International Telecommunication Union

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

G.9962

Amendment 1

(04/2016)

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

Access networks – In premises networks

Unified high-speed wire-line based home networking transceivers – Management specification

Amendment 1

Recommendation ITU-T G.9962 (2014) – Amendment 1

International Telecommunication Union

ITU-T G-SERIES RECOMMENDATIONS

TRANSMISSION SYSTEMS AND MEDIA, DIGITAL SYSTEMS AND NETWORKS

INTERNATIONAL TELEPHONE CONNECTIONS AND CIRCUITS	G.100–G.199
GENERAL CHARACTERISTICS COMMON TO ALL ANALOGUE CARRIER-TRANSMISSION SYSTEMS	G.200–G.299
INDIVIDUAL CHARACTERISTICS OF INTERNATIONAL CARRIER TELEPHONE SYSTEMS ON METALLIC LINES	G.300–G.399
GENERAL CHARACTERISTICS OF INTERNATIONAL CARRIER TELEPHONE SYSTEMS ON RADIO-RELAY OR SATELLITE LINKS AND INTERCONNECTION WITH METALLIC LINES	G.400–G.449
COORDINATION OF RADIOTELEPHONY AND LINE TELEPHONY	G.450–G.499
TRANSMISSION MEDIA AND OPTICAL SYSTEMS CHARACTERISTICS	G.600–G.699
DIGITAL TERMINAL EQUIPMENTS	G.700–G.799
DIGITAL NETWORKS	G.800–G.899
DIGITAL SECTIONS AND DIGITAL LINE SYSTEM	G.900–G.999
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
Metallic access networks	G.9700–G.9799
Optical line systems for local and access networks	G.9800–G.9899
In premises networks	**G.9900–G.9999**

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

Recommendation ITU-T G.9962

Unified high-speed wire-line based home networking transceivers – Management specification

Amendment 1

Summary

Recommendation ITU-T G.9962 specifies the physical and data link layer management for the ITU-T G.996x-series home networking transceiver specifications. It defines common management parameters and protocols for all ITU-T G.996x-series Recommendations for the purpose of device configuration, status and performance management, fault monitoring and diagnostics. It also provides management functionalities to coordinate multiple domains.

Amendment 1 includes support for LCMP communication through the L1 and L6 interfaces.

History

Edition	Recommendation	Approval	Study Group	Unique ID*
1.0	ITU-T G.9962	2013-07-12	15	11.1002/1000/11901
1.1	ITU-T G.9962 (2013) Amd.1	2013-08-29	15	11.1002/1000/12005
2.0	ITU-T G.9962	2014-10-14	15	11.1002/1000/12084
2.1	ITU-T G.9962 (2014) Amd. 1	2016-04-13	15	11.1002/1000/12821

* To access the Recommendation, type the URL http://handle.itu.int/ in the address field of your web browser, followed by the Recommendation's unique ID. For example, http://handle.itu.int/11.1002/1000/11830-en.

FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications, information and communication technologies (ICTs). The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of ITU. ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

Compliance with this Recommendation is voluntary. However, the Recommendation may contain certain mandatory provisions (to ensure, e.g., interoperability or applicability) and compliance with the Recommendation is achieved when all of these mandatory provisions are met. The words "shall" or some other obligatory language such as "must" and the negative equivalents are used to express requirements. The use of such words does not suggest that compliance with the Recommendation is required of any party.

INTELLECTUAL PROPERTY RIGHTS

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As of the date of approval of this Recommendation, ITU had 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

Recommendation ITU-T G.9962

Unified high-speed wire-line based home networking transceivers – management specification

Amendment 1

Editorial note: This is a complete-text publication. Modifications introduced by this amendment are shown in revision marks relative to Recommendation ITU-T G.9962 (2014).

1 Scope

This Recommendation specifies the physical and data link layer management for the ITU-T G.996x-series home networking transceiver specifications. It defines the management architecture, protocols and common management parameters, for all ITU-T G.996x-series Recommendations. More specifically, this Recommendation includes the following:

– Architecture and reference model for management layer;

– Management protocols defined in [ITU-T G.9980], [BBF TR-069], necessary for device configuration, status and performance management, fault monitoring, and diagnostics and security;

– Management parameters defined in [BBF TR-181 I2A8] for transparent integration with remote management functionality;

– Global master (GM) functionality that facilitates coordination of multiple ITU-T G.996x domains.

