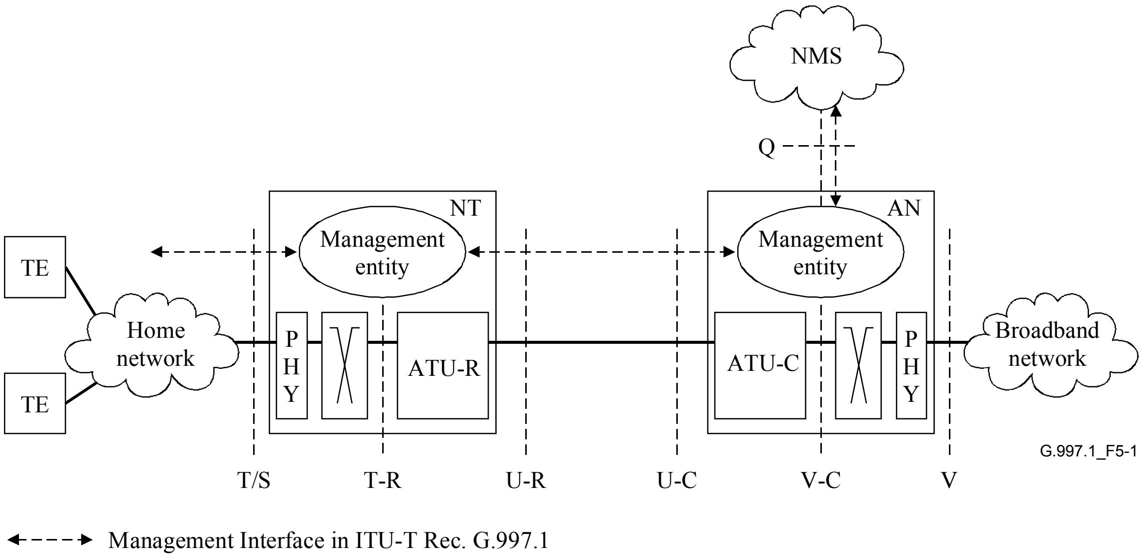


Figure 5-1/G.997.1 – System reference model

There are four management interfaces defined in this Recommendation.

The Q-interface at the AN for Network Management Systems (NMS). All the parameters specified in this Recommendation apply at the Q-interface. The Q-interface provides the interface between the Network Management Systems of the operator and the Management Entity in the Access Node.

The near-end parameters supported in the Management Entity are derived from ATU-C while the far-end parameters (from the ATU-R) can be derived by either of two interfaces over the U-interface:

- By use of the indicator bits and EOC message, which are provided at the PMD layer, can be used to generate the required ATU-R parameters in the Management Entity of the AN.
- By use of the OAM channel and protocol (specified in clause 6) to retrieve the parameters from the ATU-R, when requested by the Management Entity of the AN.

The definition of the transport of the management instrumentation over the Q-interface is outside the scope of this Recommendation.

At the U-interface there are two management interfaces, one at the ATU-C and one at the ATU-R. The main purposes are to provide:

- At the ATU-C: the ATU-C near-end parameters for the ATU-R to retrieve over the U-interface.
- At the ATU-R: the ATU-R near-end parameters for the ATU-C to retrieve over the U-interface.

This Recommendation defines (see clause 6) a method for the communication of the parameters (as defined in clause 7) over the U-interface.

At the T-/S-interface a subset of the parameters specified in this Recommendation may apply. The purpose is to indicate the ADSL link status to the TE. These parameters are maintained by the Management Entity of the NT and are made available over the T-/S-interface.

The far-end parameters (from the ATU-C) can be derived by either of two interfaces over the U-interface:

- By use of the indicator bits and EOC message, which are provided at the PMD layer, can be used to generate the required ATU-C parameters in the Management Entity of the NT.
- By use of the OAM channel and protocol (specified in clause 6) to retrieve the parameters from the ATU-C, when requested by the Management Entity of the NT.

The definition of the transport of this management information over the T-/S-interfaces is outside the scope of this Recommendation.

Dependent on the transceiver Recommendation (e.g., G.992.1 or G.992.2), some of the parameters may not apply (i.e., fast data stream parameters for ITU-T Rec. G.992.2).

5.1 Physical layer management mechanisms

The general definition of OAM for ATM networks is defined in ITU-T Rec. I.610. The physical layer contains the three lowest OAM levels as outlined in Figure 5-2. The allocation of the OAM flows is as follows:

– F1: regenerator section level;

– F2: digital section level;

– F3: transmission path level.

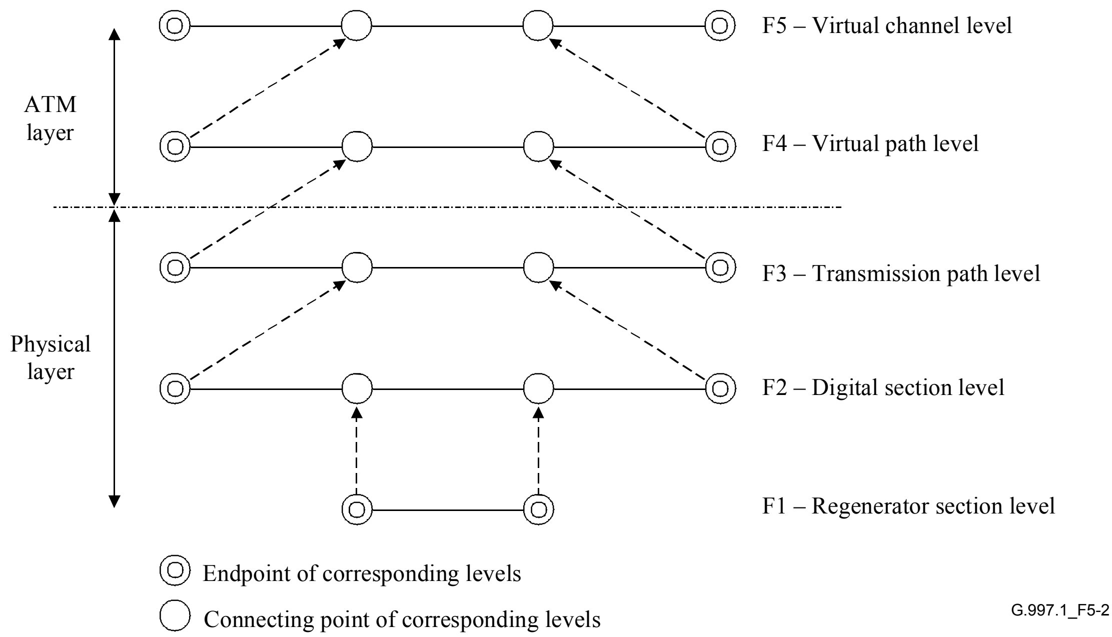


Figure 5-2/G.997.1 – OAM hierarchical levels and their relationship with the ATM layer and physical layer

The physical layer (F1-F3) is in this Recommendation defined as the PMD – Physical Media Dependent layer and the ATM-TC layer. The Physical layer and the ATM layer are coupled from the fault management perspective. When a F3 fault (e.g., LOS) is detected it is reported to the NMS but a F4/F5, as defined in Recommendation I.610, fault is generated as well.

The ADSL LINE (see Figure 5-3) is characterized by a metallic transmission medium utilizing an analogue coding algorithm, which provides both analogue and digital performance monitoring at the line entity. The ADSL LINE is delimited by the two end points, known as line terminations. ADSL LINE terminations are the point, where the analogue coding algorithms end, and the subsequent digital signal is monitored for integrity. The ADSL LINE is defined between the V-D and the T-D reference points.

The ADSL ATM PATH is defined between the V-C and T-R reference points.

The ADSL STM PATH is for further study.

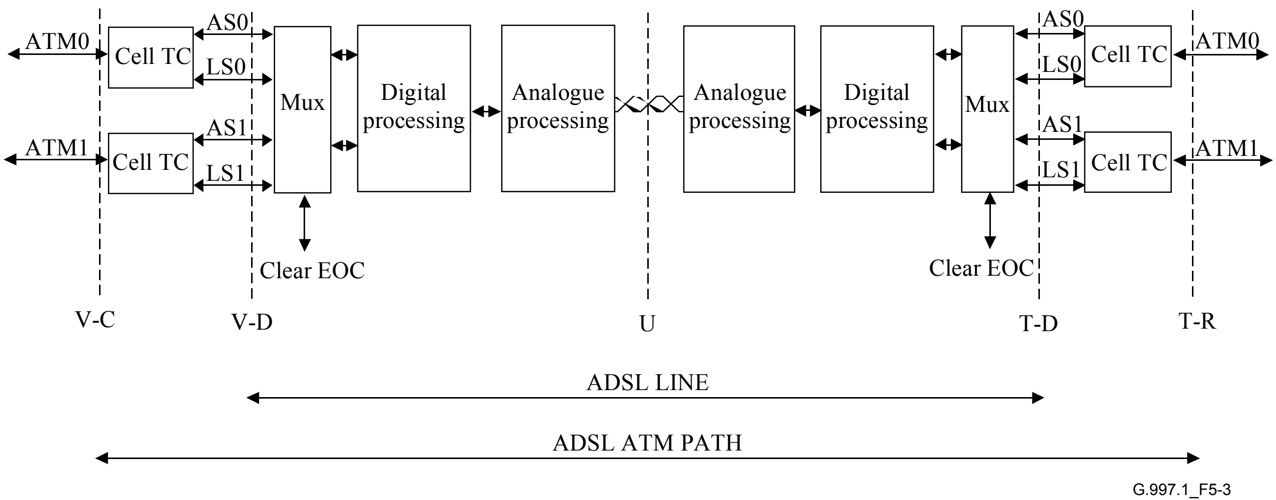


Figure 5-3/G.997.1 – ADSL LINE and ADSL ATM PATH definition

The HDSL LINE (see Figure 5-4) is terminated in the HTU-C and HTU-R. It is also called an Access Digital Section. Within the Access Digital Section a regenerator could be present.

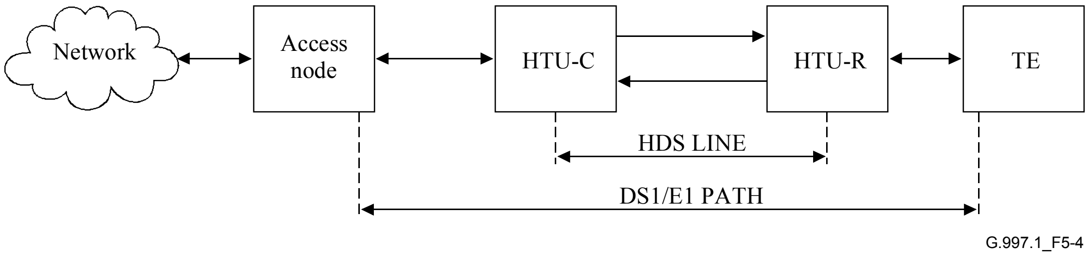


Figure 5-4/G.997.1 – HDSL LINE and PATH definition

6 OAM communications channel

This clause specifies an optional OAM communication channel across the U-interface (see Figure 6-1). If this channel is implemented, the ATU-C and the ATU-R may use it for transporting physical layer OAM messages. If either the ATU-C or the ATU-R do not have the capability of this OAM channel, the far-end parameters, defined in clause 7, at the ATU-C shall be derived from the indicator bits and EOC messages defined in ITU-T Recs G.992.1, G.992.2, G.992.3 and G.992.4. Support for the OAM communication channel defined in this clause will be indicated during initialization by messages defined in ITU-T Rec. G.994.1 for G.992.1 and G.992.2.

NOTE – In those cases where neither the ATU-R nor ATU-C implements this communication channel, there are some reduced physical layer OAM capabilities (see clause 7).

G.99x Recommendations may provide one of two mechanisms to transport physical layer OAM messages either:

– through a bit-oriented clear EOC (e.g., G.992.1, G.992.2), then the channel shall meet the requirements specified in 6.1. The data link layer shall be as specified in 6.3.
– or, through a message-oriented clear EOC (e.g., G.992.3, G.992.4, G.992.5), then the channel shall meet the requirements specified in 6.2. The data link layer shall be as specified in 7.8.2.3, 7.8.2.4 and 9.4.1.8 of G.992.3.

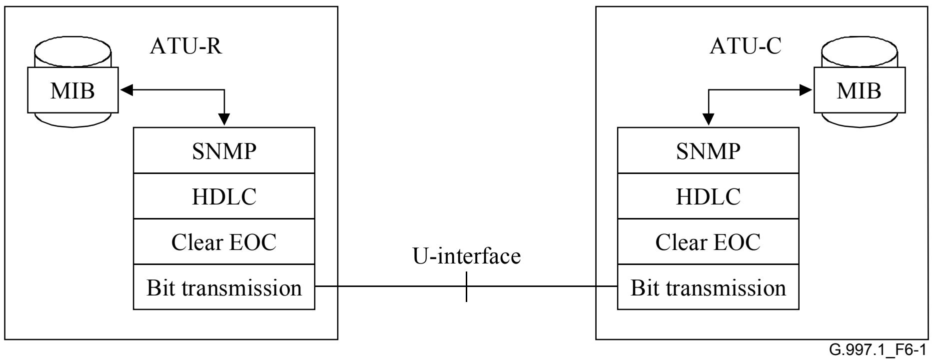


Figure 6-1/G.997.1 – OAM communication channel layers for bit-oriented clear EOC

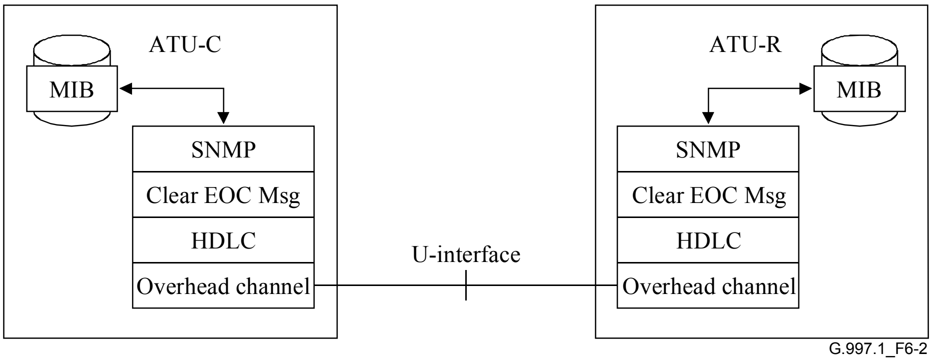


Figure 6-2/G.997.1 – OAM communication channel layers for message-oriented clear EOC

6.1 Requirements on the PMD layer for the bit-oriented clear EOC

In order to support the physical layer OAM protocols defined in this Recommendation, a physical layer Recommendation shall provide a full duplex data channel for support of the data link layer defined in 6.3.

The Clear EOC serves the function of a physical layer of the protocol stack defined in this Recommendation for ITU-T Recs G.992.2 and G.992.1.

1) The Clear EOC shall be a part of the protocol overhead for the particular xDSL line coding.
2) The Clear EOC shall be available to carry traffic whenever the xDSL protocol is in a normal transmission mode (e.g., "showtime").
3) The Clear EOC shall be available regardless of the specific configuration options or run time adaptation of an ATU-C and ATU-R that are communicating.
4) The Clear EOC shall be terminated in the ATU-R and the ATU-C.
5) The Clear EOC shall support traffic of at least 4 kbit/s.
6) The Clear EOC shall support delineation of individual octets in order to support the link level protocol defined in 7.1.
7) The Clear EOC should not support error correction or detection. Error correction and detection is supported by use of the OAM stack defined in this Recommendation.
8) The Clear EOC should not guarantee the delivery of data carried over the channel.
9) The Clear EOC should not support retransmission of data upon error.
10) The Clear EOC should not acknowledge the receipt of data by the far end of the link.
11) The Clear EOC should not require a specific initialization procedure, it can be assumed to be operational whenever the two modems are in synchronization for "showtime" transport of data.

6.2 Requirements on the PMD layer for the message-oriented clear EOC

In order to support the physical layer OAM protocols defined in this Recommendation, a physical layer Recommendation shall provide a full duplex data channel for support of SNMP protocol defined in 6.4.

1) The Clear EOC shall be a part of the protocol overhead for the particular xDSL line coding.
2) The Clear EOC shall be available to carry traffic whenever the xDSL protocol is in a normal transmission mode (e.g., "showtime").
3) The Clear EOC shall be available regardless of the specific configuration options or run time adaptation of an ATU-C and ATU-R that are communicating.
4) The Clear EOC shall be terminated in the ATU-R and the ATU-C.

5) The Clear EOC shall support traffic of at least 4 kbit/s.

6) The Clear EOC shall support delineation of messages through HDLC in order to support the link level protocol defined in 7.1.

7) The Clear EOC should not support retransmission of data upon error.

8) The Clear EOC should not require a specific initialization procedure, it can be assumed to be operational whenever the two modems are in synchronization for "showtime" transport of data.

6.3 Data link layer

For the transport mechanism, an HDLC-like mechanism is proposed with the characteristics detailed in the following subclauses. The defined method is based on ISO/IEC 3309.

NOTE – For ITU-T Recs G.992.3, G.992.4 and G.992.5, the data link layer uses the clear EOC messages embedded in the overhead channel as defined in 7.8.2.3, 7.8.2.4 and 9.4.1.8 of G.992.3. This mechanism supersedes the characteristics presented in the following subclauses.

The main differences between G.997.1 6.3 protocol and G.992.3 protocol are:

– The address field and control field shall be as defined in 7.8.2.4/G.992.3.

– The maximum payload length of G.992.3 is 1024 octets instead of 510 octets.

– The first byte of the payload is always 01_{16} to indicate a clear EOC command.

– Each G.992.3 clear EOC command is acknowledged by the remote side.

6.3.1 Format convention

The basic format convention used for messages is illustrated in Figure 6-3. Bits are grouped into octets. The bits of each octet are shown horizontally and are numbered from 1 to 8. Octets are displayed vertically and are numbered from 1 to N.

The octets are transmitted in ascending numerical order.

The Frame Check Sequence (FCS) field spans two octets: Bit 1 of the first octet is the MSB and bit 8 of the second octet is the LSB (Figure 6-4).

8	7	6	5	4	3	2	1	Octet
								1
								2
								...
								N

Figure 6-3/G.997.1 – Format convention

8	7	6	5	4	3	2	1	Octet
2^8							2^{15}	1
2^0							2^7	2

Figure 6-4/G.997.1 – FCS mapping convention

6.3.2 OAM frame structure

The frame structure is as depicted in Figure 6-5.

$7E_{16}$	Opening Flag
FF_{16}	Address field
03_{16}	Control field = UI frame
Information Payload	Max 510 bytes
FCS	Frame Check Sequence (First octet)
FCS	Frame Check Sequence (Second octet)
$7E_{16}$	Closing Flag

Figure 6-5/G.997.1 – OAM frame structure

The opening and closing flag sequence shall be the octet $7E_{16}$. The address and control field of the frame shall be coded with FF_{16} and 03_{16}, respectively.

Transparency of the information payload to the flag sequence and the frame check sequence are described below.

6.3.3 Octet transparency

In this approach, any data that is equal to $7E_{16}$ (01111110_2) (the Flag Sequence) or $7D_{16}$ (the Control Escape) are escaped as described below.

After Frame Check Sequence (FCS) computation, the transmitter examines the entire frame between the two Flag Sequences. Any data octets which are equal to the Flag Sequence ($7E_{16}$) or the Control Escape ($7D_{16}$D) are replaced by a two-octet sequence consisting of the Control Escape octet followed by the original octet Exclusive-OR'ed with hexadecimal 0x20 (this is bit 5 complemented, where the bit positions are numbered 76543210). In summary, the following substitutions are made:

- a data octet of $7E_{16}$ is encoded as two octets $7D_{16}$, $5E_{16}$
- a data octet of $7D_{16}$ is encoded as two octets $7D_{16}$, $5D_{16}$

On reception, prior to FCS computation, each Control Escape octet ($7D_{16}$) is removed, and the following octet is exclusive-OR'ed with hexadecimal 20_{16} (unless the following octet is $7E_{16}$, which is the flag, and indicates the end of frame, and therefore an abort has occurred). In summary, the following substitutions are made:

- a sequence of $7D_{16}$, $5E_{16}$ is replaced by the data octet $7E_{16}$
- a sequence of $7D_{16}$, $5D_{16}$ is replaced by the data octet $7D_{16}$
- a sequence of $7D_{16}$, $7E_{16}$ aborts the frame

Note that since octet stuffing is used, the data frame is guaranteed to have an integer number of octets.

