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Digital sections and digital line system – Metallic access
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Physical layer management for MGfast transceivers

Recommendation ITU-T G.997.3

ITU-T G-SERIES RECOMMENDATIONS
TRANSMISSION SYSTEMS AND MEDIA, DIGITAL SYSTEMS AND NETWORKS

INTERNATIONAL TELEPHONE CONNECTIONS AND CIRCUITS	G.100–G.199
GENERAL CHARACTERISTICS COMMON TO ALL ANALOGUE CARRIER-TRANSMISSION SYSTEMS	G.200–G.299
INDIVIDUAL CHARACTERISTICS OF INTERNATIONAL CARRIER TELEPHONE SYSTEMS ON METALLIC LINES	G.300–G.399
GENERAL CHARACTERISTICS OF INTERNATIONAL CARRIER TELEPHONE SYSTEMS ON RADIO-RELAY OR SATELLITE LINKS AND INTERCONNECTION WITH METALLIC LINES	G.400–G.449
COORDINATION OF RADIOTELEPHONY AND LINE TELEPHONY	G.450–G.499
TRANSMISSION MEDIA AND OPTICAL SYSTEMS CHARACTERISTICS	G.600–G.699
DIGITAL TERMINAL EQUIPMENTS	G.700–G.799
DIGITAL NETWORKS	G.800–G.899
DIGITAL SECTIONS AND DIGITAL LINE SYSTEM	G.900–G.999
General	G.900–G.909
Parameters for optical fibre cable systems	G.910–G.919
Digital sections at hierarchical bit rates based on a bit rate of 2048 kbit/s	G.920–G.929
Digital line transmission systems on cable at non-hierarchical bit rates	G.930–G.939
Digital line systems provided by FDM transmission bearers	G.940–G.949
Digital line systems	G.950–G.959
Digital section and digital transmission systems for customer access to ISDN	G.960–G.969
Optical fibre submarine cable systems	G.970–G.979
Optical line systems for local and access networks	G.980–G.989
Metallic access networks	G.990–G.999
MULTIMEDIA QUALITY OF SERVICE AND PERFORMANCE – GENERIC AND USER-RELATED ASPECTS	G.1000–G.1999
TRANSMISSION MEDIA CHARACTERISTICS	G.6000–G.6999
DATA OVER TRANSPORT – GENERIC ASPECTS	G.7000–G.7999
PACKET OVER TRANSPORT ASPECTS	G.8000–G.8999
ACCESS NETWORKS	G.9000–G.9999

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Recommendation ITU-T G.997.3

Physical layer management for MGfast transceivers

Summary

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

History

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Table of Contents

		Page
1	Scope.....	1
2	References.....	1
3	Definitions	1
	3.1 Terms defined elsewhere	1
	3.2 Terms defined in this Recommendation.....	2
4	Abbreviations and acronyms	2
5	Management architecture.....	6
6	Network management protocol.....	8
7	Managed objects	8
	7.1 Link identification	24
	7.2 Line configuration objects	24
	7.3 Channel configuration objects	43
	7.4 Data path configuration objects.....	46
	7.5 Line failures.....	48
	7.6 Channel failures.....	49
	7.7 Data path failures.....	49
	7.8 Line performance monitoring objects	49
	7.9 Channel performance monitoring objects	55
	7.10 Data path performance monitoring objects	58
	7.11 Line test, diagnostics and status objects	58
	7.12 Channel test, diagnostics and status objects	74
	7.13 Data path test, diagnostics and status objects	78
	7.14 Inventory objects	78
	7.15 P2MP configuration objects	81
	7.16 P2MP status objects.....	82
8	Procedures for performance monitoring functions	83
	8.1 Link transmission states	83
	8.2 Threshold reports.....	83
	8.3 Unavailable and available state filters	84
	8.4 TR1 filter	84
	8.5 TR2 filter	84
	8.6 Evaluation of TR1	84
	8.7 Evaluation of TR2	85
	8.8 Threshold report evaluation during transmission state changes.....	85
	8.9 Performance history storage in network elements.....	85
	8.10 Register size.....	85
	8.11 Parameter counts	85
	8.12 Date and time stamping of reports.....	86

	Page
8.13 Inhibiting performance monitoring parameters	86
Annex A to Annex R.....	87
Annex S – Management for network termination software upgrade process	88
S.1 Scope	88
S.2 References	88
S.3 Definitions	88
S.4 Abbreviations and acronyms	88
S.5 DPU management architecture	88
S.6 Network management protocol	88
S.7 Managed objects	88
Annex T – Annex D and Annex T of ITU-T G.9711 – Managed objects	93
T.1 Overview of Annex D and Annex T of ITU-T G.9711 managed objects	93
T.2 Annex D and Annex T of [ITU-T G.9711] configuration objects	93
T.3 Annex D and Annex T of ITU-T G.9711 status objects.....	95
Bibliography.....	96

Recommendation ITU-T G.997.3

Physical layer management for MGfast transceivers

1 Scope

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

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

2 References

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

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

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following term defined elsewhere:

3.1.1 anomaly [ITU-T G.997.2]: A discrepancy between the actual and desired characteristics of an item. The desired characteristic may be expressed in the form of a specification. An anomaly may or may not affect the ability of an item to perform a required function.

3.1.2 defect [ITU-T G.997.2]: A limited interruption in the ability of an item to perform a required function. It may or may not lead to maintenance action depending on the results of additional analysis. Successive anomalies causing a decrease in the ability of an item to perform a required function are considered a defect.

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

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

3.1.5 failure [ITU-T G.997.2]: A termination of the ability of an item to perform a required function.

NOTE – After failure, the item has a fault. Analysis of successive anomalies or defects affecting the same item can lead to the item being considered as "failed".

