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

Digital networks – Optical transport networks

Management aspects of optical transport network elements

Recommendation ITU-T G.874

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
General aspects	G.800–G.809
Design objectives for digital networks	G.810–G.819
Synchronization, quality and availability targets	G.820–G.829
Network capabilities and functions	G.830–G.839
SDH network characteristics	G.840–G.849
Management of transport network	G.850–G.859
SDH radio and satellite systems integration	G.860–G.869
Optical transport networks	**G.870–G.879**
DIGITAL SECTIONS AND DIGITAL LINE SYSTEM	G.900–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

For further details, please refer to the list of ITU-T Recommendations.

Recommendation ITU-T G.874

Management aspects of optical transport network elements

Summary

Recommendation ITU-T G.874 addresses management aspects of optical transport network (OTN) elements containing transport functions of one or more of the layer networks of the OTN. The management of optical layer networks is separable from that of its client layer networks so that the same means of management can be used regardless of the client. The management functions for fault management, configuration management (CM) and performance monitoring are specified.

Recommendation ITU-T G.874 (2008) updated the management information (MI) to align with Recommendation ITU-T G.798, reorganized the sections to align with the structure of Recommendation ITU-T G.7710/Y.1701, and replaced the generic text with pointers to Recommendation ITU-T G.7710/Y.1701.

Recommendation ITU-T G.874 (2010) added the management of new transport functions that were introduced in ITU-T G.798 (2010), including OPSMnk_TT, OPSM/OTUk a_A, and ODUk for k=0, 2e, 4, and flex.

Recommendation ITU-T G.874 (2013) added the management of hitless adjustment of ODUflex(GFP) (HAO), automatic protection switching (APS), application codes and performance management (PM) data collection.

Recommendation ITU-T G.874 (2017) added a description to cover OTUCn GCC0, added the application code related MI signals, updated the MI signals for ODU2eP/FC-1200_A, OSM256.4/CBRx_A, OSx/CBRx-b_A_Sk and OSx/CBRx-c_A_Sk, removed the nDelay, nES, and fES primitives, moved the description of O.MN, O.MSN, and O.NE to the convention clause, updated the default values of DEGThr and DEGM, updated Appendix III to align with Table 15-9 of ITU-T G.709/Y.1331 (2016), and removed the adaptation function activation and MI_Active to align with ITU-T G.798.

Recommendation ITU-T G.874 (2020) aligns with the latest editions of ITU-T G.709 and ITU-T G.798, and harmonizes generic requirements with clauses 8 and 10 of ITU-T G.7710/Y.1701 .

History

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Optical transport network, OTN.

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FOREWORD

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As of the date of approval of this Recommendation, ITU had not 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/.

Table of Contents

Page

Recommendation ITU-T G.874

Management aspects of optical transport network elements

1 Scope

This Recommendation addresses management aspects of optical transport network (OTN) elements containing transport functions of one or more layer networks of the OTN as described in [ITU-T G.709]. The management of optical layer networks is separable from that of its client layer networks; therefore the same means of management can be used regardless of the client. This Recommendation specifies the management functions for fault management, configuration management (CM), account management, performance management (PM) and security management.

This Recommendation describes the management network organizational model for communication between an element management layer (EML) operations system (OS) and the optical equipment management function (EMF) within an OTN network element (O.NE).

The architecture described in this Recommendation for the management of OTNs is based upon the following considerations.

– The management view of network element (NE) functional elements should be uniform whether those elements form part of an inter-domain interface (IrDI) or part of an intra-domain interface (IaDI). Those properties necessary to form such a uniform management view are to be included in this Recommendation.
– OTN layer network entities (OLNEs) include trail termination (TT), adaptation and connection functions as described in [ITU-T G.872] for the OTN digital layer.
– An NE may only contain OLNEs.
– An NE may contain both OLNEs and client layer network entities (CLNEs).
– CLNEs are managed as part of their own logical domain [e.g., a synchronous digital hierarchy (SDH) management network].
– CLNEs and OLNEs may or may not share a common message communication function (MCF) and management application function (MAF) depending on application.
– CLNEs and OLNEs may or may not share the same agent.

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.695] Recommendation ITU-T G.695 (2018), *Optical interfaces for coarse wavelength division multiplexing applications*.

[ITU-T G.698.2] Recommendation ITU-T G.698.2 (2018), *Amplified multichannel dense wavelength division multiplexing applications with single channel optical interfaces*.

[ITU-T G.7041] Recommendation ITU-T G.7041/Y.1303 (2016), *Generic framing procedure.*

[ITU-T G.7044] Recommendation ITU-T G.7044/Y.1347 (2011), *Hitless adjustment of ODUflex(GFP).*

[ITU-T G.709] Recommendation ITU-T G.709/Y.1331 (2020), *Interfaces for the optical transport network*.

[ITU-T G.709.1] Recommendation ITU-T G.709.1/Y.1331.1 (2018), *Flexible OTN short-reach interfaces*.

[ITU-T G.784] Recommendation ITU-T G.784 (2008), *Management aspects of synchronous digital hierarchy (SDH) transport network elements*.

[ITU-T G.798] Recommendation ITU-T G.798 (2017), *Characteristics of optical transport network hierarchy equipment functional bocks*.

[ITU-T G.806] Recommendation ITU-T G.806 (2012), *Characteristics of transport equipment – Description methodology and generic functionality*.

[ITU-T G.826] Recommendation ITU-T G.826 (2002), *End-to-end error performance parameters and objectives for international, constant bit-rate digital paths and connections*.

[ITU-T G.870] Recommendation ITU-T G.870/Y.1352 (2016), *Terms and definitions for optical transport networks*.

[ITU-T G.872] Recommendation ITU-T G.872 (2019), *Architecture of optical transport networks*.

[ITU-T G.873.1] Recommendation ITU-T G.873.1 (2017), *Optical transport network: Linear protection.*

[ITU-T G.875] Recommendation ITU-T G.875 (2020), *Optical transport network: Protocol-neutral management information model for the network element view*.

[ITU-T G.959.1] Recommendation ITU-T G.959.1 (2018), *Optical transport network physical layer interfaces*.

[ITU-T G.7710] Recommendation ITU-T G.7710/Y.1701 (2020), *Common equipment management function requirements*.

[ITU-T G.7712] Recommendation ITU-T G.7712/Y.1703 (2019), *Architecture and specification of data communication network.*

[ITU-T G.8121] Recommendation ITU-T G.8121/Y.1381 (2018), *Characteristics of MPLS-TP equipment functional blocks*.

[ITU-T M.20] Recommendation ITU-T M.20 (1992), *Maintenance philosophy for telecommunication networks*.

[ITU-T M.60] Recommendation ITU-T M.60 (1993), *Maintenance terminology and definitions*.

[ITU-T M.2120] Recommendation ITU-T M.2120 (2002), *International multi-operator paths, sections and transmission systems fault detection and localization procedures*.

[ITU-T M.3010] Recommendation ITU-T M.3010 (2000), *Principles for a telecommunications management network.*

[ITU-T M.3100] Recommendation ITU-T M.3100 (2005), *Generic network information model*.

[ITU-T X.700] Recommendation ITU-T X.700 (1992), *Management framework for Open Systems Interconnection (OSI) for CCITT applications*.

[ITU-T X.701] Recommendation ITU-T X.701 (1997) | ISO/IEC 10040:1998, *Information technology – Open Systems Interconnection – Systems management overview*.

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 Terms defined in [ITU-T G.784]

3.1.1.1 Data communication channel (DCC).

3.1.2 Terms defined in [ITU-T G.806]

3.1.2.1 Atomic function.

3.1.2.2 Management point (MP).

3.1.3 Terms defined in [ITU-T G.870]

3.1.3.1 Intra-domain interface (IaDI).

3.1.3.2 Inter-domain interface (IrDI).

3.1.4 Terms defined in [ITU-T G.7710]

3.1.4.1 Local craft terminal (LCT).

3.1.4.2 Management application function (MAF).

3.1.5 Terms defined in [ITU-T G.7712]

3.1.5.1 Data communication network (DCN).

3.1.5.2 Embedded communication channel (ECC).

3.1.6 Terms defined in [ITU-T M.60]

3.1.6.1 Message communication function (MCF).

3.1.7 Terms defined in [ITU-T M.3010]

3.1.7.1 Network element.

3.1.7.2 Network element function.

3.1.7.3 Operations system (OS).

3.1.7.4 Q interface.

3.1.7.5 Workstation function.

3.1.8 Terms defined in [ITU-T M.3100]

3.1.8.1 Aggregate audible/visual indicators.

3.1.8.2 Alarm reporting.

3.1.8.3 Alarm reporting control.

3.1.8.4 Inhibited.

3.1.8.5 Managed entity.

3.1.8.6 Managed resource.

3.1.8.7 Managed resource-specific/unit audible/visual indicator.

3.1.8.8 Management interface.

3.1.8.9 Persistence interval.

3.1.8.10 Qualified problem.

3.1.8.11 Timed interval.

3.1.9 Terms defined in [ITU-T X.700]

3.1.9.1 Managed object.

3.1.10 Terms defined in [ITU-T X.701]

3.1.10.1 Agent.

3.1.10.2 Managed object class.

3.1.10.3 Manager.

3.2 Terms defined in this Recommendation

None.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

AcPT	Accepted Payload Type
AcSTAT	Accepted Status
AcTI	Accepted Trace Identifier
AdminState	Administrative State
AIS	Alarm Indication Signal
ALM	Alarm
AP	Access Point
APR	Automatic Power Reduction
APRCntrl	Automatic Power Reduction Control
APS	Automatic Protection Switching
ARC	Alarm Reporting Control
AST	Alarm Status
ASY	Alarm Synchronization

AutoMS	Automatic configuration of the Multiplex Structure
BDI-O	Backward Defect Indicator Overhead
BDI-P	Backward Defect Indicator Payload
BIAE	Backward Incoming Alignment Error
BIP	Bit Interleaved Parity
CBRx	Constant Bit Rate signal of bit rate [range] x
CBRx-a	Constant Bit Rate signal of bit rate [range] x -Asynchronous mapping
CBRx-b	Constant Bit Rate signal of bit rate [range] x -Bit synchronous mapping
CLNE	Client Layer Network Entity
CM	Configuration Management
COMMS	Communications
COMMS OH	Communications Overhead
CP	Connection Point
CPL	Current Problem List
CSACM	Calendar Slot Availability Count Mismatch
CSF	Client Signal Failure
CTP	Connection Termination Point
CWDM	Coarse Wavelength Division Multiplexing
DCC	Data Communication Channel
DCN	Data Communication Network
DS	Defect Second
DS-O	Defect Second Overhead
DS-P	Defect Second Payload
DEG	Degraded
DEGM	DEG consecutive 1 s Monitoring intervals
DEGThr	DEG 1 s EBC Threshold
DTDL	Defect Type and Defect Location
DWDM	Dense Wavelength Division Multiplexing
EBC	Errored Block Count
ECC	Embedded Communication Channel
EMF	Equipment Management Function
EML	Element Management Layer
ETH	Ethernet
ETH-C	Ethernet connection
ExDAPI	Expected Destination Access Point Identifier
ExMSI	Expected Multiplex Structure Identifier
ExSAPI	Expected Source Access Point Identifier

ExtCMD	External Command
F	Far end
FCAPS	Fault, Configuration, Accounting, Performance and Security
FEC	Forward Error Correction
FECEn	Forward Error Correction Enabled
FFS	For Further Study
FlexO	Flexible Optical transport network
FOP-PM	Failure of Protocol; Provisioning Mismatch
FOP-NR	Failure of Protocol; No Response
GCC	General Communication Channel
GCCAccess	General Communication Channel Access
GCCCont	General Communication Channel Continue
GetAcTI	Get Accepted trail Trace Identifier
GFC	Generic Flow Control
GIDM	Group Identification Mismatch
HAO	Hitless Adjustment of ODUflex(GFP)
HEC	Header Error Control
HO	High Order
HoTime	Hold-off Time
IaDI	Intra-Domain Interface
IAE	Incoming Alignment Error
IrDI	Inter-Domain Interface
LAN	Local Area Network
LCK	Locked
LCS	Loss of Character Synchronization
LCT	Local Craft Terminal
LFD	Loss of Frame Delineation
LOA	Loss of Alignment
LOF	Loss of Frame
LOFLOM	Loss of Frame and Loss of Multiframe
LOG	Logging
LOL	Loss Of Lane
LOM	Loss Of Multiframe
LOOMFI	Loss of OPU Multiframe Indication
LOS	Loss Of Signal
LOS-O	Loss Of Signal Overhead
LOS-P	Loss Of Signal Payload

LSS	Loss of pseudo-random bit Sequence lock
LTC	Loss of Tandem Connection
MAF	Management Application Function
MCC	Maintenance Communication Channel
MCF	Message Communication Function
MCN	Management Communication Network
MI	Management Information
MIB	Management Information Base
MO	Managed Object
MP	Management Point
MPI-R	Main Path Interface-Reference point
MPI-S	Main Path Interface-S interface
MS	Multiplex Session
MSIM	Multiplex Structure Identifier Mismatch
NE	Network Element
NEA	Network Element Alarm
NEF	Network Element Function
NT	Network Termination
OCh	Optical Channel
OCI	Open Connection Indication
ODTUjk	Optical Data Tributary Unit j into k
ODU	Optical Data Unit
ODUCn	Optical Data Unit-Cn
ODUCnP	Optical Data Unit-Cn, Path
ODUi	Optical Data Unit of level i
ODU[i]j	Optical Data Unit of level j and i (i is optional; i < j)
ODUj	Optical Data Unit of level j
ODUk	Optical Data Unit of level k, k=0, 1, 2, 2e, 3, 4, flex
ODUkP	Optical Data Unit of level k, Path, k=0, 1, 2, 2e, 3, 4, flex
ODUkT	Optical Data Unit of level k, Tandem connection sub-layer, k=0, 1, 2, 2e, 3, 4, flex
ODUkTm	ODUkT non-intrusive monitoring function, k=0, 1, 2, 2e, 3, 4, flex
ODUT	Optical Data Unit, Tandem
OLNE	OTN Layer Network Entity
O.MN	OTN Management Network
OMS-O	Optical Multiplex Section – Overhead
O.MSN	OTN Management Subnetwork

O.NE	OTN Network Element
OOS	Overhead Signal
OPS	Operational State
OS	Operations System
OSC	Optical Supervisory Channel
OSI	Open Systems Interconnection
OTH	Open Transport Hierarchy
OTM	Optical Transport Module
OTN	Optical Transport Network
OTS	Optical Transmission Section
OTSi	Optical Tributary Signal
OTSiG	Optical Tributary Signal Group
OTUCn	Optical Transport Unit-Cn
OTUk	Optical Transport Unit-k
OTU	Optical Transmission Unit
OTUk	Optical Transmission Unit of level k, k=1, 2, 3, 4
OTUkV	Optical Transmission Unit of level k, functional standardized, k=1, 2, 3, 4
PCS	Physical Coding Sublayer
PLM	Payload Mismatch
PM	Performance Management
PMC	Performance Monitoring Clock
PMM	Physical layer Map Mismatch
PPP	Point-to-Point Protocol
ProtType	Protection Type
PRBS	Pseudo-Random Bit Sequence
PRS	Persistency
PT	Payload Type
REP	Reportable failure
RSn	Regenerator Section of level n
RTC	Real-Time Clock
RTR	Reset Threshold Report
SCC	Signalling Communication Channel
SCN	Signalling Communication Network
SDH	Synchronous Digital Hierarchy
SEV	Severity assignment
Sk	Sink
So	Source

SSF-O	Server Signal Fail Overhead
SSF-P	Server Signal Fail Payload
STA	Station Alarm
STAT	Status
STM-N	Synchronous Transfer Mode-N
TAN	TMN Alarm event Notification
TCM	Tandem Connection Monitoring
TCMCP	TCM Control Point
TCP	Termination Connection Point
TEP	TMN Event Pre-processing alarm
TIM	Trail trace Identifier Mismatch
TIMActDis	Trace Identifier Mismatch consequent Actions Disabled
TIMDetMo	Trace Identifier Mismatch Detection Mode
TMN	Telecommunications Management Network
TP	Termination Point
TPusgActive	TP usage measurement Active
TR	Threshold Report
TSE	Test Sequence Error
TT	Trail Termination
TTI	Trail Trace Identifier
TTP	Trail Termination Point
TxMSI	Transmitted Multiplex Structure Identifier
TxTI	Transmitted trail Trace Identifier
UNA	Unit Alarm
VPI	Virtual Path Identifier
WDM	Wavelength Division Multiplexing

5 Conventions

An O.MN is a subset of a telecommunications management network (TMN) that is responsible for managing those parts of anNE that contain OLNEs. An O.MN may be subdivided into a set of O.MSNs.

An O.MSN consists of a set of separate OTN ECCs and associated intra-site data communication links that have been interconnected to form a DCN within any given OTN transport topology.

An O.NE is that part of an NE that contains entities from one or more OTN layer networks. An O.NE may therefore be a standalone physical entity or a subset of an NE. It supports at least network element functions (NEFs) and may also support an OS function or a mediation function. It contains managed objects (MOs), an MCF and an MAF. The functions of an O.NE may be contained within an NE that also supports other layer networks. These layer network entities are considered to be managed separately from OTN entities. As such, they are not part of the O.MSN or O.MN.

6 Optical transport network management architecture

See clause 6 of [ITU-T G.7710] for the generic architecture for managing transport equipment.

The transport layer networks of the OTN are described in [ITU-T G.872], [ITU-T G.798] and [ITU-T G.709]. The management of the OTN layer networks is separable from that of its client layer networks so that the same means of management can be used regardless of the client.

6.1 OTN management network architecture

6.1.1 Relationship between telecommunications management network, O.MN and O.MSN

The inter-relationship between a management network, its subnetworks and a TMN as generically described in clause 6.1.1 of [ITU-T G.7710] is applicable to OTN.

This Recommendation specifies the O.MN and O.MSNs.

6.1.2 Access to the O.MSN

See clause 6.1.2 of [ITU-T G.7710] for the generic requirements.

6.1.3 O.MSN requirements

See clause 6.1.3 of [ITU-T G.7710] for the generic requirements.

The main ECC for OTN is considered to be the communications overhead (COMMS OH) in the optical supervisory channel (OSC), see clause 15.1.7 of [ITU-T G.709]. The COMMS OH is carried in the OSC in OTN optical networking interfaces, type I. This COMMS-based ECC is equivalent to the SDH synchronous transfer mode-N (STM-N) multiplex session-data communication channel (MS-DCC). A general communication channel (GCC) is typically used as an ECC when a remote CPE or a remote subnetwork has to be reached, and on OTN point-to-point interfaces of type I and type II only.

In addition, the O.MSN allows for the support of the following:

1) The OTN allows the ECC options of using the general management COMMS OH or the GCCs.
   - All O.NEs, which are not connected through an Ethernet local area network (LAN) with a co-located NE, are required to terminate the COMMS OH.
   - All O.NEs, which are not connected through an Ethernet LAN with a co-located NE, are required to terminate the optical transmission unit of level k (OTUk; k=1, 2, 3, 4) GCC0 to connect to O.NEs [e.g., open transport hierarchy (OTH) network terminations (NTs)] that are equipped with OTN point-to-point interfaces of type I and type II only.
2) OTN inter-site communications. The inter-site or inter-office communications link between O.NEs will normally be formed from the COMMS OH.
3) OTN intra-site communications. Within a particular site, O.NEs may communicate via an intra-site COMMS OH or via an LAN.

The use of GCCs and COMMS OH for management communications is described in clauses 6.1.3.1 and 6.1.3.2.

6.1.3.1 General communication channels

The OTN supports three GCCs:

1) GCC0;
2) GCC1;
3) GCC2.