6.3.4 Frame check sequence

The FCS field is 16 bits (2 octets) in length. As defined in ISO/IEC 3309, it shall be the one's complement of the sum (modulo 2) of:

a) the remainder of $x^k (x^{15} + x^{14} + x^{13} + x^{12} + x^{11} + x^{10} + x^9 + x^8 + x^7 + x^6 + x^5 + x^4 + x^3 + x^2 + x + 1)$ divided (modulo 2) by the generator polynomial $x^{16} + x^{12} + x^5 + 1$, where k is the number of bits in the frame existing between, but not including, the last bit of the final opening flag and the first bit of the FCS, excluding octets inserted for transparency; and

b) the remainder of the division (modulo 2) by the generator polynomial $x^{16} + x^{12} + x^5 + 1$, of the product of x^{16} by the content of the frame existing between, but not including, the last bit of the final opening flag and the first bit of the FCS, excluding octets inserted for transparency.

As a typical implementation at the transmitter, the initial content of the register of the device computing the remainder of the division is preset to all binary ONEs and is then modified by division by the generator polynomial (as described above) on the information field. The one's complement of the resulting remainder is transmitted as the 16-bit FCS.

As a typical implementation at the receiver, the initial content of the register of the device computing the remainder of the division is preset to all binary ONEs. The final remainder, after multiplication by 16 and then division (modulo 2) by the generator polynomial $x^{16} + x^{12} + x^5 + 1$ of the serial incoming protected bits after removal of the transparency octets and the FCS, will be 0001110100001111_2 (x^{15} through x^0, respectively) in the absence of transmission errors.

The FCS is calculated over all bits of the Address, Control, and Information payload fields of the frame.

The register used to calculate the CRC shall be initialized to the value $FFFF_{16}$, both at the transmitter and the receiver.

The LSB of the FCS is sent first, followed by the MSB.

On the receiver a message received without errors results in a CRC calculation of $F0B8_{16}$.

6.3.5 Invalid frames

The following conditions result in an invalid frame:

- Frames which are too short (less than 4 octets in between flags not including transparency octets).
- Frames which contain a Control Escape octet followed immediately by a Flag (i.e., $7D_{16}$, $7E_{16}$).
- Frames which contain control escape sequences other than $7D_{16}$, $5E_{16}$ and $7D_{16}$, $5D_{16}$.

Invalid frames shall be discarded. The receiver shall immediately start looking for the beginning flag of a subsequent frame.

6.3.6 Synchronism

The EOC frame structure transport is octet synchronous. Octet transport and synchronism for this transport is defined in accordance with the TC layer.

6.3.7 Time fill

Inter-frame time fill is accomplished by inserting additional flag octets ($7E_{16}$) between the closing and the subsequent opening flag on the EOC transport channel. Inter-octet time fill is not supported.

6.4 The SNMP protocol

If implemented, SNMP messages shall be used as the message encoding over the HDLC data link channel defined in 6.2 for ITU-T Recs G.992.1 and G.992.2; or over the clear EOC message embedded in the overhead channel as defined in clauses 7.8.2.3, 7.8.2.4 and 9.4.1.8 of G.992.3 for ITU-T Recs G.992.3 and G.992.4.

6.4.1 SNMP message mapping in HDLC frames

This clause applies only to Recommendations defining a bit-oriented clear EOC (e.g., G.992.1, G.992.2).

The SNMP messages are placed directly in the HDLC frame together with the protocol identifier (see Figure 6-6). The protocol identifier is two bytes ahead of the SNMP message. The two bytes contain the ethertype SNMP value $814C_{16}$ as defined in RFC 1700. A single HDLC frame is used to transport each SNMP message.

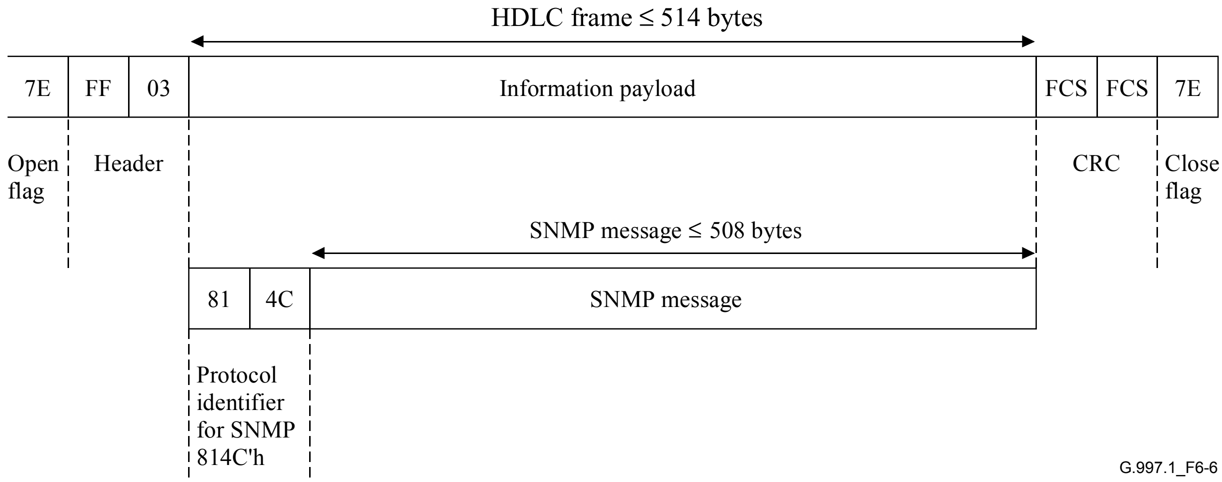


Figure 6-6/G.997.1 – OAM communication channel protocol over the U-Interface

The length of an SNMP message shall be less than or equal to 508 bytes.

Due to the transparency mechanism described in 6.3.3, the number of bytes actually transmitted in between opening and closing flag may be higher than 514.

6.4.2 SNMP message mapping in clear EOC messages

This clause applies only to Recommendations defining message-oriented clear EOC (e.g., G.992.3, G.992.4).

The SNMP messages are placed directly in the clear EOC messages together with the protocol identifier (see Figure 6-7). The protocol identifier is two bytes ahead of the SNMP message. The two bytes contain the ethertype SNMP value $814C_{16}$ as defined in RFC 1700. A single HDLC frame is used to transport each SNMP message.

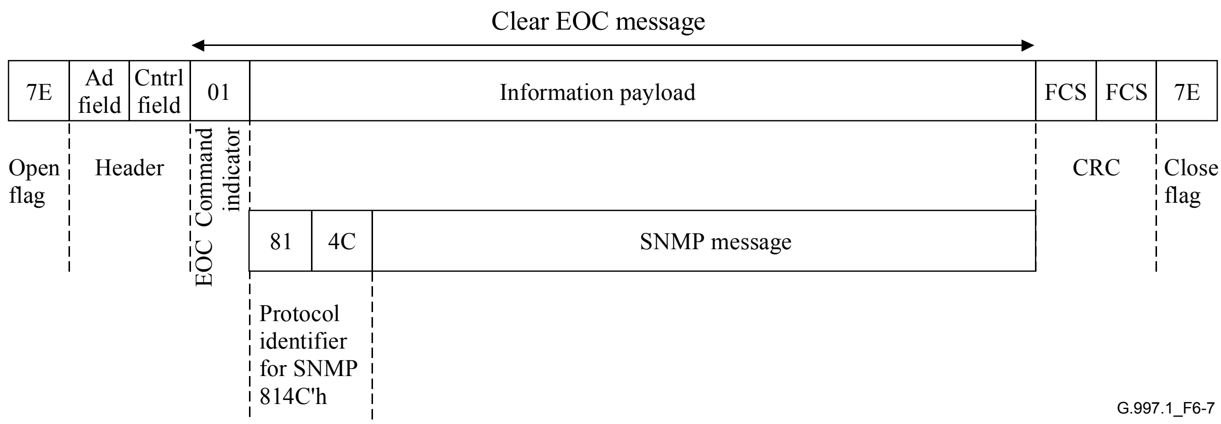


Figure 6-7/G.997.1 – OAM communication channel protocol over the U-interface

The length of an SNMP message shall be less than or equal to 508 bytes.

Due to the transparency mechanism described in 6.3.3, the number of bytes actually transmitted in between opening and closing flag may be greater than 515.

6.4.3 Protocol based on SNMP

The SNMP protocol as defined in [1] consists of four types of operations, which are used to manipulate management information. These are:

Get	Used to retrieve specific management information.
Get-Next	Used to retrieve, via traversal of the MIB, management information.
Set	Used to alter management information.
Trap	Used to report extraordinary events.

These four operations are implemented using five types of PDUs:

GetRequest-PDU	Used to request a Get operation.
GetNextRequest-PDU	Used to request a Get-Next operation.
GetResponse-PDU	Used to respond to a Get, Get-Next, or Set operation.
SetRequest-PDU	Used to request a Set operation.
Trap-PDU	Used to report a Trap operation.

If implemented, SNMP messages shall be used according to the following requirements.

6.4.3.1 Use of EOC channel

The ADSL OAM channel will be used for sending HDLC-encapsulated SNMP messages between adjacent AME's.

An AME-ADSL Management Entity residing in the ATU-R and ATU-C will send and interpret these SNMP messages. This ADSL OAM channel is used for requests, responses, and traps, differentiated according to the SNMP PDU type.

6.4.3.2 Message format

The message format specified in [1] shall be used. That is, messages shall be formatted according to SNMP version 1.

All SNMP messages shall use the community name "ADSL", that is, the OCTET STRING value: "$4144534C_{16}$".

In all SNMP Traps, the agent-addr field (which has syntax NetworkAddress), shall always have the IpAddress value: 0.0.0.0.

In all SNMP Traps, the time-stamp field in the Trap-PDU shall contain the value of an AME's MIB object at the time of trap generation.

In any standard SNMP Trap, the enterprise field in the Trap-PDU shall contain the value of the agent's sysObjectID MIB object (sysObjectID is defined in the system group of MIB-II).

6.4.3.3 Message sizes

All ADSL OAM implementations shall be able to support SNMP messages of size up to and including 508 octets.

6.4.3.4 Message response time

Response time refers to the elapsed time from the submission of an SNMP message (e.g., GetRequest, GetNextRequest or SetRequest message) by an AME across an ADSL Interface to the receipt of the corresponding SNMP message (e.g., GetResponse message) from the adjacent

AME. An SNMP GetRequest, GetNextRequest, or SetRequest message is defined in this context as a request concerning a single object.

The AME shall support maximum Response Times of 1 s for 95% of all SNMP GetRequests, GetNextRequests or SetRequests containing a single object received from an adjacent AME independent of the ADSL Interface's physical line rate.

6.4.3.5 Object value data correctness

Data correctness refers to the maximum elapsed time since an object value in the ADSL Interface MIB was known to be current. The following specifies the requirements on the Data Correctness of the ADSL OAM objects and the event notifications.

The ADSL Interface MIB objects shall have the Data Correctness of a maximum of 30 s.

The AME shall support event notifications (i.e., SNMP Traps) for generic SNMP events within 2 s of the event detection by the AME.

7 Management Information Base (MIB) elements

The Management Information Base (MIB) contains six types of information:

- Fault monitoring – Failures (alarm indications);
- Fault monitoring – Threshold crossing (alert messages);
- Performance monitoring parameters (counters);
- Configuration parameters;
- Inventory parameters;
- Test, diagnostic and status parameters.

Figure 7-1 shows the In-service performance monitoring process. The primitives are specified in the physical layer of G.992.x.-series ITU-T Recommendations.

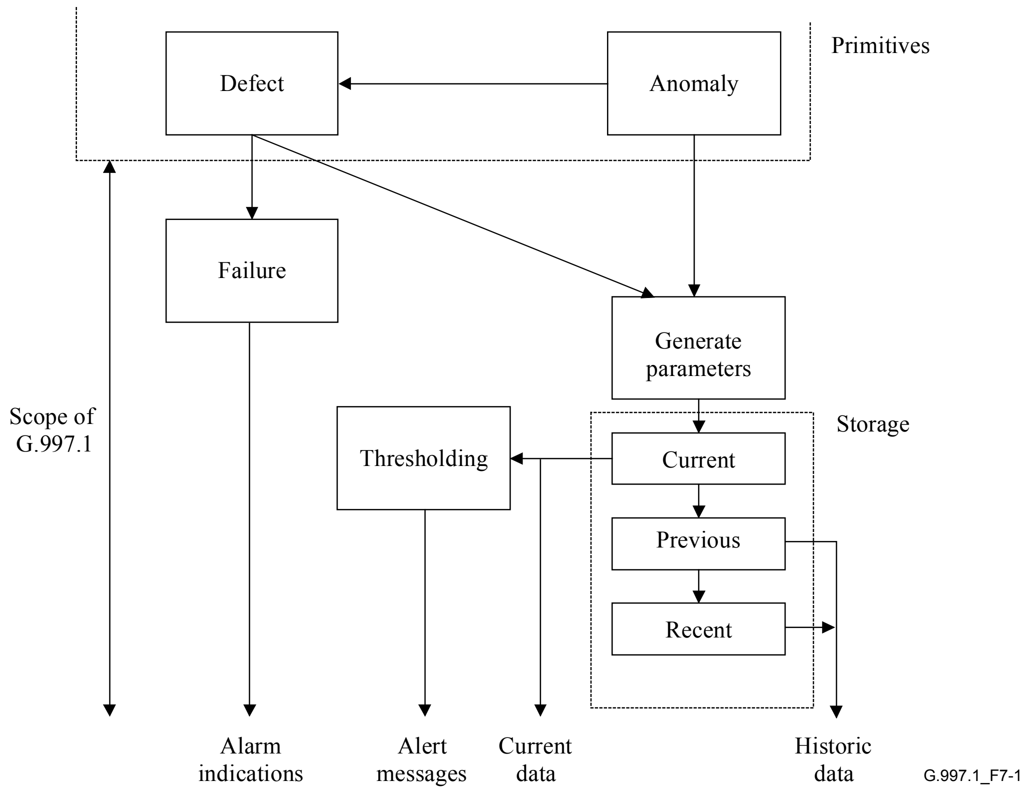


Figure 7-1/G.997.1 – In-service performance monitoring process

As an Access Node can handle a large number of ATU-Cs (e.g., hundreds or perhaps thousands of ADSL lines), provisioning every parameter on every ATU-C may become burdensome. In response, two modes have been created to define ADSL equipment configuration data profiles, as well as a mechanism to associate the equipment to these profiles. Profile tables may be implemented in one of two ways, but not simultaneously:

- MODE-I: Dynamic Profiles – one profile shared by one or multiple ADSL lines.

  Implementations using this mode will enable the operator of the system to dynamically create and delete profiles as needed. One or more ADSL lines may be configured to share parameters of a single profile (e.g., adslLineConfProfileName = 'silver') by setting its adslLineConfProfile objects to the index value of this profile. If a change is made to the profile, all lines that refer to it will be re-configured to the changed parameters. Before a profile can be deleted or taken out of service, it shall be first unreferenced from all associated lines.

- MODE-II: Static Profiles – one profile per ADSL physical line always.

  Implementations with this mode will automatically create a profile one-for-one with each ADSL line. The name of this profile is a system generated read-only object whose value is equivalent to the index of the line. The management agent in the Access Node will not allow the operator of the system to create/delete profiles in this mode.

NOTE – For more details on the use of profiles, refer to the IETF RFC 2662.

At the Q-interface, a line is configured by linking the following information to the line (see Figure 7-2):

- One Line Configuration Profile (see Table 7-9) for the line;
- One Channel Configuration Profile (see Table 7-11) for each downstream and each upstream bearer channel;
- One Data Path Configuration Profile (see Table 7-13) for each downstream and each upstream bearer channel.

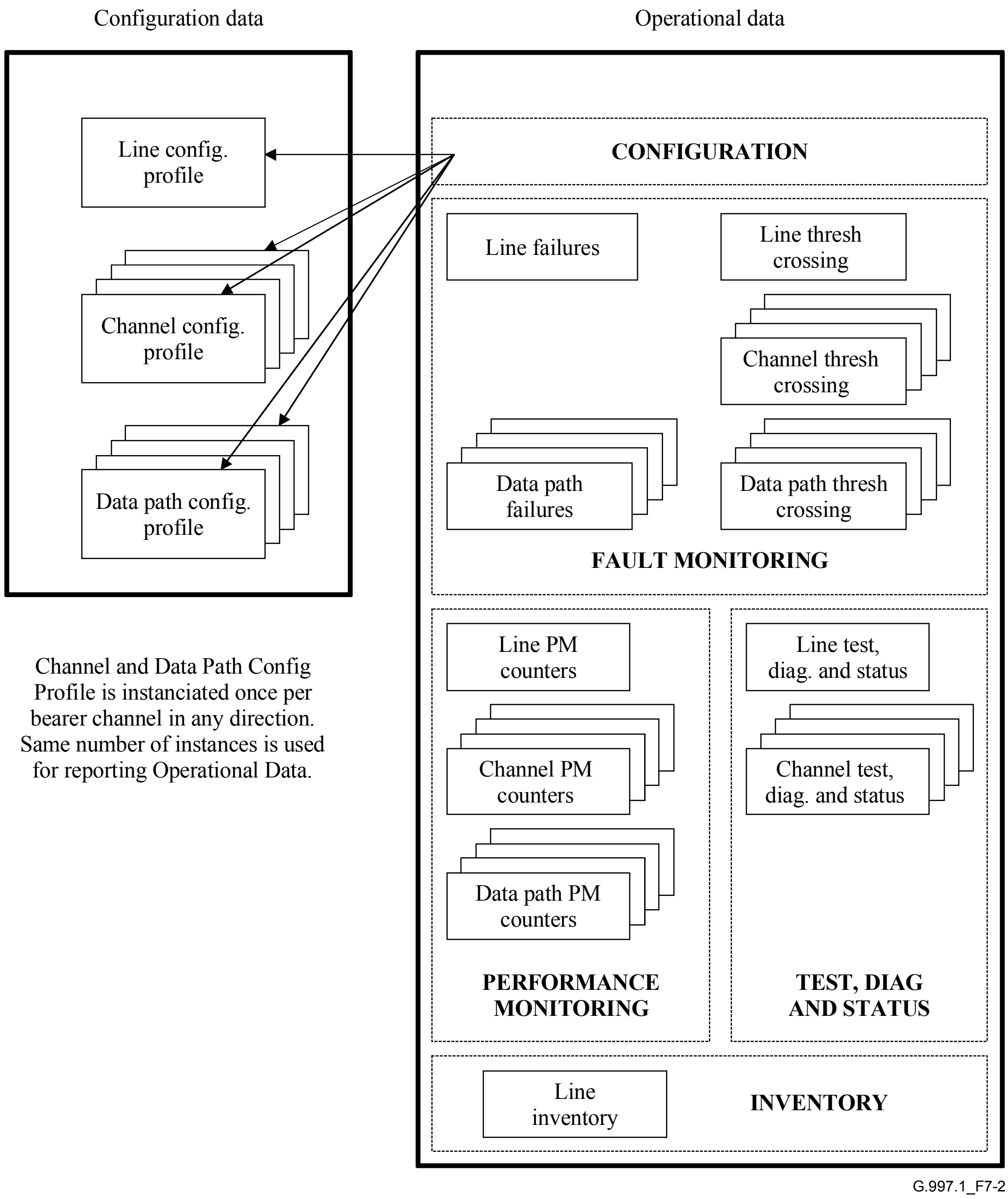


Figure 7-2/G.997.1 – Overview of the MIB elements provided for each line

Some or all of the configuration parameters contained in the Line, Channel and Data Path Configuration Profiles linked to the line, may be written and/or read, depending on the interface under consideration:

Q interface: Management interface towards the ATU-C, from the network side perspective.

U-C interface: Management interface towards the ATU-C, from the ATU-R's perspective.

U-R interface: Management interface towards the ATU-C, from the ATU-R's perspective.

T/S interface: Management interface towards the ATU-R, from the premises side perspective.

In 7.5, a detailed list is given of the management elements applying to each of these interfaces,with indication whether they are mandatory or optional and whether they can be read, written or both.

7.1 Failures

Any failure defined in this clause shall be conveyed to the NMS by the ATU-C (over the Q-interface) and should be conveyed to the NMS by the ATU-R (over the T-/S-interface) after it is detected.

The near-end failure detections shall be provided at the ATU-C and shall be provided at the ATU-R.

The far-end failure detections shall be provided at the ATU-C (ATU-R is at the far-end), and may be provided at the ATU-R (ATU-C is at the far-end).

7.1.1 Line failures

7.1.1.1 Line near-end failures

7.1.1.1.1 Loss-of-signal (LOS) failure

An LOS failure is declared after 2.5 ± 0.5 s of contiguous LOS defect, or, if LOS defect is present when the criteria for LOF failure declaration have been met (see LOF definition below). A LOS failure is cleared after 10 ± 0.5 s of no LOS defect.

7.1.1.1.2 Loss-of-frame (LOF) failure

An LOF failure is declared after 2.5 ± 0.5 s of contiguous SEF defect, except when an LOS defect or failure is present (see LOS definition above). A LOF failure is cleared when LOS failure is declared, or after 10 ± 0.5 s of no SEF defect.

