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Purpose: Proposal

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Abstract: The document contains the editor version of draft new Recommendation G.8152.1 “OAM Information/Data Models for MPLS-TP Network Element”, v0.07 for consent.

Document history:

Version	Date	Description
0.01	WD1214-19 (01/2019 Wuhan)	Initial version based on wd1214-31, wd1214-33 and wd1214-35 (01/2019).
0.02	WD14-20 (04/2019) Xi’an TD377/3 (7/2019) Geneva	Modified Clause 6 and Clause 7 according to wd14-34, wd14-36 and discussion suggestion

Version	Date	Description
0.03	WD14-20 (07/2019) Geneva	● Modified Clause 4 according to C-1232 and discussion suggestion ● Add Clause 6.1 to 6.4 according to C-1232 and discussion suggestion ● Modified Clause 7.1 and 7.3 according to C-1233 and C-1444 and discussion suggestion ● Add Appendix I according to C-1233 discussion suggestion
0.04	WD14-15 (09/2019) Gothenburg	● Modified Figure 7-5 and Table 7-4 in Clause 7 according to WD14-28 ● Modified Table 6-1 according to WD14-25 and discussion ● Moving Table7-1 ~ Table7-4 to Appendix **II** according to discussion
0.05	TD486R1 (01/2020) Geneva	● As per C1784: • Add high-level description and diagrams to clause 7 • Update the text and diagrams of clause 7 • Update the Appendix II with Table II-5 • Use the UML model files to update sub-clause 7.4 ● As per C1804: add initial version of YANG model
0.06	CD08r1 (5/2020) v0.06-E1	● Review Table II-1 ~ Table II-5, update the rationale for pruning or re-factoring each attribute ● Update Figure 7-1 ~ Figure II-1 according to discussion ● Update the menu ● Update the text of clause 7.2.3 and 7.2.4, delete the Figure 7-4 and Figure 7-5 ● Update the UML model of clause 7.4 according to discussion ● Align the statement of Pacs with the Pac classes defined in UML model
	CD08r2 (6/2020) v0.06-E2	● Change marks are all accepted.
	CD08r3 (6/2020) v0.06-E3	● Update as per contribution CD11r1.

Version	Date	Description
	CD08r4 (6/2020) v0.06-E4	● Re-engineer UML model from RFC8531 YANG model. ● Add MaSpec to augment IETF Ma class and SessionSpec to augment IETF Session class. ● Change the MtMepOamSpec to augment the IETF Mep, and also the MtMipOamSpec to augment the IETF Mip. ● Add measurement job control constraints and update measurement job control classes. ● CC/CV oam Pacs are deprecated and removed. ● Update MtLckPac and MtAisPac with reusing IETF Cos and refactoring G.8152 LckAisPeriod data types. ● All MPLS-TP OAM operations are refactored into MtMepActions which is composite to MtMepOamSpec and then augment the IETF Mep. ● Update Figure 7-1 ~ 7-5 and text of clause 7. ● Add Figure 7-6 and 7-7.
	CD08r5 (6/2020) V0.06-E5	● Update Figure 7-7 with association to the IETF Mep. ● A note was added to clause 7.1 to demonstrate the relationship among MEG, MD and MA. ● Update the title of Figure 7-3.
0.07	TD582r1 (09/2020) Geneva	Update as per: – Per the agreed C2163 proposal – Per the comment resolution of C2161 and editing instruction captured in WD14-14r6.

Contents

Recommendation ITU-T G.8152.1

OAM Information/Data Models for MPLS-TP Network Element

Summary

Keywords

MPLS-TP, OAM, Protocol-Neutral, Transport Resource, Information Model, UML, Data Model, YANG

1 Scope

This Recommendation specifies the OAM information model and data models for MPLS-TP transport Network Element (NE) to support specific interface protocols and specific management and control functions. The information model is interface protocol neutral and derived from pruning and refactoring the G.7711 core information model and G.8152 foundation MPLS-TP NE information model. The data models are interface protocol specific and translated from these information models. The specific data models considered in this Recommendation include, but not limited to, YANG data models.~~The specific interface protocols considered include, but not limited to, NETCONF/YANG.~~ The specific management and control functions covered by this Recommendation are the G.8113.1 specific OAM functions.

The YANG modules of this Recommendation are aimed to be compatible with the relevant base generic YANG modules from the IETF for the G.8113.1 OAM functionality.

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.7711] Recommendation ITU-T G.7711/Y.1702 (3/2018), *Generic protocol-neutral information model for transport resources.*

[ITU-T G.8113.1] Recommendation ITU-T G.8113.1/Y.1372.1 (8/2015), *Operations, administration and maintenance mechanisms for MPLS-TP in packet transport networks.*

[ITU-T G.8121] Recommendation ITU-T G.8121/Y.1381 (11/2018), *Characteristics of MPLS-TP equipment functional blocks.*

[ITU-T G.8121.1] Recommendation ITU-T G.8121.1/Y.1381.1 (11/2018), *Characteristics of MPLS-TP equipment functional blocks supporting ITU-T G.8113.1/Y.1372.1 OAM mechanisms.*

[ITU-T G.8151] Recommendation ITU-T G.8151/Y.1374 (10/2018), *Management aspects of the MPLS-TP network element.*

[ITU-T G.8152] Recommendation ITU-T G.8152/Y.1735 (10/2018), *Protocol-neutral management information model for the MPLS-TP network element.*

~~[IETF RFC 5860] IETF RFC5860 (05/2010), *Requirements for Operations, Administration, and Maintenance (OAM) in MPLS Transport Networks.*~~

[IETF RFC 6371] IETF RFC6371 (09/2011), *Operations, Administration, and Maintenance Framework For MPLS-Based Transport Networks.*

[IETF RFC 6991] IETF RFC6371 (07/2013), *Common YANG Data Types.*

[IETF RFC 8531] IETF RFC8531 (04/2019), *Generic YANG Data Model for Connection-Oriented Operations, Administration, and Maintenance(OAM) Protocols.*

[IETF RFC 7950] IETF RFC7950 (08/2016), *The YANG 1.1 Data Modeling Language.*

[IETF RFC 8340] IETF RFC8340 (03/2018), *YANG Tree Diagrams.*

[IETF RFC 8342] IETF RFC8340 (03/2018), *Network Management Datastore Architecture (NMDA).*

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 maintenance entity (ME): [ITU-T G.8013]
3.1.2 maintenance entity group (MEG): [ITU-T G.8013]
3.1.3 MEG end point (MEP): [ITU-T G.8013]
3.1.4 MEG intermediate point (MIP): [ITU-T G.8013]
3.1.5 on-demand monitoring: [ITU-T G.8013]
3.1.6 proactive monitoring: [ITU-T G.8013]
3.1.7 maintenance domain (MD): [IETF RFC 8531]
3.1.8 maintenance association (MA): [IETF RFC 8531]
3.1.9 session: [IETF RFC 8531]

~~**3.2 Terms defined in this Recommendation**~~

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

TH One-way Throughput Test

AIS Alarm Indication Signal

APS ——Automatic Protection Switching

CCM Continuity Check Message

CTP ——Connection Termination Point

DM Delay Measurement

DMo On-demand Delay Measurement

DMp Proactive Delay Measurement

DMM Delay Measurement Message

DMR Delay Measurement Reply

DT Diagnostic Test

LCK ——Locked

LM Loss Measurement

LMo On-demand Loss Measurement

LMp Proactive Loss Measurement

LMM Loss Measurement Message

LMR Loss Measurement Reply

LOC ——Loss of Continuity

LSP Label Switched Path

LT Link Trace

MCC Management Communication Channel

ME Maintenance Entity

MEG Maintenance Entity Group

MEP Maintenance entity group End Point

MD Maintenance Domain

MA Maintenance Association

MI Management Information

MIB ——Management Information Base

MIP ——Maintenance entity group Intermediate Point

MPLS Multi-Protocol Label Switching

MPLS-TP Multi-Protocol Label Switching – Transport Profile

NC Network Connection

NE Network Element

OAM Operation, Administration and Maintenance

PDU Protocal Data Unit

PM Performance Monitoring

PW Pseudowire

RDI Remote Defect Indication

RT Route Trace

SCC ——Signalling Communication Channel

Sk Sink

SLA ——Service Level Agreement

SL Synthetic Loss Measurement

SLp Proactive Synthetic Loss Measurement

SLo On-demand Synthetic Loss Measurement

SN Sub-Network

SNC ——Sub-Network Connection

SNCP Sub-Network Connection Protection

SNMP Simple Network Management Protocol

So Source

SQ Sequence

TCM Tandem Connection Monitoring

TCS —Traffic Conditioning and Shaping

TH Throughput

TST —Test

TP Termination Point

TT Trail Termination

TTL —Time-To-Live

TTP —Trail Termination Point

UML Unified Modelling Language

YANG Yet Another New Generation

5 Conventions

5.1 Information modeling 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 (MEP) [ITU-T G.8121]

See clause 5.2.1 of [ITU-T G.8152].

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

See clause 5.2.2 of [ITU-T G.8152].

5.2.3 MEPs and MIPs along a Maintenance Entity

See clause 5.2.3 of [ITU-T G.8152].

5.3 Color Conventions

See clause 5.3 of [ITU-T G.8152].

6 Functions of MPLS-TP OAM

~~<Editor Note: Also look at clauses 7.1 and 7.2 of G.8152.>~~

~~<Briefly describe the function and point to G.8121,G.8121.1 and G.8113.1 for the OAM PDU formate and processes of the MPLS-TP OAM function.>~~

The specific functions covered by this recommendation are OAM functions of [ITU-T G.8121], [ITU-T G.8121.1] and [ITU-T G.8113.1]. The OAM capability support is listed in Table 6-1. The right-most column is used to describe the involved object instances of the OAM functions.

Table 6-1 – OAM capability support

Consolidation of Tables 7-1/G.8152, 7-1/G.8113.1,

OAM function [ITU-T G.8113.1]			**OAM mechanism** [ITU-T G.8121] and [ITU-T G.8121.1]	**Involved Object Instances**
Proactive performance measurement (PM)	Loss measurement (LM)	Direct Near-end Loss	CCM (Dual-ended) 8.8.4/G.8121 8.8.1/G.8121.1 8.2.1/G.8113.1	Both the A-end MEP and Z-end MEP
		Direct Near-end Loss & Far-end Loss	LM (Single-ended) 8.8.4/G.8121 8.8.4/G.8121.1 8.2.6/G.8113.1	Single MEP
		Synthetic Near-end Loss	-- For further study	
		Synthetic Near-end Loss & Far-end Loss	-- For further study	
	Delay measurement (DM)	1-way near-end delay	1DM (dual-ended) 8.8.6/G.8121 8.8.6/G.8121.1 8.2.7/G.8113.1	Both the A-end MEP and Z-end MEP
		• 2-way delay, • 1-way near-end delay • 1-way far-end delay	DM (single-ended) 8.8.6/G.8121 8.8.6/G.8121.1 8.2.8/G.8113.1	Single MEP
On-demand performance measurement	Loss measurement (LM)	Direct Near-end Loss & Far-end Loss	LM (single-ended) 8.8.5/G.8121 8.8.5/G.8121.1	Single MEP

