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DIGITAL SYSTEMS AND NETWORKS

Digital networks – Optical transport networks

Management aspects of optical transport network elements

Recommendation ITU-T G.874

ITU-T

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 the 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 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), APS, Application codes and performance management (PM) data collection.

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

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Table of Contents

Page

1	Scope.....	1
2	References.....	1
3	Definitions	3
3.1	Terms defined elsewhere	3
3.2	Terms defined in this Recommendation.....	4
4	Abbreviations and acronyms	4
5	Conventions	9
6	Optical transport network management functions.....	9
6.1	Optical transport network management architecture.....	9
6.2	Optical transport network equipment management function	14
6.3	Information flows over management points.....	15
7	Fault management.....	16
7.1	Fault management applications	16
7.2	Fault management functions.....	18
8	Configuration management	32
8.1	Hardware	32
8.2	Software.....	33
8.3	Protection switching	33
8.4	Trail termination.....	33
8.5	Adaptation	37
8.6	Connection.....	48
8.7	DEG thresholds	50
8.8	XXX_Reported.....	50
8.9	Alarm severity	50
8.10	Alarm reporting control.....	50
8.11	Performance management thresholds	50
8.12	Tandem connection monitoring activations	51
8.13	Date and time.....	51
8.14	Control function.....	52
8.15	Application identifier management	52
8.16	Media element management.....	53
9	Account management	54
10	Performance management	54
10.1	Performance management applications.....	54
10.2	Performance management functions	57
11	Security management.....	59

	Page
Appendix I – Management information for configuration management	60
Appendix II – Management information for performance management	62
Appendix III – Mapping between OPUk payload type and adaptation atomic function	63
Bibliography.....	69

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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. The management functions for fault management, configuration management, account management, performance management and security management are specified.

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 within an OTN network element (NE).

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

- The management view of NE functional elements should be uniform whether those elements form part of an inter-domain interface (IrDI) or part of an intra-domain interface. Those properties necessary to form such a uniform management view are to be included in this Recommendation.
- OTN layer network entities (OLNEs) refer to trail termination (TT), adaptation and connection functions as described in [ITU-T G.872] for the OTN digital layer.
- An NE may only contain optical layer network entities.
- An NE may contain both optical layer network entities (OLNEs) and client layer network entities (CLNEs).
- CLNEs are managed as part of their own logical domain [e.g., synchronous digital hierarchy (SDH) management network].
- CLNEs and OLNEs may or may not share a common message communications 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 (2015), <i>Optical interfaces for coarse wavelength division multiplexing applications</i> . |
| [ITU-T G.698.2] | Recommendation ITU-T G.698.2 (2009), <i>Amplified multichannel dense wavelength division multiplexing applications with single channel optical interfaces</i> . |
| [ITU-T G.709] | Recommendation ITU-T G.709/Y.1331 (2016), <i>Interfaces for the optical transport network</i> . |

- [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 (2012), *Characteristics of optical transport network hierarchy equipment functional blocks.*
- [ITU-T G.805] Recommendation ITU-T G.805 (2000), *Generic functional architecture of transport networks.*
- [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 (2017), *Architecture of optical transport networks.*
- [ITU-T G.873.1] Recommendation ITU-T G.873.1 (2014), *Optical transport network (OTN): Linear protection.*
- [ITU-T G.874.1] Recommendation ITU-T G.874.1 (2016), *Optical transport network: Protocol-neutral management information model for the network element view.*
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- [ITU-T G.7710] Recommendation ITU-T G.7710/Y.1701 (2012), *Common equipment management function requirements.*
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- [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.*
- [ITU-T X.733] Recommendation ITU-T X.733 (1992) | ISO/IEC 10164-4:1992, *Information technology – Open Systems Interconnection – Systems Management: Alarm reporting function.*

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 inter-domain interface (IrDI).

3.1.3.2 intra-domain interface (IaDI).

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.

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 management interface.

3.1.8.8 persistence interval.

3.1.8.9 qualified problem.

3.1.8.10timed interval.

3.1.8.11unit audible/visual indicator.

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]

3.1.10.1agent.

3.1.10.2managed object class.

3.1.10.3manager.

