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Digital terminal equipments – Principal characteristics of
multiplexing equipment for the synchronous digital
hierarchy

Management aspects of the Synchronous Digital Hierarchy (SDH) transport network element

CAUTION !

PREPUBLISHED RECOMMENDATION

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ITU-T Recommendation G.784

Management aspects of the Synchronous Digital Hierarchy (SDH) transport network element

Summary

This Recommendation addresses management aspects of the Synchronous Digital Hierarchy (SDH) Network Element containing transport functions of one or more of the layer networks of the SDH transport network. The management of the SDH 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.

The 2008 revision of this Recommendation has updated the management information to align with Recommendations [ITU-T G.783], [ITU-T G.781] and [ITU-T G.7712], reorganized the sections to align with the structure of Recommendation [ITU-T G.7710], and replaced the generic text with pointers to [ITU-T G.7710].

Keywords

Alarm reporting control, configuration management function, degraded performance, equipment management function, fault management functions, management application function, message communications function, performance management, performance monitoring functions, persistency, severity, thresholding.

1 Scope

This Recommendation addresses management aspects of the Synchronous Digital Hierarchy (SDH) Network Element containing transport functions of one or more of the layer networks of the SDH transport network. The management of the SDH 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, account management, performance management, and security management are to be specified.

This Recommendation describes the management network organizational model for communication between an element management layer (EML) Operations System and the SDH equipment management function within an SDH network element.

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

- SDH layer network entities (SLNE) refer to trail termination, adaptation and connection functions as described in [ITU-T G.803],
- a network element may only contain SDH layer network entities,
- a network element may contain both SDH layer network entities (SLNE) and client layer network entities (CLNE),
- client layer entities are managed as part of their own logical domain (e.g. PDH management network),
- CLNE and SLNE may or may not share common message communications function (MCF) and management application function (MAF) depending on application,

- CLNE and OLNE may or may not share same agent.

The SDH management subnetwork (SMS) architecture, SDH embedded control channel (ECC) functions, and SDH ECC protocols are specified. Detailed message sets are for further study.

The management of SDH equipment should be seen as a subset of the telecommunications management network (TMN) described in Recommendation [ITU-T M.3000], and reference is made to Recommendations [ITU-T Q.811] and [ITU-T Q.812] for the specification of protocol suites to be used at external (Q) management interfaces.

This Recommendation specifies for fault management, performance monitoring, and configuration management a library of basic equipment management function (EMF) building blocks and a set of rules by which they are combined in order to describe a digital transmission equipment's EMF functionality. The library defined in this Recommendation forms part of the set of libraries defined furthermore in Recommendation [ITU-T G.783].

Not every function defined in this Recommendation is required for every application. Different subsets of functions may be assembled in different ways to provide a variety of different capabilities. Network operators and equipment suppliers may choose which functions must be implemented for each application.

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.7710/Y.1701] ITU-T Recommendation G.7710/Y.1701 (2007), *Common equipment management function requirements*.
- [ITU-T G.707/Y.1322] ITU-T Recommendation G.707/Y.1322 (2007), *Network node interface for the synchronous digital hierarchy (SDH)*.
- [ITU-T G.774] ITU-T Recommendation G.774 (1992), *Synchronous Digital Hierarchy (SDH) management information model for the network element view*.
- [ITU-T G.774.1] ITU-T Recommendation G.774.1 (2001), *Synchronous digital hierarchy (SDH) - Bidirectional performance monitoring for the network element view*.
- [ITU-T G.781] ITU-T Recommendation G.781 (1999), *Synchronization layer functions*.
- [ITU-T G.783] ITU-T Recommendation G.783 (2006), *Characteristics of Synchronous Digital Hierarchy (SDH) equipment functional blocks*.
- [ITU-T G.803] ITU-T Recommendation G.803 (2000), *Architecture of transport networks based on the synchronous digital hierarchy (SDH)*.
- [ITU-T G.805] ITU-T Recommendation G.805 (2000), *Generic functional architecture of transport networks*.
- [ITU-T G.806] ITU-T Recommendation G.806 (2006), *Characteristics of transport equipment – Description methodology and generic functionality*.

