

**Question(s):** 14/15

Geneva, 20 November – 1 December 2023

**TD****Source:** Editors – G.8052**Title:** Draft revision to ITU-T G.8052 “Protocol-neutral management information model for the Ethernet transport capable network element”, v4.0 for consent


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**Abstract:** The document contains the editor draft of revision to Recommendation G.8052 (12/2018) “Protocol-neutral management information model for the Ethernet transport capable network element”, v4.0, for consent.

**Document history:**

Version	Date	Description
3.01	TD374/3 (7/2019) Geneva	<p>Initial version created by taking the in-force G.8052 (12/2018) as the base and incorporated with the following agreed changes at the July 2019 SG15 plenary meeting.</p> <p>Updates:</p> <ul style="list-style-type: none"> <li>– Up-version the <i>Model development environment</i> <ul style="list-style-type: none"> <li>▪ Eclipse 4.7.2 (i.e. version Oxygen)</li> <li>▪ Papyrus 3.2.0,</li> <li>▪ OpenModel_Profile 0.2.13 → v0.2.17</li> <li>▪ OpenInterfaceModel_Profile 0.8 → v0.0.10</li> <li>▪ ProfileLifecycle_Profile 0.0.4, and</li> <li>▪ Gendoc v0.7.0 milestone 2</li> </ul> </li> <li>– Update MedIdentifier per C1215 and C1235. Add new Figure 6-3A.</li> </ul> <p>TO DO</p> <ul style="list-style-type: none"> <li>– Develop the FlexE UML model per C1235 and the received comments (See meeting report TD388/P section 3.6.9.2)</li> </ul>


Version	Date	Description
3.02	WD14-10 (9/2019) Gothenburg TD484/WP3 (1/2020)	Per WD14-25 on LM & DM classification – 7.3.1 & 7.3.2 on LM & DM classification To Do: – Papyrus up-version (done in v3.0.6) – FlexE model per G.8051 (WD14-39 on G.8023 FlexE MIs) – C1234 (July 2019 editing instruction)
3.03	TD484R1/WP3 (2/2020)	Updates: – Per C1871, and as shown in the new diagram Fig. 6-10.A EthCtpGfpConfiguration: ○ New GfpEthCsf_Pac/csfRdiFdiEnable, which is contained in ETH CTP ○ Import G.875 GfpCsfSo_Pac & GfpCsfSk_Pac, which are contained in ETH CTP So & ETH CTP Sk respectively ○ To do: import the G.875 model
3.04	TD710/WP3 (4/2021)	Update: – Rename the UML module from ItutG8052 to itut-eth-mgmt – Update the Open Model Statement (including urn:itu:t:rec:eth-ne-mgmt:uml:itut-eth-mgmt) and Reference of the module – Update the Applied Comments and reference of the ETHnull TP Sk/So/Bi object class so that to align with G.8021 – Add the suffix _D to the names of the existing object classes and also shorten the object classes names using abbreviation (e.g., Eth, Ttp, Ctp, Mea, EthNullTtpBidirectional, Snc, Sn, Raps, etc.) – Prune/Refactor Eth TTP <div style="text-align: center;">               ETH TTP              Overview.png           </div> ○ – Update clause 8 – New Appendix IV. To do: – Eth CTP P/R from G.7711 – Forwarding P/R from G.7711 – Align the OAM model with G.8052.1. This will be done after G.8052.1 has further progressed on On-Demand measurement.

Version	Date	Description
3.05	CD14a-06 (9/29/2021) CD14a-06r1 (10/4/2021) TD843/3 (12/2021)	Update: <ul style="list-style-type: none"> <li>– New structure for the main body clauses of G.8052 per CD14a-21 (2021-09-29) and CD14a-21r1 (2021-10-04)</li> <li>– Clause 7.1.1 &amp; Appendix V for ETH TTP per CD14a-15 (2021-08-04)</li> <li>– Clauses 7.1.2 &amp; 7.1.3 &amp; Appendix V for ETH CTP and ETH connectivity per CD14a-18 (2021-09-01) on ETH TTP and ETH CTP84</li> <li>– Clause 8 contains the updated UML files.</li> </ul>
	TD843r1/3 (2021-12-15)	To be updated per agreement on C2645
3.0.6	CD14c-06 (2022-03-16)	Per C2645 agreement (To do. Pending on the ongoing G.8052.1 modeling) <ul style="list-style-type: none"> <li>– Per proposal 2.1: deprecate the current CD and HD</li> <li>– Per proposal 2.2: adopt the G.8052.1 CD and HD and their respective single-ended and dual-ended subclasses</li> </ul> Per cd14c-11 <ul style="list-style-type: none"> <li>– Updated Fig.6-1 to align with new Fig.1-1/G.8021 <ul style="list-style-type: none"> <li>• Also add CTPs for BP, MCC, client.</li> <li>• Need to discuss ETHG CTP.</li> </ul> </li> <li>– (Pending on TCIM decision) To delete the non-Ethernet Server Layer classes in UML diagram, including SDH_TrailTerminationPoint, OTH_TrailTerminationPoint, MT_TrailTerminationPoint, PDH_TrailTerminationPoint, ATM_ConnectionTerminationPoint, MT_ConnectionTerminationPoint, PDH_ConnectionTerminationPoint</li> </ul>
	CD14c-06r1 (2022-07-20)	Update <ul style="list-style-type: none"> <li>– Up-version modeling tool to Eclipse 2020-06 (4.16) &amp; Papyrus 4.8. <ul style="list-style-type: none"> <li>• Clause 8 contains the updated UML files in cd14c-06r1_G.8052_v3.0.6_uml@2022-07-19.zip.</li> </ul> </li> </ul>
	CD14c-06r2 (2022-07-21) TD24/WP3 (2022-09)	Update <ul style="list-style-type: none"> <li>– New clause 7.8 for the FlexE model which was proposed in cd14c-16r4 and agreed by the Track-c 2022-07-20 E-meeting.</li> </ul> <p><i>NOTE:</i> The UML in clause 8 does not have the FlexE, FlexE Group and FlexE Client classes yet.</p>

Version	Date	Description
	TD24R1/WP3 (2022-09)	<p>Update</p> <ul style="list-style-type: none"> <li>– In the G.8052 Papyrus project, create new Papyrus model “itut-eth-mgmt-flex” for the FlexE model, which is separate from the existing Papyrus model “itut-eth-mgmt”.</li> <li>– FlexE model object class naming convention: FlexeCtp, FlexeTtp, FlexeGroup, FlexeClientCtp, FlexeClientTtp.</li> <li>– The UML diagrams in clause 7.8 have been replaced accordingly</li> <li>– The UML in clause 8 now includes the FlexE model.</li> </ul>
3.0.7	TD175/3 (2023-04)	<p>Update</p> <ul style="list-style-type: none"> <li>– Renames the uml model names to itut-eth and itut-eth-flexe</li> <li>– Open model statement</li> <li>– Per agreement in WD14-07r2 from discussion of C517 (Common Linear Protection Model)</li> <li>– Per agreement in WD14-03 from discussion on C515</li> </ul> <p>TO DO:</p> <ul style="list-style-type: none"> <li>– To merge the FlexE uml models into the base itut-eth model according to the agreement that only one uml model per papyrus project of base recommendation</li> <li>– Per agreement in WD14-03 from discussion of C403</li> </ul>
	CD14c-05 (2023.05.10)	<p>Update</p> <ul style="list-style-type: none"> <li>– Per agreement in WD14-03 from discussion of C403 (except agreement items 1 &amp; 2). <ul style="list-style-type: none"> <li>• See CD14c-09 for details.</li> </ul> </li> <li>–</li> </ul> <p>TO DO:</p> <ul style="list-style-type: none"> <li>– To merge the FlexE uml models into the base itut-eth model according to the agreement that only one uml model per papyrus project of base recommendation</li> <li>–</li> </ul>



Version	Date	Description
	CD14c-05r1 (2023.06.01)	<p>Updates</p> <ul style="list-style-type: none"> <li>- Per agreement from CD14c-09r2               <ul style="list-style-type: none"> <li>• Still need to discuss the “comment/description” of acceptedGid and acceptedIid.</li> </ul> </li> <li>- References</li> <li>- Figure 7-8 FlexE function and object mapping</li> </ul> <p>TO DO:</p> <ul style="list-style-type: none"> <li>- To discuss and agree on the “comment/description” of acceptedGid and acceptedIid (CD14c-09r2)</li> <li>- To clean up/model the existing blank attribute of FlexeTtp with type FlexeGroup</li> <li>- To merge the FlexE uml models into the base itut-eth model according to the agreement that only one uml model per papyrus project of base recommendation.</li> </ul> <p>To discuss:</p> <ul style="list-style-type: none"> <li>- CD14c-12:               <ul style="list-style-type: none"> <li>• Model structure</li> <li>• Modeling of the MI signals in clause 7 of G.8023.</li> <li>• Model artifact details (Applied comments, stereotypes, etc.)</li> </ul> </li> </ul>
3.0.8	WD1214-18 (2023.09)  <i>Aim for TD/PLEN (11/2023) for consent</i>	<p>Updates to the FlexE model</p> <ul style="list-style-type: none"> <li>- Per 14 June e-meeting cd14c-12 editing instruction, deleted attributes esmcEnable and ieee802.2Atts from FlexeCtpPac</li> <li>- Per agreed additional proposed changes in cd14c-12r1.</li> <li>-</li> </ul> <p>TO DO:</p> <ul style="list-style-type: none"> <li>- To progressing the FlexE model artifact details (applied comments, references, stereotypes, etc.).</li> <li>- To discuss and agree on the “comment/description” of acceptedGid and acceptedIid (CD14c-09r2)</li> <li>- To merge the FlexE uml models into the base itut-eth model according to the agreement that only one uml model per papyrus project of base recommendation.</li> <li>- To migrate the ETH Multiplexing configuration model Figure 7-1.E and Traffic conditioning &amp; shaping model F.7-1.G to base on the new Ltp/Lp-refactored EthTtp and EthCtp classes.</li> <li>- To adopt the G.8052.1 PM model as the base PM model</li> <li>- To pretty-up the uml diagrams in the itut-eth module</li> </ul>

Version	Date	Description
	WD1214-18r1 (2023.09.22)  <i>Aim for TD/PLEN (11/2023) for consent</i>	Updates to the FlexE model per meeting decision <ul style="list-style-type: none"> <li>- Merge FlexeTtp and FlexeCtp into a single object class FlexeMember.</li> <li>- Update FlexE model artifact details (applied comments, references, stereotypes, etc.).</li> <li>- The updated UML papyrus files and Data dictionary (DD)</li> </ul>  itut-eth-flexe-v3.0.8- DD_2023.09.21.docx
4.0 →3.0.9	TD235/P (11/2023) for consent	Updates <ul style="list-style-type: none"> <li>- Up versioned the UML model to v4.0 and update the Open Model Statement</li> <li>- Dates of references</li> </ul>
3.0.10	TD235R1/P (12/2023) for consent, wd14-61	Updates per agreement on C709 <ul style="list-style-type: none"> <li>- Clause 3.1 atomic function and compound function</li> <li>- Clause 3.2 on-demand/proactive monitoring and measurement</li> </ul> Updates per decision on C710R1 <ul style="list-style-type: none"> <li>- Clause 7.1.4 ETH multiplexing EthTtp &amp; EthCtp</li> <li>- Clause 7.1.6 ETH TCS</li> <li>- Clause 7.2.1 MEP</li> <li>- Clause 7.2.2 MIP</li> </ul> Updates per 2023.11.26 Sunday drafting session (see wd14-11_2023.11.26-drafting_Editing-instructions) <ul style="list-style-type: none"> <li>- Add Clause 7.1.5 ETH TP auxiliary object classes</li> <li>- Replace the content of Annex A with the text of Clause 7 of the 2018 edition of G.8052 (i.e., the version 3 ETH model)</li> <li>- Drop the Y series recommendation number</li> <li>- Renumber the figures, e.g., 7-9.A, .B, ...; A-1, A-2, )</li> </ul>

I n t e r n a t i o n a l   T e l e c o m m u n i c a t i o n   U n i o n

**ITU-T**

TELECOMMUNICATION  
STANDARDIZATION SECTOR  
OF ITU

**G.8052**

(xx/2024)

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

Packet over Transport aspects – Ethernet over Transport  
aspects

SERIES Y: GLOBAL INFORMATION  
INFRASTRUCTURE, INTERNET PROTOCOL ASPECTS,  
NEXT-GENERATION NETWORKS, INTERNET OF  
THINGS AND SMART CITIES

Internet protocol aspects – Transport

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**Protocol-neutral management information  
model for the Ethernet transport capable  
network element**

Recommendation ITU-T G.8052



ITU-T G-SERIES RECOMMENDATIONS  
**TRANSMISSION SYSTEMS AND MEDIA, DIGITAL SYSTEMS AND NETWORKS**

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GENERAL CHARACTERISTICS COMMON TO ALL ANALOGUE CARRIER-TRANSMISSION SYSTEMS	G.200–G.299
INDIVIDUAL CHARACTERISTICS OF INTERNATIONAL CARRIER TELEPHONE SYSTEMS ON METALLIC LINES	G.300–G.399
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*For further details, please refer to the list of ITU-T Recommendations.*

## Recommendation ITU-T G.8052

### Protocol-neutral management information model for the Ethernet transport capable network element

#### Summary

Recommendation ITU-T G.8052 contains the protocol neutral UML information model for Ethernet transport network (NE) management. The model is based on the Ethernet equipment functions specified in Recommendation ITU-T G.8021, generic management requirements in Recommendation ITU-T G.7710, and Ethernet specific management requirements in Recommendation ITU-T G.8051.

The 2016 revision of this Recommendation changes the UML modelling tool from RSA to open source Papyrus tool, updates the Recommendation ITU-T G.8052 information model to align it with the Recommendation ITU-T G.7711 v2.0 Core information model, drops subclassing of the TP classes from Recommendation ITU-T M.3160, and supports the additional management requirements in Recommendation ITU-T G.8051.

The 2018 revision of this Recommendation up-versions the UML model tool to Papyrus v3.2.0 and the profile to v0.2.13, deletes ODUkP-X-L (from the CsfRdiFdiEnableSink\_Pac, CsfRdiFdiEnableSource\_Pac, and CsfReportSink\_Pac), replaces ETY termination points with ETHnull termination points, removes ODUkp/ETH\_A and ODU2P/ETHPP-OS\_A, adds Annex A for the Ethernet Spec model.

Edition 4.0 of this Recommendation adds the FlexE UML model and updates the ETH 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 modeling tool to Eclipse 2020-06 (4.16) & Papyrus 4.8.

#### History

Edition	Recommendation	Approval	Study Group	Unique ID*
1.0	ITU-T G.8052/Y.1346	2013-08-29	15	<a href="http://handle.itu.int/11.1002/1000/12023">11.1002/1000/12023</a>
2.0	ITU-T G.8052/Y.1346	2016-11-13	15	<a href="http://handle.itu.int/11.1002/1000/13097">11.1002/1000/13097</a>
3.0	ITU-T G.8052/Y.1346	2018-12-14	15	<a href="http://handle.itu.int/11.1002/1000/13798">11.1002/1000/13798</a>
4.0	ITU-T G.8052	2023-12-xx	15	

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\* To access the Recommendation, type the URL <http://handle.itu.int/> in the address field of your web browser, followed by the Recommendation's unique ID. For example, <http://handle.itu.int/11.1002/1000/1830-en>.

**Keywords**

Carrier Ethernet, information model, protocol-neutral, transport resource, UML.

## FOREWORD

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

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

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

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

## NOTE

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

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

## INTELLECTUAL PROPERTY RIGHTS

ITU draws attention to the possibility that the practice or implementation of this Recommendation may involve the use of a claimed Intellectual Property Right. ITU takes no position concerning the evidence, validity or applicability of claimed Intellectual Property Rights, whether asserted by ITU members or others outside of the Recommendation development process.

As of the date of approval of this Recommendation, ITU had not received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementers are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database at <http://www.itu.int/ITU-T/ipr/>.

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## **Introduction**

This Recommendation contains the object classes for the Ethernet transport network element (NE) management. It includes the termination points (TP), maintenance entity group (MEG) end point (MEP), MEG 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.8051].

The Ethernet TPs are modelled as subclasses of the generic Global Class defined in Recommendation [ITU-T G.7711] and for extending LTP and LP classes of [ITU-T G.7711].

The Ethernet general PM CD and HD object classes are modelled as subclasses of the generic current data and history data defined in [ITU-T Q.822].

The Ethernet general CD and HD object classes support only the quality of service (QoS) directly related PM parameters, i.e., severely errored second (SES) and unavailable second (UAS), for service level agreement (SLA) verification. The additional PM object classes for supporting loss measurement (LM) and delay measurement (DM) monitoring uses the general CD and HD object classes as super classes.

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

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

## **Recommendation ITU-T G.8052**

### **Protocol-neutral management information model for the Ethernet transport capable network element**

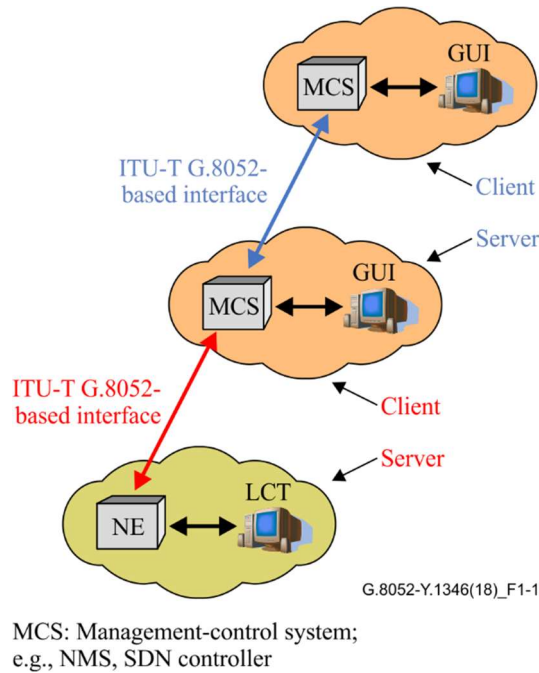
#### **1 Scope**

This Recommendation provides a management/control-protocol-neutral information model for managing/controlling network elements in the Ethernet transport network as defined in [ITU-T G.8010]. It identifies the managed entities required for the management/control of Ethernet transport network elements. These entities are relevant to information exchanged across standardized interfaces defined in ITU-T M.3010 TMN architecture. The management/control-protocol-neutral information model should be used as the base for defining management-protocol-specific information models, for example, XML (web service or Netconf/Yang) information model, common object request broker architecture (CORBA) interface definition language (IDL) model, and simple network management protocol (SNMP) management information base (MIB).

The information model defined in this Recommendation is an augmentation to the generic code model specified in [ITU-T G.7711] for managing Ethernet transport resources. The core information model defined in [ITU-T G.7711] can be used as the base for the extension of Ethernet-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 will be described in other Recommendations and is out of the scope of this Recommendation.

This Recommendation applies to Ethernet transport network elements and those systems that manage/control such network elements. The management/control system could be an NMS, EMS, SDN controller or hybrid of them. Recommendation [ITU-T G.7701] defines the management-control-continuum concept whereby management and control functions are considered to be a continuum. Those systems are thus referred to as a management-control system (MCS) in general in this Recommendation. Functional capabilities of Ethernet transport equipment are defined in [ITU-T G.8021], and requirements of the management of Ethernet transport equipment are provided in [ITU-T G.7710] and [ITU-T G.8051]. The information model specified in this Recommendation applies to the management/control interface, as shown in Figure 1-1, specifically for managing/controlling the Ethernet functional capabilities of the NE.



**Figure 1-1 – Scope of ITU-T G.8052 interface**

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

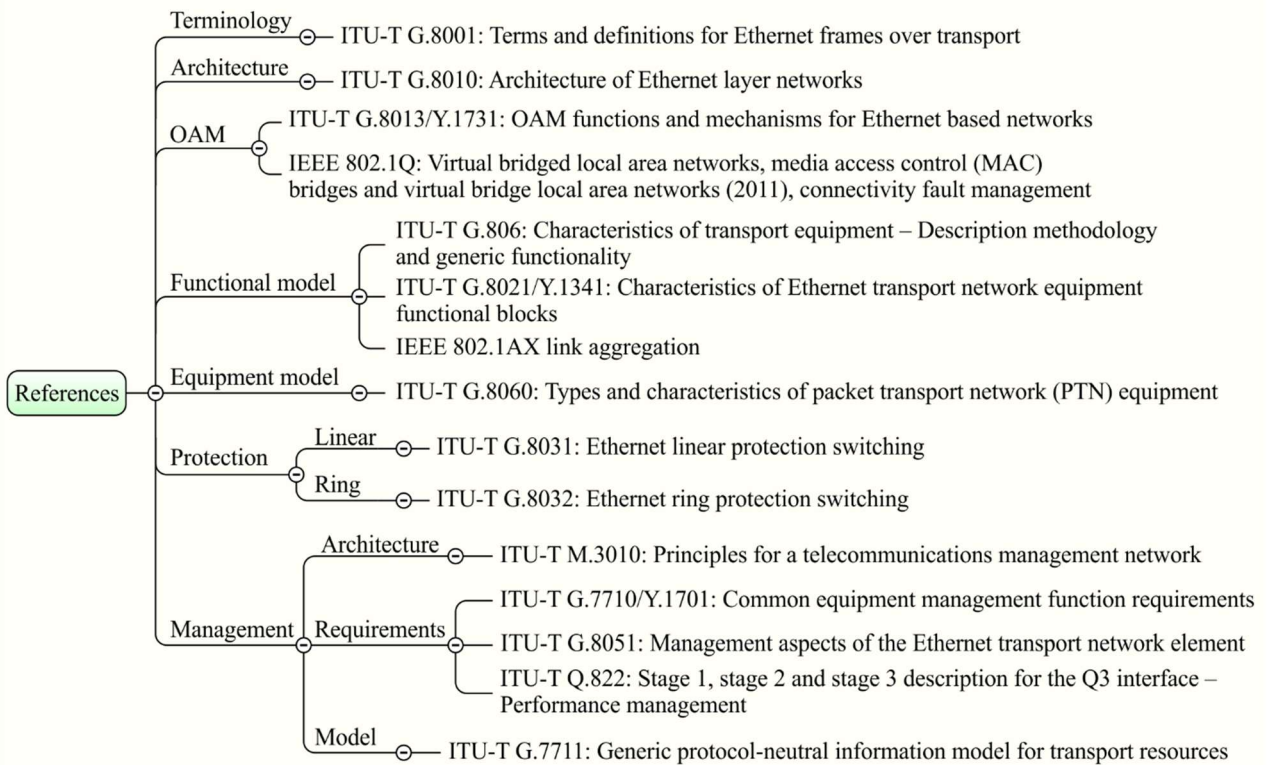
The management/control-protocol-neutral information model specified in this Recommendation consists of a set of transport-technology-specific managed object classes, i.e., Ethernet-specific managed object classes. These Ethernet-specific managed object classes are inherited from the generic managed object classes defined in other ITU-T Recommendations such as [ITU-T G.7711] and [ITU-T M.3160], including termination point and its subclasses, subnetwork, and subnetwork connection. Because of object class inheritance, the Ethernet management information 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 is outside the scope of this Recommendation.

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

## 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.798] Recommendation ITU-T G.798 (2023), *Characteristics of optical transport network hierarchy equipment functional blocks*.
- [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 (04/2022), *Common control aspects*, plus Amendment 1 (03/2018).
- [ITU-T G.7710] Recommendation ITU-T G.7710/Y.1701 (10/2022), *Common equipment management function requirements*.
- [ITU-T G.7711] Recommendation ITU-T G.7711/Y.1702 (02/2022), *Generic protocol-neutral information model for transport resources*.
- [ITU-T G.8010] Recommendation ITU-T G.8010 (02/2004), *Architecture of Ethernet layer networks*.
- [ITU-T G.8013] Recommendation ITU-T G.8013/Y.1731 (06/2023), *Operations, administration and maintenance (OAM) functions and mechanisms for Ethernet-based networks*.
- [ITU-T G.8021] Recommendation ITU-T G.8021/Y.1341 (04/2022), *Characteristics of Ethernet transport network equipment functional blocks*.
- [ITU-T G.8023] Recommendation ITU-T G.8023 (02/2022), *Characteristics of equipment functional blocks supporting Ethernet physical layer and Flex Ethernet interfaces*.
- [ITU-T G.8031] Recommendation ITU-T G.8031 (01/2015), *Ethernet linear protection switching*.
- [ITU-T G.8032] Recommendation ITU-T G.8032 (03/2020), *Ethernet ring protection switching*.
- [ITU-T G.8051] Recommendation ITU-T G.8051/Y.1345 (07/2023), *Management aspects of the Ethernet transport (ET) cable network element*.
- [ITU-T M.3100] Recommendation ITU-T M.3100 (2005), *Generic network information model*.
- [ITU-T M.3160] Recommendation ITU-T M.3160 (2008), *Generic, protocol-neutral management information model, plus Amendment 1 (2016)*.
- [ITU-T Q.822] Recommendation ITU-T Q.822 (1994), *Stage 1, stage 2 and stage 3 description for the Q3 interface – Performance management*.
- [IEEE 802.1AX] IEEE 802.1AX-2020 – *IEEE Standard for Local and metropolitan area networks – Link Aggregation*.
- [IEEE 802.1Q] IEEE 802.1Q-2022 – *IEEE Standard for Local and metropolitan area networks – Media Access Control (MAC) Bridges and Virtual Bridge Local Area Networks*.
- [IEEE 802.3] IEEE 802.3 (2022), *IEEE Standard for Ethernet*.
- [OIF FLEXE IA] OIF IA OIF-FLEXE 2.2 (2021), *Flex Ethernet Implementation Agreement 2.2*.



G.8052-Y.1346(16)\_F2-1

**Figure 2-1 – Structure of references**

### 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 **one-way** [ITU-T G.8013].
- 3.1.9 **ring protection link (RPL)** [ITU-T G.8032].
- 3.1.10 **single-ended** [ITU-T G.8013].
- 3.1.11 **traffic conditioning function** [ITU-T G.8051].
- 3.1.12 **traffic shaping function** [ITU-T G.8021].
- 3.1.13 **two-way** [ITU-T G.8013].

#### 3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

- 3.2.1 on-demand measurement:** The measurement of on-demand monitoring.
- 3.2.2 on-demand monitoring:** Monitoring at a specific time.
- 3.2.3 proactive measurement:** The measurement of proactive monitoring.
- 3.2.4 proactive monitoring:** Monitoring continuously.

#### **4 Abbreviations and acronyms**

This Recommendation uses the following abbreviations and acronyms:

1DM	Delay Measurement 1-way (using 1DM)
1LM	Loss Measurement 1-way (using 1SL, CCM)
1SL	1-way Synthetic Loss measurement
AIS	Alarm Indication Signal
APS	Automatic Protection Switching
ASN.1	Abstract Syntax Notation One
CBS	Committed Burst Size
CC	Cross Connect
CCM	Continuity Check Message
CD	Current Data
CF	Coupling Flag
CIR	Committed Information Rate
CM	Colour Mode
CMISE	Common Management Information Service Element
CORBA	Common Object Request Broker Architecture
CRC	Cyclic Redundancy Check
CSF	Client Signal Fail
CTP	Connection Termination Point
DEG	Degraded
DM	Delay Measurement 2-way (using DMM/DMR)
DMo	On-Demand Delay Measurement
EBS	Excess Burst Size
EIR	Excess Information Rate
EMS	Element Management System
ETH	Ethernet layer
EUI	Extended Unique Identifier
F-Flr	Far-end - Frame loss ratio
FD	Frame Delay
FDV	Frame Delay Variation

FFS	For Further Study
FP	Flow Point
GTCS	Group Traffic Conditioning and Shaping
GUI	Graphical User Interface
HD	History Data
HTML	HyperText Markup Language
IaDI	Intra Domain Interface
IDL	Interface Definition Language
IrDI	Inter Domain Interface
LAG	Link Aggregation Group
LAN	Local Area Network
LB	Loop Back
LBM	Loop Back Message
LBR	Loop Back Reply
LCC	Lower Camel Case
LCK	Lock
LCT	Local Craft Terminal
LLDP	Link Layer Discovery Protocol
LM	Loss Measurement 2-way (using LMM/LMR, SLM/SLR)
LMM	Loss Measurement Message
LMo	On-Demand Loss Measurement
LMR	Loss Measurement Reply
LT	Link Trace
LTM	Link Trace Message
LTR	Link Trace Reply
MAC	Medium Access Control
ME	Maintenance Entity
MEG	Maintenance Entity Group
MEL	Maintenance Entity Level
MEP	MEG End Point
MI	Management Information
MIB	Management Information Base
MIP	MEG Intermediate Point
MMRP	Multiple MAC Registration Protocol
MTU	Maximum Transmission Unit
MVRP	Multiple VLAN Registration Protocol



N-Flr	Near-end - Frame loss ratio
NA	Not Applicable
NCM	Network Connection Monitoring
NE	Network Element
NMS	Network Management System
OAM	Operation, Administration & Maintenance
PDU	Protocol Data Unit
PM	Performance Monitoring
PTN	Packet Transport Network
QoS	Quality of Service
RAPS	Ring Automatic Protection Switching
RPL	Ring Protection Link
SD	Signal Degrade
SDL	Specification and Description Language
SES	Severely Errored Second
SLA	Service Level Agreement
SLM	Synthetic Loss Message
SLR	Synthetic Loss Reply
SMS	Service Management System
SNCP	SubNetwork Connection Protection
SNMP	Simple Network Management Protocol
SSL	Server Signal Fail
TCM	Tandem Connection Monitoring
TCS	Traffic Conditioning & Shaping
tfFlr	total far-end Frame loss ratio
tfLf	total far-end Lost frames
tfTf	total far-end Transmitted frames
TLV	Type-Length-Value
TMN	Telecommunications Management Network
tnFlr	total near-end Frame loss ratio
tnLf	total near-end Lost frames
tnTf	total near-end Transmitted frames
TP	Termination Point
TST	Test
TTL	Time To Live
TTP	Trail Termination Point

UAS	Unavailable Second
UCC	Upper Camel Case
UML	Unified Modelling Language
UTC	Coordinated Universal Time
VLAN	Virtual Local Area Network
XML	Extensible Markup 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

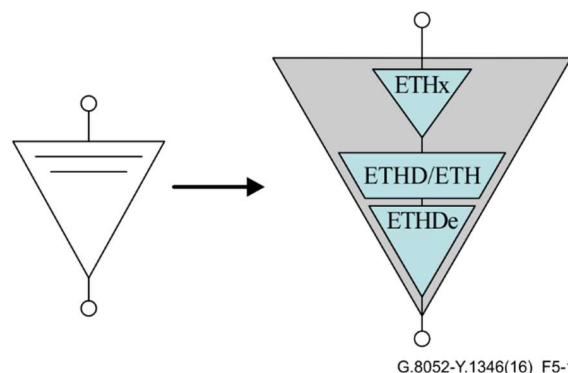
See clause 5.5 of [ITU-T G.7711].

### 5.2 Equipment function conventions

#### 5.2.1 Maintenance entity group end point (MEP) [ITU-T G.8021]

MEG end points (MEPs) terminate maintenance entities (MEs) which can span the end-to-end network connection or a portion of the network connection defined as a tandem connection.

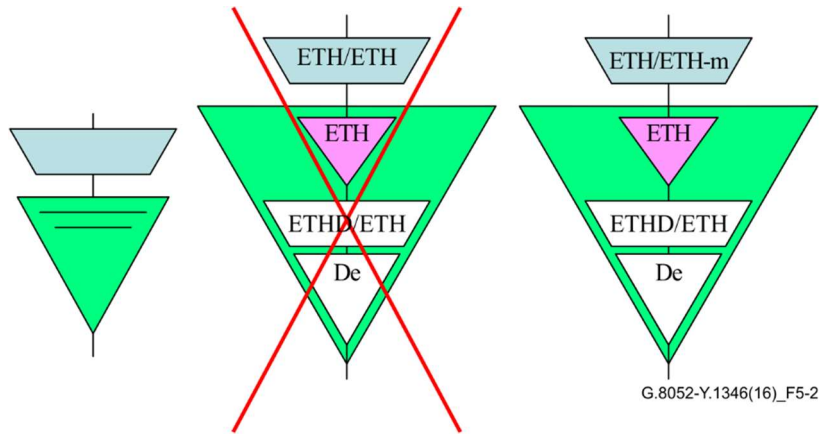
The diagrammatic convention for network connection monitoring MEP (NCM MEP) compound functions is shown in Figure 5-1:



**Figure 5-1 – ETH NCM MEP compound functions**  
(Same as Figure 9-81 of [ITU-T G.8021])

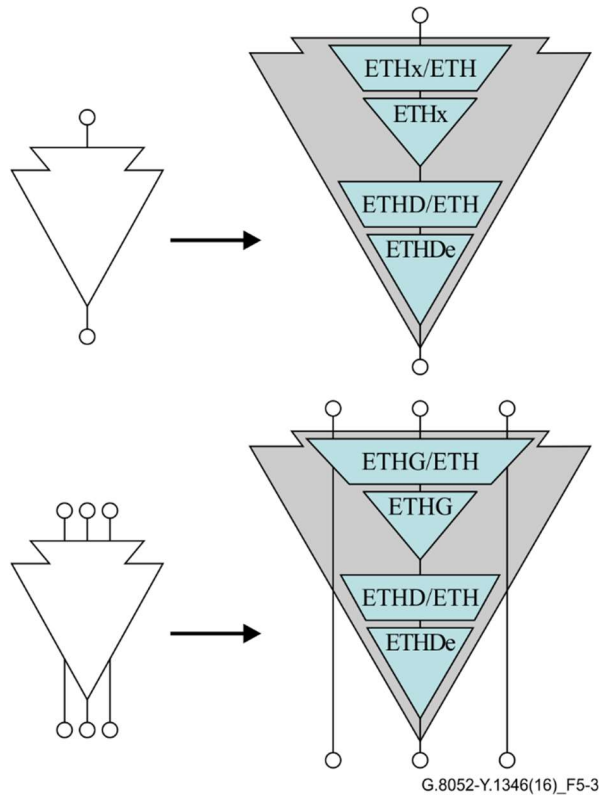
NOTE – The ETH/ETH atomic function defined in [ITU-T G.8021] is only used within the optional TCM MEP compound function (i.e., ETH/ETH is not "stand alone") whereas the ETH/ETH-m atomic function defined in [ITU-T G.8021] is only used at the layer boundary (i.e., ETH/ETH-m is "stand alone" and never as a part of a MEP), regardless of the number of client signals (even in case of only one client signal when there is no multiplexing).

The diagrammatic convention for network connection monitoring MEP (NCM MEP) compound functions is shown in Figure 5-2.



**Figure 5-2 – ETH NCM MEP at the boundary of a layer network**

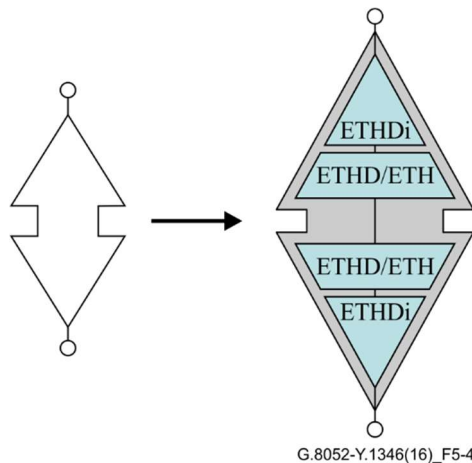
The diagrammatic convention for tandem connection monitoring MEP (TCM MEP) compound functions is shown in Figure 5-3.



**Figure 5-3 – ETH TCM MEP compound functions**  
(Same as Figure 9-82 of [ITU-T G.8021])

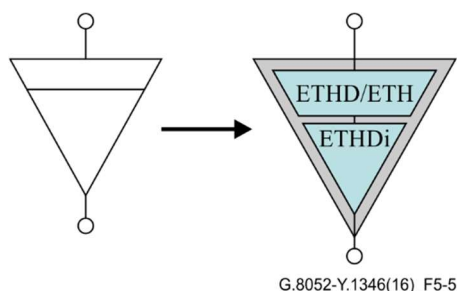
### 5.2.2 Maintenance entity group intermediate point (MIP) [ITU-T G.8021]

The diagrammatic convention for MIP compound functions is shown in Figure 5-4:



**Figure 5-4 – ETH MIP compound functions**  
(Same as Figure 9-83 of [ITU-T G.8021])

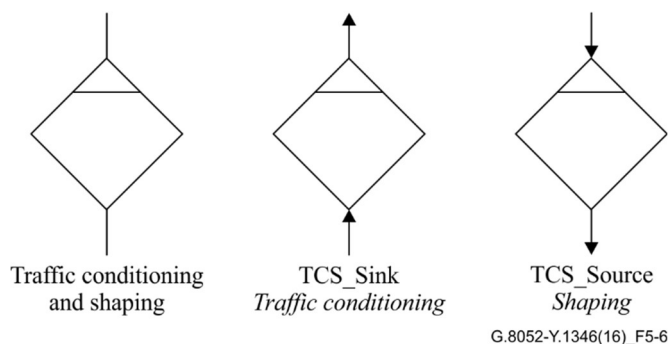
The diagrammatic convention for half MIP compound functions is shown in Figure 5-5:



**Figure 5-5 – ETH MIP compound functions**  
(Same as Figure 9-84 of [ITU-T G.8021])

### 5.2.3 Traffic conditioning and shaping function (TCS) [ITU-T G.806]

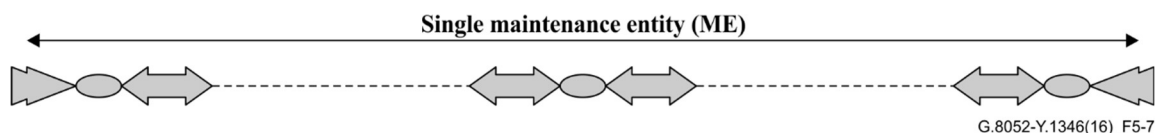
The diagrammatic convention for a TCS function is shown in Figure 5-6:



**Figure 5-6 – Diagrammatic convention for traffic conditioning and shaping function**  
(Same as Figure 5-3B of [ITU-T G.806] Amd.1)

### 5.2.4 MEPs and MIPs along an individual ME

The diagrammatic convention for MEPs and MIPs along an individual ME as shown in Figure 5-7:



**Figure 5-7 – MEPs and MIPs along a maintenance entity (ME)**

Note that the ME can span the whole end-to-end Network Connection or a portion of it called a Tandem Connection.

## 5.3 Conventions defined in this Recommendation

This Recommendation uses the following conventions:

### 5.3.1 Colour code convention

The following "colour code" is used in this Recommendation:

**Table 5-1 – Colour code convention**

"colour code"	ITU-T G.8052/Y.1346 Object Class
	MaintenanceEntityGroupEndPoint
	ETH_TrailTerminationPoint
	ETH_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 will always be active in the Ethernet technology.

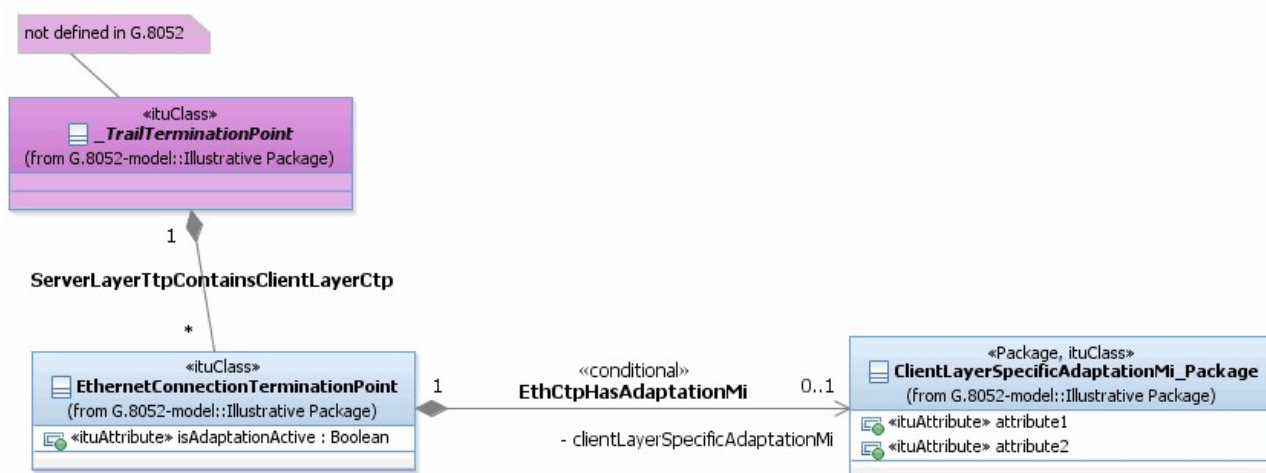
#### 5.3.2.1 Ethernet server adaptation modelling



NOTE – This figure is also available on the ITU website [here](#).

**Figure 5-8 – Illustrative diagram for Ethernet server adaptation modelling**

### 5.3.2.2 Non-Ethernet server adaptation modelling



NOTE – This figure is also available on the ITU website [here](#).