Figure 6-1 illustrates a network scenario consisting of two operators. Operator B provides an optical data unit of level k (ODUk; k=0, 1, 2, 2e, 3, 4, flex) service to operator A (i.e., operator B transports the ODUk frame that begins and ends in operator A's domain). According to [ITU-T G.709], only a subset of the ODUk overhead (e.g., path monitoring) is guaranteed to be passed through operator B's network. Other overheads, such as tandem connection monitoring (TCM) overhead, as well as GCC1 and GCC2 are subject to the service level agreement made between operator A and operator B.

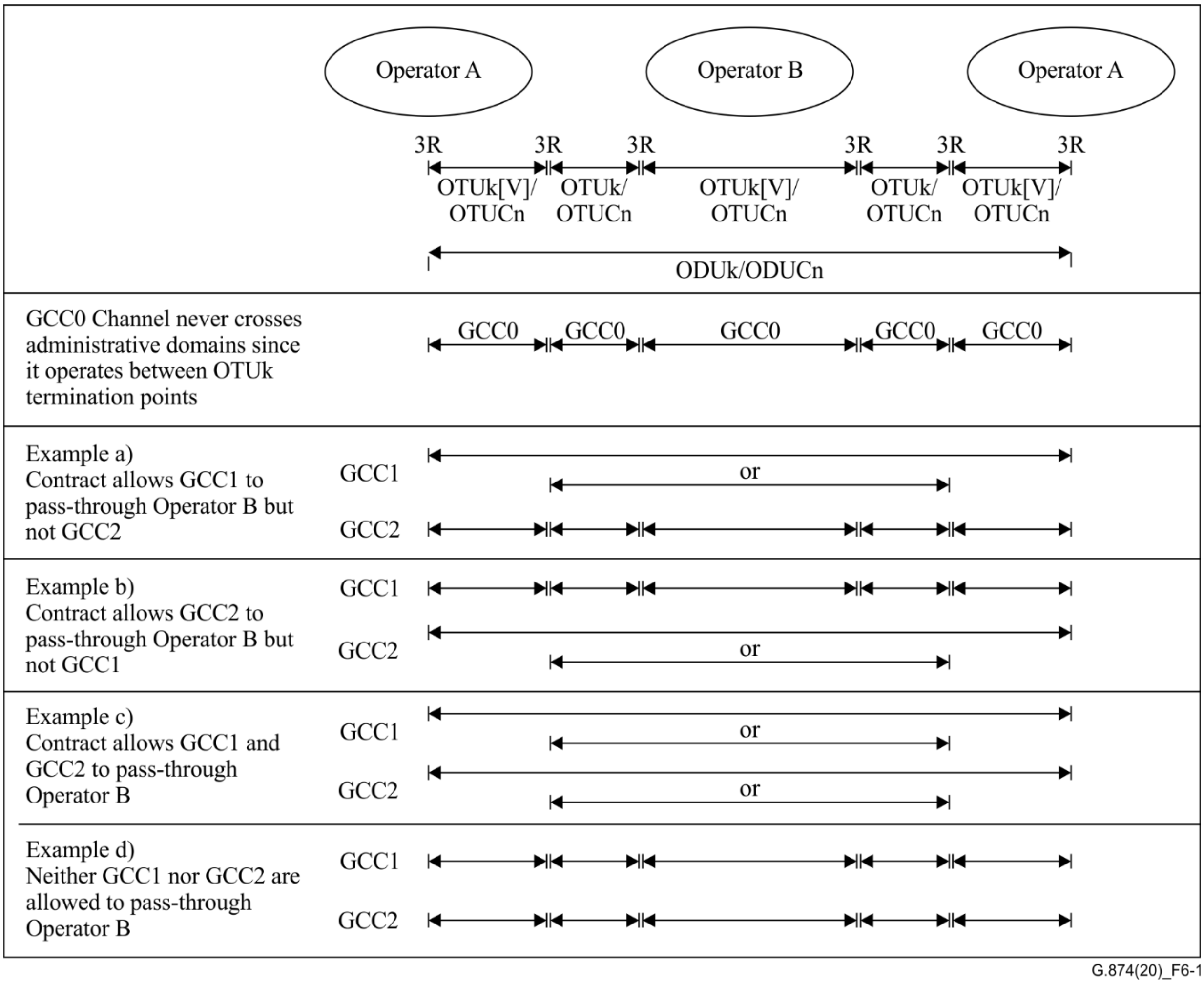

Figure 6-1 – GCC contract scenarios

OTUk[V]: OTUk or OTUkV

GCC0 is a channel between OTUk/OTUCn termination points (TPs) and therefore does not cross administrative domains, since an IrDI interface supports 3R points on either end of the interface. Example a) illustrates a scenario where the contract between operators A and B only allows GCC1 to pass through operator B's network. In such a scenario, operator B may use GCC2 within its own network. Example b) illustrates a scenario where the contract between operators A and B only allows GCC2 to pass through operator B's network. In this scenario, operator B may use GCC1 within its own network. Example c) illustrates a scenario where the contract between operators A and B allows both GCC1 and GCC2 to pass through operator B's network. In this scenario, operator B cannot use GCC1 or GCC2. Example d) illustrates a scenario where the contract between operators A and B does not allow GCC1 or GCC2 to pass through operator B's network. In this scenario, operator B can use both GCC1 and GCC2 within its own network.

6.1.3.1.1 General communication channel physical characteristics

The OTUk GCC0 shall operate as a single message channel between OTUk TPs using the OTUk overhead bytes located in row 1, columns 11 and 12 of the OTUk overhead. The bit rate of the GCC0 depends on the rate of the OTUk. For an OTU1, the GCC0 channel shall operate at 326.723 kbit/s. For an OTU2, the GCC0 channel shall operate at 1 312.405 kbit/s. For an OTU3, the GCC0 channel shall operate at 5 271.864 kbit/s. For an OTU4, the GCC0 channel shall operate at 13 702.203 kbit/s. The OTUCn GCC0 shall operate as a single message channel between OTUCn TPs using the OTUC overhead bytes located in row 1, columns 11 and 12 of the OTUC overhead. The OTUCn contains n instances of the OTUC GCC0 overhead, numbered 1 to n (GCC0 #1 to GCC0 #n). The bit rate of the OTUCn GCC0 depends on the value of n. The GCC0 #1 to #n overhead instances are combined to provide one communication channel as illustrated in Figure 15-15 of [ITU-T G.709] with an approximated bandwidth of n × 13.762 8 Mbit/s. According to [ITU-T G.709], vendor specific interfaces could use the first GCC0 only.

The ODUk GCC1 shall operate as a single message channel between any two NEs with access to the ODUk frame structure using the optical data unit (ODU) overhead bytes located in row 4, columns 1 and 2 of the ODUk overhead. The bit rate of the GCC1 depends on the rate of the ODUk. For an ODU1, the GCC1 channel shall operate at 326.723 kbit/s. For an ODU2, the GCC1 channel shall operate at 1 312.405 kbit/s. For an ODU2e, the GCC1 channel shall operate at 1 359 kbit/s. For an ODU3, the GCC1 channel shall operate at 5 271.864 kbit/s. For an ODU4, the GCC1 channel shall operate at 13 702.203 kbit/s. For an ODU flex (packet) of n timeslots, the GCC1 channel shall operate at ODUflex rate/7 648 kbit/s. For an ODU flex (CBR), the GCC1 channel shall operate at (239/238)/7 648 × client bit rate kbit/s. The completely standardized optical data unit/Cn (ODUCn) GCC1 shall operate as a single message channel between any two NEs with access to the ODUCn frame structure using the ODUC overhead bytes located in row 4, columns 1 and 2 of the ODUC overhead. The bit rate of the GCC1 depends on the rate of the ODUCn. The OTUCn contains n instances of the ODUC GCC1 overhead, numbered 1 to n (GCC1 #1 to GCC1#n). The GCC1 #1 to #n overhead instances are combined to provide one communication channel as illustrated in Figure 15-25 of [ITU-T G.709] with an approximated bandwidth of n × 13.768 Mbit/s.

The ODUk GCC2 shall operate as a single message channel between any two NEs with access to the ODUk frame structure using the ODU overhead bytes located in row 4, columns 3 and 4 of the ODUk overhead. The bit rate of the GCC2 depends on the rate of the ODUk. For an ODU1, the GCC1 channel shall operate at 326.723 kbit/s. For an ODU2, the GCC2 channel shall operate at 1 312.405 kbit/s. For an ODU2e, the GCC2 channel shall operate at 1 359 kbit/s. For an ODU3, the GCC2 channel shall operate at 5 271.864 kbit/s. For an ODU4, the GCC2 channel shall operate at 13 702.203 kbit/s. For an ODU flex (packet) of n timeslots, the GCC2 channel shall operate at ODUflex rate/7 648 kbit/s. For an ODU flex (CBR), the GCC2 channel shall operate at (239/238)/7 648 × client bit rate kbit/s. The ODUCn GCC2 shall operate as a single message channel between any two NEs with access to the ODUCn frame structure using the ODUC overhead bytes located in row 4, columns 1 and 2 of the ODUC overhead. The bit rate of the GCC2 depends on the rate of the ODUCn. The OTUCn contains n instances of the ODUC GCC2 overhead, numbered 1 to n (GCC2 #1 to GCC2 #n). The GCC2 #1 to #n overhead instances are combined to provide one communication channel as illustrated in Figure 15-25 of [ITU-T G.709] with an approximated bandwidth of n × 13.768 Mbit/s.

The GCC1 #1 to #n plus GCC2 #1 to #n overhead may be combined to provide one communication channel as illustrated in Figure 15-25 of [ITU-T G.709] with an approximated bandwidth of n × 27.525 Mbit/s.

NOTE 1 – The GCC0/1/2 rates specified in this clause are nominal rates with ±20 ppm rate tolerance.

NOTE 2 – The GCC0 rates is based on Table 13-10 of [ITU-T G.798], The GCC1 and GCC2 rates is based on Table 14-49 of [ITU-T G.798].

6.1.3.1.2 GCC data link layer protocol

When used for management applications, the data link point-to-point protocol (PPP) provides connections between nodes of the underlying transmission network. Mapping of an OTN data-link layer frame into the GCC is specified in [ITU-T G.7712].

6.1.3.1.3 Support of the management communication network and signalling communication network separation

In some network deployment scenarios, it might be desirable to have separation of the management communication network (MCN) and signalling communication network (SCN), such as separately enabling or disabling the MCN and SCN traffic on each DCN interface. This might include scenarios where the SCN spans multiple network domains. The following mechanisms can be used to meet such an application requirement.

– GCC1 and GCC2 can be used simultaneously and separately via two parallel independent instances of the ODUkP/COMMS_A function or via two parallel independent instances of the ODUCnP/COMMS_A function. For these two instances, one must be configured as GCC1 (MI_GCCAccess = "GCC1") while the other instance must be configured as GCC2 (MI_GCCAccess = "GCC2"). The two COMMS_CPs can then be assigned to the MCN and SCN, respectively. See Figure 6-2.

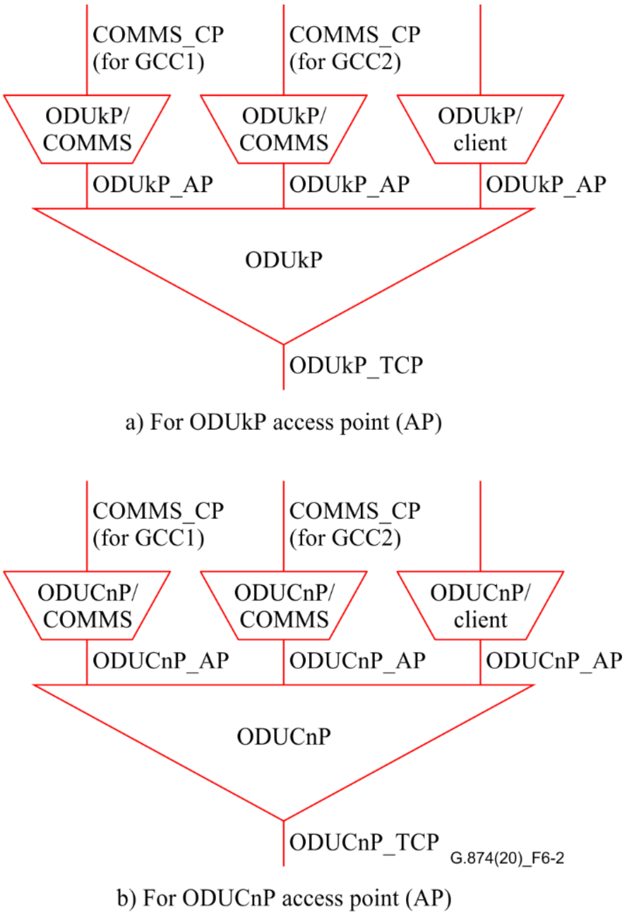

Figure 6-2 – COMMS (GCC1 and GCC2) access at ODUkP access point
(Updated from Figure 14-104 and Figure 14-106 of [ITU-T G.798])
ODUkP: optical data unit of level k, Path (k=0, 1, 2, 2e, 3, 4, flex)

– GCC1 and GCC2 can be used simultaneously and separately via two cascaded independent instances of the ODUk/COMMS_AC atomic function or via two parallel independent instances of the ODUCnP/COMMS_AC function. For these two instances, one must be configured as GCC1 (MI_GCCAccess = "GCC1") while the other instance must be configured as GCC2 (MI_GCCAccess = "GCC2"). The two COMMS_CPs can then be assigned to the MCN and SCN, respectively. See Figure 6-3.

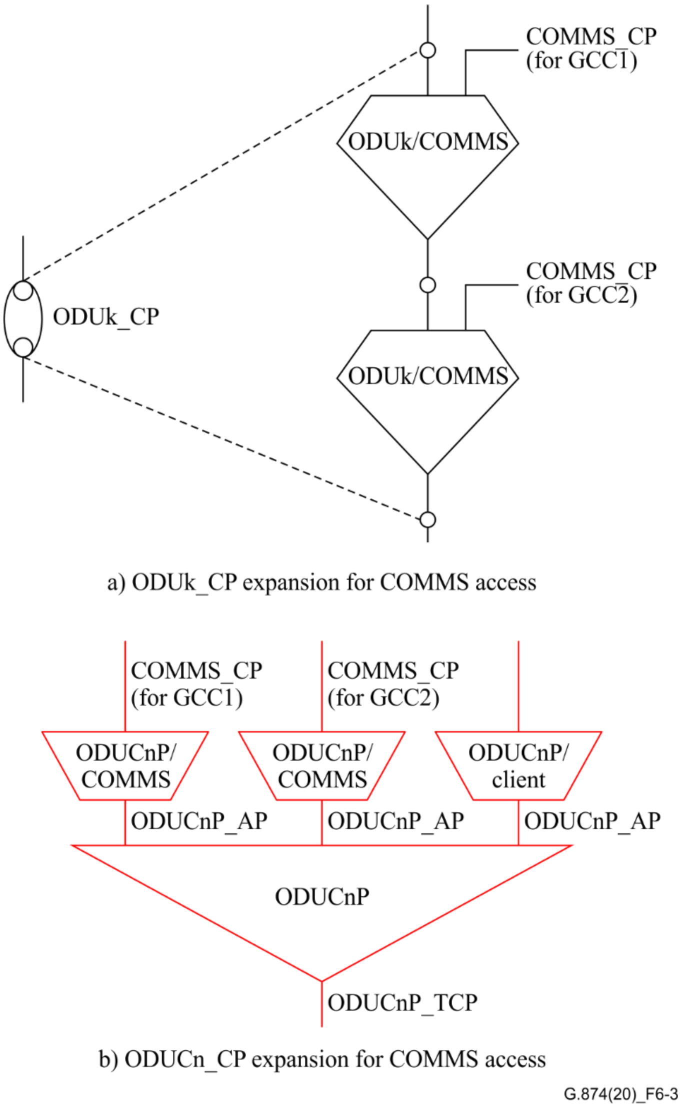

Figure 6-3 – ODUk_CP expansion for COMMS access for GCC1 and GCC2
(Updated version of Figure 14-108 of [ITU-T G.798])

– If there is limitation in the ODUk layer network deployment, such that GCC1 and GCC2 cannot be used separately and simultaneously, it is necessary to have at least two ODUk connections between the two NEs (if possible) such that the GCC of one high-order (HO) ODUk connection can be used as the maintenance communication channel (MCC) and the GCC of the other ODUk connection can be used as the signalling communication channel (SCC).
– If there is limitation in the ODUCn layer network deployment, such that GCC1 and GCC2 cannot be used separately and simultaneously, it is necessary to have at least two other ODUCn connections between the two NEs (if possible) such that the GCC of one ODUCn connection can be used as the MCC and the GCC of the other ODUCn connection can be used as the SCC.

– If there is limitation in the ODUk/ ODUCn layer network deployment, such that GCC1 and GCC2 cannot be used separately and simultaneously and it is also not possible to have two ODUk connections between the two NEs, mechanisms such as deep packet inspection would be needed if the MCC and the SCC share that single GCC. This would, however, mean that the MCC or SCC messages need to be analysed beyond open systems interconnection (OSI) layer 3.

6.1.3.2 General management communications overhead

The general management COMMS OH is specified in [ITU-T G.709].

6.1.3.2.1 COMMS OH physical characteristics

The COMMS OH is a logical element within the optical transport module (OTM) overhead signal (OOS). It provides general management communications between two optical NEs with access to the OOS. As such, the COMMS OH supports the ECC of the OTN OSC. The OOS is transported via the OSC.

The specific physical frame structure and coding for the COMMS OH lies outside the scope of [ITU-T G.709] and is therefore not standardized.

6.1.3.2.2 COMMS OH data link layer protocol

The adaptation of COMMS OH data link layer into the physical layer is FFS.

6.1.4 O.MSN data communications network

See clause 6.1.4 of [ITU-T G.7710] for the generic requirements.

6.1.5 Management of data communication network

See clause 6.1.5 of [ITU-T G.7710] for the generic requirements.

6.1.6 Remote log-in

See clause 6.1.6 of [ITU-T G.7710] for the generic requirements.

6.1.7 Relationship between technology domains

See clause 6.1.7 of [ITU-T G.7710] for the generic requirements.

6.2 Optical transport network equipment management architecture

See clause 6.2 of [ITU-T G.7710] for a generic description of the equipment management architecture.

Protocol-neutral specifications of the OTN MAFs, in terms of MO classes, attributes and message specification are provided in [ITU-T G.875].

The OTN EMF interacts with the other atomic functions specified in [ITU-T G.798]. See [ITU-T G.806] and [ITU-T G.798] for more information on atomic functions and on MP reference points.

See Figure 6-4.

