International Telecommunication Union

ITU-T G.8011/Y.1307

(10/2020)

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

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

Ethernet service characteristics

Recommendation ITU-T G.8011/Y.1307

ITU-T G-SERIES RECOMMENDATIONS

TRANSMISSION SYSTEMS AND MEDIA, DIGITAL SYSTEMS AND NETWORKS

INTERNATIONAL TELEPHONE CONNECTIONS AND CIRCUITS	G.100–G.199
GENERAL CHARACTERISTICS COMMON TO ALL ANALOGUE CARRIER-TRANSMISSION SYSTEMS	G.200–G.299
INDIVIDUAL CHARACTERISTICS OF INTERNATIONAL CARRIER TELEPHONE SYSTEMS ON METALLIC LINES	G.300–G.399
GENERAL CHARACTERISTICS OF INTERNATIONAL CARRIER TELEPHONE SYSTEMS ON RADIO-RELAY OR SATELLITE LINKS AND INTERCONNECTION WITH METALLIC LINES	G.400–G.449
COORDINATION OF RADIOTELEPHONY AND LINE TELEPHONY	G.450–G.499
TRANSMISSION MEDIA AND OPTICAL SYSTEMS CHARACTERISTICS	G.600–G.699
DIGITAL TERMINAL EQUIPMENTS	G.700–G.799
DIGITAL NETWORKS	G.800–G.899
DIGITAL SECTIONS AND DIGITAL LINE SYSTEM	G.900–G.999
MULTIMEDIA QUALITY OF SERVICE AND PERFORMANCE – GENERIC AND USER-RELATED ASPECTS	G.1000–G.1999
TRANSMISSION MEDIA CHARACTERISTICS	G.6000–G.6999
DATA OVER TRANSPORT – GENERIC ASPECTS	G.7000–G.7999
PACKET OVER TRANSPORT ASPECTS	G.8000–G.8999
Ethernet over Transport aspects	**G.8000–G.8099**
MPLS over Transport aspects	G.8100–G.8199
Synchronization, quality and availability targets	G.8200–G.8299
Mobile network transport aspects	G.8300–G.8399
Service Management	G.8600–G.8699
ACCESS NETWORKS	G.9000–G.9999

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

Recommendation ITU-T G.8011/Y.1307

Ethernet service characteristics

Summary

Recommendation ITU-T G.8011/Y.1307 establishes a framework to describe network-oriented characteristics of Ethernet services based on the documents of a non-profit industry forum of network, cloud and technology providers, the MEF. The framework is supported by the modelling of Ethernet layer networks described by ITU-T and MEF. The service definition, service attributes and operation, administration and maintenance (OAM) introduced in this framework are used to create numerous specific Ethernet services.

History

Edition	Recommendation	Approval	Study Group	Unique ID*
1.0	ITU-T G.8011/Y.1307	2004-08-22	15	11.1002/1000/7358
1.1	ITU-T G.8011/Y.1307 (2004) Cor. 1	2005-06-29	15	11.1002/1000/8530
1.2	ITU-T G.8011/Y.1307 (2004) Amd. 1	2005-08-22	15	11.1002/1000/7359
2.0	ITU-T G.8011/Y.1307	2009-01-13	15	11.1002/1000/9660
3.0	ITU-T G.8011/Y.1307	2012-10-29	15	11.1002/1000/11782
3.1	ITU-T G.8011/Y.1307 (2012) Cor. 1	2013-08-29	15	11.1002/1000/12002
4.0	ITU-T G.8011/Y.1307	2015-01-13	15	11.1002/1000/12380
5.0	ITU-T G.8011/Y.1307	2016-11-13	15	11.1002/1000/13093
6.0	ITU-T G.8011/Y.1307	2018-11-29	15	11.1002/1000/13756
7.0	ITU-T G.8011/Y.1307	2020-10-29	15	11.1002/1000/14504

Keywords

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

---

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

FOREWORD

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

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

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

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

NOTE

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

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

INTELLECTUAL PROPERTY RIGHTS

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

Table of Contents

Recommendation ITU-T G.8011/Y.1307

Ethernet service characteristics

1 Scope

This Recommendation establishes a framework to describe Ethernet services based on the documents of a non-profit industry forum of network, cloud and technology providers, the MEF. The framework consists of a set of service definitions, service attributes and operation, administration and maintenance (OAM) for each Ethernet virtual connection (EVC), operator virtual connection (OVC), Ethernet services layer connection (EC), Ethernet user-to-network interface (UNI) and Ethernet external network-to-network interface (ENNI). The resulting services that can be described do not refer to a particular network technology implementation and are supported by ITU-T and MEF Ethernet layer architecture models.

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

[ITU-T G.8013 (2015)] Recommendation ITU-T G.8013/Y.1731 (2015), *Operations, administration and maintenance (OAM) functions and mechanisms for Ethernet-based networks*.

[IEEE 802.1AX] IEEE 802.1AX-2014, *IEEE Standard for Local and metropolitan area networks – Link aggregation*.