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.9960] Recommendation ITU-T G.9960 (2011), *Unified high-speed wire-line based home networking transceivers – System architecture and physical layer specification*.

[ITU-T G.9961] Recommendation ITU-T G.9961 (2014), *Unified high-speed wire-line based home networking transceivers – Data link layer specification*.

[ITU-T G.9963] Recommendation ITU-T G.9963 (2011), *Unified high-speed wire-line based home networking transceivers – Multiple input/multiple output specification*.

[ITU-T G.9964] Recommendation ITU-T G.9964 (2011), *Unified high-speed wire-line based home networking transceivers – Power spectral density specification*.

[ITU-T G.9980] Recommendation ITU-T G.9980 (2012), *Remote management of customer premises equipment over broadband networks – Customer premises equipment WAN Management Protocol*.

[BBF TR-069] Broadband Forum TR-069 (2013), *CPE WAN Management Protocol*.

[BBF TR-181 I2A8] Broadband Forum TR-181 Issue 2, Amendment 8 (2014), *Device data model for TR-069*[1].

3 Definitions

3.1 Terms defined elsewhere

None.

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 client: An application entity distinguished in the network by its unique address (e.g., MAC address).

3.2.2 domain: A part of an ITU-T G.996x home network comprising the domain master and all those nodes that are registered with the same domain master. In the context of this Recommendation, use of the term "domain" without a qualifier means "ITU-T G.996x domain", and use of the term "alien domain" means "non-ITU-T G.996x domain". Additional qualifiers (e.g., "power-line") may be added to either "domain" or "alien domain".

3.2.3 domain master (DM): A node that manages (coordinates) all other nodes of the same domain (i.e., assigns bandwidth resources and manages user priorities). A node with domain master capabilities has all the capabilities of an endpoint node and may act as a relay node.

3.2.4 endpoint node: This term is used in this Recommendation according to the context to differentiate between the domain master node functionalities and non-domain master node functionalities.

3.2.5 global master (GM): A function that provides coordination between different domains (such as communication resources, priority setting, policies of domain masters and crosstalk mitigation). A global master may also convey management functions initiated by the remote management system (e.g., the Broadband Forum CPE WAN management protocol) to support broadband access.

3.2.6 home network: Two or more nodes that can communicate with each other either directly or through a relay node at the physical layer, or through an inter-domain bridge above the physical layer. A home network consists of one or more domains. In the context of this Recommendation, use of the term "home network" means "ITU-T G.9960 home network". Use of the term "alien home network" means "non-ITU-T G.9960 home network". Use of the term "network" without a qualifier means any combination of "ITU-T G.9960 home network", "non-ITU-T G.9960 home network" and "access network". Use of the term "alien network" means any combination of "non-ITU-T G.9960 home network" and "access network".

3.2.7 logical (functional) interface: An interface in which the semantic, syntactic and symbolic attributes of information flows are defined. Logical interfaces do not define the physical properties of signals used to represent the information. It is defined by a set of primitives.

3.2.8 medium: A wire-line facility, of a single wire class, allowing physical connection between nodes. Nodes connected to the same medium may communicate on the physical layer, and may interfere with each other unless they use orthogonal signals (e.g., different frequency bands, different time periods).

3.2.9 node: Any network device that contains an ITU-T G.9960 transceiver. In the context of this Recommendation, use of the term "node" without a qualifier means "ITU-T G.9960 node", and use

[1] See also http://www.broadband-forum.org/cwmp/tr-181-2-8-0.html for the root object definitions.

of the term "alien node" means "non-ITU-T G.9960 node". Additional qualifiers (e.g., "relay") may be added to either "node" or "alien node".

3.2.10 reference point: A location in a signal flow, either logical or physical, that provides a common point for observation and/or measurement of the signal flow.

3.2.11 registration: The process used by a node to join the domain.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

AE Application Entity

DLL Data Link Layer

DM Domain Master

DME DLL Management Entity

DMME Domain Master Management Entity

GM Global Master

GME Global Master Entity

LCMP Layer 2 Configuration and Management Protocol

LLC Logical Link Control

LSB Least Significant Bit

MCS Management, Control and Security

MSB Most Significant Bit

NME Node Management Entity

NMS Network Management System

PHY Physical

PME PHY Management Entity

SC Security Controller

SCE Security Controller Entity

5 Conventions

None.