**Figure 5-9 – Illustrative diagram for non-Ethernet server adaptation modelling**

## 6 Overview of the Ethernet model

This Recommendation models the Ethernet transport network functions that are relevant to Ethernet transport network elements management. These functions are defined in the equipment specification [ITU-T G.8021] for the termination, adaptation, and connection functions of the ETH layer, OAM functions at the maintenance entity group (MEG) end point (MEP) and intermediate point (MIP), diagnostic maintenance operations, performance measurement (including on-demand and proactive), traffic conditioning and shaping (TCS), Ethernet linear protection (ELP), Ethernet ring protection (ERP), link aggregation group (LAG), and physical sub-system. In particular, the input and output management information (MI) exchanged across the management point (MP) between the equipment transport functions (TF) and equipment management function (EMF) are modelled. The input/output MIs cover the areas of configuration, fault management, and performance management as described in [ITU T G.7710] and [ITU T G.8051]. Details of the management functions that need to be modelled are provided in [ITU-T G.7710] and [ITU T G.8051].

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) classes.

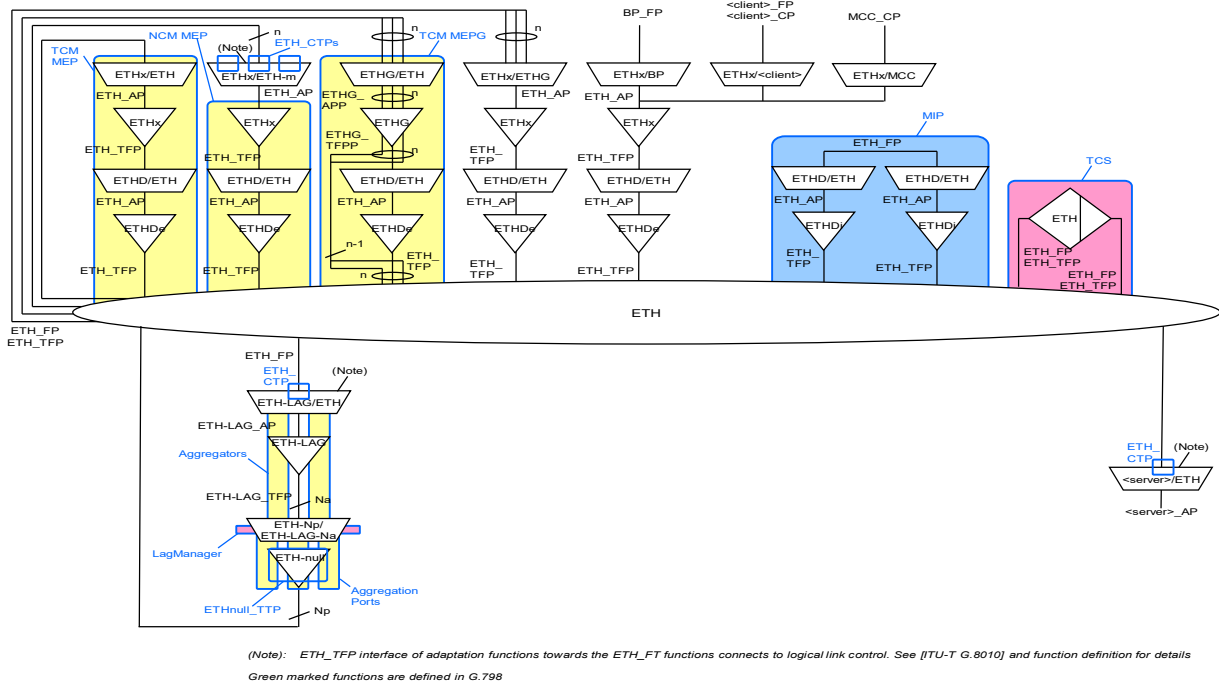
Object classes, attribute types and operations are defined for the purpose of communicating network management messages between managed systems (such as the transport devices) and the management-control (MC) systems (MCS). They need not be related to the structure of data stored within those systems.

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. In this Recommendation, the Ethernet specific transport object classes are defined. Some of these object classes are derived from the [ITU-T G.7711] core information model through pruning and/or refactoring.

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

## 6.1 ETH layer

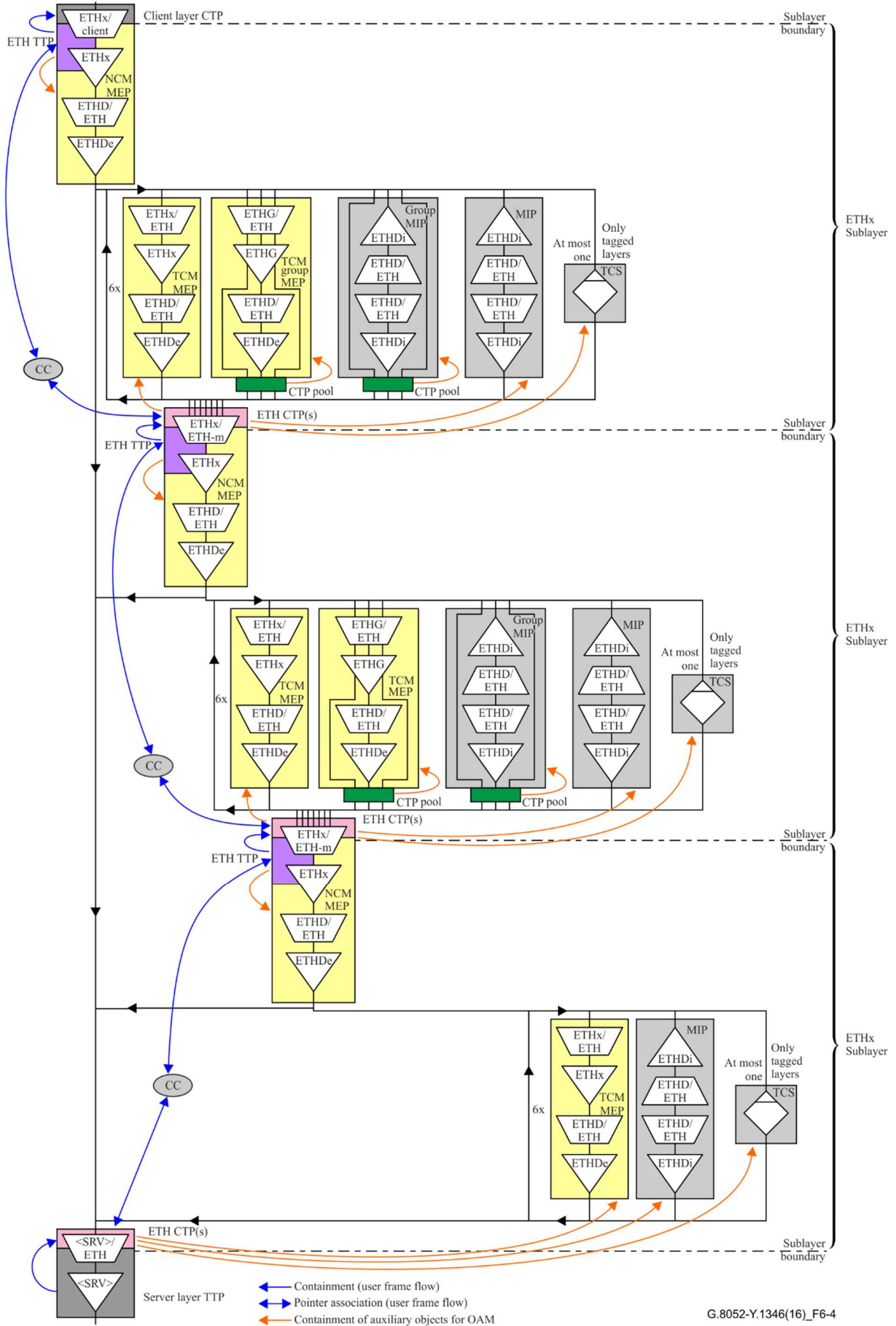
Figure 6-1 below shows the mapping between the object classes and the Ethernet atomic functions defined in Figure 1-1 of [ITU-T G.8021].



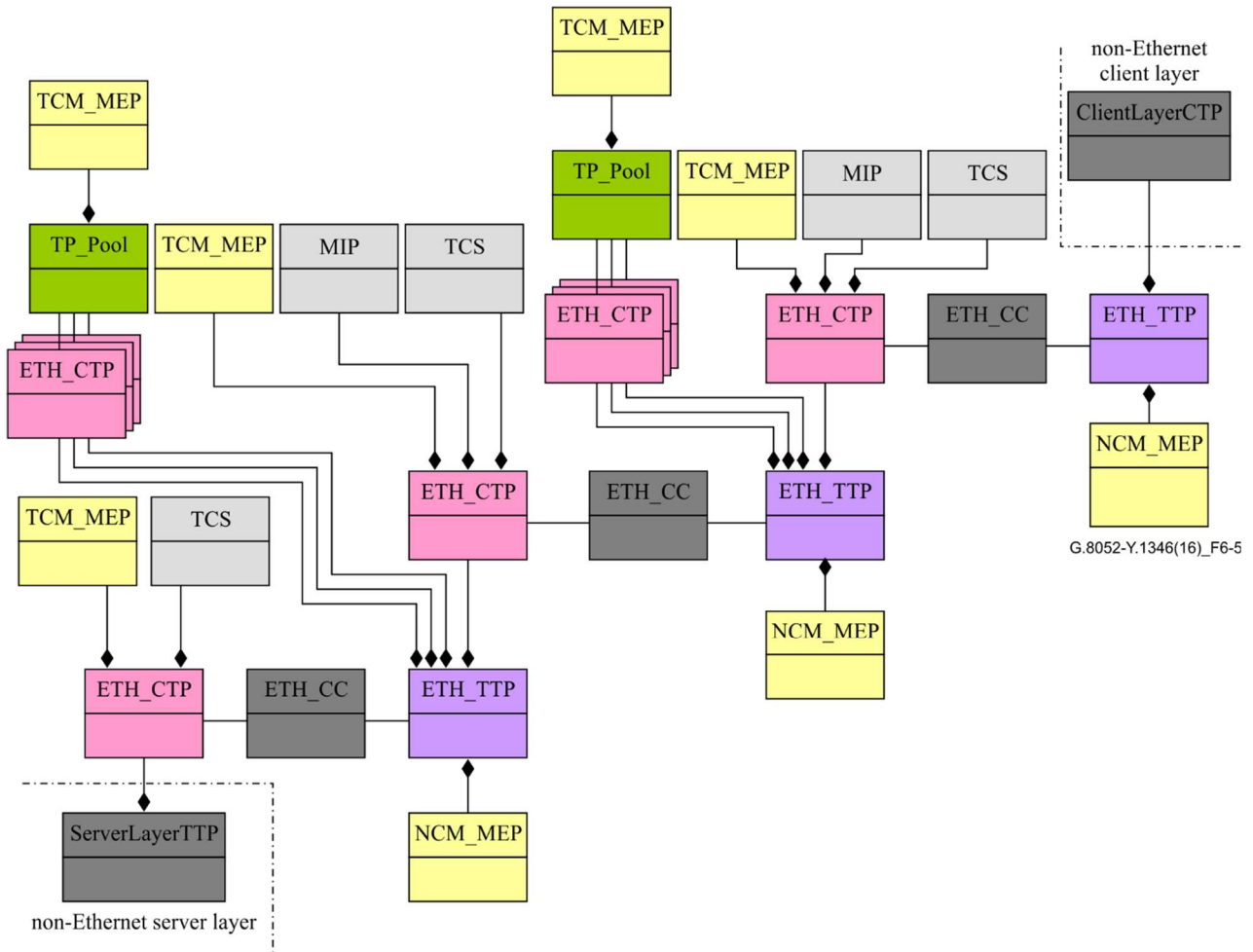
**Figure 6-1 – Overview of object class mapping to ITU-T G.8021 atomic functions**  
(based on Figure 1-1 of [ITU-T G.8021])

Figure 6-2 (based on Figure 9-1 of [ITU-T G.8021]) shows the sub-layer structure within the Ethernet layer. The ITU-T G.8052/Y.1346 managed object classes have been added to the figure. The corresponding (high-level) object instance diagram is contained in Figure 6-3 and Figure 6-4.

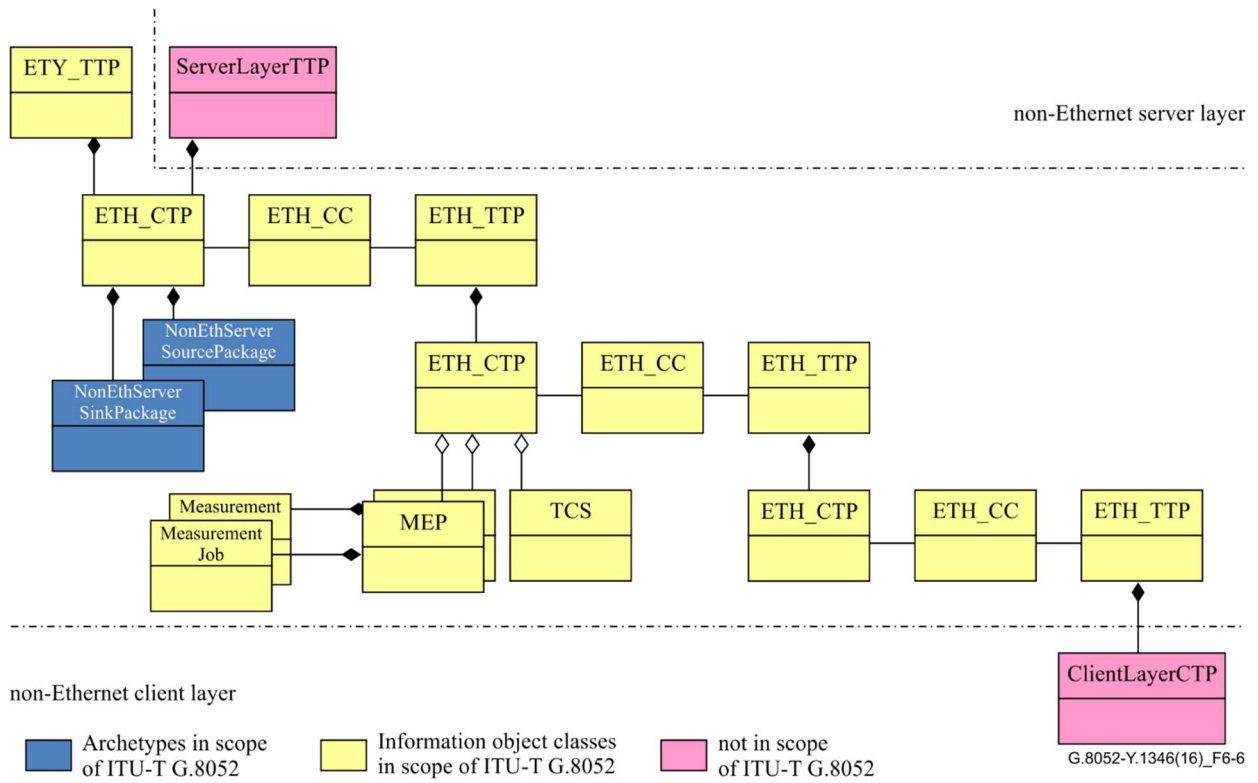




**Figure 6-2 – ETH sublayer object class mapping**  
(based on Figure 9-1 of [ITU-T G.8021])



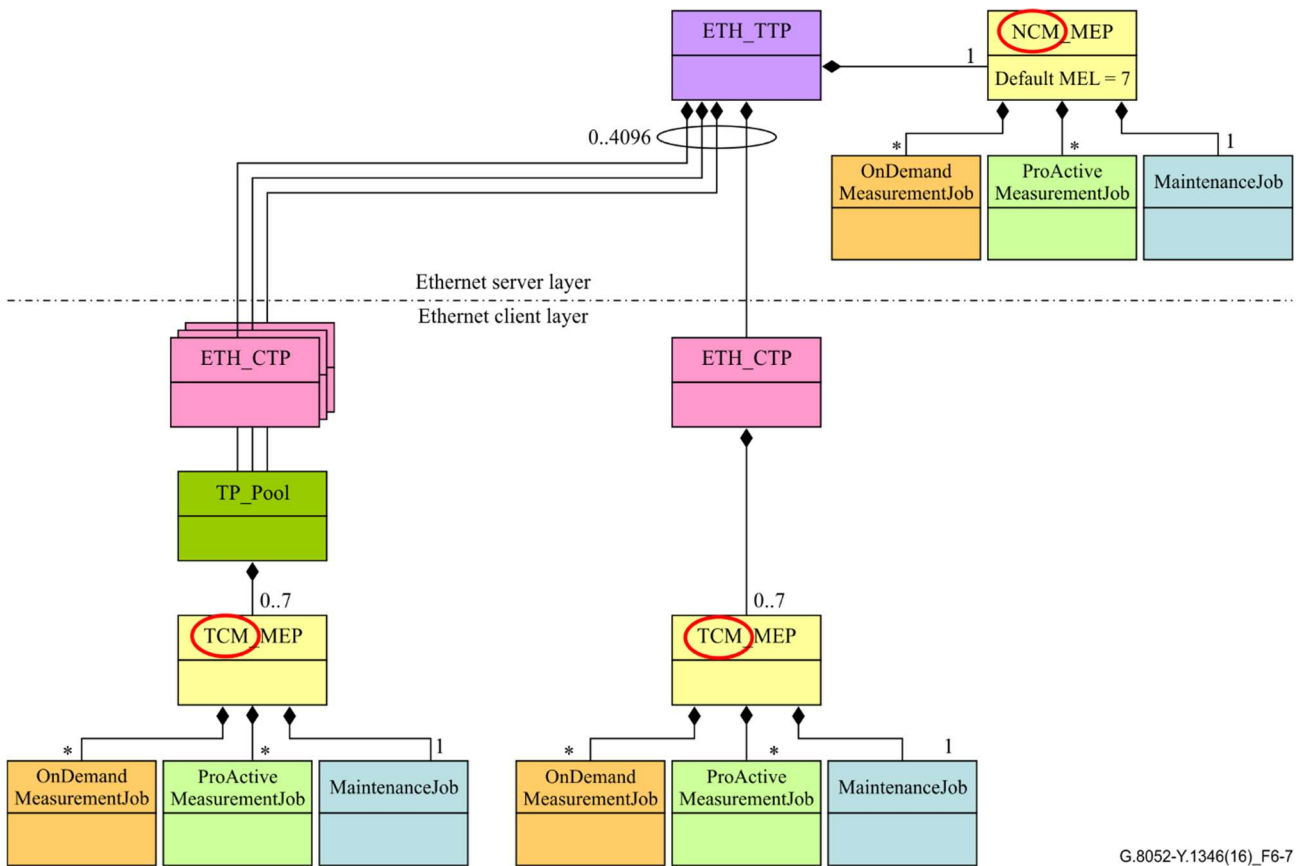
**Figure 6-3 – ETH sublayer object instance example**



**Figure 6-4 – ETH sublayer object instance example with measurement job**

## 6.2 OAM infrastructure

All "auxiliary" object classes (e.g., MEP, MIP, TCS) will be attached to ETH TTP and/or CTP basic object classes as necessary. This is shown in Figure 6-5 below.



G.8052-Y.1346(16)\_F6-7

**Figure 6-5 – MEP infrastructure with maintenance and measurement jobs**

In this Recommendation the MEG Identifier is defined as a structured datatype that supports the ITU-T format types 32 and 33. It also supports the IEEE format types 1 through 4. In summary, the datatype of MEG Identifier is of the following high-level structure:

- meglFormatType: Integer, range 0..255
- meglLength: Integer, which indicates the length in number of Octets
- meglValue: Choice of
  - type1 vid Integer [1] 0..4095
  - type2 characterString DisplayString 0..255 Octet
  - type3 integer16 2-octet integer
  - type4 vpnId 3-octet OUI, 4-octet VPN index
  - type32 iccBased 13 characters: ICC & UMC
  - type33 cclccBased 15 characters: CC & ICC & UMC

The following UML diagram exhibits the model of the datatype of the structured MEG Identifier.

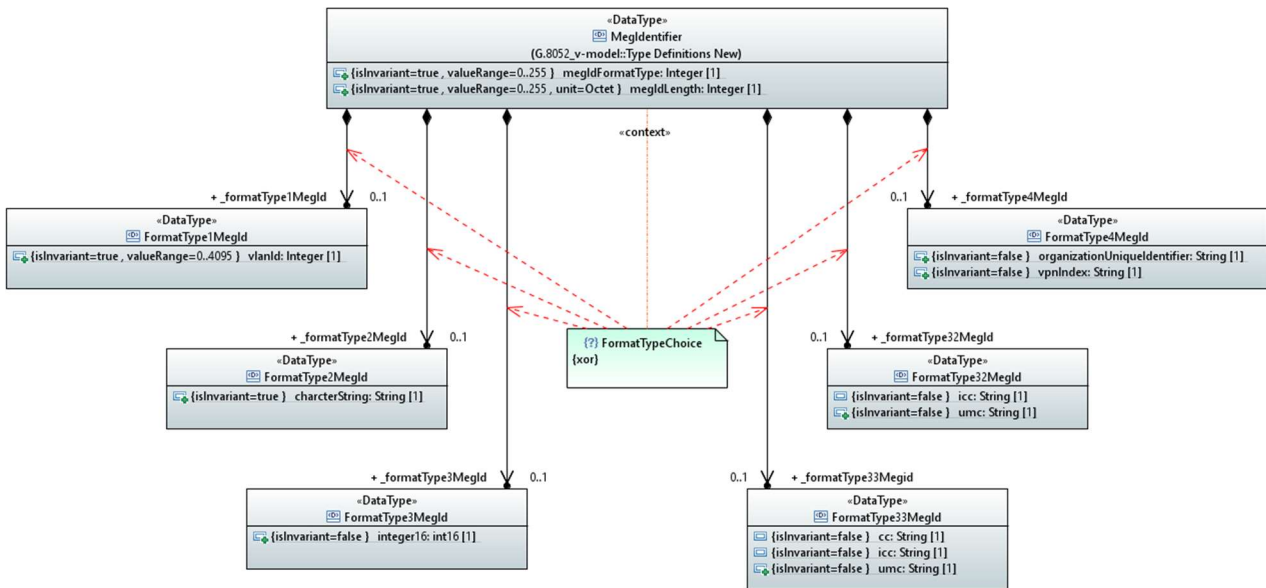


Figure 6-6 – MEG identifier



### 6.3 Location of OAM functions

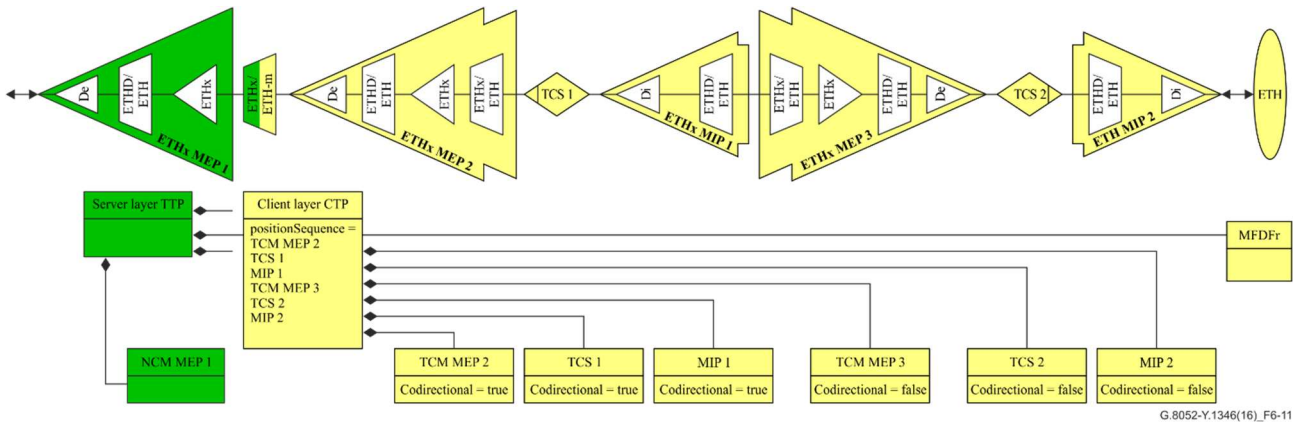
The OAM functions will be modelled as auxiliary objects attached to the basic object classes (TrailTerminationPoint and ConnectionTerminationPoint); see also clause 6.2. From monitoring point of view the **direction** and the **order** of the OAM functions TCM MEP, MIP and TCS within the signal flow of the ConnectionTerminationPoint (CTP) is important. This is reflected in the model by two attributes: codirectional and positionSequence.

The direction of the auxiliary object identifies if the sink part of the OAM function handle the same signal direction as the sink part of the containing CTP. This is modelled using a Boolean typed codirectional attribute in the auxiliary object. TRUE identifies that the sink part of the OAM function and the sink part of the containing CTP handle the same signal direction (i.e., the TCM MEP, MIP and TCS is facing the server layer of the containing CTP). FALSE identifies that the sink part of the OAM function and the sink part of the containing CTP handle the opposite signal direction.

The order determines the processing sequence of all auxiliary objects contained within the same CTP. This is modelled using the positionSequence attribute in the containing CTP. The ordered listing of the containing auxiliary objects starts from the server side of the CTP.

Figure 6-7 illustrates the positionSequence and codirectional attributes.

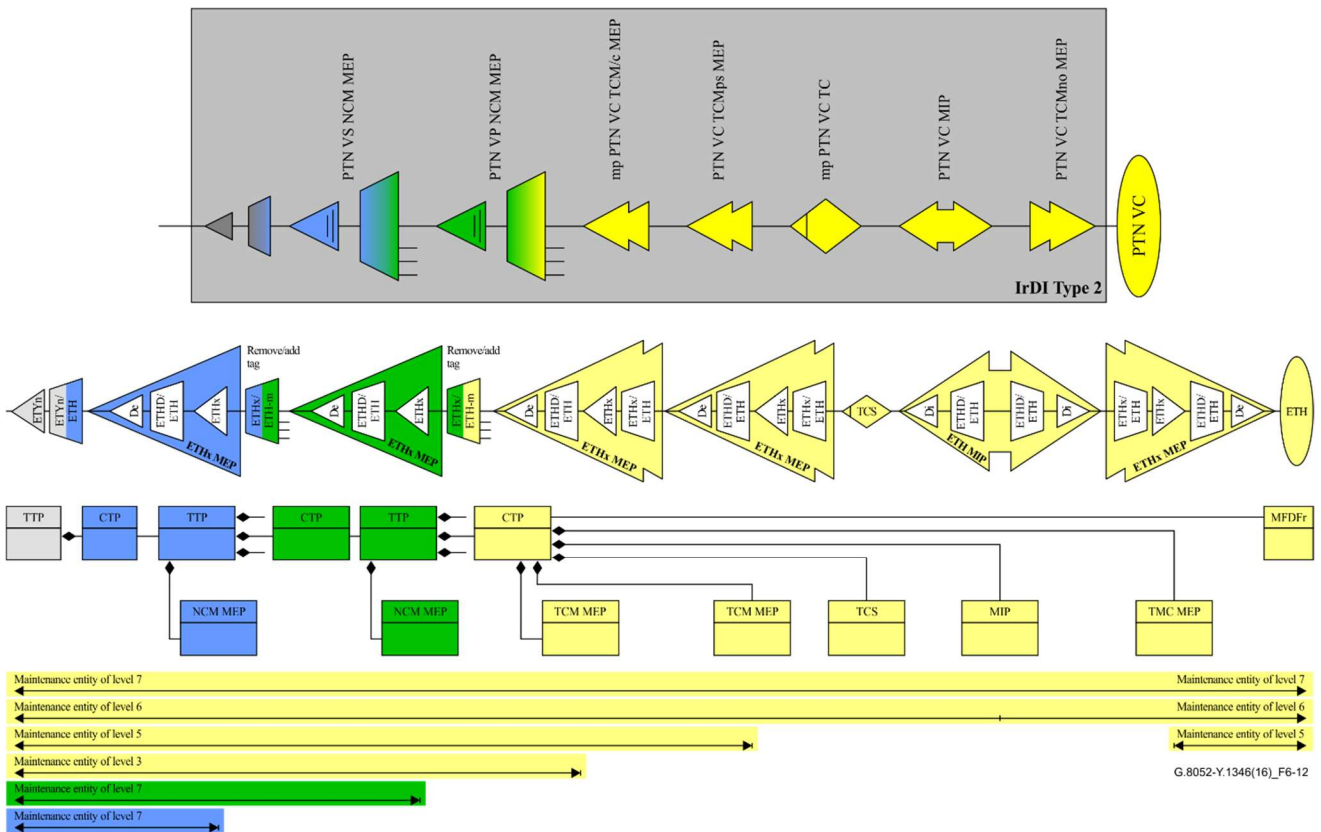
Note that this is a fictitious example trying to show many possible locations in one figure.



G.8052-Y.1346(16)\_F6-11

Figure 6-7 – Illustration of positionSequence and codirectional attributes

Realistic examples are shown in the following Figure 7-8 and Figure 6-9. These examples are based on two interface types IaDI and IrDI. Note that the assignment of the maintenance entity of levels less than 7 in the figures is arbitrary.



G.8052-Y.1346(16)\_F6-12

Figure 6-8 – Modelling of an IrDI example

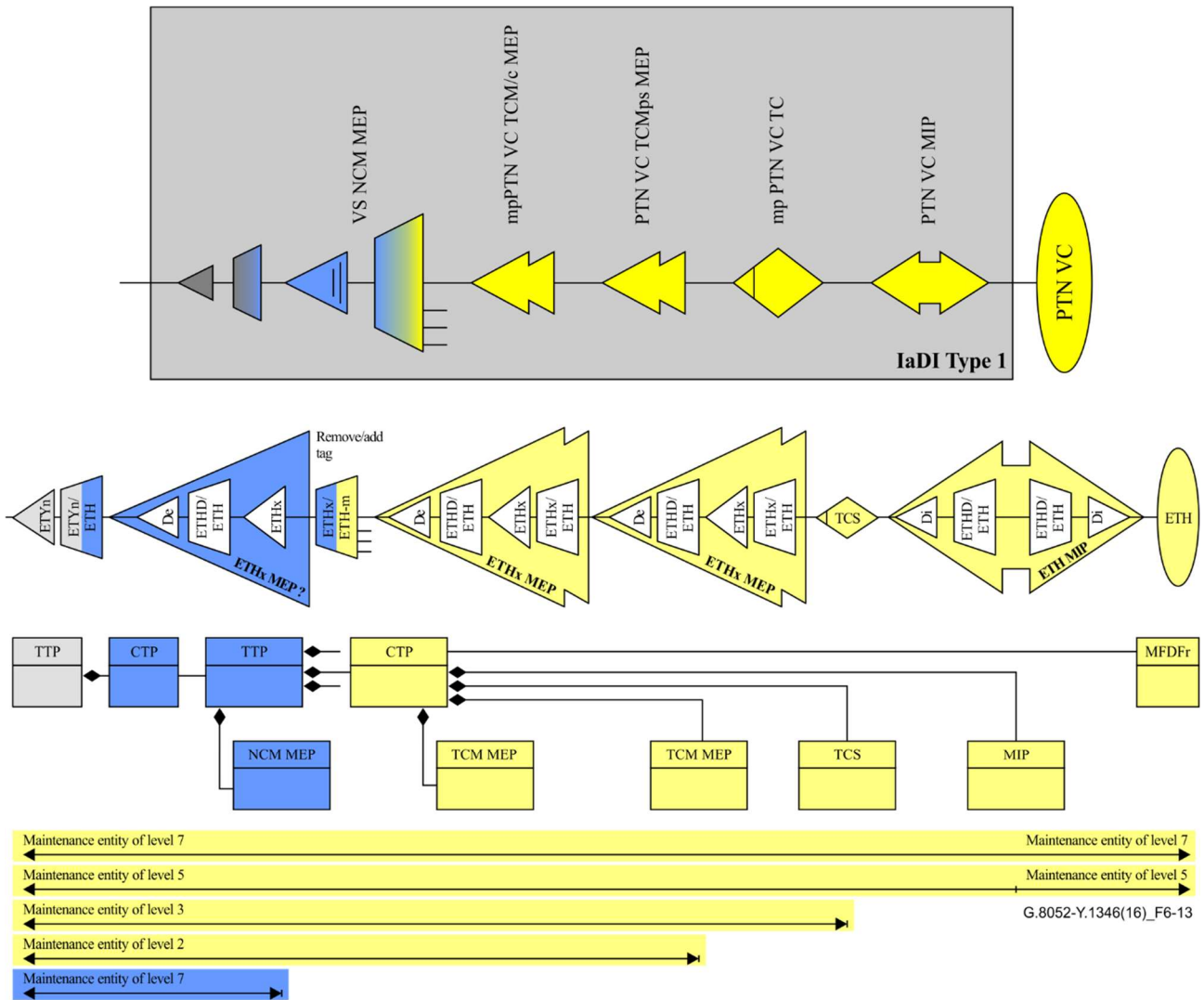


Figure 6-9 – Modelling of an IaDI example

## 7 UML Model of Ethernet

### 7.1 ETH fragment

#### 7.1.1 ETH CTP object classes

The EthCtp (Ethernet 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 = 'ETH' and terminationState = 'LP\_CAN\_NEVER\_TERMINATE'.

The EthCtp object class is «ExtendedComposite»<sup>1</sup> with the Ethernet technology-specific attributes defined within the *EthCtpPac*, *EthCtpSourcePac*, *EthCtpSinkPac* and *EthCtpBidirPac* abstract object classes as shown in Figure 7-1.A.

<sup>1</sup> The «ExtendedComposite» aggregation means that the extending class will never be explicitly instantiated (i.e., are abstract), but that the attributes defined by the extending class will be transferred to the class being extended at runtime.











**Figure 7-1.C – ETH Connectivity Overview**

In particular:

- The EthSn object class is defined via pruning and refactoring of the G.7711 FD object class when it has only one layerProtocolName = 'ETH'.
- The EthSnc object class is defined via pruning and refactoring of the G.7711 FC object class when layerProtocolName = 'ETH'.
  - The EthSnc object class has been refactored from the G.7711 FC global object class as a local object class, as defined in [ITU-T G.7711], and the EthSnSupportsSnc 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 EthSncPort object class is defined via pruning and refactoring of the G.7711 FcPort object class when the FC instance is realized by an EthSnc instance.

As a consequence:

- The EthSnSupportsSnc and the EthSncHasSncPorts associations have been defined via pruning and refactoring of, respectively, the G.7711 FdSupportsFcs and FcHasFcPorts associations.
- The relationship between the EthSncPort and the EthCtp or EthTtp being connected is modelled by the EthSncPortConnectedToEthTp {xor} constraint between the EthSncPortConnectedToEthCtp and EthSncPortConnectedToEthTtp associations, defined via pruning and refactoring of the G.7711 FcPortConnectedToLtp association.

An EthCtp instance can have either:

- Flexible connectivity via an EthSn instance (e.g., as shown in Figure 7-1.C), which is modelled by the EthSnProvidesFlexibleConnectivityForEthCtp association, defined via pruning and refactoring of the G.7711 FdAggregatesLtp association.
- Fixed connectivity with a peer EthCtp instance (e.g., as shown in Figure 7-1.A), which is modelled by the EthCtpConnectsToPeerEthCtp association, defined via pruning and refactoring of the G.7711 LtpConnectsToPeerLtp association.
- Fixed termination on an EthTtp instance (e.g., as shown in Figure 7-1.A), which is modelled by the EthCtpTerminatesOnEthTtp association, defined via pruning and refactoring of the G.7711 LtpHasPeerLtp association.

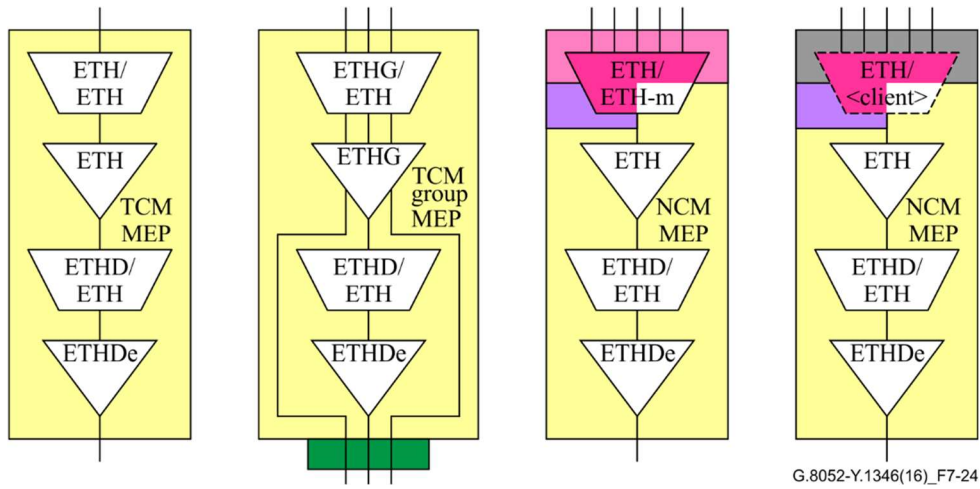
An EthTtp instance can have either:

- Flexible connectivity via an EthSn instance (e.g., as shown in Figure 7-1.C), which is modelled by the EthSnProvidesFlexibleConnectivityForEthTtp association, defined via pruning and refactoring of the G.7711 FdAggregatesLtp association.
- Fixed termination for an EthCtp instance (as shown Figure 7-1.A), which is modelled by the EthCtpTerminatesOnEthTtp association, defined via pruning and refactoring of the G.7711 LtpHasPeerLtp association

#### **7.1.4 ETH multiplexing**

This clause maps the Ethernet multiplexing related MIs to the corresponding object classes.

The Ethernet multiplexing configuration function exists only in ETH TTP and ETH CTP.



**Figure 7-1.D – Ethernet multiplexing configuration function**

NOTE – The ETH/<client>\_A atomic function is for further study.

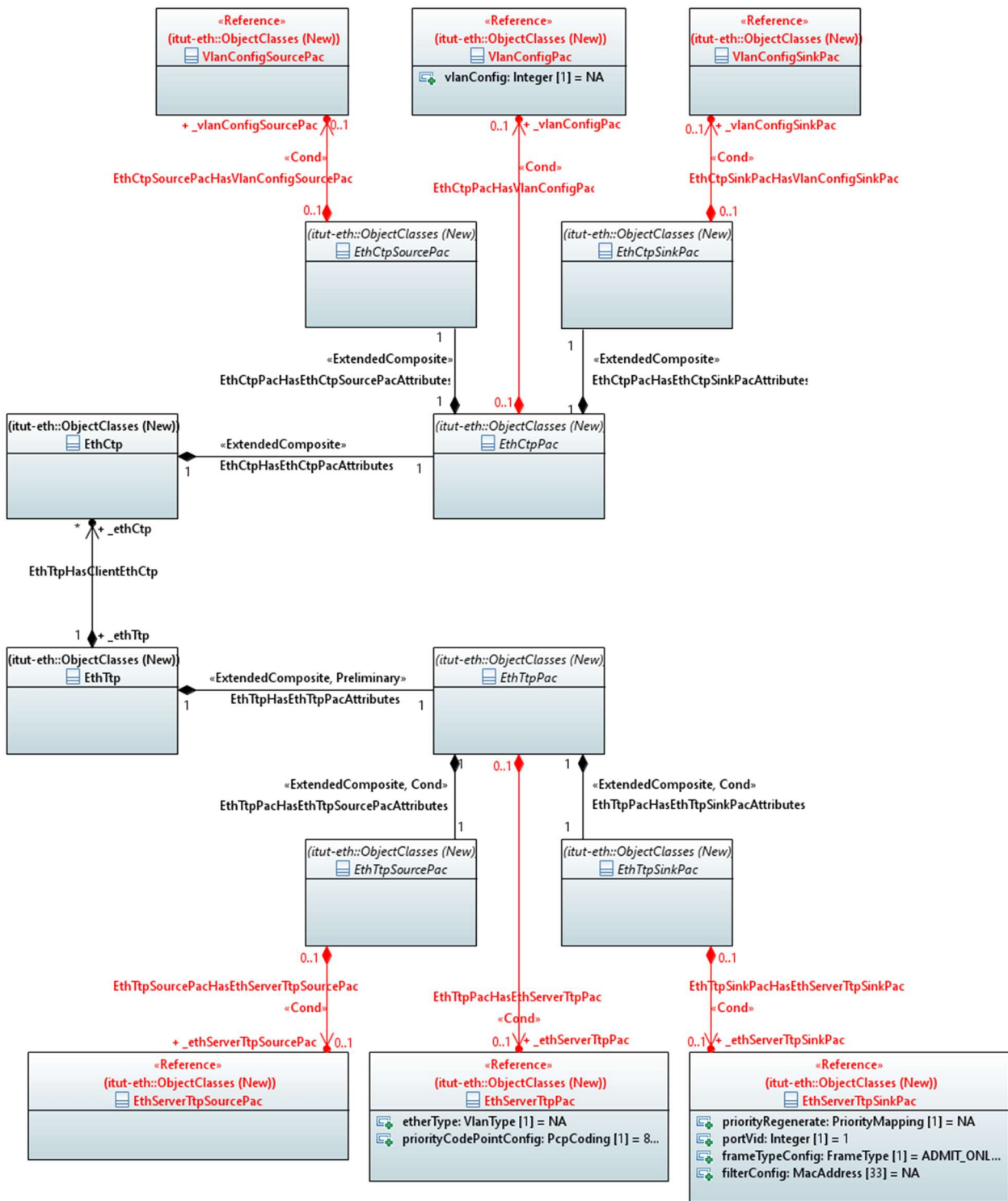
[ITU-T G.8021] defines the following management information (MI) for configuring the Ethernet multiplexing function:

**Table 7-1.A – Mapping of multiplexing related MI to model artefacts**

Functionality	ITU-T G.8021/Y.1341 ETHx/ETH-m_A_So_MI	ITU-T G.8021/Y.1341 ETHx/ETH- m_A_Sk_MI
TTP associated MI	Etype	Etype
	PCP_Config	PCP_Config
		P_Regenerate
		PVID
		Frametype_Config
		Filter_Config
CTP associated MI	VLAN_Config[1...M]	VLAN_Config[1...M]

Note that the set of MI signals listed in the above Table 7-6 is a subset of the MI signals specified in [ITU-T G.8121] clause 9.3.2 ETHx/ETH-m\_A (in its Table 9-10 and Table 9-11). These MI signals are multiplexing specific and are the delta between clause 9.3.1 ETHx/ETH-m\_A and clause 9.3.1 ETHx/ETN\_A of G.8121. The MI signals of clause 9.3.1 ETHx/ETN\_A are modelled using the Sink/Source/Bidir Pac object classes of EthTtp and EthCTP.

