International Telecommunication Union

ITU-T G.8012/Y.1308

(02/2022)

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Recommendation ITU-T G.8012/Y.1308

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Recommendation ITU-T G.8012/Y.1308

Ethernet UNI and Ethernet NNI

Summary

Recommendation ITU-T G.8012/Y.1308 specifies the Ethernet user-to-network interface (UNI) and the Ethernet network node interface (NNI). First, a set of physical Ethernet interfaces is defined for the Ethernet UNI and the Ethernet NNI. Further on, an Ethernet over transport interface is defined for the Ethernet NNI. The Ethernet over transport NNI uses the optical transport hierarchy (OTH) server layer network.

This edition of the Recommendation supersedes Recommendation ITU-T G.8012.1/Y.1308.1 (2012), and together with Recommendation ITU-T G.8021/Y.1341, supersedes Recommendation ITU-T G.8021.1/Y.1341.1 (2012).

This edition also removes items formerly considered for further study and incorporates terms formerly defined in Recommendations ITU-T G.8001/Y.1354 (04/2016) and ITU-T G.8101/Y.1355 (11/2016).

History

Edition	Recommendation	Approval	Study Group	Unique ID*
1.0	ITU-T G.8012/Y.1308	2004-08-22	15	11.1002/1000/7362
1.1	ITU-T G.8012/Y.1308 (2004) Amd. 1	2006-05-07	15	11.1002/1000/8775
1.2	ITU-T G.8012/Y.1308 (2004) Amd. 2	2016-11-13	15	11.1002/1000/13094
2.0	ITU-T G.8012/Y.1308	2022-02-13	15	11.1002/1000/14931

Keywords

Ethernet NNI, Ethernet UNI.

* 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

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Recommendation ITU-T G.8012/Y.1308

Ethernet UNI and Ethernet NNI

1 Scope

This Recommendation specifies the Ethernet UNI and the Ethernet NNI, where the Ethernet UNI is formed by an Ethernet interface and the Ethernet NNI by an Ethernet interface or an Ethernet over transport interface. The Ethernet over transport NNI uses the OTH server layer network. The detailed requirements applicable to these interfaces are specified in a number of ITU-T Recommendations, and in IEEE Standards that are referenced.

This Recommendation defines the interfaces of the Ethernet transport network to be used within and between subnetworks of the Ethernet network, in terms of Ethernet transport hierarchy, formats for mapping and multiplexing client signals into Ethernet connections and formats for multiplexing Ethernet connection signals into Ethernet or non-Ethernet connection signals.

This Recommendation assumes but does not specify the Ethernet component and/or equipment models to support the Ethernet UNI and NNI. Those models are specified in [ITU-T G.8021]. This Recommendation limits the specification of the Ethernet UNI and NNI to Ethernet equipment types aligned with the bridge types specified in [IEEE 802.1Q] and supporting only the untagged, priority-tagged or tagged traffic units covered in [ITU-T G.8021].

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.709] Recommendation ITU-T G.709/Y.1331 (2020), *Interfaces for the optical transport network*.

[ITU-T G.873.1] Recommendation ITU-T G.873.1 (2017), *Optical transport network: Linear protection*.

[ITU-T G.873.2] Recommendation ITU-T G.873.2 (2015), *ODUk shared ring protection*.

[ITU-T G.7041] Recommendation ITU-T G.7041/Y.1303 (2016), *Generic framing procedure*.

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

[ITU-T G.8011] Recommendation ITU-T G.8011/Y.1307 (2020), *Ethernet service characteristics*.

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

[ITU-T G.8031] Recommendation ITU-T G.8031/Y.1342 (2015), *Ethernet linear protection switching*.

[ITU-T G.8032] Recommendation ITU-T G.8032/Y.1344 (2020), *Ethernet ring protection switching*.

[ITU-T G.8262] Recommendation ITU-T G.8262/Y.1362 (2018), *Timing characteristics of a synchronous equipment slave clock*.

[ITU-T G.8264] Recommendation ITU-T G.8264/Y.1364 (2017), *Distribution of timing information through packet networks*.

[ITU-T Y.1415] Recommendation ITU-T Y.1415 (2005), *Ethernet-MPLS network interworking – User plane interworking*.

[IEEE 802] IEEE Std 802-2014, *IEEE standard for local and metropolitan area networks: Overview and architecture*.

[IEEE 802.1AX] IEEE Std 802.1AX-2020, *IEEE standard for local and metropolitan area networks – Link aggregation*.

[IEEE 802.1Q] IEEE Std 802.1Q-2018, *IEEE standard for local and metropolitan area networks – Bridges and bridged networks*.

[IEEE 802.3] IEEE Std 802.3-2018, *IEEE standard for Ethernet*.

3 Terms and definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 ETH_CI traffic unit: [ITU-T G.8010].

3.1.2 Ethernet services layer connection: [ITU-T G.8011].

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 customer Ethernet connection: An Ethernet connection of which the traffic units are encapsulated with an IEEE Std 802.1Q customer VLAN tag when they are transported through an Ethernet link[1]. Outside an Ethernet link the traffic units are without such customer VLAN tag.