[IEEE 802.1Q] IEEE 802.1Q-2014, *IEEE Standard for Local and metropolitan area networks – Bridges and bridged networks*.

[IEEE 802.3] IEEE 802.3-2015, *IEEE Standard for Ethernet.*

[MEF 6.3] MEF 6.3 (2019), *Subscriber Ethernet services definitions*.

[MEF 10.4] MEF 10.4 (2018), *Subscriber Ethernet service attributes*.

[MEF 12.2] MEF 12.2 (2014), *Carrier Ethernet network architecture framework part 2: Ethernet services layer*.

[MEF 13] MEF 13 (2005), *User network interface (UNI) type 1 implementation agreement.*

[MEF 20] MEF 20 (2008), *User network interface (UNI) type 2 implementation agreement*.

[MEF 22.3] MEF 22.3 (2018), *Transport services for mobile networks.*

[MEF 22.3.1] MEF 22.3.1 (2020), *Amendment to MEF 22.3: Transport services for mobile networks*.

[MEF 23.2] MEF 23.2 (2016), *Carrier Ethernet class of service – Phase 3 implementation agreement*.

[MEF 23.2.1] MEF 23.2.1 (2017), *Models for bandwidth profiles with token sharing – Amendment to MEF 23.2.*

[MEF 26.2] MEF 26.2 (2016), *External network network interfaces (ENNI) and operator service attributes*.

[MEF 30.1] MEF 30.1 (2013), *Service OAM fault management implementation agreement: Phase 2*.

[MEF 30.1.1] MEF 30.1.1 (2014), *Amendment to MEF 30.1 – Correction to requirement.*

[MEF 33] MEF 33 (2012), *Ethernet Access services definition.*

[MEF 35.1] MEF 35.1 (2015), *Service OAM performance monitoring implementation agreement.*

[MEF 43] MEF 43 (2014), *Virtual NID (vNID) functionality for E-access services.*

[MEF 45.1] MEF 45.1 (2018), *Layer 2 control protocols in Ethernet services*.

[MEF 47] MEF 47 (2014), *Carrier Ethernet services for cloud implementation agreement.*

[MEF 51] MEF 51 (2015), *OVC services definitions.*

[MEF 51.1] MEF 51.1 (2018), *Operator Ethernet service definitions*.

[MEF 62] MEF 62 (2018), *Managed access E-line service implementation agreement.*

[MEF 65] MEF 65 (2020), *Simplified transit E-line service.*

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 Ethernet virtual connection (EVC): [MEF 10.4].

3.1.2 External NNI (ENNI): [MEF 26.2].

3.1.3 operator virtual connection (OVC): [MEF 26.2].

3.1.4 service frame: [MEF 10.4].

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 customer: The entity that has ownership authority over a set of flow points. The customer may have one or more service instances.

3.2.2 Ethernet service: An Ethernet service supports an Ethernet flow (as specified in [ITU-T G.8010] as ETH flow). It is determined by the topology of the Ethernet network and a corresponding set of attributes associated with the Ethernet services layer connection (EC), the user-to-network interface (UNI) ports and network-to-network interface (NNI) ports.

NOTE – Based on [MEF 10.4].

3.2.3 network-to-network interface (NNI): An interface that is used for the interconnection of network elements within a transport network.

3.2.4 user-to-network interface (UNI): An interface that is used for the interconnection of customer equipment with a network element of the transport network.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

5G	fifth Generation
AP	Access Provider
APP	Application
CE	Carrier Ethernet
CEN	Carrier Ethernet Network
CoS	Class of Service
CPO	CoS Performance Objective
DCA	Data Centre Access
DCI	Data Centre Interconnect
E-	Ethernet-
EC	Ethernet services layer Connection
EFD	Ethernet Flow Domain
EI	External Interface
ENNI	External Network-to-Network Interface
EP	End Point
ETH	Ethernet MAC layer network
EVC	Ethernet Virtual Connection
FM	Fault Management
FP	Flow Point
IA	Implementation Agreement
L2CP	Layer 2 Control Protocol
LAN	Local Area Network
LMI	Link Management Interface
MAC	Media Access Control
MEG	Maintenance Entity Group
MPLS	Multi-Protocol Label Switching
NID	Network Interface Device
NNI	Network-to-Network Interface
OAM	Operation, Administration and Maintenance
O-	OVC-
O-EC	OVC-Ethernet services layer Connection
OVC	Operator Virtual Connection
PM	Performance Monitoring
RMI	Remote Management Interface
S-EC	Subscriber Ethernet services layer Connection

SDH Synchronous Digital Hierarchy

SOAM Service Operation, Administration and Maintenance

SONET Synchronous Optical Network

SN Subscriber Network

SP Service Provider

STEL Simplified Transit E-Line

TFP Termination Flow Point

TRAN Transport

UNI User-to-Network Interface

UNI-C User-to-Network Interface-Customer

UNI-N User-to-Network Interface-Network

VLAN Virtual Local Area Network

vNID virtual NID

5 Conventions

None.