6 Architecture and reference model

6.1 Architecture

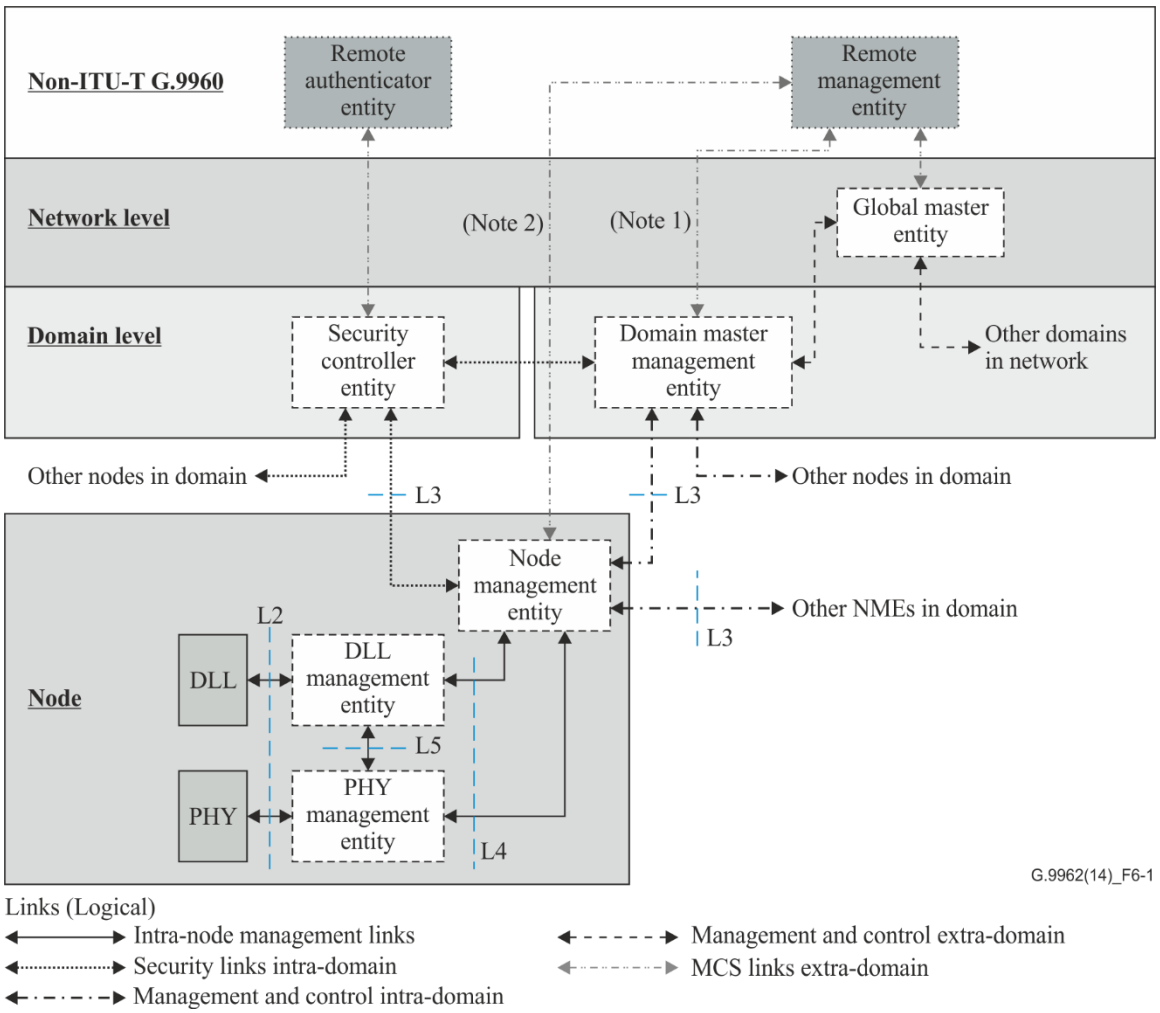
A model of the ITU-T G.9960 management, control, and security (MCS) architecture is depicted in Figure 6-1. The model consists of various entities located either within nodes, within a domain, or external to the domain. MCS entities provide management, control, and security of the layer they reside in as well as services and interfaces to enable MCS communications.

