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

Digital sections and digital line system – Metallic access networks

Physical layer management for G.fast transceivers

Corrigendum 1

Recommendation ITU-T G.997.2 (2015) – Corrigendum 1

Recommendation ITU-T G.997.2

Physical layer management for G.fast transceivers

Corrigendum 1

Summary

Recommendation ITU-T G.997.2 specifies the physical layer management for fast access to subscriber terminals (G.fast) transmission systems. It specifies managed objects for configuration, fault, status, inventory and performance management.

Corrigendum 1 includes:

- Clarification of the DPU-NB interface.
- An increase of number of RFI bands from 16 to 32.
- Replacement of "short init" with "fast init".
- Fix for a typographical error in Table 7-8.
- Additon of special value for FRA time parameters.
- Fix for references.

History

Edition	Recommendation	Approval	Study Group	Unique ID[*]
1.0	ITU-T G.997.2	2015-05-22	15	11.1002/1000/12375
1.1	ITU-T G.997.2 (2015) Cor. 1	2016-03-29	15	11.1002/1000/12800
1.2	ITU-T G.997.2 (2015) Amd. 1	2016-05-07	15	11.1002/1000/12555
1.3	ITU-T G.997.2 (2015) Amd. 2	2016-07-22	15	11.1002/1000/12799

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[*] To access the Recommendation, type the URL http://handle.itu.int/ in the address field of your web browser, followed by the Recommendation's unique ID. For example, http://handle.itu.int/11.1002/1000/11830-en.

FOREWORD

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As of the date of approval of this Recommendation, ITU had received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementers are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database at http://www.itu.int/ITU-T/ipr/.

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Recommendation ITU-T G.997.2

Physical layer management for G.fast 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.997.2 (2015).

1 Scope

This Recommendation specifies the physical layer management for fast access to subscriber terminals (G.fast) transmission systems.

It specifies managed 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 "DPU-MIB" nomenclature used in [ITU-T G.9701]. The managed objects are defined to provide, at least, all the information necessary for translation into a YANG data model [b-IETF RFC 6020], although this does not exclude translation to other formats such as an abstract syntax notation one (ASN.1) (ITU-T X.680 series) management information base (MIB) description used in connection with the simple network management protocol (SNMP) [b-IETF RFC 1157]. The definition of the YANG data model for G.fast-managed objects is 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 (2012), *Handshake procedures for digital subscriber line transceivers*.

[ITU-T G.9700]   Recommendation ITU-T G.9700 (2014), *Fast access to subscriber terminals (G.fast) – Power spectral density specification*.

[ITU-T G.9701]   Recommendation ITU-T G.9701 (2014), *Fast access to subscriber terminals (G.fast) – Physical layer specification*.

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following term defined elsewhere:

3.1.1 managed resource [b-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 anomaly: 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.

3.2.2 defect: 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.

3.2.3 empty array: An array whose number of elements is zero.

3.2.4 failure: 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".

3.2.5 managed object: The management view of a managed resource.

3.2.6 DPU-NB interface: The interface between the persistent management agent and the management entity of the distribution point unit.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

ASN.1	Abstract Syntax Notation one
CV	Code Violation
CV-C	Code Violation – Channel
DPU	Distribution Point Unit
DPU-NB	DPU Northbound
DRA	Dynamic Resource Allocation
ES	Errored Second
FAST	Fast Access to Subscriber Terminals
FE	Far-End
FRA	Fast Rate Adaptation
FTTdp	Fibre To The distribution point
FTTx	Fibre To The x
FTU	FAST Transceiver Unit
FTU-O	FAST Transceiver Unit – Central office end (i.e., network operator end of the loop)
FTU-R	FAST Transceiver Unit – Remote side (i.e., subscriber end of the loop)
GDR	Gamma Data Rate
G.fast	fast access to subscriber terminals
LOM	Loss of Margin
LOM-FE	Far-End Loss of Margin
LOR	Loss of RMC

LOR-FE	Far-End Loss of RMC
LORS	LOR Second
LOS	Loss of Signal
LOS-FE	Far-End Loss of Signal
LOSS	LOS Second
LPR	Loss of Power
LPR-FE	Far-End Loss of Power
MIB	Management Information Base
MDU	Multi-Dwelling Unit
ME	Management Entity
NDR	Net Data Rate
NDRds	downstream Net Data Rate
NDRus	upstream Net Data Rate
NE	Network Element
NMS	Network Management System
NT	Network Termination
OLR	On-Line Reconfiguration
OSS	Operations Support Systems
PM	Performance Monitoring
PMA	Persistent Management Agent
PMD	Physical Media Dependent
PMS-TC	Physical Media Specific – Transmission Convergence
PSD	Power Spectral Density
REIN	Repetitive Electrical Impulse Noise
RMC	Robust Management Channel
RPA	RMC Parameter Adjustment
SES	Severely Errored Second
SNMP	Simple Network Management Protocol
SNR	Signal-to-Noise Ratio
SRA	Seamless Rate Adaptation
TDD	Time Division Multiplexing
TPS-TC	Transport Protocol Specific – Transmission Convergence
TR	Threshold Report
UAS	UnAvailable Second
U-O	Loop interface – Central office end
U-R	Loop interface – Remote side (i.e., subscriber end of the loop)

5   ~~DPU m~~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 AN's management entity (ME) (see Figure 5-1a) or through a ~~P~~persistent ~~M~~management ~~A~~gent (PMA) to the each DPU's ~~management entity (~~ME~~) over the Q reference point~~ (see Figure 5-1b). The NMS may also monitor each ~~FAST~~ G.fast transceiver unit – remote side (FTU-R) via the related network termination's (NT's) ME and G reference point. The connection between the ME functions at the AN or DPU and at the NT is established over management channels provided by the ~~FAST~~ G.fast transceiver unit – central office ends (FTU-Os) and FTU-Rs via the copper pairs.

G.997.2(15)-Cor.1(16)_F5-1a
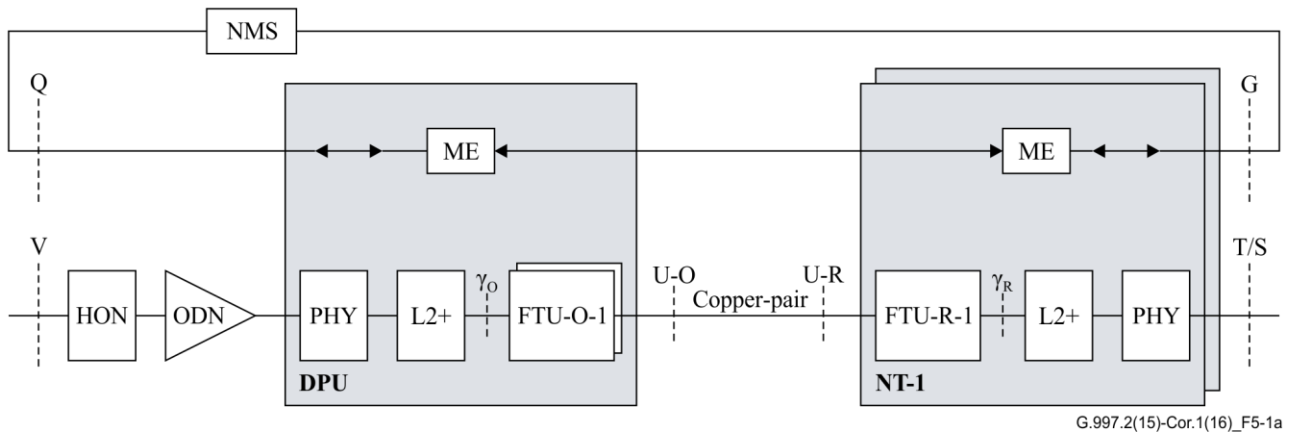
Figure 5-1~~a~~ – Reference model of ~~FTTdp~~ traditional AN deployment
(shown for line 1 in all N lines (N≥1) connected to ~~a DPU~~an AN)~~FTTdp deployment~~
~~(shown for line 1 in all N lines (N≥1) connected to a DPU)~~

G.997.2(15)-Cor.1(16)_F5-1b
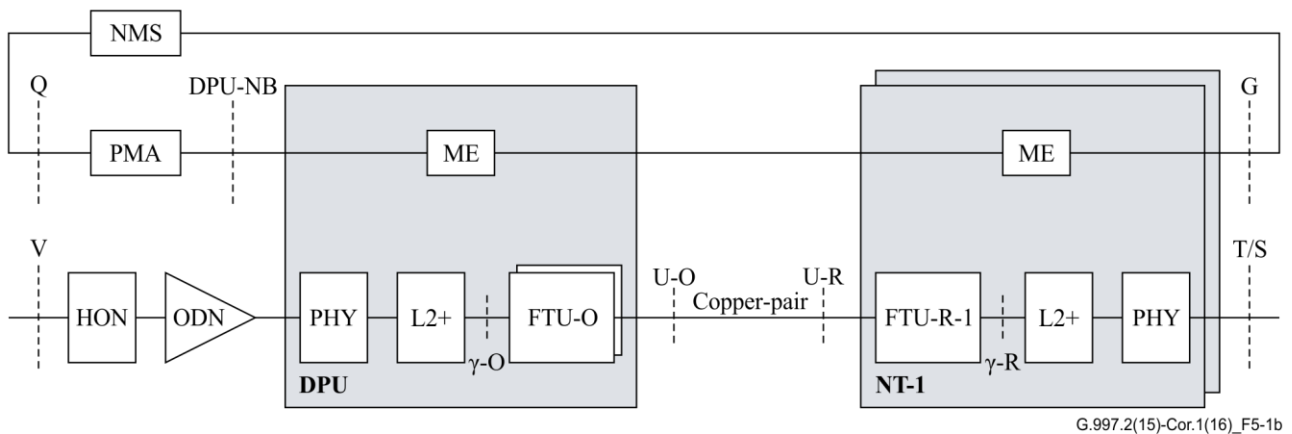
Figure 5–1b – Reference model of FTTdp deployment with PMA and DPU
(shown for line 1 in all N lines (N>=1) connected to a DPU)

Appendix I 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 ~~persistent management agent (~~PMA~~)~~ (see Appendix I) is to allow the operations support systems (OSS)/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 ~~Northbound to OSS and Southbound to DPU~~ Q interface and the DPU-Northbound interface (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 the current information is not available from the DPU.

The OSS/NMS also still needs to be able to ascertain the true power state of the DPU as a whole, and of each given line, for example 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 ~~northbound~~ as a separate entity to~~of~~ the DPU (if the DPU could still be unpowered at times) ~~or a PMA could be integrated with the DPU in the same physical equipment (in which case the equipment performs the PMA functionality listed above, presenting itself to the OSS/NMS as an access node)~~.

[ITU-T G.9701] defines the interfaces between the FTU-O (which is part of the AN or DPU) and the FTU-R (which is part of the NT). This Recommendation specifies the physical layer management for fast access to subscriber terminals (~~FAST~~G.fast) transmission systems as seen by the NMS (if the FTU-O is in an AN, see Figure 5-1a) and as seen by the PMA (if the FTU-O is in a DPU, see Figure 5-1b)~~PMA~~.

~~It~~Clause 7 and 8 specifies managed objects for configuration, fault, test, diagnostics, status, and inventory management, and for performance monitoring. The list of managed objects applies at the ~~DPU-Northbound (~~DPU-NB~~)~~ interface shown in Figure 5-1b, relating to the "DPU-MIB" naming as used in [ITU-T G.9701]. The managed objects are defined to provide at least all the information necessary for translation into a YANG data model [b-IETF RFC 6020], although this does not exclude translation to other formats such as an ASN.1 (X.680 series) MIB description used in connection with SNMP [b-IETF RFC 1157].

The definitions of the managed objects defined in clause 7 provide the following information:
- description;
- type;
- unit;
- valid values;
- default value (for configuration objects only);
- reference.