- [ITU-T G.826] ITU-T Recommendation G.826 (2002), *End-to-end error performance parameters and objectives for international, constant bit-rate digital paths and connections.*
- [ITU-T G.827] ITU-T Recommendation G.827 (2003), *Availability performance parameters and objectives for end-to-end international constant bit-rate digital paths.*
- [ITU-T G.7712/Y.1703] ITU-T Recommendation G.7712/Y.1703 (2003), *Architecture and specification of data communication network.*
- [ITU-T G.7714/Y.1705] ITU-T Recommendation G.7714/Y.1705 (2005), *Generalized automatic discovery for Transport Entities.*
- [ITU-T G.7714.1/Y.1705.1] ITU-T Recommendation G.7714.1/Y.1705.1 (2003), *Protocol for automatic discovery in SDH and OTN networks.*
- [ITU-T G.7714.1 Am1] ITU-T Recommendation G.7714.1 Amendment 1 (2006), *Usage of the Different Discovery Mechanisms.*
- [ITU-T M.20] ITU-T Recommendation M.20 (1992), *Maintenance philosophy for telecommunication networks.*
- [ITU-T M.2100] ITU-T Recommendation M.2100 (2003), *Performance limits for bringing-into-service and maintenance of international multi-operator PDH paths and connections.*
- [ITU-T M.2101] ITU-T Recommendation M.2101 (2003), *Performance limits for bringing-into-service and maintenance of international multi-operator SDH paths and multiplex sections.*
- [ITU-T M.2120] ITU-T Recommendation M.2120 (2002), *International multi-operator paths, sections and transmission systems fault detection and localization procedures.*
- [ITU-T M.2140] ITU-T Recommendation M.2140 (2000), *Transport network event correlation.*
- [ITU-T M.3000] ITU-T Recommendation M.3000 (2000), *Overview of TMN Recommendations.*
- [ITU-T M.31010] ITU-T Recommendation M.3010 (2000), *Principles for a telecommunications management network.*
- [ITU-T M.3013] ITU-T Recommendation M.3013 (2000), *Considerations for a telecommunications management network.*
- [ITU-T M.3100] ITU-T Recommendation M.3100 (2005), *Generic network information model.*
- [ITU-T M.3300] ITU-T Recommendation M.3300 (1998), *TMN F interface requirements.*
- [ITU-T M.3400] ITU-T Recommendation M.3400 (2000), *TMN management functions.*
- [ITU-T Q.811] ITU-T Recommendation Q.811 (2004), *Lower layer protocol profiles for the Q and X interfaces.*
- [ITU-T Q.812] ITU-T Recommendation Q.812 (2004), *Upper layer protocol profiles for the Q and X interfaces.*

[ITU-T X.700]	ITU-T Recommendation X.700 (1992), <i>Management framework for Open Systems Interconnection (OSI) For CCITT Applications</i> .
[ITU-T X.701]	ITU-T Recommendation X.701 (1997), <i>Information technology – Open Systems Interconnection – Systems management overview</i> .
[ITU-T X.735]	ITU-T Recommendation X.735 (1992), <i>Information technology – Open Systems Interconnection – Systems management: Log control function</i> .
[ITU-T X.744]	ITU-T Recommendation X.744 (1996), <i>Information technology – Open Systems Interconnection – Systems management: Software Management function</i> .

3 Definitions

3.1 This Recommendation defines or specializes the following terms:

3.1.1 data communication channel (DCC): Within an STM-N signal there are two DCC channels, comprising bytes D1-D3, giving a 192 kbit/s channel, and bytes D4-D12, giving a 576 kbit/s channel. D1-D3 (DCC_R) are accessible by all SDH NEs whereas D4-D12 (DCC_M), not being part of the regenerator section overhead, are not accessible at regenerators. It is recommended to have both DCC_M and DCC_R available in backbone STM-16 (and higher order) network sections. DCC_M is used to forward data over the multiplex sections (using the OSI-routing protocols), and DCC_R is used to forward data to the regenerators within the destination MS span. DCC_M can be regarded as the backbone, while DCC_R and LAN are used to interconnect this backbone to equipment that cannot be accessed through DCC_M, e.g. regenerators and non-SDH equipment.

DCC_M and DCC_R can be used to carry two independent, possibly proprietary management applications. An NE can choose to throughconnect DCC_M on the physical level, or to terminate the DCC_M and route the PDUs, while using the DCC_R for interconnection within a subnetwork.

3.1.2 SDH management network (SMN): An SDH management network is a subset of a TMN that is responsible for managing those parts of a network element that contain SDH layer network entities. An SMN may be subdivided into a set of SDH management subnetworks.