6 Carrier Ethernet services and attributes

6.1 Description of MEF carrier Ethernet service

Carrier Ethernet (CE) service is defined in [b-MEF 6.2]. In [MEF 6.3] and [MEF 10.4] some of the terminology used to describe Ethernet Services has been updated. The [b-MEF 6.2] term "carrier Ethernet network" (CEN) is now referred to as a "service provider network" and the abbreviations CE and CEN are replaced by subscriber network (SN) and service provider (SP) network, respectively. The CEN terminology is still used in some MEF documents. As depicted in Figure 1, the MEF network reference model defines Ethernet services that transport subscriber Ethernet frames across an SP network. The SP is responsible for the performance and availability of the service between the UNI demarcation points.

Ethernet service frames are transported across the SP network through virtual connections. [MEF 6.3] defines three service types: an Ethernet-line (E-line), which is a point-to-point EVC, an Ethernet-local area network (E-LAN), which is a multipoint-to-multipoint EVC, and an E-tree, which uses a rooted multipoint EVC. The MEF service definition is built on virtual connections, as specified in [IEEE 802.1Q], established over lower-layer transport services. Therefore, Ethernet service frames, as specified in [IEEE 802.3], can be transported over a variety of different technologies, such as synchronous optical network/synchronous digital hierarchy (SONET/SDH), multi-protocol label switching (MPLS), bundled-copper and fibre. The underlying transport mechanisms may vary on a link-by-link basis. Thus, SPs can offer CE services independently of the underlying transport technology.

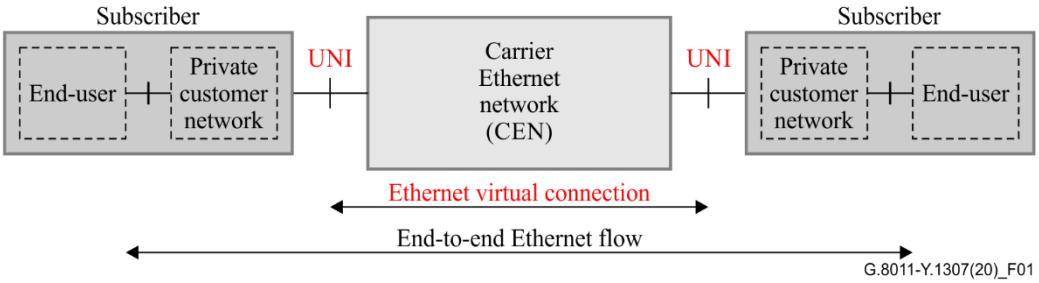


Figure 1 – Basic MEF framework reference model

Building on the basic reference model illustrated in Figure 1, SPs needed the capability to extend service delivery outside of their franchise. To enable this connectivity, the MEF created a UNI tunnelled access [MEF 26.2] and an E-access service definition [MEF 33]. Figure 2 illustrates a SN service using an E-access service [MEF 51.1]. As the SP does not have the facilities to deliver SN service end-to-end, it uses an access provider (AP) from an ENNI to the end subscriber. By connecting together two OVCs, they can deliver the end-to-end service. The case where the SP does not have to deploy an additional network interface device (NID) is described as a virtual NID E-access service [MEF 43].

Another means to deliver end-to-end connectivity is achieved by using a UNI tunnelled access [MEF 26.2], which resembles an E-access service, but has the AP UNI functionality located at both ENNI and remote UNI.

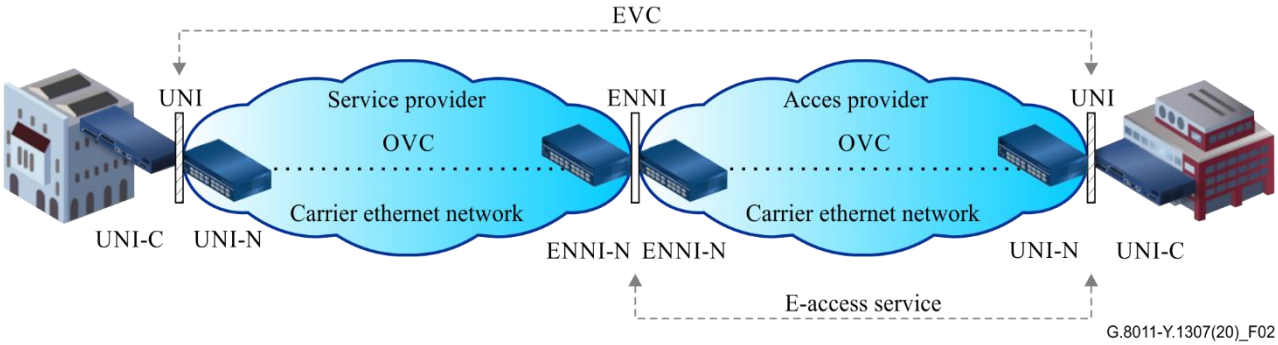


Figure 2 – E-access service example

The application of this service definition to mobile backhaul is described in [MEF 22.3] and [MEF 22.3.1]. The mobile backhaul application defines the addition of resiliency, availability and synchronization with the service definition.