7.1.1.1.3 Loss-of-power (LPR) failure

An LPR failure is declared after 2.5 ± 0.5 s of contiguous near-end LPR primitive presence. An LPR failure is cleared after 10 ± 0.5 s of no near-end LPR primitive presence.

7.1.1.2 Line far-end failures

7.1.1.2.1 Far-end Loss-of-Signal (LOS-FE) failure

A far-end Loss of Signal – LOS-FE failure is declared after 2.5 ± 0.5 s of contiguous far-end LOS defect, or, if far-end LOS defect is present when the criteria for LOF failure declaration have been met (see LOF definition below). A far-end LOS failure is cleared after 10 ± 0.5 s of no far-end LOS defect.

7.1.1.2.2 Far-end Loss-of-frame (LOF-FE) failure

A far-end Loss of Frame – LOF-FE failure is declared after 2.5 ± 0.5 s of contiguous RDI defect, except when a far-end LOS defect or failure is present (see LOS definition above). A far-end LOF failure is cleared when far-end LOS failure is declared, or after 10 ± 0.5 s of no RDI defect.

7.1.1.2.3 Far-end Loss-of-Power (LPR-FE) failure

A far-end Loss of power – LPR-FE failure is declared after the occurrence of a far-end LPR primitive followed by 2.5 ± 0.5 s of contiguous near-end LOS defect. A far-end LPR failure is cleared after 10 ± 0.5 s of no near-end LOS defect.

7.1.1.3 Line Initialization (LINIT) failure

If the line is forced to the L0 state (or into loop diagnostics mode) and an attempt to reach the L0 state (or to succesfully complete the loop diagnostics procedures) fails (after a vendor discretionary number of retries and/or within a vendor discretionary timeout), then an Initialization Failure occurs. An Initialization Failure cause and Last Successful Transmitted State is given with the Line Initialization Failure (see 7.5.1.3). A Line Initialization failure shall be conveyed to the

NMS by the ATU-C (over the Q-interface) and should be conveyed to the NMS by the ATU-R (over the T-/S-interface) after it is detected.

7.1.2 Channel failures

No channel failures are defined.

7.1.3 STM data path failures

The STM Data Path Failures are for further study.

7.1.4 ATM data path failures

7.1.4.1 ATM data path near-end failures

7.1.4.1.1 No Cell Delineation (NCD) failure

An NCD failure is declared when an NCD anomaly persists for more than 2.5 ± 0.5 s after the start of SHOWTIME. An NCD failure terminates when no NCD anomaly is present for more than 10 ± 0.5 s.

7.1.4.1.2 Loss of Cell Delineation (LCD) failure

An LCD failure is declared when an LCD defect persists for more than 2.5 ± 0.5 s. An LCD failure terminates when no LCD defect is present for more than 10 ± 0.5 s.

7.1.4.2 ATM data path far-end failures

7.1.4.2.1 Far-end No Cell Delineation (NCD-FE) failure

An NCD-FE failure is declared when an NCD-FE anomaly persists for more than 2.5 ± 0.5 s after the start of SHOWTIME. An NCD-FE failure terminates when no NCD-FE anomaly is present for more than 10 ± 0.5 s.

7.1.4.2.2 Far-end Loss of Cell Delineation (LCD-FE) failure

An LCD-FE failure is declared when an LCD-FE defect persists for more than 2.5 ± 0.5 s. An LCD-FE failure terminates when no LCD-FE defect is present for more than 10 ± 0.5 s.

7.1.5 PTM Data Path failures

The PTM Data Path Failures are for further study.

7.2 Performance monitoring functions

Near-end performance monitoring (PM) functions shall be provided at the ATU-C and at the ATU-R. Far-end performance monitoring functions shall be provided at the ATU-C (ATU-R is at the far-end) and are optional at the ATU-R (ATU-C is at the far-end).

If the line is forced to the L0 state (see 7.3.1.3), then Performance Monitoring counters are active, irrespective of the actual Power management state of the line (see 7.5.1.2). If the line is forced to the L3 state, then all Performance Monitoring counters are frozen, including the UAS counter.

7.2.1 Line performance monitoring parameters

This clause defines a set of Line performance monitoring parameters. Support of the performance parameters in a network element is indicated as mandatory (M) or optional (O) in Table 7-1.

7.2.1.1 Near-end Line Performance monitoring parameters

7.2.1.1.1 Forward Error Correction second – line (FECS-L)

This parameter is a count of 1-second intervals with one or more FEC anomalies summed over all received bearer channels.

7.2.1.1.2 Errored second – line (ES-L)

This parameter is a count of 1-second intervals with one or more CRC-8 anomalies summed over all received bearer channels, or one or more LOS defects, or one or more SEF defects, or one or more LPR defects.

7.2.1.1.3 Severely errored second – line (SES-L)

This parameter is a count of 1-second intervals with 18 or more CRC-8 anomalies summed over all received bearer channels, or one or more LOS defects, or one or more SEF defects, or one or more LPR defects.

If a common CRC is applied over multiple bearer channels, then each related CRC-8 anomaly shall be counted only once for the whole set of bearer channels over which the CRC is applied.

7.2.1.1.4 LOS second – Line (LOSS-L)

This parameter is a count of 1-second intervals containing one or more LOS defects.

7.2.1.1.5 Unavailable second – Line (UAS-L)

This parameter is a count of 1-second intervals for which the ADSL line is unavailable. The ADSL line becomes unavailable at the onset of 10 contiguous SES-Ls. The 10 SES-Ls are included in unavailable time. Once unavailable, the ADSL line becomes available at the onset of 10 contiguous seconds with no SES-Ls. The 10 seconds with no SES-Ls are excluded from unavailable time. Some parameter counts are inhibited during unavailability – see 7.2.7.13.

7.2.1.2 Far-end Line performance monitoring parameters

7.2.1.2.1 Forward Error Correction second – Line far-end (FECS-LFE)

This parameter is a count of 1-second intervals with one or more FFEC anomalies summed over all transmitted bearer channels.

7.2.1.2.2 Errored second – Line far-end (ES-LFE)

This parameter is a count of 1-second intervals with one or more FEBE anomalies summed over all transmitted bearer channels, or one or more LOS-FE defects, or one or more RDI defects, or one or more LPR-FE defects.

7.2.1.2.3 Severely Errored Second – Line far-end (SES-LFE)

This parameter is a count of 1-second intervals with 18 or more FEBE anomalies summed over all transmitted bearer channels, or one or more far-end LOS defects, or one or more RDI defects, or one or more LPR-FE defects.

If a CRC is applied over multiple bearer channels, then each related FEBE anomaly shall be counted only once for the whole set of related bearer channels.

7.2.1.2.4 LOS second – Line far-end (LOSS-LFE)

This parameter is a count of 1-second intervals containing one or more far-end LOS defects.

7.2.1.2.5 Unavailable seconds – Line far-end (UAS-LFE)

This parameter is a count of 1-second intervals for which the far-end ADSL line is unavailable.

The far-end ADSL line becomes unavailable at the onset of 10 contiguous SES-LFEs. The 10 SES-LFEs are included in unavailable time. Once unavailable, the far-end ADSL line becomes available at the onset of 10 contiguous seconds with no SES-LFEs. The 10 seconds with no SES-LFEs are excluded from unavailable time. Some parameter counts are inhibited during unavailability – see 7.2.7.13.

7.2.1.3 Line initialization performance monitoring parameters

7.2.1.3.1 Full initialization count

This parameter is a count of the total number of full initializations attempted on the line (successful and failed) during the accumulation period. Parameter procedures shall be as defined in 7.2.7.

7.2.1.3.2 Failed full initialization count

This performance parameter is a count of the total number of failed full initializations during the accumulation period. A failed full initialization is when showtime is not reached at the end of the full initialization procedure, e.g., when:

- A CRC error is detected.
- A time-out occurs.
- Unexpected message content is received.

Parameter procedures shall be as defined in 7.2.7.

7.2.1.3.3 Short initialization count

This parameter is a count of the total number of fast retrains or short initializations attempted on the line (successful and failed) during the accumulation period. Parameter procedures shall be as defined in 7.2.7.

Fast Retrain is defined in ITU-T Rec. G.992.2.

Short Initialization is defined in ITU-T Recs G.992.3 and G.992.4.

7.2.1.3.4 Failed short initialization count

This performance parameter is a count of the total number of failed fast retrains or short initializations during the accumulation period. A failed fast retrain or short initialization is when showtime is not reached at the end of the fast retrain or short initialization procedure, e.g., when:

- A CRC error is detected.
- A time-out occurs.
- A fast retrain profile is unknown.

Parameter procedures shall be as defined in 7.2.7.

7.2.2 Channel performance monitoring parameters

This clause defines a set of Channel performance monitoring parameters. Support of the performance parameters in a network element is indicated as mandatory (M) or optional (O) in Table 7-2.

7.2.2.1 Channel near-end performance monitoring parameters

7.2.2.1.1 Code violation – Channel (CV-C)

This parameter is a count of CRC-8 anomalies (the number of incorrect CRC) occurring in the bearer channel during the accumulation period. This parameter is subject to inhibiting – see 7.2.7.13.

If the CRC is applied over multiple bearer channels, then each related CRC-8 anomaly shall increment each of the counters related to the individual bearer channels.

7.2.2.1.2 Forward Error Correction – Channel (FEC-C)

This parameter is a count of FEC anomalies (the number of corrected code words) occurring in the bearer channel during the accumulation period. This parameter is subject to inhibiting – see 7.2.7.13.

If FEC is applied over multiple bearer channels, then each related FEC anomaly shall increment each of the counters related to the individual bearer channels.

7.2.2.2 Channel far-end performance monitoring parameters

7.2.2.2.1 Code Violation – Channel far-end (CV-CFE)

This parameter is a count of FEBE anomalies occurring in the bearer channel during the accumulation period. This parameter is subject to inhibiting – see 7.2.7.13.

If the CRC is applied over multiple bearer channels, then each related FEBE anomaly shall increment each of the counters related to the individual bearer channels.

7.2.2.2.2 Forward Error Correction – Channel far-end (FEC-CFE)

This parameter is a count of FFEC anomalies occurring in the bearer channel during the accumulation period. This parameter is subject to inhibiting – see 7.2.7.13.

If FEC is applied over multiple bearer channels, then each related FFEC anomaly shall increment each of the counters related to the individual bearer channels.

7.2.3 STM Data Path performance monitoring parameters

The STM channel performance monitoring parameters are for further study.

7.2.4 ATM Data Path performance monitoring parameters

This clause defines a set of ATM Data Path performance monitoring parameters using the cell transfer outcomes. Support of the performance parameters in a network element is indicated as mandatory (M) or optional (O) in Table 7-3.

NOTE – The far-end parameters cannot be supported using only the indicator bits or EOC messages specified in ITU-T Rec. G.992.1 or ITU-T Rec. G.992.2. They may be provided using the OAM communication channel specified in clause 6.

7.2.4.1 ATM Data Path near-end performance monitoring parameters

7.2.4.1.1 Near-end HEC violation count (HEC-P)

The near-end HEC_violation_count performance parameter is a count of the number of occurrences of a near-end HEC anomaly in the ATM Data Path.

7.2.4.1.2 Near-end delineated total cell count (CD-P)

The near-end delineated_total_cell_count performance parameter is a count of the total number of cells passed through the cell delineation and HEC function process operating on the ATM Data Path while in the SYNC state.

7.2.4.1.3 Near-end User total cell count (CU-P)

The near-end User_total_cell_count performance parameter is a count of the total number of cells in the ATM Data Path delivered at the V-C (for ATU-C) or T-R (for ATU-R) interface.

7.2.4.1.4 Near-end Idle Cell Bit Error Count (IBE-P)

The near-end idle_bit_error_count performance parameter in a count of the number of bit errors in the idle cell payload received in the ATM Data Path at the near-end.

NOTE – The idle cell payload is defined in ITU-T Recs I.361 and I.432.

7.2.4.2 ATM Data Path far-end performance monitoring parameters

7.2.4.2.1 Far-end HEC violation count (HEC-PFE)

The far-end HEC_violation_count performance parameter is a count of the number of occurrences of a far-end HEC anomaly in the ATM Data Path.

7.2.4.2.2 Far-end delineated total cell count (CD-PFE)

The far-end delineated_total_cell_count performance parameter is a count of the total number of cells passed through the cell delineation process and HEC function operating on the ATM Data Path while in the SYNC state.

7.2.4.2.3 Far-end User total cell count (CU-PFE)

The far-end User_total_cell_count performance parameter is a count of the total number of cells in the ATM Data Path delivered at the V-C (for ATU-C) or T-R (for ATU-R) interface.

7.2.4.2.4 Far-end Idle Cell Bit Error Count (IBE-PFE)

The far-end idle_bit_error_count performance parameter is a count of the number of bit errors in the idle cell payload received in the ATM Data Path at the far-end.

7.2.5 PTM Data Path performance monitoring parameters

The PTM Channel performance monitoring parameters are for further study.

7.2.6 Performance monitoring data collection

Parameter definitions, failure definitions, and other indications, parameters, and signals are defined above and in Tables 7-1, 7-2 and 7-3. Functions are indicated as mandatory (M) or optional (O). Mandatory functions shall be met for performance monitoring. Optional functions should be provided according to the needs of the users.

Table 7-1/G.997.1 – Line performance monitoring parameter definitions

Name	Text subclause	End	Use at ATU-C	Use at ATU-R	Definition
FECS-L		Near	M	M	FEC ≥ 1 for one or more bearer channels
FECS-LFE		Far	M	O	FFEC ≥ 1 for one or more bearer channels
ES-L		Near	M	M	CRC-8 ≥ 1 for one or more bearer channels **OR** LOS ≥ 1 **OR** SEF ≥ 1 **OR** LPR ≥ 1
ES-LFE		Far	M	O	FEBE ≥ 1 for one or more bearer channels **OR** LOS-FE ≥ 1 **OR** RDI ≥ 1 **OR** LPR-FE ≥ 1
SES-L		Near	M	M	(CRC-8 summed over all bearer channels) ≥ 18 **OR** LOS ≥ 1 **OR** SEF ≥ 1 **OR** LPR ≥ 1
SES-LFE		Far	M	O	(FEBE summed over all bearer channels) ≥ 18 **OR** LOS-FE ≥ 1 **OR** RDI ≥ 1 **OR** LPR-FE ≥ 1
LOSS-L		Near	O	O	LOS ≥ 1
LOSS-LFE		Far	O	O	LOS-FE ≥ 1
UAS-L		Near	M	M	A second of unavailability
UAS-LFE		Far	M	O	A second of unavailability

Table 7-1/G.997.1 – Line performance monitoring parameter definitions

NOTE 1 – Note that **OR** represents a logical OR of two conditions. NOTE 2 – Unavailability begins at the onset of 10 contiguous severely errored seconds, and ends at the onset of 10 contiguous seconds with no severely errored seconds. NOTE 3 – If a common CRC or FEC is applied over multiple bearer channels, then each related CRC-8 or FEC anomaly shall be counted only once for the whole set of bearer channels over which the CRC or FEC is applied.

Table 7-2/G.997.1 – Channel performance monitoring parameter definitions

Name	Text subclause	End	Use at ATU-C	Use at ATU-R	Definition
CV-C		Near	M	M	Count of CRC-8 anomalies in the bearer channel
CV-CFE		Far	M	O	Count of FEBE anomalies in the bearer channel
EC-C		Near	M	M	Count of FEC anomalies in the bearer channel
EC-CFE		Far	M	O	Count of FFEC anomalies in the bearer channel

Table7-3/G.997.1 – ATM data path performance monitoring parameter definitions

Name	Text subclause	End	Use at ATU-C	Use at ATU-R	Definition
HEC-P		Near	M	M	Count of HEC anomalies in the bearer channel
HEC-PFE		Far	M	O	Count of FHEC anomalies in the bearer channel
CD-P		Near	M	M	Count of delineated cells in the bearer channel
CD-PFE		Far	M	O	Count of delineated cells in the bearer channel
CU-P		Near	M	M	Count of cells to user in the bearer channel
CU-PFE		Far	M	O	Count of cells to user in the bearer channel
IBE-P		Near	M	M	Count of idle cell payload bit errors in the bearer channel
IBE-PFE		Far	M	O	Count of idle cell payload bit errors in the bearer channel

The line performance monitoring parameters (Table 7-1) are observed for downstream and upstream directions. In the downstream direction, the near-end line performance monitoring parameters are observed by the ATU-R and far-end line performance monitoring parameters are observed by the ATU-C. In the upstream direction, near-end line performance monitoring parameters are observed by the ATU-C and far-end line performance monitoring parameters are observed by the ATU-R.

For a downstream bearer channel, near-end channel (Table 7-2) and ATM Data Path (Table 7-3, if applicable) performance monitoring parameters are observed by the ATU-R and far-end performance monitoring parameters are observed by the ATU-C. For an upstream bearer channel, near-end channel and ATM Data Path performance monitoring parameters are observed by the ATU-C and far-end performance monitoring parameters are observed by the ATU-R.

7.2.7 Procedures for performance monitoring functions

The functions described in this subclause can be performed inside or outside the network element.

7.2.7.1 Line transmission states

A line can be in one of two transmission states:

- unavailable state;
- available state.

The transmission state is determined from filtered SES/non-SES data. The definition of unavailable state is defined in 7.2.1.1.5. An ADSL Line is available when it is not unavailable.

7.2.7.2 Threshold reports

A TR is an unsolicited error performance report from a ME – Management Entity – over the Q-interface and from the ATU-R over the U-interface with respect to either a 15-minute or 24-hour evaluation period. TRs can only occur when the concerned direction is in the available state. At the Q-interface, TRs for near-end and far-end ES, SES and UAS parameters are mandatory and TRs for the other defined parameters are optional. Threshold reports are not provided at the T-/S-interface.

TR1s shall occur within 10 seconds after the 15-minute threshold is reached or exceeded.

TR2s shall occur within 10 seconds after the 24-hour threshold is reached or exceeded.

7.2.7.3 Unavailable and available state filters

The unavailable state filter is a 10-second rectangular sliding window with 1-second granularity of slide.

The available state filter is also a 10-second rectangular sliding window with 1-second granularity of slide.

7.2.7.4 TR1 filter

The TR1 filter are 15-minute rectangular fixed windows. The start and end times for the 15-minute rectangular fixed windows shall fall on the hour and at 15, 30 and 45 minutes after the hour.

7.2.7.5 TR2 filter

The TR2 filter is a 24-hour rectangular fixed window. The start and end times for the 24-hour rectangular fixed windows shall fall on a 15-minute window boundary.

7.2.7.6 Evaluation of TR1

The parameters are counted separately, second by second, over each 15-minute rectangular fixed window period. The threshold values should be programmable over the range 0 to 900 with default values. The default values are given in ITU-T Recs M.2100 and M.2101.1.

A threshold can be crossed at any second within the 15-minute rectangular fixed window. As soon as a threshold is crossed, a TR1 as appropriate should be sent to the performance management centre together with a date/time-stamp. Moreover, performance events should continue to be counted to the end of the current 15-minute period, at which time the current parameter counts are stored in the history registers and the current parameter registers are reset to zero.

7.2.7.7 Evaluation of TR2

The parameters are counted separately over each 24-hour period. The threshold values should be programmable with default values.

The network element shall recognize a 24-hour threshold crossing within 15 minutes of its occurrence. The threshold crossing shall be given the date/time-stamp of the moment of recognition. A TR2 as appropriate should be sent to the performance management centre with the date/time-stamp. Moreover, performance events should continue to be counted to the end of the current 24-hour period, at which time the parameter counts are stored in the history registers and the current parameter registers are reset to zero.

7.2.7.8 Threshold report evaluation during transmission state changes

Care should be taken to ensure that threshold reports are correctly generated and parameter counters are correctly processed during changes in the transmission state. This implies that all threshold reports should be delayed by 10 seconds (see ITU-T Rec. M.2120).

7.2.7.9 Performance history storage in network elements

The parameters for ME performance history storage at the Q-interface that shall be supported are ES, SES and UAS. Performance history storage for the other defined parameters is optional.

There shall be a current 15-minute (which can also facilitate the TR1 filter) register plus a further *N* 15-minute history registers for each parameter in each ME. The *N* 15-minute history registers are used as a stack, i.e., the value held in each register is pushed down the stack one place at the end of each 15-minute period, and the oldest register value at the bottom of the stack is discarded.

The N for the parameters ES, SES and UAS shall be at least 16. For the other parameters N shall be at least 1 (i.e., only current and previous value is required).

There shall be a current 24-hour register (which can also facilitate the TR2 filter) plus one previous 24-hour register for each parameter.