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

6 Network management protocol

This Recommendation makes no presumption about which management protocol is used between the NMS and the AN (see Figure 5-1a) or between the PMA and the DPU (see Figure 5-1b) for transport of the G.fast-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) performance monitoring objects (counters);

5) test, diagnostic and status objects;

6) inventory objects.

Figure 7-1 shows the in-service performance monitoring process. The primitives are specified in [ITU-T G.9701].
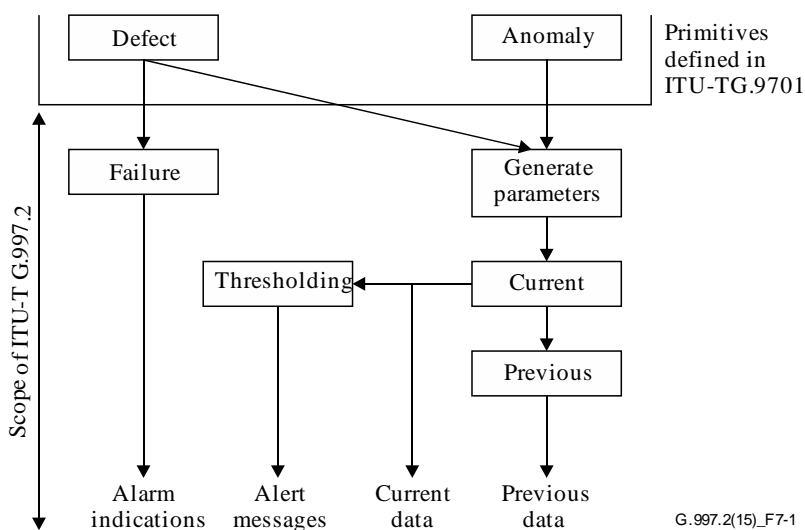
Figure 7-1 – In-service performance monitoring process

As [ITU-T G.9701] supports a DPU with up to 128 lines, provisioning every managed object for every G.fast port on the DPU may become burdensome. Therefore, the DPU configuration management (as defined in the Broadband Forum) defines G.fast configuration profiles, as well as a mechanism to associate these profiles to the individual ports. The definition of G.fast configuration profiles is outside the scope of this Recommendation. The allocation of the individual G.fast-managed objects (as defined in this Recommendation) to G.fast 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.9701]. This clause uses the term "profile" for simplifying the configuration of [ITU-T G.9701] ports on a DPU in the field. Clause 6 of [ITU-T G.9701] is a discussion of a technique for defining the native capabilities (e.g., the particular subset of [ITU-T G.9701]) supported by a particular G.fast transceiver.

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

• line configuration objects (see Table 7-1) for the line;

• channel configuration objects (see Table 7-2) for the downstream channel;

- channel configuration objects (see Table 7-2) for the upstream channel;
- data path configuration objects (see Table 7-3) for the downstream data path;
- data path configuration objects (see Table 7-3) for the upstream data path.

Line configuration objects relate to the physical media dependent (PMD) sublayer and the robust management channel (RMC). Channel configuration objects relate to the bearer channel-related aspects of the physical media specific – transmission convergence (PMS-TC) sublayer. Data path configuration objects relate to the transport protocol specific – transmission convergence (TPS-TC) sublayer.

At the DPU-NB interface, a line is monitored through the following information:
- line failures (see Table 7-4);
- channel failures (see Table 7-5);
- data path failures (see Table 7-6);
- line performance monitoring objects (see Table 7-7);
- channel performance monitoring objects (see Table 7-8) for the downstream channel;
- channel performance monitoring objects (see Table 7-8) for the upstream channel;
- data path performance monitoring objects (see Table 7-9) for the downstream data path;
- data path performance monitoring objects (see Table 7-9) for the upstream data path;
- line test, diagnostics and status objects (see Table 7-10);
- channel test, diagnostics and status objects (see Table 7-11) for the downstream channel;
- channel test, diagnostics and status objects (see Table 7-11) for the upstream channel;
- data path test, diagnostic and status objects (see Table 7-12) for the downstream channel;
- data path test, diagnostic and status objects (see Table 7-12) for the upstream channel;
- inventory objects (see Table 7-13).

As [ITU-T G.9701] supports a DPU with up to 128 lines, maintaining the performance monitoring and the test, diagnostic and status information for every line may become burdensome. Although access to all mandatory managed objects shall be supported at all times for all ports on the DPU at the DPU-NB interface towards the PMA (see Figure 5-1), the objects may not be maintained within the management entity of the DPU simultaneously for all lines at all times. Although reasonable performance shall be provided at the DPU-NB interface for access to the managed objects of any line, this Recommendation does not define specific performance requirements at this interface.

When the update request flag for test parameters (see clause 7.1.9) is set (its value is changed from 0 to 1), the near-end test parameters shall be updated in the DPU-MIB within 10 s. The update request flag for the near-end test parameters is defined in the DPU-MIB and is independent of any autonomous update process in the system. The parameter shall be reset (its value changed back to 0) by the DPU after a period shorter than 3 min to allow reception of another update request. The 3 min period starts from the last time the flag was set (externally or by an autonomous process in the system). This applies only to the elements maintained in the DPU.

Tables 7-1 to 7-11 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
- (O):   Optional

Entries in Tables 7-1 to 7-11 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, B_D_F. Also, the entry labelled with the name Ads/us represents two objects with names Ads and Aus. Near-end (-NE) objects apply to the FTU-O, while far-end (-FE) objects apply to the FTU-R.

Table 7-1 – Line configuration objects

Category/object	Defined in clause:	DPU-NB interface
Profiles		
[ITU-T G.9701] profiles enabling (PROFILES)	7.1.0.1	R/W (M)
Time division multiplexing (TDD)		
Symbol periods per TDD frame (MF)	7.1.1.1	R/W (M)
Symbol periods per TDD frame dedicated for downstream transmission (Mds)	7.1.1.2	R/W (M)
Cyclic extension (CE)	7.1.1.3	R/W (M)
Power and spectrum usage		
MAXATPds	7.1.2.1	R/W (M)
MAXATPus	7.1.2.2	R/W (M)
CARMASKds	7.1.2.3	R/W (M)
CARMASKus	7.1.2.4	R/W (M)
MIBPSDMASKds	7.1.2.5	R/W (M)
MIBPSDMASKus	7.1.2.6	R/W (M)
RFIBANDS	7.1.2.7	R/W (M)
IARBANDS	7.1.2.8	R/W (M)
UPBOPSDA	7.1.2.9	R/W (M)
UPBOPSDB	7.1.2.10	R/W (M)
UPBOKL	7.1.2.11	R/W (M)
UPBOKLF	7.1.2.12	R/W (M)
UPBOKLREF	7.1.2.13	R/W (M)
Noise margins		
TARSNRMds	7.1.3.1	R/W (M)
TARSNRMus	7.1.3.2	R/W (M)
MAXSNRMus	7.1.3.3	R/W (M)
MINSNRMds	7.1.3.4	R/W (M)
MINSNRMus	7.1.3.5	R/W (M)
Seamless rate adaptation (SRA)		
SRA-USNRMds	7.1.4.1	R/W (M)
SRA-UTIMEds	7.1.4.2	R/W (M)
SRA-USNRMus	7.1.4.3	R/W (M)
SRA-UTIMEus	7.1.4.4	R/W (M)
SRA-DSNRMds	7.1.4.5	R/W (M)

Table 7-1 – Line configuration objects

Category/object	Defined in clause:	DPU-NB interface
SRA-DTIMEds	7.1.4.6	R/W (M)
SRA-DSNRMus	7.1.4.7	R/W (M)
SRA-DTIMEus	7.1.4.8	R/W (M)
Fast rate adaptation (FRA)		
FRA-TIMEds	7.1.5.1	R/W (M)
FRA-TIMEus	7.1.5.2	R/W (M)
FRA-NTONESds	7.1.5.3	R/W (M)
FRA-NTONESus	7.1.5.4	R/W (M)
FRA-RTXUCds	7.1.5.5	R/W (M)
FRA-RTXUCus	7.1.5.6	R/W (M)
FRA-VENDISCds	7.1.5.7	R/W (M)
FRA-VENDISCus	7.1.5.8	R/W (M)
Robust management channel (RMC)		
TARSNRM-RMCds	7.1.6.1	R/W (M)
TARSNRM-RMCus	7.1.6.2	R/W (M)
MINSNRM-RMCds	7.1.6.3	R/W (M)
MINSNRM-RMCus	7.1.6.4	R/W (M)
MAXBL-RMCds	7.1.6.5	R/W (M)
MAXBL-RMCus	7.1.6.6	R/W (M)
Vectoring		
FEXT cancellation enabling/disabling downstream (FEXT_TO_CANCEL_ENABLEds)	7.1.7.1	R/W (M)
FEXT cancellation enabling/disabling upstream (FEXT_TO_CANCEL_ENABLEus)	7.1.7.2	R/W (M)
Re-initialization policy		
LOS-PERSISTENCYds	7.1.8.1	R/W (M)
LOS-PERSISTENCYus	7.1.8.2	R/W (M)
LOM-PERSISTENCYds	7.1.8.3	R/W (M)
LOM-PERSISTENCYus	7.1.8.4	R/W (M)
LOR-PERSISTENCYds	7.1.8.5	R/W (M)
LOR-PERSISTENCYus	7.1.8.6	R/W (M)
REINIT_TIME_THRESHOLDds	7.1.8.7	R/W (M)
REINIT_TIME_THRESHOLDus	7.1.8.8	R/W (M)
LOW_ETR_THRESHOLDds	7.1.8.9	R/W (M)
LOW_ETR_THRESHOLDus	7.1.8.10	R/W (M)
Update test parameters request		
UPDATE-NE-TEST	7.1.9.1	R/W (M)
UPDATE-FE-TEST	7.1.9.2	R/W (M)

Table 7-2 – Channel configuration objects

Category/object	Defined in clause:	DPU-NB interface
Data rate (downstream/upstream)		
Maximum net data rate (NDR) (MAXNDR ds/us)	7.2.1.1	R/W (M)
Minimum expected throughput (MINETRds/us)	7.2.1.2	R/W (M)
Maximum gamma data rate (GDR) (MAXGDRds/us)	7.2.1.3	R/W (M)
Minimum gamma data rate (MINGDRds/us)	7.2.1.4	R/W (M)
Retransmission (downstream/upstream)		
DELAYMAXds/us	7.2.2.1	R/W (M)
INPMIN_SHINEds/us	7.2.2.2	R/W (M)
SHINERATIOds/us	7.2.2.3	R/W (M)
INPMIN_REINds/us	7.2.2.4	R/W (M)
IAT_REINds/us	7.2.2.5	R/W (M)
RNRATIOds/us	7.2.2.6	R/W (M)
RTX_TESTMODEds/us	7.2.2.7	R/W (M)

Table 7-3 – Data path configuration objects

Category/object	Defined in clause:	DPU-NB interface
TPS_TESTMODE	7.3.1	R/W (M)
DRA_TESTMODE	7.3.2	R/W (M)

Table 7-4 – Line failures

Category/object	Defined in clause:	DPU-NB interface
Near-end (FTU-O) failures		
Loss of signal (LOS)	7.4.1.1	R (M)
Loss of margin (LOM)	7.4.1.2	R (M)
Loss of RMC (LOR)	7.4.1.3	R (M)
Loss of power (LPR)	7.4.1.4	R (M)
Far-end (FTU-R) failures		
Far-end loss of signal (LOS-FE) failure	7.4.2.1	R (M)
Far-end loss of margin (LOM-FE) failure	7.4.2.2	R (M)
Far-end loss of RMC (LOR-FE) failure	7.4.2.3	R (M)
Far-end loss of power (LPR-FE) failure	7.4.2.4	R (M)
Initialization failures		
Line init (LINIT) failure	7.4.3.1	R (M)