3.2.2 Ethernet connection[2]: Connectivity at the media independent layer of an Ethernet network.

3.2.3 link Ethernet connection: An Ethernet connection of which the traffic units are either not encapsulated (i.e., untagged) or encapsulated with an IEEE Std 802.1Q priority tag (i.e., priority-tagged).

3.2.4 service Ethernet connection: An Ethernet connection of which the traffic units are encapsulated with an IEEE Std 802.1Q service VLAN tag when they are transported through an Ethernet link. Outside an Ethernet link[3] the traffic units are without such service VLAN tag.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

C-EC Customer Ethernet Connection

C-Tag Customer Tag

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1 The term 'Ethernet link' refers to the 'ETH link' topological component in [ITU-T G.8010].

2 "Ethernet connection" as defined in this Recommendation is a superset of the "Ethernet services layer connection" defined in [ITU-T G.8011]. "EC" is a common abbreviation for both terms.

3 The term 'Ethernet link' refers to the 'ETH link' topological component in [ITU-T G.8010].

C-VID	Customer Virtual local area network Identifier
cHEC	core Header Error Check
CI	Characteristic Information
DA	Destination Address
EC	Ethernet Connection
EoT	Ethernet over Transport
ETH	Ethernet media access control
ETH_CI	Ethernet media access control Characteristic Information
EVC	Ethernet Virtual Connection
EXI	Extension Header Identifier
FCS	Frame Check Sequence
GFP	Generic Framing Procedure
GFP-F	Generic Framing Procedure – Frame mapped
IP	Internet Protocol
L-EC	Link Ethernet Connection
LAN	Local Area Network
MAC	Media Access Control
MPLS	Multi-Protocol Label Switching
MPLS_CI	Multi-Protocol Label Switching Characteristic Information
MSDU	Media access control Service Data Unit
NNI	Network Node Interface
OAM	Operations, Administration and Maintenance
ODU	Optical Channel Data Unit
ODUj	Optical Channel Data Unit – Order j
ODUk	Optical Channel Data Unit – Order k
OTH	Optical Transport Hierarchy
OTN	Optical Transport Network
PA	(Ethernet) Preamble
PB	Provider Bridge
PDU	Protocol Data Unit
PEB	Provider Edge Bridge
PFI	Payload Frame check sequence Indicator
PLI	Payload Length Indicator
PTI	Payload Type Identifier
S	Bottom of Stack
S-EC	Service Ethernet connection
S-Tag	Service Provider Tag

S-VID Service Provider virtual local area network Identifier

SA Source Address

SFD Start of Frame Delimiter

TTL Time To Live

UNI User-to-Network Interface

UPI User Payload Identifier

VID Virtual local area network Identifier

VLAN Virtual Local Area Network

5 Conventions

None.

6 Ethernet transport network interface structure

The Ethernet transport network as specified in [ITU-T G.8010] implies two interface classes:

- Ethernet interface as specified in [IEEE 802.3];
- Ethernet-over-transport (EoT) interface as specified in this Recommendation.

The user-to-network interface (UNI) in an Ethernet transport network is formed by an Ethernet interface. The network node interface (NNI) in an Ethernet transport network can be formed by an Ethernet interface or an EoT interface.

In this Recommendation, connectivity at the media independent layer of an Ethernet network, also known as the Ethernet media access control (ETH) layer, supports Ethernet connections (ECs), of which there are three types[4]:

- Link Ethernet connection (L-EC);
- Customer Ethernet connection (C-EC); or
- Service Ethernet connection (S-EC).

In this Recommendation, the term 'Ethernet link' refers to the 'ETH link' topological component in [ITU-T G.8010]. The tags mentioned in the definitions of L-EC, C-EC and S-EC, and their addition to or removal from [IEEE 802.3] media access control (MAC) service data units (MSDUs), are specified in [IEEE 802.1Q], as discussed in clause 6.2.1. ECs and MSDUs exist in the context of the ETH layer represented by the "type/length" and "ETH" parts of Figure 6-1.

ECs support [ITU-T G.8011]-defined Ethernet virtual connections (EVCs) between Ethernet UNIs by providing either point-to-point, multipoint-to-multipoint or rooted-multipoint connectivity thereby giving rise to E-Line, E-LAN or E-Tree Ethernet services, respectively; see [ITU-T G.8011] for references to relevant Metro Ethernet Forum (MEF) standards. Further details about support of rooted-multipoint connectivity are provided in subclause F.1.3.2 of [IEEE 802.1Q].

The rest of this Recommendation focuses on the data plane aspects of Ethernet UNIs and NNIs.

6.1 Basic structure of Ethernet and EoT interfaces

The basic structure of Ethernet and EoT interfaces is shown in Figure 6-1. The abbreviations in Figure 6-1 are expanded in clause 4. A client signal of the ETH layer network is mapped into an

[4] MEF 12.2 as discussed in [ITU-T G.8011] specifies other EC types.

MSDU by adding a 2-byte length/type field per clause 9 of [IEEE 802] and subclause 3.2.6 of [IEE 802.3].