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

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

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

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

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

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

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

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

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

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

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

ALN	Active Line Noise
AN	Access Node
ASN.1	Abstract Syntax Notation one
ATTGDR	Attainable Gamma Data Rate

BER	Bit Error Ratio
CE	Cyclic Extension
CRC	Cyclic Redundancy Check
CV	Code Violation
DMT	Discrete Multitone
DPU	Distribution Point Unit
DPU-MIB	Distribution Point Unit-Management Information Base
DPU-NB	DPU Northbound
DRA	Dynamic Resource Allocation
ds	downstream
DSNRM	Downshift SNRM
DTA	Dynamic Time Assignment
DTU	Data Transfer Unit
DTFO	Discontinuous Time Frequency Operation
DTU	Data Transfer Unit
EFTR	Error-Free Throughput Rate
eoc	embedded operations channel
ES	Errored Second
FDS	Full duplex compatible Downstream Sub-frame
FDX	Full Duplex
FE	Far End
FEC	Forward Error Correction
FEXT	Far-End crosstalk
FRA	Fast Rate Adaptation
FTTdp	Fibre To The distribution point
FTTx	Fibre To The x
FTU	Fast Transceiver Unit
FUS	Full duplex compatible Upstream Sub-frame
GDR	Gamma Data Rate
HON	Higher Order Node
HS	harmonized system
IAR	International Amateur Radio
IAT	Inter Arrival Time
ID	Identifier
INP	Impulse Noise Protection
INPEQ	Impulse Noise Protection Equivalent
L2+	Layer 2 and above

LOM	Loss of Margin
LOM-FE	Loss of Margin-Far End
LOR	Loss of RMC
LOR-FE	Loss of RMC-Far End
LORS	LOR Second
LOS	Loss of Signal
LOS-FE	Loss of Signal-Far End
LOSS	LOS Second
LPR	Loss of Power
LPR-FE	Loss of Power-Far End
M	Mandatory
MAXGDR	Maximum Gamma Data Rate
MGfast	Multi-Gigabit fast access to subscriber terminals
MIB	Management Information Base
MINGDR	Minimum Gamma Data Rate
MDU	Multi-Dwelling Unit
ME	Management Entity
ME-O	Management Entity—central office end
ME-R	Management Entity—Remote side
MTU	MGfast Transceiver Unit
MTU-O	MGfast Transceiver Unit—central office end
MTU-R	MGfast Transceiver Unit—Remote side
NDR	Net Data Rate
NE	Network Element
NMS	Network Management System
NOI	Normal Operation Interval
NPSF	Non-Priority Sub-Frame
NT	Network Termination
O	Optional
ODN	Optical Distribution Network
OLR	On-Line Reconfiguration
OSS	Operations Support System
P2MP	Point to Multipoint
P2P	Point to Point
PCS-LCM	Probabilistic Constellation Shaping-LDPC Coded Modulation
PHY	Physical layer
PM	Performance Monitoring

PMA	Persistent Management Agent
PMD	Physical Media Dependent
PMS-TC	Physical Media Specific–Transmission Convergence
POTS	Plain Old Telephony Service
PSD	Power Spectral Density
PSE	Power Source Equipment
PSF	Priority Sub-Frame
QID	Queue Identifier
QLN	Quiet Line Noise
QoS	Quality of Service
R	Read
REIN	Repetitive Electrical Impulse Noise
RFI	Radio Frequency Interference
RMC	Robust Management Channel
RPF	Reverse Power Feeding
RPA	RMC Parameter Adjustment
SATN	Signal Attenuation
SES	Severely Errored Second
SHINE	Single High Impulse Noise Event
SNMP	Simple Network Management Protocol
SNR	Signal-to-Noise Ratio
SNRM	Signal-to-Noise Ratio Margin
SRA	Seamless Rate Adaptation
SREC	Showtime Reconfiguration
TCM	Trellis Coded Modulation
TDD	Time Division Duplexing
TIGA	Transmitter-Initiated Gain Adjustment
TPS-TC	Transport Protocol Specific–Transmission Convergence
TR	Threshold Report
UAS	Unavailable Second
UPBO	Upstream Power Back-Off
us	upstream
USNRM	Upshift SNRM
VCE	Vectoring Control Entity
VoIP	Voice over Internet Protocol
W	Write
WAN	Wide-Area Network

