International Telecommunication Union

ITU-T G.8011.2/Y.1307.2

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TELECOMMUNICATION
STANDARDIZATION SECTOR
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SERIES G: TRANSMISSION SYSTEMS AND MEDIA, DIGITAL SYSTEMS AND NETWORKS

Ethernet over Transport aspects – General aspects

SERIES Y: GLOBAL INFORMATION INFRASTRUCTURE, INTERNET PROTOCOL ASPECTS AND NEXT-GENERATION NETWORKS

Internet protocol aspects – Transport

Ethernet virtual private line service

ITU-T Recommendation G.8011.2/Y.1307.2

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ITU-T Recommendation G.8011.2/Y.1307.2

Ethernet virtual private line service

Summary

This Recommendation defines the service attributes and parameters for carrying Ethernet characteristic information over shared bandwidth, point-to-point connections, provided by SDH, PDH, ATM, MPLS, OTH, or ETY server layer networks. This type of service is referred to as Ethernet Virtual Private Line (EVPL) service. This Recommendation is based on the Ethernet service framework as defined in ITU-T Rec. G.8011/Y.1307.

Source

ITU-T Recommendation G.8011.2/Y.1307.2 was approved on 22 September 2005 by ITU-T Study Group 15 (2005-2008) under the ITU-T Recommendation A.8 procedure.

FOREWORD

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1 Scope

This Recommendation defines the service attributes and parameters for carrying Ethernet characteristic information over shared-bandwidth, point-to-point connections, provided by SDH, ATM, MPLS, PDH, ETY, OTH, or ETY server layer networks. This type of service is referred to as Ethernet Virtual Private Line (EVPL) service. The Recommendation is based on the Ethernet service framework as defined in ITU-T Rec. G.8011/Y.1307.

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 Recommendation G.707/Y.1322 (2003), *Network node interface for the synchronous digital hierarchy (SDH)*.

– ITU-T Recommendation G.709/Y.1331 (2003), *Interfaces for the optical transport network (OTN)*.

– ITU-T Recommendation G.805 (2000), *Generic functional architecture of transport networks*.

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

– ITU-T Recommendation G.7043/Y.1343 (2004), *Virtual concatenation of plesiochronous digital hierarchy (PDH) signals*.

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

– ITU-T Recommendation G.8011/Y.1307 (2004), *Ethernet over transport – Ethernet services framework*, plus Amendment 1 (2005), plus Corrigendum 1 (2005).

– ITU-T Recommendation G.8011.1/Y.1307.1 (2004), *Ethernet private line service*, plus Corrigendum 1 (2005).

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

– ITU-T Recommendation G.8021/Y.1341 (2004), *Characteristics of Ethernet transport network equipment functional blocks*.

– IEEE 802.3-2005, *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*.

– IEEE 802.1D-2004, *IEEE Standard for local and metropolitan area networks – Media Access Control (MAC) Bridges*.

– IEEE 802.1X-2004, *IEEE Standard for local and metropolitan area networks – Port-Based Network Access Control*.

– IEEE 802.1Q-2003, *Standard for local and metropolitan area networks – Virtual Bridged Local Area Networks*.

– IEEE 802.1AB-2005, *IEEE Standard for local and metropolitan area networks – Station and Media Access Control Connectivity Discovery*.

3 Terms and definitions

This Recommendation uses the following terms defined in ITU-T Rec. G.8010/Y.1306:

3.1 ETH link:

This Recommendation uses the following terms defined in ITU-T Rec. G.8011/Y.1307:

3.1.1 Access link

3.1.2 Block

3.1.3 Committed Information Rate (CIR)

3.1.4 Customer

3.1.5 Dedicated

3.1.6 Ethernet service

3.1.7 Network access point

3.1.8 Pass

3.1.9 Process (with respect to L2 control protocol frames)

3.1.10 Service Instance

3.1.11 Spatial

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

3.1.12 Flow domain

3.1.13 Flow domain flow

3.1.14 Flow Point

3.1.15 Flow termination

3.1.16 Link flow

3.1.17 Network flow

3.1.18 Termination flow point

3.1.19 Traffic Conditioning function

This Recommendation uses the following terms defined in ITU-T Rec. G.8012/Y.1308:

3.1.20 Ety-NNI

3.1.21 Ety-UNI

This Recommendation uses the following terms defined in ITU-T Rec. G.8011.1/Y.1307.1:

3.1.22 EPL type 1 – An EPL type 1 service carries the ETH_CI traffic units between two Ethernet UNIs.

3.1.23 EPL type 2 – An EPL type 2 service carries the information from the 8B/10B symbol stream between two Ethernet UNIs.

3.1.24 N/R = not relevant: clause/subclause, which is not relevant to this Recommendation.

This Recommendation defines the following terms:

3.1.25 EVPL type 1 – EVPL over Multiplexed Access and dedicated CO-CS and CO-PS. (This is also recognized as Multiplexed Access EPL.)

3.1.26 EVPL type 2 – EVPL over shared CO-CS, CO-PS, and CL-PS.

3.1.27 EVPL type 3 – EVPL over Multiplexed Access and shared CO-CS, CO-PS, and CL-PS.

4 Acronyms and abbreviations

This Recommendation uses the following abbreviations:

ATM	Asynchronous Transfer Mode
CBR	Constant Bit Rate
CBS	Committed Burst Size
CI	Characteristic Information
CIR	Committed Information Rate
CLPS	Connectionless Packet Switched
CO-CS	Connection Oriented Circuit Switched
CO-PS	Connection Oriented Packet Switched
DA	Destination Address
EC	Ethernet Connection
EIR	Excess Information Rate
EPL	Ethernet Private Line
ETH	Ethernet MAC layer network
ETH_CI	Ethernet MAC Characteristic Information
ETY	Ethernet PHY layer network
EVC	Ethernet Virtual Circuit
FCS	Frame Check Sequence
FD	Flow Domain
GFP	Generic Framing Procedure
LACP	Link Aggregation Control Protocol
LCAS	Link Capacity Adjustment Scheme
MAC	Media Access Control
MEF	Metro Ethernet Forum
MPLS	Multi-Protocol Label Switching
NNI	Network-to-Network Interface
OAM	Operations, Administration, Maintenance
OTH	Optical Transport Hierarchy
OTN	Optical Transport Network
PA	(Ethernet) Preamble

PDH	Plesiochronous Digital Hierarchy
PHY	Physical device
SA	Source Address
SDH	Synchronous Digital Hierarchy
SDU	Service Data Unit
SFD	Start of Frame Delimiter
SNCP	Subnetwork Connection Protection
STP	Spanning Tree Protocol
UNI	User Network Interface

5 Conventions

In this Recommendation, the term 'shared server layer' is equivalent to a server layer that is supporting Ethernet links with a G.8011/Y.1307 Ethernet Connection link type attribute of shared.

6 Ethernet virtual private lines

6.1 Description

An EVPL service is a point-to-point service between two demarcation points as illustrated in Figure 6-1. The service is provided over connection oriented or connectionless server layer networks. The service has a committed information rate (CIR), committed burst size (CBS), excess information rate (EIR), excess burst size (EBS). Note that if a CO-PS or CL-PS server layer is used, traffic management is required to ensure that the CIR and EIR are maintained.

