

Recommendation

ITU-T G.997.3 (2021) Cor. 1 (11/2022)

SERIES G: Transmission systems and media, digital systems and networks

Digital sections and digital line system – Metallic access networks

Physical layer management for MGfast transceivers

Corrigendum 1



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Recommendation ITU-T G.997.3

Physical layer management for MGfast transceivers

Corrigendum 1

Summary

Recommendation ITU-T G.997.3 specifies the physical layer management for multi-gigabit fast access to subscriber terminals (MGfast) transmission systems. It specifies managed objects for configuration, fault, status, inventory and performance management.

Corrigendum 1 integrates Amendment 1 and corrects or clarifies the following item:

- Clarify the format of the reporting of line failures

The changes relative to corrected items are with the following change bars.

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Recommendation ITU-T G.997.3

Physical layer management for MGfast transceivers

Corrigendum 1

Editorial note: This is a complete-text publication. Modifications introduced by this corrigendum are shown in revision marks relative to Recommendation ITU-T G.997.3 (2021) plus its Amendment 1.

1 Scope

This Recommendation specifies the physical layer management for multi-gigabit fast access to subscriber terminals (MGfast) transmission systems.

It specifies objects for configuration, fault, status, inventory and performance management. The list of managed objects applies at the distribution point unit-northbound (DPU-NB) interface, relating to the distribution point unit-management information base (DPU-MIB) nomenclature used in [ITU-T G.9711]. The managed objects are specified to provide, at least, all information necessary for translation into a yet another next generation (YANG) data model [b-IETF RFC 7950], although this does not exclude translation to other formats, such as an abstract syntax notation one (ASN.1; [b-ITU-T X.68x] series) management information base (MIB) description used in connection with the simple network management protocol (SNMP) [b-IETF RFC 1157]. The specification of the YANG data model for MGfast-managed objects lies outside the scope of this Recommendation.

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.

- [ITU-T G.994.1] Recommendation ITU-T G.994.1 (2021), *Handshake procedures for digital subscriber line transceivers*.
- [ITU-T G.997.2] Recommendation ITU-T G.997.2 (2019), *Physical layer management for G.fast transceivers*.
- [ITU-T G.9710] Recommendation ITU-T G.9710 (2020), *Multi-gigabit fast access to subscriber terminals (MGfast) – Power spectral density specification*.
- [ITU-T G.9711] Recommendation ITU-T G.9711 (2021), *Multi-gigabit fast access to subscriber terminals (MGfast) – Physical layer specification*.

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following term defined elsewhere:

3.1.1 anomaly [ITU-T G.997.2]: 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.

3.1.2 defect [ITU-T G.997.2]: 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 a defect.

3.1.3 DPU-NB interface [ITU-T G.997.2]: The interface between the persistent management agent and the management entity of the distribution point unit.

3.1.4 empty array [ITU-T G.997.2]: An array whose number of elements is zero.

3.1.5 failure [ITU-T G.997.2]: A 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".

3.1.6 managed object [ITU-T G.997.2]: The management view of a managed resource.

3.1.7 managed resource [ITU-T M.3010]: The abstraction of those aspects of a telecommunication resource (logical or physical) required for telecommunications management.

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 AdminStatus: The representation of the configured, desired state of the interface. AdminStatus "up" is equivalent to the interface "enabled=true", where the desired link state is L0. AdminStatus "down" is equivalent to the interface "enabled=false", where the desired link state is L3.

NOTE 1 – The relation between the AdminStatus ("up" or "down") and the interface (enabled="true" or "false") is specified in [b-IETF RFC 8343].

NOTE 2 – Based on clause 12.1.1.5.1 of [ITU-T G.9711].

3.2.2 link: The pair of a path in the MGfast transceiver unit–central office end and its corresponding path in the MGfast transceiver unit–remote side.

3.2.3 line: A physical medium connected to the MGfast transceiver unit (MTU) at the U reference point, which may be used by a link to convey user data and management data between its MTU–central office end path and its MTU–remote side path. At the distribution point unit, a line connects to a hardware port.

3.2.4 OperStatus: The OperStatus represents the actual state of the interface. The OperStatus "up" is equivalent with the interface "enabled=true", where the actual link state is L0. The OperStatus "down" is equivalent with the interface "enabled=false", where the actual link state is L3.

NOTE 1 – The relation between the OperStatus ("up" or "down") and the interface (enabled="true" or "false") is specified in [b-IETF RFC 8343].

NOTE 2 – Based on clause 12.1.1.5 of [ITU-T G.9711].

3.2.5 path: The combination of a single transport protocol specific–transmission convergence (TPS-TC), a single physical media specific–transmission convergence (PMS-TC) and a single physical media dependent (PMD) in the MGfast transceiver unit–central office end (MTU-O) or in the MGfast transceiver unit–remote side (MTU-R), which conveys user data between the γ reference point and the U reference point and conveys management data for this TPS-TC, PMS-TC and PMD between the MTU management entity and the U reference point.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

ALN	Active Line Noise
AN	Access Node
ASN.1	Abstract Syntax Notation one
ATTGDR	Attainable Gamma Data Rate
BER	Bit Error Ratio
CE	Cyclic Extension
CRC	Cyclic Redundancy Check
CV	Code Violation
DMT	Discrete Multitone
DPU	Distribution Point Unit
DPU-MIB	Distribution Point Unit-Management Information Base
DPU-NB	DPU Northbound
DRA	Dynamic Resource Allocation
ds	downstream
DSNRM	Downshift SNRM
DTA	Dynamic Time Assignment
DTU	Data Transfer Unit
DTFO	Discontinuous Time Frequency Operation
DTU	Data Transfer Unit
EFTR	Error-Free Throughput Rate
eoc	embedded operations channel
ES	Errored Second
FDS	Full duplex compatible Downstream Sub-frame
FDX	Full Duplex
FE	Far End
FEC	Forward Error Correction
FEXT	Far-End crosstalk
FRA	Fast Rate Adaptation
FTTdp	Fibre To The distribution point
FTTx	Fibre To The x
FTU	Fast Transceiver Unit
FUS	Full duplex compatible Upstream Sub-frame
GDR	Gamma Data Rate
HON	Higher Order Node
HS	harmonized system

IAR	International Amateur Radio
IAT	Inter Arrival Time
ID	Identifier
INP	Impulse Noise Protection
INPEQ	Impulse Noise Protection Equivalent
L2+	Layer 2 and above
LOM	Loss of Margin
LOM-FE	Loss of Margin-Far End
LOR	Loss of RMC
LOR-FE	Loss of RMC-Far End
LORS	LOR Second
LOS	Loss of Signal
LOS-FE	Loss of Signal-Far End
LOSS	LOS Second
LPR	Loss of Power
LPR-FE	Loss of Power-Far End
M	Mandatory
MAXGDR	Maximum Gamma Data Rate
MGfast	Multi-Gigabit fast access to subscriber terminals
MIB	Management Information Base
MINGDR	Minimum Gamma Data Rate
MDU	Multi-Dwelling Unit
ME	Management Entity
ME-O	Management Entity-central office end
ME-R	Management Entity-Remote side
MTU	MGfast Transceiver Unit
MTU-O	MGfast Transceiver Unit–central office end
MTU-R	MGfast Transceiver Unit–Remote side
NDR	Net Data Rate
NE	Network Element
NMS	Network Management System
NOI	Normal Operation Interval
NPSF	Non-Priority Sub-Frame
NT	Network Termination
O	Optional
ODN	Optical Distribution Network
OLR	On-Line Reconfiguration

OSS	Operations Support System
P2MP	Point to Multipoint
P2P	Point to Point
PCS-LCM	Probabilistic Constellation Shaping-LDPC Coded Modulation
PDX	PHY Duplexing
PHY	Physical layer
PM	Performance Monitoring
PMA	Persistent Management Agent
PMD	Physical Media Dependent
PMS-TC	Physical Media Specific–Transmission Convergence
POTS	Plain Old Telephony Service
PSD	Power Spectral Density
PSE	Power Source Equipment
PSF	Priority Sub-Frame
QID	Queue Identifier
QLN	Quiet Line Noise
QoS	Quality of Service
R	Read
REIN	Repetitive Electrical Impulse Noise
RFI	Radio Frequency Interference
RMC	Robust Management Channel
RPF	Reverse Power Feeding
RPA	RMC Parameter Adjustment
SATN	Signal Attenuation
SES	Severely Errored Second
SHINE	Single High Impulse Noise Event
SNMP	Simple Network Management Protocol
SNR	Signal-to-Noise Ratio
SNRM	Signal-to-Noise Ratio Margin
SRA	Seamless Rate Adaptation
SREC	Showtime Reconfiguration
TCM	Trellis Coded Modulation
TDD	Time Division Duplexing
TIGA	Transmitter-Initiated Gain Adjustment
TPS-TC	Transport Protocol Specific–Transmission Convergence
TR	Threshold Report
UAS	Unavailable Second

UPBO	Upstream Power Back-Off
us	upstream
USNRM	Upshift SNRM
VCE	Vectoring Control Entity
VoIP	Voice over Internet Protocol
W	Write
WAN	Wide-Area Network
YANG	Yet Another Next Generation

5 Management architecture

The management of an access node (AN) or a distribution point unit (DPU) is performed by the network management system (NMS), passing management information over the Q reference point to each management entity (ME) of the AN (see Figure 5-1) or through a persistent management agent (PMA) to each ME of the DPU (see Figure 5-2). The NMS may also monitor each MTU-R (i.e., subscriber end of the loop) via the ME and G reference point of the related network termination (NT). The connection between the ME functions at the AN or DPU and at the NT is established over management channels provided by the MTU-Os (i.e., network operator ends of the loop) and MTU-Rs via the copper pairs.

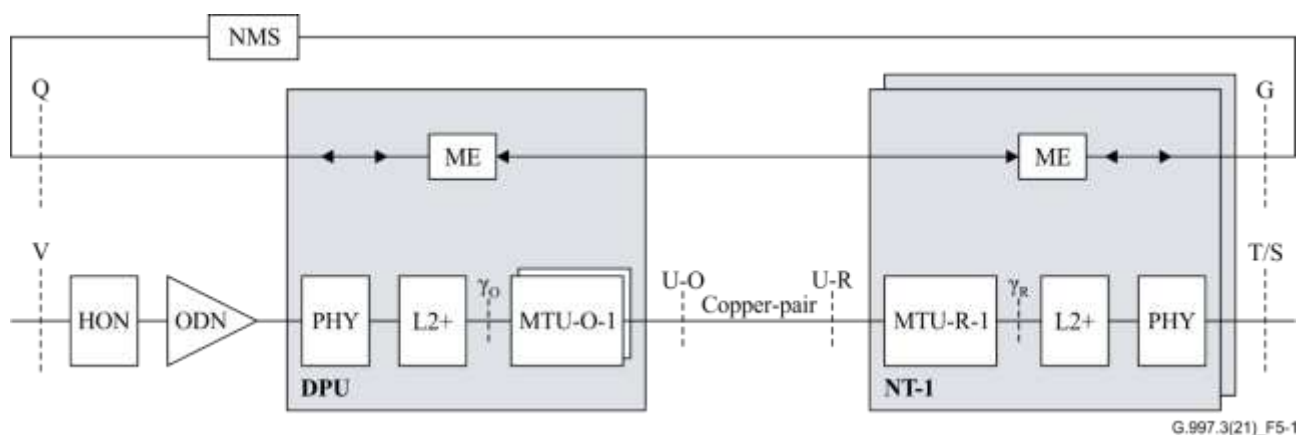


Figure 5-1 – Reference model of traditional access node deployment

(shown for line 1 in all N lines ($N \geq 1$) connected to an AN)

G, Q, T/S, V: reference points; HON: higher order node; ODN: optical distribution network; PHY: physical layer; U-O: loop interface–central office end; U-R: loop interface–remote side (i.e., subscriber end of the loop)

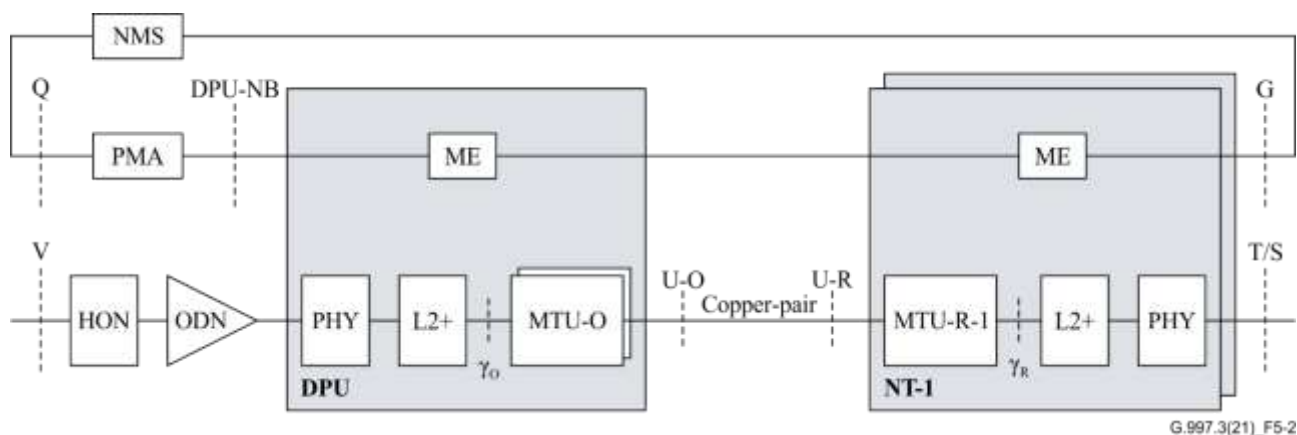


Figure 5-2 – Reference model of FTTdp deployment with PMA and DPU
(shown for line 1 in all N lines ($N \geq 1$) connected to a DPU)

An MTU-O always serves a single transceiver port on the DPU. A line always connects to a hardware port on the DPU. In both Figure 5-1 and Figure 5-2, MTU-O may be connected to only one or to multiple peer MTU-Rs. A connection with only one MTU-R is further referenced as a point-to-point (P2P) connection, consisting of a single link, with the transceiver port consisting of a single hardware port and a single MTU-R connected to this hardware port. A connection with multiple MTU-Rs is further referenced as a point-to-multipoint (P2MP) connection, consisting of multiple links, with the transceiver port consisting of one or more hardware ports and with one or more MTU-Rs connected per hardware port.

The DPU ME associates each link with an instance of the set of management objects. In the case of a P2MP connection, when an NT attempts to connect to the DPU, the DPU ME associates this NT to an already existing or newly created instance of the set of management objects, based on NT identification during ITU-T G.994.1 handshake (see clause 12.4 of [ITU-T G.9711]). Once the path in the MTU-O and the corresponding path in the MTU-R are both in the SHOWTIME state, the link is in the L0 state and the NT identity is verified through NT authentication at layer 2.

Appendix I of [ITU-T G.997.2] contains additional information regarding the Broadband Forum considerations on the fibre to the distribution point (FTTdp) deployment scenario (see also [b-BBF TR-301]).

The fundamental purpose of the PMA (see Appendix I of [ITU-T G.997.2]) is to allow operations support systems (OSSs) or NMS to perform all operations on a given DPU whether or not that DPU is actually powered. This includes the following PMA functionality:

- firmware download and management;
- initial provisioning;
- configuration, including rate control;
- test and diagnostics;
- statistics gathering;
- event reporting;
- performance monitoring (PM) history beyond current and previous interval counters;
- management protocol translation between the Q interface and the DPU-NB interface.

Some of these operations have limited capabilities when the DPU is without power. For example, statistics gathering is limited to the history present in the PMA, since current information is not available from the DPU.

The OSSs or NMS also still need to be able to ascertain the true power state of the DPU as a whole, and of each given link, e.g., for diagnostics purposes. It can choose to take into account the power state of a DPU for various processes, e.g., a new firmware download, but does not have to.

While distribution points are at locations where local power is typically not available, DPUs may also be deployed at locations where local powering or forward powering is available (e.g., in multi-dwelling unit (MDU) basements or in fibre to the x (FTTx) cabinets). In this case, a PMA could still exist as a separate entity to the DPU (if the DPU could still be unpowered at times).

If the DPU is deployed with reverse power feeding (RPF) and only P2P connections are supported, the physical layer management for RPF shall be as specified in Annex A of [ITU-T G.997.2]. If P2MP connections are supported, the physical layer management for RPF is for further study.

[ITU-T G.9711] specifies interfaces between the MTU-O (which is part of the AN or DPU) and the MTU-R (which is part of the NT). This Recommendation specifies the physical layer management for MGfast transmission systems as seen by the NMS (if the MTU-O is in an AN, see Figure 5-1) and as seen by the PMA (if the MTU-O is in a DPU, see Figure 5-2).

Clauses 7 and 8 specify managed objects for configuration, fault, test, diagnostics, status and inventory management, as well as for PM. The list of managed objects applies at the DPU-NB interface shown in Figure 5-2, relating to the DPU-MIB nomenclature used in [ITU-T G.9711]. The managed objects are designed to provide at least all the information necessary for translation into a YANG data model [b-IETF RFC 7950], although this does not exclude translation to other formats such as an ASN.1 [b-ITU-T X.68x] MIB description used in connection with SNMP [b-IETF RFC 1157].

The definitions of the managed objects specified in clause 7 provide the following information:

- description;
- type;
- unit;
- valid values;
- default value (for configuration objects only);
- reference.

The list of managed objects specified in clauses 7 and 8 also applies at the Q reference point shown in Figure 5-1.

6 Network management protocol

This Recommendation makes no presumption about which management protocol is used between the NMS and the AN (see Figure 5-1) or between the PMA and the DPU (see Figure 5-2) for transport of MGfast-managed objects.

7 Managed objects

The list of managed objects contains six types of information:

- 1) configuration objects;
- 2) fault monitoring – failures (alarm indications);
- 3) fault monitoring – threshold crossing (alert messages);
- 4) PM objects (counters);
- 5) test, diagnostic and status objects;
- 6) inventory objects.

Figure 7-1 shows the in-service PM process. The primitives are specified in [ITU-T G.9711].

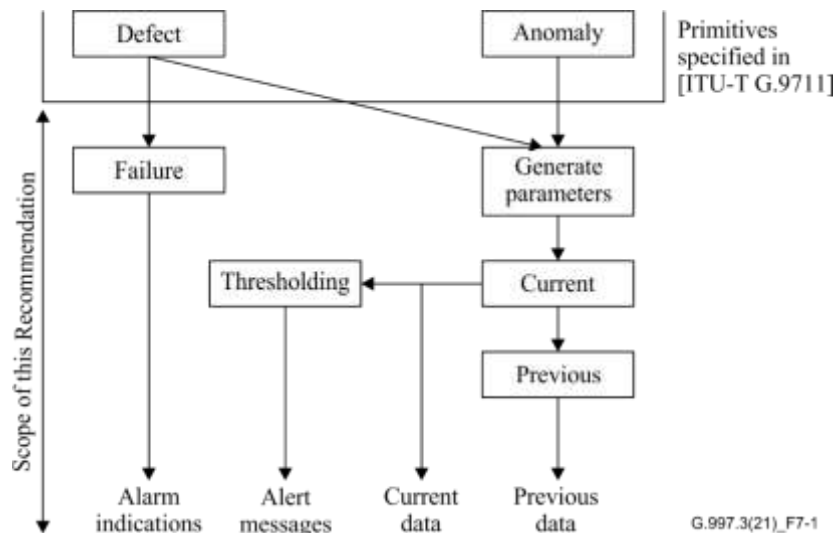


Figure 7-1 – In-service performance monitoring process

As [ITU-T G.9711] supports a DPU with multiple links, provisioning every managed object for every MGfast link on the DPU may become burdensome for large number of links. Therefore, DPU configuration management (as specified by the Broadband Forum) establishes MGfast configuration profiles, as well as a mechanism to associate these profiles to the individual links. The establishment of MGfast configuration profiles lies outside the scope of this Recommendation. The allocation of the individual MGfast-managed objects (as specified in this Recommendation) to MGfast configuration profiles is addressed within the scope of the Broadband Forum.

NOTE – The "configuration profiles" are not the "profiles" discussed in clause 6 of [ITU-T G.9711]. This clause uses the term "profile" to simplify the configuration of ITU-T G.9711 links on a DPU in the field. Clause 6 of [ITU-T G.9711] discusses a technique for determining native capabilities (e.g., the particular subset of [ITU-T G.9711]) supported by a particular MGfast transceiver.

The link configuration data and link state data at the DPU-NB interface are shown in Figure 7-2.

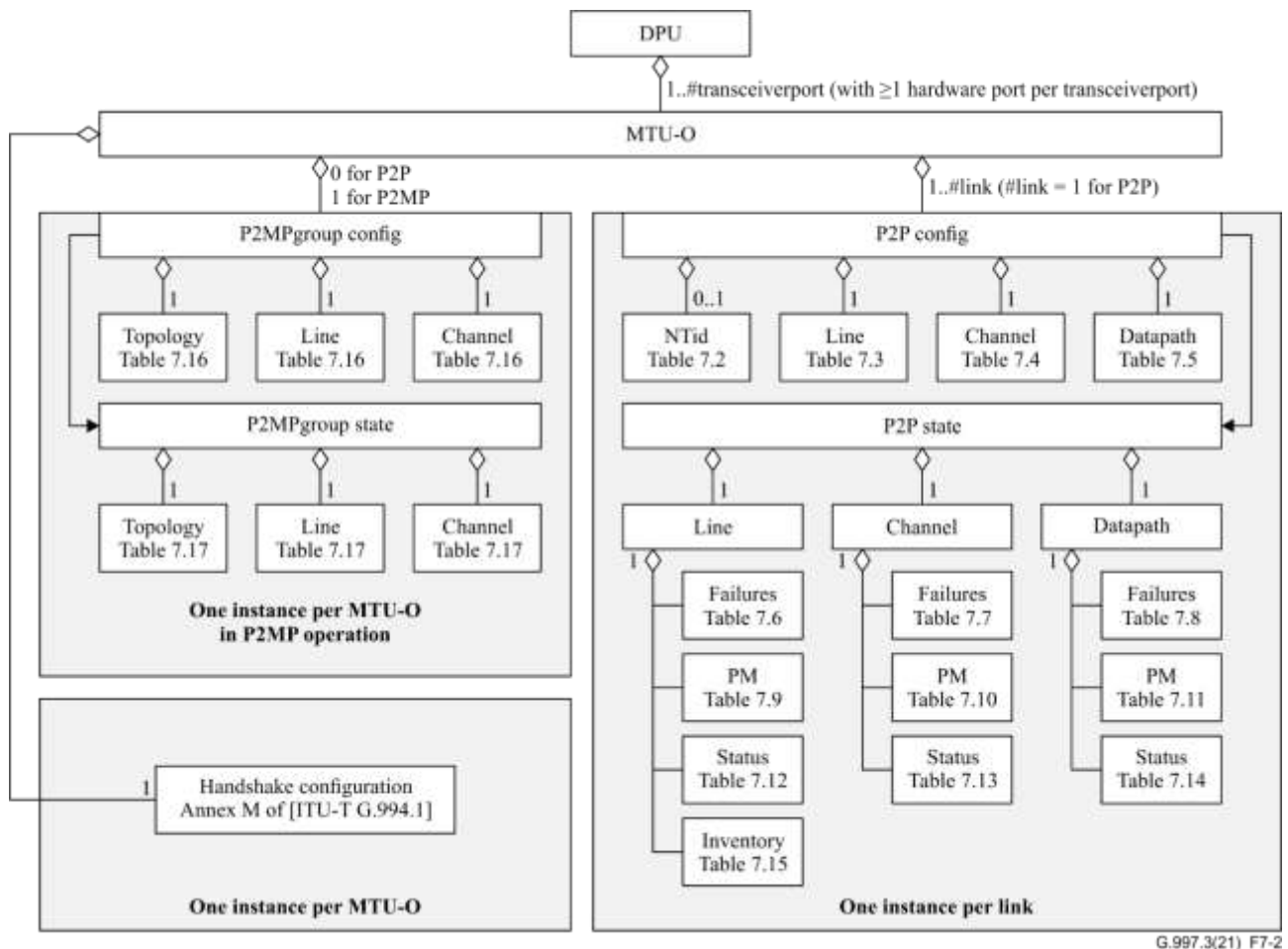


Figure 7-2 – Link configuration data and link state data at DPU-NB interface

At the DPU-NB interface, a link is configured through the following information:

- configuration of desired link state (AdminStatus);
- configuration of link identification (see Table 7-2);
- line configuration objects (see Table 7-3);
- channel configuration objects (see Table 7-4);
- data path configuration objects (see Table 7-5);

The link identification identifies the NT to which the link configuration applies. Line configuration objects relate to the PMD sublayer and the robust management channel (RMC). Channel configuration objects relate to the bearer channel-related aspects of the PMS-TC sublayer. Data path configuration objects relate to the TPS-TC sublayer.

At the DPU-NB interface, a link is monitored through the following information:

- actual link state (OperStatus);
- line failures (see Table 7-6);
- channel failures (see Table 7-7);
- data path failures (see Table 7-8);
- line PM objects (see Table 7-9);
- channel PM objects (see Table 7-10);
- data path PM objects (see Table 7-11);
- line test, diagnostics and status objects (see Table 7-12);

- channel test, diagnostics and status objects (see Table 7-13);
- data path test, diagnostic and status objects (see Table 7-14);
- inventory objects (see Table 7-15).

At the DPU-NB interface, if the DPU supports P2MP operation, a P2MP connection is configured through the following information:

- topology configuration objects (see Table 7-16);
- line configuration objects (see Table 7-16);
- channel configuration objects (see Table 7-16).

At the DPU-NB interface, if the DPU supports P2MP operation, a P2MP connection is monitored through the following information:

- topology monitoring objects (see Table 7-17);
- line status objects (see Table 7-17);
- channel status objects (see Table 7-17).

As [ITU-T G.9711] supports a DPU with multiple links, maintaining the PM and the test, diagnostic and status information for every link may become burdensome for a large number of links. Although access to all mandatory managed objects shall be supported at all times for all links on the DPU at the DPU-NB interface towards the PMA (see Figure 5-1), the objects may not be maintained within the ME of the DPU simultaneously for all links at all times. Although reasonable performance shall be provided at the DPU-NB interface for access to the managed objects of any link, this Recommendation does not specify performance requirements at this interface.

When the update request flag for a test parameter group (see clause 7.1.9) is set (its value is changed from 0 to 1), the parameters of the associated test parameter groups shall be updated in the DPU-MIB within the update time period specified in Table 7-1. The update request flag for the associated test parameter group is defined in the DPU-MIB and is independent of any autonomous update process in the system. The update request flag shall be reset (its value changed back to 0) by the DPU after the request parameter update is complete. The reset shall be within a period that is shorter than the reset time period specified in Table 7-1 to allow reception of another update request. The reset time period starts since the last time the update request flag was set (externally or by an autonomous process in the system). This applies only to the elements maintained in the DPU.

Test parameters and status parameters shall be updated in the L0 link state, unless explicitly stated otherwise in [ITU-T G.9711]. The gamma data rate downstream or upstream (GDRds/us) and attainable gamma data rate downstream or upstream (ATTGDRds/us) shall be updated only in the L0 state.

Table 7-1 – Test parameter groups

Test parameter group (see Note)	Update time period	Reset time period
Network element (NE) test parameter group 1 (NE-G1)	10 s	3 min
FE test parameter group 1 (FE-G1)	15 s	3 min
NE test parameter group 2 (NE-G2)	3 min	10 min
FE test parameter group 2 (FE-G2)	3 min	10 min
NOTE – The test parameters contained in each test parameter group are specified in Tables 7-12 and 7-13.		

Tables 7-2 to 7-17 indicate the status of each managed object over the DPU-NB interface:

- R: Read only;
- W: Write only;

- R/W: Read and write;
- M: Mandatory. If the functionality is optional in [ITU-T G.9711] and supported by the DPU, it is mandatory to include the managed object in the DPU-MIB;
- O: Optional.

Entries in Tables 7-2 to 7-17 labelled with names containing the separator "/" represent multiple objects whose names are obtained by considering all combinations of the elements isolated with the separator. For example, the entry labelled with the name A/B_C/D_E/F represents eight objects with names A_C_E, A_C_F, A_D_E, A_D_F, B_C_E, B_C_F, B_D_E and B_D_F. Also, the entry labelled with the name Ads/us represents two objects with names Ads and Aus. Near-end (indicated by the suffix -NE) objects apply to the MTU-O, while far-end (indicated by the suffix -FE) objects apply to the MTU-R.

