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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 AND NEXT-GENERATION NETWORKS

Internet protocol aspects – Transport

Ethernet service characteristics

Recommendation ITU-T G.8011/Y.1307

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Recommendation ITU-T G.8011/Y.1307

Ethernet service characteristics

Summary

Recommendation ITU-T G.8011/Y.1307 describes a framework for defining network-oriented characteristics of Ethernet services that is aligned with MEF 10.2. The framework is based on the modelling of Ethernet layer networks described in Recommendation ITU-T G.8010/Y.1306. The attribute sets introduced in this framework, (Ethernet virtual connection (EVC), Ethernet connection (EC), user-to-network interface (UNI) and network-to-network interface (NNI)), are intended to be used to create numerous specific Ethernet services.

History

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1.2	ITU-T G.8011/Y.1307 (2004) Amd. 1	2005-08-22	15
2.0	ITU-T G.8011/Y.1307	2009-01-13	15
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Keywords

Ethernet, Ethernet connection, Ethernet service, framework, network-to-network interface, user-to-network interface.

FOREWORD

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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.

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

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Recommendation ITU-T G.8011/Y.1307

Ethernet service characteristics

1 Scope

This Recommendation defines a framework to describe a set of Ethernet services based on [MEF 10.2]. The framework consists of a set of attributes for each Ethernet virtual connection (EVC), Ethernet connection (EC), Ethernet user-to-network interface (UNI) and Ethernet network-to-network interface (NNI). The resulting services that can be defined do not refer to a particular network technology implementation and are supported by the Ethernet layer architecture model presented in [ITU-T G.8010] and [MEF 12.1].

This Recommendation provides the framework to define different services to carry an Ethernet link connection. The Ethernet subnetwork for each of the services introduced in this Recommendation is defined in a companion set of Recommendations ITU-T G.8011.x/Y.1307.x based on [MEF 6.1].

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.809] Recommendation ITU-T G.809 (2003), *Functional architecture of connectionless layer networks*.

[ITU-T G.8001] Recommendation ITU-T G.8001/Y.1354 (2011), *Terms and definitions for Ethernet frames over transport*.

[ITU-T G.8010] Recommendation ITU-T G.8010/Y.1306 (2004), *Architecture of Ethernet layer networks*.

[ITU-T G.8011.1] Recommendation ITU-T G.8011.1/Y.1307.1 (2013), *Ethernet private line service*.

[ITU-T G.8011.2] Recommendation ITU-T G.8011.2/Y.1307.2 (2013), *Ethernet virtual private line service.*

[ITU-T G.8011.3] Recommendation ITU-T G.8011.3/Y.1307.3 (2013), *Ethernet virtual private LAN service.*

[ITU-T G.8011.4] Recommendation ITU-T G.8011.4/Y.1307.4 (2013), *Ethernet virtual private rooted multipoint service.*

[ITU-T G.8011.5] Recommendation ITU-T G.8011.5/Y.1307.5 (2013), *Ethernet private LAN service.*

[ITU-T G.8012] Recommendation ITU-T G.8012/Y.1308 (2004), *Ethernet UNI and Ethernet NNI*.

[ITU-T G.8012.1] Recommendation ITU-T G.8012.1/Y.1308.1 (2012), *Interfaces for the Ethernet transport network.*

[ITU-T G.8013] Recommendation ITU-T G.8013/Y.1731 (2013), *OAM functions and mechanisms for Ethernet based networks*.

[ITU-T G.8021] Recommendation ITU-T G.8021/Y.1341 (2010), *Characteristics of Ethernet transport network equipment functional blocks*.

[ITU-T G.8021.1] Recommendation ITU-T G.8021.1/Y.1341.1 (2012), Types and *characteristics of Ethernet equipment*.

[IEEE 802.1Q] IEEE 802.1Q (2011), *IEEE standard for Local and Metropolitan Area Networks – Virtual Bridged Local Area Networks*.

[IEEE 802.1AX] IEEE 802.1AX (2008), *IEEE Standard for Local and Metropolitan Area Networks – Link Aggregation*.

[IEEE 802.3] IEEE 802.3-2012, *IEEE Standard for Information technology – Telecommunications and Information exchange between systems – Local and metropolitan area networks – Specific requirements – Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications*.

[MEF 6.1] The Metro Ethernet Forum MEF (2008), *Technical Specification MEF 10.2 – Ethernet Services Definitions – Phase 2*.

[MEF 6.1.1] The Metro Ethernet Forum MEF (2012), *Layer 2 Control Protocol Handling Amendment to MEF 6.1*.

[MEF 10.2] The Metro Ethernet Forum MEF (2009), *Technical Specification MEF 10.2 – Ethernet Services Attributes – Phase 2*.

[MEF 12.1] The Metro Ethernet Forum MEF (2010), *Carrier Ethernet Network Architecture Framework Part 2: Ethernet Services Layer - Basic Elements*.

[MEF 26.1] The Metro Ethernet Forum MEF (2012), *External Network Network Interface (ENNI)–Phase 2*.

[MEF 30] The Metro Ethernet Forum MEF (2012), *Service OAM Fault Management Implementation Agreement*.

[MEF 35] The Metro Ethernet Forum MEF (2012), *Service OAM Performance Monitoring Implementation Agreement*.

3 Definitions

This Recommendation uses the following terms defined in [ITU-T G.8010]:

3.1 ETH link

3.2 subnetwork connection

3.3 link

3.4 link connection

3.5 subnetwork

3.6 traffic conditioning function

This Recommendation uses the following terms defined in [ITU-T G.809]:

3.7 flow point

3.8 flow termination

3.9 termination flow point

This Recommendation uses the following terms defined in [ITU-T G.8001]:

3.10 access link

3.11 customer

3.12 Ethernet connection (EC)

3.13 Ethernet service

3.14 Ethernet service area

3.15 Ethernet service instance

3.16 NNI

3.17 UNI

This Recommendation uses the following terms defined in [MEF 10.2]:

3.18 Ethernet virtual connection (EVC)

3.19 service frame

This Recommendation uses the following term defined in [MEF 26.1]:

3.20 ENNI

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

CFM	Connectivity Fault Management
CI	Characteristic Information
EC	Ethernet Connection
E-LAN	Ethernet LAN
E-Line	Ethernet Line
E-Tree	Ethernet Tree
ENNI	External Network-to-Network Interface
ETH	Ethernet MAC Layer Network
ETY	Ethernet PHY Layer Network
EVC	Ethernet Virtual Connection
FP	Flow Point
GARP	Generic Attribute Registration Protocol
GMRP	GARP Multicast Registration Protocol
GVRP	GARP VLAN Registration Protocol
ID	Identification
INNI	Internal Network-to-Network Interface
LACP	Link Aggregation Control Protocol
LAMP	Link Aggregation Marker Protocol
LAN	Local Area Network
LBM	Loopback Message
LBR	Loopback Reply
LC	Link Connection

LTM	Link Trace Message
LTR	Link Trace Reply
MAC	Media Access Control
ME	Maintenance Entity
MEG	Maintenance Entity Group
MEN	Metro Ethernet Network
MEP	MEG End Point
MIP	MEG Intermediate Point
MSTP	Multiple Spanning Tree Protocol
MVRP	Multiple VLAN Registration Protocol
NNI	Network-to-Network Interface
OVC	Operator Virtual Connection
PHY	Physical device
RSTP	Rapid Spanning Tree Protocol
SN	Subnetwork
SNC	Subnetwork Connection
STP	Spanning Tree Protocol
TFP	Termination Flow Point
UNI	User-to-Network Interface
UNI-C	Customer side of UNI
UNI-N	Network side of UNI
VLAN	Virtual Local Area Network

5 Conventions

The diagrammatic convention for Ethernet services described in this Recommendation is that of [ITU-T G.8010].