3.2 Terms defined in this Recommendation

None.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

1second	1 s pulse
AcPT	Accepted PT
AcSTAT	Accepted STAT
AcTI	Accepted TTI
AdminState	Administrative State
AIS	Alarm Indication Signal
ALM	Alarm reporting
AP	Access Point
APR	Automatic Power Reduction
APRCntrl	Automatic Power Reduction Control
ARC	Alarm Reporting Control
AST	Alarm Status function
ASY	Alarm Synchronization function
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
CLNE	Client Layer Network Entity
CM	Configuration Management
COMMS	general management Communications
COMMS OH	general management Communications Overhead

CP	Connection Point
CPL	Current Problem List function
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 defect
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
EMS	Element Management System
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
FOP	Failure of Protocol
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

GNE	Gateway Network Element
HEC	Header Error Control
HO	High Order
HoTime	Hold-off Time
IAE	Incoming Alignment Error
IaDI	Intra-Domain Interface
IrDI	Inter-Domain Interface
LAN	Local Area Network
LCK	Locked defect
LFD	Loss of Frame Delineation
LOA	Loss of Alignment
LOF	Loss of Frame
LOFLOM	Loss of Frame and (Loss of) Multiframe
LOG	Logging function
LOL	Loss of Lane alignment
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 Communications Function
MCN	Management Communication Network
MI	Management Information
MIB	Management Information Base
MO	Managed Object
MP	Management Point
MPI	Main Path Interface
MSIM	Multiplex Structure Identifier Mismatch
NALM	No Alarm reporting
NALM-CD	No Alarm reporting, Countdown
NALM-NR	No Alarm reporting, NotReady
NALM-QI	No Alarm reporting, Qualified Inhibit
NALM-TI	No Alarm reporting, Timed Inhibit

NE	Network Element
NEA	Network Element Alarm function
NEF	Network Element Function
OCh	Optical Channel
OCI	Open Connection Indication
ODU	Optical Data Unit
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
ODUj[i]	Optical Data Unit of level j or i (i is optional; $i < j$)
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
OLNE	OTN Layer Network Entity
O.MN	OTN Management Network
O.MS-O	Optical Multiplex Section – Overhead
O.MSN	OTN Management Subnetwork
O.NE	OTN Network Element
OOS	Overhead Signal
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
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
PPP	Point-to-Point Protocol
ProtType	Protection Type
PRBS	Pseudo-Random Bit Sequence

PRS	fault cause Persistency function
PT	Payload Type
REP	Reportable failure function
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 function
Sk	Sink
So	Source
SSF	Server Signal Fail
SSF-O	Server Signal Fail Overhead
SSF-P	Server Signal Fail Payload
STA	Station Alarm function
STAT	Status field
TAN	TMN Alarm event Notification function
TCM	Tandem Connection Monitoring
TCP	Termination Connection Point
TEP	TMN Event Pre-processing function
TI	Trace Identifier
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 function
VPI	Virtual Path Identifier

5 Conventions

In this Recommendation, O.MN stands for OTN management network, O.MSN for OTN management subnetwork, O.NE for OTN NE and FFS for further study.

An O.MN is a subset of a telecommunications management network (TMN) that is responsible for managing those parts of a network element (NE) that contain OTN layer network entities. An O.MN may be subdivided into a set of O.MSNs.

An O.MSN consists of a set of separate OTN embedded communication channels (ECCs) and associated intra-site data communication links that have been interconnected to form a data communication network (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, 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 functions

See clause 6 of [ITU-T G.7710] for the generic architecture for managing transport equipment. OTN-specific management architecture is described in clause 6.1.

6.1 Optical transport network management architecture

The transport layer networks of the OTN are described in [ITU-T G.872] 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.

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

The O.MN may be partitioned into O.MSNs. The inter-relationship between a management network, its subnetworks and a TMN as generically described in clause 6 of [ITU-T G.7710] is applicable to OTN.

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.

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

- 1) O.NEs must support management communications functions. The MCF of an O.NE initiates or terminates (in the sense of the lower protocol layers), forwards, or otherwise processes management messages over ECCs, or over other DCN interfaces. The OTN allows the ECC options of using the general management communication overhead (COMMS OH) or the general communication channels (GCCs).
 - All O.NEs are required to terminate the COMMS OH, see clause 6.1.4. In open systems interconnection (OSI) terms, this means that each NE must be able to perform the functions of an end system.