For each configuration managed object, a default value is specified. Configuring a managed object with a value different from the default may change the applicable valid values of other managed objects and therefore may require reconfiguration of these objects.

Table 7-2 – Link identification

Category/object	Described in clause	DPU-NB interface
<i>NT identity</i>		
UNKNOWN_NT_ID	7.1.1	Notification
NT_ID	7.1.2	R/W (M)

Table 7-3 – Line configuration objects

Category/object	Described in clause	DPU-NB interface
<i>Profiles</i>		
ITU-T G.9711 profiles enabling (PROFILES)	7.2.1.1	R/W (M)
<i>Duplexing</i>		
Symbol periods per PDX frame (MF)	7.2.2.1	R/W (M)
Symbol periods per PDX frame dedicated for downstream transmission (Mds)	7.2.2.2	R/W (M)
Cyclic extension (CE)	7.2.2.3	R/W (M)
<i>Power and spectrum usage</i>		
MAXATPds	7.2.3.1	R/W (M)
MAXATPus	7.2.3.2	R/W (M)
CARMASKds	7.2.3.3	R/W (M)
CARMASKus	7.2.3.4	R/W (M)
MIBPSDMASKds	7.2.3.5	R/W (M)
MIBPSDMASKus	7.2.3.6	R/W (M)
RFIBANDS	7.2.3.7	R/W (M)
IARBANDS	7.2.3.8	R/W (M)
UPBOPSDA	7.2.3.9	R/W (M)

Table 7-3 – Line configuration objects

Category/object	Described in clause	DPU-NB interface
UPBOPSDB	7.2.3.10	R/W (M)
UPBOKL	7.2.3.11	R/W (M)
UPBOKLF	7.2.3.12	R/W (M)
UPBOKLREF	7.2.3.13	R/W (M)
CLASSMASKds	7.2.3.14	R/W (M)
CLASSMASKus	7.2.3.15	R/W (M)
RMCCARMASKds	7.2.3.16	R/W (M)
RMCCARMASKus	7.2.3.17	R/W (M)
<i>Noise margins</i>		
TARSNRMds	7.2.4.1	R/W (M)
TARSNRMus	7.2.4.2	R/W (M)
MAXSNRMus	7.2.4.3	R/W (M)
MINSNRMds	7.2.4.4	R/W (M)
MINSNRMus	7.2.4.5	R/W (M)
<i>Seamless rate adaptation (SRA)</i>		
SRA-USNRMds	7.2.5.1	R/W (M)
SRA-UTIMEds	7.2.5.2	R/W (M)
SRA-USNRMus	7.2.5.3	R/W (M)
SRA-UTIMEus	7.2.5.4	R/W (M)
SRA-DSNRMds	7.2.5.5	R/W (M)
SRA-DTIMEds	7.2.5.6	R/W (M)
SRA-DSNRMus	7.2.5.7	R/W (M)
SRA-DTIMEus	7.2.5.8	R/W (M)
<i>Fast rate adaptation (FRA)</i>		
FRA-TIMEds	7.2.6.1	R/W (M)
FRA-TIMEus	7.2.6.2	R/W (M)
FRA-NTONESds	7.2.6.3	R/W (M)
FRA-NTONESus	7.2.6.4	R/W (M)
FRA-RTXUCds	7.2.6.5	R/W (M)
FRA-RTXUCus	7.2.6.6	R/W (M)
FRA-VENDISCds	7.2.6.7	R/W (M)
FRA-VENDISCus	7.2.6.8	R/W (M)
<i>Robust management channel (RMC)</i>		
TARSNRM-RMCds	7.2.7.1	R/W (M)
TARSNRM-RMCus	7.2.7.2	R/W (M)
MINSNRM-RMCds	7.2.7.3	R/W (M)
MINSNRM-RMCus	7.2.7.4	R/W (M)

Table 7-3 – Line configuration objects

Category/object	Described in clause	DPU-NB interface
MAXBL-RMCds	7.2.7.5	R/W (M)
MAXBL-RMCus	7.2.7.6	R/W (M)
Vectoring		
FEXT cancellation enabling/disabling downstream (FEXT_TO_CANCEL_ENABLEds)	7.2.8.1	R/W (M)
FEXT cancellation enabling/disabling upstream (FEXT_TO_CANCEL_ENABLEus)	7.2.8.2	R/W (M)
XLOG requested subcarrier group size (XLOGGREQds)	7.2.8.3	R/W (M)
Requested crosstalk disturber index (XTALKDREQ)	7.2.8.4	R/W (M)
Fast-retrain policy		
LOS_PERSISTENCYds	7.2.9.1	R/W (M)
LOS_PERSISTENCYus	7.2.9.2	R/W (M)
LOM_PERSISTENCYds	7.2.9.3	R/W (M)
LOM_PERSISTENCYus	7.2.9.4	R/W (M)
LOR_PERSISTENCYds	7.2.9.5	R/W (M)
LOR_PERSISTENCYus	7.2.9.6	R/W (M)
REINIT_TIME_THRESHOLDds	7.2.9.7	R/W (M)
REINIT_TIME_THRESHOLDus	7.2.9.8	R/W (M)
LOW_ETR_THRESHOLDds	7.2.9.9	R/W (M)
LOW_ETR_THRESHOLDus	7.2.9.10	R/W (M)
Update test parameters request		
UPDATE-NE-TEST	7.2.10.1	R/W (M)
UPDATE-FE-TEST	7.2.10.2	R/W (M)
Impulse noise monitoring (INM)		
INMIATods/us	7.2.11.1	R/W(M)
INMIATSDs/us	7.2.11.2	R/W(M)
INMCCds/us	7.2.11.3	R/W(M)
INM_INPEQ_FORMATds/us	7.2.11.4	R/W(M)
BRGNds/us	7.2.11.5	R/W(M)
INPEQ_SF	7.2.11.6	R/W(M)
IAT_SF	7.2.11.7	R/W(M)
INM_ENABLE	7.2.11.8	R/W(M)
RMCR recovery (RMCR)		
RMCR_LOR_TRIGGERds/us	7.2.12.1	R/W(M)
Showtime reconfiguration		
SREC_ALLOWED	7.2.13.1	R/W(M)
PMD forward error correction		
PMDFECSCHMEDs/us	7.2.14	R/W(M)

Table 7-4 – Channel configuration objects

Category/object	Described in clause	DPU-NB interface
<i>Data rate (downstream/upstream)</i>		
Maximum net data rate (NDR) (MAXNDR ds/us)	7.3.1.1	R/W (M)
Minimum expected throughput (MINETRds/us)	7.3.1.2	R/W (M)
Maximum gamma data rate (MAXGDRds/us)	7.3.1.3	R/W (M)
Minimum gamma data rate (MINGDRds/us)	7.3.1.4	R/W (M)
<i>Retransmission (downstream/upstream)</i>		
INPMIN_SHINEDs/us	7.3.2.1	R/W (M)
SHINERATIOds/us	7.3.2.2	R/W (M)
INPMIN_REINDs/us	7.3.2.3	R/W (M)
IAT_REINDs/us	7.3.2.4	R/W (M)
RNRATIOds/us	7.3.2.5	R/W (M)
RTX_TESTMODE	7.3.2.6	R/W (M)
<i>Rate threshold (downstream/upstream)</i>		
LOW-ANDEFTR-THRESHOLDds/us	7.3.3.1	R/W (M)
LOW-ANDEFTR0-THRESHOLDds/us	7.3.3.2	R/W (M)

Table 7-5 – Data path configuration objects

Category/object	Described in clause	DPU-NB interface
TPS_TESTMODE	7.4.1	R/W (M)
DRA_TESTMODE	7.4.2	R/W (M)
QUEUE2CHANNELMAPds/us	7.4.3	R/W (M)
QOSCLASSds/us	7.4.4	R/W (M)

Table 7-6 – Line failures

Category/object	Described in clause	DPU-NB interface
<i>Near-end (MTU-O) failures</i>		
Loss of signal (LOS)	7.5.1.1	R (M)
Loss of margin (LOM)	7.5.1.2	R (M)
Loss of RMC (LOR)	7.5.1.3	R (M)
Loss of power (LPR)	7.5.1.4	R (M)
<i>Far-end (MTU-R) failures</i>		
Loss of signal-far-end (LOS-FE) failure	7.5.2.1	R (M)
Loss of margin-far-end (LOM-FE) failure	7.5.2.2	R (M)

Table 7-6 – Line failures

Category/object	Described in clause	DPU-NB interface
Loss of RMC-far end (LOR-FE) failure	7.5.2.3	R (M)
Loss of power-far end (LPR-FE) failure	7.5.2.4	R (M)
Initialization failures		
Link init (LINIT) failure	7.5.3.1	R (M)

Table 7-7 – Channel failures

Category/object	Described in clause	DPU-NB interface
Near-end (MTU-O) failures		
Far-end (MTU-R) failures		

Table 7-8 – Data path failures

Category/object	Described in clause	DPU-NB interface
Near-end (MTU-O) failures		
Far-end (MTU-R) failures		

Table 7-9 – Line performance monitoring objects

Category/object	Described in clause	DPU-NB interface
Near-end (MTU-O)/far-end (MTU-R) performance monitoring counters (current/previous 15 min/24 h interval)		
Measured time (CURR/PREV_NE/FE_15/24_L_TIME)	7.8.1	R (M)
Invalid data flag (PREV_NE/FE_15/24_L_INVALID)	7.8.2	R (M)
Time Stamp (PREV_NE/FE_15/24_L_STAMP)	7.8.3	R (M)
LOS failure counter (CURR/PREV_NE/FE_15/24_LOS)	7.8.4	R (M)
LOM failure counter (CURR/PREV_NE/FE_15/24_LOM)	7.8.5	R (M)
LOR failure counter (CURR/PREV_NE/FE_15/24_LOR)	7.8.6	R (M)
LPR failure counter (CURR/PREV_NE/FE_15/24_LPR)	7.8.7	R (M)

Table 7-9 – Line performance monitoring objects

Category/object	Described in clause	DPU-NB interface
ES counter (CURR/PREV_NE/FE_15/24_ES)	7.8.8	R (M)
Severely errored second (SES) counter (CURR/PREV_NE/FE_15/24_SES)	7.8.9	R (M)
LOS second (LOSS) counter (CURR/PREV_NE/FE_15/24_LOSS)	7.8.10	R (M)
LOR second (LORS) counter (CURR/PREV_NE/FE_15/24_LORS)	7.8.11	R (M)
Unavailable second (UAS) counter (CURR/PREV_NE/FE_15/24_UAS)	7.8.12	R (M)
<i>Initialization performance monitoring counters (current/previous 15 min/24 h interval)</i>		
Full inits counter (CURR/PREV_15/24_FULL_INITS)	7.8.13	R (M)
Failed full inits counter (CURR/PREV_15/24_FAILEDFULL_INITS)	7.8.14	R (M)
Fast inits counter (CURR/PREV_15/24_FAST_INITS)	7.8.15	R (M)
Failed Fast inits counter (CURR/PREV_15/24_FAILEDFAST_INITS)	7.8.16	R (M)
<i>Near-end (MTU-O) short interruption performance monitoring counters (current/previous 15 min/24 h interval)</i>		
LPR_INTRPT counter (CURR/PREV_15/24_LPR_INTRPT)	7.8.17	R (M)
HRI_INTRPT counter (CURR/PREV_15/24_HRI_INTRPT)	7.8.18	R (M)
SPONT_INTRPT counter (CURR/PREV_15/24_SPONT_INTRPT)	7.8.19	R (M)
ME_O_INTRPT counter (CURR/PREV_15/24_ME_O_INTRPT)	7.8.26	R (M)
<i>Near-end (MTU-O)/far-end (MTU-R) initiated OLR/FRA performance monitoring counters (current and previous 15 min/24 h interval)</i>		
Successful bitswap counter (CURR/PREV_NE/FE_15/24_BSW)	7.8.20	R (M)
Successful autonomous SRA counter (CURR/PREV_NE/FE_15/24_SRA)	7.8.21	R (M)
Successful FRA counter (CURR/PREV_NE/FE_15/24_FRA)	7.8.22	R (M)
Successful RMC parameter adjustment (RPA) counter (CURR/PREV_NE/FE_15/24_RPA)	7.8.23	R (M)
Successful RMCR counter CURR/PREV_NE/FE_15/24_RMCR	7.8.28	R (M)

Table 7-9 – Line performance monitoring objects

Category/object	Described in clause	DPU-NB interface
<i>Near-end (MTU-O) performance monitoring counters (current and previous 15 min/24 h interval)</i>		
Successful transmitter-initiated gain adjustment (TIGA) counter (CURR/PREV_15/24_TIGA)	7.8.24	R (M)
Successful showtime reconfiguration (SREC) counter (CURR/PREV_15/24_SUCCESS_SREC)	7.8.27	R (M)
<i>Near-end (MTU-O)/far-end (MTU-R) INM performance monitoring counters (current and previous 15 min/24 h interval)</i>		
INM INPEQ histogram (CURR/PREV_NE/FE_15/24_INMINPEQ)	7.8.25.1	R (M)
INM total measurement time (CURR/PREV_NE/FE_15/24_INMAME)	7.8.25.2	R (M)
INM IAT histogram (CURR/PREV_NE/FE_15/24_INMIAT)	7.8.25.3	R (M)
INM blank frame counter (CURR/PREV_NE/FE_15/24_INMBLFC)	7.8.25.4	R (M)

Table 7-10 – Channel performance monitoring objects

Category/object	Described in clause	DPU-NB interface
<i>Near-end (MTU-O)/far-end (MTU-R) performance monitoring counters (current/previous 15 min/24 h interval)</i>		
Measured Time (CURR/PREV_NE/FE_15/24_C_TIME)	7.9.1	R (M)
Invalid Data Flag (PREV_NE/FE_15/24_C_INVALID)	7.9.2	R (M)
Time Stamp (PREV_NE/FE_15/24_C_STAMP)	7.9.3	R (M)
Code violation (CV) counter (CURR/PREV_NE/FE_15/24_CV)	7.9.4	R (M)
RTXUC counter (CURR/PREV_NE/FE_15/24_RTXUC)	7.9.5	R (M)
RTXTX counter (CURR/PREV_NE/FE_15/24_RTXTX)	7.9.6	R (M)
LANDEFTRS counter (CURR/PREV_NE/FE_15/24_LANDEFTRS)	7.9.7	R (M)
LANDEFTR0S counter (CURR/PREV_NE/FE_15/24_LANDEFTR0S)	7.9.8	R (M)
ANDEFTRDS counter (CURR/PREV_NE/FE_15/24_ANDEFTRDS)	7.9.9	R (M)
ANDEFTR0DS counter (CURR/PREV_NE/FE_15/24_ANDEFTR0DS)	7.9.10	R (M)
<i>Near-end (NE) and far-end (FE) rate parameters per time interval (current/previous 15 min/24 h time interval)</i>		
MINANDEFTR per time interval (MINANDEFTR_CURR/PREV_NE/FE_15/24)	7.9.11	R (M)

Table 7-10 – Channel performance monitoring objects

Category/object	Described in clause	DPU-NB interface
MINANDEFTR0 per time interval (MINANDEFTR0_CURR/PREV_NE/FE_15/24)	7.9.12	R (M)
MAXANDEFTR per time interval (MAXANDEFTR_CURR/PREV_NE/FE_15/24)	7.9.13	R (M)
MAXANDEFTR0 per time interval (MAXANDEFTR0_CURR/PREV_NE/FE_15/24)	7.9.14	R (M)
SUMANDEFTR per time interval (SUMANDEFTR_CURR/PREV_NE/FE_15/24)	7.9.15	R (M)
SUMANDEFTR0 per time interval (SUMANDEFTR0_CURR/PREV_NE/FE_15/24)	7.9.16	R (M)
NOTE – The Measured Time, Invalid Data Flag and Time Stamp objects may have the same values as the respective line performance monitoring objects.		

Table 7-11 – Data path performance monitoring objects

Category/object	Described in clause	DPU-NB interface

Table 7-12 – Line test, diagnostic and status objects

Category/object	Described in clause	Test parameter group	DPU-NB interface
Profile			
ITU-T G.9711 profile (PROFILE)	7.11.1.1	Not applicable	R (M)
Initialization			
Initialization success/failure cause (INITSFCAUSE)	7.11.2.1	Not applicable	R (M)
Initialization last transmitted downstream signal (INITLASTSSIGNALds)	7.11.2.2	Not applicable	R (M)
Initialization last received upstream signal (INITLASTSIGNALus)	7.11.2.3	Not applicable	R (M)
Signal-to-noise ratio margin			
SNRMds	7.11.3.1	Not applicable	R (M)
SNRMus	7.11.3.2	Not applicable	R (M)
Upstream power back-off			
UPBOKLE	7.11.4.1	Not applicable	R (M)
UPBOKLE-R	7.11.4.2	Not applicable	R (M)
Actual aggregate transmit power			
ACTATPDs	7.11.5.1	FE-G1	R (M)
ACTATPus	7.11.5.2	NE-G1	R (M)

Table 7-12 – Line test, diagnostic and status objects

Category/object	Described in clause	Test parameter group	DPU–NB interface
<i>Actual transmit power spectrum density per sub–carrier</i>			
ACTPSDpsds	7.11.6.1	FE-G1	R (M)
ACTPSDpsus	7.11.6.2	NE-G1	R (M)
<i>Channel characteristics per sub–carrier</i>			
HLOGMTds	7.11.7.1	NE-G2	R (M)
HLOGGds	7.11.7.2	NE-G2	R (M)
HLOGpsds	7.11.7.3	NE-G2	R (M)
HLOGMTus	7.11.1.4	NE-G2	R (M)
HLOGGus	7.11.7.5	NE-G2	R (M)
HLOGpsus	7.11.7.6	NE-G2	R (M)
<i>Signal–to–noise ratio per sub–carrier</i>			
SNRMTds	7.11.8.1	FE-G1	R (M)
SNRGds	7.11.8.2	FE-G1	R (M)
SNRpsds	7.11.8.3	FE-G1	R (M)
SNRNPSFpsds	7.11.8.4	FE-G1	R (M)
SNRMTus	7.11.8.5	NE-G1	R (M)
SNRGus	7.11.8.6	NE-G1	R (M)
SNRpsus	7.11.8.7	NE-G1	R (M)
SNRNPSFpsus	7.11.8.8	NE-G1	R (M)
<i>Quiet line noise per subcarrier</i>			
QLNMTds	7.11.9.1	FE-G2	R (M)
QLNGds	7.11.9.2	FE-G2	R (M)
QLNpsds	7.11.9.3	FE-G2	R (M)
QLNMTus	7.11.9.4	NE-G2	R (M)
QLNGus	7.11.9.5	NE-G2	R (M)
QLNpsus	7.11.9.6	NE-G2	R (M)
<i>Active line noise per subcarrier</i>			
ALNMT	7.11.10.1	FE-G2	R (M)
ALNG	7.11.10.2	FE-G2	R (M)
ALNps	7.11.10.3	FE-G2	R (M)
<i>Bit allocation per sub–carrier on data symbols</i>			
BITSpsds	7.11.11.1	Not applicable	R (M)
BITSNPSFpsds	7.11.11.2	Not applicable	R (M)
BITSpsus	7.11.11.3	Not applicable	R (M)
BITSNPSFpsus	7.11.11.4	Not applicable	R (M)
RMC			
SNRM-RMCds	7.11.12.1	Not applicable	R (M)

Table 7-12 – Line test, diagnostic and status objects

Category/object	Described in clause	Test parameter group	DPU–NB interface
SNRM-RMCus	7.11.12.2	Not applicable	R (M)
BITS-RMCpsds	7.11.12.3	Not applicable	R (M)
BITS-RMCpsus	7.11.12.4	Not applicable	R (M)
<i>Test parameter time stamps</i>			
STAMP-TEST-NE-G1	7.11.13.1	Not applicable	R (M)
STAMP-TEST-FE-G1	7.11.13.2	Not applicable	R (M)
STAMP-TEST-NE-G2	7.11.13.3	Not applicable	R (M)
STAMP-TEST-FE-G2	7.11.13.4	Not applicable	R (M)
<i>OLR time stamps</i>			
STAMP-BSWds	7.11.14.1	Not applicable	R (M)
STAMP-BSWus	7.11.14.2	Not applicable	R (M)
STAMP-SRAds	7.11.14.3	Not applicable	R (M)
STAMP-SRAus	7.11.14.4	Not applicable	R (M)
STAMP-FRAds	7.11.14.5	Not applicable	R (M)
STAMP-FRAus	7.11.14.6	Not applicable	R (M)
STAMP-RPAds	7.11.14.7	Not applicable	R (M)
STAMP-RPAus	7.11.14.8	Not applicable	R (M)
STAMP-TIGA	7.11.14.9	Not applicable	R (M)
STAMP-SREC	7.11.14.10	Not applicable	R (M)
STAMP-RMCRds	7.11.14.11	Not applicable	R (M)
STAMP-RMCRus	7.11.14.12	Not applicable	R (M)
<i>Signal attenuation</i>			
SATNds	7.11.15.1	FE-G1	R (M)
SATNus	7.11.15.2	NE-G1	R (M)
<i>Vectoring</i>			
XTALKDIST	7.11.16.1	NE-G2	R (M)
XLOGBANDSds	7.11.16.2	NE-G2	R (M)
XLOGpsds	7.11.16.3	NE-G2	R (M)
ANEXTBANDSds/us	7.11.16.4	NE-G2	R (M)
ANEXTNCALCSETds/us	7.11.16.5	NE-G2	R (M)
ANEXTds/us	7.11.16.6	NE-G2	R (M)
<i>PMD forward error correction</i>			
ACTPMDFECSCHMEDs/us	7.11.17	Not applicable	R (M)
<i>Framing type</i>			
ACTPDXFRAMINGMODE	7.11.18	Not applicable	R (M)

Table 7-13 – Channel test, diagnostic and status objects

Category/object	Described in clause	Test parameter group	DPU–NB interface
<i>Actual data rates(downstream/upstream)</i>			
Net data rate (NDRds/us)	7.12.1.1	Not applicable	R (M)
Net data rate with DTFO disabled (NDR0ds/us)	7.12.1.2	Not applicable	R (M)
Expected throughput (ETRds/us)	7.12.1.3	Not applicable	R (M)
Expected throughput with DTFO disabled (ETR0ds/us)	7.12.1.4	Not applicable	R (M)
Gamma data rate (GDRds/us)	7.12.1.5	Not applicable	R (M)
<i>Attainable data rates (downstream/upstream)</i>			
Attainable net data rate (ATTNDRds/us)	7.12.2.1	Not applicable	R (M)
Attainable expected throughput (ATTETRds/us)	7.12.2.2	Not applicable	R (M)
Attainable gamma data rate (ATTGDRds/us)	7.12.2.3	Not applicable	R (M)
<i>Actual impulse noise protection (downstream/upstream)</i>			
ACTINPds/us	7.12.3.1	Not applicable	R (M)
ACTINP_REINds/us	7.12.3.2	Not applicable	R (M)
<i>Actual framer setting (downstream/upstream)</i>			
DTU–NFECds/us	7.12.4.1	Not applicable	R (M)
DTU–RFECds/us	7.12.4.2	Not applicable	R (M)
DTU–Qds/us	7.12.4.3	Not applicable	R (M)
<i>Test parameters per time interval (downstream/upstream)</i>			
Error–free bits current 15 min (EFB–C15Mds/us)	7.12.5.1	Not applicable	R (M)
Error–free bits previous 15 min (EFB–P15Mds/us)	7.12.5.2	Not applicable	R (M)
Error–free bits current 24 h (EFB–C24Hds/us)	7.12.5.3	Not applicable	R (M)
Error–free bits previous 24 h (EFB–P24Hds/us)	7.12.5.4	Not applicable	R (M)
MINEFTR current15 min (MINEFTR_C15Mds/us)	7.12.5.5	Not applicable	R (M)
MINEFTR previous15 min (MINEFTR_P15Mds/us)	7.12.5.6	Not applicable	R (M)
MINEFTR current 24 h (MINEFTR_C24Hds/us)	7.12.5.7	Not applicable	R (M)
MINEFTR previous 24 h (MINEFTR_P24Hds/us)	7.12.5.8	Not applicable	R (M)

Table 7-14 – Data path test, diagnostic and status objects

Category/object	Described in clause	DPU-NB interface

Table 7-15 – Inventory objects

Category/object	Described in clause	DPU-NB interface
<i>MTU related inventory</i>		
MTU-O ITU-T G.994.1 vendor ID (MTUO_GHS_VENDOR)	7.14.1.1	R (M)
MTU-R ITU-T G.994.1 vendor ID (MTUR_GHS_VENDOR)	7.14.1.2	R (M)
MTU-O version number (MTUO_VERSION)	7.14.1.3	R (M)
MTU-R version number (MTU-R VERSION)	7.14.1.4	R (M)
MTU-O self-test result (MTUO-SELFTEST)	7.14.1.5	R (M)
MTU-R self-test result (MTUR-SELFTEST)	7.14.1.6	R (M)
ITU-T G.9711 profile support (MTUO_PROFILES)	7.14.1.7	R (M)
ITU-T G.9711 profile support (MTUR_PROFILES)	7.14.1.8	R (M)
<i>System related inventory</i>		
DPU system vendor ID (DPU_SYSTEM_VENDOR)	7.14.2.1	R (M)
NT system vendor ID (NT_SYSTEM_VENDOR)	7.14.2.2	R (M)
DPU serial number (DPU_SYSTEM_SERIALNR)	7.14.2.3	R (M)
NT serial number (NT_SYSTEM_SERIALNR)	7.14.2.4	R (M)
VCE identifier (VCE_ID)	7.14.2.5	R (M)
VCE port index (VCE_PORT_INDEX)	7.14.2.6	R (M)
NT identity	7.14.2.7	R (M)

Table 7-16 – P2MP configuration objects

Category/object	Described in clause	DPU-NB interface
<i>Topology</i>		
MAXP2MPGROUPSIZE	7.15.1	R/W (M)
<i>Line</i>		
MAXP2MPGROUPATPDs/us	7.15.2	R/W (M)

Category/object	Described in clause	DPU-NB interface
<i>Channel</i>		
MAXP2MPGROUPNDRds/us	7.15.3	R/W (M)

Table 7-17 – P2MP status objects

Category/object	Described in clause	DPU-NB interface
<i>Topology</i>		
ACTP2MPGROUPSIZE	7.16.1	R (M)
<i>Line</i>		
ACTP2MPGROUPATPds/us	7.16.2	R (M)
<i>Channel</i>		
ACTP2MPGROUPNDRds/us	7.16.3	R (M)

7.1 Link identification

7.1.1 Unknown NT identification (UNKNOWN_NT_ID)

Description: Notification sent by the management entity–central office end (ME-O) upon completion of an ITU-T G.994.1 phase to request link configuration for an unknown NT_ID. The notification contains the unknown NT_ID.

Reference: Clause 12.4 of [ITU-T G.9711].

7.1.2 NT identification (NT_ID)

Description: Identifies the NT for which the link is configured (see clause 7.14.2.7). This object (and other related link configuration objects) are configured in the DPU-MIB autonomously or in response to an UNKNOWN_NT_ID notification sent by the ME-O.

Type: Binary (16 octets) or "p2p".

NOTE – An NT_id of type "binary" represents a 128-bit NT_id.

Default: "p2p".

Reference: Clause 11.4.6.2.1 of [ITU-T G.9711].

7.2 Line configuration objects

7.2.1 Profiles

7.2.1.1 ITU-T G.9711 profiles enabling (PROFILES)

Description: Determines for each profile whether operation according to that profile is allowed or disallowed. Profiles P424amp, P424dmp, Q424cmp or Q424dmp may be enabled only if the MTU-O supports P2MP operation.

Type: Array of PROFILEDescriptor[0...N–1] with N=8.

PROFILEDescriptor

- **Type:** Boolean.
- **Valid values:** False (disallowed) and true (allowed).

Bit representation

0	ITU-T G.9711 profile P424a
1	ITU-T G.9711 profile P424amp
2	ITU-T G.9711 profile P424d
3	ITU-T G.9711 profile P424dmp
4	ITU-T G.9711 profile Q424c
5	ITU-T G.9711 profile Q424cmp
6	ITU-T G.9711 profile Q424d
7	ITU-T G.9711 profile Q424dmp

Default value: All elements of the array set to true (all profiles allowed).

