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International Telecommunication Union
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Recommendation

ITU-T G.8152 (01/2024)

SERIES G: Transmission systems and media, digital systems and networks

Packet over Transport aspects – MPLS over Transport aspects

Protocol-neutral management information model for MPLS-TP network elements

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Recommendation ITU-T G.8152

Protocol-neutral management information model for MPLS-TP network elements

Summary

Recommendation ITU-T G.8152 contains the protocol neutral unified modelling language (UML) model for multi-protocol label switching–transport profile (MPLS-TP) network element (NE) management.

This Recommendation provides a representation of the MPLS-TP technology using the methodologies that have been used for other transport technologies (e.g., synchronous digital hierarchy, optical transport network and Ethernet).

The 2018 revision of this Recommendation up-versions the UML model tool to Papyrus v3.2.0 and the profile to v0.2.13, updates the model to add the maintenance entity group end point (MEP) proactive measurement management information (MI), MEP configuration MI and maintenance entity group intermediate point (MIP) configuration MI, adds the Spec model for MPLS-TP model, replaces the G.8152NetworkElement and MT_NE with MT_ConstraintDomain, and MT_SubnetworkProtectionGroup specifies the FcSwitch, and MT_CrossConnection specifies the ForwardingConstruct.

Edition 3.0 of this Recommendation updates the MPLS-TP model to prune and refactor the TTP, CTP, Connectivity, Auxiliary MEP and MIP object classes from the G.7711 core model object classes, and up-versions the modelling tool to Eclipse 2020-06 (4.16) and Papyrus 4.8.

History [*]

Edition	Recommendation	Approval	Study Group	Unique ID
1.0	ITU-T G.8152/Y.1375	2016-12-22	15	11.1002/1000/13104
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3.0	ITU-T G.8152	2024-01-13	15	11.1002/1000/15829

Keywords

Information model, MPLS-TP, protocol-neutral, transport resource, UML.

[*] To access the Recommendation, type the URL https://handle.itu.int/ in the address field of your web browser, followed by the Recommendation's unique ID.

FOREWORD

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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.

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Introduction

This Recommendation contains the object classes for multi-protocol label switching–transport profile (MPLS-TP network element management. It includes the termination points (TPs), maintenance entity group end point (MEP), maintenance entity group intermediate point (MIP), traffic conditioning and shaping (TCS), loss measurement (LM), delay measurement (DM), and the general performance monitoring (PM) current data (CD) and history data (HD).

The TP, MEP, MIP, LM, DM and TCS object classes support the configuration and fault management functions as specified in [ITU-T G.8151].

The MPLS-TP TPs are modelled as subclasses of the generic GlobalClass specified in [ITU-T G.7711] and extending the Logical Termination Point and Layer Protocol classes of [ITU-T G.7711].

The MPLS-TP general PM CD and HD object classes are modelled as subclasses of the generic CD and HD specified in [b-ITU-T Q.822].

The MPLS-TP general CD and HD object classes support only the quality of service (QoS) directly related PM parameters, i.e., severely errored second and unavailable second, for service level agreement verification. The additional PM object classes for supporting LM and DM monitoring use the general CD and HD object classes as super classes.

The object model specified in this Recommendation is protocol neutral with respect to management protocols. The model could be used as the base for further specifying the information model for any specific management protocol.

The model in this Recommendation has been specified using the open source unified modelling language modelling tool Papyrus.

Recommendation ITU-T G.8152

Protocol-neutral management information model for MPLS-TP network elements

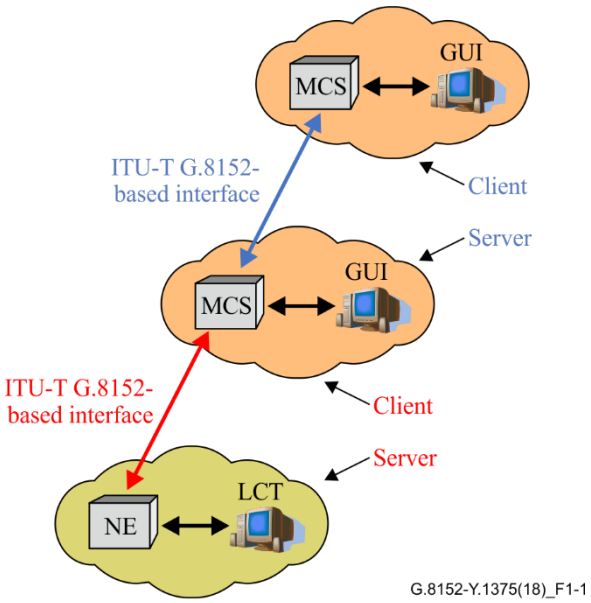
1 Scope

This Recommendation provides a management-control protocol-neutral information model for managing-controlling network elements (NEs) in the multi-protocol label switching-transport profile (MPLS-TP) transport network as specified in [ITU-T G.8110.1]. It identifies the managed entities required for the management-control of MPLS-TP transport NEs. These entities are relevant to information exchanged across standardized interfaces in the telecommunications management network architecture specified in [ITU-T M.3010]. The management-control protocol-neutral information model should be used as the base for defining management protocol-specific information models, e.g., extensible markup language (web service or Netconf/Yang) information model, common object request broker architecture interface definition language model and simple network management protocol (SNMP) management information base (MIB).

The information model specified in this Recommendation is an augmentation to the generic code model specified in [ITU-T G.7711] for managing MPLS-TP transport resources. The core information model defined in [ITU-T G.7711] can be used as the base for the extension of MPLS-TP-specific information models.

The specific mapping of the management-control protocol-neutral model into management-control-protocol-specific model is the decision of the management-control-protocol-specific solution design. For example, an object class defined in this Recommendation may be mapped into multiple tables in a SNMP MIB. Protocol-specific solutions and their mapping from the protocol-neutral model may be described in other Recommendations and lie outside the scope of this Recommendation.

This Recommendation applies to MPLS-TP transport NEs and those systems that manage/control them. The management-control system could be a network management system, element management system, software-defined network controller or their hybrids. [ITU-T G.7701] specifies the management-control continuum concept whereby management and control functions are considered to be a continuum. Those systems are thus referred to as management-control systems (MCSs) in general in this Recommendation. Functional capabilities of MPLS-TP transport equipment are specified in [ITU-T G.8121], [ITU-T G.8121.1], [ITU-T G.8121.2] and requirements of the management of MPLS-TP transport equipment are provided in [ITU-T G.7710] and [ITU-T G.8151]. The information model specified in this Recommendation applies to the management-control interface, as shown in Figure 1-1, specifically for managing-controlling the MPLS-TP functional capabilities of the NE.



GUI: graphical user interface; LCT: local craft terminal

Figure 1-1 – Scope of ITU-T G.8152 interface

The object classes specified in this Recommendation cover the areas of fault management, configuration management, and performance management.

There are several different perspectives from which management information (MI) may be specified for management purposes. The NE viewpoint is concerned with the information that is required to manage an NE. This refers to information required to manage the function and physical aspects of the NE. This Recommendation addresses only the NE view of Ethernet transport network management.

The management-control-protocol-neutral information model specified in this Recommendation consists of a set of transport-technology-specific managed object classes, i.e., MPLS-TP-specific managed object classes. These MPLS-TP-specific managed object classes are inherited from the generic managed object classes specified in other ITU-T Recommendation such as [ITU-T G.7711] and [ITU-T M.3160], including managed element, TP, and its subclasses, subnetwork and subnetwork connection. Because of object class inheritance, the MPLS-TP MI model also inherits the generic object management capabilities, such as object creation/deletion, notification of object creation/deletion, attribute value retrieval/modification, notification of attribute/state value change, scoped and filtered retrieval of object instances, and abortion of outstanding operations. The description of these generic object management capabilities is provided in other ITU-T Recommendations, such as the ITU-T M.3700 series, and therefore lies outside the scope of this Recommendation.

The object classes specified in this Recommendation cover the areas of fault management, configuration management, and performance management.

This Recommendation provides a representation of the MPLS-TP technology using the methodologies that have been used for other transport technologies (e.g., synchronous digital hierarchy, optical transport network and Ethernet).

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

[ITU-T G.7701] Recommendation ITU-T G.7701 (2022), *Common control aspects.*

[ITU-T G.7710] Recommendation ITU-T G.7710/Y.1701 (2022), *Common equipment management function requirements*.

[ITU-T G.7711] Recommendation ITU-T G.7711/Y.1702 (2022), *Generic protocol-neutral information model for transport resources*.

[ITU-T G.8013] Recommendation ITU-T G.8013/Y.1731 (2023), *Operation, administration and maintenance (OAM) functions and mechanisms for Ethernet-based networks.*

[ITU-T G.8052] Recommendation ITU-T G.8052/Y.1346 (2024), *Protocol-neutral management information model for the Ethernet transport capable network element.*

[ITU-T G.8110.1] Recommendation ITU-T G.8110.1/Y.1370.1 (2011), *Architecture of the Multi-Protocol Label Switching transport profile layer network.*

[ITU-T G.8113.1] Recommendation ITU-T G.8113.1/Y.1372.1 (2016), *Operations, administration and maintenance mechanism for MPLS-TP in packet transport networks.*

[ITU-T G.8113.2] Recommendation ITU-T G.8113.2/Y.1372.2 (2017), *Operations, administration and maintenance mechanisms for MPLS-TP networks using the tools defined for MPLS.*

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

[ITU-T G.8121.1] Recommendation ITU-T G.8121.1/Y.1381.1 (2018), *Characteristics of MPLS-TP equipment functional blocks supporting ITU-T G.8113.1/Y.1373.1 OAM mechanisms.*

[ITU-T G.8121.2] Recommendation ITU-T G.8121.2/Y.1381.2 (2018), *Characteristics of MPLS-TP equipment functional blocks supporting ITU-T G.8113.2/Y.1373.2 OAM mechanisms.*

[ITU-T G.8131] Recommendation ITU-T G.8131/Y.1382 (2018), *Linear protection switching for MPLS transport profile*.

[ITU-T G.8151] Recommendation ITU-T G.8151/Y.1374 (2020), *Management aspects of the MPLS-TP network element*.

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

[ITU-T M.3160] Recommendation ITU-T M.3160 (2008), *Generic protocol-neutral management information model.*

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 atomic function [ITU-T G.806]

3.1.2 compound function [ITU-T G.806]

3.1.3 dual-ended [ITU-T G.8013]

3.1.4 maintenance entity (ME) [ITU-T G.8013]

3.1.5 maintenance entity group (MEG) [ITU-T G.8013]

3.1.6 MEG end point (MEP) [ITU-T G.8013]

3.1.7 MEG intermediate point (MIP) [ITU-T G.8013]

3.1.8 on-demand monitoring [ITU-T G.8052]

3.1.9 one-way [ITU-T G.8013]

3.1.10 proactive monitoring [ITU-T G.8052]

3.1.11 single-ended [ITU-T G.8013]

3.1.12 two-way [ITU-T G.8013]

3.2 Terms defined in this Recommendation

None.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

1DM	one-way Delay Measurement
1DMo	on-demand one-way Delay Measurement
1DMp	proactive one-way Delay Measurement
AIS	Alarm Indication Signal
APS	Automatic Protection Switching
CCM	Continuity Check Message
CD	Current Data
CTP	Connection Termination Point
CW	Control Word
DD	Data Dictionary
DM	Delay Measurement
DMo	on-demand Delay Measurement
DMp	proactive Delay Measurement
DP	Data Plane
ECC	Embedded Communication Channel

ETH	Ethernet MAC layer network
GAL	Generic Associated channel Label
GUI	Graphical User Interface
HD	History Data
IPv4	Internet Protocol version 4
IPv6	Internet Protocol version 6
LCK	Locked
LCT	Local Craft Terminal
LM	Loss Measurement
LMo	on-demand Loss Measurement
LMp	proactive Loss Measurement
LSP	Label-Switched Path
LT	Link Trace
LTP	Logical Termination Point
MAC	Medium Access Control
MCC	Management Communication Channel
MCS	Management-Control System
ME	Maintenance Entity
MEG	Maintenance Entity Group
MEP	Maintenance entity group End Point
MI	Management Information
MIB	Management Information Base
MIP	Maintenance entity group Intermediate Point
MP	Management Point
MPLS-TP	Multi-Protocol Label Switching – Transport Profile
MT	Multi-Protocol Label Switching – Transport Profile
MTDe	MPLS-TP MEP Diagnostic function
MTDi	MPLS-TP Diagnostic function within MTx MIP
NC	Network Connection
NCM	Network Connection Monitoring
NE	Network Element
OAM	Operation, Administration and Maintenance
OSI	Open Systems Interconnection
PHB	Per Hop Behaviour
PM	Performance Monitoring
QoS	Quality of Service
RDI	Remote Defect Indication

SCC	Signalling Communication Channel
Sk	Sink
SL	Synthetic Loss
SLo	on-demand Synthetic Loss
SLp	proactive Synthetic Loss
SNCP	Subnetwork Connection Protection
SNMP	Simple Network Management Protocol
So	Source
TCM	Tandem Connection Monitoring
TCS	Traffic Conditioning and Shaping
TF	Transport Function
TP	Termination Point
TSNUM	Tributary Slot Number
TT	Trail Termination
TTL	Time-To-Live
TTP	Trail Termination Point
UML	Unified Modelling Language

5 Conventions

5.1 Information modelling conventions

See clause 5.1 of [ITU-T G.7711].

5.1.1 UML modelling conventions

See clause 5.1 of [ITU-T G.7711].

5.1.2 Model artefact lifecycle stereotypes conventions

See clause 5.2 of [ITU-T G.7711].

5.1.3 Forwarding entity terminology conventions

See clause 5.3 of [ITU-T G.7711].

5.1.4 Conditional package conventions

See clause 5.4 of [ITU-T G.7711].

5.1.5 Pictorial diagram conventions

See clause 5.5 of [ITU-T G.7711].

5.2 Equipment function conventions

5.2.1 Maintenance entity group end point [ITU-T G.8121]

MEPs terminate maintenance entities (MEs) that can span an end-to-end network connection (NC) or a portion of it (denoted a tandem connection).

Figure 5-1 shows the diagrammatic convention for network connection monitoring (NCM) MEP compound functions.

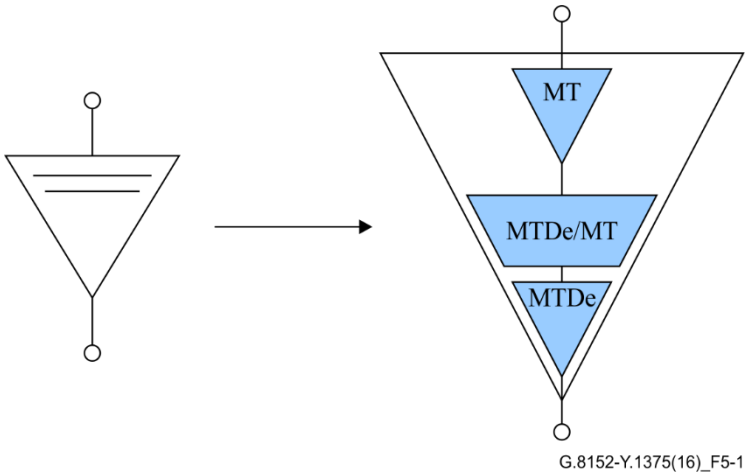


Figure 5-1 – MPLS-TP (MT) NCM MEP compound functions (reproduction of Figure 9-39 of [ITU-T G.8121])

Figure 5-2 shows the diagrammatic convention for tandem connection monitoring (TCM) MEP compound functions.

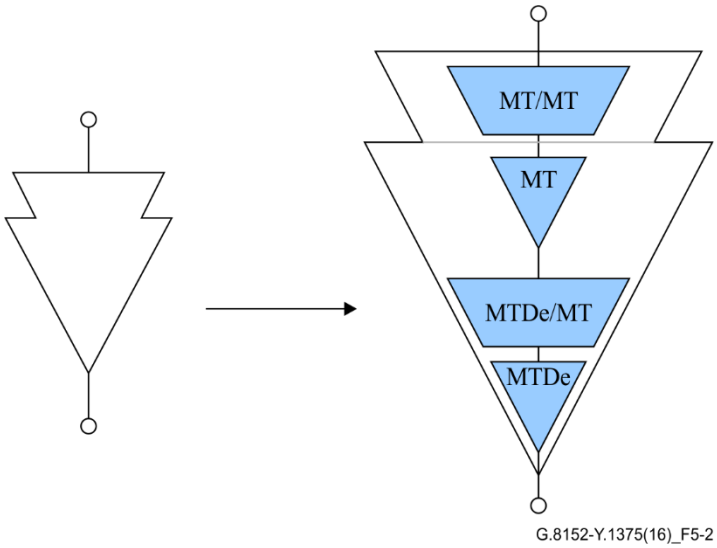


Figure 5-2 – MT TCM MEP compound functions (reproduction of Figure 9-40 of [ITU-T G.8121])

NOTE – Unlike Ethernet technology, the same MT/MT atomic function specified in [ITU-T G.8121] can be used either within the optional TCM MEP (i.e., not "stand alone") or at the layer boundary (i.e., "stand alone" and not part of an MEP), regardless of the number of client signals (even if there is only one signal when there is no multiplexing).

5.2.2 Maintenance entity group intermediate point [ITU-T G.8121]

Figure 5-3 shows the diagrammatic convention for maintenance entity group intermediate point (MIP) compound functions.

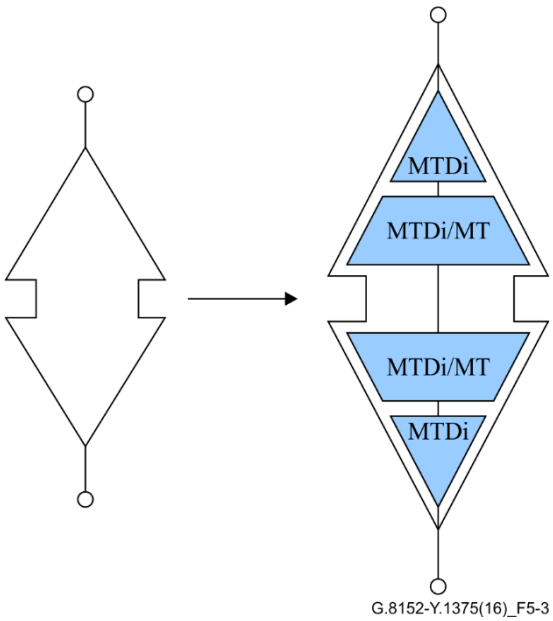


Figure 5-3 – MT MIP compound functions
(reproduction of Figure 9-41 of [ITU-T G.8121])

Figure 5-4 shows the diagrammatic convention for half MIP compound functions.

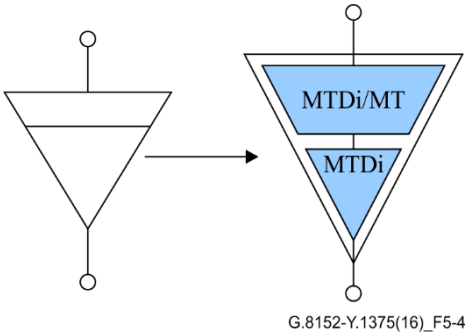


Figure 5-4 – MT half MIP compound functions
(reproduction of Figure 9-42 of [ITU-T G.8121])

5.2.3 MEPs and MIPs along a maintenance entity

Figure 5-5 shows the diagrammatic convention for MEPs and MIPs along an individual maintenance entity (ME).