(PM)			8.2.6/G.8113.1	
		Synthetic Near-end Loss	-- For further study	
		Synthetic Near-end Loss & Far-end Loss	-- For further study	
	Delay measurement (DM)	1-way near-end delay	1DM (dual-ended) 8.8.7/G.8121 8.8.7/G.8121.1 8.2.7/G.8113.1	Both the A-end MEP and Z-end MEP
		• way near-end delay • way far-end delay • 2-way delay	DM (single-ended) 8.8.7/G.8121 8.8.7/G.8121.1 8.2.8/G.8113.1	Single MEP
	Throughput	1-way throughput test (1TH)	TST (dual-ended) 8.8.8/G.8121, 8.8.8/G.8121.1 8.2.5/G.8113.1	Both the A-end MEP and Z-end MEP
Proactive fault management (FM)	Continuity check and connectivity verification (CC/CV)		CCM 8.8.1/G.8121.1 8.2.1/G.8113.1)	Gen: A-end MEP of the LSP (or PW or TCM or Section) to Z-end MEP Rec: Z-end MEP
	Remote defect indication (RDI)		RDI bit of CCM 8.8.2/ G.8121.1 8.2.1/G.8113.1	Gen: Z-end MEP of the LSP (or PW or TCM or Section) to A-end MEP Rec: A-end MEP
	Alarm indication signal (AIS)		AIS 8.6.2 & 8.8.10/G.8121, 8.6.2 & 8.8.10/G.8121.1,8.2.3/G.8113.1	Gen: Intermediate TP of the LSP (or PW or TCM) to downstream Rec: Downstream MEP
	Locked signal (Lock report) (LCK)		LCK 8.6.3 & 8.8.10/G.8121, 8.6.3 & 8.8.10/G.8121.1, 8.2.4/G.8113.1	Gen: Intermediate TP of the LSP (or PW or TCM) to both up/down stream Rec: Downstream MEP Rec: Upstream MEP
	Client Signal Failure (CSF)		CSF 8.7.3/G.8121 8.7.3/G.8121.1 8.2.9/G.8113.1	Gen: A-end MEP to Z-end MEP Rec: Z-end MEP
On-demand	Connectivity verification (CV)			Gen: A-end MEP of the

fault management (FM)		LB 8.8.3/G.8121 8.8.3/G.8121.1 8.2.2/G.8113.1	LSP (or PW or TCM or Section) to Z-end MEP Rec: Z-end MEP or Intermediate MIP
	Lock instruction (LKI) – Out of scope of G.8152.1		-
	Route Tracing (RT) – For further study	RT 8.8.9/G.8121 8.8.9/G.8121.1 7.2.1.3/G.8113.1	For further study
	Diagnostic Test (DT)	LB (bidirectional) -/G.8121 8.8.3/G.8121.1 8.2.2/G.8113.1 TST (unidirectional) -/G.8121 8.8.8/G.8121.1 8.2.5/G.8113.1	Gen: A-end MEP of the LSP (or PW or TCM or Section) to Z-end MEP Rec: Z-end MEP and Respond back to A-end MEP
OAM for other applications	Automatic protection switching (APS) – Out of scope of G.8152.1		-
	Management communication channel (MCC)/ Signalling communication channel (SCC) – Out of scope of G.8152.1		-

In Table 6-1, there are five types of MPLS-TP OAM, include proactive OAM for performance measurement, on-demand OAM for performance measurement, proactive OAM for fault management and on-demand OAM for fault management and OAM for other applications. The functions of OAM for other applications are out of scope of G.8152.1. All these MPLS-TP OAM functions are applicable to MPLS-TP sections, label switched paths (LSPs) and pseudowires (PWs).

6.1 Proactive OAM for performance measurement

The proactive OAM for performance measurement is used to performance monitoring purposes. There are two types of functions in table 6-1: proactive loss measurement and proactive delay measurement.

6.1.1 Proactive loss measurement (LM)

The proactive loss measurement (LM) function is used to measure packet loss on a connection for performance-monitoring purposes. It is performed continuously, and its result is used to verify the performance of the connection against the service level agreement (SLA). This function can be performed by two methods: dual-ended proactive LM by CCM and single-ended proactive LM by LMM/LMR. The CCM process for dual-ended proactive LM is defined in clause 8.8.4 of [ITU-T G.8121] and 8.8.1 of [ITU-T G.8121.1]. This process calculates the number of transmitted and lost packets per second. The LMM/LMR process for single-ended LM is defined in clause 8.8.4 of [ITU-T G.8121.1]. This process counts the number of transmitted and received packets.

6.1.2 Proactive delay measurement

The proactive delay measurement is used to measure packet delay (PD) and packet delay variation (PDV) on a connection for performance-monitoring purposes. It is performed continuously, and its result is used to verify the performance of the connection against the service level agreement (SLA). This function can be performed by two methods: single-ended DM by DMM/DMR and dual-ended DM by 1DM. The DMM/DMR process for single-ended proactive DM is defined in clause 8.8.6.3-8.8.6.6 of [ITU-T G.8121.1]. A source MEP sends frames with delay measurement message (DMM) to its peer sink MEP and receives frames with DM reply (DMR) information from its peer sink MEP to carry out two-way frame delay and two-way frame delay variation measurements. The 1DM process for dual-ended proactive DM is defined in clause 8.8.6 of [ITU-T G.8121] and 8.8.6.7-8.8.6.10 of [ITU-T G.8121.1]. A source MEP sends frames with 1DM packet to its peer sink MEP and sink MEP enables 1DM to calculate one-way frame delay and one-way frame delay variation. This method needs the clocks between the two MEPs should be synchronized.

6.2 On-demand for performance measurement

The on-demand OAM for performance measurement is used to maintenance purposes. It is performed during a configured specific time interval and its result can be used for diagnosis and analysis. There are three types of functions in table 6-1: on-demand loss measurement, on-demand delay measurement and throughput measurement.

6.2.1 On-demand loss measurement

The On-demand loss measurement is used to measure packet loss for direct near-end and far-end. This function commonly be performed by the method of single-ended on demand LM with LMM/LMR. The LMM/LMR process for single-ended LM is defined in clause 8.8.5 of [ITU-T G.8121] & [ITU-T G.8121.1] and OAM PDU formats is defined in clause 8.2.6 of [ITU-T G.8113.1].

6.2.2 On-demand delay measurement

The on-demand delay measurement is used to measure packet delay for near-end and far-end. This function can be performed by two methods: single-ended DM by DMM/DMR and dual-ended DM by 1DM. The DMM/DMR process for single-ended proactive DM is defined in clause 8.8.7.3-8.8.7.6 of [ITU-T G.8121.1] and OAM PDU format is defined in clause 8.2.8 of [ITU-T G.8113.1]. A source MEP sends frames with delay measurement message (DMM) to its peer sink MEP and receives frames with DM reply (DMR) information from its peer sink MEP to carry out two-way frame delay and two-way frame delay variation measurements. The 1DM process for dual-ended proactive DM is defined in clause 8.8.7 of [ITU-T G.8121] and 8.8.7.7-8.8.7.10 of [ITU-T G.8121.1] and OAM PDU format is defined in clause 8.2.7 of [ITU-T G.8113.1]. A source MEP sends frames with 1DM packet to its peer sink MEP and sink MEP enables 1DM to calculate one-way frame delay and one-way frame delay variation. This method needs the clocks between the two MEPs should be synchronized.

6.2.3 Throughput measurement

Throughput measurement is a test function for measuring the rate of receiving packet percentage at sink MEP when source MEP sends OAM test packets at an increasing rate. This function can be performed by two methods: single-ended throughput and dual-ended throughput. This function

commonly is performed by the method of dual-ended throughput through TST (1TH). The TST (1TH) process for dual-ended throughput is defined in clause 8.8.8 of [ITU-T G.8121] and 8.8.8.2-8.8.8.5 of [ITU-T G.8121.1] and OAM PDU format is defined in clause 8.2.5 of [ITU-T G.8113.1].

6.3 Proactive fault management

The proactive OAM for fault measurement is used to fault management for monitoring purposes. In table 6-1, there are five types of functions: CC/CV, RDI, AIS, LCK and CSF.

6.3.1 Continuity check and connectivity verification (CC/CV)

The proactive Continuity check and connectivity verification (CC/CV) function is used to fault monitoring. The source (So) MEP sends continuity check/connectivity verification (CC/CV) OAM packets periodically at the configured rate. Then the sink (Sk) MEP monitors the arrival of these CC/CV OAM packets at the configured rate and detects the defect of loss of continuity (LOC). The CC/CV function is defined in clause 7.2.1.1.1 of [ITU-T G.8113.1] and OAM PDU format is defined in clause 8.2.1 of [ITU-T G.8113.1]. The CCM process is defined in clause 8.8.1.2-8.8.1.3 of [ITU-T G.8121.1].

6.3.2 Remote defect indication (RDI)

The proactive remote defect indication (RDI) is an indicator which can be used by a MEP to communicate to its peer MEPs. When a MEP detects a signal fail condition, it sends an RDI to its peer MEPs. An RDI is used only when proactive CC/CV bidirectional transmission is enabled. The RDI function is defined in clause 7.2.1.1.2 of [ITU-T G.8113.1] and OAM PDU format is defined in clause 8.2.1 of [ITU-T G.8113.1]. The CCM process for RDI is defined in clause 8.8.1.2-8.8.1.3 of [ITU-T G.8121.1].

6.3.3 Alarm indication signal (AIS)

The proactive alarm indication signal (AIS) function is used to suppress alarms from a server MEP to the downstream sink client MEP. The AIS function is defined in clause 7.2.1.1.3 of [ITU-T G.8113.1] and OAM PDU format is defined in clause 8.2.3 of [ITU-T G.8113.1]. The AIS process is defined in clause 8.6.2&8.8.10 of [ITU-T G.8121] and [ITU-T G.8121.1].

6.3.4 Locked signal (Lock report) (LCK)

The proactive locked signal (LCK) function is used to communicate to the client (sub-)layer MEPs the administrative locking of a server (sub-)layer MEP and consequential interruption of data traffic forwarding in the client (sub-)layer. The LCK function is defined in clause 7.2.1.1.4 of [ITU-T G.8113.1] and OAM PDU format is defined in clause 8.2.4 of [ITU-T G.8113.1]. The LCK process is defined in clause 8.6.3&8.8.10 of [ITU-T G.8121] and [ITU-T G.8121.1].

6.3.5 Client signal failure (CSF)

The proactive client signal fail (CSF) function is used to process client defects and propagate a client signal defect to the associated remote MEPs using OAM packets. This function is usually used when the client of the MPLS-TP trail does not support a native defect/alarm indication mechanism. The CSF function is defined in clause 7.2.1.1.5 of [ITU-T G.8113.1] and OAM PDU

format is defined in clause 8.2.9 of [ITU-T G.8113.1]. The CSF process is defined in clause 8.7.3 of [ITU-T G.8121] and [ITU-T G.8121.1].

6.4 On-demand fault management

The on-demand OAM for fault measurement is used to fault management for maintenance purposes. In table 6-1, there are six types of functions: CV, LKI, RT, DT. LKI is out of scope G.8152.1 and RT is for further study.

6.4.1 Connectivity verification (CV)

On-demand connectivity verification (CV) function is used to detect failures in the path for trouble-shooting purposes. It can be used to check in end-to-end MEG or just between an MEP and a specific MIP. This function is defined in clause 7.2.1.2.1 of [ITU-T G.8113.1] and OAM PDU format is defined in clause 8.2.1 of [ITU-T G.8113.1]. The CVM/CVR process is defined in clause 8.8.3 of [ITU-T G.8121] and [ITU-T G.8121.1].

6.4.2 Diagnostic test (DT)

The on-demand DT function is used to estimate fault location by sending OAM DT packets on one direction of the MEG, such as packet loss and bit errors estimation. DT can be performed by two methods: bidirectional loopback (LB) and unidirectional TST. LB procedure for DT is defined in clause 9.1.2 of [ITU-T G.8113.1] and its OAM PDU format is defined in clause 8.2.2 of [ITU-T G.8113.1]. TST process is defined in clause 8.8.8 of [ITU-T G.8121.1] and its OAM PDU format is defined in clause 8.2.5 of [ITU-T G.8113.1].

7 Information Model of MPLS-TP OAM

This clause contains the UML information model of the MPLS-TP OAM functions identified in Clause 6. This information model is derived through pruning and refactoring the Recommendation [ITU-T G.7711/Y.1702] core information model and Recommendation [ITU-T G.8152/Y.1375] foundation MPLS-TP NE information model.

~~<Editor Note: The scope of G.8152.1 is for supporting the G.8113.1 OAM functions and the G.8121 & G.8121.1 equipment behaviours. So what we need to do is to take the G.8152 information model as the base and prune out the G.8113.2 and G.8121.2 specific object classes and attributes and operations. >~~

Because IETF LIME WG has developed the ietf-connection-oriented-oam YANG model, defined in [IETF RFC 8531], which is generic YANG model for OAM intended to be used as the basis for technology-specific (e.g., MPLS-TP OAM) augmentations, the first step to model G.8152.1 information model is to re-engineer the UML model from [IETF RFC8531] YANG model.