Reference: Clause 6 of [ITU-T G.9711].

7.2.2 Duplexing

7.2.2.1 Number of symbol periods in a PDX frame (MF)

Description: Determines the total number of symbol periods in a PHY duplexing (PDX) frame.

Type: 8-bit unsigned integer.

Valid values: 23 and 36.

Default value: 36.

Reference: Clause 10.5 of [ITU-T G.9711].

7.2.2.2 Number of downstream symbol periods in a PDX frame (Mds)

Description: Determines the total number of symbol positions in a PDX frame allocated for downstream transmission. The total number of symbol positions in a PDX frame allocated for upstream transmission is calculated as $M_{us} = MF - 1 - M_{ds}$.

Type: 8-bit unsigned integer.

Valid values: 10...32 (if MF=36) and 6...19 (if MF=23).

Default value: 28.

NOTE – If MF=23, a value different from the default value needs to be configured (see clause 7.2).

Reference: Clause 10.5 of [ITU-T G.9711].

7.2.2.3 Cyclic extension

Description: Determines the CE (L_{CP}) to be used.

Type: 8-bit unsigned integer.

Unit: N/64 samples, with N = index of highest supported downstream data-bearing subcarrier as specified for the enabled profile (see Table P-1 and Q-1 of [ITU-T G.9711]) plus one.

Valid values: 4, 8, 10, 12, 14, 16, 20, 24, 30 and 33.

Default value: 10.

Reference: Clause 10.4.4 of [ITU-T G.9711].

7.2.3 Power and spectrum usage

7.2.3.1 Downstream maximum aggregate transmit power (MAXATPds)

Description: Determines the maximum aggregate transmit power at the U-O2 reference point in the downstream direction during initialization and showtime (in decibels with reference to 1 mW).

Type: 16-bit signed integer.

Unit: 0.1 dBm.

Valid values: -310...+310 (-31 to +31 dBm).

Default value: 40 (4 dBm).

Reference: Clause 7.3.2 of [ITU-T G.9711].

7.2.3.2 Upstream maximum aggregate transmit power (MAXATPus)

Description: Determines the maximum aggregate transmit power at the U-R2 reference point in the upstream direction during initialization and showtime (in decibels with reference to 1 mW).

Type: 16-bit signed integer.

Unit: 0.1 dBm.

Valid values: -310...+310 (-31 to +31 dBm).

Default value: 40 (4 dBm).

Reference: Clause 7.3.2 of [ITU-T G.9711].

7.2.3.3 Downstream subcarrier masking (CARMASKds)

Description: Determines the masked subcarrier bands in the downstream direction. All subcarriers within the band, i.e., with indices greater than or equal to the start subcarrier index and less than or equal to the stop subcarrier index, are masked, i.e., have a transmit power set to zero (linear scale).

Type: Array of CARMASKdescriptor[0...N-1], with $1 \leq N \leq 32$, or an empty array (no masked subcarriers).

CARMASKdescriptor

Type: Record of a start subcarrier index and a stop subcarrier index.

Sub-carrier index

Type: 16-bit unsigned integer.

Valid values: 0...16383 (subcarrier index 0 to 16383).

Default value: Empty array (No masked subcarriers).

Reference: Clause 6.3 of [ITU-T G.9710] and clause 7.3.1.3 of [ITU-T G.9711].

7.2.3.4 Upstream subcarrier masking (CARMASKus)

Description: Determines the masked subcarrier bands in the upstream direction. All subcarriers within the band, i.e., with indices greater than or equal to the start subcarrier index and less than or equal to the stop subcarrier index, have a transmit power set to zero (linear scale).

Type: Array of CARMASKdescriptor[0...N-1], with $1 \leq N \leq 32$, or an empty array (no masked subcarriers).

CARMASKdescriptor: See CARMASKds in clause 7.2.3.3.

Default value: Empty array (No masked subcarriers).

Reference: Clause 6.3 of [ITU-T G.9710] and clause 7.3.1.3 of [ITU-T G.9711].

7.2.3.5 Downstream PSD mask (MIBPSDMASKds)

Description: Determines the downstream power spectral density (PSD) mask applicable at the U-O2 reference point as a set of N breakpoints as per clause 7.3.1.1.1 of [ITU-T G.9711]. Requirements for a valid MIBPSDMASKds are defined in clauses 7.3.1.1.2.1 and 7.3.1.1.2.2 of [ITU-T G.9711].

Type: Array of PSDMASKdescriptor[0...N-1], with $2 \leq N \leq 32$, or an empty array (no breakpoints).

PSDMASKdescriptor

- **Type:** Record of a breakpoint frequency index and a PSD level.
- **Breakpoint frequency index:**
 - **Type:** 16-bit unsigned integer.
 - **Valid values:** 0...16384 (subcarrier index 0 to 847.872 MHz).
- **PSD level:**
 - **Type:** 8-bit unsigned integer.
 - **Unit:** -0.5 dBm/Hz.
 - **Valid values:** 0...255 (0 to -127.5 dBm/Hz).

Default value: Empty array (limit PSD mask defined in [ITU-T G.9710]).

Reference: Clause 7.3.1.1 of [ITU-T G.9711].

7.2.3.6 Upstream PSD mask (MIBPSDMASKus)

Description: Determines the upstream PSD mask applicable at the U-R2 reference point as a set of N breakpoints as per clause 7.3.1.1.1 of [ITU-T G.9711]. Requirements for a valid MIBPSDMASKus are defined in clauses 7.3.1.1.2.1 and 7.3.1.1.2.2 of [ITU-T G.9711].

Type: Array of PSDMASKdescriptor[0...N-1], with $2 \leq N \leq 32$, or an empty array (no breakpoints).

PSDMASKdescriptor: See MIBPSDMASKds in clause 7.2.3.5.

Default value: Empty array (limit PSD mask defined in [ITU-T G.9710]).

Reference: Clause 7.3.1.1 of [ITU-T G.9711].

7.2.3.7 RFI bands (RFIBANDS)

Description: Determines the bands where the PSD shall be reduced as specified in clause 7.3.1.2 of [ITU-T G.9711].

Type: Array of RFIBANDdescriptor[0...N-1], with $1 \leq N \leq 32$, or an empty array (No radio frequency interference (RFI) bands, no PSD reduction).

RFIBANDdescriptor

- **Type:** Record of a start subcarrier index and a stop subcarrier index.
- **Sub-carrier index:**
 - **Type:** 16-bit unsigned integer.
 - **Valid values:** 0...16383 (subcarrier index 0 to 16383).

Default value: Empty array (no RFI bands, no PSD reduction).

Reference: Clauses 7.3.1.2 and 12.3.2.1.1 of [ITU-T G.9711].

7.2.3.8 International amateur radio bands (IARBANDS)

Description: Determines for each international amateur radio (IAR) band whether transmit PSD reduction is enabled or disabled in that band.

Type: Array of IARBANDdescriptor[0...14].

IARBANDdescriptor

- **Type:** Boolean.
- **Valid values:** False (disabled) and true (enabled).

Bit representation

0	International amateur radio band 1800-2000 kHz
1	International amateur radio band 3500-4000 kHz
2	International amateur radio band 7000-7300 kHz
3	International amateur radio band 10 100-10 150 kHz
4	International amateur radio band 14 000-14 350 kHz
5	International amateur radio band 18 068-18 168 kHz
6	International amateur radio band 21 000-21 450 kHz
7	International amateur radio band 24 890-24 990 kHz
8	International amateur radio band 28 000-29 700 kHz
9	International amateur radio band 50 000-54 000 kHz
10	International amateur radio band 69 900-70 500 kHz
11	International amateur radio band 144 000-148 000 kHz
12	International amateur radio band 5351.5-5366.5 kHz
13	International amateur radio band 219 000-225 000 kHz
14	International amateur radio band 420 000-450 000 kHz

Default value: All elements of the array set to false (All IAR bands disabled, no PSD reduction).

Reference: Clauses 7.3.1.2 and 12.3.2.1.1 of [ITU-T G.9711], Tables 11.72.8, 11.72.8.1 and 11.72.8.2 of [ITU-T G.994.1].

7.2.3.9 Upstream power back-off reference PSD (UPBOPSDA)

Description: Determines the parameter a for the upstream power back-off (UPBO) reference PSD used to compute the UPBO for the upstream frequency band.

Type: 16-bit unsigned integer.

Unit: 0.01 dBm/Hz.

Offset: 40 dBm/Hz.

Valid values: 0...4095 (40 to 80.95 dBm/Hz).

Default value: 0 (40 dBm/Hz).

Reference: Clause 7.3.1.5 of [ITU-T G.9711].

7.2.3.10 Upstream power back-off reference PSD (UPBOPSDb)

Description: Determines the parameter b for the UPBO reference PSD used to compute the UPBO for the upstream frequency band.

Type: 16-bit unsigned integer.

Unit: 0.01 dBm/Hz.

Valid values: 0...4095 (0 to 40.95 dBm/Hz).

Default value: 0 (0 dBm/Hz).

Reference: Clause 7.3.1.5 of [ITU-T G.9711].

7.2.3.11 Upstream electrical length (UPBOKL)

Description: Determines the electrical length kl_0 (expressed in decibels at 1 MHz).

Type: 16-bit unsigned integer.

Unit: 0.1 dB.

Valid values: 0...1280 (0 to 128 dB).

Default value: 0 (0 dB).

Reference: Clause 7.3.1.5.2.1 of [ITU-T G.9711].

7.2.3.12 Force electrical length (UPBOKLF)

Description: Determines whether the MTU-R is forced to use the electrical length $kl_0 = \text{UPBOKL}$ to compute the UPBOMASK. If not forced, the MTUs determine the electrical length kl_0 .

Type: Boolean.

Valid values: False (not forced) and true (forced).

Default value: False (not forced).

Reference: Clause 7.3.1.5.2.1 of [ITU-T G.9711].

7.2.3.13 UPBO reference electrical length per band (UPBOKLREF)

Description: Determines the UPBO reference electrical length kl_{0_REF} used to compute the UPBO for the equalized far-end crosstalk (FEXT) UPBO method. If $kl_{0_REF} = 0$ (special value) then the equal PSD UPBO method is used.

Type: 16-bit unsigned integer.

Unit: 0.1 dB.

Valid values: 0 (special value) and 18...255 (1.8 to 25.5 dB).

Default value: 0 (special value).

Reference: Clause 7.3.1.5.2.2 of [ITU-T G.9711].

7.2.3.14 Class of downstream limit masks (CLASSMASKds)

Description: Determines, through a class, which limit mask can be used with each profile in the downstream direction.

Type: Enumeration.

Valid values: 0 (classmask_1).

Default value: 0 (classmask_1).

Reference: Clause 7.3.1.6 of [ITU-T G.9711].

7.2.3.15 Class of upstream limit masks (CLASSMASKus)

Description: Determines, through a class, which limit mask can be used with each profile in the upstream direction.

Type: Enumeration.

Valid values: 0 (classmask_1).

Default value: 0 (classmask_1).

Reference: Clause 7.3.1.6 of [ITU-T G.9711].

7.2.3.16 Downstream RMC subcarrier masking (RMCCARMASKds)

Description: Determines the RMC-masked subcarrier bands in the downstream direction. All subcarriers within the band, i.e., with indices greater than or equal to the start subcarrier index and less than or equal to the stop subcarrier index, are masked. Masked subcarriers for the RMC are not included in the subcarrier set for RMC (RTSds) nor in the backup subcarrier set for RMC (RTS-bds).

NOTE – To increase the RMC robustness against noise, the MTU receiver may choose to use up to 428 subcarriers for the RMC. Depending on the channel characteristics, the number of usable subcarriers may already be reduced. Hence, configuration of RMC subcarrier masking should be considered with care to avoid that the achievable RMC robustness is even further reduced, possibly to the extent that the line may no longer initialize.

Type: Array of CARMASKdescriptor[0...N-1], with $1 \leq N \leq 2$, or an empty array (No masked subcarriers).

CARMASKdescriptor: See CARMASKdescriptor in clause 7.2.3.3.

Default value: Empty array (No masked subcarriers).

Reference: Clauses 12.3.3.2.1, 13.2.1.3.1 and 13.3.1.2.3 of [ITU-T G.9711].

7.2.3.17 Upstream RMC subcarrier masking (RMCCARMASKus)

Description: Determines the RMC-masked subcarrier bands in the upstream direction. All subcarriers within the band, i.e., with indices greater than or equal to the start subcarrier index and less than or equal to the stop subcarrier index, are masked. Masked subcarriers for the RMC are not included in the subcarrier set for RMC (RTSus) nor in the backup subcarrier set for RMC (RTS-bus).

NOTE – To increase RMC robustness against noise, the FTU receiver may choose to use up to 428 subcarriers for the RMC. Depending on the channel characteristics, the number of usable subcarriers may already be reduced. Hence, configuration of RMC subcarrier masking should be considered, taking care to avoid achievable RMC robustness being even further reduced, possibly to the extent that the line may no longer initialize.

Type: Array of CARMASKdescriptor[0...N-1], with $1 \leq N \leq 2$, or an empty array (No masked subcarriers).

CARMASKdescriptor: See CARMASKds in clause 7.2.3.3.

Default value: Empty array (No masked subcarriers).

Reference: Clauses 12.3.4.2.7, 13.2.1.3.1 and 13.3.1.2.3 of [ITU-T G.9711].

7.2.3.18 Downstream FDX subcarrier masking (FDXMASKds)

Description: Determines the subcarrier bands masked for full duplex (FDX) transmission in the downstream direction. For all subcarriers within the band, i.e., with indices greater than or equal to the start subcarrier index and less than or equal to the stop subcarrier index, the transceivers shall force subcarriers to be allowed to transmit in the DS direction only during the full duplex compatible downstream sub-frame (FDS) part of the frame. If the transceivers are in the FDX mode and FDX masking is not applied to a subcarrier, then that subcarrier may be used for simultaneous upstream and downstream transmission in the FDS part of the frame.

Type: Array of FDXMASKdescriptor[0...N-1], with $1 \leq N \leq 2$, or an empty array (No masked subcarriers).

FDXMASKdescriptor: See CARMASKdescriptor in clause 7.2.3.3.

Default value: Empty array (No masked subcarriers).

Reference: Clause 7.2.1.4 of [ITU-T G.9711].

7.2.3.19 Upstream subcarrier masking (FDXMASKus)

Description: Determines the subcarrier bands masked for FDX transmission in the downstream direction. For all subcarriers within the band, i.e., with indices greater than or equal to the start subcarrier index and less than or equal to the stop subcarrier index, the transceivers shall force these subcarriers to be allowed to transmit in the US direction only during the full duplex compatible upstream sub-frame (FUS) part of the frame. If the transceivers are in the FDX mode and FDX masking is not applied to a subcarrier, then that subcarrier may be used for simultaneous upstream and downstream transmission in the FUS part of the frame.

Type: Array of FDXMASKdescriptor[0...N-1], with $1 \leq N \leq 2$, or an empty array (No masked subcarriers).

FDXMASKdescriptor: See CARMASKdescriptor in clause 7.2.3.3.

Default value: Empty array (No masked subcarriers).

Reference: Clause 7.2.1.4 of [ITU-T G.9711].

7.2.4 Noise margin

7.2.4.1 Downstream target noise margin (TARSNRMds)

Description: Determines the downstream target noise margin for the channel initialization policy.

Type: 16-bit unsigned integer.

Unit: 0.1 dB.

Valid values: 0...310 (0 to 31 dB).

Default value: 60 (6 dB).

Reference: Clause 12.3.7 of [ITU-T G.9711].

7.2.4.2 Upstream target noise margin (TARSNRMus)

Description: Determines the upstream target noise margin used in the channel initialization policy.

Type: 16-bit unsigned integer.

Unit: 0.1 dB.

Valid values: 0...310 (0 to 31 dB).

Default value: 60 (6 dB).

Reference: Clause 12.3.7 of [ITU-T G.9711].

7.2.4.3 Upstream maximum noise margin (MAXSNRMus)

Description: Determines the upstream maximum noise margin used in the channel initialization policy. The special value indicates there is no maximum bound for the upstream noise margin (i.e., the upstream maximum noise margin is infinite).

Type: 16-bit unsigned integer.

Unit: 0.1 dB.

Valid values: 0...310 (0 to 31 dB) and 511 (special value).

Default value: 511 (special value).

Reference: Clause 12.3.7 of [ITU-T G.9711].

7.2.4.4 Downstream minimum noise margin (MINSNRMds)

Description: Determines the downstream minimum noise margin the MTU-R receiver shall tolerate. If the signal-to-noise ratio margin downstream (SNRMds) falls below this level, a loss-of-margin (*lom*) defect occurs. Upon persistency of the *lom* defect, the MTU-R triggers a re-initialization (see clause 12.1.4.2 of [ITU-T G.9711]).

Type: 16-bit unsigned integer.

Unit: 0.1 dB.

Valid values: 0...310 (0 to 31 dB).

Default value: 0 (0 dB).

Reference: Clause 12.3.3.2.1 of [ITU-T G.9711].

7.2.4.5 Upstream minimum noise margin (MINSNRMus)

Description: Determines the upstream minimum noise margin the MTU-O receiver shall tolerate. If the SNRM upstream (SNRMus) falls below this level, the MTU-O requests the MTU-R to increase the MTU-R transmit power. If an increase to MTU-R transmit power is not possible, a *lom* defect occurs. Upon persistency of the *lom* defect, the MTU-O triggers a re-initialization (see clause 12.1.4.2 of [ITU-T G.9711]).

Type: 16-bit unsigned integer.

Unit: 0.1 dB.

Valid values: 0...310 (0 to 31 dB).

Default value: 0 (0 dB).

Reference: Clause 12.3.3.2.1 of [ITU-T G.9711].

7.2.5 Seamless rate adaptation

7.2.5.1 Downstream upshift noise margin (SRA-USNRMds)

Description: If the SNRMds 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 (SRA-UTIMEds), the MTU-R autonomously attempts to increase the net data rate downstream (NDRds).

Type: 16-bit unsigned integer.

Unit: 0.1 dB.

Valid values: 0...310 (0 to 31 dB).

Default value: 70 (7 dB).

Reference: Clause 12.3.4.2.1 of [ITU-T G.9711].

7.2.5.2 Upstream upshift noise margin (SRA-USNRMus)

Description: If the SNRMus is above the upstream upshift noise margin and stays above that for more than the time specified by the upstream minimum upshift rate adaptation interval (SRA-UTIMEus), the MTU-O autonomously attempts to increase the net data rate upstream (NDRus).

Type: 16-bit unsigned integer.

Unit: 0.1 dB.

Valid values: 0...310 (0 to 31 dB).

Default value: 70 (7 dB).

Reference: Clause 12.3.4.2.1 of [ITU-T G.9711].

7.2.5.3 Downstream minimum time interval for upshift SRA (SRA-UTIMEds)

Description: Determines the interval of time the SNRMds should stay above the upshift SNRM downstream (SRA-USNRMds) before the MTU-R autonomously attempts to increase the NDRds.

Type: 16-bit unsigned integer.

Unit: 1 s.

Valid values: 0...16383 (0 to $2^{14} - 1$ s).

Default value: 8 (8 s).

Reference: Clause 12.3.4.2.1 of [ITU-T G.9711].

7.2.5.4 Upstream minimum time interval for upshift SRA (SRA-UTIMEus)

Description: Determines the interval of time the SNRMus should stay above the USNRM upstream (SRA-USNRMus) before the MTU-O autonomously attempts to increase the NDRus.

Type: 16-bit unsigned integer.

Unit: 1 s.

Valid values: 0...16383 (0 to $2^{14} - 1$ s).

Default value: 8 (8 s).

Reference: Clause 12.3.4.2.1 of [ITU-T G.9711].

7.2.5.5 Downstream downshift noise margin (SRA-DSNRMds)

Description: If the SNRMds is below the downstream downshift noise margin and stays there for more than the time specified by the downstream minimum downshift rate adaptation interval (SRA-DTIMEds), the MTU-R autonomously attempts to decrease the NDRds.

Type: 16-bit unsigned integer.

Unit: 0.1 dB.

Valid values: 0...310 (0 to 31 dB).

Default value: 50 (5 dB).

Reference: Clause 12.3.4.2.1 of [ITU-T G.9711].

7.2.5.6 Upstream downshift noise margin (SRA-DSNRMus)

Description: If the SNRMus is below the upstream downshift noise margin and stays there for more than the time specified by the upstream minimum downshift rate adaptation interval (SRA-DTIMEus), the MTU-O autonomously attempts to decrease the NDRus.

Type: 16-bit unsigned integer.

Unit: 0.1 dB.

Valid values: 0...310 (0 to 31 dB).

Default value: 50 (5 dB).

Reference: Clause 12.3.4.2.1 of [ITU-T G.9711].

7.2.5.7 Downstream minimum time interval for downshift SRA (SRA-DTIME_{ds})

Description: Determines the interval of time the SNRM_{ds} should stay below the downshift SNRM downstream (SRA-DSNRM_{ds}) before the MTU-R autonomously attempts to decrease the NDR_{ds}.

Type: 16-bit unsigned integer.

Unit: 1 s.

Valid values: 0...16383 (0 to $2^{14} - 1$ s).

Default value: 2 (2 s).

Reference: Clause 12.3.4.2.1 of [ITU-T G.9711].

7.2.5.8 Upstream minimum time interval for downshift SRA (SRA-DTIME_{us})

Description: Determines the interval of time the SNRM_{us} should stay below the DSNRM upstream (SRA-DSNRM_{us}) before the MTU-O autonomously attempts to decrease the NDR_{us}.

Type: 16-bit unsigned integer.

Unit: 1 s.

Valid values: 0...16383 (0 to $2^{14} - 1$ s).

Default value: 2 (2 s).

Reference: Clause 12.3.4.2.1 of [ITU-T G.9711].

7.2.6 Fast rate adaptation

7.2.6.1 Downstream FRA time window (FRA-TIME_{ds})

Description: Determines the duration of the time window used in the standard FRA triggering criteria (see clause 13.3.1.1.1.5 of [ITU-T G.9711]) for the downstream direction. The special value 0 indicates that vendor discretionary values for *fra-ntones*, *fra-rtx-uc* and *fra-time* may be used in the downstream direction.

Type: 8-bit unsigned integer.

Unit: 1 logical frame length.

Valid values: 0 (special value) and (1...24 (if MF=36) or 1...36 (if MF=23)).

Default value: 8.

Reference: Clause 13.3.1.1.1.1 of [ITU-T G.9711].

7.2.6.2 Upstream FRA time window (FRA-TIME_{us})

Description: Determines the duration of the time window used in the standard FRA triggering criteria (see clause 13.3.1.1.1.5 of [ITU-T G.9711]) for the upstream direction. The special value 0 indicates that vendor discretionary values for *fra-ntones*, *fra-rtx-uc* and *fra-time* may be used in the upstream direction.

Type: 8-bit unsigned integer.

Unit: 1 logical frame length.

Valid values: 0 (special value) and (1...24 (if MF=36) or 1...36 (if MF=23)).

Default value: 8.

Reference: Clause 13.3.1.1.1.1 of [ITU-T G.9711].

7.2.6.3 Downstream FRA minimum percentage of degraded tones (FRA-NTONESds)

Description: Determines the minimum percentage of loaded subcarriers that are detected as degraded throughout a time window equal to FRA-TIMEds in order to arm the first FRA triggering criteria (see clause 13.3.1.1.1.5 of [ITU-T G.9711]) in the downstream direction. The special value 0 indicates that monitoring of the percentage of degraded subcarriers is disabled.

Type: 8-bit unsigned integer.

Valid values: 0 and 1...100.

Default value: 50.

Reference: Clause 13.3.1.1.1.2 of [ITU-T G.9711].

7.2.6.4 Upstream FRA minimum percentage of degraded tones (FRA-NTONESus)

Description: Determines the minimum percentage of loaded subcarriers (i.e., subcarriers with $b_i > 0$) that are detected as degraded throughout a time window equal to FRA-TIMEds in order to arm the first FRA triggering criteria (see clause 13.3.1.1.1.5 of [ITU-T G.9711]) in the upstream direction. The special value 0 indicates that monitoring of the percentage of degraded subcarriers is disabled.

Type: 8-bit unsigned integer.

Valid values: 0 and 1...100.

Default value: 50.

Reference: Clause 13.3.1.1.1.2 of [ITU-T G.9711].

7.2.6.5 Downstream FRA number of uncorrectable DTU (FRA-RTXUCds)

Description: Determines the minimum number of *rtx-uc* anomalies received throughout a time window equal to FRA-TIMEds in order to arm the second FRA triggering criteria (see clause 13.3.1.1.1.5 of [ITU-T G.9711]) in the downstream direction. The special value 0 indicates that monitoring of the number of *rtx-uc* anomalies is disabled.

Type: 16-bit unsigned integer.

Valid values: 0 and 1...1023.

Default value: 150.

Reference: Clause 13.3.1.1.1.3 of [ITU-T G.9711].

7.2.6.6 Upstream FRA number of uncorrectable DTU (FRA-RTXUCus)

Description: Determines the minimum number of *rtx-uc* anomalies received throughout a time window equal to FRA-TIMEds in order to arm the second FRA triggering criteria (see clause 13.3.1.1.1.5 of [ITU-T G.9711]) in the upstream direction. The special value 0 indicates that monitoring of the number of *rtx-uc* anomalies is disabled.

Type: 16-bit unsigned integer.

Valid values: 0 and 1...1023.

Default value: 150.

Reference: Clause 13.3.1.1.1.3 of [ITU-T G.9711].

7.2.6.7 Downstream vendor discretionary FRA triggering criteria (FRA-VENDISCds)

Description: Determines whether vendor discretionary FRA triggering criteria may be used (enabled) or not (disabled) in the downstream direction.

Type: Boolean.

Valid values: False (disabled) and true (enabled).

Default value: False (disabled).

Reference: Clause 13.3.1.1.1.4 of [ITU-T G.9711].

7.2.6.8 Upstream vendor discretionary FRA triggering criteria (FRA-VENDISCus)

Description: Determines whether vendor discretionary FRA triggering criteria may be used (enabled) or not (disabled) in the upstream direction.

Type: Boolean.

Valid values: False (disabled) and true (enabled).

Default value: False (disabled).

Reference: Clause 13.3.1.1.1.4 of [ITU-T G.9711].

7.2.7 Robust management channel

7.2.7.1 Downstream target noise margin for RMC (TARSNRM-RMCds)

Description: Determines the SNRM-RMCds that the MTU-R receiver shall achieve, relative to the bit error ratio (BER) requirement, or better, to successfully complete initialization.

Type: 16-bit unsigned integer.

Unit: 0.1 dB.

Valid values: 0...310 (0 to 31 dB).

Default value: 60 (6 dB).

Reference: Clause 12.3.4.2.1 of [ITU-T G.9711].

7.2.7.2 Upstream target noise margin (TARSNRM-RMCus)

Description: Determines the SNRM-RMCus that the MTU-O receiver shall achieve, relative to the BER requirement, or better, to successfully complete initialization.

Type: 16-bit unsigned integer.

Unit: 0.1 dB.

Valid values: 0...310 (0 to 31 dB).

Default value: 60 (6 dB).

Reference: Clause 12.3.4.2.1 of [ITU-T G.9711].

7.2.7.3 Downstream minimum noise margin for RMC (MINSNRM-RMCds)

Description: Determines the downstream minimum noise margin the MTU-R receiver tolerates for the RMC. If the SNRM-RMCds falls below this level, the MTU-R initiates the RMC parameter adjustment (RPA) procedure.

Type: 16-bit unsigned integer.

Unit: 0.1 dB.

Valid values: 0...310 (0 to 31 dB).

Default value: 0 (0 dB).

Reference: Clause 13.2.1.3 of [ITU-T G.9711].

7.2.7.4 Upstream minimum noise margin for RMC (MINSNRM-RMCus)

Description: Determines the upstream minimum noise margin the MTU-O receiver tolerates for the RMC. If the SNRM-RMCus falls below this level, the MTU-O initiates the RPA procedure.

Type: 16-bit unsigned integer.

Unit: 0.1 dB.

Valid values: 0...310 (0 to 31 dB).

Default value: 0 (0 dB).