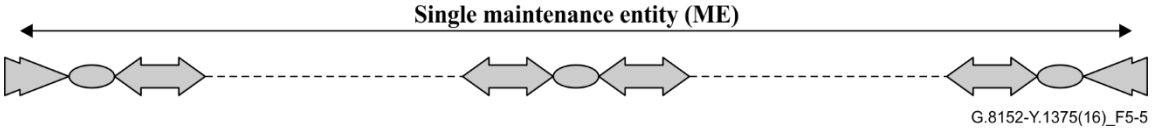


Figure 5-5 – MEPs and MIPs along a maintenance entity

Note that the ME can span the whole end-to-end NC or a tandem connection.

5.3 Conventions defined in this Recommendation

This Recommendation uses the following conventions:

5.3.1 Colour code convention

Table 5-1 lists the colour codes used in this Recommendation.

Table 5-1 – Colour code convention

Colour code	ITU-T G.8152 object class
	MaintenanceEntityGroupEndPoint
	MT_TrailTerminationPoint
	MT_ConnectionTerminationPoint
	OnDemandMeasurementJob
	ProActiveMeasurementJob
	MaintenanceJob
	TerminationPointPool
	Specific highlighting
	Not in scope

5.3.2 Modelling convention for adaptation functions

Every adaptation function has a MI_Active parameter. This is not modelled since it is always active in the MPLS-TP technology.

5.3.2.1 MPLS-TP server adaptation modelling

See Figure 5-6.

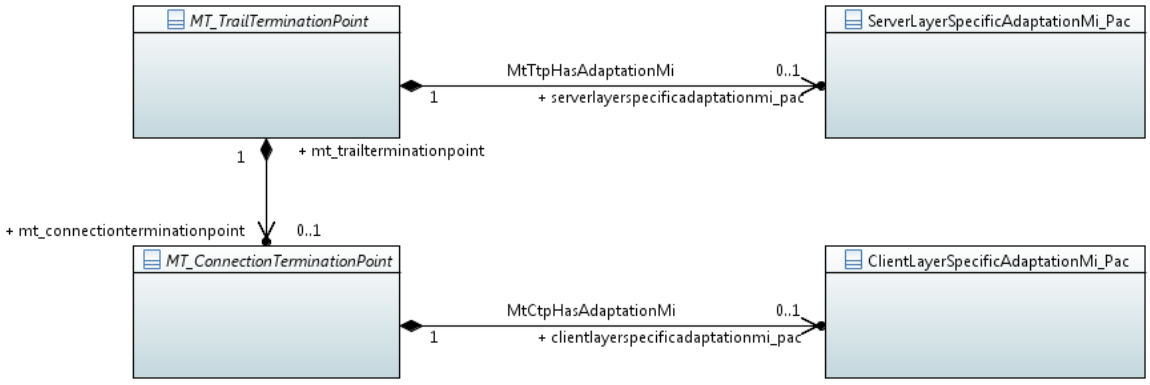
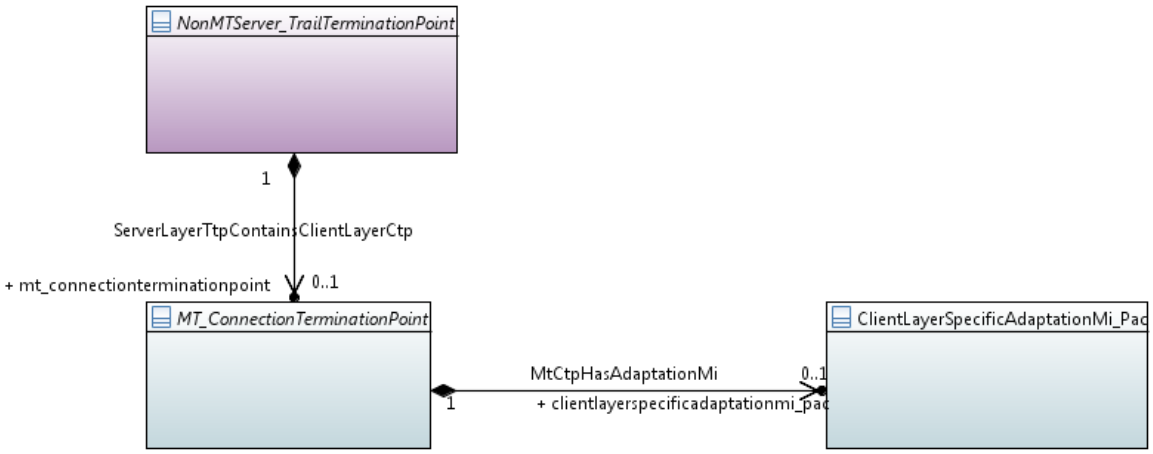


Figure 5-6 –MPLS-TP server adaptation modelling diagram

5.3.2.2 Non-MPLS-TP server adaptation modelling

See Figure 5-7.



NOTE – Figure 5-7 is also available from the ITU website here.

Figure 5-7 – Non-MPLS-TP server adaptation modelling diagram

6 Overview of the MPLS-TP model

This Recommendation models the MPLS-TP network functions that are relevant to MPLS-TP NE management. These functions are described in the equipment specification [ITU-T G.8121], [ITU-T G.8121.1] and [ITU-T G.8121.2] for the termination, adaptation, and connection functions of the MT layer, operation, administration and maintenance (OAM) functions at the MEP and MIP, diagnostic maintenance operations, performance measurement (including that on demand and proactive), MPLS-TP linear protection, and MPLS-TP ring protection. In particular, the input and output MI exchanged across the management point (MP) between the equipment transport functions (TFs) and equipment management function are modelled. The input/output MI covers the areas of configuration, fault management and performance management as described in [ITU T G.7710] and [ITU T G.8151]. Details of the management functions that need to be modelled are provided in [ITU-T G.7710] and [ITU T G.8151].

In this Recommendation, managed resources and management support resources are modelled as objects in the information model. The management view of a resource is a managed object. This Recommendation specifies the properties of the resources visible for management. Objects with similar properties are grouped into object classes. An object instance is an instantiation of an object class. The properties of an object include the behaviour, attributes and operations that can be applied to the object. An object instance is characterized by its object class and may possess multiple attribute types and associated values. In the protocol-neutral model, object classes are represented as: unified modelling language (UML) object classes, for static properties; interface classes, for operations; and signal classes, for notifications.

Object classes, attribute types, operations and notifications are specified for the purpose of communicating network management messages between managed systems (such as transport devices) and the MCSs). They need not be related to the structure of data stored within those systems.

An object class may be a subclass of another class. A subclass inherits properties of its superclass, in addition to possessing its own specific attributes and properties. This Recommendation specifies MPLS-TP specific transport object classes. Some of these object classes are derived from the ITU-T G.7711 core information model through pruning or refactoring.

In addition to the MPLS-TP transport resource, the model also includes object classes for management support functions such as alarm reporting control and alarm severity assignment.

6.1 MT layer

Figure 6-1 shows the mapping between the object classes and the MPLS-TP atomic functions based on Figure 1 of [ITU-T G.8121].

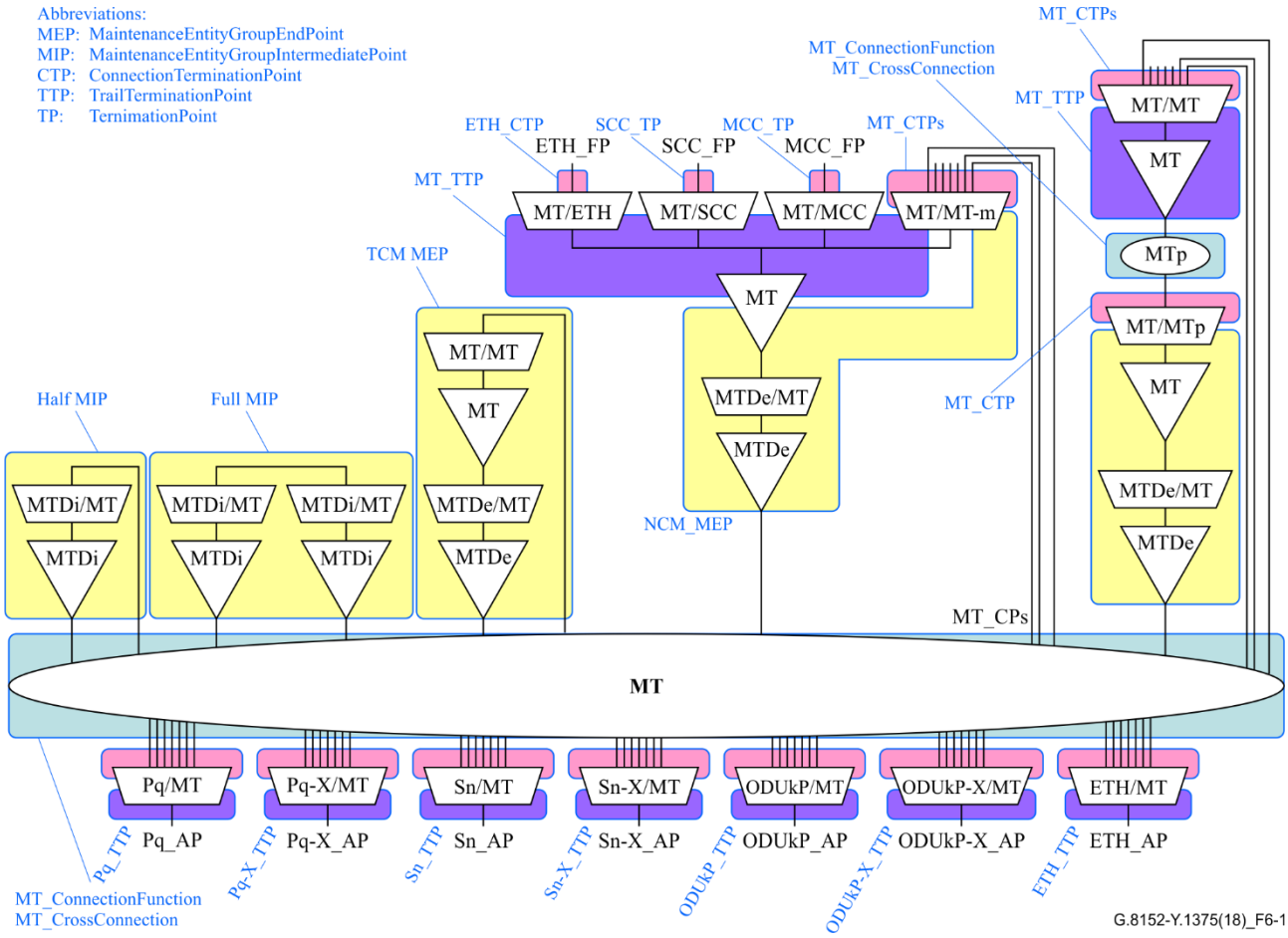


Figure 6-1 – Overview of object class mapping to ITU-T G.8121 atomic functions (based on Figure 1-1 of [ITU-T G.8121])

6.2 MPLS-TP OAM infrastructure

All MPLS-TP OAM auxiliary object classes (e.g., MEP, MIP, measurement job, maintenance job) are attached to these MPLS-TP TTP and/or CTP basic object classes as necessary. Examples are shown in Figures 6-2 to 6-4.