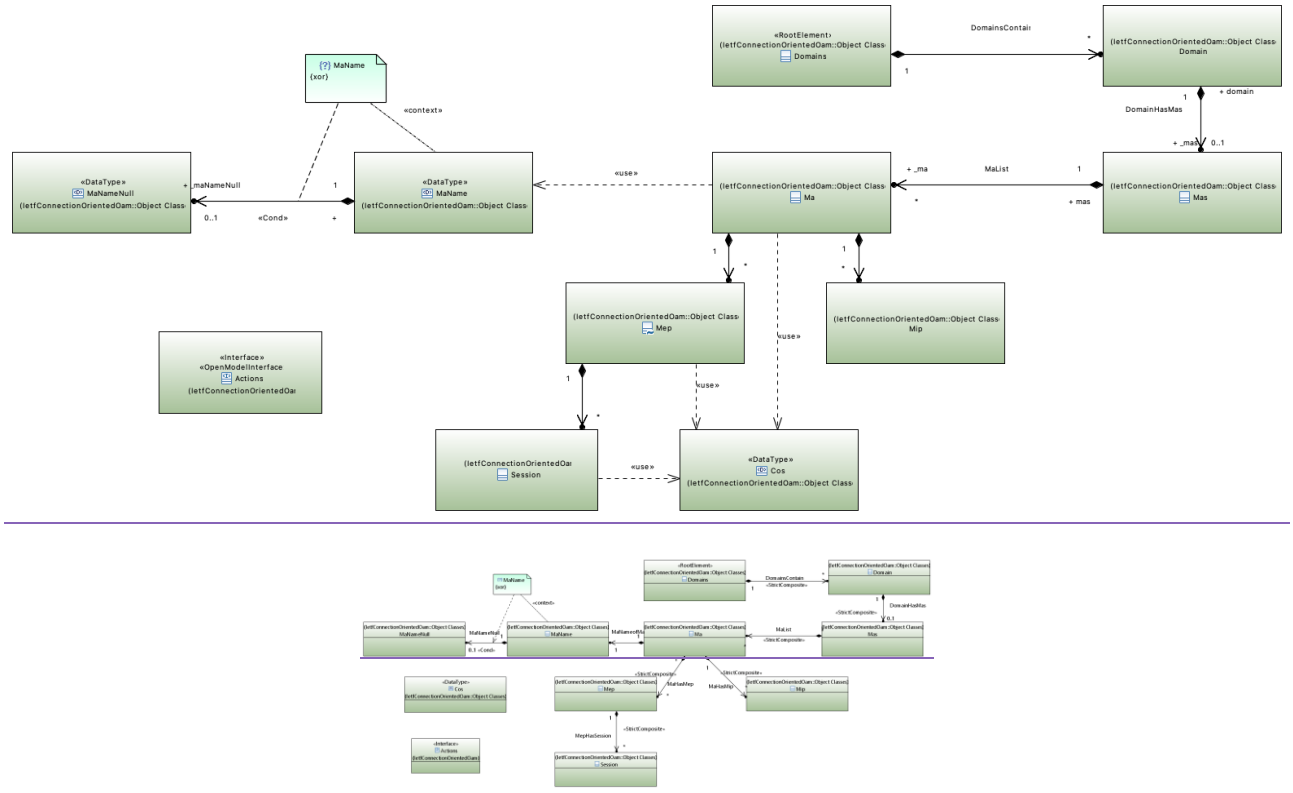
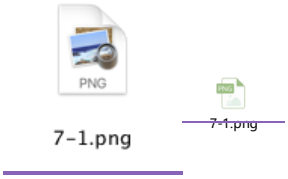


Figure 7-1 Object Classes re-engineered from RFC8531 YANG model



PNG

7-1.png

7-1.png

In order to extract from G.8152 for the G.8113.1 OAM specific properties, and to simplify the models of G.8152.1, a few Pac classes are defined by pruning & refactoring the G.8152 TTP and CTP to specify the TerminationSpec and ConnectionPointAndAdapterSpec, following G.8152's usage of the G.7711 model. The G.8113.1 related OAM attributes and operations of the G.8152 UML model are retained in the pruning and refactoring.

a. OAM function Pacs:

They are re-factored from Mep, MT TTP and MT CTP of G.8152.See Table II-2 and Table II-3 in Appendix II of this Recommendation. These Pac classes are used to manage the OAM functions listed in clause 6.

b. Measurement Job Pacs:

They are re-factored from the measurement job classes of G.8152. See Figure 7-3. These Pac classes are used to manage the performance measurement functions listed in clause 6.

The Measurement Job Pacs are composite to the SessionSpec, which is used to augment the IETF Session object class.

c. Mep and Mip:

In G.8152.1, the IETF Mep and Mip are used. And in order to augment IETF Mep and Mip with G.8113.1 OAM functions, the MtMepSpec and MtMipSpec are used. The MtMepSpec contains OAM function Pacs.

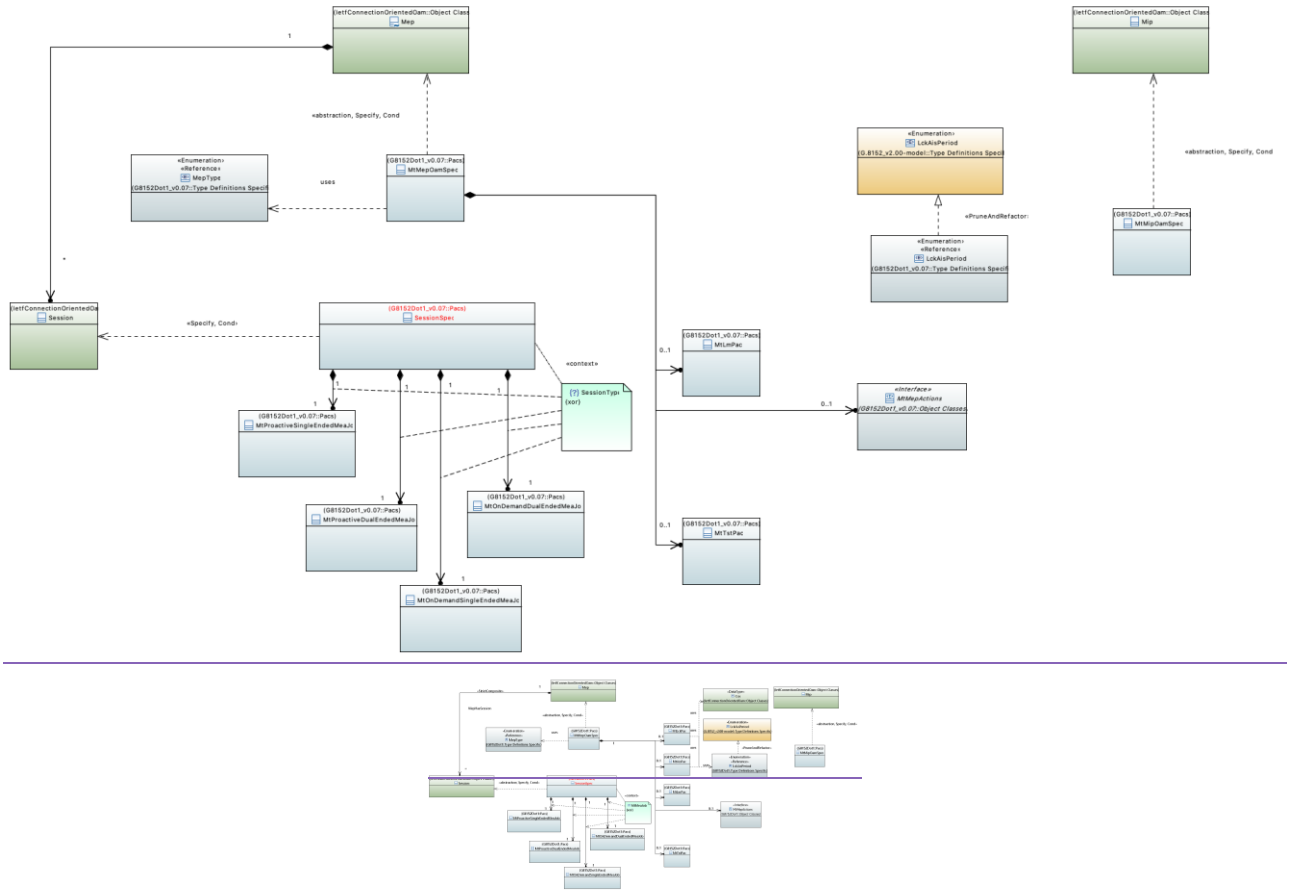
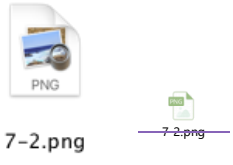


Figure 7-2 High-level Sketch of G.8152.1 Object Classes



From clause 7.1 to clause 7.4, the intent of all these clauses is to prune & refactor G.8113.1 OAM properties from G.8152 UML model.

7.1 Required Object Classes

To manage the carrier MPLS-TP OAM functions identified in Clause 6, the following object classes are required:

- MT_TrailTerminationPoint/Bidirectional/Sink/Source *and the subordinate Pacs*
- MT_ConnectionTerminationPoint/Bidirectional/Sink/Source *and the subordinate Pacs*
- Mep/ Bidirectional/Sink/Source

– Mip/ Bidirectional/Sink/Source
– MepControl
– MipControl
– OnDemandMeasurementJobControl
– OnDemandSingleEndedMeasuremnetJobControl
– OnDemandSingleEndedMeasuremnetJobControlSource
– OnDemandDualEndedMeasurementJobControlSink
– ProactiveMeasurementJobControl
– ProactiveDualEndedMeasurementJobControlSink
– ProactiveDualEndedMeasurementJobControlSource
– ProactiveSingleEndedMeasurementJobControlSink
– ProactiveSingleEndedMeasurementJobControlSource
– ProactiveSingleEndedMeasurementJobControlSinkG8113Dot1
– ProactiveSingleEndedMeasurementJobControlSourceG8113Dot1
– MT_CurrentData
– ProactiveDmCurrent/HistoryData
– ProactiveLmCurrentData/HistoryData
– Proactive1LmCurrentData/HistoryData
– Proactive1DmCurrentData/HistoryData
– ThresholdProfile

The concepts ME, MEG, MEP, and MIP are described in both of G.8113.1 and RFC6371. Note that the information model in G.8152 is an NE-view information model and therefore it doesn't explicitly model the ME and MEG, which are beyond the scope of an NE-view. Rather, the MEP object class has the attribute megId, which identifies the MEG that the MEP is belonging to, like ~~the following~~ Figure 7-~~1~~ 2.A depicts.

Note: The MEG is modeled in RFC8531 as a MD with a single MA. The MD name is null and the MA name provides the MEG-ID, which augments the MA name choice.

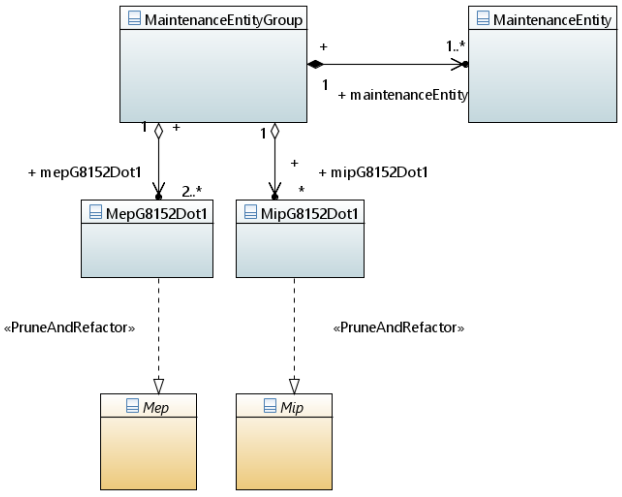


Figure 7-2.A High-level MEG Class Diagram

High-level MEG
Class Diagram.pr

– From the definition in G.8113.1, a MEP is the end point of a MEG, and a MIP is a point between the two MEPs within a MEG rather.
– From the definition in G.8113.1, a ME can be viewed as an association between two MEPs.
– A ME may contain zero or more MIP.
– A MEG contain MEP and MIP instances, leaving ME only references of MEP and MIP.
– An attribute ‘mepId’ is defined in MEP class of [ITU-T G.8152], it could identify the MEP instances. So a ‘mepId’ is a good candidate for referring to a MEP instance, two of which could represent an association between two MEPs.

As Figure 7-~~1~~ 2.B depicts, the RFC8531 uses MD and MA concepts to manage MEPs and MIPs. In order to augment the IETF MA class, ~~a~~an MtMaSpec class is designed to contain MPLS-TP specific attributes.