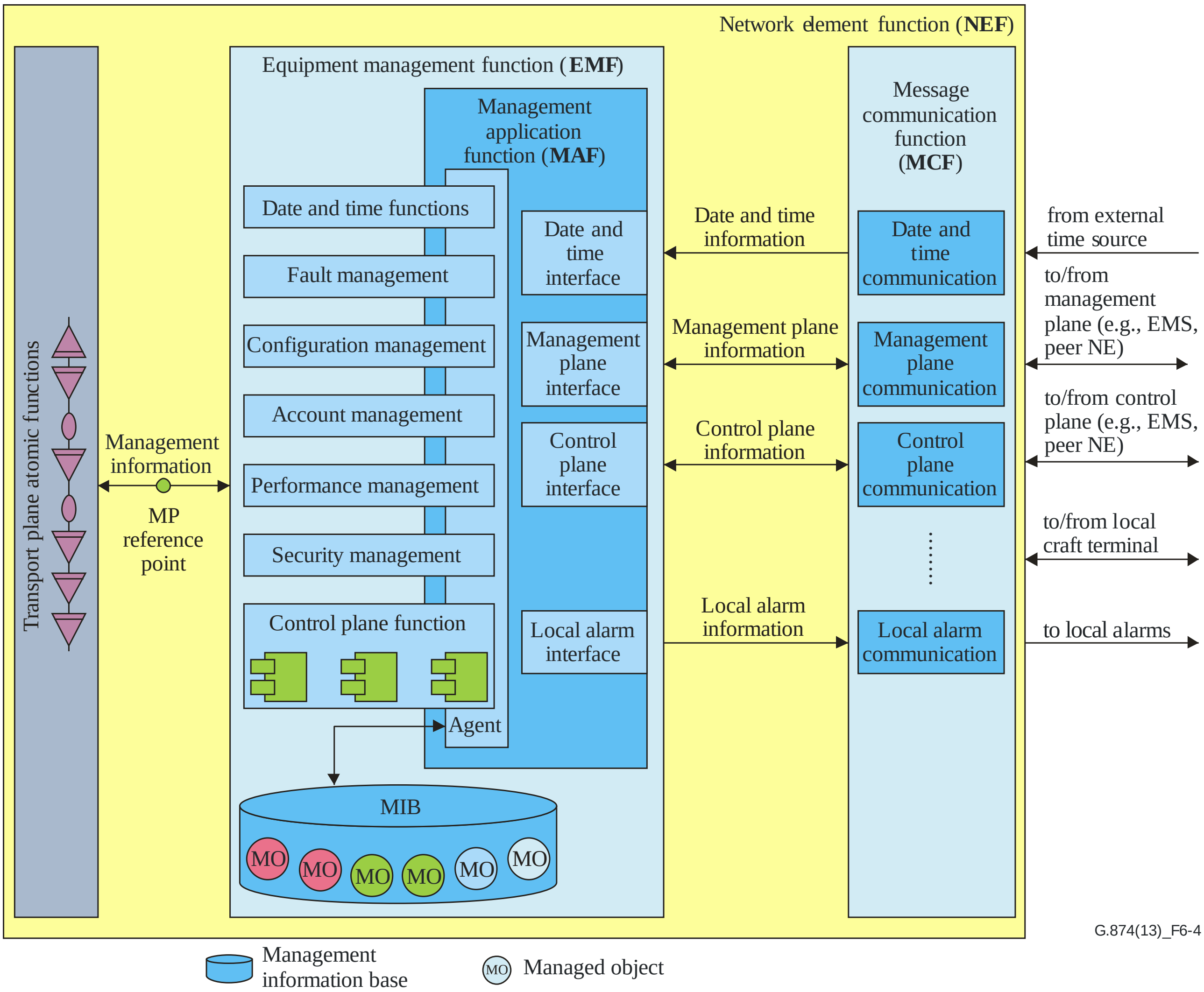

Figure 6-4 – Optical equipment management architecture (Figure 5 of [ITU-T G.7710])

6.3 Information flows over management points

See clause 6.3 of [ITU-T G.7710] for a generic description of information flows over MPs.

The information flow over the MP reference points is described in specific detail for each atomic function in [ITU-T G.798]. Note that these information flows and associated functions apply equally to both the client and supervisory channel due to the independent nature of these signals. This implies neither that the supervisory channel shall provide all the functions described, nor that [ITU-T G.798] will provide the details of which functions are available.

7 Fault management

See clause 7 of [ITU-T G.7710] for generic requirements for fault management. OTN-specific specifications, if needed, are explicitly described.

7.1 Fault management applications

See clause 7.1 of [ITU-T G.7710] for a description of basic fault management applications.

7.1.1 Supervision

See clause 7.1.1 of [ITU-T G.7710] for a generic description of supervision applications.

The supervision philosophy for OTN is also based on the concepts underlying the OTN functional model of [ITU-T G.872].

7.1.1.1 Transmission supervision

See clause 7.1.1.1 of [ITU-T G.7710] for a description of transmission supervision.

7.1.1.2 Quality of service supervision

See clause 7.1.1.2 of [ITU-T G.7710] for a description of quality of service supervision.

7.1.1.3 Processing supervision

See clause 7.1.1.3 of [ITU-T G.7710] for a description of processing supervision.

7.1.1.4 Hardware supervision

See clause 7.1.1.4 of [ITU-T G.7710] for a description of hardware supervision.

7.1.1.5 Environment supervision

See clause 7.1.1.5 of [ITU-T G.7710] for a description of environment supervision.

7.1.2 Fault cause validation

See clause 7.1.2 of [ITU-T G.7710] for a description of fault cause validation.

7.1.3 Alarm handling

7.1.3.1 Severity assignment

See clause 7.1.3.1 of [ITU-T G.7710] for a description of severity categories.

7.1.3.2 Alarm reporting control

See clause 7.1.3.2 of [ITU-T G.7710] for a description of alarm reporting control (ARC).

7.1.3.3 Reportable failures

See clause 7.1.3.3 of [ITU-T G.7710] for a description of reportable failures.

7.1.3.4 Alarm surveillance

See clause 7.1.3.4 of [ITU-T G.7710] for a description of alarm surveillance.

7.1.3.4.1 Local reporting

See clause 7.1.3.4.1 of [ITU-T G.7710] for a description of local reporting.

7.1.3.4.2 Telecommunications management network reporting

See clause 7.1.3.4.2 of [ITU-T G.7710] for a description of TMN reporting.

7.2 Fault management functions

See clause 7.2 of [ITU-T G.7710] for a description of fault management inside the EMF.

Figure 7-1 shows the functional model of fault management inside the OTN EMF.

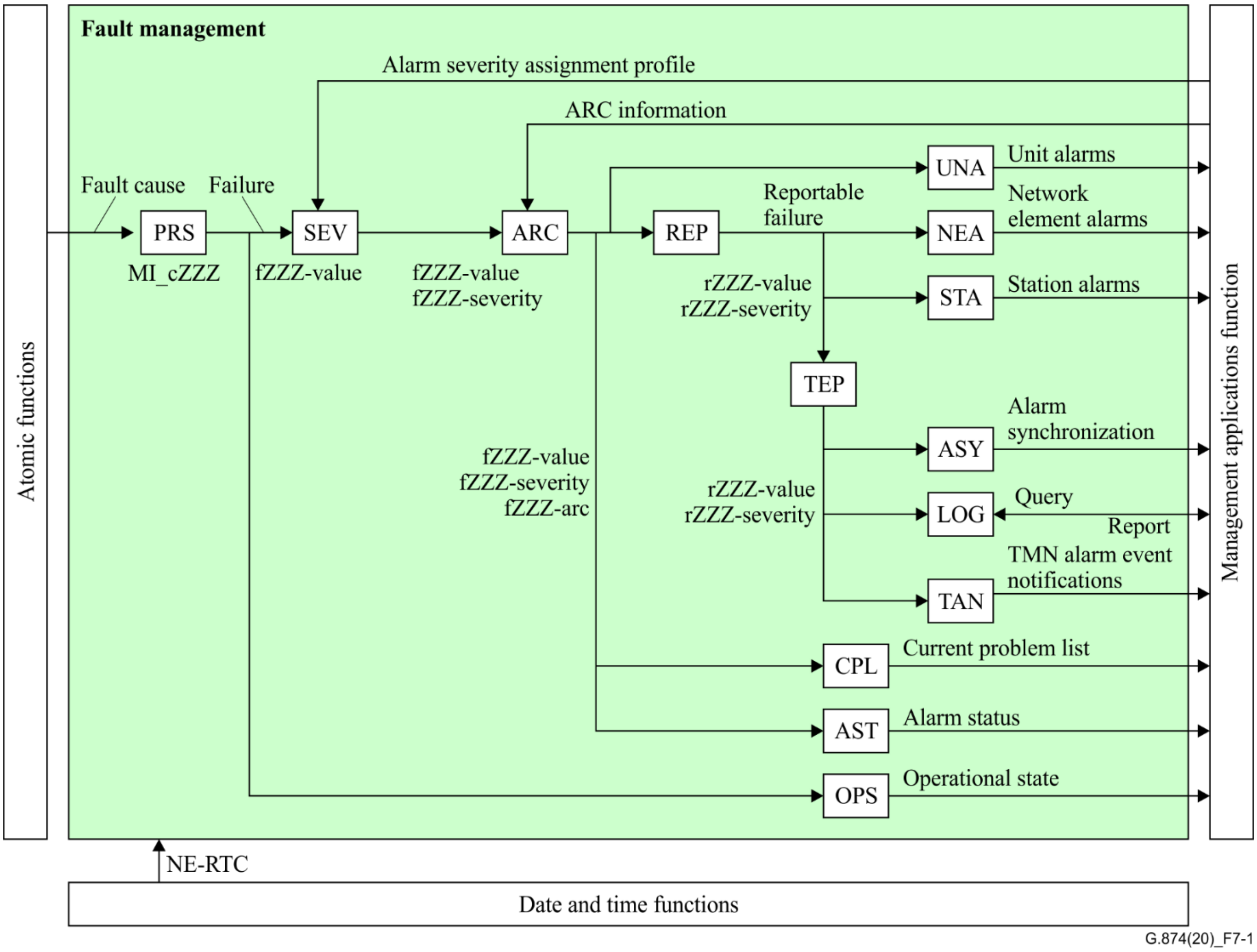

Figure 7-1 – Fault management within the optical transport network network element function (Figure 7 of [ITU-T G.7710])

7.2.1 Fault cause persistency function

See clause 7.2.1 of [ITU-T G.7710] for a description of the fault cause persistency (PRS) function.

For an O.NE that supports the atomic functions listed in Table 7-1, the EMF PRS process shall support the persistency check for the associated fault causes.

Table 7-1 – Inputs and outputs for the fault cause persistency function

Atomic functions	Input (fault cause)	Output (failure)
OSM256.4/CBRx_A_So	cLOF	fLOF
OTS-O_TT_Sk	cTIM cBDI cBDI-O cBDI-P cLOS-P cLOS	fTIM fBDI fBDI-O fBDI-P fLOS-P fLOS
OMS-O_TT_Sk	cBDI cBDI-O cBDI-P cSSF cSSF-O	fBDI fBDI-O fBDI-P fSSF fSSF-O

Table 7-1 – Inputs and outputs for the fault cause persistency function

Atomic functions	Input (fault cause)	Output (failure)
	cSSF-P cLOS-P	fSSF-P fLOS-P
OMS-O/OTSiG|OCh-O_A_Sk	cMSIM[1..(n+m)]	fMSIM[1..(n+m)]
OCh-O_TT_Sk	cLOS-P cOCI cSSF cSSF-P cSSF-O	fLOS-P fOCI fSSF fSSF-P fSSF-O
OTSiG-O_TT_Sk	cOCI cSSF cSSF-P cSSF-O cTIM cBDI cBDI-P cBDI-O	fOCI fSSF fSSF-P fSSF-O fTIM fBDI fBDI-P fBDI-O
OTSi/OTUkV_A_Sk	cLOS-P cLOF cLOM (if the optical transmission unit of level k, functional standardized (OTUkV; k=1, 2, 3, 4) has a multiframe)	fLOS-P fLOF fLOM
OTSi/OTUCn_A_Sk	cLOS-P cLOL cLOF cLOM	fLOS-P fLOL fLOF fLOM
OTSi/FlexO-1-SC_A_Sk	cLOS-P cLOL cLOM	fLOS-P fLOL fLOM
OTSi/OTUk_A_Sk See Table 16-1 in [ITU-T G.798] for the function types	cLOS-P cLOF cLOM	fLOS-P fLOF fLOM
OTSiG/OTUkV_A_Sk	cLOS-P cLOF cLOM (if OTUkV has a multiframe)	fLOS-P fLOF fLOM
OTSiG/OTUk_A_Sk See Table 16-6 of [ITU-T G.798] for the function types	cLOS-P cLOL cLOF cLOM	fLOS-P fLOL fLOF fLOM
OTSiG/OTUCn_A_Sk	cLOS-P cLOL cLOF cLOM	fLOS-P fLOL fLOF fLOM
OTSiG/FlexO_A_Sk	cLOS-P	fLOS-P

Table 7-1 – Inputs and outputs for the fault cause persistency function

Atomic functions	Input (fault cause)	Output (failure)
	cLOL cLOM	fLOL fLOM
OTSi/OSC_A_Sk	cLOS-O	fLOS-O
OTU_TT_Sk	cTIM cDEG cBDI cSSF	fTIM fDEG fBDI fSSF
OTUkV_TT_Sk	cTIM cDEG cBDI cSSF	fTIM fDEG fBDI fSSF
OTUkV/ODU_A_Sk (if loss of alignment supervision is performed)	cLOA	fLOA
ODUk_C	cFOP-PM cFOP-NR	fFOP-PM fFOP-NR
ODUP_TT_Sk	cOCI cTIM cDEG cBDI cSSF cLCK	fOCI fTIM fDEG fBDI fSSF fLCK
ODUkP/CBRx_A_Sk	cPLM cCSF	fPLM fCSF
ODUP/NULL_A_Sk	cPLM	fPLM
ODUP/PRBS_A_Sk	cPLM cLSS	fPLM fLSS
ODUkP/RSn_A_Sk	cPLM cLOF	fPLM fLOF
ODUkP/CBRx-g_A_SkFor the value of k and x in ODUkP/CBRx, see Table 14-18 of [ITU-T G.798]	cPLM cCSF cLCS (Note)	fPLM fCSF fLCS (Note)
ODUkP/ODU[i]j_A_Sk	cPLM cMSIM[1..n+m)] cLOFLOM[1..(n+m)]	fPLM fMSIM[1..n+m)] fLOFLOM[1..(n+m)]
ODUkP/ODUj-21_A_Sk	cPLM cLOOMFI cMSIM[p] cLOFLOM[1..n]	fPLM fLOOMFI fMSIM[p] fLOFLOM[1..n]
ODUkP-h/ODUj-21_A_Sk	cPLM cLOOMFI cMSIM[1..n] cLOFLOM[1..n] cRCOHM	fPLM fLOOMFI fMSIM[1..n] fLOFLOM[1..n] fRCOHM
ODUkP/ETH_A_Sk	cPLM cLFD	fPLM fLFD

Table 7-1 – Inputs and outputs for the fault cause persistency function

Atomic functions	Input (fault cause)	Output (failure)
	cUPM cEXM cCSF	fUPM fEXM fCSF
ODUkP-h/ETH_A_Sk	cPLM cLFD cUPM cEXM cCSF	fPLM fLFD fUPM fEXM fCSF
ODU2P/ERS10G_A_Sk	cPLM cLFD cUPM cEXM cCSF	fPLM fLFD fUPM fEXM fCSF
ODU2eP/FC-1200_A_Sk	cPLM cCSF cLFD	fPLM fCSF fLFD
ODUCnP/ODUk_A_Sk	cPLM cLOOMFI cMSIM[1..m] cLOFLOM[1..m]	fPLM fLOOMFI fMSIM[1..m] fLOFLOM[1..m]
ODUflexP/FlexEC_A_Sk	cPLM cCSF cLCS	fPLM fCSF fLCS
ODUflexP/FlexESG_A_So	cPMM cGIDM cLOL cCSACM	fPMM fGIDM fLOL fCSACM
ODUflexP/FlexESG_A_Sk	cPLM cCSF cCSACM cLCS cLOF cLOM	fPLM fCSF fCSACM fLCS fLOF fLOM
ODUflexP/ETCy_A_Sk See Table 14-47.1 of [ITU-T G.798] for the value of y	cPLM cCSF cLCS cLRC	fPLM fCSF fLCS fLRC
ODUT_TT_Sk	cOCI cTIM cDEG cBDI cSSF cLCK cLTC	fOCI fTIM fDEG fBDI fSSF fLCK fLTC

Table 7-1 – Inputs and outputs for the fault cause persistency function

Atomic functions	Input (fault cause)	Output (failure)
ODUTm_TT_Sk	cOCI cTIM cDEG cBDI cSSF cLCK cLTC	fOCI fTIM fDEG fBDI fSSF fLCK fLTC
FlexO_TT_Sk	cRDI cSSF	fRDO fSSF
FlexO-n/OTUCn_A_Sk	cLOFLOM[1..n] cGIDM cPMM cLOL	fLOFLOM[1..n] fGIDM fPMM fLOL
ME_MI	cLOS[i]	fLOS
OSx_TT_Sk, x=2G5, 10G, 40G	cLOS	fLOS
OSx/CBRx-b_A_Sk	cLFA	f LFA
OSx/CBRx-c_A_Sk	cLFA	f LFA
NOTE – Applicable only when (k=3, CBRx=ETC40GR) or (k=4, CBRx=ETC100GR).		

7.2.2 Severity assignment function

See clause 7.2.2 of [ITU-T G.7710] for a description of the severity assignment (SEV) function.

7.2.3 Alarm reporting control function

See clause 7.2.3 of [ITU-T G.7710] for a description of the severity alarm reporting control (ARC) function.

The alarms that can be controlled with this function are specified for each atomic function in [ITU-T G.798].

In Table 7-2, for each atomic function, a subset of the plausible failures (specified in Table 7-1) is selected, consisting of qualified problems. These qualified problems are recommended as they are deemed essential to the operability of the subject managed entity. Note that for each managed entity, one or more of the qualified problems could then be further selected by the management system to be included in the ARC list for controlling alarm reporting for the entity.

The default ARC state is also specified for each managed entity. If the ARC function is supported by the O.NE and an ARC state is not explicitly provisioned from the management system for the managed entity, then the default ARC specified in Table 7-2 should be in effect.

For an O.NE that supports the atomic functions listed in Table 7-2, the EMF ARC process shall support ARC for the associated fault causes.