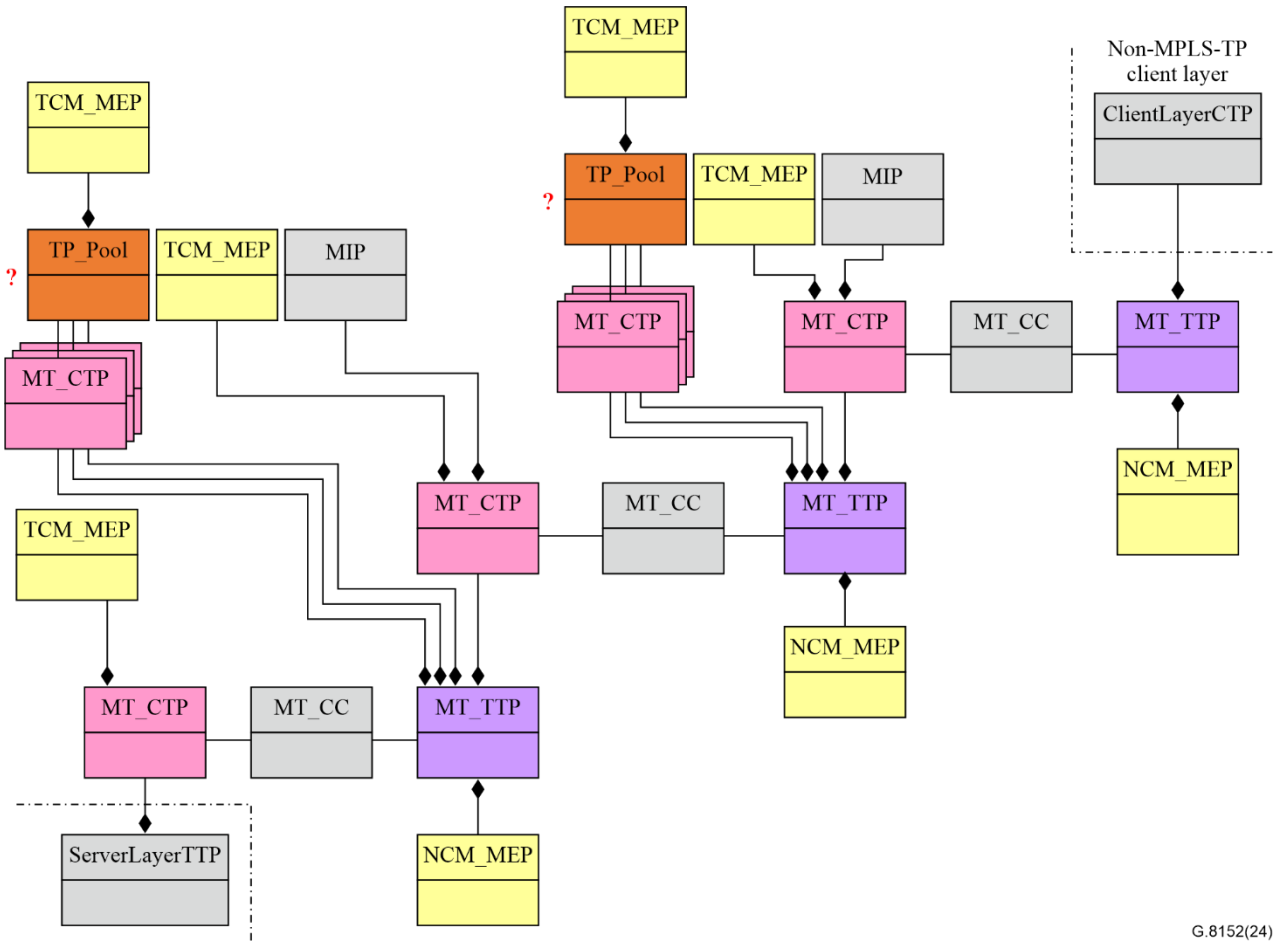


Figure 6-2 – MT object instance example

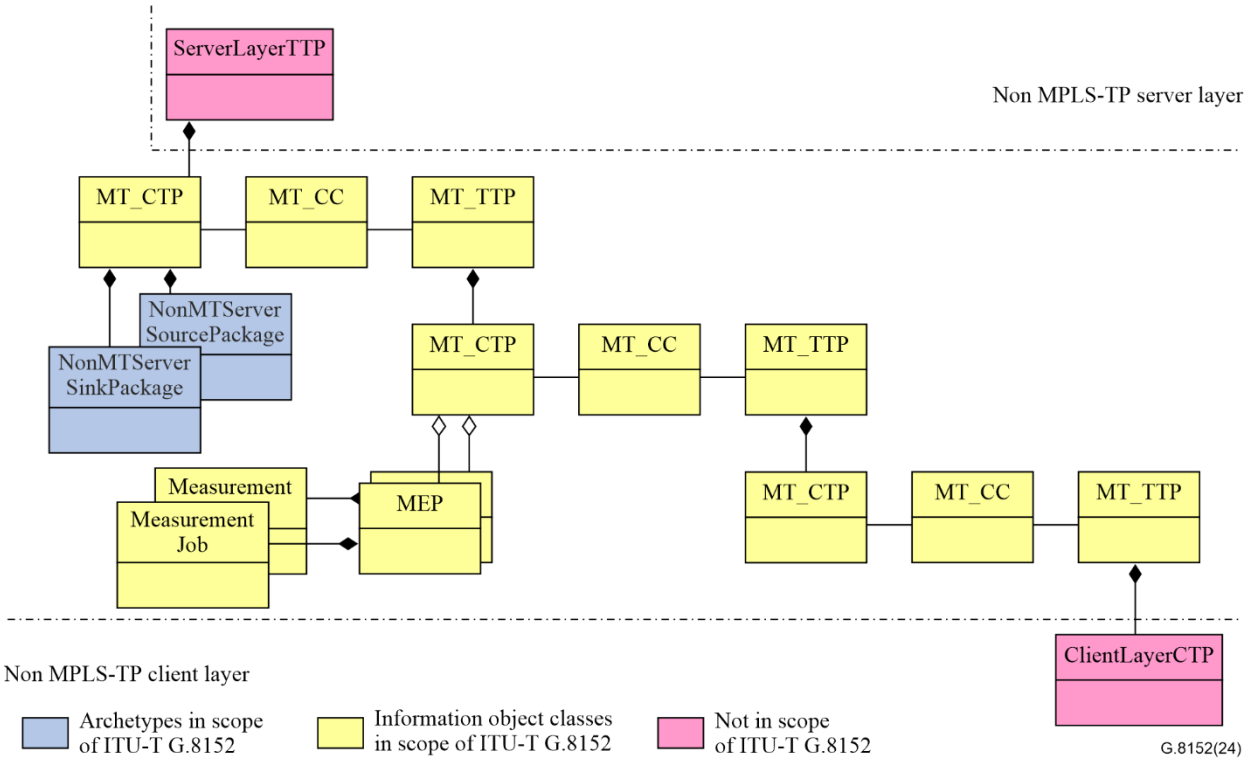


Figure 6-3 – MT layer object instance example with measurement job

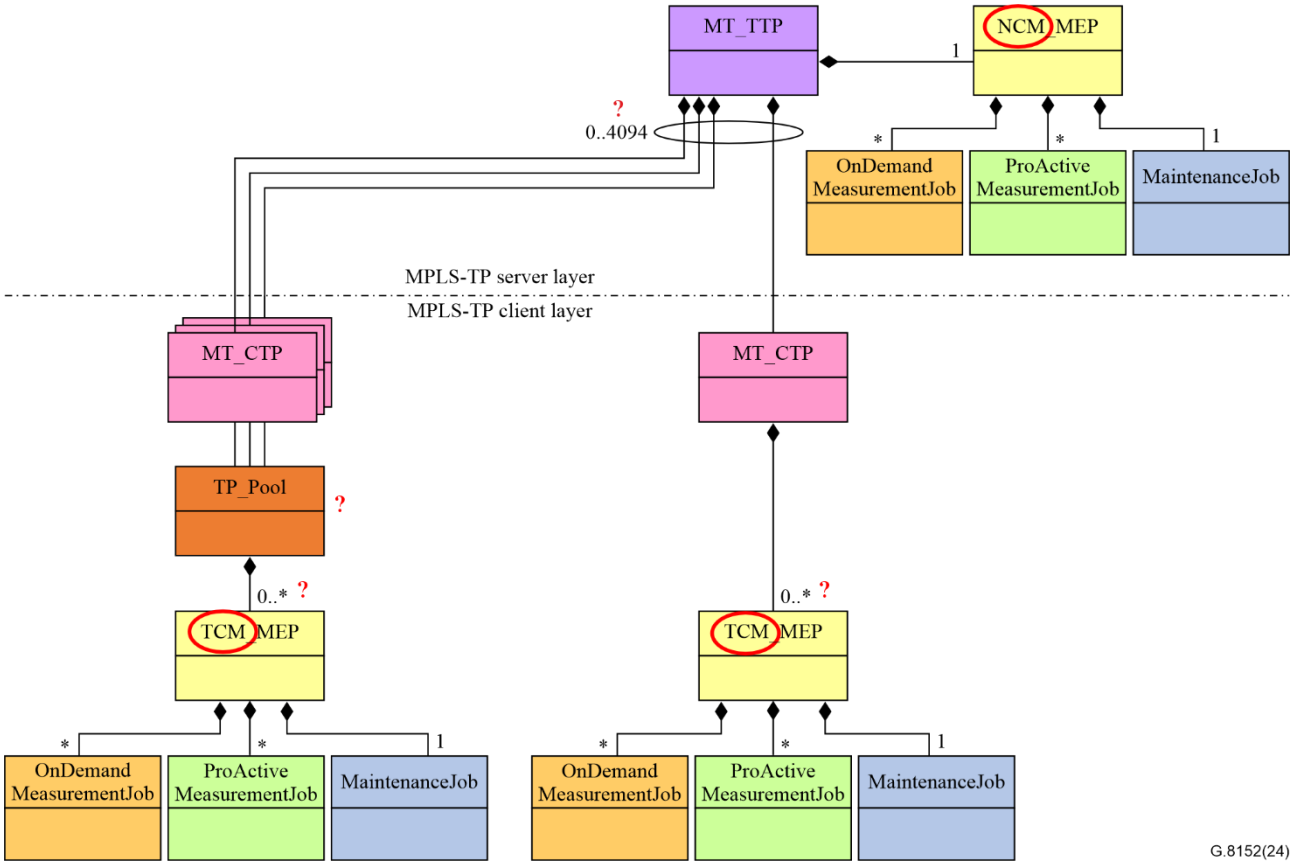


Figure 6-4 – MEP infrastructure with maintenance and measurement jobs

7 UML model of MPLS-TP

7.1 MT fragment

7.1.1 MT CTP object classes

The MtCtp (MPLS-TP Connection Termination Point) object class is defined via pruning and refactoring of the G.7711 LTP (Logical Termination Point) and LP (Layer Protocol) object classes, when the LTP has a server LTP and it includes only one LP with layerProtocolName = 'MT' and terminationState = 'LP_CAN_NEVER_TERMINATE'.

The MtCtp object class is «ExtendedComposite»[1] with the MPLS-TP technology-specific attributes defined within the MtCtpPac, MtCtpSourcePac, MtCtpSinkPac and MtCtpBidirPac abstract object classes as shown in Figure 7-1.A.

[1] The «ExtendedComposite» aggregation means that the extending class is never explicitly instantiated (i.e., are abstract), but that the attributes determined by the extending class are transferred to the class being extended at runtime.

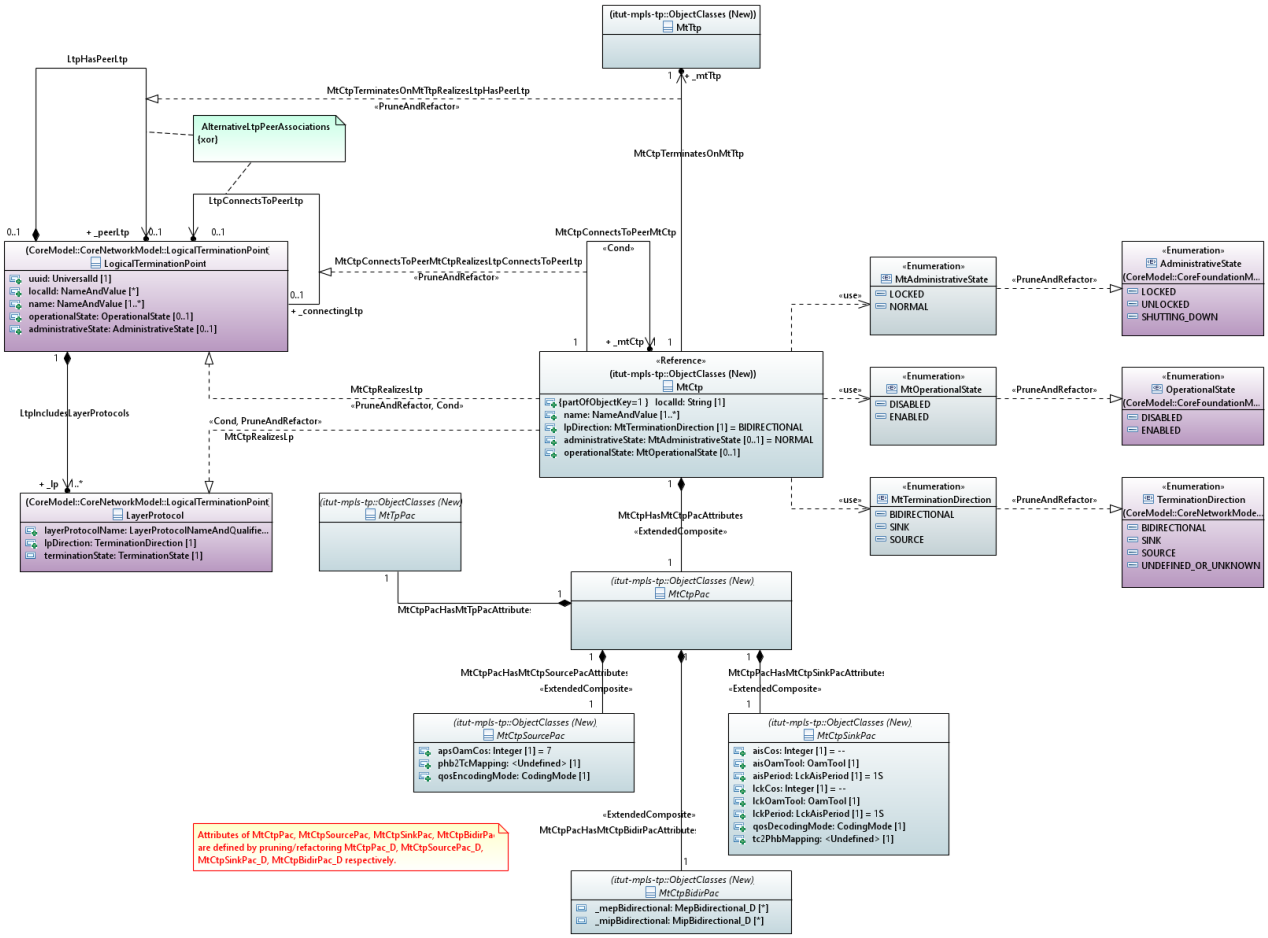


Figure 7-1.A – MPLS-TP CTP overview

7.1.2 MT TTP object classes

The MtTtp (MPLS-TP Trail Termination Point) object class is defined via pruning and refactoring of the G.7711 LTP (Logical Termination Point) and LP (Layer Protocol) object classes, when LTP has no server layer LTP and it contains only one LP with layerProtocolName = 'MT' and terminationState = 'LP_PERMANENTLY_TERMINATED'.

The MtTtp object class is «ExtendedComposite» with the MPLS-TP technology-specific attributes defined within the *MtTtpPac*, *MtTtpSourcePac*, *MtTtpSinkPac* and *MtTtpBidirPac* abstract object classes as shown in Figure 7-1.B.

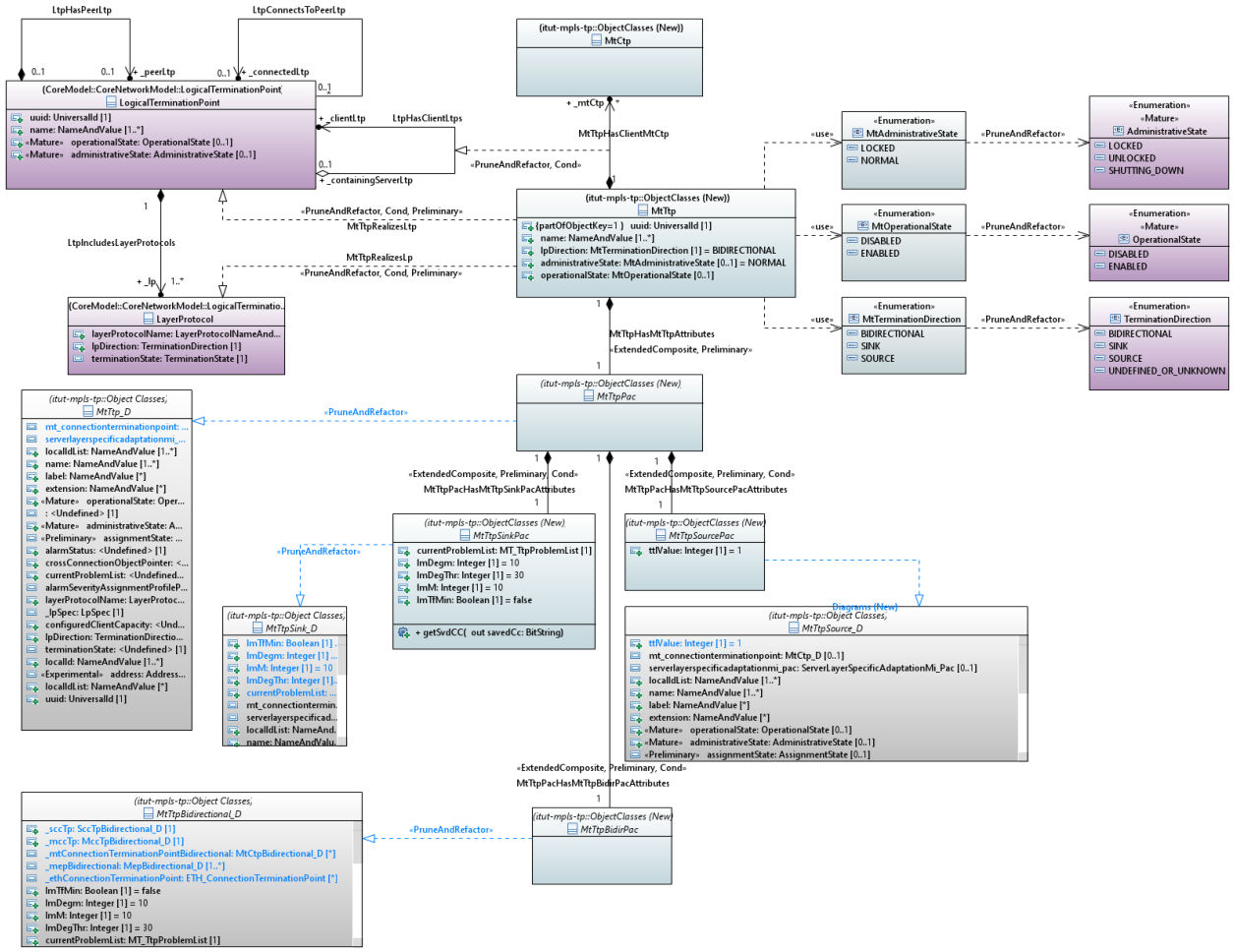


Figure 7-1.B – MPLS-TP TTP overview

7.1.3 MT connectivity object classes

In order to model flexible MT Connectivity, the MtSn, MtSnc and MtSncPort object classes are defined via pruning and refactoring of the ITU-T G.7711 core model FD, FC and FcPort object classes, as shown in Figure 7-1.C.

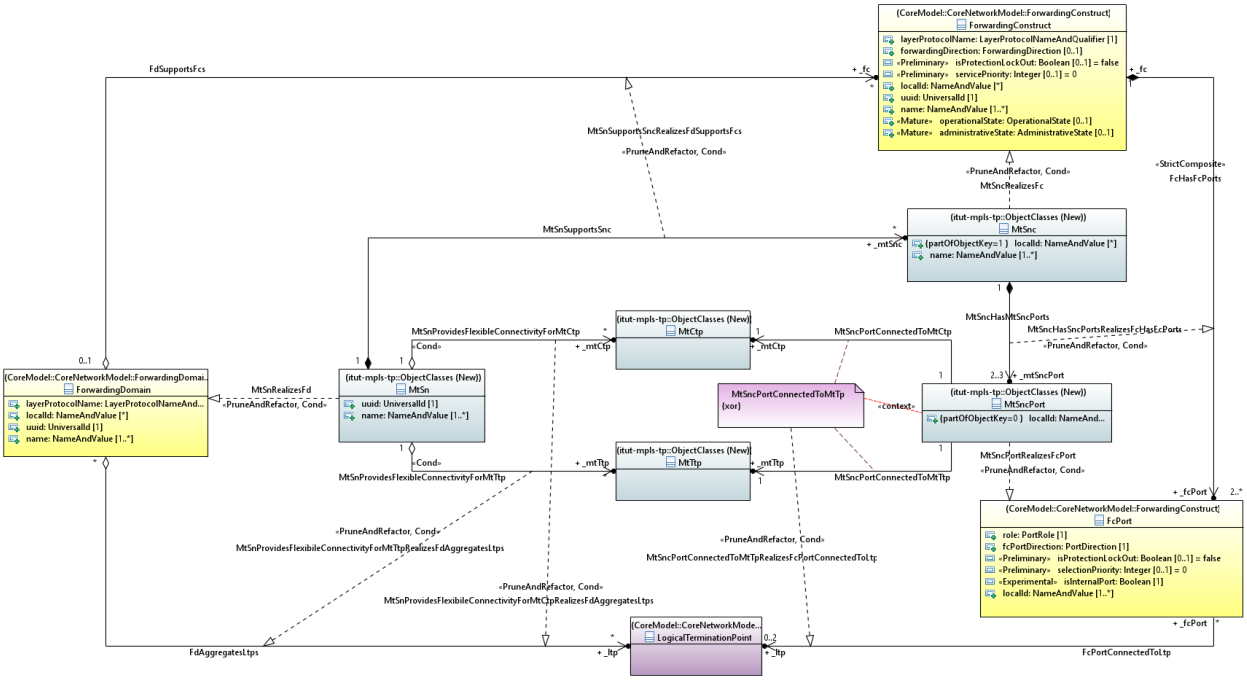


Figure 7-1.C – MPLS-TP connectivity overview

In particular, note the following.

– The MtSn object class is derived via pruning and refactoring of the ITU-T G.7711 FD object class when it has only one layerProtocolName = 'MT'.

– The MtSnc object class is derived via pruning and refactoring of the ITU-T G.7711 FC object class when layerProtocolName = 'MT'.

  o The MtSnc object class has been refactored from the ITU-T G.7711 FC global object class as a local object class, as specified in [ITU-T G.7711], and the MtSnSupportsSnc has been refactored as a composition, since for the purpose of NE management the FC object class instances always exist within an FD object class instance.

– The MtSncPort object class is derived via pruning and refactoring of the ITU-T G.7711 FcPort object class when the FC instance is realized by an MtSnc instance.

Note the following consequences.

– The MtSnSupportsSnc and the MtSncHasSncPorts associations have been derived via pruning and refactoring of the ITU-T G.7711 FdSupportsFcs and FcHasFcPorts associations, respectively.

– The relationship between the MtSncPort and the MtCtp or MtTtp being connected is modelled by the MtSncPortConnectedToMtTp {xor} constraint between the MtSncPortConnectedToMtCtp and MtSncPortConnectedToMtTtp associations, derived via pruning and refactoring of the ITU-T G.7711 FcPortConnectedToLtp association.

An MtCtp instance can have one of the following.

– Flexible connectivity via an MtSn instance (e.g., as shown in Figure 7-1.C), which is modelled by the MtSnProvidesFlexibleConnectivityForMtCtp association, is derived via pruning and refactoring of the ITU-T G.7711 FdAggregatesLtp association.

– Fixed connectivity with a peer MtCtp instance (e.g., as shown in Figure 7-1.A), which is modelled by the MtCtpConnectsToPeerMtCtp association, is derived via pruning and refactoring of the ITU-T G.7711 LtpConnectsToPeerLtp association.

– Fixed termination on an MtTtp instance (e.g., as shown in Figure 7-1.A), which is modelled by the MtCtpTerminatesOnMtTtp association, is derived via pruning and refactoring of the ITU-T G.7711 LtpHasPeerLtp association.

An MtTtp instance can have either of the following.

– Flexible connectivity via an MtSn instance (e.g., as shown in Figure 7-1.C), which is modelled by the MtSnProvidesFlexibleConnectivityForMtTtp association, is derived via pruning and refactoring of the ITU-T G.7711 FdAggregatesLtp association.

– Fixed termination for an MtCtp instance (as shown Figure 7-1.A), which is modelled by the MtCtpTerminatesOnMtTtp association, is derived via pruning and refactoring of the ITU-T G.7711 LtpHasPeerLtp association.

7.1.4 MT multiplexing

This clause maps the MPLS-TP multiplexing-related MI to the corresponding object classes. See Figure 7-1.D.

The MPLS-TP multiplexing configuration function exists only in MT TTP and MT CTP.

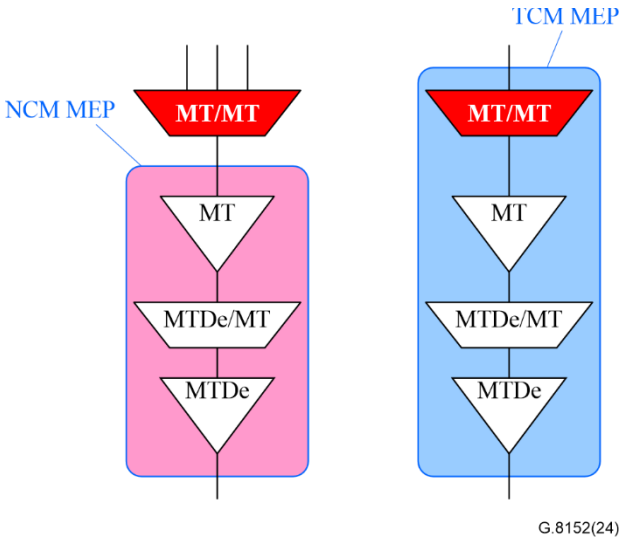


Figure 7-1.D – MPLS-TP multiplexing configuration function

[ITU-T G.8121] specifies the following MI to configure the MPLS-TP multiplexing function, as given in Table 7-1. See Figure 7-1.E.