Further, the use of the ETH link in this Recommendation is that of [ITU-T G.8010]. Specifically, the ETH link is a generalization that collectively refers to the ETH link and ETH link connection.

6 Ethernet services

This Recommendation does not define Ethernet services, but provides a framework from which services can be defined. This framework is based on the Ethernet transport architecture described in [ITU-T G.8010]. Unlike the original version of this Recommendation, the base Ethernet service attributes and their definitions are imported from [MEF 10.2] to ensure alignment. This Recommendation adds further explanation to some of these attributes to clearly show the relationship with [ITU-T G.8010]. In addition, several ITU-T specific attributes are defined to provide a superset of attributes.

6.1 Ethernet service areas

Ethernet service areas identify the various portions of a network that support an Ethernet service instance. A simple model of an Ethernet network (for a single carrier's network) is shown in

Figure 6-1. Three Ethernet service areas are identified: access (UNI-C to UNI-N), edge-to-edge (the Ethernet connection from UNI-N to UNI-N) and end-to-end (UNI-C to UNI-C).

Figure 6-1 also shows a three-tier relationship. The three tiers (equipment at the top, Ethernet MAC layer network (ETH layer) in the middle and Ethernet PHY layer network (ETY layer) at the bottom) allow a clear identification of how the equipment functions map onto the ETH and ETY layers. Note that the customer equipment is shown as a flow point on the right and a subnetwork (SN) on the left of the diagram, to illustrate that both are possible.

It is further shown that the UNI reference point occurs in the middle of the access link, or more precisely that the UNI is a reference point whose functionality is split into customer (UNI-C) and network (UNI-N) components. Additional UNI details are defined in [ITU-T G.8012] and [ITU-T G.8012.1].

The relationship between the Ethernet service areas illustrated in Figure 6-1 (and in Figures 6-2 and 6-3) and the maintenance entities (MEs) described in [ITU-T G.8010] is shown in Table 6-1:

Table 6-1 – Ethernet areas and maintenance entities

Ethernet area	Maintenance entity
Access link	Access link
End-to-end	UNI-C to UNI-C
Edge-to-edge	UNI-N to UNI-N

Note that a maintenance entity (ME) is point-to-point whilst the Ethernet service may be multipoint-to-multipoint. Therefore, in general, an Ethernet service area will contain multiple ME instances (these are referred to as a maintenance entity group (MEG)).

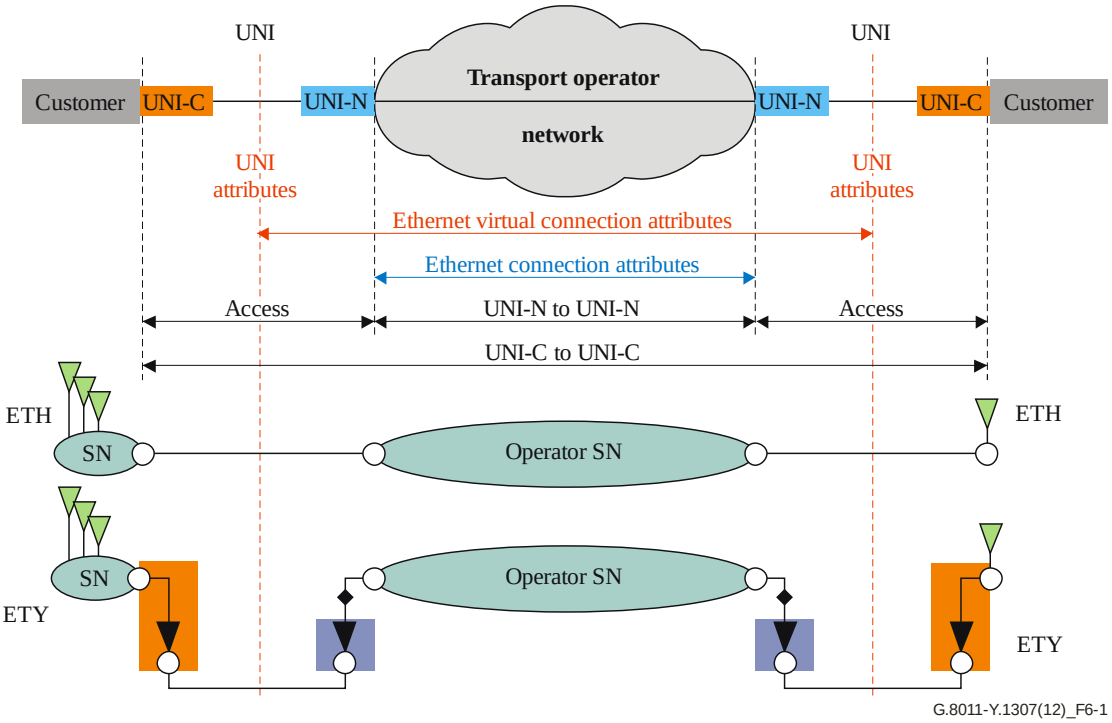

Figure 6-1 – Single-provider view of Ethernet service areas

Figure 6-2 shows a simple network where the service provider's network is a single link. It introduces the network-to-network (NNI) link, which is the link between the user-to-network interface - network side (UNI-N) and the NNI reference point.

Similar to the user-to-network interface (UNI), a demarcation occurs in the middle of the NNI link, or more precisely the NNI is a reference point whose functionality is split in half – either between different providers or within the same provider. Additional NNI details are defined in [ITU-T G.8012] and [ITU-T G.8012.1].