NOTE – Length encapsulation is not used in Ethernet over transport and, therefore, is not addressed in this Recommendation. However, Ethernet over transport is transparent for MSDUs that contain length encapsulated client data.

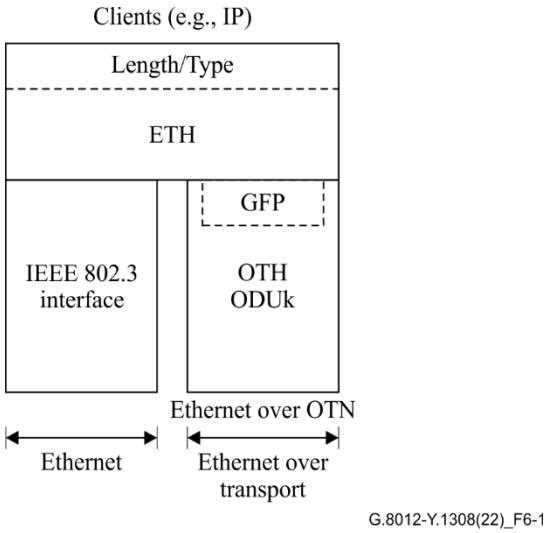


Figure 6-1 – Basic structure of Ethernet and EoT interfaces

The Ethernet interface of Figure 6-1 is discussed in clause 6.1.2 while the Ethernet-over-transport interface of Figure 6-1 is discussed in clause 6.1.3.

6.1.1 ETH substructure

The ETH layer as defined in [ITU-T G.8010] is further structured in sublayers in order to support the network management and supervision functionalities defined in [ITU-T G.8010], [ITU-T G.8013] and [IEEE 802.1Q].

6.1.2 Ethernet interface structure

The Ethernet interface structure consists of an [IEEE 802.3] interface.

6.1.3 Ethernet-over-transport interface structure

The Ethernet-over-transport interface structure maps Ethernet into the optical transport network (OTN) as specified in [ITU-T G.709].

6.2 Information structure for the Ethernet and EoT interfaces

The information structure for the Ethernet and EoT interfaces is represented by information containment relationships and flows as described in this clause 6.2.

6.2.1 ETH principal information containment relationships

The principal information containment relationships that enable the ETH layer to deploy a link frame from a client signal (and vice versa) are described in this clause 6.2.1, which is summarized in Table 6-1 and illustrated in Figure 6-2.

A client signal of the ETH layer network, the MAC client data, is mapped into an MSDU via:

– Length/Type encapsulation: see [IEEE 802], clause 9; and

– Optional tag encapsulation: see [IEEE 802.1Q], subclauses 9.3 and 9.6 for information about priority code point and drop eligible indicator.

An ETH_CI traffic unit consists of a MAC Destination Address (DA), a MAC Source Address (SA), and the MSDU; see [ITU-T G.8010] and [IEEE 802.3], clause 2. DA and SA are 48-bit MAC addresses as specified in [IEEE 802.3]. Any of these addresses could occur at the UNI and NNI. The set of 2^{48} MAC addresses is divided into two main subsets ([IEEE 802], clause 9):

– 2^{47} individual MAC addresses (referred to as unicast);

– 2^{47} group MAC addresses (referred to as multicast).

One of the group MAC addresses is defined as a broadcast MAC address (FF-FF-FF-FF-FF-FF). [IEEE 802.1Q] also specifies a subset of the group MAC addresses, starting with the prefix 01-80-C2, that is used or reserved for use by control frames; see clause 8 for further information about the propagation scope of these group MAC addresses.

An ETH_CI traffic unit is mapped into a link frame per subsequent clauses in clause 6.2.1.

Table 6-1 – Overview of encapsulated units

Encapsulated unit	Reference
Length/Type-encapsulated MAC client data = MSDU	[IEEE 802.3], subclause 3.2
(Tag-encapsulated) MSDU = (tagged) MSDU	[IEEE 802.1Q], subclause 9.3
DA/SA-encapsulated (tagged) MSDU = ETH_CI traffic unit	[IEEE 802.3], subclause 3.2
Link header/trailer-encapsulated ETH_CI traffic unit = Link frame	Subsequent clauses in clause 6.2.1 or [IEEE 802.3], subclause 3.2

