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Digital sections and digital line system – Metallic access
networks

Physical layer management for G.fast transceivers

Recommendation ITU-T G.997.2

ITU-T

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Recommendation ITU-T G.997.2

Physical layer management for G.fast transceivers

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.

History

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Recommendation ITU-T G.997.2

Physical layer management for G.fast transceivers

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.

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 management architecture

The management of a distribution point unit (DPU) is performed by the network management system (NMS), passing management information to each DPU's management entity (ME) over the Q reference point (see Figure 5-1). The NMS may also monitor each 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 DPU and at the NT is established over management channels provided by the FAST transceiver unit – central office ends (FTU-Os) and FTU-Rs via the copper pairs.

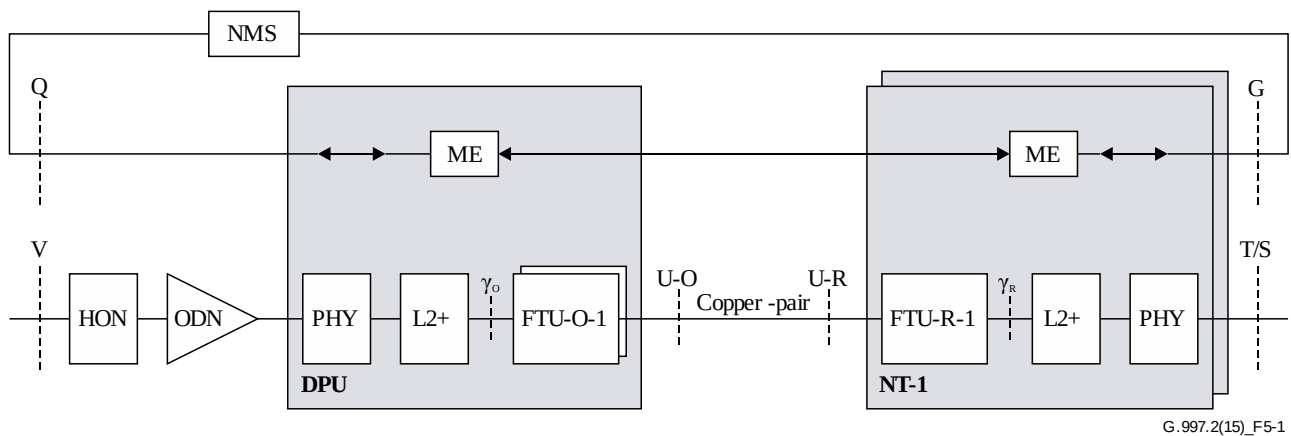


**Figure 5-1 – Reference model of FTTdp deployment
(shown for line 1 in all N lines (N≥1) connected to a DPU)**

Appendix I contains additional information regarding the Broadband Forum considerations on the fibre to the distribution point (FTTdp) deployment scenario.

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.

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 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 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) transmission systems as seen by the PMA. It 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, 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.

6 Network management protocol

This Recommendation makes no presumption about which management protocol is used between the PMA and the DPU 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].

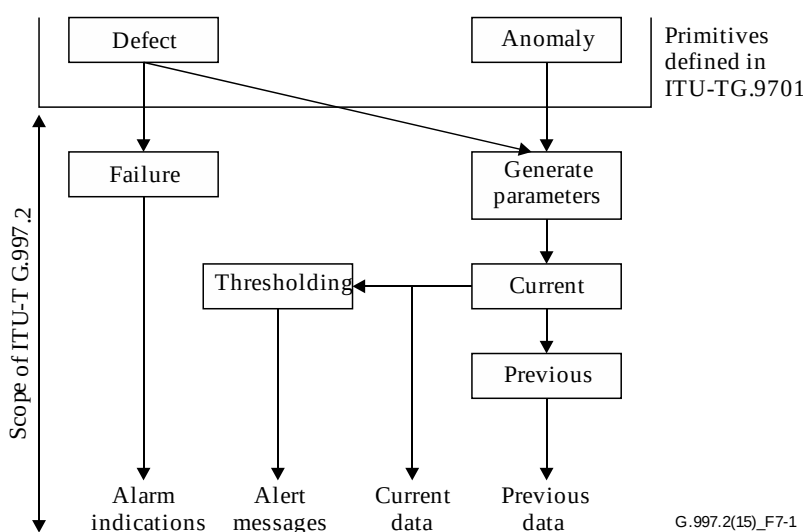


Figure 7-1 – In-service performance monitoring process

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)