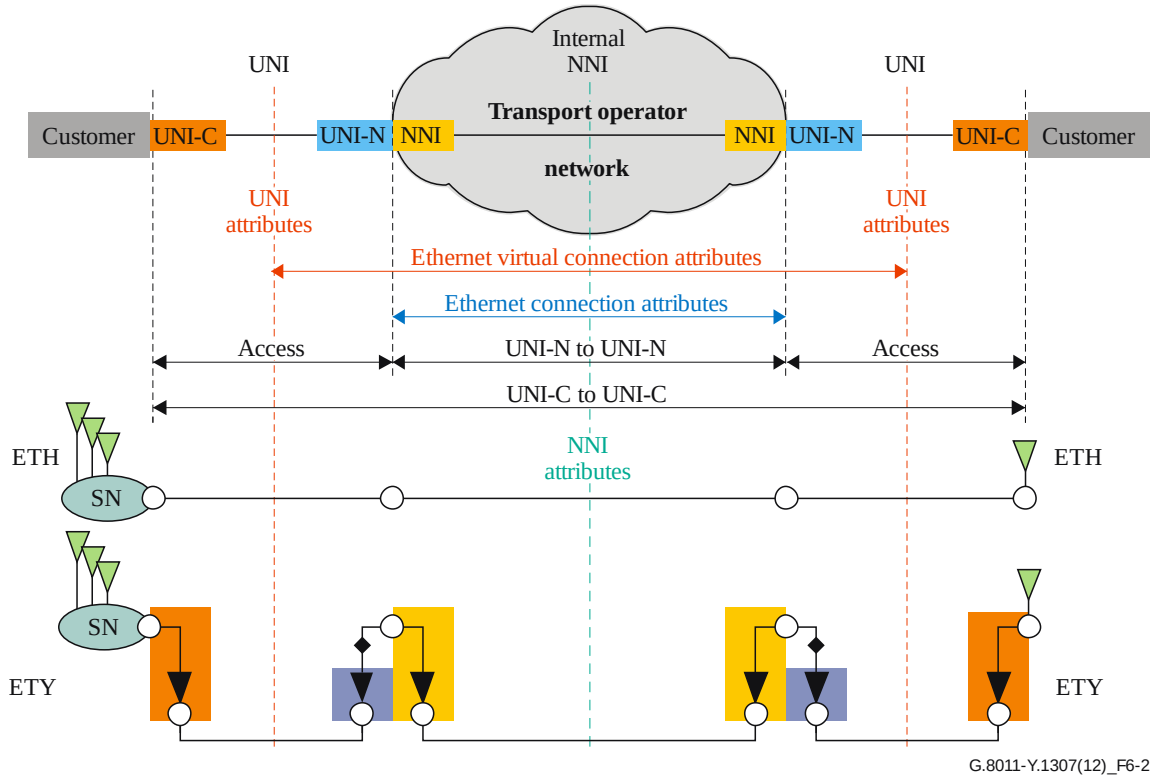

Figure 6-2 – Single-provider with NNI view of Ethernet service areas

Figure 6-3 shows the case of two interconnected operators and illustrates the implications to the NNI. Notably, this is an inter-domain NNI as defined in [ITU-T G.8012] and [ITU-T G.8012.1].

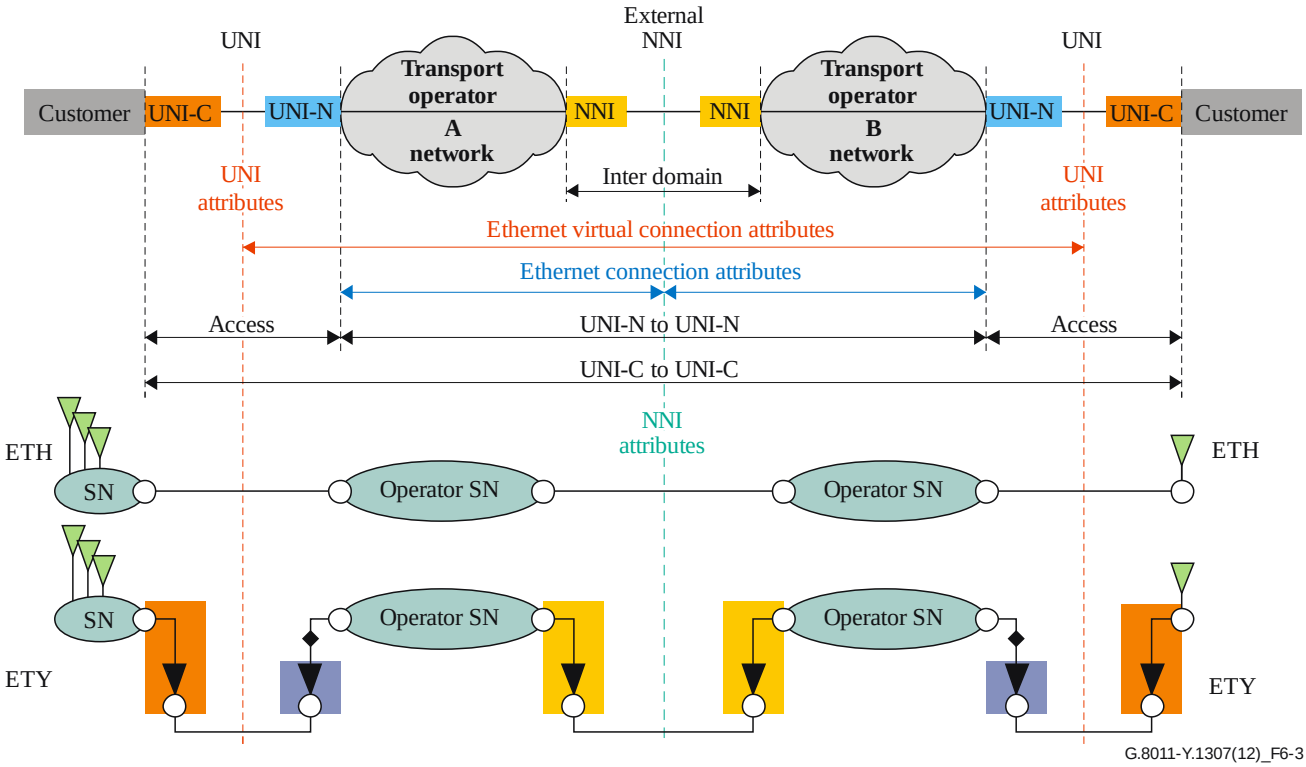

Figure 6-3 – Multi provider with NNI view of Ethernet service areas

An additional network view is shown in Annex A. Note that more complex networks beyond those described are for further study.

6.2 Ethernet service aspects

An Ethernet service provider provides Ethernet services between the UNI reference points shown in Figure 6-1, using the topology of the Ethernet network. This topology may be composed of a simple Ethernet link or alternatively one or more subnetworks and the links between them. Five sets of attributes can be derived from the Ethernet service areas figures to form a framework to define a specific Ethernet service. The locations of these five attribute sets (UNI-C port, UNI-N port, NNI port, Ethernet connection and Ethernet virtual connection) are also shown in Figures 6-1, 6-2 and 6-3.