NOTE – ETHx/ETHG\_A has the same MI as ETHx/ETH-m\_A. ETHx/ETHG\_A is on hold for the time being.



itut-eth\_ETH\_Multipl  
 exing.png

Figure 7-1.E – Ethernet multiplexing model overview

### 7.1.5 ETH CTP and TTP auxiliary object classes

The *EthAuxTp* object class is defined via pruning and refactoring of the LP object class, when the *layerProtocolName* is set to 'ETH\_MEP' or 'ETH\_MIP' or 'ETH\_TCS', as shown in Figure 7-1.H.

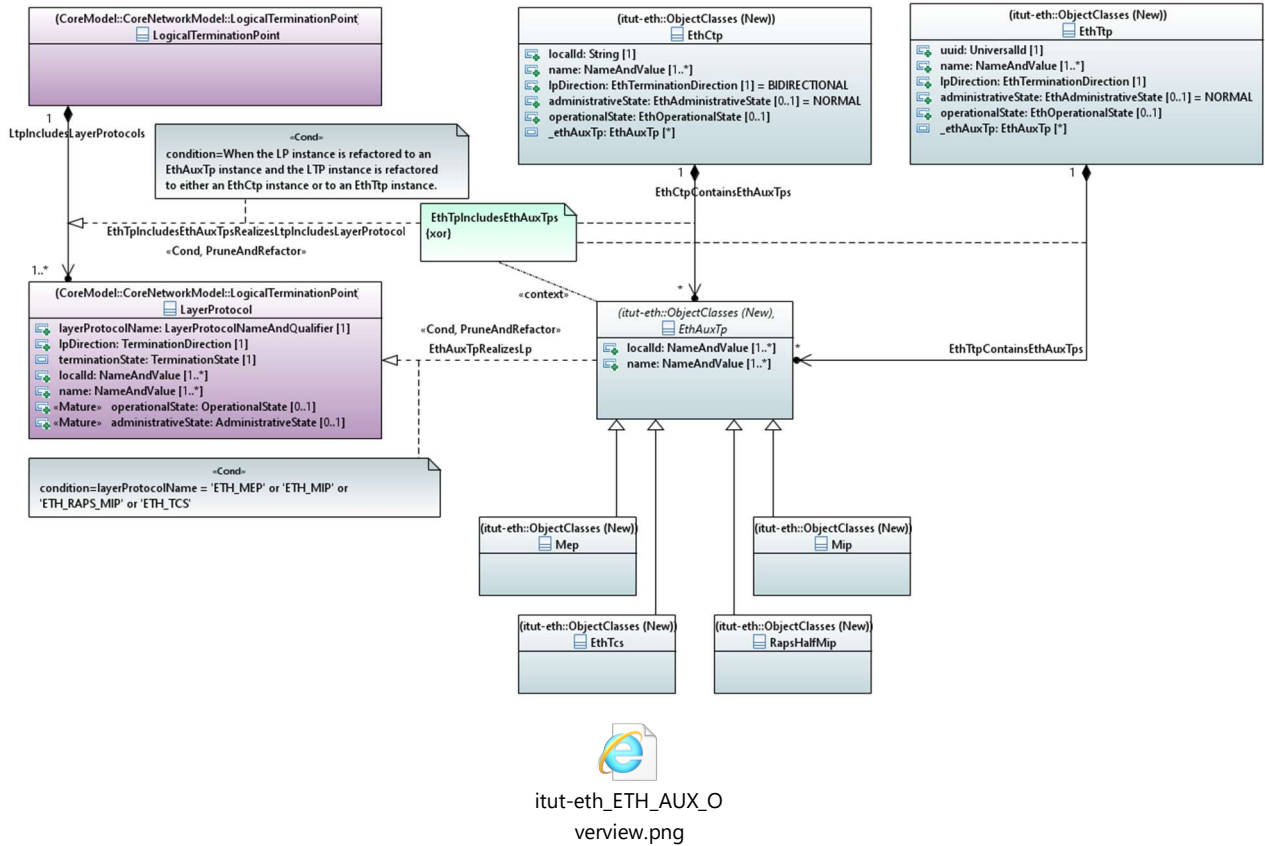


Figure 7-1.F – ETH auxiliary object classes

The *EthAuxTp* object class is an abstract object class that is inherited by the object classes, described in clauses 7.1.5 and 7.2, used to model ETH auxiliary functions.

ETH auxiliary functions can be located either:

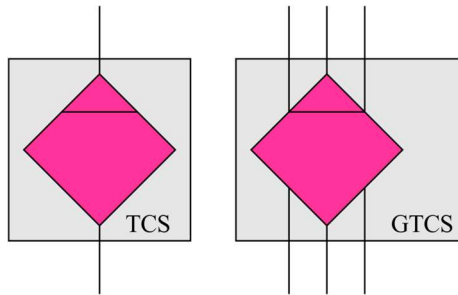
- between the adaptation function and the connection function, as modelled by the *EthCtpContainsEthAuxTps* association; or,
- between the connection function and the trail termination function, as modelled by the *EthTtpContainsEthAuxTps* association.

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

The *EthCtpContainsEthAuxTps* and *EthTtpContainsEthAuxTps* associations defined, together with the *EthTpIncludesEthAuxTps* constraint, via pruning and refactoring of the G.7711 *LpIncludesLayerProtocols* ordered association. The *EthCtpContainsEthAuxTps* and *EthTtpContainsEthAuxTps* are ordered.

### 7.1.6 ETH TCS

This clause maps the ETH traffic conditioning and shaping (TCS) function related MIs to the corresponding object classes.



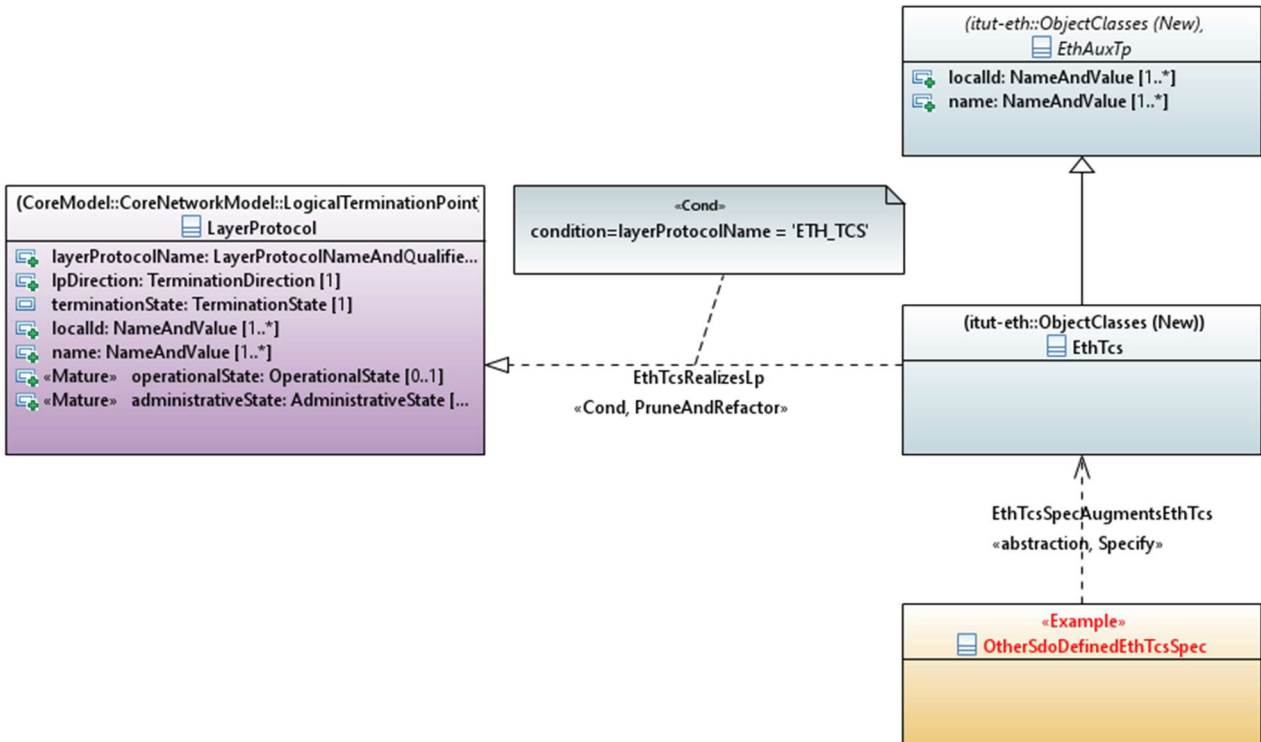
G.8052-Y.1346(16)\_F7-20

Figure 7-1.G – TCS/GTCS configuration function

Table 7-1.B – TCS configuration MI list

Functionality	ETH_TCS_So_MI	ETH_TCS_Sk_MI
Conditioning and Shaping	ETH_TCS_So_MI_[IEEE 802.1Q]	ETH_TCS_Sk_MI_[IEEE 802.1Q]

Figure 7-1.H below provides an overview of the ETH TCS model. The EthTcs object class is an anchor object class that can be augmented with TCS-specific properties, e.g. defined in the OtherSdoDefinedEthTcsSpec object class. The specification of such TCS specific object classes are out of the scope of this Recommendation.







itut-eth\_ETH\_TCS\_Ov  
 erview.png

**Figure 7-1.H – ETH TCS Overview**

## 7.2 OAM fragment

See Annex A.1 for the general description of the OAM compound functions.

### 7.2.1 MEP compound function

See Annex A.1.1 for the description of the MEP compound function.

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

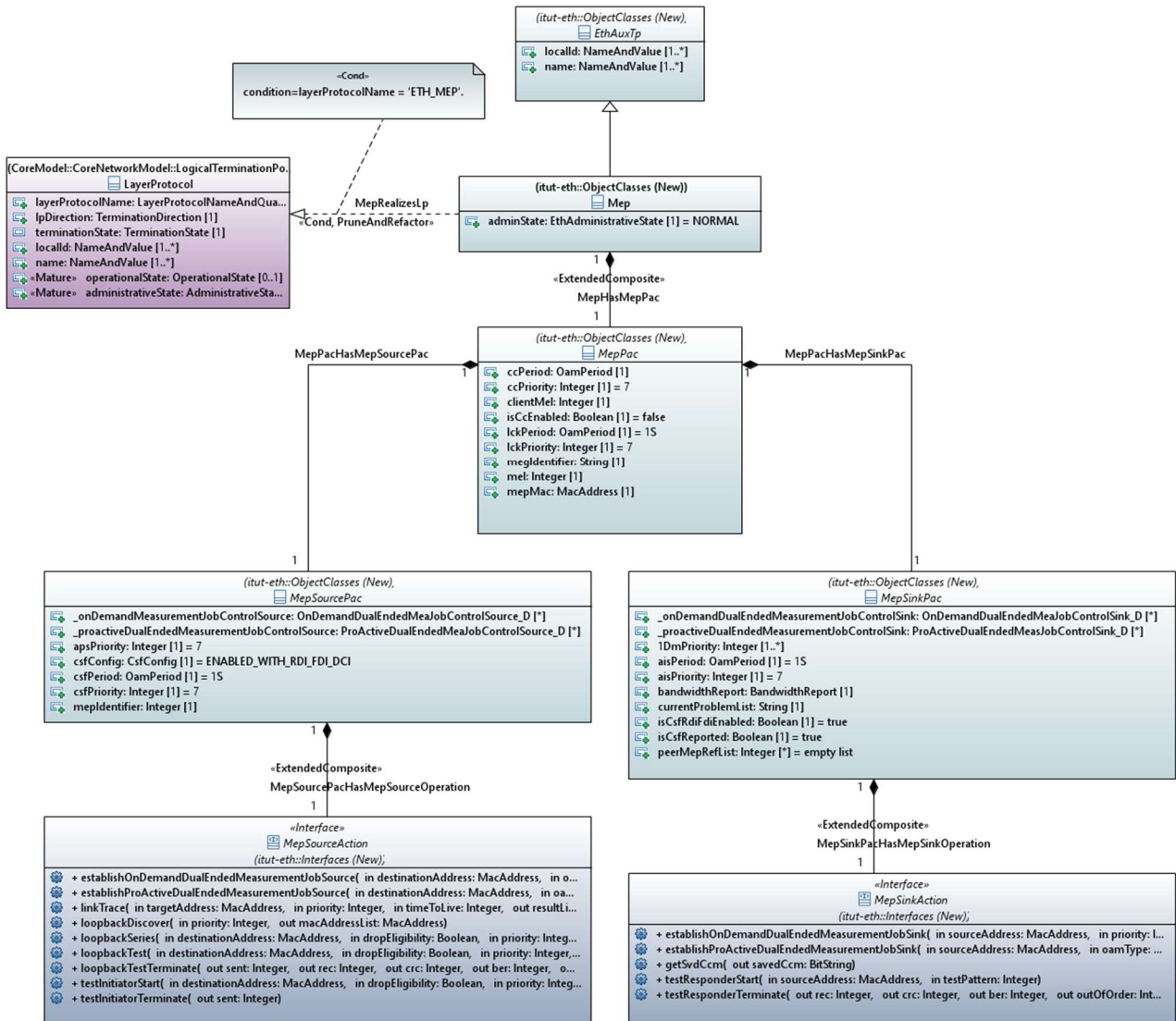




Figure 7-2.A – ETH MEP Overview

### 7.2.2 MIP compound function

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

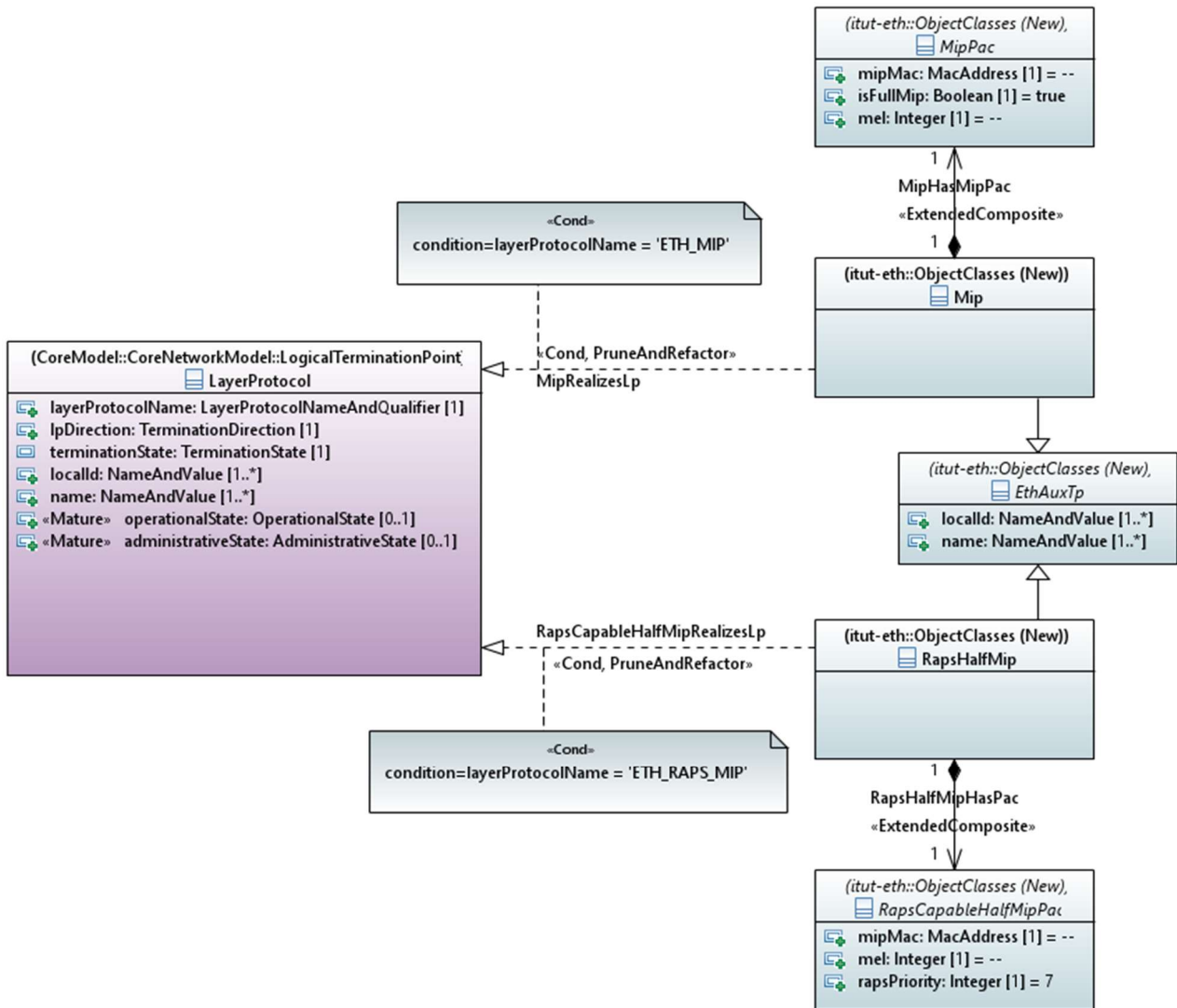
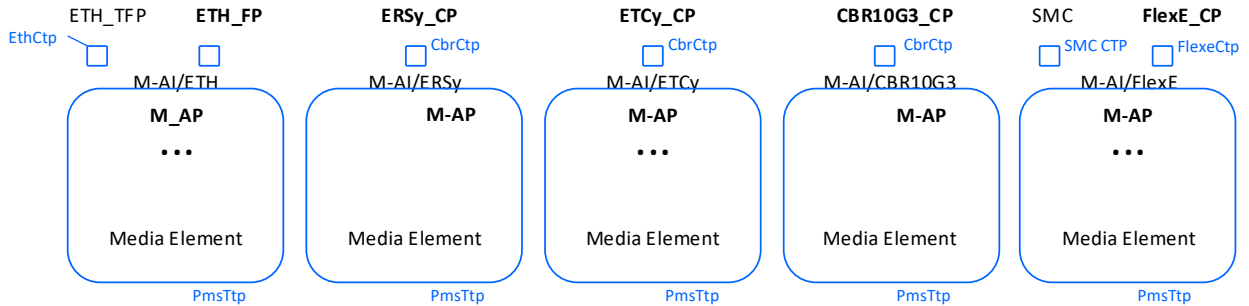


Figure 7-2.B – ETH MIP Overview



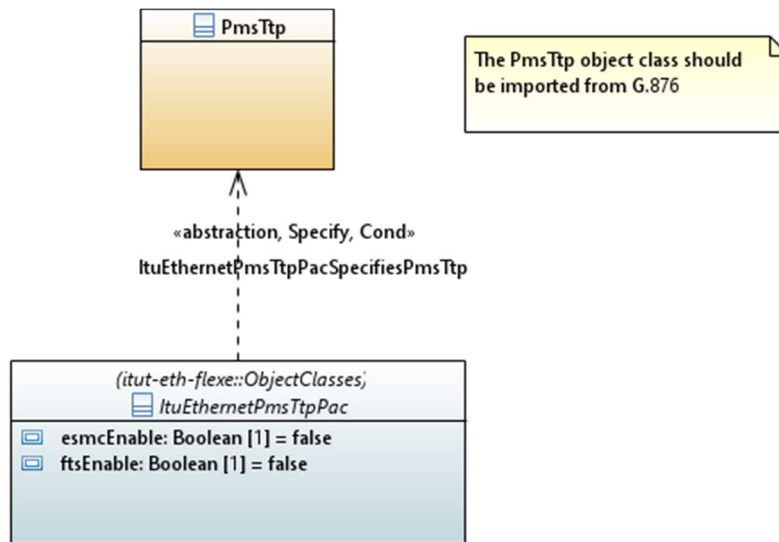


NOTE – In case of a single OTSi or ETSi, only one OTSi/ETSi modulator/demodulator is applicable.

**Figure 7-3.A – Overview of the object class mapping to M-AI atomic functions (based on Figure 6-1 of [ITU-T G.8023])**

NOTE: The Media Element object class *PmsTtp* is outside the scope of this document and is defined in [ITU-T G.876].

The following diagram illustrates that in case the *PmsTtp* represents an Ethernet media layer that is compliant with [ITU-T G.8023], additional attributes are needed in order to specify the *PmsTtp*.



**Figure 7-3.B – Ethernet Media UML diagram**

## 7.4 FlexE fragment

### 7.4.1 Overview of FlexE related object classes

Figure 7-4.A shows the mapping between the object classes and the atomic functions defined in Figure A.1 of [ITU-T G.8023] that represent the M-AI, FlexE and FlexE Client functions.

The FlexE related object classes are FlexE CTP, FlexE Group, FlexE Member (that combines FlexE CTP and FlexE CTP into a single object class), PMS CTP and CBR CTP.

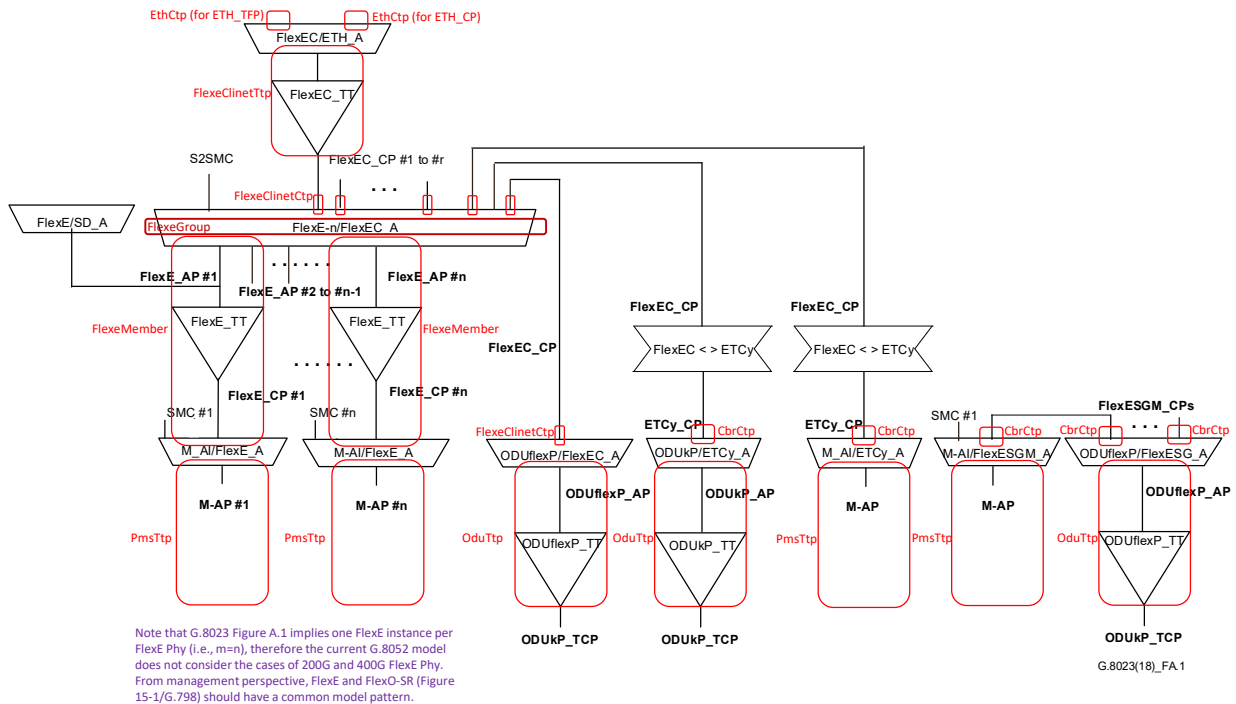


Fig7-8.png

**Figure 7-4.A – Overview of the object class mapping to FlexE related atomic functions (based on Figure A.1 of [ITU-T G.8023])**

Note: According to [ITU-T G.8023] Clause 6.6 Tables 6-13 & 6-14 and [ITU-T G.798] Clause 14.3.18 Tables 14-46 and 14-47, the MI signals of M-AI/FlexESGM\_A and ODUflexP/FlexESG\_A are quite different. But they can be connected directly though.

## 7.4.2 FlexE UML model

### 7.4.2.1 FlexE Member

As shown in Figure 7-4.A above, one instance of FlexE Member is contained in the server layer PMS TTP. The FlexE Member instance models the combined functions of FlexE\_CP and FlexE\_TT and also some of the client adaptation function.

Figure 7-4.B shows the class diagram of FlexE Member.



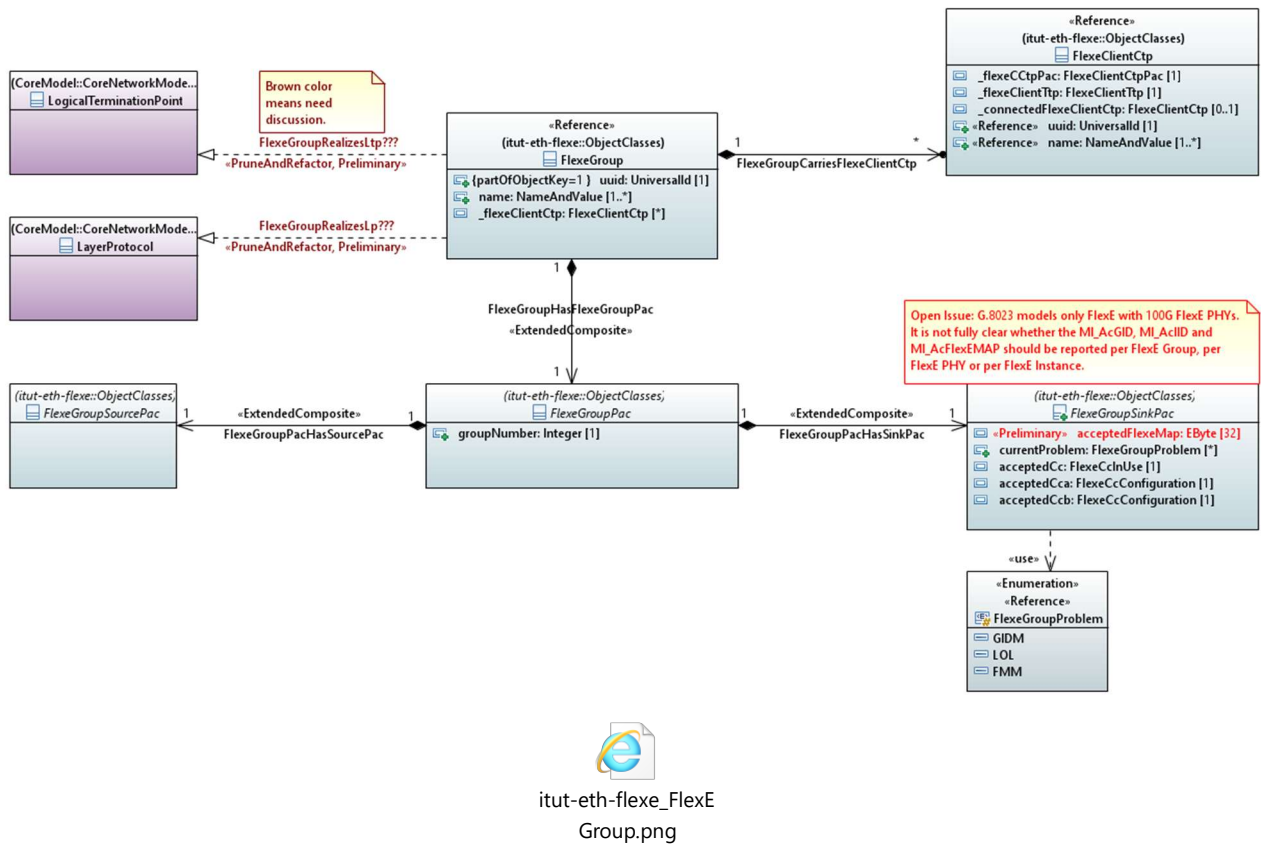


Figure 7-4.C – FlexE Group UML diagram

### 7.4.3 FlexE Client UML model

Figure 7-4.D and Figure 7-4.E show the mapping between UML object classes and the FlexE Client termination (FlexEC\_TT) and Adaptation (FlexEC/ETH\_A) functions. The object classes are FlexEC TTP, FlexEC CTP and Comms CTP.

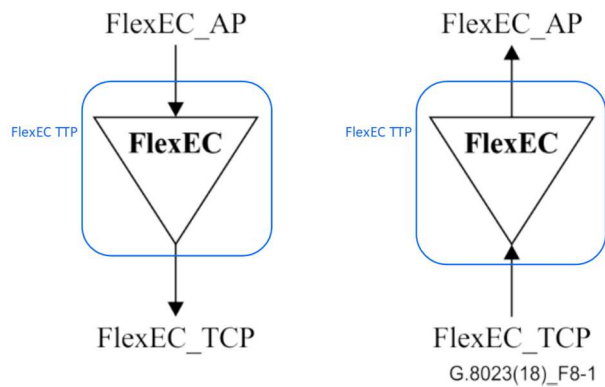
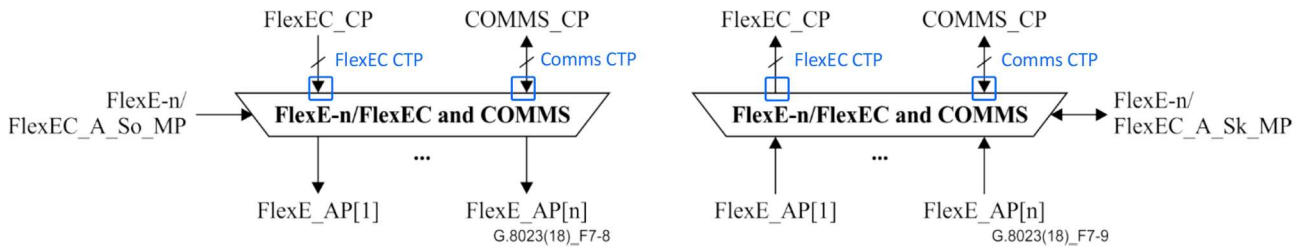


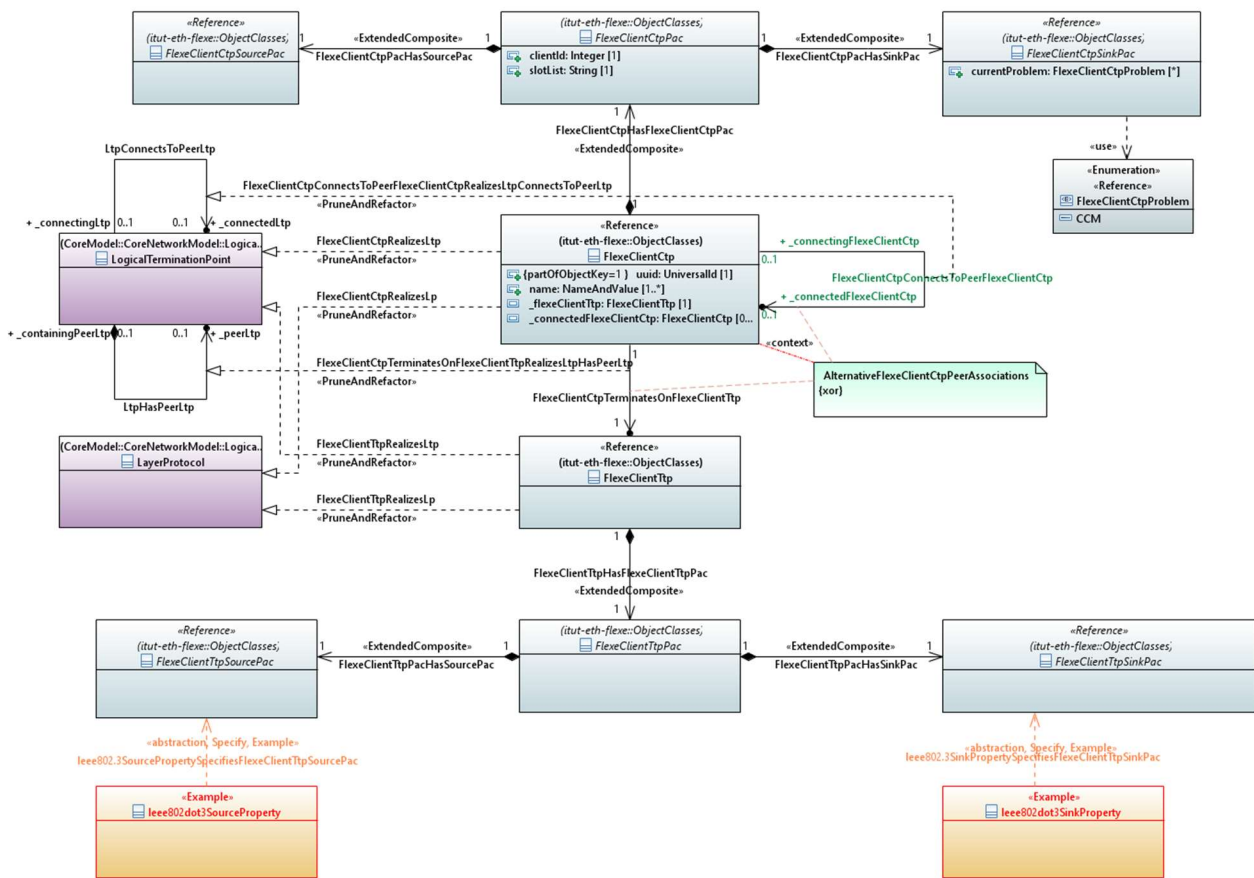
Figure 7-4.D – Overview of the object class mapping to FlexEC\_TT atomic functions (based on Figure 8-1 of [ITU-T G.8023])



**Figure 7-4.E – Overview of the object class mapping to FlexEC/ETH\_A atomic functions (based on Figure 7-8 and Figure 7-10 of [ITU-T G.8023])**

### 7.4.3.1 FlexEC TTP

Figure 7-4.F shows the FlexEC TTP UML diagram. The FlexEC TTP object class is defined via pruning and refactoring of the G.7711 LTP and LP object classes.



**Figure 7-4.F – FlexEC TTP and FlexEC CTP UML diagram**

### 7.4.3.2 FlexEC CTP

Figure 7-4.F also shows the FlexEC CTP. The FlexEC CTP object class is defined via pruning and refactoring of the G.7711 LTP and LP object classes.

In the figure, the FlexEC CTP to FlexEC CTP association is highlighted in green color. This allows direct fix-connectivity between two FlexEC CTP instances.

In the figure, the Green {xor} constrain shows that the FlexEC CTP may connect to a peer FlexEC CTP or terminate on an FlexEC TTP.

## 8 UML model file

Embedded below is a zip file, which contains the G.8052 UML model developed using the Papyrus open-source modelling tool.



G.8052\_v3.0.10\_uml.z  
ip

This zip file contains the following folders:

- The G.8052 folder, which contains the following files:
  - The papyrus project file
    - .project
  - The .di, .notation, and .uml files of the following modules
    - itut-eth,
    - itut-eth-flexe,
    - G.8052\_v3.0-model
  - The gdITUTemplate-8052.docx file, which can be used to generate the data dictionary (DD) form of the G.8052 UML model
  - The doc sub-folder, which contains the data dictionary of the G.8052 UML model
  - The UmlProfiles sub-folder, which contains the UML Profiles that defines the properties of the UML artifacts.
    - The OpenModelProfile folder, which contains the .di, .notation, and uml of the *open model profile*
    - The OpenInterfaceModelProfile folder, which contains the .di, .notation, and uml of the *open model interface profile*
    - The ProfileLifecycleProfile folder, which contains the .di, .notation, and uml of the *profile lifecycle profile*
    - The ClassDiagramStyleSheet.css style sheet
  - The diagrams sub-folder, which contains the PNG images of all the class diagrams.
- The G.7711 folder, which contains the [ITU-T G.7711] Core model that is needed (i.e., imported) by the G.8052 model.

NOTE-1: If the imported model has been up-versioned or has changed the module name, then the xmi code of the G.8052 module will need to be updated.

To load the G.8052 UML model into an Eclipse Papyrus workspace, follow the steps below:

- In the Project Explorer / right click / Import / General / Projects from Folder or Archive / Next / Archive / Select the G.8052 zip file / Open / Select the folders of the models to be loaded (NOTE) / Finish

NOTE-2: If a supporting (i.e., to be imported by G.8052) model already exists in the workspace, do not select it for loading.

NOTE-3: The ITU-T G.8052 UML information models and the open model profile are specified using the Papyrus open source modelling tool. In order to view and further extend or modify the information model, one will need to install the open source Eclipse software and the Papyrus tool, which is available at [b-Eclipse-Papyrus]. The installation guide for Eclipse and Papyrus can be found in [b-ONF TR-515].

NOTE 4 – The ITU-T G.8052 UML information models expressed in a data dictionary form has been produced for the convenience of readers who do not have access to the Papyrus tool. The data dictionary presents the model artifacts in tabular format. The G.8052 data dictionary is embedded below.



G.8052\_v3.0.10-DD.zi

p

## Annex A

### Version 3 of the Ethernet model

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

This annex contains the previous version (version 3) of the Ethernet model, which was described in Clause 7 of the 2018 Edition of G.8052. Version 3 of the Ethernet model now is annotated with the lifecycle stereotype *«LikelyToChange»*. The papyrus uml files of v3.0 is contained in the v4.0 papyrus project as a separate module. That is, the v4.0 papyrus project contains both the v4.0 module and also the v3.0 module.

#### A.1 OAM compound functions

OAM is done in the network by creating maintenance entities (ME). In multipoint services multiple MEs are grouped together forming a maintenance entities group (MEG); see definitions in clause 7 (Ethernet network management) of [ITU-T G.8010].

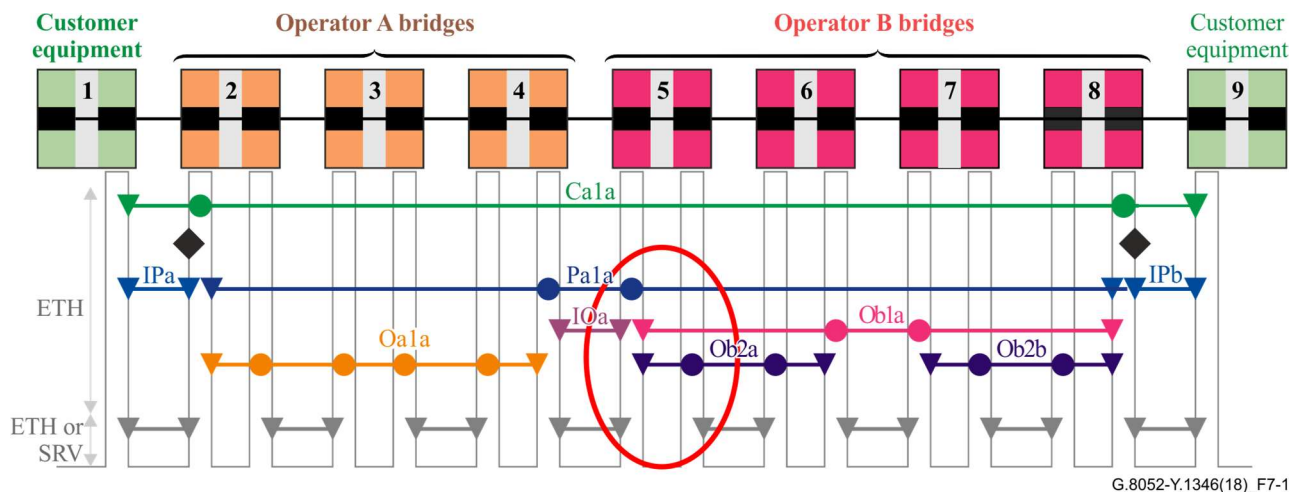
Each MEG is terminated by a set of MEG end points (MEPs). It is also possible to perform OAM functions on a MEG by MEG intermediate points (MIPs) which allow a limited set of OAM functions along the MEs.

#### MEL dependencies between layers

From an architectural point of view, each layer has its own eight maintenance entity levels (MELs) which are independent from the MELs of its client and server layer. But it is also possible that two layers share the same eight MELs. In these cases the management has to make sure that the MELs of both layers do not overlap.

#### Management of MEPs and MIPs

Maintenance entities (ME) are monitored using MEPs and MIPs; see the following figure from [ITU-T G.8013].