Reference: Clause 13.2.1.3 of [ITU-T G.9711].

7.2.7.5 Downstream maximum bitloading for RMC (MAXBL-RMCds)

Description: Determines the maximum allowed bit-loading (for trellis coded modulation (TCM)) and the maximum allowed modulation index (for probabilistic constellation shaping-LDPC coded modulation (PCS-LCM)) for the downstream RMC subcarriers.

Type: 8-bit unsigned integer.

Valid values: 2...6.

Default value: 6.

Reference: Clause 12.3.4.2.1 of [ITU-T G.9711].

7.2.7.6 Upstream maximum bitloading for RMC (MAXBL-RMCus)

Description: Determines the maximum allowed bit-loading (for TCM) and the maximum allowed modulation index (for PCS-LCM) for the upstream RMC subcarriers.

Type: 8-bit unsigned integer.

Valid values: 2...6.

Default value: 6.

Reference: Clause 12.3.4.2.1 of [ITU-T G.9711].

7.2.8 Vectoring

7.2.8.1 FEXT cancellation enabling/disabling downstream (FEXT_TO_CANCEL_ENABLEDs)

Description: Determines whether FEXT cancellation in the downstream direction from all the other vectored lines into the line in the vectored group is enabled or disabled.

Type: Boolean.

Valid values: False (disabled) or true (enabled).

Default value: True (enabled).

Reference: Clause 11.4.3.1 of [ITU-T G.9711].

7.2.8.2 FEXT cancellation enabling/disabling upstream (FEXT_TO_CANCEL_ENABLEus)

Description: Determines whether FEXT cancellation in the upstream direction from all the other vectored lines into the line in the vectored group is enabled or disabled.

Type: Boolean.

Valid values: False (disabled) or true (enabled).

Default value: True (enabled).

Reference: Clause 11.4.3.1 of [ITU-T G.9711].

7.2.8.3 XLOG requested subcarrier group size (XLOGGREQds)

Description: This parameter is the requested lower bound on the value of XLOGGs in the reporting of Xlogpsds

Type: 8-bit signed integer.

Unit: 1 subcarrier.

Valid values: 1, 2, 4, 8, 16, 32, 64.

Default value: 1.

Reference: Clause 11.4.3.2 of [ITU-T G.9711].

7.2.8.4 Requested crosstalk disturber index (XTALKDREQ)

Description: This parameter is the requested value of the VCE_port_index (XTALKDIST) for the disturber link in the reporting of XLOGpsds and ANEXTds/us.

Type: 16-bit unsigned integer.

Valid values: 1..65535.

Default value: 1.

Reference: Clause 11.4.3.3 of [ITU-T G.9711].

7.2.9 Fast-retrain policy

7.2.9.1 Downstream los defect persistency (LOS_PERSISTENCYds)

Description: Determines the downstream *los* defect persistency for triggering a re-initialization (see clause 12.1.4.2 of [ITU-T G.9711]) at the MTU-R receiver, as part of the fast-retrain policy.

Type: 8-bit unsigned integer.

Unit: 0.1 s.

Valid values: 1...20 (0.1 to 2 s).

Default value: 2 (0.2 s).

Reference: Clause 12.1.4.3.1 of [ITU-T G.9711].

7.2.9.2 Upstream los defect persistency (LOS_PERSISTENCYus)

Description: Determines the upstream *los* defect persistency for triggering a re-initialization (see clause 12.1.4.2 of [ITU-T G.9711]) at the MTU-O receiver, as part of the fast-retrain policy.

Type: 8-bit unsigned integer.

Unit: 0.1 s.

Valid values: 1...20 (0.1 to 2 s).

Default value: 2 (0.2 s).

Reference: Clause 12.1.4.3.1 of [ITU-T G.9711].

7.2.9.3 Downstream lom defect persistency (LOM_PERSISTENCYds)

Description: Determines the downstream *lom* defect persistency for triggering a re-initialization (see clause 12.1.4.2 of [ITU-T G.9711]) at the MTU-R receiver, as part of the fast-retrain policy.

Type: 8-bit unsigned integer.

Unit: 1 s.

Valid values: 1...20 (1 to 20 s).

Default value: 2 (2 s).

Reference: Clause 12.1.4.3.2 of [ITU-T G.9711].

7.2.9.4 Upstream *lom* defect persistency (LOM_PERSISTENCY_{us})

Description: Determines the upstream *lom* defect persistency for triggering a re-initialization (see clause 12.1.4.2 of [ITU-T G.9711]) at the MTU-O receiver, as part of the fast-retrain policy.

Type: 8-bit unsigned integer.

Unit: 1 s.

Valid values: 1...20 (1 to 20 s).

Default value: 2 (2 s).

Reference: Clause 12.1.4.3.2 of [ITU-T G.9711].

7.2.9.5 Downstream *lor* defect persistency (LOR_PERSISTENCY_{ds})

Description: Determines the downstream *lor* defect persistency for triggering a re-initialization (see clause 12.1.4.2 of [ITU-T G.9711]) at the MTU-R receiver, as part of the fast-retrain policy.

Type: 8-bit unsigned integer.

Unit: 0.1 s.

Valid values: 1...20 (0.1 to 2 s).

Default value: 2 (0.2 s).

Reference: Clause 12.1.4.3.3 of [ITU-T G.9711].

7.2.9.6 Upstream *lor* defect persistency (LOR_PERSISTENCY_{us})

Description: Determines the upstream *lor* defect persistency for triggering a re-initialization (see clause 12.1.4.2 of [ITU-T G.9711]) at the MTU-O receiver, as part of the fast-retrain policy.

Type: 8-bit unsigned integer.

Unit: 0.1 s.

Valid values: 1...20 (0.1 to 2 s).

Default value: 2 (0.2 s).

Reference: Clause 12.1.4.3.3 of [ITU-T G.9711].

7.2.9.7 Downstream re-initialization time threshold (REINIT_TIME_THRESHOLD_{ds})

Description: Determines the downstream threshold for the severely errored second (SES) and embedded operations channel (eoc) timeout conditions for declaring a High_BER event (see clause 12.1.4.3.4 of [ITU-T G.9711]) at the MTU-R receiver, as part of the fast-retrain policy.

Type: 8-bit unsigned integer.

Unit: 1 s.

Valid values: 5...31 (5 to 31 s).

Default value: 10 (10 s).

Reference: Clause 12.1.4.3.4 of [ITU-T G.9711].

7.2.9.8 Upstream re-initialization time threshold (REINIT_TIME_THRESHOLD_{Dus})

Description: Determines the upstream threshold for the SES and eoc timeout conditions for declaring a High_BER event (see clause 12.1.4.3.4 of [ITU-T G.9711]) at the MTU-O receiver, as part of the fast-retrain policy.

Type: 8-bit unsigned integer.

Unit: 1 s.

Valid values: 5...31 (5 to 31 s).

Default value: 10 (10 s).

Reference: Clause 12.1.4.3.4 of [ITU-T G.9711].

7.2.9.9 Downstream low ETR threshold (LOW_ETR_THRESHOLD_{Dds})

Description: Determines the downstream threshold for the low ETR condition for declaring a High_BER event (see clause 12.1.4.3.4 of [ITU-T G.9711]) at the MTU-R receiver, as part of the fast-retrain policy. The special value 0 indicates that no High_BER event is declared based on *ETR* being below the *ETR_{min}*.

Type: 8-bit unsigned integer.

Unit: 1 s.

Valid values: 0 and 1...30 (1 to 30 s).

Default value: 20 (20 s).

Reference: Clause 12.1.4.3.4 of [ITU-T G.9711].

7.2.9.10 Upstream low ETR threshold (LOW_ETR_THRESHOLD_{Dus})

Description: Determines the upstream threshold for the low ETR condition for declaring a High_BER event (see clause 12.1.4.3.4 of [ITU-T G.9711]) at the MTU-O receiver, as part of the fast-retrain policy. The special value 0 indicates that no High_BER event is declared based on *ETR* being below the *ETR_{min}*.

Type: 8-bit unsigned integer.

Unit: 1 s.

Valid values: 0 and 1...30 (1 to 30 s).

Default value: 20 (20 s).

Reference: Clause 12.1.4.3.4 of [ITU-T G.9711].

7.2.10 Update test parameters

7.2.10.1 Update request flag for near-end test parameters (UPDATE-NE-TEST)

Description: Forces an update of one or more of the near-end test parameter groups that can be updated during showtime. See introductory text to clause 7.

Type: Array of UPDATEREQUESTFLAGdescriptor[0..1].

UPDATEREQUESTFLAGdescriptor

Type: Boolean.

Valid values: False (no update forced) or true (update forced).

Bit representation

0) Near-end test parameter group 1 (NE-G1)

- 1) Near-end test parameter group 2 (NE-G2)

Default value: All elements of the array set to false (no update forced).

Reference: Clause 11.1 of ITU-T G.9711.

7.2.10.2 Update request flag for far-end test parameters (UPDATE-FE-TEST)

Description: Forces an update of one or more of the FE test parameter group that can be updated during showtime. See introductory text to clause 7.

Type: Array of UPDATEREQUESTFLAGdescriptor[0...1].

UPDATEREQUESTFLAGdescriptor: See clause 7.2.10.1.

Bit representation

- 0) Far-end test parameter group 1 (FE-G1)

- 1) Far-end test parameter group 2 (FE-G2)

Default value: All elements of the array set to false (no update forced).

Reference: Clause 11.1 of [ITU-T G.9711].

7.2.11 INM configuration objects

The following configuration objects are defined to control the impulse noise monitor in the receive direction in the MTU. A downstream impulse noise monitor applies to the MTU-R, an upstream impulse noise monitor applies to the MTU-O.

7.2.11.1 INM inter arrival time offset (INMIATods/us)

Description: Determines the inter arrival time (IAT) offset per direction that the MTU receiver shall use to determine in which bin of the histogram the IAT is reported.

Type: 16-bit unsigned integer.

Unit: One IAT time unit (see clause 7.2.11.7).

Valid values: 3...511.

Default value: 3.

Reference: Clause 11.4.4.7.2.1 of [ITU-T G.9711].

7.2.11.2 INM inter arrival time step (INMIATSds/us)

Description: Determines the IAT step per direction that the MTU receiver shall use to determine in which bin of the histogram the IAT is reported.

Type: 8-bit unsigned integer.

Unit: One IAT time unit (see clause 7.2.11.7).

Valid values: 0...7.

Default value: 1.

Reference: Clause 11.4.4.7.2.2 of [ITU-T G.9711].

7.2.11.3 INM cluster continuation value (INMCCds/us)

Description: Determines the cluster continuation value per direction that the MTU receiver shall use in the cluster indication process.

Type: 8-bit unsigned integer.

Unit: One discrete multitone (DMT) symbol.

Valid values: 1...255.

Default value: 1.

Reference: Clause 11.4.4.7.2.3 of [ITU-T G.9711].

7.2.11.4 INM equivalent INP format (INM_INPEQ_FORMATds/us)

Description: Determines the way the scale is configured for the INM_INPEQ histogram

Type: enumeration

Valid values: 0, 1.

0) Linear scale

1) Logarithmic scale

Default value: 0 (linear scale).

Reference: Clause 11.4.4.7.2.4 of [ITU-T G.9711].

7.2.11.5 DTU cluster bridging (BRGNds/us)

Description: Determines per direction whether the MTU receiver shall use bridging in the determination of the data transfer unit (DTU) cluster size.

Type: Boolean.

Valid values: False (disabled), true (enabled).

Default value: False (disabled).

Reference: Clause 11.4.4.7.2.5 of [ITU-T G.9711].

7.2.11.6 INPEQ time unit scaling factor (INPEQ_SF)

Description: Determines time unit scaling factor for the link that the MTU receivers shall use for reporting the impulse noise protection equivalent (INPEQ).

Type: 8-bit unsigned integer.

Valid values: 4, 8, 12.

Default value: 12.

Reference: Clause 11.4.4.7.2.6 of [ITU-T G.9711].

7.2.11.7 IAT time unit scaling factor (IAT_SF)

Description: Determines the time unit scaling factor for the link that the MTU receivers shall use for reporting IAT. One IAT time unit is defined as IAT_SF DMT symbols.

Type: 8-bit unsigned integer.

Valid values: 4, 8, 12.

Default value: 12.

Reference: Clause 11.4.4.7.2.7 of [ITU-T G.9711].

7.2.11.8 INM enable (INM_ENABLE)

Description: Determines whether the INM functionality is enabled or disabled.

Type: Boolean.

Valid values: False (disabled), true (enabled).

Default value: False (disabled).

Reference: Clause 11.4.4.7 of [ITU-T G.9711].

7.2.12 RMCR configuration objects

The following configuration objects are defined to control the RMCR procedure in the receive direction in the MTU.

7.2.12.1 RMCR *lor* persistency trigger (RMCR_LOR_TRIGGERds/us)

Description: Determines the persistency period of a *lor* defect before the RMC is declared severely degraded. The value 0 is a special value that indicates that the RMCR procedure is disabled. It can only be set to 0 in one direction if the value is also set to 0 in the opposite direction. The setting for RMCR_LOR_TRIGGER for both upstream and downstream shall be less than the corresponding value of parameter LOR_PERSISTENCY in the corresponding transmission direction (see clauses 7.2.9.5 and 7.2.9.6) by at least 200 ms.

NOTE – If the RMCR procedure is enabled, both the LOR_PERSISTENCYds (see clause 7.2.9.5) and the LOR_PERSISTENCYus (see clause 7.2.9.6) need to be configured to a value higher than their default value.

Type: 8-bit unsigned integer.

Unit: 50 ms.

Valid values: 0 (disabled), 1 (50 ms)...20 (1000 ms)

Default value: 0 (disabled).

Reference: Clause 13.3.1.2.1 of [ITU-T G.9711].

7.2.13 Showtime reconfiguration configuration objects

The following configuration objects are defined to control the showtime reconfiguration (SREC) procedures.

7.2.13.1 SREAllowed (SREC_ALLOWED)

Description: Indicates whether the SREC procedures shall not be used (SREC_allowed = false), or the SREC procedures may be used (SREC_allowed = true) to force a new configuration on to the link. The conditions of use of SREC procedures are specified in clause 13.2.1.5 of [ITU-T G.9711].

Type: Boolean.

Valid values: False (not allowed) and true (allowed).

Default value: False.

Reference: Clause 13.2.1.5.4 of [ITU-T G.9711].

7.2.14 PMD forward error correction scheme (PMDFECSCHEMEDs/us)

Description: Indicates whether the PMD forwards error correction scheme shall be determined by the receiver or shall be forced to TCM, separately for the downstream and the upstream direction.

Type: Enumeration.

Valid values: 0, 1.

- 0) receiver: PMD forward error correction (FEC) scheme (TCM or PCS-LCM) is determined by the receiver;
- 1) forced-tcm: PMD FEC scheme is forced to TCM.

Default value: 0 (receiver).

Reference: Clause 12.3.4.2.3 of [ITU-T G.9711].

7.3 Channel configuration objects

7.3.1 Data rates

7.3.1.1 Maximum net data rate (MAXNDRds/us)

Description: Determines the value of the maximum NDR (see clause 11.4.2.2 of [ITU-T G.9711]).

Type: 32-bit unsigned integer.

Unit: 1000 bits/s.

Valid values: 0...4294967295 (0 to $2^{32} - 1$ kbit/s).

Default value: 4294967295 (4294967295 kbit/s).

Reference: Clause 11.4.2.2 of [ITU-T G.9711].

7.3.1.2 Minimum expected throughput (MINETRds/us)

Description: Determines the value of the minimum expected throughput (see clause 11.4.2.1 of [ITU-T G.9711]).

Type: 32-bit unsigned integer.

Unit: 1000 bits/s.

Valid values: 0...4294967295 (0 to $2^{32} - 1$ kbit/s).

Default value: 0 (0 bit/s).

Reference: Clause 11.4.2.1 of [ITU-T G.9711].

7.3.1.3 Maximum gamma data rate (MAXGDRds/us)

Description: Determines the maximum value of the gamma data rate (GDR) (see clause 7.12.1.5). The GDR shall not exceed MAXGDR at the start of showtime and during showtime.

Type: 32-bit unsigned integer.

Unit: 1000 bits/s.

Valid values: 0...4294967295 (0 to $2^{32} - 1$ kbit/s).

Default value: 4294967295 (4294967295 kbit/s).

Reference: None.

7.3.1.4 Minimum gamma data rate (MINGDRds/us)

Description: Determines the minimum value of the GDR (see clause 7.12.1.5). The GDR may be less than the minimum gamma data rate (MINGDR). If the GDR is less than the MINGDR at initialization or when GDR becomes less than MINGDR during showtime, a threshold crossing alert occurs.

Type: 32-bit unsigned integer.

Unit: 1000 bits/s.

Valid values: 0...4294967295 (0 to $2^{32} - 1$ kbit/s).

Default value: 0 (0 bits/s).

Reference: None.

7.3.2 Retransmission

7.3.2.1 Minimum impulse noise protection against SHINE (INPMIN_SHINEds/us)

Description: Determines the minimum impulse noise protection against a single high impulse noise event (SHINE; see clause 9.8 of [ITU-T G.9711]). The [ITU-T G.9711] control parameter *INP_min_shine* is set to the same value as the minimum impulse noise protection against SHINE (see clause 11.4.2.4 of [ITU-T G.9711]).

Type: 16-bit unsigned integer.

Unit: 1 symbol period.

Valid values: 0...520 (0 to 520 symbol periods).

Default value: 0 (0 symbol periods).

Reference: Clause 11.4.2.4 of [ITU-T G.9711].

7.3.2.2 SHINE ratio (SHINERATIOds/us)

Description: Determines the *SHINERatio* that is used in the setting of the expected throughput rate (*ETR*) (see clause 9.8 of [ITU-T G.9711]). The [ITU-T G.9711] control parameter *SHINERatio* is set to the same value as the SHINE ratio (see clause 11.4.2.5 of [ITU-T G.9711]).

Type: 8-bit unsigned integer.

Unit: 0.001.

Valid values: 0...100 (0 to 0.1).

Default value: 0 (0).

Reference: Clause 11.4.2.5 of [ITU-T G.9711].

7.3.2.3 Minimum impulse noise protection against REIN (INPMIN_REINds/us)

Description: Determines the minimum impulse noise protection against repetitive electrical impulse noise (REIN) (see clause 9.8 of [ITU-T G.9711]). The [ITU-T G.9711] control parameter *INP_min_rein* is set to the same value as the minimum impulse noise protection against REIN (see clause 11.4.2.6 of [ITU-T G.9711]).

Type: 8-bit unsigned integer.

Unit: 1 symbol period.

Valid values: 0...63 (0 to 63 symbol periods).

Default value: 0 (0 symbol periods).

Reference: Clause 11.4.2.6 of [ITU-T G.9711].

7.3.2.4 REIN inter-arrival time (IAT_REINds/us)

Description: Determines the REIN inter-arrival time (see clause 9.8 of [ITU-T G.9711]). The [ITU-T G.9711] control parameter *iat_rein_flag* is set to the same value as the REIN inter-arrival time (see clause 11.4.2.7 of [ITU-T G.9711]).

Type: Enumeration.

Valid values: 0 (100 Hz), 1 (120 Hz), 2 (300 Hz), 3 (360 Hz).

Default value: 0 (100 Hz).

Reference: Clause 11.4.2.7 of [ITU-T G.9711].

7.3.2.5 Minimum Reed-Solomon $R_{\text{FEC}}/N_{\text{FEC}}$ ratio (RNRATIOds/us)

Description: Determines the minimal required ratio, $R_{\text{FEC}}/N_{\text{FEC}}$, where R_{FEC} is the number of redundancy bytes divided by N_{FEC} the total number of bytes in each FEC codeword, of Reed-Solomon code parameters. The [ITU-T G.9711] control parameter *rnratio* is set to the same value as the minimum Reed-Solomon $R_{\text{FEC}}/N_{\text{FEC}}$ ratio (see clause 11.4.2.8 of [ITU-T G.9711]).

Type: 8-bit unsigned integer.

Unit: 1/32.

Valid values: 0...8 (0 to 1/4).

Default value: 0 (0).

Reference: Clause 11.4.2.8 of [ITU-T G.9711].

7.3.2.6 RTX-TC test mode (RTX_TESTMODE)

Description: Determines whether the retransmission test mode defined in clause 9.8.3.1.2 of [ITU-T G.9711] is enabled or disabled in the upstream and downstream directions. The RTX_TESTMODE setting may be changed during showtime. When changed, it shall take effect on the link within 2 s without re-initialization.

Type: Boolean.

Valid values: False (disabled) or true (enabled).

Default value: False (disabled).

Reference: Clause 9.8.3.1.2 of [ITU-T G.9711].

7.3.3 Rate threshold

7.3.3.1 "landeftr" defect threshold (LOW-ANDEFTR-THRESHOLDds/us)

Description: Determines the value of the low all-normal operation interval (NOI) data error-free throughput rate (EFTR) threshold (see clause 11.3.1.3 of [ITU-T G.9711]).

Type: 32-bit unsigned integer.

Unit: 1000 bits/s.

Valid values: 0...4294967295 (0 to $2^{32} - 1$ kbit/s).

Default value: 0 (0 kbit/s).

Reference: Clause 11.3.1.3 of [ITU-T G.9711].

7.3.3.2 "landeftr0" defect threshold with DTFO disabled (LOW-ANDEFTR0-THRESHOLDds/us)

Description: Determines the value of the low all-NOI data EFTR threshold with discontinuous time frequency operation (DTFO) disabled (ANDEFTR0) (see clause 11.3.1.3 of [ITU-T G.9711]).

Type: 32-bit unsigned integer.

Unit: 1000 bits/s.

Valid values: 0...4294967295 (0 to $2^{32} - 1$ kbit/s).

Default value: 0 (0 kbit/s).

Reference: Clause 11.3.1.3 of [ITU-T G.9711].

7.4 Data path configuration objects

7.4.1 TPS-TC test mode (TPS_TESTMODE)

Description: Determines whether the TPS-TC test mode defined in clause 8.3.1 of [ITU-T G.9711] is enabled or disabled in the upstream and downstream directions. The TPS_TESTMODE setting may be changed during showtime. When changed, it shall take effect on the link within 2 s without re-initialization.

Type: Boolean.

Valid values: False (disabled) or true (enabled).

Default value: False (disabled).

Reference: Clause 8.3.1 of [ITU-T G.9711].

7.4.2 DRA test mode (DRA_TESTMODE)

Description: Determines whether the dynamic resource allocation (DRA) test mode defined in clause 9.8.3.1.2 of [ITU-T G.9711] is enabled or disabled in the upstream and downstream directions. The DRA_TESTMODE setting may be changed during showtime. When changed, it shall take effect on the link within 2 s without re-initialization.

Type: Boolean.

Valid values: False (disabled) or true (enabled).

Default value: False (disabled).

Reference: Clause 9.8.3.1.2 of [ITU-T G.9711].

7.4.3 Mapping of layer 2 QoS queue to QoS channel (QUEUE2CHANNELMAPds/us)

Description: Determines the mapping of layer 2 quality of service (QoS) queues (queue-id) to QoS channels (channel-id), separately for downstream (as relevant for the ME-O) and upstream (as relevant for the management entity–remote side (ME-R)). More than one queue-id may be mapped to a particular channel-id. The set of configured channel-id values shall be one of {0}, {0,1}, {0,1,2}, or {0,1,2,3} and shall be the same for downstream and upstream.

Type: Array of Q2CMAPdescriptor[0...N–1], with $1 \leq N \leq 8$.

Q2CMAPdescriptor

- **Type:** Record of a local-queue-id and a local-channel-id.
- **Local-queue-id (QID):** (NOTES 1 and 2)
 - **Type:** 32-bit unsigned integer.
 - **Valid values:** 0...7.
- **Local-channel-id (CID):**
 - **Type:** 8-bit unsigned integer.
 - **Valid values:** 0...3.

Reference: Clause 11.4.7.1 of [ITU-T G.9711].

NOTE 1 – The identification of layer 2 queues lies outside the scope of this Recommendation. It is defined as part of layer 2 QoS traffic management, e.g., in [b-BBF TR-383] for the DPU and in the [b-BBF TR-181] data model definition and Annex Y of [ITU-T G.9711] for the NT.

NOTE 2 – If the NT device has no explicit queue identifier (QID) established for the MGfast wide-area network (WAN) interface, then a management system could, over the G-reference point as shown in Figures 5-1 and 5-2, for example:

- 1) configure the QoS queue table such that all queues associated with an MGfast-supporting egress interface have a unique precedence (or unique weight in case of equal precedence);
- 2) have an out-of-band understanding that QID=0 refers to the queue with the lowest precedence (i.e., the highest precedence value as specified in [b-BBF TR-383]) and weight (in case of equal precedence), QID=1 refers to the second lowest, etc.

7.4.4 QoS class association (QOSCLASSds/us)

Description: Determines the associated QoS class for each of the QoS channels configured through the QUEUE2CHANNELMAP, separately for downstream (relevant to the ME-O) and upstream (relevant to the ME-R).

Type: Array of QOSCLASSassociation[0...N-1], with $1 \leq N \leq 4$.

QOSCLASSassociation

Type: Record of a local-channel-id (see clause 7.4.3) and a reference to a QOSCLASSdescriptor.

QOSCLASSdescriptor

Type: Record of a priority value (see clause 7.4.4.1), a target maximum delay value (see clause 7.4.4.2) and a proactive retransmission type (see clause 7.4.4.3).

Reference: Clause 11.4.7.2 of [ITU-T G.9711].

7.4.4.1 Priority (PRIORITY)

Description: Determines the value of the priority for this QoS class. A higher value represents a higher priority. The downstream QoS classes associated with the downstream QoS channels shall have a different PRIORITY. The upstream QoS classes associated with the upstream QoS channels shall have a different PRIORITY.

Type: 8-bit unsigned integer.

Valid values: 0..3.

Default: None (object shall be explicitly configured).

Reference: Clause 11.4.7.2.1 of [ITU-T G.9711].

7.4.4.2 Target maximum delay (MAXDELAY)

Description: Determines the value of the target maximum delay between γ_O and γ_R reference points for this QoS class. A channel with a higher PRIORITYds value shall have an equal or lower MAXDELAYds value compared to all other channels with a lower PRIORITYds value. The transmitting TPS-TC derives the value of *delay_max* (as a control parameter for the PMS-TC) from the value of MAXDELAY in a vendor discretionary way.

Type: 32-bit unsigned integer.

Unit: 0.25 ms.

Valid values: 0..64.

Default value: 40 (10 ms).

Reference: Clauses 8.1 and 11.4.7.2.2 of [ITU-T G.9711].

7.4.4.3 Proactive retransmission (PROACTIVE_RTX)

Description: Determines the type of proactive retransmission for this QoS class.

Type: enumeration.

Valid values: 0..2.

- 0) not-required: DTUs carrying DTU frames of this QoS class are not required, but may be retransmitted proactively;
- 1) forced1: DTUs carrying DTU frames of this QoS class shall be retransmitted at least once;
- 2) forced2: DTUs carrying DTU frames of this QoS class shall be retransmitted at least twice.

Default: 0 (not required).

Reference: Clause 11.4.7.2.3 of [ITU-T G.9711].

7.5 Line failures

Any failure specified in this clause shall be conveyed by the DPU over the DPU-NB interface and may be conveyed by the NT over the T/S interface after it is detected.

The near-end failure detections shall be provided at the DPU and may be provided at the NT.

The FE failure detections shall be provided at the DPU (NT is at the FE), and may be provided at the NT (DPU is at the FE).

7.5.1 Near end failures

The LOS, LOR, and LOM failures are mutually exclusive and reflect the cause of the triggered re-initialization. If no LOS, LOR, or LOM failure is declared, then the re-initialization is triggered by a High_BER event (see clause 12.1.4 of [ITU-T G.9711]).

7.5.1.1 Loss-of-signal failure

A LOS failure is declared when a re-initialization is triggered by a persistent near-end *los* defect (see [clause 12.1.4.3.1 of \[ITU-T G.9711\]](#)). A LOS failure is cleared immediately at the start of showtime in the receiving direction.

Type: Boolean.

Valid values: False (failure is cleared) or true (failure is declared).

7.5.1.2 Loss-of-RMC failure

A LOR failure is declared when a re-initialization is triggered by a persistent near-end *lor* defect (see [clause 12.1.4.3.3 of \[ITU-T G.9711\]](#)). A LOR failure is cleared immediately at the start of showtime in the receiving direction.