As a minimum, an invalid data flag shall be provided for each stored interval for each direction for each monitored transmission entity. For example:

An invalid data flag is set to indicate that the data stored is incomplete or otherwise invalid when:

- The data in the previous and recent intervals has been accumulated over a period of time that is greater or less than the nominal accumulation period duration.
- The data in the current interval is suspect because a terminal is restarted or a register is reset in the middle of an accumulation period.
- The data is incomplete in an accumulation period. For example, an incoming transmission failure or defect may prevent complete collection of far-end performance reports.

The invalid data flag is not set as a result of register saturation.

7.2.7.10 Register size

Every performance parameter register shall be large enough to accumulate all integer numbers from zero to a particular maximum value, which determines the minimum register size for that parameter. When the maximum value of a register is reached, the register shall remain at that maximum value until it is reset, or the value is transferred or discarded, as described in this clause. Minimum register sizes are 16 bits.

7.2.7.11 Parameter counts

All parameter counts shall be actual counts for the 15-minute filtering period.

Although all parameter counts should (ideally) also be actual for the 24-hour filtering periods, it is recognized that it might be desirable to limit register sizes. In such cases register overflow may occur. Should register overflow occur, the registers shall hold their maximum value for the parameter considered until the registers are read and reset at the end of the 24-hour period. An implementation involving setting and resetting an overflow bit may be used.

7.2.7.12 Date/time-stamping of reports

The date/time-stamping accuracy of reports, together with the method of maintaining the accuracy, is under study.

The format for date/time-stamps is as follows:

- 15-minute window will be stamped Year, Month Day, Hour, Minute;
- 24-hour window will be stamped Year, Month, Day, Hour;
- Unavailable Time events will be stamped Year, Month, Day , Hour, Minute, Second;
- Alarms will be stamped either at the declaration of the alarm by the equipment or at the exact time of the event (to be decided) with Year, Month, Day, Hour, Minute, Second.

Equipment clock accuracy requirements are for further study.

7.2.7.13 Inhibiting performance monitoring parameters

For a given monitored entity, the accumulation of certain performance parameters is inhibited during periods of unavailability, during SESs or during seconds containing defects on that monitored entity. Inhibiting on a given monitored entity (e.g., ADSL ATM Data Path) is not explicitly effected by conditions on any other monitored entity (ADSL line). The inhibiting rules are as follows:

- UAS and Failure Count parameters shall not be inhibited.
- All other performance parameter counts shall be inhibited during UAS and SES. Inhibiting shall be retroactive to the onset of unavailable time and shall end retroactively to the end of unavailable time.

7.3 Configuration functions

7.3.1 Line configuration parameters

7.3.1.1 State configuration parameters

7.3.1.1.1 ATU Transmission System Enabling (ATSE)

This configuration parameter defines the transmission system coding types to be allowed by the near-end ATU on this line. This parameter only applies to the Q-interface. It is coded in a bit-map representation (0 if not allowed, 1 if allowed) with following definition:

Bit	Representation
Octet 1	
1	Regional standards (see Note).
2	Regional standards (see Note).
3	G.992.1 operation over POTS non-overlapped spectrum (Annex A/G.992.1).
4	G.992.1 operation over POTS overlapped spectrum (Annex A/G.992.1).
5	G.992.1 operation over ISDN non-overlapped spectrum (Annex B/G.992.1).
6	G.992.1 operation over ISDN overlapped spectrum (Annex B/G.992.1).
7	G.992.1 operation in conjunction with TCM-ISDN non-overlapped spectrum (Annex C/G.992.1).
8	G.992.1 operation in conjunction with TCM-ISDN overlapped spectrum (Annex C/G.992.1).
Octet 2	
9	G.992.2 operation over POTS non-overlapped spectrum (Annex A/G.992.2).
10	G.992.2 operation over POTS overlapped spectrum (Annex B/G.992.2).
11	G.992.2 operation in conjunction with TCM-ISDN non-overlapped spectrum (Annex C/G.992.2).
12	G.992.2 operation in conjunction with TCM-ISDN overlapped spectrum (Annex C/G.992.2).
13	Reserved.
14	Reserved.

15 Reserved.

16 Reserved.

Octet 3

17 Reserved.

18 Reserved.

19 G.992.3 operation over POTS non-overlapped spectrum (Annex A/G.992.3).

20 G.992.3 operation over POTS overlapped spectrum (Annex A/G.992.3).

21 G.992.3 operation over ISDN non-overlapped spectrum (Annex B/G.992.3).

22 G.992.3 operation over ISDN overlapped spectrum (Annex B/G.992.3).

23 Reserved.

24 Reserved.

Octet 4

25 G.992.4 operation over POTS non-overlapped spectrum (Annex A/G.992.4).

26 G.992.4 operation over POTS overlapped spectrum (Annex A/G.992.4).

27 Reserved.

28 Reserved.

29 G.992.3 All Digital Mode operation with non-overlapped spectrum (Annex I/G.992.3).

30 G.992.3 All Digital Mode operation with overlapped spectrum (Annex I/G.992.3).

31 G.992.3 All Digital Mode operation with non-overlapped spectrum (Annex J/G.992.3).

32 G.992.3 All Digital Mode operation with overlapped spectrum (Annex J/G.992.3).

Octet 5

33 G.992.4 All Digital Mode operation with non-overlapped spectrum (Annex I/G.992.4).

34 G.992.4 All Digital Mode operation with overlapped spectrum (Annex I/G.992.4).

35 Reserved.

36 Reserved.

37 Reserved.

38 Reserved.

39 Reserved.

40 Reserved.

Octet 6

41 G.992.5 operation over POTS non-overlapped spectrum (Annex A/G.992.5).

42 G.992.5 operation over POTS overlapped spectrum (Annex A/G.992.5).

43 G.992.5 operation over ISDN non-overlapped spectrum (Annex B/G.992.5).

44 G.992.5 operation over ISDN overlapped spectrum (Annex B/G.992.5).

45 Reserved.

46 Reserved.

47 G.992.5 All Digital Mode operation with non-overlapped spectrum (Annex I/G.992.5).

48 G.992.5 All Digital Mode operation with overlapped spectrum (Annex I/G.992.5).

Octet 7

49 Reserved.

50 Reserved.

51 Reserved.

52 Reserved.

53 Reserved.

54 Reserved.

55 Reserved.

56 Reserved.

NOTE – It is recommended that the bit 1 be used for the ANSI T1.413-1998 Standard. It is recommended that the bit 2 be used for the Annex C of TS 101 388 v1.3.1.

7.3.1.1.2 ATU Impedance State forced (AISF)

This configuration parameter defines the impedance state to be forced on the near-end ATU. It applies only to the T-/S-interface. It is coded as an integer value with following definition:

1 Force the near-end ATU to the disabled state.

2 Force the near-end ATU to the inactive state.

3 Force the near-end ATU to the active state.

Impedance states only to the G.992.3 Annex A operation mode and are defined in A.4.1/G.992.3.

7.3.1.1.3 Power management state forced (PMSF)

This configuration parameter defines the line states to be forced by the near-end ATU on this line. It is coded as an integer value with following definition:

0 Force the line to transition from the L3 idle state to the L0 full-on state. This transition requires the (short) initialization procedures. After reaching the L0 state, the line may transition into or exit from the L2 low power state (if L2 state is enabled). If the L0 state is not reached (after a vendor discretionary number of retries and/or within a vendor discretionary timeout), then an Initialization Failure occurs. Whenever the line is in the L3 state, attemps shall be made to transition to the L0 state until it is forced into another state through this configuration parameter.

2 Force the line to transition from L0 full on to L2 low power state. This transition requires the entry into L2 mode. This is a out-of-service test value for triggering the L2 mode.

3 Force the line to transition from the L0 full-on or L2 low power state to the L3 idle state. This transition requires the (orderly) shutdown procedure. After reaching the L3 state, the line shall remain in the L3 idle state until it is forced into another state through this configuration parameter.

Forced line state transitions require the line to enter or exit from the L3 idle state. These transitions are not restricted by the Line state enabling parameter value.

NOTE – This configuration parameter maps to the AdminStatus of the line, which is part of the GeneralInformationGroup object group specified in RFC 2233, and may not need to be duplicated in the ADSL MIB. See also RFC 2662. The Administrative Status of the line is UP when the line is forced to the L0 state and is DOWN when the line is forced to the L3 state.

7.3.1.1.4 Power Management State Enabling (PMMode)

This configuration parameter defines the line states the ATU-C or ATU-R may autonomously transition to on this line. It is coded in a bit-map representation (0 if not allowed, 1 if allowed) with following definition:

Bit 0 L3 state (Idle state)

Bit 1 L1/L2 state (Low power state)

7.3.1.1.5 Minimum L0 time interval between L2 exit and next L2 entry (L0-TIME)

This parameter represents the minimum time (in seconds) between an Exit from the L2 state and the next Entry into the L2 state. It ranges from 0 to 255 seconds.

7.3.1.1.6 Minimum L2 time interval between L2 entry and first L2 trim (L2-TIME)

This parameter represents the minimum time (in seconds) between an Entry into the L2 state and the first Power Trim in the L2 state and between two consecutive Power Trims in the L2 State. It ranges from 0 to 255 seconds.

7.3.1.1.7 Maximum aggregate transmit power reduction per L2 trim (L2-ATPR)

This parameter represents the maximum aggregate transmit power reduction (in dB) that can be performed through a single Power Trim in the L2 state. It ranges from 0 dB to 31 dB.

7.3.1.1.8 Loop Diagnostics Mode forced (LDSF)

This configuration parameter defines whether the line should be forced into the loop diagnostics mode by the near-end ATU on this line. It is coded as an integer value with following definition:

0 Inhibits the near-end ATU from performing loop diagnostics mode procedures on the line. Loop diagnostic mode procedures may still be initiated by the far-end ATU.

1 Forces the near-end ATU to perform the loop diagnostics procedures.

The line needs to be forced to the L3 state (see 7.3.1.1.3) before it can be forced to the loop diagnostics mode. Only while the line power management state is the L3 state (see 7.5.1.2), the line can be forced into the loop diagnostics mode procedures. When the loop diagnostics mode procedures are completed succesfully, the Access Node shall reset the LDSF MIB element to 0 and the line shall return to remain in the L3 idle state. The loop diagnostics data shall be available at least until the line is forced to the L0 state (see 7.3.1.1.3). If the loop diagnostics procedures cannot be completed succesfully, (after a vendor discretionary number of retries and/or within a vendor discretionary timeout), then an Initialization Failure occurs. As long as loop diagnostics procedures are not completed succesfully, attemps shall be made to do so, until the loop diagnostics mode is no longer forced on the line through this configuration parameter.

7.3.1.2 Power/PSD configuration parameters

7.3.1.2.1 Downstream Maximum Nominal Power Spectral Density (MAXNOMPSDds)

This parameter represents the maximum nominal transmit PSD in the downstream direction during initialization and showtime (in dBm/Hz). It ranges from –60 to –40 dBm/Hz, with 0.1 dB steps.

7.3.1.2.2 Upstream Maximum Nominal Power Spectral Density (MAXNOMPSDus)

This parameter represents the maximum nominal transmit PSD in the upstream direction during initialization and showtime (in dBm/Hz). It ranges from –60 to –38 dBm/Hz, with 0.1 dB steps.

7.3.1.2.3 Downstream Maximum Nominal Aggregate Transmit Power (MAXNOMATPds)

This parameter represents the maximum nominal aggregate transmit power in the downstream direction during initialization and showtime (in dBm). It ranges from 0 to 25.5 dBm, with 0.1 dB steps.

7.3.1.2.4 Upstream Maximum Nominal Aggregate Transmit Power (MAXNOMATPus)

This parameter represents the maximum nominal aggregate transmit power in the upstream direction during initialization and showtime (in dBm). It ranges from 0 to 25.5 dBm, with 0.1 dB steps.

7.3.1.2.5 Upstream Maximum Aggregate Receive Power (MAXRXPWRus)

This parameter represents the maximum upstream aggregate receive power over a set of subcarriers (in dBm) as specified in the relevant Recommendation. The ATU-C shall request an upstream power cutback such that the upstream aggregate receive power over that set of subcarriers is at or below the configured maximum value. It ranges from –25.5 to 25.5 dBm, with 0.1 dB steps. A special value is used to indicate that no Upstream Maximum Aggregate Receive Power limit is to be applied (i.e., the maximum value is infinite).

7.3.1.2.6 Downstream subcarrier masking (CARMASKds)

This configuration parameter is an array of boolean values sc(i). Each entry sc(i) defines whether subcarrier index i is masked on this line in the downstream direction, for i ranging from 0 to NSCds-1. It is coded as 1 if masked and 0 if not masked. This parameter only applies to the Q-interface.

NSCds is the higher subcarrier that can be transmitted in the downstream direction. For G.992.3 and G.992.4, it is defined in the corresponding Recommendations. For G.992.1, NSCds = 256 and for G.992.2, NSCds = 128.

7.3.1.2.7 Upstream subcarrier masking/enabling (CARMASKus)

This configuration parameter is an array of boolean values sc(i). Each entry sc(i) defines whether transmission of subcarrier index i is allowed on this line in the upstream direction, for i ranging from 0 to NSCus-1. It is coded as 0 if not allowed and 1 if allowed. This parameter only applies to the Q-interface.

NSCus is the higher subcarrier that can be transmitted in the upstream direction. For G.992.3 and G.992.4, it is defined in the corresponding Recommendation. For G.992.1 Annex A and G.992.2, NSCus = 32 and for G.992.1 Annex B, NSCus = 64.

7.3.1.2.8 Downstream PSD Mask (PSDMASKds)

This configuration parameter defines the downstream PSD mask applicable at the U-C2 reference point. This MIB PSD mask may impose PSD restrictions in addition to the Limit PSD mask defined in the relevant Recommendation (e.g., G.992.5).

The downstream PSD mask in the CO-MIB shall be specified through a set of breakpoints. Each breakpoint shall consist of a subcarrier index t and a MIB PSD mask level (expressed in dBm/Hz) at that subcarrier. The set of breakpoints can then be represented as $[(t_1, PSD_1), (t_2, PSD_2), \ldots , (t_N, PSD_N)]$. The subcarrier index shall be coded as an unsigned integer. The MIB PSD mask level shall be coded as an unsigned integer representing the MIB PSD mask levels 0 dBm/Hz (coded as 0) to –95 dBm/Hz (coded as 255), in steps of 0.5 dBm/Hz. The maximum number of breakpoints is 32.

The requirements for a valid set of breakpoints are defined in the relevant Recommendations (e.g., G.992.5).

7.3.1.2.9 Downstream RFI bands (RFIBANDSds)

This configuration parameter defines the subset of downstream PSD mask breakpoints, as specified in PSDMASKds, that shall be used to notch an RFI band. This subset consists of couples of consecutive subcarrier indices belonging to breakpoints: [ti; ti + 1], corresponding to the low level of the notch.

The specific interpolation around these points is defined in the relevant Recommendations (e.g., G.992.5).

The CO-MIB shall define the RFI notches using breakpoints in the PSDMASKds as specified in the relevant Recommendations (e.g., G.992.5).

7.3.1.3 Noise Margin configuration parameters

The following configuration parameters are defined to control the Noise Margin in the receive direction in the ATU. A downstream Noise Margin applies to the ATU-R, an upstream Noise Margin applies to the ATU-C.

NOTE – The Noise Margin should be controlled to ensure operation at the target BER (Bit Error Ratio) for each of the received bearer channels, or better. Figure 7-3 shows the relationship between these parameters. They will be described in detail in the following subclauses.

	Reduce Power
Maximum Noise Margin	--
	Increase Rate if Noise Margin > Upshift Noise Margin for Upshift Interval
Upshift Noise Margin	--
	Steady State Operation
Target Noise Margin	--
	Steady State Operation
Downshift Noise Margin	--
	Decrease Rate if Noise Margin < Downshift Noise Margin for Downshift Interval
Minimum Noise Margin	--
	Increase Power. If not possible – reinitialize

NOTE 1 – Upshift Noise Margin, and Downshift Noise Margin are only supported for Rate Adaptive Mode.

NOTE 2 – Minimum Noise Margin ≤ Downshift Noise Margin ≤ Target Noise Margin ≤ Upshift Noise Margin ≤ Maximum Noise Margin.

Figure 7-3/G.997.1 – Noise margins

7.3.1.3.1 Downstream Target Noise Margin (TARSNRMds)

This is the Noise Margin the ATU-R receiver shall achieve, relative to the BER requirement for each of the downstream bearer channels, or better, to successfully complete initialization. The target noise margin ranges from 0 to 31 dB with 0.1 dB steps.

7.3.1.3.2 Upstream Target Noise Margin (TARSNRMus)

This is the Noise Margin the ATU-C receiver shall achieve, relative to the BER requirement for each of the upstream bearer channels, or better, to successfully complete initialization. The target noise margin ranges from 0 to 31 dB with 0.1 dB steps.

7.3.1.3.3 Downstream Maximum Noise Margin (MAXSNRMds)

This is the maximum noise margin the ATU-R receiver shall try to sustain. If the Noise Margin is above this level, the ATU-R shall request the ATU-C to reduce the ATU-C transmit power to get a noise margin below this limit (if this functionality is supported – see Note). The maximum noise margin ranges from 0 to 31 dB with 0.1 dB steps. A special value is used to indicate that no Maximum Noise Margin limit is to be applied (i.e., the maximum value is infinite).

NOTE – This functionality should be supported by ADSL transmission systems. This functionality shall be supported by ADSL2 transmission systems.

7.3.1.3.4 Upstream Maximum Noise Margin (MAXSNRMus)

This is the maximum noise margin the ATU-C receiver shall try to sustain. If the Noise Margin is above this level, the ATU-C shall request the ATU-R to reduce the ATU-R transmit power to get a noise margin that is below this limit (if this functionality is supported – see Note). The maximum noise margin ranges from 0 to 31 dB with 0.1 dB steps. A special value is used to indicate that no Maximum Noise Margin limit is to be applied (i.e., the maximum value is infinite).

NOTE – This functionality should be supported by ADSL transmission systems. This functionality shall be supported by ADSL2 transmission systems.

7.3.1.3.5 Downstream Minimum Noise Margin (MINSNRMds)

This is the minimum Noise Margin the ATU-R receiver shall tolerate. If the noise margin falls below this level, the ATU-R shall request the ATU-C to increase the ATU-C transmit power. If an increase to ATU-C transmit power is not possible, a loss-of-margin (LOM) defect occurs, the ATU-R shall fail and attempt to re-initialize and the NMS shall be notified. The minimum noise margin ranges from 0 to 31 dB with 0.1 dB steps.

7.3.1.3.6 Upstream Minimum Noise Margin (MINSNRMus)

This is the minimum Noise Margin the ATU-C receiver shall tolerate. If the noise margin falls below this level, the ATU-C shall request the ATU-R to increase the ATU-R transmit power. If an increase of ATU-R transmit power is not possible, a loss-of-margin (LOM) defect occurs, the ATU-C shall fail and attempt to re-initialize and the NMS shall be notified. The minimum noise margin ranges from 0 to 31 dB with 0.1 dB steps.

7.3.1.4 Rate Adaptation configuration parameters

The following configuration parameters are defined to manage the Rate-Adaptive behaviour in the transmit direction for both the ATU-C and the ATU-R. An ATU-C Rate Adaptation Mode applies to the upstream direction. An ATU-R Rate Adaptation Mode applies to the downstream direction.

7.3.1.4.1 Downstream Rate Adaptation Mode (RA-MODEds)

This parameter specifies the mode of operation of a rate-adaptive ATU-C in the transmit direction. The parameter can take three values.

Mode 1: MANUAL – Rate changed manually.

At startup:

The Downstream Minimum Data Rate parameter specifies the data rate the ATU-C transmitter shall operate at for each of the bearer channels, with a downstream noise margin which is at least as large as the specified Downstream Target Noise Margin, relative to the required BER for each of the downstream bearer channels, or better. If the ATU-C fails to achieve the Downstream Minimum Data Rate for one of the bearer channels, the ATU-C will fail to initialize, and the NMS will be notified. Although the ATU-C and the line might be able to support a higher data rate, the ATU-C shall not transmit a higher data rate than what is requested for each of the bearer channels.

At showtime:

The ATU-C transmitter shall maintain the specified Downstream Minimum Data Rate for each of the bearer channels.

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

At startup:

The Downstream Minimum Rate parameter specifies the minimum data rate the ATU-C transmitter shall operate at for each of the bearer channels, with a downstream noise margin which is at least as large as the specified Downstream Target Noise Margin, relative to the required BER for each of the bearer channels, or better. If the ATU-C fails to achieve the Downstream Minimum Data Rate for one of the bearer channels, the ATU-C will fail to initialize, and the NMS will be notified. If the ATU-C transmitter is able to support a higher downstream data rate at initialization, the excess data rate will be distributed amongst the downstream bearer channels according to the ratio (0 to 100%) specified by the Rate Adaptation Ratio parameter for each bearer channel (adding up to 100% over all bearer channels). When the Downstream Maximum Data Rate is achieved in one of the bearer channels, then the remaining excess bit rate is assigned to the other bearer channels, still according to their relative Rate Adaptation Ratio parameters. As long as the downstream data rate is below the Downstream maximum Data Rate for one of the bearer channels, data rate increase shall take priority over transmit power reduction.