5 Management architecture

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

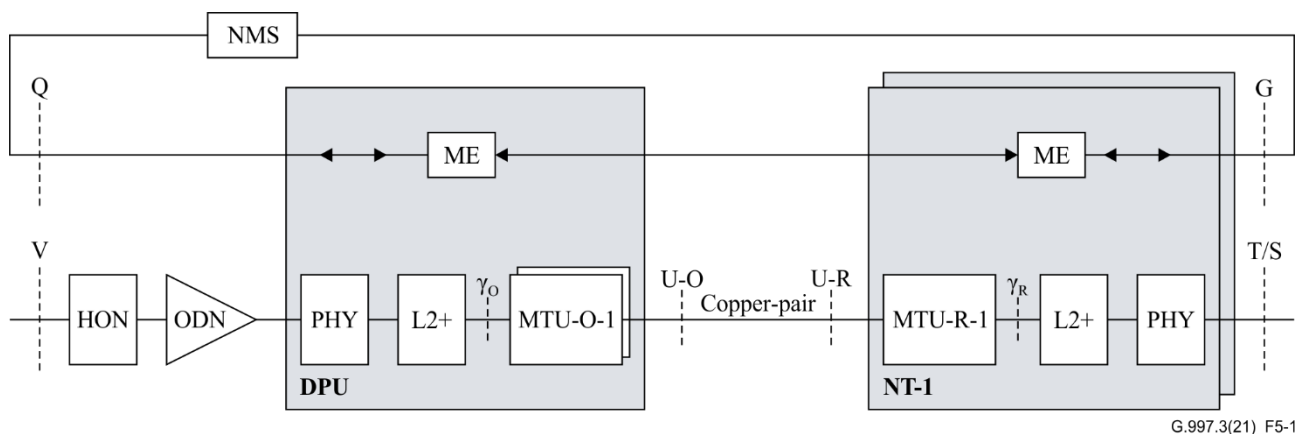


Figure 5-1 – Reference model of traditional access node deployment

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

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

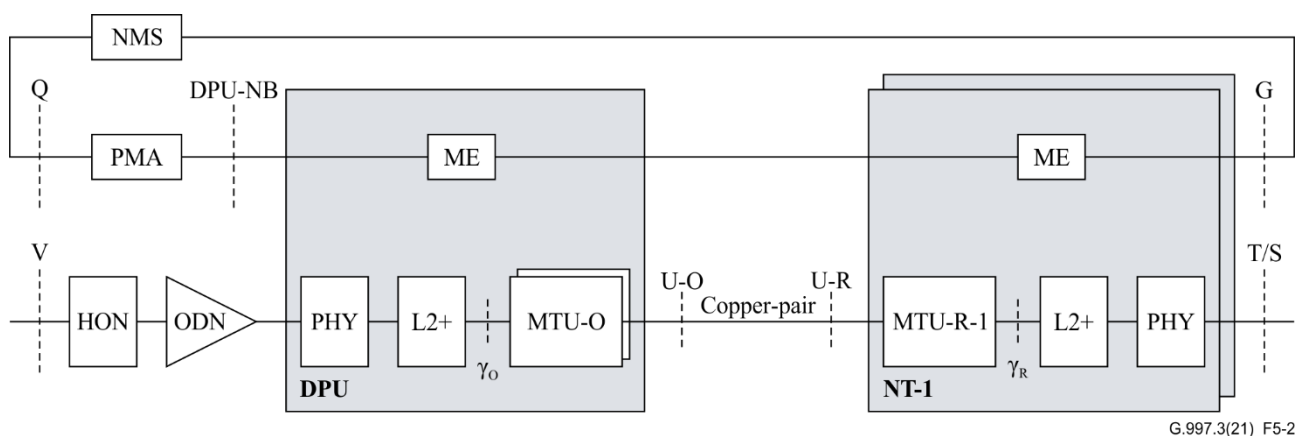


Figure 5-2 – Reference model of FTTdp deployment with PMA and DPU

(shown for line 1 in all N lines ($N \geq 1$) connected to a DPU)

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

transceiver port consisting of one or more hardware ports and with one or more MTU-Rs connected per hardware port.

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

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

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

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

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

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

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

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

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

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

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

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

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

6 Network management protocol

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

7 Managed objects

The list of managed objects contains six types of information:

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

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

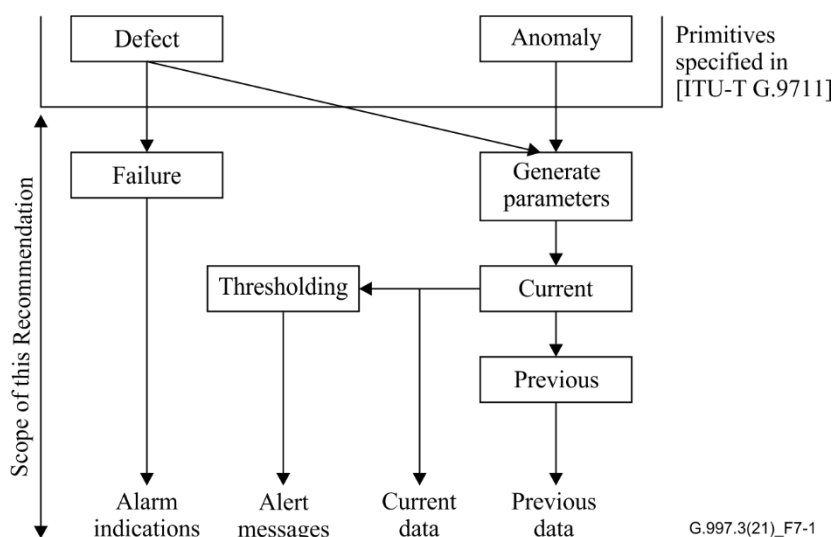


Figure 7-1 – In-service performance monitoring process

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

of MGfast configuration profiles lies outside the scope of this Recommendation. The allocation of the individual MGfast-managed objects (as specified in this Recommendation) to MGfast configuration profiles is addressed within the scope of the Broadband Forum.