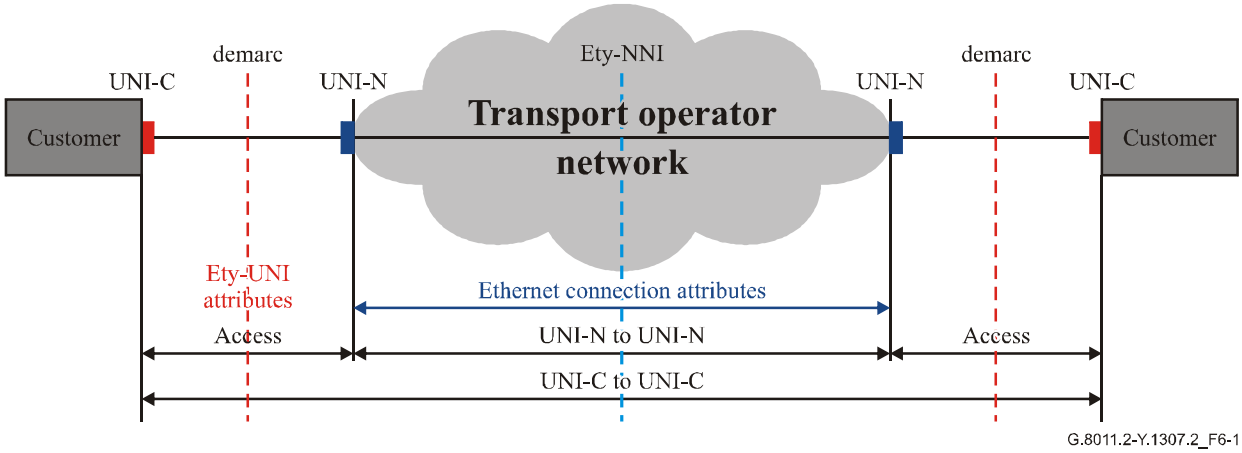

Figure 6-1/G.8011.2/Y.1307.2 – Ethernet virtual private line

The G.8010/Y.1306 maintenance entities (ME) listed in Table 6-1/G.8011/Y.1307 are shown on the bottom of Figure 6-1 and apply to EVPL. Additional details on the use of these for management of Ethernet services are described in ITU-T draft Rec. Y.17ethoam.

6.2 EVPL service architecture

There are three types of EVPL described in this clause:

- EVPL type 1 (multiplexed access with EPL);
- EVPL type 2 (shared server layer with dedicated access);
- EVPL type 3 (shared server layer with multiplexed access).

These types are based on a combination of G.8011/Y.1307 attributes shown in Table 6-1 below. The subtypes shown in the following clauses are degenerate cases of the base type.

Table 6-1/G.8011.2/Y.1307.2 – EVPL types

Type	Shared server layer	Multiplexed access
EVPL type 1	N	Y
EVPL type 2	Y	N
EVPL type 3	Y	Y
EPL (see ITU-T Rec. G.8011.1/Y.1307.1)	N	N

The components used to support an EVPL service shown in the figures of this clause are:

– the Ety-UNIs (UNI-N, UNI-C);
– the Ety-NNI;
– the Ethernet connection;
– the Access link.

The EVPL service uses an Ethernet UNI and is supported over Ethernet NNIs. EVPL type 1 service can specifically be supported over Ethernet-over-PDH, Ethernet-over-SDH, and Ethernet-over-OTH NNIs. EVPL type 1 service may also be supported over Ethernet-over-ATM with CIR and Ethernet-over-MPLS with CIR NNIs. EVPL type 2 and type 3 services can be supported over Ety-NNI in addition to those indicated for type 1. EVPL type 2 service may also be supported over Ethernet-over-ATM and Ethernet-over-MPLS with CIR, EIR, CBS and EBS NNIs. The UNI and NNI are specified in ITU-T Rec. G.8012/Y.1308.

6.2.1 EVPL type 1

Figure 6-2 shows the basic architecture of the EVPL type 1 service. The ETY layer is terminated at the UNI-N and the multiplexed ETH frames are forwarded over single ETH_FPs to the dedicated server layer. The UNI uses the VLAN tag for multiplexing at the demarcation point[1]. Multiplexed access (per 8.1.2/G.8011/Y.1307) is an Ethernet UNI attribute that indicates multiple service instances existing across a single Ethernet UNI demarcation. Since this is the principle feature on the ingress of EVPL type 1, it is also referred to as multiplexed access.

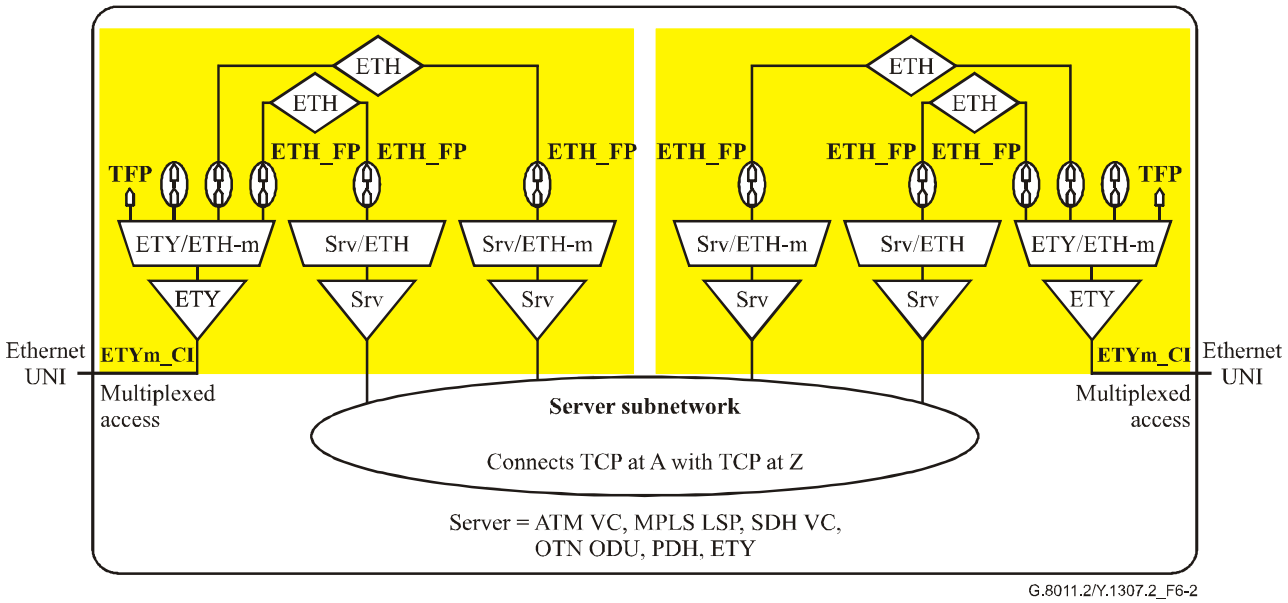

Figure 6-2/G.8011.2/Y.1307.2 – Ethernet virtual private line type 1 (multiplexed access with EPL) architecture

[1] Note that the choice of customer or provider VLAN tags is dependent on service provider agreement.

6.2.1.1 EVPL type 1a

Figure 6-3 shows the basic architecture of the EVPL type 1a service. This shows a more typical case with multiplexed access only on one side of the service.

In the case of the type 1a service, the CIR of the multiplexed access Ethernet UNI must be equal to or greater than the sum of the individual CIRs of the Ethernet service instances running over the two UNIs. Additional details will be described in ITU-T Rec. G.8021/Y.1341.

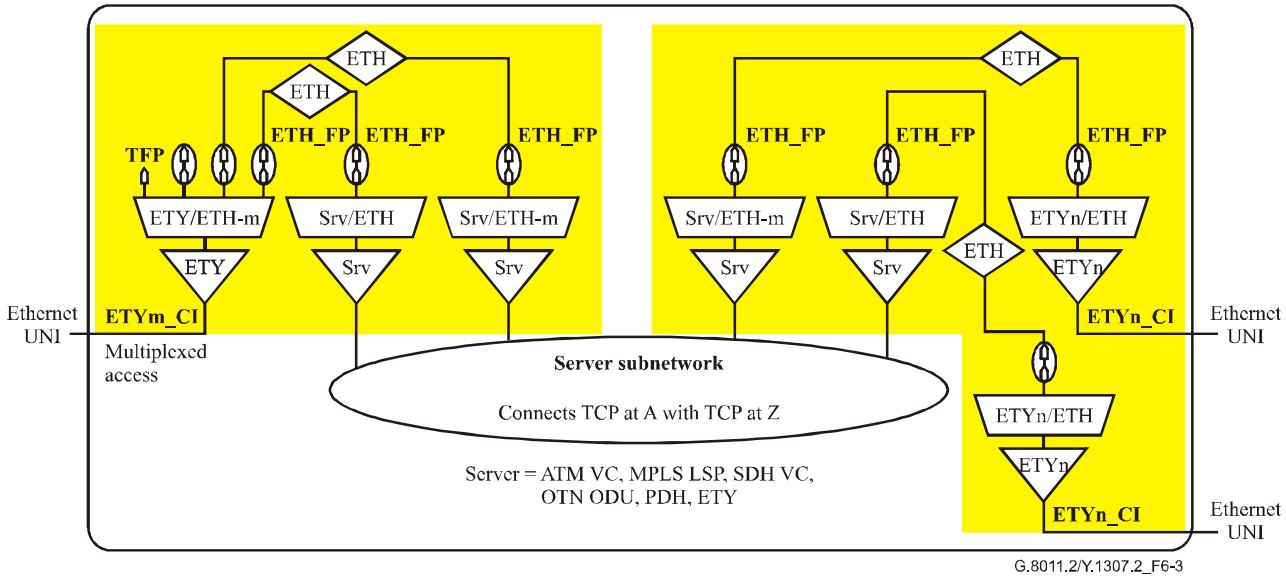

Figure 6-3/G.8011.2/Y.1307.2 – Ethernet virtual private line type 1a (multiplexed access with EPL) architecture