At showtime:

During showtime, no downstream data rate adaptation is allowed. The downstream data rate, which has been settled during initialization for each of the bearer channels, shall be maintained.

Mode 3: DYNAMIC – Data rate is automatically selected at initialization and is continuously adapted during operation (showtime). The DYNAMIC Rate Adaptation mode is optional. All related configuration parameters are also optional.

At startup:

In Mode 3, the ATU-C 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 data rate amongst the bearer channels (see Mode 2), and assuring that the Downstream Minimum Data Rate remains available at the required BER for each of the bearer channels or better. The downstream data rate can vary between the Downstream Minimum Data Rate, and the Downstream Maximum Data Rate. Downstream Rate Adaptation is performed when the conditions specified for Downstream Upshift Noise Margin and Downstream Upshift Interval – or for Downstream Downshift Noise Margin and Downstream Downshift Interval – are satisfied. This means:

– For an Upshift action: Allowed when the downstream noise margin is above the Downstream Upshift Noise Margin during Downstream Minimum Time Interval for Upshift Rate Adaptation (i.e., upon RAU anomaly).
– For a Downshift action: Allowed when the downstream noise margin is below the Downstream Downshift Noise Margin during Downstream Minimum Time Interval for Downshift Rate Adaptation (i.e., upon RAD anomaly).

As long as the downstream data rate is below the Downstream Maximum Data Rate for one of the bearer channels, data rate increase shall take priority over transmit power reduction.

7.3.1.4.2 Upstream Rate Adaptation Mode (RA-MODEus)

This parameter specifies the mode of operation of a rate-adaptive ATU-R in the transmit direction. The parameter is used only if the rate-adaptive functionality is supported and can take three values (MANUAL, AT_INIT, DYNAMIC). The definition of each of the values is identical to their definition in the Downstream Rate Adaptation Mode (with replacing of ATU-C with ATU-R and downstream with upstream).

7.3.1.4.3 Downstream Up-shift Noise Margin (RA-USNRMds)

If the downstream noise margin is above the Downstream Upshift Noise Margin and stays above that for more than the time specified by the Downstream Minimum Upshift Rate Adaptation Interval, the ATU-R shall attempt to increase the downstream net data rate. The Downstream Up-shift Noise Margin ranges from 0 to 31 dB with 0.1 dB steps.

7.3.1.4.4 Upstream Up-shift Noise Margin (RA-USNRMus)

If the upstream noise margin is above the Upstream Up-shift Noise Margin and stays above that for more than the time specified by the Upstream Minimum Upshift Rate Adaptation Interval, the ATU-C shall attempt to increase the upstream net data rate. The Upstream Up-shift Noise Margin ranges from 0 to 31 dB with 0.1 dB steps.

7.3.1.4.5 Downstream Minimum Time Interval for Up-shift Rate Adaptation (RA-UTIMEds)

This parameter defines the interval of time the downstream noise margin should stay above the Downstream Up-shift Noise Margin before the ATU-R shall attempt to increase the downstream net data rate. The time interval ranges from 0 to 16383 s.

7.3.1.4.6 Upstream Minimum Time Interval for Up-shift Rate Adaptation (RA-UTIMEus)

This parameter defines the interval of time the upstream noise margin should stay above the Upstream Up-shift Noise Margin before the ATU-C shall attempt to increase the upstream net data rate. The time interval ranges from 0 to 16383 s.

7.3.1.4.7 Downstream Down-shift Noise Margin (RA-DSNRMds)

If the downstream noise margin is below the Downstream Down-shift Noise Margin and stays below that for more than the time specified by the Downstream Minimum Downshift Rate Adaptation Interval, the ATU-R shall attempt to decrease the downstream net data rate. The Downstream Down-shift Noise Margin ranges from 0 to 31 dB with 0.1 dB steps.

7.3.1.4.8 Upstream Down-shift Noise Margin (RA-DSNRMus)

If the upstream noise margin is below the Upstream Down-shift Noise Margin and stays below that for more than the time specified by the Upstream Minimum Downshift Rate Adaptation Interval, the ATU-C shall attempt to decrease the upstream net data rate. The Upstream Down-shift Noise Margin ranges from 0 to 31 dB with 0.1 dB steps.

7.3.1.4.9 Downstream Minimum Time Interval for Downshift Rate Adaptation (RA-DTIMEds)

This parameter defines the interval of time the downstream noise margin should stay below the Downstream Down-shift Noise Margin before the ATU-R shall attempt to decrease the downstream net data rate. The time interval ranges from 0 to 16383 s.

7.3.1.4.10 Upstream Minimum Time Interval for Downshift Rate Adaptation (RA-DTIMEus)

This parameter defines the interval of time the upstream noise margin should stay below the Upstream Downshift Noise Margin before the ATU-C shall attempt to decrease the upstream net data rate. The time interval ranges from 0 to 16383 s.

7.3.1.5 Line overhead configuration parameters

These parameters are used for testing purpose.

7.3.1.5.1 Minimum Overhead Rate Upstream (MSGMINus)

This parameter defines the minimum rate of the message based overhead that shall be maintained by the ATU in upstream direction. MSGMINus is expressed in bits per second and ranges from 4000 to 64 000 bit/s.

7.3.1.5.2 Minimum Overhead Rate Downstream (MSGMINds)

This parameter defines the minimum rate of the message based overhead that shall be maintained by the ATU in downstream direction. MSGMINds is expressed in bits per second and ranges from 4000 to 64 000 bit/s.

7.3.1.6 Line performance monitoring parameter thresholds

All Line performance monitoring parameters (counters, see Table 7-1) shall have an individual 15-minute and 24-hour threshold parameter if supported.

7.3.2 Channel configuration parameters

7.3.2.1 Data rate configuration parameters

These data rate parameters refer to the transmit direction for both the ATU-C and the ATU-R and apply to the configuration of an individual upstream or downstream bearer channel. The two data rate parameters define the data rate minimum and maximum bounds as specified by the operator of the system (the operator of the ATU-C). It is assumed that the ATU-C and the ATU-R will interpret the value set by the operator as appropriate for the specific implementation of ADSL between the ATU-C and the ATU-R in setting the line rates. This model defined in this interface makes no assumptions about the possible range of these attributes. The Network Management System used by the operator to manage the ATU-R and the 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.

7.3.2.1.1 Minimum data rate

This parameter specifies the minimum net data rate for the bearer channel as desired by the operator of the system. The rate is coded in bit/s.

7.3.2.1.2 Minimum reserved data rate

This parameter specifies the minimum reserved net data rate for the bearer channel as desired by the operator of the system. The rate is coded in bit/s.

This parameter is optional. It is used only if the Rate Adaptation Mode is set to DYNAMIC.

7.3.2.1.3 Maximum data rate

This parameter specifies the maximum net data rate for the bearer channel as desired by the operator of the system. The data rate is coded in bit/s.

7.3.2.1.4 Rate adaptation ratio

This parameter (expressed in %) specifies the ratio that should be taken into account for the bearer channel when performing rate adaptation in the direction of the bearer channel. The ratio is defined as a percentage in the 0 to 100 range. A ratio of 20% means that 20% of the available data rate (in excess of the Minimum Data Rate summed over all bearer channels) will be assigned to this bearer channel and 80% to the other bearer channels.

The sum of rate adaption ratios over all bearers in one direction shall be equal to 100 %.

7.3.2.1.5 Minimum Data Rate in low power state

This parameter specifies the minimum net data rate for the bearer channel as desired by the operator of the system during the low power state (L1/L2). The power management low power states L1 and L2 are defined in ITU-T Recs G.992.2 and G.992.3 respectively. The data rate is coded in bit/s.

7.3.2.2 Maximum interleaving delay

This parameter is the maximum one-way interleaving delay introduced by the PMS-TC between the alfa and the beta reference points, in the direction of the bearer channel. The one-way interleaving delay is defined in individual ADSL Recommendations as $\lceil S*D \rceil /4$ ms, where "S" is the S-factor and "D" is the "Interleaving Depth" and $\lceil x \rceil$ denotes rounding to the higher integer.

The ATUs shall choose the S and D values such that the actual one-way interleaving delay (see Actual Interleaving Delay status parameter in 7.5.2.3) is less or equal than the configured Maximum

Interleaving Delay. The delay is coded in ms, with the value 0 and 1 special values. The value 0 indicates no delay bound is being imposed. The value 1 indicates the Fast Latency Path shall be used in the G.992.1 operating mode and S and D shall be selected such that $S \leq 1$ and $D = 1$ in ITU-T Recs G.992.2, G.992.3 and G.992.4 operating modes.

NOTE – A single Maximum Delay value is configured. As a consequence, ATUs supporting multiple ADSL Recommendations will use the configured value regardless of the operating mode actually being selected at line initialization.

7.3.2.3 Minimum impulse noise protection

This parameter specifies the minimum impulse noise protection for the bearer channel. The impulse noise protection is expressed in symbols and can take the values 0, ½, 1 or 2 symbols.

7.3.2.4 Maximum bit error ratio

This parameter specifies the maximum bit error ratio for the bearer channel as desired by the operator of the system. The bit error ratio can take the values 1E-3, 1E-5 or 1E-7.

NOTE – ATUs supporting multiple ADSL Recommendations may use or ignore the configured value depending on the operating mode actually being selected at line initialization. In ITU-T Rec. G.992.3, the ATUs will use the configured value. In ITU-T Rec. G.992.1, ATUs operate with the Maximum Bit Error Ratio fixed to 1E-7, regardless of the configured value.

7.3.2.5 Channel performance monitoring parameter thresholds

All Channel performance monitoring parameters (counters, see Table 7-2) shall have an individual 15-minute and 24-hour threshold parameter if supported.

7.3.2.6 Channel data rate thresholds

The data rate threshold parameter procedures shall be as defined in 7.2.7.

7.3.2.6.1 Data rate threshold upshift

This parameter is a threshold on the net data rate upshift achieved over one or more bearer channel data rate adaptations. An upshift rate change alarm (event) is triggered when the actual data rate exceeds the data rate at the last entry into showtime by more than the threshold. The data rate threshold is coded in bit/s.

7.3.2.6.2 Data rate threshold downshift

This parameter is a threshold on the net data rate downshift achieved over one or more bearer channel data rate adaptations. A downshift rate change alarm (event) is triggered when the actual data rate is below the data rate at the last entry into showtime by more than the threshold. The data rate threshold is coded in bit/s.

7.3.3 STM Data Path configuration parameters

No STM Data Path configuration parameters are defined.

7.3.4 ATM Data Path configuration parameters

7.3.4.1 IMA operation mode enable parameter

This parameter enables the IMA operation mode in the ATM Data Path. It shall indicate to the ATM data path that he must comply to the requirements for IMA transmission, i.e., minimum amount of idle cells shall be inserted and no cell discard shall be enabled at the receiver.

7.3.4.2 ATM Data Path performance monitoring parameter thresholds

All ATM Data Path performance monitoring parameters (counters, see Table 7-3) shall have an individual 15-minute and 24-hour threshold parameter if supported.

7.3.5 PTM Data Path configuration parameters

No STM Data Path configuration parameters are defined.

7.4 Inventory information

7.4.1 ATU-C G.994.1 Vendor ID

The ATU-C G.994.1 Vendor ID is the Vendor ID as inserted by the ATU-C in the G.994.1 CL message. It consists of 8 binary octets, including a country code followed by a (regionally allocated) provider code, as defined in ITU-T Rec. T.35.

Table 7-4/G.997.1 – Vendor ID information block (8 octets)

T.35 country code (2 octets)
T.35 provider code (vendor identification) (4 octets)
T.35 provider oriented code (vendor revision number) (2 octets)

The G.994.1 Vendor ID should typically identify the vendor of the ATU-C G.994.1 functionality, whether implemented in hardware or software. It is not intended to indicate the system integrator. Further details are defined in ITU-T Rec. G.994.1.

7.4.2 ATU-R G.994.1 Vendor ID

The ATU-R G.994.1 Vendor ID is the Vendor ID as inserted by the ATU-R in the G.994.1 CLR message. It consists of 8 binary octets, with same format as the ATU-C G.994.1 Vendor ID.

The G.994.1 Vendor ID should typically identify the vendor of the ATU-R G.994.1 functionality, whether implemented in hardware or software. It is not intended to indicate the system integrator. Further details are defined in ITU-T Rec. G.994.1.

7.4.3 ATU-C System Vendor ID

The ATU-C System Vendor ID is the Vendor ID as inserted by the ATU-C in the Overhead Messages (G.992.3 and G.992.4). It consists of 8 binary octets, with same format as the ATU-C G.994.1 Vendor ID.

The ATU-C System Vendor ID should typically identify the ATU-C system integrator. In this context, the system integrator usually refers to the vendor of the smallest field-replaceable unit. As such, the ATU-C System Vendor ID may not be the same as the ATU-C G.994.1 Vendor ID.

7.4.4 ATU-R System Vendor ID

The ATU-R System Vendor ID is the Vendor ID as inserted by the ATU-R in the Embedded Operations Channel (G.992.1 and G.992.2) and the Overhead Messages (G.992.3 and G.992.4). It consists of 8 binary octets, with same format as the ATU-C G.994.1 Vendor ID.

The ATU-R System Vendor ID should typically identify the ATU-R system integrator. In this context, the system integrator usually refers to the vendor of the smallest field-replaceable unit. As such, the ATU-R System Vendor ID may not be the same as the ATU-R G.994.1 Vendor ID.

7.4.5 ATU-C version number

The ATU-C version number is the version number as inserted by the ATU-C in the Overhead Messages (G.992.3 and G.992.4). It is for version control and is vendor specific information. It consists of up to 16 binary octets.

7.4.6 ATU-R version number

The ATU-R version number is the version number as inserted by the ATU-R in the Embedded Operations Channel (G.992.1 and G.992.2) or Overhead Messages (G.992.3 and G.992.4). It is for version control and is vendor specific information. It consists of up to 16 binary octets.

7.4.7 ATU-C serial number

The ATU-C serial number is the serial number as inserted by the ATU-C in the Overhead Messages (G.992.3 and G.992.4). It is vendor specific information. It consists of up to 32 ascii characters.

Note that the combination of System Vendor ID and serial number creates a unique number for each ATU-C.

7.4.8 ATU-R serial number

The ATU-R version number is the version number as inserted by the ATU-R in the Embedded Operations Channel (G.992.1 and G.992.2) or Overhead Messages (G.992.3 and G.992.4). It is vendor specific information. It consists of up to 32 ascii characters.

Note that the combination of System Vendor ID and serial number creates a unique number for each ATU-R.

7.4.9 ATU-C self-test result

This parameter defines the ATU-C self-test result. It is coded as a 32-bit integer. The most significant octet of the self-test result is 00hex if the self-test passed and 01hex if the self-test failed. The interpretation of the other octets is vendor discretionary and can be interpreted in combination with G.994.1 and system Vendor IDs.

7.4.10 ATU-R self-test result

This parameter defines the ATU-R self-test result. It is coded as a 32-bit integer. The most significant octet of the self-test result is 00hex if the self-test passed and 01hex if the self-test failed. The interpretation of the other octets is vendor discretionary and can be interpreted in combination with G.994.1 and system Vendor IDs.

7.4.11 ATU-C ADSL transmission system capabilities

This parameter defines the ATU-C transmission system capability list of the different coding types. It is coded in a bit-map representation with the bits defined in 7.3.1.1.1. This parameter may be derived from the handshaking procedures defined in ITU-T Rec. G.994.1.

7.4.12 ATU-R ADSL transmission system capabilities

This parameter defines the ATU-R transmission system capability list of the different coding types. It is coded in a bit-map representation with the bits defined in 7.3.1.1.1. This parameter may be derived from the handshaking procedures defined in ITU-T Rec. G.994.1.

7.5 Test, diagnostic and status parameters

7.5.1 Line test, diagnostics and status parameters

7.5.1.1 ADSL transmission system

This parameter defines the transmission system in use. It is coded in a bit-map representation with the bits defined in 7.3.1.1.1. This parameter may be derived from the handshaking procedures defined in ITU-T Rec. G.994.1.

7.5.1.2 Line power management state

The Line has four possible power management states, numbered 0 to 3 and corresponding to respectively:

L0 – Synchronized – This Line state (L0) is when the Line has full transmission (i.e., showtime).

L1 – Power Down Data transmission – This line state (L1) is when there is transmission on the line but the net data rate is reduced (e.g., only for OAM and higher layer connection and session control). This state applies to G.992.2 only.

L2 – Power Down Data transmission – This line state (L2) is when there is transmission on the line but the net data rate is reduced (e.g., only for OAM and higher layer connection and session control). This state applies to G.992.3 and G.992.4 only.

L3 – No-power – This Line state (L3) is when there is No Power transmitted on the line at all.

NOTE – This configuration parameter maps to the OperStatus of the line, which is part of the GeneralInformationGroup object group specified in RFC 2233, and may not need to be duplicated in the ADSL MIB. See also RFC 2662 and RFC 3440. The Operational Status of the line is UP in the L0, L1 or L2 state (i.e., during showtime) and is DOWN in the L3 state (e.g., during (short) initialization and loop diagnostics mode).

7.5.1.3 Initialization success/failure cause

This parameter represents the success of failure cause of the last full initilization performed on the line. It is coded as an integer in the 0 to 5 range, coded as follows:

0 Successful

1 Configuration error

This error occurs with inconsistencies in configuration parameters. E.g., when the line is initialized in an ADSL Transmission system where an ATU does not support the configured Maximum Delay or the configured Minimum or Maximum Data Rate for one or more bearer channels.

2 Configuration not feasible on the line

This error occurs if the Minimum Data Rate cannot be reached on the line with the Minimum Noise Margin, Maximum PSD level, Maximum Delay and Maximum Bit Error Ratio for one or more bearer channels.

3 Communication problem

This error occurs, for example, due to corrupted messages or bad syntax messages or if no common mode can be selected in the G.994.1 handshaking procedure or due to a timeout.

4 No peer ATU detected.

This error occurs if the peer ATU is not powered or not connected or if the line is too long to allow detection of a peer ATU.

5 Any other or unknown Initialization Failure cause.

7.5.1.4 Downstream last transmitted state

This parameter represents the last successful transmitted initialization state in the downstream direction in the last full intialization performed on the line. Initialization states are defined in the individual ADSL Recommendations and are counted from 0 (if G.994.1 is used) or 1 (if G.994.1 is not used) up to Showtime. This parameter must be interpreted along with the ADSL Transmission System.

This parameter is available only when, after a failed full initialization, the line diagnostics procedures are activated on the line. Line diagnostics procedures can be activated by the operator of the system (through the Line State Forced line configuration parameter) or autonomously by the ATU-C or ATU-R.

7.5.1.5 Upstream last transmitted state

This parameter represents the last successful transmitted initialization state in the upstream direction in the last full intialization performed on the line. Initialization states are defined in the individual ADSL Recommendations and are counted from 0 (if G.994.1 is used) or 1 (if G.994.1 is not used) up to Showtime. This parameter must be interpreted along with the ADSL Transmission System.

This parameter is available only when, after a failed full initialization, the line diagnostics procedures are activated on the line. Line diagnostics procedures can be activated by the operator of the system (through the Line State Forced line configuration parameter) or autonomously by the ATU-C or ATU-R.

7.5.1.6 Downstream Line Attenuation (LATNds)

This parameter is the measured difference in the total power transmitted by the ATU-C and the total power received by the ATU-R over all subcarriers during diagnostics mode and initialization. The downstream line attenuation ranges from 0 to +127 dB with 0.1 dB steps. A special value indicates the line attenuation is out of range to be represented.

7.5.1.7 Upstream Line Attenuation (LATNus)

This parameter is the measured difference in dB in the total power transmitted by the ATU-R and the total power received by the ATU-C over all subcarriers during diagnostics mode and initialization. The upstream line attenuation ranges from 0 to +127 dB with 0.1 dB steps. A special value indicates the line attenuation is out of range to be represented.

7.5.1.8 Downstream Signal Attenuation (SATNds)

This parameter is the measured difference in the total power transmitted by the ATU-C and the total power received by the ATU-R over all subcarriers during showtime. The downstream line attenuation ranges from 0 to +127 dB with 0.1 dB steps. A special value indicates the line attenuation is out of range to be represented.

NOTE – During showtime, only a subset of the subcarriers may be transmitted by the ATU-C, as compared to diagnostics mode and initialization. Therefore, the downstream Signal attenuation may be significantly lower than the downstream Line attenuation.