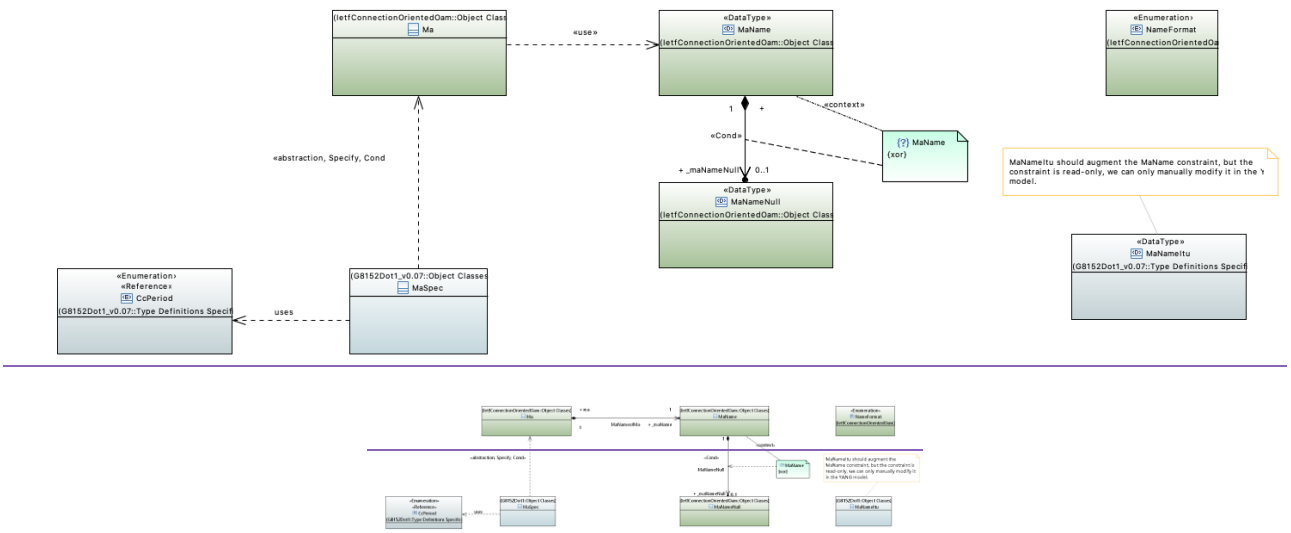


Figure 7-2.B High-level MA Class Diagram

7-2.B.png ~~7-2.B.png~~

The required object classes and their relationships are shown in Figure 7-3.

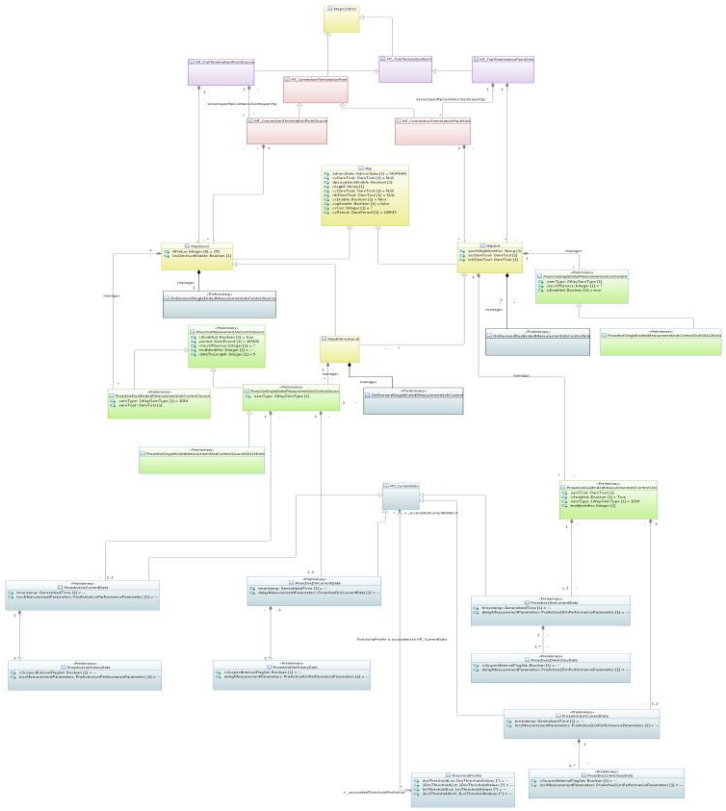


Figure 7-3 G.8152 Object Classes considered for G.8152.1 MPLS-TP OAM model

Required Object
Classes for MSPL

7.2 Required attributes and operations

This section identifies which attributes and operations of the section 7.1 object classes should be pruned and which should remain.

~~<Editor Note: The Pacs defined in this clause should be consistent with the ones in Table 6-1. >~~

7.2.1 Termination points

The required object classes are pruned and refactored from the [ITU-T G.8152] information model, which augment the TerminationSpec and ConnectionPointAndAdapterSpec of LpSpec of [ITU-T G.7711] with the MPLS-TP TTP and CTP as shown in ~~Figure 7-2~~Figure 7-.

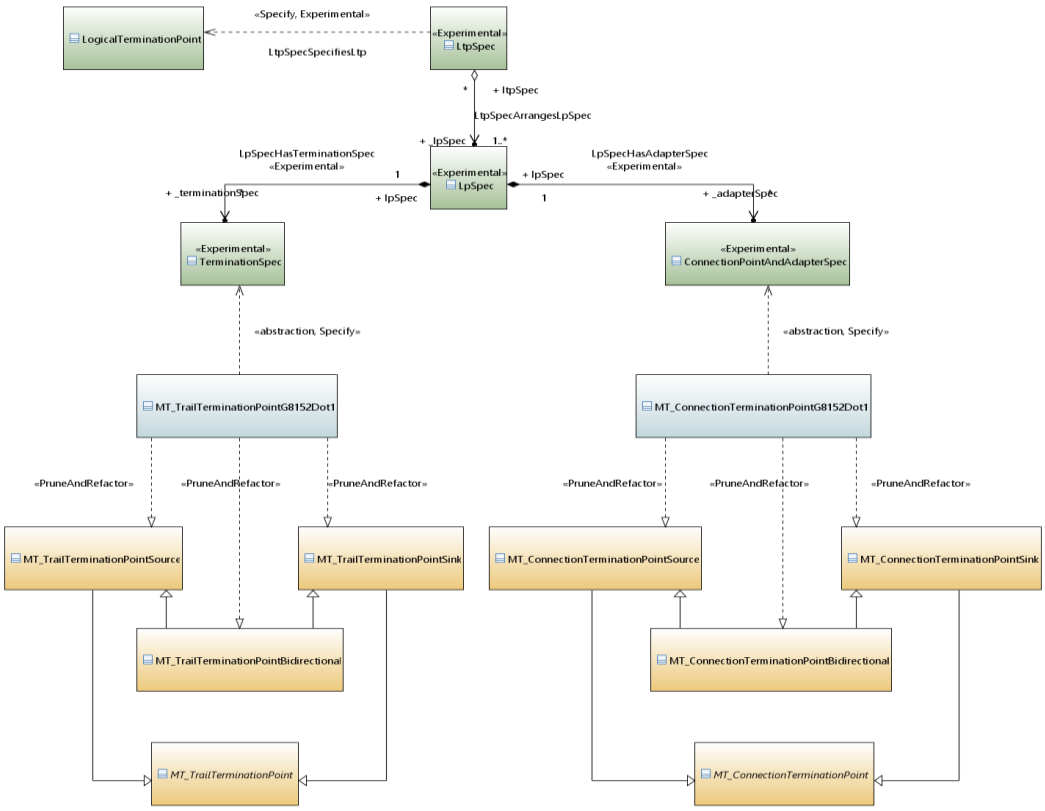


Figure 7-4 **Termination Point augmentation and pruning/refactoring**

G.8152.1
Termination Poir

– OAM related attributes of TTP and CTP are refactored into OAM function Pacs (showed in Figure 7-4), such as MtCcPac, MtAisPac or MtTstPac, and other attributes are pruned.
– G.8152 MT_TrailTerminationPointBidirectional and MT_ConnectionTerminationPointBidirectional both have attributes _mepBidirectional and _mipBidirectional in order to manage Mep and Mip. MT_TrailTerminationPointSource (or MT_ConnectionTerminationPointSource) and MT_TrailTerminationPointSink (or MT_ConnectionTerminationPointSink) do not have attributes refer to MepSource or MepSink. It is implicit that [ITU-T G.8152] only ~~support~~supports bidirectional MEP.

Figure 7-~~3~~ 4 provides a few Pacs to prune & refactor attributes from TTP and CTP object classes, and Table II-1 of appendix II has listed all attributes to be pruned & refactored in details.

~~<Editor Note: The touch point of Mep and MPLS-TP data plane may need re-engineer from IETF YANG model. It is for future study.>~~

7.2.2 MEP attributes

The required object classes that supporting the MPLS-TP OAM functions for CC/CV, AIS, LCK, CSF, DM and LM are listed as following and shown in the ~~Figure 7-3~~**Figure 7-**.

ProactiveSingleEndedMeaJob:

It contains only one instance of ProactiveSingleEndedMeasurementJobControl class, which can control a two-way proactive measurement job by sending request from source Mep to sink Mep, and waiting for replies from sink Mep, then reporting result at the source Mep.

ProactiveDualEndedMeaJob:

It contains two instances of each proactive measurement job classes: ProactiveDualEndedMeasurementJobControlSource and ProactiveDualEndedMeasurementJobControlSink, which can control a one-way proactive measurement job by sending request from source Mep to sink Mep, and reporting result at the sink Mep.

For above two measurement jobs, ProactiveSingleEndedMeasurementJobControl and ProactiveDualEndedMeasurementJobControlSource inherit from abstract class ProactiveMeasurementJobControl, because they have common attributes.

OnDemandSingleEndedMeaJob:

It contains only one instance of OnDemandSingleEndedMeasurementJobControl class, which can control a two-way ondemand measurement job by sending request from source Mep to sink Mep, and waiting for replies from sink Mep, then reporting result at the source Mep.

OnDemandDualEndedMeaJob:

It contains two instances of each ondemand measurement job class:

OnDemandDualEndedMeasurementJobControlSource and OnDemandDualEndedMeasurementJobControlSink, which can control a one-way ondemand measurement job by sending request from source Mep to sink Mep, and reporting result at the sink Mep.

For above two measurement jobs, OnDemandSingleEndedMeasurementJobControl and OnDemandDualEndedMeasurementJobControlSource inherit from abstract class OnDemandMeasurementJobControl, because they have common attributes.

The above four measurement jobs cannot be enabled at the same time, so there is an ‘xor’ constraint on them.

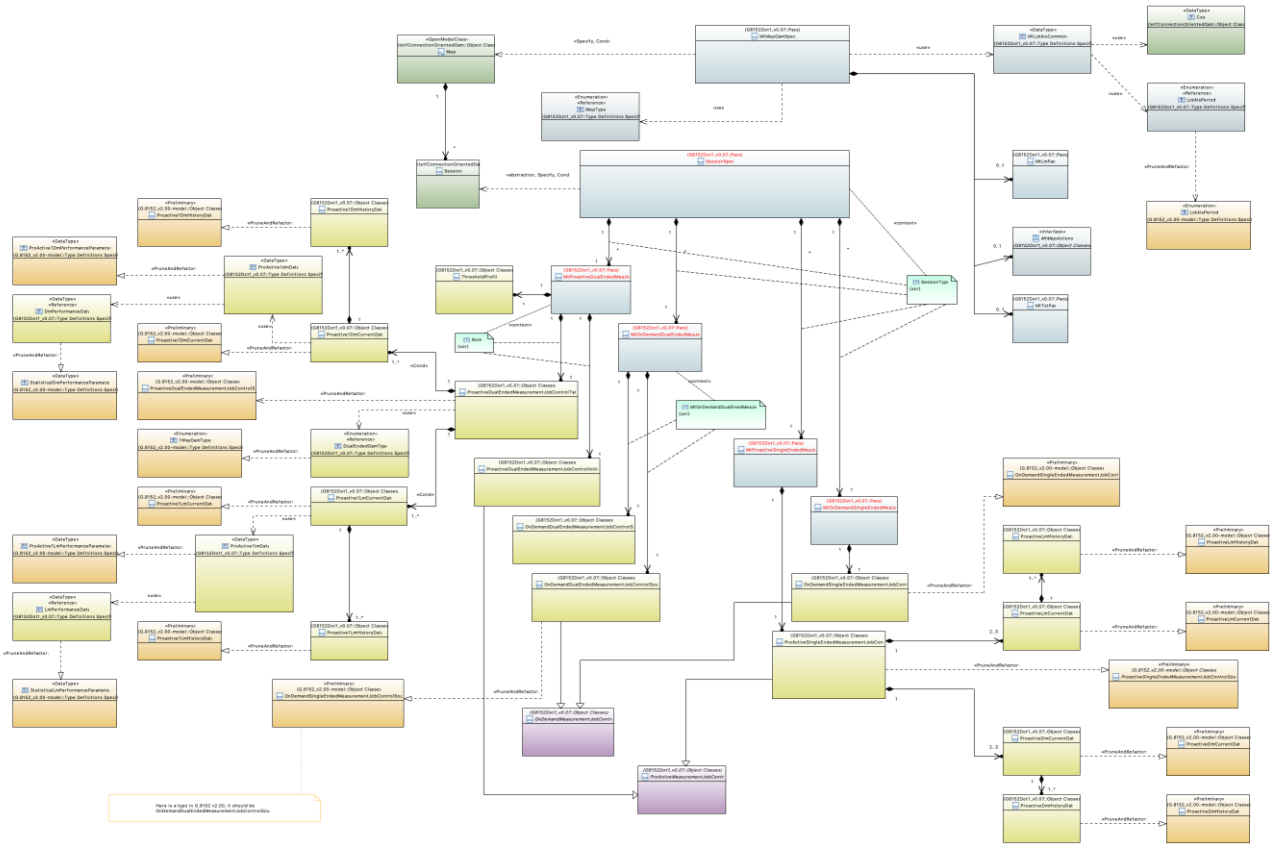
Also, for dual ended measurement job, when the measurement session is establishing, one end of the session can and only can be configured as source, and another end of the session can and only can be configured as sink. So, there is an ‘xor’ constraint on the source and sink measurement job control classes.