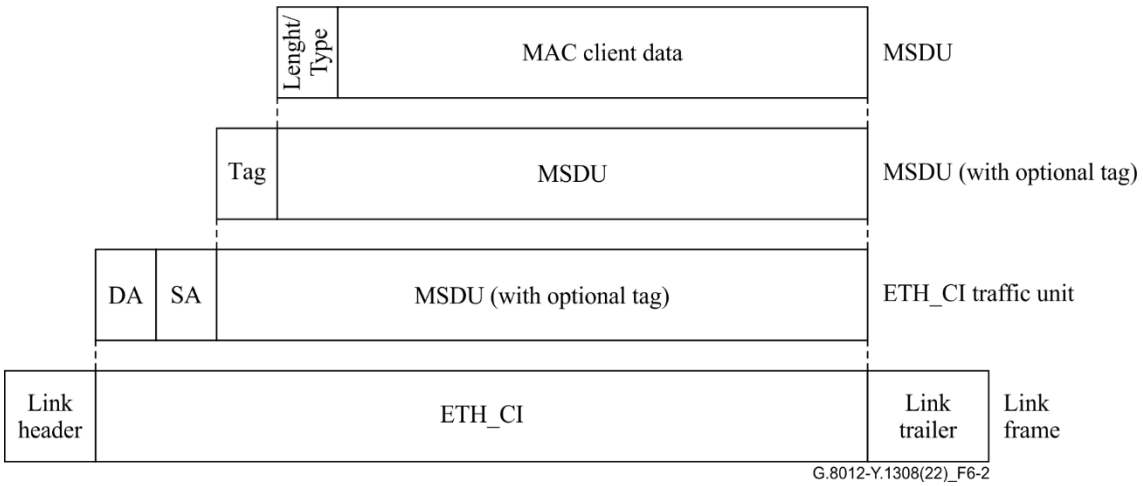


Figure 6-2 – ETH principal information containment relationships

The MAC client data field has a maximum length as specified in subclause 3.2.7 of [IEEE 802.3]. It can carry a tagged and/or encapsulated client EC frame, non-EC client information, an EC operations, administration and maintenance (OAM) protocol data unit (PDU) as specified in [ITU-T G.8013], or a control PDU as specified in [IEEE 802.1Q].

The ETH_CI traffic unit comprises ETH_CI Data (ETH_CI_D), i.e., the MAC frame specified in subclause 3.1.1 of [IEEE 802.3] without its pad and frame check sequence (FCS) fields. ETH_CI_D includes EC priority (ETH_CI_P) and drop eligible (ETH_CI_DE) information elements, i.e., the priority and drop_eligible indicator fields per subclauses 6.9.3 and 9.6 of [IEEE 802.1Q].

6.2.1.1 MAC frame

The ETH_CI traffic unit is extended with a MAC FCS field and a Preamble (PA) and Start of Frame Delimiter (SFD) to form a MAC frame as specified in clause 3 of [IEEE 802.3]. See Figure 6-3.

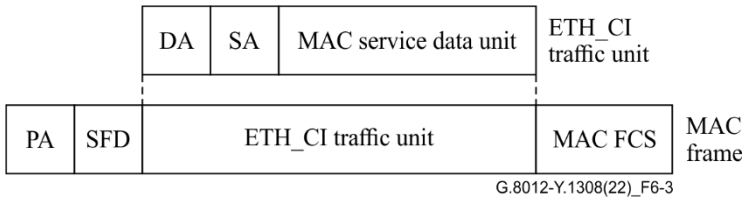


Figure 6-3 – MAC frame

Prior to transmission over an [IEEE 802.3] interface, this frame is encoded into a transmission frame based on the link characteristics. Refer to [IEEE 802.3] for details of such encodings.

The MAC frame is used to support synchronous Ethernet as specified in [ITU-T G.8262] and [ITU-T G.8264].

NOTE – In this Recommendation, the term 'MAC frame' and '[IEEE 802.3] Ethernet link frame' are interchangeable.

6.2.1.2 GFP-F link frame

The ETH_CI traffic unit is extended with a MAC FCS field and then mapped as specified in [ITU-T G.7041] in the generic framing procedure (GFP) payload information field to form a GFP-F link frame. A core header with PLI and cHEC fields and a payload header field with subfield is prepended. The PTI subfield has value 000, the PFI subfield has value 0, the EXI subfield has value 0000 and the UPI subfield has value 0x01. See Figure 6-4. The maximum size of the GFP payload information field is specified in clause 6.1.2 of [ITU-T G.7041].

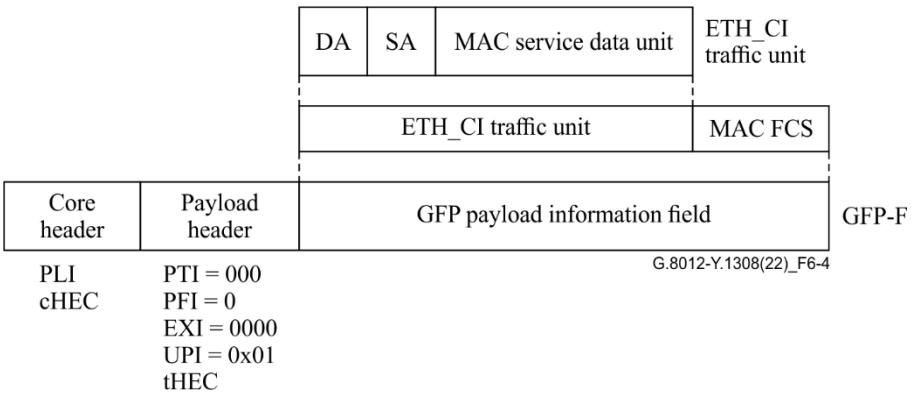


Figure 6-4 – GFP-F link frame

6.2.2 Ethernet UNI

The Ethernet UNI includes the following layers:

- ETH layer as described in clause 6 and its clauses 6.1.1 and 6.2.1; and
- [IEEE 802.3] layer based on the MAC frame illustrated in clause 6.2.1.1.