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

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

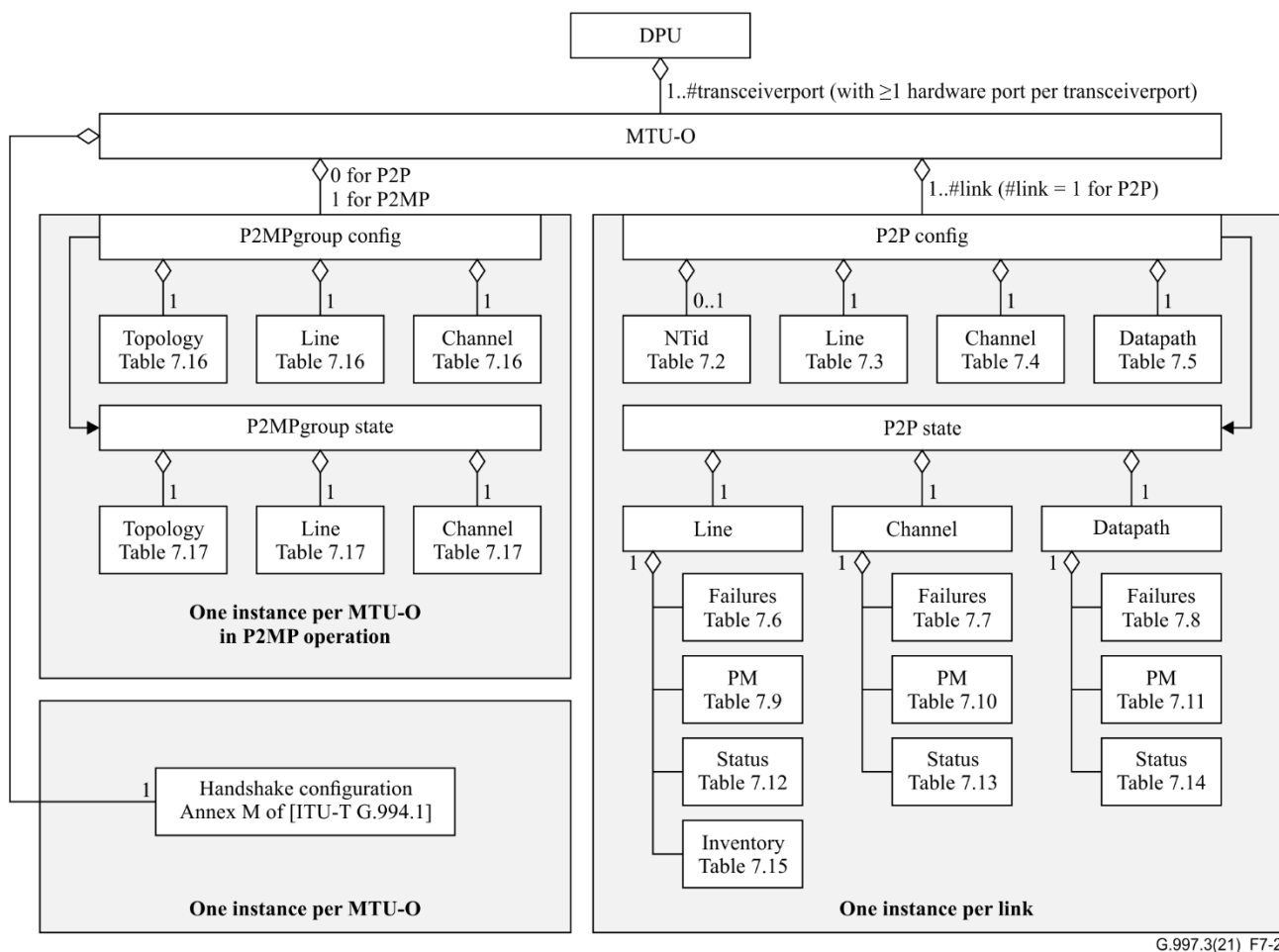


Figure 7-2 – Link configuration data and link state data at DPU-NB interface

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

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

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

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

- actual link state (OperStatus);
- line failures (see Table 7-6);
- channel failures (see Table 7-7);
- data path failures (see Table 7-8);
- line PM objects (see Table 7-9);
- channel PM objects (see Table 7-10);
- data path PM objects (see Table 7-11);
- line test, diagnostics and status objects (see Table 7-12);
- channel test, diagnostics and status objects (see Table 7-13);
- data path test, diagnostic and status objects (see Table 7-14);
- inventory objects (see Table 7-15).

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

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

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

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

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

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

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

Table 7-1 – Test parameter groups

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

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

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

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

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

Table 7-2 – Link identification

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

Table 7-3 – Line configuration objects

Category/object	Described in clause	DPU-NB interface
Profiles		
ITU-T G.9711 profiles enabling (PROFILES)	7.2.1.1	R/W (M)
Time division duplexing (TDD)		
Symbol periods per TDD frame (MF)	7.2.2.1	R/W (M)
Symbol periods per TDD frame dedicated for downstream transmission (Mds)	7.2.2.2	R/W (M)
Cyclic extension (CE)	7.2.2.3	R/W (M)

Table 7-3 – Line configuration objects

Category/object	Described in clause	DPU-NB interface
<i>Power and spectrum usage</i>		
MAXATPds	7.2.3.1	R/W (M)
MAXATPus	7.2.3.2	R/W (M)
CARMASKds	7.2.3.3	R/W (M)
CARMASKus	7.2.3.4	R/W (M)
MIBPSDMASKds	7.2.3.5	R/W (M)
MIBPSDMASKus	7.2.3.6	R/W (M)
RFIBANDS	7.2.3.7	R/W (M)
IARBANDS	7.2.3.8	R/W (M)
UPBOPSDA	7.2.3.9	R/W (M)
UPBOPSDB	7.2.3.10	R/W (M)
UPBOKL	7.2.3.11	R/W (M)
UPBOKLF	7.2.3.12	R/W (M)
UPBOKLREF	7.2.3.13	R/W (M)
CLASSMASKds	7.2.3.14	R/W (M)
CLASSMASKus	7.2.3.15	R/W (M)
RMCCARMASKds	7.2.3.16	R/W (M)
RMCCARMASKus	7.2.3.17	R/W (M)
<i>Noise margins</i>		
TARSNRMds	7.2.4.1	R/W (M)
TARSNRMus	7.2.4.2	R/W (M)
MAXSNRMus	7.2.4.3	R/W (M)
MINSNRMds	7.2.4.4	R/W (M)
MINSNRMus	7.2.4.5	R/W (M)
<i>Seamless rate adaptation (SRA)</i>		
SRA-USNRMds	7.2.5.1	R/W (M)
SRA-UTIMEds	7.2.5.2	R/W (M)
SRA-USNRMus	7.2.5.3	R/W (M)
SRA-UTIMEus	7.2.5.4	R/W (M)
SRA-DSNRMds	7.2.5.5	R/W (M)
SRA-DTIMEds	7.2.5.6	R/W (M)
SRA-DSNRMus	7.2.5.7	R/W (M)
SRA-DTIMEus	7.2.5.8	R/W (M)
<i>Fast rate adaptation (FRA)</i>		
FRA-TIMEds	7.2.6.1	R/W (M)
FRA-TIMEus	7.2.6.2	R/W (M)
FRA-NTONESds	7.2.6.3	R/W (M)