**Figure A-1 – Example MEG level assignment for shared MEG levels**  
(based on Figure I.1 of [ITU-T G.8013/Y.1731])

It is assumed that the management systems "north" of the ITU-T G.8052/Y.1346 interface are responsible for establishing the necessary configuration, like the example shown above. The management systems involved may include a service management system (SMS) of the service



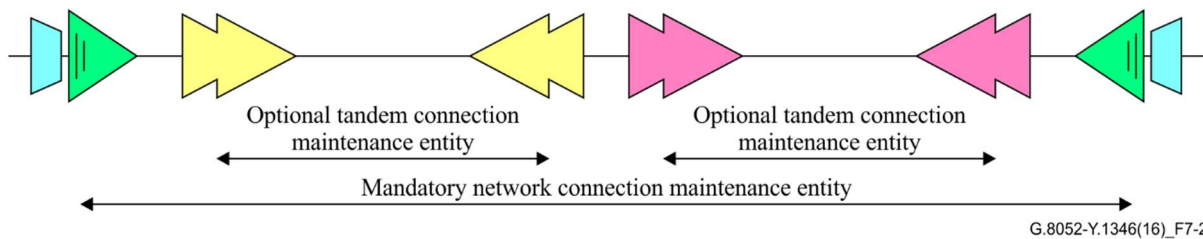
provider and the network management system (NMS) and element management system (EMS) of the operators. The EMS/NE interface has to provide means (operations) to create all the necessary MEPs and MIPs separately.

For example, the 5 MEPs and 2 MIPs in network element 5 above are created manually via the EMS/NE interface.

### A.1.1 MEP compound function

There are two different types of MEP compound functions:

- mandatory NCM MEPs at the boundary of a layer network, monitoring a network connection;
- optional TCM MEPs in the middle of a layer network, monitoring a tandem connection.



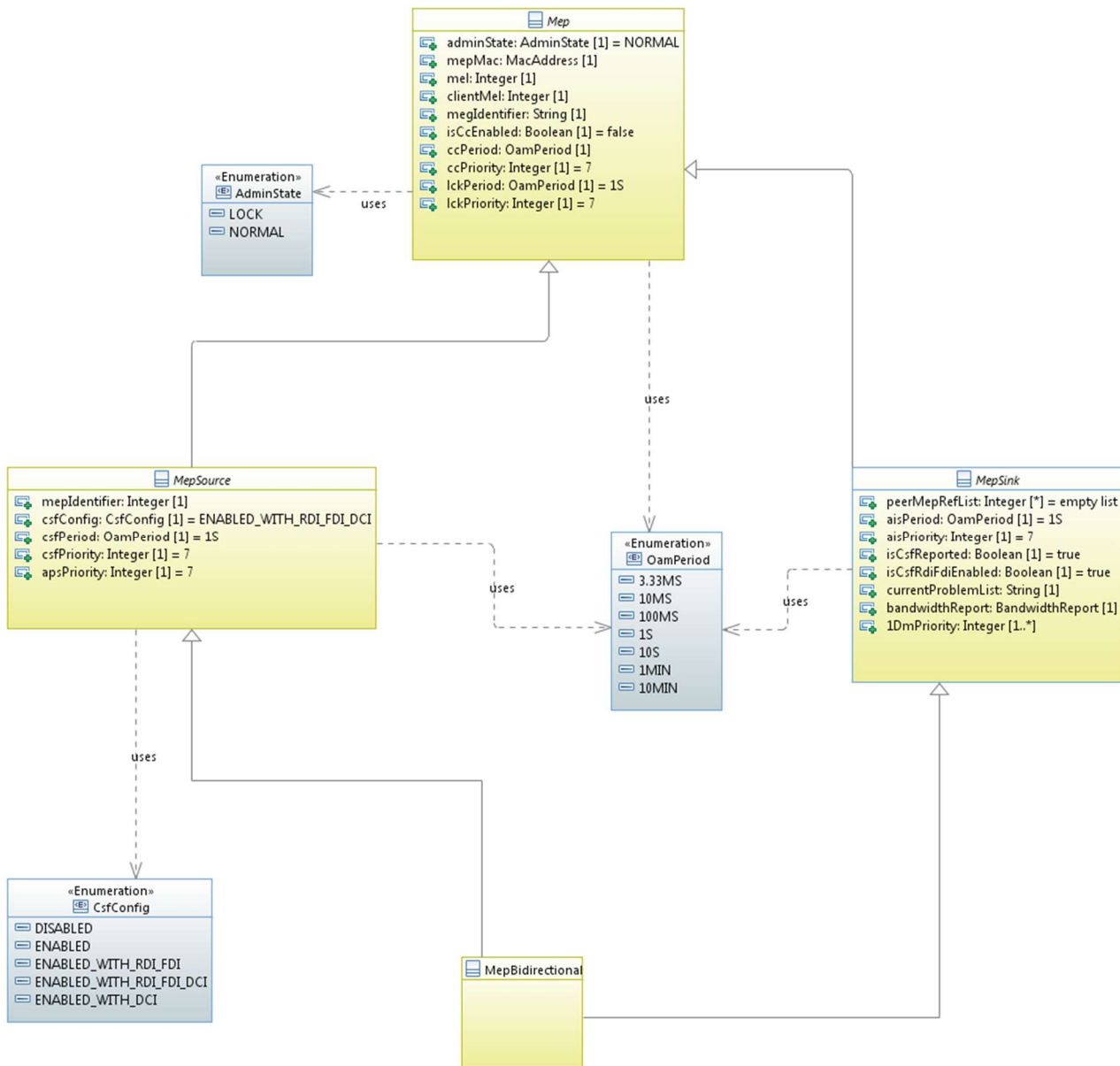
**Figure A-2 – Mandatory and optional MEPs**

From management point of view a MEP has the following constraints:

- A MEP can be unidirectional or bidirectional; unidirectional MEPs have a limited set of OAM functionality.
- A MEP belongs to one, and only one, MEL. MEPs terminate MEGs and each MEG is associated to one MEL.
- A MEP is addressed by one, and only one, MAC address. The MAC address (or more precise 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 which are organised in "jobs":

- On-demand measurement job;
- Proactive measurement job;
- Maintenance job.



NOTE – This diagram is the lower portion of Figure 7-15. This figure is also available from the ITU website [here](#).

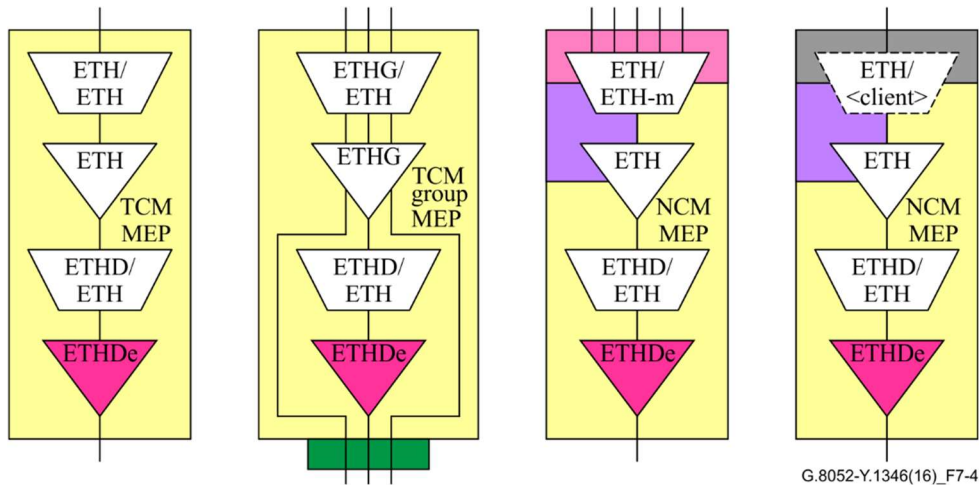
**Figure A-3 – MEP class diagram**

NOTE – The MEP object is further described later on in Figures 7-8, 7-13 and 7-15 below describing the individual segments of the MEP model.

The management information (MI) of the compound functions (defined in [ITU-T G.8021]) needs to be mapped to ITU-T G.8052/Y.1346 artefacts. The following clauses list all the MIs defined for the MEP compound function in tables and associate them to 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.



**Figure A-4 – MEP on-demand diagnostic function**

NOTE – The ETH/<client>\_A atomic function is for further study.

[ITU-T G.8021] defines the following management information (MI) for on-demand measurements and maintenance:

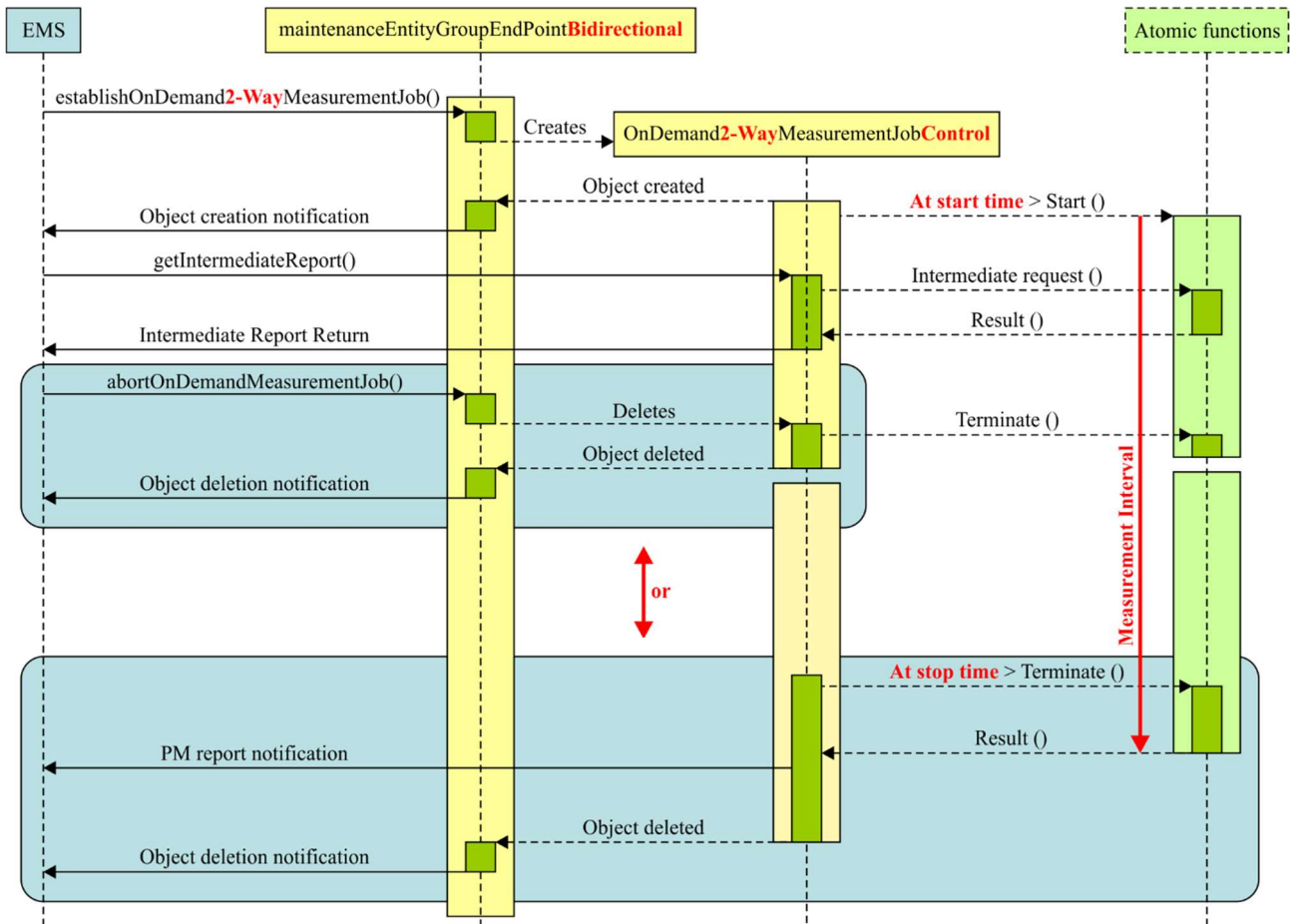
**Table A-1 – On-demand measurement and maintenance MI list**

Functionality	ITU-T G.8021/Y.1341 ETHDe_FT_So_MI	ITU-T G.8021/Y.1341 ETHDe_FT_Sk_MI
General identifiers	MEL	MEL
	MEP_MAC	MEP_MAC
	MEP_ID	
2-way on-demand loss of frame measurement	LM_Start(DA,P,Period)	
	LM_Terminate	
	LM_Result(N_TF, N_LF, F_TF, F_LF)	
1-way on-demand synthetic loss of frame measurement	1SL_Start(DA,P,Test_ID,Length,Period)	1SL_Start(SA,MEP ID, Test ID)
	1SL_Terminate	1SL_Terminate
		1SL_Result(N_TF,N_LF)
2-way on-demand synthetic loss of frame measurement	SL_Start(DA,P,Test_ID,Length,Period)	
	SL_Terminate	
	SL_Result(N_TF,N_LF,F_TF,F_LF)	
1-way on-demand frame delay measurement	1DM_Start(DA,P Test ID,Length,Period)	1DM_Start(SA,Test ID)
	1DM_Terminate	1DM_Terminate
		1DM_Result(count,N_FD[])
2-way on-demand frame delay measurement	DM_Start(DA,P,Test ID,Length,Period)	
	DM_Terminate	
	DM_Result(count,B_FD[],F_FD[],N_FD[])	

**Table A-1 – On-demand measurement and maintenance MI list**

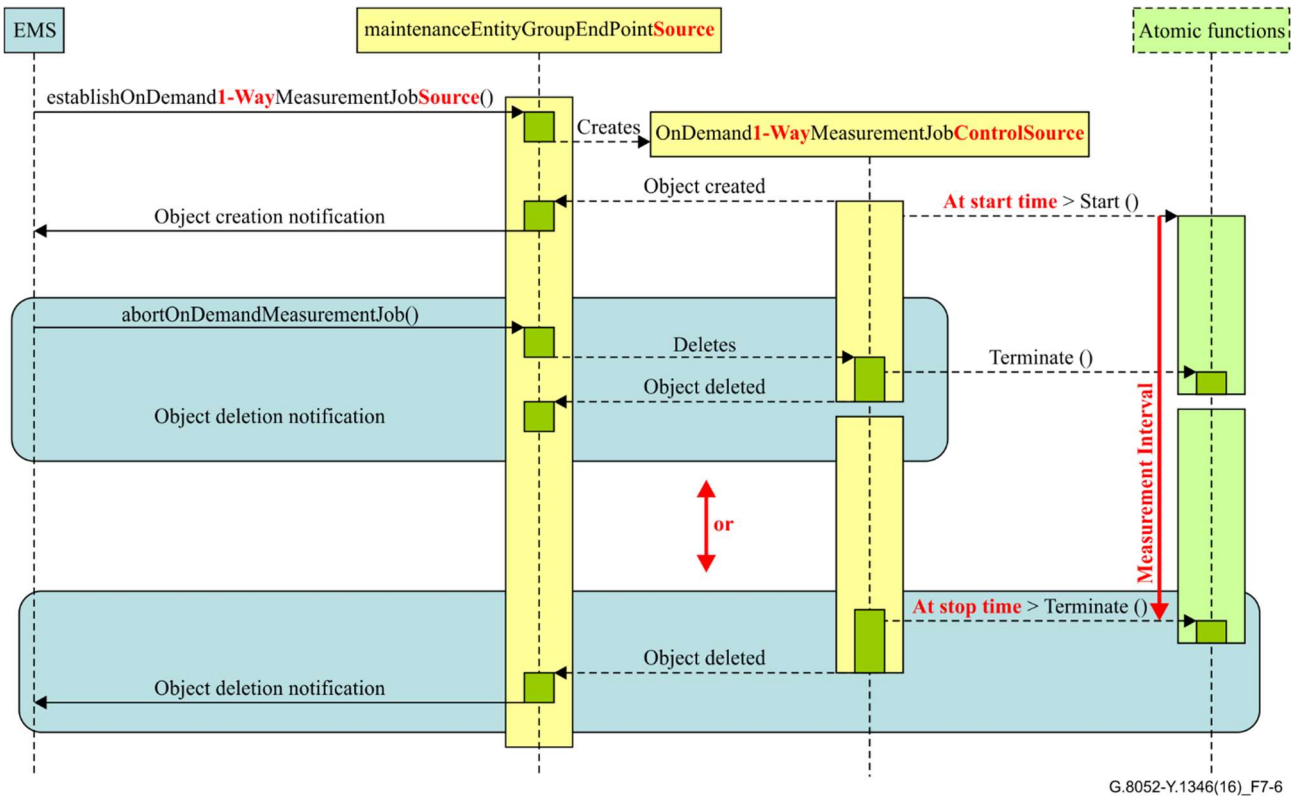
Functionality	ITU-T G.8021/Y.1341 ETHDe_FT_So_MI	ITU-T G.8021/Y.1341 ETHDe_FT_Sk_MI
On-demand loop back	LB_Discover(P)	
	LB_Series(DA,DE,P,N, Length, Period)	
	LB_Test(DA,DE,P,Pattern, Length, Period)	
	LB_Test_Terminate	
	LB_Discover_Result(MACs)	
	LB_Series_Result(REC, OO)	
	LB_Test_Result(Sent, REC, CRC, BER, OO)	
On-demand test	TST(DA,DE,P,Pattern, Length, Period)	TST_Start(SA,Pattern)
	TST_Terminate	TST_Terminate
	TST_Result(Sent)	TST_Result(REC,CRC,BER, OO)
On-demand link trace	LT(TA,TTL.P)	
	LT_Results(Results)	

Figures A-5, A-6 and A-7 provide three sequence diagrams describing the message sequences related to the on-demand measurements.



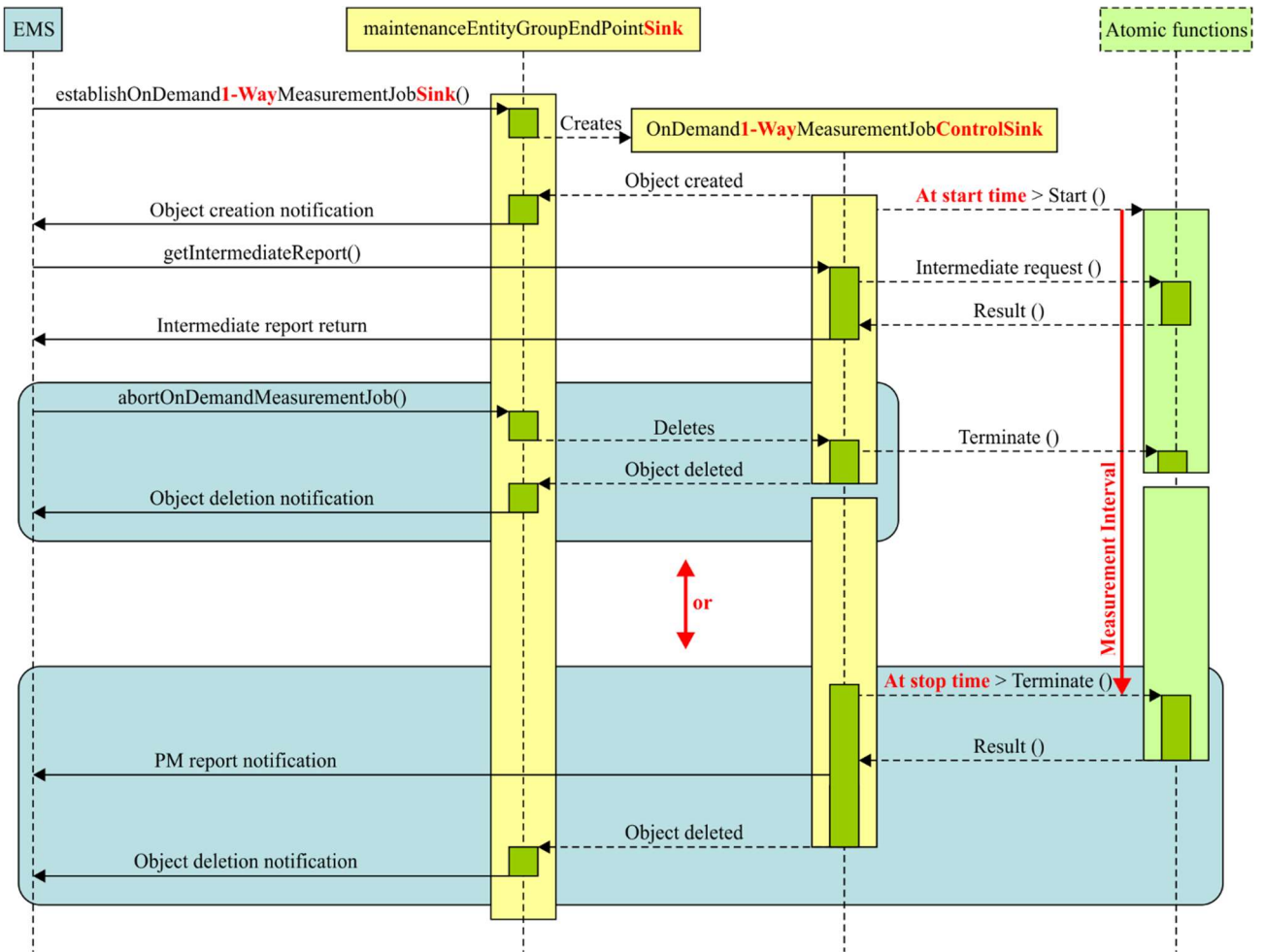
G.8052-Y.1346(16)\_F7-5

Figure A-5 – 2-way on-demand measurement



G.8052-Y.1346(16)\_F7-6

Figure A-6 – 1-way on-demand measurement control source

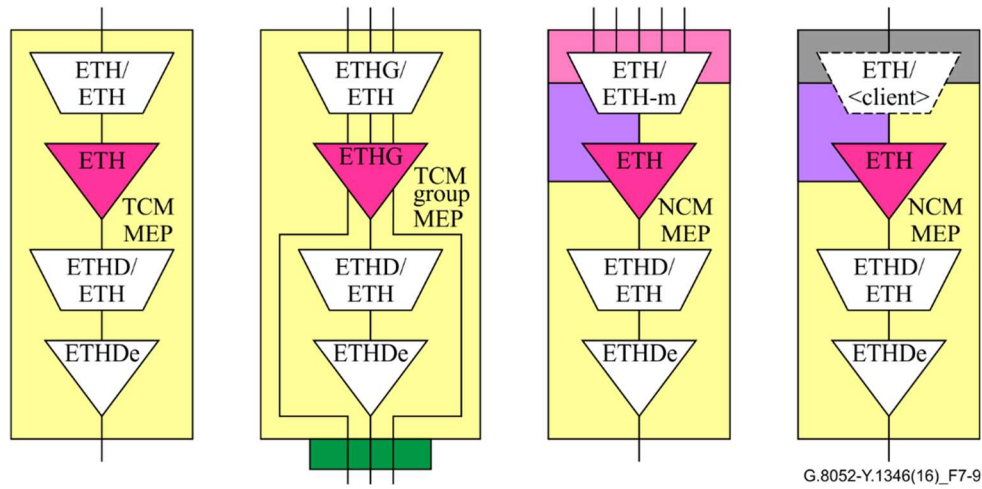


G.8052-Y.1346(16)\_F7-7

**Figure A-7 – 1-way on-demand measurement control sink**







**Figure A-9 – MEP proactive measurement function**

NOTE – The ETH/<client>\_A atomic function is for further study.

[ITU-T G.8021] defines the following Management Information (MI) for proactive measurements:

**Table A-2 – Proactive measurement MI list**

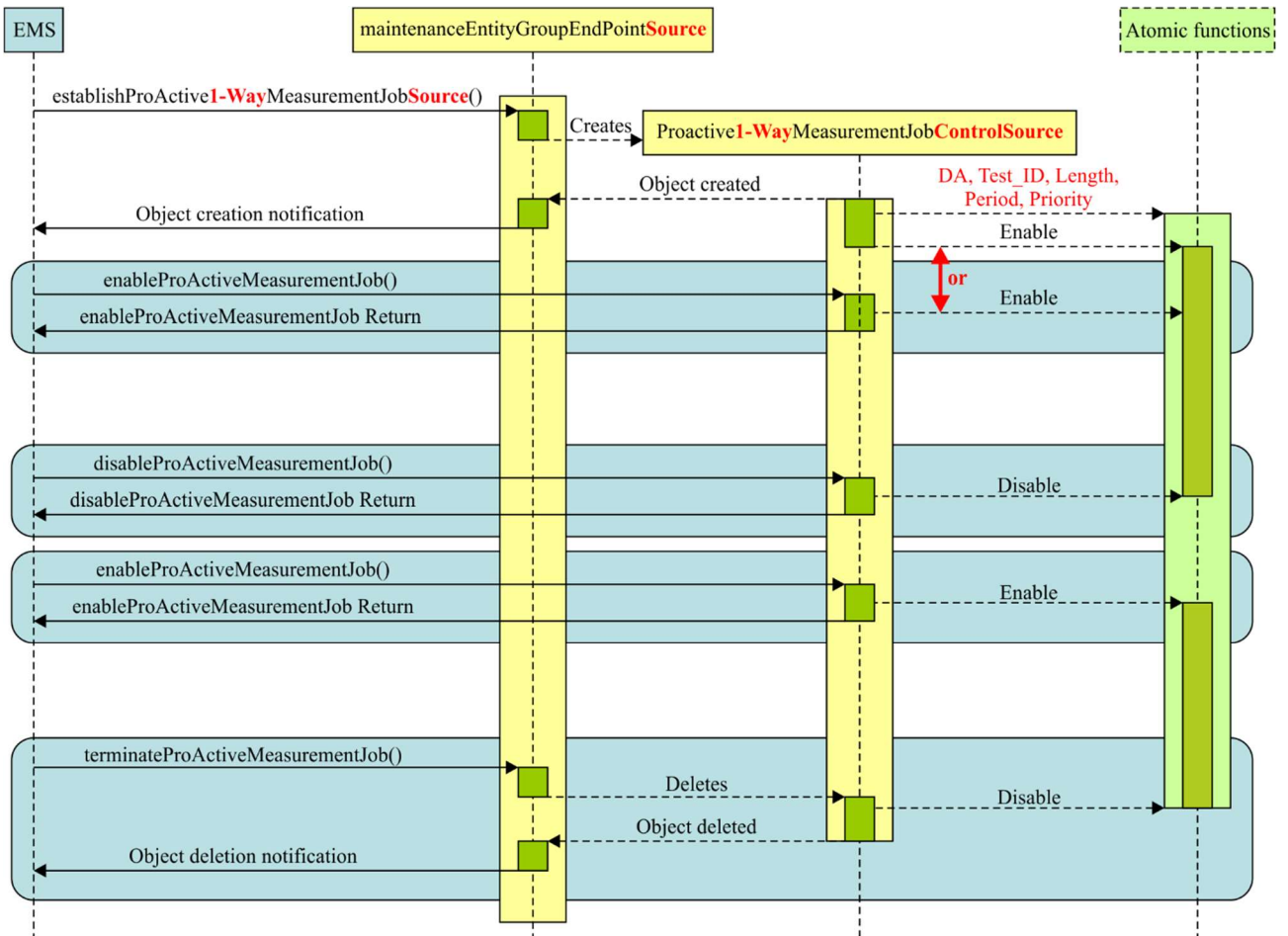
Functionality	[ITU-T G.8021] ETH(G)_FT_So_MI	[ITU-T G.8021] ETH(G)_FT_Sk_MI
General identifiers	MEL	MEL
	MEG_ID	MEG_ID
	MEP_ID	PeerMEP_ID[i]
	MEP_MAC	
Continuity check	CC_Enable	CC_Enable
	CC_Period	CC_Period
	CC_Pri	CC_Pri
Last CCM triggering a fault received		GetSvdCCM
		(out) SvdCCM
1-way proactive loss of frame measurement using CCM	LMC_Enable	LMC_Enable
		LM_DEGM
		LM_M
		LM_DEGTHR
		LM_TFMIN
1-way proactive loss of frame measurement using LMM/LMR	LML_Enable	
	LM_MAC_DA	
	LM_Period	
	LM_Pri	
1-way proactive synthetic loss of frame measurement	1SL_Enable	1SL_Enable
	1SL_MAC_DA	1SL_MAC_SA
	1SL_Test_ID	1SL_MEP_ID
	1SL_Length	1SL_Test_ID
	1SL_Period	

**Table A-2 – Proactive measurement MI list**

Functionality	[ITU-T G.8021] ETH(G)_FT_So_MI	[ITU-T G.8021] ETH(G)_FT_Sk_MI
	1SL_Pri	
2-way proactive synthetic loss of frame measurement	SL_Enable	
	SL_MAC_DA	
	SL_Test_ID	
	SL_Length	
	SL_Period	
	SL_Pri	
1-way proactive frame delay measurement	1DM_Enable	1DM_Enable
	1DM_MAC_DA	1DM_MAC_SA
	1DM_Test_ID	1DM_Test_ID
	1DM_Length	
	1DM_Period	
	1DM_Pri	
2-way proactive frame delay measurement	DM_Enable	
	DM_MAC_DA	
	DM_Test_ID	
	DM_Length	
	DM_Period	
	DM_Pri	
Fault cause list		cLOC[i], cUNL, cMMG, cUNM, cDEG, cUNP, cUNPr, cRDI, cSSF, cLCK
Performance primitive list		pN_TF, pN_LF, pF_TF, pF_LF, pF_DS, pN_DS, pB_FD, pB_FD, pF_FD, pF_FD, pN_FD, pN_FD

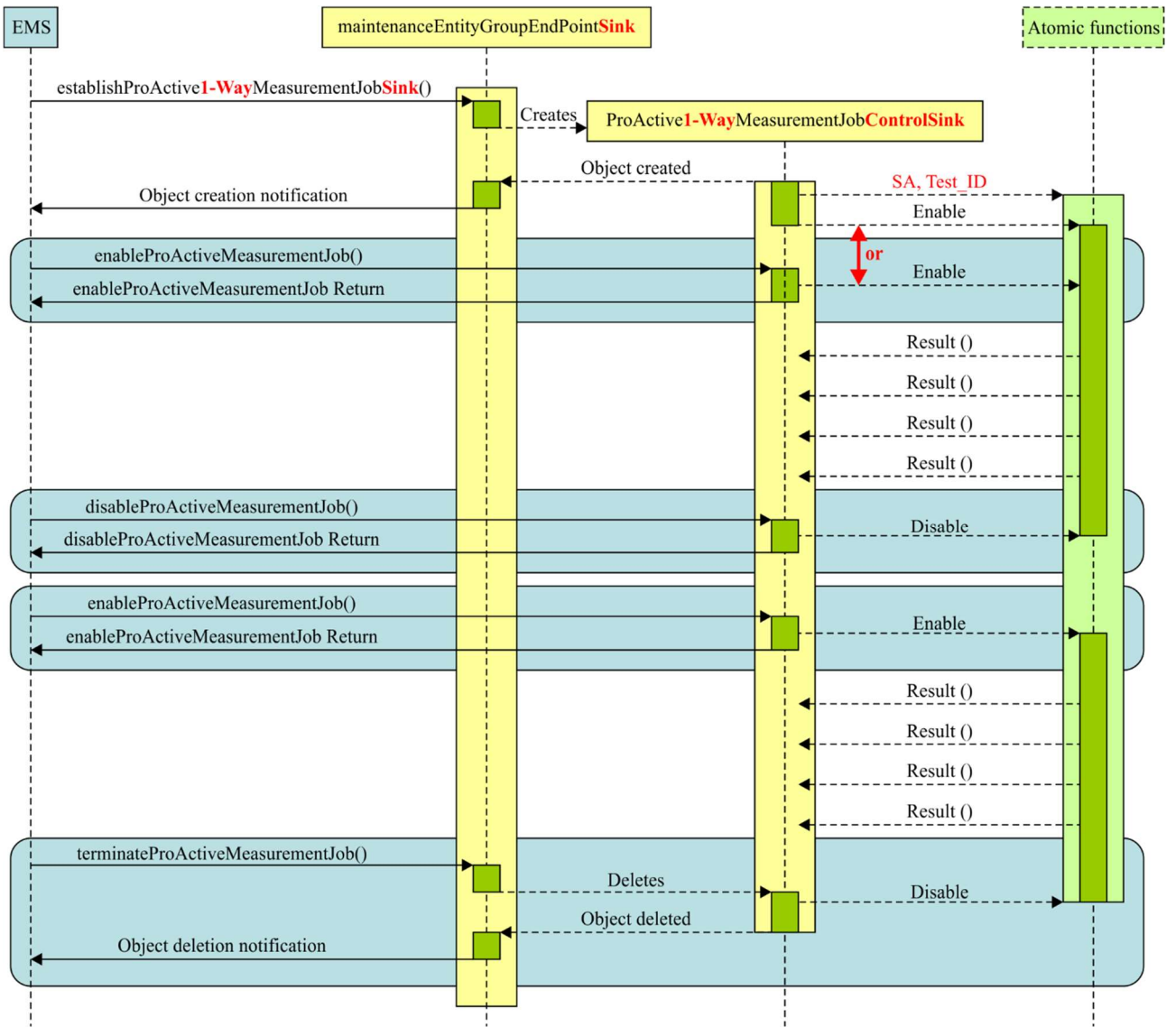
Figures A-10, A-11 and A-12 provide three sequence diagrams describing the message sequences related to the proactive measurements.





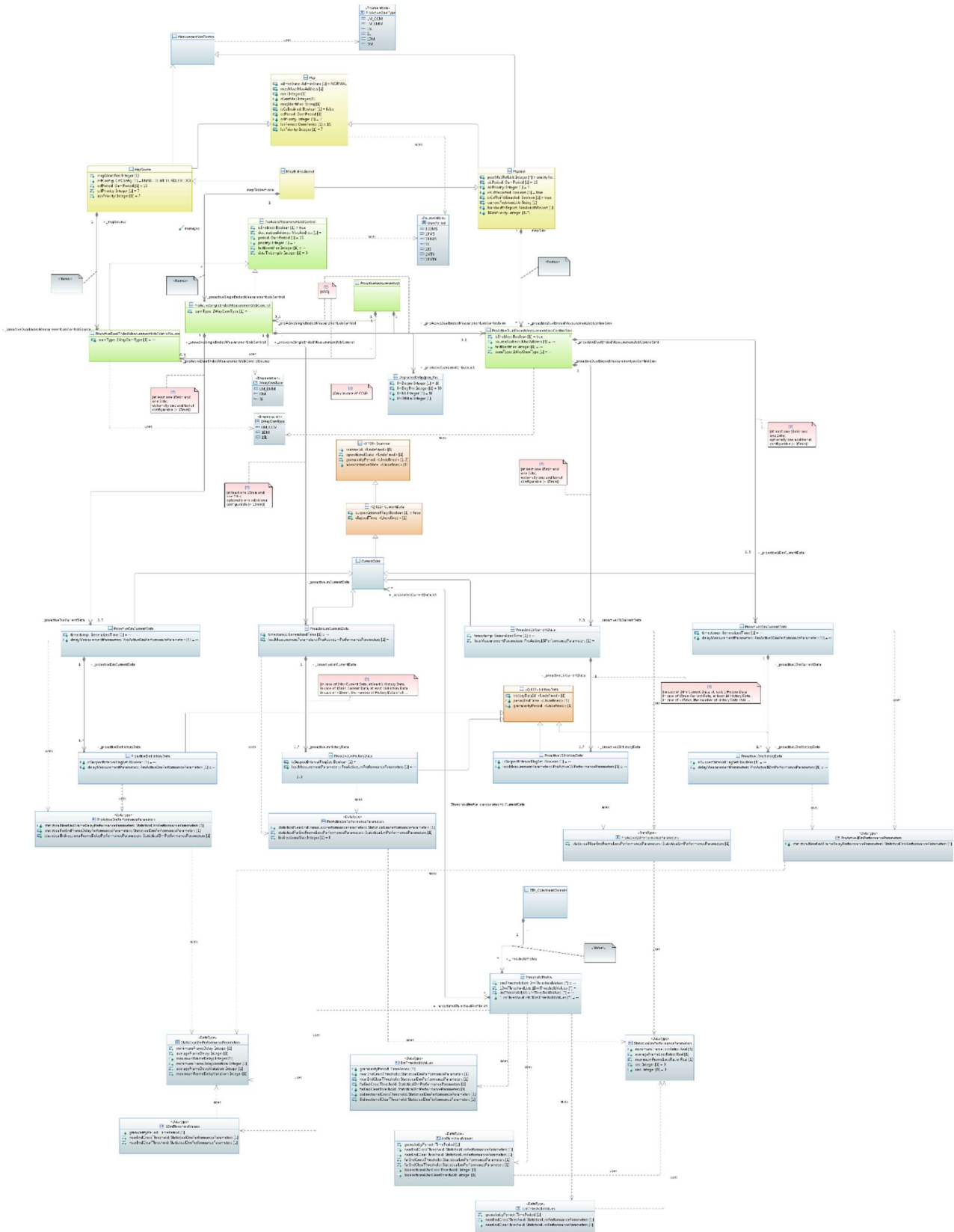
G.8052-Y.1346(16)\_F7-11

Figure A-11 – 1-way proactive measurement control source



G.8052-Y.1346(16)\_F7-12

Figure A-12 – 1-way proactive measurement control sink

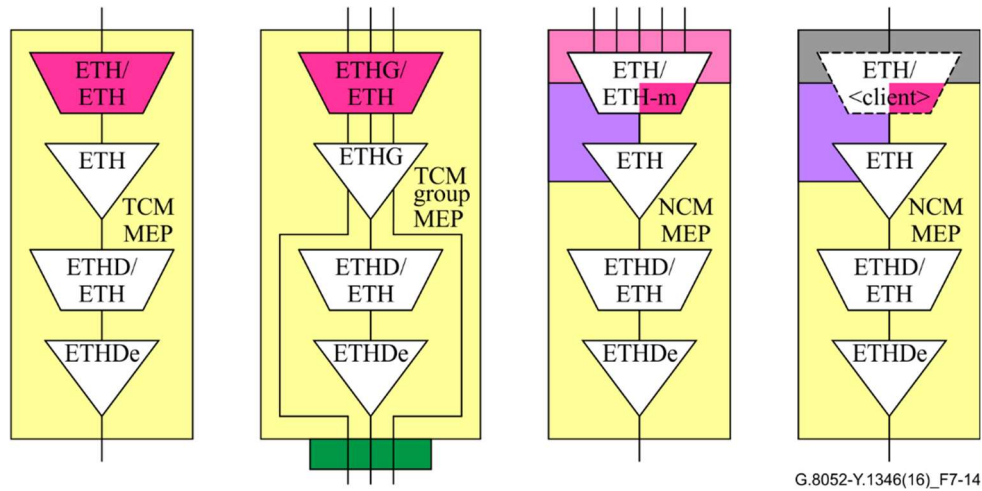


NOTE – This figure is also available on the ITU website [here](#).

**Figure A-13 – Proactive measurement**

### A.1.1.3 MEP configuration function

The MEP configuration function exists in NCM and TCM MEPs.



**Figure A-14 – MEP configuration function**

NOTE – The ETH/<client>\_A atomic function is for further study.

[ITU-T G.8021] defines the following Management Information (MI) for configuring a MEP:

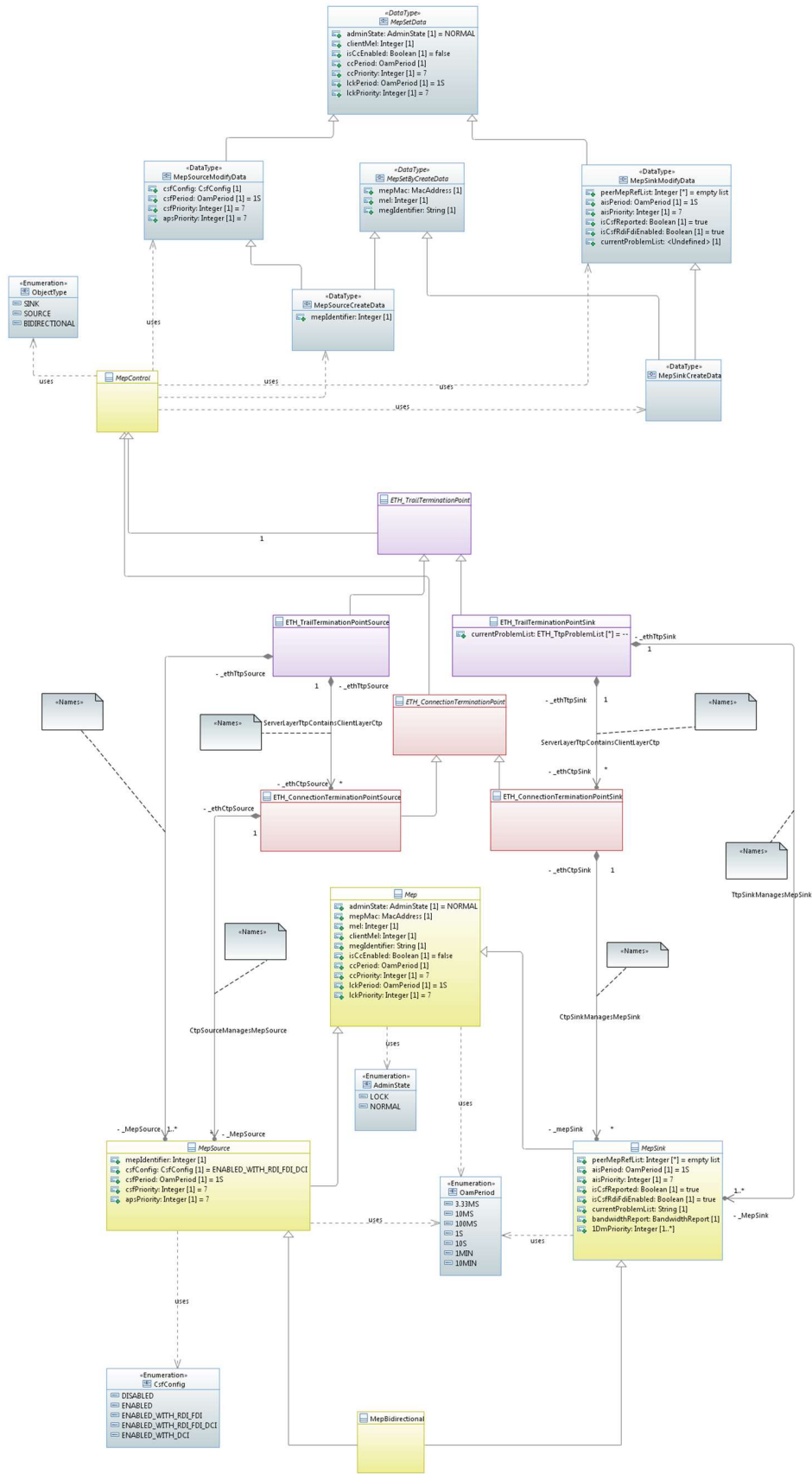
**Table A-3 – MEP configuration MI list**

Functionality	ITU-T G.8021/Y.1341 ETH(G)/ETH_A_So_MI + ETHx/ETH-m_A_So_MI	ITU-T G.8021/Y.1341 ETH(G)/ETH_A_Sk_MI + ETHx/ETH-m_A_Sk_MI
General identifiers	MEP_MAC	MEP_MAC
	MEL	MEL
	Client_MEL[1..M]	Client_MEL[1...M]
Lock	Admin_State	Admin_State
	LCK_Period[1..M]	LCK_Period[1...M]
	LCK_Pri[1..M]	LCK_Pri[1...M]
Alarm indication signal		AIS_Period[1...M]
		AIS_Pri[1...M]
Client signal fail	CSF_Enable	CSF_Reported
	CSFrdifdiEnable	CSFrdifdiEnable
	CSF_Period	cCSF
	CSF_Pri	
	CSFdciEnable	
Automatic protection switching	APS_Pri	

NOTE – APS\_Pri MI not in ETHx/ETH-m\_A since APS is only used for SNCP which is not possible at the layer boundary.