The Ethernet UNI may be protected by means of link aggregation as specified in [IEEE 802.1AX].

NOTE – Edition 1 of this Recommendation included a description, based on a referenced in-force Recommendation, of the Ethernet over Synchronous Digital Hierarchy UNI that may still be used in some networks.

6.2.3 Ethernet NNI

An Ethernet NNI formed by an Ethernet interface (e.g., a [b-MEF 26.2] External Network–Network Interface as discussed in [ITU-T G.8011]) includes the following layers:

- ETH layer as described in clause 6 and its subclauses 6.1.1 and 6.2.1; and
- [IEEE 802.3] layer based on the MAC frame illustrated in clause 6.2.1.1.

It may be protected by means of link aggregation as specified in [IEEE 802.1AX].

An Ethernet NNI formed by an EoT interface includes the following layers:

- ETH layer as described in clause 6 and its subclauses 6.1.1 and 6.2.1; and
- OTN layer supported by the interfaces listed in clause 6.2.3.1.

It may be protected by means of ODUk linear protection switching as specified in [ITU-T G.873.1] or ODUk ring protection as specified in [ITU-T G.873.2].

ECs over an Ethernet NNI formed by an Ethernet interface or an EoT interface may be protected by means of Ethernet linear protection switching as specified in [ITU-T G.8031] or Ethernet ring protection as specified in [ITU-T G.8032].

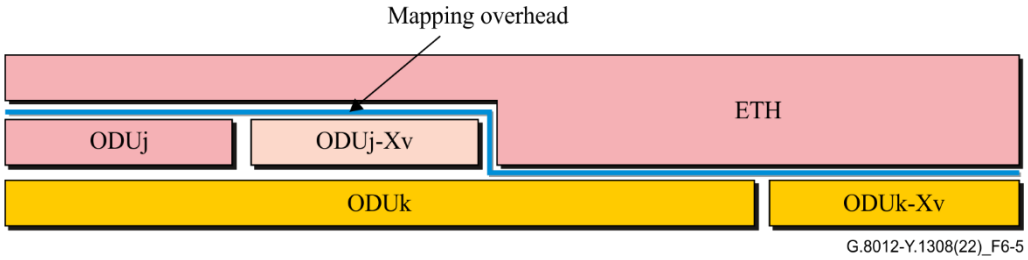
NOTE 1 – Edition 1 of this Recommendation included descriptions, based on referenced in-force Recommendations, of the Ethernet over asynchronous transfer mode NNI, ethernet over plesiochronous digital hierarchy NNI, and Ethernet over synchronous digital hierarchy NNI that may still be used in some networks.

NOTE 2 – Annex A describes the possible use of multi-protocol label switching (MPLS) as a server layer to the ETH layer. MPLS can then be a client layer of either the [IEEE 802.3] server layer or the OTN server layer.

6.2.3.1 Ethernet over OTN NNI

The Ethernet over OTN NNI may deploy the GFP-F link frame as specified in clause 6.2.1.2, or may use a codeword-transparent mapping. Both of these are as illustrated in Figure 6-5. The mappings of the GFP-F link frame or codeword-transparent mapping of [IEEE 802.3] interfaces into ODUj/ODUk are specified in clause 17 of [ITU-T G.709].

The format of the ODUs is specified in [ITU-T G.709].



Legend: ODUj-Xv – Virtual concatenated Optical Channel Data Unit – order j; ODUk-Xv – virtual concatenated optical channel data unit – order k.

Figure 6-5 – Components of the Ethernet over OTN NNI

7 Mapping and multiplexing principles

Figure 7-1 shows the relationship between various information structure elements and illustrates the mapping and multiplexing structure for Ethernet from client signal to link frames. The mapping and

multiplexing principles are further discussed in clauses 7.1 and 7.2, respectively. Multiplexing is based on virtual local area network (VLAN) identifiers (VIDs).

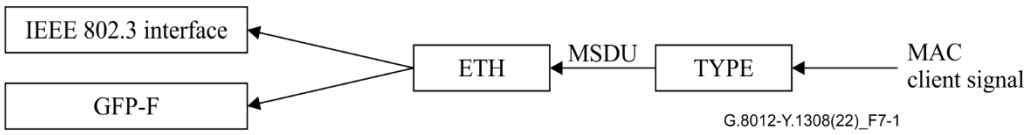


Figure 7-1 – Ethernet mapping and multiplexing

Multiplexing or aggregation of the client signals may occur at each interface between a client EC and server EC, and between a client EC and server ODUk.

7.1 Mapping

The client signal is mapped into the ETH signal (frame) directly via type encapsulation; see clause 6.2.1. The ETH signal (frame) is then mapped into the applicable link frame and those link frames are transported over an Ethernet link.

7.2 Ethernet single level VID multiplexing

Figure 7-2 illustrates a single level multiplexing of up to 4094 ETH signals into an Ethernet link. The ETH_CI traffic unit is for that purpose extended with a C-Tag including a Customer VID (Figure 7-3), as specified in [IEEE 802.1Q]. This multiplexing structure is applicable for the Ethernet UNI and NNI.