Table 7-2 – Alarm reporting control specifications for the optical transport network

Atomic function	Qualified problems	QoS reporting	Default ARC state value constraints
OSM256.4/CBRx_A_So	fLOF	FFS	Alarm (ALM)
OTS-O_TT_Sk	fTIM fBDI fBDI-P fLOS-P fLOS	FFS	ALM
OMS-O_TT_Sk	fBDI fBDI-O fBDI-P fSSF fSSF-O fSSF-P fLOS-P	FFS	ALM
OMS-O/OTSiG|OCh-O_A_Sk	fMSIM[1..(n+m)]	FFS	ALM
OCh-O_TT_Sk	fLOS-P fOCI fSSF fSSF-O fSSF-P	FFS	ALM
OTSiG-O_TT_Sk	fOCI fSSF fSSF-P fSSF-O fTIM fBDI fBDI-P fBDI-O	FFS	ALM
OTSi/OTUk_A_Sk See Table 16-1 of [ITU-T G.798] for the function types	fLOS-P fLOF fLOM	FFS	ALM
OTSiG/OTUk_A_Sk See Table 16-6 of [ITU-T G.798] for the function types	fLOS-P fLOL fLOF fLOM	FFS	ALM
OTSi/OTUkV_A_Sk	fLOS-P fLOF fLOM	FFS	ALM
OTSiG/OTUkV_A_Sk	fLOS-P fLOF fLOM	FFS	ALM
OTSi/OTUCn_A_Sk	fLOS-P fLOL fLOF fLOM	FFS	ALM
OTSiG/OTUCn_A_Sk	fLOS-P	FFS	ALM

Table 7-2 – Alarm reporting control specifications for the optical transport network

Atomic function	Qualified problems	QoS reporting	Default ARC state value constraints
	fLOL fLOF fLOM		
OTSiG/FlexO_A_Sk	fLOS-P fLOL fLOM	FFS	ALM
OTSi/FlexO-1-SC_A_Sk	fLOS-P fLOL fLOM	FFS	ALM
OTSi/OSC_A_Sk	fLOS-O	FFS	ALM
OTU_TT_Sk	fTIM fDEG fBDI fSSF	FFS	ALM
OTUkV_TT_Sk	fTIM fDEG fBDI fSSF	FFS	ALM
OTUkV/ODU_A_Sk	fLOA	FFS	ALM
ODUk_C	fFOP-PM fFOP-NR	FFS	ALM
ODUP_TT_Sk	fOCI fTIM fDEG fBDI fSSF fLCK	FFS	ALM
ODUkP/CBRx_A_Sk	fPLM fCSF	FFS	ALM
ODUP/NULL_A_Sk	fPLM	FFS	ALM
ODUP/PRBS_A_Sk	fPLM fLSS	FFS	ALM
ODUkP/RSn_A_Sk	fPLM fLOF	FFS	ALM
ODUkP/CBRx-g_A_Sk For the value of k and x in CBRx, see Table 14-18 of [ITU-T G.798]	fPLM fCSF fLCS (Note)	FFS	ALM
ODUkP/ODU[i]j_A_Sk	fPLM fMSIM[1..(n+m)] fLOFLOM[1..(n+m)]	FFS	ALM
ODUkP/ODUj-21_A_Sk	fPLM fLOOMFI	FFS	ALM

Table 7-2 – Alarm reporting control specifications for the optical transport network

Atomic function	Qualified problems	QoS reporting	Default ARC state value constraints
	fMSIM[1..n] fLOFLOM[1..n]		
ODUkP-h/ODUj-21_A_Sk	fPLM fLOOMFI fMSIM[1..n] fLOFLOM[1..n] fRCOHM	FFS	ALM
ODUkP/ETH_A_Sk	fPLM fLFD fUPM fEXM fCSF	FFS	ALM
ODUkP-h/ETH_A_Sk(k=flex)	fPLM fLFD fUPM fEXM fCSF	FFS	ALM
ODU2P/ERS10G_A_Sk	fPLM fLFD fUPM fEXM fCSF	FFS	ALM

Table 7-2 – Alarm reporting control specifications for the optical transport network

Atomic function	Qualified problems	QoS reporting	Default ARC state value constraints
ODU2eP/FC-1200_A_Sk	fPLM fCSF fLFD	FFS	ALM
ODUCnP/ODUk_A_Sk	fPLM fLOOMFI fMSIM[1..m] fLOFLOM[1..m]	FFS	ALM
ODUflexP/FlexEC_A_Sk	fPLM fCSF fLCS	FFS	ALM
ODUflexP/FlexESG_A_So	fPMM fGIDM fLOL fCSACM	FFS	ALM
ODUflexP/FlexESG_A_Sk	fPLM fCSF fCSACM fLCS fLOF fLOM	FFS	ALM
ODUflexP/ETCy_A_Sk See Table 14-47.1 of [ITU-T G.798] for the value of y	fPLM fCSF fLCS fLRC	FFS	ALM
ODUT_TT_Sk	fOCI fTIM fDEG fBDI fSSF fLCK fLTC	FFS	ALM
ODUTm_TT_Sk	fOCI fTIM fDEG fBDI fSSF fLCK fLTC	FFS	ALM
FlexO_TT_Sk	fRDI fSSF	FFS	ALM
FlexO-n/OTUCn_A_Sk	fLOFLOM[1..n] fGIDM fPMM fLOL	FFS	ALM

Table 7-2 – Alarm reporting control specifications for the optical transport network

Atomic function	Qualified problems	QoS reporting	Default ARC state value constraints
ME_MI	fLOS[i]	FFS	ALM
OSx_TT_Sk	fLOS	FFS	ALM
OSx/CBRx-b_A_Sk	fLFA	FFS	ALM
OSx/CBRx-c_A_Sk	fLFA	FFS	ALM
NOTE – Applicable only when (k=3, CBRx=ETC40GR) or (k=4, CBRx=ETC100GR).			

7.2.4 Reportable failure function

See clause 7.2.4 of [ITU-T G.7710] for a description of the reportable failure (REP) function.

7.2.5 Unit alarm function

See clause 7.2.5 of [ITU-T G.7710] for a description of the unit alarm (UNA) function.

7.2.6 Network element alarm function

See clause 7.2.6 of [ITU-T G.7710] for a description of the network element alarm (NEA) function.

7.2.7 Station alarm function

See clause 7.2.7 of [ITU-T G.7710] for a description of the station alarm (STA) function.

7.2.8 Telecommunications management network event pre-processing function

See clause 7.2.8 of [ITU-T G.7710] for a description of the TMN event pre-processing alarm (TEP) function.

7.2.9 Alarm synchronization function

See clause 7.2.9 of [ITU-T G.7710] for a description of the alarm synchronization (ASY) function.

7.2.10 Logging function

See clause 7.2.10 of [ITU-T G.7710] for a description of the logging (LOG) function.

7.2.11 Telecommunications management network alarm event notification function

See clause 7.2.11 of [ITU-T G.7710] for a description of the TMN alarm event notification (TAN) function.

7.2.12 Current problem list function

See clause 7.2.12 of [ITU-T G.7710] for a description of the current problem list (CPL) function.

7.2.13 Alarm status function

See clause 7.2.13 of [ITU-T G.7710] for a description of the alarm status (AST) function.

7.2.14 Operational state function – OPS

See clause 7.2.14 of [ITU-T G.7710] for a description of the operational state function.

Table 7-3 lists the failures that could influence the operational state of the related objects.

For an O.NE that supports the atomic functions listed in Table 7-3, the EMF OPS process shall support the operational state for the associated fault causes.

Table 7-3 – Input and output signals of the operational state function for the optical transport network

Atomic function	Failure input (fZZZ-value)	Operational state output (enabled/disabled) of the trail object class
OSM256.4/CBRx_A_So	fLOF	Disabled
OTS-O_TT_Sk	fTIM fBDI fBDI-P fBDI-O fLOS-P fLOS	Enabled Enabled Enabled Enabled Disabled Disabled
OMS-O_TT_Sk	fBDI fBDI-O fBDI-P fSSF fSSF-O fSSF-P fLOS-P	Enabled Enabled Enabled Enabled Enabled Enabled Disabled
OMS-O/OTSiG|OCh-O_A_Sk	fMSIM[1..(n+m)]	Enabled
OCh-O_TT_Sk	fLOS-P fOCI fSSF fSSF-P fSSF-O	Disabled Enabled Enabled Enabled Enabled
OTSiG-O_TT_Sk	fOCI fSSF fSSF-P fSSF-O fTIM fBDI fBDI-P fBDI-O	Enabled Enabled Enabled Enabled Enabled Enabled Enabled Enabled
OTSi/OTUkV_A_Sk	fLOS-P fLOF fLOM	Disabled Disabled Disabled
OTSiG/OTUkV_A_Sk	fLOS-P fLOF fLOM	Disabled Disabled Disabled
OTSi/OTUk_A_Sk See Table 16-1 of [ITU-T G.798] for the function types	fLOS-P fLOF fLOM	Disabled Disabled Disabled
OTSiG/OTUk_A_Sk See Table 16-6 of [ITU-T G.798] for the function types	fLOS fLOL fLOF fLOM	Disabled Disabled Disabled Disabled
OTSi/FlexO-1-SC_A_Sk	fLOS-P fLOL	Disabled Disabled

Table 7-3 – Input and output signals of the operational state function for the optical transport network

Atomic function	Failure input (fZZZ-value)	Operational state output (enabled/disabled) of the trail object class
	fLOM	Disabled
OTSi/OTUCn_A_Sk	fLOS-P fLOL fLOF fLOM	Disabled Disabled Disabled Disabled
OTSiG/OTUCn_A_Sk	fLOS-P fLOL fLOF fLOM	Disabled Disabled Disabled Disabled
OTSiG/FlexO_A_Sk	fLOS-P fLOL fLOM	Disabled Disabled Disabled
OTSi/OSC_A_Sk	fLOS-O	Disabled
OTU_TT_Sk	fTIM fDEG fBDI fSSF	Enabled Enabled Enabled Enabled
OTUkV_TT_Sk	fTIM fDEG fBDI fSSF	Enabled Enabled Enabled Enabled
OTUkV/ODU_A_Sk	fLOA	Disabled
ODUk_C	fFOP-PM fFOP-NR	Disabled Disabled
ODUP_TT_Sk	fOCI fTIM fDEG fBDI fSSF fLCK	Enabled Enabled Enabled Enabled Enabled Enabled
ODUkP/CBRx_A_Sk	fPLM fCSF	Disabled Enabled
ODUP/NULL_A_Sk	fPLM	Disabled
ODUkP/PRBS_A_Sk	fPLM fLSS	Disabled Disabled
ODUkP/RSn_A_Sk	fPLM fLOF	Disabled Disabled
ODUkP/CBRx-g_A_SkFor the values of k and x in CBRx, see Table 14-18 of [ITU-T G.798]	fPLM fCSF fLCS (Note)	Disabled Enabled Disabled
ODUkP/ETH_A_Sk	fPLMfLFD fUPM	Disabled

Table 7-3 – Input and output signals of the operational state function for the optical transport network

Atomic function	Failure input (fZZZ-value)	Operational state output (enabled/disabled) of the trail object class
	fEXM fCSF	Disabled Disabled Enabled
ODUkP/ODU[i]j_A_Sk	fPLM fMSIM[1..(n+m)] fLOFLOM[1..(n+m)]	Disabled Disabled Disabled
ODUkP/ODUj-21_A_Sk	fPLM fLOOMFI fMSIM[1..n] fLOFLOM[1..n]	FFS FFS FFS Disabled
ODUkP-h/ETH_A_Sk	fPLM fLFD fUPM fEXM fCSF	Disabled Disabled Disabled Disabled Enabled
ODUkP-h/ODUj-21_A_Sk	fPLM fLOOMFI fMSIM[1..n] fLOFLOM[1..n] fRCOHM	Disabled Disabled Disabled Disabled FFS
ODU2P/ERS10G_A_Sk	fPLM fLFD fUPM fEXM fCSF	Disabled Disabled Disabled Disabled Enabled
ODU2eP/FC-1200_A_Sk	fPLM fCSF fLFD	Disabled Enabled Disabled
ODUCnP/ODUk_A_Sk	cPLM cLOOMFI cMSIM[1..m] cLOFLOM[1..m]	Disabled Disabled Disabled Disabled
ODUflexP/FlexEC_A_Sk	fPLM fCSF fLCS	Disabled Disabled Disabled
ODUflexP/FlexESG_A_So	fPMM fGIDM fLOL fCSACM	Disabled Disabled Disabled Disabled

Table 7-3 – Input and output signals of the operational state function for the optical transport network

Atomic function	Failure input (fZZZ-value)	Operational state output (enabled/disabled) of the trail object class
ODUflexP/FlexESG_A_Sk	fPLM fCSF fCSACM fLCS fLOF fLOM	Disabled Disabled Disabled Disabled Disabled Disabled
ODUflexP/ETCy_A_Sk See Table 14-47.1 of [ITU-T G.798] for the value of y	fPLM fCSF fLCS fLRC	Disabled Disabled Disabled Disabled
ODUT_TT_Sk	fOCI fTIM fDEG fBDI fSSF fLCK fLTC	Enabled Enabled Enabled Enabled Enabled Enabled FFS
ODUTm_TT_Sk	fOCI fTIM fDEG fBDI fSSF fLCK fLTC	Enabled Enabled Enabled Enabled Enabled Enabled FFS
FlexO_TT_Sk	fRDI fSSF	Enabled Enabled
FlexO-n/OTUCn_A_Sk	fLOFLOM[1..n] fGIDM fPMM fLOL	Disabled Disabled Disabled Disabled
ME_MI	fLOS[i]	Disabled
OSx_TT_Sk	fLOS	Disabled
OSx/CBRx-b_A_Sk	fPLM	Disabled
OSx/CBRx-c_A_Sk	fPLM	Disabled
NOTE – Applicable only when (k=3, CBRx=ETC40GR) or (k=4, CBRx=ETC100GR).		

8 Configuration management

See clause 8 of [ITU-T G.7710] for the generic requirements for CM. OTN-specific specifications, if needed, are explicitly described.

8.1 Hardware

See clause 8.1 of [ITU-T G.7710] for a description of hardware management.

8.2 Software

See clause 8.2 of [ITU-T G.7710] for a description of software management.

8.3 Protection switching

See clause 8.3 of [ITU-T G.7710] for a description of protection switching management.

This function allows a user to provision and monitor the operation of protection processes deployed in an Ethernet (ETH) connection (ETH-C) process.

Management information (MI) signals concerning the protection processes are listed in Table 8-3 and communicated between the EMF and the protection process through the MP. According to these MI signals, the EMF generates a corresponding event notification and state report signals to the MAF.

For the protection processes supported by an O.NE, the O.NE EMF shall support the following management functions:

– provisioning the protection switching MI;

– retrieving the protection switching MI;

– notifying the changes of the protection switching MI;

– receiving the monitored protection switching MI.

8.4 Trail termination

See clause 8.4 of [ITU-T G.7710] for a description of TT management.

This function allows a user to provision and monitor the operation of the OTN TT process.

A trail trace identifier (TTI) at the optical transmission section (OTS) layer is useful to ensure proper fibre connection between NEs, in particular in meshed network topology with optical cross-connects that have several line input ports and several line output ports.

TTIs are also a means for the OS to deduce the network topology at the OTS layer first, and then at the OMS and optical channel (OCh) level. Specifically, the OS gets the list of source and sink (Sk) TTIs of all NEs and can automatically deduce the trails at the OTS layer by a comparison of the expected TTIs of the Sk objects and the TTIs sent from the source objects. Then, as there is only one instance of an OMS connection point (CP) and one instance of an OMS trail termination point (TTP), the OS can deduce automatically the topology at the OMS layer. A similar method may be applied at the OCh level from the list of existing ochCTP (which are named by omsTTP).

The TTIs received are used at the NE level to detect wrong fibre connection and generate an OTS trail trace identifier mismatch (TIM) alarm if the accepted value is different from the expected value.

The TTI at the OCh layer is necessary to check that the signal received by an Sk originates from the intended source. To be able to localize the cross-connection responsible for a TIM, the expected and the received OCh TTIs are needed at the Sk.

The received OCh TTI is used at the NE level to detect incorrect OCh connections and to generate an OCH TIM alarm.

The MI signals listed in Table 8-1 are communicated between the EMF and the OTN TT process across the MP within the O.NE.

For the TT functions supported by an O.NE, the O.NE EMF shall support the following management functions:

– provisioning the TT MI;

– retrieving the TT MI;

– notifying the changes of the TT MI;

– receiving the monitored TT MI.

Table 8-1 – Trail termination-related provisioning and reporting

MI signal	Value range	Default value
OTS-O_TT_So Provisioning		
OTS-O_TT_So_MI_TxTI	According to [ITU-T G.709]	Not applicable
OTS-O_TT_Sk Provisioning		
OTS-O_TT_Sk_MI_ExSAPI	According to [ITU-T G.709]	Not applicable
OTS-O_TT_Sk_MI_ExDAPI	According to [ITU-T G.709]	Not applicable
OTS-O_TT_Sk_MI_GetAcTI	According to [ITU-T G.798]	Not applicable
OTS-O_TT_Sk_MI_TIMDetMo	According to [ITU-T G.798]	OFF
OTS-O_TT_Sk_MI_TIMActDis	True, false	True
OTS-O_TT_Sk_MI_1second	According to [ITU-T G.798]	Not applicable
OTS-O_TT_Sk Reporting		
OTS-O_TT_Sk_MI_AcTI	According to [ITU-T G.709]	Not applicable
OTSiG-O_TT_So Provisioning		
OTSiG-O_TT_So_MI_TxTI	According to [ITU-T G.709]	Not applicable
OTSiG-O_TT_Sk Provisioning		
OTSiG-O_TT_Sk_MI_ExSAPI	According to [ITU-T G.709]	Not applicable
OTSiG-O_TT_Sk_MI_ExDAPI	According to [ITU-T G.709]	Not applicable
OTSiG-O_TT_Sk_MI_GetAcTI	According to [ITU-T G.798]	Not applicable
OTSiG-O_TT_Sk_MI_TIMDetMo	According to [ITU-T G.798]	OFF
OTSiG-O_TT_Sk_MI_TIMActDis	True, false	True
OTSiG-O_TT_Sk_MI_1second	According to [ITU-T G.798]	Not applicable
OTSiG-O_TT_Sk Reporting		
OTSiG-O_TT_Sk_MI_AcTI	According to [ITU-T G.709]	Not applicable
OMS-O_TT_Sk Provisioning		
OMS-O_TT_Sk_MI_1second	According to [ITU-T G.798]	Not applicable
OCh_TT_So Provisioning (Note 1)		
OCh_TT_So_MI_nominalCentralFrequencyOrWavelength	See [ITU-T G.875] for the object OCh_TerminationPoint	–
OCh_TT_So_MI_selectedApplicationIdentifier	See [ITU-T G.875] for the object OCh_TerminationPoint	–
OCh_TT_So Reporting (Note 1)		
OCh_TT_So_MI_nominalCentralFrequencyOrWavelength	See [ITU-T G.875] for the object OCh_TerminationPoint	–
OCh_TT_So_MI_supportableApplicationIdentifierList	See [ITU-T G.875] for the object OCh_TerminationPoint	–
OCh_TT_Sk Reporting (Note 1)		
OCh_TT_Sk_MI_supportableApplicationIdentifierList	See [ITU-T G.875] for the object OCh_TerminationPoint	–
OTU_TT_So Provisioning		
OTU_TT_So_MI_TxTI	According to [ITU-T G.709]	Not applicable

Table 8-1 – Trail termination-related provisioning and reporting

MI signal	Value range	Default value
OTU_TT_Sk Provisioning		
OTU_TT_Sk_MI_ExSAPI	According to [ITU-T G.709]	Not applicable
OTU_TT_Sk_MI_ExDAPI	According to [ITU-T G.709]	Not applicable
OTU_TT_Sk_MI_GetAcTI	According to [ITU-T G.798]	Not applicable
OTU_TT_Sk_MI_TIMDetMo	According to [ITU-T G.798]	OFF
OTU_TT_Sk_MI_TIMActDis	True, false	True
OTU_TT_Sk_MI_DEGThr	In number of errored blocks or as a percentage between 0% and 100%; see Table 7-1 of [ITU-T G.806]	SES Threshold (Note 2)
OTU_TT_Sk_MI_DEGM	2-10; see Table 7-1 of [ITU-T G.806]	(Note 2)
OTU_TT_Sk_MI_1second	According to [ITU-T G.798]	Not applicable
OTU_TT_Sk Reporting		
OTU_TT_Sk_MI_AcTI	According to [ITU-T G.709]	Not applicable
OTUkV_TT_So Provisioning		
OTUkV_TT_So_MI_TxTI	According to [ITU-T G.709]	Not applicable
OTUkV_TT_Sk Provisioning		
OTUkV_TT_Sk_MI_ExSAPI	According to [ITU-T G.709]	Not applicable
OTUkV_TT_Sk_MI_ExDAPI	According to [ITU-T G.709]	Not applicable
OTUkV_TT_Sk_MI_GetAcTI	According to [ITU-T G.798]	Not applicable
OTUkV_TT_Sk_MI_TIMDetMo	According to [ITU-T G.798]	OFF
OTUkV_TT_Sk_MI_TIMActDis	Enabled, disabled	Disabled
OTUkV_TT_Sk_MI_DEGThr	In number of errored blocks or as a percentage between 0% and 100%; see Table 7-1 of [ITU-T G.806]	SES Threshold (Note 2)
OTUkV_TT_Sk_MI_DEGM	2-10; see Table 7-1 of [ITU-T G.806]	(Note 2)
OTUkV_TT_Sk_MI_1second	According to [ITU-T G.798]	Not applicable
OTUkV_TT_Sk Reporting		
OTUkV_TT_Sk_MI_AcTI	According to [ITU-T G.709]	Not applicable
ODUP_TT_So Provisioning		
ODUP_TT_So_MI_TxTI	According to [ITU-T G.709]	Not applicable
ODUP_TT_So_MI_DM_Source	true, false	false
ODUP_TT_So_MI_DMValue	Not applicable. See [ITU-T G.798]	Not applicable
ODUP_TT_Sk Provisioning		
ODUP_TT_Sk_MI_ExSAPI	According to [ITU-T G.709]	Not applicable
ODUP_TT_Sk_MI_ExDAPI	According to [ITU-T G.709]	Not applicable
ODUP_TT_Sk_MI_GetAcTI	According to [ITU-T G.798]	Not applicable