6.2 Description of MEF carrier Ethernet service attributes

As shown in Figure 1, an EVC connects two UNIs to deliver SN services. The attributes and parameters for this service are defined in [MEF 10.4]. The attributes detailing the interaction of layer 2 control protocols (L2CPs) in multi-CEN environments are defined in [MEF 45.1]. The resulting service attributes are categorized as subscriber UNI service attributes, EVC end point (EP) service attributes, and EVC service attributes, as shown in Table 1.

Table 1 – Ethernet service attributes

UNI service attribute	EVC per UNI service attribute	EVC service attribute
Subscriber UNI ID	EVC EP ID	EVC ID
Subscriber UNI instantiation	EVC EP UNI	EVC list of EVC EPs
Subscriber UNI virtual frame map	EVC EP role	EVC type
Subscriber UNI list of physical links	EVC EP map	EVC data service frame disposition
Subscriber UNI link aggregation	EVC EP ingress class of service map	EVC C-tag PCP preservation
Subscriber UNI port conversation ID	EVC EP colour map	EVC C-tag DEI preservation
Subscriber UNI service frame format	EVC EP egress map	EVC list of class of service names
Subscriber UNI maximum service frame size	EVC EP ingress bandwidth profile	EVC service level specification
Subscriber UNI maximum number of EVC EPs	EVC EP class of service name ingress bandwidth profile	EVC group membership
Subscriber UNI maximum number of C-tag VLAN IDs per EVC EP	EVC EP egress bandwidth profile	EVC maximum service frame size
Subscriber UNI token share	EVC EP class of service name egress bandwidth profile	EVC available MEG level
Subscriber UNI envelopes	EVC EP source MAC address limit	
Subscriber UNI link OAM	EVC EP subscriber MEG MIP	
Subscriber UNI MEG		
Subscriber UNI LAG link MEG		
Subscriber UNI L2CP address set		
Subscriber UNI L2CP peering		

As shown in Figure 2, CE services can be delivered by connecting OVCs through an ENNI, therefore using different operator CENs.

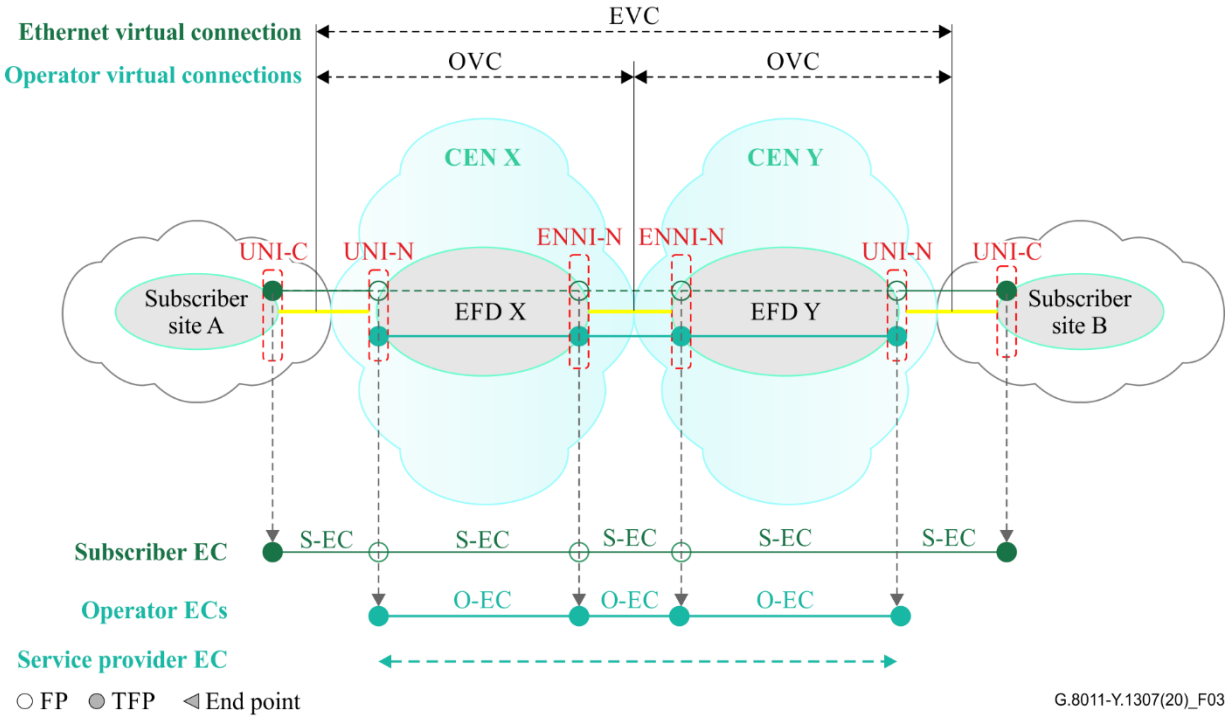
MEF has defined a set of three standardized classes of service (CoSs) in [MEF 23.2], as well as a fourth for synchronization in [MEF 22.2] in support of mobile backhaul. Elastic services that allow modification of service attributes related to CoSs, in support of cloud services, are specified in [MEF 47]. In addition, CoS performance objectives for a number of defined metrics are specified and grouped into performance tiers.