Table 7-5 – Channel failures

Category/object	Defined in clause:	DPU-NB interface
Near-end (FTU-O) failures		
Far-end (FTU-R) failures		

Table 7-6 – Data path failures

Category/object	Defined in clause:	DPU-NB interface
Near-end (FTU-O) failures		
Far-end (FTU-R) failures		

Table 7-7 – Line performance monitoring objects

Category/object	Defined in clause:	DPU-NB interface
Near-end (FTU-O)/Far-end (FTU-R) performance monitoring counters (current/previous 15 min/24 h interval)		
Measured time (CURR/PREV_NE/FE_15/24_L_TIME)	7.7.1	R (M)
Invalid data flag (PREV_NE/FE_15/24_L_INVALID)	7.7.2	R (M)
Time Stamp (PREV_NE/FE_15/24_L_STAMP)	7.7.3	R (M)
LOS failure counter (CURR/PREV_NE/FE_15/24_LOS)	7.7.4	R (M)
LOM failure counter (CURR/PREV_NE/FE_15/24_LOM)	7.7.5	R (M)
LOR failure counter (CURR/PREV_NE/FE_15/24_LOR)	7.7.6	R (M)
LPR failure counter (CURR/PREV_NE/FE_15/24_LPR)	7.7.7	R (M)
ES counter (CURR/PREV_NE/FE_15/24_ES)	7.7.8	R (M)
Severely errored second (SES) counter (CURR/PREV_NE/FE_15/24_SES)	7.7.9	R (M)
LOSS counter (CURR/PREV_NE/FE_15/24_LOSS)	7.7.10	R (M)
LOR second (LORS) counter (CURR/PREV_NE/FE_15/24_LORS)	7.7.11	R (M)

Table 7-7 – Line performance monitoring objects

Category/object	Defined in clause:	DPU-NB interface
Unavailable second (UAS) counter (CURR/PREV_NE/FE_15/24_UAS)	7.7.12	R (M)
Initialization performance monitoring counters (current/previous 15 min/24 h interval)		
Full inits counter (CURR/PREV_15/24_FULL_INITS)	7.7.13	R (M)
Failed full inits counter (CURR/PREV_15/24_FAILEDFULL_INITS)	7.7.14	R (M)
~~Short~~ Fast inits counter (CURR/PREV_15/24_FAST_INITS)	7.7.15	R (M)
Failed ~~short~~ Fast inits counter (CURR/PREV_15/24_FAILEDFAST_INITS)	7.7.16	R (M)
Short interruption performance monitoring counters (current/previous 15 min/24 h interval)		
LPR_INTRPT counter (CURR/PREV_15/24_LPR_INTRPT)	7.7.17	R (M)
HRI_INTRPT counter (CURR/PREV_15/24_HRI_INTRPT)	7.7.18	R (M)
SPONT_INTRPT counter (CURR/PREV_15/24_SPONT_INTRPT)	7.7.19	R (M)
Near-end (FTU-O)/far-end (FTU-R) initiated OLR/FRA performance monitoring counters (current and previous 15 min/24 h interval)		
Successful bitswap counter (CURR/PREV_NE/FE_15/24_BSW)	7.7.20	R (M)
Successful autonomous SRA counter (CURR/PREV_NE/FE_15/24_SRA)	7.7.21	R (M)
Successful FRA counter (CURR/PREV_NE/FE_15/24_FRA)	7.7.22	R (M)
Successful RPA counter (CURR/PREV_NE/FE_15/24_RPA)	7.7.23	R (M)
Near-end (FTU-O) initiated TIGA performance monitoring counters (current and previous 15 min/24 h interval)		
Successful TIGA counter (CURR/PREV_15/24_TIGA)	7.7.24	R (M)

Table 7-8 – Channel performance monitoring objects

Category/object	Defined in clause:	DPU-NB interface
Near-end (FTU-O)/far-end (FTU-R) performance monitoring counters (current/previous 15 min/24 h interval)		
Measured Time (CURR/PREV_NE/FE_15/24_C_TIME)	7.8.1	R (M)
Invalid Data Flag (PREV_NE/FE_15/24_C_INVALID)	7.8.2	R (M)
Time Stamp (PREV_NE/FE_15/24_C_STAMP)	7.8.3	R (M)
CV C counter (CURR/PREV_NE/FE_15/24_CV)	7.8.4	R (M)
RTXUC C counter (CURR/PREV_NE/FE_15/24_RTXUC)	7.8.5	R (M)
RTXTX C counter (CURR/PREV_NE/FE_15/24_RTXTX)	7.8.6	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 7-9 – Data path performance monitoring objects

Category/object	Defined in clause:	DPU-NB interface

Table 7-10 – Line test, diagnostic and status objects

Category/object	Defined in clause:	DPU-NB interface
Profile		
[ITU-T G.9701] profile (PROFILE)	7.10.1.1	R (M)
Initialization		
Initialization success/failure cause (INITSFCAUSE)	7.10.2.1	R (M)
Initialization last transmitted downstream signal (INITLASTSSIGNALds)	7.10.2.2	R (M)
Initialization last received upstream signal (INITLASTSIGNALus)	7.10.2.3	R (M)
Signal-to-noise ratio (SNR) margin		
SNRMds	7.10.3.3	R (M)
SNRMus	7.10.3.2	R (M)
Upstream power back-off		
UPBOKLE	7.10.4.1	R (M)
UPBOKLE-R	7.10.4.2	R (M)

Table 7-10 – Line test, diagnostic and status objects

Category/object	Defined in clause:	DPU-NB interface
Actual aggregate transmit power		
ACTATPds	7.10.5.1	R (M)
ACTATPus	7.10.5.2	R (M)
Actual transmit power spectrum density per sub-carrier		
ACTPSDpsds	7.10.6.1	R (M)
ACTPSDpsus	7.10.6.2	R (M)
Channel characteristics per sub-carrier		
For further study	7.10.7	
Signal-to-noise ratio per sub-carrier		
SNRMTds	7.10.8.1	R (M)
SNRGds	7.10.8.2	R (M)
SNRpsds	7.10.8.3	R (M)
SNRMTus	7.10.8.4	R (M)
SNRGus	7.10.8.5	R (M)
SNRpsus	7.10.8.6	R (M)
Bit allocation per sub-carrier on data symbols		
BITSpsds	7.10.11.1	R (M)
BITSpsus	7.10.11.2	R (M)
Robust management channel (RMC)		
SNRM-RMCds	7.10.12.1	R (M)
SNRM-RMCus	7.10.12.2	R (M)
BITS-RMCpsds	7.10.12.3	R (M)
BITS-RMCpsus	7.10.12.4	R (M)
Test parameter time stamps		
STAMP-TEST-NE	7.10.13.1	R (M)
STAMP-TEST-FE	7.10.13.2	R (M)
On-line reconfiguration (OLR) time stamps		
STAMP-BSWds	7.10.14.1	R (M)
STAMP-BSWus	7.10.14.2	R (M)
STAMP-SRAds	7.10.14.3	R (M)
STAMP-SRAus	7.10.14.4	R (M)
STAMP-FRAds	7.10.14.5	R (M)
STAMP-FRAus	7.10.14.6	R (M)
STAMP-RPAds	7.10.14.7	R (M)
STAMP-RPAus	7.10.14.8	R (M)
STAMP-TIGA	7.10.14.9	R (M)

Table 7-11 – Channel test, diagnostic and status objects

Category/object	Defined in clause:	DPU-NB interface
Actual data rates (downstream/upstream)		
Net data rate (NDRds/us)	7.11.1.1	R (M)
Expected throughput (ETRds/us)	7.11.1.2	R (M)
Gamma data rate (GDRds/us)	7.11.1.3	R (M)
Attainable data rates (downstream/upstream)		
Attainable net data rate (ATTNDRds/us)	7.11.2.1	R (M)
Attainable expected throughput (ATTETRds/us)	7.11.2.2	R (M)
Attainable gamma data rate (ATTGDRds/us)	7.11.2.3	R (M)
Actual impulse noise protection (downstream/upstream)		
ACTINPds/us	7.11.3.1	R (M)
ACTINP_REINds/us	7.11.3.2	R (M)
Actual framer setting (downstream/upstream)		
DTU-NFECds/us	7.11.4.1	R (M)
DTU-RFECds/us	7.11.4.2	R (M)
DTU-Qds/us	7.11.4.3	R (M)
Test parameters per time interval (downstream/upstream)		
Error-free bits current 15 min (EFB-C15Mds/us)	7.11.5.1	R (M)
Error-free bits previous 15 min (EFB-P15Mds/us)	7.11.5.2	R (M)
Error-free bits current 24 h (EFB-C24Hds/us)	7.11.5.3	R (M)
Error-free bits previous 24 h (EFB-P24Hds/us)	7.11.5.4	R (M)
MINEFTR current 15 min (MINEFTR_C15Mds/us)	7.11.5.5	R (M)
MINEFTR previous 15 min (MINEFTR_P15Mds/us)	7.11.5.6	R (M)
MINEFTR current 24 h (MINEFTR_C24Hds/us)	7.11.5.7	R (M)
MINEFTR previous 24 h (MINEFTR_P24Hds/us)	7.11.5.8	R (M)

Table 7-12 – Data path test, diagnostic and status objects

Category/object	Defined in clause:	DPU-NB interface

Table 7-13 – Inventory objects

Category/object	Defined in clause:	DPU-NB interface
FTU related inventory		
FTU-O ITU-T G.994.1 vendor ID (FTUO_GHS_VENDOR)	7.13.1.1	R (M)
FTU-R ITU-T G.994.1 vendor ID (FTUR_GHS_VENDOR)	7.13.1.2	R (M)
FTU-O version number (FTUO_VERSION)	7.13.1.3	R (M)
FTU-R version number (FTU-R VERSION)	7.13.1.4	R (M)
FTU-O self-test result (FTUO-SELFTEST)	7.13.1.5	R (M)
FTU-R self-test result (FTUR_SELFTEST)	7.13.1.6	R (M)
System related inventory		
DPU system vendor ID (DPU_SYSTEM_VENDOR)	7.13.2.1	R (M)
NT system vendor ID (NT_SYSTEM_VENDOR)	7.13.2.2	R (M)
DPU serial number (DPU_SYSTEM_SERIALNR)	7.13.2.3	R (M)
NT serial number (NT_SYSTEM_SERIALNR)	7.13.2.4	R (M)

7.1 Line configuration objects

7.1.0 Profiles

7.1.0.1 ITU-T G.9701 profiles enabling (PROFILES)

Description: Defines for each profile whether operation according to that profile is allowed or disallowed.

Type: Array of PROFILEdescriptor[0...N-1] with N<=1.

PROFILEdescriptor

> **Type**: boolean.
> **Valid values**: false (disallowed) and true (allowed).

Bit representation

0   [ITU-T G.9701] profile 106a.

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

Reference: Clause 6 of [ITU-T G.9701].

7.1.1 Time division multiplexing

7.1.1.1 Number of symbol periods in a TDD frame (MF)

Description: Defines the total number of symbol periods in a TDD frame.

Type: 8-bit unsigned integer.

Valid values: 23 and 36.

Default value: 36.

Reference: Clause 10.5 of [ITU-T G.9701].

7.1.1.2   Number of downstream symbol periods in a TDD frame (Mds)

Description: Defines the total number of symbol positions in a TDD frame allocated for downstream transmission. The total number of symbol positions in a TDD frame allocated for upstream transmission is calculated as Mus = MF--1--Mds.

Type: 8-bit unsigned integer.

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

Default value: 28 (if MF=36) and 18 (if MF=23).

Reference: Clause 10.5 of [ITU-T G.9701].

7.1.1.3   Cyclic extension (CE)

Description: Defines the cyclic extension (L_{CP}) to be used.

Type: 8-bit unsigned integer.