Table 7-1 – Mapping of multiplexing related MI to ITU-T G.8152 artefacts

Functionality	ITU-T G.8121 MT/MT_A_So_MI	ITU-T G.8121 MT/MT_A_Sk_MI	ITU-T G.8152 v4.0 object class
TTP associated M	Admin_State	Admin_State	MtTtp
	Mode	Mode	MtMuxServerTtpPac
	APS_CoS		MtMuxServerTtpSourcePac
	APS_OAM_Tool	APS_OAM_Tool	MtMuxServerTtpPac
CTP associated MI	Label[1…M]	Label[1…M]	MtMuxClientCtpPac
	LSPType[1…M]	LSPType[1…M]	MtMuxClientCtpPac
	CoS[1…M]	CoS[1…M]	MtMuxClientCtpPac
	PHB2TCMapping[1…M]	TC2PHBMapping[1…M]	MtMuxClientCtp [Source|Sink]Pac
	QoSEncodingMode[1…M]	QoSDecodingMode[1…M]	MtMuxClientCtp [Source|Sink]Pac
	LCK_Period[1…M]	LCK_Period[1…M]	MtMuxClientCtpPac
	LCK_CoS[1…M]	LCK_CoS[1…M]	MtMuxClientCtpPac
	LCK_OAM_Tool[1...M]	LCK_OAM_Tool[1...M]	MtMuxClientCtpPac
	GAL_Enable[1...M]	GAL_Enable[1...M]	MtMuxClientCtpPac
		AIS_Period[1...M]	MtMuxClientCtpSinkPac
		AIS_CoS[1...M]	MtMuxClientCtpSinkPac
		AIS_OAM_Tool[1...M]	MtMuxClientCtpSinkPac

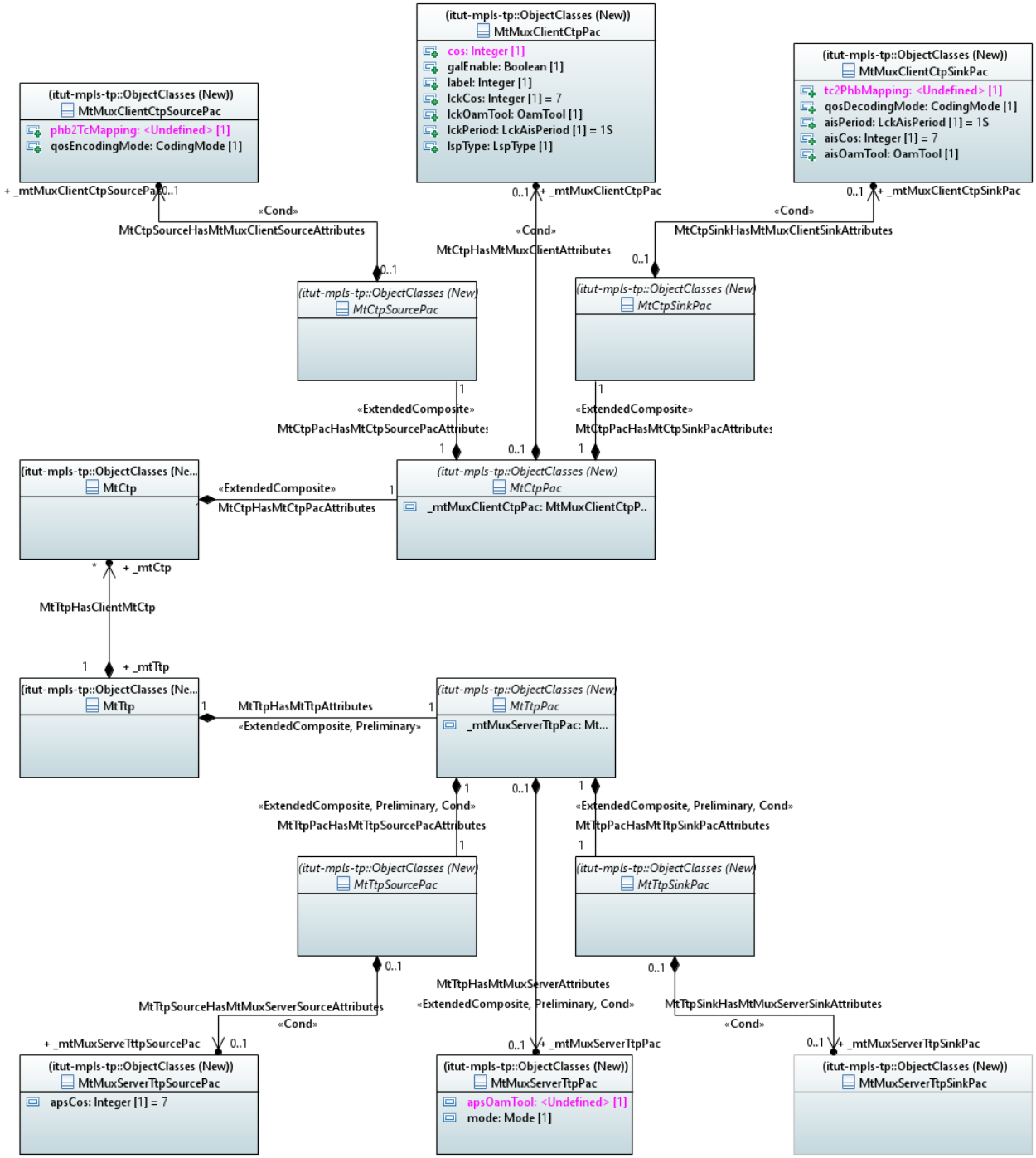


Figure 7-1.E – MPLS-TP multiplexing model overview

7.1.5 MPLS-TP CTP and TTP auxiliary object classes

The MtAuxTp object class is derived via pruning and refactoring of the LP object class, when the layerProtocolName is set to 'MT_MEP' or 'MT_MIP', as shown in Figure 7-1.F.

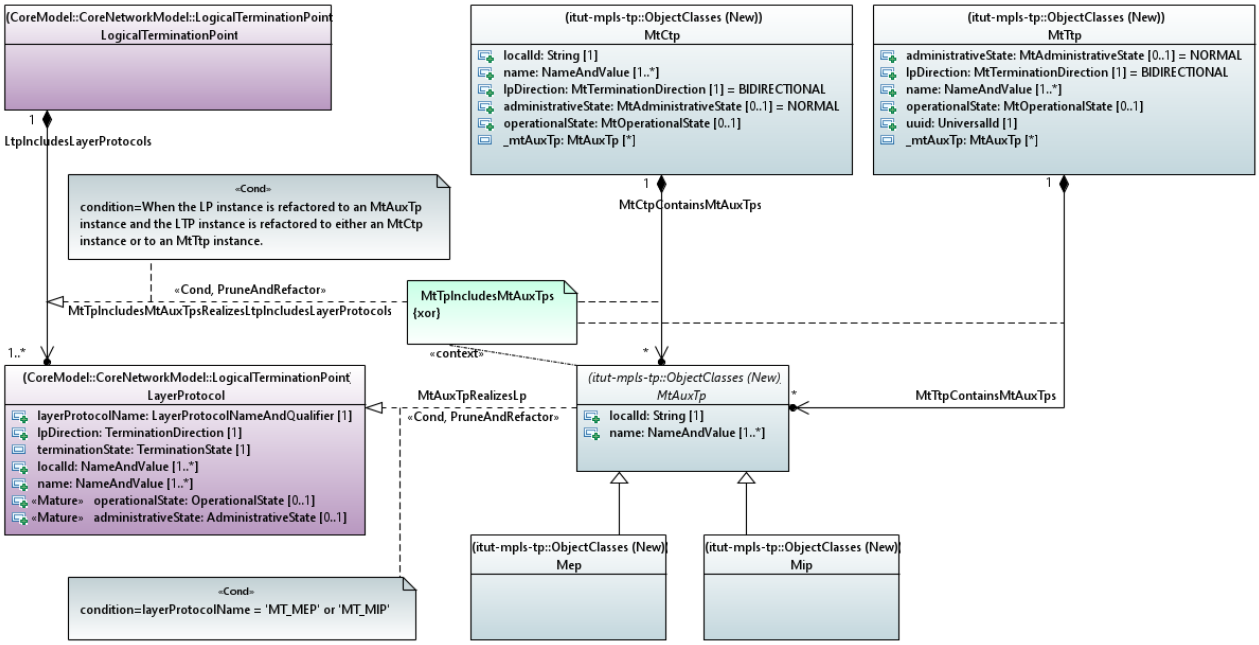


Figure 7-1.F – MPLS-TP auxiliary object classes

The *MtAuxTp* object class is an abstract object class that is inherited by the object classes, described in clauses 7.1.1, 7.1.2 and 7.2, used to model MPLS-TP (MT) auxiliary functions.

MT auxiliary functions can be located either between:

- the adaptation function and the connection function, as modelled by the *MtCtpContainsMtAuxTps* association; or,
- the connection function and the trail termination function, as modelled by the *MtTtpContainsMtAuxTps* association.

The *MtTpIncludesMtAuxTps* constraint is used to model the fact that a given *MtAuxTp* object class instance is either contained by an *MtCtp* or by an *MtTtp* object class instance and in the latter case it is either located below the trail termination function or above the trail termination function.

The MtCtpContainsMtAuxTps and *MtTtpContainsMtAuxTps* associations derived, together with the *MtTpIncludesMtAuxTps* constraint, via pruning and refactoring of the ITU-T G.7711 *LpIncludesLayerProtocols* ordered association. The *MtCtpContainsMtAuxTps* and *MtTtpContainsMtAuxTps* are ordered.

7.2 OAM fragment

See clause A.1 for the general description of the MPLS-TP OAM compound functions.

7.2.1 MEP compound function

See clause A.1.1 for the description of the MPLS-TP compound function.

Figure 7-2.A provides an overview of the MT MEP model.

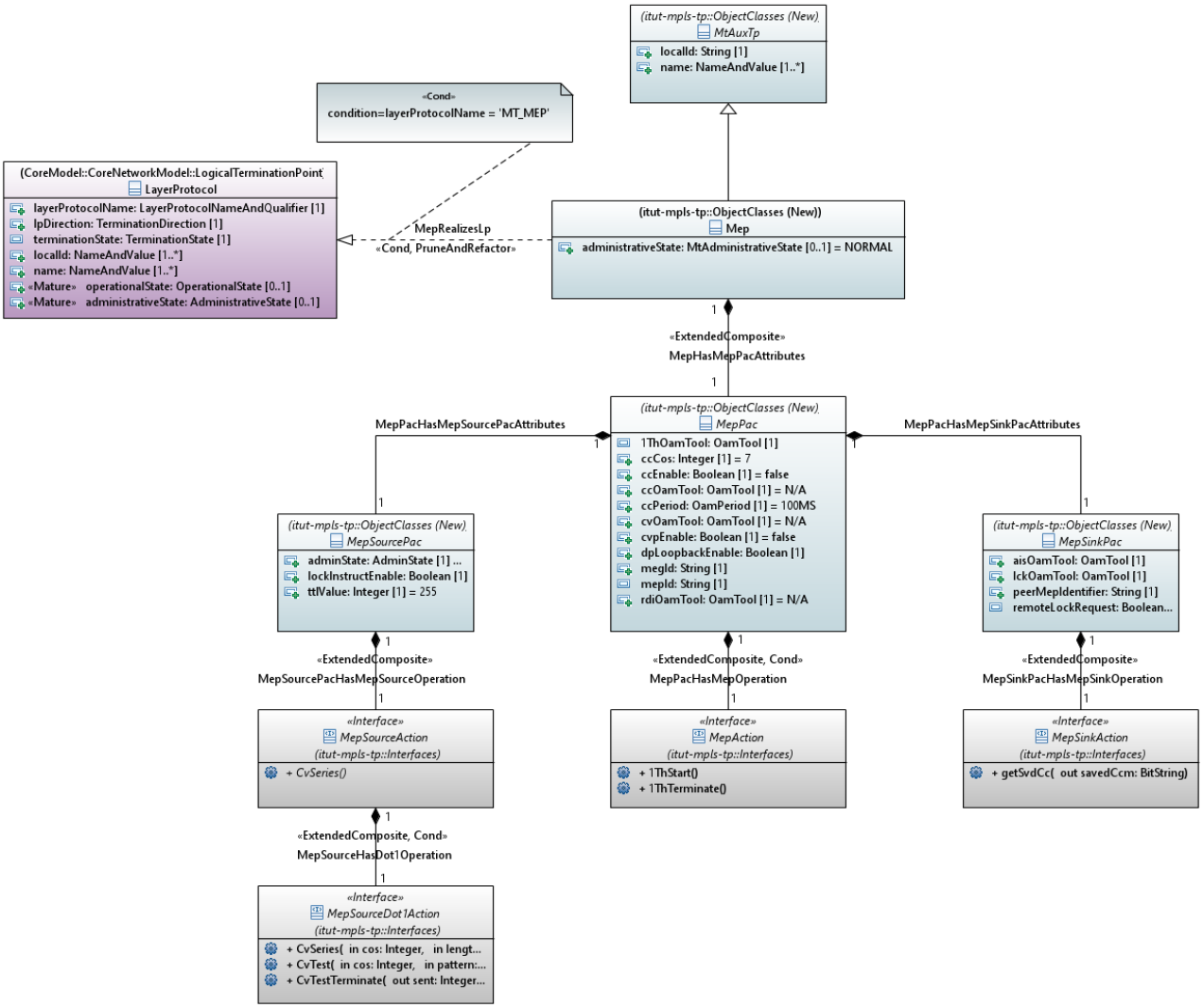


Figure 7-2.A – MT MEP overview

7.2.2 MIP compound function

Figure 7-2.B depicts the object classes of the MIP model. Details of the functions supported by the model are described in clause A.1.2.

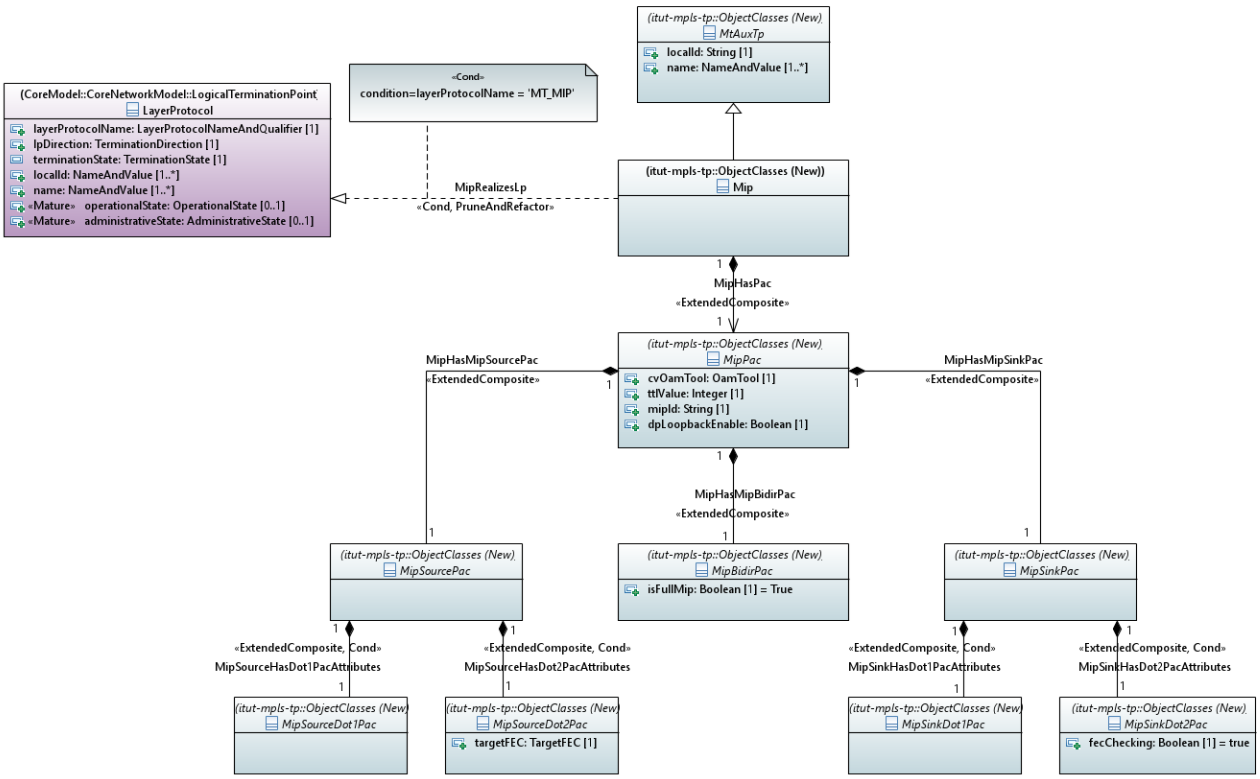


Figure 7-2.B – MT MIP overview

8 UML model file

The G.8152 UML model developed using the Papyrus open-source modelling tool can be downloaded from this repository.

The zip file includes the following folders:

– The G.8152_v3.0 folder, which contains the following:
  - The .project file
  - The .di, .notation, and .uml files of the itut-mpls-tp model
  - The .di, .notation, and .uml files of the itut-mpls-tp v2.00 model
  - The Diagrams folder, which contains PNG images of the UML diagrams in the above model.
  - The Doc folder, which contains the data dictionaries (DD) and the DD templates of the above model.
  - The UmlProfiles folder, which contains the UML profiles that define the properties of the UML artifacts.

    Note that the G.8152_v3.0 folder also contains the version v2.0 of the itut-mpls-tp model. See Annex A for more information about the status of the v2.0 information model.

– The G.7711_v4.0 folder, which contains the [ITU-T G.7711] Core information model, which is imported by the G.8052.1 models above.

The UML information models above have been developed using the Papyrus 2020-06 modelling tool, which is available at [b-Eclipse-Papyrus]. The installation guide for Eclipse and Papyrus can be found in [b-ONF TR-515].

To load the ITU-T G.8152 UML models into a Papyrus workspace, follow the steps below:

– In the *Project Explorer* / right click / *Import* / *General* / *Projects from Folder or Archive* / *Next* / *Archive* / *Select* the G.8152 zip file / *Open* / *Select* the folders of the models to be loaded (Note) / *Finish*

NOTE – If an UML model imported by the ITU-T G.8152 model above already exist in the workspace, should not be selected for loading.

Annex A

Version 2 of the MPLS-TP model

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

This annex contains the previous version (version 2) of the MPLS-TP model, which was described in clause 7 of ITU-T G.8152 (2018). Version 2 of the MPLS-TP model now is annotated with the lifecycle stereotype "*LikelyToChange*". The papyrus uml files of v2.0 are contained in the v3.0 papyrus project as a separate module, i.e., the v3.0 papyrus project contains both the v3.0 and v2.0 modules.

A.1 OAM compound functions

OAM is done in the network by creating MEs. In multipoint services, multiple MEs are grouped together forming a maintenance entity group (MEG); see specifications in clause 8 of [ITU-T G.8110.1].

Each MEG is terminated by a set of MEPs. It is also possible to perform OAM functions on an MEG by MIPs that allow a limited set of OAM functions along the MEs. See Table A.1.