7.5.1.9 Upstream Signal Attenuation (SATNus)

This parameter is the measured difference in dB in the total power transmitted by the ATU-R and the total power received by the ATU-C over all subcarriers during showtime. The upstream line attenuation ranges from 0 to +127 dB with 0.1 dB steps. A special value indicates the line attenuation is out of range to be represented.

NOTE – During showtime, only a subset of the subcarriers may be transmitted by the ATU-R, as compared to diagnostics mode and initialization. Therefore, the upstream Signal attenuation may be significantly lower than the upstream Line attenuation.

7.5.1.10 Downstream Signal-to-Noise Ratio Margin (SNRMds)

The downstream signal-to-noise ratio margin is the maximum increase in dB of the noise power received at the ATU-R, such that the BER requirements are met for all downstream bearer channels. The downstream SNR margin ranges from –64 dB to +63 dB with 0.1 dB steps. A special value indicates the parameter is out of range to be represented.

NOTE – The downstream SNR margin measurement at the ATU-R may take up to 10 s.

7.5.1.11 Upstream Signal-to-Noise Ratio Margin (SNRMus)

The upstream signal-to-noise ratio margin is the maximum increase in dB of the noise power received at the ATU-C, such that the BER requirements are met for all upstream bearer channels. The upstream SNR margin ranges from –64 dB to +63 dB with 0.1 dB steps. A special value indicates the parameter is out of range to be represented.

NOTE – The upstream SNR margin measurement at the ATU-C may take up to 10 s.

7.5.1.12 Downstream Maximum Attainable Data Rate (ATTNDRds)

This parameter indicates the maximum downstream net data rate currently attainable by the ATU-C transmitter and the ATU-R receiver. The rate is coded in bit/s.

7.5.1.13 Upstream Maximum Attainable Data Rate (ATTNDRus)

This parameter indicates the maximum upstream net data rate currently attainable by the ATU-R transmitter and the ATU-C receiver. The rate is coded in bit/s.

7.5.1.14 Downstream Actual Power Spectrum Density (ACTPSDds)

This parameter is the average downstream transmit power spectrum density over the used subcarriers (subcarriers to which downstream user data are allocated) delivered by the ATU-C at the U-C reference point, at the instant of measurement. The power spectrum density level ranges from –90 dBm/Hz to 0 dBm/Hz with 0.1 dB steps. A special value indicates the parameter is out of range to be represented.

NOTE – The downstream actual power spectrum dessity is the sum (in dB) of the REFPSDds and RMSGIds. See 8.5.1/G.992.3.

7.5.1.15 Upstream Actual Power Spectrum Density (ACTPSDus)

This parameter is the average upstream transmit power spectrum density over the used subcarriers (subcarriers to which upstream user data are allocated) delivered by the ATU-C at the U-C reference point, at the instant of measurement. The power spectrum density level ranges from –90 dBm/Hz to 0 dBm/Hz with 0.1 dB steps. A special value indicates the parameter is out of range to be represented.

NOTE – The upstream actual power spectrum dessity is the sum (in dB) of the REFPSDus and RMSGIus. See 8.5.1/G.992.3.

7.5.1.16 Downstream Actual Aggregate Transmit Power (ACTATPds)

This parameter is the total amount of transmit power delivered by the ATU-C at the U-C reference point, at the instant of measurement. The total output power level ranges from –31 dBm to +31 dBm with 0.1 dB steps. A special value indicates the parameter is out of range to be represented.

NOTE – The downstream nominal aggregate transmit power may be taken as a best estimate of the parameter. See 8.12.3.8/G.992.3.

7.5.1.17 Upstream Actual Aggregate Transmit Power (ACTATPus)

This parameter is the total amount of transmit power delivered by the ATU-R at the U-R reference point, at the instant of measurement. The total output power level ranges from –31 dBm to +31 dBm with 0.1 dB steps. A special value indicates the parameter is out of range to be represented.

NOTE – The upstream nominal aggregate transmit power may be taken as a best estimate of the parameter. See 8.12.3.8/G.992.3.

7.5.1.18 Channel characteristics function per subcarrier

This function is defined in 8.12.3.1/G.992.3.

7.5.1.18.1 Downstream H(f) linear representation Scale (HLINSCds)

This Parameter is the scale factor to be applied to the downstream Hlin(f) values. It is coded as a 16-bit 2's complement signed integer. This parameter is only available after a loop diagnostic procedure.

7.5.1.18.2 Downstream H(f) linear representation (HLINpsds)

This parameter is an array of complex downstream Hlin(f) values in linear scale. Each array entry represents the Hlin($f = i*\Delta f$) value for a particular subcarrier index i, ranging from 0 to NSCds – 1. The Hlin(f) is represented as ((scale/2^15)*((a(i) + j*b(i))/2^15)), with scale, a(i) and b(i) 16-bit 2's complement signed integers in the (–2^15 + 1) to (+2^15 – 1) range. A special value a(i) = b(i) = –2^15 indicates that no measurement could be done for the subcarrier because it is out of the passband or that the attenuation is out of range to be represented. This parameter is only available after a loop diagnostic procedure.

7.5.1.18.3 Downstream H(f) logarithmic Measurement Time (HLOGMTds)

This parameter contains the number of symbols used to measure the downstream Hlog(f) values. It is represented as a 16-bit unsigned value.

After a loop diagnostic procedure, this parameter shall contain the number of symbols used to generate the associate parameter. It should correspond to the value specified in the Recommendation (e.g., the number of symbols in 1 s time interval for G.992.3).

7.5.1.18.4 Downstream H(f) logarithmic representation (HLOGpsds)

This parameter is an array of real downstream Hlog(f) values in dB. Each array entry represents the real Hlog($f = i*\Delta f$) value for a particular sub-carrier index i, ranging from 0 to NSCds – 1. The real Hlog(f) value is represented as (6 – m(i)/10), with m(i) 10-bit unsigned integer in the 0 to 1022 range. A special value m = 1023 indicates that no measurement could be done for the subcarrier because it is out of the passband or that the attenuation is out of range to be represented.

7.5.1.18.5 Upstream H(f) linear representation Scale (HLINSCus)

This parameter is the scale factor to be applied to the upstream Hlin(f) values. It is coded in the same way as the related downstream parameter. This parameter is only available after a loop diagnostic procedure.

7.5.1.18.6 Upstream H(f) linear representation (HLINpsus)

This parameter is an array of complex upstream Hlin(f) values in linear scale. It is coded in the same way as the related downstream parameter. This parameter is only available after a loop diagnostic procedure.

7.5.1.18.7 Upstream H(f) logarithmic Measurement Time (HLOGMTus)

This parameter contains the number of symbols used to measure the upstream Hlog(f) values. It is represented as a 16-bit unsigned value.

After a loop diagnostic procedure, this parameter shall contain the number of symbols used to generate the associate parameter. It should correspond to the value specified in the Recommendation (e.g., the number of symbols in 1 s time interval for G.992.3).

7.5.1.18.8 Upstream H(f) logarithmic representation (HLOGpsus)

This parameter is an array of real upstream Hlog(f) values in dB. It is coded in the same way as the related downstream parameter.

7.5.1.19 Quiet Line Noise PSD per subcarrier

This function is defined in 8.12.3.1/G.992.3.

7.5.1.19.1 Downstream Quiet Line Noise PSD Measurement Time (QLNMTds)

This parameter contains the number of symbols used to measure the downstream QLN(f) values. It is represented as a 16-bit unsigned value

After a loop diagnostic procedure, this parameter shall contain the number of symbols used to generate the associate parameter. It should correspond to the value specified in the Recommendation (e.g., the number of symbols in 1 s time interval for G.992.3).

7.5.1.19.2 Downstream QLN(f) (QLNpsds)

This parameter is an array of real downstream QLN(f) values in dB. Each array entry represents the QLN($f = i*\Delta f$) value for a particular subcarrier index i, ranging from 0 to NSCds – 1. The QLN(f) is represented as ($-23 - n(i)/2$), with n(i) an 8-bit unsigned integer in the 0 to 254 range. A special value n(i) = 255 indicates that no measurement could be done for the subcarrier because it is out of the passband or that the noise PSD is out of range to be represented.

7.5.1.19.3 Upstream Quiet Line Noise PSD Measurement Time (QLNMTus)

This parameter contains the number of symbols used to measure the upstream QLN(f) values. It is represented as a 16-bit unsigned value.

After a loop diagnostic procedure, this parameter shall contain the number of symbols used to generate the associate parameter. It should correspond to the value specified in the Recommendation (e.g., the number of symbols in 1 s time interval for G.992.3).

7.5.1.19.4 Upstream QLN(f) (QLNpsus)

This parameter is an array of real upstream QLN(f) values in dB. It is coded in the same way as the related downstream parameter.

7.5.1.20 Signal to Noise Ratio per subcarrier

This function is defined in 8.12.3.3/G.992.3.

7.5.1.20.1 Downstream SNR Measurement Time (SNRMTds)

This parameter contains the number of symbols used to measure the downstream SNR(f) values. It is represented as a 16-bit unsigned value.

After a loop diagnostic procedure, this parameter shall contain the number of symbols used to generate the associate parameter. It should correspond to the value specified in the Recommendation (e.g., the number of symbols in 1 s time interval for G.992.3).

7.5.1.20.2 Downstream SNR(f) (SNRpsds)

This parameter is an array of real downstream SNR(f) values in dB. Each array entry represents the SNR($f = i*\Delta f$) value for a particular subcarrier index i, ranging from 0 to NSCds – 1. The SNR(f) is represented as ($-32 + snr(i)/2$), with snr(i) an 8-bit unsigned integer in the 0 to 254 range. A special value snr(i) = 255 indicates that no measurement could be done for the subcarrier because it is out of the passband or that the noise PSD is out of range to be represented.

7.5.1.20.3 Upstream SNR Measurement Time (SNRMTus)

This parameter contains the number of symbols used to measure the downstream SNR(f) values. It is represented as a 16-bit unsigned value.

After a loop diagnostic procedure, this parameter shall contain the number of symbols used to generate the associate parameter. It should correspond to the value specified in the Recommendation (e.g., the number of symbols in 1 s time interval for G.992.3).

7.5.1.20.4 Upstream SNR(f) (SNRpsus)

This parameter is an array of real upstream SNR(f) values in dB. It is coded in the same way as the related downstream parameter.

7.5.1.21 Bits and gains allocation per subcarrier

7.5.1.21.1 Downstream Bits Allocation (BITSpsds)

This parameter defines the downstream bits allocation table per subcarrier. It is an array of integer values in the 0 to 15 range for subcarriers 0 to NSCds – 1.

7.5.1.21.2 Upstream Bits Allocation (BITSpsus)

This parameter defines the upstream bits allocation table per subcarrier. It is an array of integer values in the 0 to 15 range for subcarriers 0 to NSCus – 1.

7.5.1.21.3 Downstream Gains Allocation (GAINSpsds)

This parameter defines the downstream gains allocation table per subcarrier. It is an array of integer values in the 0 to 4093 range for subcarriers 0 to NSCds – 1. The gain value is represented as a multiple of 1/512 on linear scale.

7.5.1.21.4 Upstream Bits Allocation (GAINSpsus)

This parameter defines the upstream gains allocation table per subcarrier. It is an array of integer values in the 0 to 4093 range for subcarriers 0 to NSCus – 1. The gain value is represented as a multiple of 1/512 on linear scale.

7.5.1.21.5 Downstream Transmit Spectrum Shaping (TSSpsds)

This parameter contains the downstream transmit spectrum shaping parameters expressed as the set of breakpoints exchanged during G.994.1. Each breakpoint consists in a subcarrier index and the associated shaping parameter. The shaping parameter is an integer value in the 0 to 127 range. It is represented as a multiple of –0.5 dB. The value 127 is a special value indicating the subcarrier is not transmitted.

7.5.1.21.6 Upstream Transmit Spectrum Shaping (TSSpsus)

This parameter contains the upstream transmit spectrum shaping parameters expressed as the set of breakpoints exchanged during G.994.1. Each breakpoint consists in a subcarrier index and the associated shaping parameter. The shaping parameter is an integer value in the 0 to 127 range. It is represented as a multiple of –0.5 dB. The value 127 is a special value indicating the subcarrier is not transmitted.

7.5.2 Channel status parameters

7.5.2.1 Actual data rate

This parameter reports the actual net data rate the bearer channel is operating at excluding rate in L1 and L2 states. In L1 or L2 states, the parameter contains the net data rate in the previous L0 state. The data rate is coded in bit/s.

7.5.2.2 Previous data rate

This parameter reports the previous net data rate the bearer channel was operating at just before the latest rate change event occurred excluding all transitions between L0 state and L1 or L2 states. A rate change can occur at a power management state transition, e.g., at full or short initialization, fast retrain or power down or at a dynamic rate adaptation. The rate is coded in bit/s.

7.5.2.3 Actual interleaving delay

This parameter is the actual one-way interleaving delay introduced by the PMS-TC between the alfa and beta reference points excluding delay in L1 and L2 state. In L1 and L2 state, the parameter contains the interleaving delay in the previous L0 state. This parameter is derived from the S and D parameters as $\lceil S*D \rceil /4$ ms, where "S" is the Symbols per codeword, and "D" is the "Interleaving Depth" and $\lceil x \rceil$ denotes rounding to the higher integer. The Actual Interleaving Delay is coded in ms (rounded to the nearest ms).

7.6 Network management elements partitioning

This clause defines the network management elements which correspond to the specific management interfaces:

Q interface: Management interface towards the ATU-C, from the network side perspective. The ATU-C provides its near-end (at ATU-C) and far-end (at ATU-R) parameters for the system operator to read and write.

U-C interface: Management interface towards the ATU-C, from the ATU-R's perspective. The ATU-C provides its near-end parameters (ATU-R far-end) for the ATU-R to read.

U-R interface: Management interface towards the ATU-C, from the ATU-R's perspective. The ATU-R provides its near-end parameters (ATU-C far-end) for the ATU-C to read.

T-/S-interface: Management interface towards the ATU-R, from the premises side perspective. The ATU-R provides its near-end (at ATU-R) and far-end (at ATU-C) parameters for the subscriber to read and write.

The management interface described at the U interface covers the network management elements to be supported through the OAM communications channel specified in this Recommendation (Clear EOC between ATU-C and ATU-R). The support of such communications channel is optional. The exchange between ATU-C and ATU-R of some or all of these network elements may already be covered by the (EOC) commands listed in the mamagement plane procedures of individual Recommendations.

Parameters indicated with:

- R are read only.
- W are write only.
- R/W are read and write.
- (M) are mandatory.
- (O) are optional.

The far-end fault and performance monitoring over the Q-interface is equivalent to the near-end fault and performance monitoring over the T-/S-interface. The near-end fault and performance monitoring over the Q-interface is equivalent to the far-end fault and performance monitoring over the T-/S-interface. Over the Q-interface, near-end fault and performance monitoring applies to the upstream direction only and far-end performance monitoring applies to the downstream direction only. Over the T-/S-interface, near-end fault and performance monitoring applies to the downstream direction only and far-end performance monitoring applies to the upstream direction only.

The second table for each category indicates for which Recommendations, the management element is relevant. A "Y" in a column means that this MIB element is relevant for this Recommendation.

Table 7-5/G.997.1 – Line failures

Category/Element	Defined in:	Q-Interface	U-C Interface	U-R Interface	T-/S-Interface
Near-end (ATU-C) failures					
Loss-of-Signal (LOS)	7.1.1.1.1	R (M)	R(O)		R (O)
Loss-of-Frame (LOF)	7.1.1.1.2	R (M)	R(O)		R (O)
Loss-of-Power (LPR)	7.1.1.1.3	R (M)	R(O)		R (O)
Far-end (ATU-R) failures					
Loss-of-Signal (LOS-FE) failure	7.1.1.2.1	R (M)		R(O)	R (O)
Loss-of-Frame (LOF-FE) failure	7.1.1.2.2	R (M)		R(O)	R (O)
Loss-of-Power (LPR-FE) failure	7.1.1.2.3	R (M)		R(O)	R (O)
Initialization failures					
Line Init (LINIT) Failure	7.1.1.3	R (M)			R (O)

Table 7-6/G.997.1 – Line Failures

Category/Element	G.992.1	G.992.2	G.992.3	G.992.4	G.992.5
Near-end failures					
Loss-of-Signal (LOS)	Y	Y	Y	Y	Y
Loss-of-Frame (LOF)	Y	Y	Y	Y	Y
Loss-of-Power (LPR)	Y	Y	Y	Y	Y
Far-end failures					
Loss-of-Signal (LOS-FE) failure	Y	Y	Y	Y	Y
Loss-of-Frame (LOF-FE) failure	Y	Y	Y	Y	Y
Loss-of-Power (LPR-FE) failure	Y	Y	Y	Y	Y
Initialization failures					
Line Init (LINIT) Failure	Y	Y	Y	Y	Y

Table 7-7/G.997.1 – ATM data path failures

Category/Element	Defined in:	Q-Interface	U-C Interface	U-R Interface	T-/S-Interface
Near-end (ATU-C) failures					
No Cell Delineation (NCD) failure	7.1.4.1.1	R (M)	R(O)		
Loss of Cell Delineation (LCD) failure	7.1.4.1.2	R (M)	R(O)		
Far-end (ATU-R) failures					
No Cell Delineation (NCD-FE) failure	7.1.4.2.1	R (M)		R(O)	
Loss of Cell Delineation (LCD-FE) failure	7.1.4.2.2	R (M)		R(O)	

Table 7-8/G.997.1 – ATM data path failures

Category/Element	G.992.1	G.992.2	G.992.3	G.992.4	G.992.5
Near-end failures					
No Cell Delineation (NCD) failure	Y	Y	Y	Y	Y
Loss of Cell Delineation (LCD) failure	Y	Y	Y	Y	Y
Far-end failures					
No Cell Delineation (NCD-FE) failure	Y	Y	Y	Y	Y
Loss of Cell Delineation (LCD-FE) failure	Y	Y	Y	Y	Y

Table 7-9/G.997.1 – Line configuration profile

Category/Element	Defined in:	Q-Interface	U-C Interface	U-R Interface	T-/S-Interface
Line/ATU State					
ATU Transmission System Enabling (ATSE)	7.3.1.1.1	R/W (M)			R(O)
ATU Impedance State Forced (AISF)	7.3.1.1.2				R/W (M)
Power Management State Forced (PMSF)	7.3.1.1.3	R/W (M)			R/W (M)
Power Management State Enabling (PMMode)	7.3.1.1.4	R/W (M)			
L0-TIME	7.3.1.1.5	R/W (M)	R (O)		
L2-TIME	7.3.1.1.6	R/W (M)	R (O)		
L2-ATPR	7.3.1.1.7	R/W (M)	R (O)		
Loop Diagnostics Mode Forced	7.3.1.1.8	R/W (M)			R/W (M)
Power and Spectrum Usage					
MAXNOMPSD downstream	7.3.1.2.1	R/W (M)	R (O)		
MAXNOMPSD upstream	7.3.1.2.2	R/W (M)	R (O)		
MAXNOMATP downstream	7.3.1.2.3	R/W (M)	R (O)		
MAXNOMATP upstream	7.3.1.2.4	R/W (M)	R (O)		
MAXRXPWR upstream	7.3.1.2.5	R/W (M)	R (O)		
CARMASK downstream	7.3.1.2.6	R/W (M)	R (O)		
CARMASK upstream	7.3.1.2.7	R/W (M)	R (O)		
PSDMASK downstream	7.3.1.2.8	R/W(M)	R (O)		
RFIBANDS downstream	7.3.1.2.9	R/W(M)	R (O)		