Unit: N/64 samples, with N = index of highest supported downstream data-bearing sub-carrier as defined for the enabled profile (see Table 6-1 of [ITU-T G.9701]) 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.9701].

7.1.2   Power and spectrum usage

7.1.2.1   Downstream maximum aggregate transmit power (MAXATPds)

Description: Defines the maximum aggregate transmit power at the U-O2 reference point in the downstream direction during initialization and showtime (in dBm).

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.9701].

7.1.2.2   Upstream maximum aggregate transmit power (MAXATPus)

Description: Defines the maximum aggregate transmit power at the U-R2 reference point in the upstream direction during initialization and showtime (in dBm).

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.9701].

7.1.2.3 Downstream sub-carrier masking (CARMASKds)

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

Type: Array of CARMASKdescriptor[0...N-1], with N <= 32.

CARMASKdescriptor:

Type: Record of a start sub-carrier index and a stop sub-carrier index.

Sub-carrier index:

Type: 16-bit unsigned integer.

Valid values: 0...4095 (sub-carrier index 0 to 4095).

Default value: Empty array (No masked sub-carriers).

Reference: Clause 6.3 of [ITU-T G.9700], and clause 7.3.1.3 of [ITU-T G.9701].

7.1.2.4 Upstream sub-carrier masking (CARMASKus)

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

Type: Array of CARMASKdescriptor[0...N-1], with N <= 32.

CARMASKdescriptor: See CARMASKds in clause 7.1.2.3.

Default value: Empty array (No masked sub-carriers).

Reference: Clause 6.3 of [ITU-T G.9700] and clause 7.3.1.3 of [ITU-T G.9701].

7.1.2.5 Downstream PSD mask (MIBPSDMASKds)

Description: Defines the downstream power spectral density (PSD) mask applicable at the U-O2 reference point. 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.9701].

Type: Array of MIBPSDMASKdescriptor[0...N-1], with N=0 or 2<=N <= 32.

PSDMASKdescriptor:

> **Type**: Record of a sub-carrier index and a PSD level.
> **Sub-carrier index**:
>> **Type**: 16-bit unsigned integer.
>> **Valid values:** 0...4095 (sub-carrier index 0 to 4095).
> **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.9700]).

Reference: Clause 7.3.1.1 of [ITU-T G.9701].

7.1.2.6 Upstream PSD mask (MIBPSDMASKus)

Description: Defines the upstream PSD mask applicable at the U-R2 reference point. 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.9701].

Type: Array of MIBPSDMASKdescriptor[0...N-1], with N=0 or 2<=N <= 32.

PSDMASKdescriptor: See MIBPSDMASKds in clause 7.1.2.5.

Default value: Empty array (Limit PSD mask defined in [ITU-T G.9700]).

Reference: Clause 7.3.1.1 of [ITU-T G.9701].

7.1.2.7   RFI bands (RFIBANDS)

Description: Defines the bands where the PSD shall be reduced as specified in clause 7.3.1.2 of [ITU-T G.9701].

Type: Array of RFIBANDdescriptor[0...N-1], with N <= ~~16~~32.

RFIBANDdescriptor:

    Type: Record of a start sub-carrier index and a stop sub-carrier index.

    Sub-carrier index:

        Type: 16-bit unsigned integer.

        Valid values: 0...4095 (sub-carrier index 0 to 4095).

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.9701].

7.1.2.8   International amateur radio bands (IARBANDS)

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

Type: Array of IARBANDdescriptor[0...11].

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 10100-10150 kHz
4	International amateur radio band 14000-14350 kHz
5	International amateur radio band 18068-18168 kHz
6	International amateur radio band 21000-21450 kHz
7	International amateur radio band 24890-24990 kHz
8	International amateur radio band 28000-29700 kHz
9	International amateur radio band 50000-54000 kHz
10	International amateur radio band 70000-70500 kHz
11	International amateur radio band 144000-148000 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.9701], Tables 11.70.8 and 11.70.8.1 of [ITU-T G.994.1].

7.1.2.9   Upstream power back-off reference PSD (UPBOPSDA)

Description: Defines the parameter *a* for the UPBO reference PSD used to compute the upstream power back-off 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 7.3.1.4 of [ITU-T G.9701].

7.1.2.10   Upstream power back-off reference PSD (UPBOPSDB)

Description: Defines the parameter *b* for the UPBO reference PSD used to compute the upstream power back-off 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 7.3.1.4 of [ITU-T G.9701].

7.1.2.11   Upstream electrical length (UPBOKL)

Description: Defines the electrical length kl_0 (expressed in dB 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 7.3.1.4.2.1 of [ITU-T G.9701].

7.1.2.12   Force electrical length (UPBOKLF)

Description: Defines whether or not the FTU-R is forced to use the electrical length $kl_0 = $ UPBOKL to compute the UPBOMASK. If not forced, the FTUs determine the electrical length kl_0.

Type: boolean.

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

Default value: false (not forced).

Reference: Clause 7.3.1.4.2.1 of [ITU-T G.9701].

7.1.2.13   UPBO reference electrical length per band (UPBOKLREF)

Description: Defines the UPBO reference electrical length kl_{0_REF} used to compute the upstream power back-off for the Equalized 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 7.3.1.4.2.2 of [ITU-T G.9701].

7.1.3 Noise margin

7.1.3.1 Downstream target noise margin (TARSNRMds)

Description: Defines 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.9701].

7.1.3.2 Upstream target noise margin (TARSNRMus)

Description: Defines 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.9701].

7.1.3.3 Upstream maximum noise margin (MAXSNRMus)

Description: Defines 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.9701].

7.1.3.4 Downstream minimum noise margin (MINSNRMds)

Description: Defines the downstream minimum noise margin the FTU-R receiver shall tolerate. If the downstream noise margin (SNRMds) falls below this level, a loss-of-margin (*lom*) defect occurs. Upon persistency of the *lom* defect, the FTU-R triggers a re-initialization (see clause 12.1.4.2 of [ITU-T G.9701]).

Type: 16-bit unsigned integer.

Unit: 0.1 dB.

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

Default value: 0 (0 dB).

Reference: Clause 12.3.4.2.1 of [ITU-T G.9701].

7.1.3.5 Upstream minimum noise margin (MINSNRMus)

Description: Defines the upstream minimum noise margin the FTU-O receiver shall tolerate. If the upstream noise margin (SNRMus) falls below this level, the FTU-O requests the FTU-R to increase the FTU-R transmit power. If an increase to FTU-R transmit power is not possible, a *lom* defect occurs. Upon persistency of the *lom* defect, the FTU-O triggers a re-initialization (see clause 12.1.4.2 of [ITU-T G.9701]).

Type: 16-bit unsigned integer.

Unit: 0.1 dB.

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

Default value: 0 (0 dB).

Reference: Clause 12.3.4.2.1 of [ITU-T G.9701].

7.1.4 Seamless rate adaptation

7.1.4.1 Downstream upshift noise margin (SRA-USNRMds)

Description: If the downstream noise margin (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 FTU-R autonomously attempts to increase the downstream net data rate (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.9701].

7.1.4.2 Upstream upshift noise margin (SRA-USNRMus)

Description: If the upstream noise margin (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 FTU-O autonomously attempts to increase the upstream net data rate (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.9701].

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

Description: Defines the interval of time the downstream noise margin (SNRMds) should stay above the downstream upshift noise margin (SRA-USNRMds) before the FTU-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.9701].

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

Description: Defines the interval of time the upstream noise margin (SNRMus) should stay above the upstream upshift noise margin (SRA-USNRMus) before the FTU-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.9701].

7.1.4.5 Downstream downshift noise margin (SRA-DSNRMds)

Description: If the downstream noise margin (SNRMds) is below the downstream downshift noise margin and stays below that for more than the time specified by the downstream minimum downshift rate adaptation interval (SRA-DTIMEds), the FTU-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.9701].

7.1.4.6 Upstream downshift noise margin (SRA-DSNRMus)

Description: If the upstream noise margin (SNRMus) is below the upstream downshift noise margin and stays below that for more than the time specified by the upstream minimum downshift rate adaptation interval (SRA-DTIMEus), the FTU-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.9701].

7.1.4.7 Downstream minimum time interval for downshift SRA (SRA-DTIMEds)

Description: Defines the interval of time the downstream noise margin (SNRMds) should stay below the downstream downshift noise margin (SRA-DSNRMds) before the FTU-R autonomously attempts to decrease the NDRds.

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.9701].

7.1.4.8 Upstream minimum time interval for downshift SRA (SRA-DTIMEus)

Description: Defines the interval of time the upstream noise margin (SNRMus) should stay below the upstream downshift noise margin (SRA-DSNRMus) before the FTU-O autonomously attempts to decrease the NDRus.

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.9701].

7.1.5 Fast rate adaptation

7.1.5.1 Downstream FRA time window (FRA-TIMEds)

Description: Defines the duration of the time window used in the standard FRA triggering criteria (see clause 13.4.3.2 of [ITU-T G.9701]) 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...8 (if MF=36) or ~~and~~ 1...12 (if MF=23)).

Default value: 8 (if MF=36) or~~and~~ 12 (if MF=23).

Reference: Clause 13.3.1.1.1.1 of [ITU-T G.9701].

7.1.5.2 Upstream FRA time window (FRA-TIMEus)

Description: Defines the duration of the time window used in the standard FRA triggering criteria (see clause 13.4.3.2 of [ITU-T G.9701]) 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...8 (if MF=36) or ~~and~~ 1...12 (if MF=23)).

Default value: 8 (if MF=36) or~~and~~ 12 (if MF=23).

Reference: Clause 13.3.1.1.1.1 of [ITU-T G.9701].

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

Description: Defines the minimum percentage of loaded sub-carriers 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.9701]) in the downstream direction. The special value 0 indicates that monitoring of the percentage of degraded sub-carriers 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.9701].

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

Description: Defines the minimum percentage of loaded sub-carriers (i.e., sub-carriers with $bi>0$) 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.9701]) in the upstream direction. The special value 0 indicates that monitoring of the percentage of degraded sub-carriers 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.9701].

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

Description: Defines 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.9701]) 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.9701].

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

Description: Defines 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.9701]) 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.9701].

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

Description: Defines 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.9701].

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

Description: Defines 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.9701].

7.1.6 Robust management channel

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

Description: Defines the downstream RMC noise margin (SNRM-RMCds) that the FTU-R 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 12.3.3.2.1 of [ITU-T G.9701].

7.1.6.2 Upstream target noise margin (TARSNRM-RMCus)

Description: Defines the upstream RMC noise margin (SNRM-RMCus) that the FTU-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 12.3.3.2.1 of [ITU-T G.9701].

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

Description: Defines the downstream minimum noise margin the FTU-R receiver tolerates for the RMC. If the downstream RMC noise margin (SNRM-RMCds) falls below this level, the FTU-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.9701].

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

Description: Defines the upstream minimum noise margin the FTU-O receiver tolerates for the RMC. If the downstream RMC noise margin (SNRM-RMCus) falls below this level, the FTU-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.9701].

7.1.6.5 Downstream maximum bitloading for RMC (MAXBL-RMCds)

Description: Defines the maximum allowed bit-loading for the downstream RMC sub-carriers.

Type: 8-bit unsigned integer.

Valid values: 2...6.

Default value: 6.

Reference: Clause 12.3.3.2.1 of [ITU-T G.9701].

7.1.6.6 Upstream maximum bitloading for RMC (MAXBL-RMCus)

Description: Defines the maximum allowed bit-loading for the upstream RMC sub-carriers.

Type: 8-bit unsigned integer.

Valid values: 2...6.

Default value: 6.

Reference: Clause 12.3.3.2.1 of [ITU-T G.9701].

7.1.7 Vectoring

7.1.7.1 FEXT cancellation enabling/disabling downstream (FEXT_TO_CANCEL_ENABLEds)

Description: Defines 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.9701].