In IETF re-enginnered UML model, a Mep can has zero, one or more sessions. A Session Spec is designed to be a composite of these four measurement jobs, and augments to the IETF Session in order to make the IETF Mep have ability to do [ITU-T G.8113.1] measurement jobs.

MtAisPac, MtLckPac, MtTstPac, and MtLmPac are used to package MPLS-TP OAM related attributes. Cc and Cv related attributes are already defined in [IETF RFC8531], so they are pruned from [ITU-T G.8152].

MtAisPac and MtLckPac use the Cos from IETF and LckAisPeriod refactored from [ITU-T G.8152]. ~~A~~An MtMepOamSpec is a composite of these Pacs, and augments the IETF Mep. MtMepOamSpec uses MepType to identify the UP, DOWN and Node Mep.

Because IETF Mep already has ‘name’ to identify Mep, the mepId attribtue is not needed in MtMepOamSpec.



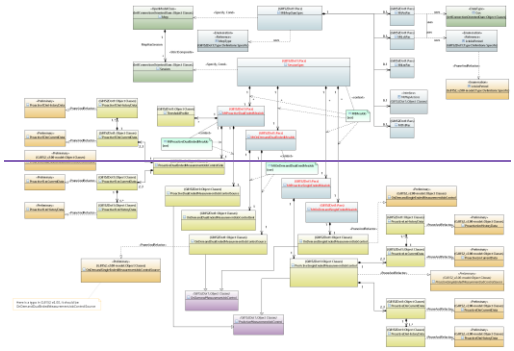
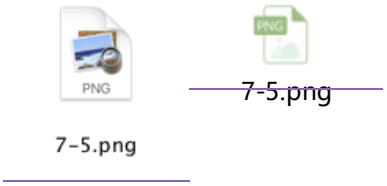


Figure 7-5 MPLS-TP MEP OAM augmentation & pruning/refactoring



The pruning/refactoring of the attributes of MEP is listed in the **Error! Reference source not found.**.

7.2.3 MIP attributes

Since IETF Mip already have ‘name’ to identify mip, so mipId is not needed in MtMipOamSpec. And for isFullMip attribute, it is much convenient to direcly use it in MtMipOamSpec which is used to augment the IETF Mip.

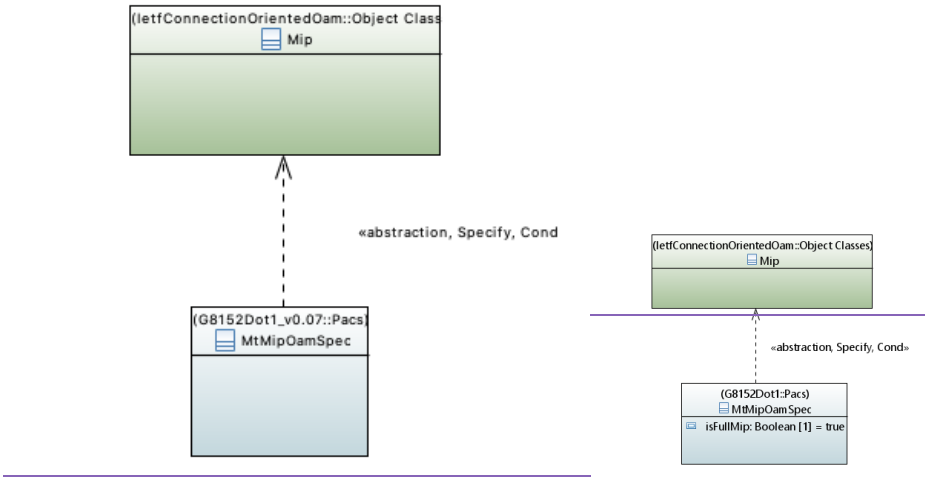


Figure 7-6 MPLS-TP MIP OAM augmentation & pruning/refactoring

7.2.4 MEP and MIP operations

The required operations to support MPLS-TP OAM functions for CC/CV, AIS, LCK, CSF, DM and LM.

As Figure 7-~~2~~ 7 depicts, a MtMepActions interface is designed to contain all the operations of the MPLS-TP OAM functions, and the MtMepSpec contains zero or one MtMepActions instance in order to augment the IETF Mep with these operations.

Here we provide a detail diagram of pruing and refactoring as below:

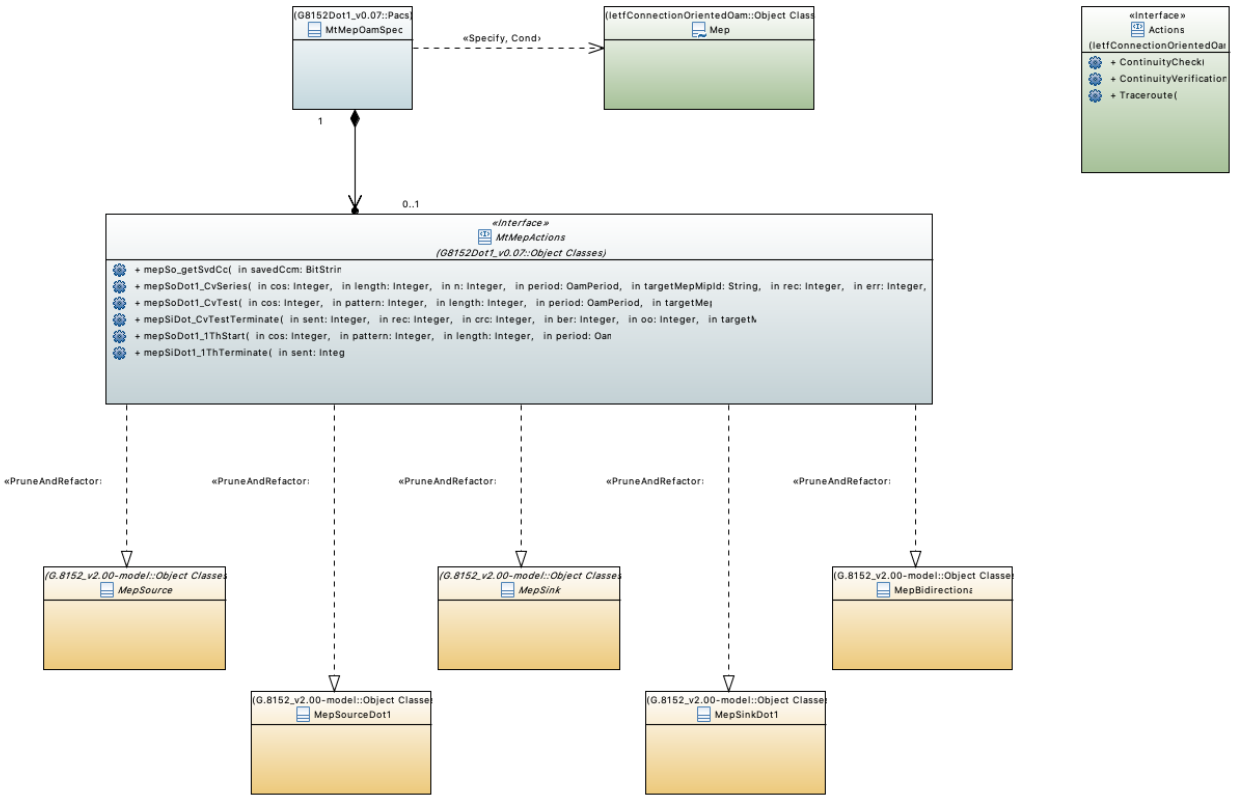
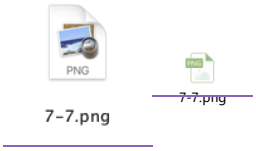


Figure 7-7 MEP/MIP OAM operations pruning/refactoring



The pruning/refactoring of the operations of MEP and MIP is listed in the **Error! Reference source not found.**.

7.3 OAM functions modelling

7.3.1 Proactive OAM for performance measurement

The procative OAM for performance measurement functions mainly use two object classes: MtProactiveDualEndedMeasurementJobPac and MtProactiveSingleEndedMeasurementJobPac. They are pruned and refactored from object classes of [ITU-T G.8152] as following.

MtProactiveDualEndedMeasurementJobPac

- ProactiveMeasurementJobControlSource::isEnabled
- ProactiveMeasurementJobControlSource::period
- ProactiveMeasurementJobControlSource::classOfService
- ProactiveMeasurementJobControlSource::testOfIdentifier
- ProactiveMeasurementJobControlSource::dataTlvLength
- ProactiveDualEndedMeasurementJobControlSource::oamType
- ProactiveDualEndedMeasurementJobControlSource::oamTool
- ProactiveDualEndedMeasurementJobControlSink::oamTool
- ProactiveDualEndedMeasurementJobControlSink::isEnabled
- ProactiveDualEndedMeasurementJobControlSink::oamType
- ProactiveDualEndedMeasurementJobControlSink::testIdentifier

MtProactiveSingleEndedMeasurementJobPac

- ProactiveMeasurementJobControlSource::isEnabled
- ProactiveMeasurementJobControlSource::period
- ProactiveMeasurementJobControlSource::classOfService
- ProactiveMeasurementJobControlSource::testOfIdentifier
- ProactiveMeasurementJobControlSource::dataTlvLength
- ProactiveSingleEndedMeasurementJobControlSource::oamType
- ProactiveSingleEndedMeasurementJobControlSink::oamType
- ProactiveSingleEndedMeasurementJobControlSink::classOfService
- ProactiveSingleEndedMeasurementJobControlSink::isEnabled

The attributes of ProactiveMeasurementJobControlSource are all refactored into an abstract class ProactiveMeasurementJobControl.

7.3.1.1 Proactive loss measurement (LM)

The dual-ended proactive LM by CCM uses MtProactiveDualEndedMeasurementJobPac and single-ended proactive LM by LMM/LMR uses MtProactiveSingleEndedMeasurementJobPac.

7.3.1.2 Proactive delay measurement (DM)

The single-ended DM by DMM/DMR uses MtProactiveSingleEndedMeasurementJobPac and dual-ended DM by 1DM uses MtProactiveDualEndedMeasurementJobPac.

7.3.2 On-demand OAM for performance measurement

The functions of On-demand OAM for performance measurement mainly use two object classes: MtOnDemandDualEndedMeasurementJobPac and MtOnDemandSingleEndedMeasurementJobPac . They are pruned and refactored from object classes of [ITU-T G.8152] as following.

MtOnDemandDualEndedMeasurementJobPac

- OnDemandMeasurementJobControl::startTime
- OnDemandMeasurementJobControl::stopTime
- OnDemandMeasurementJobControl::oamPduGenerationType
- OnDemandMeasurementJobControl::measurementInterval
- OnDemandMeasurementJobControl::messagePeriod
- OnDemandMeasurementJobControl::repetitionPeriod
- OnDemandMeasurementJobControl::classOfService
- OnDemandMeasurementJobControl::testIdentifier
- OnDemandMeasurementJobControl::dataTlvLength
- OnDemandDualEndedMeasurementJobControlSink::oamType
- OnDemandDualEndedMeasurementJobControlSink::onDemandPerformanceData
- OnDemandDualEndedMeasurementJobControlSink::startTime
- OnDemandDualEndedMeasurementJobControlSink::stopTime
- OnDemandDualEndedMeasurementJobControlSink::testIdentifier

MtOnDemandSingleEndedMeasurementJobPac

- OnDemandMeasurementJobControl::startTime
- OnDemandMeasurementJobControl::stopTime
- OnDemandMeasurementJobControl::oamPduGenerationType
- OnDemandMeasurementJobControl::measurementInterval
- OnDemandMeasurementJobControl::messagePeriod
- OnDemandMeasurementJobControl::repetitionPeriod
- OnDemandMeasurementJobControl::classOfService
- OnDemandMeasurementJobControl::testIdentifier
- OnDemandMeasurementJobControl::dataTlvLength
- OnDemandSingleEndedMeasurementJobControlSource::oamType
- OnDemandSingleEndedMeasurementJobControlSink::oamType
- OnDemandSingleEndedMeasurementJobControlSink::onDemandPerformanceData

The attributes of G. [ITU-T 8152] class OnDemandMeasurementJobControl are all refactored into an abstract class OnDemandMeasurementJobCotrol in G.8152.1.