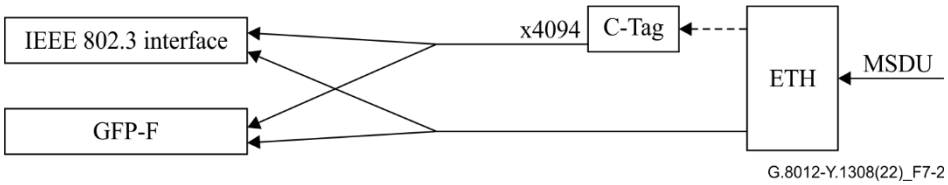


Figure 7-2 – Ethernet single level multiplexing

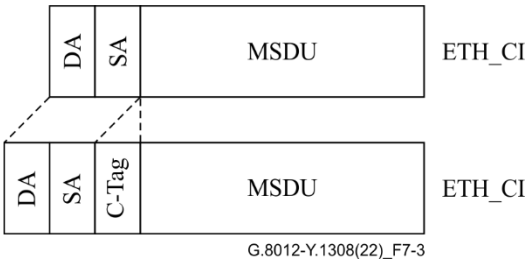


Figure 7-3 – Ethernet single level multiplexing method

7.3 Ethernet two level VID multiplexing

Figure 7-4 illustrates a two-level multiplexing of up to 4094 × 4094 ETH signals into an Ethernet link. The ETH_CI traffic unit is for that purpose extended with a C-Tag including a C-VID as

specified in [IEEE 802.1Q] and then extended with an S-Tag including an S-VID (Figure 7-5). The structure of the S-Tag is defined in [IEEE 802.1Q].

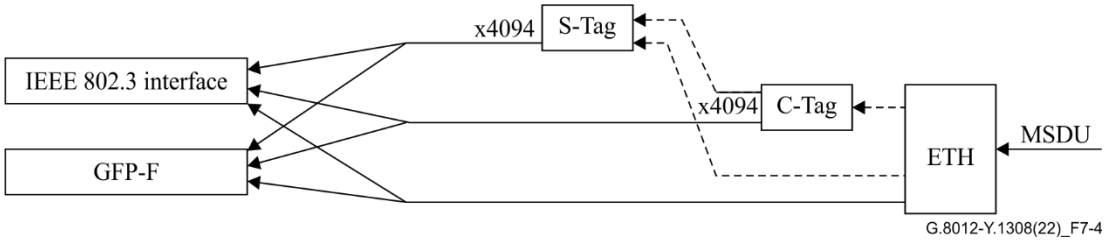


Figure 7-4 – Ethernet two-level multiplexing

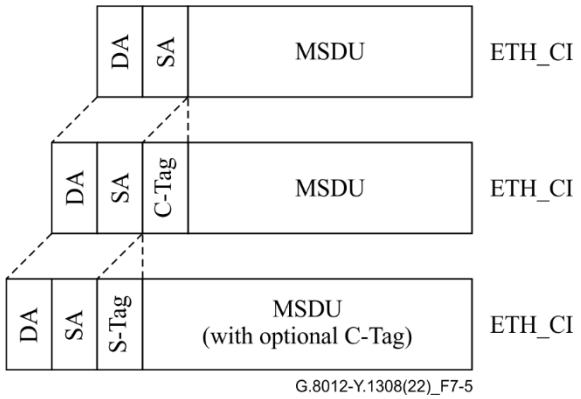


Figure 7-5 – Ethernet two-level multiplexing method

8 Mapping of EC signals

The mapping of L-EC signals and C-EC signals into S-EC signals is supported by port-based, C-tagged and S-tagged service interfaces[5] as specified in clause 15 of [IEEE 802.1Q] and using the correspondence of Table 8-1. In turn, these service interfaces allow these EC signals to support the transport of Ethernet services using EVCs, as defined in [ITU-T G.8011].

Table 8-1 – Correspondence of EC signals in [IEEE 802.1Q]

EC signals	[IEEE 802.1Q] correspondence
L-EC signals	Untagged[a] frames as specified in 3.281 and related content of [IEEE 802.1Q] or priority-tagged[b] frames as specified in 3.184 and related content of [IEEE 802.1Q]
C-EC signals	Frames carrying a customer VLAN tag as specified in 3.58 and related content of [IEEE 802.1Q]
S-EC signals	Frames carrying a service VLAN tag as specified in 3.230 and related content of [IEEE 802.1Q]
[a] No tag follows the destination and source address fields of an Ethernet frame that is untagged. [b] Only a priority value is carried in the tag of a priority-tagged Ethernet frame, the VID is zero.	

[5] In general, when a service interface is referred to as "X-tagged", it means that the service interface is configured to accept a client signal which carries a tag type of "X" following the DA and SA fields; other addresses and tags may follow that outer X-tag. A port-based interface can be thought of as the opposite of X-Tagged; it is configured to accept client signals which are untagged, or priority tagged.

These service interfaces depend on the type of Ethernet equipment. An example is provided in Table 8-2 that provides a subset of [IEEE 802.1Q] bridge types and their supported UNI service interfaces.