3.1.3 SDH management subnetwork (SMS): An SDH management subnetwork (SMS) consists of a set of separate SDH ECCs and associated intra-site data communication links which have been interconnected to form a data communications network (DCN) within any given SDH transport topology. An SMS represents an SDH specific local communications network (LCN) portion of a network operator's overall data communications network or TMN.

3.1.4 SDH network element (SDH NE): That part of a network element that contains entities from one or more SDH layer networks. An SDH NE may therefore be a standalone physical entity or a subset of a network element. It supports at least network element functions and may also support an operations system function (OSF) and or a mediation function (MF). It contains managed objects, a message communications function (MCF) and a management application function (MAF). The functions of an SDH NE may be contained within an NE that also supports other layer networks. These layer network entities are considered to be managed separately from SDH entities. As such they are not part of the SMS or SMN.

3.1.5 manager: Part of the MAF which is capable of issuing network management operations (i.e. retrieve alarm records, set thresholds) and receiving events (i.e. alarms, performance). SDH NEs may or may not include a manager while SDH OS/MDs will include at least one manager.

3.1.6 agent: Part of the MAF which is capable of responding to network management operations issued by a manager and may perform operations on managed objects, issuing events on behalf of managed objects. The managed objects can reside within the entity or in another open system. Managed objects from other open systems are controlled by a distant agent via a local manager. All SDH NEs will support at least an agent. Some SDH NEs will provide managers and agents (being managed). Some NEs (e.g. regenerators) will only support an agent.

3.1.7 managed object (MO): The management view of a resource within the telecommunication environment that may be managed via the agent. Examples of SDH managed objects are: equipment, receive port, transmit port, power supply, plug-in card, virtual container, multiplex section and regenerator section.

3.1.8 operations system function or mediation function (OSF/MF): A telecommunications management network (TMN) entity that processes management information to monitor and control the SDH network. In the SDH sub-portion of the TMN, no distinction is made between the operations system function and the mediation function; this entity being a MAF containing at least a manager.

3.1.9 operations system or mediation device (OS/MD): A stand-alone physical entity that supports OSF/MFs but does not support NEFs. It contains a message communication function (MCF) and a MAF.

3.1.10 trail segment: A segment for which one end is a trail termination.

3.2 The following terms are defined in [ITU-T G.7710/Y.1701]:

- Local craft terminal
- Management Application Function (MAF)

3.3 The following terms are defined in [ITU-T G.7712/Y.1703]:

- Data Communications Network (DCN)
- Embedded Control Channel (ECC)

3.4 The following terms are defined in [ITU-T G.806]:

- Atomic Function (AF)
- Management Point (MP)

3.5 The following terms are defined in [ITU-T G.707/Y.1322]:

- Data Communication Channel (DCC)

3.6 The following terms are defined in [ITU-T M.3010]:

- Network Element (NE)
- Network Element Function (NEF)
- Operations System (OS)
- Q-Interface
- Workstation Function (WF)

3.7 The following term is defined in [ITU-T M.3013]:

- Message Communications Function (MCF)

3.8 The following terms are defined in [ITU-T M.3100]:

- Alarm reporting;

- Alarm reporting control;
- Managed entity;
- Management interface;
- Persistence interval;
- Qualified problem;
- Reset threshold report;
- Threshold report;
- Timed interval;

3.8 The following term is defined in [ITU-T M.3300]:

- F-Interface.

3.9 The following term is defined in [ITU-T X.700]:

- Managed Object (MO)

3.10 The following terms are defined in [ITU-T X.701]:

- Agent
- Manager
- Managed Object Class (MOC)

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations:

A	Agent
ACSE	Association control service element
AcSL	Accepted Signal Label
AcTI	Accepted Trace Identifier
AF	Application Function
AF	Atomic Function
AIS	Alarm Indication Signal
AITs	Acknowledged information transfer service
ALM	ALarM reporting
AP	Access Point
APDU	Application protocol data unit
API	Access Point Identifier
APS	Automatic Protection Switching
ARC	Alarm Report Control
ASE	Application service element
ASN.1	Abstract Syntax Notation One
CC	Connect confirm