Table A.1 – OAM capability support

OAM function			**OAM mechanism**
Compound function	MEP	Network connection monitoring	
		Tandem connection monitoring	
	MIP		(on-demand) CV
	Traffic conditioning and shaping (TCS)		–
Proactive measurement	Loss measurement (LM)	one-way	Continuity check message (CCM) (G.8121.1)
		two-way	LM (G.8121, G.8121.2), LMDM (G.8121.2)
		one-way synthetic	–
		two-way synthetic	SLM (G.8121) LM (G.8121.2) *LMDM (G.8121.2)*
	Delay measurement (DM)	one-way (1)	1DM (G.8121)
		two-way	DM (G.8121, G.8121.2) *LMDM (G.8121.2)*
On-demand measurement	Loss measurement	two-way	LM (G.8121, G.8121.2), LMDM (G.8121.2)
		one-way synthetic	–
		two-way synthetic	SLM (G.8121) LM (G.8121.2) *LMDM (G.8121.2)*
	Delay measurement	one-way	1DM (G.8121, G.8121.1)
		two-way	DM (G.8121, G.8121.1, G.8121.2) *LMDM (G.8121.2)*

Table A.1 – OAM capability support

OAM function			OAM mechanism
	Maintenance	one-way throughput test	1TH (G.8121, G.8121.1)
		On-demand loop back	CV (G.8121, G.8121.1, G.8121.2)
		On-demand link trace (LT)	CV (G.8121) CV (G.8121.2)
Proactive fault management	Continuity check and connectivity verification		CC/CV (G.8121, G.8121.2) CCM (G.8121.1)
	Remote defect indication		RDI (G.8121, G.8121.1, G.8121.2)
	Alarm indication signal		AIS (G.8121, G.8121.1, G.8121.2)
	Locked signal (Lock report)		LCK (G.8121, G.8121.1, G.8121.2)
On-demand fault management	Connectivity verification		CV (G.8121, G.8121.1, G.8121.2)
	Lock instruction		LKI (G.8121.2)
	Automatic protection switching		APS (G.8121)
	Management communication channel/Signalling communication channel		MCC/SCC (G.8121)
NOTE 1 – OAM mechanisms for MEP are all the OAMs specified in the [ITU-T G.8121] series. (The exception is APS, which NCM MEP does not support.) NOTE 2 – OAM mechanism for MIP is (on-demand) CV only.			

A.1.1 MEP compound function

There are two different types of MEP compound function:

– mandatory NCM MEPs at the boundary of a layer network, monitoring an NC;

– optional TCM MEPs in the middle of a layer network, monitoring a tandem connection.

See Figure A.1.

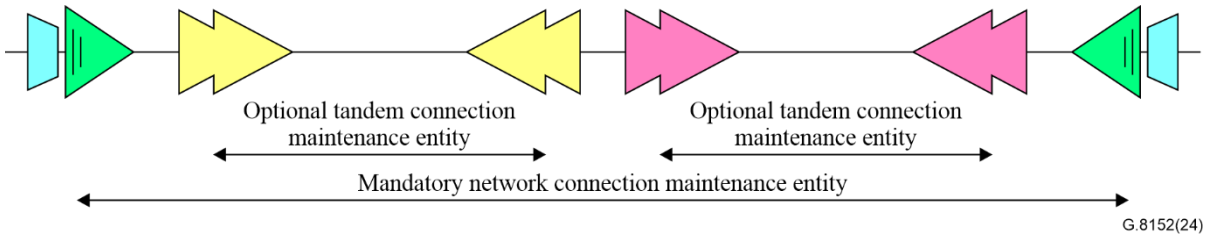


Figure A.1 – Mandatory and optional MEPs

From the management perspective, an MEP has the following constraints.

– An MEP can be unidirectional or bidirectional; unidirectional MEPs have a limited set of OAM functionality.

– An MEP belongs to one, and only one, MEL. MEPs terminate MEGs and each MEG is associated to one MEL.

– An MEP is addressed by one, and only one, medium access control (MAC) address. The MAC address (or more precisely the EUI-48) is bound to a physical subsystem and one

physical subsystem can hold thousands of MEP functions, and all those MEP functions share in such case one MAC address.

The MEP compound function supports three applications that are organized in types of job:

– on-demand measurement;

– proactive measurement;

– maintenance.

See Figure A.2.

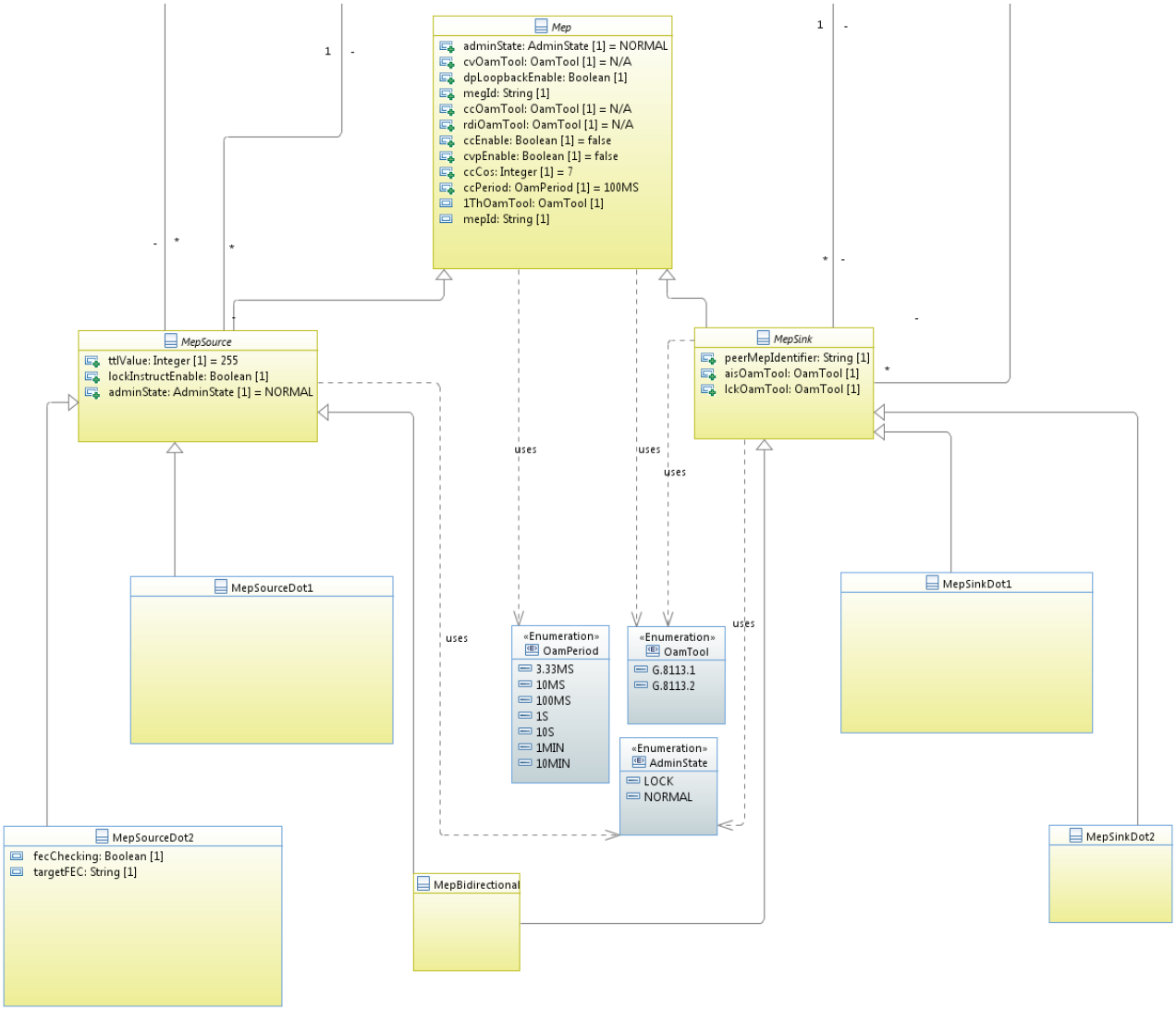


Figure A.2 – MEP class diagram

The MI of the compound functions (specified in [ITU-T G.8121]) needs to be mapped to ITU-T G.8152 artefacts. Clauses A.1.1.1 to A.1.1.3 list all the MI specified for the MEP compound function in tables and associate them with applications (coloured background). The corresponding part of the model is shown below the table.

A.1.1.1 MEP on-demand diagnostic function

The MEP on-demand diagnostic function exists in NCM and TCM MEPs. See Figure A.3.

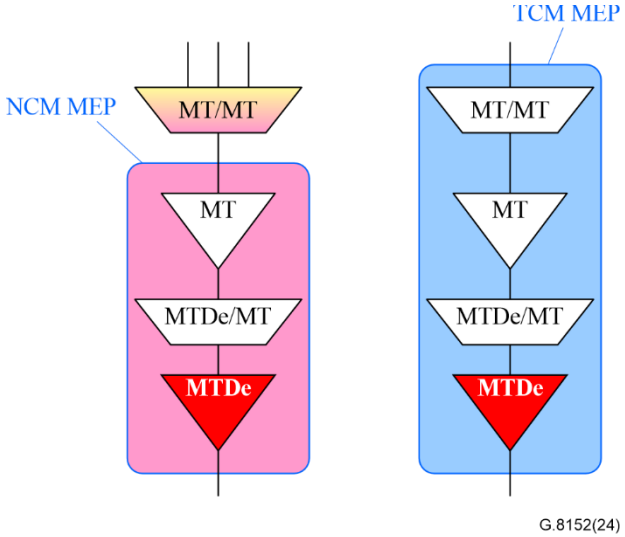


Figure A.3 – MEP on-demand diagnostic function

[ITU-T G.8121] specifies MI for on-demand measurements and maintenance as listed in Table A.2.

Table A.2 – On-demand measurement and maintenance MI list

Functionality	ITU-T G.8121 MTDe_TT_So_MI	ITU-T G.8121 MTDe_TT_Sk_MI	ITU-T G.8121.1 MTDe_TT_So_MI	ITU-T G.8121.1 MTDe_TT_Sk_MI	ITU-T G.8121.2 MTDe_TT_So_MI	ITU-T G.8121.2 MTDe_TT_Sk_MI
General	GAL_Enable	GAL_Enable	GAL_Enable	GAL_Enable	GAL_Enable	GAL_Enable
	TTLVALUE		TTLVALUE			
			MEP_ID	MEP_ID		
Two-way on-demand loss of frame measurement	LMo_OAM_Tool	LMo_OAM_Tool	LMo_OAM_Tool	LMo_OAM_Tool	LMo_OAM_Tool	LMo_OAM_Tool
	LMo_Start(CoS,Period)[1...M_{LMo}]		LMo_Start(CoS,Period)[1...M_{LMo}]		LMo_Start(CoS, Test_ID, Period, LMType, CountBytes)[1...M_{LMo}]	
	LMo_Intermediate_Request[1...M_{LMo}]		LMo_Intermediate_Request[1...M_{LMo}]		LMo_Intermediate_Request[1...M_{LMo}]	
	LMo_Terminate[1...M_{LMo}]		LMo_Terminate[1...M_{LMo}]		LMo_Terminate[1...M_{LMo}]	
	LMo_Result(N_TF,N_LF,F_TF,F_LF)[1...M_{LMo}]		*LMo_Result(N_TF,N_LF,F_TF,F_LF)[1...M_{LMo}]*		*LMo_Result(N_TF, N_LF, F_TF, F_LF)[1...M_{LMo}]*	
					LMo_ReportError(Error)[1...M_{LMo}]	
					LMo_PeriodChanged[1...M_{LMo}]	
One-way on-demand synthetic loss of frame measurement						
Two-way on-demand synthetic loss of frame measurement	SLo_OAM_Tool	SLo_OAM_Tool				
	SLo_Start (CoS,Test_ID,Length,Period)[1...M_{SLo}]					
	SLo_Intermediate_Request[1...M_{SLo}]					
	SLo_Terminate[1...M_{SLo}]					
	SLo_Result(N_TF,N_LF,F_TF,F_LF)[1...M_{SLo}]					
	1DMo_OAM_Tool	1DMo_OAM_Tool	1DMo_OAM_Tool	1DMo_OAM_Tool		

Table A.2 – On-demand measurement and maintenance MI list

Functionality	ITU-T G.8121 MTDe_TT_So_MI	ITU-T G.8121 MTDe_TT_Sk_MI	ITU-T G.8121.1 MTDe_TT_So_MI	ITU-T G.8121.1 MTDe_TT_Sk_MI	ITU-T G.8121.2 MTDe_TT_So_MI	ITU-T G.8121.2 MTDe_TT_Sk_MI
One-way on-demand frame delay measurement	1DMo_Start (CoS,Test_ID,Length,Period)[1...M_{1DMo}]	1DMo_Start(Test_ID)[1...M_{1DMo}]	1DMo_Start (CoS,,Length,Period)[1...M_{1DMo}]	1DMo_Start[1...M_{1DMo}]		
	1DMo_Terminate[1...M_{1DMo}]	1DMo_Terminate[1...M_{1DMo}]	1DMo_Terminate[1...M_{1DMo}]	1DMo_Terminate[1...M_{1DMo}]		
Two-way on-demand frame delay measurement	DMo_OAM_Tool	DMo_OAM_Tool	DMo_OAM_Tool	DMo_OAM_Tool	DMo_OAM_Tool	DMo_OAM_Tool
	DMo_Start (CoS,Test_ID,Length,Period)[1...M_{DMo}]		DMo_Start (CoS,Length,Period)[1...M_{DMo}]		DMo_Start(CoS, Test_ID, Length, Period, CopyPad)[1...M_{DMo}]	
	DMo_Intermediate_Request[1...M_{LMo}]		DMo_Intermediate_Request[1...M_{LMo}]		DMo_Intermediate_Request[1...M_{LMo}]	
	DMo_Terminate[1...M_{DMo}]		DMo_Terminate[1...M_{DMo}]		DMo_Terminate[1...M_{DMo}]	
	DMo_Result(count,B_FD[],F_FD[],N_FD[])[1...M_{DMo}]	*1DMo_Result(count,N_FD[])[1...M_{DMo}]]*	*DMo_Result(count,B_FD[],F_FD[],N_FD[])[1...M_{DMo}]*		*DMo_Result(count, B_FD[], F_FD[], N_FD[])[1...M_{DMo}]*	
					DMo_ReportError(Error) [1...M_{DMo}]	
					DMo_PeriodChanged [1...M_{DMo}]	
Two-way on-demand frame loss / frame delay measurement					LMo_OAM_Tool (Note1)	
					DMo_OAM_Tool (Note2)	
					LMDMo_Start(CoS, Test_ID, Length, Period, LMType, CountBytes, CopyPad)[1...M_{LMDMo}]	
					LMDMo_IntermediateReport[1...M_{LMDMo}]	
					LMDMo_Terminate [1...M_{LMDMo}]	
					LMo_Result(N_TF, N_LF, F_TF, F_LF)[1...M_{LMo}]	

Table A.2 – On-demand measurement and maintenance MI list

Functionality	ITU-T G.8121 MTDe_TT_So_MI	ITU-T G.8121 MTDe_TT_Sk_MI	ITU-T G.8121.1 MTDe_TT_So_MI	ITU-T G.8121.1 MTDe_TT_Sk_MI	ITU-T G.8121.2 MTDe_TT_So_MI	ITU-T G.8121.2 MTDe_TT_Sk_MI
					DMo_Result(count, B_FD[], F_FD[], N_FD[])[1...M_{DMo}]	
					LMo_ReportError(Error) [1...M_{LMo}]	
					LMo_PeriodChanged [1...M_{LMo}]	
On-demand loop back	CV_OAM_Tool	CV_OAM_Tool	CV_OAM_Tool	CV_OAM_Tool	CV_OAM_Tool	CV_OAM_Tool
	CV_Series()		CV_Series (TTL,CoS,N,Length,Period)		CV_Series (Session_ID, Count, Period, CoS, Size, ValidateFEC, ValidateReverse, TargetFECStack)	
	CV_Series_Result()		*CV_Series_Result(REC,ERR,OO)*		FEC_Checking	FEC_Checking
					Target_FEC	FEC_Checking
					CV_Series_Result(Session_ID, Rcv, OOO, FWErr, BWErr)	
					CV_FWErr(Session_ID, Seq, RC, SubRC, ErrTLV)	
					CV_BWErr(Session_ID, Seq, RC, SubRC, ErrTLV)	
On-demand lock instruct	Admin_State	*Admin_State_Request*			Admin_State	*Admin_State_Request*
	Lock_Instruct_Enable				Lock_Instruct_Enable	
	LI_Period				LI_Period	
	LI_MEPID				LI_MEPID	
	LI_CoS				LI_CoS	

Table A.2 – On-demand measurement and maintenance MI list

Functionality	ITU-T G.8121 MTDe_TT_So_MI	ITU-T G.8121 MTDe_TT_Sk_MI	ITU-T G.8121.1 MTDe_TT_So_MI	ITU-T G.8121.1 MTDe_TT_Sk_MI	ITU-T G.8121.2 MTDe_TT_So_MI	ITU-T G.8121.2 MTDe_TT_Sk_MI
One-way on-demand throughput test	1TH_OAM_Tool	1TH_OAM_Tool	1TH_OAM_Tool	1TH_OAM_Tool		
	1TH_Start (CoS, Length, Period)	1TH_Start	1TH_Start (CoS, Pattern, Length, Period)	1TH_Start (Period)		
	1TH_Terminate	1TH_Terminate	1TH_Terminate	1TH_Terminate		
	1TH_Result(Sent)	*1TH_Result(REC,CRC,BER,OO)*	*1TH_Result(Sent)*	*1TH_Result(REC,CRC,BER,OO)*		
On-demand LT	CV_OAM_Tool	CV_OAM_Tool	CV_OAM_Tool	CV_OAM_Tool	CV_OAM_Tool	CV_OAM_Tool
					CV_Trace (Session_ID, CoS, ValidateFEC, ValidateReverse, TargetFECStack)	
					CV_Trace_Result (Session_ID, Result)	
					CV_FWErr(Session_ID, Seq, RC, SubRC, ErrTLV)	
					CV_BWErr(Session_ID, Seq, RC, SubRC, ErrTLV)	
On-demand test	CV_OAM_Tool	CV_OAM_Tool	CV_OAM_Tool	CV_OAM_Tool		
			CV_Test (CoS, Pattern, Length,Period)			
			CV_Terminate			
			CV_Test_Result(Sent, REC, REC,ERR,OO)			

A.1.1.2 MEP proactive measurement function

The MEP proactive measurement function exists in NCM and TCM MEPs. See Figure A.4.