Table 8-1 – Trail termination-related provisioning and reporting

MI signal	Value range	Default value
ODUP_TT_Sk_MI_TIMDetMo	According to [ITU-T G.798]	OFF
ODUP_TT_Sk_MI_TIMActDis	Enabled, disabled	Disabled
ODUP_TT_Sk_MI_DEGThr	In number of errored blocks or as a percentage between 0% and 100%; see Table 7-1 of [ITU-T G.806]	SES Threshold (Note 2)
ODUP_TT_Sk_MI_DEGM	2-10; see Table 7-1 of [ITU-T G.806]	(Note 2)
ODUP_TT_Sk_MI_1second	According to [ITU-T G.798]	Not applicable
ODUP_TT_Sk_MI_DM_Source	true, false	false
ODUP_TT_Sk_MI_DMValue	Not applicable. See [ITU-T G.798]	Not applicable.
ODUP_TT_Sk Reporting		
ODUP_TT_Sk_MI_AcTI	According to [ITU-T G.709]	Not applicable
ODUT_TT_So Provisioning		
ODUT_TT_So_MI_TxTI	According to [ITU-T G.709]	Not applicable
ODUT_TT_So_MI_DM_Source	true, false	false
ODUT_TT_So_MI_DMValue	Not applicable. See [ITU-T G.798]	Not applicable.
ODUT_TT_Sk Provisioning		
ODUT_TT_Sk_MI_ExSAPI	According to [ITU-T G.709]	Not applicable
ODUT_TT_Sk_MI_ExDAPI	According to [ITU-T G.709]	Not applicable
ODUT_TT_Sk_MI_GetAcTI	According to [ITU-T G.798]	Not applicable
ODUT_TT_Sk_MI_TIMDectMo	According to [ITU-T G.798]	FFS
ODUT_TT_Sk_MI_TIMActDis	Enabled, disabled	Disabled
ODUT_TT_Sk_MI_DEGThr	In number of errored blocks or as a percentage between 0% and 100%; See Table 7-1 of [ITU-T G.806]	SES Threshold (Note 2)
ODUT_TT_Sk_MI_DEGM	2-10; see Table 7-1 of [ITU-T G.806]	(Note 2)
ODUT_TT_Sk_MI_1second	According to [ITU-T G.798]	Not applicable
ODUT_TT_Sk_MI_DM_Source	true, false	true
ODUT_TT_Sk_MI_DMValue	Not applicable. See [ITU-T G.798]	Not applicable.
ODUT_TT_Sk_MI_LTCAct_Enable	true, false	false
ODUT_TT_Sk Reporting		
ODUT_TT_Sk_MI_AcTI	According to [ITU-T G.709]	Not applicable
ODUTm_TT_Sk Provisioning		
ODUTm_TT_Sk_MI_Level	1..6	Not applicable
ODUTm_TT_Sk_MI_ExSAPI	According to [ITU-T G.709]	Not applicable

Table 8-1 – Trail termination-related provisioning and reporting

MI signal	Value range	Default value
ODUTm_TT_Sk_MI_ExDAPI	According to [ITU-T G.709]	Not applicable
ODUTm_TT_Sk_MI_GetAcTI	According to [ITU-T G.798]	Not applicable
ODUTm_TT_Sk_MI_TIMDectMo	According to [ITU-T G.798]	FFS
ODUTm_TT_Sk_MI_TIMActDis	Enabled, disabled	Disabled
ODUTm_TT_Sk_MI_DEGThr	In number of errored blocks or as a percentage between 0% and 100%; see Table 7-1 of [ITU-T G.806]	SES Threshold (Note 2)
ODUTm_TT_Sk_MI_DEGM	2-10; see Table 7-1 of [ITU-T G.806]	(Note 2)
ODUTm_TT_Sk_MI_1second	According to [ITU-T G.798]	Not applicable
ODUTm_TT_Sk Reporting		
ODUTm_TT_Sk_MI_AcTI	According to [ITU-T G.709]	Not applicable
OSx_TT_So Provisioning		
OSx_TT_So_MI_APRCntrl (Notes 3 and 4)	Enable, disable	Enable
NOTE 1 – These MIs are specified in [ITU-T G.798]. NOTE 2 – Equipment designed prior to the 2017 edition of this Recommendation may use a default MI_DEGTHR value of 30% and of MI_DEGM of 10. NOTE 3 – If automatic power reduction (APR) is required. NOTE 4 – The automatic power reduction control (APRCntrl) commands depend on the specific APR process.		

For the management of the connectivity at the OTS layer, the following TTI attributes are recommended:

1) otsTTIsent attribute in every otsTTPsource (get – replace);
2) otsTTIexpected attribute in every otsTTPsink (get – replace);
3) otsTTIreceived attribute in every otsTTPsink (get – replace).

For the management of the connectivity at the OCH layer, the following TTI attributes are recommended:

1) ochTTIsent attribute in every ochTTPsource (get – replace);
2) ochTTIexpected attribute in every ochTTPsink and ochCTPsink (get – replace);
3) ochTTIreceived attribute in every ochTTPsink and ochCTPsink (get only).

8.5 Adaptation

See clause 8.5 of [ITU-T G.7710] for a description of adaptation management.

An access point (AP) that has multiple adaptation functions connected to it, thereby allowing different clients to be transported via the server signal, requires a mechanism for the selection of the active client.

The adaptation function allows a user to provision and monitor the operation of the OTN adaptation processes.

Both OMS/OCh_A and OCh/Application_A will report on request from the OTN EMF the value of the received and accepted payload type (PT) indication signal via the MI_AcPTI.

The MI signals listed in Table 8-2 are communicated between the EMF and the adaptation processes across the MP within the OTN NE.

NOTE – ODUkP/ETH_A and ODU2P/ETHPP-OS_A are specified in [ITU-T G.798].

For the adaptation functions supported by an O.NE, the O.NE EMF shall support the following management functions:

– provisioning the adaptation MI;

– retrieving the adaptation MI;

– notifying the changes of the adaptation MI.

Table 8-2 – Provisioning and reporting for adaptation functions

MI signal	Value range	Default value
OMS-O/OTSiG|OCh-O_A_So Provisioning		
OMS-O/OTSiG|OCh-O_A_So_MI_TxMSI	The value range is implementation specific. See clause 8.7.2.3 of [ITU-T G.798].	Not applicable
OMS-O/OTSiG|OCh-O_A_Sk Provisioning		
OMS-O/OTSiG|OCh-O_A_Sk_MI_ExMSI[1..(n+m)] for the n OTSiG-O_CPs and m OCh-O_CPs	The value range is implementation specific. See clause 8.7.2.3 of [ITU-T G.798].	Not applicable
OMS-O/OTSiG|OCh-O_A_Sk Reporting		
OMS-O/OTSiG|OCh-O_A_Sk_MI_AcMSI[1..(n+m)] for the n OTSiG-O_CPs and m OCh-O_CPs	The value range is implementation specific. See clause 8.7.2.3 of [ITU-T G.798].	Not applicable
OSC/COMMS_A_So Provisioning		
None		
OSC/COMMS_A_Sk Provisioning		
None		
OSM256.4/CBRx_So Provisioning		
None		
OTSi/OTUkV_A_So Provisioning		
None		
OTSi/OTUkV_A_Sk Provisioning		
OTSi /OTUkV_A_Sk_MI_1second	According to [ITU-T G.798]	Not applicable
OTSi/OTUk_A_So Provisioning		
None		
OTSi/OTUk_A_Sk Provisioning See Table 16-1 of [ITU-T G.798] for the function types		
OTSi/OTUk_A_Sk_MI_FECEn	True, false	True

Table 8-2 – Provisioning and reporting for adaptation functions

MI signal	Value range	Default value
OTSi/OTUk_A_Sk_MI_1second	According to [ITU-T G.798]	Not applicable
OTSiG/OTUk_A_So Provisioning See Table 16-6 of [ITU-T G.798] for the function types		
None		
OTSiG/OTUk_A_Sk Provisioning See Table 16-6 of [ITU-T G.798] for the function types		
OTSiG/OTUk_A_Sk_MI_FECEn	True, false	True
OTSiG/OTUk_A_Sk_MI_1second	According to [ITU-T G.798]	Not applicable
OTSiG/OTUkV_A_So Provisioning		
None		
OTSiG/OTUkV_A_Sk Provisioning See Table 16-6 of [ITU-T G.798] for the function types		
OTSiG/OTUkV_A_Sk_MI_1second	According to [ITU-T G.798]	Not applicable
OTSi/FlexO-1-SC_A_So Provisioning		
None		
OTSi/FlexO-1-SC_A_Sk Provisioning		
OTSi/FlexO-1-SC_A_Sk _MI_FECEn	True, false	True
OTSi/FlexO-1-SC_A_Sk _MI_1second	According to [ITU-T G.798]	Not applicable
OTSiG/OTUCn_A_So Provisioning		
OTSiA/OTUCn_A_So_MI_Active	True, false	False
OTSiG/OTUCn_A_Sk Provisioning		
OTSiG/OTUCn_A_Sk_MI_1second	According to [ITU-T G.798]	Not applicable
OTSiG/FlexO_A_So Provisioning		
None		
OTSiG/FlexO_A_Sk Provisioning		
OTSiG/FlexO_A_Sk_MI_FECEn		
OTSiG/FlexO_A_Sk_MI_1second	According to [ITU-T G.798]	Not applicable
OTSiG/OTUk-SC_A_Sk _MI_1second		
OTSi/OSC_A_So Provisioning		
None		
OTSi/OSC_A_Sk Provisioning		
OTSi/OSC_A_Sk_MI_1second	According to [ITU-T G.798]	Not applicable
OTU/ODU_A_So_Provisioning		

Table 8-2 – Provisioning and reporting for adaptation functions

MI signal	Value range	Default value
OTU/ODU_A_So_MI_AdminState	LOCKED, Not LOCKED	Not LOCKED
OTU/ODU_A_So_MI_APS_EN	true, false	true
OTU/ODU_A_So_MI_APS_LVL	0..6, 0 for path and 1..6 for TCM	–
OTU/ODU_A_Sk_Provisioning		
OTU/ODU_A_Sk_MI_AdminState	LOCKED, Not LOCKED	Not LOCKED
OTU/ODU_A_Sk_MI_APS_EN	true, false	true
OTU/ODU_A_Sk_MI_APS_LVL	0..6, 0 for path and 1..6 for TCM	–
OTUkV/ODU_A_So_Provisioning		
OTUkV/ODU_A_So_MI_AdminState	LOCKED, Not LOCKED	Not LOCKED
OTUkV/ODU_A_So_MI_APS_EN	true, false	true
OTUkV/ODU_A_So_MI_APS_LVL	0..6, 0 for path and 1..6 for TCM	–
OTUkV/ODU_A_Sk_Provisioning		
OTUkV/ODU_A_Sk_MI_AdminState	LOCKED, Not LOCKED	Not LOCKED
OTUkV/ODU_A_Sk_MI_APS_EN	true, false	true
OTUkV/ODU_A_Sk_MI_APS_LVL	0..6, 0 for path and 1..6 for TCM	–
OTU/COMMS_A_So_Provisioning		
None		
OTU/COMMS_A_Sk_Provisioning		
None		
OTUkV/COMMS_A_So_Provisioning		
None		
OTUkV/COMMS_A_Sk_Provisioning		
None		
ODUkP/CBRx-a_A_So_Provisioning		
None		
ODUkP/CBRx-b_A_So_Provisioning		
None		
ODUkP/CBRx_A_Sk_Provisioning		
ODUkP/CBRx_A_Sk_MI_CSF_Enable	True, False	False

Table 8-2 – Provisioning and reporting for adaptation functions

MI signal	Value range	Default value
ODUkP/CBRx_A_Sk Reporting		
ODUkP/CBRx_A_Sk_MI_AcPT, (Note 1)	According to [ITU-T G.798]	Not applicable
ODUkP/CBRx-g_A_So Provisioning		
None		
ODUkP/CBRx-g_A_Sk Provisioning		
None		
ODUkP/ CBRx-g_A_Sk Reporting		
ODUkP/CBRx_A_Sk_MI_AcPT (For the values of k and x in CBRx, see Table 15-8 of [ITU-T G.709])	0 to 255	Not applicable
ODUP/NULL_A_So Provisioning		
ODUP/NULL_A_So_MI_Nominal_Bitrate_and_Tolerance	According to [ITU-T G.798]	Not applicable
ODUP/NULL_A_Sk_Provisioning		
None		
ODUP/NULL_A_Sk Reporting		
ODUP/NULL_A_Sk_MI_AcPT, k=0, 1, 2, 2e, 3, 4, flex	According to [ITU-T G.798]	Not applicable
ODUP/PRBS_A_So Provisioning		
ODUP/PRBS_A_So_MI_Nominal_Bitrate_and_Tolerance	According to [ITU-T G.798]	Not applicable
ODUP/PRBS_A_Sk Provisioning		
ODUP/PRBS_A_Sk_MI_1second	According to [ITU-T G.798]	Not applicable
ODUP/PRBS_A_Sk Reporting		
ODUP/PRBS_A_Sk_MI_AcPT, k=0, 1, 2, 2e, 3, 4, flex	According to [ITU-T G.798]	Not applicable
ODUkP/RSn_A_So Provisioning See clause 14.3.6 of [ITU-T G.798]		
None		
ODUkP/RSn_A_Sk Provisioning See clause 14.3.6 of [ITU-T G.798]		
None		
ODUkP/RSn_A_Sk Reporting See clause 14.3.6 of [ITU-T G.798]		
ODUkP/RSn_A_Sk_MI_AcPT	According to [ITU-T G.709]	Not applicable
ODUkP/ODU[i]j_A_So Provisioning		
ODUkP/ODU[i]j_A_So_MI_AdminState[1..(n+m)]	LOCKED, Not LOCKED	Not LOCKED
ODUkP/ODU[i]j_A_So_MI_APS_EN[1..(n+m)]	true, false	true

Table 8-2 – Provisioning and reporting for adaptation functions

MI signal	Value range	Default value
ODUkP/ODU[i]j_A_So_MI_APS_LVL[1..(n+m)]	0..6, 0 for path and 1..6 for TCM	–
ODU3P/ODU12_A_So Provisioning		
ODU3P/ODU12_A_So_MI_TxMSI	According to Table 14-30 of [ITU-T G.798]	Not applicable
ODUkP/ODU[i]j_A_Sk Provisioning		
ODUkP/ODU[i]j_A_Sk_MI_AdminState[1..(n+m)]	LOCKED, Not LOCKED	Not LOCKED
ODUkP/ODU[i]j_A_Sk_MI_APS_EN[1..(n+m)] when doing m x ODUi_CP respectively.	true, false	true
ODUkP/ODU[i]j_A_Sk_MI_APS_LVL[1..(n+m)]	0..6, 0 for path and 1..6 for TCM	–
ODU3P/ODU12_A_Sk Provisioning		
ODU3P/ODU12_A_Sk_MI_ExMSI[1..(n+m)]	According to Table 14-32 of [ITU-T G.798]	Not applicable
ODUkP/ODU[i]j_A_Sk Reporting		
ODUkP/ODU[i]j_A_Sk_MI_AcPT	According to [ITU-T G.709]	Not applicable
ODUkP/ODU[i]j_A_Sk_MI_AcMSI[1..(n+m)]	According to [ITU-T G.709]	Not applicable
ODUkP/ODUj-21_A_So Provisioning		
ODUkP/ODUj-21_A_So_MI_TxMSI	According to [ITU-T G.798]	Not applicable
ODUkP/ODUj-21_A_So_MI_AUTOpayloadtype	According to [ITU-T G.798]	Not applicable
ODUkP/ODUj-21_A_So_MI_ODUType_Rate[1..n]	According to clause 19.6 of [ITU-T G.709]	Not applicable
ODUkP/ODUj_A_So_MI_AdminState[1..n]	LOCKED, Not LOCKED	Not LOCKED
ODUkP/ODUj-21_A_So_MI_APS_EN[1..n]	true, false	true
ODUkP/ODUj-21_A_So_MI_APS_LVL[1..n]	0..6, 0 for path and 1..6 for TCM	–
ODUkP/ODUj-21_A_So Reporting		
ODUkP/ODUj-21_A_So_MI_TrPT	According to [ITU-T G.709]	Not applicable

Table 8-2 – Provisioning and reporting for adaptation functions

MI signal	Value range	Default value
ODUkP/ODUj-21_A_Sk Provisioning		
ODUkP/ODUj-21_A_Sk_MI_ExMSI[1..n]	According to [ITU-T G.798]	Not applicable
ODUkP/ODUj-21_A_Sk_MI_AdminState[1..n]	LOCKED, Not LOCKED	Not LOCKED
ODUkP/ODUj-21_A_Sk_MI_Nominal_Bitrate_and_Tolerance[1..n]	According to [ITU-T G.798]	Not applicable
ODUkP/ODUj-21_A_Sk_MI_ODUType[1..n]	According to clause 19.6 of [ITU-T G.709]	Not applicable
ODUkP/ODUj-21_A_Sk_MI_APS_EN[1..n]	true, false	true
ODUkP/ODUj-21_A_Sk_MI_APS_LVL[1..n]	0..6, 0 for path and 1..6 for TCM	–
ODUkP/ODUj-21_A_Sk Reporting		
ODUkP/ODUj-21_A_Sk_MI_AcPT	According to [ITU-T G.709]	Not applicable
ODUkP/ODUj-21_A_Sk_MI_AcMSI[1..n]	According to [ITU-T G.709]	Not applicable
ODU2P/ERS10G_A_So Provisioning		
ODU2P/ERS10G_A_So_MI_CSFEnable	True, False	True
ODU2P/ERS10G_A_So Reporting		
None		
ODU2P/ERS10G_A_Sk Provisioning		
ODU2P/ERS10G_A_Sk_MI_CSF_Reported	True, False	False
ODU2P/ERS10G_A_Sk Reporting		
ODU2P/ERS10G_A_Sk_MI_AcPT	0 to 255 (See Table 15-8 of [ITU-T G.709])	Not applicable
ODU2P/ERS10G_A_Sk_MI_AcEXI	0 to 255 (See Table 6-2 of [ITU-T G.7041])	Not applicable
ODU2P/ERS10G_A_Sk_MI_AcUPI	0 to 255 (See Table 6-3 of [ITU-T G.7041])	Not applicable
ODUkP/ETH_A_So Provisioning, in G.798		
ODUkP/ETH_A_So_MI_CSFEnable	True, False	True
ODUkP/ETH_A_So_MI_CSFrdifdiEnable (Note 2)	True, False	True
ODUkP/ETH_A_Sk Provisioning,		
ODUkP/ETH_A_Sk_MI_FilterConfig	(Note 3)	(Note 3)
ODUkP/ETH_A_Sk_MI_CSF_Reported	True, False	False
ODUkP/ETH_A_Sk_MI_CSFrdifdiEnable (Note 2)	True, False	True