7.1.7.2 FEXT cancellation enabling/disabling upstream (FEXT_TO_CANCEL_ENABLEus)

Description: Defines 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.9701].

7.1.8 Re-initialization policy

7.1.8.1 Downstream los defect persistency (LOS_PERSISTENCYds)

Description: Defines the downstream *los* defect persistency for triggering a re-initialization (see clause 12.1.4.2) at the FTU-R receiver, as part of the re-initialization 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.9701].

7.1.8.2 Upstream los defect persistency (LOS_PERSISTENCYus)

Description: Defines the upstream *los* defect persistency for triggering a re-initialization (see clause 12.1.4.2) at the FTU-O receiver, as part of the re-initialization 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.9701].

7.1.8.3 Downstream *lom* defect persistency (LOM_PERSISTENCYds)

Description: Defines the downstream *lom* defect persistency for triggering a re-initialization (see clause 12.1.4.2) at the FTU-R receiver, as part of the re-initialization policy.

Type: 8-bit unsigned integer.

Unit: 1 s.

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

Default value: 2 (2 s).

Reference: Clause 12.1.4.3.2 of [ITU-T G.9701].

7.1.8.4 Upstream *lom* defect persistency (LOM_PERSISTENCYus)

Description: Defines the upstream *lom* defect persistency for triggering a re-initialization (see clause 12.1.4.2) at the FTU-O receiver, as part of the re-initialization policy.

Type: 8-bit unsigned integer.

Unit: 1 s.

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

Default value: 2 (2 s).

Reference: Clause 12.1.4.3.2 of [ITU-T G.9701].

7.1.8.5 Downstream *lor* defect persistency (LOR_PERSISTENCYds)

Description: Defines the downstream *lor* defect persistency for triggering a re-initialization (see clause 12.1.4.2) at the FTU-R receiver, as part of the re-initialization 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.9701].

7.1.8.6 Upstream *lor* defect persistency (LOR_PERSISTENCYus)

Description: Defines the upstream *lor* defect persistency for triggering a re-initialization (see clause 12.1.4.2) at the FTU-O receiver, as part of the re-initialization 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.9701].

7.1.8.7 Downstream re-initialization time threshold (REINIT_TIME_THRESHOLDds)

Description: Defines the downstream threshold for the SES and eoc timeout conditions for declaring a High_BER event (see clause 12.1.4.3.4) at the FTU-R receiver, as part of the re-initialization 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.9701].

7.1.8.8 Upstream re-initialization time threshold (REINIT_TIME_THRESHOLDus)

Description: Defines the upstream threshold for the SES and eoc timeout conditions for declaring a High_BER event (see clause 12.1.4.3.4) at the FTU-O receiver, as part of the re-initialization 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.9701].

7.1.8.9 Downstream low ETR threshold (LOW_ETR_THRESHOLDds)

Description: Defines the downstream threshold for the low ETR condition for declaring a High_BER event (see clause 12.1.4.3.4) at the FTU-R receiver, as part of the re-initialization 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.9701].

7.1.8.10 Upstream low ETR threshold (LOW_ETR_THRESHOLDus)

Description: Defines the upstream threshold for the low ETR condition for declaring a High_BER event (see clause 12.1.4.3.4) at the FTU-O receiver, as part of the re-initialization 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.9701].

7.1.9 Update test parameters

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

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

Type: boolean.

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

Default value: false (no update forced).

Reference: Clause 11.1 of [ITU-T G.9701].

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

Description: Forces an update of the far-end test parameters that can be updated during showtime. See introductory text to clause 7.

Type: boolean.

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

Default value: false (no update forced).

Reference: Clause 11.1 of [ITU-T G.9701].

7.2 Channel configuration objects

7.2.1 Data rates

7.2.1.1 Maximum net data rate (MAXNDRds/us)

Description: Defines the value of the maximum NDR (see clause 11.4.2.2 of [ITU-T G.9701]).

Type: 32-bit unsigned integer.

Unit: 1000 bit/second.

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.9701].

7.2.1.2 Minimum expected throughput (MINETRds/us)

Description: Defines the value of the minimum expected throughput (see clause 11.4.2.1 of [ITU-T G.9701]).

Type: 32-bit unsigned integer.

Unit: 1000 bit/second.

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.9701].

7.2.1.3 Maximum gamma data rate (MAXGDRds/us)

Description: Defines the maximum value of the gamma data rate (GDR) (see clause 7.11.1.3). The GDR shall not exceed MAXGDR at the start of showtime and during showtime.

Type: 32-bit unsigned integer.

Unit: 1000 bit/second.

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

Default value: 4294967295 (4294967295 kbit/s).

Reference: None.

7.2.1.4 Minimum gamma data rate (MINGDRds/us)

Description: Defines the minimum value of the GDR (see clause 7.11.1.3). The GDR may be less than MINGDR. If the GDR is less than MINGDR at initialization or when GDR becomes less than MINGDR during showtime, a threshold crossing alert occurs.

Type: 32-bit unsigned integer.

Unit: 1000 bit/second.

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

Default value: 0 (0 bit/second).

Reference: None.

7.2.2 Retransmission

7.2.2.1 Maximum delay (DELAYMAXds/us)

Description: Defines the maximum allowed delay for retransmission (see clause 9.8 of [ITU-T G.9701]). The ITU-T G.9701 control parameter *delay_max* is set to the same value as the maximum delay (see clause 11.4.2.3 of [ITU-T G.9701]).

Type: 32-bit unsigned integer.

Unit: 0.25 ms.

Valid values: 4...252 (1 to 63 ms).

Default value: 40 (10 ms).

Reference: Clause 11.4.2.3 of [ITU-T G.9701].

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

Description: Defines the minimum impulse noise protection against SHINE (see clause 9.8 of [ITU-T G.9701]). The ITU-T G.9701 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.9701]).

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.9701].

7.2.2.3 SHINE ratio (SHINERATIOds/us)

Description: Defines the *SHINEratio* that is used in the definition of the expected throughput rate (*ETR*) (see clause 9.8 of [ITU-T G.9701]). The ITU-T G.9701 control parameter *SHINEratio* is set to the same value as the SHINE ratio (see clause 11.4.2.5 of [ITU-T G.9701]).

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.9701].

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

Description: Defines the minimum impulse noise protection against repetitive electrical impulse noise (REIN) (see clause 9.8 of [ITU-T G.9701]). The ITU-T G.9701 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.9701]).

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.9701].

7.2.2.5 REIN inter-arrival time (IAT_REINds/us)

Description: Defines the REIN inter-arrival time (see clause 9.8 of [ITU-T G.9701]). The ITU-T G.9701 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.9701]).

Type: enumeration.

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

Default value: 0 (100 Hz).

Reference: Clause 11.4.2.7 of [ITU-T G.9701].

7.2.2.6 Minimum Reed-Solomon RFEC/NFEC ratio (RNRATIOds/us)

Description: Defines the minimal required ratio, RFEC/NFEC, of Reed-Solomon code parameters. The ITU-T G.9701 control parameter *rnratio* is set to the same value as the minimum Reed-Solomon RFEC/NFEC ratio (see clause 11.4.2.8 of [ITU-T G.9701]).

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.9701].

7.2.2.7 RTX-TC testmode (RTX_TESTMODEds/us)

Description: Defines whether the retransmisison testmode defined in clause 9.8.3.1.2 of [ITU-T G.9701] is enabled or disabled. The RTX_TESTMODE setting may be changed during showtime. When changed, it shall take effect on the line 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.9701].

7.3 Data path configuration objects

7.3.1 TPS-TC testmode (TPS_TESTMODE)

Description: Defines whether the TPS-TC testmode defined in clause 8.3.1 of [ITU-T G.9701] is enabled or disabled. The TPS_TESTMODE setting may be changed during showtime. When changed, it shall take effect on the line 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.9701].

7.3.2 DRA testmode (DRA_TESTMODE)

Description: Defines whether the dynamic resource allocation (DRA) testmode defined in clause 9.8.3.1.2 of [ITU-T G.9701] is enabled or disabled. The DRA_TESTMODE setting may be changed during showtime. When changed, it shall take effect on the line 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.9701].

7.4 Line failures

Any failure defined 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 far-end failure detections shall be provided at the DPU (NT is at the far-end), and may be provided at the NT (DPU is at the far-end).

7.4.1 Near-end failures

7.4.1.1 Loss of signal failure

A LOS failure is declared when a re-initialization is triggered by a persistent near-end *los* defect. A LOF failure is cleared immediately at the start of showtime in the receiving direction.

7.4.1.2 Loss of RMC failure

A loss of RMC (LOR) failure is declared when a re-initialization is triggered by a persistent near-end *lor* defect and no LOS failure is present. A LOR failure is cleared immediately at the start of showtime in the receiving direction.

7.4.1.3 Loss of margin failure

A LOM failure is declared when a re-initialization is triggered by a persistent near-end *lom* defect and no LOS failure is present an no LOR failure is present. A LOM failure is cleared immediately at the start of showtime in the receiving direction.

7.4.1.4 Loss of power failure

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

7.4.2 Far-end failures

7.4.2.1 Far-end loss of signal failure

A LOS-FE failure is declared when a re-initialization is triggered with a far-end *los* defect present. A LOS-FE failure is cleared immediately at the start of showtime in the transmitting direction.

7.4.2.2 Far-end loss of RMC failure

A LOR-FE failure is declared when a re-initialization is triggered with a far-end *lor* defect present and no LOS-FE failure is present. A LOR-FE failure is cleared immediately at the start of showtime in the transmitting direction.

7.4.2.3 Far-end loss of margin failure

A LOM-FE failure is declared when a re-initialization is triggered with a far-end *lom* defect present 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.

7.4.2.4 Far-end loss of power failure

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

7.4.3 Initialization failures

7.4.3.1 Line 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 and/or within a vendor discretionary timeout), then an initialization failure occurs. An initialization failure cause and last successful transmitted state are reported (see clause 7.10.2).

7.5 Channel failures

No channel failures are defined.

7.6 Data path failures

No data path failures are defined.

7.7 Line performance monitoring objects

The line performance monitoring objects defined in Table 7-7 are subject to the rules defined 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.

7.7.1 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.

7.7.2 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.

7.7.3 Time Stamp (PREV_NE/FE_15/24_L_STAMP)

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

Type: String (as defined in clause 8.12).

Reference: None.

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

Description: For NE, reports a count of the LOS failures defined in clause 7.4.1.1. For FE, reports a count of the LOS-FE failures defined in clause 7.4.2.1.

Type: 32-bit unsigned integer.

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

Reference: Clauses 7.4.1.1 and 7.4.2.1.

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

Description: For NE, reports a count of the LOR failures defined in clause 7.4.1.2. For FE, reports a count of the LOR-FE failures defined in clause 7.4.2.2.

Type: 32-bit unsigned integer.

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

Reference: Clauses 7.4.1.2 and 7.4.2.2.

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

Description: For NE, reports a count of the LOM failures defined in clause 7.4.1.3. For FE, reports a count of the LOM-FE failures defined in clause 7.4.2.3.

Type: 32-bit unsigned integer.

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

Reference: Clauses 7.4.1.3 and 7.4.2.3.

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

Description: For NE, reports a count of the LPR failures defined in clause 7.4.1.4. For FE, reports a count of the LPR-FE failures defined in clause 7.4.2.4.

Type: 32-bit unsigned integer.

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

Reference: Clauses 7.4.1.4 and 7.4.2.4.

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

Description: Reports the count of errored seconds (ESs). An ES is defined in clause 11.4.4.2 of [ITU-T G.9701].

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.9701].

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

Description: Reports the count of SESs. An SES is defined in clause 11.4.4.3 of [ITU-T G.9701].

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.9701].

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

Description: Reports the count of LOS seconds (LOSS). A LOSS is defined in clause 11.4.4.4 of [ITU-T G.9701].