- All O.NEs are required to terminate the OTUk GCC0, see clause 6.1.4, to connect to O.NEs [e.g., open transport hierarchy (OTH) NTs] that are equipped with OTM-0 or OTM-nr interfaces only.
 - O.NEs may also be required to forward management messages between ports according to routing control information held in the O.NE. In OSI terms, this means that some O.NEs may be required to perform the functions of an intermediate system.
 - In addition to supporting interfaces for the COMMS OH and GCC, an O.NE may also be required to support other DCN interfaces.
- 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 a local area network (LAN).

Each O.MSN must have at least one O.NE/mediation device that is connected to an OS. This O.NE is termed a gateway network element (GNE). The GNE should be able to perform an intermediate system network layer forwarding function for COMMS OH messages destined for any end system in the O.MSN. Messages passing between the OS and any of the end systems in the subnetwork are routed through the GNE and, in general, other intermediate systems.

The use of GCCs for management communications is within the scope of this Recommendation, see clause 6.1.4.

6.1.4 O.MSN data communications network

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

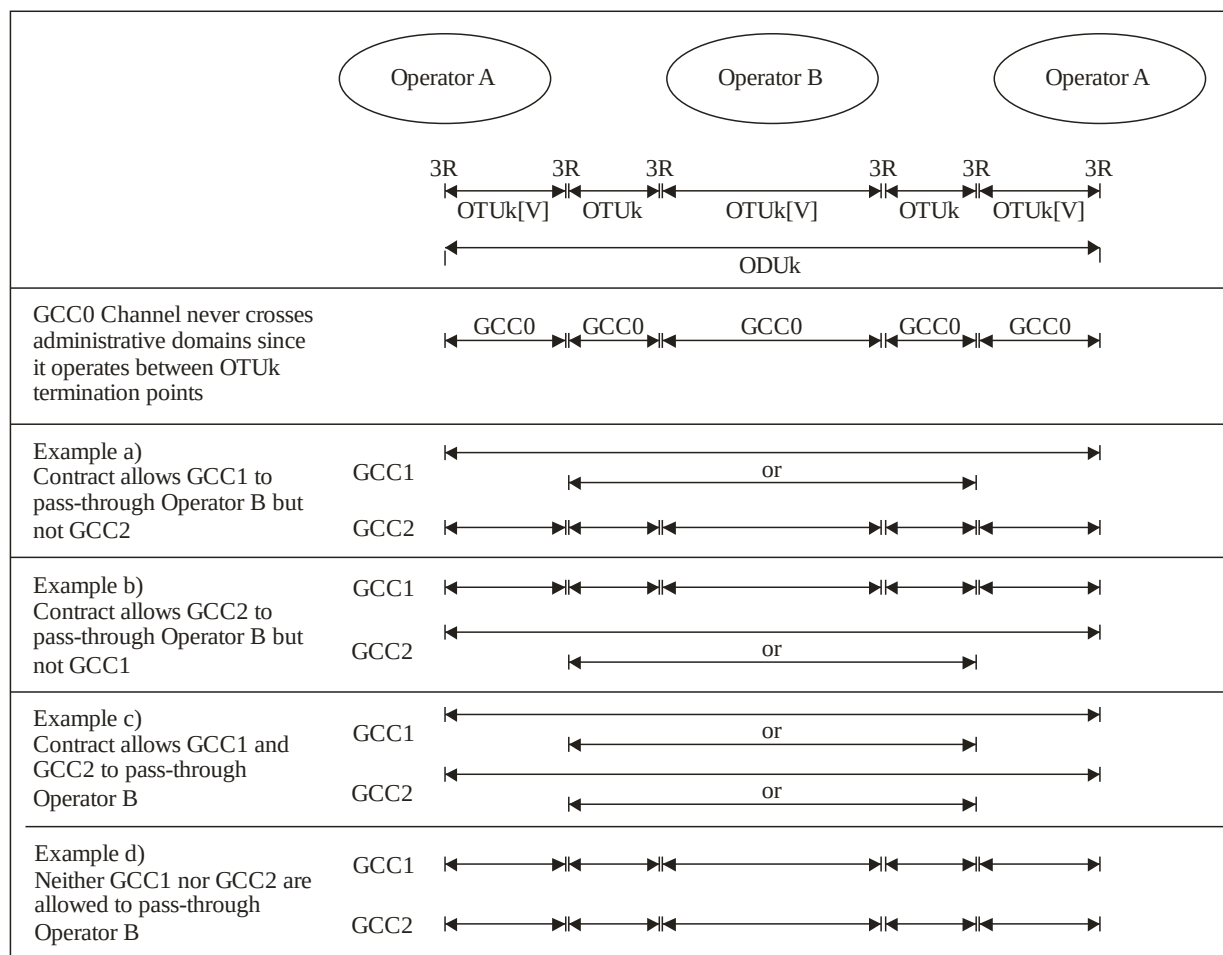
The main ECC for OTN is considered to be the COMMS OH in the OTM-n signal, see clause 15.1.7 of [ITU-T G.709]. The COMMS OH is carried in the optical transport module (OTM) overhead signal (OOS), which in turn is carried in the optical supervisory channel (OSC). This COMMS-based ECC is equivalent to the SDH STM-N MS-DCC. The use of a GCC as an ECC is typically used when one has to reach a remote CPE or a remote subnetwork, and on OTM-0 and OTM-nr type interfaces (OTUk GCC0).