6.2.2 EVPL type 2

Figure 6-4 shows the basic architecture of the EVPL type 2 service. Each service instance has dedicated access to the UNI-N. The ETY layer is terminated at the UNI-N and the ETH frames are forwarded over ETH_FPs to the shared server layer. A frame tag is associated with each frame in the server layer (i.e., logical separation) to perform the multiplexing. The tag is a Service Provider VLAN tag (S-VLAN).

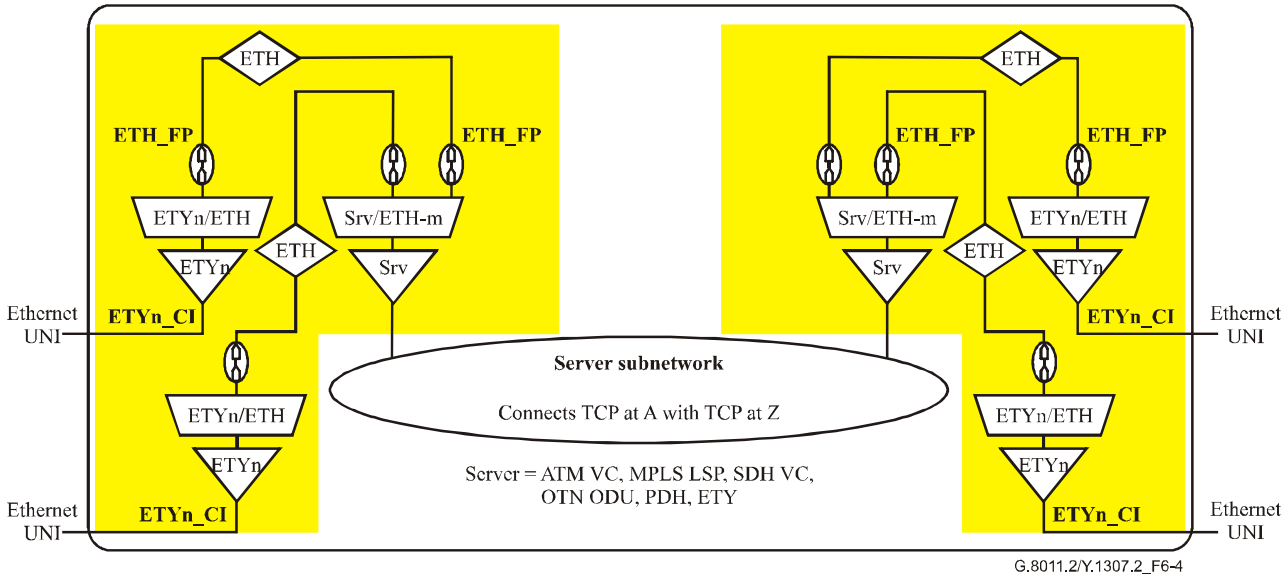

Figure 6-4/G.8011.2/Y.1307.2 – Ethernet virtual private line type 2 (shared server layer with dedicated access) architecture

6.2.2.1 EVPL type 2a

Figure 6-5 shows the basic architecture of the EVPL type 2a service. Each service instance has dedicated access to the UNI-N. The ETY layer is terminated at the UNI-N and the ETH frames are forwarded over ETH_FPs to a first dedicated server layer (i.e., spatial separation). The first server layer is connected to a second server layer (not illustrated) which multiplexes the flows (e.g., as in EVPL type 2). This is the case where the two server layer subnetworks are joined by some type of multiplexing function.

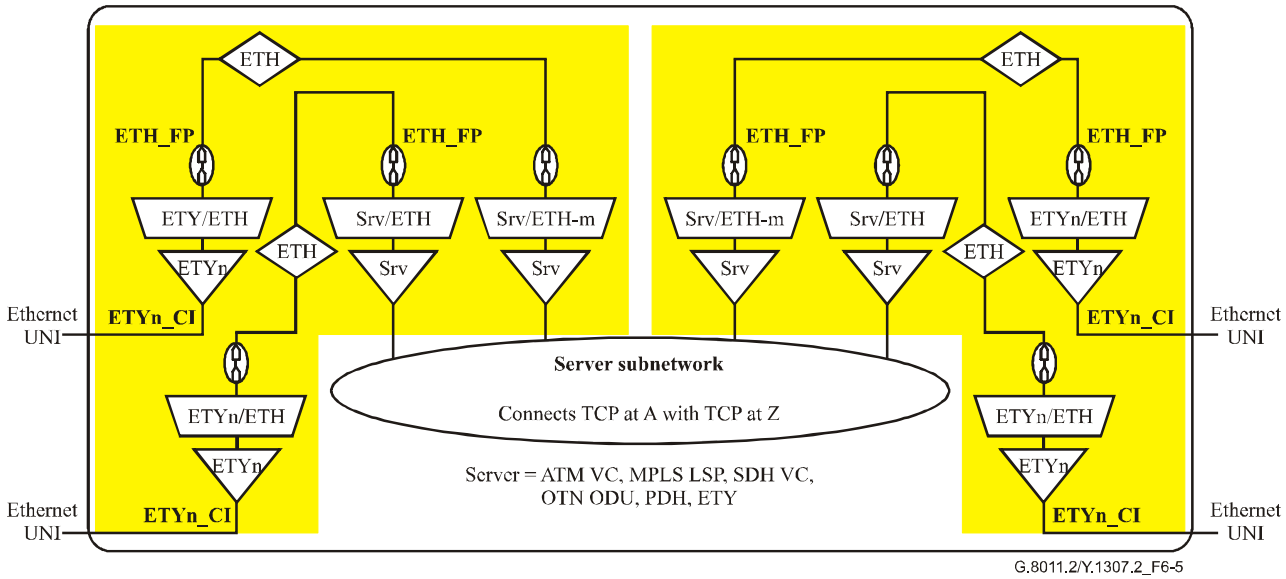

Figure 6-5/G.8011.2/Y.1307.2 – Ethernet virtual private line type 2a (shared server layer with dedicated access) architecture

Though not explicitly shown in Figure 6-5, type 2a service is distinguished by multiplexing within the server layer subnetwork.

A frame tag is associated with each frame in the server layer (i.e., logical separation) to perform the multiplexing. The tag may be an MPLS label, or some other server layer tag. This label/tag is inserted by the adaptation function (not illustrated) below the SRV_TT/SRV_FT function.

6.2.3 EVPL type 3

Figure 6-6 shows the basic architecture of the EVPL type 3 service. Each service instance is separated either logically or spatially at the UNI-N (as shown in the figure). The ETY layer is terminated at the UNI-N and the multiplexed ETH frames (i.e., logical separation) are forwarded over ETH_FPs to the shared server layer. In the combined multiplexing model, a frame tag is used for the multiplexing in the access network and in the server layer subnetwork. The access network may use VLAN tags[1] and the server layer subnetwork may use VLAN tags (S-VLAN) or MPLS labels. For EVPL type 3, this results in two possible combinations resulting from a combination of type 1 and type 2 EVPLs, which are:

1) Access links use VLAN tags and the server layer subnetwork uses VLAN tags;

2) Access links use VLAN tags and the server layer subnetwork uses MPLS labels.