Table 7-9/G.997.1 – Line configuration profile

Category/Element	Defined in:	Q-Interface	U-C Interface	U-R Interface	T-/S-Interface
Noise Margins					
TARSNRM downstream	7.3.1.3.1	R/W (M)	R (O)		
TARSNRM upstream	7.3.1.3.2	R/W (M)	R (O)		
MAXSNRM downstream	7.3.1.3.3	R/W (M)	R (O)		
MAXSNRM upstream	7.3.1.3.4	R/W (M)	R (O)		
MINSNRM downstream	7.3.1.3.5	R/W (M)	R (O)		
MINSNRM upstream	7.3.1.3.6	R/W (M)	R (O)		
Rate Adaptation					
RA-MODE downstream	7.3.1.4.1	R/W (M)	R (O)		
RA-MODE upstream	7.3.1.4.2	R/W (M)	R (O)		
RA-USNRM downstream	7.3.1.4.3	R/W (O)	R (O)		
RA-USNRM upstream	7.3.1.4.4	R/W (O)	R (O)		
RA-UTIME downstream	7.3.1.4.5	R/W (O)	R (O)		
RA-UTIME upstream	7.3.1.4.6	R/W (O)	R (O)		
RA-DSNRM downstream	7.3.1.4.7	R/W (O)	R (O)		
RA-DSNRM upstream	7.3.1.4.8	R/W (O)	R (O)		
RA-DTIME downstream	7.3.1.4.9	R/W (O)	R (O)		
RA-DTIME upstream	7.3.1.4.10	R/W (O)	R (O)		
Overhead					
MSGMIN upstream	7.3.1.5.1	R/W(O)	R(O)		
MSGMIN downstream	7.3.1.5.2	R/W(O)	R(O)		
Near-end (ATU-C) Performance Monitoring Thresholds (15-minute interval)					
FECS-L threshold 15 minutes	7.3.1.6	R/W (O)	R (O)		
ES-L threshold 15 minutes	7.3.1.6	R/W (M)	R (O)		
SES-L threshold 15 minutes	7.3.1.6	R/W (M)	R (O)		
LOSS-L threshold 15 minutes	7.3.1.6	R/W (O)	R (O)		
UAS-L threshold 15 minutes	7.3.1.6	R/W (M)	R (O)		
Near-end (ATU-C) Performance Monitoring Thresholds (1 day interval)					
FECS-L threshold 1 day	7.3.1.6	R/W (O)	R (O)		
ES-L threshold 1 day	7.3.1.6	R/W (M)	R (O)		
SES-L threshold 1 day	7.3.1.6	R/W (M)	R (O)		
LOSS-L threshold 1 day	7.3.1.6	R/W (O)	R (O)		
UAS-L threshold 1 day	7.3.1.6	R/W (M)	R (O)		

Table 7-9/G.997.1 – Line configuration profile

Category/Element	Defined in:	Q-Interface	U-C Interface	U-R Interface	T-/S-Interface
Far-end (ATU-R) Performance Monitoring Thresholds (15-minute interval)					
FECS-LFE threshold 15 minutes	7.3.1.6	R/W (O)	R (O)		
ES-LFE threshold 15 minutes	7.3.1.6	R/W (M)	R (O)		
SES-LFE threshold 15 minutes	7.3.1.6	R/W (M)	R (O)		
LOSS-LFE threshold 15 minutes	7.3.1.6	R/W (O)	R (O)		
UAS-LFE threshold 15 minutes	7.3.1.6	R/W (M)	R (O)		
Far-end (ATU-R) Performance Monitoring Thresholds (1 day interval)					
FECS-LFE threshold 1 day	7.3.1.6	R/W (O)	R (O)		
ES-LFE threshold 1 day	7.3.1.6	R/W (M)	R (O)		
SES-LFE threshold 1 day	7.3.1.6	R/W (M)	R (O)		
LOSS-LFE threshold 1 day	7.3.1.6	R/W (O)	R (O)		
UAS-LFE threshold 1 day	7.3.1.6	R/W (M)	R (O)		
Initialization Performance Monitoring Thresholds (15-minute interval)					
Full inits threshold 15 minutes	7.3.1.6	R (M)	R (O)		
Failed full inits threshold 15 minutes	7.3.1.6	R (M)	R (O)		
Short inits threshold 15 minutes	7.3.1.6	R (O)	R (O)		
Failed short inits threshold 15 minutes	7.3.1.6	R (O)	R (O)		
Initialization Performance Monitoring Thresholds (1 day interval)					
Full inits threshold 1 day	7.3.1.6	R (M)	R (O)		
Failed full inits threshold 1 day	7.3.1.6	R (M)	R (O)		
Short inits threshold 1 day	7.3.1.6	R (O)	R (O)		
Failed short inits threshold 1 day	7.3.1.6	R (O)	R (O)		

Table 7-10/G.997.1 – Line configuration profile

Category/Element	G.992.1	G.992.2	G.992.3	G.992.4	G.992.5
Line/ATU State					
ATU Transmission System Enabling (ATSE)	Y	Y	Y	Y	Y
ATU Impedance State Forced (AISF)			Y (Annex A)	Y (Annex A)	Y (Annex A)
Power Management State Forced (PMSF)	Y	Y	Y	Y	Y
Power Management State Enabling (PMMode)	Y	Y	Y	Y	Y
L0-TIME			Y	Y	Y
L2-TIME			Y	Y	Y

Table 7-10/G.997.1 – Line configuration profile

Category/Element	G.992.1	G.992.2	G.992.3	G.992.4	G.992.5
L2-ATPR			Y	Y	Y
Loop Diagnostics Mode Forced			Y	Y	Y
Power and Spectrum Usage					
MAXNOMPSD downstream			Y	Y	Y
MAXNOMPSD upstream			Y	Y	Y
MAXNOMATP downstream			Y	Y	Y
MAXNOMATP upstream			Y	Y	Y
MAXRXPWR upstream			Y	Y	Y
CARMASK downstream			Y	Y	Y
CARMASK upstream			Y	Y	Y
PSDMASK downstream					Y
RFIBANDS downstream					Y
Noise Margins					
TARSNRM downstream	Y	Y	Y	Y	Y
TARSNRM upstream	Y	Y	Y	Y	Y
MAXSNRM downstream	Y	Y	Y	Y	Y
MAXSNRM upstream	Y	Y	Y	Y	Y
MINSNRM downstream	Y	Y	Y	Y	Y
MINSNRM upstream	Y	Y	Y	Y	Y
Rate Adaptation					
RA-MODE downstream		Y	Y	Y	Y
RA-MODE upstream		Y	Y	Y	Y
RA-USNRM downstream		Y	Y	Y	Y
RA-USNRM upstream		Y	Y	Y	Y
RA-UTIME downstream		Y	Y	Y	Y
RA-UTIME upstream		Y	Y	Y	Y
RA-DSNRM downstream		Y	Y	Y	Y
RA-DSNRM upstream		Y	Y	Y	Y
RA-DTIME downstream		Y	Y	Y	Y
RA-DTIME upstream		Y	Y	Y	Y
Overhead					
MSGMIN upstream			Y	Y	Y
MSGMIN downstream			Y	Y	Y

Table 7-10/G.997.1 – Line configuration profile

Category/Element	G.992.1	G.992.2	G.992.3	G.992.4	G.992.5
Near-end Performance Monitoring Thresholds (15-minute interval)					
FECS-L threshold 15 minutes	Y	Y	Y	Y	Y
ES-L threshold 15 minutes	Y	Y	Y	Y	Y
SES-L threshold 15 minutes	Y	Y	Y	Y	Y
LOSS-L threshold 15 minutes	Y	Y	Y	Y	Y
UAS-L threshold 15 minutes	Y	Y	Y	Y	Y
Near-end Performance Monitoring Thresholds (1 day interval)					
FECS-L threshold 1 day	Y	Y	Y	Y	Y
ES-L threshold 1 day	Y	Y	Y	Y	Y
SES-L threshold 1 day	Y	Y	Y	Y	Y
LOSS-L threshold 1 day	Y	Y	Y	Y	Y
UAS-L threshold 1 day	Y	Y	Y	Y	Y
Far-end Performance Monitoring Thresholds (15-minute interval)					
FECS-LFE threshold 15 minutes	Y	Y	Y	Y	Y
ES-LFE threshold 15 minutes	Y	Y	Y	Y	Y
SES-LFE threshold 15 minutes	Y	Y	Y	Y	Y
LOSS-LFE threshold 15 minutes	Y	Y	Y	Y	Y
UAS-LFE threshold 15 minutes	Y	Y	Y	Y	Y
Far-end Performance Monitoring Thresholds (1 day interval)					
FECS-LFE threshold 1 day	Y	Y	Y	Y	Y
ES-LFE threshold 1 day	Y	Y	Y	Y	Y
SES-LFE threshold 1 day	Y	Y	Y	Y	Y
LOSS-LFE threshold 1 day	Y	Y	Y	Y	Y
UAS-LFE threshold 1 day	Y	Y	Y	Y	Y
Initialization Performance Monitoring Thresholds (15-minute interval)					
Full inits threshold 15 minutes	Y	Y	Y	Y	Y
Failed full inits threshold 15 minutes	Y	Y	Y	Y	Y
Short inits threshold 15 minutes		Y	Y	Y	Y
Failed short inits threshold 15 minutes		Y	Y	Y	Y
Initialization Performance Monitoring Thresholds (1 day interval)					
Full inits threshold 1 day	Y	Y	Y	Y	Y
Failed full inits threshold 1 day	Y	Y	Y	Y	Y
Short inits threshold 1 day		Y	Y	Y	Y
Failed short inits threshold 1 day		Y	Y	Y	Y

Table 7-11/G.997.1 – Channel configuration profile

Category/Element	Defined in:	Q-Interface	U-C Interface	U-R Interface	T-/S-Interface
Data Rate					
Minimum Data Rate	7.3.2.1.1	R/W (M)	R (O)		
Minimum Reserved Data Rate	7.3.2.1.2	R/W (O)	R (O)		
Maximum Data Rate	7.3.2.1.3	R/W (M)	R (O)		
Rate Adaptation Ratio	7.3.2.1.4	R/W (O)	R (O)		
Minimum Data Rate in low power state	7.3.2.1.5	R/W (M)	R (O)		
Maximum Interleaving Delay	7.3.2.2	R/W (M)	R (O)		
Minimum Impulse Noise Protection	7.3.2.3	R/W(M)	R (O)		
Maximum Bit Error Ratio	7.3.2.4	R/W (M)	R (O)		
Data Rate Threshold Upshift	7.3.2.6.1	R/W(M)			
Data Rate Threshold Downshift	7.3.2.6.2	R/W(M)			
Near-end (ATU-C) Performance Monitoring Thresholds (15-minute interval)					
CV-C threshold 15 minutes	7.3.2.5	R/W (O)	R (O)		
FEC-C threshold 15 minutes	7.3.2.5	R/W (O)	R (O)		
Near-end (ATU-C) Performance Monitoring Thresholds (1 day interval)					
CV-C threshold 1 day	7.3.2.5	R/W (O)	R (O)		
FEC-C threshold 1 day	7.3.2.5	R/W (O)	R (O)		
Far-end (ATU-R) Performance Monitoring Thresholds (15-minute interval)					
CV-CFE threshold 15 minutes	7.3.2.5	R/W (O)	R (O)		
FEC-CFE threshold 15 minutes	7.3.2.5	R/W (O)	R (O)		
Far-end (ATU-R) Performance Monitoring Thresholds (1 day interval)					
CV-CFE threshold 1 day	7.3.2.5	R/W (O)	R (O)		
FEC-CFE threshold 1 day	7.3.2.5	R/W (O)	R (O)		

Table 7-12/G.997.1 – Channel configuration profile

Category/Element	G.992.1	G.992.2	G.992.3	G.992.4	G.992.5
Data Rate					
Minimum Data Rate	Y	Y	Y	Y	Y
Minimum Reserved Data Rate		Y	Y	Y	Y
Maximum Data Rate	Y	Y	Y	Y	Y
Rate Adaptation Ratio	Y	Y	Y	Y	Y
Minimum Data Rate in low power state		Y	Y	Y	Y
Maximum Interleaving Delay	Y	Y	Y	Y	Y
Minimum Impulse Noise Protection			Y	Y	Y

Table 7-12/G.997.1 – Channel configuration profile

Category/Element	G.992.1	G.992.2	G.992.3	G.992.4	G.992.5
Maximum Bit Error Ratio			Y	Y	Y
Data Rate Threshold Upshift	Y	Y	Y	Y	Y
Data Rate Threshold Downshift	Y	Y	Y	Y	Y
Near-end Performance Monitoring Thresholds (15-minute interval)					
CV-C threshold 15 minutes	Y	Y	Y	Y	Y
FEC-C threshold 15 minutes	Y	Y	Y	Y	Y
Near-end Performance Monitoring Thresholds (1 day interval)					
CV-C threshold 1 day	Y	Y	Y	Y	Y
FEC-C threshold 1 day	Y	Y	Y	Y	Y
Far-end Performance Monitoring Thresholds (15-minute interval)					
CV-CFE threshold 15 minutes	Y	Y	Y	Y	Y
FEC-CFE threshold 15 minutes	Y	Y	Y	Y	Y
Far-end Performance Monitoring Thresholds (1 day interval)					
CV-CFE threshold 1 day	Y	Y	Y	Y	Y
FEC-CFE threshold 1 day	Y	Y	Y	Y	Y

Table 7-13/G.997.1 – ATM Data path configuration profile

Category/Element	Defined in:	Q-Interface	U-C Interface	U-R Interface	T-/S-Interface
IMA configuration					
IMA Operation Mode Enable Parameter	7.3.4.1	R/W (M)			
Near-end (ATU-C) Performance Monitoring Thresholds (15-minute interval)					
HEC-P threshold 15 minutes	7.3.4.2	R/W (O)	R (O)		
CD-P threshold 15 minutes	7.3.4.2	R/W (O)	R (O)		
CU-P threshold 15 minutes	7.3.4.2	R/W (O)	R (O)		
IBE-P threshold 15 minutes	7.3.4.2	R/W (O)	R (O)		
Near-end (ATU-C) Performance Monitoring Thresholds (1 day interval)					
HEC-P threshold 1 day	7.3.4.2	R/W (O)	R (O)		
CD-P threshold 1 day	7.3.4.2	R/W (O)	R (O)		
CU-P threshold 1 day	7.3.4.2	R/W (O)	R (O)		
IBE-P threshold 1 day	7.3.4.2	R/W (O)	R (O)		
Far-end (ATU-R) Performance Monitoring Thresholds (15-minute interval)					
HEC-PFE threshold 15 minutes	7.3.4.2	R/W (O)	R (O)		
CD-PFE threshold 15 minutes	7.3.4.2	R/W (O)	R (O)		
CU-PFE threshold 15 minutes	7.3.4.2	R/W (O)	R (O)		
IBE-PFE threshold 15 minutes	7.3.4.2	R/W (O)	R (O)		

Table 7-13/G.997.1 – ATM Data path configuration profile

Category/Element	Defined in:	Q-Interface	U-C Interface	U-R Interface	T-/S-Interface
Far-end (ATU-R) Performance Monitoring Thresholds (1 day interval)					
HEC-PFE threshold 1 day	7.3.4.2	R/W (O)	R (O)		
CD-PFE threshold 1 day	7.3.4.2	R/W (O)	R (O)		
CU-PFE threshold 1 day	7.3.4.2	R/W (O)	R (O)		
IBE-PFE threshold 1 day	7.3.4.2	R/W (O)	R (O)		

Table 7-14/G.997.1 – ATM Data path configuration profile

Category/Element	G.992.1	G.992.2	G.992.3	G.992.4	G.992.5
IMA configuration					
IMA Operation Mode Enable Parameter			Y	Y	Y
Near-end Performance Monitoring Thresholds (15-minute interval)					
HEC-P threshold 15 minutes	Y	Y	Y	Y	Y
CD-P threshold 15 minutes	Y	Y	Y	Y	Y
CU-P threshold 15 minutes	Y	Y	Y	Y	Y
IBE-P threshold 15 minutes	Y	Y	Y	Y	Y
Near-end Performance Monitoring Thresholds (1 day interval)					
HEC-P threshold 1 day	Y	Y	Y	Y	Y
CD-P threshold 1 day	Y	Y	Y	Y	Y
CU-P threshold 1 day	Y	Y	Y	Y	Y
IBE-P threshold 1 day	Y	Y	Y	Y	Y
Far-end Performance Monitoring Thresholds (15-minute interval)					
HEC-PFE threshold 15 minutes	Y	Y	Y	Y	Y
CD-PFE threshold 15 minutes	Y	Y	Y	Y	Y
CU-PFE threshold 15 minutes	Y	Y	Y	Y	Y
IBE-PFE threshold 15 minutes	Y	Y	Y	Y	Y
Far-end Performance Monitoring Thresholds (1 day interval)					
HEC-PFE threshold 1 day	Y	Y	Y	Y	Y
CD-PFE threshold 1 day	Y	Y	Y	Y	Y
CU-PFE threshold 1 day	Y	Y	Y	Y	Y
IBE-PFE threshold 1 day	Y	Y	Y	Y	Y

Table 7-15/G.997.1 – Line inventory

Category/Element	Defined in:	Q-Interface	U-C Interface	U-R Interface	T-/S-Interface
ATU-C G.994.1 Vendor ID	7.4.1	R (M)	R (O)		R (O)
ATU-R G.994.1 Vendor ID	7.4.2	R (M)		R (O)	R (O)
ATU-C System Vendor ID	7.4.3	R (M)	R (O)		R (O)
ATU-R System Vendor ID	7.4.4	R (M)		R (O)	R (O)
ATU-C Version Number	7.4.5	R (M)	R (O)		R (O)
ATU-R Version Number	7.4.6	R (M)		R (O)	R (O)
ATU-C Serial Number	7.4.7	R (M)	R (O)		R (O)
ATU-R Serial Number	7.4.8	R (M)		R (O)	R (O)
ATU-C Self-Test Result	7.4.9	R (M)	R (O)		R (O)
ATU-R Self-Test Result	7.4.10	R (M)		R (O)	R (O)
ATU-C Transmission System Capabilities	7.4.11	R (M)	R (O)		R (O)
ATU-R Transmission System Capabilities	7.4.12	R (M)		R (O)	R (O)

Table 7-16/G.997.1 – Line inventory

Category/Element	G.992.1	G.992.2	G.992.3	G.992.4	G.992.5
ATU-C G.994.1 Vendor ID	Y	Y	Y	Y	Y
ATU-R G.994.1 Vendor ID	Y	Y	Y	Y	Y
ATU-C System Vendor ID	Y	Y	Y	Y	Y
ATU-R System Vendor ID	Y	Y	Y	Y	Y
ATU-C Version Number	Y	Y	Y	Y	Y
ATU-R Version Number	Y	Y	Y	Y	Y
ATU-C Serial Number	Y	Y	Y	Y	Y
ATU-R Serial Number	Y	Y	Y	Y	Y
ATU-C Self-Test Result	Y	Y	Y	Y	Y
ATU-R Self-Test Result	Y	Y	Y	Y	Y
ATU-C Transmission System Capabilities	Y	Y	Y	Y	Y
ATU-R Transmission System Capabilities	Y	Y	Y	Y	Y

Table 7-17/G.997.1 – Line performance monitoring parameters

Category/Element	Defined in:	Q-Interface	U-C Interface	U-R Interface	T-/S-Interface
Near-end (ATU-C) Performance Monitoring Counters (current and previous 15-minute interval)					
FECS-L counter 15 minutes	7.2.1.1.1	R (M)	R (O)		
ES-L counter 15 minutes	7.2.1.1.2	R (M)	R (O)		R(O)
SES-L counter 15 minutes	7.2.1.1.3	R (M)	R (O)		R(O)
LOSS-L counter 15 minutes	7.2.1.1.4	R (M)	R (O)		
UAS-L counter 15 minutes	7.2.1.1.5	R (M)	R (O)		
Near-end (ATU-C) Performance Monitoring Counters (current and previous 1 day interval)					
FECS-L counter 1 day	7.2.1.1.1	R (M)	R (O)		
ES-L counter 1 day	7.2.1.1.2	R (M)	R (O)		R(O)
SES-L counter 1 day	7.2.1.1.3	R (M)	R (O)		R(O)
LOSS-L counter 1 day	7.2.1.1.4	R (M)	R (O)		
UAS-L counter 1 day	7.2.1.1.5	R (M)	R (O)		
Far-end (ATU-R) Performance Monitoring Counters (current and previous 15-minute interval)					
FECS-LFE counter 15 minutes	7.2.1.2.1	R (M)		R (O)	
ES-LFE counter 15 minutes	7.2.1.2.2	R (M)		R (O)	R(O)
SES-LFE counter 15 minutes	7.2.1.2.3	R (M)		R (O)	R(O)
LOSS-LFE counter 15 minutes	7.2.1.2.4	R (M)		R (O)	
UAS-LFE counter 15 minutes	7.2.1.2.5	R (M)		R (O)	
Far-end (ATU-R) Performance Monitoring Counters (current and previous 1 day interval)					
FECS-LFE counter 1 day	7.2.1.2.1	R (M)		R (O)	
ES-LFE counter 1 day	7.2.1.2.2	R (M)		R (O)	R(O)
SES-LFE counter 1 day	7.2.1.2.3	R (M)		R (O)	R(O)
LOSS-LFE counter 1 day	7.2.1.2.4	R (M)		R (O)	
UAS-LFE counter 1 day	7.2.1.2.5	R (M)		R (O)	
Initialization Performance Monitoring Counters (current and previous 15-minute interval)					
Full inits counter 15 minutes	7.2.1.3.1	R (M)	R (O)		
Failed full inits counter 15 minutes	7.2.1.3.2	R (M)	R (O)		
Short inits counter 15 minutes	7.2.1.3.3	R (O)	R (O)		
Failed short inits counter 15 minutes	7.2.1.3.4	R (O)	R (O)		
Initialization Performance Monitoring Counters (current and previous 1 day interval)					
Full inits counter 1 day	7.2.1.3.1	R (M)	R (O)		
Failed full inits counter 1 day	7.2.1.3.2	R (M)	R (O)		
Short inits counter 1 day	7.2.1.3.3	R (O)	R (O)		
Failed short inits counter 1 day	7.2.1.3.4	R (O)	R (O)		