Link aggregation [IEEE 802.1AX] is used for UNI resiliency.

6.3 Description of MEF carrier Ethernet service architecture

The MEF has defined a carrier Ethernet architecture in [MEF 12.2]. This work is aligned with and builds on the topological constructs of the Ethernet layer architecture model in [ITU-T G.8010]. Figure 3 shows a base model of an Ethernet service and the relationship between the EVC, the OVC, as well as the underlying ECs including EPs and flow points (FPs).

In addition, MEF has further detailed two modes of operation for configuration of the user-to-network interface-customer (UNI-C) side and the user-to-network interface-network (UNI-N) side. These are UNI type 1 [MEF 13] and UNI type 2 [MEF 20].



EFD: Ethernet flow domain; O-EC: OVC-Ethernet services layer connection;
S-EC: subscriber-Ethernet services layer connection; TFP: termination flow point

Figure 3 – Base MEF architecture

6.4 Description of MEF carrier Ethernet OAM

Connectivity monitoring can be achieved via Ethernet OAM mechanisms specified in [ITU-T G.8013 (2015)]. Additional specifications on the use of service operation, administration and maintenance (SOAM) for fault management (FM) and performance monitoring (PM) are defined in [MEF 30.1] and [MEF 35.1], respectively.

6.5 Description of MEF OVC service

An operator virtual connection (OVC) is defined in [MEF 26.2]. The OVC service is described in [MEF 51.1], which defines OVC services that can be offered by an operator of a CEN. The OVC services are constructed using the OVC, the OVC EPs at the ENNI and the UNI. [MEF 51.1] contains the general OVC-based services (OVC-line (O-line), O-LAN and O-tree) along with transit E-line and transit E-LAN service definitions that are built on the general OVC-based services.

Appendix I

Summary of MEF documents

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

Table I.1 lists the MEF documents that are cited in this Recommendation. They are listed in numerical order and grouped according to the structure of clause 6.

This latest set of approved MEF documents describes carrier Ethernet architecture, service definitions and service attributes.

Table I.1 –MEF documents cited in this Recommendation

Reference	MEF document title	Group name
[MEF 6.3]	*Subscriber Ethernet services definitions*	Service definition
[MEF 10.4]	*Subscriber Ethernet service attributes*	Service attributes
[MEF 12.2]	*Carrier Ethernet network architecture framework part 2: Ethernet services layer*	Architecture
[MEF 13]	*User network interface (UNI) type 1 implementation agreement*	Architecture
[MEF 20]	*User network interface (UNI) type 2 implementation agreement*	Architecture
[MEF 22.3]	*Transport services for mobile networks*	Service definition
[MEF 22.3.1]	*Amendment to MEF 22.3: Transport services for mobile networks*	Service definition
[MEF 23.2]	*Carrier Ethernet class of service – Phase 3implementation agreement*	Service attributes
[MEF 23.2.1]	*Models for bandwidth profiles with token sharing – Amendment to MEF 23.2*	Service attributes
[MEF 26.2]	*External network network interface (ENNI) and operator service attributes*	Service attributes
[MEF 30.1]	*Service OAM fault management implementation agreement: Phase 2*	OAM
[MEF 30.1.1]	Amendment to [MEF 30.1] – Correction to Requirement	OAM
[MEF 33]	*Ethernet Access services definition*	Service definition
[MEF 35.1]	*Service OAM performance monitoring*	OAM
[MEF 43]	*Virtual NID (vNID) functionality for E-access services*	Service definition
[MEF 45.1]	*Layer 2 control protocols in Ethernet services*	Service attributes
[MEF 47]	*Carrier Ethernet services for cloud implementation agreement*	Service definition
[MEF 51]	*OVC services definitions*	Service definition
[MEF 51.1]	*Operator Ethernet service definitions*	Service definition
[MEF 62]	*Managed access E-line service implementation agreement*	Service definition
[MEF 65]	*Simplified transit E-line service*	Service definition

Clauses I.1 to I.4 provide a brief summary of the content of cited MEF documents.

I.1 Architecture documents

MEF 12.2*, Carrier Ethernet network architecture framework part 2: Ethernet services layer*

[MEF 12.2] provides the architecture framework to model the Ethernet services layer of MEF compliant CENs. The Ethernet services layer architecture framework describes the high-level topological and functional constructs used to model the various architectural components of the Ethernet service subscriber and provider networks, their associated functional elements and their interconnect relationships. The architecture framework also describes the relationship between Ethernet services layer interfaces, functional elements and their reference points, and other architectural elements in the transport (TRAN) layer and application (APP) layers of the [b-MEF 4].