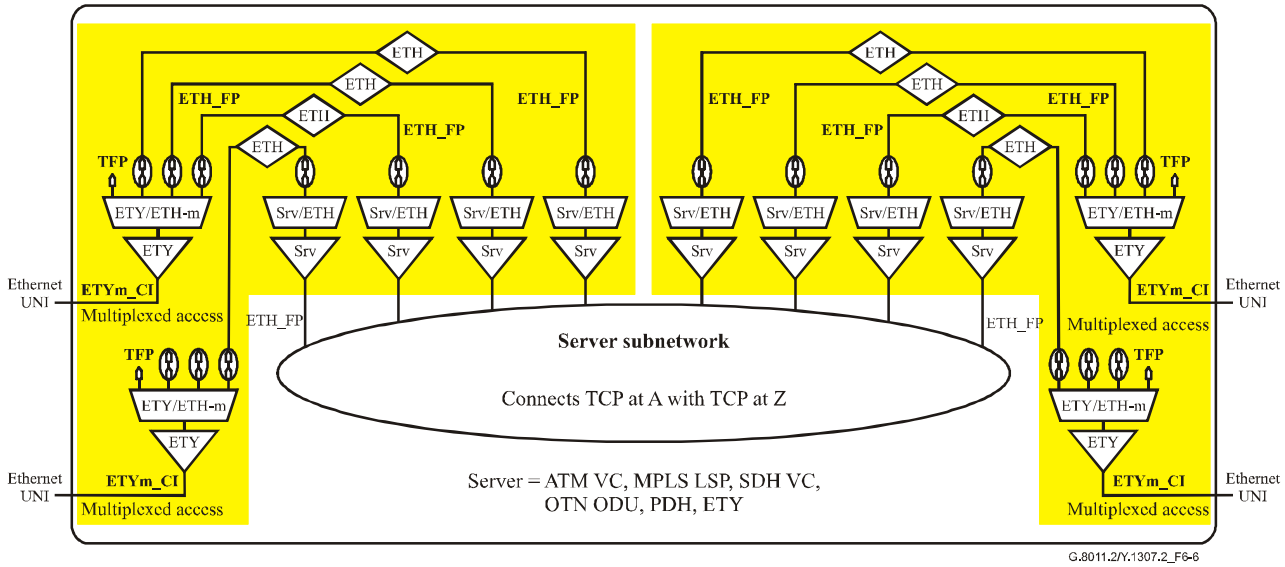

Figure 6-6/G.8011.2/Y.1307.2 – Ethernet virtual private line type 3 (shared server layer with multiplexed access) architecture

6.2.3.1 EVPL type 3a

Figure 6-7 shows a subset of the EVPL type 3 service. This specific architecture shows a single Ethernet UNI and a single connection to the server layer with separate traffic conditioning per service instance.

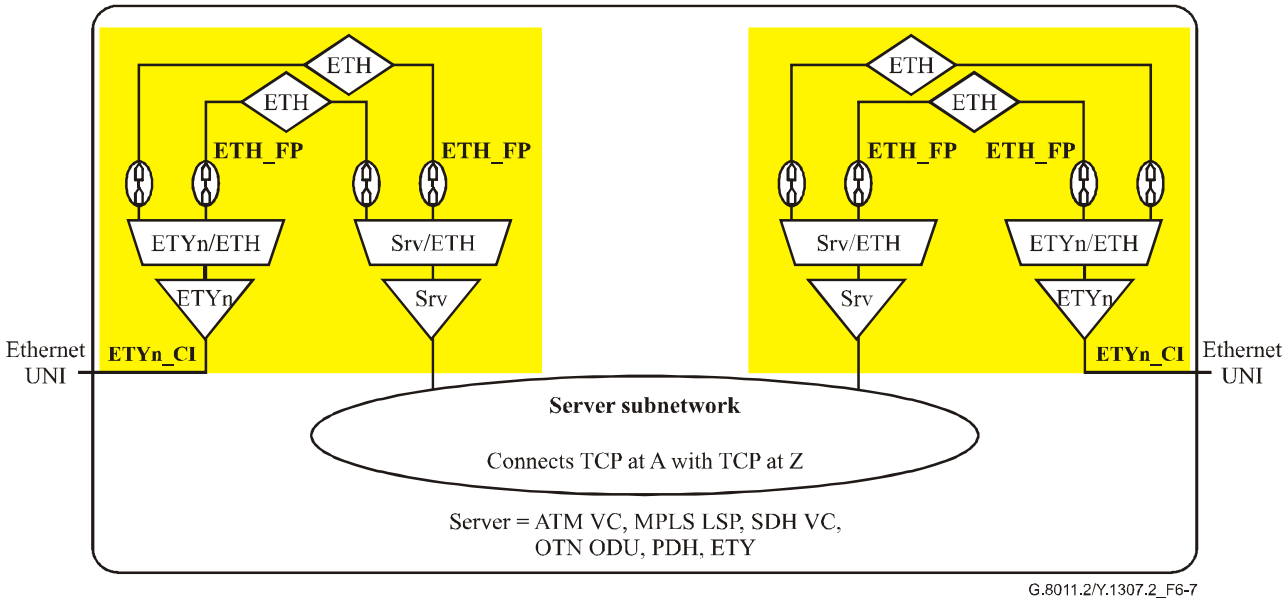

Figure 6-7/G.8011.2/Y.1307.2 – Ethernet virtual private line type 3a (shared server layer with multiplexed access) architecture

7 EVPL service characteristics

ITU-T Rec. G.8011/Y.1307 defines connections UNI and NNI attributes for Ethernet services. In the case of an EVPL service, some of these attributes have fixed values or a limited allowed range of parameters.

7.1 Ethernet Connection (EC) service attributes

The Ethernet connection service attributes are described in the following subclauses and are summarized in Table 7-1. Interworking with bridge control frames and MAC control frames is described in Tables 8-2, 8-3, 8-4, 9-2, and 9-3.

Table 7-1/G.8011.2/Y.1307.2 – EC service attributes

EC Service Attribute	Service attribute parameters and values
Network connectivity	Point-to-point
Transfer characteristics	Address – deliver unconditionally. For EVPL type 1, 3 may be delivered conditionally as well. Drop Precedence – drop randomly or drop conditionally depending on CIR and EIR parameters
Link type	Dedicated – EVPL type 1 Shared – EVPL type 2, 3
Customer separation	Logical – EVPL type 1 Spatial or Logical – EVPL type 2, 3
Service instance separation	Logical – EVPL type 1 Spatial or Logical – EVPL type 2, 3
Connectivity monitoring	Sub-layer monitoring: On demand and/or proactive Inherent monitoring: Proactive
Bandwidth profile	CIR, CBS, EIR, EBS – EVPL type 2, 3 CIR and CBS – EVPL type 1
UNI list	Arbitrary text string to identify associated UNIs
Preservation	VLAN – yes or no CoS – yes or no
Survivability	None, Server specific

7.1.1 Network connectivity

The connectivity of EVPL is point-to-point.

7.1.2 Transfer characteristics of ETH_CI

All Ethernet MAC data frames are transported regardless of their Destination Address.

For EVPL type 1 and 3 with multiplexed access, the Ethernet MAC data frames may be conditionally transported based on their Destination Address and optionally class of service (priority) of the ETH_CI.

7.1.3 Link type

The server link is referred to as dedicated for EVPL type 1 as defined in 7.3.1/G.8011/Y.1307. The server link is referred to as shared for EVPL type 2 and 3 as defined in 7.3.2/G.8011/Y.1307.

7.1.4 Customer separation

The EVPL may use logical or spatial separation between customer traffic, as defined in 7.4.2/G.8011/Y.1307, for EVPL types 2 and 3. EVPL type 1 uses logical separation.

7.1.5 Service instance separation

The EVPL may use logical or spatial separation between service instances, as defined in 7.4.1/G.8011/Y.1307, for EVPL types 2 and 3. EVPL type 1 uses logical separation.

7.1.6 Connectivity monitoring

Connectivity monitoring can either be proactive (sub-layer monitoring, inherent monitoring) or on-demand using tools to be specified in future Recommendations under study in SG 13. In some network implementations, the connectivity monitoring can rely on the server layer connectivity monitoring (inherent monitoring). It is also an option to not perform monitoring.