Table 8-2 – Provisioning and reporting for adaptation functions

MI signal	Value range	Default value
ODUkP/ETH_A_Sk_MI_MAC_Length	1518, 1522, 2000	2000
ODUkP/ETH_A_Sk Reporting		
ODUkP/ETH_A_So_MI_MI_AcPT	0 to 255 (See Table 15-8 of [ITU-T G.709])	Not applicable
ODUkP/ETH_A_So_MI_MI_AcEXI	0 to255 (See Table 6-2 of [ITU-T G.7041])	Not applicable
ODUkP/ETH_A_So_MI_MI_AcUPI	0 to 255 (See Table 6-3 of [ITU-T G.7041])	Not applicable
ODUkP-h/ETH_A_So Provisioning		
ODUkP-h/ETH_A_So_MI_CSFEnable	True, False	True
ODUkP-h/ETH_A_So_MI_CSFrdifdiEnable (Note 2)	True, False	True
ODUkP-h/ETH_A_So_MI_INCREASE	True, False	False
ODUkP-h/ETH_A_So_MI_DECREASE	True, False	False
ODUkP-h/ETH_A_So_MI_TSNUM	According to [ITU-T G.7044]	Not applicable
ODUkP-h/ETH_A_So_MI_ODUflexRate	FlexCBR, FlexGFP	Not applicable
ODUkP-h/ETH_A_So Reporting		
ODUkP-h/ETH-m_A_So_MI_ADJSTATE	According to [ITU-T G.7044]	Not applicable
ODUkP-h/ETH_A_Sk Provisioning		
ODUkP/ETH-h_A_Sk_MI_FilterConfig	(Note 3)	(Note 3)
ODUkP/ETH-h_A_Sk_MI_CSF_Reported	True, False	False
ODUkP-h/ETH_A_Sk_MI_CSFrdifdiEnable (Note 2)	True, False	True
ODUkP/ETH-h_A_Sk_MI_MAC_Length	1518, 1522, 2000	2000
ODUkP-h/ETH_A_Sk_MI_INCREASE	True, False	False
ODUkP-h/ETH_A_Sk_MI_DECREASE	True, False	False
ODUkP-h/ETH_A_Sk Reporting		
ODUkP-h/ETH_A_Sk_MI_AcPT	0 to 255 (See Table 15-8 of [ITU-T G.709])	Not applicable
ODUkP-h/ETH_A_Sk_MI_AcEXI	0 to 255 (See Table 6-2 of [ITU-T G.7041])	Not applicable
ODUkP-h/ETH_A_Sk_MI_AcUPI	0 to 255 (See Table 6-3 of [ITU-T G.7041])	Not applicable
ODUkP-h/ODUj-21_A_So Provisioning;		
ODUkP-h/ODUj-21_A_So_MI_TxMSI	According to [ITU-T G.798]	Not applicable

Table 8-2 – Provisioning and reporting for adaptation functions

MI signal	Value range	Default value
ODUkP-h/ODUj-21_A_So_MI_AUTOpayloadtype mapping.	According to [ITU-T G.798]	Not applicable
ODUkP-h/ODUj-21_A_So_MI_ODUType_Rate[1..n]	According to clause 19.6 of [ITU-T G.709]	Not applicable
ODUkP-h/ODUj-21_A_So_MI_AdminState[1..n]	According to [ITU-T G.798]	Not applicable
ODUkP-h/ODUj-21_A_So_MI_APS_EN[1..n]	true, false	true
ODUkP-h/ODUj-21_A_So_MI_APS_LVL[1..n]	0..6, 0 for path and 1..6 for TCM	–
ODUkP-h/ODUj-21_A_So_MI_INCREASE	True, false	False
ODUkP-h/ODUj-21_A_So_MI_DECREASE	True, false	False
ODUkP-h/ODUj-21_A_So_MI_TSMAP	According to [ITU-T G.7044]	Not applicable
ODUkP-h/ODUj-21_A_So_MI_TPID	According to [ITU-T G.7044]	Not applicable
ODUkP-h/ODUj-21_A_So Reporting		
ODUkP-h/ODUj-21_A_So_MI_TRPT	According to [ITU-T G.7044]	Not applicable
ODUkP-h/ODUj-21_A_So_MI_ADJSTATE	According to [ITU-T G.7044]	Not applicable
ODUkP-h/ODUj-21_A_Sk Provisioning		
ODU3P-h /ODUj21_A_Sk_MI_ExMSI[1..n]	According to [ITU-T G.798]	Not applicable
ODUkP-h /ODUj-21_A_Sk_MI_AdminState[1..n]	According to [ITU-T G.798]	Not applicable
ODUkP-h /ODUj-21_A_Sk_MI_Nominal_Bitrate_and_Tolerance[1..n]	According to [ITU-T G.709]	Not applicable
ODUkP-h/ODUj-21_A_Sk_MI_APS_EN[1..n]	true, false	true
ODUkP-h/ODUj-21_A_Sk_MI_APS_LVL[1..n]	0..6, 0 for path and 1..6 for TCM	–
ODUkP-h/ODUj-21_A_Sk_MI_ODUType[1..n]	According to clause 19.6 of [ITU-T G.709]	Not applicable
ODUkP-h/ODUj-21_A_Sk_MI_INCREASE	True, false	False
ODUkP-h/ODUj-21_A_Sk_MI_DECREASE	True, false	False
ODUkP-h/ODUj-21_A_Sk_MI_TSMAP	According to [ITU-T G.7044]	Not applicable
ODUkP-h/ODUj-21_A_Sk_MI_TPID	According to [ITU-T G.7044]	Not applicable

Table 8-2 – Provisioning and reporting for adaptation functions

MI signal	Value range	Default value
ODUkP-h/ODUj-21_A_Sk Reporting		
ODUkP-h/ODUj-21_A_Sk_MI_AcPT	According to [ITU-T G.709]	Not applicable
ODUkP-h/ODUj-21_A_Sk_MI_AcMSI[1..n].	According to [ITU-T G.709]	Not applicable
ODU2eP/FC-1200_A_So Provisioning		
None		
ODU2eP/FC-1200_A_Sk Provisioning		
None		
ODU2eP/FC-1200_A_Sk Reporting		
ODU2eP/FC-1200_A_Sk_MI_AcPT	0 to 255 (See Table 15-8 of [ITU-T G.709])	Not applicable
ODUCnP/ODUk _A_So Provisioning		
ODUCnP/ODUk_A_So_MI_TxMSI	According to [ITU-T G.798]	Not applicable
ODUCnP/ODUk_A_So_MI_Nominal_Bitrate_and_Tolerance[1..m]	According to [ITU-T G.709]	Not applicable
ODUCnP/ODUk_A_So_MI_AdminState[1..m]	LOCKED, Not LOCKED	Not LOCKED
ODUCnP/ODUk _A_So_MI_APS_EN[1..m]	true, false	true
ODUCnP/ODUk_A_SoMI_APS_LVL[1..m]	0..6, 0 for path and 1..6 for TCM	–
ODUCnP/ODUk _A_Sk Provisioning		
ODUCnP/ODUk_A_Sk_MI_ExMSI	According to [ITU-T G.798]	Not applicable
ODUCnP/ODUk_A_Sk_MI_Nominal_Bitrate_and_Tolerance[1..m]	According to [ITU-T G.709]	Not applicable
ODUCnP/ODUk_A_Sk_MI_AdminState[1..m]	LOCKED, Not LOCKED	Not LOCKED
ODUCnP/ODUk _A_Sk_MI_APS_EN[1..m]	true, false	true
ODUCnP/ODUk_A_SkMI_APS_LVL[1..m]	0..6, 0 for path and 1..6 for TCM	–
ODUCnP/ODUk _A_Sk Reporting		
ODUCnP/ODUk_A_Sk_MI_AcPT	According to [ITU-T G.709]	Not applicable
ODUCnP/ODUk_A_Sk_MI_AcMSI	According to [ITU-T G.709]	Not applicable

Table 8-2 – Provisioning and reporting for adaptation functions

MI signal	Value range	Default value
ODUflexP/FlexEC_A_So Provisioning		
None		
ODUflexP/FlexEC_A_Sk Provisioning		
None		
ODUflexP/FlexEC_A_Sk Reporting		
ODUflexP/FlexEC_A_Sk_MI_AcPT	According to [ITU-T G.709]	Not applicable
ODUflexP/FlexESG_A_So Provisioning		
ODUflexP/FlexESG_A_So_MI_ExGID	See clause 9.2.2 of [ITU-T G.709.1].	Not applicable
ODUflexP/FlexESG_A_So_MI_ExPhyMAP	A 256 bit (8 byte) Bit Map. A bit is set to "1" indicating a member/PHY is part of the FlexO Group. See clause 9.2.4 of [ITU-T G.709.1].	Not applicable
ODUflexP/FlexESG_A_So_MI_CS_n[1..p]	Integer from 1 to 254. See clause 9.2.2 of [ITU-T G.709.1].	Not applicable
ODUflexP/FlexESG_A_So Reporting		
ODUflexP/FlexESG_A_So_MI_AcCC[1..p]	According to [ITU-T G.709.1]	Not applicable
ODUflexP/FlexESG_A_So_MI_AcCCA[1..p]	According to [ITU-T G.709.1]	Not applicable
ODUflexP/FlexESG_A_So_MI_AcCCB[1..p]	According to [ITU-T G.709.1]	Not applicable
ODUflexP/FlexESG_A_Sk Provisioning		
ODUflexP/FlexESG_A_Sk_MI_CS_n[1..p]	According to [ITU-T G.709.1]	Not applicable
ODUflexP/FlexESG_A_Sk Reporting		
ODUflexP/FlexESG_A_Sk_MI_AcPT	According to [ITU-T G.709.1]	Not applicable
ODUflexP/ETCy_A_So Provisioning		
None		
ODUflexP/ETCy_A_So Reporting		
None		
ODUflexP/ETCy_A_Sk Provisioning (See Table 14-47.1 of [ITU-T G.798] for the value of y)		
ODUflexP/ETCy_A_Sk_MI_CSF_Enable	True, False	False

Table 8-2 – Provisioning and reporting for adaptation functions

MI signal	Value range	Default value
ODUflexP/ETCy_A_Sk Reporting (See Table 14-47.1 of [ITU-T G.798] for the value of y)		
ODUflexP/ETCy_A_Sk_MI_AcPT	According to [ITU-T G.709]	Not applicable
ODUP/COMMS_A_So Provisioning		
ODUP/COMMS_A_So_MI_GCCAccess, k=0, 1, 2, 2e, 3, 4, flex	GCC1, GCC2, GCC1+GCC2	Not applicable
ODUP/COMMS_A_Sk Provisioning		
ODUP/COMMS_A_Sk_MI_GCCAccess, k=0, 1, 2, 2e, 3, 4, flex	GCC1, GCC2, GCC1+GCC2	Not applicable
ODU/COMMS_AC_So Provisioning		
ODU/COMMS_AC_So_MI_GCCAccess, k=0, 1, 2, 2e, 3, 4, flex	GCC1, GCC2, GCC1+GCC2	Not applicable
ODU/COMMS_AC_Sk Provisioning		
ODU/COMMS_AC_Sk_MI_GCCAccess, k=0, 1, 2, 2e, 3, 4, flex	GCC1, GCC2, GCC1+GCC2	Not applicable
ODU/COMMS_AC_Sk_MI_GCCCont, k=0, 1, 2, 2e, 3, 4, flex	True, false	True
ODUT/ODU_A_So Provisioning		
ODUT/ODU_A_So_MI_AdminState, k=0, 1, 2, 2e, 3, 4, flex	LOCKED, Not LOCKED	Not LOCKED
ODUT/ODU_A_Sk Provisioning		
ODUT/ODU_A_Sk_MI_AdminState, k=0, 1, 2, 2e, 3, 4, flex	LOCKED, Not LOCKED	Not LOCKED
FlexO-n/OTUCn_A_So Provisioning		
FlexO-n/OTUCn_A_So_MI_TxGID(Note 4)	Integer >=0 encoded in 20-bit. See clause 9.2.2 of [ITU-T G.709.1].	None
FlexO-n/OTUCn_A_So_MI_TxPID[1..n] (Note 5 and Note 6)	Integer from 1 to 254. See clause 9.2.3 of [ITU-T G.709.1].	None
FlexO-n/OTUCn_A_So_MI_TxPhyMAP (Note 5 and Note 8)	A 256 bit (8 byte) Bit Map. A bit is set to "1" indicating a member/PHY is part of the FlexO Group. See clause 9.2.4 of [ITU-T G.709.1].	None
FlexO-n/OTUCn_A_Sk Provisioning		
FlexO/OTUCn_A_Sk_MI_ExGID (Note 4)	Integer >=0 encoded in 20-bit.	None

Table 8-2 – Provisioning and reporting for adaptation functions

MI signal	Value range	Default value
	See clause 9.2.2 of [ITU-T G.709.1].	
FlexO/OTUCn_A_Sk_MI_ExPhyMAP (Note 7 and Note 8)	A 256-bit (8 bytes) Bit Map. A bit is set to "1" indicating a member/PHY is part of the FlexO Group. See clause 9.2.4 of [ITU-T G.709.1].	None
FlexO/OTUCn_A_Sk_MI_ExPID[1..n] (Note 6 and Note 7)	Integer from 1 to 254. See clause 9.2.2 of [ITU-T G.709.1].	None
FlexO/FCC_A_So Provisioning		
None defined in [ITU-T G.798]		
FlexO/FCC_A_Sk Provisioning		
None defined in [ITU-T G.798]		
OSx/CBRx_A_So_Provisioning		
None defined in [ITU-T G.798]		
OSx/CBRx_A_Sk Provisioning		
None defined in [ITU-T G.798]		
OSx/CBRx-b_A_So_Provisioning		
None defined in [ITU-T G.798]		
OSx/CBRx-b_A_Sk Provisioning		
OSx/CBRx-b_A_Sk_MI_FECEn	True, false	False
OSx/CBRx-b_A_Sk_MI_1second	True, false	False
OSx/CBRx-c_A_Sk Provisioning		
OSx/CBRx-c_A_Sk_MI_1second	True, false	False

NOTE 1 – x = 2G5, 10G, 10G3, 40G.

NOTE 2 – The EMF shall configure the same value for the MI_CSFrdifdiEnable signals of the paired source and Sk functions.

NOTE 3 – According to clause 8.3 of [ITU-T G.8021].

NOTE 4 – The EMF shall configure the same value for the MI_TxGID and MI_ExGID signals of the paired FlexO-n/OTUCn_A_So and FlexO-n/OTUCn_A_Sk functions.

NOTE 5 – The EMF shall configure consistent values between the MI_TxPID[1..n] and MI_TxPhyMAP of the same FlexO-n/OTUCn_A_So function, as described in clause 9.2.4 of [ITU-T G.709.1].

NOTE 6 – The EMF shall configure the same values for the MI_TxPID[1..n] and MI_ExPID[1..n] signals of the paired FlexO-n/OTUCn_A_So and FlexO-n/OTUCn_A_Sk functions.

NOTE 7 – The EMF shall configure consistent values between the MI_ExPID[1..n] and MI_ExPhyMAP of the same FlexO-n/OTUCn_A_Sk function, as described in clause 9.2.4 of [ITU-T G.709.1].

NOTE 8 – The EMF shall configure the same values for the MI_TxPhyMAP and MI_ExPhyMAP signals of the paired FlexO-n/OTUCn_A_So and FlexO-n/OTUCn_A_Sk functions.

8.6 Connection

See clause 8.6 of [ITU-T G.7710] for a description of connection management.

This function allows a user to provision the operation of an OTN connection process.

The MI signals listed in Table 8-3 are communicated from the EMF to the connection process through the MP.

For the connection functions supported by an O.NE, the O.NE EMF shall support the following management functions:

– provisioning the connection MI;

– retrieving the connection MI;

– notifying the changes of the connection MI.

Table 8-3 – Provisioning and reporting for connection functions

MI signal	Value range	Default value
OMSnP_C Provisioning		
OMSnP_C_MI_OperType	Revertive, non-revertive	Revertive
OMSnP_C_MI_WTR	5..12 min	FFS
OMSnP_C_MI_HoTime	0..10 s in steps of 100 ms	FFS
OMSnP_C_MI_ExtCMD	– (Command)	Not applicable
OMSnP_C_MI_SSF-ODis	True, false	False
OTSiA|OCh_C Provisioning		
OTSiA|OCh_C_MI_MatrixControl *Per protection group*: OTSiA|OCh_C_MI_OperType OTSiA|OCh_C_MI_WTR OTSiA|OCh_C_MI_HoTime OTSiA|OCh_C_MI_ExtCMD OTSiA|OCh_C_MI_TSF-ODis	Connect, disconnect Revertive, non-revertive 5..12 min 0..10 s in steps of 100 ms – (Command) True, false	Not applicable Revertive FFS FFS Not applicable False
ODUk_C Provisioning		
ODUk_C_MI_MatrixControl *Per protection group*: ODUk_C_MI_ProtType ODUk_C_MI_OperType ODUk_C_MI_WTR ODUk_C_MI_HoTime ODUk_C_MI_ExtCMD ODUk_C_MI_APSChannel (Note) ODUk_C_MI_SDEnable NOTE – According to 14.1.1 in G.798, ODUCn is excluded from ODU_C.	Connect, disconnect According to clause 8.4 of [ITU-T G.873.1]. Revertive, non-revertive 5..12 min 0..10 s in steps of 100 ms – (Command) 0..7 (for Path, TCM1..6, Section) True, false	Not applicable 000x Revertive FFS FFS Not applicable Not applicable True
NOTE – For SNC protection with an automatic protection switching (APS) protocol.		

Reconfigurable NEs provide connection capabilities at the OCh layer. Cross-connections can be configured between client add ports and line output ports or between line input ports and client drop ports or between line input ports and line output ports (straight through matrix connections).

NOTE 1 – A matrix connection between a client add port and a client drop port is not useful from a network provisioning point of view, as it does not carry a signal through the optical core network, but it can be useful for loop back test purposes.

The following management functions are identified.

1) *Get connectivity capabilities*

   Because reconfigurable NEs may have static cross-connection restrictions, the OS should be aware of these restrictions.

   This function gives an overview of the fabric's static capability to connect TPs. This is done by identifying one or more sets of TPs that can be interconnected.

   Restrictions of connectivity may be caused by principal design of the switch matrix or by the fact that not all Sk TPs are fully reachable from all source TPs. One example for restricted connectivity capability is a missing frequency conversion function in an all-optical network.

   This function should not take limited processing capacity, usage or current problems into account. These additional restrictions have to be considered dynamically by the OS.

2) *Report connectivity changes of an optical cross-connect*

   The availability of frequency converters in a cross-connect may change. As a consequence, the connectivity sets (sets of TPs that can be connected by the fabric) may change. The NE has to send a report when the connectivity of the fabric changes.

NOTE 2 – After receiving a report about connectivity changes, the OS may again get all connectivity sets to update its connectivity topology.

3) *Create a unidirectional point-to-point cross-connection*

   A unidirectional point-to-point cross-connection can be created between:

   a) one ochCTPsink and one ochCTPsource (straight through); in case of connection monitoring via och adapter;
   b) one ochCTPsink and one ochTTPsink (drop);
   c) one ochTTPsource and one ochCTPsource (add);
   d) one ochTTPsource and one ochTTPsink (for loop back test purposes).

   A cross-connection object is created and a report on this creation has to be sent to the OS.

4) *Remove a unidirectional point-to-point cross-connection*

   This action disconnects the ochXTPs connected together. The cross-connection object is deleted and a report on this deletion has to be sent to the OS.

5) *Suspend/resume traffic on a point-to-point cross-connection*

   This function provides the possibility to suspend and resume traffic on a point-to-point cross-connection to put it out of service (suspend) or to put it in service (resume). This change has to be reported to the OS.

6) *Get all point-to-point cross-connections*

   This action returns the list of all point-to-point cross-connections created.

8.7 DEG thresholds

See clause 8.7 of [ITU-T G.7710] for a description of degraded (DEG) thresholds configuration.

8.8 ZZZ_Reported

ZZZ_Reported is not applicable to O.NEs.

8.9 Alarm severity

See clause 8.9 of [ITU-T G.7710] for a description of alarm severity configuration functions.

8.10 Alarm reporting control

See clause 8.10 of [ITU-T G.7710] for a description of ARC configuration functions.

8.11 Performance management thresholds

See clause 8.11 of [ITU-T G.7710] for a description of PM threshold configuration functions.

8.12 Tandem connection monitoring activations

See clause 8.12 of [ITU-T G.7710] for a description of TCM activation configuration functions.