The structure of MCS begins with the layers of the node; the physical (PHY) layer and the data link layer (DLL). Each of these has a specific MCS entity. Above these in the MCS hierarchy, but still within Layer 2, is the node management entity (NME), which is responsible for managing the node's overall functions. Outside of the node are two entities that reside in the same domain as the node.

These are the security controller entity (SCE) and the domain master management entity (DMME). These manage and control their specific areas of responsibility (e.g., security for the SCE) within the domain. These two entities are still within Layer 2 as they are solely functioning to facilitate Layer 2 activities. These two entities are considered to operate at the domain level, unlike the node located ones that operate at the node or device level. The next entity is the global master entity (GME). This entity is defined as external to the domain, performing management and control functions for all domains within a specific home network. Global master (GM) functions are logical and able to be distributed among its managed domain masters (DMs). As GM functions concern actions that span multiple domains within a common network, it is referenced as operating at the network level for logical representation of its place in the MCS hierarchy. This is an arbitrary assignment given the logical nature of the GM. Entities that perform functions above the security controller (SC) and the GM or, in its absence the DM, are considered to be non-ITU-T G.9960 entities and out of scope. They are described in summary here as they may exist and effect the operation of the entities lower than them in the hierarchy.

The SC and DM are depicted as separate entities as they might or might not be located within the same device and might or might not be associated with the same node.

NOTE – the SC itself may be a proxy function versus a standalone entity, as it may be only a local presence of a remote authenticating system/entity that is out of scope of [ITU-T G.9960]. The internal operation and structure of the SC is as well out of scope, only its operations facing into the domain are within scope of [ITU-T G.9960], such operations as represented by its messaging and functions as described in clauses 8 and 9 of [ITU-T G.9961].



NOTE 1 – In the absence of a GME or when the GM functions are distributed, the DMME may communicate directly with the remote management entity.
NOTE 2 – The remote management entity may communicate with select nodes using specific read/write functions.

Figure 6-1 – Architecture of management, control and security

At the device level within the same domain, management and control messages are exchanged between node NMEs and between node NMEs and Application Entities (AEs).

An AE may exchange management and control messages with the NME in its device or with another node's NME in the same domain (L1 interface) using the LCMP protocol (see clause 8.22 of [ITU-T G.9961]). Nodes ~~may~~ exchange management and control messages between NMEs to facilitate communications between nodes (L3 interface). These interactions are illustrated in Figure 6-2 and discussed at length in clause 7 of [ITU-T G.9960] and clause 8 of [ITU-T G.9961].

Specific AE to AE communications are outside of scope of [ITU-T G.9960].