7.1.7 Bandwidth profile

Except for EVPL type 1, the EVPL service is generally defined by the four traffic parameters: CIR, CBS, EIR, and EBS. For EVPL type 1 the service definition is based on CIR and CBS only. The table below summarizes the traffic parameters relevant to each EVPL type.

Table 7-2/G.8011.2/Y.1307.2 – EVPL bandwidth profile parameters

EVPL service type	Traffic parameters
Type 1	CIR, CBS
Type 2	CIR, CBS, EIR, EBS
Type 3	CIR, CBS, EIR, EBS

An Ethernet flow that exceeds its committed rate will have its frames dropped or tagged with high drop precedence depending on the value of the EIR. Frames that exceed the flow EIR will be denied entry to the network and will be dropped at the access. Frames that exceed the flow CIR but are within its EIR will be marked with high drop precedence. Frames with high drop precedence will be dropped first when the network encounters congestion.

The function of the traffic conditioner includes frame metering and marking. The metering function is responsible for ensuring flow compliance to CIR and EIR. The marking function is responsible for marking the flow frames with the appropriate drop precedence based on frame compliance with CIR or EIR. A customer may implement shaping to avoid frame loss due to statistical variation in traffic.

Network engineering and a level of resource allocation is required in order to ensure that flow performance objectives, e.g., frame delay and frame loss, are satisfied. Performance measures are usually applicable only to frames that are compliant with the flow CIR.

7.1.8 UNI List

The UNI list is an arbitrary string administered by the Service Provider that is used to identify the UNIs connected to the EC. It is intended for management and control purposes.

7.1.9 Preservation

This attribute indicates the preservation of specific components of the ETH_CI provided by the ETH layer network that is used to transport the Ethernet service. Preservation means that the parameter value will be the same on ingress and egress to the EC. The two parameters are the ingress VLAN ID and class of service (priority) of the ETH_CI. Both can be preserved in EVPL.

7.1.10 Survivability

The transport network can provide survivability for the EVPL. The survivability alternatives for the ETH link are, for example:

– No protection;

– Protection by means of SDH or OTH or ATM or MPLS protection schemes;
– Restoration by means of SDH or OTH or ATM or MPLS restoration schemes.

8 EVPL UNI attributes

8.1 ETH_UNI attributes

This clause describes the UNI service attributes that modify the behaviour of a particular instance of an Ethernet service at the demarc of the UNI to characterize the service. There is a UNI defined at each of the ETH and ETY layers. These are summarized in Table 8-1.

Table 8-1/G.8011.2/Y.1307.2 – UNI service attributes

	UNI service attribute	Service attribute parameters and values
ETH	MAC service	IEEE 802.3-2005 Frame format
	Multiplexed Access	No – EVPL type 2 Yes – EVPL type 1 and 3
	UNI ID	Arbitrary text string to identify each UNI instance
	UNI EC ID	Arbitrary text string to identify each EC instance
	VLAN ID mapping	Yes – EVPL type 1 Yes/No – EVPL type 2, 2a, 3
	Bundling	No – EVPL type 1 and 3 All-to-one – EVPL type 2
	Bandwidth profile	For further study
	Layer 2 Control Protocol Processing	Specified in Tables 8-2, 8-3, and 8-4
ETY	PHY Speed	10 Mbit/s, 100 Mbit/s, 1 Gbit/s or 10 Gbit/s
	PHY Mode	Full duplex
	PHY Medium	IEEE 802.3-2005 Physical Interface

8.1.1 MAC service

The EVPL type 1 UNI supports all 802.3 MAC frames. From a service viewpoint, the FCS is passed through at the ETY_UNI. If the FCS is bad (i.e., the frame is errored) at the ETY_UNI, the frame is dropped.

8.1.2 Multiplexed access

This attribute indicates if the access to the Ethernet transport service is multiplexed (i.e., contains multiple service instances) or not. EVPL type 2 does not use multiplexed access. However, EVPL type 1 and 3 support multiplexed access.

8.1.3 UNI ID

The UNI ID is an arbitrary string administered by the Service Provider that is used to identify the UNI. It is intended for management and control purposes.

8.1.4 UNI EC ID

The UNI EC ID is an arbitrary string administered by the Service Provider that is used to identify an EC at the UNI. It is intended for management and control purposes.

8.1.5 VLAN ID mapping

At the UNI there is a mapping of each customer VLAN ID to at most one EC. For EVPL, VLAN ID mapping is supported.

8.1.6 Bundling

When a UNI has the Bundling attribute, it is configurable so that more than one VLAN ID can map to an EC at the UNI. For EVPL type 2, bundling is all-to-one. For EVPL type 1 and 3, bundling is not supported.

8.1.7 Bandwidth profile

For further study.

8.1.8 Layer 2 control protocol processing

L2 control frames may be passed, processed, generated, or blocked as specified in Tables 8-2, 8-3, and 8-4. ITU-T Rec. G.8011/Y.1307 describes these actions.

For EVPL, the choice of pass, block or process is independent of the server layer (except as noted), but is customer service dependent.

Table 8-2.1/G.8011.2/Y.1307.2 – Ingress (sink) 802 L2 control protocols UNI processing for EVPL type 1 and 3

MAC address	Valid actions	L2 control protocol
01-80-C2-00-00-00	Block	STP, MSTP, RSTP
01-80-C2-00-00-01	See Table 8-3.1	MAC Control (PAUSE)
01-80-C2-00-00-02	See Table 8-3.1	Slow protocols
01-80-C2-00-00-03	Block or process	802.1X Port Authentication
01-80-C2-00-00-04	Block	reserved address
01-80-C2-00-00-05	Block	reserved address
01-80-C2-00-00-06	Block	reserved address
01-80-C2-00-00-07	Block	reserved address
01-80-C2-00-00-08	Block	reserved address
01-80-C2-00-00-09	Block	reserved address
01-80-C2-00-00-0A	Block	reserved address
01-80-C2-00-00-0B	Block	reserved address
01-80-C2-00-00-0C	Block	reserved address
01-80-C2-00-00-0D	Block	reserved address
01-80-C2-00-00-0E	Block or process	802.1AB (LLDP)
01-80-C2-00-00-0F	Block	reserved address
01-80-C2-00-00-10	Block	Bridge management
01-80-C2-00-00-20	Block	GARP – GMRP address
01-80-C2-00-00-21	Block	GARP – GVRP address
01-80-C2-00-00-22	Block	GARP – reserved address
01-80-C2-00-00-23	Block	GARP – reserved address
01-80-C2-00-00-24	Block	GARP – reserved address
01-80-C2-00-00-25	Block	GARP – reserved address

Table 8-2.1/G.8011.2/Y.1307.2 – Ingress (sink) 802 L2 control protocols UNI processing for EVPL type 1 and 3

MAC address	Valid actions	L2 control protocol
01-80-C2-00-00-26	Block	GARP – reserved address
01-80-C2-00-00-27	Block	GARP – reserved address
01-80-C2-00-00-28	Block	GARP – reserved address
01-80-C2-00-00-29	Block	GARP – reserved address
01-80-C2-00-00-2A	Block	GARP – reserved address
01-80-C2-00-00-2B	Block	GARP – reserved address
01-80-C2-00-00-2C	Block	GARP – reserved address
01-80-C2-00-00-2D	Block	GARP – reserved address
01-80-C2-00-00-2E	Block	GARP – reserved address
01-80-C2-00-00-2F	Block	GARP – reserved address

Table 8-2.2/G.8011.2/Y.1307.2 – Ingress (sink) 802 L2 control protocols UNI processing for EVPL type 2