Type: Boolean.

Valid values: False (failure is cleared) or true (failure is declared).

7.5.1.3 Loss-of-margin failure

A LOM failure is declared when a re-initialization is triggered by a persistent near-end *lom* defect (see [clause 12.1.4.3.2 of \[ITU-T G.9711\]](#)). A LOM failure is cleared immediately at the start of showtime in the receiving direction.

Type: Boolean.

Valid values: False (failure is cleared) or true (failure is declared).

7.5.1.4 Loss of power failure

An LPR failure is declared after 2.5 ± 0.5 s of contiguous near-end *lpr* primitive presence (see [clause 11.3.3.1 of \[ITU-T G.9711\]](#)). An LPR failure is cleared after 10 ± 0.5 s of no near-end *lpr* primitive presence.

Type: Boolean.

Valid values: False (failure is cleared) or true (failure is declared).

7.5.2 Far-end failures

7.5.2.1 Loss of signal-far end failure

A LOS-FE failure is declared when a re-initialization is triggered with an FE *los* defect present (see clause 11.3.1.4 of [ITU-T G.9711]). A LOS-FE failure is cleared immediately at the start of showtime in the transmitting direction.

Type: Boolean.

Valid values: False (failure is cleared) or true (failure is declared).

7.5.2.2 Loss of RMC-far end failure

A LOR-FE failure is declared when a re-initialization is triggered with an FE *lor* defect present (see clause 11.3.1.4 of [ITU-T G.9711]) and no LOS-FE failure is present. A LOR-FE failure is cleared immediately at the start of showtime in the transmitting direction.

Type: Boolean.

Valid values: False (failure is cleared) or true (failure is declared).

7.5.2.3 Loss of margin failure-far end

A LOM-FE failure is declared when a re-initialization is triggered with an FE *lom* defect present (see clause 11.3.1.4 of [ITU-T G.9711]) and no LOS-FE failure is present and no LOR-FE failure is present. A LOM-FE failure is cleared immediately at the start of showtime in the transmitting direction.

Type: Boolean.

Valid values: False (failure is cleared) or true (failure is declared).

7.5.2.4 Loss of power-far end failure

An LPR-FE failure is declared after the occurrence of an FE *lpr* primitive (see clause 11.3.3.2 of [ITU-T G.9711]) followed by 2.5 ± 0.5 s of contiguous near-end *los* defect. An LPR-FE failure is cleared after 10 ± 0.5 s of no near-end *los* defect.

Type: Boolean.

Valid values: False (failure is cleared) or true (failure is declared).

7.5.3 Initialization failures

7.5.3.1 Link initialization (LINIT) failure

When the near-end transmitter enters the SILENT state and fails to reach the SHOWTIME state (after a vendor discretionary number of retries or within a vendor discretionary timeout), then an initialization failure occurs. An initialization failure cause and last successful transmitted state are reported (see clause 7.11.2). An initialization failure is cleared when the near-end transmitter enters the SHOWTIME state.

Type: Boolean.

Valid values: False (failure is cleared) or true (failure is declared).

7.6 Channel failures

No channel failures are specified.

7.7 Data path failures

No data path failures are specified.

7.8 Line performance monitoring objects

The line PM objects defined in Table 7-9 are subject to the rules specified in clause 8.

CURR/PREV means that the object may apply separately for the current interval and the previous interval, NE/FE means that the object may apply separately for network element (NE) and FE, and 15/24 means that the object may apply separately for 15 min and 24 h intervals.

7.8.1 Measured time (CURR/PREV_NE/FE_15/24_L_TIME)

Description: Reports the amount of time, measured in seconds, that statistics for this interval have been counted.

Type: 32-bit unsigned integer.

Valid values: 0...900 (for 15 min interval) and 0...86400 (for 24 h interval).

Reference: Clause 8.9.

7.8.2 Invalid data flag (PREV_NE/FE_15/24_L_INVALID)

Description: Reports the validity of the corresponding PM data. Reported only with the previous interval PM counters.

Type: Boolean.

Valid values: TRUE (PM data is incomplete or invalid) and FALSE (PM data is complete and valid).

Reference: Clause 8.9.

7.8.3 Time stamp (PREV_NE/FE_15/24_L_STAMP)

Description: Reports the start date and time for this interval. Reported only with the previous interval PM counters.

Type: String (as specified in clause 8.12).

Reference: None.

7.8.4 LOS failure counter (CURR/PREV_NE/FE_15/24_LOS)

Description: For NE, reports the LOS failure count described in clause 7.5.1.1. For FE, reports the LOS-FE failure count described in clause 7.5.2.1.

Type: 32-bit unsigned integer.

Valid values: 0...4294967295 (event counter).

Reference: Clauses 7.5.1.1 and 7.5.2.1.

7.8.5 LOR failure counter (CURR/PREV_NE/FE_15/24_LOR)

Description: For NE, reports the LOR failure count described in clause 7.5.1.2. For FE, reports the LOR-FE failure count described in clause 7.5.2.2.

Type: 32-bit unsigned integer.

Valid values: 0...4294967295 (event counter).

Reference: Clauses 7.5.1.2 and 7.5.2.2.

7.8.6 LOM failure counter (CURR/PREV_NE/FE_15/24_LOM)

Description: For NE, reports the LOM failure count described in clause 7.5.1.3. For FE, reports the LOM-FE failure count described in clause 7.5.2.3.

Type: 32-bit unsigned integer.

Valid values: 0...4294967295 (event counter).

Reference: Clauses 7.5.1.3 and 7.5.2.3.

7.8.7 LPR failure counter (CURR/PREV_NE/FE_15/24_LPR)

Description: For NE, reports the LPR failure count described in clause 7.5.1.4. For FE, reports the LPR-FE failure count described in clause 7.5.2.4.

Type: 32-bit unsigned integer.

Valid values: 0...4294967295 (event counter).

Reference: Clauses 7.5.1.4 and 7.5.2.4.

7.8.8 ES counter (CURR/PREV_NE/FE_15/24_ES)

Description: Reports the errored second (ES) count. An ES is specified in clause 11.4.4.1 of [ITU-T G.9711].

Type: 32-bit unsigned integer.

Valid values: 0...900 (15 min interval) and 0...86400 (24 h interval).

Reference: Clause 11.4.4.1 of [ITU-T G.9711].

7.8.9 SES counter (CURR/PREV_NE/FE_15/24_SES)

Description: Reports the SES count. An SES is specified in clause 11.4.4.2 of [ITU-T G.9711].

Type: 32-bit unsigned integer.

Valid values: 0...900 (15 min interval) and 0...86400 (24 h interval).

Reference: Clause 11.4.4.2 of [ITU-T G.9711].

7.8.10 LOSS counter (CURR/PREV_NE/FE_15/24_LOSS)

Description: Reports the LOS second (LOSS) count. A LOSS is specified in clause 11.4.4.3 of [ITU-T G.9711].

Type: 32-bit unsigned integer.

Valid values: 0...900 (15 min interval) and 0...86400 (24 h interval).

Reference: Clause 11.4.4.3 of [ITU-T G.9711].

7.8.11 LORS counter (CURR/PREV_NE/FE_15/24_LORS)

Description: Reports the LORS count. A LORS is specified in clause 11.4.4.4 of [ITU-T G.9711].

Type: 32-bit unsigned integer.

Valid values: 0...900 (15 min interval) and 0...86400 (24 h interval).

Reference: Clause 11.4.4.4 of [ITU-T G.9711].

7.8.12 UAS counter (CURR/PREV_NE/FE_15/24_UAS)

Description: Reports the unavailable second (UAS) count. A UAS is defined in clause 11.4.4.5 of [ITU-T G.9711].

Type: 32-bit unsigned integer.

Valid values: 0...900 (15 min interval) and 0...86400 (24 h interval).

Reference: Clause 11.4.4.5 of [ITU-T G.9711].

7.8.13 Full inits counter (CURR/PREV_15/24_FULL_INITS)

Description: Reports the full initialization primitive (*full_init*) count. A full initialization primitive (*full_init*) is specified in clause 11.3.1.5 of [ITU-T G.9711]. Reported only with the near-end PM counters.

Type: 32-bit unsigned integer.

Valid values: 0...4294967295 (event counter).

Reference: Clause 11.3.1.5 of [ITU-T G.9711].

7.8.14 Failed full inits counter (CURR/PREV_15/24_FAILEDFULL_INITS)

Description: Reports the failed full initialization primitive (*failedfull_init*) count. A failed full initialization primitive (*failedfull_init*) is specified in clause 11.3.1.5 of [ITU-T G.9711]. Reported only with the near-end PM counters.

Type: 32-bit unsigned integer.

Valid values: 0...4294967295 (event counter).

Reference: Clause 11.3.1.5 of [ITU-T G.9711].

7.8.15 Fast inits counter (CURR/PREV_15/24_FAST_INITS)

Description: Reports the fast initialization primitive (*fast_init*) count. A fast initialization primitive (*fast_init*) is specified in clause 11.3.1.5 of [ITU-T G.9711]. Reported only with the near-end PM counters.

Type: 32-bit unsigned integer.

Valid values: 0...4294967295 (event counter).

Reference: Clause 11.3.1.5 of [ITU-T G.9711].

7.8.16 Failed fast inits counter (CURR/PREV_15/24_FAILEDFAST_INITS)

Description: Reports the failed fast initialization primitive (*failedfast_init*) count. A failed fast initialization primitive (*failedfast_init*) is specified in clause 11.3.1.5 of [ITU-T G.9711]. Reported only with the near-end PM counters.

Type: 32-bit unsigned integer.

Valid values: 0...4294967295 (event counter).

Reference: Clause 11.3.1.5 of [ITU-T G.9711].

7.8.17 LPR_INTRPT counter (CURR/PREV_15/24_LPR_INTRPT)

Description: Reports the loss-of-power interruption anomaly (*lpr_intrpt*) count. A loss-of-power interruption anomaly (*lpr_intrpt*) is specified in clause 11.3.1.1 of [ITU-T G.9711]. Reported only with the near-end PM counters.

Type: 32-bit unsigned integer.

Valid values: 0...4294967295 (event counter).

Reference: Clause 11.3.1.1 of [ITU-T G.9711].

7.8.18 HRI_INTRPT counter (CURR/PREV_15/24_HRI_INTRPT)

Description: Reports the host-reinit interruption anomaly (*hri_intrpt*) count. A host-reinit interruption anomaly (*hri_intrpt*) is specified in clause 11.3.1.1 of [ITU-T G.9711]. Reported only with the near-end PM counters.

Type: 32-bit unsigned integer.

Valid values: 0...4294967295 (event counter).

Reference: Clause 11.3.1.1 of [ITU-T G.9711].

7.8.19 SPONT_INTRPT counter (CURR/PREV_15/24_SPONT_INTRPT)

Description: Reports the spontaneous interruption anomaly (*spont_intrpt*) count. A spontaneous interruption anomaly (*spont_intrpt*) is specified in clause 11.3.1.1 of [ITU-T G.9711]. Reported only with the near-end PM counters.

Type: 32-bit unsigned integer.

Valid values: 0...4294967295 (event counter).

Reference: Clause 11.3.1.1 of [ITU-T G.9711].

7.8.20 Successful bit swap counter (CURR/PREV_NE/FE_15/24_BSW)

Description: Reports the successful bit swap primitive (*success_BSW*) count. A successful bit swap primitive (*success_BSW*) is specified in clause 11.3.1.6 of [ITU-T G.9711].

Type: 32-bit unsigned integer.

Valid values: 0...4294967295 (event counter).

Reference: Clause 11.3.1.6 of [ITU-T G.9711].

7.8.21 Successful autonomous SRA (CURR/PREV_NE/FE_15/24_SRA)

Description: Reports the successful autonomous seamless rate adaptation (SRA) primitive (*success_SRA*) count. A successful autonomous SRA primitive (*success_SRA*) is specified in clause 11.3.1.6 of [ITU-T G.9711].

Type: 32-bit unsigned integer.

Valid values: 0...4294967295 (event counter).

Reference: Clause 11.3.1.6 of [ITU-T G.9711].

7.8.22 Successful FRA counter (CURR/PREV_NE/FE_15/24_FRA)

Description: Reports the successful FRA primitive (*success_FRA*) count. A successful FRA primitive (*success_FRA*) is specified in clause 11.3.1.6 of [ITU-T G.9711].

Type: 32-bit unsigned integer.

Valid values: 0...4294967295 (event counter).

Reference: Clause 11.3.1.6 of [ITU-T G.9711].

7.8.23 Successful RPA counter (CURR/PREV_NE/FE_15/24_RPA)

Description: Reports the successful RPA primitive (*success_RPA*) count. A successful RPA primitive (*success_RPA*) is specified in clause 11.3.1.6 of [ITU-T G.9711].

Type: 32-bit unsigned integer.

Valid values: 0...4294967295 (event counter).

Reference: Clause 11.3.1.6 of [ITU-T G.9711].

7.8.24 Successful TIGA counter (CURR/PREV_15/24_TIGA)

Description: Reports the successful transmitter-initiated gain adjustment (TIGA) primitive (*success_TIGA*) count. A successful TIGA primitive (*success_TIGA*) is specified in clause 11.3.1.6 of [ITU-T G.9711]. Reported only with the near-end PM counters.

Type: 32-bit unsigned integer.

Valid values: 0...4294967295 (event counter).

Reference: Clause 11.3.1.6 of [ITU-T G.9711].

7.8.25 INM performance monitoring objects

7.8.25.1 INM INPEQ histogram (CURR/PREV_NE/FE_15/24_INMINPEQ)

Description: Reports the count of the INMAINPEQ_{*i*} anomalies occurring on the link during the accumulation period.

Type: Array of INPEQBINdescriptor[1...17]. The bin with subscript *i* shall include the count of INMAINPEQ_{*i*} anomalies.

INPEQBINdescriptor

Type: 32-bit unsigned integer.

Valid values: 0...2³² – 1

Reference: Clause 11.4.4.7.3.1 of [ITU-T G.9711].

7.8.25.2 INM total measurement (CURR/PREV_NE/FE_15/24_INMAME)

Description: Reports the count of INMAME anomalies occurring on the link during the accumulation period.

Type: 32-bit unsigned integer.

Valid values: 0...2³² – 1

Reference: Clause 11.4.4.7.3.2 of [ITU-T G.9711].

7.8.25.3 INM IAT histogram (CURR/PREV_NE/FE_15/24_INMIAT)

Description: Reports the count of INMAIAT_{*i*} anomalies occurring on the link during the accumulation period.

Type: Array of IATBINdescriptor[0...7]. The bin with subscript *i* shall include the count of INMAIAT_{*i*} anomalies.

IATBINdescriptor

Type: 32-bit unsigned integer.

Valid values: 0...2³² – 1

Reference: Clause 11.4.4.7.3.3 of [ITU-T G.9711].

7.8.25.4 INM blank frame counter (CURR/PREV_NE/FE_15/24_INMBLFCds/us)

Description: Reports the count of INMBLFC anomalies occurring on the link during the accumulation period.

Type: 32-bit unsigned integer.

Valid values: 0...2³² – 1

Reference: Clause 11.4.4.7.3.4 of [ITU-T G.9711].

7.8.26 Reinitializations due to ME-O trigger counter (CURR/PREV_15/24_ME_O_INTRPT)

Description: Reports a *me_o_intrpt* anomaly count. A *me_o_intrpt* anomaly is specified in clause 13.2.1.5.5 of [ITU-T G.9711]. Reported only with the near-end PM counters.

Type: 32-bit unsigned integer.

Valid values: 0...2³² – 1 (event counter).

Reference: Clause 13.2.1.5.5 of [ITU-T G.9711].

7.8.27 Successful SREC counter (CURR/PREV_15/24_SUCCESS_SREC)

Description: Reports a *success_srec* primitive count. A *success_srec* primitive is specified in clause 13.2.1.5.3 of [ITU-T G.9711]. Reported only with the near-end PM counters.

Type: 32-bit unsigned integer.

Valid values: $0 \dots 2^{32} - 1$ (event counter).

Reference: Annex 13.2.1.5.3 of [ITU-T G.9711].

7.8.28 Successful RMCR counter (CURR/PREV_NE/FE_15/24_RMCR)

Description: Reports the successful RMCR primitive (*success_RMCR*) count. A successful RMCR primitive is specified in clause 11.3.1.6 of [ITU-T G.9711].

Type: 32-bit unsigned integer.

Valid values: $0 \dots 4294967295$ (event counter).

Reference: Clause 11.3.1.6 of [ITU-T G.9711].

7.9 Channel performance monitoring objects

The channel PM objects defined in Table 7-10 are subject to the rules defined in clause 8.

7.9.1 Measured time (CURR/PREV_NE/FE_15/24_C_TIME)

Description: Reports the amount of time, measured in seconds, during which statistics have been counted.

Type: 32-bit unsigned integer.

Valid values: $0 \dots 900$ (for 15 min interval) and $0 \dots 86400$ (for 24 h interval).

Reference: Clause 8.9.

7.9.2 Invalid data Flag (PREV_NE/FE_15/24_C_INVALID)

Description: Reports the validity of the corresponding PM data. Reported only with the previous interval PM counters.

Type: Boolean.

Valid values: TRUE (PM data is incomplete or invalid) and FALSE (PM data is complete and valid).

Reference: Clause 8.9.

7.9.3 Time stamp (PREV_NE/FE_15/24_C_STAMP)

Description: Reports the start date and time for this interval. Reported only with the previous interval PM counters.

Type: String (as specified in clause 8.12).

Reference: None.

7.9.4 CV counter (CURR/PREV_NE/FE_15/24_CV)

Description: Reports a count of cyclic redundancy check (CRC) anomalies. A CRC anomaly is specified in clause 11.3.1.1 of [ITU-T G.9711].

Type: 32-bit unsigned integer.

Valid values: $0 \dots 4294967295$ (event counter).

Reference: Clause 11.3.1.1 of [ITU-T G.9711].

7.9.5 Uncorrected DTU counter (CURR/PREV_NE/FE_15/24_RTXUC)

Description: Reports a count of the uncorrected DTU anomalies (*rtx-uc*). An uncorrected DTU anomaly (*rtx-uc*) is specified in clause 11.3.1.1 of [ITU-T G.9711].

Type: 32-bit unsigned integer.

Valid values: 0...4294967295 (event counter).

Reference: Clause 11.3.1.1 of [ITU-T G.9711].

7.9.6 Retransmitted DTU counter (CURR/PREV_NE/FE_15/24_RTXTX)

Description: Reports a count of the retransmitted DTU anomalies (*rtx-tx*). A retransmitted DTU anomaly (*rtx-tx*) is specified in clause 11.3.1.1 of [ITU-T G.9711].

Type: 32-bit unsigned integer.

Valid values: 0...4294967295 (event counter).

Reference: Clause 11.3.1.1 of [ITU-T G.9711].

7.9.7 LANDEFTRS counter (CURR/PREV_NE/FE_15/24_LANDEFTRS)

Description: Reports the count of low ANDEFTR seconds (LANDEFTRS). LANDEFTRS is specified in clause 11.4.4.8 of [ITU-T G.9711].

Type: 32-bit unsigned integer.

Valid values: 0...900 (15 min interval) and 0...86400 (24 h interval).

Reference: Clause 11.4.4.8 of [ITU-T G.9711].

7.9.8 LANDEFTR0S counter (CURR/PREV_NE/FE_15/24_LANDEFTR0S)

Description: Reports the count of low ANDEFTR0 seconds (LANDEFTR0S). LANDEFTR0S is specified in clause 11.4.4.8 of [ITU-T G.9711].

Type: 32-bit unsigned integer.

Valid values: 0...900 (15 min interval) and 0...86400 (24 h interval).

Reference: Clause 11.4.4.8 of [ITU-T G.9711].

7.9.9 ANDEFTRDS counter (CURR/PREV_NE/FE_15/24_ANDEFTRDS)

Description: Reports the count of all-NOI with data symbols EFTR determined seconds (ANDEFTRDS). ANDEFTRDS is specified in clause 11.4.1.1.21 of [ITU-T G.9711].

Type: 32-bit unsigned integer.

Valid values: 0...900 (15 min interval) and 0...86400 (24 h interval).

Reference: Clause 11.4.1.1.21 of [ITU-T G.9711].

7.9.10 ANDEFTR0DS counter (CURR/PREV_NE/FE_15/24_ANDEFTR0DS)

Description: Reports the count of all-NOI with data symbols EFTR with DTFO disabled (ANDEFTR0) determined seconds (ANDEFTR0DS). ANDEFTR0DS is specified in clause 11.4.1.1.21 of [ITU-T G.9711].

Type: 32-bit unsigned integer.

Valid values: 0...900 (15 min interval) and 0...86400 (24 h interval).

Reference: Clause 11.4.1.1.21 of [ITU-T G.9711].

7.9.11 Minimum all-NOI with data symbols EFTR per time interval (MINANDEFTR_CURR/PREV_NE/FE_15/24)

Description: Reports the minimum all-NOI with data symbols EFTR (see clause 11.4.1.1.18 of [ITU-T G.9711]) over the associated time interval. A special value ($2^{32} - 1$) indicates that the MINANDEFTR is undetermined.

Type: 32-bit unsigned integer.

Unit: 1000 bits/s.

Valid values: 0...4294967294 (0 to $2^{32} - 2$ kbit/s) and 4294967295 ($2^{32} - 1$ special value).

Reference: Clause 11.4.1.1.18 of [ITU-T G.9711].

7.9.12 Minimum all-NOI with data symbols EFTR with DTFO disabled (ANDEFTR0) per time interval (MINANDEFTR0_CURR/PREV_NE/FE_15/24)

Description: Reports the minimum all-NOI with data symbols EFTR with DTFO disabled (ANDEFTR0) (see clause 11.4.1.1.18 of [ITU-T G.9711]) over the associated time interval. A special value ($2^{32} - 1$) indicates that the MINANDEFTR0 is undetermined.

Type: 32-bit unsigned integer.

Unit: 1000 bits/s.

Valid values: 0...4294967294 (0 to $2^{32} - 2$ kbit/s) and 4294967295 ($2^{32} - 1$ special value).

Reference: Clause 11.4.1.1.18 of [ITU-T G.9711].

7.9.13 Maximum all-NOI with data symbols EFTR per time interval (MAXANDEFTR_CURR/PREV_NE/FE_15/24)

Description: Reports the maximum all-NOI with data symbols EFTR (see clause 11.4.1.1.19 of [ITU-T G.9711]) over the associated time interval. A special value ($2^{32} - 1$) indicates that the MAXANDEFTR is undetermined.

Type: 32-bit unsigned integer.

Unit: 1000 bits/s.

Valid values: 0...4294967294 (0 to $2^{32} - 2$ kbit/s) and 4294967295 ($2^{32} - 1$ special value).

Reference: Clause 11.4.1.1.19 of [ITU-T G.9711].

7.9.14 Maximum all-NOI with data symbols EFTR with DTFO disabled (ANDEFTR0) per time interval (MAXANDEFTR0_CURR/PREV_NE/FE_15/24)

Description: Reports the maximum all-NOI with data symbols EFTR with DTFO disabled (ANDEFTR0) (see clause 11.4.1.1.19 of [ITU-T G.9711]) over the associated time interval. A special value ($2^{32} - 1$) indicates that the MAXANDEFTR0 is undetermined.

Type: 32-bit unsigned integer.

Unit: 1000 bits/s.

Valid values: 0...4294967294 (0 to $2^{32} - 2$ kbit/s) and 4294967295 ($2^{32} - 1$ special value).

Reference: Clause 11.4.1.1.19 of [ITU-T G.9711].

7.9.15 Sum all-NOI with data symbols EFTR per time interval (SUMANDEFTR_CURR/PREV_NE/FE_15/24)

Description: Reports the sum of all-NOI with data symbols EFTR bits (see clause 11.4.1.1.20 of [ITU-T G.9711]), divided by 65536, over the associated time interval. A special value ($2^{32} - 1$) indicates that the SUMANDEFTR is undetermined.

NOTE – SUMANDEFTR and ANDEFTRDS can be used to compute the mean of ANDEFTR.

Type: 32-bit unsigned integer.

Unit: 65536 bits.

Valid values: 0...4294967294 ((0 to $(2^{32} - 2)$) $\times 2^{16}$ bits) and 4294967295 ($2^{32} - 1$ special value).

Reference: Clause 11.4.1.1.20 of [ITU-T G.9711].

7.9.16 Sum all-NOI with data symbols EFTR with DTFO disabled (ANDEFTR0) per time interval (SUMANDEFTR0_CURR/PREV_NE/FE_15/24)

Description: Reports the sum of all-NOI with data symbols EFTR with DTFO disabled (ANDEFTR0) bits (see clause 11.4.1.1.20 of [ITU-T G.9711]), divided by 65536, over the associated time interval. A special value ($2^{32} - 1$) indicates that the SUMANDEFTR0 is undetermined.

NOTE – SUMANDEFTR0 and ANDEFTRDS can be used to compute the mean of ANDEFTR0.

Type: 32-bit unsigned integer.

Unit: 65536 bits.

Valid values: 0...4294967294 ((0 to $(2^{32} - 2)$) $\times 2^{16}$ bits) and 4294967295 ($2^{32} - 1$ special value).

Reference: Clause 11.4.1.1.20 of [ITU-T G.9711].

7.10 Data path performance monitoring objects

No data path PM objects are specified.

7.11 Line test, diagnostics and status objects

7.11.1 Profile

7.11.1.1 ITU-T G.9711 profile (PROFILE)

Description: Reports for each profile whether operation according to that profile is enabled or disabled. Only one profile can be enabled.

Type: Array of PROFILEDescriptor[0...N-1] with N = 8.

PROFILEDescriptor

Type: Boolean.

Valid values: 0 (disabled) and 1 (enabled).

Bit representation

- 0) ITU-T G.9711 profile P424a
- 1) ITU-T G.9711 profile P424amp
- 2) ITU-T G.9711 profile P424d
- 3) ITU-T G.9711 profile P424dmp
- 4) ITU-T G.9711 profile Q424c
- 5) ITU-T G.9711 profile Q424cmp
- 6) ITU-T G.9711 profile Q424d
- 7) ITU-T G.9711 profile Q424dmp

Reference: Clause 6 of [ITU-T G.9711].

7.11.2 Initialization

7.11.2.1 Initialization success or failure cause (INITSFCAUSE)

Description: Reports whether the last full or fast initialization procedure was successful. If the last initialization procedure was not successful, this parameter provides the reason.

Type: Enumeration.

Valid values: 0...6

- 0) Successful.
- 1) Configuration error.
This error occurs if the link cannot reach the L0 state due to a mismatch of configuration and MTU capabilities.
- 2) Configuration not feasible on the link.
This error occurs if the link cannot reach the L0 state due to a mismatch of configuration and line and noise characteristics.
- 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 ITU-T G.994.1 handshaking procedure or due to a timeout.
- 4) No FE MTU detected.
This error occurs if the FE MTU is not powered or not connected or if the line is too long to allow detection of an FE MTU.
- 5) Any other or unknown initialization failure cause.

Reference: Clause 12.3.1 of [ITU-T G.9711].

7.11.2.2 Initialization last transmitted downstream signal (INITLASTSIGNALds)

Description: Reports the downstream signal count of the last transmitted initialization signal in the last full or fast initialization performed on the link. The downstream signal count is specified in clause 12.3.1 of [ITU-T G.9711].

Type: 8-bit unsigned integer.

Valid values: 0...21

Reference: Clause 12.3.1 of [ITU-T G.9711].

7.11.2.3 Initialization last received upstream signal (INITLASTSIGNALus)

Description: Reports the upstream signal count of the last received initialization signal in the last full or fast initialization performed on the link. The upstream signal count is specified in clause 12.3.1 of [ITU-T G.9711].

Type: 8-bit unsigned integer.

Valid values: 0...10

Reference: Clause 12.3.1 of [ITU-T G.9711].

7.11.3 Signal-to-noise ratio margin

7.11.3.1 Downstream signal-to-noise ratio margin (SNRMds)

Description: Reports the SNRM (as specified in clauses 9.8.3.2 of [ITU-T G.9711] and 11.4.1.1.10 of [ITU-T G.9711]) in the downstream direction during the L0 link state. A first special value (−512) indicates that the SNRM is undetermined. A second special value (−511) indicates that the SNRM is

less than or equal to -51.1 dB. A third special value (+511) indicates that the SNRM is greater than or equal to $+51.1$ dB.