7.3.2.1 On-demand loss measurement

This function commonly be performed by the method of single-ended on demand LM with LMM/LMR, so only MtOnDemandSingleEndedMeasurementJobPac is used.

7.3.2.2 On-demand delay measurement

The single-ended DM by DMM/DMR uses MtOnDemandSingleEndedMeasurementJobPac and dual-ended DM by 1DM uses MtOnDemandDualEndedMeasurementJobPac.

7.3.2.3 Throughput measurement

The single-ended throughput function uses MtOnDemandSingleEndedMeasurementJobPac and the dual-ended throughput function uses MtOnDemandDualEndedMeasurementJobPac.

7.3.3 Proactive fault management

The attributes of this function can be set as MepControl creates the Mep instances by using createMep operation.

7.3.3.1 Continuity check and connectivity verification (CC/CV)

This function mainly uses two object classes: MtProactiveCcCvPac and MtOnDemandCcCvPac. They are pruned and refactored from [ITU-T G.8152] information models as followings.

MtProactiveCcCvPac

- Mep::ccEnable
- Mep::ccPeriod
- Mep::ccCos
- Mep::cvpEnable

MtOnDemandCcCvPac

- MepSourceDot1::CvSeries()

All these attribues are pruned from [ITU-T G.8152], because [IETF RFC8531] already has them.

7.3.3.2 Remote defect indication (RDI)

This function mainly uses object class MtProactiveCcCvPac. It is pruned and refactored from [ITU-T G.8152] information model as followings.

MtProactiveCcCvPac

- Mep::rdiOamTool

7.3.3.3 Alarm indication signal (AIS)

This function mainly uses object class MtAisPac. It is pruned and refactored from [ITU-T G.8152] information model as followings.

MtAisPac

- MT_CtpSi::aisPeriod

– MT_CtpSi::aisCos

7.3.3.4 Locked signal (Lock report)

This function mainly uses object class MtLckPac. It is pruned and refactored from [ITU-T G.8152] information model as followings.

MtLckPac

– MT_CtpSi::lckPeriod
– MT_CtpSi::lckCos

7.3.3.5 Client signal failure (CSF)

The MtCcPac for CSF is defined in 7.3.3.1 can be used.

7.3.4 On-demand fault management

7.3.4.1 Connectivity verification (CV)

The MtCvPac for proactive CV is defined in 7.3.3.1 can be used.

7.3.4.2 Diagnostic test (DT)

Bidirectional loopback(LB) for DT, the MtCvPac defined in 7.3.3.1 can be used.

Unidirectional TST for DT, the MtTstPac is pruned and refactored from G.8152 information model as followings.

MtTstPac

– Mep::1ThOamTool
– MepSo::ttlValue
– Mip::ttlValue
– MepSourceDot1::1ThStart()
– MepSourceDot1::1ThTermination()
– MepSinkDot1::1ThStart()
– MepSinkDot1::1ThTermination()

7.4 UML model files

This sub-clause contains the UML model files developed using .the Papyrus open-source modelling tool.

G.
.1_v0.07@2020091

G.8152.1_v0.06_E5.zip

This zip contains the ITU-T G.8152.1 model files (i.e., the .project, .di, .notation and .uml files) and the profiles.

The G.8152.1 0.07 model uses the following modelling tool and profiles:

- Eclipse 4.9 (i.e. version 2018.09)
- Papyrus 4.1.0,
- OpenModel_Profile 0.2.17,
- OpenInterfaceModel_Profile 0.0.10,
- ProfileLifecycle_Profile 0.0.4, and
- Gendoc v0.7.1

8 Data Models of MPLS-TP OAM

This clause contains the interface-protocol-specific data models of the MPLS-TP OAM functions identified in Clause 6. These data models are translated from the interface-protocol-neutral UML information specified in Clause 7.

8.1 YANG Data Models

This clause contains the G.8152.1 YANG data model.

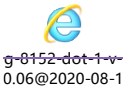
The YANG data models defined in this version of the Recommendation uses the YANG 1.1 language defined in [IETF RFC 7950]. The tree format defined in [IETF RFC8340] is used for the YANG data model tree representation.

The YANG data model(s) defined in this Recommendation conforms to the Network Management Datastore Architecture in [IETF RFC8342].

The YANG file and tree are attached as:

g-8152-dot-1-v-0.07.yang

g-8152-dot-1-v-0.07.tree



The G.8152.1 YANG model is translated and manually modified, from the interface-protocol-neutral UML information provided in Clause 7.34. The translation is done with the assistance of the Open Source translation tooling xmi2yang, which is developed according to the [b-ONF TR-531] Mapping Guidelines.

8.2 Others Data Models

For further study.

Appendix I
Overview of the MPLS-TP OAM model configuration cases

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

The information model of G.8152.1 contains ME,MEG,MEP,MIP, and several OAM function Pacs. In a specific case of OAM configuration, it is necessary to describe how these object classes are used.

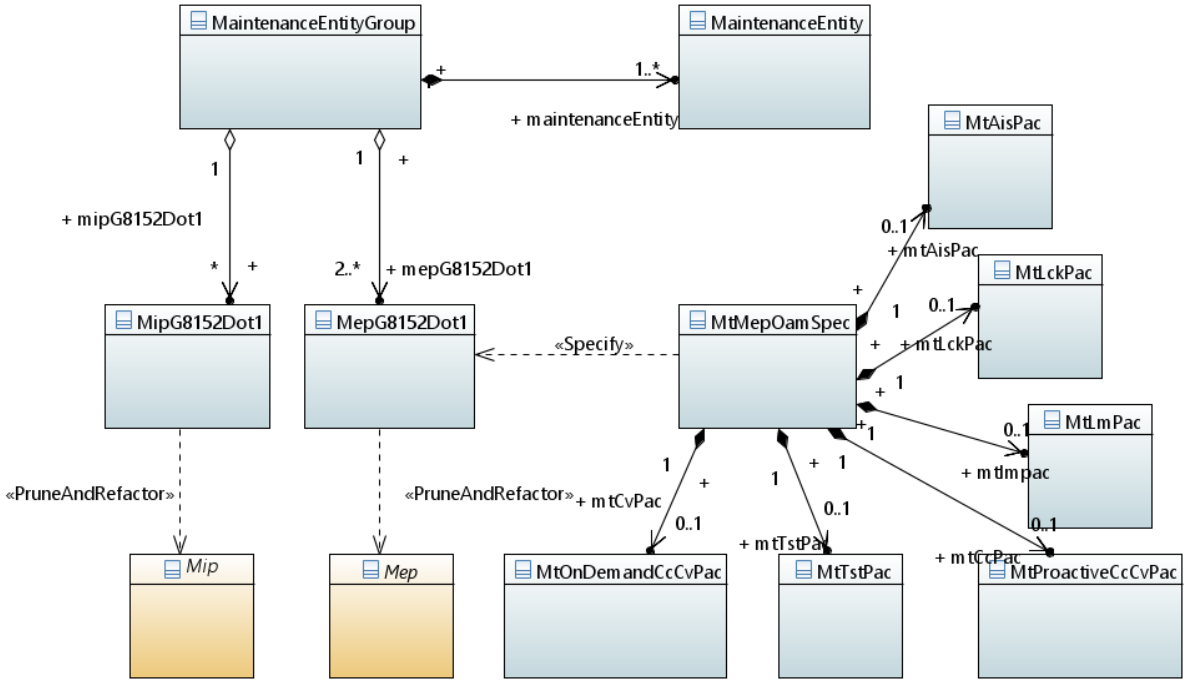


Figure I-1 OAM configuration

OAM Configuration.pr

From the Figure I-1, some constraint need to be considered:

- In case of an unidirectinal ME, it uses a MepSource at the head-end and MepSink at the tail-end, the MepBidirectional is not used.
- In case of a bidirectional ME, it uses a MepBidirectional at the head-end and the tail-end, the MepSource and MepSink are not used.
- In case of point-to-multipoint MEG, several MEs could share MepSource at root end.

I.1 MEP and MIP configuration

The [IETF RFC6371] provided four type of ME and the [ITU-T G.8110.1] provided point-to-point and point-to-multipoint MEG, the following table concludes all configuration cases.

Table I-1 MEP and MIP configuration

Case	ME & MEG	MEP	MIP
A unidirectional point-to-point transport path	A single unidirectional ME in the point-to-point MEG	A pair of MepSource and MepSink (the MepSource is at the head-end of the path and the MepSink is at the tail-end of the path).	Zero or several pairs of MipSink and MipSource
Associated bidirectional point-to-point transport paths	Two independent unidirectional MEs in the point-to-point MEG	A pair of MepSource and MepSink for each direction of the path (the MepSource is at the head-end of the path and the MepSink is at the tail-end of the path).	Zero or several pairs of MipSink and MipSource
Co-routed bidirectional point-to-point transport paths	A single bidirectional ME in the point-to-point MEG	A pair of MepBidirectional	Zero or serveral MepBidirectional
Unidirectional point-to-multipoint transport path	A single unidirectional ME for each leaf in point-to-multipoint MEG	A pair of MepSource and MepSink for the path of each of the leaves (the MepSource is at the root and the MepSink is at the leaf. Can use/share a common MepSource at the root.).	Zero or several pairs of MipSink and MipSource

Note 1 - The OAM mechanism in [ITU-T G.8113.1] only supports co-routed bidirectional point-to-point MPLS-TP connections.

I.2 OAM Pac configuration

All OAM function attributes are pruned & refactored from [ITU-T G.8152] model to form MtCc/Cv/Lck/AisPacs in G.8152.1, and anchor to the MtMepOamSpec class. When configuring an specific OAM function on a transport path, Mep could be enhanced by using one or more Pacs of MtMepOamSpec.

Appendix II–
Analysis of G.8152 attributes & operations for G.8152.1

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

This appendix summarized the analysis and disposition of the attributes and operations of the base [ITU-T G.8152] model on whether they should be retained, refactored or pruned for G.8152.1, and the rationale of doing so.

Table II-1 MT TTP and CTP Pruning/Refactoring

Source artifact	To be pruned or moved to	Rationale
Inherited by MT_ConnectionTerminationPoint/Sink/Source/Bidirectional		
Address::address	Pruned	Not needed. It can be inherited from LTP.
G8152LocalClass::localIdList	Pruned	Not needed. It can be inherited from LTP
LocalClass::localId	Pruned	Not needed. It can be inherited from LTP
G8152LayerProtocol::layerProtocolName	Pruned	Not needed.
G8152LayerProtocol::_lpSpec	Pruned	No Spec is needed so far.
G8152LayerProtocol::configuredClientCapacity	Pruned	Not needed. This attribute is from the core model LayerProtocol. The client LTP association should provide all necessary detail hence this attribute is questionable, even in the core model.
G8152LayerProtocol::lpDirection	Pruned	Not needed. Already have explicit Bi/Sink/Source object class instances (although in most case is Bidirectional), so no need for the attribute lpDirection (which is

		Bi/Si/So/UndefinedOrUnknown)
G8152LayerProtocol::terminationState	Pruned	Indicates whether the layer is terminated and if so how. For MT CTP, it is not terminated.
State_Pac::lifecycleState	Pruned	It can be inherited from the LTP.
State_Pac::administrativeState	Pruned	It can be inherited from the LTP.
State_Pac::administrativeControl	Pruned	It can be inherited from the LTP.
State_Pac::operationalState	Pruned	It can be inherited from the LTP.
Extension::extension	Pruned	Not needed. It can be inherited from LTP
Label::label	Pruned	Not needed. It can be inherited from LTP
Name::name	Pruned	Not needed. It can be inherited from LTP
ClientLayerSpecificAdaptationMi_Pac::clientlayerspecificadaptationmi_pac	Pruned	Not needed. Not complete in G.8152 model
AdminState::adminState	Retained	Used in Selector process defined in clause 8.6.1 of G.8121
MT_ConnectionTerminationPointSink		
tc2PhbMapping	Pruned	Qos is out of scope of G.8152.1 Used in TC/Label process defined in clause 8.2 of G.8121 to support E-LSP and L-LSP

qosDecodingMode	Pruned	Qos is out of scope of G.8152.1 Used in TC/Label process defined in clause 8.2 of G.8121 to support E-LSP and L-LSP
lckOamTool lckOamTool:OamTool → move to G.8152.1 MtLckPac	refactored: MtLckPac	MT CTP Sink Pac aggregates (new extended composite) new MtLckSiPac, which has three attributes: lckOamTool:OamTool, lckPeriod::LckAisPeriod and lckCos::Integer
lckPeriod lckPeriod::LckAisPeriod → move to G.8152.1 MtLckPac	refactored: MtLckPac	
lckCos lckCos::Integer → move to G.8152.1 MtLckPac	Refactored: MtLckPac	
aisOamTool aisOamTool:OamTool → move to G.8152.1 MtAisPac	Refactored: MtAisPac	MT CTP Sink Pac aggregates (new extended composite) new MtAisSiPac, which has three attributes: aisOamTool:OamTool, aisPeriod::LckAisPeriod and aisCos::Integer
aisPeriod aisPeriod:LckAisPeriod → move to G.8152.1 MtAisPac	Refactored: MtAisPac	
aisCos aisCos:Integer → move to G.8152.1 MtAisPac	Refactored: MtAisPac	
MT_ConnectionTerminationPointSource		
tc2PhbMapping	Pruned	Qos is out of scope of G.8152.1
qosDecodingMode	Pruned	Qos is out of scope of G.8152.1
apsOamCos	Pruned	APS is out of scope of G.8152.1
MT_ConnectionTerminationPointBidirectional		