MAC address	Valid actions	L2 control protocol
01-80-C2-00-00-00	pass or block or process	STP, MSTP, RSTP
01-80-C2-00-00-01	See Table 8-3.2	MAC Control (PAUSE)
01-80-C2-00-00-02	See Table 8-3.2	Slow protocols
01-80-C2-00-00-03	pass or block or process	802.1X Port Authentication
01-80-C2-00-00-04	pass or block	reserved address
01-80-C2-00-00-05	pass or block	reserved address
01-80-C2-00-00-06	pass or block	reserved address
01-80-C2-00-00-07	pass or block	reserved address
01-80-C2-00-00-08	pass or block	reserved address
01-80-C2-00-00-09	pass or block	reserved address
01-80-C2-00-00-0A	pass or block	reserved address
01-80-C2-00-00-0B	pass or block	reserved address
01-80-C2-00-00-0C	pass or block	reserved address
01-80-C2-00-00-0D	pass or block	reserved address
01-80-C2-00-00-0E	pass or block or process	802.1AB (LLDP)
01-80-C2-00-00-0F	pass or block	reserved address
01-80-C2-00-00-10	pass or block	Bridge management
01-80-C2-00-00-20	pass or block or process	GARP – GMRP address
01-80-C2-00-00-21	pass or block or process	GARP – GVRP address
01-80-C2-00-00-22	pass or block or process	GARP – reserved address
01-80-C2-00-00-23	pass or block or process	GARP – reserved address
01-80-C2-00-00-24	pass or block or process	GARP – reserved address
01-80-C2-00-00-25	pass or block or process	GARP – reserved address

Table 8-2.2/G.8011.2/Y.1307.2 – Ingress (sink) 802 L2 control protocols UNI processing for EVPL type 2

MAC address	Valid actions	L2 control protocol
01-80-C2-00-00-26	pass or block or process	GARP – reserved address
01-80-C2-00-00-27	pass or block or process	GARP – reserved address
01-80-C2-00-00-28	pass or block or process	GARP – reserved address
01-80-C2-00-00-29	pass or block or process	GARP – reserved address
01-80-C2-00-00-2A	pass or block or process	GARP – reserved address
01-80-C2-00-00-2B	pass or block or process	GARP – reserved address
01-80-C2-00-00-2C	pass or block or process	GARP – reserved address
01-80-C2-00-00-2D	pass or block or process	GARP – reserved address
01-80-C2-00-00-2E	pass or block or process	GARP – reserved address
01-80-C2-00-00-2F	pass or block or process	GARP – reserved address

NOTE 1 – Link layer protocols (802.1X, 802.1AB) processed at the UNI are port-based and will act on all services on the link.

NOTE 2 – Link layer protocols (802.1X, 802.1AB) can be passed unless the EC is realized using 802.1ad (i.e., logical separation) or Note 3 is applicable.

NOTE 3 – If the process action is applied for the Slow Protocols – LACP and LAMP, the Pass action is not applicable for the link layer, L2, control protocols (e.g., 802.1X and 802.1AB).

Table 8-3.1/G.8011.2/Y.1307.2 – Ingress (sink) 802.3 L2 control protocols UNI processing for EVPL type 1 and 3

MAC address	Ethertype	Subtype	Valid actions	L2 control protocol
01-80-C2-00-00-01 or unicast	88-08	0x0001	block	MAC Control (PAUSE)
01-80-C2-00-00-02	88-09	0x01, 0x02	Block or process	Slow protocols – LACP, LAMP
01-80-C2-00-00-02	88-09	0x03	Block or process	Slow protocols – EFM OAM

Table 8-3.2/G.8011.2/Y.1307.2 – Ingress (sink) 802.3 L2 control protocols UNI processing for EVPL type 2

MAC address	Ethertype	Subtype	Valid actions	L2 control protocol
01-80-C2-00-00-01 or unicast	88-08	0x0001	block	MAC Control (PAUSE)
01-80-C2-00-00-02	88-09	0x01, 0x02	pass or block or process	Slow protocols – LACP, LAMP
01-80-C2-00-00-02	88-09	0x03	block or process (see Note 2)	Slow protocols – EFM OAM

Table 8-3.2/G.8011.2/Y.1307.2 – Ingress (sink) 802.3 L2 control protocols UNI processing for EVPL type 2

NOTE 1 – Link layer protocols (e.g., Slow protocols) processed at the UNI are port based and will act on all services on the link. NOTE 2 – If there is no UNI/NNI process implementing the 802.3ah OAM and the Slow Protocols are not processed by the UNI, then the valid action becomes Pass for the ingress table. For the egress table below it becomes none. As a consequence, if the customer is sending OAM frames across the Access Link, these frames will be received by the customer equipment at the other end of the virtual private line. For example, such a situation may occur when there is no support for 802.3ah OAM on the provider edge devices, while there is support for 802.3ah OAM on the two end customer devices (i.e., at the end of each access link).

Table 8-4.1/G.8011.2/Y.1307.2 – Egress (source) 802.3 L2 control protocols UNI processing for EVPL type 1 and 3

MAC address	Ethertype	Subtype	Valid actions	L2 control protocol
01-80-C2-00-00-01 or unicast	88-08	0x0001	None	MAC Control (PAUSE)
01-80-C2-00-00-02	88-09	0x01, 0x02	None or generate	Slow protocols – LACP, LAMP
01-80-C2-00-00-02	88-09	0x03	None or generate	Slow protocols – EFM OAM

Table 8-4.2/G.8011.2/Y.1307.2 – Egress (source) 802.3 L2 control protocols UNI processing for EVPL type 2

MAC address	Ethertype	Subtype	Valid actions	L2 control protocol
01-80-C2-00-00-01 or unicast	88-08	0x0001	None or generate	MAC Control (PAUSE)
01-80-C2-00-00-02	88-09	0x01, 0x02	None or generate	Slow protocols – LACP, LAMP
01-80-C2-00-00-02	88-09	0x03	None or generate	Slow protocols – EFM OAM
NOTE – Slow protocols generated at the UNI are port based and will represent all services on the link.				

8.2 ETY UNI attributes

The ETY_UNI is a PHY characterized by speed, mode, and medium. These attributes are described in ITU-T Rec. G.8011/Y.1307. The attributes that apply to EVPL are specified as follows:

8.2.1 Speed

This attribute indicates the speed of Ethernet PHY layer that is used to transport the Ethernet service. There are four values defined by ITU-T Rec. G.8012/Y.1308: 10 Mbit/s, 100 Mbit/s, 1 Gbit/s or 10 Gbit/s.

8.2.2 Mode

This attribute indicates the mode of Ethernet PHY layer that is used to transport the Ethernet service. EVPL uses the full duplex mode.

8.2.3 Medium

This attribute indicates the medium of Ethernet PHY layer that is used to transport the Ethernet service. The values are defined by ITU-T Rec. G.8012/Y.1308.

9 EVPL NNI attributes

9.1 ETH_NNI attributes

Table 9-1/G.8011.2/Y.1307.2 – NNI service attributes

	NNI service attribute	Service attribute parameters and values
ETH	MAC service	IEEE 802.3-2005 Frame format
	NNI ID	Arbitrary text string to identify each NNI instance
	NNI EC ID	Arbitrary text string to identify each EC instance
	Multiplexed Link	No – EVPL type 1 Yes or no – EVPL type 2 and 3
	VLAN mapping	Not applicable – EVPL type 1 Specify or not applicable – EVPL type 2 and 3
	Bundling	For further study
	Bandwidth profile	For further study
	Layer 2 Control Protocol Processing	Specified in Tables 9-2 and 9-3
Server	Server layer	SDH, PDH, OTH, ETY, ATM, MPLS

9.1.1 MAC service

The EVPL NNI supports all 802.3 MAC frames. All ETH_CI is passed.

9.1.2 NNI identification

The NNI ID is an arbitrary string administered by the Service Provider that is used to identify the NNI. It is intended for management and control purposes.

9.1.3 NNI EC identification

Per 8.1.4.

9.1.4 Multiplexed link

EVPL type 1 does not support multiplexed NNI links. EVPL type 2 and 3 can use or not use multiplexed NNI links.

9.1.5 VLAN mapping

At the multiplexed NNI there is a mapping of service provider VLAN ID to at most one EC.

For non-multiplexed NNI, VLAN ID mapping is not applicable.

9.1.6 Bundling

For further study.

9.1.7 Bandwidth profile

For further study.

9.1.8 Layer 2 control protocol processing

L2 protocols are only visible at the NNI if it is an ETY. In this case, the L2 control protocols can be passed, processed, blocked, or none (per ITU-T Rec. G.8011/Y.1307). All 802.1 L2 protocols as listed in Table 8-2/G.8011/Y.1307 are passed. The 802.3 L2 protocols processing are shown in Tables 9-2 and 9-3. Note that the action taken at the NNI should be consistent with action taken at the UNI.