Red enhancements only in ETHG/ETH\_A and ETHx/ETH-m\_A.

ETHx/ETHG\_A has the same MI as ETHx/ETH-m\_A but without CSF. This is because ETHx/ETHG\_A is on hold for the time being.



NOTE – This figure is also available on the ITU website [here](#).

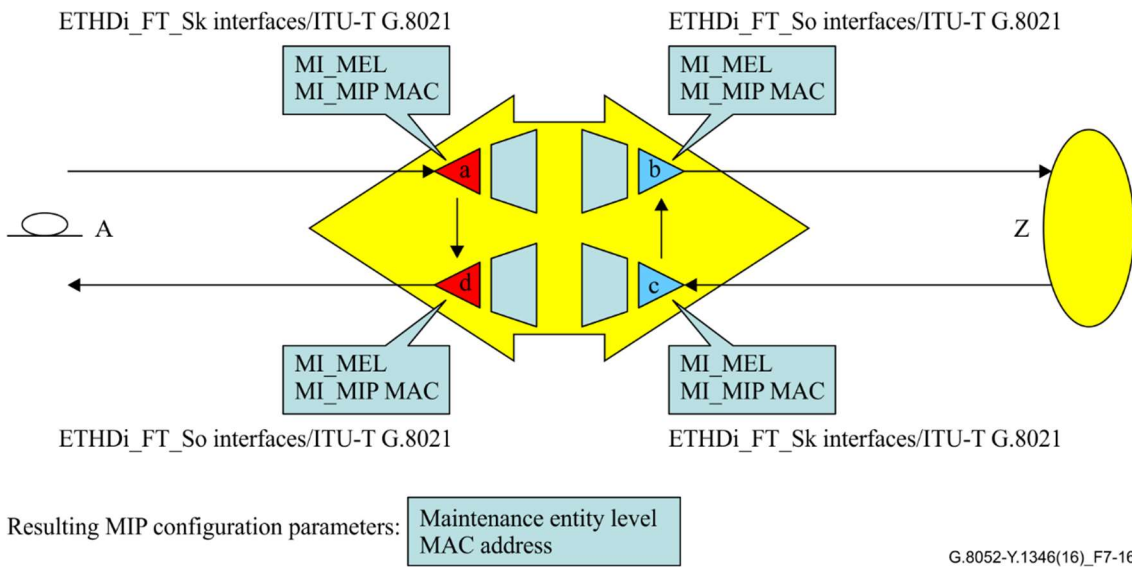
Figure A-15 – MEP configuration



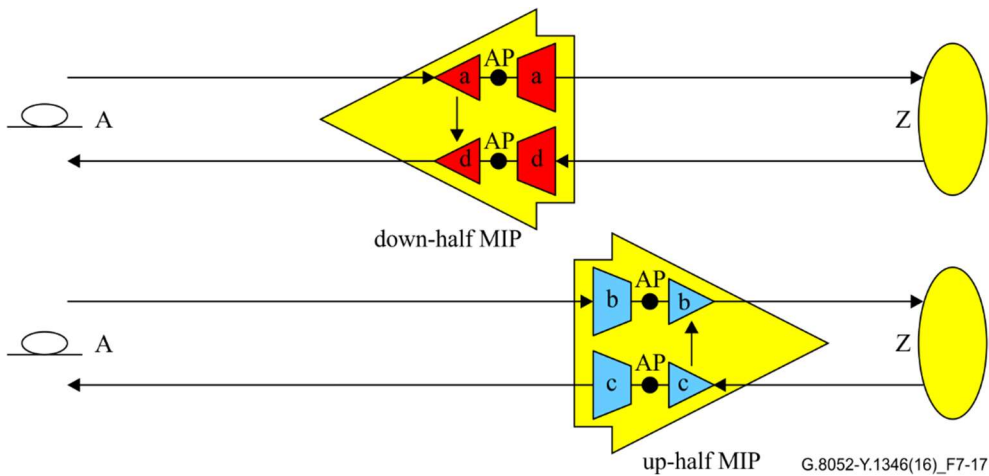
### A.1.2 MIP compound function

From management point of view a MIP has the following constraints:

- A MIP is always bidirectional; i.e., can only be used in bidirectional connections in the carrier Ethernet environment. Note that a unidirectional MIP is possible in the Enterprise environment as defined in [IEEE 802.1Q].
- A MIP belongs to one, and only one, MEL. MIPs are associated to a specific MEG and a MEG is associated to one MEL.
- A MIP is addressed by one, and only one, MAC address. The MAC address (or more precise the EUI-48) is bound to a physical subsystem and one physical subsystem can hold thousands of MIP functions, and all those MIP functions share in such case one MAC address.
- A MIP compound function can be divided in two "half MIP" functions; see Figure 7-17. This is necessary because some current implementations are not able to support full MIP functions (i.e., half MIP functions need to be modelled).



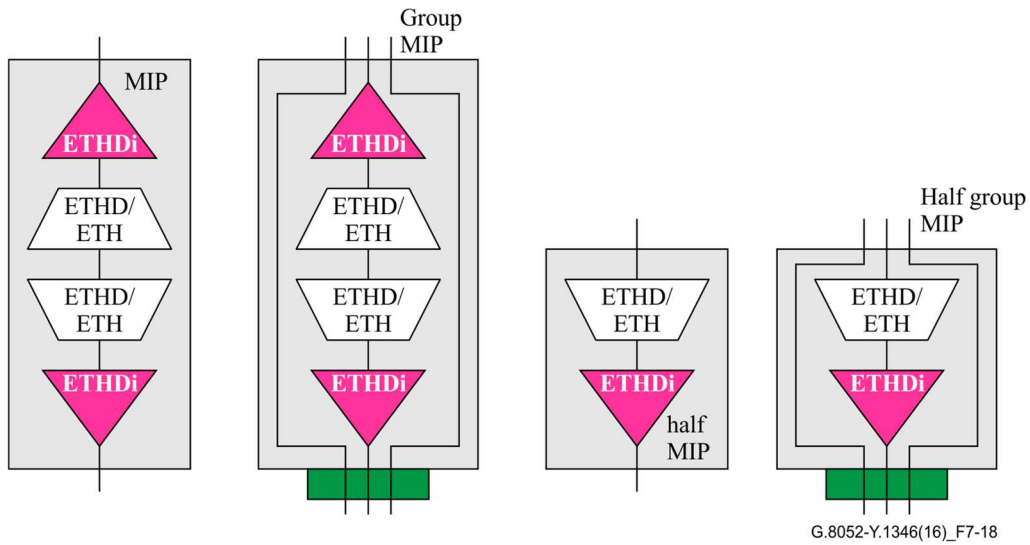
**Figure A-16 – MIP configuration parameters**



**Figure A-17 – "half MIP" compound function**

The identification of the "half MIPs" from management point of view is modelled by a Boolean attribute "isFullMip". Note that the up-half MIP is not supported in the model.

The Management Information (MI) of the MIP compound function (defined in [ITU-T G.8021]) is mapped to the MipBidirectional object class.

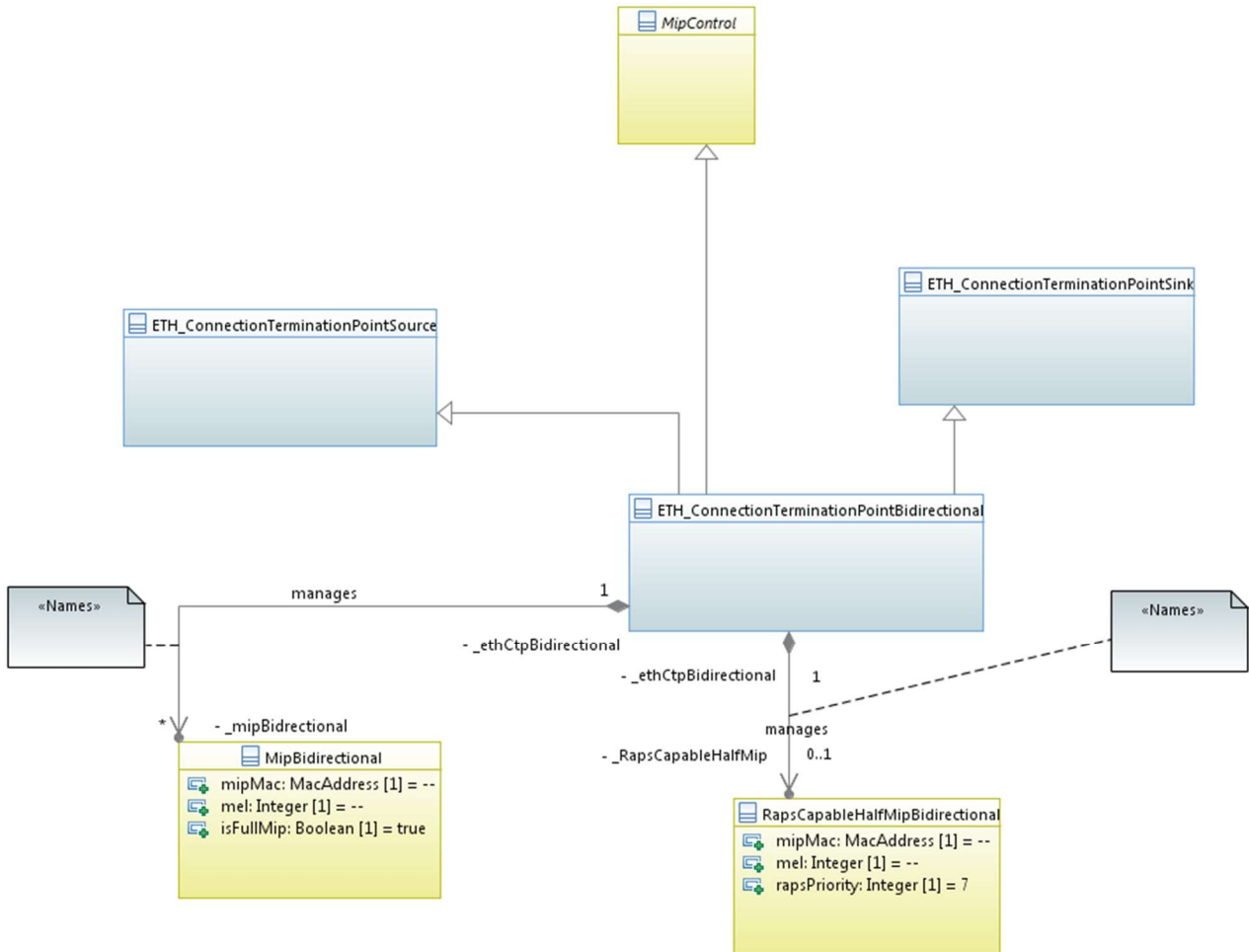


**Figure A-18 – MIP/half MIP configuration function**

[ITU-T G.8021] defines the following management information (MI) for configuring a MIP:

**Table A-4 – MIP configuration MI list**

Functionality	ETHDi_FT_So	ETHDi_FT_Sk
General identifiers	MEL	MEL
	MIP_MAC	MIP_MAC

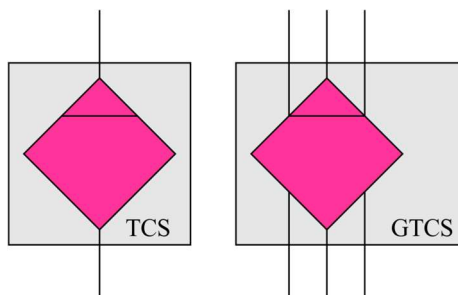


NOTE – This figure is also available on the ITU website [here](#).

**Figure A-19 – MIP class diagram**

## A.2 TCS Function

This clause maps the (G)TCS function related MIs to the corresponding object classes.



G.8052-Y.1346(16)\_F7-20

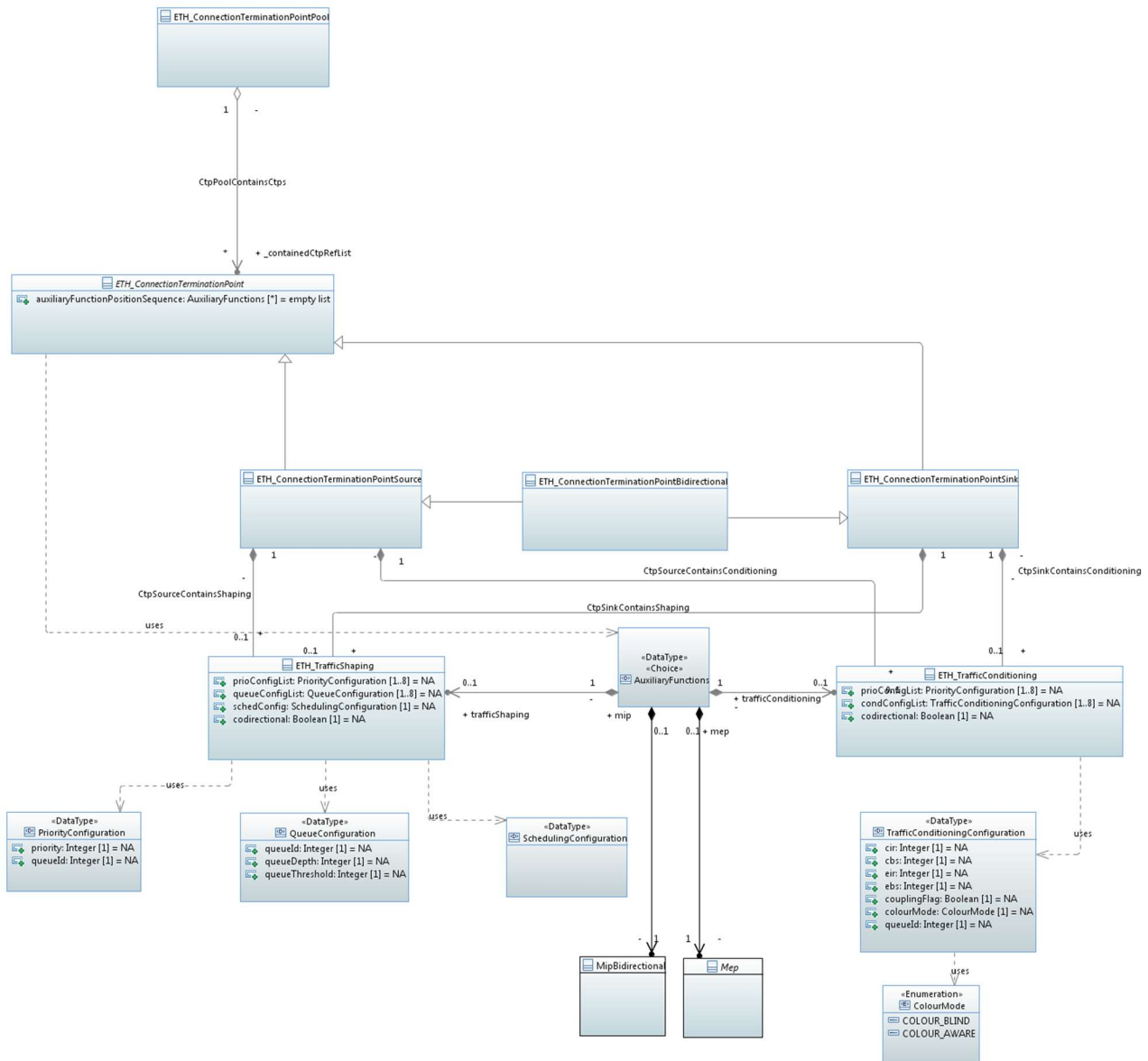
**Figure A-20 – TCS/GTCS configuration function**

**Table 7-5 – TCS configuration MI list**

Functionality	ETH_(G)TCS_So_MI	ETH_(G)TCS_Sk_MI
General identifiers	Prio_Config[1..M]	Prio_Config[1..M]*
Queing	Queue_Config[][1..M]	
Scheduling	Sched_Config	
Conditioning		Cond_Config[][1..M]*

NOTES – Red enhancements only in GTCS.

\* ETH Group Traffic, traffic conditioning process is performed per flow point but there is no correlation between each process. Therefore, an ETH\_GTCS\_Sk function can be modelled by multiple ETH\_TCS\_Sk functions and no specific function is defined in this Recommendation.



NOTE – This figure is also available on the ITU website [here](#).

**Figure A-21 – TCS containment class diagram**



LM using CMM or LMM is restricted to MEGs which have only a single ME.

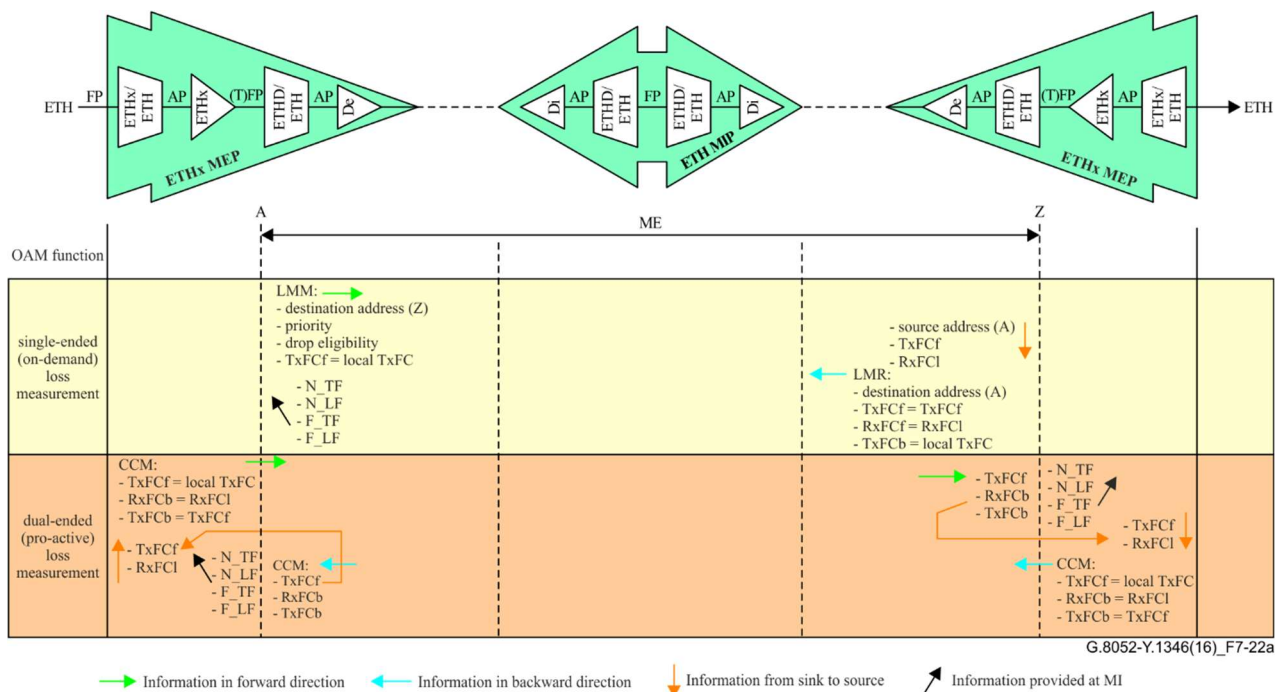
Six LM functions are defined:

- 2-way on-demand LM
- 1-way on-demand synthetic LM
- 2-way on-demand synthetic LM
- 1-way proactive LM
- 1-way proactive synthetic LM
- 2-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.

Figure 7-22A shows the information flows within the [ITU-T G.8021] atomic functions.



**Figure A-22A – Frame loss measurement mechanisms**

### A.3.2 Delay measurement

The frame delay measurement (DM) provides performance data that is based on the delay of the frames between the ingress and the egress of a maintenance entity (ME); i.e., between two maintenance group end points (MEPs).

Four DM functions are defined:

- 1-way on-demand DM
- 2-way (round-trip) on-demand DM.
- 1-way proactive DM
- 2-way (round-trip) proactive DM.

The 1-way DM function is started at the source MEP and enabled at the sink MEP.

The 2-way DM function is managed only at the source MEP. The sink MEP does not need any management.

Figure 7-22B shows the information flows within the [ITU-T G.8021] atomic functions.

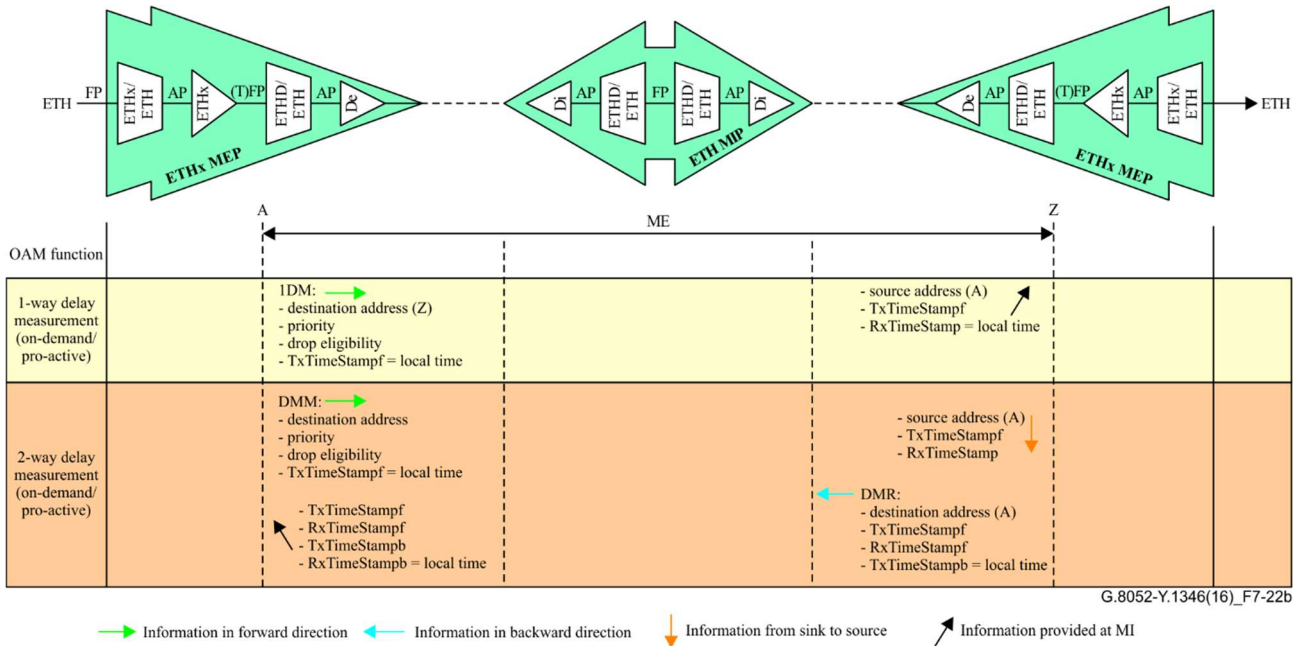
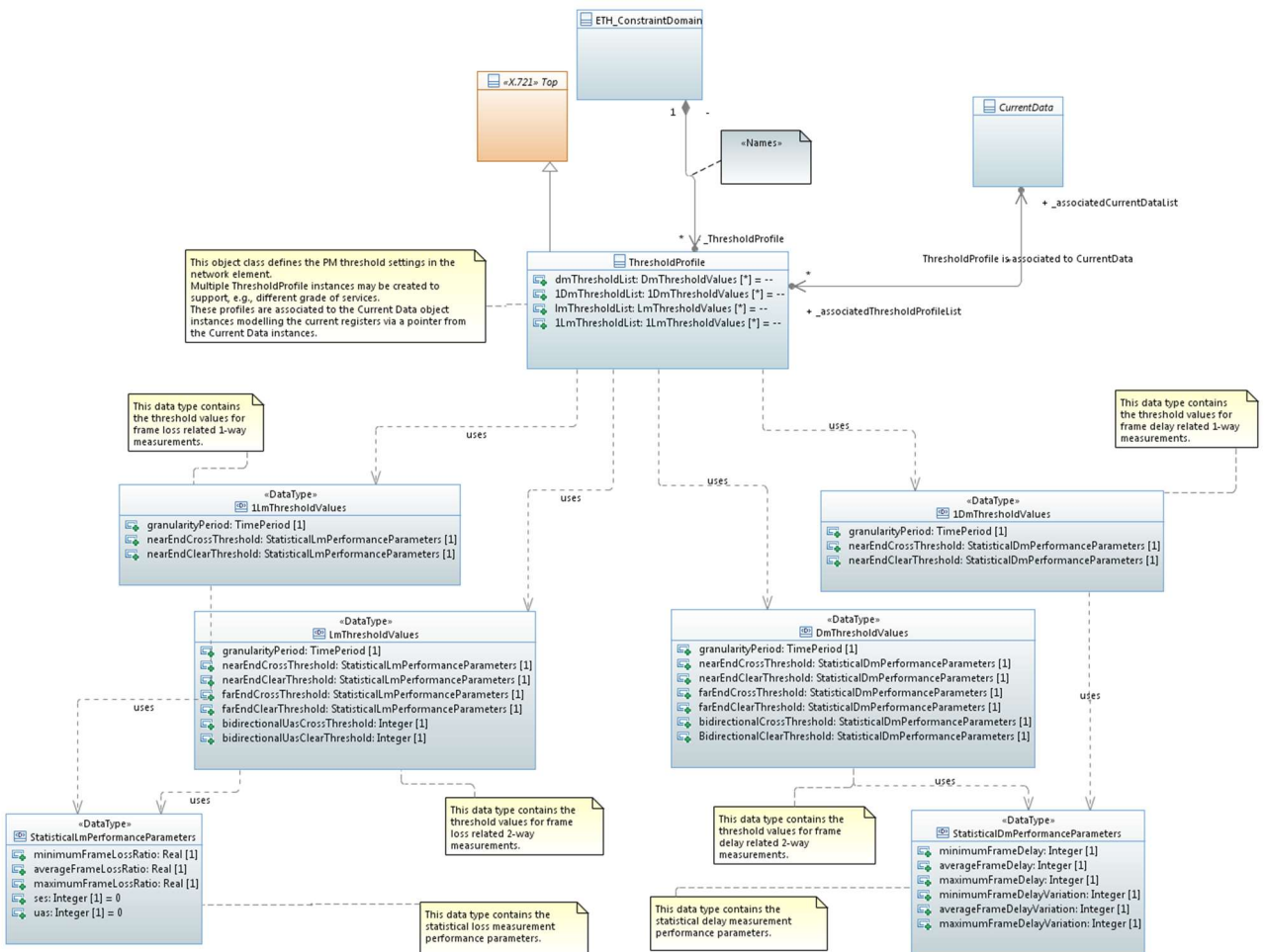


Figure A-22B – Frame delay measurement mechanisms

### A.3.3 Threshold profile control



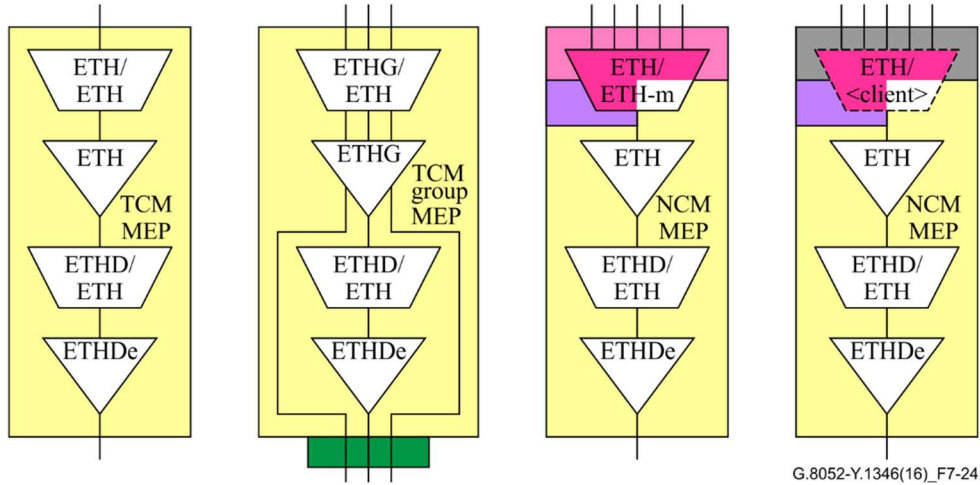
NOTE – This figure is also available on the ITU website [here](#).



**Figure A-23 – Threshold profile control mechanisms**

**A.4 Ethernet multiplexing**

This clause maps the Ethernet multiplexing related MIs to the corresponding object classes. The Ethernet multiplexing configuration function exists only in ETH TTP and ETH CTP.



**Figure A-24 – Ethernet multiplexing configuration function**

NOTE – The ETH/<client>\_A atomic function is for further study.

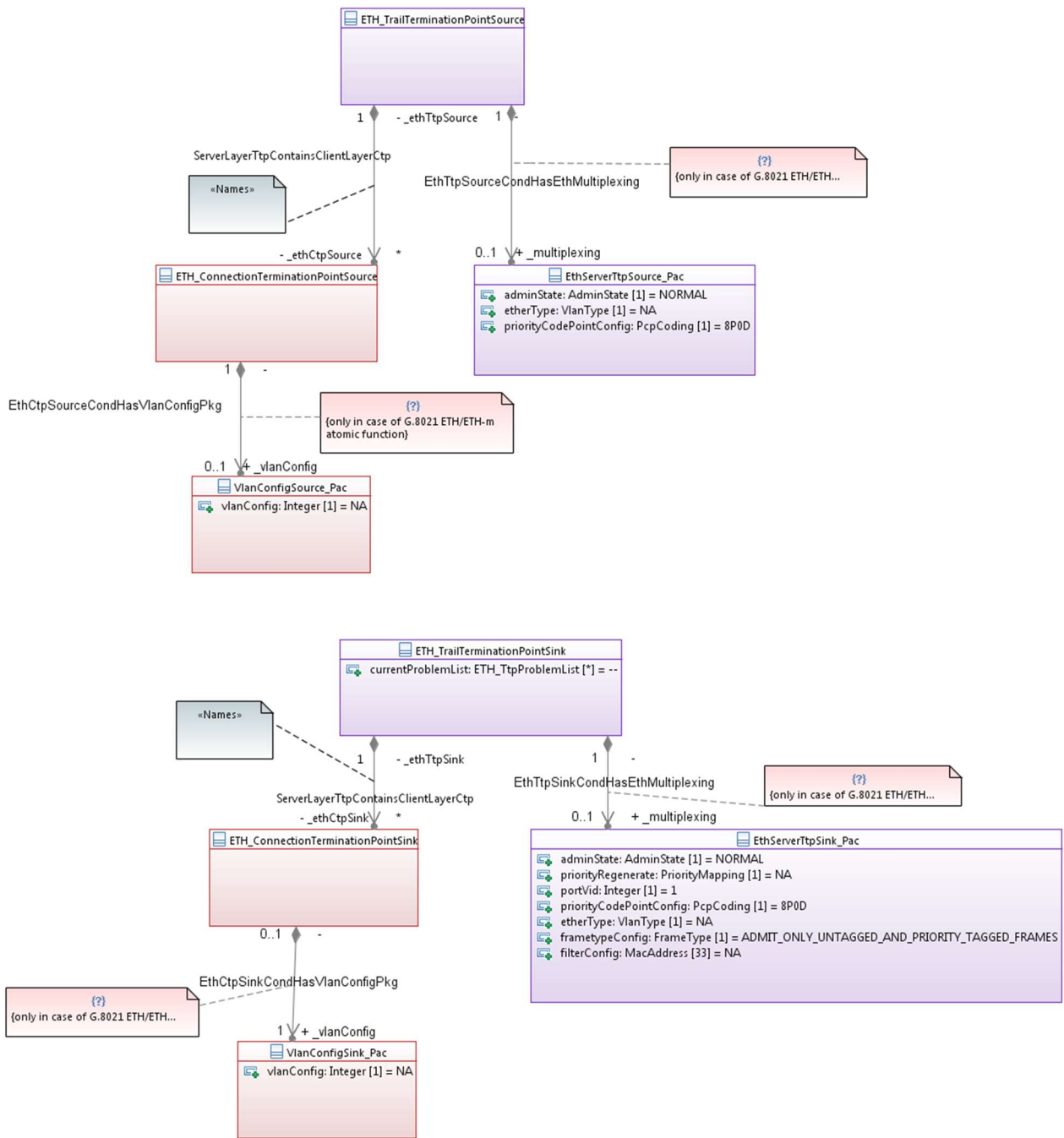
[ITU-T G.8021] defines the following management information (MI) for configuring the Ethernet multiplexing function:

**Table A-6 – Mapping of multiplexing related MI to model artefacts**

Functionality	ITU-T G.8021/Y.1341 ETHx/ETH-m_A_So_MI	ITU-T G.8021/Y.1341 ETHx/ETH- m_A_Sk_MI
TTP associated MI	Etype	Etype
	PCP_Config	PCP_Config
		P_Regenerate
		PVID
		Frametype_Config
		Filter_Config
CTP associated MI	VLAN_Config[1...M]	VLAN_Config[1...M]

NOTE – ETHx/ETHG\_A has the same MI as ETHx/ETH-m\_A. ETHx/ETHG\_A is on hold for the time being.



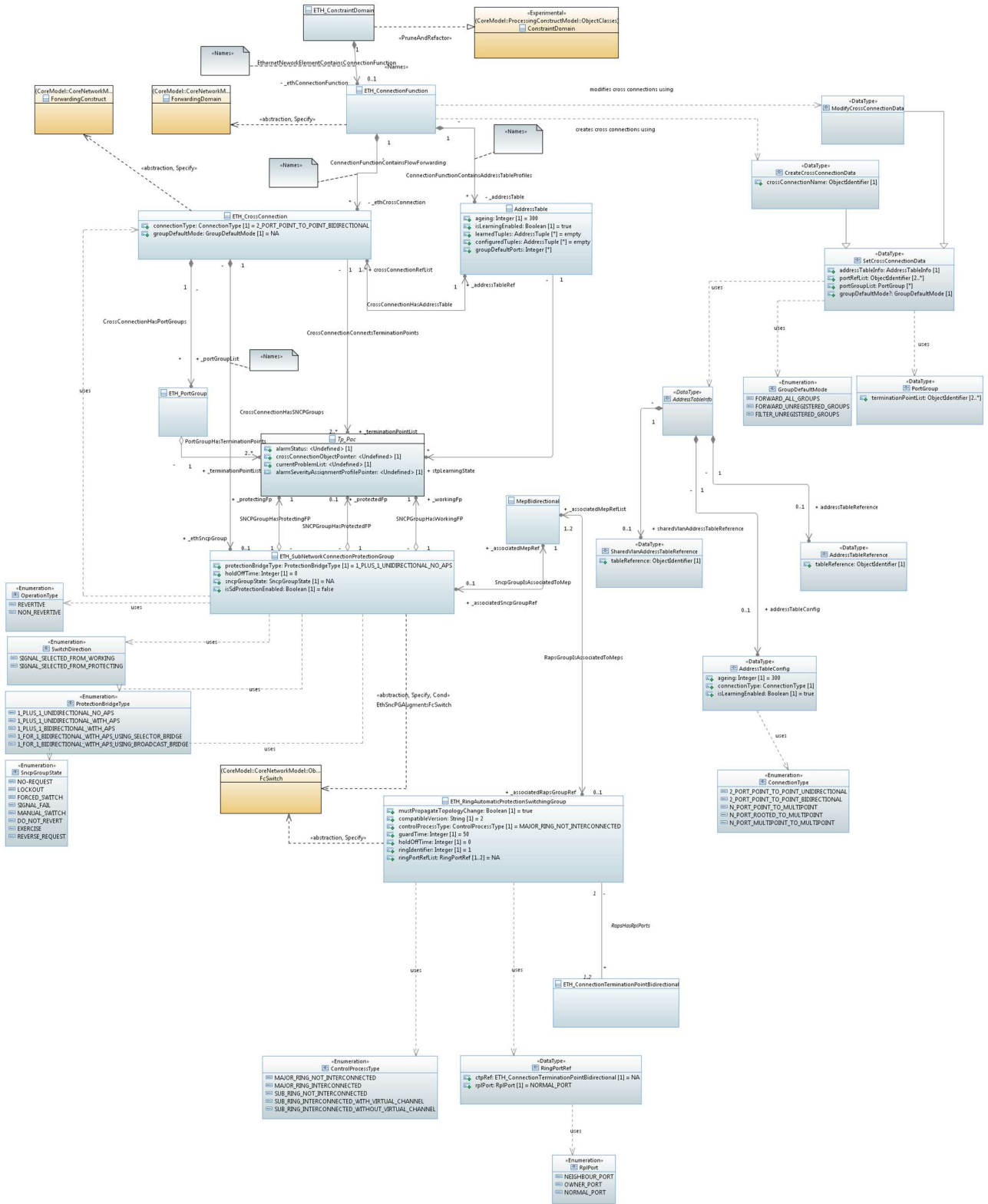


NOTE – This figure is also available on the ITU website [here](#).

**Figure A-25 – Ethernet multiplexing configuration**

### A.5 Connection function

This clause maps the connection function related MIs to the corresponding object classes.



NOTE – This figure is also available on the ITU website [here](#).