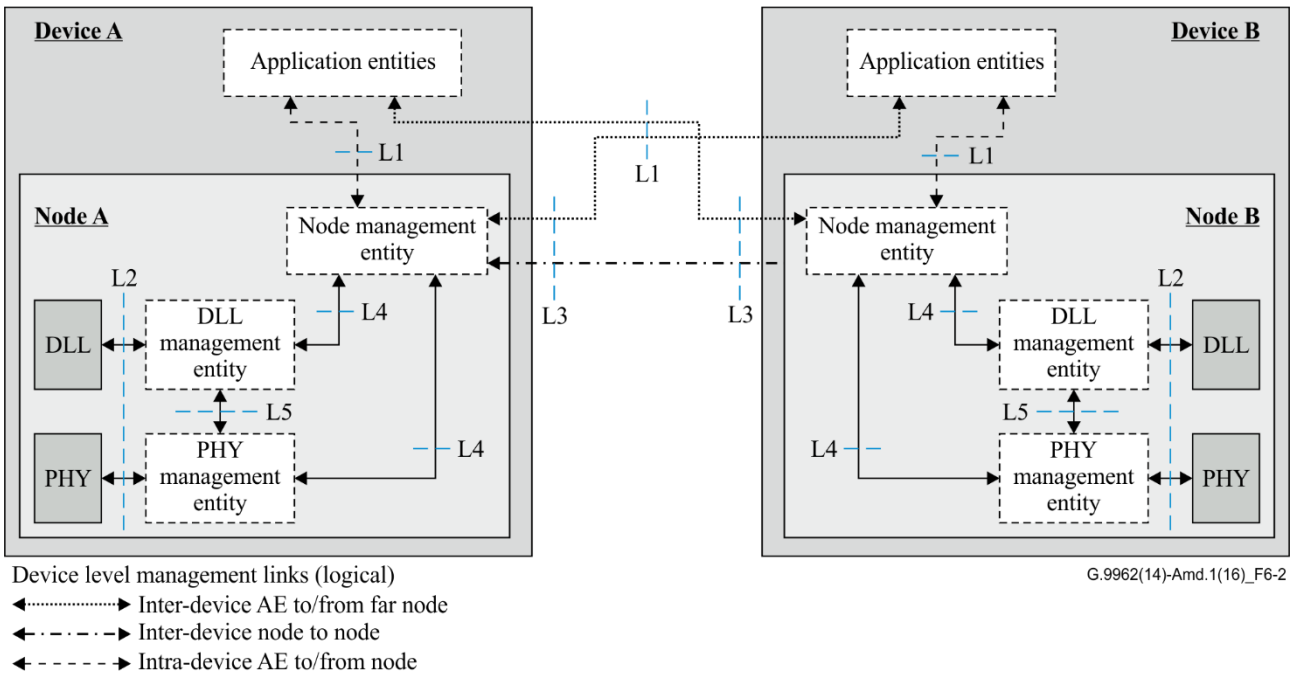


Figure 6-2 – Device level management links

6.1.1 Overall MCS structure

The MCS entities are associated with physical and network components of the ITU-T G.9960 architecture. Each node has a PHY layer and a DLL, with each of these having its own management entity, the PHY management entity (PME) and the DLL management entity (DME), respectively. These entities are under control of the node management entity (NME). The NME is under control of the domain master management entity (DMME) as well it may receive commands from application entities above the node's A interface. Further, the node must be authenticated and its security status controlled by the security controller entity (SCE). The SCE and the DMME communicate between themselves for management of security in the network (e.g., node authentication failure notification to the DMME from SCE). The domain may be part of a larger ITU-T G.9960 network consisting of itself and possibly several other ITU-T G.9960 domains under control of a global master entity (GME). The GME may be under the control of a remote management entity while the SCE may be under the control of, or depend on functions located in, a remote authenticator entity. Neither the remote management entity nor the remote authenticator are defined within [ITU-T G.9960] other than as references to MCS services provided by entities that control entities defined within [ITU-T G.9960].

6.1.2 Management and control entities

The management and control functions and their interactions are as follows.

6.1.2.1 PHY management entity (PME)

The PME manages the node's PHY layer. The PME provides the PHY services to the DME and NME.

6.1.2.2 DLL management entity (DME)

The DME manages the node's DLL. The DME provides the DLL's services to the PME and NME.

6.1.2.3 Node management entity (NME)

The NME manages the node through the PME and DME while also providing domain-interfacing functions as needed for registration, authentication, and bandwidth control. The NME provides a node management service to the DME and PME while also providing a node service interface and client functions to the SCE and DMME.

6.1.2.4 Domain master management entity (DMME)

The domain master management entity manages and controls the nodes in its domain through each node's NME by way of management messages and the MAP. The DMME also manages communications with neighbouring domains to address interference mitigation. The DMME provides the domain management services to each node within its domain as well as the SCE while providing domain-level service interface and client functions to the GME or a remote management entity if there is no GME.

6.1.2.5 Global master entity (GME)

The Global master manages all domains it is responsible for through the domains' individual DMME. The GME provides the network management services to each ITU-T G.9960 domain within its network while providing network-level service interface and client functions to the remote management entity and the WAN its network is a part of.

6.1.2.6 Note regarding DMME and GME communications (L6 interface)

While it may occur with certain implementations that the DMME and GME are located within the same physical device, there remains the need to pass messages between these entities. In this case, ~~T~~the formats of these intra-device messages are vendor specific. For the case when the DMME and GME are physically separated, the messages passed between them ~~are for further study~~may use the G.hn LCMP protocol as described in Annex B.

6.1.2.7 Note regarding Application entities and NME communication (L1 interface)

While it may occur with certain implementations that the application entity may reside in the same physical device as the NME, there remains the need to pass messages between these entities. In this case, the formats of these intra-device messages are vendor specific. For the case when the application entity and the NME are physically separated, the messages passed between them shall use G.hn LCMP protocol as described in Annex A.

6.1.3 Security entities

6.1.3.1 Security controller entity (SCE)

The security controller (SC) manages security for the domain as specified in clause 9 (Security) of [ITU-T G.9961]. The SC may be under control of a remote authenticator entity. The SCE provides security services for the nodes in the domain as well as for the domain master.