Table 7-18/G.997.1 – Line performance monitoring parameters

Category/Element	G.992.1	G.992.2	G.992.3	G.992.4	G.992.5
Near-end Performance Monitoring Counters (current and previous 15-minute interval)					
FECS-L counter 15 minutes	Y	Y	Y	Y	Y
ES-L counter 15 minutes	Y	Y	Y	Y	Y
SES-L counter 15 minutes	Y	Y	Y	Y	Y
LOSS-L counter 15 minutes	Y	Y	Y	Y	Y
UAS-L counter 15 minutes	Y	Y	Y	Y	Y
Near-end Performance Monitoring Counters (current and previous 1 day interval)					
FECS-L counter 1 day	Y	Y	Y	Y	Y
ES-L counter 1 day	Y	Y	Y	Y	Y
SES-L counter 1 day	Y	Y	Y	Y	Y
LOSS-L counter 1 day	Y	Y	Y	Y	Y
UAS-L counter 1 day	Y	Y	Y	Y	Y
Far-end Performance Monitoring Counters (current and previous 15-minute interval)					
FECS-LFE counter 15 minutes	Y	Y	Y	Y	Y
ES-LFE counter 15 minutes	Y	Y	Y	Y	Y
SES-LFE counter 15 minutes	Y	Y	Y	Y	Y
LOSS-LFE counter 15 minutes	Y	Y	Y	Y	Y
UAS-LFE counter 15 minutes	Y	Y	Y	Y	Y
Far-end Performance Monitoring Counters (current and previous 1 day interval)					
FECS-LFE counter 1 day	Y	Y	Y	Y	Y
ES-LFE counter 1 day	Y	Y	Y	Y	Y
SES-LFE counter 1 day	Y	Y	Y	Y	Y
LOSS-LFE counter 1 day	Y	Y	Y	Y	Y
UAS-LFE counter 1 day	Y	Y	Y	Y	Y
Initialization Performance Monitoring Counters (current and previous 15-minute interval)					
Full inits counter 15 minutes	Y	Y	Y	Y	Y
Failed full inits counter 15 minutes	Y	Y	Y	Y	Y
Short inits counter 15 minutes		Y	Y	Y	Y
Failed short inits counter 15 minutes		Y	Y	Y	Y
Initialization Performance Monitoring Counters (current and previous 1 day interval)					
Full inits counter 1 day	Y	Y	Y	Y	Y
Failed full inits counter 1 day	Y	Y	Y	Y	Y
Short inits counter 1 day		Y	Y	Y	Y
Failed short inits counter 1 day		Y	Y	Y	Y

Table 7-19/G.997.1 – Channel performance monitoring parameters

Category/Element	Defined in:	Q-Interface	U-C Interface	U-R Interface	T-/S-Interface
Near-end (ATU-C) Performance Monitoring Counters (current and previous 15-minute interval)					
CV-C counter 15 minutes	7.2.2.1.1	R (M)	R (O)		
FEC-C counter 15 minutes	7.2.2.1.2	R (M)	R (O)		
Near-end (ATU-C) Performance Monitoring Counters (current and previous 1 day interval)					
CV-C counter 1 day	7.2.2.1.1	R (M)	R (O)		
FEC-C counter 1 day	7.2.2.1.2	R (M)	R (O)		
Far-end (ATU-R) Performance Monitoring Counters (current and previous 15-minute interval)					
CV-CFE counter 15 minutes	7.2.2.2.1	R (M)		R (O)	
FEC-CFE counter 15 minutes	7.2.2.2.2	R (M)		R (O)	
Far-end (ATU-R) Performance Monitoring Counters (current and previous 1 day interval)					
CV-CFE counter 1 day	7.2.2.2.1	R (M)		R (O)	
FEC-CFE counter 1 day	7.2.2.2.2	R (M)		R (O)	

Table7-20/G.997.1 – ATM data path performance monitoring parameters

Category/Element	Defined in:	Q-Interface	U-C Interface	U-R Interface	T-/S-Interface
Near-end (ATU-C) Performance Monitoring Counters (current and previous 15-minute interval)					
HEC-P counter 15 minutes	7.2.4.1.1	R (M)	R (O)		
CD-P counter 15 minutes	7.2.4.1.2	R (M)	R (O)		
CU-P counter 15 minutes	7.2.4.1.3	R (M)	R (O)		
IBE-P counter 15 minutes	7.2.4.1.4	R (M)	R (O)		R(O)
Near-end (ATU-C) Performance Monitoring Counters (current and previous 1 day interval)					
HEC-P counter 1 day	7.2.4.1.1	R (M)	R (O)		
CD-P counter 1 day	7.2.4.1.2	R (M)	R (O)		
CU-P counter 1 day	7.2.4.1.3	R (M)	R (O)		
IBE-P counter 1 day	7.2.4.1.4	R (M)	R (O)		R(O)
Far-end (ATU-R) Performance Monitoring Counters (current and previous 15-minute interval)					
HEC-PFE counter 15 minutes	7.2.4.2.1	R (M)		R (O)	
CD-PFE counter 15 minutes	7.2.4.2.2	R (M)		R (O)	
CU-PFE counter 15 minutes	7.2.4.2.3	R (M)		R (O)	
IBE-PFE counter 15 minutes	7.2.4.2.4	R (M)		R (O)	R(O)
Far-end (ATU-R) Performance Monitoring Counters (current and previous 1 day interval)					
HEC-PFE counter 1 day	7.2.4.2.1	R (M)		R (O)	
CD-PFE counter 1 day	7.2.4.2.2	R (M)		R (O)	
CU-PFE counter 1 day	7.2.4.2.3	R (M)		R (O)	
IBE-PFE counter 1 day	7.2.4.2.4	R (M)		R (O)	R(O)

Table 7-21/G.997.1 – Channel performance monitoring parameters

Category/Element	G.992.1	G.992.2	G.992.3	G.992.4	G.992.5
Near-end Performance Monitoring Counters (current and previous 15-minute interval)					
CV-C counter 15 minutes	Y	Y	Y	Y	Y
FEC-C counter 15 minutes	Y	Y	Y	Y	Y
Near-end Performance Monitoring Counters (current and previous 1 day interval)					
CV-C counter 1 day	Y	Y	Y	Y	Y
FEC-C counter 1 day	Y	Y	Y	Y	Y
Far-end Performance Monitoring Counters (current and previous 15-minute interval)					
CV-CFE counter 15 minutes	Y	Y	Y	Y	Y
FEC-CFE counter 15 minutes	Y	Y	Y	Y	Y
Far-end Performance Monitoring Counters (current and previous 1 day interval)					
CV-CFE counter 1 day	Y	Y	Y	Y	Y
FEC-CFE counter 1 day	Y	Y	Y	Y	Y

Table 7-22/G.997.1 – ATM data path performance monitoring parameters

Category/Element	G.992.1	G.992.2	G.992.3	G.992.4	G.992.5
Near-end Performance Monitoring Counters (current and previous 15-minute interval)					
HEC-P counter 15 minutes	Y	Y	Y	Y	Y
CD-P counter 15 minutes	Y	Y	Y	Y	Y
CU-P counter 15 minutes	Y	Y	Y	Y	Y
IBE-P counter 15 minutes	Y	Y	Y	Y	Y
Near-end Performance Monitoring Counters (current and previous 1 day interval)					
HEC-P counter 1 day	Y	Y	Y	Y	Y
CD-P counter 1 day	Y	Y	Y	Y	Y
CU-P counter 1 day	Y	Y	Y	Y	Y
IBE-P counter 1 day	Y	Y	Y	Y	Y
Far-end Performance Monitoring Counters (current and previous 15-minute interval)					
HEC-PFE counter 15 minutes	Y	Y	Y	Y	Y
CD-PFE counter 15 minutes	Y	Y	Y	Y	Y
CU-PFE counter 15 minutes	Y	Y	Y	Y	Y
IBE-PFE counter 15 minutes	Y	Y	Y	Y	Y
Far-end Performance Monitoring Counters (current and previous 1 day interval)					
HEC-PFE counter 1 day	Y	Y	Y	Y	Y
CD-PFE counter 1 day	Y	Y	Y	Y	Y
CU-PFE counter 1 day	Y	Y	Y	Y	Y
IBE-PFE counter 1 day	Y	Y	Y	Y	Y

Table 7-23/G.997.1 – Line test, diagnostics and status parameters

Category/Element	Defined in:	Q-Interface	U-C Interface	U-R Interface	T-/S-Interface
ADSL Transmission System	7.5.1.1	R (M)			R (O)
Power Mangagement State	7.5.1.2	R (M)			R (O)
Initialization					
Success/Failure Cause	7.5.1.3	R (M)			R (M)
Last State Transmitted Downstream	7.5.1.4	R (M)			R (M)
Last State Transmitted Upstream	7.5.1.5	R (M)			R (M)
Attenuation					
LATNds	7.5.1.6	R (M)		R (O)	R (M)
LATNus	7.5.1.7	R (M)	R (O)		R (M)
SATNds	7.5.1.8	R (M)		R (O)	R (M)
SATNus	7.5.1.9	R (M)	R (O)		R (M)
Signal-to-Noise Ratio Margin					
SNRMds	7.5.1.10	R (M)		R (O)	R (M)
SNRMus	7.5.1.11	R (M)	R (O)		R (M)
Attainable Data rate					
ATTNDRds	7.5.1.12	R (M)	R (O)		R (M)
ATTNDRus	7.5.1.13	R (M)		R (O)	R (M)
Actual Power Spectral Density					
ACTPSDds	7.5.1.14	R (M)	R (O)		
ACTPSDus	7.5.1.15	R (M)		R (O)	
Actual Aggregate Transmit Power					
ACTATPds	7.5.1.16	R (M)		R (O)	R (M)
ACTATPus	7.5.1.17	R (M)	R (O)		R (M)
Channel Characteristics per subcarrier					
HLINSCds	7.5.1.18.1	R(M)	R (O)		R (M)
HLINpsds	7.5.1.18.2	R (M)	R (O)		R (M)
HLOGMTds	7.5.1.18.3	R (M)	R (O)		R (M)
HLOGpsds	7.5.1.18.4	R (M)	R (O)		R (M)
HLINSCus	7.5.1.18.5	R (M)		R (O)	R (M)
HLINpsus	7.5.1.18.6	R (M)		R (O)	R (M)
HLOGMTus	7.5.1.18.7	R (M)		R (O)	R (M)
HLOGpsus	7.5.1.18.8	R (M)		R (O)	R (M)

Table 7-23/G.997.1 – Line test, diagnostics and status parameters

Category/Element	Defined in:	Q-Interface	U-C Interface	U-R Interface	T-/S-Interface
Quiet Line Noise PSD per subcarrier					
QLNMTds	7.5.1.19.1	R (M)	R (O)		R (M)
QLNpsds	7.5.1.19.2	R (M)	R (O)		R (M)
QLNMTus	7.5.1.19.3	R (M)		R (O)	R (M)
QLNpsus	7.5.1.19.4	R (M)		R (O)	R (M)
Signal-to-Noise Ratio per subcarrier					
SNRMTds	7.5.1.20.1	R (M)	R (O)		R (M)
SNRpsds	7.5.1.20.2	R (M)	R (O)		R (M)
SNRMTus	7.5.1.20.3	R (M)		R (O)	R (M)
SNRpsus	7.5.1.20.4	R (M)		R (O)	R (M)
Bit Allocation per subcarrier					
BITSpsds	7.5.1.21.1	R (M)	R (O)		
BITSpsus	7.5.1.21.2	R (M)		R (O)	
Gain Scaling per subcarrier					
GAINSpsds	7.5.1.21.3	R (M)	R (O)		
GAINSpsus	7.5.1.21.4	R (M)		R (O)	
TSSpsds	7.5.1.21.5	R (M)	R (O)		
TSSpsus	7.5.1.21.6	R (M)	R (O)		

Table 7-24/G.997.1 – Line test, diagnostics and status parameters

Category/Element	G.992.1	G.992.2	G.992.3	G.992.4	G.992.5
ADSL Transmission System	Y	Y	Y	Y	Y
Power Mangagement State	Y	Y	Y	Y	Y
Initialization					
Success/Failure Cause	Y	Y	Y	Y	Y
Last State Transmitted Downstream			Y	Y	Y
Last State Transmitted Upstream			Y	Y	Y
Attenuation					
LATNds	Y	Y	Y	Y	Y
LATNus	Y	Y	Y	Y	Y
SATNds			Y	Y	Y
SATNus			Y	Y	Y
Signal-to-Noise Ratio Margin					
SNRMds	Y	Y	Y	Y	Y
SNRMus	Y	Y	Y	Y	Y

Table 7-24/G.997.1 – Line test, diagnostics and status parameters

Category/Element	G.992.1	G.992.2	G.992.3	G.992.4	G.992.5
Attainable Data rate					
ATTNDRds	Y	Y	Y	Y	Y
ATTNDRus	Y	Y	Y	Y	Y
Actual Power Spectral Density					
ACTPSDds			Y	Y	Y
ACTPSDus			Y	Y	Y
Actual Aggregate Transmit Power					
ACTATPds	Y	Y	Y	Y	Y
ACTATPus	Y	Y	Y	Y	Y
Channel Characteristics per subcarrier					
HLINSCds			Y	Y	Y
HLINMTds			Y	Y	Y
HLINpsds			Y	Y	Y
HLOGMTds			Y	Y	Y
HLOGpsds			Y	Y	Y
HLINSCus			Y	Y	Y
HLINMTus			Y	Y	Y
HLINpsds			Y	Y	Y
HLOGMTus			Y	Y	Y
HLOGpsus			Y	Y	Y
Quiet Line Noise PSD per subcarrier					
QLNMTds			Y	Y	Y
QLNpsds			Y	Y	Y
QLNMTus			Y	Y	Y
QLNpsus			Y	Y	Y
Signal-to-Noise Ratio per subcarrier					
SNRMTds			Y	Y	Y
SNRpsds			Y	Y	Y
SNRMTus			Y	Y	Y
SNRpsus			Y	Y	Y
Bit Allocation per subcarrier					
BITSpsds			Y	Y	Y
BITSpsus			Y	Y	Y

Table 7-24/G.997.1 – Line test, diagnostics and status parameters

Category/Element	G.992.1	G.992.2	G.992.3	G.992.4	G.992.5
Gain Scaling per subcarrier					
GAINSpsds			Y	Y	Y
GAINSpsus			Y	Y	Y
TSSpsds			Y	Y	Y
TSSpsus			Y	Y	Y

Table 7-25/G.997.1 – Channel test, diagnostics and status parameters

Category/Element	Defined in:	Q-Interface	U-C Interface	U-R Interface	T-/S-Interface
Actual Data Rate	7.5.2.1	R (M)			R (O)
Previous Data Rate	7.5.2.2	R (M)			R (O)
Actual Interleaving Delay	7.5.2.3	R (M)		R (O)	R (O)

Table 7-26/G.997.1 – Channel test, diagnostics and status parameters

Category/Element	G.992.1	G.992.2	G.992.3	G.992.4	G.992.5
Actual Data Rate	Y	Y	Y	Y	Y
Previous Data Rate	Y	Y	Y	Y	Y
Actual Interleaving Delay	Y	Y	Y	Y	Y

Appendix I

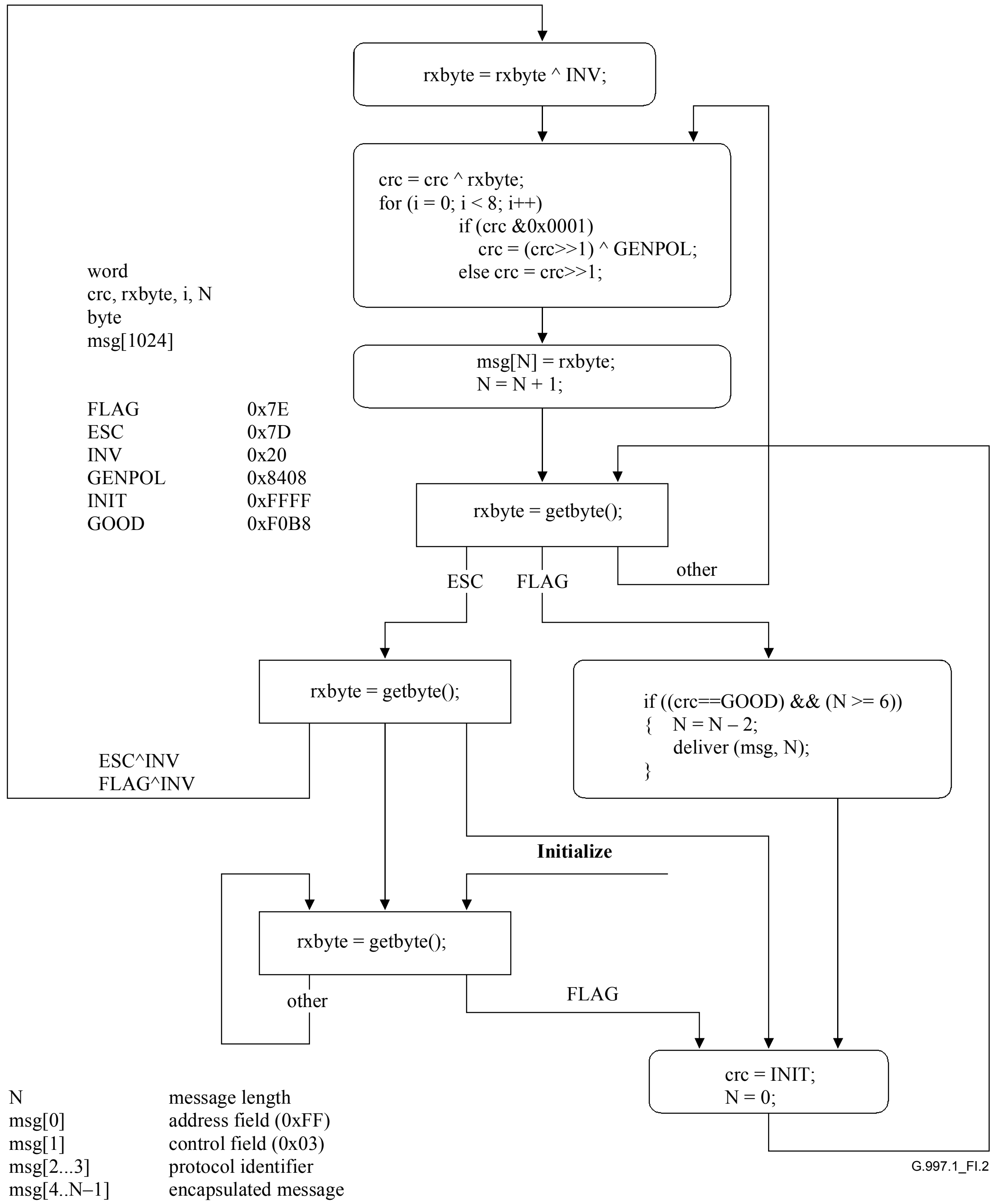
Processing examples

I.1 Illustration of transmitter processing

```
#define        INIT      0xFFFF
#define        FLAG      0x7E
#define        ESC       0x7D
#define        INV       0x20
#define        GENPOL    0x8408
unsigned char      msg[1024], temp;   /*  8 bit unsigned char      */
unsigned short int crc;               /* 16 bit unsigned integer */
int            N, j, msglen;
{
     crc = INIT;
     msg[0] = 0xFF;
     crc = update_crc(msg[0], crc);
     msg[1] = 0x03;
     crc = update_crc(msg[1], crc);
     N = 2;
     j = 0;
     while (j < msglen)
     {
          temp = xmit_msg_byte(j++);
          crc = update_crc(temp, crc);
          if ( (temp = FLAG) || (temp = ESC) )
          {
               msg[N] = ESC;
               msg[N+1] = temp ^ INV;
               N = N + 2;
          }
          else
          {
               msg[N] = temp;
               N = N + 1;
          }
     }
     crc = ~crc;
     msg [N] = crc & 0x00FF;
     msg[N+1] = (crc >> 8) & 0x00FF;
     xmit_msg();
}

unsigned short int update_crc(unsigned char new_byte, unsigned short int
crc_reg)
{
int  i;
     crc_reg = crc_reg ^ new_byte;
     for (i=0; i<8; i++)
          if (crc_reg & 0x0001)
               crc_reg = (crc_reg>>1) ^ GENPOL;
          else
               crc_reg = crc_reg >> 1;
     return (crc_reg);
}
```

I.2 Illustration of receiver processing



Appendix II

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Printed in Switzerland
Geneva, 2004