The remainder of this Recommendation defines Ethernet virtual connection attributes and Ethernet connection attributes for the support of Ethernet services for UNI-N to UNI-N (clause 7), Ethernet UNI-N port attributes (clause 8) and Ethernet NNI port attributes for intra- and inter-carrier handoff (clause 9). The attributes for the UNI-C port are for further study. Details on the structures and mappings of the UNI and NNI to specific server layers are specified in [ITU-T G.8012] and [ITU-T G.8012.1]. The equipment functions of these interfaces are defined in [ITU-T G.8021] and [ITU-T G.8021.1].

Note that in most cases, EC is functionally equivalent to the EC defined by [MEF 12.1]. The EC is used to describe the network underlying the Ethernet service. To describe the Ethernet service, this Recommendation will use the term EVC as equivalent to the MEF EVC[1].

The permitted values for the sets of attributes will be specified for each of the Ethernet services that are defined in other Recommendations: [ITU-T G.8011.1], [ITU-T G.8011.2], [ITU-T G.8011.3], [ITU-T G.8011.4] and [ITU-T G.8011.5]. These Recommendations are aligned with similar services defined in [MEF 6.1]. The result is that this Recommendation allows classification of many Ethernet services.

6.3 Ethernet services perspective

It is important to understand the perspective of an Ethernet service. The full lists of attributes and their values may differ depending on whether the service is viewed from the network looking out or from the customer looking in.

The end result is that a service defined from the customer's perspective with MEF EVC and UNI attributes can be deployed over a network infrastructure service defined with ITU-T G.8011 EVC, EC and UNI attributes. This is especially true since the base attributes of this Recommendation are defined by MEF [MEF 10.2].

In [MEF 12.1], there is a clear relationship described between the "Service Model" constructs and the "Architecture Model" constructs, as well as a relationship between the reference points of the service model and the flow points/flow point pools of the architecture model. In particular, the term EVC is exclusively used as a service model construct that specifies an association between certain types of reference points, UNIs, while the term EC is used exclusively as an architecture model construct that identifies connection(s) created by network operators to instantiate the requested association of reference points.

6.3.1 Network perspective

This Recommendation presents the framework for a series of Ethernet services from the perspective of the network, that is, the operator or service provider. As a result, various topology, service and performance characteristics are visible that may not be visible from other views. This can result in a wide variety of services based on these parameters.

In addition, each service will have attributes that describe the behaviour of the network connection. These attributes may be simple (e.g., connectivity – pt-pt) or may be a grouping of attribute elements (e.g., characteristics – address, priority, etc.). It should be noted that in the network view, for example, the Ethernet connection (per Figure 6-1) set of attributes will have a number of infrastructure specific attributes. That is, the EC is not network agnostic.

6.3.2 Customer perspective

Ethernet services can also be described from the perspective of the customer, that is, the subscriber. Such a description does not provide any details about how a service is realized. That is, the EVC is network agnostic.

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[1] NOTE – The ITU-T G.8011-2004 Ethernet connection (EC) definition excluded the UNI-N. This was a significant difference from the MEF EVC at the time. As a result, ITU-T G.8011-2009 clarified that the EVC starts in the UNI-N making the EC and EVC essentially equivalent. However, additional clarifications from MEF 12.1 Figure 10 align with the original ITU-T G.8011. As a result, this Recommendation reinstates the difference between EC and EVC. Exactly where the start of the EVC is located depends on the underlying server layer.

This Recommendation is complementary to the definitions of Ethernet services from the viewpoint of the customer looking into the network. For example, the MEF EVC may be carried over an EC as described in [ITU-T G.8001].

7 Ethernet virtual connection and Ethernet connection attributes

7.1 Ethernet virtual connection (EVC)

This clause describes Ethernet virtual connection (EVC) attributes that characterize a particular instance of an Ethernet service. The area of applicability of these EVC attributes is identified in Figure 6-1 as being equivalent to the ETH connection or ETH connectivity (per clause 6.6 of [ITU-T G.8010]). The base set of ITU-T G.8011 EVC attributes is the same as the Ethernet virtual connection (EVC) attributes defined in Table 13 of [MEF 10.2] and they are summarized in Table 7-1.

Table 7-1 – EVC service attributes

EVC service attribute	Service attribute parameters and values	MEF 10.2 reference
EVC type	Point-to-point, multipoint-to-multipoint, or rooted-multipoint	6.1
EVC ID	An arbitrary string, unique across the MEN, for the EVC supporting the service instance	6.2
UNI list	A list of <UNI Identifier, UNI Type> pairs	6.3
Maximum number of UNIs	Integer. **MUST** be 2 if EVC type is point-to-point. **MUST** be greater than or equal to 2 otherwise	6.4
EVC maximum transmission unit size	2000 ≥ Integer ≥ 1522	6.10
CE-VLAN ID preservation	Yes or No	6.6.1
CE-VLAN CoS preservation	Yes or No	6.6.2
Unicast service frame delivery	Discard, deliver unconditionally, or deliver conditionally. If deliver conditionally is used, then the conditions **MUST** be specified	6.5.1.1
Multicast service frame delivery	Discard, deliver unconditionally, or deliver conditionally. If deliver conditionally is used, then the conditions **MUST** be specified	6.5.1.2
Broadcast service frame delivery	Discard, deliver unconditionally, or deliver conditionally. If deliver conditionally is used, then the conditions **MUST** be specified	6.5.1.3
Layer 2 control protocols processing	A list of Layer 2 control protocols labelled tunnel or discard	6.7
EVC performance	Performance objectives for frame delay performance, frame delay variation performance, frame loss ratio performance, and availability performance and associated class of service identifier(s) as defined in clause 6.8 of MEF 10.1	6.8, 6.9
NOTE – The upper bound of 2000 bytes for EVC MTU size is not indicated in [MEF 10.2]. It only applies for transport server layers that impose this restriction (e.g., 802.3 PHYs per [IEEE 802.3]).		

The relationship of these attributes to [ITU-T G.8010] is shown in Appendix I.

The values for these attributes will be specified for each of the Ethernet services defined in the ITU-T G.8011.x/Y.1307.x series of Recommendations.

7.2 Ethernet connection (EC)

This clause describes Ethernet connection (EC) attributes that characterize a particular instance of an Ethernet service. The area of applicability of these EC attributes is identified in Figure 6-1 as being equivalent to the ETH link (per clause 6.6 of [ITU-T G.8010]). These attributes are in addition to those defined in MEF and summarized in the previous clause.

Table 7-2 – EC service attributes

EC service attribute	Service attribute parameters and values	clause
Link type	Dedicated, shared	7.2.1
Survivability	None, specify	7.2.2

The relationship of these attributes to [ITU-T G.8010] is shown in Appendix I.

The values for these attributes will be specified for each of the Ethernet services defined in the ITU-T G.8011.x/Y.1307.x series of Recommendations.

7.2.1 Link type

This ITU service attribute indicates the characteristics of the server layer that is used to transport the Ethernet service. There are two options: dedicated or shared.