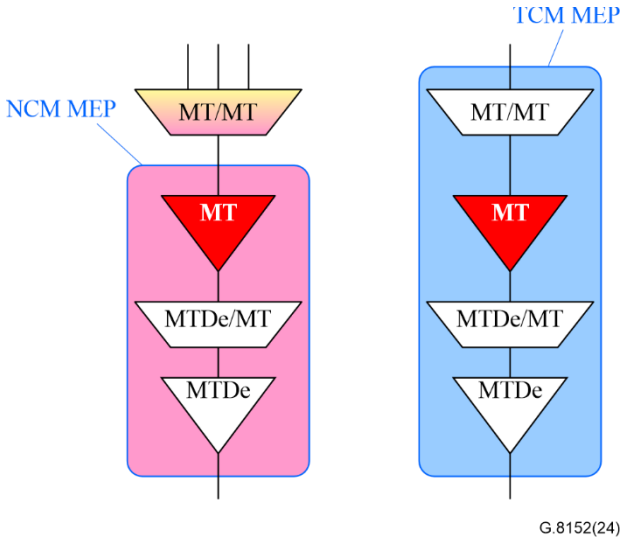


Figure A.4 – MEP proactive measurement function

[ITU-T G.8121] specifies MI for proactive measurements as listed in Table A.3.

Table A.3 – Pro-active measurement MI list

Functionality	ITU-T G.8121 MT_TT_So_MI	ITU-T G.8121 MT_TT_Sk_MI	ITU-T G.8121.1 MT_TT_So_MI	ITU-T G.8121.1 MT_TT_Sk_MI	ITU-T G.8121.2 MT_TT_So_MI	ITU-T G.8121.2 MT_TT_Sk_MI
General	GAL_Enable	GAL_Enable	GAL_Enable	GAL_Enable	GAL_Enable	GAL_Enable
	TTLVALUE		TTLVALUE		TTLVALUE	
	MEG_ID	MEG_ID	MEG_ID	MEG_ID		
	MEP_ID	PeerMEP_ID	MEP_ID	PeerMEP_ID	MEP_ID	PeerMEP_ID
		AIS_OAM_Tool				
		LCK_OAM_Tool				
						PM_ClearError

Table A.3 – Pro-active measurement MI list

Functionality	ITU-T G.8121 MT_TT_So_MI	ITU-T G.8121 MT_TT_Sk_MI	ITU-T G.8121.1 MT_TT_So_MI	ITU-T G.8121.1 MT_TT_Sk_MI	ITU-T G.8121.2 MT_TT_So_MI	ITU-T G.8121.2 MT_TT_Sk_MI
						PM_Responder_Enable
Continuity check and Connectivity Verification	CC_OAM_Tool	CC_OAM_Tool	CC_OAM_Tool	CC_OAM_Tool	CC_OAM_Tool	CC_OAM_Tool
	RDI_OAM_Tool	RDI_OAM_Tool	RDI_OAM_Tool	RDI_OAM_Tool	RDI_OAM_Tool	RDI_OAM_Tool
	CC_Enable (Note1)	CC_Enable (Note1)	CC_Enable (Note2)	CC_Enable	CC_Enable[1…M_{CCCV}]	
	CVp_Enable (Note1)	CVp_Enable (Note1)			CVp_Enable[1…M_{CCCV}]	
					CCCV_Mode[1…M_{CCCV}]	
	MEP_ID	PeerMEP_ID	MEP_ID	PeerMEP_ID	MEP_ID[1…M_{CCCV}]	PeerMEP_ID[1…M_{CCCV}]
	CC_CoS	CC_CoS	CC_CoS	CC_CoS	CC_CoS[1…M_{CCCV}]	CC_CoS[1…M_{CCCV}]
	CC_Period	CC_Period	CC_Period	CC_Period	CC_Period	CC_Period
		Get_SvdCC		Get_SvdCC		Get_SvdCC[1…M_{CCCV}]
		SvdCC		*SvdCC*		*SvdCC*
	NOTE 1 – MI_CC_Enable and MI_CVp_Enable are used to enable CC and CV functions respectively. *The possible combinations are:* – *no CC function and no CV function: MI_CC_Enable = false and MI_CVp_Enable = false* – *CC-only function: MI_CC_Enable = true and MI_CVp_Enable = false* – *CC and CV functions: MI_CC_Enable = true and MI_CVp_Enable = true* *NOTE 2 – MI_CVp_Enable defined in [ITU-T G.8121] is automatically configured true by setting MI_CC_Enable true.*					
One-way proactive loss of frame measurement using CC	CC_OAM_Tool	CC_OAM_Tool	CC_OAM_Tool	CC_OAM_Tool		
	1LMp_Enable	1LMp_Enable	LMC_Enable	LMC_Enable		
			MEP_ID	PeerMEP_ID		
			CC_CoS	CC_CoS		
			CC_Period	CC_Period		

Table A.3 – Pro-active measurement MI list

Functionality	ITU-T G.8121 MT_TT_So_MI	ITU-T G.8121 MT_TT_Sk_MI	ITU-T G.8121.1 MT_TT_So_MI	ITU-T G.8121.1 MT_TT_Sk_MI	ITU-T G.8121.2 MT_TT_So_MI	ITU-T G.8121.2 MT_TT_Sk_MI
Two-way proactive loss of frame measurement	LMp_OAM_Tool	LMp_OAM_Tool	LMp_OAM_Tool	LMp_OAM_Tool	LMp_OAM_Tool	LMp_OAM_Tool
	LMp_Enable[1...M_{LMp}]	LMp_Enable[1... M_{LMp}]	LMp_Enable[1...M_{LMp}]	LMp_Enable[1... M_{LMp}]	LMp_Enable[1...M_{LMp}]	LMp_Enable[1... M_{LMp}]
	LMp_Period[1...M_{LMp}]		LMp_Period[1...M_{LMp}]		LMp_Period[1...M_{LMp}]	
	LMp_CoS[1...M_{LMp}]	LMp_CoS[1... M_{LMp}]	LMp_CoS[1...M_{LMp}]	LMp_CoS[1... M_{LMp}]	LMp_CoS[1...M_{LMp}]	
					LMp_Test_ID[1...M_{LMp}]	
					LMp_LMType[1...M_{LMp}]	
					LMp_CountBytes[1...M_{LMp}]	
					LMp_PeriodChanged[1... M_{LMp}]	
						LMp_ReportError(Error) [1...M_{LMp}]
		LM_DEGM		LM_DEGM		
		LM_M		LM_M		
		LM_DEGTHR		LM_DEGTHR		
		LM_TFMIN		LM_TFMIN		
One-way proactive synthetic loss of frame measurement	1SLp_OAM_Tool	1SLp_OAM_Tool				
	1SLp_Enable[1...M_{1SLp}]	1SLp_Enable[1...M_{1SLp}]				
	1SLp_Period[1...M_{1SLp}]					
	1SLp_Test_ID[1...M_{1SLp}]	1SLp_Test_ID[1...M_{1SLp}]				
	1SLp_Length[1...M_{1SLp}]					
	1SLp_CoS[1...M_{1SLp}]					
Two-way proactive synthetic loss of frame measurement	SLp_OAM_Tool	SLp_OAM_Tool			(covered by delay management proactive (DMp))	(covered by DMp)
	SLp_Enable[1...M_{SLp}]	SLp_Enable[1… M_{SLp}]				
	SLp_Period[1...M_{SLp}]					
	SLp_Test_ID[1...M_{SLp}]					
	SLp_Length[1...M_{SLp}]					

Table A.3 – Pro-active measurement MI list

Functionality	ITU-T G.8121 MT_TT_So_MI	ITU-T G.8121 MT_TT_Sk_MI	ITU-T G.8121.1 MT_TT_So_MI	ITU-T G.8121.1 MT_TT_Sk_MI	ITU-T G.8121.2 MT_TT_So_MI	ITU-T G.8121.2 MT_TT_Sk_MI
	SLp_CoS[1...M_{SLp}]	SLp_CoS[1… M_{SLp}]				
One-way proactive frame delay measurement	1DMp_OAM_Tool	1DMp_OAM_Tool				
	1DMp_Enable[1...M_{1DMp}]	1DMp_Enable[1...M_{1DMp}]				
	1DMp_Period[1...M_{1DMp}]					
	1DMp_Test_ID[1...M_{1DMp}]	1DMp_Test_ID[1...M_{1DMp}]				
	1DMp_Length[1...M_{1DMp}]					
	1DMp_CoS[1...M_{1DMp}]					
two-way proactive frame delay measurement	DMp_OAM_Tool	DMp_OAM_Tool	DMp_OAM_Tool	DMp_OAM_Tool	DMp_OAM_Tool	DMp_OAM_Tool
	DMp_Enable[1...M_{DMp}]	DMp_Enable[1… M_{DMp}]	DMp_Enable[1...M_{DMp}]	DMp_Enable[1… M_{DMp}]	DMp_Enable[1...M_{DMp}]	DMp_Enable[1… M_{DMp}]
	DMp_Period[1...M_{DMp}]		DMp_Period[1...M_{DMp}]		DMp_Period[1...M_{DMp}]	
	DMp_Test_ID[1...M_{DMp}]		DMp_Test_ID[1...M_{DMp}]		DMp_Test_ID[1...M_{DMp}]	
	DMp_CoS[1...M_{DMp}]	DMp_CoS[1… M_{DMp}]	DMp_CoS[1...M_{DMp}]	DMp_CoS[1… M_{DMp}]	DMp_CoS[1...M_{DMp}]	
	DMp_Length[1...M_{DMp}]		DMp_Length[1...M_{DMp}]		DMp_Length[1...M_{DMp}]	
					DMp_CopyPad[1...M_{DMp}]	
					DMp_PeriodChanged[1... M_{LMp}]	
						DMp_ReportError(Error) [1...M_{DMp}]
Fault cause list		cSSF cLCK cLOC cMMG cUNM cUNP cUNC cDEG cRDI		cSSF cLCK cLOC cMMG cUNM cUNP cUNC cDEG cRDI		cSSF cLCK cLOC[] cMMG cUNM cUNC cDEG cRDI

Table A.3 – Pro-active measurement MI list

Functionality	ITU-T G.8121 MT_TT_So_MI	ITU-T G.8121 MT_TT_Sk_MI	ITU-T G.8121.1 MT_TT_So_MI	ITU-T G.8121.1 MT_TT_Sk_MI	ITU-T G.8121.2 MT_TT_So_MI	ITU-T G.8121.2 MT_TT_Sk_MI
Performance primitive list		pN_LF[1...P] pN_TF[1...P] pF_LF[1...P] pF_TF[1...P] pF_DS pN_DS pB_FD[1...P] pB_FDV[1...P] pN_FD[1...P] pN_FDV[1...P] pF_FD[1...P] pF_FDV[1...P]		pN_LF pN_TF pF_LF pF_TF pF_DS pN_DS		pN_LF[1...P] pN_TF[1...P] pF_LF[1...P] pF_TF[1...P] pF_DS pN_DS pB_FD[1...P] pB_FDV[1...P] pN_FD[1...P] pN_FDV[1...P] pF_FD[1...P] pF_FDV[1...P]

A.1.1.3 MEP configuration function

The MEP configuration function exists in NCM and TCM MEPs. See Figure A.5.

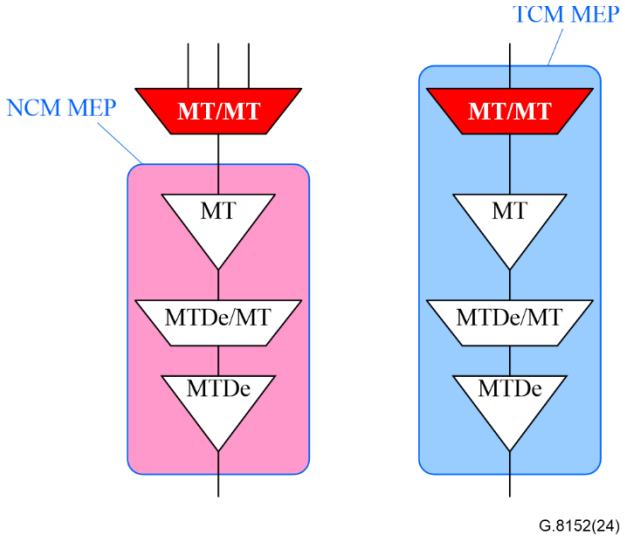


Figure A.5 – MEP configuration function

[ITU-T G.8121] specifies MI to configure an MEP as listed in Table A.4.

Table 0A.4 – MEP configuration MI list

Functionality	ITU-T G.8121 MT/MT_A_So_MI	ITU-T G.8121 MT/MT_A_Sk_MI	ITU-T G.8121.1 MT/MT_A_So_MI	ITU-T G.8121.1 MT/MT_A_Sk_MI	ITU-T G.8121.2 MT/MT_A_So_MI	ITU-T G.8121.2 MT/MT_A_Sk_MI
General	GAL_Enable	GAL_Enable				
	TTLVALUE					
Lock	Admin_State	Admin_State				
	LCK_Period	LCK_Period				
	LCK_CoS	LCK_CoS				
	LCK_OAM_Tool	LCK_OAM_Tool				
Alarm indication signal (Note)	AIS_Period	AIS_Period			Local_Defect	
	AIS_CoS	AIS_CoS				
	AIS_OAM_Tool	AIS_OAM_Tool				
Client signal fail	CSF_Tool	CSF_Tool				
	CSF_Period					
	CSF_CoS					
	CSF_Enable					
	CSFrdifdiEnable	CSFrdifdiEnable				
		CSF_Reported				
Automatic protection switching	APS_OAM_Tool	APS_OAM_Tool				
	APS_CoS					

NOTE – MI for AIS at source is configured at server MEP.

A.1.2 MIP compound function

See Figures A.6 and A.7.

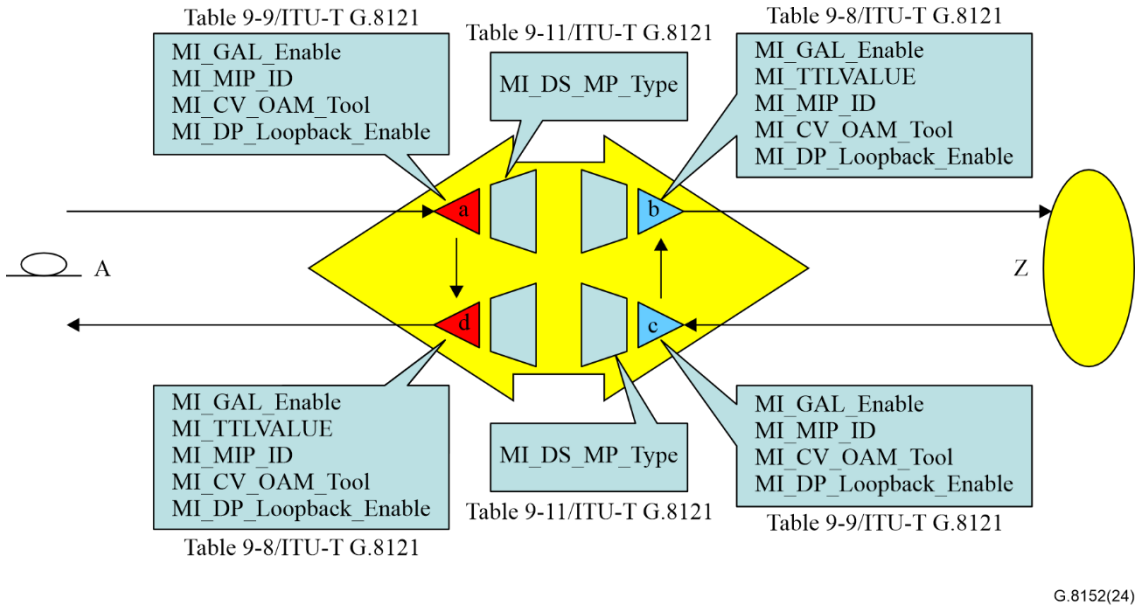


Figure A.6 – MIP configuration parameters

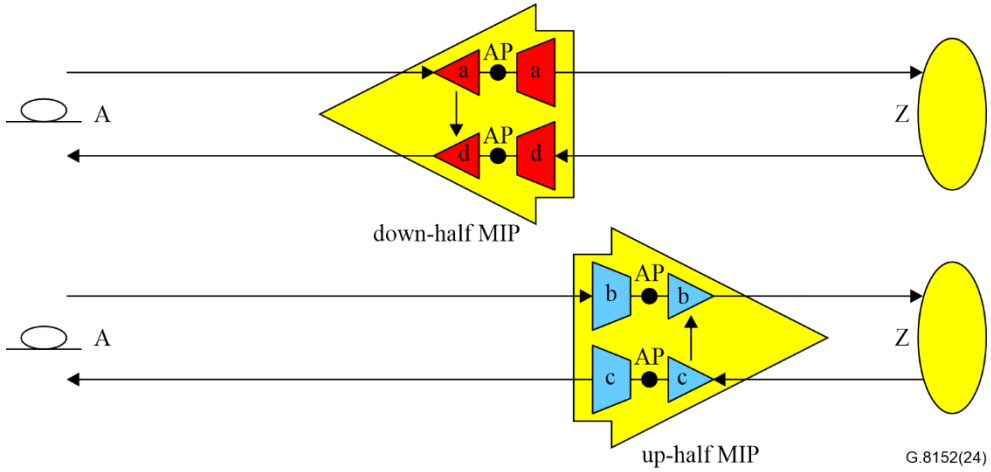


Figure A.7 – "half MIP" compound function

The MI of the MIP compound function (specified in [ITU-T G.8121]) is mapped to the MipBidirectional object class. See Figure A.8.

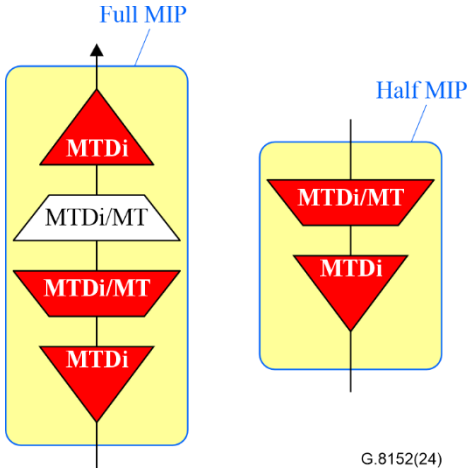


Figure A.8 – MIP/half MIP configuration function

[ITU-T G.8121] specifies MI to configure an MIP as listed in Table A.5.

Table 0A.5 – MIP configuration MI list

Functionality	ITU-T G.8121 MTDi_TT_So_MI	ITU-T G.8121 MTDi_TT_Sk_MI	ITU-T G.8121.1 MTDi_TT_So_MI	ITU-T G.8121.1 MTDi_TT_Sk_MI	ITU-T G.8121.2 MTDi_TT_So_MI	ITU-T G.8121.2 MTDi_TT_Sk_MI
General	GAL_Enable	GAL_Enable				
	TTLVALUE					
	MIP_ID	MIP_ID				
		DS_MP_Type [Note]				
	[Note] DS_MP_type is configured at MTDi/MT_A_Sk					
On-demand CV	CV_OAM_Tool	CV_OAM_Tool			Target_FEC	

A.2 Fault management

For further study.

A.3 Performance monitoring

Performance monitoring (PM) allows measurement of different performance parameters like frame loss ratio, frame delay and frame delay variation.

A.3.1 Loss measurement

The frame LM provides performance data that is based on the lost frames between the ingress and the egress of an ME; i.e., between two MEPs.

LM is restricted to MEGs which have only a single ME.

The following LM functions are specified:

– two-way on-demand LM;
– one-way on-demand synthetic LM;
– two-way on-demand synthetic LM;
– two-way proactive LM;
– one-way proactive synthetic LM;
– two-way proactive synthetic LM.