Table 9-2/G.8011.2/Y.1307.2 – Ingress (sink) 802.3 L2 control protocols NNI processing for EVPL type 1, 2 and 3

MAC address	Ethertype	Subtype	Valid actions	L2 control protocol
01-80-C2-00-00-01 or unicast	88-08	0x0001	Pass	MAC Control (PAUSE)
01-80-C2-00-00-02	88-09	0x01, 0x02	Pass	Slow protocols – LACP, LAMP
01-80-C2-00-00-02	88-09	0x03	Pass	Slow protocols – EFM OAM

Table 9-3/G.8011.2/Y.1307.2 – Egress (source) 802.3 L2 control protocols NNI processing for EVPL type 1, 2 and 3

MAC address	Ethertype	Subtype	Valid actions	L2 control protocol
01-80-C2-00-00-01 or unicast	88-08	0x0001	None	MAC Control (PAUSE)
01-80-C2-00-00-02	88-09	0x01, 0x02	None	Slow protocols – LACP, LAMP
01-80-C2-00-00-02	88-09	0x03	None	Slow protocols – EFM OAM

9.2 Server layer adaptation

The server layers for all EVPL types described in clause 6 are specified in Table 9-4.

Table 9-4/G.8011.2/Y.1307.2 – EVPL server layers

Server layer technology
SDH
OTH
PDH
MPLS
ATM
ETY

Appendix I

Customer view and network view of Ethernet services

I.1 Introduction

This Recommendation describes Ethernet services from the network perspective. Ethernet services may also be described from the customer perspective.

The network viewpoint may be used by a carrier to define its network and manage the services and facilities within that network. A carrier may choose to expose these services to its customers in SLAs or choose to use them internally.

The customer viewpoint of a service is simply viewing the carrier network from the customer side. None of the network configuration, topology or management is visible to the customer. However, performance measurements may be used to infer carrier network specifics.

It is important to note that both views are valid for all Ethernet services, though they both need not be used. In the majority of cases, where customer and network view services are both used, it is important to understand that they are complementary.

I.2 MEF – G.8011.2/Y.1307.2 comparison

Using the MEF as an example, the MEF E-Line Ethernet service type that is defined in the MEF Ethernet Services Phase I can be implemented using the EVPL infrastructure Ethernet services defined in this Recommendation.

This can be further refined with the review of the many possible service definitions that the MEF suggests is possible. Only the EVPL service definition is explored in this appendix. The EPL service definition is explored in Appendix I/G.8011.1/Y.1307.1.

I.3 Ethernet virtual private line implementation

The G.8011.2/Y.1307.2 EVPL service can be viewed as a subset of the MEF Ethernet Virtual Private Line service of the E-line service type and shows the mapping of G.8011.2/Y.1307.2 attributes to MEF attributes. That is, the EVPL described in this Recommendation can be used to implement the MEF service.

The attributes of the MEF Ethernet Virtual Private Line service are shown in the following tables along with the matched ETH_CI attribute from the G.8011.2/Y.1307.2 EVPL definition.

Table I.1/G.8011.2/Y.1307.2 – E-line service type EVC service attribute requirements for MEF Ethernet virtual private line implemented with G.8011.2/Y.1307.2 EVPL

MEF EVC service attribute	MEF service attribute parameters and values	G.8011/Y.1307 EC attribute	G.8011.2/Y.1307.2 value
EVC Type	**MUST** be Point-to-Point	Network Connectivity	point-to-point
		Link type	Dedicated – EVPL type 2 Shared – EVPL type 1, 3
UNI List	**MUST** list the two UNIs associated with the EVC.	UNI list	Arbitrary text string to identify the UNIs
CE-VLAN ID Preservation	Yes or No	Preservation – VLAN	Yes or No
CE-VLAN CoS Preservation	Yes or No	Preservation – CoS	Yes or No
Unicast Service Frame Delivery	Deliver Unconditionally or Deliver Conditionally. If Delivered Conditionally, **MUST** specify the delivery criteria.	Transfer characteristics – address	Deliver unconditionally. For EVPL type 1, 3 may be delivered conditionally as well.
Multicast Service Frame Delivery	Deliver Unconditionally or Deliver Conditionally. If Delivered Conditionally, **MUST** specify the delivery criteria.		
Broadcast Service Frame Delivery	Deliver Unconditionally or Deliver Conditionally. If Delivered Conditionally, **MUST** specify the delivery criteria.		
(Note a)	–	Transfer characteristics – drop precedence	drop randomly or drop conditionally depending on CIR and EIR parameters
Layer 2 Control Protocol Processing (only applies for L2CP passed to the EVC)	**SHOULD** discard PAUSE, **MUST** not tunnel **SHOULD** discard LACP, LAMP, 802.1x **SHOULD** discard STP, RSTP, MSTP, All LANs Bridge Management Group, GARP	UNI L2 Control protocol processing (Note 2)	EVPL type 1, 3 – block all, also may process 802.1X, 802.1AB, slow protocols EVPL type 2: PAUSE – block 33 reserved addresses 802.1X, 802.1AB, slow protocols – pass, block or process
Service Performance	**MAY** support none, one or more CoS. If supported, a CoS ID, Frame Delay and Frame Loss Ratio **MUST** be specified. Frame Delay Variation **MAY** be specified.	(Note 1)	
(Note b)	–	Customer separation	Logical or Spatial
(Note b)	–	Service instance separation	Logical or Spatial
(Note c)	–	Connectivity monitoring	proactive, on demand
(Note c)	–	Survivability	None, Server specific

MEF notes:

a) Not specified by MEF, but handled implicitly by Service performance.

b) Handled implicitly by Service performance parameters that allow the sharing of resources.

c) No equivalent.

G.8011/Y.1307 notes:

NOTE 1 – Not defined in ITU-T Rec. G.8011/Y.1307. Depends on server layer.

NOTE 2 – Valid actions per L2 control protocol on ingress and egress are summarized here and are clearly defined in Tables 8-2, 8-3 and 8-4.

Table I.2/G.8011.2/Y.1307.2 – E-line service type UNI service attribute requirements for MEF Ethernet virtual private line implemented with G.8011.2/Y.1307.2 EVPL

MEF UNI service attribute	MEF service attribute parameters and values	G.8011/Y.1307 UNI attribute	G.8011.2/Y.1307.2 value
UNI Identifier	Arbitrary text string to identify the UNI	UNI ID	Arbitrary text string to identify the UNI
Physical Medium	IEEE 802.3-2002 Physical Interface	PHY Medium	Defined in ITU-T Rec. G.8012/Y.1308
Speed	10 Mbit/s, 100 Mbit/s, 1 Gbit/s or 10 Gbit/s	PHY Speed	10 Mbit/s, 100 Mbit/s, 1 Gbit/s or 10 Gbit/s
Mode	**MUST** be Full Duplex	PHY Mode	Full Duplex
MAC Layer	IEEE 802.3-2002	MAC Service	IEEE 802.3-2005
Service Multiplexing	**SHOULD** be supported. When more than one EVC is multiplexed at a UNI, All to One Bundling **MUST** be No.	Multiplexed access	No – EVPL type 2 Yes – EVPL type 1, 3
UNI EVC ID	Arbitrary text string to identify each EVC instance	UNI EC ID	Arbitrary text string to identify each EC
CE-VLAN ID / EVC Map	Mapping table of CE-VLAN IDs to E-Line Service type UNI EVC IDs.	VLAN Mapping	EVPL type 1, 3 – No EVPL type 2 – Yes or No
Maximum number of EVCs	≥ 1	(Note 1)	–
Bundling	Yes or No. If Yes, then CE-VLAN ID Preservation **MUST** be Yes. **MUST** be No if All to One Bundling is Yes	Bundling	EVPL type 1, 3 – No EVPL type 2 – all-to-one
All to One Bundling	Yes or No. If Yes, then CE-VLAN ID Preservation **MUST** be Yes. **MUST** be No if Bundling or Service Multiplexing is Yes.		
Ingress Bandwidth Profile Per Ingress UNI	No or <CIR, CBS, EIR, EBS, CM, CF>	EC Bandwidth Profile	CIR, CBS, EIR, EBS
Layer 2 Control Protocol Processing	**SHOULD** discard PAUSE, **MUST** not tunnel **SHOULD** discard LACP, LAMP, 802.1 **SHOULD** discard STP, RSTP, MSTP, All LANs Bridge Management Group, GARP	L2 Control protocol processing (Note 2)	EVPL type 1, 3 – block all, also may process 802.1X, 802.1AB, slow protocols EVPL type 2: PAUSE – block 33 reserved addresses 802.1X, 802.1AB, slow protocols – pass, block or process

NOTE 1 – EVPL is defined as point-to-point service with no limit on the number of EC.