This attribute describes the bandwidth competition that an Ethernet service instance will encounter within the network. The use of the link type attribute in the context of a customer is for further study.

7.2.1.1 Dedicated link

A dedicated link type indicates that all ETH links supporting the EC have the following characteristics:

- Each ETH link is exclusively allocated to transport the ETH_CI of a single service instance.
- The ETH_CI transported by an ETH link does not compete for resources with the CI of other service instances.

This attribute is referring to an EC; an EC does not necessarily map onto a single link. As a result, if the link type is dedicated it follows that all links supporting the EC must be dedicated and have the corresponding characteristics.

7.2.1.2 Shared link

A shared link type indicates that one or more ETH links supporting the EC have the following characteristics:

- The ETH link is allocated to transport the ETH_CI of one or more service instances.
- The ETH_CI transported by an ETH link competes for resources with the CI of other service instances.

7.2.2 Survivability

The transport network can provide survivability for each service. The survivability alternatives for protection and restoration are related to Ethernet layer protection switching and/or server layer specific protection switching. As a result, the protection or restoration mechanism associated with the appropriate server layer as defined in [ITU-T G.8012] would be specified. Any additional relevant details on the server layer survivability would be listed in the definition of the service.

The options are: none or specify.

The options include:

- ITU-T G.8031 – Ethernet linear protection
- ITU-T G.8032 – Ethernet ring protection
- IEEE 802.1AX – Link aggregation
- IEEE 802.1Q (RSTP, MSTP, GVRP, MVRP) – Spanning Tree Restoration
- IEEE 802.1aq – Shortest path bridging

MEF defines metrics for resiliency and availability performance as part of [MEF 10.2] and [MEF 10.2.1].

8 Ethernet UNI attributes

8.1 UNI attributes

This clause describes service UNI attributes that characterize a particular instance of an Ethernet service at the demarc of the UNI noted in Figure 6-1. There is a UNI defined at each of the ETH and ETY layers. The base set of ITU-T G.8011 UNI attributes is the same as the UNI attributes defined in [MEF 10.2] Table 12 and they are summarized in Table 8-1.

Table 8-1 – UNI service attributes

Layer	UNI service attribute	Service attribute parameters and values	MEF 10.2 reference
ETH	UNI identifier	Any string	7.1
	MAC layer	IEEE 802.3 – 2012	7.3
	UNI maximum transmission unit size	2000 ≥ Integer ≥ 1522	7.4
	Service multiplexing	Yes or No	7.5
	UNI EVC ID	A string formed by the concatenation of the UNI ID and the EVC ID	7.6.2
	CE-VLAN ID for untagged and priority tagged service frames	A number in 1, 2, …, 4094	7.6.1
	CE-VLAN ID/EVC map	Map	7.7
	Maximum number of EVCs	Integer ≥ 1	7.8
	Bundling	Yes or No	7.9
	All to one bundling	Yes or No	7.10
	Ingress bandwidth profile per ingress UNI	No, or parameters	7.11.2.1, 7.11.1
	Ingress bandwidth profile per class of service identifier	No, or parameters for each class of service identifier	7.11.2.3, 7.11.1
	Ingress bandwidth Profile per EVC	No, or parameters for each EVC	7.11.2.2, 7.11.1
	Egress bandwidth profile per egress UNI	No, or parameters	7.11.3.1, 7.11.1
	Egress bandwidth profile per class of service identifier	No, or parameters for each class of service identifier	7.11.3.3, 7.11.1

Table 8-1 – UNI service attributes

Layer	UNI service attribute	Service attribute parameters and values	MEF 10.2 reference
	Egress bandwidth profile per EVC	No, or parameters for each EVC	7.11.3.2, 7.11.1
	Layer 2 control protocols processing	A list of layer 2 control protocols with each being labelled with one of Discard, Peer, Pass to EVC, Peer and Pass to EVC	7.13
ETY	Physical medium	A Standard Ethernet PHY	7.2
	Speed	10 Mbit/s, 100 Mbit/s, 10/100 Mbit/s Auto-negotiation, 1 Gbit/s, or 10 Gbit/s	7.2
	Mode	Full duplex	7.2
NOTE – The upper bound of 2000 bytes for UNI MTU size is not indicated in [MEF 10.2]. It only applies for transport server layers that impose this restriction (e.g., SDH and 802.3 PHYs per [IEEE 802.3]).			

9 Ethernet NNI attributes

9.1 Internal network-to-network interface (INNI) attributes

As it is internal to a network operator's network, this Recommendation does not specify service INNI attributes. However, an operator may specify attributes to characterize a particular instance of an Ethernet service at the demarc line of the internal NNI noted in Figure 6-2. There is an INNI defined at each of the ETH and server layers. These are described in [ITU-T G.8012] and [ITU-T G.8012.1].

9.2 External network-to-network interface (ENNI) attributes

This clause describes service ENNI attributes that characterize a particular instance of an Ethernet service at the demarc line of the external NNI noted in Figure 6-3. There is an ENNI defined at each of the ETH and server layers. The base set of ITU-T G.8011 ENNI attributes is the same as the ENNI attributes defined in Table 2 of [MEF 26.1] and they are summarized in Table 9-1.

Table 9-1 – ENNI service attributes

ENNI service attribute	Service attribute parameters and values	MEF 26.1 reference
Operator ENNI identifier	A string that is unique across the operator metro Ethernet network (MEN)	7.1.1
Physical layer	One of the PHYs listed in [R5] of [MEF 26.1]	7.1.2
Frame format	Frame formats as specified in 7.1.3 of [MEF 26.1]	7.1.3
Number of links	An integer with value 1 or 2	7.1.4
Protection mechanism	Link aggregation, none, or other	7.1.5
ENNI maximum transmission unit size	An integer number of bytes greater than or equal to 1526	7.1.6

Table 9-1 – ENNI service attributes

ENNI service attribute	Service attribute parameters and values	MEF 26.1 reference
End point map	A table with rows of the form <S-VLAN ID value, End Point Identifier, End Point Type>	7.1.7
Maximum number of OVCs	An integer greater than or equal to 1	7.1.8
Maximum number of OVC end points per OVC	An integer greater than or equal to 1	7.1.9

The relationship of these attributes to [ITU-T G.8010] is shown in Appendix I.

Other options for the protection mechanisms attribute are listed in clause 7.2.3.

10 Connectivity monitoring

Connectivity monitoring can be achieved via Ethernet OAM mechanisms defined in [ITU-T G.8013].

Additional specifications on the use of CFM as service OAM for fault management are defined in [MEF 30] and for performance monitoring are defined in [MEF 35].

Service OAM fault management [MEF 30] and service OAM performance monitoring [MEF 35] are used to implement the "EVC performance" EVC attribute.

CFM [ITU-T G.8013] may also be used to implement the "Survivability" EC attribute.