Figure A-26 – Connection fragment class diagram

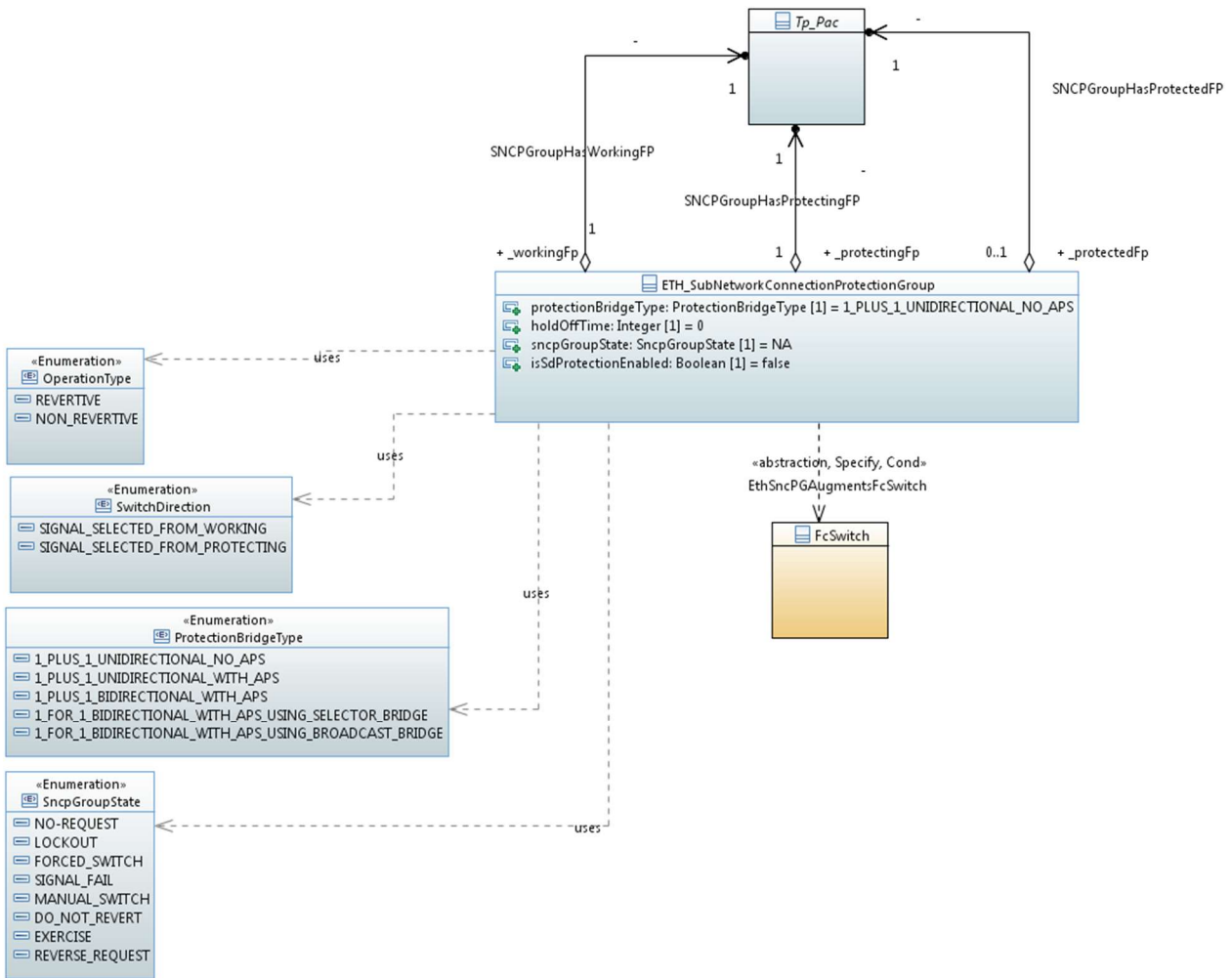
**Table A-7 – Mapping of connection function related MI to ITU-T G.8052/Y.1346 artefacts**

Functionality	ETH_C_MI	ITU-T G.8052/Y.1346
General connection management	Create_FF	
	Modify_FF	
	Delete_FF	
Individual connection management	ETH_C_MP per flow forwarding process:	
	FF_Set_PortIds	
	FF_ConnectionType	
	FF_Flush_Learned	
	FF_Flush_Config	
	FF_Group_Default	
	FF_ETH_FF	
	FF_Ageing	
	FF_Learning	
	FF_STP_Learning_State[i]	
SNCP configuration	ETH_C_MP per SNC/S protection process:	
	PS_WorkingPortId	
	PS_ProtectionPortId	
	PS_ProfType	
	PS_OperType	
	PS_HoTime	
	PS_WTR	
	PS_ExtCMD	
	PS_BridgeType	
	PS_SD_Protection	
	RAPS configuration	
RAPS_RPL_Owner_Node		
RAPS_RPL_Neighbour_Node		
RAPS_Propagate_TC[1...M]		
RAPS_Compatible_Version		
RAPS_Revertive		
RAPS_Sub_Ring_Without_Virtual_Channel		
RAPS_HoTime		
RAPS_WTR		
RAPS_GuardTime		
RAPS_ExtCMD		
RAPS_RingID		

### A.5.1 Linear protection function

The Ethernet linear protection function is defined in [ITU-T G.8031]. The related "Management Information" is listed in [ITU-T G.8021] and further clarified in [ITU-T G.8031].

This function is modelled by the ETH\_SNCP\_Group object class.



**Figure A-27 – Linear protection class diagram**

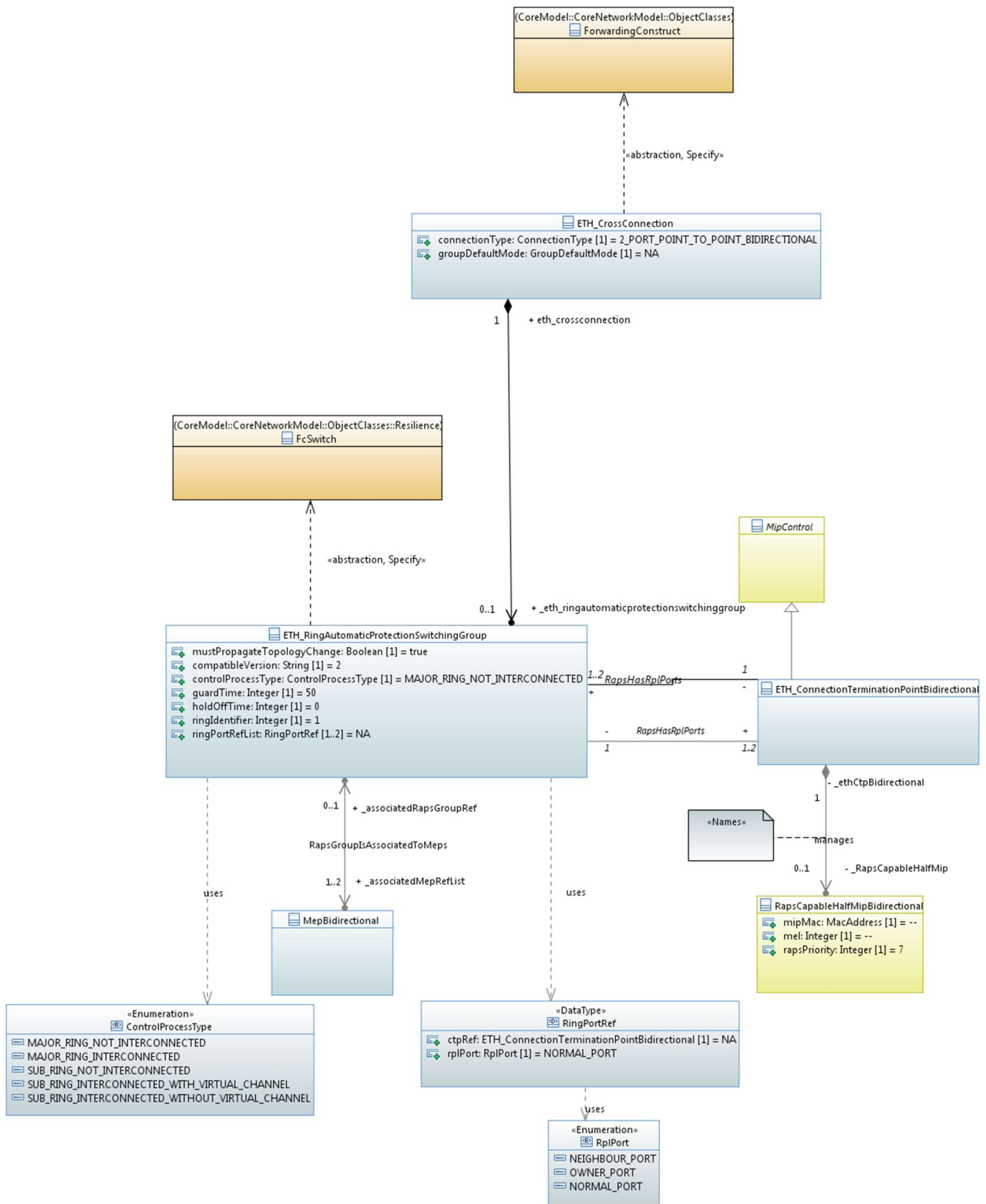
NOTE – This diagram is the lower left portion of Figure 7-26.

### A.5.2 Ring protection function

The Ethernet ring protection function is defined in [ITU-T G.8032]. The related "Management Information" is listed in [ITU-T G.8021] and further clarified in [ITU-T G.8032].

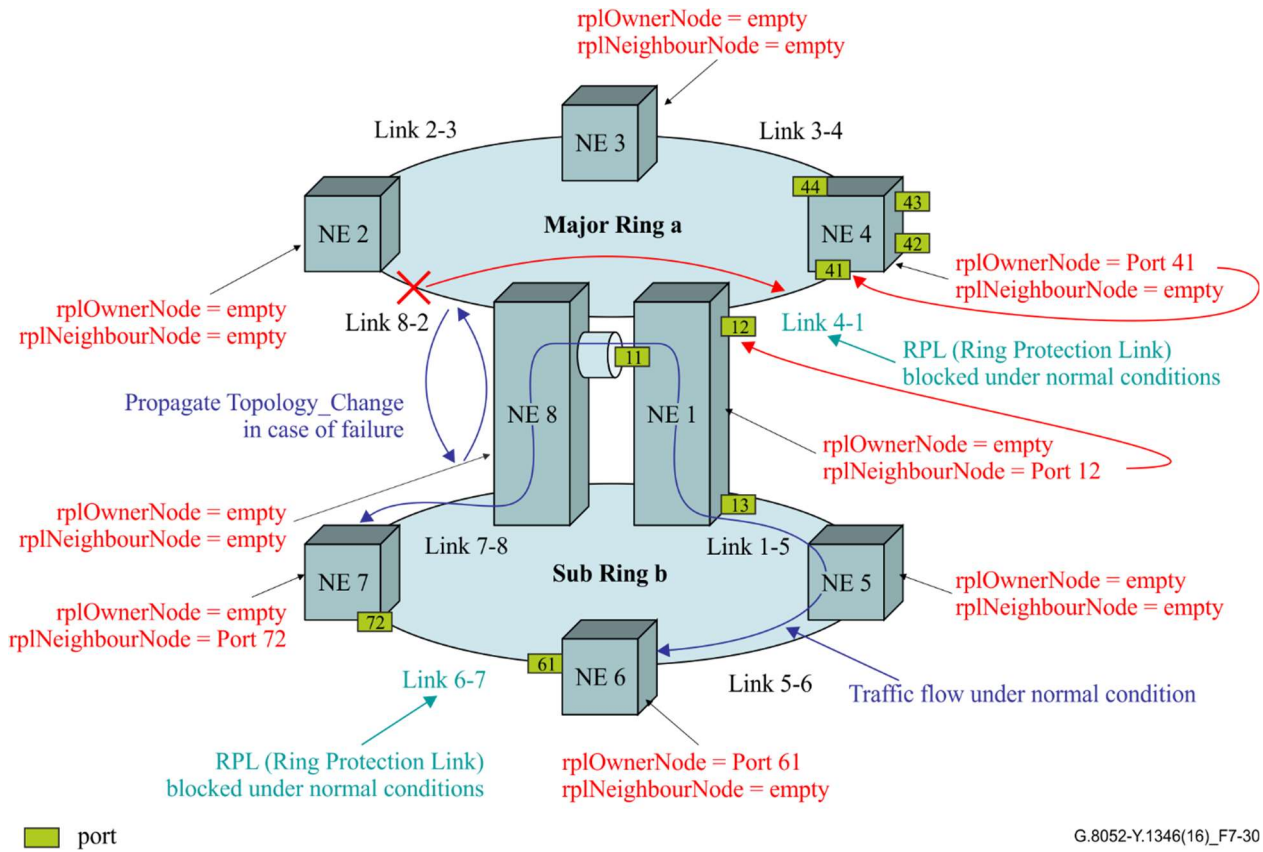
Each ring protection control process is modelled by an ETH\_RAPS\_Group object class.





NOTE – This figure is also available on the ITU website [here](#).

**Figure A-29 – Ring protection class diagram**



G.8052-Y.1346(16)\_F7-30

**Figure A-30 – Ring protection: RPL parameters**

Network elements without interconnection have one ring protection control process. Network elements with interconnection have one ring protection control process per ring interconnected. The type of control process is modelled by the controlProcessType attribute. For an example, see Figure 7-31 below.

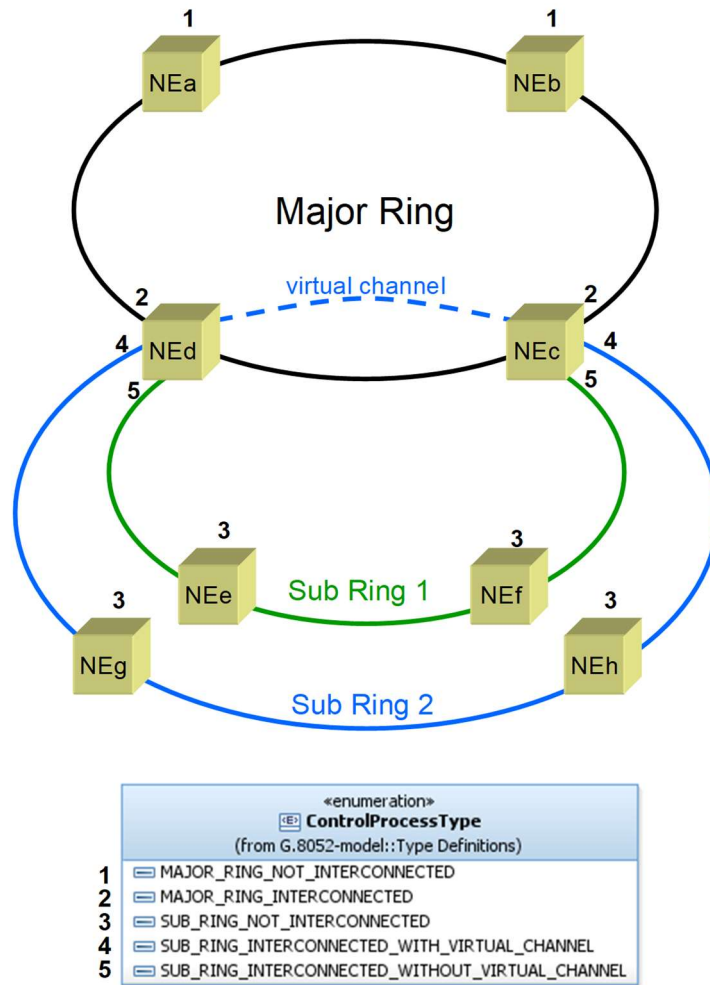
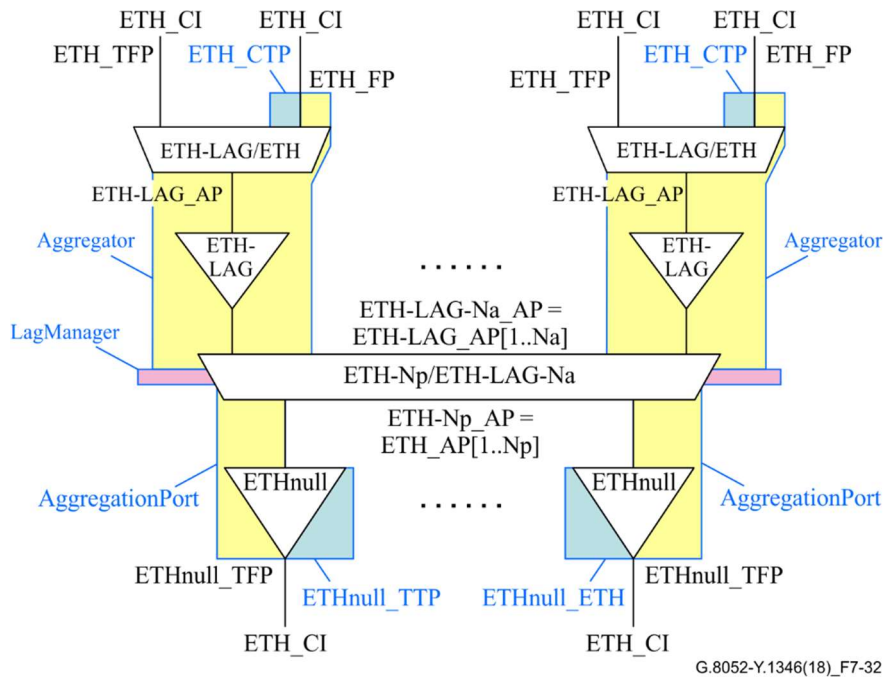


Figure A-31 – R-APS control process type

## A.6 LAG management modelling

The management of link aggregation groups (LAGs) is based on the generic model shown in Figure 7-32 and on the specifications from [IEEE 802.1AX].

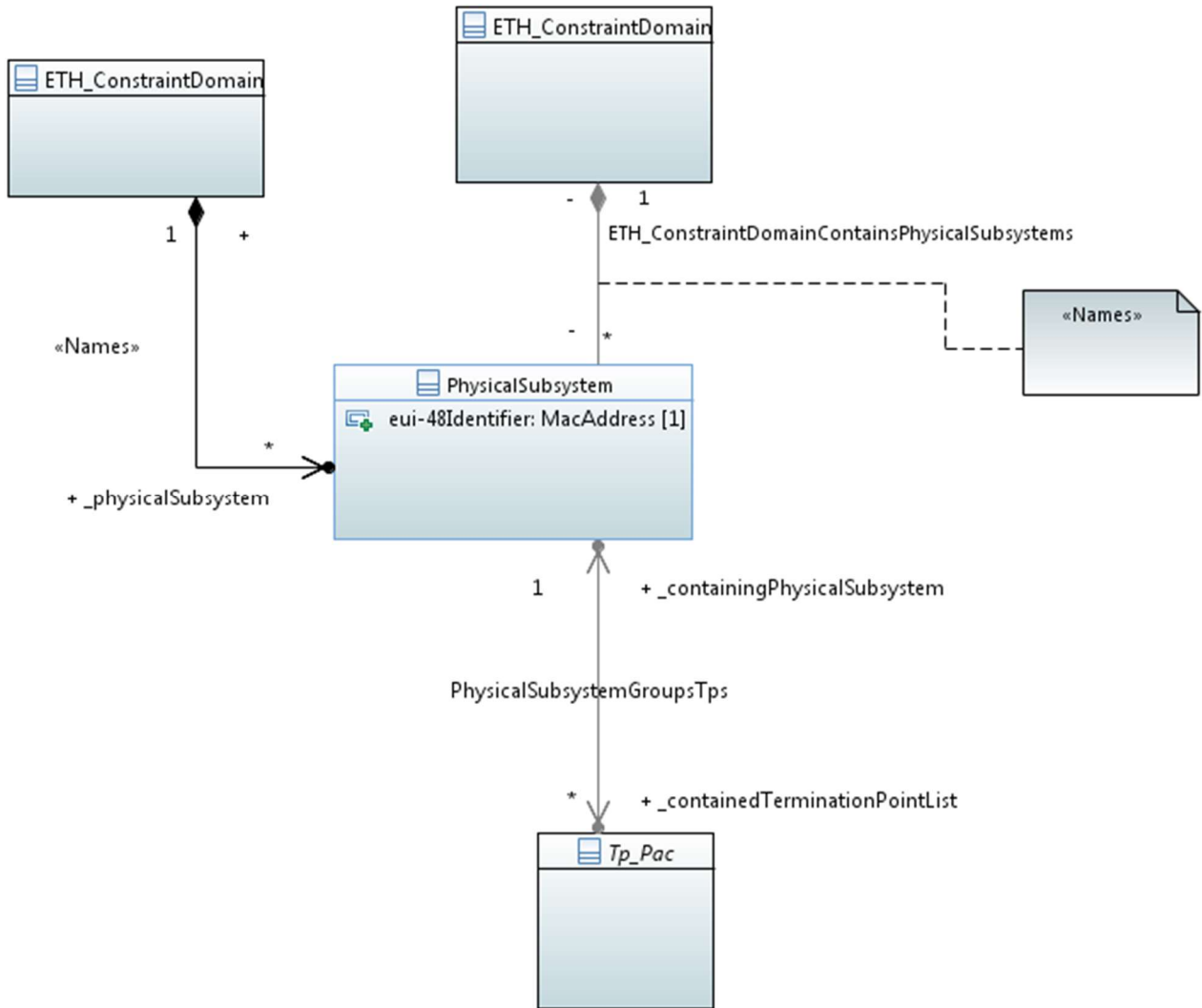




**Figure A-32 – Generic model of Ethernet link aggregation**  
 (based on Figure 9-71 of [ITU-T G.8021])

The corresponding object classes are contained in Figure A-33.





NOTE – This figure is also available on the ITU website [here](#).

**Figure A-34 – Physical subsystem modelling overview**

## **Appendix I**

### **UML modelling principles and guidelines and tooling**

(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 the 7/2013 version of this Recommendation has been enhanced and normatively specified in Annex A of [ITU-T G.7711].

## Appendix II

### Grouping and Mapping of [ITU-T G.8021] MI signals to model artefacts

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

This Appendix lists (from [ITU-T G.8021]) all atomic functions together with their MI. It is structured according to the clauses in [ITU-T G.8021]:

- II.1 Ethernet MAC layer (ETH) and mapping.
- II.2 Ethernet PHY Layer (ETYn) and mapping.  
NOTE – ETYn has been moved from [ITU-T G.8021] to [ITU-T G.8023] as ETSi(G)
- II.3 Non-Ethernet server to ETH adaptation and mapping.

Conventions used in the tables:

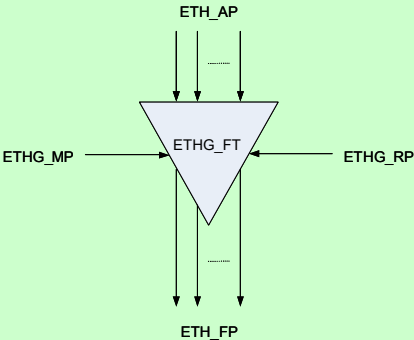
- Atomic functions having the same list of MIs are grouped.
- Fault and performance MIs are not shown.
- Complementary atomic functions are shown with a **green background**.
- MI of adaptation functions are identified as "client layer related" (**blue**) or "server layer related" (**red**).

#### II.1 Ethernet MAC layer (ETH) and mapping

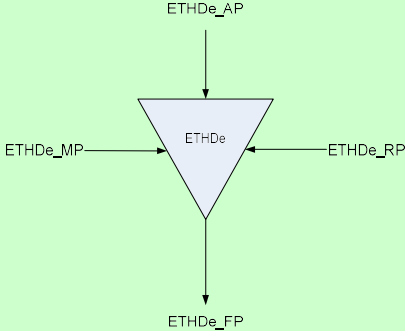
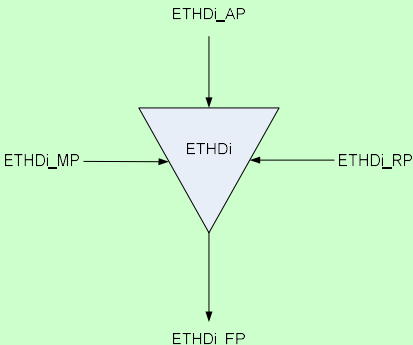

**Table 6-1 – MI groupings of the Ethernet MAC layer (ETH) functions**

Symbol	Management information	ITU-T G.8052/Y.1346 artefact
Ethernet MAC layer (ETH) termination source functions		
	MI_MEL MI_MEP_MAC MI_CC_Enable MI_LM_Enable MI_MEG_ID MI_MEP_ID MI_CC_Period MI_CC_Pri MI_DM_Enable MI_DM_MAC_DA MI_DM_Length MI_DM_Period MI_DM_Pri MI_1DM_Enable[1...M <sub>1DM</sub> ] MI_1DM_MAC_DA[1...M <sub>1DM</sub> ] MI_1DM_Test_ID[1...M <sub>1DM</sub> ] MI_1DM_Length[1...M <sub>1DM</sub> ] MI_1DM_Period[1...M <sub>1DM</sub> ] MI_1DM_Pri[1...M <sub>1DM</sub> ] MI_SL_Enable[1...M <sub>SL</sub> ] MI_SL_MAC_DA[1...M <sub>SL</sub> ] MI_SL_Test_ID[1...M <sub>SL</sub> ] MI_SL_Length[1...M <sub>SL</sub> ]	EthTtp  Mep  ProActiveDualEnd edMeaJobControl Source  ProActiveSingleE ndedMeaJobContr olSource

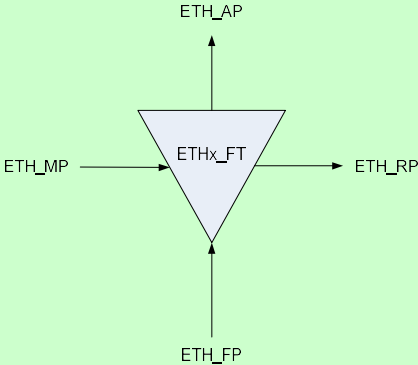
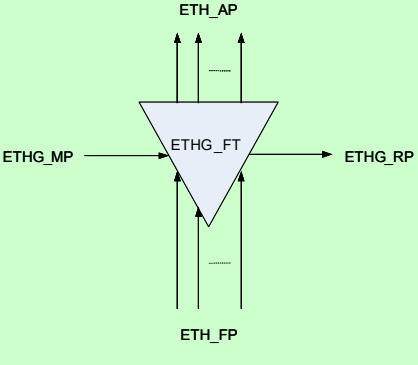
**Table 6-1 – MI groupings of the Ethernet MAC layer (ETH) functions**

Symbol	Management information	ITU-T G.8052/Y.1346 artefact
	MI_SL_Period[1...M <sub>SL</sub> ] MI_SL_Pri[1...M <sub>SL</sub> ] MI_1SL_Enable[1...M <sub>1SL</sub> ] MI_1SL_MAC_DA[1...M <sub>1SL</sub> ] MI_1SL_Test_ID[1...M <sub>1SL</sub> ] MI_1SL_Length[1...M <sub>1SL</sub> ] MI_1SL_Period[1...M <sub>1SL</sub> ] MI_1SL_Pri[1...M <sub>1SL</sub> ]	
	MI_MEL MI_MEP_MAC MI_CC_Enable MI_LM_Enable MI_MEG_ID MI_MEP_ID MI_CC_Period MI_CC_Pri MI_LML_Enable[1...M <sub>LM</sub> ] MI_LM_MAC_DA[1...M <sub>LM</sub> ] MI_LM_Period[1...M <sub>LM</sub> ] MI_LM_Pri [1...M <sub>LM</sub> ] MI_DM_Enable [1...M <sub>DM</sub> ] MI_DM_MAC_DA [1...M <sub>DM</sub> ] MI_DM_Test_ID [1...M <sub>DM</sub> ] MI_DM_Length [1...M <sub>DM</sub> ] MI_DM_Period [1...M <sub>DM</sub> ] MI_DM_Pri [1...M <sub>DM</sub> ] MI_1DM_Enable [1...M <sub>1DM</sub> ] MI_1DM_MAC_DA [1...M <sub>1DM</sub> ] MI_1DM_Test_ID [1...M <sub>1DM</sub> ] MI_1DM_Length [1...M <sub>1DM</sub> ] MI_1DM_Period [1...M <sub>1DM</sub> ] MI_1DM_Pri [1...M <sub>1DM</sub> ] MI_SL_Enable [1...M <sub>SL</sub> ] MI_SL_MAC_DA [1...M <sub>SL</sub> ] MI_SL_Test_ID [1...M <sub>SL</sub> ] MI_SL_Length [1...M <sub>SL</sub> ] MI_SL_Period [1...M <sub>SL</sub> ] MI_SL_Pri [1...M <sub>SL</sub> ] MI_1SL_Enable [1...M <sub>1SL</sub> ] MI_1SL_MAC_DA [1...M <sub>1SL</sub> ] MI_1SL_Test_ID [1...M <sub>1SL</sub> ] MI_1SL_Length [1...M <sub>1SL</sub> ] MI_1SL_Period [1...M <sub>1SL</sub> ]	Mep  ProActiveDualEnd edMeaJobControl Source  ProActiveSingleE ndedMeaJobContr olSource

**Table 6-1 – MI groupings of the Ethernet MAC layer (ETH) functions**

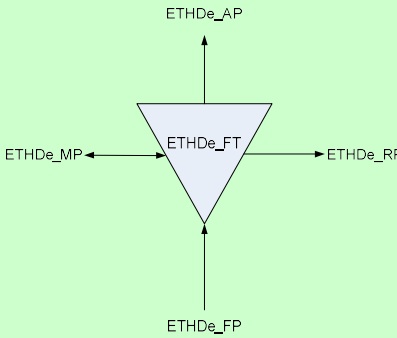
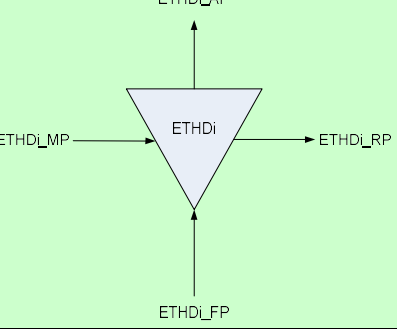
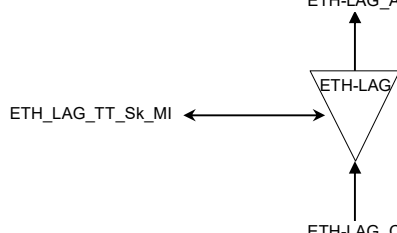
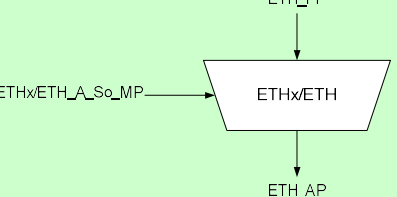
Symbol	Management information	ITU-T G.8052/Y.1346 artefact
	<p>MI_1SL_Pri [1...M<sub>1SL</sub>]</p> <p>MI_LM_Start(DA,P,Period)  MI_LM_Terminate  MI_LB_Discover(P)  MI_LB_Series(DA,DE,P,N, Length, Period)  MI_LB_Test(DA,DE,P,Pattern, Length, Period)  MI_LB_Test_Terminate  MI_DM_Start(DA,P, Length,Period)  MI_DM_Terminate  MI_IDM_Start(DA,P, Length,Period)  MI_IDM_Terminate  MI_TST(DA,DE,P,Pattern, Length, Period)  MI_TST_Terminate  MI_LT(TA,TTL,P)  MI_MEP_MAC  MI_MEL  MI_MEP_ID  MI_LM_Pri  MI_SL_Start(DA,P,Length,Period,Type)  ETHDe_FT_So_MI_SL_Terminate  ETH_De_FT_So_MI_SL_Enable  ETHDe_FT_So_MI_SL_Intermediate_Request  ETHDe_FT_So_MI_SL_Terminate  ETHDe_FT_So_MI_1SL_Start(DA, P,Test_ID,Length, Period)  ETHDe_FT_So_MI_1SL_Terminate</p>	<p>Mep</p> <p>OnDemandDualEndedMeaJobControlSource</p> <p>OnDemandSingleEndedMeaJobControlSource</p>
	<p>MI_MEL  MI_MIP_MAC</p>	<p>Mip</p>
	<p>no MI</p>	<p>Aggregator</p>

**Table 6-1 – MI groupings of the Ethernet MAC layer (ETH) functions**

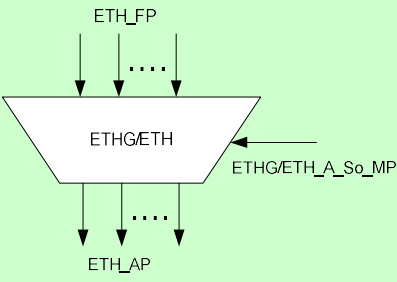
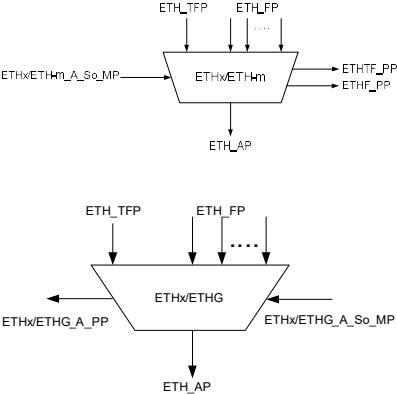
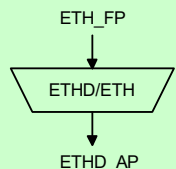
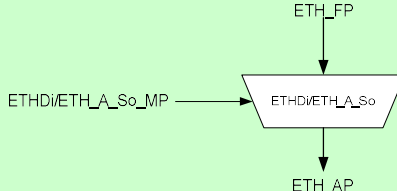
Symbol	Management information	ITU-T G.8052/Y.1346 artefact
<b>Ethernet MAC layer (ETH) termination sink functions</b>		
	<p>MI_CC_Enable MI_LM_Enable MI_1Second MI_LM_DEGM MI_LM_M MI_LM_DEGTHR MI_LM_TFMIN MI_MEL MI_MEG_ID MI_PeerMEP_ID[i] MI_CC_Period MI_CC_Pri MI_GetSvdCCM MI_IDM_Enable MI_IDM_MAC_SA ETHx_FT_Sk_MI_1SL_Test_ID[1...M<sub>1SL</sub>] ETHx_FT_Sk_MI_BW_Report(SA, PortID, NominalBW, CurrentBW)</p>	<p>EthTtp  Mep  ProActiveDualEndedMeaJobControlSink  ProActiveSingleEndedMeaJobControlSink</p>
	<p>MI_CC_Enable MI_LM_Enable MI_1Second MI_LM_DEGM MI_LM_M MI_LM_DEGTHR MI_LM_TFMIN MI_MEL MI_MEG_ID MI_PeerMEP_ID[i] MI_CC_Period MI_CC_Pri MI_GetSvdCCM MI_IDM_Enable [1...M<sub>IDM</sub>] MI_IDM_MAC_SA [1...M<sub>IDM</sub>] MI_IDM_Test_ID [1...M<sub>IDM</sub>] MI_1SL_Enable [1...M<sub>1SL</sub>] MI_1SL_MAC_SA [1...M<sub>1SL</sub>] MI_1SL_Test_ID [1...M<sub>1SL</sub>] MI_BW_Report(SA, PortID, NominalBW, CurrentBW)</p>	<p>Mep  ProActiveDualEndedMeaJobControlSink  ProActiveSingleEndedMeaJobControlSink</p>



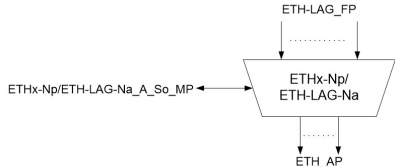
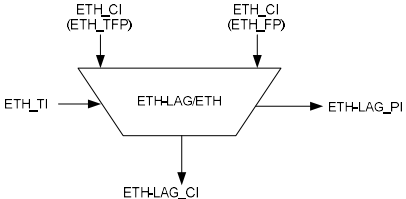
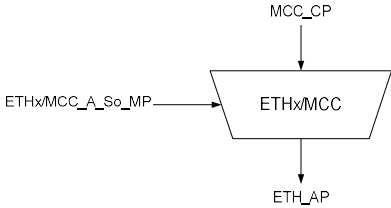
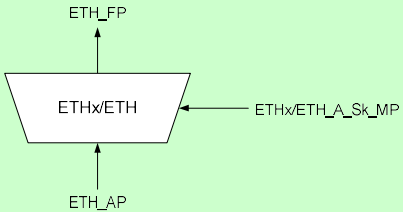
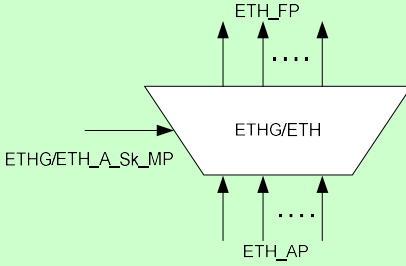
**Table 6-1 – MI groupings of the Ethernet MAC layer (ETH) functions**

Symbol	Management information	ITU-T G.8052/Y.1346 artefact
	<p>MI_Active MI_LM_Pri MI_MEL MI_MEP_MAC MI_1DM_Start(SA, Test_ID) MI_1DM_Intermediate_Request MI_1DM_Terminate MI_TST_Start(SA,Pattern) MI_TST_Terminate MI_1SL_Start(SA,MEP_ID, Test_ID) MI_1SL_Intermediate_Request MI_1SL_Terminate MI_1DM_Result(count, N_FD[]) MI_TST_Result(REC,CRC,BER,OO) MI_1SL_Result(N_TF,N_LF)</p>	<p>Mep  OnDemandDualEndedMeaJobControlSink  OnDemandSingleEndedMeaJobControlSink</p>
	<p>MI_MEL MI_MIP_MAC</p>	<p>Mip</p>
	<p>MI_SSF_Reported</p>	<p>Aggregator</p>
Ethernet MAC layer (ETH) adaptation source functions		
	<p>MI_Active MI_MEP_MAC MI_Client_MEL[1..M] MI_LCK_Period[1...M] MI_LCK_Pri[1...M] MI_Admin_State MI_MEL MI_APS_Pri MI_CSF_Period MI_CSF_Pri</p>	<p>Mep</p>

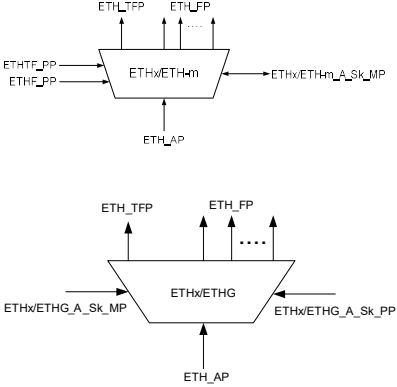
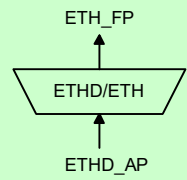
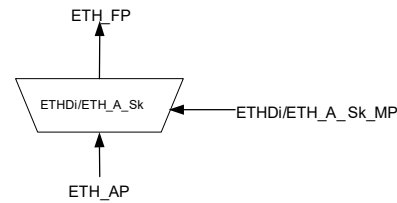
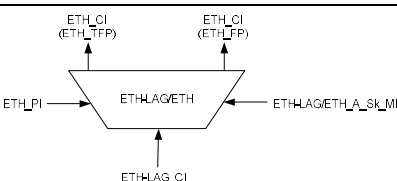
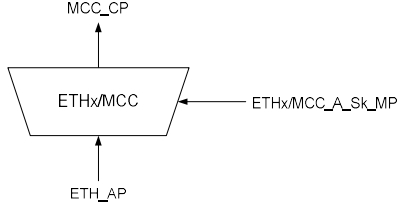
**Table 6-1 – MI groupings of the Ethernet MAC layer (ETH) functions**

Symbol	Management information	ITU-T G.8052/Y.1346 artefact
	<p>MI_CSF_Enable MI_CSFrdifdiEnable MI_CSFdciEnable</p>	
	<p>MI_Active MI_MEP_MAC MI_Client_MEL[1..M] MI_LCK_Period[1..M] MI_LCK_Pri[1..M] MI_Admin_State MI_MEL MI_APS_Pri MI_CSF_Period MI_CSF_Pri MI_CSF_Enable MI_CSFrdifdiEnable MI_CSFdciEnable</p>	Mep
 <p>ETHx/ETHG has exactly the same MI as ETHx/ETH-m.</p>	<p>MI_Active MI_MEP_MAC MI_Client_MEL[1..M] MI_LCK_Period[1..M] MI_LCK_Pri[1..M] MI_Admin_State MI_Vlan_Config[1..M] MI_Etype MI_PCP_Config MI_MEL MI_CSF_Period MI_CSF_Pri MI_CSF_Enable MI_CSFrdifdiEnable MI_CSFdciEnable</p>	EthCtp EthTtp Mep
	no MI	Mep
	<p>MI_Active MI_MEL MI_RAPS_Pri MI_MIP_MAC</p>	Mip
		LagManager

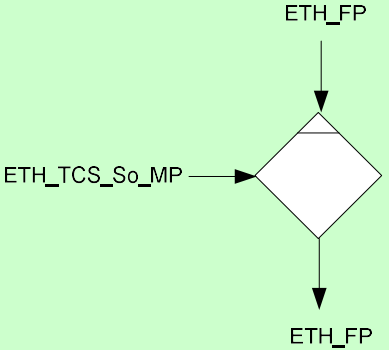
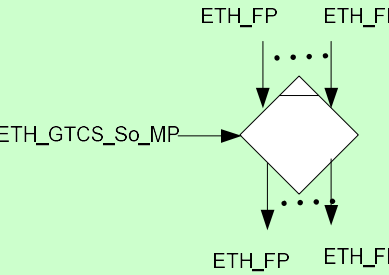
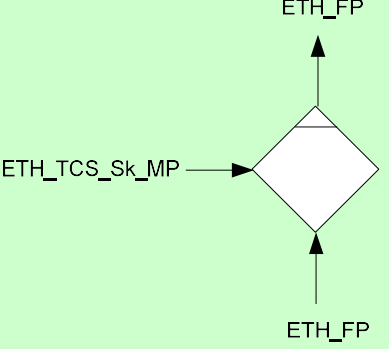
**Table 6-1 – MI groupings of the Ethernet MAC layer (ETH) functions**

Symbol	Management information	ITU-T G.8052/Y.1346 artefact
		Aggregator  AggregationPort
	MI_Active	EthCtp  Aggregator
	MI_Active MI_MEL MI_MEP_MAC MI_MCC_Pri MI_MEP_ID MI_EDM_Enable MI_EDM_Period MI_EDM_Duration	
Ethernet MAC layer (ETH) adaptation sink functions		
	MI_Active MI_MEP_MAC MI_Client_MEL MI_LCK_Period MI_LCK_Pri MI_Admin_State MI_AIS_Period MI_AIS_Pri MI_MEL MI_CSF_Reported MI_CSFrdifdiEnable	
	MI_Active MI_MEP_MAC MI_Client_MEL[1..M] MI_LCK_Period[1..M] MI_LCK_Pri[1..M] MI_Admin_State MI_AIS_Period[1..M] MI_AIS_Pri[1..M] MI_MEL	

**Table 6-1 – MI groupings of the Ethernet MAC layer (ETH) functions**

Symbol	Management information	ITU-T G.8052/Y.1346 artefact
 <p>ETHx/ETHG exactly the same as ETHx/ETH-m.</p>	<p>MI_Active MI_Admin_State MI_MEP_MAC MI_Client_MEL[1...M] MI_LCK_Period[1...M] MI_LCK_Pri[1...M] MI_AIS_Period[1...M] MI_AIS_Pri[1...M] MI_VLAN_Config[1...M] MI_P_Regenerate MI_PVID MI_PCP_Config MI_Etype MI_MEL MI_FrameType_Config MI_Filter_Config</p>	
	no MI	
	<p>MI_Active MI_RAPS_MEL</p>	
	<p>MI_Active MI_FilterConfig</p>	
	<p>MI_Active MI_MEP_MAC MI_MEL MI_EDM_received (MEP_ID, Duration)</p>	

**Table 6-1 – MI groupings of the Ethernet MAC layer (ETH) functions**

Symbol	Management information	ITU-T G.8052/Y.1346 artefact
<b>Ethernet MAC layer (ETH) traffic conditioning source functions</b>		
	MI_Prio_Config MI_Queue_Config[] MI_Sched_Config	
	MI_Prio_Config[] MI_Queue_Config[][] MI_Sched_Config	
<b>Ethernet MAC layer (ETH) traffic conditioning sink functions</b>		
	MI_Prio_Config MI_Cond_Config[]	
ETH Group Traffic Conditioning Function (ETH_GTCS_Sk) ETH_GTCS_Sk function can be modelled by multiple ETH_TCS_Sk functions		

Based on the groupings above the following packages have been identified.