Table 8-2 – Bridge types and interfaces

[IEEE 802.1Q] bridge type	UNI service interface	NNI service interface
Provider edge bridge (PEB)	C-tagged (individual, bundled)	S-tagged
Provider bridge (PB)	Port-based (untagged, priority C/S-tagged)	S-tagged
	S-tagged (peering)	
NOTE – In this table, "peering" means that any OAM flows associated with the client signal share the same maintenance entity group level space as used by the operator's OAM flows because no tag is added by the UNI mapping.		

[ITU-T G.8011] references [b-MEF 12.2] that details EC specifics applicable to EVCs including to relevant client/server and peering relationships, [b-MEF 13] and [b-MEF 20] that detail Ethernet UNI specifics, [b-MEF 26.2] that details external NNI (i.e., an Ethernet NNI) specifics[6], and [b-MEF 45.1] that details the specifics of how Ethernet UNI and Ethernet NNI either 'pass', 'peer' or 'discard' layer 2 control protocol frames. In [b-MEF 45.1], passing, peering or discarding a given layer 2 control protocol frame is specified in part based on the propagation scope of the group MAC DA used in the frame. Applicable propagation scopes are specified in subclause 8.6.3 of [IEEE 802.1Q]. These MEF specifics apply to EC signals using the correspondence of Table 8-1 since these MEF standards base their terminology on that of [IEEE 802.1Q].

6 In particular, MEF external NNI links carry S-tagged EC signals.

Annex A

Ethernet over MPLS

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

A.1 MPLS link frame

A.1.1 MPLS link frame without common interworking indicators and without MAC FCS

An ETH_CI traffic unit is mapped without any extension into the payload of the MPLS_CI traffic unit. See Figure A.1.

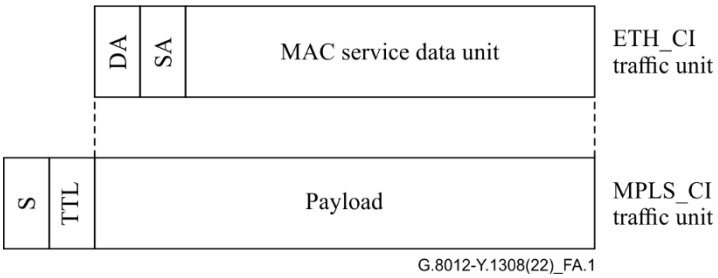


Figure A.1 – MPLS link header without common interworking indicators and without MAC FCS preservation

A.1.2 MPLS link frame without common interworking indicators and with MAC FCS

An ETH_CI traffic unit is extended with a MAC FCS and then mapped into the payload of the MPLS_CI traffic unit. See Figure A.2.

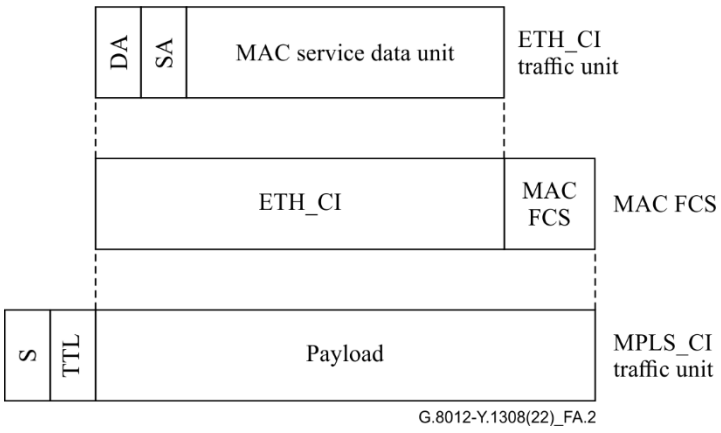


Figure A.2 – MPLS link header without common interworking indicators and with MAC FCS preservation

A.1.3 MPLS link frame with common interworking indicators and without MAC FCS

An ETH_CI traffic unit is extended with 32-bit common interworking indicators as specified in [ITU-T Y.1415] and then mapped into the payload of the MPLS_CI traffic unit. The 32-bit common interworking indicators comprise an 8-bit control field set to all-0s, an 8-bit fragmentation and length field set to all-0s and a 16-bit Sequence Number field. See Figure A.3.

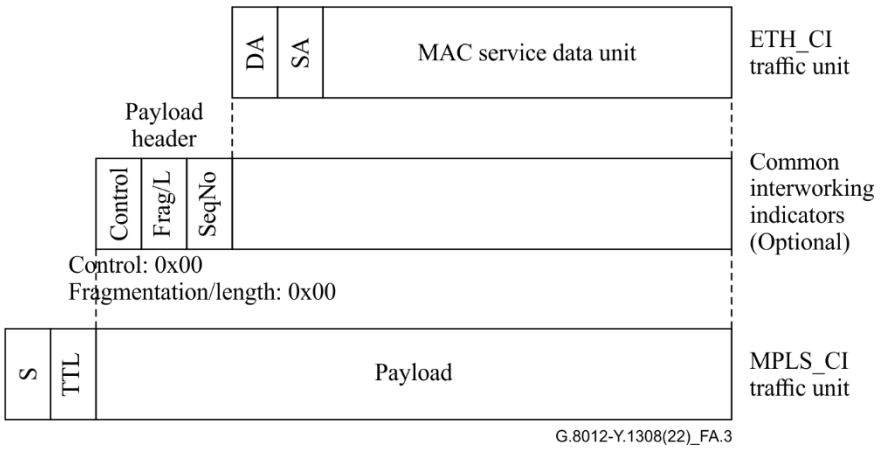


Figure A.3 – MPLS link header with common interworking indicators and without MAC FCS preservation