Annex A

Extended UNI

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

A.1 Introduction

This Recommendation introduced a simple network model in clause 6 while indicating that more complex models are possible. The UNI shown in Figure 6-1 is a simple or collapsed case. This annex introduces additional models that are possible.

A.2 Extended UNI-N

This case introduces an access network or private line inside the operator network that 'extends' the UNI link towards the demarc. The extended UNI would result in the UNI-N function that is shown in Figure A.1. The functions and attributes of the UNI-N are located in the device closest to the demarc thus extending from the device closest to the operator's network across an intermediate access network.

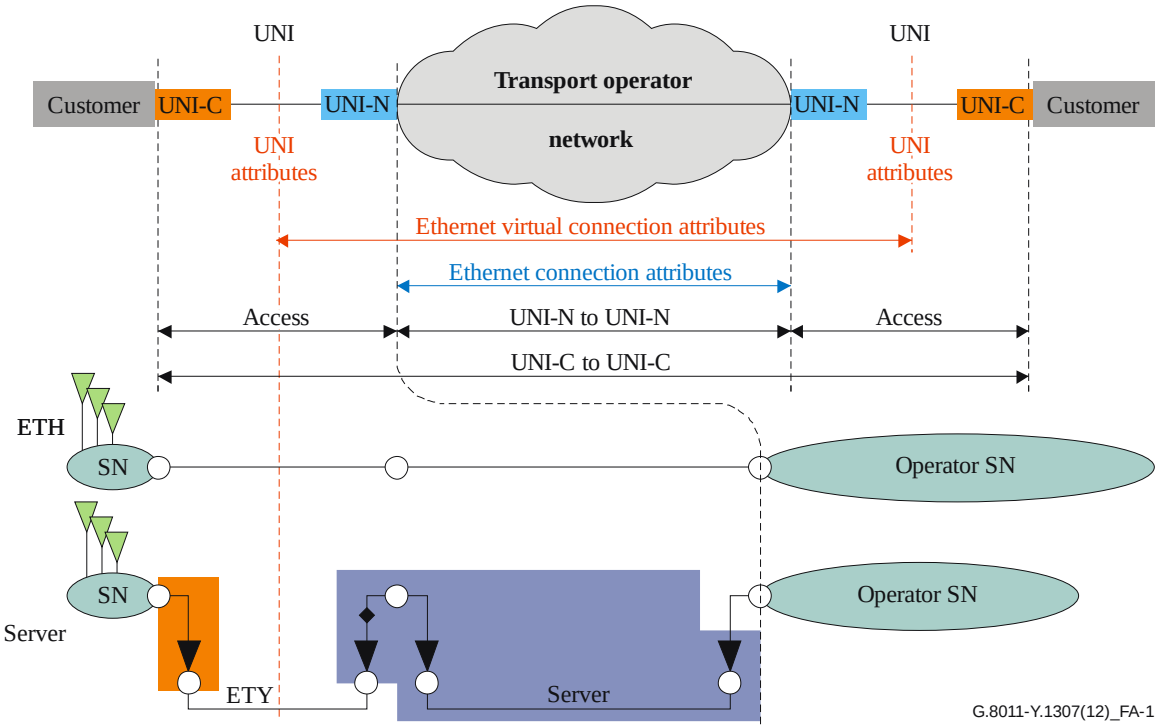


Figure A.1 – Single-provider view of Ethernet service areas with distributed UNI-N

Appendix I

Relationship of attributes defined in ITU-T G.8011 with the architecture of ITU-T G.8010

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

I.1 Introduction

This appendix describes the direct relationship of the attributes defined in this Recommendation with the architecture of [ITU-T G.8010].

I.2 Ethernet connection attributes

All Ethernet connection services are built by interconnecting ETH links. The service or EVC attributes are related to a set of ETH links, or an ETH subnetwork. They define restrictions on interconnection, or on the attributes of links to be used. The relationship of these attributes to [ITU-T G.8010] is shown in Table I.1 and Table I.2. Note that many of the architectural relationships listed below shown are in Figure 8-4.

Table I.1 – Relationship of EVC attributes defined in [ITU-T G.8011] with those in [ITU-T G.8010]

EVC service attribute (Table 7-1)	Service attribute parameters and values	ITU-T G.8010/Y.1306 relationship
EVC type	p2p, mp2mp, rooted mp	EC type
EVC ID	Arbitrary text string to identify associated EVC	Management plane identifier of EVC (not defined in[ITU-T G.8010])
UNI list	UNI ID + UNI type	Management plane list of addresses of FP (not defined in [ITU-T G.8010])
Preservation	VLAN – yes or no CoS – yes or no	Allowing for insertion/extraction of VLAN tag in ETH/ETH-m adaptation with the same VID and PCP/DEI values as on the UNI
Service frame delivery	Discard, deliver unconditionally, or deliver conditionally	Address – Determines whether EC uses filtering when forwarding traffic units between interconnecting links Priority – Determines whether all Queuing process should differentiate based on priority (PCP/DEI bits)
L2CP processing	Discard, or tunnel	Determines whether EC uses filtering when interconnecting links. Filtering is performed in ETH/ETH or ETH/ETH-m adaptation sink
Performance	Specify	Performance associated with ETH SNC
Bandwidth profile	Specify	Bandwidth associated with the EC at the UNI-N

Table I.2 – Relationship of EC attributes defined in [ITU-T G.8011] with those in [ITU-T G.8010]

EC service attribute (Table 7-2)	Service attribute parameters and values	ITU-T G.8010/Y.1306 relationship
Link type	Dedicated, shared	Determines the mapping of EC to ETH links. Dedicated means exactly 1 EC per ETH link, Shared means 1 or more ECs per ETH link
Survivability	None, specify	ETH and server layer survivability.

I.3 Interface attributes

Tables I.3 and I.4 show the relationship between [ITU-T G.8010] and the UNI and ENNI attributes defined in this Recommendation. Note that many of the architectural functions listed are in Figure 15 of [ITU-T G.8010].

Table I.3 – Relationship of UNI attributes defined in [ITU-T G.8011] with those in [ITU-T G.8010]

UNI attributes (Table 8-1)	ITU-T G.8010/Y.1306 description	ITU-T G.8010/Y.1306 architectural function
UNI ID	Management identifier of ETH FP (not defined in [ITU-T G.8010])	One or more flow points (FPs)
UNI EVC ID	Management identifier of UNI EVC (not defined in [ITU-T G.8010])	–
MAC layer	ETH layer	ETH layer network
CE-VLAN ID /EVC mapping	Flow point mapping to configure EC function	ETH_FP to/from SNC
Service multiplexing	ETH multiplexing	ETY/ETH-m adaptation function used
Bundling		
Bandwidth profile	Traffic conditioning and shaping	ETH_TCS function
Layer 2 control protocol processing	IEEE 802.3 L2 protocol generation and termination	IEEE 802.3 protocols process in Srv/ETH adaptation
	GARP & reserved-address filtering	Filter process in Srv/ETH adaptation
PHY speed/mode/medium	Server layer technology	ETY adaptation and TT

Table I.4 shows the relationship between [ITU-T G.8010] and the ENNI attributes defined in this Recommendation.