NOTE 2 – These are the ingress actions. Valid actions per L2 control protocol on ingress and egress are summarized here and are are clearly defined in Tables 8-2, 8-3 and 8-4.

Appendix II

Traffic conditioning

II.1 Introduction

Ethernet traffic conditioning will be detailed in a revision of ITU-T Rec. G.8021/Y.1341. In the interim, a description is provided in this appendix.

II.2 Traffic conditioning

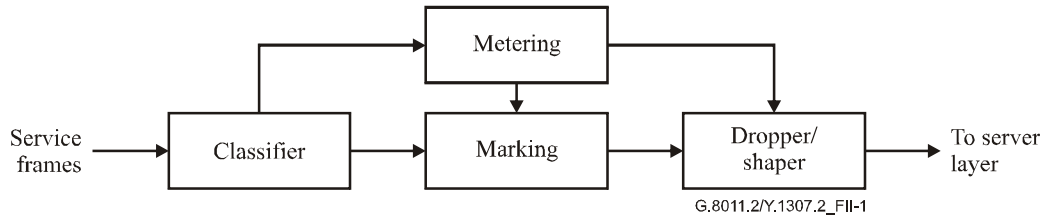

Figure II.1/G.8011.2/Y.1307.2 – Traffic conditioner

The traffic conditioner consists of classifier, metering, marking, dropper and shaper. Ethernet traffic conditioning functions are all optional. Traffic conditioning functions are applied on an Ethernet flow that share some common characteristic as selected by the classifier. Classification criteria could, for example, be based on VLAN Tag.

The metering function of the traffic conditioner ensures the conformance of the Ethernet flow to a certain bandwidth profile as specified by the parameters CIR, CBS, EIR, and EBS. The metering algorithm is shown in Figure II.2.

The marking function sets a bit in the Ethernet frame header to indicate the frame colour, based on frame compliance, as determined by the metering function. Frames that are compliant with CIR and CBS are marked green. Frames that are not compliant with CIR and CBS, but are compliant with EIR and EBS, are marked yellow. Frames that are not compliant with the bandwidth profile parameters are marked as red. Frame marking can also be based on criteria other than frame compliance, for instance, based on policies. Yellow frames are marked with discard eligibility flag and would be discarded first when the server layer is congested. Frame colour is only of significance when the server layer is either CO-PS or CLPS.

The dropping function of the traffic conditioning brings the Ethernet flow to its specified bandwidth profile by dropping non-conformant (red) frames. Similar to the marking function, dropping can also be based on server layer policies.

II.3 Traffic conditioning algorithm

The objective of traffic conditioning is to determine the conformance of the incoming Ethernet frames. The level of conformance is expressed as one of three colours: Green, Yellow or Red.

Compliance for a Bandwidth Profile is described by 4 parameters. The parameters are:

1) Committed Information Rate (CIR) expressed as bits per second. CIR must be ≥ 0.
2) Committed Burst Size (CBS) expressed as bytes. When CIR > 0, CBS must be ≥ Maximum Ethernet frame allowed to enter the network.
3) Excess Information Rate (EIR) expressed as bits per second. EIR must be ≥ 0.
4) Excess Burst Size (EBS) expressed as bytes. When EIR > 0, EBS must be ≥ Maximum Ethernet frame allowed to enter the network.

Two additional parameters are used to determine the behaviour of the Bandwidth Profile algorithm. The algorithm is said to be in colour-aware mode when each incoming Ethernet Frame already has a level of conformance colour associated with it and that colour is taken into account in determining the level of conformance to the bandwidth profile parameters. The Bandwidth Profile algorithm is said to be in colour blind mode when level of conformance colour (if any) already associated with each incoming Ethernet Frame is ignored in determining the level of conformance. Colour blind mode support is required at the UNI. Colour aware mode is optional at the UNI.

5) Coupling Flag (CF) must have only one of two possible values, 0 or 1.

6) Colour Mode (CM) must have only one of two possible values, "colour-blind" and "colour-aware".

For a sequence of ingress Ethernet frames, {tj,lj}j≥0, with arrival times tj and lengths lj, the colour assigned to each frame during traffic conditioning is defined by using the algorithm shown in Figure II.1. For this algorithm, $Bc(t_0)$ = CBS and $Be(t_0)$ = EBS. $B_c(t)$ and $B_e(t)$ are the number of bytes in the Committed and Excess token buckets respectively at a given time t.

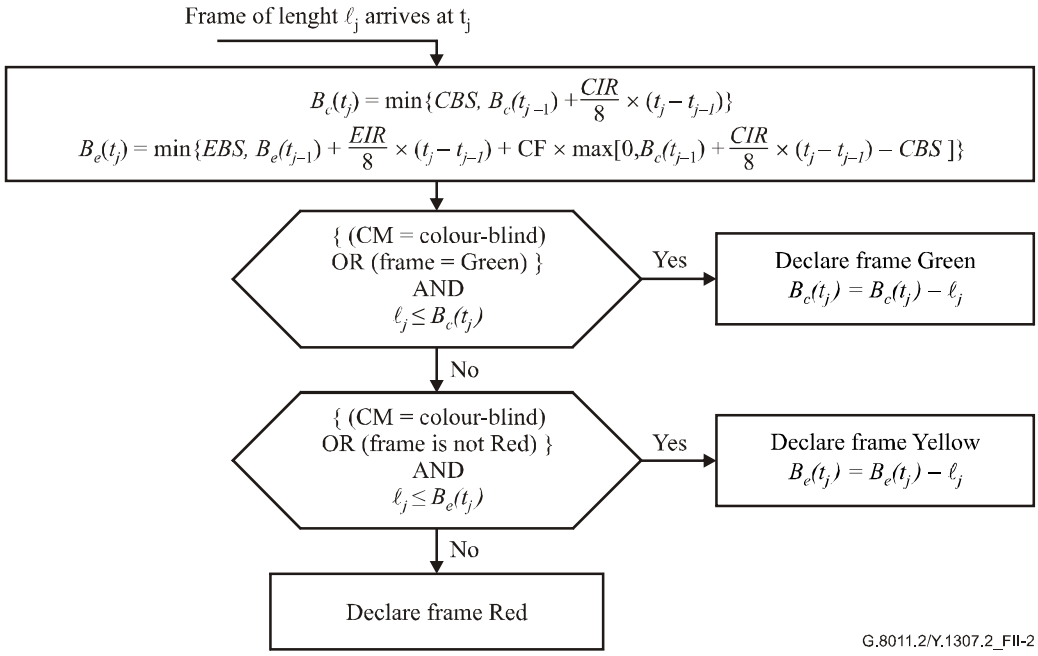

Figure II.2/G.8011.2/Y.1307.2 – Traffic conditioning algorithm

Note that the algorithm does not define an implementation of any network equipment. Any implementation that results in the same conditioning results meets the requirement of this Recommendation.

II.4 Customer shaping

In some deployment scenarios there may be a mismatch between the shaping algorithm deployed at the UNI-C and the metering algorithm in Figure II.2. This is particularly true when shaping is based on the algorithm described in RFC 2698. For those scenarios, since RFC 2698 policing is not used, mapping of shaping parameters to service parameters CIR, CBS, EIR, and EBS is required. For the particular case where the algorithm in RFC 2698 is used for shaping, the parameters CIR and CBS match in the two algorithms. EIR is set equal to PIR – CIR, while EBS is engineered to accommodate as many yellow frames as allowed by the shaping algorithm.

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