**Table 6-2 – Derived MI groupings of the Ethernet MAC layer (ETH) functions**

MI groupings	Package name
<b>TTP MI source grouping</b>	
MI_Active MI_MEP_MAC MI_Admin_State MI_MEL	EthServerTtpSourcePackage
MI_Etype MI_PCP_Config	EthServerTtpEtypeSourcePackage
MI_APS_Pri	EthServerTtpApsSourcePackage
<b>TTP MI sink grouping</b>	
MI_Active MI_MEL MI_Admin_State MI_MEP_MAC	EthServerTtpSinkPackage
MI_P_Regenerate MI_PVID MI_PCP_Config MI_Etype MI_Frametype_Config MI_Filter_Config	EthServerTtpEtypeSinkPackage
<b>CTP MI source grouping</b>	
MI_Client_MEL[1..M] MI_LCK_Period[1..M] MI_LCK_Pri[1..M]	EthServerSourcePackage
MI_Vlan_Config[1..M]	EthServerVlanConfigSourcePackage
<b>CTP MI sink grouping</b>	
MI_Client_MEL[1..M] MI_LCK_Period[1..M] MI_LCK_Pri[1..M] MI_AIS_Period[1..M] MI_AIS_Pri[1..M] MI_VLAN_Config[1..M]	EthServerSinkPackage

**II.2 Non-Ethernet server to ETH adaptation and mapping**

**Table 6-3 – MI groupings of the non-Ethernet server to ETH adaptation functions**

Symbol	Management information	Managed object class
<b>Non-Ethernet server to ETH adaptation source functions</b>		
	<p>MI_Active MI_CSFEnable MI_CSFRdifiEnable</p>	

**Table 6-3 – MI groupings of the non-Ethernet server to ETH adaptation functions**

Symbol	Management information	Managed object class

**Table 6-3 – MI groupings of the non-Ethernet server to ETH adaptation functions**

Symbol	Management information	Managed object class
	<p>MI_Active MI_CSFEnable</p>	<p>?</p>
<p><b>Non-Ethernet server to ETH adaptation sink functions</b></p>		
	<p>MI_Active MI_FilterConfig MI_CSF_Reported MI_MAC_Length MI_CSFRdifdiEnable MI_AcSL MI_AcEXI MI_AcUPI ODUkP/ETH_A_Sk: MI_AcPT MI_AcEXI MI_AcUPI ODUkP-X-L/ETH_A_Sk: MI_AcVcPT MI_AcEXI MI_AcUPI</p>	



**Table 6-3 – MI groupings of the non-Ethernet server to ETH adaptation functions**

Symbol	Management information	Managed object class
	<p>MI_Active MI_CSF_Reported Sn-X/ETC3_A_Sk: MI_AcSL MI_AcEXI MI_AcPFI MI_AcUPI ODU2P/ETHPP-OS_A_Sk: MI_AcPT MI_AcEXI MI_AcUPI</p>	?

Based on the groupings above the following packages have been identified.

**Table 6-4 – Derived MI groupings of the non-Ethernet server adaptation functions**

MI groupings	Package name
MI source grouping	
MI_CSFrdifdiEnable	CsfRdiFdiEnableSource_Package
MI_CSFEnable	CsfEnableSource_Package
MI sink grouping	
MI_FilterConfig MI_MAC_Length MI_CSFrdifdiEnable	CsfRdiFdiEnableSink_Package
MI_CSF_Reported	CsfReportedSink_Package

### II.3 Ethernet adaptation modelling

Figure II-1 below summarizes the modelling in the above 3 clauses.



## **Appendix III**

### **UML model data dictionary**

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

The Data Dictionary contains, in MS Word document format, the details of the Ethernet 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.8052 data dictionary is provided in clause 8.

## Appendix IV

### Ethernet ring protection modelling examples

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

#### IV.1 The protection scheme

The ITU-T G.8032 protection scheme is a network scheme that is built by constructing logical rings that are formed from assemblies of the basic nodal structure shown in Figure IV-1.

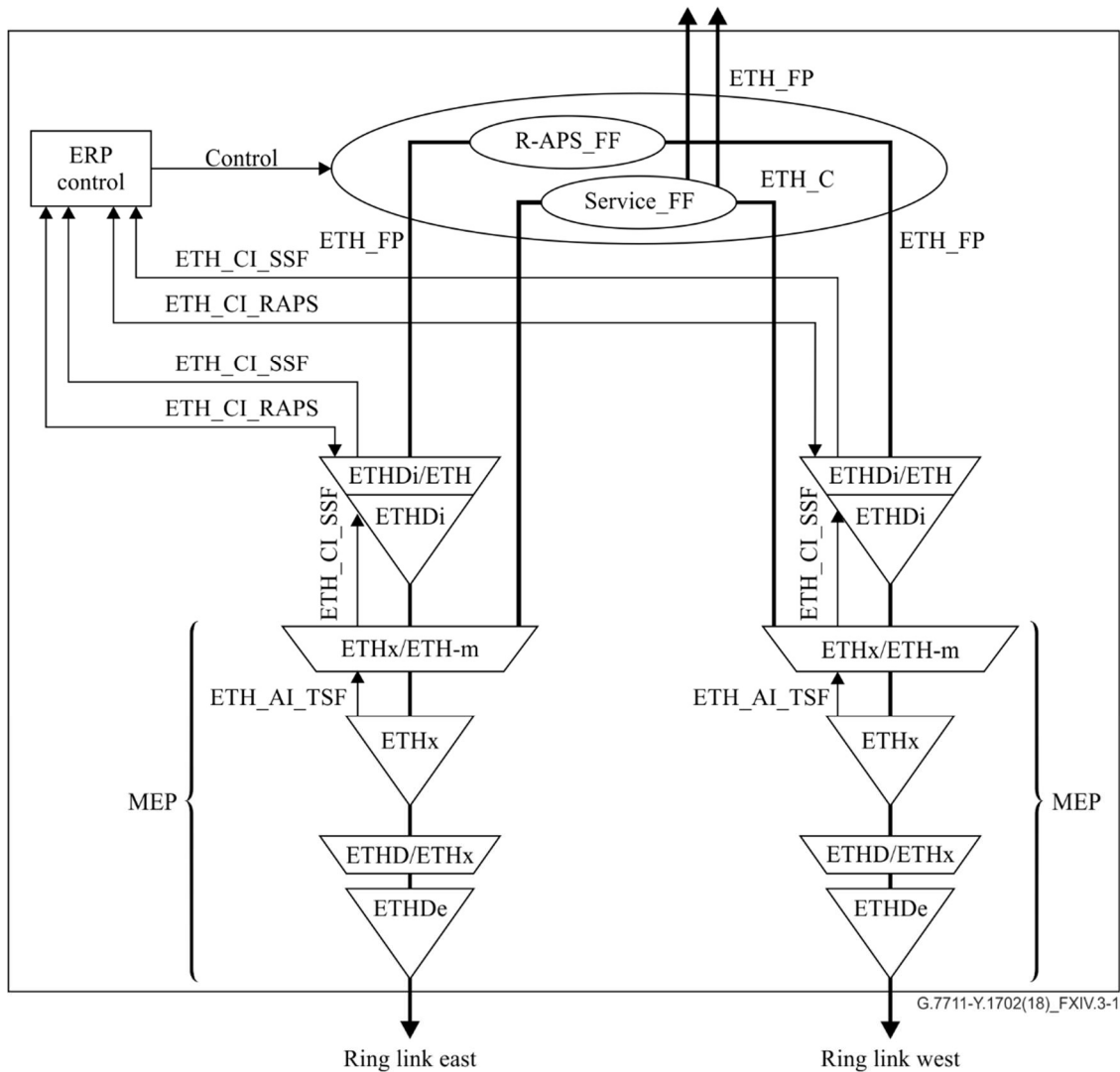
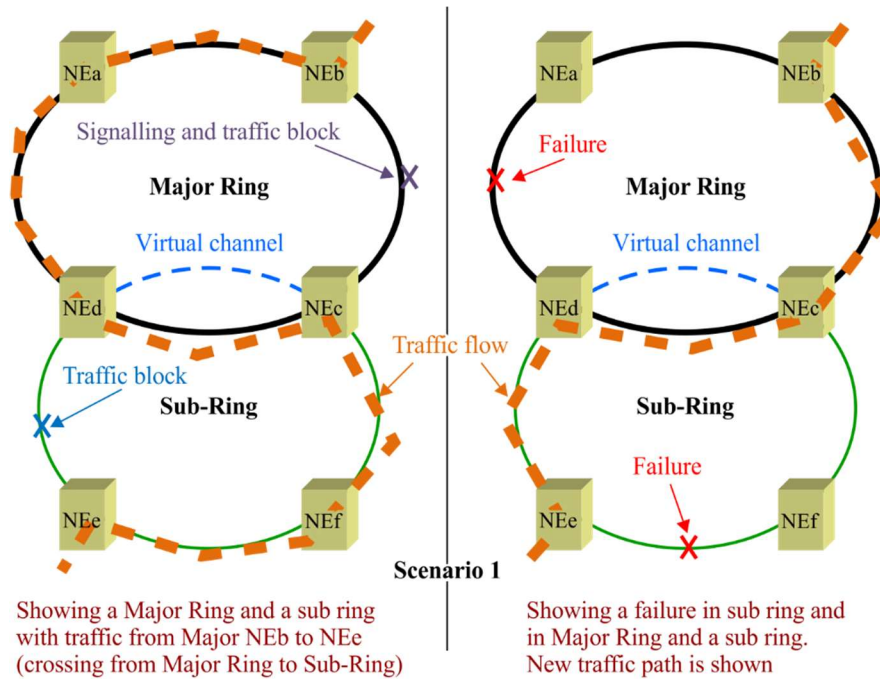


Figure IV-1 – ITU-T G.8032 ring node control and signalling

A logical ring is defined by the flow of signalling messages that control the protected ring. The protected traffic and control messages use the same links between nodes. When traffic frame enters the protected ring it is sent both ways round the ring. Continuous circulation of Ethernet frames within the ring is prevented by blocks in both the control and the traffic forwarding paths at some point in the ring. When a failure occurs these blocks are moved to position over the failure thus maintaining the flow of both traffic and signalling.

The scope of the scheme can be extended beyond the ring by adding sub-rings. The sub-ring is a partial ring from a signalling perspective. When one or more Sub-Rings are present the complete ring is called a major ring. The sub-ring closes protection via the major ring.

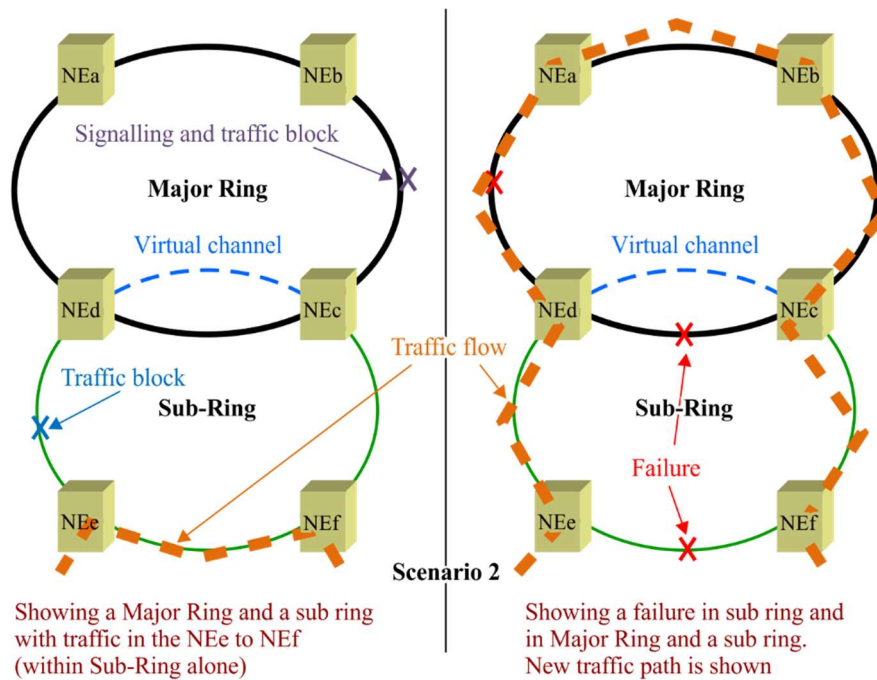
The two figures below show a view of ITU-T G.8032 protection highlighting major ring and sub-ring configurations and examples ring behaviour on failure.



Based on Fig. 7-31/ITU-T G.8052 (Control process types)  
G.7711-Y.1702(18)\_FXIV.3-2

**Figure IV-2 – ITU-T G.8032 Rings showing traffic flow under normal and failure conditions (1)**

Figure IV-2 shows traffic that flows between a node in the major ring and a node in the sub-ring. Figure IV-3 shows how the major ring offers protection to traffic that is between nodes in the sub-ring.



Based on Fig. 7-31/ITU-T G.8052 (Control process types)  
G.7711-Y.1702(18)\_FXIV.3-3

**Figure IV-3 – ITU-T G.8032 rings showing traffic flow under normal and failure conditions (2)**

In a major ring that has no failure present the traffic block is typically positioned in the same place as the control signalling block (although fundamentally it need not be the case). In a sub-ring only the traffic needs to be blocked. Each active node in a ring has a controller for the ring to ensure the block behaviour. The signalling may transit nodes that are not involved in the scheme so long as the traffic transits the same nodes with no drop opportunity.

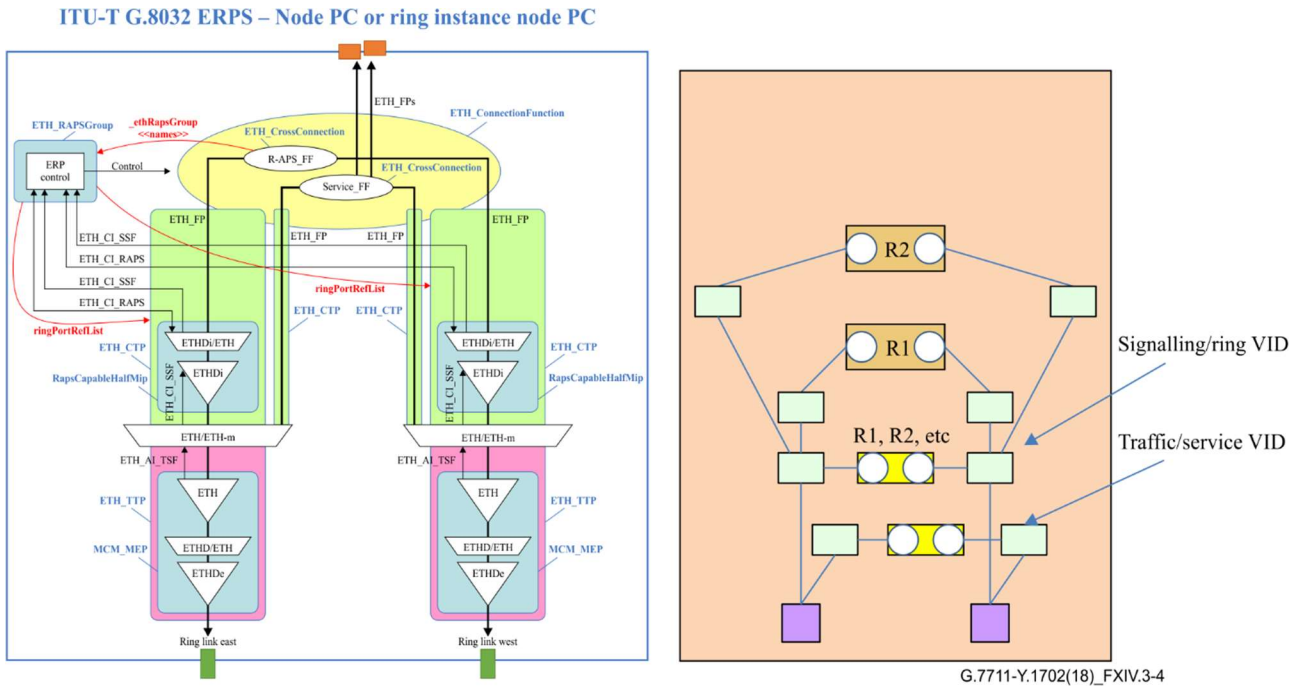
The protection scheme supports multiple overlaid logical rings (see Figure IV-13, Two overlaid ITU-T G.8032 major rings). The protection scheme uses reserved MAC addresses for the ring controllers. All controllers on any specific ring have the same (reserved) MAC address. Part of the MAC address is the Ring ID. All controllers for any case of ring ID have the same MAC address and it is this MAC ring that essentially defines the boundary of an individual protection control domain. A single VID can be used to carry signalling (the R-APS VID) for multiple different rings (where each ring has a different ring IDs). Each traffic ring has one of more dedicated VIDs. Multiple traffic VIDs may be controlled by a single protection control domain.

The controller controls a subset of the FCs passing through the NE (see Base Model in Figure IV-9, View of NE actively participating in two rings showing spec and encapsulation). The blocking of the signalling is per MAC address whereas the blocking of traffic is per VID.

Signalling goes both clockwise and anticlockwise. Signalling traffic uses the normal multi-cast drop and continue forwarding behaviour.

In the ring node model shown in Figure IV-4 there is a clear split between VID termination and MAC termination to handle the different multiplicity (one VID and n MAC terminations).

Note that in an implementation the Control functionality may be shared between rings but in the model it is the logical function that is considered and from that perspective the control functions are completely separate/disjoint.



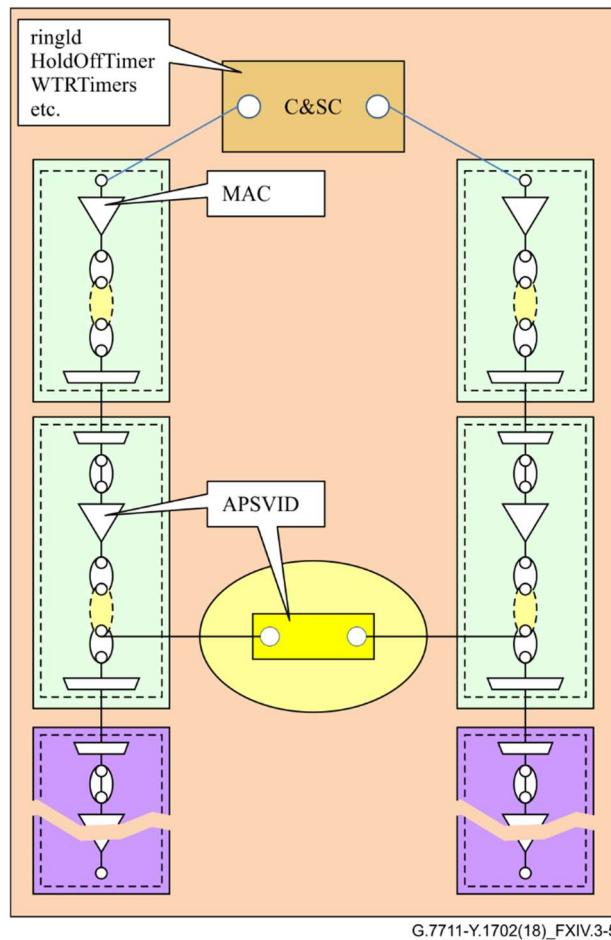
**Figure IV-4 – Basic model for a ring node**

The model reflects the following key features

- Propagation of signalling is by drop and continue
  - The effect in the Ring is that messages do not terminate and hence there is a signalling block.
- The ring is defined by the RingId in the last byte of the MAC address.
- The signalling FC is at the VID scope and hence it is a filter<sup>2</sup> in the LTP not a switch in the FC that does the ring block
  - The block on the signalling VID on a per MAC basis.
  - Not all rings using the same VID need to be blocked at the same node.
  - Not all rings using the same VID need to be co-routed.
- The signalling VID block is constructed by provisioning MAC to propagate (the RingX signalling block is formed by not configuring the MAC address (this is a detail)).
- The signal block and the traffic block are assumed to be at the same node for a ring (this appears to be a minor simplification).
- The traffic block could be represented as as switch in the FC or an attribute in the LTP.

Figure IV-5 shows expanded detail in the LTPs that deals with signalling.

<sup>2</sup> A filter in the LTP is essentially a switch in an FC encapsulated in the LTP



**Figure IV-5 – Detailed node model focusing on signal flow**

In Figure IV-5 the FC supports the signalling information flow (i.e., it is no different to the traffic forwarding function).

The Figure IV-5 shows a single CASC. There would be a CASC for each ring. The CASC is a relatively complex function as shown in Figure IV-6 but dealing with the detail in the controller appears not relevant. In a future form that detail could (should) be laid out in a scheme spec (as it is invariant) such that in future a smart controller could interpret failure modes, etc.



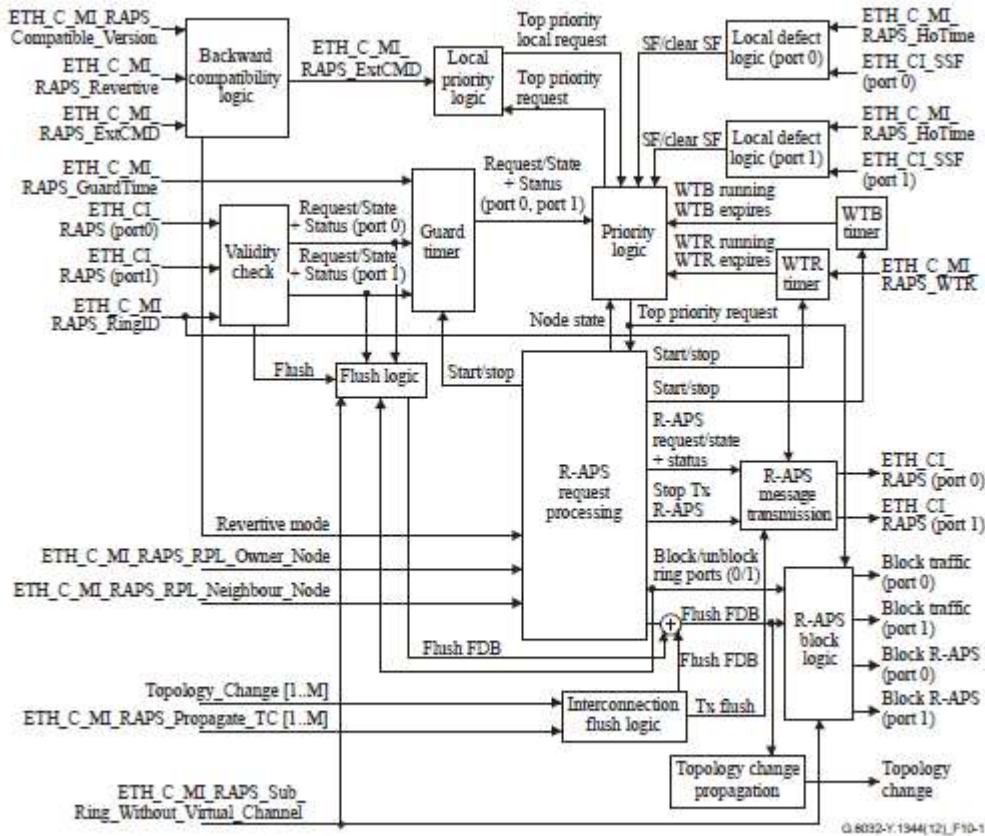
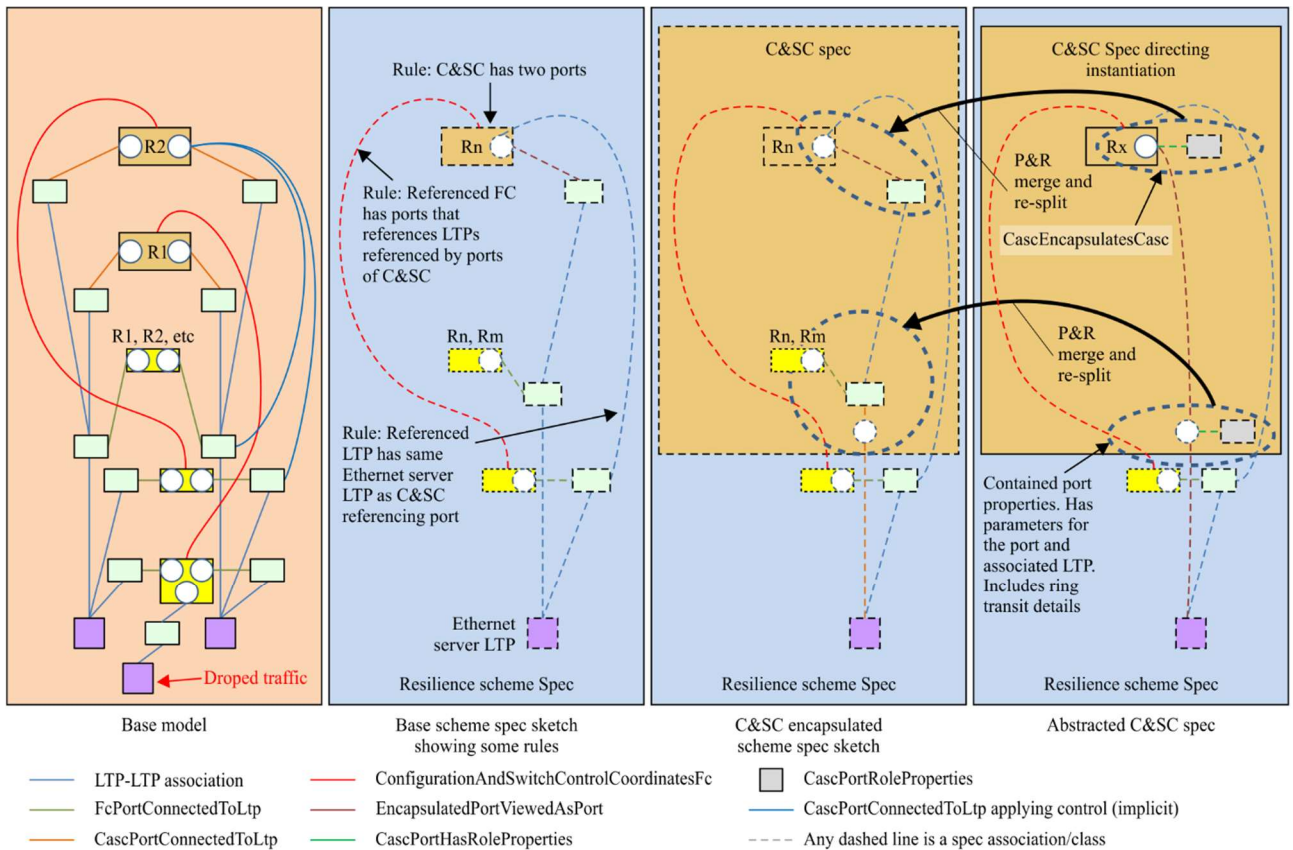


Figure 10-1 – Breakdown of the ERP control process

**Figure IV-6 – Detailed view of a control function from ITU-T G.8032**

- There are several different views of the ring control that can be derived from the protection model:
- The raw functionality can be exposed per logical ring node as shown in Figure IV-5, Detailed node model focusing on signal flow
    - The CASCs for all nodes in the ring can be considered as a single emergent CASC (see Figure IV-12, The basic ITU-T G.8032 ring). This allows "ring wide" parameters to be provisioned across the ring instead of per node.
  - The functionality, VID through signalling traffic and all CASCs related to the signalling VID can be encapsulated in a larger CASC where that element would represent the control of all rings (see Figure IV-7). This encapsulation obscures some details. For example:
    - If there is a ring that simply passes through the node then that Ring ID is not apparent other than via configuration of the CASC ports.
    - Where there is an intermediate NE that does not engage in the protection scheme but does pass the signalling there would be a normal FC such that the representation is not uniform from NE to NE.
  - Both the control and the traffic VIDs could be encapsulated in a CASC
    - The model supports this view as any VIDs for the FD can be allocated to the CASC as the FCs are created. The traffic VIDs are not directly owned by the CASC other than when the traffic FCs are created.





**Figure IV-9 – View of NE actively participating in two rings showing spec and encapsulation**

The "Base model" diagram shows an example layout, in an instance diagram form, of a single ITU-T G.8032 node that is involved in two protected rings (R1 and R2).

The "Base scheme spec sketch..." diagram shows a detailed representation of the nodal aspects of the ITU-T G.8032 protection scheme spec (see Annex G, Core IM Specification, for more details on scheme specs). The elements of the spec are created from the ONF CIM using the "Prune and Refactor" (P&R) approach. This supports the construction of several cases of any class from the model with corresponding associations from the ONF CIM. The spec is augmented with rules that constrain the creation of instances of entities of the scheme so as to abide by the scheme definition. For example, "no more than two ports per ring id" on the signalling FC.

The "CASC Encapsulated..." diagram shows the results of a second P&R stage where the scheme spec is taken and embedded in a CASC shell. This intermediate step provides an aspect of the mapping of the raw scheme to the "Abstracted CASC spec". As the FCs and LTP cannot be embedded in the CASC the model is somewhat of a hybrid but it allows the next step of construction.

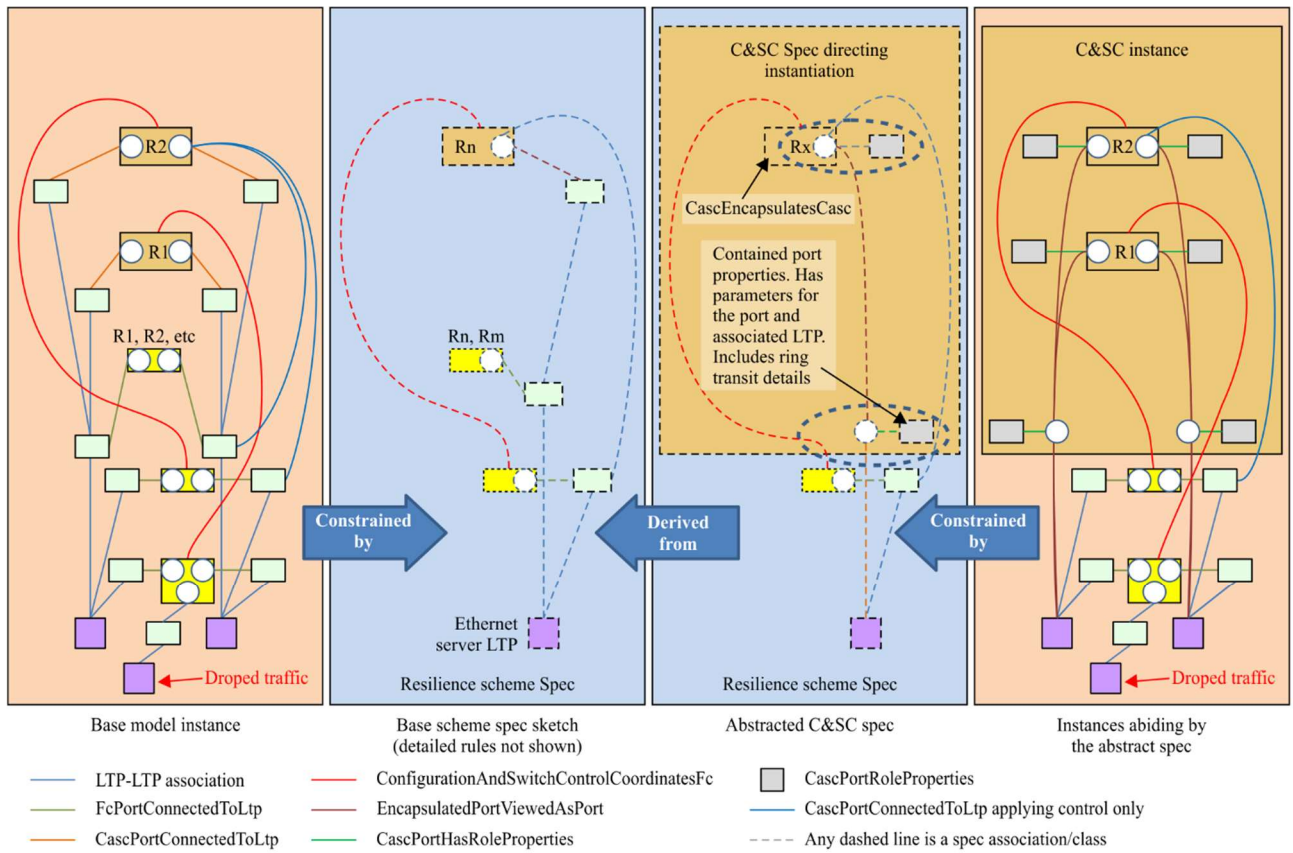
The "Abstracted CASC spec" diagram shows the results of a third P&R stage where the properties of the LTPs (including association ends) are merged into the corresponding CASC ports as are the port properties of the FC and the FC itself (the FC itself has no relevant properties).

In this case the "Base scheme spec..." is further backed up by a more detailed set of specs for the CASC for ITU-T G.8032. At this point the spec for ITU-T G.8032 is not documented in a machine interpretable form. The longer term intention is that it would be machine interpretable.

As a consequence of the above steps there is a formal path from the "Abstracted CASC spec" to the definition of the detailed underlying mechanism. As a consequence the representation from an implementation that uses the "Abstract CASC spec" form can be transformed in a running solution to

a view that follows the "Base scheme spec.." using a machine interpretable definition of the transformation.

As the detailed set of specs are moved to machine interpretable forms an advanced controller will have the information to fully interpret the protection scheme and its data.



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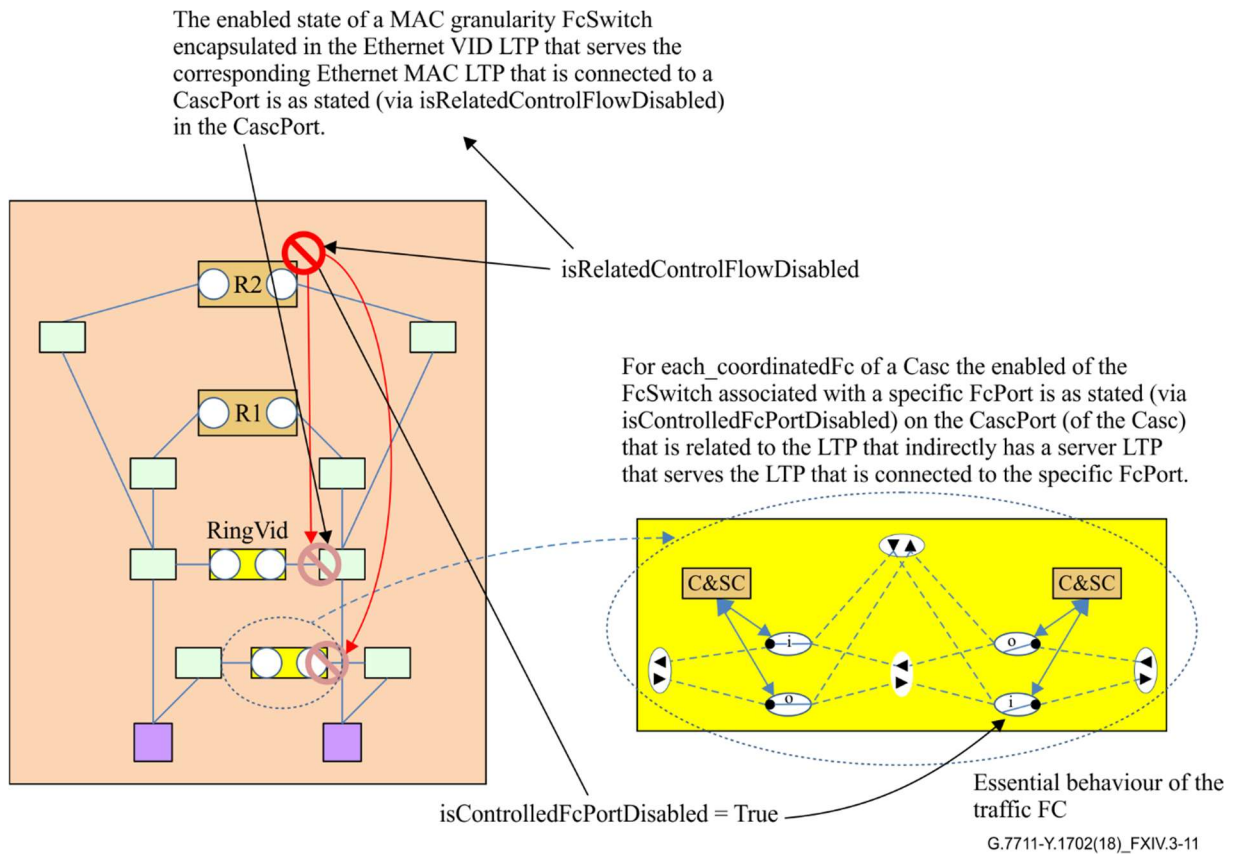
**Figure IV-10 – Relationship between the two instance views shown via their related spec**

Figure IV-10 shows the relationship between instance sketches and the corresponding specs and highlights the relationship between the specs.

The scheme specs and the rigorous relationship between those enable a controller to interpret and expand a compact form. If any other compact forms are chosen they should be rigorously related.



#### IV.4 Representing the blocksodel to explain the alternative encapsulations functiin



**Figure IV-11 – Applying the "blocks" to the ring**

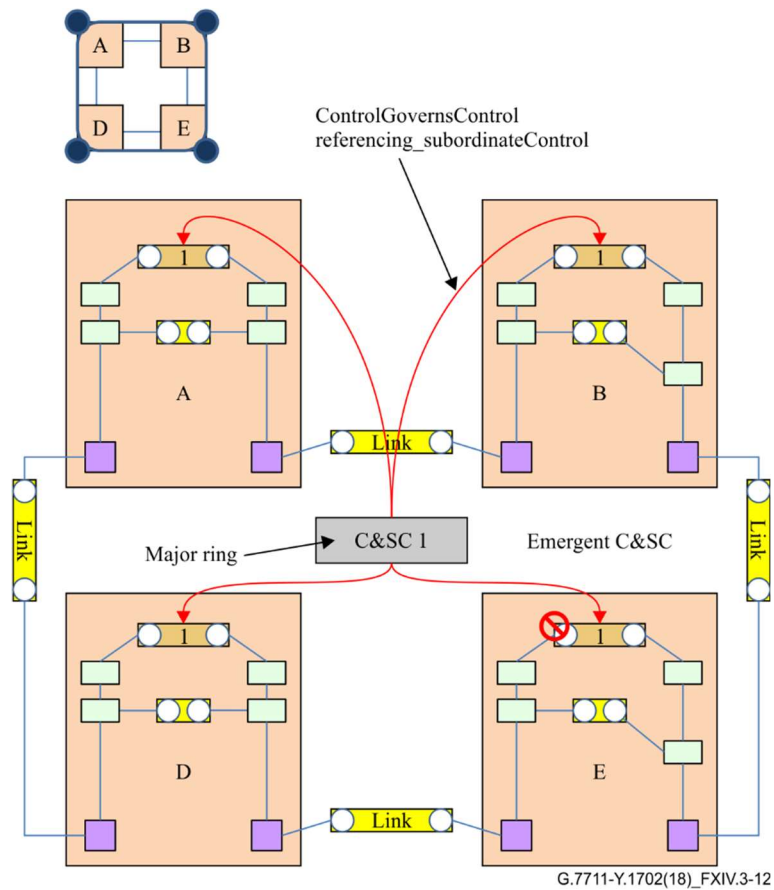
The CascPort supports both the sending of signalling through and/or application of control to the associated LTP and/or the gathering of monitoring information from the associated LTP. The controls can be applied directly to the associated LTP and/or indirectly to an appropriately deterministically related LTP peer or server to the associated LTP as described by the scheme spec and illustrated in Figure IV-11. The same applies to the gathering of monitoring information.

Considering [ITU-T G.8032] protection as an example the control parameter related to the "isRelatedControlFlowDisabled" property of the port applies also to the indirectly related LTP dealing with the control signal and the "isControlledFcPortDisabled" property of the port applies specifically to the port of the controlled FC as explained by the scheme spec.

In addition the scheme spec will indicate whether the actual state of each individual controlled FC can be determined directly from the FC or whether only the aggregate state is available. Clearly the former may cause performance issues in an implementation if hundreds of FCs are controlled and switched together especially if notifications are sent for changes in every one independently.

#### IV.5 Forming the ring

Figure IV-12 shows an example of the protection scheme where there is only one ring set up (controllers and signalling) and there is no traffic applied to the ring. As noted previously the ring is emergent from the signalling and nodal control arrangement. The ring can be represented by a superior CASC that groups the nodal CASCs for the ring.