_mepBidirectional	Retained & Refactored	In G.8152.1 model, MepG8152Dot1 is used instead of G.8152 class MepBidirectional
_mipBidirectional	Retained & Refactored	In G.8152.1 model, MipG8152Dot1 is used instead of G.8152 class MipBidirectional.
Inherited by MT_TrailTerminationPoint/Sink/Source/Bidirectional		
G8152LocalClass::localId	Pruned	Not needed. It can be inherited from LTP
G8152GlobalClass::localIdList	Pruned	Not needed. It can be inherited from LTP
G8152LocalClass::localIdList	Pruned	Not needed. It can be inherited from LTP
G8152GlobalClass::uuid	Pruned	Not needed. It can be inherited from LTP
G8152LayerProtocol::layerProtocolName	Pruned	The object class already indicates it is MT TTP Not needed. It can be inherited from LTP
G8152LayerProtocol::_lpSpec	Pruned	No Spec is needed so far. Not needed. It can be inherited from LTP
G8152LayerProtocol::configuredClientCapacity	Pruned	Not needed. This attribute is from the core model LayerProtocol. The client LTP association should provide all necessary detail hence this attribute is questionable, even

		in the core model.
G8152LayerProtocol::lpDirection	Pruned	Not needed. Already have explicit Bi/Sink/Source object class instances (although in most case is Bidirectional), so no need for the attribute lpDirection (which is Bi/Si/So/UndefiedOrUnknown).
G8152LayerProtocol::terminationState	Pruned	Not needed. MT TTP is terminated. Not needed. It can be inherited from LTP
Pacs::Tp_Pac::alarmStatus	Pruned	In G.8152 v2.00, Tp_Pac is incomplete.
Pacs::Tp_Pac::crossConnectionObjectPointer	Pruned	In G.8152 v2.00, Tp_Pac is incomplete.
Pacs::Tp_Pac::currentProblemList	Pruned	In G.8152 v2.00, Tp_Pac is incomplete.
Pacs::Tp_Pac::alarmSeverityAssignmentProfilePointer	Pruned	In G.8152 v2.00, Tp_Pac is incomplete.
Serverlayerspecificadaptationmi_pac	Pruned	In G.8152 v2.00, Tp_Pac is incomplete.
mt_connectionterminationpoint	Pruned	Not needed
MT_TrailTerminationPointSink		
lmTfMin lmTfMin:Boolean → move to G.8152.1 MtLmPac	refactored: MtLmPac	These four attributes are defined in clause 6.1.3.3 of G.8121 for Degrade signal defect (dDEG) to monitor connectivity of a MT trail. According to Figure 9-6 of G.8121.1, these attributes are used for defect generation after a proactive oam sink control
lmDegm lmDegm:Integer → move to G.8152.1 MtLmPac	refactored: MtLmPac	
lmM lmM:Integer → move to G.8152.1 MtLmPac	refactored: MtLmPac	
lmDegThr	refactored:	

lmDegThr:Integer → move to G.8152.1 MtLmPac	MtLmPac	process. So they are moved to MtLmPac, because loss measurement could generate dDEG defect.
currentProblemList	Retained & Refactored	OAM process can generate defects, but we should check enumeration literals of MT_TtpProblemList to retain only OAM defects defined in G.8121.
MT_TrailTerminationPointSource		
ttlValue	Retained	From source Mep to Mip, and from Mip to sink Mep, "Time To Live" value is inserted in the outer shim header's TTL field within the MT_AI traffic unit
MT_TrailTerminationPointBidirectional		
_sccTp	Pruned	Assume not in the scope of G.8152.1
_mccCtp	Pruned	Assume not in the scope of G.8152.1
_mepBidirectional	Retained & Refactored	In G.8152.1 model, a class MepG8152Dot1 is used instead of G.8152 class MepBidirectional
_ethConnectionTerminationPoint	Pruned	Not needed

Table II-1 MT MEP Classes Pruning/Refactoring

Source artifact	To be pruned or moved to	Rationale
G8152LocalClass::localId	Pruned	Not needed It can be inheried from LTP
MEP		
Mep::adminState	Retained	Used in Selector process defined in clause 8.6.1 of G.8121
Mep::mepMac	Pruned	It dose not exist in G.8152 model
Mep::mel	Pruned	It dose not exist in G.8152 model
G8152LocalClass::localIdList	Pruned	Not needed It can be inheried from LTP
Mep::megId	Retained	This attribute identifies the MEG instance that the subject MEP belongs to.
Mep::mepId	Retained	This attribute models the MI_MEP_ID signal defined in G.8121 and configured as specified in G.8151.
Mep::cvOamTool	MtOnDemandCcCvPac	As is demonstrated in clause 8.8.3 and Figure 9-28 of G.8121, cvOamTool is used for ondemand OAM CV function.
Mep::cvpEnable	Refactored: MtProactiveCcCvPac	As can be seen from Table 9-3 of G.8121, cvpEnable is used for proactive OAM CV function.

Mep::ccEnable	Refactored: MtProactiveCcCvPac	Based on the statement of clause 8.8.1 and Figure 9-11 of G.8121, ccEnable, ccPeriod, ccCos and ccOamTool are used for proactive OAM CC function
Mep::ccPeriod	Refactored: MtProactiveCcCvPac	
Mep::ccCos	Refactored: MtProactiveCcCvPac	
Mep::ccOamTool	Refactored: MtProactiveCcCvPac	
Mep::dpLoopbackEnable	Pruned	dpLoopback is for G.8113.2, is out of scope of G.8113.1.
Mep::rdiOamTool	Refactored: MtProactiveCcCvPac	According to the statement of clause 8.8.2, RDI is associated with proactive CC/CV
Mep::1ThOamTool	Refactored: MtTstPac	Based Table 6-1 of G.8152.1 and Figure 9-28 of G.8121, 1ThOamTool is used for ondemand PM function, it is not belonged to DM or LM, it's for testing throughput.
MEP Sink		
MepSink::peerMepIdentifier	Retained	MepId and peerMepIdentifier can identify a ME.
MepSink::aisOamTool	Refactored: MtAisPac	The aisOamTool is used for AIS process as demonstrated in clause 8.6.2 of G.8121, MI_AIS_Period and MI_AIS_Cos are also needed while modeling. As seen from Table 6-1 of

		G.8152.1, AIS is a proactive FM function.
MepSink::lckOamTool	Refactored: MtLckPac	The lckOamTool is used for LCK process as stated in clause 8.6.3, MI_LCK_Period and MI_LCK_Cos are also needed while modeling. As seen from Table 6-1 of G.8152.1, LCK is a proactive FM function.
MepSink::remoteLockRequest	Pruned	As Table 6-1 of G.8152.1 shows that, LKI is out of scope of G.8152.1. The remoteLockRequest models for MI_Admin_State_Request defined in clause 8.8.11 of G.8121 for Lock Instruct process.
MEP Source		
MepSource::ttlValue	Retained	From source Mep to Mip, and from Mip to sink Mep, “Time To Live” value is inserted in the outer shim header's TTL field within the MT_AI traffic unit
MepSource::lockInstructEnable	Pruned	As Table 6-1 of G.8152.1 shows that, LKI is out of scope of G.8152.1. The remoteLockRequest models for MI_Admin_State_Request defined in clause 8.8.11 of G.8121 for Lock Instruct

		process.
MepSource::adminState	Retained	Used in Selector process defined in clause 8.6.1 of G.8121
MEP Bidirectional		

Table II-2 MT MIP Classes Pruning/Refactoring

Source artifact	To be pruned or moved to	Rationale
G8152LocalClass::localId	Pruned	It can be inherited from LTP
MIP		
G8152LocalClass::localIdList	Pruned	It can be inherited from LTP
Mip::mipId	Retained	For identify a Mip instance.
Mip::ttlValue	Retained	From source Mep to Mip, and from Mip to sink Mep, “Time To Live” value is inserted in the outer shim header's TTL field within the MT_AI traffic unit
Mip::cvOamTool	Refactored: MtOnDemandCcCvPac	Used for Ondemand OAM CV process.
Mip::dpLoopbackEnable	Pruned	It is defined in G.8113.2, is out of scope of G.8113.1.
MIP Sink		

MIP Source		
MIP Bidirectional		
Mip::isFullMip	Retained	

Table II-3 Pruning/refactoring of MEP/MIP operations

Source artifact	To be pruned or moved to	Rationale
MtMepInterface		
mepSi_establishOnDemandDualEndedMeasurementJobSink	Pruned	Achieved via object creation of an instance of OnDemandDualEndedMeaJob and a subtending OnDemandDualEndedMeasurementJobControl instance
mepSi_establishProactiveDualEndedMeasurementJobSink	Pruned	Achieved via object creation of an instance of ProactiveDualEndedMeaJob and a subtending ProactiveDualEndedMeasurementJobControl instance
mepSi_getSvdCc	Retained	Cc is a Proactive FM function using CCM which is an ITU-T OAM mechanism
mepSo_establishOnDemandDualEndedMeasurementJobSource	Pruned	Achieved via object creation of an instance of OnDemandDualEndedMeaJob and a subtending OnDemandDualEndedMeasurementJobControl instance
mepSo_establishProactiveDualEndedMeasurementJobSource	Pruned	Achieved via object creation of an instance of ProactiveDualEndedMeaJob and a subtending

		ProactiveDualEndedMeasurementJobControl instance
mepSo_CvSeries	Pruned	Achieved via mepSoDot1_CvSeries
mepBi_establishOnDemandDualEndedMeasurementJob	Pruned	Achieved via object creation of an instance of OnDemandDualEndedMeaJob and a subtending OnDemandDualEndedMeasurementJobControl instance
mepBi_establishProactiveDualEndedMeasurementJob	Pruned	Achieved via object creation of an instance of ProactiveDualEndedMeaJob and a subtending ProactiveDualEndedMeasurementJobControl instance
mepSoDot1_1ThStart	Retained	1Th is an On-demand PM function using TST which is an ITU-T OAM mechanism
mepSoDot1_1ThTerminate	Retained	1Th is an On-demand PM function using TST which is an ITU-T OAM mechanism
mepSoDot1_CvSeries	Retained	Cv is a Proactive FM function using CCM or an On-demand FM function using LB which both are ITU-T OAM mechanisms
mepSoDot1_CvTest	Retained	Cv is a Proactive FM function using CCM or an On-demand FM function using LB which both are ITU-T OAM mechanisms
mepSoDot1_CvTestTerminate	Retained	Cv is a Proactive FM function using CCM or an On-demand FM function using LB which both are ITU-T OAM mechanisms
mepSiDot1_1ThStart	Retained	1Th is an On-demand PM function using TST which is an ITU-T OAM mechanism

mepSiDot1_1ThTerminate	Retained	1Th is an On-demand PM function using TST which is an ITU-T OAM mechanism
mepControl_createMep	Pruned	Achieved via object creation of an instance of Mep
mepControl_deleteMep	Pruned	Achieved via object deletion of an instance of Mep
mepControl_getAllContainedMeps	Pruned	Achieved via retrieval of all object instances of Mep
mepControl_modifyMep	Pruned	Achieved via object modification of an instance of Mep
onDemandDualEndedMeaJobControlSink_getIntermediateReport	Retained	This is an ITU-T measurement job
onDemandSingleEndedMeaJobControl_getIntermediateReport	Retianed	This is an ITU-T measurement job
MtMipInterface		
mipControl_createMip	Pruned	Achieved via object creation of an instance of Mip
mipControl_modifyMip	Pruned	Achieved via object modification of an instance of Mip
mipControl_deleteMip	Pruned	Achieved via object deletion of an instance of Mip
mipControl_getAllContainedMips	Pruned	Achieved via retrieval of all contained instances of Mip