MEF 13, *User network interface (UNI) type 1 implementation agreement*

The main objective of [MEF 13] is to specify the MEF UNI characteristics and operation in manual configuration mode. This allows existing Ethernet devices (e.g., switches, routers, work stations) acting as CEs to be instantly compliant with [MEF 13] with no additional software or hardware upgrades. The main functionality of [MEF 13] is to allow data plane Ethernet connectivity between the UNI-C and UNI-N. [MEF 13] cites MEF UNI requirements and a framework for all concepts, constructs and terminology. The UNI type 1 mode provides the minimum data plane connectivity services with no control plane or management plane capabilities.

MEF 20, *User network interface (UNI) type 2 implementation agreement*

[MEF 20] adds new functionalities to MEF UNI type 1 [MEF 13], such as Ethernet-link management interface (E-LMI) based on [b-MEF 16], link OAM based on clause 57 of [IEEE 802.3], SOAM based on [b-ITU-T Y.1731 (2006)] and [b-IEEE 802.1ag] and protection using link aggregation based on clause 43 of [IEEE 802.3].

I.2 Service attribute documents

MEF 10.4 – *Subscriber Ethernet service attributes*

[MEF 10.4] describes the service attributes for subscriber Ethernet services provided to an Ethernet subscriber by an Ethernet SP. The service attributes describe behaviours observable at an Ethernet user network interface and from Ethernet user network interface to Ethernet user network interface. In addition, a framework for defining specific instances of subscriber Ethernet services is described.

MEF 23.2*, Carrier Ethernet class of service – Phase 3 implementation agreement*

[MEF 23.2] defines a set of three CoS names called CoS labels for EVCs and OVCs. [MEF 23.2] also defines values for CoS performance objectives (CPOs) grouped in performance tier sets, as well as performance parameters.

MEF 23.2.1, *Models for bandwidth profiles with token sharing – Amendment to MEF 23.2*

[MEF 23.2.1] adds a new normative section to the parent document that defines a set of token sharing bandwidth profile models. These models allow for multiple bandwidth profile flows in an envelope, thus enabling token sharing among them.

MEF 26.2*, External network network interface (ENNI) and operator service attributes*

The MEF defines a reference point between two CENs, where each operator CEN is under the control of a distinct administrative authority. This reference point is termed the ENNI, which is intended to support the extension of Ethernet services across multiple operator CENs. [MEF 26.2] specifies the requirements at the ENNI reference point, as well as the interface functionality in sufficient detail to ensure interoperability between two operator CENs including link OAM. [MEF 26.2] also defines the connectivity attributes UNI to UNI, UNI to ENNI and ENNI to ENNI such that multiple operator

CENs can be interconnected, and the Ethernet services and attributes in [b-MEF 6.2] and [b-MEF 10.3] can be realized.

MEF 45.1, ***Layer 2 control protocols in Ethernet services***

[MEF 45.1] specifics the service attributes and requirements for handling L2CP frames for Ethernet services.

I.3 Service definition documents

MEF 6.3, ***Subscriber Ethernet services definitions***

[MEF 6.3] defines three subscriber Ethernet service constructs called subscriber Ethernet service types and six subscriber Ethernet services with service attribute values as specified in [MEF 10.4] and [MEF 45.1]. These subscriber Ethernet service types are used to create point-to-point, multipoint-to-multipoint, and rooted-multipoint Ethernet services that are either port or virtual local area network (VLAN) based.

MEF 22.3, ***Transport services for mobile networks***

[MEF 22.3] identifies the requirements for MEF Ethernet services and MEF external interfaces (EIs such as UNIs) for use in mobile backhaul networks based on MEF documents. In addition, new interface and service attributes have been specified where needed. The services and requirements in [MEF 22.3] are based on the services defined in [b-MEF 6.2], [MEF 33] and [MEF 51], as well as the attributes in [b-MEF 10.3], [MEF 26.2] and [MEF 22.3].

MEF 22.3.1, ***Amendment to MEF 22.3: Transport services for mobile networks***

[MEF 22.3.1] specifies changes to the baseline document [MEF 22.3] to include requirements for Ethernet services that can be used as transport for fifth generation (5G) mobile networks. The services and requirements in this document are based on the services defined in [b-MEF 6.2] as well as the service attributes defined in [b-MEF 10.3].