8.13 Date and time

The date and time functions within the OTN EMF comprise the local real-time clock (RTC) function and the performance monitoring clock (PMC) function. The MCF within the OTN NEF shall be capable of setting the local RTC function.

The date and time values are incremented by a free-running local clock, or by an external timing source. The fault, configuration, accounting, performance and security (FCAPS) management functions need date and time information, e.g., to time stamp event reports. They obtain this information from the date and time function.

8.13.1 Date and time applications

Clause 8.13.1 of [ITU-T G.7710] identifies three date and time applications. These are:

- time-stamping;
- PMC signals;
- activity scheduling.

The OTN NEF functional requirements for these applications are specified in clauses 8.13.1.1 to 8.13.1.3.

8.13.1.1 Time stamping

See clause 8.13.1.1 of [ITU-T G.7710] for a description of the time-stamping application.

8.13.1.2 Performance monitoring clock signals

See clause 8.13.1.2 of [ITU-T G.7710] for a description of the PMC signals.

8.13.1.3 Activity scheduling

See clause 8.13.1.3 of [ITU-T G.7710] for a description of the activity scheduling.

8.13.2 Date and time functions

See clause 8.13.2 of [ITU-T G.7710] for a description of the date and time application.

8.13.2.1 Local real-time clock function

The local RTC function is specified in clause 8.13.2.1 of [ITU-T G.7710].

8.13.2.2 Local real-time clock alignment function with external time reference

The local RTC alignment function with an external time reference is specified in clause 8.13.2.2 of [ITU-T G.7710].

8.13.2.3 Performance monitoring clock function

The PMC function is specified in clause 8.13.2.3 of [ITU-T G.7710].

8.14 Control function

The ODUT_TCMC function (i.e., ODUkT_TCMC or ODUCnT_TCMC functions) are responsible for the activation or deactivation of a TCM trail. An ODUT _TCMC function is connected to the ODUT _TT and ODUT/ODUk_A functions at the TCM control points (TCMCPs) as shown in Figure 14-93 of [ITU-T G.798].

Currently only an ODUT _TCMC function for manual activation or deactivation via the management is defined. ODUT _TCMC functions for automatic activation are FFS.

The MI signals listed in Table 8-4 are communicated from the EMF to the connection process through the MP.

For the control functions supported by an O.NE, the O.NE EMF shall support the following management functions:

– provisioning the control MI;

– retrieving the control MI;

– notifying the changes of the control MI.

Table 8-4 – Provisioning and reporting for control functions

MI signal	Value range	Default value
ODUT_TCMCm Provisioning		
ODUT_TCMCm_MI_Level	1..6	Not applicable
ODUT_TCMCm_MI_ModeSo	OPERATIONAL, MONITOR, TRANSPARENT	FFS
ODUT_TCMCm_MI_ModeSk	OPERATIONAL, MONITOR, TRANSPARENT	FFS
ODUT_TCMCm_MI_TCM_Extension	Normal, Pass-through, Erase	Normal
ODUT_TCMCm Reporting		
ODUT_TCMCm_MI_AcSTATSo[1..6]	According to clause 15.8.2.2.5 of [ITU-T G.709]	Not applicable
ODUT_TCMCm_MI_AcSTATSk[1..6]	According to clause 15.8.2.2.5 of [ITU-T G.709]	Not applicable

8.15 Application identifier management

This clause specifies management requirements for the OTN NE having OChs that support optical system standard applications (specified in ITU-T Recommendations, e.g., [ITU-T G.695], [ITU-T G.698.2] and [ITU-T G.959.1]) and proprietary applications.

[ITU-T G.695], [ITU-T G.698.2] and [ITU-T G.959.1] provide optical parameter values of physical layer interfaces for the coarse wavelength division multiplexing (CWDM) system, dense wavelength division multiplexing (DWDM) system, and non-wavelength division multiplexing (non-WDM) system, respectively. The applications specified in these Recommendations are determined using optical interface parameters at the main path interface S (or MPI-S) reference point, at the R (or MPI-R) reference point, as well as for the optical link between the reference points.

The specifications of the optical interface parameters in [ITU-T G.695], [ITU-T G.698.2] and [ITU-T G.959.1] are organized according to sets of application codes. The current edition of [ITU-T G.872] has generalized the application code to application identifier so that proprietary (i.e., non-standard) applications can be handled.

For the OTN NE having OChs that support standards or proprietary applications, there is a need to provision or report on the supported set of application identifiers and to select a specific one from the set to ensure application identifier compatibility among the transmitter, receiver and link.

Note that an application identifier does not specify the actual nominal central frequency or actual nominal central wavelength, though it does specify the range of the nominal central frequency or wavelength. In the cases of DWDM and CWDM, in addition to the application identifier, the nominal central frequency or nominal central wavelength needs also to be specified.

[ITU-T G.872] has introduced some new terms to better describe the media aspects of optical networking. In particular, the media path that interconnects an OCh source (So) with an OCh Sk is called a network media channel. A black link is an instance of a network media channel.

For the OCh TT in an OTN-compliant NE supporting standard or proprietary application identifiers, the OTN NE EMF shall support the following management functions:

– provisioning the supportable application identifiers for the OCh TT;
– retrieving the supportable application identifiers from the OCh TT;
– notifying the changes of the supportable application identifiers of the OCh TT;
– selecting the application identifier to be used for the OCh TT;
– retrieving the selected application identifier from the OCh TT;
– notifying the changes of the selected application identifier of the OCh TT;
– if the selected application identifier defines a tributary to a DWDM system, provisioning the nominal central frequency of the OCh_TT;
– if the selected application identifier defines a tributary to a DWDM system, retrieving the nominal central frequency of the OCh_TT;
– if the selected application identifier defines a tributary to a DWDM system, notifying the changes in the nominal central frequency of the OCh_TT;
– if the selected application identifier defines a tributary to a CWDM system, provisioning the nominal central wavelength of the OCh_TT;
– if the selected application identifier defines a tributary to a CWDM system, retrieving the nominal central wavelength of the OCh_TT;
– if the selected application identifier defines a tributary to a CWDM system, notifying the changes in the nominal central wavelength of the OCh_TT.

Valid ITU-T standard application identifiers are specified in ITU-T Recommendations, e.g., [ITU-T G.695], [ITU-T G.698.2] and [ITU-T G.959.1]. In the management interface, when an ITU-T standard application code is referred to, the values and value ranges of the optical parameters as specified in the corresponding ITU-T Recommendation for that application code are assumed.

Note that an operable OCh trail is formed from an OCh_TT So, a network media channel and an OCh_TT Sk, all of which share a common application identifier.

Note that OCh_TT had been specified in [ITU-T G.798]. The specification of OCh_TT was integrated into the optical tributary signal (OTSi) modulation and demodulator processes in the 2017 edition of [ITU-T G.798].

8.16 Media element management

This clause specifies the management requirements for the media element, in particular the input provisioning information to and the output information from the media element, of which the equipment functionality is specified in clause 16 of [ITU-T G.798]. See Table 8-5.

Table 8-5 – Media element-related provisioning and reporting

MI signal	Value range	Default value
Media element provisioning		
ME_MI_configureMediaChannel(port j, port k, freqSlot, signalTransfer)	FFS	FFS
ME_MI_configureNOM(port j, freqSlot, threshold)	FFS	FFS
Media element reporting		
ME_MI_queryMediaChannel(port j, port k, freqSlot, signalTransfer)	FFS	FFS
ME_MI_NOM(port j, freqSlot, value)	FFS	FFS

9 Account management

Account management is FFS.

10 Performance management

See clause 10 of [ITU-T G.7710] for the generic requirements for PM. OTN-specific management requirements are described as follows.

Note that, due to the frame synchronous mapping between an optical data unit of level k, path (ODUkP, k=0, 1, 2, 2e, 3, 4, flex) and an optical data unit of level k, tandem connection sub-layer, (ODUkT; k=0, 1, 2, 2e, 3, 4, flex) and between an ODUk and an OTUk, a frame slip that already exists at the source of the ODUkT or the OTUk trail is also detected at the Sk of the ODUkT and the OTUk trail. This frame slip will result in bit error detection at the TT Sk, even if the trail contains no errors. In order to suppress these bit errors, incoming alignment error (IAE) and backward incoming alignment error (BIAE) signalling is supported in the OTN. IAE is generated at the trail source if a frame slip is detected. It is transmitted to the trail Sk to suppress the bit errors. BIAE is the signalling for the reverse direction and is used to suppress the backward error indication. Due to the detection, propagation and signalling delay, no fixed time relation between the occurrence of bit errors and the detection of the IAE exists. Therefore, bit errors detected in the current or previous second are wrong and must be suppressed if an IAE is detected.

The following rules apply:

– if pBIAE is active, the F_DS and the F_EBC values of the previous and the current second must be discarded;

– if pIAE is active, the N_DS, the F_DS, the N_EBC and the F_EBC values for the previous and the current second must be discarded.

Note that the previous second must be discarded due to the delay of the IAE information coming from the remote source.

10.1 Performance management applications

See clause 10.1 of [ITU-T G.7710] for the generic description for PM applications.

10.1.1 Concepts of near-end and far-end

See clause 10.1.1 of [ITU-T G.7710] for a description of near-end and far-end concepts.

10.1.2 Maintenance

See clause 10.1.2 of [ITU-T G.7710] for a description of PM for maintenance.

10.1.3 Bringing-into-service

See clause 10.1.3 of [ITU-T G.7710] for a description of bringing-into-service.

10.1.4 Quality of service

See clause 10.1.4 of [ITU-T G.7710] for a description of quality of service.

10.1.5 Availability

See clause 10.1.5 of [ITU-T G.7710] for a description of availability.

10.1.6 Reporting

See clause 10.1.6 of [ITU-T G.7710] for a description of reporting.

As soon as a threshold is reached or crossed in a 15 min/24 h period for a given performance measurement, a threshold report (TR) is generated.

As an option for 15 min periods, an alternative method of threshold reporting can be used. When, for the first time, a threshold is reached or crossed for a given performance measurement, a TR is generated. No TRs will be generated in subsequent 15 min periods until the value of the performance measurement falls below a specific threshold. Then, a reset threshold report (RTR) is generated.

Performance data shall be reportable across the NE/OS interface automatically upon reaching or crossing a performance-monitoring threshold.

10.1.6.1 Performance data collection

See clause 10.1.6.1 of [ITU-T G.7710] for the generic description of performance data collection.

Counter-based performance data collection refers to the measurement counting associated with each of the performance measurements and any additional performance parameter specified in this Recommendation.

Two types of performance data collection are possible.

– A collection as specified in [ITU-T M.2120], i.e., based on information of each direction of transport independently. This type is also referred to as performance data collection for maintenance purposes.
– The collection as specified in [ITU-T G.826], i.e., based on information of both directions of transport together. This type is also referred to as performance data collection for error performance assessment purposes.

Counts are taken over fixed time periods of 15 min and 24 h. Counting is stopped during unavailable time.

Gauge-based performance data collection refers to the measurement gauge crossings associated with each of the performance measurements and any additional performance parameter specified in this Recommendation.

Performance history data is necessary to assess the recent performance of transmission systems. Such information can be used to sectionalize faults and to locate the source of intermittent errors.

Historical data, in the form of performance measurement, may be stored in registers in the NE or in mediation devices associated with the NE. For specific applications, e.g., when only quality of service alarms are used, historical data may not be stored.

All the history registers shall be time-stamped.

The history registers operate as follows.

– 15 min registers

  The history of the 15 min monitoring is contained in a stack of 16 registers per monitored measurement. These registers are called the recent registers.

  Every 15 min, the contents of the current registers are moved to the first of the recent registers. When all 15 min registers are used, the oldest information will be discarded.

– 24 h registers

  The history of the 24 h monitoring is contained in a single register per monitored measurement. This register is called the recent register.

  Every 24 h, the contents of the current register are moved to the recent register.

10.1.6.2 History storage suppression

See clause 10.1.6.2 of [ITU-T G.7710] for a description of history storage suppression.

10.1.7 Thresholding

A thresholding mechanism can be used to generate an autonomous measurement report when the performance of a transport entity falls below a predetermined level. The general strategy for the use of thresholds is described in [ITU-T M.20]. Specific information for optical networks is FFS. The thresholding mechanism is applicable only for the maintenance-based collection.

See clause 10.1.7 of [ITU-T G.7710] for a description of thresholding.

10.1.7.1 Threshold setting

The thresholds may be set in the NE via the OS. The OS shall be able to retrieve and change the settings of the 15 min and 24 h thresholds.

The threshold values for measurements evaluated over the 15 min period should be programmable within the specified range.

10.1.7.2 Threshold reporting

As soon as a threshold is reached or crossed in a 15 min/24 h period for a given performance measurement, a TR is generated.

As an option for 15 min periods, an alternative method of threshold reporting can be used. When, for the first time, a threshold is reached or crossed for a given performance measurement, a TR is generated. No TRs will be generated in subsequent 15 min periods until the value of the performance measurement falls below a specific threshold. Then, an RTR is generated.

The detailed functioning of the threshold mechanisms is FFS.

Performance data shall be reportable across the NE/OS interface automatically upon reaching or crossing a performance-monitoring threshold.

10.1.7.3 Evaluation for counters

See clause 10.1.7.3 of [ITU-T G.7710] for a generic description.

10.1.7.4 Evaluation for gauges

See clause 10.1.7.4 of [ITU-T G.7710] for a generic description.

10.1.8 Delay measurement requirements

1) OTN delay measurement is defined as a "round trip" measurement; i.e., it can only be used in bidirectional connections.

2) The toggling of the DMValue has to be synchronized between the source and Sk atomic functions.

3) DM_Source in the So and Sk atomic functions always has the same value.

4) DM_Source should be set to false in all involved atomic functions when no delay measurement is required.

5) On-demand delay measurement must be supported.

6) Proactive delay measurement is FFS.

10.2 Performance management functions

See clause 10.2 of [ITU-T G.7710] for generic requirements of PM functions.

OTN NE provides the PM MI in Table 10-1.

Table 10-1 – Performance management information

<table>
<tr><th>Performance management information</th><th>OTN function</th><th>PM current data and history data collected in EMF</th></tr>
<tr><td>OTS-O_TT_Sk_MI_pN_DS-P
OTS-O_TT_Sk_MI_pN_DS-O
OTS-O_TT_Sk_MI_pF_DS-P
OTS-O_TT_Sk_MI_pF_DS-O</td><td>OT-On_TT_Sk</td><td>OTS-O_TTP_Sk:
nSES, fSES,
{UAS|nUAS, fUAS}(Note 1)</td></tr>
<tr><td>OMS-O_TT_Sk_MI_pN_DS-P
OMS-O_TT_Sk_MI_pN_DS-O
OMS-O_TT_Sk_MI_pF_DS-P
OMS-O_TT_Sk_MI_pF_DS-O</td><td>OMS-O_TT_Sk</td><td>OMSn_TTP_Sk:
nSES, fSES,
{UAS|nUAS, fUAS}</td></tr>
<tr><td>OTSi/OTUk_A_Sk_MI_pFECcorrErr (Note 2)</td><td>OTSi/OTUk-a_A_Sk
See Table 16-1 of [ITU-T G.798] for the function types</td><td rowspan="4">OTU_CTP_Sk:
CD/HD: #FECcorrErr
OTSi_TTP_Sk:
CD/HD: #FECcorrErr
where #FECcorrErr = count of FEC-corrected Errors</td></tr>
<tr><td>OTSi/OTUkV_A_Sk_MI_pFECcorrErr (Note 2)</td><td>OTSi/OTUkV_A_Sk</td></tr>
<tr><td>OTSiG/OTUkV_A_Sk_MI_pFECcorrErr (Note 2)</td><td>OTSiG/OTUkV_A_Sk</td></tr>
<tr><td>OTSi/FlexO-1-SC_A_Sk_MI_pFECcorrErr</td><td>OTSi/FlexO-1-SC_A_Sk</td></tr>
<tr><td>OTSiG/OTUk_A_Sk_MI_pFECcorrErr</td><td>OTSiG/OTUk_A_Sk
See Table 16-6 of [ITU-T G.798] for the function types</td><td rowspan="3">OTSiG_TTP_Sk:
CD/HD: #FECcorrErr
where #FECcorrErr = count of FEC-corrected Errors</td></tr>
<tr><td>OTSiG/OTUCn_A_Sk_MI_pFECcorrErr</td><td>OTSiG/OTUCn_A_Sk</td></tr>
<tr><td>OTSiG/FlexO_A_Sk_MI_pFECcorrErr</td><td>OTSiG/FlexO_A_Sk</td></tr>
<tr><td>OTSi/OSC_A_MI_pN_DS-O</td><td>OTSi/OSC_A_Sk</td><td>OTSi/OSC_A_Sk:
nSES, fSES,
{UAS|nUAS, fUAS} (Note 1)
pN_DS-O is missing this primitive in Table 16-18 of [ITU-T G.798].</td></tr>
</table>

Table 10-1 – Performance management information

Performance management information	OTN function	PM current data and history data collected in EMF
OTU_TT_Sk_MI_pN_EBC OTU_TT_Sk_MI_pN_DS OTU_TT_Sk_MI_pF_EBC OTU_TT_Sk_MI_pF_DS OTU_TT_Sk_MI_pBIAE OTU_TT_Sk_MI_pIAE	OTU_TT_Sk	OTU_TTP_Sk: nSES, fSES, {UAS|nUAS, fUAS}, nBBE, fBBE, (Note 4)
OTUkV_TT_Sk_MI_pN_EBC OTUkV_TT_Sk_MI_pN_DS OTUkV_TT_Sk_MI_pF_EBC OTUkV_TT_Sk_MI_pF_DS OTUkV_TT_Sk_MI_pBIAE (Note 3) OTUkV_TT_Sk_MI_pIAE (Note 3)	OTUkV_TT_Sk	
OTSiG-O_TT_Sk_MI_pN_DS-P OTSiG-O_TT_Sk_MI_pN_DS-O OTSiG-O_TT_Sk_MI_pF_DS-P OTSiG-O_TT_Sk_MI_pF_DS-O	OTSiG-O_TT_Sk	OTSiG-O_TTP_Sk: nSES, fSES, {UAS|nUAS, fUAS}, nBBE, fBBE,
ODUP_TT_Sk_MI_pN_EBC ODUP_TT_Sk_MI_pN_DS ODUP_TT_Sk_MI_pF_EBC ODUP_TT_Sk_MI_pF_DS ODUP_TT_Sk_MI_pN_delay	ODUP_TT_Sk	ODUkP_TTP_Sk: nSES, fSES, {UAS|nUAS, fUAS}, nBBE, fBBE, Proactive DM is FFS. See clause 14.2.1 of [ITU-T G.798] for pN_Delay
ODUkP/PRBS_A_Sk_MI_pN_TSE	ODUkP/PRBS_A_Sk	PRBS or generic client layer CTP_Sk: Sum of pN_TSE
ODUkP/CBRx-g_A_So_MI_pN_PCS_BIP (Note 5)	ODUkP/CBRx-g_A_So For the value of k and x in ODUkP/CBRx, see Table 14-18 of [ITU-T G.798]	generic client layer CTP_So: Sum of pN_PCS_BIP
ODUkP/CBRx-g_A_Sk_MI_pN_PCS_BIP (Note 5)	ODUkP/CBRx-g_A_Sk For the value of k and x in ODUkP/CBRx, see Table 14-18 of [ITU-T G.798]	generic client layer CTP_Sk: Sum of pN_PCS_BIP
ODUkP/ETH_A_Sk_MI_pFCSErrors	ODUkP/ETH_A_Sk	ETH or generic client layer CTP_Sk: Sum of pFCSErrors
ODUkP-h/ETH_A_Sk_MI_pFCSErrors	ODUkP-h/ETH_A_Sk	ETH or generic client layer CTP_Sk: Sum of pFCSErrors