Table 7-1 – Line configuration objects

Category/object	Defined in clause:	DPU-NB interface
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)
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)

Table 7-1 – Line configuration objects

Category/object	Defined in clause:	DPU-NB interface
LOM-PERSISTENCY _{us}	7.1.8.4	R/W (M)
LOR-PERSISTENCY _{ds}	7.1.8.5	R/W (M)
LOR-PERSISTENCY _{us}	7.1.8.6	R/W (M)
REINIT_TIME_THRESHOLD _{ds}	7.1.8.7	R/W (M)
REINIT_TIME_THRESHOLD _{us}	7.1.8.8	R/W (M)
LOW_ETR_THRESHOLD _{ds}	7.1.8.9	R/W (M)
LOW_ETR_THRESHOLD _{us}	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 (MINETR _{ds/us})	7.2.1.2	R/W (M)
Maximum gamma data rate (GDR) (MAXGDR _{ds/us})	7.2.1.3	R/W (M)
Minimum gamma data rate (MINGDR _{ds/us})	7.2.1.4	R/W (M)
Retransmission (downstream/upstream)		
DELAYMAX _{ds/us}	7.2.2.1	R/W (M)
INPMIN_SHINE _{ds/us}	7.2.2.2	R/W (M)
SHINERATIO _{ds/us}	7.2.2.3	R/W (M)
INPMIN_REIN _{ds/us}	7.2.2.4	R/W (M)
IAT_REIN _{ds/us}	7.2.2.5	R/W (M)
RNRATIO _{ds/us}	7.2.2.6	R/W (M)
RTX_TESTMODE _{ds/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
<i>Near-end (FTU-O) failures</i>		
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)
<i>Far-end (FTU-R) failures</i>		
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)
<i>Initialization failures</i>		
Line init (LINIT) failure	7.4.3.1	R (M)

Table 7-5 – Channel failures

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

Table 7-6 – Data path failures

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

Table 7-7 – Line performance monitoring objects

Category/object	Defined in clause:	DPU-NB interface
<i>Near-end (FTU-O)/Far-end (FTU-R) performance monitoring counters (current/previous 15 min/24 h interval)</i>		
Measured time (CURR/PREV_NE/FE_15/24_L_TIME)	7.7.1	R (M)

Table 7-7 – Line performance monitoring objects

Category/object	Defined in clause:	DPU-NB interface
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)
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 inits counter (CURR/PREV_15/24_FAST_INITS)	7.7.15	R (M)
Failed short 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)

Table 7-7 – Line performance monitoring objects

Category/object	Defined in clause:	DPU-NB interface
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)
<i>Near-end (FTU-O) initiated TIGA performance monitoring counters (current and previous 15 min/24 h interval)</i>		
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
<i>Near-end (FTU-O)/far-end (FTU-R) performance monitoring counters (current/previous 15 min/24 h interval)</i>		
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)
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		
BITSpds	7.10.11.1	R (M)
BITSpus	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		

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

Category/object	Defined in clause:	DPU-NB interface
STAMP-TEST-NE	7.10.13.1	R (M)
STAMP-TEST-FE	7.10.13.2	R (M)
<i>On-line reconfiguration (OLR) time stamps</i>		
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
<i>Actual data rates (downstream/upstream)</i>		
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)
<i>Attainable data rates (downstream/upstream)</i>		
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)
<i>Actual impulse noise protection (downstream/upstream)</i>		
ACTINPds/us	7.11.3.1	R (M)
ACTINP_REINds/us	7.11.3.2	R (M)
<i>Actual framer setting (downstream/upstream)</i>		
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)
<i>Test parameters per time interval (downstream/upstream)</i>		
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)