6.1.4.1 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 ODUk 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 overhead, as well as GCC1 and GCC2 are subject to the service level agreement made between operator A and operator B.



G.874(13)_F6-1

Figure 6-1 – GCC contract scenarios

GCC0 is a channel between OTUk 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.

6.1.4.1.1 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 1312.405 kbit/s. For an OTU3, the GCC0 channel shall operate at 5271.864 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 $n \times 13.768$ Mbit/s. According to 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 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 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.

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 ODU2, the GCC2 channel shall operate at 326.723 kbit/s. For an ODU2, the GCC2 channel shall operate at 1 312.405 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.

Note that the above GCC0/1/2 rates are nominal rates with ± 20 ppm rate tolerance.

6.1.4.1.2 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 OTN data-link layer frame into the GCC is specified in [ITU-T G.7712].

6.1.4.1.3 Support of management communication network and signalling communication network separation

In some network deployment scenarios, it might be desirable to have separation of the MCN and signalling communication network (SCN), such as separately enabling/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. 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.

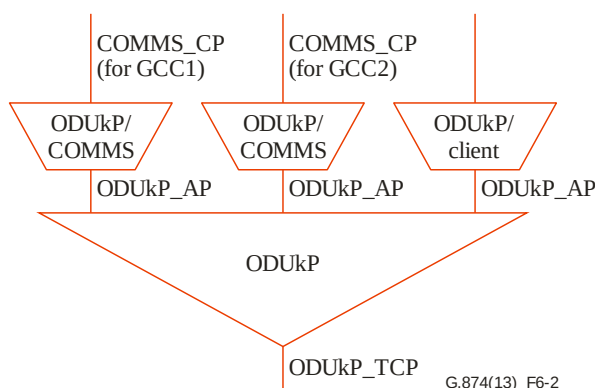


**Figure 6-2 – COMMS (GCC1 and GCC2) access at ODUkP access point (AP)
(Enhancement to Figure 14-70 of [ITU-T G.798])**

- GCC1 and GCC2 can be used simultaneously and separately via two cascaded independent instances of the ODUk/COMMS_AC atomic 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.