6.1.3.2 Note regarding DMME and SCE communications

While it may occur with certain implementations that the DMME and SCE are located within the same physical device, there remains the need to pass messages between these entities. The formats of these intra-device messages are vendor specific. For the case when the DMME and SCE are physically separated (i.e., not in the same node), the messages passed between them are specified within clause 9 of [ITU-T G.9961].

~~6.2 Logical interfaces for control and management planes~~

~~A logical interface is one that has no specific physical attributes. It is a reference point across which messages pass to and from an entity. Logical interfaces may be defined for both control and management planes.~~

~~While the A interface is the demarcation point between the application entities (AEs) and the nodes (at the data link layer (DLL)), there are several logical interfaces to entities within the node and domain (L1 to L5) as shown in Figures 6-1 and 6-2. This clause describes these logical interfaces and their use.~~

~~Those control and management plane messages to/from an entity are considered to have passed to/from the relevant entity within the node via its logical interface, e.g., messages destined for the DME pass across the L2 interface shown above while messages destined to the NME pass across the L1 or L3 interfaces, depending on the remote entity.~~

6.2~~3~~ Reference model

Figure 6-3 illustrates data-plane, control-plane and management-plane reference models for an ITU-T G.9960/G.9961 transceiver. Data-plane and control-plane reference models are described in clause 5.3 of [ITU-T G.9960].

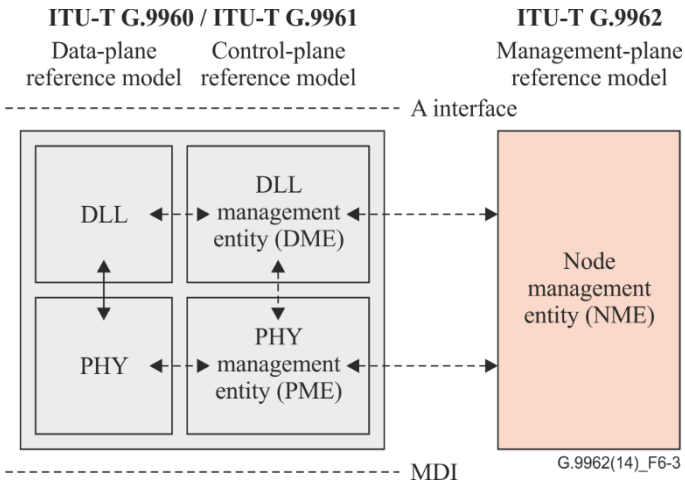


Figure 6-3 – ITU-T G.9962 reference model

7 ITU-T G.996x interface data model

ITU-T G.996x interface data model shall comply with [BBF TR-181 I2A5].

Annex A

LCMP communication through L1 interface

(This annex forms an integral part of this Recommendation.)

A.1 LCMP_CONTROL in L1 interface

LCMP frames conveying information via the L1 interface shall use 0_{16} as LCMP_CONTROL.

Annex B

LCMP communication through L6 interface

(This annex forms an integral part of this Recommendation.)

B.1 LCMP_CONTROL in L6 interface

LCMP frames conveying information via the L6 interface shall use 5_{16} as LCMP_CONTROL.

Annexes ~~A~~C to U

Annexes intentionally left blank

Annex V

Versioning dependencies of ITU-T G.9962

(This annex forms an integral part of this Recommendation.)

For details on the versioning mechanism, see clause 8.19 (*Version control and capabilities exchange*) of [ITU-T G.9961].

The versioning dependencies between this Recommendation and other Recommendations of the ITU-T G.996x family is described in Table V.1. The number indicated in the following table represents the minimum amendment that is compatible with the Recommendation described in this document.

Table V.1 – Versioning dependencies of ITU-T G.9962 Version 1

ITU-T G.9960	**ITU-T G.9961**	**ITU-T G.9962**	**ITU-T G.9963** (Note 2)	**ITU-T G.9964**
0	0	N/A	0	0

NOTE 1 – The following values apply to this table:

- A value of zero indicates the base document of a Recommendation.
- A value of X indicates that this Recommendation is not dependent on the indicated Recommendation.
- A value of N/A indicates this Recommendation.

NOTE 2 – Applicable if [ITU-T G.9963] is supported.

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