CLNE	Client Layer Network Entity
CLNP	Connectionless network layer protocol
CLNS	Connectionless network layer service
CLR	Clear
CMIP	Common management information protocol
CMISE	Common management information service element
CMSN	Client Management Subnetwork
CONP	Connection oriented network-layer protocol
CP	Connection Point
CR	Connection request
CSES	Consecutive severely errored seconds
CV	Code violation
DCC	Data communication channel
DCN	Data communications network
DEG	Degraded signal
DS	Defect Second
EB	Errored Block
EBC	Errored Block Count
ECC	Embedded control channel
ES	Errored second
ESA	Errored Seconds Type A
ESB	Errored Seconds Type B
EXC	Excessive errors
EXER	Exercise
ExTI	Expected Trace Identifier
FBBE	Far-end Background Block Error
FC	Failure Counts
FCAPS	Fault Management, Configuration Management, Account Management, Performance Management and Security Management
FDS	Far-end Defect Second
FEBC	Far-end Errored Block Count
FEBE	Far end block error
FES	Far-end Errored Second
FFS	For Further Study
FLS	Frame loss second

FOP	Failure of Protocol
FSES	Far-end Severely Errored Second
FPME	Far-end Performance Monitoring Event
FSw	Forced Switch
FU	Functional unit
GNE	Gateway network element
HO	Hold Off
IFU	Interworking functional unit
IP	Interworking protocol
IS	Intermediate system
ISO	International Organization for Standardization
ITU-T	International Telecommunication Union – Telecommunication Standardization Sector
LAD	Layer Adjacency Discovery
LAN	Local Area Network
LCN	Local communications network
LCT	Local Craft Terminal
LO	Lockout of protection
LOF	Loss of Frame
LOM	Loss of Multiframe
LOP	Loss of Pointer
LOS	Loss of Signal
LOW	Lockout of Working
LTC	Loss of Tandem Connection
M	Manager
MAF	Management application function
MAINTREG	Maintenance Registers
MCF	Message communications function
MD	Mediation device
MF	Mediation function
MI	Management Information
MIB	Management Information Base
MO	Managed object
MOC	Managed object class
MP	Management Point

MSOH	Multiplex Section OverHead
MSw	Manual Switch
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
NBBE	Near-end Background Block Error
NDS	Near-end Defect Second
NE	Network element
NEBC	Near-end Errored Block Count
NEF	Network element function
NEL	Network Element Layer
NES	Near-end Errored Second
NLR	Network layer relay
NPDU	Network protocol data unit
NPME	Near-end Performance Monitoring Event
NSAP	Network service access point
NSES	Near-end Severely Errored Second
OAM&P	Operations, administration, maintenance and provisioning
ODI	Outgoing Defect Indication
OEI	Outgoing Error Indication
OH	OverHead
OS	Operations system
OSF	Operations system function
OSF	Outgoing Signal Fail
OSI	Open systems interconnection
P	Protection
PDU	Protocol data unit
PERFREG	Performance Registers
PJC	Pointer Justification Count
PJE	Pointer justification event
PLM	Payload Mismatch
PMC	Performance Monitoring Clock
PPDU	Presentation protocol data unit

PSN	Packet switched network
QoS	Quality of service
RDI	Remote Defect Indication
REI	Remote Error Indication
ROSE	Remote operations service element
RSOH	Regenerator Section OverHead
RTC	Real Time Clock
RTR	Reset Threshold Report
SAPI	Service access point identifier
SD	Signal Degrade
SDH	Synchronous digital hierarchy
SEMF	Synchronous Equipment Management Function
SF	Signal Fail
SMN	SDH management network
SMS	SDH management subnetwork
SNDCEF	Subnetwork dependent convergence function
SPDU	Session protocol data unit
SSD	Server Signal Degrade
SSF	Server Signal Fail
STM	Synchronous transport module
SVC	Switched virtual circuit
TCP	Termination Connection Point
TEI	Terminal end-point identifier
TI	Trace Identifier
TIM	Trace Identifier Mismatch
TMN	Telecommunications management network
TP	Termination Point
TPDU	Transport protocol data unit
TR	Threshold Report
TSAP	Transport service access point
TSD	Trail Signal Degrade
TSF	Trail Signal Fail
TSN	Time Slot Number
TTI	Trail Trace Identifier
TTP	Trail Termination Point

TxTI	Transmitted Trace Identifier
UAS	Unavailable second
UAT	Unavailable time
UI	Unnumbered information
UITS	Unacknowledged information transfer service
UTC	Coordinated Universal Time
W	Working
WAN	Wide Area Network
WS	WorkStation
WTR	Wait to Restore