Type: 16-bit signed integer.

Unit: 0.1 dB.

Valid values: -512 , -511 , 511 (special values) and $-510 \dots +510$ (-51.0 dB to $+51.0$ dB).

Reference: Clauses 9.8.3.2 and 11.4.1.1.10 of [ITU-T G.9711].

7.11.3.2 Downstream signal-to-noise ratio margin (SNRM_{us})

Description: Reports the SNRM (as specified in clauses 9.8.3.2 of [ITU-T G.9711] and 11.4.1.1.10 of [ITU-T G.9711]) in the upstream direction during the L0 link state. The same special values as for SNRM_{ds} are defined.

Type: 16-bit signed integer.

Unit: 0.1 dB.

Valid values: -512 , -511 , $+511$ (special value) and $-510 \dots +510$ (-51.0 dB to $+51.0$ dB).

Reference: Clauses 9.8.3.2 and 11.4.1.1.10 of [ITU-T G.9711].

7.11.4 Upstream power back-off

7.11.4.1 MTU-O estimated upstream power back-off electrical length (UPBOKLE)

Description: Reports the electrical length that would have been sent from the MTU-O to the MTU-R if the electrical length were not forced by the DPU-MIB. If the electrical length is not forced by the DPU-MIB, then this object reports the final electrical length, as determined by the MTU-O (see clause 7.3.1.5.2.1 of [ITU-T G.9711]) and conveyed in the O-UPDATE initialization message (see clause 12.3.3.2.6 of [ITU-T G.9711]).

Type: 16-bit unsigned integer.

Unit: 0.1 dB.

Valid values: $0 \dots 1280$ (0 dB to 128 dB).

Reference: Clauses 7.3.1.5.2.1 and 12.3.3.2.6 of [ITU-T G.9711].

7.11.4.2 MTU-R estimated upstream power back-off electrical length (UPBOKLE-R)

Description: Reports the estimate of the electrical length, as determined by the MTU-R (see clause 7.3.1.5.2.1 of [ITU-T G.9711]) and conveyed in the R-MSG1 initialization message (see clause 12.3.3.2.35 of [ITU-T G.9711]).

Type: 16-bit unsigned integer.

Unit: 0.1 dB.

Valid values: $0 \dots 1280$ (0 dB to 128 dB).

Reference: See clauses 7.3.1.5.2.1 and 12.3.3.2.35 of [ITU-T G.9711].

7.11.5 Actual aggregate transmit power

7.11.5.1 Downstream actual aggregate transmit power (ACTATPDs)

Description: Reports the total amount of transmit power delivered by the MTU-O at the U-O2 reference point, at the instant of measurement during the priority sub-frame (PSF). A first special value (-512) indicates that the transmit power is undetermined. A second special value (-311) indicates that the transmit power is less than or equal to -31.1 dBm. A third special value ($+311$) indicates that the transmit power is greater than or equal to $+31.1$ dBm.

Type: 16-bit signed integer.

Unit: 0.1 dB.

Valid values: -512, -311, 311 (special values) and -310...310 (-31 dBm to +31 dBm).

Reference: Clause 11.4.1.2.6 of [ITU-T G.9711].

7.11.5.2 Upstream actual aggregate transmit power (ACTATP_{us})

Description: Reports the total amount of transmit power delivered by the MTU-R at the U-R2 reference point, at the instant of measurement during the PSF. The same special values as for ACTATP_{ds} are determined.

Type: 16-bit signed integer.

Unit: 0.1 dB.

Valid values: -512, -311, 311 (special values) and -310...310 (-31 dBm to +31 dBm).

Reference: Clause 11.4.1.2.6 of [ITU-T G.9711].

7.11.6 Actual transmit PSD per subcarrier

7.11.6.1 Downstream actual transmit PSD per subcarrier (ACTPSD_{psds})

Description: Reports the transmit PSD per subcarrier delivered by the MTU-O at the U-O2 reference point during the PSF, as calculated by the vectoring control entity (VCE) from the downstream ACTPSDREF_{ps}. A special value indicates that: no transmit PSD value is available for the subcarrier; or its transmit power is zero; or is out of the range to be represented.

Type: Array of PSDdescriptor[0...N-1], where N is the number of the highest supported downstream data-bearing subcarriers as specified for the enabled profile (see Tables P-1 and Q-1 of [ITU-T G.9711]).

PSDdescriptor

Type: 8-bit unsigned integer.

Unit: -0.5 dBm/Hz.

Valid values: 0...254 (0 to -127 dBm/Hz) and 255 (special value).

Reference: Clause 11.4.1.2.5 of [ITU-T G.9711].

7.11.6.2 Upstream actual transmit PSD per subcarrier (ACTPSD_{psus})

Description: Reports the transmit PSD per subcarrier delivered by the MTU-R at the U-R2 reference point during the PSF, as calculated by the VCE from the upstream ACTPSDREF_{ps}. A special value indicates that no transmit PSD value is available for the subcarrier, or its transmit power is zero, or is out of the range to be represented.

Type: Array of PSDdescriptor[0...N-1], where N is the number of the highest supported upstream data-bearing subcarriers as specified for the enabled profile (see Tables P-1 and Q-1 of [ITU-T G.9711]).

PSDdescriptor: See ACTPSD_{psds} in clause 7.11.6.1.

Reference: Clause 11.4.1.2.5 of [ITU-T G.9711].

7.11.7 Channel characteristics function per subcarrier (HLOG)

7.11.7.1 Downstream HLOG measurement time (HLOGMT_{ds})

Description: Reports the number of symbols used to measure the downstream Hlog(*f*) values. The object is updated only in the L0 link state.

Type: 16-bit unsigned integer.

Unit: 1 symbol.

Valid values: 0...65535

Reference: Clause 11.4.1.2.1 of [ITU-T G.9711].

7.11.7.2 Downstream HLOG subcarrier group size (HLOGGds)

Description: Reports the number of subcarriers in any one subcarrier group used to represent the downstream $H_{\log}(f)$ values. The object is updated only in the L0 link state.

Type: 8-bit unsigned integer.

Unit: 1 subcarrier.

Valid values: 1, 2, 4, 8, 16, 32

Reference: Clause 11.4.1.2.1 of [ITU-T G.9711].

7.11.7.3 Downstream HLOG(f) (HLOGpsds)

Description: Reports the downstream $H_{\log}(f)$ as one value per subcarrier group. A first special value (1023) indicates that the $H_{\log}(f)$ for this subcarrier group is undetermined. A second special value (1022) indicates that no measurement could be done for this subcarrier group because it is out of the MEDLEY set. A third special value (0) indicates that the $H_{\log}(f)$ for this subcarrier group is greater than or equal to +6.0 dB. A fourth special value (1020) indicates that the $H_{\log}(f)$ for this subcarrier group is less than or equal to -96.0 dB. The object is updated only in the L0 link state.

Type: Array of HLOGdescriptor[0...N], where N is the number of the highest subcarrier index in the downstream MEDLEY set, divided by HLOGGds, rounded down to the nearest integer.

HLOGdescriptor

Type: 16-bit unsigned integer.

Unit: -0.1 dB.

Offset: 6 dB.

Valid values: 1...1019 (+5.9 to -95.9 dB) and 0,1020,1022,1023 (special values).

Reference: Clause 11.4.1.2.1 of [ITU-T G.9711].

7.11.7.4 Upstream HLOG measurement time (HLOGMTus)

Description: Reports the number of symbols used to measure the upstream $H_{\log}(f)$ values.

Type: 16-bit unsigned integer.

Unit: 1 symbol.

Valid values: 0...65535

Reference: Clause 11.4.1.2.1 of [ITU-T G.9711].

7.11.7.5 Upstream HLOG subcarrier group size (HLOGGus)

Description: Reports the number of subcarriers in any one subcarrier group used to represent the upstream $H_{\log}(f)$ values.

Type: 8-bit unsigned integer.

Unit: 1 subcarrier.

Valid values: 1, 2, 4, 8, 16, 32.

Reference: Clause 11.4.1.2.1 of [ITU-T G.9711].

7.11.7.6 Upstream Hlog(*f*) (HLOGpsus)

Description: Reports the upstream Hlog(*f*) as one value per subcarrier group. The same special values as for the HLOGpsds are specified. The object is updated only in the L0 link state.

Type: Array of HLOGdescriptor[0...N], where N is the number of the highest subcarrier index in the upstream MEDLEY set, divided by HLOGGus, rounded down to the nearest integer.

HLOGdescriptor

Type: 16-bit unsigned integer.

Unit: −0.1 dB.

Offset: 6 dB.

Valid values: 1...1019 (+5.9 to −95.9 dB) and 0,1020,1022,1023 (special values).

Reference: Clause 11.4.1.2.1 of [ITU-T G.9711].

7.11.8 Signal-to-noise ratio per subcarrier

7.11.8.1 Downstream signal-to-noise ratio PSD measurement time (SNRMTds)

Description: Reports the number of symbols used to measure the downstream SNR(*f*) values during both the PSF and the non-priority sub-frame (NPSF).

Type: 16-bit unsigned integer.

Unit: 1 symbol.

Valid values: 0...65535

Reference: Clause 11.4.1.2.2 of [ITU-T G.9711].

7.11.8.2 Downstream SNR(*f*) subcarrier group size (SNRGds)

Description: Reports the number of subcarriers in any one subcarrier group used to represent the downstream SNR(*f*) values during both the PSF and the NPSF.

Type: 8-bit unsigned integer.

Unit: 1 subcarrier.

Valid values: 1, 2, 4, 8, 16, 32.

Reference: Clause 11.4.1.2.2 of [ITU-T G.9711].

NOTE – As per [ITU-T G.9711], the MTU-R reports the SNR on all subcarriers (*G*=1), while the DPU-MIB reported values, SNRpsds, depend on the SNRGds value (i.e., 1, 2, 4, 8, 16 and 32).

7.11.8.3 Downstream SNR(*f*) during the PSF (SNRpsds)

Description: Reports the downstream SNR(*f*) values during the PSF. A special value indicates the cases defined in clause 11.4.1.2.2 of [ITU-T G.9711].

Type: Array of SNRdescriptor[0...N], where N is the number of the highest supported downstream data-bearing subcarriers as specified for the enabled profile (see Tables P-1 and Q-1 of [ITU-T G.9711]), divided by SNRGds, rounded down to the nearest integer.

SNRdescriptor

Type: 8-bit unsigned integer.

Unit: 0.5 dB.

Offset: −32 dB.

Valid values: 0...254 (−32 to 95 dB) and 255 (special value).

Reference: Clause 11.4.1.2.2 of [ITU-T G.9711].

7.11.8.4 Downstream SNR(*f*) during the NPSF (SNRNPSFpsds)

Description: Reports the downstream SNR(*f*) values during the NPSF. A special value indicates the cases defined in clause 11.4.1.2.2 of [ITU-T G.9711].

Type: Array of SNRdescriptor[0...N], where N is the number of the highest supported downstream data-bearing subcarriers as specified for the enabled profile (see Tables P-1 and Q-1 of [ITU-T G.9711]), divided by SNRGds, rounded down to the nearest integer.

SNRdescriptor: See SNRpsds in clause 7.11.8.3.

Reference: Clause 11.4.1.2.2 of [ITU-T G.9711].

7.11.8.5 Upstream signal-to-noise ratio PSD measurement time (SNRMTus)

Description: Reports the number of symbols used to measure the upstream SNR(*f*) values during both the PSF and the NPSF.

Type: 16-bit unsigned integer.

Unit: 1 symbol.

Valid values: 0...65535 (0 to $2^{16} - 1$ symbols).

Reference: Clause 11.4.1.2.2 of [ITU-T G.9711].

7.11.8.6 Upstream SNR(*f*) subcarrier group size (SNRGus)

Description: Reports the number of subcarriers in any one subcarrier group used to represent the upstream SNR(*f*) values during both the PSF and the NPSF.

Type: 8-bit unsigned integer.

Unit: 1 subcarrier.

Valid values: 1, 2, 4, 8, 16, 32.

Reference: Clause 11.4.1.2.2 of [ITU-T G.9711].

NOTE – As per [ITU-T G.9711], the MTU-O reports the SNR on all subcarriers ($G=1$), while the DPU-MIB reported values, SNRpsus, depend on the SNRGus value (i.e., 1, 2, 4, 8, 16 and 32).

7.11.8.7 Upstream SNR(*f*) during the PSF (SNRpsus)

Description: Reports the upstream SNR(*f*) values during the PSF. A special value indicates the cases defined in clause 11.4.1.2.2 of [ITU-T G.9711].

Type: Array of SNRdescriptor[0...N], where N is the number of the highest supported upstream data-bearing subcarriers as specified for the enabled profile (see Tables P-1 and Q-1 of [ITU-T G.9711]), divided by SNRGus, rounded down to the nearest integer.

SNRdescriptor: See SNRpsds in clause 7.11.8.3.

Reference: Clause 11.4.1.2.2 of [ITU-T G.9711].

7.11.8.8 Upstream SNR(*f*) during the NPSF (SNRNPSFpsus)

Description: Reports the upstream SNR(*f*) values during the NPSF. A special value indicates the cases defined in clause 11.4.1.2.2 of [ITU-T G.9711].

Type: Array of SNRdescriptor[0...N], where N is the number of the highest supported upstream data-bearing subcarriers as specified for the enabled profile (see Tables P-1 and Q-1 of [ITU-T G.9711]), divided by SNRGus, rounded down to the nearest integer.

SNRdescriptor: See SNRpsds in clause 7.11.8.3.

Reference: Clause 11.4.1.2.2 of [ITU-T G.9711].

7.11.9 Quiet line noise PSD per subcarrier (QLN)

7.11.9.1 Downstream QLN measurement time (QLNMTds)

Description: Reports the number of symbols used to measure the downstream QLN(*f*) values. The object is updated only in the L0 link state.

Type: 16-bit unsigned integer.

Unit: 1 symbol.

Valid values: 0...65535.

Reference: Clause 11.4.1.2.3 of [ITU-T G.9711].

7.11.9.2 Downstream QLN subcarrier group size (QLNGds)

Description: Reports the number of subcarriers in any one subcarrier group used to represent the downstream QLN(*f*) values. The object is updated only in the L0 link state.

Type: 8-bit unsigned integer.

Unit: 1 subcarrier.

Valid values: 1, 2, 4, 8, 16, 32.

Reference: Clause 11.4.1.2.3 of [ITU-T G.9711].

7.11.9.3 Downstream QLN(*f*) (QLNpsds)

Description: Reports the downstream QLN(*f*) as one value per subcarrier group. A first special value (255) indicates that the QLN(*f*) for this subcarrier group is undetermined. A second special value (254) indicates that no measurement could be done for this subcarrier group because it is out of the downstream MEDLEY set. A third special value (0) indicates that the QLN(*f*) for this subcarrier group is greater than or equal to -35dBm/Hz . A fourth special value (251) indicates that the QLN(*f*) for this subcarrier group is less than or equal to -160.5 dBm/Hz . The object is updated only in the L0 link state.

Type: Array of QLNdescriptor[0...N], where N is the number of the highest subcarrier index in the downstream MEDLEY set, divided by QLNGds, rounded down to the nearest integer.

QLNdescriptor

Type: 8-bit unsigned integer.

Unit: -0.5 dBm/Hz .

Offset: -35 dBm/Hz .

Valid values: 1..250 (-35.5 to -160 dBm/Hz), 0, 251, 254, 255 (special values).

Reference: Clause 11.4.1.2.3 of [ITU-T G.9711].

7.11.9.4 Upstream QLN measurement time (QLNMTus)

Description: Reports the number of symbols used to measure the upstream QLN(*f*) values. The object is updated only in the L0 link state.

Type: 16-bit unsigned integer.

Unit: 1 symbol.

Valid values: 0...65535.

Reference: Clause 11.4.1.2.3 of [ITU-T G.9711].

7.11.9.5 Upstream QLN subcarrier group size (QLNGus)

Description: Reports the number of subcarriers in any one subcarrier group used to represent the upstream QLN(f) values. The object is updated only in the L0 link state.

Type: 8-bit unsigned integer.

Unit: 1 subcarrier.

Valid values: 1, 2, 4, 8, 16, 32.

Reference: Clause 11.4.1.2.3 of [ITU-T G.9711].

7.11.9.6 Upstream QLN(f) (QLNpsus)

Description: Reports the upstream quiet line noise PSD QLN(f) as one value per subcarrier group. The same special values as for the QLNpsds are defined. The object is updated only in the L0 link state.

Type: Array of QLNdescriptor[0...N]. If the object is updated in the L0 link state, N is the number of the highest subcarriers in the upstream MEDLEY set (Θ), divided by QLNGus, rounded down to the nearest integer.

QLNdescriptor: See clause 7.11.9.3.

Reference: Clause 11.4.1.2.3 of [ITU-T G.9711].

7.11.10 Active line noise PSD per subcarrier (ALN)

7.11.10.1 ALN measurement time (ALNMT)

Description: Reports the number of symbols used to measure the ALN(f) values. The object is updated only in the L0 link state.

Type: 16-bit unsigned integer.

Unit: 1 symbol.

Valid values: 0...65535

Reference: Clause 11.4.1.2.4 of [ITU-T G.9711].

7.11.10.2 ALN subcarrier group size (ALNG)

Description: Reports the number of subcarriers in any one subcarrier group used to represent the ALN(f) values. The object is updated only in the L0 link state.

Type: 8-bit unsigned integer.

Unit: 1 subcarrier.

Valid values: 1, 2, 4, 8, 16, 32.

Reference: Clause 11.4.1.2.4 of [ITU-T G.9711].

7.11.10.3 ALN(f) (ALNps)

Description: Reports the ALN(f). A first special value (255) indicates that the ALN(f) for this subcarrier is undetermined. A second special value (254) indicates that no measurement could be done for this subcarrier because it is out of the downstream MEDLEY set. A third special value (0) indicates that the ALN(f) for this subcarrier is greater than or equal to -35dBm/Hz . A fourth special value (251) indicates that the ALN(f) for this subcarrier is less than or equal to -160.5 dBm/Hz . The object is updated only in the L0 link state.

Type: Array of ALNdescriptor[0...N], where N is the number of highest subcarrier index in the downstream MEDLEY set, divided by ALNG, rounded down to the nearest integer.

ALNdescriptor

Type: 8-bit unsigned integer.

Unit: −0.5 dBm/Hz.

Offset: −35 dBm/Hz.

Valid values: 1..250 (−35.5 to −160 dBm/Hz), 0, 251, 254 and 255 (special values).

Reference: Clause 11.4.1.2.4 of [ITU-T G.9711].

7.11.11 Bit allocation per subcarrier on data symbols

7.11.11.1 Downstream bits allocation during the PSF (BITSpsds)

Description: Reports the bit allocation values on data symbols in the NOI of the PSF in the downstream direction for both band 0 and band 1. This parameter reports the b_i values in the case of TCM, and the modulation index values, m_i , in case of PCS-LCM.

Type: Array of BITSdescriptor[0...N−1], where N is the number of the highest supported downstream data-bearing subcarriers as specified for the enabled profile (see Tables P-1 and Q-1 of [ITU-T G.9711]) plus one.

BITSdescriptor

Type: 8-bit unsigned integer.

Unit: 1 bit.

Valid values: 0...15.

Reference: Clause 11.4.1.1.15 of [ITU-T G.9711].

7.11.11.2 Downstream bits allocation during the NPSF (BITSNPSFpsds)

Description: Reports the bit allocation values on data symbols in the NOI of the NPSF in the downstream direction for both band 0 and band 1. This parameter reports the b_i values in case of TCM, and the modulation index values, m_i , in case of PCS-LCM.

Type: Array of BITSdescriptor[0...N−1], where N is the number of the highest supported downstream data-bearing subcarriers as specified for the enabled profile (see Tables P-1 and Q-1 of [ITU-T G.9711]) plus one.

BITSdescriptor: See BITSpsds in clause 7.11.11.1.

Reference: Clause 11.4.1.1.15 of [ITU-T G.9711].

7.11.11.3 Upstream bits allocation during the PSF (BITSpsus)

Description: Reports the bit allocation values on data symbols in the NOI of the PSF in the upstream direction for both band 0 and band 1. This parameter reports the b_i values in the case of TCM, and the modulation index values, m_i , in the case of PCS-LCM.

Type: Array of BITSdescriptor[0...N−1], where N is the number of the highest supported upstream data-bearing subcarriers as specified for the enabled profile (see Tables P-1 and Q-1 of [ITU-T G.9711]) plus one.

BITSdescriptor: See BITSpsds in clause 7.11.11.1.

Reference: Clause 11.4.1.1.15 of [ITU-T G.9711].

7.11.11.4 Upstream bits allocation during the NPSF (BITSNPSFpsus)

Description: Reports the bit allocation values on data symbols in the NOI of the NPSF in the upstream direction for both band 0 and band 1. This parameter reports the b_i values in the case of TCM, and the modulation index values, m_i , in the case of PCS-LCM.

Type: Array of BITSdescriptor[0...N-1], where N is the number of the highest supported upstream data-bearing subcarriers as specified for the enabled profile (see Tables P-1 and Q-1 of [ITU-T G.9711]) plus one.

BITSdescriptor: See BITSpsds in clause 7.11.11.1.

Reference: Clause 11.4.1.1.15 of [ITU-T G.9711].

7.11.12 Robust management channel

7.11.12.1 Downstream signal-to-noise ratio margin for RMC (SNRM-RMCds)

Description: Reports the SNRM (as specified in clause 11.4.1.1.11 of [ITU-T G.9711]) for the RMC in the downstream direction during the L0 link state. A first special value (-512) indicates that the SNRM is undetermined. A second special value (-511) indicates that the SNRM is less than or equal to -51.1 dB. A third special value (+511) indicates that the SNRM is greater than or equal to +51.1 dB.

Type: 16-bit signed integer.

Unit: 0.1 dB.

Valid values: -512, -511, +511 (special values) and -510...+510 (-51.0 dB to +51.0 dB).

Reference: Clause 11.4.1.1.11 of [ITU-T G.9711].

7.11.12.2 Upstream signal-to-noise ratio margin for RMC (SNRM-RMCus)

Description: Reports the SNRM (as specified in clause 11.4.1.1.11 of [ITU-T G.9711]) for the RMC in the upstream direction during the L0 link state. The same special values as for SNRM-RMCds are specified.

Type: 16-bit signed integer.

Unit: 0.1 dB.

Valid values: -512, -511, +511 (special values) and -510...+510 (-51.0 dB to +51.0 dB).

Reference: Clause 11.4.1.1.11 of [ITU-T G.9711].

7.11.12.3 Downstream bits allocation for RMC (BITS-RMCpsds)

Description: Reports the bit allocation values on RMC subcarriers in RMC symbols in the downstream direction. This parameter reports the b_i values in the case of TCM, and the modulation index values, m_i , in the case of PCS-LCM.

Type: Array of BITSRMCdescriptor[0...N-1], where $N \leq 512$.

BITS-RMCdescriptor

Type: Record of a subcarrier index and a bit allocation value.

Sub-carrier index

Type: 16-bit unsigned integer.

Valid values: 0...16383 (subcarrier index 0 to 16383).

Bit allocation value

Type: 8-bit unsigned integer.

Unit: 1 bit.

Valid values: 0...6.

Reference: Clause 11.4.1.1.16 of [ITU-T G.9711].

7.11.12.4 Upstream bits allocation for RMC (BITS-RMCpsus)

Description: Reports the bit allocation values on RMC subcarriers in RMC symbols in the upstream direction. This parameter reports the b_i values in the case of TCM, and the modulation values, m_i , in the case of PCS-LCM.

Type: Array of BITSRMCdescriptor[0...N-1], where N is the number of the highest supported upstream data-bearing subcarriers as specified for the enabled profile (see Tables P-1 and Q-1 of [ITU-T G.9711]) plus one.

BITSRMCdescriptor: See BITS-RMCpsds in clause 7.11.12.3.

Reference: Clause 11.4.1.1.16 of [ITU-T G.9711].

7.11.13 Test parameter time stamps

7.11.13.1 Date and time stamping of near-end test parameter group 1 (STAMP-TEST-NE-G1)

Description: Reports the date and time when the near-end test parameter group 1 that can change during showtime was last updated.

Type: String (as specified in clause 8.12).

Reference: Clause 11.1 of [ITU-T G.9711].

7.11.13.2 Date and time stamping of far-end test parameter group 1 (STAMP-TEST-FE-G1)

Description: Reports the date and time when the FE test parameter group 1 that can change during showtime was last updated.

Type: String (as specified in clause 8.12).

Reference: Clause 11.1 of [ITU-T G.9711].

7.11.13.3 Date and time stamping of near-end test parameter group 2 (STAMP-TEST-NE-G2)

Description: Reports the date and time when the near-end test parameter group 2 that can change during showtime was last updated.

Type: String (as specified in clause 8.12).

Reference: Clause 11.1 of [ITU-T G.9711].

7.11.13.4 Date and time stamping of far-end test parameter group 2 (STAMP-TEST-FE-G2)

Description: Reports the date and time when the FE test parameter group 2 that can change during showtime was last updated.

Type: String (as specified in clause 8.12).

Reference: Clause 11.1 of [ITU-T G.9711].

7.11.14 On-line reconfiguration (OLR) or FRA time stamps

7.11.14.1 Date and time stamping of last successful downstream bit swap operation (STAMP-BSWds)

Description: Reports the date and time of the last successful MTU-R initiated bit swap execution that has modified the bits allocation.

Type: String (as specified in clause 8.12).

Reference: Clause 11.2.2.5 of [ITU-T G.9711].

7.11.14.2 Date and time stamping of last successful upstream bit swap operation (STAMP-BSWus)

Description: Reports the date and time of the last successful MTU-O initiated bit swap execution that has modified the bits allocation.

Type: String (as specified in clause 8.12).

Reference: Clause 11.2.2.5 of [ITU-T G.9711].

7.11.14.3 Date and time stamping of last successful downstream autonomous SRA operation (STAMP-SRAds-)

Description: Reports the date and time of the last successful MTU-R initiated autonomous SRA execution (excluding SRAs in response to TIGA) that has modified the bits allocation.

Type: String (as specified in clause 8.12).

Reference: Clause 11.2.2.5 of [ITU-T G.9711].

7.11.14.4 Date and time stamping of last successful upstream autonomous SRA operation (STAMP-SRAus-)

Description: Reports the date and time of the last successful MTU-O initiated autonomous SRA execution that has modified the bits allocation.

Type: String (as specified in clause 8.12).

Reference: Clause 11.2.2.5 of [ITU-T G.9711].

7.11.14.5 Date and time stamping of last successful downstream FRA operation (STAMP-FRAds-)

Description: Reports the date and time of the last successful MTU-R initiated FRA execution that has modified the bits allocation.

Type: String (as specified in clause 8.12).

Reference: Clause 13.3.1.1 of [ITU-T G.9711].

7.11.14.6 Date and time stamping of last successful upstream FRA operation (STAMP-FRAus-)

Description: Reports the date and time of the last successful MTU-O initiated FRA execution that has modified the bits allocation.

Type: String (as specified in clause 8.12).

Reference: Clause 13.3.1.1 of [ITU-T G.9711].

7.11.14.7 Date and time stamping of last successful downstream RPA operation (STAMP-RPAds)

Description: Reports the date and time of the last successful MTU-R initiated RPA execution that has modified the bits allocation for the RMC.

Type: String (as specified in clause 8.12).

Reference: Clause 11.2.2.5 of [ITU-T G.9711].

7.11.14.8 Date and time stamping of last successful upstream RPA operation (STAMP-RPAus)

Description: Reports the date and time of the last successful MTU-O initiated RPA execution that has modified the bits allocation for the RMC.

Type: String (as specified in clause 8.12).

Reference: Clause 11.2.2.5 of [ITU-T G.9711].

7.11.14.9 Date and time stamping of last successful downstream TIGA operation (STAMP-TIGA)

Description: Reports the date and time of the last successful MTU-O initiated TIGA execution.

Type: String (as specified in clause 8.12).

Reference: Clause 11.2.2.5 of [ITU-T G.9711].

7.11.14.10 Date and time stamping of last successful SREC operation (STAMP-SREC)

Description: Reports the date and time of the last occurrence of the successful SREC (*success_srec*) primitive.

Type: String (as specified in clause 8.12).