Table 7-3 – Line configuration objects

Category/object	Described in clause	DPU-NB interface
FRA-NTONESus	7.2.6.4	R/W (M)
FRA-RTXUCds	7.2.6.5	R/W (M)
FRA-RTXUCus	7.2.6.6	R/W (M)
FRA-VENDISCds	7.2.6.7	R/W (M)
FRA-VENDISCus	7.2.6.8	R/W (M)
Robust management channel (RMC)		
TARSNRM-RMCds	7.2.7.1	R/W (M)
TARSNRM-RMCus	7.2.7.2	R/W (M)
MINSNRM-RMCds	7.2.7.3	R/W (M)
MINSNRM-RMCus	7.2.7.4	R/W (M)
MAXBL-RMCds	7.2.7.5	R/W (M)
MAXBL-RMCus	7.2.7.6	R/W (M)
Vectoring		
FEXT cancellation enabling/disabling downstream (FEXT_TO_CANCEL_ENABLEds)	7.2.8.1	R/W (M)
FEXT cancellation enabling/disabling upstream (FEXT_TO_CANCEL_ENABLEus)	7.2.8.2	R/W (M)
XLOG requested subcarrier group size (XLOGGREQds)	7.2.8.3	R/W (M)
Requested crosstalk disturber index (XTALKDREQ)	7.2.8.4	R/W (M)
Fast-retrain policy		
LOS-PERSISTENCYds	7.2.9.1	R/W (M)
LOS-PERSISTENCYus	7.2.9.2	R/W (M)
LOM-PERSISTENCYds	7.2.9.3	R/W (M)
LOM-PERSISTENCYus	7.2.9.4	R/W (M)
LOR-PERSISTENCYds	7.2.9.5	R/W (M)
LOR-PERSISTENCYus	7.2.9.6	R/W (M)
REINIT_TIME_THRESHOLDds	7.2.9.7	R/W (M)
REINIT_TIME_THRESHOLDus	7.2.9.8	R/W (M)
LOW_ETR_THRESHOLDds	7.2.9.9	R/W (M)
LOW_ETR_THRESHOLDus	7.2.9.10	R/W (M)
Update test parameters request		
UPDATE-NE-TEST	7.2.10.1	R/W (M)
UPDATE-FE-TEST	7.2.10.2	R/W (M)
Impulse noise monitoring (INM)		
INMIATods/us	7.2.11.1	R/W(M)
INMIATSds/us	7.2.11.2	R/W(M)
INMCCds/us	7.2.11.3	R/W(M)
INM_INPEQ_FORMATds/us	7.2.11.4	R/W(M)

Table 7-3 – Line configuration objects

Category/object	Described in clause	DPU-NB interface
BRGNds/us	7.2.11.5	R/W(M)
INPEQ_SF	7.2.11.6	R/W(M)
IAT_SF	7.2.11.7	R/W(M)
INM_ENABLE	7.2.11.8	R/W(M)
<i>RMCR recovery (RMCR)</i>		
RMCR_LOR_TRIGGERds/us	7.2.12.1	R/W(M)
<i>Showtime reconfiguration</i>		
SREC_ALLOWED	7.2.13.1	R/W(M)
<i>PMD forward error correction</i>		
PMDFECSCHMEDs/us	7.2.14	R/W(M)

Table 7-4 – Channel configuration objects

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

Table 7-5 – Data path configuration objects

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

Table 7-6 – Line failures

Category/object	Described in clause	DPU-NB interface
<i>Near-end (MTU-O) failures</i>		
Loss of signal (LOS)	7.5.1.1	R (M)
Loss of margin (LOM)	7.5.1.2	R (M)
Loss of RMC (LOR)	7.5.1.3	R (M)
Loss of power (LPR)	7.5.1.4	R (M)
<i>Far-end (MTU-R) failures</i>		
Loss of signal-far-end (LOS-FE) failure	7.5.2.1	R (M)
Loss of margin-far-end (LOM-FE) failure	7.5.2.2	R (M)
Loss of RMC-far end (LOR-FE) failure	7.5.2.3	R (M)
Loss of power-far end (LPR-FE) failure	7.5.2.4	R (M)
<i>Initialization failures</i>		
Link init (LINIT) failure	7.5.3.1	R (M)

Table 7-7 – Channel failures

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

Table 7-8 – Data path failures

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

Table 7-9 – Line performance monitoring objects

Category/object	Described in clause	DPU-NB interface
<i>Near-end (MTU-O)/far-end (MTU-R) performance monitoring counters (current/previous 15 min/24 h interval)</i>		
Measured time (CURR/PREV_NE/FE_15/24_L_TIME)	7.8.1	R (M)
Invalid data flag (PREV_NE/FE_15/24_L_INVALID)	7.8.2	R (M)
Time Stamp (PREV_NE/FE_15/24_L_STAMP)	7.8.3	R (M)
LOS failure counter (CURR/PREV_NE/FE_15/24_LOS)	7.8.4	R (M)
LOM failure counter (CURR/PREV_NE/FE_15/24_LOM)	7.8.5	R (M)
LOR failure counter (CURR/PREV_NE/FE_15/24_LOR)	7.8.6	R (M)
LPR failure counter (CURR/PREV_NE/FE_15/24_LPR)	7.8.7	R (M)
ES counter (CURR/PREV_NE/FE_15/24_ES)	7.8.8	R (M)
Severely errored second (SES) counter (CURR/PREV_NE/FE_15/24_SES)	7.8.9	R (M)
LOS second (LOSS) counter (CURR/PREV_NE/FE_15/24_LOSS)	7.8.10	R (M)
LOR second (LORS) counter (CURR/PREV_NE/FE_15/24_LORS)	7.8.11	R (M)
Unavailable second (UAS) counter (CURR/PREV_NE/FE_15/24_UAS)	7.8.12	R (M)
<i>Initialization performance monitoring counters (current/previous 15 min/24 h interval)</i>		
Full inits counter (CURR/PREV_15/24_FULL_INITS)	7.8.13	R (M)
Failed full inits counter (CURR/PREV_15/24_FAILEDFULL_INITS)	7.8.14	R (M)
Fast inits counter (CURR/PREV_15/24_FAST_INITS)	7.8.15	R (M)
Failed Fast inits counter (CURR/PREV_15/24_FAILEDFAST_INITS)	7.8.16	R (M)
<i>Near-end (MTU-O) short interruption performance monitoring counters (current/previous 15 min/24 h interval)</i>		
LPR_INTRPT counter (CURR/PREV_15/24_LPR_INTRPT)	7.8.17	R (M)
HRI_INTRPT counter (CURR/PREV_15/24_HRI_INTRPT)	7.8.18	R (M)