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.9701].

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

Description: Reports the count of LORS. A LORS is defined in clause 11.4.4.5 of [ITU-T G.9701].

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.9701].

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

Description: Reports the count of unavailable seconds (UAS). An unavailable second (UAS) is defined in clause 11.4.4.6 of [ITU-T G.9701].

Type: 32-bit unsigned integer.

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

Reference: Clause 11.4.4.6 of [ITU-T G.9701].

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

Description: Reports a count of the full initialization primitives (full_init). The full initialization primitive (full_init) is defined in clause 11.3.1.5 of [ITU-T G.9701]. 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.9701].

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

Description: Reports a count of the failed full initialization primitives (failedfull_init). The failed full initialization primitive (failedfull_init) is defined in clause 11.3.1.5 of [ITU-T G.9701]. 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.9701].

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

Description: Reports a count of the fast initialization primitives (*fast_init*). The fast initialization primitive (*fast_init*) is defined in clause 11.3.1.5 of [ITU-T G.9701]. 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.9701].

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

Description: Reports a count of the failed fast initialization primitives (*failedfast_init*). The failed fast initialization primitive (*failedfast_init*) is defined in clause 11.3.1.5 of [ITU-T G.9701]. 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.9701].

7.7.17 LPR_INTRPT counter (CURR/PREV_15/24_LPR_INTRPT)

Description: Reports a count of the loss-of-power interruption anomalies (*lpr_intrpt*). The loss-of-power interruption anomaly (*lpr_intrpt*) is defined in clause 11.3.1.1 of [ITU-T G.9701]. 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.9701].

7.7.18 HRI_INTRPT counter (CURR/PREV_15/24_HRI_INTRPT)

Description: Reports a count of the host-reinit interruption anomalies (*hri_intrpt*). The host-reinit interruption anomaly (*hri_intrpt*) is defined in clause 11.3.1.1 of [ITU-T G.9701]. 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.9701].

7.7.19 SPONT_INTRPT counter (CURR/PREV_15/24_SPONT_INTRPT)

Description: Reports a count of the spontaneous interruption anomalies (*spont_intrpt*). The spontaneous interruption anomaly (*spont_intrpt*) is defined in clause 11.3.1.1 of [ITU-T G.9701]. 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.9701].

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

Description: Reports a count of the successful bit swap primitives (*success_BSW*). The successful bit swap primitive (*success_BSW*) is defined in clause 11.3.1.6 of [ITU-T G.9701].

Type: 32-bit unsigned integer.

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

Reference: Clause 11.3.1.6 of [ITU-T G.9701].

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

Description: Reports a count of the successful autonomous SRA primitives (*success_SRA*). The successful autonomous SRA primitive (*success_SRA*) is defined in clause 11.3.1.6 of [ITU-T G.9701].

Type: 32-bit unsigned integer.

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

Reference: Clause 11.3.1.6 of [ITU-T G.9701].

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

Description: Reports a count of the successful FRA primitives (*success_FRA*). The successful FRA primitive (*success_FRA*) is defined in clause 11.3.1.6 of [ITU-T G.9701].

Type: 32-bit unsigned integer.

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

Reference: Clause 11.3.1.6 of [ITU-T G.9701].

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

Description: Reports a count of the successful RPA primitives (*success_RPA*). The successful RPA primitive (*success_RPA*) is defined in clause 11.3.1.6 of [ITU-T G.9701].

Type: 32-bit unsigned integer.

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

Reference: Clause 11.3.1.6 of [ITU-T G.9701].

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

Description: Reports a count of the successful TIGA primitives (*success_TIGA*). The successful TIGA primitive (*success_TIGA*) is defined in clause 11.3.1.6 of [ITU-T G.9701]. 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.9701].

7.8 Channel performance monitoring objects

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

7.8.1 Measured Time (CURR/PREV_NE/FE_15/24_C_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_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.

7.8.3 Time Stamp (PREV_NE/FE_15/24_C_STAMP)

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

Type: String (as defined in clause 8.12).

Reference: None.

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

Description: Reports a count of the cyclic redundancy check anomalies (*crc*). The cyclic redundancy check anomaly (*crc*) is defined in clause 11.3.1.1 of [ITU-T G.9701].

Type: 32-bit unsigned integer.

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

Reference: Clause 11.3.1.1 of [ITU-T G.9701].

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

Description: Reports a count of the uncorrected DTU anomalies (*rtx-uc*). The uncorrected DTU anomaly (*rtx-uc*) is defined in clause 11.3.1.1 of [ITU-T G.9701].

Type: 32-bit unsigned integer.

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

Reference: Clause 11.3.1.1 of [ITU-T G.9701].

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

Description: Reports a count of the retransmitted DTU anomalies (*rtx-tx*). The retransmitted DTU anomaly (*rtx-tx*) is defined in clause 11.3.1.1 of [ITU-T G.9701].

Type: 32-bit unsigned integer.

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

Reference: Clause 11.3.1.1 of [ITU-T G.9701].

7.9 Data path performance monitoring objects

No data path performance monitoring objects are defined.

7.10 Line test, diagnostics and status objects

7.10.1 Profile

7.10.1.1 ITU-T G.9701 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=1.

PROFILEdescriptor:

Type: boolean.

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

Bit representation

0   [ITU-T G.9701] profile 106a.

Reference: Clause 6 of [ITU-T G.9701].

7.10.2   Initialization

7.10.2.1   Initialization success/failure cause (INITSFCAUSE)

Description: Reports whether the last full or ~~short~~ 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 line cannot reach the L0 state due to a mismatch of configuration and FTU capabilities.

2   Configuration not feasible on the line.

This error occurs if the line 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 far-end FTU detected.

This error occurs if the far-end FTU is not powered or not connected or if the line is too long to allow detection of a far-end FTU.

5   Any other or unknown initialization failure cause.

Reference: Clause 12.3.1 of [ITU-T G.9701].

7.10.2.2   Initialization last transmitted downstream signal (INITLASTSIGNALds)

Description: Reports the downstream signal count of the last transmitted initialization signal in the last full or ~~short~~ fast initialization performed on the line. The downstream signal count is defined in clause 12.3.1 of [ITU-T G.9701].

Type: 8-bit unsigned integer.

Valid values: 0...21.

Reference: Clause 12.3.1 of [ITU-T G.9701].

7.10.2.3   Initialization last received upstream signal (INITLASTSIGNALus)

Description: Reports the upstream signal count of the last received initialization signal in the last full or ~~short~~ fast initialization performed on the line. The upstream signal count is defined in clause 12.3.1 of [ITU-T G.9701].

Type: 8-bit unsigned integer.

Valid values: 0...10.

Reference: Clause 12.3.1 of [ITU-T G.9701].

7.10.3 Signal-to-noise ratio margin

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

Description: Reports the signal-to-noise ratio margin (as defined in clauses 9.8.3.2 of [ITU-T G.9701] and 11.4.1.3 of [ITU-T G.9701]) in the downstream direction. A special value indicates that the signal-to-noise ratio margin is out of the range to be represented.

Type: 16-bit signed integer.

Unit: 0.1 dB.

Valid values: −512 (special value) and −511...+511 (−51.1 dB to +51.1 dB).

Reference: Clauses 9.8.3.2 and 11.4.1.3 of [ITU-T G.9701].

7.10.3.2 Downstream signal-to-noise ratio margin (SNRMus)

Description: Reports the signal-to-noise ratio margin (as defined in clauses 9.8.3.2 of [ITU-T G.9701] and 11.4.1.3 of [ITU-T G.9701]) in the upstream direction. A special value indicates that the signal-to-noise ratio margin is out of the range to be represented.

Type: 16-bit signed integer.

Unit: 0.1 dB.

Valid values: −512 (special value) and −511...+511 (−51.1 dB to +51.1 dB).

Reference: Clauses 9.8.3.2 and 11.4.1.3 of [ITU-T G.9701].

7.10.4 Upstream power back-off

7.10.4.1 FTU-O estimated upstream power back-off electrical length (UPBOKLE)

Description: Reports the electrical length that would have been sent from the FTU-O to the FTU-R if the electrical length was 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 FTU-O (see clause 7.3.1.4.2.1 of [ITU-T G.9701]) and conveyed in the O-UPDATE initialization message (see clause 12.3.3.2.4 of [ITU-T G.9701]).

Type: 16-bit unsigned integer.

Unit: 0.1 dB.

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

Reference: Clauses 7.3.1.4.2.1 and 12.3.3.2.3 of [ITU-T G.9701].

7.10.4.2 FTU-R estimated upstream power back-off electrical length (UPBOKLE-R)

Description: Reports the estimate of the electrical length, as determined by the FTU-R (see clause 7.3.1.4.2.1 of [ITU-T G.9701]) and conveyed in the R-MSG1 initialization message (see clause 12.3.3.2.3 of [ITU-T G.9701]).

Type: 16-bit unsigned integer.

Unit: 0.1 dB.

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

Reference: See clauses 7.3.1.4.2.1 and 12.3.3.2.3 of [ITU-T G.9701].

7.10.5 Actual aggregate transmit power

7.10.5.1 Downstream actual aggregate transmit power (ACTATPds)

Description: Reports the total amount of transmit power delivered by the FTU-O at the U-O2 reference point, at the instant of measurement. A special value indicates that the downstream actual aggregate transmit power is out of the range to be represented.

Type: 16-bit signed integer.

Unit: 0.1 dB.

Valid values: −512 (special value) and −310...310 (−31 dB to +31 dB).

Reference: Clause 11.4.1.5 of [ITU-T G.9701].

7.10.5.2 Upstream actual aggregate transmit power (ACTATPus)

Description: Reports the total amount of transmit power delivered by the FTU-R at the U-R2 reference point, at the instant of measurement. A special value indicates that the upstream actual aggregate transmit power is out of the range to be represented.

Type: 16-bit signed integer.

Unit: 0.1 dB.

Valid values: −512 (special value) and −310...310 (−31 dB to +31 dB).

Reference: Clause 11.4.1.5 of [ITU-T G.9701].

7.10.6 Actual transmit PSD per sub-carrier

7.10.6.1 Downstream actual transmit PSD per sub-carrier (ACTPSDpsds)

Description: Reports the transmit PSD per sub-carrier delivered by the FTU-O at the U-O2 reference point as calculated by the VCE from the downstream ACTPSDREF-ps. A special value indicates that no transmit PSD value is available for the sub-carrier, or its transmit power is zero, or is out of the range to be represented.

Type: Array of PSDdescriptor[0...N-1], with N = index of highest supported downstream data-bearing sub-carrier as defined for the enabled profile (see Table 6-1 of [ITU-T G.9701]).

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.9701].

7.10.6.2 Upstream actual transmit PSD per sub-carrier (ACTPSDpsus)

Description: Reports the transmit PSD per sub-carrier delivered by the FTU-R at the U-R2 reference point, as calculated by the VCE from the upstream ACTPSDREF-ps. A special value indicates that no transmit PSD value is available for the sub-carrier, or its transmit power is zero, or is out of the range to be represented.

Type: Array of PSDdescriptor[0...N-1], with N = index of highest supported upstream data-bearing sub-carrier as defined for the enabled profile (see Table 6-1 of [ITU-T G.9701]).

PSDdescriptor: See ACTPSDpsds in clause 7.10.6.1.

Reference: Clause 11.4.1.2.5 of [ITU-T G.9701].

7.10.7 Channel attenuation per sub-carrier (HLOG)

For further study.

7.10.8 Signal-to-noise ratio per sub-carrier (SNR)

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

Description: Reports the number of symbols used to measure the downstream SNR(f) values.

Type: 16-bit unsigned integer.

Unit: 1 symbol.

Valid values: 0...65535.

Reference: Clause 11.4.1.2.2 of [ITU-T G.9701].