Table 10-1 – Performance management information

<table>
<tr><th>Performance management information</th><th>OTN function</th><th>PM current data and history data collected in EMF</th></tr>
<tr><td>ODUT_TT_Sk_MI_pN_EBC
ODUT_TT_Sk_MI_pN_DS
ODUT_TT_Sk_MI_pF_EBC
ODUT_TT_Sk_MI_pF_DS
ODUT_TT_Sk_MI_pN_delay
ODUT_TT_Sk_MI_pBIAE
ODUT_TT_Sk_MI_pIAE</td><td>ODUT_TT_Sk
See clause 14.5.1.1.2 of [ITU-T G.798]</td><td>ODUkT_TTP_Sk:
nSES, fSES,
{UAS|nUAS, fUAS},
nBBE, fBBE,
Proactive DM is FFS.
See clause 14.2.1 of [ITU-T G.798] for pN_Delay
(Note 4)</td></tr>
<tr><td>ODUTm_TT_Sk_MI_pN_EBC
ODUTm_TT_Sk_MI_pN_DS
ODUTm_TT_Sk_MI_pF_EBC
ODUTm_TT_Sk_MI_pF_DS
ODUTm_TT_Sk_MI_pBIAE
ODUTm_TT_Sk_MI_pIAE</td><td>ODUTm_TT_Sk
See clause 14.5.1.1.3 of [ITU-T G.798]</td><td>ODUkTm_TTP_Sk:
nSES, fSES,
{UAS|nUAS, fUAS},
nBBE, fBBE,
(Note 4)</td></tr>
<tr><td>OSx_TT_Sk_MI_pN_DS</td><td>OSx_TT_Sk</td><td>OSx_TTP_Sk:
nSES, nUAS</td></tr>
<tr><td>OSx/CBRx-b_A_Sk _MI_pFECcorrErr</td><td>OSx/CBRx-b_A_Sk</td><td rowspan="2">OSx/CBRx_Sk:
CD/HD: #FECcorrErr
where #FECcorrErr = count of FEC-corrected Errors</td></tr>
<tr><td>OSx/CBRx-c_A_Sk_MI_FECcorrErr</td><td>OSx/CBRx-c_A_Sk</td></tr>
<tr><td>OSx/CBRx-b_A_Sk_MI_pFECuncorrErr</td><td>OSx/CBRx-b_A_Sk</td><td rowspan="2">OSx/CBRx_Sk:
CD/HD: #FECuncorrErr
where #FECCuncorrErr = FEC-uncorrected Errors</td></tr>
<tr><td>OSx/CBRx-c_A_Sk_MI_pFECuncorrErr</td><td>OSx/CBRx-c_A_Sk</td></tr>
<tr><td colspan="3">NOTE 1 – {UAS|nUAS, fUAS} means bidirectional UAS or Unidirectional "nUAS and fUAS".
NOTE 2 – If the function performs forward error correction (FEC).
NOTE 3 – In case of frame-synchronous mapping of ODUk client signal.
NOTE 4 – pIAE and pBIAE are used for the suppression of the PM data in the EMFs. If pBIAE is active, the F_DS and F_EBC values of the previous and current second have to be discarded (errored block count (EBC) = 0 and defect second (DS) = false). If pIAE is active, the N/F_DS and N/F_EBC and N_delay values of the previous and current second have to be discarded (EBC = 0 and DS = false). The previous second has to be included due to the delay of the IAE information coming from the remote source.
NOTE 5 – Applicable only when (k=3, CBRx=ETC40GR) or (k=4, CBRx=ETC100GR).</td></tr>
</table>

The EMF shall support the following functions:

– collecting OTN layer-specific current PM data as specified in Table 10-1;

– collecting OTN layer-specific history PM data as specified in Table 10-1;

– resetting of the OTN layer-specific current PM data registers;

– reporting OTN layer-specific current PM data at the maturity of the monitoring time interval;

– on-demand retrieval of the collected OTN layer-specific PM data;

– setting of the threshold of the monitored OTN layer-specific PM data collection;

– reporting of threshold crossing for the collected OTN layer-specific current PM data;
– notifying the change of the threshold of the monitored OTN layer-specific PM data collection.

11 Security management

FFS.

Appendix I

Management information for configuration management

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

Regarding CM, the OTN NEs can be configured via the following MI signals that are specified per atomic function in [ITU-T G.798]:

– <atomic function name>_MI_AutoMS
– <atomic function name>_MI_AdminState
– <atomic function name>_MI_APRCntrl
– <atomic function name>_MI_APSChannel
– <atomic function name>_MI_CellDiscardActive
– <atomic function name>_MI_DTDLuseEnabled
– <atomic function name>_MI_ExtCMD
– <atomic function name>_MI_ExDAPI
– <atomic function name>_MI_ExMSI
– <atomic function name>_MI_ExSAPI
– <atomic function name>_MI_FECEn
– <atomic function name>_MI_GCCAccess
– <atomic function name>_MI_GCCCont
– <atomic function name>_MI_GetAcTI
– <atomic function name>_MI_GFCActive
– <atomic function name>_MI_HECactive
– <atomic function name>_MI_HoTime
– <atomic function name>_MI_Level
– <atomic function name>_MI_MatrixControl
– <atomic function name>_MI_ModeSk
– <atomic function name>_MI_ModeSo
– <atomic function name>_MI_OperType
– <atomic function name>_MI_ProtType
– <atomic function name>_MI_SDEnable
– <atomic function name>_MI_TIMActDis
– <atomic function name>_MI_TIMDetMo
– <atomic function name>_MI_TPusgActive
– <atomic function name>_MI_TSF-ODis
– <atomic function name>_MI_TxMSI
– <atomic function name>_MI_TxTI
– <atomic function name>_MI_VPIrange
– <atomic function name>_MI_VPI-KActive
– <atomic function name>_MI_VPIK_SAISActive
– <atomic function name>_MI_WTR

Regarding CM, the OTN NEs can provide the configuration data via the following MI signals that are specified per atomic function in [ITU-T G.798]:

– <atomic function name>_MI_AcMSI
– <atomic function name>_MI_AcPT
– <atomic function name>_MI_AcPT[1..XMR]
– <atomic function name>_MI_AcTI
– <atomic function name>_MI_AcSTATSk[1..6]
– <atomic function name>_MI_AcSTATSo[1..6]
– <atomic function name>_MI_AcVcPT

Appendix II

Management information for performance management

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

Regarding PM, the OTN NEs can be configured via the following MI signals that are specified per atomic function in [ITU-T G.798]:

– <atomic function name>_MI_1second
– <atomic function name>_MI_DEGM
– <atomic function name>_MI_DEGThr

Regarding PM, the OTN NEs can provide the performance data via the following MI signals that are specified per atomic function in [ITU-T G.798]:

– <atomic function name>_MI_pBIAE
– <atomic function name>_MI_pF_DS-O
– <atomic function name>_MI_pF_DS-P
– <atomic function name>_MI_pFECcorrErr
– <atomic function name>_MI_pF_EBC
– <atomic function name>_MI_pF_DS
– <atomic function name>_MI_pIAE
– <atomic function name>_MI_pN_DS-O
– <atomic function name>_MI_pN_DS-P
– <atomic function name>_MI_pN_EBC
– <atomic function name>_MI_pN_DS
– <atomic function name>_MI_pN_delay
– <atomic function name>_MI_pN_TSE
– <atomic function name>_MI_pN_PCS_BIP

Appendix III

Mapping between OPUk payload type and adaptation atomic function

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

Table III.1 maps the OPUk PTs specified in Table 15-9 of [ITU-T G.709] to the corresponding adaptation atomic functions.

Table III.1 – Payload type and atomic functions

<table>
<tr><th colspan="2">Payload types
Table 15-9 of [ITU-T G.709]
(clause numbers in this column are those of [ITU-T G.709])</th><th colspan="2">Atomic functions
[ITU-T G.798]</th></tr>
<tr><th>PT in Hex code</th><th>Interpretation</th><th colspan="2">Adaptation atomic function</th></tr>
<tr><td>01</td><td>Experimental mapping</td><td colspan="2">–</td></tr>
<tr><td>02</td><td>Asynchronous CBR mapping, see clause 17.2</td><td>ODUkP/
CBRx-a_A_so</td><td rowspan="2">ODUkP/
CBRx_A_Sk</td></tr>
<tr><td>03</td><td>Bit synchronous CBR mapping, see clause 17.2</td><td>ODUkP/
CBRx-b_A_So</td></tr>
<tr><td>04</td><td>Not available</td><td colspan="2">None</td></tr>
<tr><td>05</td><td>GFP mapping, see clause 17.4</td><td colspan="2">ODUkP/ETH_A
ODUkP-X-L/ETH_A;
k = 1, 2, 3
NOTE – Since GFP is not an adaptation, i.e., only a mapping, the adaptation function depends on the client signal.</td></tr>
<tr><td>06</td><td>Not available</td><td colspan="2">None</td></tr>
<tr><td>07</td><td>Physical coding sublayer (PCS) codeword transparent Ethernet mapping:
1000BASE-X into OPU0 mapping, see clauses 17.7.1 and 17.7.1.1
40GBASE-R into OPU3, see clauses 17.7.4 and 17.7.4.1
100GBASE-R into OPU4, see clauses 17.7.5 and 17.7.5.1</td><td colspan="2">ODU0P/CBRx_A
(0≤x≤1.25G)</td></tr>
<tr><td>08</td><td>FC-1200 into OPU2e mapping, see clause 17.8.2</td><td colspan="2">ODUkP/CBRx-g_A</td></tr>
<tr><td>09</td><td>GFP mapping into Extended OPU2 payload, see clause 17.4.1</td><td colspan="2">ODU2P/EthPP-OS_A</td></tr>
<tr><td>0A</td><td>STM-1 mapping into ODU0, see clause 17.7.1</td><td colspan="2" rowspan="2">ODUkP/RSn_A</td></tr>
<tr><td>0B</td><td>STM-4 mapping into ODU0, see clause 17.7.1</td></tr>
<tr><td>0C</td><td>FC-100 mapping into ODU0, see clause 17.7.1</td><td colspan="2" rowspan="5">ODUkP/CBRx-g_A</td></tr>
<tr><td>0D</td><td>FC-200 mapping into ODU1, see clause 17.7.2</td></tr>
<tr><td>0E</td><td>FC-400 mapping into ODUflex, see clause 17.9</td></tr>
<tr><td>0F</td><td>FC-800 mapping into ODUflex, see clause 17.9</td></tr>
<tr><td>10</td><td>Bit stream with octet timing mapping, see clause 17.6.1</td></tr>
</table>

Payload types Table 15-9 of [ITU-T G.709] (clause numbers in this column are those of [ITU-T G.709])		**Atomic functions [ITU-T G.798]**
PT in Hex code	**Interpretation**	**Adaptation atomic function**
11	Bit stream without octet timing mapping, see clause 17.6.2	
12	IB SDR mapping into OPUflex, see clause 17.9	
13	IB DDR mapping into OPUflex, see clause 17.9	
14	IB QDR mapping into OPUflex, see clause 17.9	
15	SDI mapping into OPU0, see clause 17.7.1	
16	(1.485/1.001) Gbit/s SDI mapping into OPU1, see clause 17.7.2	
17	1.485 Gbit/s SDI mapping into OPU1, see clause 17.7.2	
18	(2.970/1.001) Gbit/s SDI mapping into OPUflex, see clause 17.9	
19	2.970 Gbit/s SDI mapping into OPUflex, see clause 17.9	
1A	SBCON/ESCON mapping into OPU0, see clause 17.7.1	
1B	DVB_ASI mapping into OPU0, see clause 17.7.1	
1C	FC-1600 mapping into OPUflex, see clause 17.9	
1D	FlexE Client mapping into OPUflex, see clause 17.11	OPUflexP/FlexEC
1E	FlexE aware (partial rate) mapping into OPUflex, see clause 17.12	OPUflexP/FlexESG
1F	FC-3200 mapping into OPUflex, see clause 17.9	ODUkP/CBRx-g_A
20	ODU multiplex structure supporting optical data tributary unit j into k (ODTUjk) only, see clause 19 (AMP only)	ODUkP/ODU[i]j_A
21	ODU multiplex structure supporting ODTUk.ts or ODTUk.ts and ODTUjk, see clause 19 (GMP capable)	ODUkP/ODUj-21_A
22	*ODU multiplex structure supporting ODTUCn.ts, see clause 20 (GMP capable)*	ODUCnP/ODUk
30	25GBASE-R mapping into OPUflex, see clause 17.13	OPUflexP/x*GBASE-R*
31	200GBASE-R mapping into OPUflex, see clause 17.13	
32	400GBASE-R mapping into OPUflex, see clause 17.13	
33	50GBASE-R mapping into OPUflex, see clause 17.13	
55	Not available	None
66	Not available	None
80-8F	Reserved codes for proprietary use	None
FD	NULL test signal mapping, see clause 17.5.1	ODUkP/NULL_A
FE	PRBS test signal mapping, see clause 17.5.2	ODkP/PRBS_A
FF	Not available	None

NOTE – The PT does not have a unique value for every adaptation function. Multiple adaptation functions share the same PT value. An overview is presented as follows.

– 14.3.1/G.798 ODUkP/CBRx_A, bit sync: <k,x> = <1,2G5>, <2,10G>, <2e,10G3>, <3,40G>, <flex,beyond_2.5G>, async: <1,2G5> (20 ppm), <1,2G5> (32 ppm), <2,10G>, <3,40G>; no need to manage 2G5 ppm differences

  PT of these adaptation functions;

  PT=0x02 for async mapping of CBR2G5, CBR10G, CBR40G

  PT=0x03 for bitsync mapping of CBR2G5, CBR10G, CBR10G3, CBR40G

  PT=0x0E for bitsync mapping of FC400

  PT=0x0F for bitsync mapping of FC800

  PT=0x12 for bitsync mapping of IB QDR

  PT=0x13 for bitsync mapping of IB QDR

  PT=0x14 for bitsync mapping of IB QDR

  PT=0x18 for bitsync mapping of (2.970/1.001)G SDI

  PT=0x19 for bitsync mapping of 2.970G SDI

  PT=0x1C for bitsync mapping of FC1600

– 14.3.3/G.798 ODU2P/EthPP_OS_A => 11.5.3/G.8021 ODU2P/EthOS_A

  PT=0x05

– 14.3.4/G.798 ODUkP/NULL_A

  PT=0xFD.

  Additional control here is for ODUk, k=flex the nominal bit rate.

– 14.3.5/G.798 ODUkP/PRBS_A

  PT=0xFE.

  Additional control here is for ODUk, k=flex the nominal bit rate.

– 14.3.6/G.798 ODUkP/RSn_A, <k,n> = <1,16>, <2,64>, <3,256>

  PT=0x02 for async mapping of RS16, RS64, RS256,

  PT=0x03 for bitsync mapping of RS16, RS64, RS256.14.3.7 ODU0P/CBRx_A, x = 155M, 622M, ETC3, FC100, SBCON, DVB_ASI

  PT=0x0A for STM-1 (155M) mapping into OPU0

  PT=0x0B for STM-4 (622M) mapping into OPU0

  PT=0x0C for FC100

  PT=0x07 for 1000BASE-X (ETC3)

  PT=0x1A for SBCON/ESCON

  PT=0x1B for DVB_ASI

  Table III.2 maps PT values of SDHs to ODUs.

Table III.2 – PT of SDH to ODU mapping

ODUk	SDH	PT		
		BMP	AMP	GMP
ODU0	STM-1(155M)	–	–	0x0A
ODU0	STM-4(622M)	–	–	0x0B
ODU1	STM – 4	0x03	0x02	–
ODU2	STM -16	0x03	0x02	–
ODU3	STM – 64	0x03	0x02	–

– 14.3.8/G.798 ODUkP/CBRx-g_A, CBRx-g = ETC5, ETC6, FC200

PT=0x07 for 40GBASE-R (ETC5)

PT=0x07 for100GBASE-R (ETC6)

PT=0x0D for FC200

– 14.3.9/G.798 ODUkP/ODU[i]j_A

PT=0x20.

Additional control here is on a per LO optical data unit of level j (ODUj) basis, which can be performed as part of LO ODU connection management:

MI_TxMSI, MI_ExMSI[p], MI_AdminState[p], MI_APS_EN[p], MI_APS_LVL [p]

– 14.3.10/G.798 ODUkP/ODUj-21_A

PT=0x21

Additional control here is MI_AUTOpayloadtype.

Further additional control is on a per LO ODUj basis, which can be performed as part of LO ODU connection management:

MI_TxMSI. MI_ExMSI[p], MI_ODUType_Rate[i], MI_AdminState[n], MI_APS_EN [n], MI_APS_LVL [n]

– 14.3.11/G.798 ODUkP/ETH_A, see 11.5.1/G.8021 ODUkP/ETH_A

PT=0x06.

vcPT=0x05.

Additional control here is MI_CSFEnable and MI_CSFrdifdiEnable, MI_FilterConfig, MI_CSF_Reported, MI_MAC_Length.

– 14.3.12/G.798 ODUkP-h/ETH_A, k=flex

PT=0x05. The same PT value is used for this hitless adjustment of ODUflex(GFP) (HAO) capable function as for the regular, non-HAO capable function.

Additional control here is MI_ODUflexRate, MI_CSFEnable, MI_CSFrdifdiEnable, MI_FilterConfig, MI_CSF_Reported, MI_MAC_Length.

Further additional control here is for HAO; i.e., MI_INCREASE, MI_DECREASE, MI_TSNUM.

– 14.3.13/G.798 ODUkP-h/ODUj-21_A

PT=0x21. The same PT value is used for this HAO capable function as for the regular, non-HAO capable function.

Additional control here is MI_AUTOpayloadtype.

Further additional control is on a per LO ODUj basis, which can be performed as part of LO ODU connection management:

MI_TxMSI[p]. MI_ExMSI[p], MI_ODUType_Rate[i], MI_AdminState[n], MI_APS_EN [n], MI_APS_LVL [n]

Further additional control here is for HAO of a LO ODUflex; i.e., MI_INCREASE, MI_DECREASE, MI_TSMAP, MI_TPID.

– [14.3.v/G.798 ODU2eP/FC1200_A] to be added

PT=0x08.

– [14.3.x/G.798 ODUkP/MT_A] see 11.2.1/G.8121 ODUkP/MT_A

PT=0x05. This PT value is the same as for ODUkP/ETH_A functions.

Additional control here is MI_SCCType.

Further additional control is on a per PW/LSP basis, which can be performed as part of LO ODU connection management:

MI_Label[1…M], MI_LSPType[1…M], MI_CoS[1…M], MI_PHB2TCMapping[1…M], MI_QoSEncodingMode[1…M], MI_TC2PHBMapping[1…M], MI_QoSDecodingMode[1…M], MI_LCK_Period[1…M], MI_LCK_CoS[1…M], MI_Admin_State, MI_AIS_Period[1…M], MI_AIS_CoS[1…M], MI_GAL_Enable[1…M]

– [14.3.z/G.798 ODUkP-h/MT_A] to be added to e.g., 11.2.3/G.8121 or 14.3.z/G.798

Not specified yet.

– [17.13/G.709] Mapping a 64b/66b PCS coded signal into OPUflex using BMP and 2-bit alignment of 66b code words

PT=0x30, 25GBASE-R mapping into OPUflex

PT=0x31, 200GBASE-R mapping into OPUflex

PT=0x32, 400GBASE-R mapping into OPUflex

PT=0x33, 50GBASE-R mapping into OPUflex

– *[17.11/G.709] OPUflexP/FlexE*

Mapping of FlexE Client signals into OPUflex using IMP
*FlexE Client signal bit rates are s × 5,156,250.000 kbit/s ± 100 ppm, with s = 2, 8, n*5 (n ≥ 1). Refer to [OIF FlexE IA].*

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