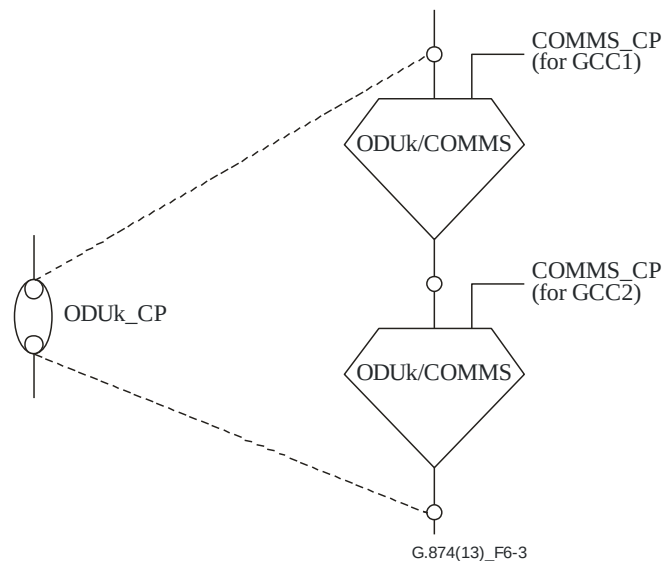


**Figure 6-3 – ODUk_CP expansion for COMMS access for GCC1 and GCC2
(Enhancement to Figure 14-75 of [ITU-T G.798])**

- 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 high-order (HO) ODUk connections between the two NEs (if possible) such that the GCC of one HO ODUk connection can be used as the maintenance communication channel (MCC) and the GCC of the other HO ODUk connection can be used as the signalling communication channel (SCC).
- If there is limitation in the ODUk layer network deployment, such that GCC1 and GCC2 cannot be used separately and simultaneously and it is also not possible to have two HO ODUk connections between the two NEs, mechanisms such as deep packet inspection would be needed if the MCC and the SCC are sharing that single GCC. This would, however, mean that the MCC/SCC messages need to be analysed beyond OSI layer 3.

6.1.4.2 General management communications overhead

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

6.1.4.2.1 COMMS OH physical characteristics

The COMMS OH is a logical element within the OTM 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 is outside the scope of [ITU-T G.709] and therefore not standardized.

6.1.4.2.2 COMMS OH data link layer protocol

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

6.1.5 Management of data communication network

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

6.1.6 Remote log-in

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

6.1.7 Relationship between technology domains

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

6.2 Optical transport network equipment management function

This clause provides an overview of the minimum functions that are required to support inter-vendor O.NE management including single-ended maintenance of O.NEs within an O.MSN or between communicating peer O.NEs across a network interface. Single-ended maintenance is the ability to access remotely located O.NEs to perform maintenance functions (see [ITU-T G.7710] for the performance management applications).

It should be noted that the management functions have been categorized according to the classifications given in [ITU-T X.700].

Protocol-neutral specifications of the MAFs, in terms of managed objects classes, attributes and message specification are provided in [ITU-T G.874.1].

The OTN equipment management function (EMF) (see Figure 6-4) provides the means through which the OTN NEF is managed by an internal or external manager. If an NE contains an internal manager, this manager will be part of the OTN EMF.

The OTN EMF interacts with the other atomic functions (refer to [ITU-T G.798]) by exchanging information across the management point (MP) reference points. See [ITU-T G.806] and [ITU-T G.798] for more information on atomic functions and on MPs. The OTN EMF contains a number of functions that provide a data reduction mechanism on the information received across the MP reference points. The outputs of these functions are available to the agent via the NE resources and MAFs that represent this information as managed objects. See Figure 6-4.