7.10.8.2 Downstream SNR(f) sub-carrier group size (SNRGds)

Description: Reports the number of sub-carriers in any one sub-carrier group used to represent the downstream SNR(f) values.

Type: 8-bit unsigned integer.

Unit: 1 sub-carrier.

Valid values: 1, 2, 4, and 8.

Reference: Clause 11.4.1.2.2 of [ITU-T G.9701].

7.10.8.3 Downstream SNR(f) (SNRpsds)

Description: Reports the downstream SNR(f) values. A special value indicates that no measurement could be done for this sub-carrier group because it is out of the downstream MEDLEY set or its transmit power is zero.

Type: Array of SNRdescriptor[0...N-1], where N = index of highest supported downstream data-bearing sub-carrier as defined for the enabled profile (see Table 6-1 of [ITU-T G.9701]), divided by SNRGds, rounded to the higher 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.9701].

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

Description: Reports the number of symbols used to measure the upstream SNR(f) values.

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.9701].

7.10.8.5 Upstream SNR(f) sub-carrier group size (SNRGus)

Description: Reports the number of sub-carriers in any one sub-carrier group used to represent the upstream SNR(f) values.

Type: 8-bit unsigned integer.

Unit: 1 sub-carrier.

Valid values: 1, 2, 4, and 8.

Reference: Clause 11.4.1.2.2 of [ITU-T G.9701].

7.10.8.6 Upstream SNR(f) (SNRpsus)

Description: Reports the upstream SNR(f) values. A special value indicates that no measurement could be done for this sub-carrier group because it is out of the upstream MEDLEY set or its transmit power is zero.

Type: Array of SNRdescriptor[0...N-1], where N = index of highest supported upstream data-bearing sub-carrier as defined for the enabled profile (see Table 6-1 of [ITU-T G.9701]), divided by SNRGds, rounded to the higher integer.

SNRdescriptor: See SNRpsds in clause 7.10.8.3.

Reference: Clause 11.4.1.2.2 of [ITU-T G.9701].

7.10.9 Quiet line noise PSD per sub-carrier

For further study.

7.10.10 Active line noise PSD per sub-carrier

For further study.

7.10.11 Bit allocation per sub-carrier on data symbols

7.10.11.1 Downstream bits allocation (BITSpsds)

Description: Reports the bit allocation values on data symbols in the normal operation interval (NOI) in the downstream direction.

Type: Array of BITSdescriptor[0...N-1], where N = index of highest supported downstream data-bearing sub-carrier as defined for the enabled profile (see Table 6-1 of [ITU-T G.9701]) plus one.

BITSdescriptor:

       Type: 8-bit unsigned integer.

       Unit: 1 bit.

       Valid values: 0...12.

Reference: Clause 10.2.1.4 of [ITU-T G.9701].

7.10.11.2 Upstream bits allocation (BITSpsus)

Description: Reports the bit allocation values on data symbols in the normal operation interval (NOI) in the upstream direction.

Type: Array of BITSdescriptor[0...N-1], where N = index of highest supported upstream data-bearing sub-carrier as defined for the enabled profile (see Table 6-1 of [ITU-T G.9701]) plus one.

BITSdescriptor: See BITSpsds in clause 7.10.10.1.

Reference: Clause 10.2.1.4 of [ITU-T G.9701].

7.10.12 Robust Management Channel (RMC)

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

Description: Reports the signal-to-noise ratio margin (as defined in clause 11.4.1.4 of [ITU-T G.9701]) for the RMC in the downstream direction. A special value indicates that the signal-to-noise ratio margin for the RMC is out of the range to be represented.

Type: 16-bit signed integer.

Unit: 0.1 dB.

Valid values: −512 (special value) and −511...+511 (−51.1 dB to +51.1 dB).

Reference: Clause 11.4.1.4 of [ITU-T G.9701].

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

Description: Reports the signal-to-noise ratio margin (as defined in clause 11.4.1.4 of [ITU-T G.9701]) for the RMC in the upstream direction. A special value indicates that the signal-to-noise ratio margin for the RMC is out of the range to be represented.

Type: 16-bit signed integer.

Unit: 0.1 dB.

Valid values: −512 (special value) and −511...+511 (−51.1 dB to +51.1 dB).

Reference: Clause 11.4.1.4 of [ITU-T G.9701].

7.10.12.3 Downstream bits allocation for RMC(BITS-RMCpsds)

Description: Reports the bit allocation values on RMC sub-carriers in RMC symbols in the downstream direction.

Type: Array of BITSRMCdescriptor[0...N-1], where N <= 512.

BITS-RMCdescriptor:

    Type: Record of a sub-carrier index and a bit allocation value.

    Sub-carrier index:

        Type: 16-bit unsigned integer.

        Valid values: 0...4095 (sub-carrier index 0 to 4095).

Bit allocation value:

    Type: 8-bit unsigned integer.

    Unit: 1 bit.

    Valid values: 0 and 2...6.

Reference: Clause 12.3.4.2.8 of [ITU-T G.9701].

7.10.12.4 Upstream bits allocation for RMC(BITS-RMCpsus)

Description: Reports the bit allocation values on RMC sub-carriers in RMC symbols in the upstream direction.

Type: Array of BITSRMCdescriptor[0...N-1], where N = index of highest supported upstream data-bearing sub-carrier as defined for the enabled profile (see Table 6-1 of [ITU-T G.9701]) plus one.

BITSRMCdescriptor: See BITS-RMCpsds in clause 7.10.12.3.

Reference: Clause 12.3.4.2.7 of [ITU-T G.9701].

7.10.13 Test parameter time stamps

7.10.13.1 Date/time-stamping of near-end test parameters (STAMP-TEST-NE)

Description: Reports the date/time when the near-end test parameters that can change during showtime were last updated.

Type: string (as defined in clause 8.12)

Reference: Clause 11.1 of [ITU-T G.9701].

7.10.13.2 Date/time-stamping of far-end test parameters (STAMP-TEST-FE)

Description: Reports the date/time when the far-end test parameters that can change during showtime were last updated.

Type: string (as defined in clause 8.12).

Reference: Clause 11.1 of [ITU-T G.9701].

7.10.14 On-line reconfiguration (OLR/FRA) time stamps

7.10.14.1 Date/time-stamping of last successful downstream bit swap operation (STAMP-BSWds)

Description: Reports the date/time of the last successful FTU-R initiated bit swap execution that has modified the bits allocation.

Type: string (as defined in clause 8.12).

Reference: Clause 11.2.2.5 of [ITU-T G.9701].

7.10.14.2 Date/time-stamping of last successful upstream bit swap operation (STAMP-BSWus)

Description: Reports the date/time of the last successful FTU-O initiated bit swap execution that has modified the bits allocation.

Type: string (as defined in clause 8.12).

Reference: Clause 11.2.2.5 of [ITU-T G.9701].

7.10.14.3 Date/time-stamping of last successful downstream autonomous SRA operation (STAMP-SRAds-)

Description: Reports the date/time of the last successful FTU-R initiated autonomous SRA execution (excluding SRAs in response to TIGA) that has modified the bits allocation.

Type: string (as defined in clause 8.12).

Reference: Clause 11.2.2.5 of [ITU-T G.9701].

7.10.14.4 Date/time-stamping of last successful upstream autonomous SRA operation (STAMP-SRAus-)

Description: Reports the date/time of the last successful FTU-O initiated autonomous SRA execution that has modified the bits allocation.

Type: string (as defined in clause 8.12).

Reference: Clause 11.2.2.5 of [ITU-T G.9701].

7.10.14.5 Date/time-stamping of last successful downstream FRA operation (STAMP-FRAds-)

Description: Reports the date/time of the last successful FTU-R initiated FRA execution that has modified the bits allocation.

Type: string (as defined in clause 8.12).

Reference: Clause 13.3.1.1 of [ITU-T G.9701].

7.10.14.6 Date/time-stamping of last successful upstream FRA operation (STAMP-FRAus-)

Description: Reports the date/time of the last successful FTU-O initiated FRA execution that has modified the bits allocation.

Type: string (as defined in clause 8.12).

Reference: Clause 13.3.1.1 of [ITU-T G.9701].

7.10.14.7 Date/time-stamping of last successful downstream RPA operation (STAMP-RPAds)

Description: Reports the date/time of the last successful FTU-R initiated RPA execution that has modified the bits allocation for the RMC.

Type: string (as defined in clause 8.12).

Reference: Clause 11.2.2.5 of [ITU-T G.9701].

7.10.14.8 Date/time-stamping of last successful upstream RPA operation (STAMP-RPAus)

Description: Reports the date/time of the last successful FTU-O initiated RPA execution that has modified the bits allocation for the RMC.

Type: string (as defined in clause 8.12).

Reference: Clause 11.2.2.5 of [ITU-T G.9701].

7.10.14.9 Date/time-stamping of last successful downstream TIGA operation (STAMP-TIGA)

Description: Reports the date/time of the last successful FTU-O initiated TIGA execution.

Type: string (as defined in clause 8.12).

Reference: Clause 11.2.2.5 of [ITU-T G.9701].

7.11 Channel test, diagnostics and status objects

7.11.1 Actual data rates

7.11.1.1 Net data rate (NDRds/us)

Description: Reports the NDR as defined in clause 11.4.1.1.1 of [ITU-T G.9701].

Type: 32-bit unsigned integer.

Unit: 1000 bit/second.

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

Reference: Clause 11.4.1.1.1 of [ITU-T G.9701].

7.11.1.2 Expected throughput (ETRds/us)

Description: Reports the expected throughput as defined in clause 11.4.1.1.3 of [ITU-T G.9701].

Type: 32-bit unsigned integer.

Unit: 1000 bit/second.

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

Reference: Clause 11.4.1.1.3 of [ITU-T G.9701].

7.11.1.3 Gamma Data Rate (GDRds/us)

Description: Reports the NDR as defined in clause 7.11.1.1, lowered by any throughput capability limitations remaining in the DRA or L2+ functions, assuming no user data is transmitted over all the other lines.

Type: 32-bit unsigned integer.

Unit: 1000 bit/second.

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

Reference: None.

7.11.2 Attainable data rates

7.11.2.1 Attainable net data rate (ATTNDRds/us)

Description: Reports the attainable NDR as defined in clause 11.4.1.1.2 of [ITU-T G.9701].

Type: 32-bit unsigned integer.

Unit: 1000 bit/second.

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

Reference: Clause 11.4.1.1.2 of [ITU-T G.9701].

7.11.2.2 Attainable expected throughput (ATTETRds/us)

Description: Reports the attainable expected throughput as defined in clause 11.4.1.1.4 of [ITU-T G.9701].

Type: 32-bit unsigned integer.

Unit: 1000 bit/second.

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

Reference: Clause 11.4.1.1.4 of [ITU-T G.9701].

7.11.2.3 Attainable gamma data rate (ATTGDRds/us)

Description: Reports the attainable NDR (as defined in clause 7.11.2.1), lowered by any throughput capability limitations remaining in the DRA or L2+ functions, assuming no user data is transmitted over all the other Lines, and assuming MAXGDR (as defined in clause 7.2.1.3) is configured to its maximum valid value.

Type: 32-bit unsigned integer.

Unit: 1000 bit/second.

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

Reference: None.

7.11.3 Actual impulse noise protection

7.11.3.1 Actual INP against SHINE (ACTINPds/us)

Description: Reports the actual INP against SHINE as defined in clause 11.4.1.1.4 of [ITU-T G.9701]. 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 11.4.1.1.4 of [ITU-T G.9701].

7.11.3.2   Actual INP against REIN (ACTINP_REINds/us)

Description: Reports the actual INP against REIN as defined in clause 11.4.1.1.5 of [ITU-T G.9701]. 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 11.4.1.1.5 of [ITU-T G.9701].