Table 7-9 – Line performance monitoring objects

Category/object	Described in clause	DPU-NB interface
SPONT_INTRPT counter (CURR/PREV_15/24_SPONT_INTRPT)	7.8.19	R (M)
ME_O_INTRPT counter (CURR/PREV_15/24_ME_O_INTRPT)	7.8.26	R (M)
<i>Near-end (MTU-O)/far-end (MTU-R) initiated OLR/FRA performance monitoring counters (current and previous 15 min/24 h interval)</i>		
Successful bitswap counter (CURR/PREV_NE/FE_15/24_BSW)	7.8.20	R (M)
Successful autonomous SRA counter (CURR/PREV_NE/FE_15/24_SRA)	7.8.21	R (M)
Successful FRA counter (CURR/PREV_NE/FE_15/24_FRA)	7.8.22	R (M)
Successful RMC parameter adjustment (RPA) counter (CURR/PREV_NE/FE_15/24_RPA)	7.8.23	R (M)
<i>Near-end (MTU-O) performance monitoring counters (current and previous 15 min/24 h interval)</i>		
Successful transmitter-initiated gain adjustment (TIGA) counter (CURR/PREV_15/24_TIGA)	7.8.24	R (M)
Successful showtime reconfiguration (SREC) counter CURR/PREV_15/24_SUCCESS_SREC	7.8.27	R (M)
Successful RMCR counter CURR/PREV_15/24_SUCCESS_RMCR	7.8.28	R (M)
<i>Near-end (MTU-O)/far-end (MTU-R) INM performance monitoring counters (current and previous 15 min/24 h interval)</i>		
INM INPEQ histogram (CURR/PREV_NE/FE_15/24_INMINPEQ)	7.8.25.1	R (M)
INM total measurement time (CURR/PREV_NE/FE_15/24_INMAME)	7.8.25.2	R (M)
INM IAT histogram (CURR/PREV_NE/FE_15/24_INMIAT)	7.8.25.3	R (M)
INM blank frame counter (CURR/PREV_NE/FE_15/24_INMBLFC)	7.8.25.4	R (M)

Table 7-10 – Channel performance monitoring objects

Category/object	Described in clause	DPU-NB interface
<i>Near-end (MTU-O)/far-end (MTU-R) performance monitoring counters (current/previous 15 min/24 h interval)</i>		
Measured Time (CURR/PREV_NE/FE_15/24_C_TIME)	7.9.1	R (M)
Invalid Data Flag (PREV_NE/FE_15/24_C_INVALID)	7.9.2	R (M)
Time Stamp (PREV_NE/FE_15/24_C_STAMP)	7.9.3	R (M)
Code violation (CV) counter (CURR/PREV_NE/FE_15/24_CV)	7.9.4	R (M)

Table 7-10 – Channel performance monitoring objects

Category/object	Described in clause	DPU-NB interface
RTXUC counter (CURR/PREV_NE/FE_15/24_RTXUC)	7.9.5	R (M)
RTXTX counter (CURR/PREV_NE/FE_15/24_RTXTX)	7.9.6	R (M)
LANDEFTRS counter (CURR/PREV_NE/FE_15/24_LANDEFTRS)	7.9.7	R (M)
LANDEFTR0S counter (CURR/PREV_NE/FE_15/24_LANDEFTR0S)	7.9.8	R (M)
ANDEFTRDS counter (CURR/PREV_NE/FE_15/24_ANDEFTRDS)	7.9.9	R (M)
ANDEFTR0DS counter (CURR/PREV_NE/FE_15/24_ANDEFTR0DS)	7.9.10	R (M)
<i>Near-end (NE) and far-end (FE) rate parameters per time interval (current/previous 15 min/24 h time interval)</i>		
MINANDEFTR per time interval (MINANDEFTR_CURR/PREV_NE/FE_15/24)	7.9.11	R (M)
MINANDEFTR0 per time interval (MINANDEFTR0_CURR/PREV_NE/FE_15/24)	7.9.12	R (M)
MAXANDEFTR per time interval (MAXANDEFTR_CURR/PREV_NE/FE_15/24)	7.9.13	R (M)
MAXANDEFTR0 per time interval (MAXANDEFTR0_CURR/PREV_NE/FE_15/24)	7.9.14	R (M)
SUMANDEFTR per time interval (SUMANDEFTR_CURR/PREV_NE/FE_15/24)	7.9.15	R (M)
SUMANDEFTR0 per time interval (SUMANDEFTR0_CURR/PREV_NE/FE_15/24)	7.9.16	R (M)
NOTE – The Measured Time, Invalid Data Flag and Time Stamp objects may have the same values as the respective line performance monitoring objects.		