Reference: Clause 13.2.1.5.3 of [ITU-T G.9711].

7.11.14.11 Date and time stamping of last successful downstream RMCR operation (STAMP-RMCRds)

Description: Reports the date and time of the last successful MTU-R initiated RMCR execution that has modified RMC tone allocation.

Type: String (as specified in clause 8.12).

Reference: Clause 13.3.1.2 of [ITU-T G.9711].

7.11.14.12 Date and time stamping of last successful upstream RMCR operation (STAMP-RMCRus)

Description: Reports the date and time of the last successful MTU-O initiated RMCR execution that has modified the RMC tones allocation.

Type: String (as specified in clause 8.12).

Reference: Clause 13.3.1.2 of [ITU-T G.9711].

7.11.15 Signal attenuation (SATN)

7.11.15.1 Downstream signal attenuation (SATNds)

Description: Reports the downstream SATN. A special value (1023) indicates that the value is undetermined. A second special value (0) indicates that the SATN is less than or equal to 0 dB. A third special value (1001) indicates that the SATN is greater than or equal to 100.1dB. The object is updated only in the L0 link state.

Type: 16-bit signed integer.

Unit: 0.1 dB.

Valid values: 1...1000 (0.1 dB to +100.0 dB), 0, 1001 and 1023 (special values).

Reference: Clause 11.4.1.2.7.1 of [ITU-T G.9711].

7.11.15.2 Upstream signal attenuation (SATNus)

Description: Reports the upstream SATN. The same special values as for SATNds are specified. The object is updated only in the L0 link state.

Type: 16-bit signed integer.

Unit: 0.1 dB.

Valid values: 0...1000 (0 dB to +100.0 dB) 0, 1001, 1023 (special values).

Reference: Clause 11.4.1.2.7.2 of [ITU-T G.9711].

7.11.16 Vectoring

7.11.16.1 Crosstalk disturber index (XTALKDIST)

Description: Reports the VCE_port_index of the disturber link to which the XLOGpsds and ANEXTds/us values apply. A special value 0 indicates that the requested VCE_port_index (XTALKDREQ) is invalid.

Type: 16-bit unsigned integer.

Valid values: 0 (special value) and 1...65535.

Reference: Clause 11.4.3.3 of [ITU-T G.9711].

7.11.16.2 Downstream XLOG bandedges (XLOGBANDSds)

Description: Reports the set of subcarriers for which XLOGpsds is reported. For each band in which XLOGpsds is reported, XLOGBANDSds contains a triplet of (start_subcarrier_index, stop_subcarrier_index, group size). The XLOGpsds is reported for all subcarriers in the band (start and stop subcarrier inclusive) with index equal to start_subcarrier_index+m*group_size, where m is an integer. The object is updated only in the L0 link state.

Type: Array of XTALKBANDSdescriptor[0...N-1], with $1 \leq N \leq 8$ or empty if XTALKDIST=0

XTALKBANDSdescriptor

Type: Record of a start subcarrier index, a stop subcarrier index and a group size.

Start subcarrier index

Type: 16-bit unsigned integer.

Valid values: 0...16383 (subcarrier index 0 to 16383).

Stop subcarrier index

Type: 16-bit unsigned integer.

Valid values: 0...16383 (subcarrier index 0 to 16383).

Group size

Type: 8-bit unsigned integer.

Valid values: 1, 2, 4, 8, 16, 32, 64.

Reference: Clause 11.4.1.2.9 of [ITU-T G.9711].

7.11.16.3 Downstream FEXT coupling per subcarrier (XLOGpsds)

Description: Reports the downstream $Xlog(f)$ as one value per subcarrier group. A first special value (255) indicates that the $Xlog(f)$ for this subcarrier group is undetermined. A second special value (254) indicates that no measurement could be done for this subcarrier group. A third special value (0) indicates that the $Xlog(f)$ for this subcarrier group is greater than or equal to +40.0 dB. A fourth special value (251) indicates that the $Xlog(f)$ for this subcarrier group is less than or equal to –85.5 dB. The object is updated only in the L0 link state.

Type: Array of XLOGdescriptor[0...N–1], with $1 \leq N \leq 512$ or empty if XTALKDIST=0.

XLOGdescriptor

Type: 8-bit unsigned integer.

Unit: –0.5 dB.

Offset: 40 dB.

Valid values: 1...250 (39.5 to –85 dB) 0, 251, 254 and 255 (special values).

Reference: Clause 11.4.1.2.9 of [ITU-T G.9711].

7.11.16.4 Average NEXT bandedges (ANEXTBANDSds/us)

Description: Reports the set of subcarriers over which ANEXT is computed, represented as an array of triplets (start_subcarrier_index, stop_subcarrier_index, group size) in increasing frequency order. The reported bands shall not intersect.

Type: Array of ANEXTBANDSdescriptor[0...N–1], with $1 \leq N \leq 8$ or empty if XTALKDIST=0.

ANEXTBANDSdescriptor

See XTALKBANDSdescriptor in Clause 7.11.16.2, with:

Group size

Valid values: 16 (for 424 MHz profiles).

Reference: Clause 11.4.1.2.10.3 of [ITU-T G.9711].

7.11.16.5 Number of subcarriers for NEXT averaging (ANEXTNCALCSETds/us)

Description: Reports the number of subcarriers over which the NEXT is averaged.

Type: 16-bit unsigned integer.

Valid values: 0...512.

Reference: Clause 11.4.1.2.10.3 of [ITU-T G.9711].

7.11.16.6 Average NEXT coupling (ANEXTds/us)

Description: Reports the value of the ANEXT as one average value over a number of subcarriers (reported as ANEXTNCALCSET) in a frequency band (reported as ANEXTBANDS). The ANEXTds relates to the MTU-R end of the line. The ANEXTus relates to the MTU-O end of the line. Several special values are defined:

- A first special value (255) indicates that the parameter is undetermined.
- A second special value (254) indicates that no measurement could be done from the disturber link identified with XTALKDREQ into the current link.
- A third special value (0) indicates a value of ANEXTds of 40 dB or higher.
- A fourth special value (251) indicates a value of ANEXTds of –85.5 dB or lower. The object is updated only in the L0 link state.

Type: Single value of type XLOGDESCRIPTOR (see clause 7.11.16.3).

Reference: Clause 11.4.1.2.10.3 of [ITU-T G.9711].

7.11.17 Actual PMD forward error correction scheme (ACTPMDFECSCHEME_{ds/us})

Description: Reports the actual PMD forward error correction scheme in use in a particular direction.

Type: Enumeration.

Valid values: 0, 1.

- 0) pcs-lcm: PMD FEC scheme in use is PCS-LCM;
- 1) tcm: PMD FEC scheme in use is TCM.

Reference: Clause 12.3.4.2.3 of [ITU-T G.9711].

7.11.18 Actual PDX framing mode (ACTPDXFRAMINGMODE)

Description: Reports the actual PDX framing mode in use.

Type: Enumeration.

Valid values: 0, 1, 2, 3.

- 0) fdxc: FDXC framing mode.
- 1) tdd : TDD framing mode.
- 2) fdxz: FDXZ framing mode.
- 3) tddz: TDDZ framing mode.

Reference: Clause 10.5 of [ITU-T G.9711].

7.12 Channel test, diagnostics and status objects

7.12.1 Actual data rates

7.12.1.1 Net data rate (NDR_{ds/us})

Description: Reports the NDR as specified in clause 11.4.1.1.1 of [ITU-T G.9711]. A special value ($2^{32} - 1$) indicates that the NDR is undetermined. The object is updated only in the L0 link state.

Type: 32-bit unsigned integer.

Unit: 1000 bits/s.

Valid values: 0...4294967294 (0 to $2^{32} - 2$ kbit/s) and 4294967295 ($2^{32} - 1$ special value).

Reference: Clause 11.4.1.1.1 of [ITU-T G.9711].

7.12.1.2 Net data rate with DTFO disabled (NDR0_{ds/us})

Description: Reports the NDR0 as specified in clause 11.4.1.1.1 of [ITU-T G.9711]. A special value ($2^{32} - 1$) indicates that the NDR0 is undetermined. The object is updated only in the L0 link state.

Type: 32-bit unsigned integer.

Unit: 1000 bits/s.

Valid values: 0...4294967294 (0 to $2^{32} - 2$ kbit/s) and 4294967295 ($2^{32} - 1$ special value).

Reference: Clause 11.4.1.1.1 of [ITU-T G.9711].

7.12.1.3 Expected throughput (ETR_{ds/us})

Description: Reports the expected throughput as specified in clause 11.4.1.1.3 of [ITU-T G.9711]. A special value ($2^{32} - 1$) indicates that the ETR is undetermined. The object is updated only in the L0 link state.

Type: 32-bit unsigned integer.

Unit: 1000 bits/s.

Valid values: 0...4294967294 (0 to $2^{32} - 2$ kbit/s) and 4294967295 ($2^{32} - 1$ special value).

Reference: Clause 11.4.1.1.3 of [ITU-T G.9711].

7.12.1.4 Expected throughput with DTFO disabled (ETR0ds/us)

Description: Reports the expected throughput with DTFO disabled (ETR0) as specified in clause 11.4.1.1.3 of [ITU-T G.9711]. A special value ($2^{32} - 1$) indicates that the ETR0 is undetermined. The object is updated only in the L0 link state.

Type: 32-bit unsigned integer.

Unit: 1000 bits/s.

Valid values: 0...4294967294 (0 to $2^{32} - 2$ kbit/s) and 4294967295 ($2^{32} - 1$ special value).

Reference: Clause 11.4.1.1.3 of [ITU-T G.9711].

7.12.1.5 Gamma data rate (GDRds/us)

Description: Reports the NDR as specified in clause 7.12.1.1, lowered by any throughput capability limitations remaining in the DRA or layer 2 and above (L2+) functions, assuming no user data is transmitted over all the other links. A special value ($2^{32} - 1$) indicates that the GDR is undetermined. The object is updated only in the L0 link state.

Type: 32-bit unsigned integer.

Unit: 1000 bits/s.

Valid values: 0...4294967294 (0 to $2^{32} - 2$ kbit/s) and 4294967295 ($2^{32} - 1$ special value).

Reference: None.

7.12.2 Attainable data rates

7.12.2.1 Attainable net data rate (ATTNDRds/us)

Description: Reports the attainable NDR as specified in clause 11.4.1.1.2 of [ITU-T G.9711]. A special value ($2^{32} - 1$) indicates that the attainable NDR is undetermined. The object is updated only in the L0 link state.

Type: 32-bit unsigned integer.

Unit: 1000 bits/s.

Valid values: 0...4294967294 (0 to $2^{32} - 1$ kbit/s) and 4294967295 ($2^{32} - 1$ special value).

Reference: Clause 11.4.1.1.2 of [ITU-T G.9711].

7.12.2.2 Attainable expected throughput (ATTETRds/us)

Description: Reports the attainable expected throughput as specified in clause 11.4.1.1.4 of [ITU-T G.9711]. A special value ($2^{32} - 1$) indicates that the attainable expected throughput is undetermined. The object is updated only in the L0 link state.

Type: 32-bit unsigned integer.

Unit: 1000 bits/s.

Valid values: 0...4294967294 (0 to $2^{32} - 2$ kbit/s) and 4294967295 ($2^{32} - 1$ special value).

Reference: Clause 11.4.1.1.4 of [ITU-T G.9711].

7.12.2.3 Attainable gamma data rate (ATTGDRds/us)

Description: Reports the attainable NDR (as specified in clause 7.12.2.1), lowered by any throughput capability limitations remaining in the DRA or L2+ functions, assuming no user data is transmitted over all the other links, and assuming MAXGDR (as specified in clause 7.3.1.3) is configured to its maximum valid value. A special value ($2^{32} - 1$) indicates that the attainable GDR is undetermined. The object is updated only in the L0 link state.

Type: 32-bit unsigned integer.

Unit: 1000 bits/s.

Valid values: 0...4294967294 (0 to $2^{32} - 2$ kbit/s) and 4294967295 ($2^{32} - 1$ special value).

Reference: None.

7.12.3 Actual impulse noise protection

7.12.3.1 Actual INP against SHINE (ACTINPds/us)

Description: Reports the actual INP against SHINE as specified in clause 11.4.1.1.7 of [ITU-T G.9711]. A special value indicates an actual INP against SHINE of 2047 symbols or higher.

Type: 16-bit unsigned integer.

Unit: 1 symbol.

Valid values: 0...2046 (0 to 2046 symbols) and 2047 (special value).

Reference: Clause 11.4.1.1.7 of [ITU-T G.9711].

7.12.3.2 Actual INP against REIN (ACTINP_REINds/us)

Description: Reports the actual impulse noise protection (INP) against REIN as specified in clause 11.4.1.1.8 of [ITU-T G.9711]. A special value indicates an actual INP against REIN of 63 symbols or higher.

Type: 8-bit unsigned integer.

Unit: 1 symbol.

Valid values: 0...62 (0 to 62 symbols) and 63 (special value).

Reference: Clause 11.4.1.1.8 of [ITU-T G.9711].

7.12.4 Actual framer settings

7.12.4.1 DTU FEC codeword length (DTU-NFECds/us)

Description: Reports the DTU FEC codeword length as specified in clause 9.3 of [ITU-T G.9711].

Type: 8-bit unsigned integer.

Unit: 1 byte.

Valid values: 32...255 (32 to 255 bytes).

Reference: Clause 9.3 of [ITU-T G.9711].

7.12.4.2 DTU FEC redundancy (DTU-RFECds/us)

Description: Reports the DTU FEC codeword redundancy as specified in clause 9.3 of [ITU-T G.9711].

Type: 8-bit unsigned integer.

Unit: 1 byte.

Valid values: 2, 4, 6, 8, 10, 12, 16 (2, 4, 6, 8, 10, 12, 16 bytes).

Reference: Clause 9.3 of [ITU-T G.9711].

7.12.4.3 Number of FEC codewords per DTU (DTU-Qds/us)

Description: Reports the number of FEC codewords per DTU as specified in clause 9.3 of [ITU-T G.9711].

Type: 8-bit unsigned integer.

Valid values: 1...16.

Reference: Clause 9.3 of [ITU-T G.9711].

7.12.5 Test parameters per time interval

7.12.5.1 Error-free bits current 15 min (EFB-C15Mds/us)

Description: Reports the number of error-free bits (see clause 11.4.1.1.6 of [ITU-T G.9711]) passed over the alpha reference point at the receiver, divided by 65536, in the current 15 min interval.

Type: 32-bit unsigned integer.

Unit: 65536 bits.

Valid values: 0...4294967295 (0 to $2^{16} \times (2^{32} - 1)$ bits).

Reference: Clause 11.4.1.1.6 of [ITU-T G.9711].

7.12.5.2 Error-free bits previous 15 min (EFB-P15Mds/us)

Description: Reports the number of error-free bits (see clause 11.4.1.1.6 of [ITU-T G.9711]) passed over the alpha reference point at the receiver, divided by 65536, in the previous 15 min interval.

Type: 32-bit unsigned integer.

Unit: 65536 bits.

Valid values: 0...4294967295 (0 to $2^{16} \times (2^{32} - 1)$ bits).

Reference: Clause 11.4.1.1.6 of [ITU-T G.9711].

7.12.5.3 Error-free bits current 24 h (EFB-C24Hds/us)

Description: Reports the number of error-free bits (see clause 11.4.1.1.6 of [ITU-T G.9711]) passed over the alpha reference point at the receiver, divided by 65536, in the current 24 h interval.

Type: 32-bit unsigned integer.

Unit: 65536 bits.

Valid values: 0...4294967295 (0 to $2^{16} \times (2^{32} - 1)$ bits).

Reference: Clause 11.4.1.1.6 of [ITU-T G.9711].

7.12.5.4 Error-free bits previous 24 hours (EFB-P24Hds/us)

Description: Reports the number of error-free bits (see clause 11.4.1.1.6 of [ITU-T G.9711]) passed over the alpha reference point at the receiver, divided by 65536, in the previous 24 h interval.

Type: 32-bit unsigned integer.

Unit: 65536 bits.

Valid values: 0...4294967295 (0 to $2^{16} \times (2^{32} - 1)$ bits).

Reference: Clause 11.4.1.1.6 of [ITU-T G.9711].

7.12.5.5 Minimum error-free throughput current 15 min (MINEFTR-C15Mds/us)

Description: Reports the minimum error-free throughput (see clause 11.4.1.1.3 of [ITU-T G.9711]) over the current 15 min interval.

Type: 32-bit unsigned integer.

Unit: 1000 bits/s.

Valid values: 0...4294967295 (0 to $2^{32} - 1$ kbit/s).

Reference: Clause 11.4.1.1.3 of [ITU-T G.9711].

7.12.5.6 Minimum error-free throughput previous 15 min (MINEFTR-P15Mds/us)

Description: Reports the minimum error-free throughput (see clause 11.4.1.1.3 of [ITU-T G.9711]) over the previous 15 min interval.

Type: 32-bit unsigned integer.

Unit: 1000 bits/s.

Valid values: 0...4294967295 (0 to $2^{32} - 1$ kbit/s).

Reference: Clause 11.4.1.1.3 of [ITU-T G.9711].

7.12.5.7 Minimum error-free throughput current 24 h (MINEFTR-C24Hds/us)

Description: Reports the minimum error-free throughput (see clause 11.4.1.1.3 of [ITU-T G.9711]) over the current 24 h interval.

Type: 32-bit unsigned integer.

Unit: 1000 bits/s.

Valid values: 0...4294967295 (0 to $2^{32} - 1$ kbit/s).

Reference: Clause 11.4.1.1.3 of [ITU-T G.9711].

7.12.5.8 Minimum error-free throughput previous 24 h (MINEFTR-P24Hds/us)

Description: Reports the minimum error-free throughput (see clause 11.4.1.1.3 of [ITU-T G.9711]) over the previous 24 h interval.

Type: 32-bit unsigned integer.

Unit: 1000 bits/s.

Valid values: 0...4294967295 (0 to $2^{32} - 1$ kbit/s).

Reference: Clause 11.4.1.1.3 of [ITU-T G.9711].

7.13 Data path test, diagnostics and status objects

No data path test, diagnostics and status objects are specified.

7.14 Inventory objects

7.14.1 MTU related inventory

7.14.1.1 MTU-O ITU-T G.994.1 vendor ID (MTUO_GHS_VENDOR)

Description: Reports the MTU-O ITU-T G.994.1 vendor identifier (ID) as inserted by the MTU-O in the ITU-T G.994.1 CL message and as specified in clause 9.3.3.1 of [ITU-T G.994.1].

Type: String (8 binary octets).

Reference: Clause 9.3.3.1 of [ITU-T G.994.1].

7.14.1.2 MTU-R ITU-T G.994.1 vendor ID (MTUR_GHS_VENDOR)

Description: Reports the MTU-R ITU-T G.994.1 vendor ID as inserted by the MTU-R in the ITU-T G.994.1 CLR message and as specified in clause 9.3.3.1 of [ITU-T G.994.1].

Type: String (8 binary octets).

Reference: Clause 9.3.3.1 of [ITU-T G.994.1].

7.14.1.3 MTU-O version number (MTUO_VERSION)

Description: Reports the MTU-O version number as inserted by the MTU-O in the eoc (see clause 11.2.2.10 of [ITU-T G.9711]). It is for version control and is vendor specific information.

Type: String (up to 16 binary octets).

Reference: Clause 11.2.2.10 of [ITU-T G.9711].

7.14.1.4 MTU-R version number (MTUR_VERSION)

Description: Reports the MTU-R version number as inserted by the MTU-R in the eoc (see clause 11.2.2.10 of [ITU-T G.9711]). It is for version control. It shall contain the MTU-R firmware version and the MTU-R model. Both shall be encoded in this order and separated by a space character, i.e., "<MTU-R firmware version><space><MTU-R model>".

Type: String (up to 16 ASCII characters).

Reference: Clause 11.2.2.10 of [ITU-T G.9711].

7.14.1.5 MTU-O self-test result (MTUO_SELFTEST)

Description: Reports the results from the most recent self-test procedure, initiated at power-up (see clause 12.1.2 of [ITU-T G.9711]). The first octet of the self-test result is 00_{hex} if the self-test passed and 01_{hex} if the self-test failed. The interpretation of the other octets is vendor discretionary and can be interpreted in combination with the MTU-O ITU-T G.994.1 vendor ID and DPU system vendor ID.

Type: String (4 binary octets).

Reference: Clause 11.2.2.10 of [ITU-T G.9711].

7.14.1.6 MTU-R self-test result (MTUR_SELFTEST)

Description: Reports the results from the most recent self-test procedure, initiated either at power-up (see clause 12.1.2 of [ITU-T G.9711]) or by the perform self-test eoc command (see clause 11.2.2.6.1 of [ITU-T G.9711]). The first octet of the self-test result is 00_{hex} if the self-test passed and 01_{hex} if the self-test failed. The interpretation of the other octets is vendor discretionary and can be interpreted in combination with the MTU-R ITU-T G.994.1 vendor ID and the NT system vendor ID.

Type: String (4 binary octets).

Reference: Clause 11.2.2.10 of [ITU-T G.9711].

7.14.1.7 ITU-T G.9711 profile support (MTUO_PROFILES)

Description: Reports for each profile whether the MTU-O supports operation according to that profile.

Type: Array of PROFILEdescriptor[0...N-1] where N = 8.

PROFILEdescriptor

Type: Boolean.

Valid values: False (not supported) and true (supported).

Bit representation

- 0) ITU-T G.9711 profile P424a
- 1) ITU-T G.9711 profile P424amp
- 2) ITU-T G.9711 profile P424d
- 3) ITU-T G.9711 profile P424dmp
- 4) ITU-T G.9711 profile Q424c
- 5) ITU-T G.9711 profile Q424cmp
- 6) ITU-T G.9711 profile Q424d
- 7) ITU-T G.9711 profile Q424dmp

Reference: Clause 6 of [ITU-T G.9711].

7.14.1.8 ITU-T G.9711 profile support (MTUR_PROFILES)

Description: Reports for each profile whether the MTU-R supports operation according to that profile.

Type: Array of PROFILEdescriptor[0...N-1] where N = 8.

PROFILEdescriptor

Type: Boolean.

Valid values: False (not supported) and true (supported).

Bit representation

- 0) ITU-T G.9711 profile P424a
- 1) ITU-T G.9711 profile P424amp
- 2) ITU-T G.9711 profile P424d
- 3) ITU-T G.9711 profile P424dmp
- 4) ITU-T G.9711 profile Q424c
- 5) ITU-T G.9711 profile Q424cmp
- 6) ITU-T G.9711 profile Q424d
- 7) ITU-T G.9711 profile Q424dmp

Reference: Clause 6 of [ITU-T G.9711].

7.14.2 System related inventory

7.14.2.1 DPU system vendor ID (DPU_SYSTEM_VENDOR)

Description: Reports the DPU system vendor ID as inserted by the MTU-O in the eoc (see clause 11.2.2.10 of [ITU-T G.9711]) and as specified in clause 9.3.3.1 of [ITU-T G.994.1].

Type: String (8 binary octets).

Reference: Clause 11.2.2.10 of [ITU-T G.9711].

7.14.2.2 NT system vendor ID (NT_SYSTEM_VENDOR)

Description: Reports the NT system vendor ID as inserted by the MTU-R in the eoc (see clause 11.2.2.10 of [ITU-T G.9711]) and as specified in clause 9.3.3.1 of [ITU-T G.994.1].

Type: String (8 binary octets).

Reference: Clause 11.2.2.10 of [ITU-T G.9711].

7.14.2.3 DPU system serial number (DPU_SYSTEM_SERIALNR)

Description: Reports the DPU serial number as inserted by the MTU-O in the eoc (see clause 11.2.2.10 of [ITU-T G.9711]). It is vendor specific information. The combination of the DPU system vendor ID and DPU system serial number creates a unique number for each DPU.

Type: String (up to 32 ASCII characters).

Reference: Clause 11.2.2.10 of [ITU-T G.9711].

7.14.2.4 NT system serial number (NT_SYSTEM_SERIALNR)

Description: Reports the NT system serial number as inserted by the MTU-R in the eoc (see clause 11.2.2.10 of [ITU-T G.9711]). It shall contain the NT system serial number, the NT model and the NT firmware version. All shall be encoded in this order and separated by space characters, i.e., "<NT serial number><space><NT model><space><NT firmware version>". The combination of NT system vendor ID and NT system serial number creates a unique number for each NT.

Type: String (up to 32 ASCII characters).

Reference: Clause 11.2.2.10 of [ITU-T G.9711].

7.14.2.5 VCE ID (VCE_ID)

Description: For the line in a vectored group, the VCE ID uniquely identifies the VCE that manages and controls the vectored group to which the line belongs. It consists of one octet and valid ranges are from 1 to 255. A special value means the line is not in a vectored group.

Type: 8-bit unsigned integer.

Valid values: 0 (special value) and 1..255.

Reference: Clause 11.4.6.1.1 of [ITU-T G.9711].

7.14.2.6 VCE port index (VCE_PORT_INDEX)

Description: For the link operating on the line in a vectored group, the VCE port index is a number that uniquely identifies the VCE port to which the link is connected. It is an integer from 1 to the maximum number of links supported by the VCE. The combination of VCE ID and VCE port index creates a unique identifier for each vectored pair of MTU-O and MTU-R.

Type: 16-bit unsigned integer.

Valid values: 0 (special value) and 1...65535.

Reference: Clause 11.4.6.1.2 of [ITU-T G.9711].

7.14.2.7 NT identity (NT_ID)

Description: Reports the identity of the NT. The NT_ID shall be 128-bits long and shall uniquely identify the NT. The NT_ID is determined by the NT vendor and hardcoded in the NT at production time. The NT_ID shall not change with NT software updates (e.g., as specified in Annex S). This NT_ID is sent by the HSTU-R during the ITU-T G.994.1 phase. The object shall be reported with value "undefined" only when operating in P2P and if no NT_ID was not exchanged in the last ITU-T G.994.1 phase.

Type: Binary (16 octets) or "undefined".

NOTE – An NT_id of type "binary" represents a 128-bit NT_id.

Reference: Clause 11.4.6.2.1 of [ITU-T G.9711].

7.15 P2MP configuration objects

7.15.1 Maximum P2MP groupsize (MAXP2MPGROUPSIZE)

Description: Determines the maximum number of active links in the P2MP group that the link belongs to. This object is specified only if the MTU-O supports P2MP operation and applies to the MTU-O only in P2MP operation.

Type: 8-bit unsigned integer.

Valid values: 1..16.

Default: 4.

Reference: Clause 11.5.1.1 of [ITU-T G.9711].

7.15.2 Maximum P2MP group aggregate transmit power (MAXP2MPGROUPATPds/us)

Description: Determines the maximum value allowed for the sum over all active links in the P2MP group of the aggregate transmit powers (ACTATP). This object is specified only if the MTU-O supports P2MP operation and applies to the MTU-O only in P2MP operation.

Type: 16-bit signed integer.

Unit: 0.1 dBm.

Valid values: -310...+310 (-31 to +31 dBm).

Default value: 40 (4 dBm).

Reference: Clause 11.5.1.2 of [ITU-T G.9711].

7.15.3 Maximum P2MP group net data rate (MAXP2MPGROUPNDRds/us)

Description: Determines the maximum value allowed for the sum over all active links in the P2MP group of the NDRs. This object is specified only if the MTU-O supports P2MP operation and applies to the MTU-O only in P2MP operation.

Type: 32-bit unsigned integer.

Unit: 1000 bits/s.

Valid values: 0...4294967295 (0 to $2^{32} - 1$ kbit/s).

Default value: 4294967295 (4294967295 kbit/s).

Reference: Clause 11.5.1.3 of [ITU-T G.9711].

7.16 P2MP status objects

7.16.1 Actual P2MP groupsize (ACTP2MPGROUPSIZE)

Description: Reports the actual number of active links in the P2MP group that the link belongs to. This object is specified only if the MTU-O supports P2MP operation and is reported by the MTU-O only in P2MP operation.

Type: 8-bit unsigned integer.

Valid values: 0..16.

Reference: Clause 11.5.2.1 of [ITU-T G.9711].

7.16.2 Actual P2MP group aggregate transmit power (ACTP2MPGROUPATPds/us)

Description: Reports the value of the actual aggregate transmit power over all active links in the P2MP group that the link belongs to. This object is specified only if the MTU-O supports P2MP operation and is reported by the MTU-O only in P2MP operation.