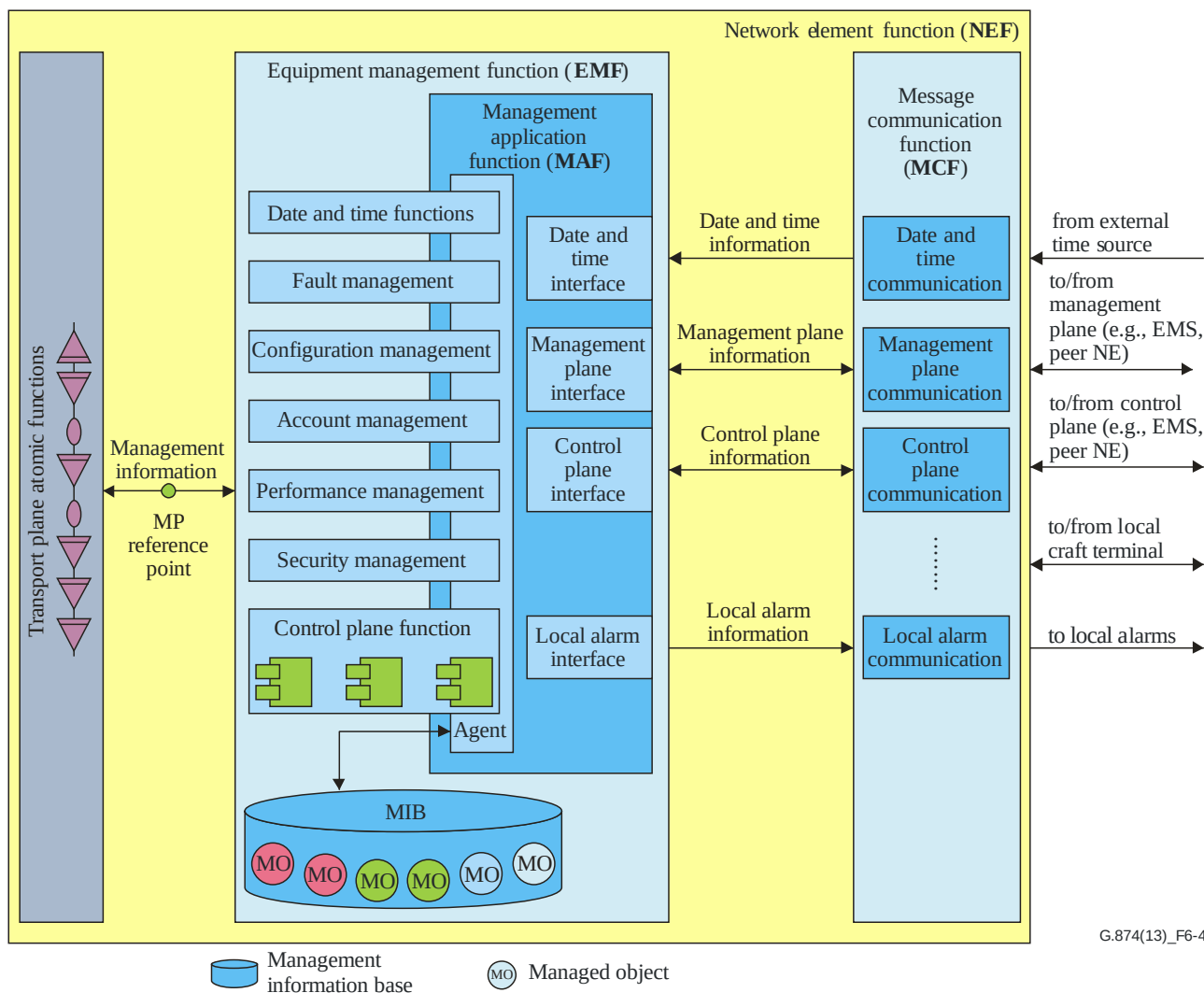


Figure 6-4 – Optical equipment management function

NE resources provide event processing and storage. The MAF processes the information provided to and by the NE resources. The agent converts this information to management messages and responds to management messages from the manager by performing the appropriate operations on the managed objects.

This information to and from the agent is passed to the MCF.

6.3 Information flows over management points

The information flows described in this clause are functional. The existence of these information flows in the equipment will depend on the functionality provided by the O.NE and the options selected.

The information flow over the MP reference points that arises from anomalies and defects detected in the atomic functions 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.

The information flow over the MP reference points that arises from provisioning and reporting data is described in specific detail for each atomic function in [ITU-T G.798]. The information listed under the input column refers to the provisioning data that is passed from the OTN EMF to the atomic functions. The information listed under the output column refers to the reports passed to the OTN EMF from the atomic functions.

7 Fault management

Fault management is a set of functions that enables the detection, isolation and correction of abnormal operation of the telecommunication network and its environment. It provides facilities for the performance of the maintenance phases from [ITU-T M.20]. The quality assurance measurements for fault management include component measurements for reliability, availability and survivability.

7.1 Fault management applications

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

7.1.1 Supervision

The supervision process describes the way in which the actual occurrence of a disturbance or fault is analysed for the purpose of providing an appropriate indication of performance or detected fault condition to maintenance personnel. The supervision philosophy is based on the concepts underlying the functional model of [ITU-T G.805] and [ITU-T G.872] and the alarm reporting function of [ITU-T X.733].

The five basic supervision categories are related to transmission, quality of service, processing, equipment and environment. These supervision processes are able to declare fault causes, which need further validation before the appropriate alarm is reported. See [ITU-T G.7710] for additional discussion of these categories.

The O.NE shall indicate to the OS when a TP is no longer able to supervise the signal (e.g., implementing equipment has a fault or loss of power).

7.1.1.1 Transmission supervision

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

7.1.1.2 Quality of service supervision

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

7.1.1.3 Processing supervision

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

7.1.1.4 Hardware supervision

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

7.1.1.5 Environment supervision

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

7.1.2 Fault cause validation

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

7.1.3 Alarm handling

7.1.3.1 Severity assignment

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