Table 7-11 – Data path performance monitoring objects

Category/object	Described in clause	DPU-NB interface

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

Category/object	Described in clause	Test parameter group	DPU–NB interface
Profile			
ITU-T G.9711 profile (PROFILE)	7.11.1.1	Not applicable	R (M)
Initialization			
Initialization success/failure cause (INITSFCAUSE)	7.11.2.1	Not applicable	R (M)
Initialization last transmitted downstream signal (INITLASTSSIGNALds)	7.11.2.2	Not applicable	R (M)
Initialization last received upstream signal (INITLASTSIGNALus)	7.11.2.3	Not applicable	R (M)
Signal–to–noise ratio margin			
SNRMds	7.11.3.1	Not applicable	R (M)
SNRMus	7.11.3.2	Not applicable	R (M)
Upstream power back–off			
UPBOKLE	7.11.4.1	Not applicable	R (M)
UPBOKLE–R	7.11.4.2	Not applicable	R (M)
Actual aggregate transmit power			
ACTATPds	7.11.5.1	FE-G1	R (M)
ACTATPus	7.11.5.2	NE-G1	R (M)
Actual transmit power spectrum density per sub–carrier			
ACTPSDpsds	7.11.6.1	FE-G1	R (M)
ACTPSDpsus	7.11.6.2	NE-G1	R (M)
Channel characteristics per sub–carrier			
HLOGMTds	7.11.7.1	NE-G2	R (M)
HLOGGds	7.11.7.2	NE-G2	R (M)
HLOGpsds	7.11.7.3	NE-G2	R (M)
HLOGMTus	7.11.1.4	NE-G2	R (M)
HLOGGus	7.11.7.5	NE-G2	R (M)
HLOGpsus	7.11.7.6	NE-G2	R (M)
Signal–to–noise ratio per sub–carrier			
SNRMTds	7.11.8.1	FE-G1	R (M)
SNRGds	7.11.8.2	FE-G1	R (M)
SNRpsds	7.11.8.3	FE-G1	R (M)
SNRNPSFpsds	7.11.8.4	FE-G1	R (M)
SNRMTus	7.11.8.5	NE-G1	R (M)
SNRGus	7.11.8.6	NE-G1	R (M)
SNRpsus	7.11.8.7	NE-G1	R (M)
SNRNPSFpsus	7.11.8.8	NE-G1	R (M)

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

Category/object	Described in clause	Test parameter group	DPU–NB interface
<i>Quiet line noise per subcarrier</i>			
QLNMTds	7.11.9.1	FE-G2	R (M)
QLNGds	7.11.9.2	FE-G2	R (M)
QLNpsds	7.11.9.3	FE-G2	R (M)
QLNMTus	7.11.9.4	NE-G2	R (M)
QLNGus	7.11.9.5	NE-G2	R (M)
QLNpsus	7.11.9.6	NE-G2	R (M)
<i>Active line noise per subcarrier</i>			
ALNMT	7.11.10.1	FE-G2	R (M)
ALNG	7.11.10.2	FE-G2	R (M)
ALNps	7.11.10.3	FE-G2	R (M)
<i>Bit allocation per sub-carrier on data symbols</i>			
BITSpds	7.11.11.1	Not applicable	R (M)
BITSNPSFpds	7.11.11.2	Not applicable	R (M)
BITSpus	7.11.11.3	Not applicable	R (M)
BITSNPSFpus	7.11.11.4	Not applicable	R (M)
RMC			
SNRM-RMCds	7.11.12.1	Not applicable	R (M)
SNRM-RMCus	7.11.12.2	Not applicable	R (M)
BITS-RMCpds	7.11.12.3	Not applicable	R (M)
BITS-RMCpus	7.11.12.4	Not applicable	R (M)
<i>Test parameter time stamps</i>			
STAMP-TEST-NE-G1	7.11.13.1	Not applicable	R (M)
STAMP-TEST-FE-G1	7.11.13.2	Not applicable	R (M)
STAMP-TEST-NE-G2	7.11.13.3	Not applicable	R (M)
STAMP-TEST-FE-G2	7.11.13.4	Not applicable	R (M)
<i>OLR time stamps</i>			
STAMP-BSWds	7.11.14.1	Not applicable	R (M)
STAMP-BSWus	7.11.14.2	Not applicable	R (M)
STAMP-SRAds	7.11.14.3	Not applicable	R (M)
STAMP-SRAus	7.11.14.4	Not applicable	R (M)
STAMP-FRAds	7.11.14.5	Not applicable	R (M)
STAMP-FRAus	7.11.14.6	Not applicable	R (M)
STAMP-RPAds	7.11.14.7	Not applicable	R (M)
STAMP-RPAus	7.11.14.8	Not applicable	R (M)
STAMP-TIGA	7.11.14.9	Not applicable	R (M)
STAMP-SREC	7.11.14.10	Not applicable	R (M)

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

Category/object	Described in clause	Test parameter group	DPU–NB interface
STAMP-RMCRds	7.11.14.11	Not applicable	R (M)
STAMP-RMCRus	7.11.14.12	Not applicable	R (M)
Signal attenuation			
SATNds	7.11.15.1	FE-G1	R (M)
SATNus	7.11.15.2	NE-G1	R (M)
Vectoring			
XTALKDIST	7.11.16.1	NE-G2	R (M)
XLOGBANDSds	7.11.16.2	NE-G2	R (M)
XLOGpsds	7.11.16.3	NE-G2	R (M)
ANEXTBANDSds/us	7.11.16.4	NE-G2	R (M)
ANEXTNCALCSETds/us	7.11.16.5	NE-G2	R (M)
ANEXTds/us	7.11.16.6	NE-G2	R (M)
PMD forward error correction			
ACTPMDFECSHEMEds/us	7.11.17	Not applicable	R (M)
Framing type			
ACTPDXFRAMINGMODE	7.11.18	Not applicable	R (M)