5 Conventions

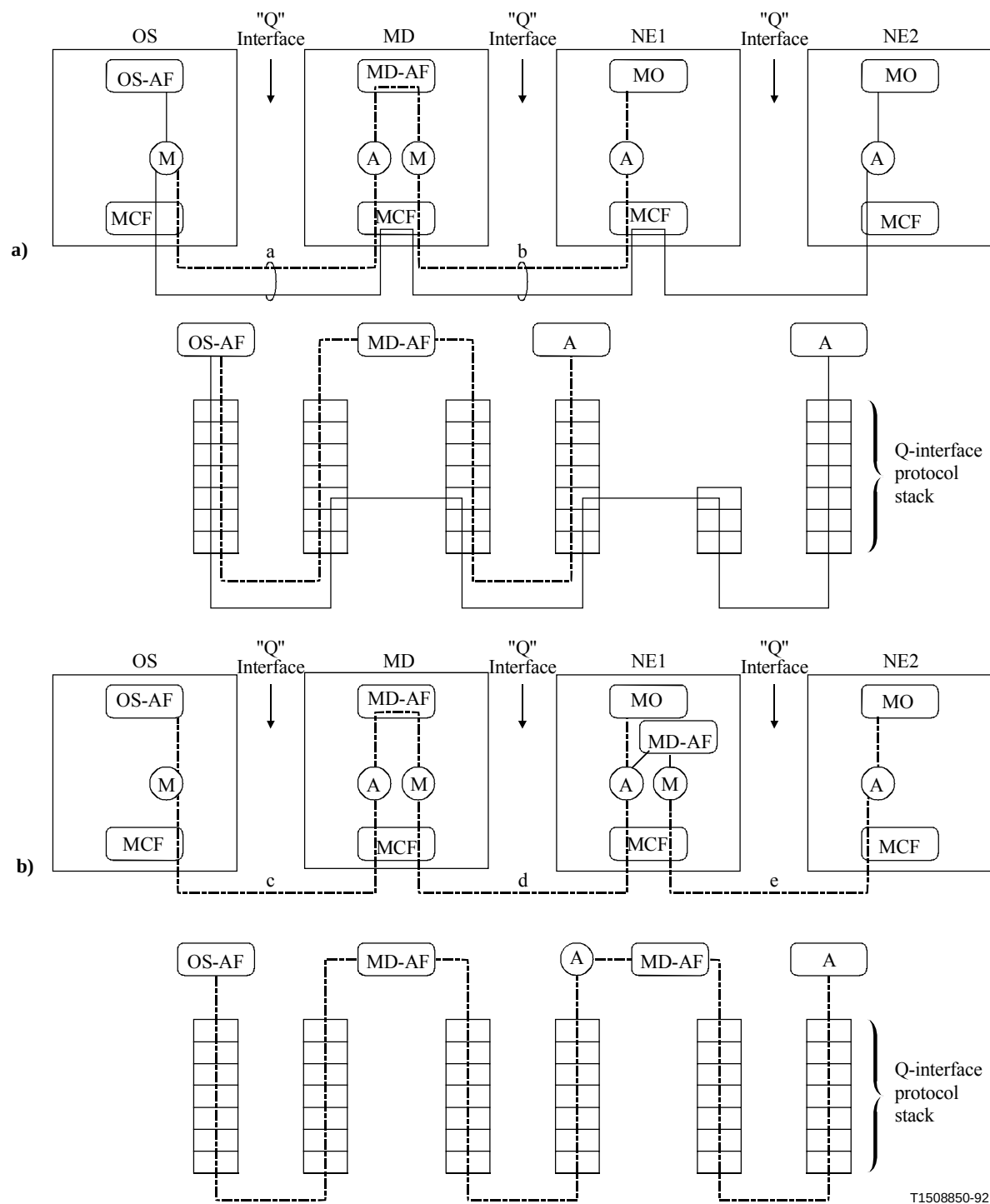
In this Recommendation, S.MN stands for SDH Management Network, S.MSN for SDH Management Subnetwork, and S.NE for SDH NE.

6 SDH management

6.1 SDH network management architecture

The transport layer networks of the SDH transport network are described in [ITU-T G.803] and [ITU-T G.707]. The management of the SDH layer networks is separable from that of their client layer networks so that the same means of management can be used regardless of the client.

See [ITU-T G.7710/Y.1701] section 6 for the generic management architecture.



OS Operations system
MD Mediation device
NE Network element
OS-AF OS-application function
MD-AF MD-application function
MCF Message communications function
A Agent
M Manager
MO Managed object

Figure 6-1/G.784 – SDH management examples