Table I.4 – Relationship of ENNI attributes defined in [ITU-T G.8011] with those in [ITU-T G.8010]

EC per UNI attributes (Table 9-1)	ITU-T G.8010/Y.1306 description	ITU-T G.8010/Y.1306 architectural function
Operator ENNI identifier	Management identifier of ETH FP (not defined in [ITU-T G.8010])	FP
Physical layer	Server layer technology	ETY adaptation and TT
Frame format	ETH_CI	ETH_CI
Number of links	Number of ETY trails	ETY trail
Protection mechanism	survivability	survivability
End point map	Flow point mapping to configure EC function	ETH_FP to/from SNC

Appendix II

EC topology

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

II.1 EC topology

The EC topology instantiated to support an EVC indicates the connectivity between Ethernet endpoints in the transport service. There are three options, as defined in clause 6.1 of [MEF 10.2]: pt-pt, mp-mp, pt-mp. They are also defined in [ITU-T G.8010]. The following clauses show how these are modelled.

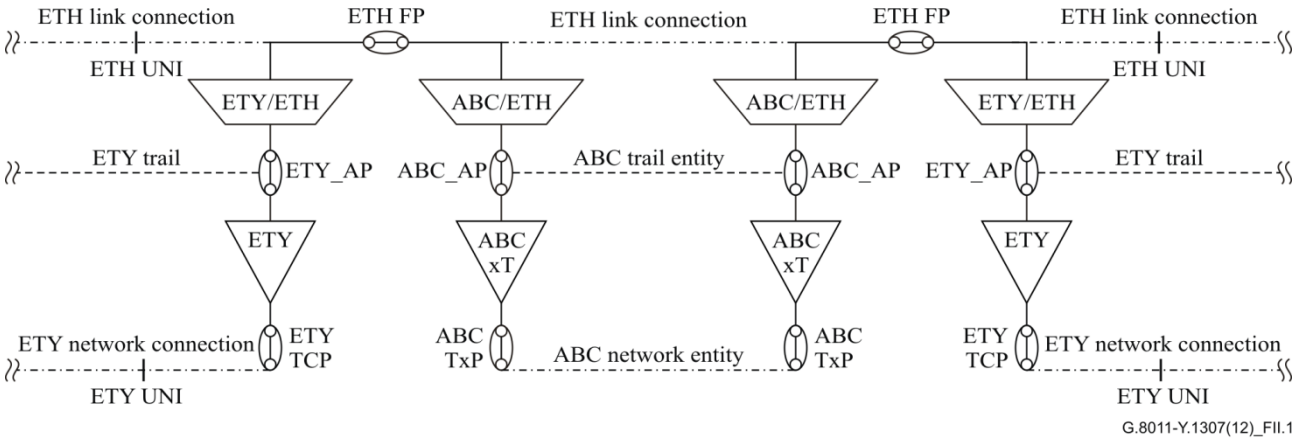
II.1.1 Point-to-point

E-Line EVC is supported by a point-to-point (pt-pt) EC which has exactly two points. The pt-pt EC is supported by:

- a link connection within the provider network (non-extendible), or
- a subnetwork connection with only two flow points in use (extendible).

The topology for the network portion of the non-extendible pt-pt service is shown in Figure II.1.

The ETH link connection may be supported by a server layer technology that is connection oriented (circuit switched or packet switched) or connectionless.



ABC - a connection-oriented circuit switched or connection-oriented packet switched or connectionless technology
ABC - xT, x = T, connection-oriented trail termination for technology ABC
ABC - xT, x = F, connectionless flow termination for technology ABC
ABC trail entity = ABC trail for connection-oriented technology, ABC connectionless trail for connectionless technology
ABC network entity = ABC network connection for connection-oriented technology, ABC network flow for connectionless technology

Figure II.1 – Network portion of the point-to-point topology

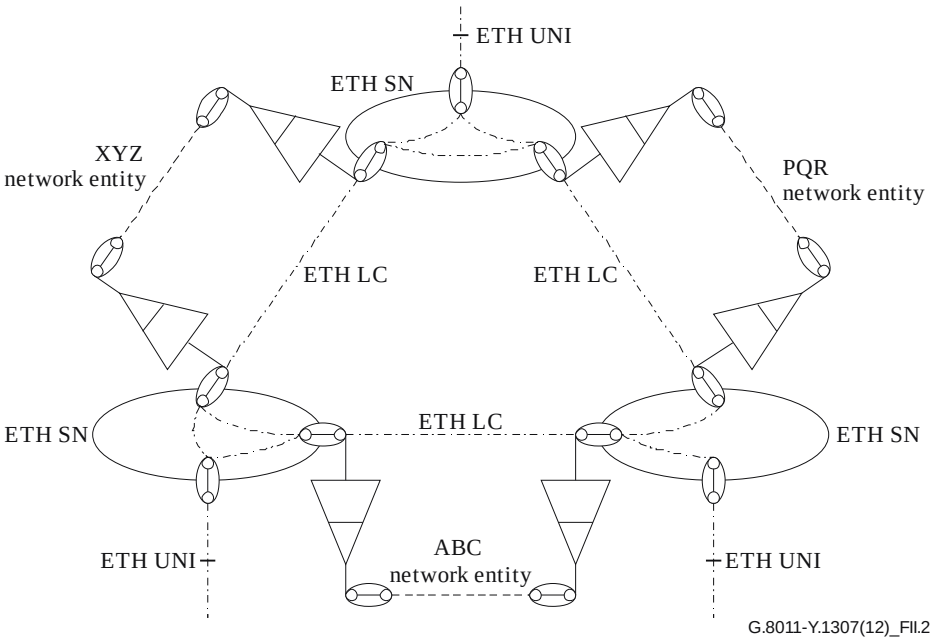
II.1.2 Multipoint-to-multipoint

ELAN EVC is supported by a multipoint to multipoint (mp-mp) EC which has two or more points.

The topology for the network portion for LAN services consists of one or more subnetworks with ETH links between them, as shown in Figure II.2.

Each of the ETH links may be supported by a server layer technology that is connection oriented (circuit switched or packet switched) or connectionless. Additional ETH termination points can be added/deleted to/from this service topology.

A special case of the mp-mp construct is where the subnetwork has only two flow points in use. In this case, it supports a pt-pt service as described in clause II.1.1.



ABC, PQR, XYZ are server layer networks (can all be the same or different).
They may be CO-CS, CO-PS, CLPS

Figure II.2 – Network portion of the multipoint-to-multipoint topology

II.1.3 Rooted-multipoint

ETREE EVC is supported by a rooted multipoint (rooted mp) EC which is between one or more root points and one or more leaf points.