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

Category/object	Described in clause	Test parameter group	DPU–NB interface
Actual data rates(downstream/upstream)			
Net data rate (NDRds/us)	7.12.1.1	Not applicable	R (M)
Net data rate with DTFO disabled (NDR0ds/us)	7.12.1.2	Not applicable	R (M)
Expected throughput (ETRds/us)	7.12.1.3	Not applicable	R (M)
Expected throughput with DTFO disabled (ETR0ds/us)	7.12.1.4	Not applicable	R (M)
Gamma data rate (GDRds/us)	7.12.1.5	Not applicable	R (M)
Attainable data rates (downstream/upstream)			
Attainable net data rate (ATTNDRds/us)	7.12.2.1	Not applicable	R (M)
Attainable expected throughput (ATTETRds/us)	7.12.2.2	Not applicable	R (M)
Attainable gamma data rate (ATTGDRds/us)	7.12.2.3	Not applicable	R (M)
Actual impulse noise protection (downstream/upstream)			
ACTINPds/us	7.12.3.1	Not applicable	R (M)
ACTINP_REINDs/us	7.12.3.2	Not applicable	R (M)
Actual framer setting (downstream/upstream)			

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

Category/object	Described in clause	Test parameter group	DPU–NB interface
DTU–NFECds/us	7.12.4.1	Not applicable	R (M)
DTU–RFECds/us	7.12.4.2	Not applicable	R (M)
DTU–Qds/us	7.12.4.3	Not applicable	R (M)
Test parameters per time interval (downstream/upstream)			
Error–free bits current 15 min (EFB–C15Mds/us)	7.12.5.1	Not applicable	R (M)
Error–free bits previous 15 min (EFB–P15Mds/us)	7.12.5.2	Not applicable	R (M)
Error–free bits current 24 h (EFB–C24Hds/us)	7.12.5.3	Not applicable	R (M)
Error–free bits previous 24 h (EFB–P24Hds/us)	7.12.5.4	Not applicable	R (M)
MINEFTR current 15 min (MINEFTR_C15Mds/us)	7.12.5.5	Not applicable	R (M)
MINEFTR previous 15 min (MINEFTR_P15Mds/us)	7.12.5.6	Not applicable	R (M)
MINEFTR current 24 h (MINEFTR_C24Hds/us)	7.12.5.7	Not applicable	R (M)
MINEFTR previous 24 h (MINEFTR_P24Hds/us)	7.12.5.8	Not applicable	R (M)

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

Category/object	Described in clause	DPU–NB interface

Table 7-15 – Inventory objects

Category/object	Described in clause	DPU–NB interface
MTU related inventory		
MTU–O ITU–T G.994.1 vendor ID (MTUO_GHS_VENDOR)	7.14.1.1	R (M)
MTU–R ITU–T G.994.1 vendor ID (MTUR_GHS_VENDOR)	7.14.1.2	R (M)
MTU–O version number (MTUO_VERSION)	7.14.1.3	R (M)
MTU–R version number (MTU–R VERSION)	7.14.1.4	R (M)
MTU–O self-test result (MTUO-SELFTEST)	7.14.1.5	R (M)

Table 7-15 – Inventory objects

Category/object	Described in clause	DPU-NB interface
MTU related inventory		
MTU-R self-test result (MTUR_SELFTEST)	7.14.1.6	R (M)
ITU-T G.9711 profile support (MTUO_PROFILES)	7.14.1.7	R (M)
ITU-T G.9711 profile support (MTUR_PROFILES)	7.14.1.8	R (M)
System related inventory		
DPU system vendor ID (DPU_SYSTEM_VENDOR)	7.14.2.1	R (M)
NT system vendor ID (NT_SYSTEM_VENDOR)	7.14.2.2	R (M)
DPU serial number (DPU_SYSTEM_SERIALNR)	7.14.2.3	R (M)
NT serial number (NT_SYSTEM_SERIALNR)	7.14.2.4	R (M)
VCE identifier (VCE_ID)	7.14.2.5	R (M)
VCE port index (VCE_PORT_INDEX)	7.14.2.6	R (M)
NT identity	7.14.2.7	R (M)

Table 7-16 – P2MP configuration objects

Category/object	Described in clause:	DPU-NB interface
Topology		
MAXP2MPGROUPSIZE	7.15.1	R/W (M)
Line		
MAXP2MPGROUPATPds/us	7.15.2	R/W (M)
Channel		
MAXP2MPGROUPNDRds/us	7.15.3	R/W (M)

Table 7-17 – P2MP status objects

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

7.1 Link identification

7.1.1 Unknown NT identification (UNKNOWN_NT_ID)

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

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

7.1.2 NT identification (NT_ID)

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

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

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

Default: "p2p".

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

7.2 Line configuration objects

7.2.1 Profiles

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

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

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

PROFILEdescriptor

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

Bit representation

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

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

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

7.2.2 Time division duplexing

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

Description: Determines the total number of symbol periods in a time division duplexing (TDD) frame.

Type: 8-bit unsigned integer.

Valid values: 23 and 36

Default value: 36

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

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

Description: Determines 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 $M_{us} = M_F - 1 - M_{ds}$.

Type: 8-bit unsigned integer.

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

Default value: 28

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

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

7.2.2.3 Cyclic extension

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

Type: 8-bit unsigned integer.

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

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

Default value: 10

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

7.2.3 Power and spectrum usage

7.2.3.1 Downstream maximum aggregate transmit power (MAXATPds)

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

Type: 16-bit signed integer.

Unit: 0.1 dBm.

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

Default value: 40 (4 dBm).

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

7.2.3.2 Upstream maximum aggregate transmit power (MAXATPus)

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

Type: 16-bit signed integer.

Unit: 0.1 dBm.

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

Default value: 40 (4 dBm).

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

7.2.3.3 Downstream subcarrier masking (CARMASKds)

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

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

CARMASKdescriptor

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

Sub-carrier index

Type: 16-bit unsigned integer.

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

Default value: Empty array (No masked subcarriers).

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

7.2.3.4 Upstream subcarrier masking (CARMASKus)

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

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

CARMASKdescriptor: See CARMASKds in clause 7.2.3.3.

Default value: Empty array (No masked subcarriers).

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

7.2.3.5 Downstream PSD mask (MIBPSDMASKds)

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

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

PSDMASKdescriptor

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

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

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