MEF 33, ***Ethernet Access services definition***

[MEF 33] defines Ethernet access services, which are OVC-based Ethernet services in contrast to the EVC-based services that are defined in [b-MEF 6.2]. [MEF 33] uses the UNI service attributes and parameters options defined in the [b-MEF 6.2] and ENNI and OVC service attributes defined in [MEF 26.2] and applies them to create new Ethernet access services between a UNI and an ENNI. These new carrier-to-carrier Ethernet access services enable Ethernet SPs to reach out-of-franchise customer locations through an Ethernet AP network and deliver E-line and E-LAN service types end-to-end. [MEF 33] defines the UNI, OVC, OVC per UNI, OVC EP per ENNI and ENNI requirements for point-to-point OVC-based Ethernet services. In addition, an informative appendix provides use cases of some of the defined services.

MEF 43, ***Virtual NID (vNID) functionality for E-access services***

[MEF 43] specifies the functionality offered by an AP that, when combined with an E-access service, allows an SP to monitor and configure selected objects associated with a given UNI and one or more OVC EPs at that UNI in the AP' network. The effect is that the AP provides functionality similar to that which would otherwise require the SP to place a NID at the customer's location. Hence, the AP is said to be providing "virtual NID (vNID)" functionality to the E-access service that the SP has purchased. This is accomplished via the SP communicating over a remote management interface (RMI) connection to the AP, using an RMI protocol.

In addition, [MEF 43] provides guidance, where necessary, on how the SP and AP should interact to configure and manage these capabilities. This framework is presented to explain the assumptions of which interactions between the SP and AP need to be supported via the RMI protocol and which interactions are assumed to be supported via the service order process.

MEF 47, *Carrier Ethernet services for cloud implementation agreement*

[MEF 47] identifies the requirements for MEF Ethernet services and MEF EIs (such as UNIs), as well as a management interface for use in support of cloud services. This support includes elastic behaviour of Ethernet service attributes that can be modified during the lifetime of the service. Support for cloud services falls into two broad categories: 1) interconnection of a cloud provider's data centres, which is referred to as data centre interconnect (DCI); and 2) interconnection of cloud consumers (e.g., enterprises) and cloud provider data centres, which is referred to as data centre access (DCA). The services and requirements in this implementation agreement (IA) are based on the services defined in [b-MEF 6.2] and the attributes defined in [b-MEF 10.3] and this IA. Support of cloud services is addressed for a single cloud provider (CP) using one or more CENs and point-to-point Ethernet services.

MEF 51, *OVC services definitions*

[MEF 51] specifies OVC services based mainly on the service attributes defined in [b-MEF 26.1]; there are also some service attributes defined in [MEF 51] that go beyond [b-MEF 26.1]. The key service constructs are the OVC itself and the OVC EPs at the EIs, such as the external network network interface (ENNI) and the (UNI). Per [b-MEF 26.1], at least one OVC EP is at an ENNI. Three general OVC services are defined, based on OVC type. In addition, two E-access and two E-transit services are defined, based on OVC type and the EIs involved.

MEF 51.1, *Operator Ethernet service definitions*

[MEF 51.1] specifies operator Ethernet services based on the service attributes defined in [MEF 26.2]. The key service constructs are the OVC and the OVC EPs at the EIs – the ENNI and the UNI. Per [MEF 26.2], at least one OVC EP is at an ENNI. Three general operator Ethernet services are defined, based on OVC type. In addition, two E-access and two E-transit services are defined, based on OVC type and the EIs involved.

MEF 62, *Managed access E-line service implementation agreement*

[MEF 62] defines an access E-line service that includes a specific set of management and class of service (CoS) capabilities. The service defined in this IA is based on applicable functionality and associated requirements from existing MEF documents, including [MEF 26.2], [MEF 30.1], [MEF 35.1] and [MEF 51].

MEF 65. *Simplified transit E-line service*

[MEF 65] specifies a simplified transit E-line (STEL) service that constrains selected values of the ENNI common attributes, ENNI service attributes and operator Ethernet service attributes specified in [MEF 26.2] to simplify ordering and provisioning for a common case of transit E-line services defined in [MEF 51.1].

I.4 OAM documents

MEF 30.1, *Service OAM fault management implementation agreement: Phase 2*

[MEF 30.1] specifies an IA for SOAM that builds upon the framework and requirements specified in [b-MEF 17]. In particular, this IA specifies SOAM requirements for maintenance entity groups (MEGs) and for FM. SOAM in general and FM in particular are defined in [IEEE 802.1Q] and [b-ITU-T G.8013 (2011)]. This IA details how to use these functions to achieve the MEF requirements of SOAM in general and SOAM FM in particular.

MEF 35.1, *Service OAM performance monitoring*

[MEF 35.1] specifies an IA for SOAM that satisfies and extends the PM framework and requirements described in [b-MEF 17]. Existing PM functions are defined by [b-ITU-T G.8013 (2013)] and [b-ITU-T G.8021]. [MEF 35.1] details how to use these functions in order to achieve the requirements of MEF SOAM PM.

Bibliography

[b-ITU-T G.8013 (2011)] Recommendation ITU-T G.8013/Y.1731 (2011), *OAM functions and mechanisms for Ethernet based networks*.