The single-ended on-demand LM function is managed only at the source MEP. The sink MEP does not need any management.

The dual-ended proactive LM function is managed at source and sink MEP.

A.3.2 Delay measurement

The frame DM provides performance data that is based on the delay of the frames between the ingress and the egress of an ME; i.e., between two MEPs.

The following DM functions are specified:

– one-way on-demand DM;
– two-way (round-trip) on-demand DM;
– one-way proactive DM;
– two-way (round-trip) proactive DM.

The one-way DM function is started at the source MEP and enabled at the sink MEP.

The two-way DM function is managed only at the source MEP. The sink MEP does not need any management.

A.4 MPLS-TP multiplexing

This clause maps the MPLS-TP multiplexing related MI to the corresponding object classes.

The MPLS-TP multiplexing configuration function exists only in MT TTP and MT CTP.

See Figure A.9.

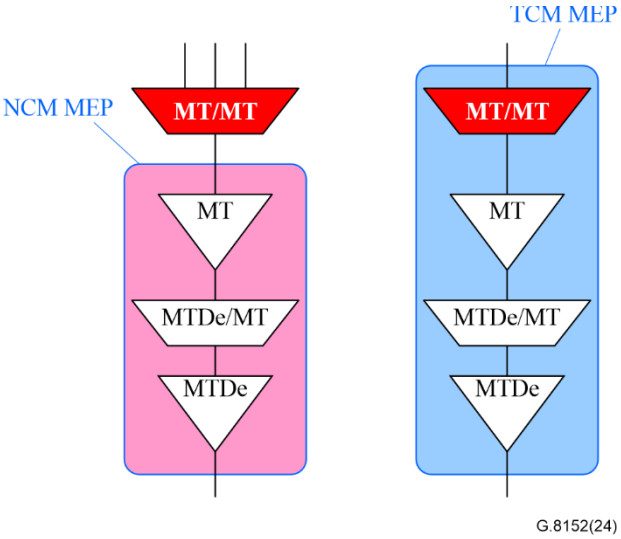


Figure A.9 – MPLS-TP multiplexing configuration function

[ITU-T G.8121] specifies MI to configure the MPLS-TP multiplexing function as listed in Table A.6.

Table A.6 – Mapping of multiplexing related MI to ITU-T G.8152 artefacts

Functionality	ITU-T G.8121 MT/MT_A_So_MI	ITU-T G.8121 MT/MT_A_Sk_MI
TTP associated MI	Label[1…M]	Label[1…M]
	LSPType[1…M]	LSPType[1…M]
	CoS[1…M]	CoS[1…M]
	PHB2TCMapping[1…M]	TC2PHBMapping[1…M]
	QoSEncodingMode[1…M]	QoSDecodingMode[1…M]
	Mode	Mode
CTP associated MI		

A.5 Connection function

This clause maps the connection function related MI to the corresponding object classes. See Table A.7.

Table A.7 – Mapping of connection function related MI to ITU-T G.8152 artefacts

Functionality	MT_C_MI	ITU-T G.8152
General connection management	Create_MC	
	Modify_MC	
	Delete_MC	
Individual connection point management	MT_C_MP per input and output connection point	
	for further study	
Individual connection management	MT_C_MP per matrix connection:	
	MT_C_MI_ConnectionType	
	MT_C_MI_Return_CP_ID	

Table A.7 – Mapping of connection function related MI to ITU-T G.8152 artefacts

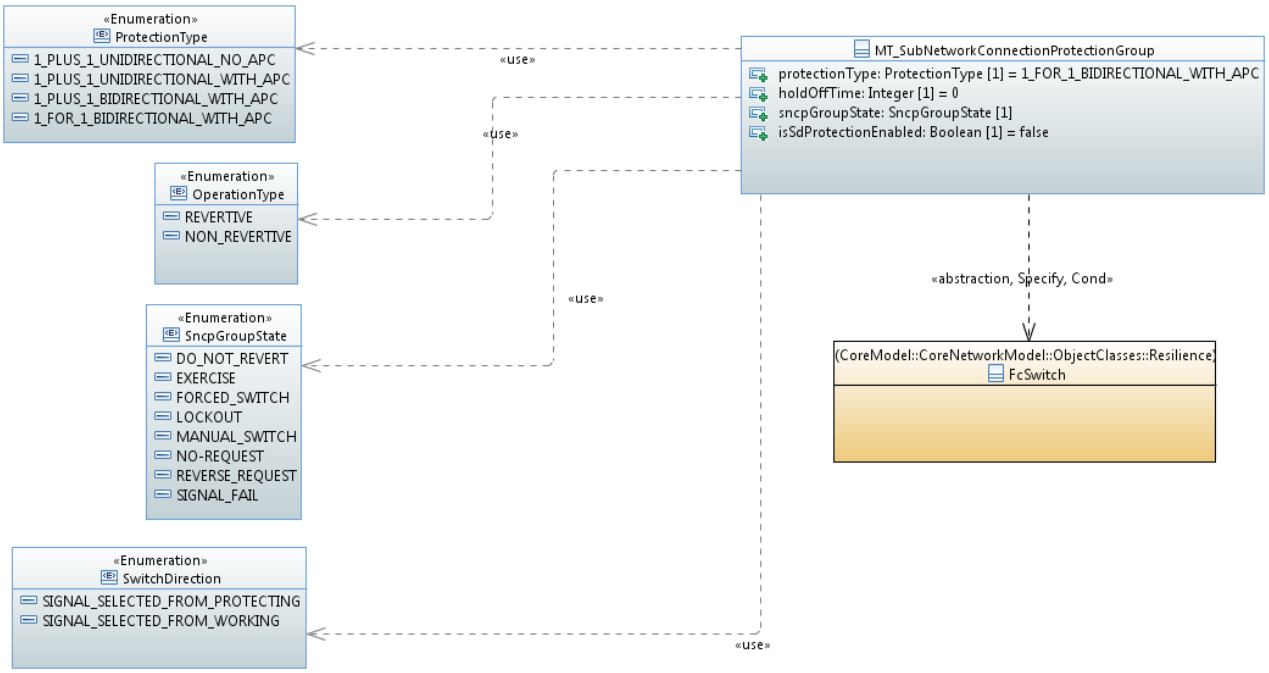
Functionality	MT_C_MI	ITU-T G.8152
	MT_C_MI_ConnectionPortIds	
Sub-network connection protection (SNCP) configuration	MT_C_MP per SNC/S protection process:	
	for further study	

A.5.1 Linear protection function

The MPLS-TP linear protection function is specified in [ITU-T G.8131]. The related MI is listed in [ITU-T G.8121].

This function is modelled by the MT_SNCP_Group object class.

See Figure A.10.



NOTE – This figure is also available from the ITU website here.

Figure A.10 – MPLS-TP linear protection

A.6 SCC/MCC access function

An SCC and MCC can be accessed when the containing label-switched path (LSP) is terminated. Each channel is able to transport Internet protocol version 4 (IPv4), 6 (IPv6) and open systems interconnection (OSI) structured signals. The diamonds in Figure A.11 represent traffic shaping and conditioning functions that may be needed to prevent the SCC/MCC forwarding points from exceeding their committed bandwidth in congestion situations.

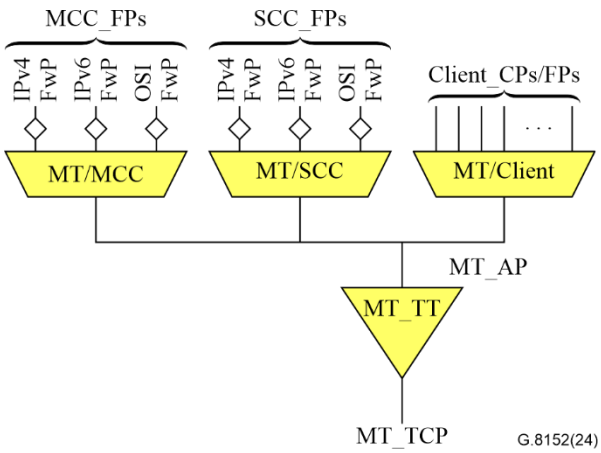
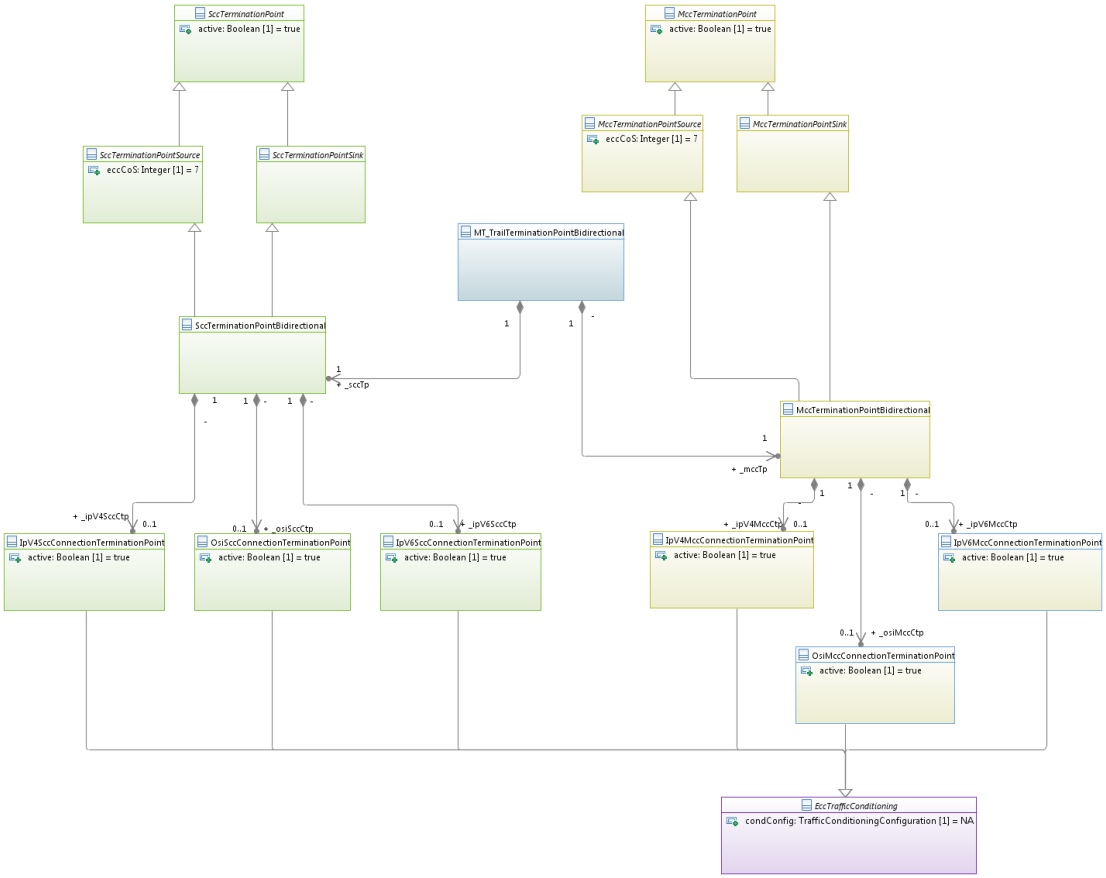


Figure A.11 – MT/SCC_A function, MT/MCC_A function, and MT/client_A function (reproduction of Figure 10-5 of [ITU-T G.8121])

SCC and MCC access are modelled using the same pattern. Only the bidirectional SCC/MCC termination point (TP) can be instantiated. Each TP contains one connection termination point (CTP) for IPv4 access, one CTP for IPv6 access and one CTP for OSI access. These CTPs have the capability to shape and condition the communication signals.

The management of the SCC/MCC access function has been added to the bidirectional MT TTP.

Figure A.12 is the related class diagram.



NOTE – This figure is also available from the ITU website here.

Figure A.12 – SCC/MCC access class diagram

Appendix I

UML modelling guidelines

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

See Annex A of [ITU-T G.7711].

NOTE – The UML modelling guidelines specified in ITU-T G.8152 (2013) have been enhanced and normatively specified in Annex A of [ITU-T G.7711].

Appendix II

Management information grouping and mapping

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

This appendix lists (from [ITU-T G.8121]) all atomic functions together with their MI. It is structured according to clause 9 of [ITU-T G.8121].

Conventions used in the tables:

– atomic functions having the same list of MI are grouped together;

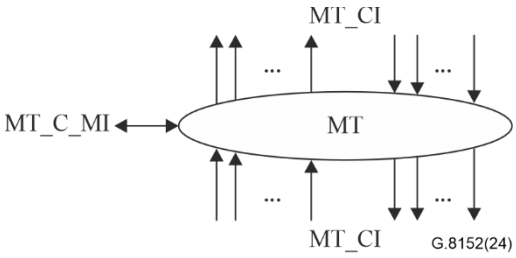
– fault and performance MI is not shown;

– MI of adaptation functions are identified as client layer related (blue) or "server layer related" (red).

II.1 MPLS-TP connection function (MT_C)

See Table II.1.

Table II.1 – MI groupings of the MPLS-TP connection function

Symbol	Management information	Managed object class
MPLS-TP connection function		
	MI_MatrixControl *per matrix connection:* MI_ConnectionType MI_Return_CP_ID MI_ConnectionPortIds *per SNCP protection group:* MI_PS_WorkingPortId MI_PS_ProtectionPortId MI_PS_ProtType MI_PS_OperType MI_PS_HoTime MI_PS_WTR MI_PS_ExtCMD MI_PS_BridgeType MI_PS_SD_Protection	

II.2 MPLS-TP termination function (MT_TT)

See Table II.2.

Table II.2 – MI groupings of the MPLS-TP termination function

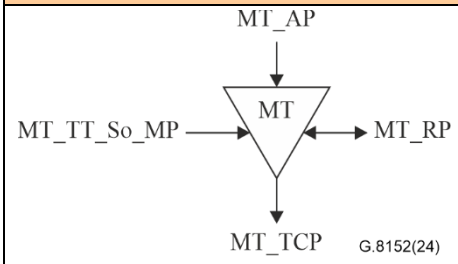
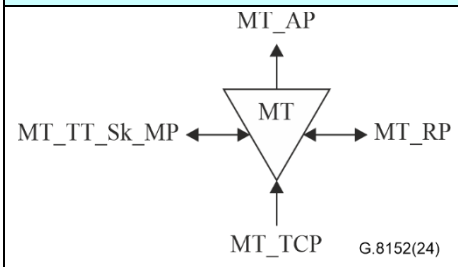
Symbol	Management information	Managed object class
MPLS-TP (MT) trail termination source function		
	MI_GAL_Enable MI_TTLVALUE MI_MEG_ID MI_MEP_ID MI_CC_OAM_Tool MI_RDI_OAM_Tool MI_CC_Enable MI_CVp_Enable MI_CC_CoS MI_CC_Period MI_LMp_OAM_Tool MI_LMp_Enable[i] MI_LMp_Period[i] MI_LMp_CoS[i] MI_DMp_OAM_Tool MI_DMp_Enable[i] MI_DMp_Period[i] MI_DMp_Test_ID[i] MI_DMp_CoS[i] MI_DMp_Length[i] MI_1DMp_OAM_Tool MI_1DMp_Enable[i] MI_1DMp_Period[i] MI_1DMp_Test_ID[i] MI_1DMp_Length[i] MI_1DMp_CoS[i] MI_SLp_OAM_Tool MI_SLp_Enable[i] MI_SLp_Period[i] MI_SLp_Test_ID[i] MI_SLp_Length[i] MT_TT_So_MI_SLp_CoS[i]	
G.8121.1 specific	MI_LMC_Enable	
G.8121.2 specific	MI_CCCV_Mode[i] MI_Local_Discr MI_DMp_CopyPad[i] MI_LMp_Test_ID[i] MI_LMp_LMType[1...MLMp] MI_LMp_CountBytes[i]	
MPLS-TP (MT) trail termination sink function		

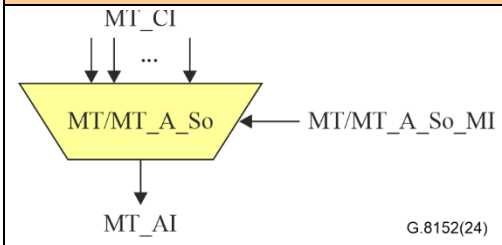
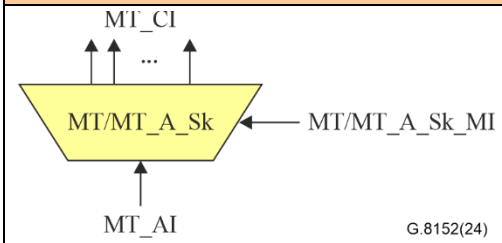
Table II.2 – MI groupings of the MPLS-TP termination function

Symbol	Management information	Managed object class
	MI_GAL_Enable MI_MEG_ID MI_PeerMEP_ID MI_CC_OAM_Tool MI_RDI_OAM_Tool MI_CC_Enable MI_CVp_Enable MI_CC_Period MI_CC_CoS MI_Get_SvdCC MI_LMp_OAM_Tool MI_LMp_Enable[i] MI_LMp_CoS[i] MI_LM_DEGM MI_LM_M MI_LM_DEGTHR MI_LM_TFMIN MI_DMp_OAM_Tool MI_DMp_Enable[i] MI_DMp_CoS[i] MI_1DMp_OAM_Tool MI_1DMp_Enable[i] MI_1DMp_Test_ID[i] MI_SLp_OAM_Tool MI_SLp_Enable[i] MI_SLp_CoS[i] MI_AIS_OAM_Tool MI_LCK_OAM_Tool MI_1second	
G.8121.1 specific	MI_LMC_Enable	
G.8121.2 specific	MI_CCCV_Mode[i] MI_Remote_Discr[i] MI_PM_ClearError MI_PM_Responder_Enable	

II.3 MPLS-TP to MPLS-TP adaptation function (MT/MT_A)

See Table II.3.

Table II.3 – MI Groupings of the MPLS-TP to MPLS-TP adaptation function

Symbol	Management information (blue: client layer related red: server layer related)	Managed object class
MPLS-TP to MPLS-TP adaptation source function		
	MI_Active MI_Admin_State MI_Label[i] MI_LSPType[i] MI_CoS[i] MI_PHB2TCMapping[i] MI_QoSEncodingMode[i] MI_Mode MI_LCK_Period[i] MI_LCK_CoS[i] MI_LCK_OAM_Tool[i] MI_GAL_Enable[i] (NOTE – Should be MI_GAL_Enable set double (Server and client)?) MI_APS_CoS MI_APS_OAM_Tool	
MPLS-TP to MPLS-TP adaptation sink function		
	MI_Active MI_AdminState MI_Label[i] MI_LSPType[i] MI_CoS[i] MI_TC2PHBMapping[i] MI_QoSDecodingMode[i] MI_Mode MI_AIS_Period[i] MI_AIS_CoS[i] MI_AIS_OAM_Tool[i] MI_LCK_Period[i] MI_LCK_CoS[i] MI_LCK_OAM_Tool[i] MI_APS_OAM_Tool MI_GAL_Enable [i] (NOTE – Should be MI_GAL_Enable set double (Server and cliene)?)	
G.8121.2 specific	MI_Local_Defect[i]	

II.4 MT diagnostic functions (MPLS-TP MEP diagnostic function (MTDe) and MPLS-TP diagnostic function within MTx MIP (MTDi))

See Table II.4.