Type: 16-bit signed integer.

Unit: 0.1 dBm.

Valid values: -310...+310 (-31 to +31 dBm).

Reference: Clause 11.5.2.2 of [ITU-T G.9711].

7.16.3 Actual P2MP group net data rate (ACTP2MPGROUPNDRds/us)

Description: Reports the value of the actual net data rate over all active links in the P2MP group that the link belongs to. This object is specified only if the MTU-O supports P2MP operation and is reported by the MTU-O only in P2MP operation.

Type: 32-bit unsigned integer.

Unit: 1000 bits/s.

Valid values: 0...4294967295 (0 to $2^{32} - 1$ kbit/s).

Reference: Clause 11.5.2.3 of [ITU-T G.9711].

8 Procedures for performance monitoring functions

The functions described in this clause can be performed inside or outside the NE.

8.1 Link transmission states

A link can be in one of two transmission states:

- 1) unavailable state;
- 2) available state.

The transmission state is determined from SES/non-SES data and the transceiver path state SHOWTIME/non-SHOWTIME. The unavailable state is specified in clause 11.4.4.5 of [ITU-T G.9711]. An MGfast link is in the available state when it is not in the unavailable state.

8.2 Threshold reports

A threshold report (TR) is an unsolicited error performance report from a DPU over its DPU-NB interface with respect to either a 15-min or 24-h evaluation period. TRs can only occur when the concerned direction is in the available state. The performance counter thresholds are listed in Tables 8-1 and 8-2. The TRs related to near-end and FE ES, SES and UAS are mandatory and other TRs are optional. TRs are not provided at the T/S interface.

TR1s shall occur within 10 s after the 15 min threshold is reached or exceeded.

TR2s shall occur within 10 s after the 24 h threshold is reached or exceeded.

Entries in Tables 8-1 and 8-2 labelled with names containing the separator "/" represents multiple objects whose names are obtained by considering all combinations of the elements isolated with the separator. For example, the entry labelled with the name A/B_C/D_E/F represents eight objects with names A_C_E, A_C_F, A_D_E, A_D_F, B_C_E, B_C_F, B_D_E, B_D_F.

Table 8-1 – Line performance counter thresholds

Category/object	Counter described in clause	DPU-NB interface	T/S interface
<i>Near-end (MTU-O)/far-end (MTU-R) performance monitoring thresholds (15 min/24 h interval)</i>			
THRESHOLD_NE/FE_15/24_ES	7.8.8	R/W (M)	N/A
THRESHOLD_NE/FE_15/24_SES	7.8.9	R/W (M)	N/A
THRESHOLD_NE/FE_15/24_LOSS	7.8.10	R/W (O)	N/A
THRESHOLD_NE/FE_15/24_LORS	7.8.11	R/W (O)	N/A
THRESHOLD_NE/FE_15/24_UAS	7.8.12	R/W (M)	N/A
<i>Initialization performance monitoring thresholds (15 min/24 h interval)</i>			
THRESHOLD_15/24_FULL_INITS	7.8.13	R/W (O)	N/A
THRESHOLD_15/24_FAILEDFULL_INITS	7.8.14	R/W (O)	N/A
THRESHOLD_15/24_FAST_INITS	7.8.15	R/W (O)	N/A
THRESHOLD_15/24_FAILEDFAST_INITS	7.8.16	R/W (O)	N/A
<i>Short interruption performance monitoring thresholds (15 min/24 h interval)</i>			
THRESHOLD_15/24_SPONT_INTRPT	7.8.19	R/W (O)	N/A

Table 8-2 – Channel performance monitoring thresholds

Category/object	Counter described in clause	DPU-NB interface	T/S interface
<i>Near-end (MTU-O)/far-end (MTU-R) performance monitoring thresholds (15 min/24 h interval)</i>			
THRESHOLD_NE/FE_15/24_CV	7.9.4	R/W (O)	N/A
THRESHOLD_NE/FE_15/24_RTXUC	7.9.6	R/W (O)	N/A
THRESHOLD_NE/FE_15/24_RTXTX	7.9.7	R/W (O)	N/A

8.3 Unavailable and available state filters

The unavailable state filter is a rectangular sliding window with a default length of 10 s and a 1 s granularity of the slide. The length of the sliding window is configured through the REINIT_TIME_THRESHOLD link configuration object (see clauses 7.2.9.7 and 7.2.9.8).

The available state filter is also a rectangular sliding window with a default length of 10 s and a 1 s granularity of the slide. The length of the sliding window is configured through the REINIT_TIME_THRESHOLD link configuration object (see clauses 7.2.9.7 and 7.2.9.8).

8.4 TR1 filter

The TR1 filter is a 15 min rectangular fixed window. The start and end times for the 15 min rectangular fixed windows shall fall on the hour and at 15, 30 and 45 min after the hour.

8.5 TR2 filter

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

8.6 Evaluation of TR1

For second counters, the parameters are counted separately, second by second, over each 15 min rectangular fixed window period. The threshold values shall be programmable over the range 0 to 900 with default value 0. A value of 0 indicates that the threshold is disabled.

For event counters, the parameters are counted separately, one by one, over each 15 min rectangular fixed window period. The threshold values shall be programmable over the range 0 to the maximum value of the counter with default value 0. A value of 0 indicates that the threshold is disabled.

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

8.7 Evaluation of TR2

For second counters, the parameters are counted separately over each 24 h period. The threshold values shall be programmable over the range 0 to 86400 with default value 0. A value of 0 indicates that the threshold is disabled.

For event counters, the parameters are counted separately over each 24 h period. The threshold values shall be programmable over the range 0 to the maximum value of the counter with default value 0. A value of 0 indicates that the threshold is disabled.

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

8.8 Threshold report evaluation during transmission state changes

Care should be taken to ensure that TRs are correctly generated and parameter counters are correctly processed during changes in the transmission state. This implies that all TRs should be delayed by the length of the sliding window in the unavailable state filer (see clause 8.3).

8.9 Performance history storage in network elements

Performance history storage at the DPU shall consist of the current and previous 15 min and 24 h parameter registers listed in clause 7. Support of performance history storage beyond the current and previous 15 min and 24 h parameter registers listed in clause 7 is not defined.

It is expected that the PMA at appropriate times pulls parameter register values from the DPU in order to store a performance history beyond the current and previous 15 min and 24 h parameter registers listed in clause 7.

As a minimum, a measured time and 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 has been accumulated over a period of time that is 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 FE performance reports;

- the link is not configured (in which case the PM data and measured time are set to ZERO).
The invalid data flag is not set as a result of register saturation.

8.10 Register size

The register size is 32 bits. 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.

8.11 Parameter counts

If the DPU-ME does not force the link into the L3 state, then PM counters shall be active, irrespective of the actual link state of the link.

If the DPU-ME forces the link into the L3 state, then all PM counters shall be frozen, including the UAS counter.

All active parameter counts shall be actual (within a tolerance of 1 s) counts for the 15 min and 24 h filtering period.

The time when the PM counters are frozen shall be excluded from the measured time (see clause 8.9).

NOTE – The DPU-ME may force the link into the L3 state, e.g., when the link is configured with AdminStatus="down", a SELT measurement is taking place (see [b-ITU-T G.996.2]), or when the RPF power source equipment (PSE) is shut down (see clause A.7.1.1.2 of [ITU-T G.997.2]).

8.12 Date and time stamping of reports

The date and time stamping accuracy of reports, together with the method of maintaining the accuracy, is for further study.

The date and time stamp is a string of ASCII characters formatted as "`\d{4}-\d{2}-\d{2}T\d{2}:\d{2}:\d{2}(\.\d+)?`" + "`(Z|[\+|-]\d{2}:\d{2})`" (see [b-IETF RFC 6021] and [b-IETF RFC 3339]).

Equipment clock accuracy requirements are for further study.

8.13 Inhibiting performance monitoring parameters

The accumulation of certain performance parameters is inhibited during certain periods. Inhibition of PM parameters is specified in clause 11.4.4.6 of [ITU-T G.9711].

Annex A to Annex R

Annexes A to R have been intentionally left blank.

Annex S

Management for network termination software upgrade process

(This annex forms an integral part of this Recommendation.)

S.1 Scope

This annex specifies the management of the NT software upgrade process specified in Annex S of [ITU-T G.9711]. Two images (0 and 1) are maintained by the software management function, so that one can be upgraded while the other is executing. These two images are managed separately using the managed objects specified in clause S.7.

S.2 References

This annex does not contain any additional references.

S.3 Definitions

This annex does not contain any additional definitions.

S.4 Abbreviations and acronyms

This annex does not contain any additional abbreviations and acronyms.

S.5 DPU management architecture

This annex does not modify the DPU management architecture specified in clause 5.

S.6 Network management protocol

This annex makes no presumption about which management protocol is used between the PMA and the DPU for transport of MGfast-managed objects.

S.7 Managed objects

The list of managed objects contains two types of information:

- 1) software image attributes;
- 2) software image configuration.

At the DPU-NB interface, the NT software upgrade process is managed through the information given in Table S.1.

When the software attribute update request flag for a software image (see clause S.7.1.1.7) is set (its value is changed from false to true), the attributes of the corresponding software image shall be updated in the DPU-MIB within 10 s. The update request flag shall be reset (its value changed back to false) by the DPU immediately after the request parameter update is complete.

Similarly, to request an action (activate, commit, or download) for an NT software image (0 or 1), the corresponding request flag (NT_SW_ACTIVATE0/1, NT_SW_COMMIT0/1, NT_SW_DOWNLOAD0/1) shall be set. The corresponding request flag shall be reset (its value changed back to false) by the DPU immediately after the requested action is complete and the result of the action is available in the DPU-MIB (NT_SW_ACTIVATE_RES0/1, NT_SW_COMMIT_RES0/1, NT_SW_DOWNLOAD_RES0/1).

Table S.1 indicates the status of each managed object over the DPU-NB interface:

- R: Read only
- W: Write only

- R/W: Read and write
- (M): Mandatory
- (O): Optional

Entries in Table S.1 labelled with names containing the separator "/" represent multiple objects whose names are obtained by considering all combinations of the elements isolated with the separator. For example, the entry labelled with the name A0/1 represents two objects, for the two managed software images (0 and 1), with names A0 and A1.

Table S.1 – NT software management objects

Category/object	Described in clause	DPU-NB interface
<i>Software image attributes</i>		
NT_SW_VERSION0/1	S.7.1.1.1	R (M)
NT_SW_COMMITTED0/1	S.7.1.1.2	R (M)
NT_SW_ACTIVE0/1	S.7.1.1.3	R (M)
NT_SW_VALID0/1	S.7.1.1.4	R (M)
NT_SW_PRODUCTCODE0/1	S.7.1.1.5	R (O)
NT_SW_HASH0/1	S.7.1.1.6	R (O)
UPDATE_NT_SW_ATTR0/1	S.7.1.1.7	R/W (M)
<i>Software image configuration</i>		
NT_SW_ACTIVATE_COND0/1	S.7.1.2.1	R/W (O)
NT_SW_ACTIVATE0/1	S.7.1.2.2	R/W (M)
NT_SW_ACTIVATE_RES0/1	S.7.1.2.3	R (M)
NT_SW_COMMIT0/1	S.7.1.2.4	R/W (M)
NT_SW_COMMIT_RES0/1	S.7.1.2.5	R (M)
NT_SW_IMAGEFILE0/1	S.7.1.2.6	R/W (M)
NT_SW_DOWNLOAD0/1	S.7.1.2.7	R/W (M)
NT_SW_DOWNLOAD_RES0/1	S.7.1.2.8	R (M)

S.7.1 NT software management objects

S.7.1.1 Software image attributes

S.7.1.1.1 Software image version (NT_SW_VERSION0/1)

Description: Reports the version of the software image (see clause S.4.1 of [ITU-T G.9711]).

Type: String (14 binary octets).

Reference: Clause S.4.1 of [ITU-T G.9711].

S.7.1.1.2 Software image committed (NT_SW_COMMITTED0/1)

Description: Reports whether the associated software image is committed or uncommitted (see clause S.4.1 of [ITU-T G.9711]).

Type: Boolean.

Valid values: False (uncommitted) and true (committed).

Reference: Clause S.4.1 of [ITU-T G.9711].

S.7.1.1.3 Software image active (NT_SW_ACTIVE0/1)

Description: Reports whether the associated software image is active or inactive (see clause S.4.1 of [ITU-T G.9711]).

Type: Boolean.

Valid values: False (inactive) and true (active).

Reference: Clause S.4.1 of [ITU-T G.9711].

S.7.1.1.4 Software image valid (NT_SW_VALID0/1)

Description: Reports whether the associated software image is valid or invalid (see clause S.4.1 of [ITU-T G.9711]).

Type: Boolean.

Valid values: False (invalid) and true (valid).

Reference: Clause S.4.1 of [ITU-T G.9711].

S.7.1.1.5 Software product code (NT_SW_PRODUCTCODE0/1)

Description: Reports the product code information of the software image (see clause S.4.1 of [ITU-T G.9711]).

Type: String (25 binary octets).

Reference: Clause S.4.1 of [ITU-T G.9711].

S.7.1.1.6 Software image hash (NT_SW_HASH0/1)

Description: Reports the MD5 hash of the software image (see clause S.4.1 of [ITU-T G.9711]).

Type: String (16 binary octets).

Reference: Clause S.4.1 of [ITU-T G.9711].

S.7.1.1.7 Update request flag for software image attributes (UPDATE_NT_SW_ATTR0/1)

Description: Forces an update of the software image attributes, specified in clauses S.7.1.1.1 to S.7.1.1.6, of the corresponding software image to 0 or 1. See introductory text to clause S.7.

Type: Boolean.

Valid values: False (no update forced) or true (update forced).

Default value: False (no update forced).

S.7.1.2 Software image configuration

S.7.1.2.1 Activate software conditions (NT_SW_ACTIVATE_COND0/1)

Description: Specifies the conditions under which the activation request for a software image shall be executed (see clauses S.7.1.2.2 and S.5.9 of [ITU-T G.9711]).

Type: Enumeration.

Valid values: 0...2.

- 0) Activate image unconditionally.
- 1) Activate image only if no plain old telephony service/voice over Internet protocol (POTS/VoIP) calls are in progress.
- 2) Activate image only if no emergency call is in progress.

Default value: 0 (activate image unconditionally).

Reference: Clause S.5.9 of [ITU-T G.9711].

S.7.1.2.2 Request activate software flag (NT_SW_ACTIVATE0/1)

Description: Activate the downloaded software image (see clause S.5.9 of [ITU-T G.9711]). The flag shall be reset after the requested action is complete (see introductory text to clause S.7).

Type: Boolean.

Valid values: False (no action) and true (activate software image).

Default value: False (no action).

Reference: Clause S.5.9 of [ITU-T G.9711].

S.7.1.2.3 Result of activate software (NT_SW_ACTIVATE_RES0/1)

Description: Reports the results from the most recent activate software image action (see clause S.5.10 of [ITU-T G.9711] and the introductory text to clause S.7).

Type: Enumeration.

Valid values: 0...6, 256.

- 0) Command processed successfully.
- 1) Command processing error.
- 2) Command not supported.
- 3) Parameter error.
- 4) Reserved for use by ITU-T.
- 5) Unknown managed software image instance.
- 6) Device busy.
- 256) No result available.

Reference: Clause S.5.10 of [ITU-T G.9711].

S.7.1.2.4 Request commit software flag (NT_SW_COMMIT0/1)

Description: Commit the downloaded software image (see clause S.5.11 of [ITU-T G.9711]). The flag shall be reset after the requested action is complete (see introductory text to clause S.7).

Type: Boolean.

Valid values: False (no action) and true (commit software image).

Default value: False (no action).

Reference: Clause S.5.11 of [ITU-T G.9711].

S.7.1.2.5 Result of commit software (NT_SW_COMMIT_RES0/1)

Description: Reports the results from the most recent commit software image action (see clause S.5.12 of [ITU-T G.9711] and the introductory text to clause S.7).

Type: Enumeration.

Valid values: 0...6, 256.

- 0) Command processed successfully.
- 1) Command processing error.
- 2) Command not supported.
- 3) Parameter error.
- 4) Reserved for use by ITU-T.

- 5) Unknown managed software image instance.
- 6) Device busy.
- 256) No result available.

Reference: Clause S.5.12 of [ITU-T G.9711].

S.7.1.2.6 Location of software image file (NT_SW_IMAGEFILE0/1)

Description: Determines the location of the software image file as uniform resource identifier according to [b-IETF RFC 3986]. When a request software image download is initiated (see clause S.7.1.2.7), the image software image file is transferred from to the NT from the specified location.

Type: String (up to 256 ASCII characters).

S.7.1.2.7 Request software image download (NT_SW_DOWNLOAD0/1)

Description: Start the download of the software image file to the NT (see clause S.5.3 of [ITU-T G.9711]). The flag shall be reset after the requested action is complete (see introductory text to clause S.7).

Type: Boolean.

Valid values: False (no action) and true (start download software image).

Default value: False (no action).

Reference: Clause S.5.3 of [ITU-T G.9711].

S.7.1.2.8 Result of software image download (NT_SW_DOWNLOAD_RES0/1)

Description: Reports the results from the most recent software image download action (see clause S.5.8 of [ITU-T G.9711] and the introductory text to clause S.7).

Type: Enumeration.

Valid values: 0...6, 256, 257.

- 0) Command processed successfully (CRC correct).
- 1) Command processing error (CRC incorrect, in addition to the normal criteria).
- 2) Command not supported.
- 3) Parameter error.
- 4) Reserved for use by ITU-T.
- 5) Unknown managed software image instance.
- 6) Device busy.
- 256) No result available.
- 257) Software image file could not be accessed at the specified location.

Reference: Clause S.5.8 of [ITU-T G.9711].

Annex T

Annex D and Annex T of ITU-T G.9711 – Managed objects

(This annex forms an integral part of this Recommendation.)

T.1 Overview of Annex D and Annex T of ITU-T G.9711 managed objects

Tables T.1 and T.2 give an overview of the managed objects used to manage the Annex D of [ITU-T G.9711] and the dynamic time assignment (DTA) cross-layer aspects specified in Annex T of [ITU-T G.9711]. Tables T.1 and T.2 use the same convention as that used in the Tables 7-1 to 7-17. Support of Annex T is optional.

Table T.1 – Annex D and Annex T of ITU-T G.9711 configuration objects

Category/object	Described in clause	DPU-NB	
<i>DTA, Annex D management</i>			
DTA allowed according to Annex D (DTA_ALLOWED)	T.2.1.1	R/W (M)	
Downstream High Utilization Second threshold (DTA_HUS_THRESHOLDds)	T.2.1.2	R/W (O)	
Upstream High Utilization Second threshold (DTA_HUS_THRESHOLDus)	T.2.1.3	R/W (O)	
<i>DRA configuration</i>			
Preferred Mds for DTA (DTA_PREF_Mds)	T.2.2.1	R/W (M)	
Maximum step size for DTA changes (DTA_SMAX)	T.2.2.2	R/W (M)	
Minimum Mds for DTA (DTA_MIN_Mds)	T.2.2.3	R/W (M)	
Maximum Mds for DTA (DTA_MAX_Mds)	T.2.2.4	R/W (M)	
Minimum expected throughput for DTA (DTA_MINETRds/us)	T.2.2.5	R/W (M)	
Maximum net data rate for DTA (DTA_MAXNDRds/us)	T.2.2.6	R/W (M)	
Minimum time between DTA updates (DTA_MIN_TIME)	T.2.2.7	R/W (M)	

Table T.2 – Annex D and Annex T of ITU-T G.9711 status objects

Category/object	Defined in clause	DPU-NB	
Annex D operation enabled (ANNEX_D_ENABLED)	T.3.1	R (M)	

Table T.3 – Annex D and Annex T of ITU-T G.9711 diagnostics and monitoring objects

Category/object	Defined in clause	DPU-NB	
<i>DTA channel performance monitoring objects</i>			
High Utilization Second counter CURR/PREV_NE/FE_15/24_DTA_HUS	T.4.1.1	R(O)	
<i>DRA line performance monitoring objects</i>			
Successful DTA counter (CURR/PREV_15/24_DTA)	T.4.2.1	R(O)	
Minimum Mds per time interval (CURR/PREV_15/24_DTA_MINMds)	T.4.2.2	R(O)	
Maximum Mds per time interval (CURR/PREV_15/24_DTA_MAXMds)	T.4.2.3	R(O)	
<i>DRA line diagnostics objects</i>			
Actual Minimum Mds (DTA_ACTMINMds)	T.4.3.1	R(O)	
Actual Maximum Mds (DTA_ACTMAXMds)	T.4.3.2	R(O)	

T.2 Annex D and Annex T of ITU-T G.9711 configuration objects

T.2.1 DTA, Annex D management

T.2.1.1 DTA allowed (DTA_ALLOWED)

Description: Determines whether DTA is allowed.

Type: Boolean.

Valid values: False (disallowed) and true (allowed).

Default value: False (disallowed).

Reference: Clauses D.5.7.2 and T.2.4 of [ITU-T G.9711].

T.2.1.2 Downstream High Utilization Second threshold (DTA_HUS_THRESHOLDds)

Description: Defines the downstream threshold in percent for declaring a downstream High Utilization Second (see clause T.4.2 of [ITU-T G.9711]). The special value 0 indicates that declaring and counting of downstream High Utilization Seconds is disabled.

Type: 8-bit unsigned integer.

Valid values: 0 and 1...100.

Default value: 90.

Reference: Clause T.4.2 of [ITU-T G.9711].

T.2.1.3 Upstream High Utilization Second threshold (DTA_HUS_THRESHOLDus)

Description: Defines the upstream threshold in percent for declaring an upstream High Utilization Second (see clause T.4.3 of [ITU-T G.9711]). The special value 0 indicates that declaring and counting of upstream High Utilization Seconds is disabled.

Type: 8-bit unsigned integer.

Valid values: 0 and 1...100.

Default value: 90.

Reference: Clause T.4.3 of [ITU-T G.9711].

T.2.2 DRA configuration

T.2.2.1 Preferred Mds for DTA (DTA_PREF_Mds)

Description: Provides the number of downstream symbol positions in a PDX frame requested by the DRA at the first opportunity upon entering showtime of a link on which DTA operation is enabled.

Type: 8-bit unsigned integer.

Valid values: 5...31 (if MF=36), 5...19 (if MF=23).

Default value: 28.

NOTE – If MF=23, a value different from the default value needs to be configured (see clause 7.1).

Reference: Clause T.2.6 of [ITU-T G.9711].

T.2.2.2 Maximum step size for DTA changes (DTA_SMAX)

Description: Determines the maximum step size for Mds requested by the DRA for a single DTA update.

Type: 8-bit unsigned integer.

Valid values: 1...26 (if MF=36), 1...14 (if MF=23).

NOTE – If MF=23, a value different from the default value needs to be configured (see clause 7.1).

Default value: 25.

Reference: Clause T.2.7 of [ITU-T G.9711].

T.2.2.3 Minimum Mds for DTA (DTA_MIN_Mds)

Description: Provides the minimum number of downstream symbol positions Mds in a PDX frame that shall be requested by the DRA.

Type: 8-bit unsigned integer.

Valid values: 5...31 (if MF=36), 5...19 (if MF=23).

Default value: 5.

NOTE – If DTA_ALLOWED=cdta, a value different from the default value needs to be configured (see clause 7.1).

Reference: Clause T.2.8 of [ITU-T G.9711].

T.2.2.4 Maximum Mds for DTA (DTA_MAX_Mds)

Description: Provides the maximum number of downstream symbol positions Mds in a PDX frame that shall be requested by the DRA.

Type: 8-bit unsigned integer.

Valid values: 5...31 (if MF=36), 5...19 (if MF=23).

Default value: 30.

NOTE – If MF=23, a value different from the default value needs to be configured (see clause 7.1).

Reference: Clauses D.5.7.4 and T.2.9 of [ITU-T G.9711].

T.2.2.5 Minimum expected throughput for DTA (DTA_MINETRds/us)

Description: Determines the value of the minimum expected throughput for DTA operation to constrain the dynamic range of Mds requested by the DRA.

Type: 32-bit unsigned integer.

Unit: 1000 bits/s.

Valid values: 0...4294967295 (0 to $2^{32} - 1$ kbit/s).

Default value: 0 (0 bit/s).

Reference: Clause T.2.10 of [ITU-T G.9711].

T.2.2.6 Maximum net data rate for DTA (DTA_MAXNDRds/us)

Description: Determines the value of the maximum NDR for DTA operation.

Type: 32-bit unsigned integer.

Unit: 1000 bits/s.

Valid values: 0...4294967295 (0 to $2^{32} - 1$ kbit/s).

Default value: 4294967295 (4294967295 kbit/s).

Reference: Clauses D.5.7.5 and T.2.11 of [ITU-T G.9711].

T.2.2.7 Minimum time between DTA updates (DTA_MIN_TIME)

Description: Determines the minimum time between any two successive DTA updates during showtime.

Type: 16-bit unsigned integer.

Unit: 0.01 s.

Valid values: 0...16383 (0 to 163.83 s).

Default value: 0 (0 s).

Reference: T.2.13 of [ITU-T G.9711].

T.3 Annex D and Annex T of ITU-T G.9711 status objects

T.3.1 Annex D operation enabled (ANNEX_D_ENABLED)

Description: Indicates whether Annex D operation is enabled.

Type: Boolean.

Valid values: False (disabled), true (enabled).

Reference: Clause D.5.8.1 of [ITU-T G.9711].

T.4 Annex D and Annex T of ITU-T G.9711 diagnostics and monitoring objects

T.4.1 DTA channel performance monitoring objects

T.4.1.1 High Utilization Second counter CURR/PREV_NE/FE_15/24_DTA_HUS

Description: Reports the count of DTA_HUS seconds. A DTA_HUS second is defined in clauses T.4.2 and T.4.3 of [ITU-T G.9711].

Type: 32-bit unsigned integer.

Valid values: 0...900 (15 min interval) and 0...86400 (24 h interval).

Reference: Clauses T.4.2 and T.4.3 of [ITU-T G.9711].

T.4.2 DRA line performance monitoring objects

T.4.2.1 Successful DTA (CURR/PREV_15/24_DTA)

Description: Reports a count of the successful DTA primitives (*success_DTA*). The successful DTA primitive (*success_DTA*) is defined in clause T.4.1 of [ITU-T G.9711].

Type: 32-bit unsigned integer.

Valid values: 0...4294967295 (event counter).

Reference: Clause T.4.1 of [ITU-T G.9711].

T.4.2.2 Minimum Mds per time interval (CURR/PREV_15/24_DTA_MINMds)

Description: Reports the minimum number of downstream symbol positions Mds in a PDX frame that was used (see clause D.5.2 of [ITU-T G.9711]) over the associated time interval.

Type: 8-bit unsigned integer.

Valid values: 5...31 (if MF=36), 5...19 (if MF=23).

Reference: Clause D.5.2 of [ITU-T G.9711].

T.4.2.3 Maximum Mds per time interval (CURR/PREV_15/24_DTA_MAXMds)

Description: Reports the maximum number of downstream symbol positions Mds in a PDX frame that was used (see clause D.5.2 of [ITU-T G.9711]) over the associated time interval.

Type: 8-bit unsigned integer.

Valid values: 5...31 (if MF=36), 5...19 (if MF=23).

Reference: Clause D.5.2 of [ITU-T G.9711].

T.4.3 DRA line diagnostics objects

T.4.3.1 Actual Minimum Mds (DTA_ACTMINMds)

Description: Reports the actual minimum number of downstream symbol positions Mds (*Act_min_Mds*) needed to provide an expected downstream throughput of at least DTA_MINETRds (see clause T.2.7 of [ITU-T G.9711]).

Type: 8-bit unsigned integer.

Valid values: 5...31 (if MF=36), 5...19 (if MF=23).

Reference: Clause T.2.7 of [ITU-T G.9711].

T.4.3.2 Actual Maximum Mds (DTA_ACTMAXMds)

Description: Reports the actual maximum number of downstream symbol positions Mds (*Act_max_Mds*) needed to provide an expected upstream throughput of at least DTA_MINETRus (see clause T.2.7 of [ITU-T G.9711]).

Type: 8-bit unsigned integer.

Valid values: 5...31 (if MF=36), 5...19 (if MF=23).

Reference: Clause T.2.7 of [ITU-T G.9711].

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