A.1.4 MPLS link frame with common interworking indicators and with MAC FCS

An ETH_CI traffic unit is extended with a MAC FCS and with 32-bit common interworking indicators as specified in [ITU-T Y.1415] and then mapped into the payload of the MPLS_CI traffic unit. The 32-bit common interworking indicators comprise an 8-bit control field set to all-0s, an 8-bit fragmentation and length field set to all-0s and a 16-bit sequence number field. See Figure A.4.

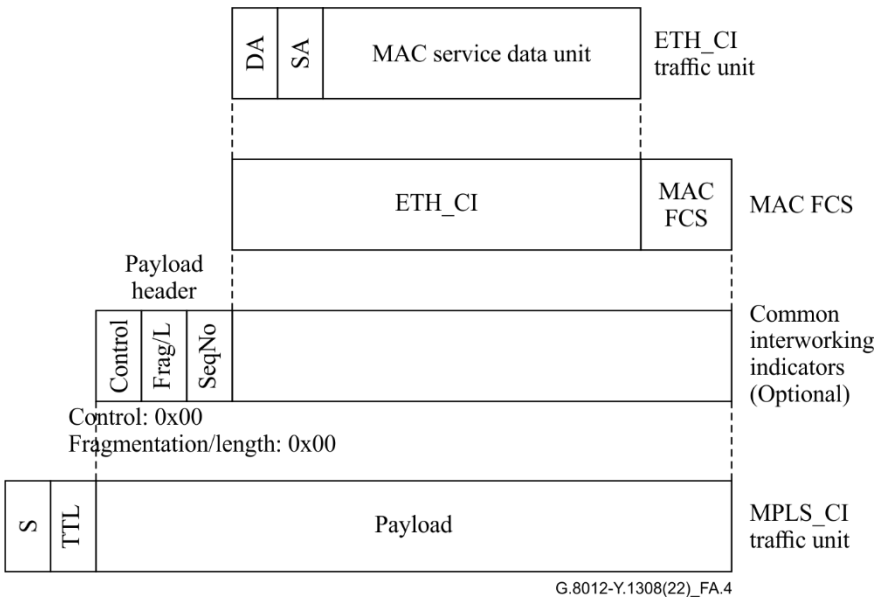


Figure A.4 – MPLS link header with common interworking indicators and MAC FCS preservation

A.2 Ethernet over MPLS

Ethernet over MPLS deploys four MPLS link frames as specified in clause A.1; two of them use common interworking indicators, the other two do not. The components of both types are illustrated in Figures A.5 and A.6.

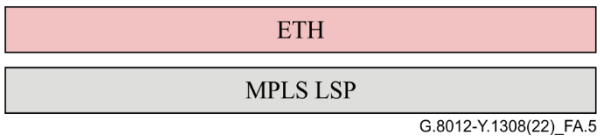


Figure A.5 – Components of Ethernet over MPLS without common interworking indicators

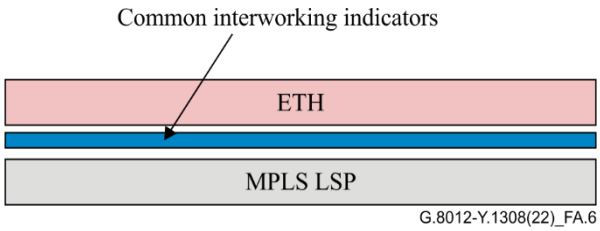


Figure A.6 – Components of Ethernet over MPLS with common interworking indicators

For interworking at administrative domain boundaries between Ethernet over MPLS over transport NNIs, the following rule applies.

At international boundaries, or at the boundaries between networks of different operators, the Ethernet encapsulation over MPLS should be applied as described in clause A.1.1, without common interworking indicators and without FCS, unless otherwise mutually agreed by the operators providing the transport. Within a national network or within the domain of a single operator, the control word may be used.

Bibliography

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

[b-MEF 13] Metro Ethernet Forum Standard 13 (2005), *User network interface (UNI) type 1 implementation agreement*.

[b-MEF 20] Metro Ethernet Forum Standard 20 (2008), *UNI type 2 implementation agreement*.

[b-MEF 26.2] Metro Ethernet Forum Standard 26.2 (2016), *External network network interfaces (ENNI)and operator service attributes*.

[b-MEF 45.1] Metro Ethernet Forum Standard 45.1 (2018), *Layer 2 control protocols in Ethernet services*.

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Printed in Switzerland
Geneva, 2022