Table II.4 – MI groupings of the MT diagnostic functions

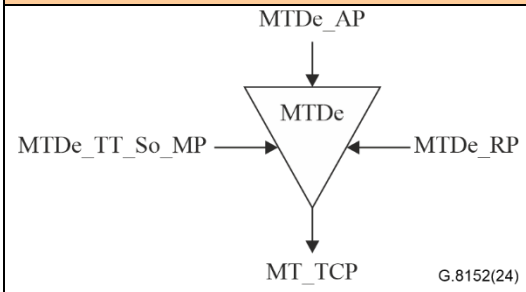
Symbol	Management information	Managed object class
MT diagnostic trail termination source function for MEP (MTDe_TT_So)		
	MI_GAL_Enable MI_TTLVALUE MI_CV_OAM_Tool MI_CV_Series () MTDe_TT_So_MI_1TH_OAM_Tool MI_1TH_Start (CoS,Length,Period) MI_1TH_Terminate MI_LMo_OAM_Tool MI_LMo_Start(CoS,Period) [i] MI_LMo_Terminate[i] MI_DMo_OAM_Tool MI_DMo_Start (CoS,Test_ID,Length,Period)[i] MI_DMo_Terminate[i] MI_1DMo_OAM_Tool MI_1DMo_Start(CoS,Test_ID,Length,Period)[i] MI_1DMo_Terminate[i] MI_SLo_OAM_Tool MI_SLo_Start (CoS,Test_ID,Length,Period)[i] MI_SLo_Terminate[i] MI_Admin_State MI_Lock_Instruct_Enable MI_DP_Loopback_Enable	
G.8121.1 specific	MI_MEP_ID MI_CV_Series (Target MEP/MIP ID, CoS, N, Length, Period) MI_CV_Test(CoS, Pattern, Length, Period)	

Table II.4 – MI groupings of the MT diagnostic functions

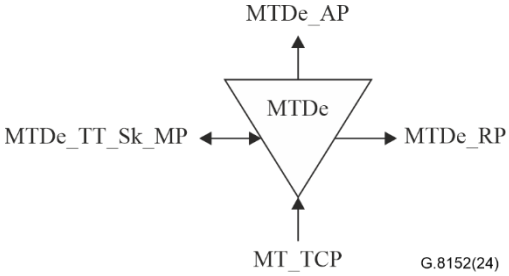
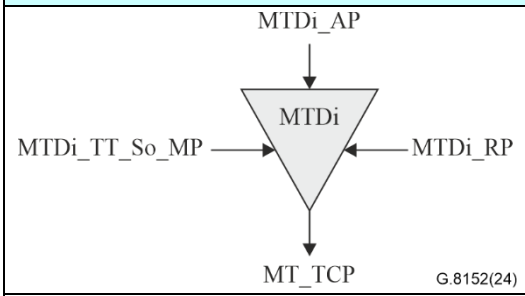
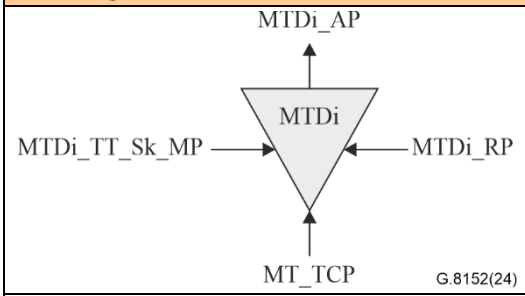
Symbol	Management information	Managed object class
G.8121.2 specific	MI_CV_Series (Session_ID, Count, Period, CoS, Size, ValidateFEC, ValidateReverse, TargetFECStack) MI_CV_Trace (Session_ID, CoS, ValidateFEC, ValidateReverse, TargetFECStack) MI_FEC_Checking MI_Target_FEC MI_Ifnum MI_MTU MI_DMo_Start(CoS, Test_ID, Length, Period, CopyPad)[i] MI_LMo_Start(CoS, Test_ID, Period, LMType,CountBytes)[i] LMDMo_Start(CoS, Test_ID, Length, Period, LMType, CountBytes, CopyPad)[i] MI_LMDMo_Terminate [i] MI_LI_Period MI_LI_MEPID MI_LI_CoS	
MT diagnostic trail termination sink function for MEP (MTDe_TT_Sk)		
	MI_GAL_Enable MI_CV_OAM_Tool MI_1TH_OAM_Tool MI_1TH_Start MI_1TH_Terminate MI_LMo_OAM_Tool MI_DMo_OAM_Tool MI_1DMo_OAM_Tool MI_1DMo_Start(Test_ID)[i] MI_1DMo_Terminate[i] MI_SLo_OAM_Tool MI_DP_Loopback_Enable	
G.8121.1 specific	MI_MEP_ID MI_1TH_Start(Period)	
G.8121.2 specific	MI_FEC_Checking PM_Responder_Enable	
MT diagnostic trail termination source function for MIP (MTDi_TT_So)		

Table II.4 – MI groupings of the MT diagnostic functions

Symbol	Management information	Managed object class
	MI_GAL_Enable MI_TTLVALUE MI_MIP_ID MI_CV_OAM_Tool MI_DP_Loopback_Enable	
G.8121.2 specific	MI_Target_FEC MI_Ifnum MI_MTU	
MT diagnostic trail termination sink function for MIP (MTDi_TT_Sk)		
	MI_GAL_Enable MI_MIP_ID MI_CV_OAM_Tool MI_DP_Loopback_Enable	
G.8121.2 specific	MI_FEC_Checking	

II.5 MPLS-TP to non-MPLS-TP client adaptation functions

See Table II.5.

Table II.5 – MI groupings of the MPLS-TP to non-MPLS-TP client adaptation functions

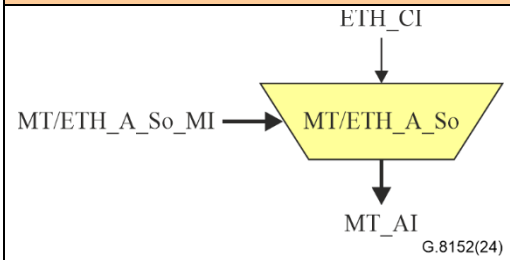
Symbol	Management information (**blue: client layer related red: server layer related**)	Managed object class
MPLS-TP to non-MPLS-TP client adaptation **source** functions		
	MI_AdminState MI_FCSEnable MI_CWEnable MI_SQUse MI_PRI2PSCMapping MI_MEP_MAC* MI_Client_MEL* MI_LCK_Period* MI_LCK_Pri* MI_MEL* *Ethernet (ETH) OAM related	

Table II.5 – MI groupings of the MPLS-TP to non-MPLS-TP client adaptation functions

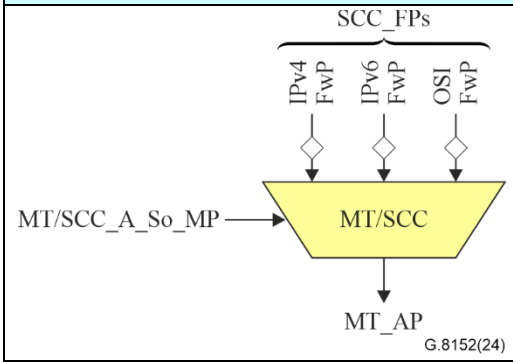
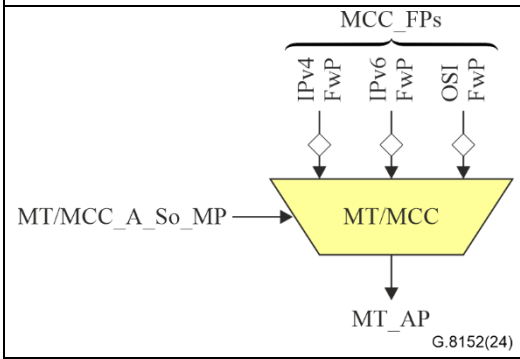
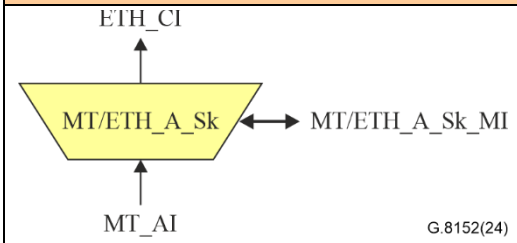
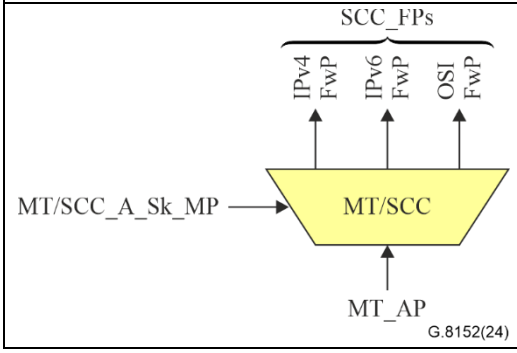
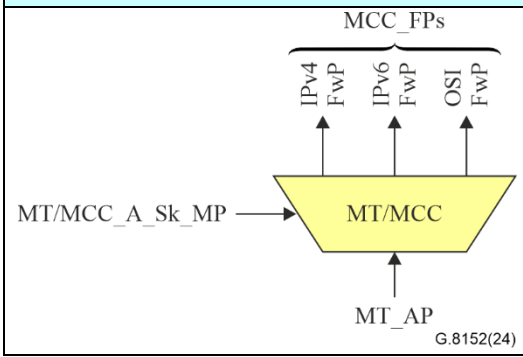
Symbol	Management information (blue: client layer related red: server layer related)	Managed object class
	MI_Active MI_ECC_CoS MI_GAL_Enable	
	MI_Active MI_ECC_CoS MI_GAL_Enable	
MPLS-TP to non-MPLS-TP client adaptation **sink** functions		
	MI_Admin_State MI_LCK_Period * MI_LCK_Pri * MI_Client_MEL * MI_MEP_MAC * MI_AIS_Pri * MI_AIS_Period * MI_MEL MI_FCSEnable MI_CWEnable MI_SQUse MI_GAL_Enable MI_CoS2PRIMapping * ETH OAM related	
	MI_Active MI_GAL_Enable	

Table II.5 – MI groupings of the MPLS-TP to non-MPLS-TP client adaptation functions

Symbol	Management information (blue: client layer related red: server layer related)	Managed object class
	MI_Active MI_GAL_Enable	

II.6 Non-MPLS-TP server to MPLS-TP adaptation functions

See Table II.6.

Table II.6 – MI groupings of the non-MPLS-TP server to MPLS-TP adaptation functions

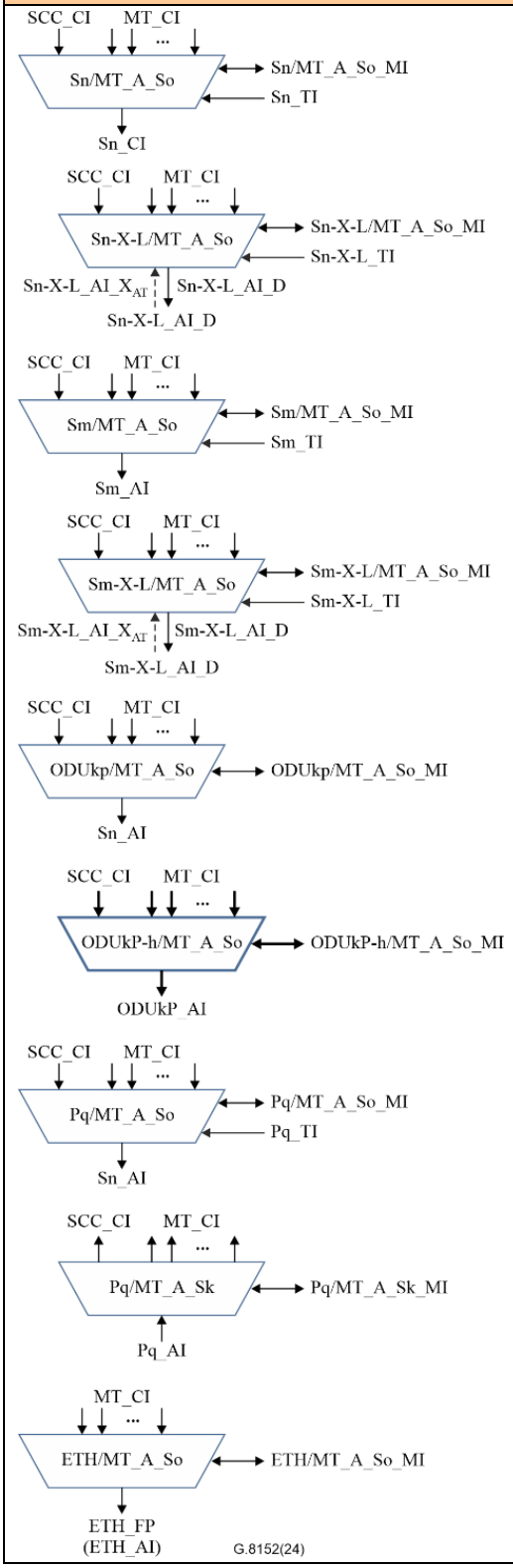
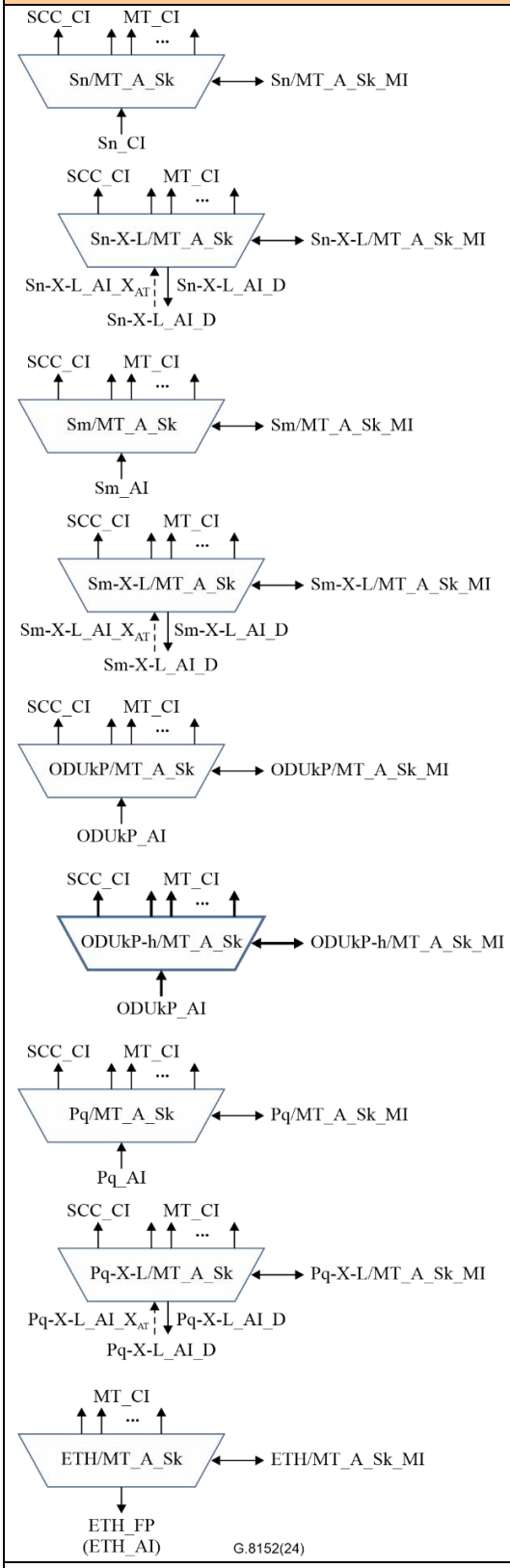
Symbol	Management information (blue: client layer related red: server layer related)	Managed object class
Non-MPLS-TP server to MPLS-TP adaptation **source** functions		
	MI_Active MI_SCCType (not in ETH/MT) MI_Etype (only in ETH/MT) MI_Label[1…M] MI_LSPType[1…M] MI_CoS[1…M] MI_PHB2TCMapping[1…M] MI_QoSEncodingMode[1…M] MI_Mode[1…M] MI_GAL_Enable[1…M] Only in ODUkP-h/MT: MI_INCREASE MI_DECREASE MI_TSNUM MI_ODUflexRate	

Table II.6 – MI groupings of the non-MPLS-TP server to MPLS-TP adaptation functions

Symbol	Management information (blue: client layer related red: server layer related)	Managed object class
Non-MPLS-TP server to MPLS-TP adaptation **sink** functions		
	MI_Active MI_SCCType (not in ETH/MT) MI_Etype (only in ETH/MT) MI_Frame_Type_Config (only in ETH/MT) MI_Label[1…M] MI_LSPType[1…M] MI_CoS[1…M] MI_TC2PHBMapping[1…M] MI_QoSDecodingMode[1…M] MI_Mode 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] MI_LCK_OAM_Tool [1…M] MI_AIS_OAM_Tool[1…M] Only in ODUkP-h/MT: MI_INCREASE MI_DECREASE MI_AcSL MI_AcEXI MI_LastInvalidUPI MI_cPLM MI_cLFD MI_cEXM MI_cUPM (not ETH/MT)	
G.8121.2 specific	MI_Local_Defect[i]	

Based on the groupings above the packages listed in Table II.7 have been identified.

Table II.7 – Derived MI groupings of the MPLS-TP functions

MI groupings	Package/Object class name
TTP MI source grouping	
MI_Active	
MI_INCREASE MI_DECREASE MI_TSNUM MI_ODUflexRate	HaoCapableTtpSource_Pac
TTP MI sink grouping	
MI_Active	
MI_Frame_Type_Config	EthServerTtpSink_Pac
MI_INCREASE MI_DECREASE	HaoCapableTtpSink_Pac
TTP MI grouping	
MI_SCCType	GfpMapping_Pac
MI_Etype	EthServerTtp_Pac
MT_CTP MI source grouping	
MI_PHB2TCMapping[1…M] MI_QoSEncodingMode[1…M] MI_APS_OAM_CoS[1…M]	MT_ConnectionTerminationPointSource
MT_CTP MI sink grouping	
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_LCK_OAM_Tool [1…M] MI_AIS_OAM_Tool[1…M]	MT_ConnectionTerminationPointSink
MT_CTP MI grouping	
MI_Label[1…M] MI_LSPType[1…M] MI_CoS[1…M] MI_Mode[1…M] MI_GAL_Enable[1…M] MI_APS_OAM_Tool[1…M]	MT_ConnectionTerminationPoint

Appendix III

UML model data dictionary

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

The DD contains, in MS Word document format, the details of the MPLS-TP NE management-protocol-neutral information model, including the description and properties of the object classes and their attributes and operations. These details information are generated automatically by a Gendoc tool from the UML model.

The ITU-T G.8152 DD is provided in the G.8152_v2.00_DD.zip file at the repository website mentioned in clause 8.

Bibliography

[b-ITU-T Q.822] Recommendation ITU-T Q.822 (1994), *Stage 1, stage 2 and stage 3 description for the Q3 interface – Performance management.*

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