For the E-Tree service, each leaf point can only exchange data with the root point, while a root point can exchange data with each leaf point and other root points.

The topology for the rooted multipoint EC consists of one or more subnetworks with ETH links between them, as shown in Figure II.3.

Each of the ETH links may be supported by a server layer technology that is connection oriented (circuit switched or packet switched) or connectionless. Additional ETH termination points can be added or deleted to/from this service topology.

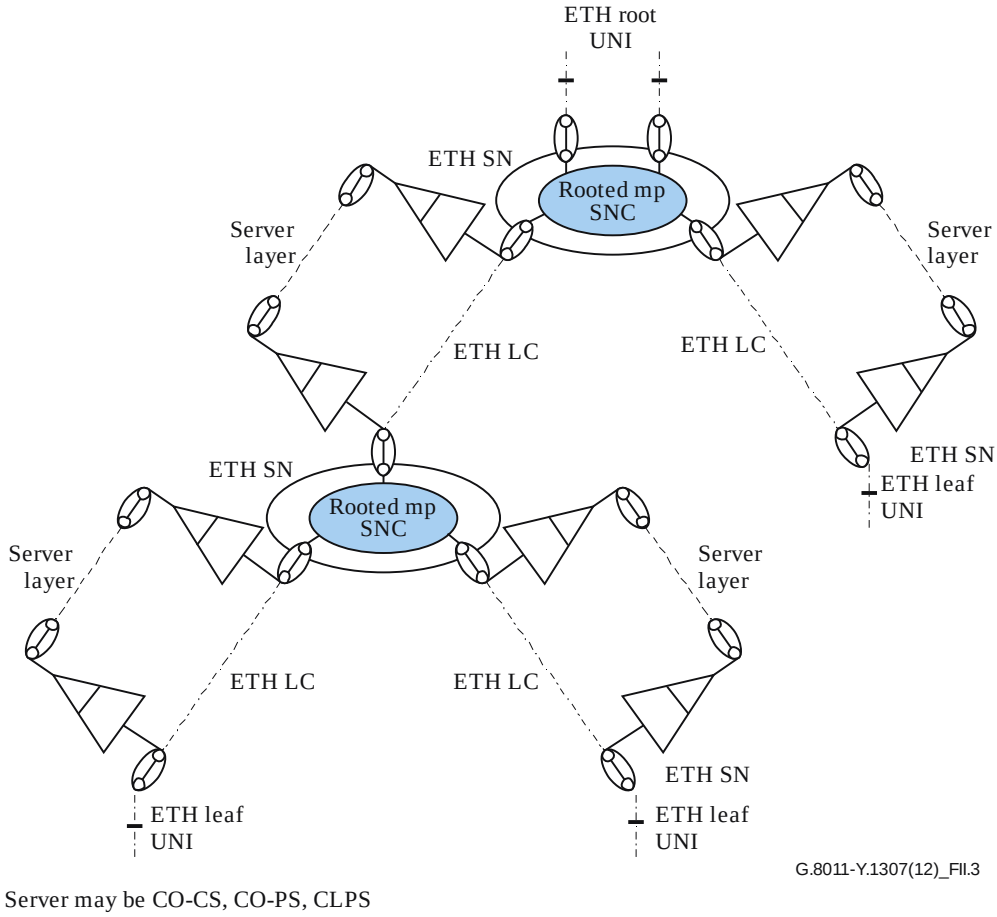
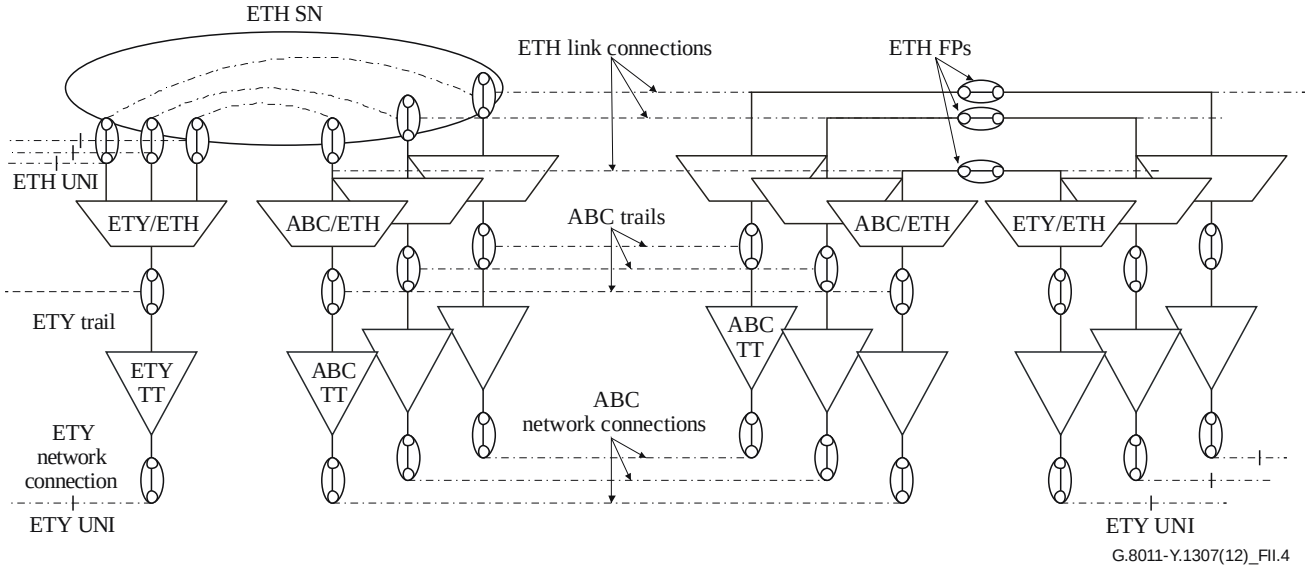


Figure II.3 – Network portion of the point-to-multipoint topology

II.2 Service multiplexing

Service multiplexing, as defined in clause 7.5 of [MEF 10.2], indicates whether the access to the Ethernet transport service is multiplexed (i.e., contains multiple service instances) or not.

The topology illustrated in Figure II.4 consists of N point-to-point connections presented to a single physical interface.



NOTE – For simplicity, connection-oriented technology ABC is shown on all server trails. Different technologies can also be used on each.

Figure II.4 – Network portion of the service multiplexing line topology

In the case of service multiplexing at the service UNI (demarc), one ETH link is used between the provider and the customer to transport ETH_CI of multiple customers' service instances. On ingress, the onus is on customer equipment to shape the service instance that will be multiplexed to ensure sufficient fairness to avoid congestion of the access link. The network can ensure service instance bandwidth on the ETH link with traffic conditioning.

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