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

[b-ITU-T G.8021] Recommendation ITU-T G.8021/Y.1341 (2018) *Characteristics of Ethernet transport network equipment functional blocks*.

[b-ITU-T Y.1731] Recommendation ITU-T Y.1731 (2006), *OAM functions and mechanisms for Ethernet based networks*.

[b-IEEE 802.1ag] IEEE 802.1ag-2007, *IEEE Standard for Local and metropolitan area networks virtual bridged local area networks Amendment 5: Connectivity fault management*.

[b-MEF 4] MEF 4 (2004), *Metro Ethernet network architecture framework – Part 1: Generic framework.*

[b-MEF 6.2] MEF 6.2 (2014), *EVC Ethernet services definitions phase 3*.

[b-MEF 10.3] MEF 10.3 (2013), *Ethernet services attributes phase 3*.

[b-MEF 16] MEF 16 (2006), *Ethernet Local management interface (E-LMI)*.

[b-MEF 17] MEF 17 (2007), *Service OAM requirements and framework – Phase 1*.

[b-MEF 26.1] MEF 26.1 (2012), *External network network interface (ENNI) – Phase 2*.

ITU-T Y-SERIES RECOMMENDATIONS

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

GLOBAL INFORMATION INFRASTRUCTURE	
General	Y.100–Y.199
Services, applications and middleware	Y.200–Y.299
Network aspects	Y.300–Y.399
Interfaces and protocols	Y.400–Y.499
Numbering, addressing and naming	Y.500–Y.599
Operation, administration and maintenance	Y.600–Y.699
Security	Y.700–Y.799
Performances	Y.800–Y.899
INTERNET PROTOCOL ASPECTS	
General	Y.1000–Y.1099
Services and applications	Y.1100–Y.1199
Architecture, access, network capabilities and resource management	Y.1200–Y.1299
Transport	**Y.1300–Y.1399**
Interworking	Y.1400–Y.1499
Quality of service and network performance	Y.1500–Y.1599
Signalling	Y.1600–Y.1699
Operation, administration and maintenance	Y.1700–Y.1799
Charging	Y.1800–Y.1899
IPTV over NGN	Y.1900–Y.1999
NEXT GENERATION NETWORKS	
Frameworks and functional architecture models	Y.2000–Y.2099
Quality of Service and performance	Y.2100–Y.2199
Service aspects: Service capabilities and service architecture	Y.2200–Y.2249
Service aspects: Interoperability of services and networks in NGN	Y.2250–Y.2299
Enhancements to NGN	Y.2300–Y.2399
Network management	Y.2400–Y.2499
Network control architectures and protocols	Y.2500–Y.2599
Packet-based Networks	Y.2600–Y.2699
Security	Y.2700–Y.2799
Generalized mobility	Y.2800–Y.2899
Carrier grade open environment	Y.2900–Y.2999
FUTURE NETWORKS	Y.3000–Y.3499
CLOUD COMPUTING	Y.3500–Y.3599
BIG DATA	Y.3600–Y.3799
QUANTUM KEY DISTRIBUTION NETWORKS	Y.3800–Y.3999
INTERNET OF THINGS AND SMART CITIES AND COMMUNITIES	
General	Y.4000–Y.4049
Definitions and terminologies	Y.4050–Y.4099
Requirements and use cases	Y.4100–Y.4249
Infrastructure, connectivity and networks	Y.4250–Y.4399
Frameworks, architectures and protocols	Y.4400–Y.4549
Services, applications, computation and data processing	Y.4550–Y.4699
Management, control and performance	Y.4700–Y.4799
Identification and security	Y.4800–Y.4899
Evaluation and assessment	Y.4900–Y.4999

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

SERIES OF ITU-T RECOMMENDATIONS

Series A	Organization of the work of ITU-T
Series D	Tariff and accounting principles and international telecommunication/ICT economic and policy issues
Series E	Overall network operation, telephone service, service operation and human factors
Series F	Non-telephone telecommunication services
Series G	**Transmission systems and media, digital systems and networks**
Series H	Audiovisual and multimedia systems
Series I	Integrated services digital network
Series J	Cable networks and transmission of television, sound programme and other multimedia signals
Series K	Protection against interference
Series L	Environment and ICTs, climate change, e-waste, energy efficiency; construction, installation and protection of cables and other elements of outside plant
Series M	Telecommunication management, including TMN and network maintenance
Series N	Maintenance: international sound programme and television transmission circuits
Series O	Specifications of measuring equipment
Series P	Telephone transmission quality, telephone installations, local line networks
Series Q	Switching and signalling, and associated measurements and tests
Series R	Telegraph transmission
Series S	Telegraph services terminal equipment
Series T	Terminals for telematic services
Series U	Telegraph switching
Series V	Data communication over the telephone network
Series X	Data networks, open system communications and security
Series Y	**Global information infrastructure, Internet protocol aspects, next-generation networks, Internet of Things and smart cities**
Series Z	Languages and general software aspects for telecommunication systems

Printed in Switzerland
Geneva, 2021