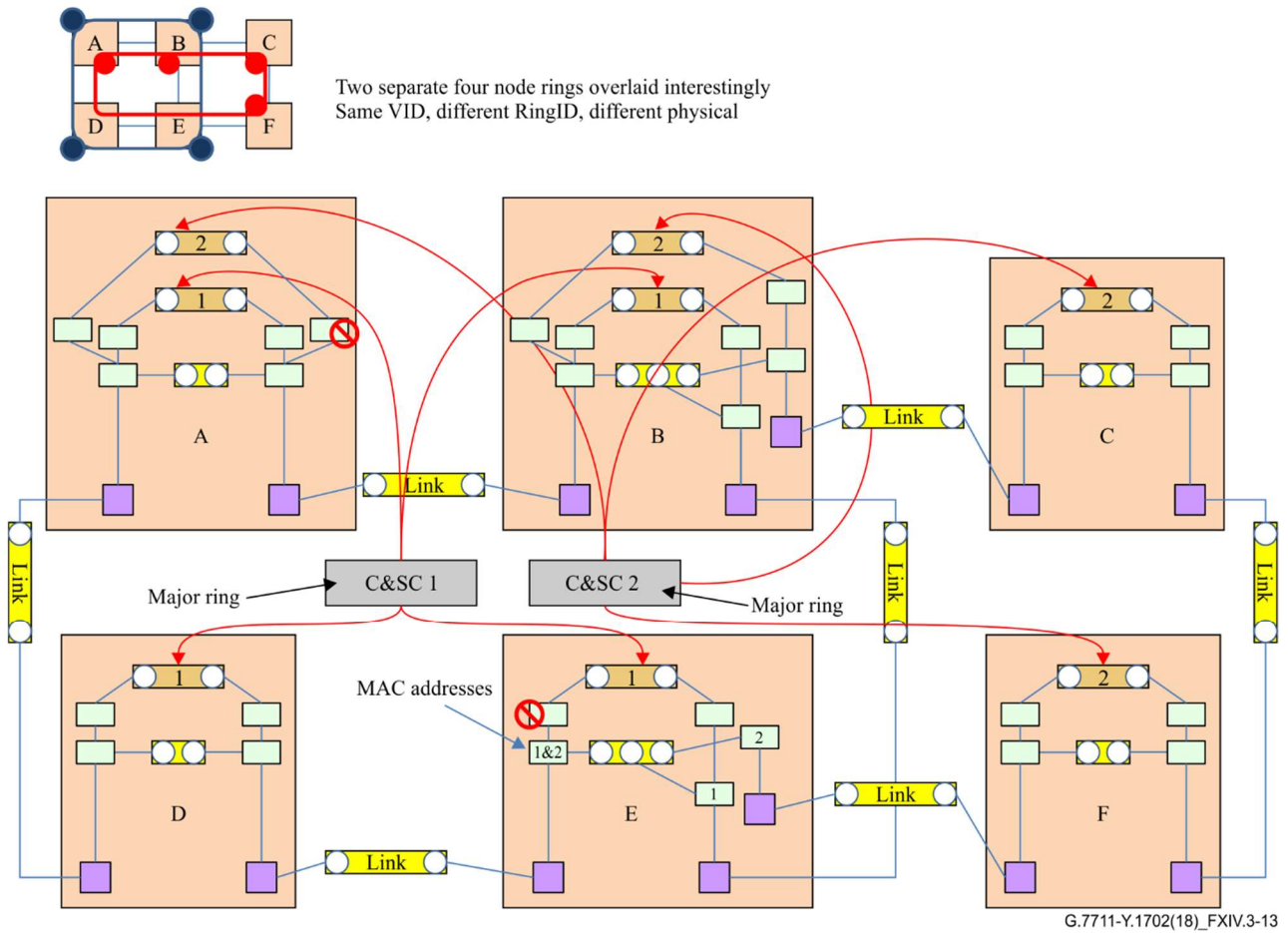


**Figure IV-12 – The basic ITU-T G.8032 ring**

Whilst in this simple case there also appears to be a control forwarding ring formed from the FCs, in more complex cases with various overlaid rings the control FC can become a complex structure where the VID is used by multiple rings that are not co-routed. This is because it is at the MAC level that the ring appears rather than at the VID level.

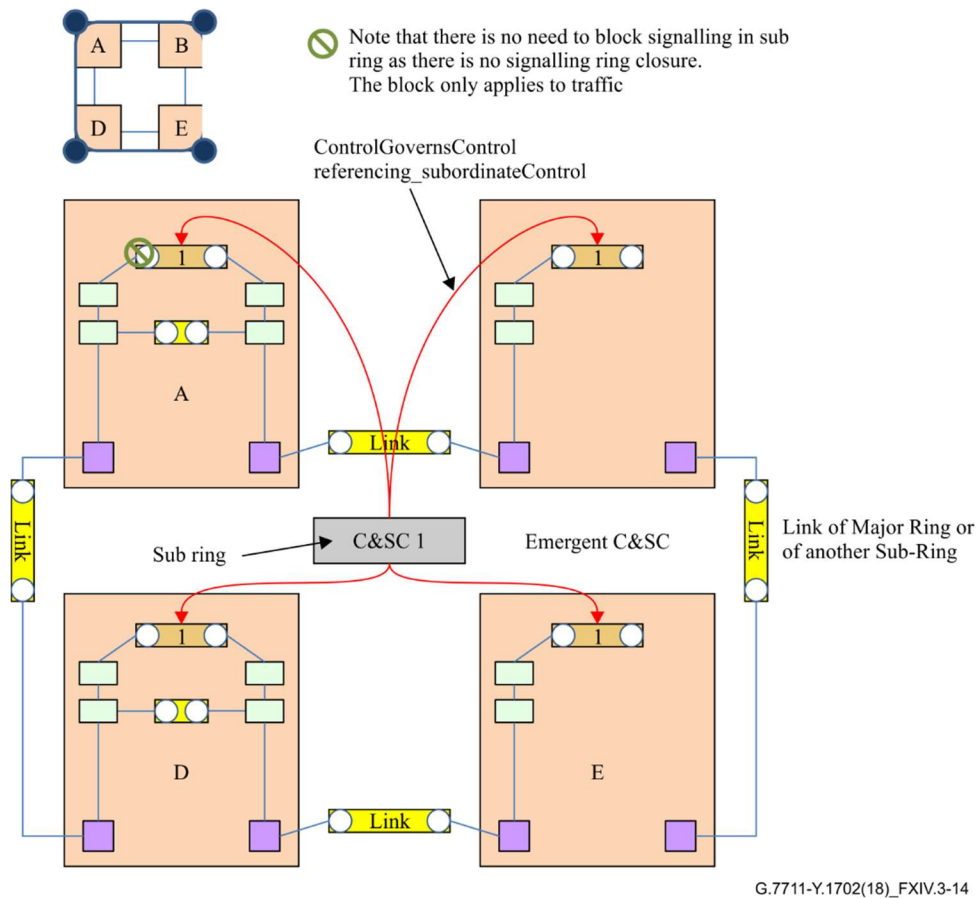
Figure IV-13 emphasizes the point as it shows two overlaid rings that are not co-routed. The figure could represent a deployment situation where protected private networks are being supported and two customers of the provider have private networks that happen to have some sites in common.

In this case there is no need to pass traffic between the two private networks. If traffic were to need to be passed traffic from the two rings could only be interconnected at one point to prevent loops. In this configuration there would be a single point of failure. To enable protection without a single point of failure an alternative configuration is constructed that uses subrings. Sub-rings are shown in later figures.



**Figure IV-13 – Two overlaid ITU-T G.8032 major rings showing signalling only**

As can be seen from the figure the two rings share a single VID for signalling but are not co-routed. Ring 2 simply transits through NE D and NE E (there is no controller present that deals specifically with Ring 2 but the signalling VID is set up to allow Ring 2 MAC to pass).

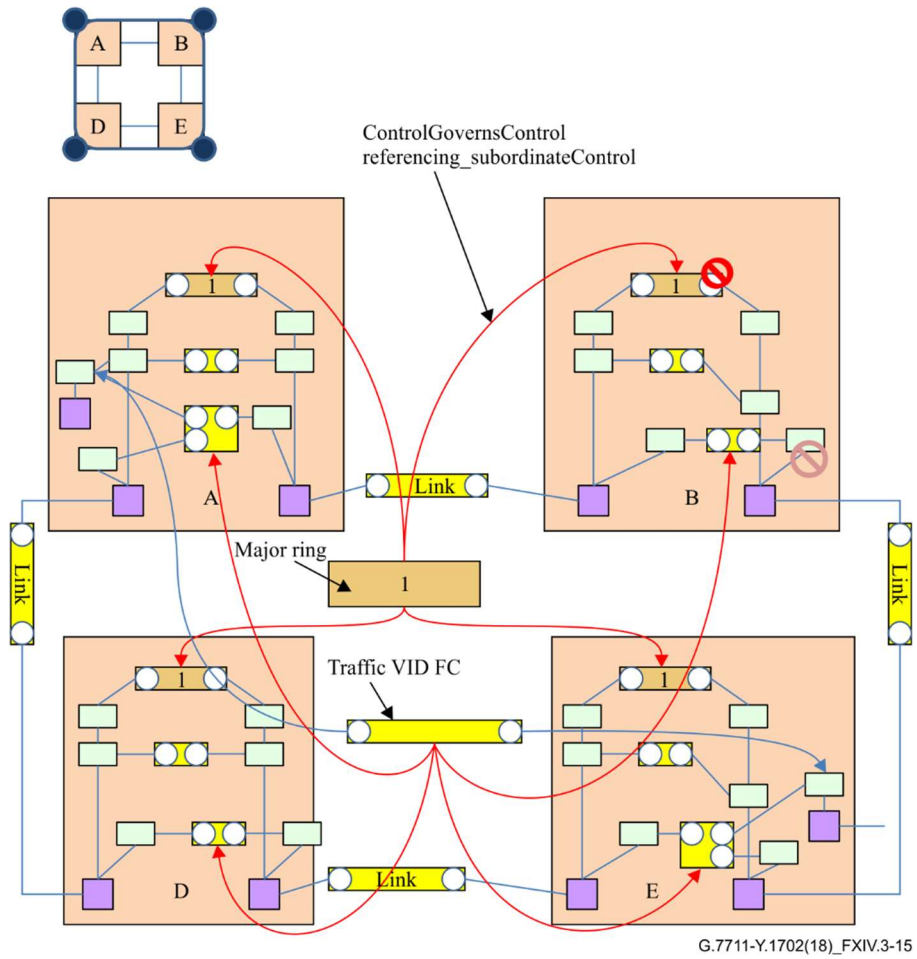


**Figure IV-14 – Basic ITU-T G.8032 sub-ring**

Figure IV-14 shows a sub-ring configuration. As described earlier, the sub-ring closes protection through a major ring (or another sub-ring where the sub-ring configuration is attached to at least one major ring). A major ring may support many sub-rings.

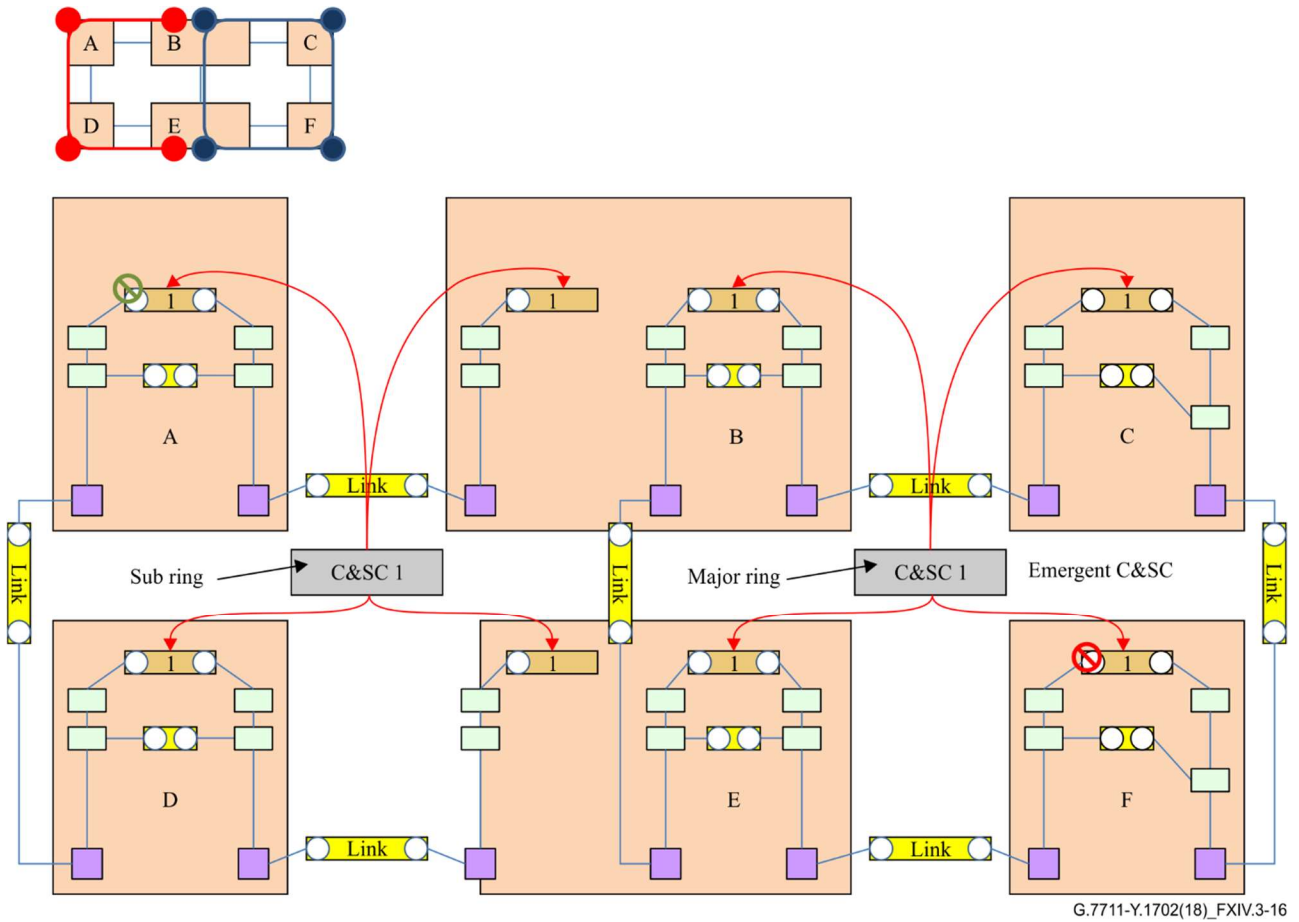
Figure IV-15 shows a major ring with one protected Traffic VID between ports on NE A and NE E. In the figure the block is such that the traffic will flow via D.





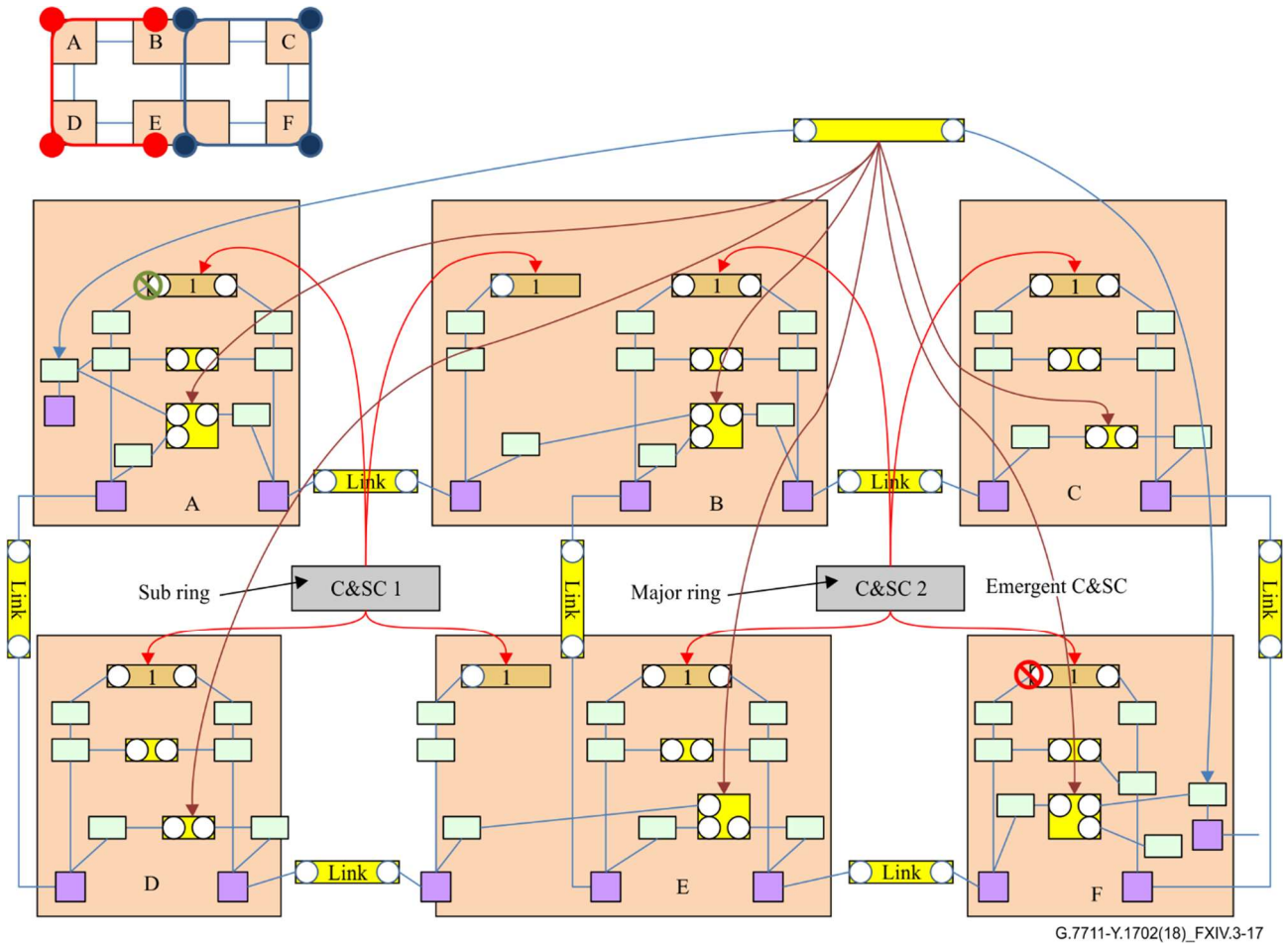
**Figure IV-15 – Major ring showing traffic**

Figure IV-16 shows a sub-ring and associated a major ring from a signalling perspective. As the figure only shows signalling the two rings appear to have no association.



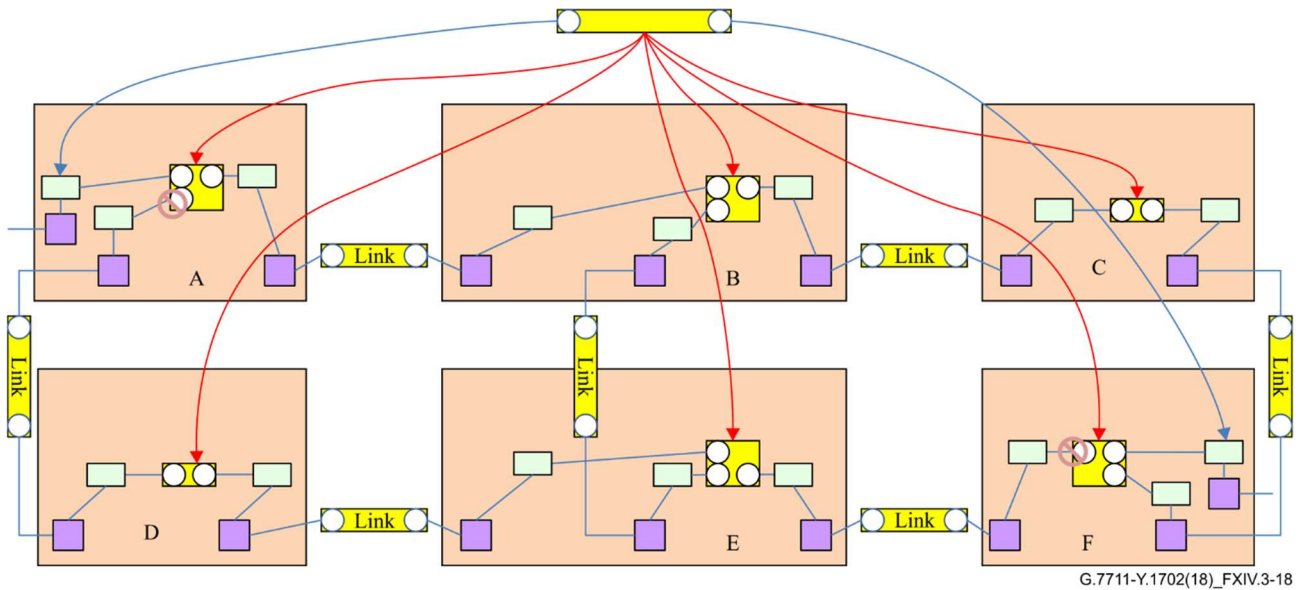
**Figure IV-16 – Basic ITU-T G.8032 major ring and sub-ring**

Figure IV-17 shows a single traffic VID between ports on NE A and NE F. In NE B and NE E there are three-way FCs that provide a broadcast that enables the protection scheme. The figure shows the necessary traffic bocks in NE A and NE F.



**Figure IV-17 – ITU-T G.8032 major ring and sub-ring showing traffic**

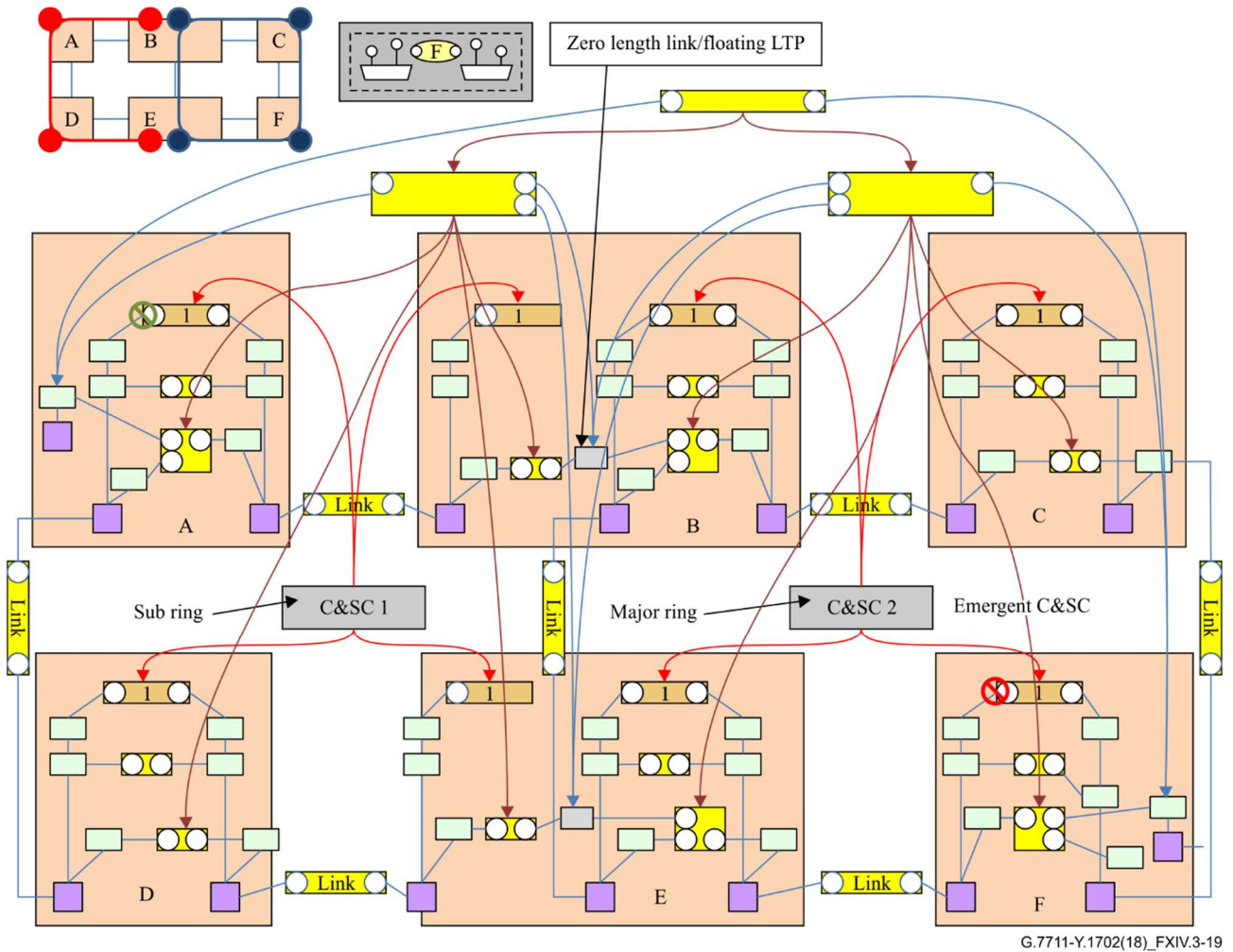
To reduce the clutter Figure IV-18 shows only the traffic.



**Figure IV-18 – ITU-T G.8032 major ring and sub-ring showing only traffic**

In the approach shown in the two figures above the FCs in NE B and NE E are partly controlled by CASC 1 and partly controlled by CASC 2. Figure IV-19 shows an alternative layout of traffic where

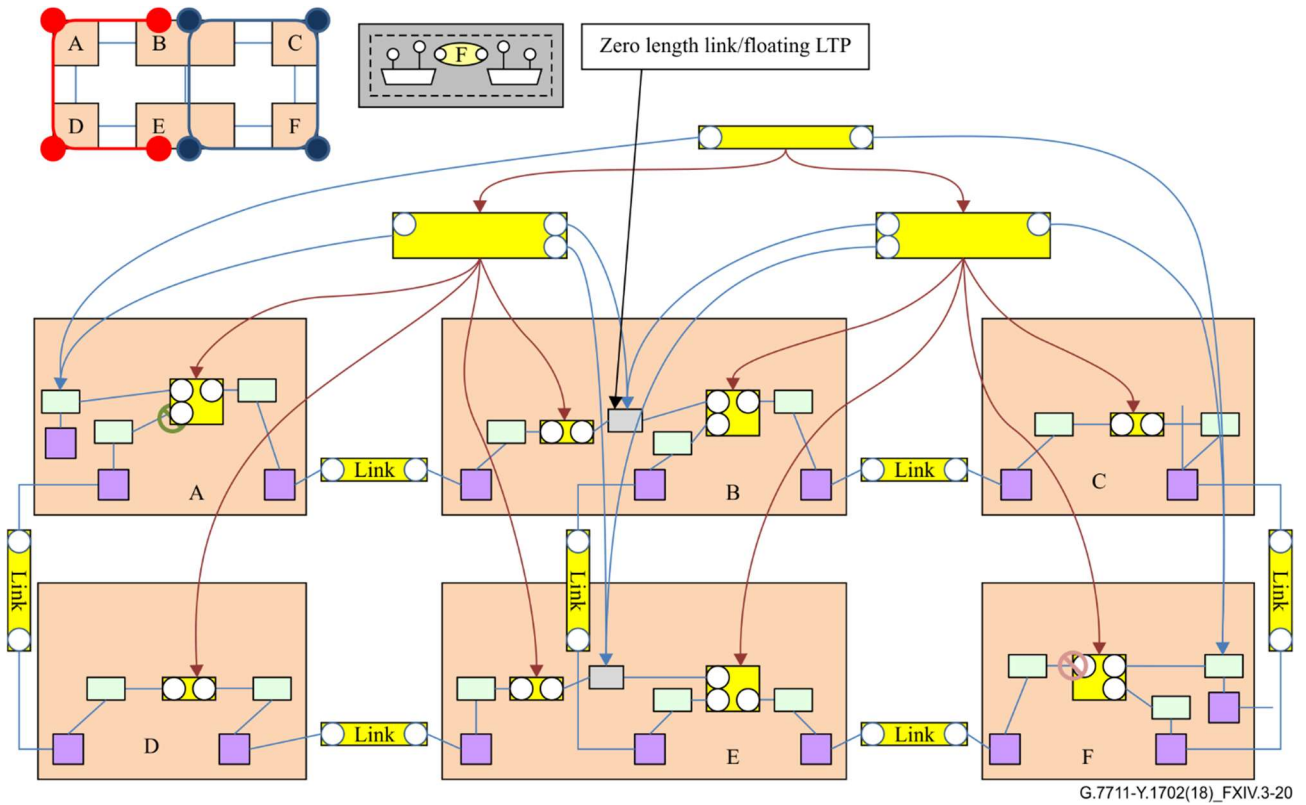
there are dedicated FCs per control domain which are interconnected via a zero length link which is an artificial termination construct that represents the boundary of the control domains.



**Figure IV-19 – ITU-T G.8032 major ring and sub-ring showing traffic with zero length link**

A zero length link can be added per traffic VID. T

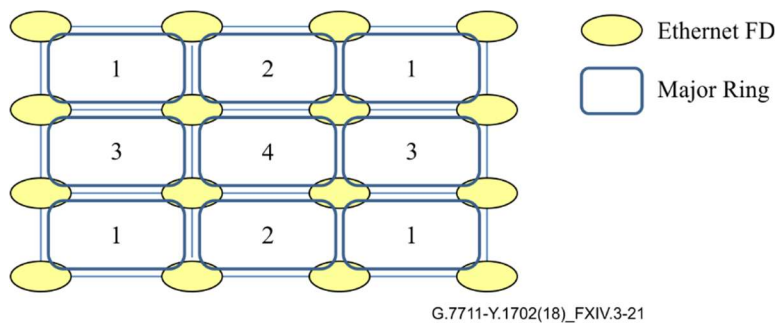
To reduce clutter, Figure IV-20 shows only the traffic.



**Figure IV-20 – ITU-T G.8032 major ring and sub-ring showing only traffic with zero length link**

The approach using a zero length link adds complexity to the traffic path model but does allow a representation of control isolation.

Figure IV-21 shows arrangements of rings in a mesh network. Each numbered Ring can use the same signalling VID so long as the Ring IDs are different for each Ring at an intersecting Node. In the example if the number is the ring ID then the VID can be the same. If the rings all have the same Ring ID then the number represents the VID.



**Figure IV-21 – ITU-T G.8032 major rings in a mesh**

More complex cases including those shown below, although not detailed here, are also covered by the model<sup>3</sup>.

<sup>3</sup> Further work will be carried out in a later release to show these and other more complex cases in detail.



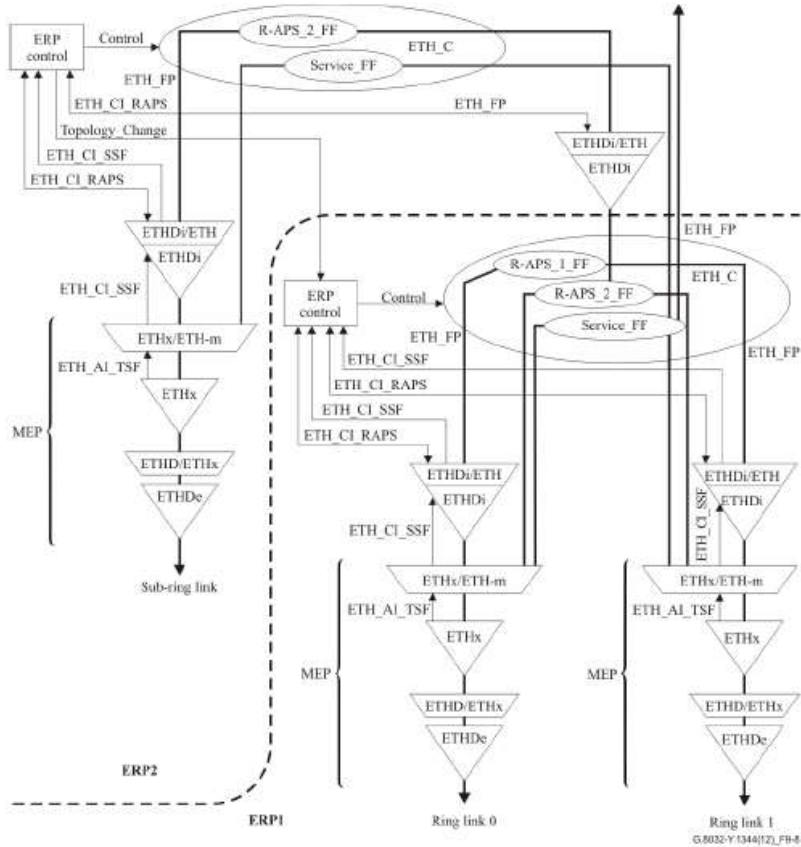


Figure 9-8 – MEPs and R-APS insertion function in an interconnection node with an R-APS virtual channel (different R-APS VIDs)

Figure IV-22 – MEPs and R-APS insertion [ITU-T G.8032]

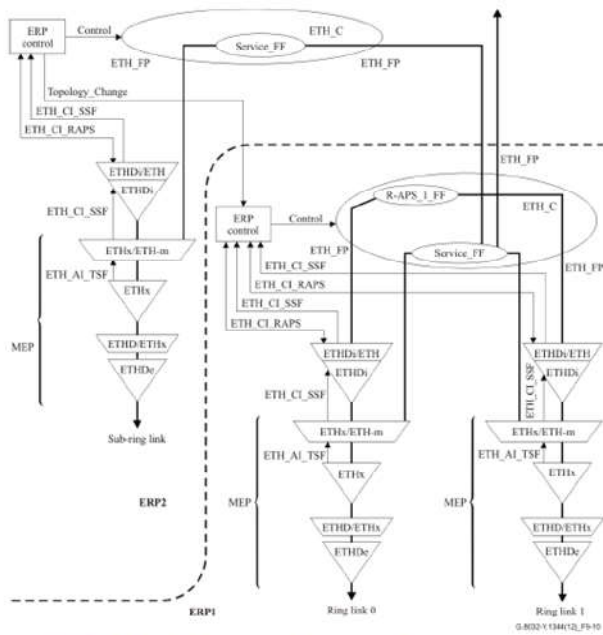


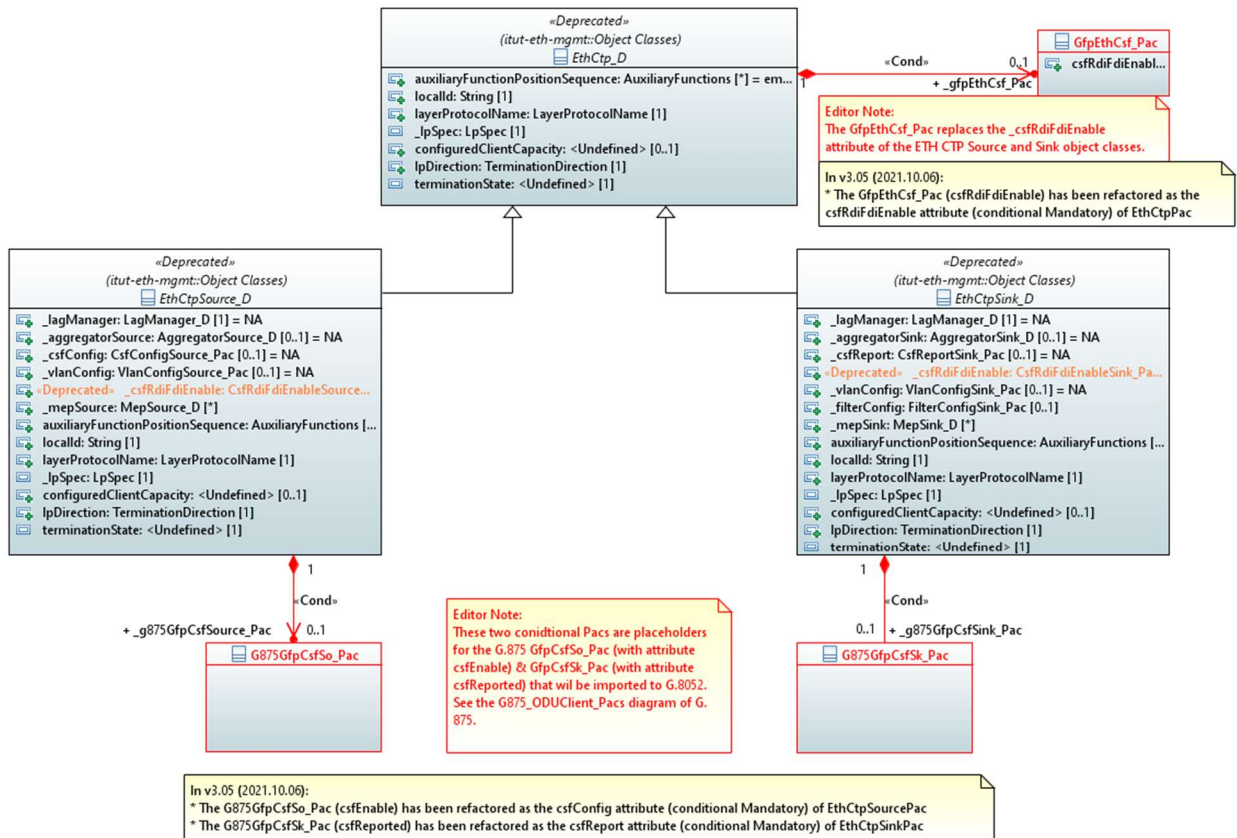
Figure 9-10 – MEPs and R-APS insertion function in a sub-ring interconnection node without an R-APS virtual channel (for a sub-ring connected to a major ring)

Figure IV-23 – MEPs and R-APS insertion without R-APS virtual channel [ITU-T G.8032]

In Figure IV-23, it is not clear how the two Service\_FF blocks are joined. This appears to be FC to FC (achievable with the current model), but there may be more complex behaviour that is implied by the figure. This requires further study.

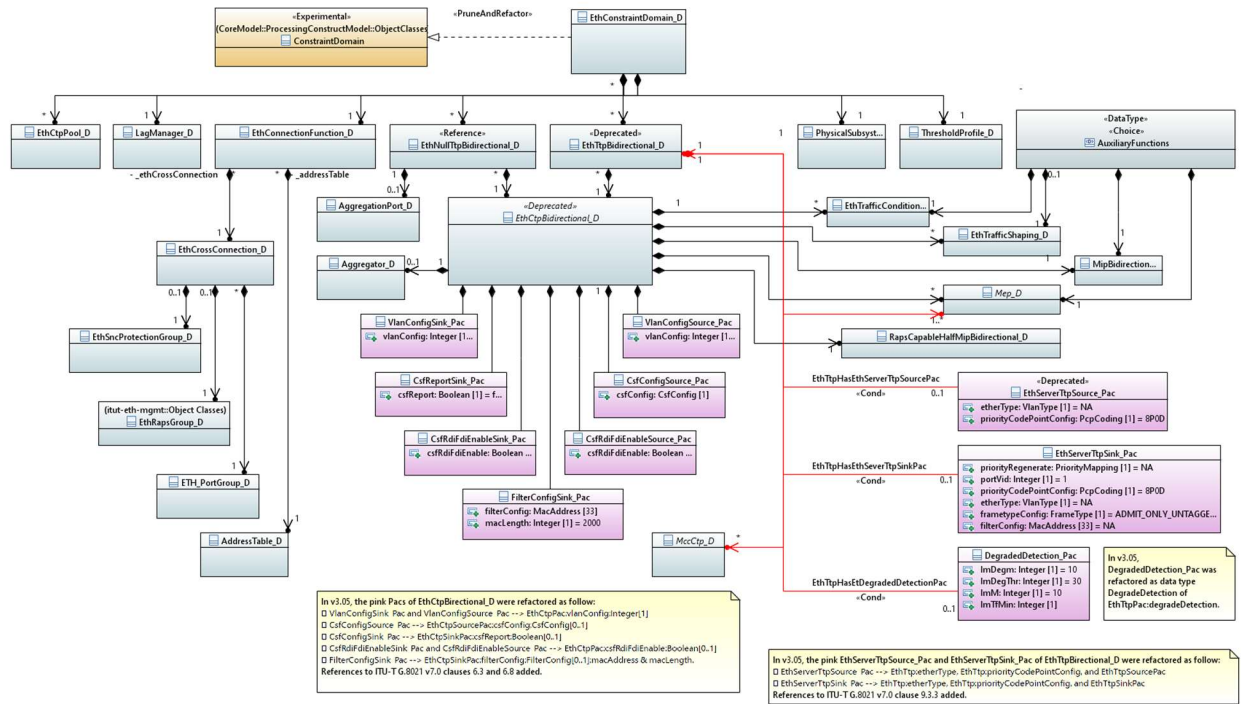






EthCtpGfpConfigurati  
on.png

**Figure V-1.B – ETH CTP refactoring of GFP configuration**



ETH CTP & TTP pacs  
refactoring.png

Figure V-1.C – ETH CTP & TTP pacs refactoring



## **Bibliography**

- [b-Eclipse-Papyrus] Papyrus Eclipse UML Modelling Tool  
<<https://www.eclipse.org/papyrus/>>
- [b-ONF TR-515] ONF TR-515\_Papyrus-Guidelines (07/2018)  
<[https://opennetworking.org/wp-content/uploads/2018/08/TR-515\\_Papyrus\\_Guidelines\\_v1.3-1-1.pdf](https://opennetworking.org/wp-content/uploads/2018/08/TR-515_Papyrus_Guidelines_v1.3-1-1.pdf)>

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

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