7.11.4   Actual framer settings

7.11.4.1   DTU FEC codeword length (DTU-NFECds/us)

Description: Reports the DTU FEC codeword length as defined in clause 9.3 of [ITU-T G.9701].

Type: 8-bit unsigned integer.

Unit: 1 byte.

Valid values: 32..255 (32 to 255 bytes).

Reference: Clause 9.3 of [ITU-T G.9701].

7.11.4.2   DTU FEC redundancy (DTU-RFECds/us)

Description: Reports the DTU FEC codeword redundancy as defined in clause 9.3 of [ITU-T G.9701].

Type: 8-bit unsigned integer.

Unit: 1 byte.

Valid values: 2, 4, 6, 8, 10, 12, and 16 (2, 4, 6, 8, 10, 12, and 16 bytes).

Reference: Clause 9.3 of [ITU-T G.9701].

7.11.4.3   Number of FEC codewords per DTU (DTU-Qds/us)

Description: Reports the number of FEC codewords per DTU as defined in clause 9.3 of [ITU-T G.9701].

Type: 8-bit unsigned integer.

Valid values: 1...16.

Reference: Clause 9.3 of [ITU-T G.9701].

7.11.5   Test parameters per time interval

7.11.5.1   Error-free bits current 15 minutes (EFB-C15Mds/us)

Description: Reports the number of error-free bits (see clause 11.4.1.1.6 of [ITU-T G.9701]) 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.9701].

7.11.5.2 Error-free bits previous 15 minutes (EFB-P15Mds/us)

Description: Reports the number of error-free bits (see clause 11.4.1.1.6 of [ITU-T G.9701]) 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.9701].

7.11.5.3 Error-free bits current 24 hours (EFB-C24Hds/us)

Description: Reports the number of error-free bits (see clause 11.4.1.1.6 of [ITU-T G.9701]) 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.9701].

7.11.5.4 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.9701]) 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.9701].

7.11.5.5 Minimum error-free throughput current 15 minutes (MINEFTR-C15Mds/us)

Description: Reports the minimum error-free throughput (see clause 11.4.1.1.3 of [ITU-T G.9701]) over the current 15 min interval.

Type: 32-bit unsigned integer.

Unit: 1000 bit/second.

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

Reference: Clause 11.4.1.1.3 of [ITU-T G.9701].

7.11.5.6 Minimum error-free throughput previous 15 minutes (MINEFTR-P15Mds/us)

Description: Reports the minimum error-free throughput (see clause 11.4.1.1.3 of [ITU-T G.9701]) over the previous 15 min interval.

Type: 32-bit unsigned integer.

Unit: 1000 bit/second.

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

Reference: Clause 11.4.1.1.3 of [ITU-T G.9701].

7.11.5.7 Minimum error-free throughput current 24 hours (MINEFTR-C24Hds/us)

Description: Reports the minimum error-free throughput (see clause 11.4.1.1.3 of [ITU-T G.9701]) over the current 24 h interval.

Type: 32-bit unsigned integer.

Unit: 1000 bit/second.

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

Reference: Clause 11.4.1.1.3 of [ITU-T G.9701].

7.11.5.8 Minimum error-free throughput previous 24 hours (MINEFTR-P24Hds/us)

Description: Reports the minimum error-free throughput (see clause 11.4.1.1.3 of [ITU-T G.9701]) over the previous 24 h interval.

Type: 32-bit unsigned integer.

Unit: 1000 bit/second.

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

Reference: Clause 11.4.1.1.3 of [ITU-T G.9701].

7.12 Data path test, diagnostics and status objects

No data path test, diagnostics and status objects are defined.

7.13 Inventory objects

7.13.1 FTU related inventory

7.13.1.1 FTU-O ITU-T G.994.1 vendor ID (FTUO_GHS_VENDOR)

Description: Reports the FTU-O [ITU-T G.994.1] vendor ID as inserted by the FTU-O in the [ITU-T G.994.1] CL message and as defined 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].

7.13.1.2 FTU-R ITU-T G.994.1 vendor ID (FTUR_GHS_VENDOR)

Description: Reports the FTU-R [ITU-T G.994.1] vendor ID as inserted by the FTU-R in the [ITU-T G.994.1] CLR message and as defined 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.

7.13.1.3 FTU-O version number (FTUO_VERSION)

Description: Reports the FTU-O version number as inserted by the FTU-O in the embedded operations channel (see clause 11.2.2.10 of [ITU-T G.9701]). 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.9701].

7.13.1.4 FTU-R version number (FTUR_VERSION)

Description: Reports the FTU-R version number as inserted by the FTU-R in the embedded operations channel (see clause 11.2.2.10 of [ITU-T G.9701]). It is for version control. It shall contain

the FTU-R firmware version and the FTU-R model. Both shall be encoded in this order and separated by a space character, i.e., "<FTU-R firmware version><space><FTU-R model>".

Type: string (up to 16 ASCII characters).

Reference: Clause 11.2.2.10 of [ITU-T G.9701].

7.13.1.5   FTU-O self-test result (FTUO_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.9701]). 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 FTU-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.9701].

7.13.1.6   FTU-R self-test result (FTUR_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.9701]) or by the perform self-test eoc command (see clause 12.2.2.6.1 of [ITU-T G.9701]). 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 FTU-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.9701].

7.13.2   System related inventory

7.13.2.1   DPU system vendor ID (DPU_SYSTEM_VENDOR)

Description: Reports the DPU system vendor ID as inserted by the FTU-O in the embedded operations channel (see clause 11.2.2.10 of [ITU-T G.9701]) and as defined 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.9701].

7.13.2.2   NT system vendor ID (NT_SYSTEM_VENDOR)

Description: Reports the NT system vendor ID as inserted by the FTU-R in the embedded operations channel (see clause 11.2.2.10 of [ITU-T G.9701]) and as defined 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.9701].

7.13.2.3   DPU system serial number (DPU_SYSTEM_SERIALNR)

Description: Reports the DPU serial number as inserted by the FTU-O in the embedded operations channel (see clause 11.2.2.10 of [ITU-T G.9701]). It is vendor specific information. The combination of 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.9701].

7.13.2.4 NT system serial number (NT_SYSTEM_SERIALNR)

Description: Reports the NT system serial number as inserted by the FTU-R in the embedded operations channel (see clause 11.2.2.10 of [ITU-T G.9701]). 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.9701].

8 Procedures for performance monitoring functions

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

8.1 Line transmission states

A line 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 state SHOWTIME/non-SHOWTIME. The unavailable state is defined in clause ~~11.3.4.6~~11.4.4.5 of [ITU-T G.9701]. A G.fast line 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 Northbound interface~~its DPU-NB interface with respect to either a 15-minute or 24-hour evaluation period. TRs can only occur when the concerned direction is in the available state. The performance counter thresholds are listed in Table 8-1 and Table 8-2. The TRs related to near-end and far-end ES, SES and UAS are mandatory and other TRs are optional. Threshold reports 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 defined in clause:	DPU-NB interface	T/S interface
Near-end (FTU-O)/far-end (FTU-R) performance monitoring thresholds (15 min/24 h interval)			
THRESHOLD_NE/FE_15/24_ES	7.7.8	R/W (M)	N/A
THRESHOLD_NE/FE_15/24_SES	7.7.9	R/W (M)	N/A
THRESHOLD_NE/FE_15/24_LOSS	7.7.10	R/W (O)	N/A
THRESHOLD_NE/FE_15/24_LORS	7.7.11	R/W (O)	N/A
THRESHOLD_NE/FE_15/24_UAS	7.7.12	R/W (M)	N/A

Table 8-1 – Line performance counter thresholds

Category/object	Counter defined in clause:	DPU-NB interface	T/S interface
Initialization performance monitoring thresholds (15 min/24 h interval)			
THRESHOLD_15/24_FULL_INITS	7.7.13	R/W (O)	N/A
THRESHOLD_15/24_FAILEDFULL_INITS	7.7.14	R/W (O)	N/A
THRESHOLD_15/24_FAST_INITS	7.7.15	R/W (O)	N/A
THRESHOLD_15/24_FAILEDFAST_INITS	7.7.16	R/W (O)	N/A
Short interruption performance monitoring thresholds (24 h interval)			
THRESHOLD_24_SPONT_INTRPT	7.7.19	R/W (O)	N/A

Table 8-2 – Channel performance monitoring thresholds

Category/object	Counter defined in clause:	DPU-NB interface	T/S interface
Near-end (FTU-O)/far-end (FTU-R) performance monitoring thresholds (15 min/24 h interval)			
THRESHOLD_NE/FE_15/24_CV	7.8.4	R/W (O)	N/A
THRESHOLD_NE/FE_15/24_RTXUC	7.8.6	R/W (O)	N/A
THRESHOLD_NE/FE_15/24_RTXTX	7.8.7	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 line configuration object (see clauses 7.1.8.7 and 7.1.8.8).

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 line configuration object (see clauses 7.1.8.7 and 7.1.8.8).

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/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/time-stamp of the moment of recognition. A TR2 as appropriate should be sent to the NMS with the date/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 threshold reports are correctly generated and parameter counters are correctly processed during changes in the transmission state. This implies that all threshold reports should be delayed by 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 far-end performance reports;
- the line 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

All parameter counts shall be actual (within a tolerance of 1 s) counts for the 15 min and 24 h filtering period.

8.12   Date/time-stamping of reports

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

The date/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 performance monitoring parameters is defined in clause 11.3.4.711.4.4.6 of [ITU-T G.9701].

Appendix I

Broadband Forum considerations on the FTTdp deployment scenario

(This appendix does not form an integral part of this Recommendation.)

As the DPU is deployed closer to the customer premises, the number of ports on a DPU gets smaller and more DPUs are deployed throughout the network. Distribution points are at locations where local power is not available. In this case, the DPU may be reverse powered where the power comes from the customer premises, sharing the same copper pair with the data service, or the DPU may be forward powered where the power comes from a nearby network power node via copper pairs to the DPU from the network power node.

Reverse powering is one aspect of FTTdp that must be accounted for in the management architecture. Reverse powering of the DPU means that it can be powered down at any time without the network operator's advance knowledge or control. Most network management systems would treat such a spontaneous loss of power as a fault condition and raise an alarm, which is clearly not appropriate for FTTdp. This gave rise to the concept of a PMA, which acts as a management proxy for the DPU when it was unpowered. Figure I.1 shows the high-level PMA architecture as defined in the Broadband Forum
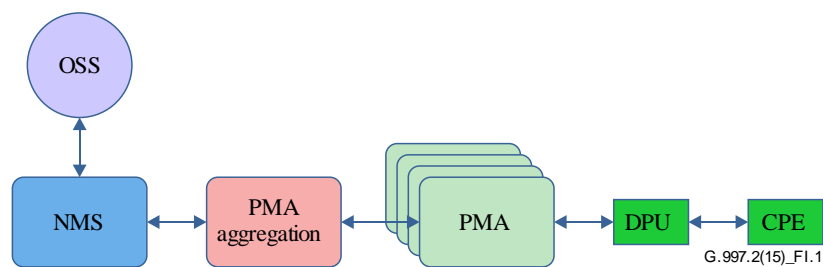

Figure I.1 – High-level PMA architecture (source: Broadband Forum)

In this architecture, there is a one to one correspondence between a PMA instance and the DPU it manages. These instances are then aggregated up to higher order management systems. This aggregation function may be realized as part of a PMA server that manages multiple DPUs, an intermediate system that aggregates PMAs residing on lower order systems, or as part of the NMS function.

The PMA uses NETCONF plus a Broadband Forum defined YANG model to manage the DPU. The definitions of the managed objects defined in clause 7 translate into YANG data model syntax (see [b-IETF RFC 6020]), for example as follows:

```
leaf <managed object name> {
    description "<Description>";
    type <Type> {
    range "<Valid values>"; }
    units "<Unit>";
    default "<Default value>";
    reference "<Reference>";
    }
```

Bibliography

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