Table II-5 MT Measurement Job Classes Pruning/Refactoring

Source artifact	To be pruned or moved to	Rationale
Inherited by		

ProactiveSingleEndedMeasurementJobControlSource/Sink/SourcG8113Dot1/SinkG8113Dot1		
G8152LocalClass::localIdList	Pruned	Not needed.
State_Pac::lifecycleState	pruned	It can be inherited from the LTP.
State_Pac::administrativeState	pruned	It can be inherited from the LTP.
State_Pac::administrativeControl	pruned	It can be inherited from the LTP.
State_Pac::operationalState	pruned	It can be inherited from the LTP.
Extension::extension	pruned	Not needed.
Label::label	pruned	Not needed.
Name::name	pruned	Not needed.
ProactiveSingleEndedMeasurementJobControlSource		
oamType ProactiveSingleEndedMeasurementJobControlSource::oamType→ move to G.8152.1 ProactiveSingleEndedMeasJob	refactored: ProactiveSingleEndedMeaJob	ProactiveSingleEndedMeaJob is used for 2-way measurement.
isEnabled ProactiveSingleEndedMeasurementJobControlSource::isEnabled→ move to G.8152.1 ProactiveSingleEndedMeasJob	refactored: ProactiveSingleEndedMeaJob	
period ProactiveSingleEndedMeasurementJobControlSource::period→ move to G.8152.1 ProactiveSingleEndedMeasJob	refactored: ProactiveSingleEndedMeaJob	
classOfService ProactiveSingleEndedMeasurementJobControlSource::classOfService→ move to G.8152.1 ProactiveSingleEndedMeasJob	refactored: ProactiveSingleEndedMeaJob	
testIdentifier ProactiveSingleEndedMeasurementJobControlSource::t	refactored: ProactiveSingleEn	

estIdentifier→ move to G.8152.1 ProactiveSingleEndedMeasJob	dedMeaJob	
dataTlvLength ProactiveSingleEndedMeasurementJobControlSource::dataTlvLength→ move to G.8152.1 ProactiveSingleEndedMeasJob	refactored: ProactiveSingleEndedMeaJob	
ProactiveSingleEndedMeasurementJobControlSink		
oamType ProactiveSingleEndedMeasurementJobControlSink::oamType→ move to G.8152.1 ProactiveSingleEndedMeaJob	refactored: ProactiveSingleEndedMeaJob	ProactiveSingleEndedMeaJob is used for 2-way measurement.
isEnabled ProactiveSingleEndedMeasurementJobControlSink::isEnabled→ move to G.8152.1 ProactiveSingleEndedMeaJob	refactored: ProactiveSingleEndedMeaJob	
period ProactiveSingleEndedMeasurementJobControlSink::period→ move to G.8152.1 ProactiveSingleEndedMeaJob	refactored: ProactiveSingleEndedMeaJob	
ProactiveSingleEndedMeasurementJobControlSourceG8113Dot1/SinkG8113Dot1		
Inherited by ProactiveDualEndedMeasurementJobSource/Sink		
G8152LocalClass::localIdList	Pruned	Not needed.
State_Pac::lifecycleState	pruned	It can be inherited from the LTP.
State_Pac::administrativeState	pruned	It can be inherited from the LTP.

State_Pac::administrativeControl	pruned	It can be inherited from the LTP.
State_Pac::operationalState	pruned	It can be inherited from the LTP.
Extension::extension	pruned	Not needed.
Label::label	pruned	Not needed.
Name::name	pruned	Not needed.
G8152LocalClass::localIdList	Pruned	Not needed.
State_Pac::lifecycleState	pruned	It can be inherited from the LTP.
State_Pac::administrativeState	pruned	It can be inherited from the LTP.
State_Pac::administrativeControl	pruned	It can be inherited from the LTP.
State_Pac::operationalState	pruned	It can be inherited from the LTP.
Extension::extension	pruned	Not needed.
ProactiveDualEndedMeasurementJobControlSource		
oamType ProactiveDualEndedMeasurementJobControlSource::oamType→ move to G.8152.1 MtProactiveDualEndedMeaJob	refactored: MtProactiveDualEndedMeaJob	MtProactiveDualEndedMeaJob is used for 1-way measurement.
oamTool ProactiveDualEndedMeasurementJobControlSource::oamType→ move to G.8152.1 MtProactiveDualEndedMeaJob	refactored: MtProactiveDualEndedMeaJob	
isEnabled ProactiveDualEndedMeasurementJobControlSource::isEnabled→ move to G.8152.1 MtProactiveDualEndedMeaJob	refactored: MtProactiveDualEndedMeaJob	
period	refactored: MtProactiveDualE	

ProactiveDualEndedMeasurementJobControlSource::period→ move to G.8152.1 MtProactiveDualEndedMeaJob	ndedMeaJob	
classOfService ProactiveDualEndedMeasurementJobControlSource::classOfService→ move to G.8152.1 MtProactiveDualEndedMeaJob	refactored: MtProactiveDualEndedMeaJob	
testIdentifier ProactiveDualEndedMeasurementJobControlSource::testIdentifier→ move to G.8152.1 MtProactiveDualEndedMeaJob	refactored: MtProactiveDualEndedMeaJob	
ProactiveDualEndedMeasurementJobControlSink		
oamType ProactiveDualEndedMeasurementJobControlSink::oamType→ move to G.8152.1 MtProactiveDualEndedMeaJob	refactored: MtProactiveDualEndedMeaJob	MtProactiveDualEndedMeaJob is used for 1-way measurement.
isEnabled ProactiveDualEndedMeasurementJobControlSink::isEnabled→ move to G.8152.1 MtProactiveDualEndedMeaJob	refactored: MtProactiveDualEndedMeaJob	
period ProactiveDualEndedMeasurementJobControlSink::period→ move to G.8152.1 MtProactiveDualEndedMeaJob	refactored: MtProactiveDualEndedMeaJob	
testIdentifier ProactiveDualEndedMeasurementJobControlSink::testIdentifier→ move to G.8152.1 MtProactiveDualEndedMeaJob	refactored: MtProactiveDualEndedMeaJob	
Inherited by OnDemandSingleEndedMeasurementJobControl		
oamType OnDemandSingleEndedMeasurementJobControl::oamType→ move to G.8152.1	refactored: MtOnDemandSingleEndedMeaJob	MtOnDemandSingleEndedMeaJob is used for 2-way

MtOnDemandSingleEndedMeaJob		measurement.
startTime OnDemandSingleEndedMeasurementJobControl::startTime→ move to G.8152.1 MtOnDemandSingleEndedMeaJob	refactored: MtOnDemandSingleEndedMeaJob	
stopTime OnDemandSingleEndedMeasurementJobControl::stopTime→ move to G.8152.1 MtOnDemandSingleEndedMeaJob	refactored: MtOnDemandSingleEndedMeaJob	
oamPduGenerationType ProactiveDualEndedMeasurementJobControl::oamPduGenerationType→ move to G.8152.1 MtOnDemandSingleEndedMeaJob	refactored: MtOnDemandSingleEndedMeaJob	
classOfService OnDemandSingleEndedMeasurementJobControl::classOfService→ move to G.8152.1 MtOnDemandSingleEndedMeaJob	refactored: MtOnDemandSingleEndedMeaJob	
testIdentifier OnDemandSingleEndedMeasurementJobControl::testIdentifier→ move to G.8152.1 MtOnDemandSingleEndedMeaJob	refactored: MtOnDemandSingleEndedMeaJob	
measurementInterval OnDemandSingleEndedMeasurementJobControl::measurementInterval→ move to G.8152.1 MtOnDemandSingleEndedMeaJob	refactored: MtOnDemandSingleEndedMeaJob	
messagePeriod OnDemandSingleEndedMeasurementJobControl::messagePeriod→ move to G.8152.1 MtOnDemandSingleEndedMeaJob	refactored: MtOnDemandSingleEndedMeaJob	
dataTlvLength OnDemandSingleEndedMeasurementJobControl::dataTlvLength→ move to G.8152.1 MtOnDemandSingleEndedMeaJob	refactored: MtOnDemandSingleEndedMeaJob	
repetitionPeriod OnDemandSingleEndedMeasurementJobControl::repeti	refactored: MtOnDemandSing	

tionPeriod→ move to G.8152.1 MtOnDemandSingleEndedMeaJob	leEndedMeaJob	
onDemandPerformanceData OnDemandSingleEndedMeasurementJobControl::onDemandPerformanceData→ move to G.8152.1 MtOnDemandSingleEndedMeaJob	refactored: MtOnDemandSingleEndedMeaJob	
Inherited by OnDemandSingleEndedMeasurementJobControlSource		
oamType OnDemandSingleEndedMeasurementJobControlSource::oamType→ move to G.8152.1 MtOnDemandDualEndedMeaJob	refactored: MtOnDemandDualEndedMeaJob	MtOnDeamndDualEndedMeaJob is used for 1-way measurement.
startTime OnDemandSingleEndedMeasurementJobControlSource::startTime→ move to G.8152.1 MtOnDemandDualEndedMeaJob	refactored: MtOnDemandDualEndedMeaJob	
stopTime OnDemandSingleEndedMeasurementJobControlSource::stopTime→ move to G.8152.1 MtOnDemandDualEndedMeaJob	refactored: MtOnDemandDualEndedMeaJob	
oamPduGenerationType OnDemandSingleEndedMeasurementJobControlSource::oamPduGenerationType→ move to G.8152.1 MtOnDemandDualEndedMeaJob	refactored: MtOnDemandDualEndedMeaJob	
classOfService OnDemandSingleEndedMeasurementJobControlSource::classOfService→ move to G.8152.1 MtOnDemandDualEndedMeaJob	refactored: MtOnDemandDualEndedMeaJob	
testIdentifier OnDemandSingleEndedMeasurementJobControlSource::testIdentifier→ move to G.8152.1 MtOnDemandDualEndedMeaJob	refactored: MtOnDemandDualEndedMeaJob	
measurementInterval OnDemandSingleEndedMeasurementJobControlSource	refactored: MtOnDemandDua	

::measurementInterval→ move to G.8152.1 MtOnDemandDualEndedMeaJob	lEndedMeaJob	
messagePeriod OnDemandSingleEndedMeasurementJobControlSource ::messagePeriod→ move to G.8152.1 MtOnDemandDualEndedMeaJob	refactored: MtOnDemandDua lEndedMeaJob	
dataTlvLength OnDemandSingleEndedMeasurementJobControlSource ::dataTlvLength→ move to G.8152.1 MtOnDemandDualEndedMeaJob	refactored: MtOnDemandDua lEndedMeaJob	
repetitionPeriod OnDemandSingleEndedMeasurementJobControlSource ::repetitionPeriod→ move to G.8152.1 MtOnDemandDualEndedMeaJob	refactored: MtOnDemandDua lEndedMeaJob	
onDemandPerformanceData OnDemandSingleEndedMeasurementJobControlSource ::onDemandPerformanceData→ move to G.8152.1 MtOnDemandDualEndedMeaJob	refactored: MtOnDemandDua lEndedMeaJob	
Inherited by OnDemandDualEndedMeasurementJobControlSink		
oamType OnDemandDualEndedMeasurementJobControlSink::Ty pe→ move to G.8152.1 MtOnDemandDualEndedMeaJob	refactored: MtOnDemandDua lEndedMeaJob	MtOnDeamndDualEn dedMeaJob is used for 1-way measurement.
startTime OnDemandDualEndedMeasurementJobControlSink::sta rtTime→ move to G.8152.1 MtOnDemandDualEndedMeaJob	refactored: MtOnDemandDua lEndedMeaJob	
stopTime OnDemandDualEndedMeasurementJobControlSink::st opTime→ move to G.8152.1 MtOnDemandDualEndedMeaJob	refactored: MtOnDemandDua lEndedMeaJob	
onDemandPerformanceData OnDemandDualEndedMeasurementJobControlSink::on	refactored: MtOnDemandDua	

DemandPerformanceData→ move to G.8152.1 MtOnDemandDualEndedMeaJob	lEndedMeaJob	
testIdentifier OnDemandDualEndedMeasurementJobControlSink::testIdentifier→ move to G.8152.1 MtOnDemandDualEndedMeaJob	refactored: MtOnDemandDualEndedMeaJob	

Bibliography

~~[b-ITU-T X.yyy] Recommendation ITU-T X.yyy (date), *Title*.~~

[b-ONF TR-531] ONF TR-531_*UML-YANG Mapping Guidelines* (https://3vf60mmveq1g8vzn48q2o71a-wpengine.netdna-ssl.com/wp-content/uploads/2014/10/TR-531_UML-YANG_Mapping_Guidelines_v1.0.pdf)