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

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Ethernet UNI and Ethernet NNI

ITU-T Recommendation G.8012/Y.1308

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ITU-T Recommendation G.8012/Y.1308

Ethernet UNI and Ethernet NNI

Summary

This Recommendation specifies the Ethernet UNI and the Ethernet NNI. A set of physical Ethernet interfaces is defined for the Ethernet UNI and the Ethernet NNI. Further, a set of Ethernet over Transport interfaces are defined for the Ethernet NNI. The Ethernet over Transport NNI uses various server layer networks like ATM, OTH, PDH and SDH.

Source

ITU-T Recommendation G.8012/Y.1308 was approved on 22 August 2004 by ITU-T Study Group 15 (2001-2004) under the ITU-T Recommendation A.8 procedure.

FOREWORD

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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.

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As of the date of approval of this Recommendation, ITU had not received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementors are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database.

CONTENTS

ITU-T Recommendation 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 various server layer networks like ATM, OTH, PDH and SDH. The detailed requirements are specified in a number of ITU-T Recommendations, ANSI Standards, IEEE Standards and IETF RFC, which are referred to.

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.691 (2003), *Optical interfaces for single channel STM-64 and other SDH systems with optical amplifiers*.
- ITU-T Recommendation G.704 (1998), *Synchronous frame structures used at 1544, 6312, 2048, 8448 and 44 736 kbit/s hierarchical levels*.
- 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.832 (1998), *Transport of SDH elements on PDH networks – Frame and multiplexing structures*, plus Amendment 1 (2004), *Payload type code for virtual concatenation of 34 368 kbit/s signals*.
- ITU-T Recommendation G.7041/Y.1303 (2003), *Generic framing procedure (GFP)*.
- ITU-T Recommendation G.7042/Y.1305 (2004), *Link capacity adjustment scheme (LCAS) for virtual concatenated signals*.
- 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.*
- ITU-T Recommendation G.8040/Y.1340 (2004), *GFP frame mapping into plesiochronous digital hierarchy (PDH)*.
- ITU-T Recommendation I.363.5 (1996), *B-ISDN ATM Adaptation Layer specification: Type 5 AAL*.
- ITU-T Recommendation X.85/Y.1321 (2001), *IP over SDH using LAPS*, plus Amendment 1 (2004), *Bit-oriented method for LAPS.*

– ITU-T Recommendation X.86/Y.1323 (2001), *Ethernet over LAPS*.

– ITU-T Recommendation Y.1730 (2004), *Requirements for OAM functions in Ethernet-based networks and Ethernet services*.

– IEEE Std 802-2001, *IEEE Standard for Local and Metropolitan Area Networks: Overview and Architecture*.

– IEEE Std 802.1D-1998, *Information Technology – Telecommunications and information exchange between systems – Local and metropolitan area networks – Common specifications – Media Access Control (MAC) Bridges*.

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

– IEEE Std 802.2-1998, *Information technology – Telecommunications and information exchange between systems – Local and metropolitan area networks – Specific requirements – Part 2: Logical Link Control*.

– IEEE Std 802.3-2002, *Information technology – Telecommunication and Information Exchange Between Systems – LAN/MAN – Specific requirements – Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications*.

– IEEE Std 802.3ae-2002, *IEEE Standard for Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications – Media Access Control (MAC) Parameters, Physical Layer and Management Parameters for 10 Gb/s Operation*.

– IETF RFC 2684 (1999), *Multiprotocol Encapsulation over ATM Adaptation Layer 5*.

– ANSI T1.107 (2002), *Digital Hierarchy – Formats Specifications*.

3 Terms and definitions

This Recommendation defines the following terms:

3.1 ETH_CI traffic unit: See ITU-T Rec. G.8010/Y.1306.

3.2 network termination: The network element in the transport network, which is connected to the customer edge equipment.

3.3 UNI: An interface that is used for the interconnection of customer equipment with a network element of the transport network.

3.4 Ety-UNI: An UNI for the transfer of ETH_CI traffic unit over a physical Ethernet interface.

3.5 NNI: An interface that is used for the interconnection of networks elements within a transport network.

3.6 EoT-NNI: An NNI for the transfer of ETH_CI traffic unit over a transport layer network referred to in this Recommendation.

3.7 Ety-NNI: An NNI for the transfer of ETH_CI traffic unit over a physical Ethernet interface.

4 Acronyms and abbreviations

This Recommendation uses the following abbreviations:

ANSI American National Standards Institute

ATM Asynchronous Transfer Mode

C-Tag Customer Tag

C-VID	Customer VID
CE	Customer Edge
CI	Characteristic Information
DA	Destination Address
EoA	Ethernet over ATM
EoM	Ethernet over MPLS
EoO	Ethernet over OTH
EoP	Ethernet over PDH
EoR	Ethernet over RPR
EoS	Ethernet over SDH
EoT	Ethernet over Transport
EoT-NNI	Ethernet over Transport NNI
ETH	Ethernet MAC layer network
ETH_CI	Ethernet MAC Characteristic Information
ETHP	ETH path layer
ETHS	ETH segment sublayer
ETY	Ethernet PHY layer
ETYn	Ethernet PHY layer network of type *n*
Ety-NNI	Ethernet NNI
Ety-UNI	Ethernet UNI
Ety-UNI-C	Customer side of the Ety-UNI
Ety-UNI-N	Network side of the Ety-UNI
EUG	Ethernet Unit Group
EUGn	EUG level n
FCS	Frame Check Sequence
GFP	Generic Framing Procedure
GFP-F	Generic Framing Procedure – Frame Mapped
IaDI	Intra-Domain Interface
IEEE	Institute of Electrical and Electronics Engineers
IETF	Internet Engineering Task Force
IrDI	Inter-Domain Interface
LAN	Local Area Network
LAPS	Link Access Procedure – SDH
LCAS	Link Capacity Adjustment Scheme
LLC	Logical Link Control
MAC	Media Access Control
M_SDU	MAC Service Data Unit

MPLS	Multi-Protocol Label Switching
MS64	Multiplex Section – level 64
NNI	Network Node Interface
NT	Network Termination
ODU	Optical Channel Data Unit
ODUj	Optical Channel Data Unit – order j
ODUj-Xv	Virtual concatenated Optical Channel Data Unit – order j
ODUk	Optical Channel Data Unit – order k
ODUk-Xv	Virtual concatenated Optical Channel Data Unit – order k
OTH	Optical Transport Hierarchy
P11s	1544 kbit/s PDH path layer with synchronous 125 µs frame structure according to ITU-T Rec. G.704
P12s	2048 kbit/s PDH path layer with synchronous 125 µs frame structure according to ITU-T Rec. G.704
P31s	34 368 kbit/s PDH path layer with synchronous 125 µs frame structure according to ITU-T Rec. G.832
P4s	139 264 kbit/s PDH path layer with synchronous 125 µs frame structure according to ITU-T Rec. G.832
PA	(Ethernet) Preamble
PDH	Plesiochronous Digital Hierarchy
PHY	Physical
PMA	Physical Medium Attachment sublayer
PMD	Physical Medium Dependent sublayer
RFC	Request for Comments
RPR	Resilient Packet Ring
RS64	Regenerator Section – level 64
S-Tag	Service Provider Tag
S-VID	Service Provider VID
SA	Source Address
SDH	Synchronous Digital Hierarchy
SFD	Start of Frame Delimiter
SNAP	Sub-Network Access Protocol
STM-N	Synchronous Transport Module – level N
TCI	Tag Control Information
UNI	User Network Interface
VC	Virtual Channel (ATM)
VC	Virtual Container (SDH)
VC-m	Lower Order VC – order m

VC-n Higher Order VC – order n

VC-n-Xc Contiguous concatenated VC – order n

VC-n-Xv Virtual concatenated VC – order n

VID VLAN Identifier

VLAN Virtual LAN

VLAN ID VLAN Identifier

5 Conventions

None.

6 Ethernet transport network interface structure

The Ethernet transport network as specified in ITU-T Rec. G.8010/Y.1306 implies two interface classes:

- Ethernet interface as specified in IEEE 802.3 series;
- Ethernet-over-Transport (EoT) interface as specified in this Recommendation.

The Ethernet interface can be deployed as an Ethernet User-to-Network Interface (Ety-UNI) at the edge of the transport network and as an Ethernet Network Node Interface (Ety-NNI) within the transport network. The Ethernet NNI may be deployed as an Intra-Domain Interface (IaDI) within a single administrative domain and as an Inter-Domain Interface (IrDI) between two administrative domains.

The Ethernet-over-Transport (EoT) interface can be deployed as an Ethernet IaDI and IrDI NNI within the transport network.

NOTE – The deployment of EoT interface as an Ethernet UNI is for further study.

The Ethernet UNI could be used for the provision of Ethernet services as described in ITU-T Rec. G.8011/Y.1307. Two or more Ety-UNIs are used for such a service as illustrated in Figure 6-1.

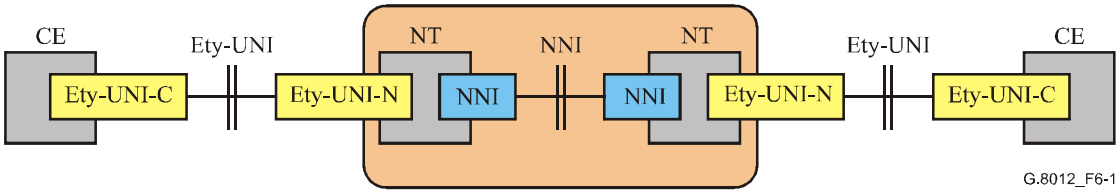

Figure 6-1/G.8012/Y.1308 – Locations of Ethernet Ety-UNI and NNI

The Ethernet UNI and NNI encompass multiple layer networks, each with its dedicated UNI and NNI (Figure 6-2).

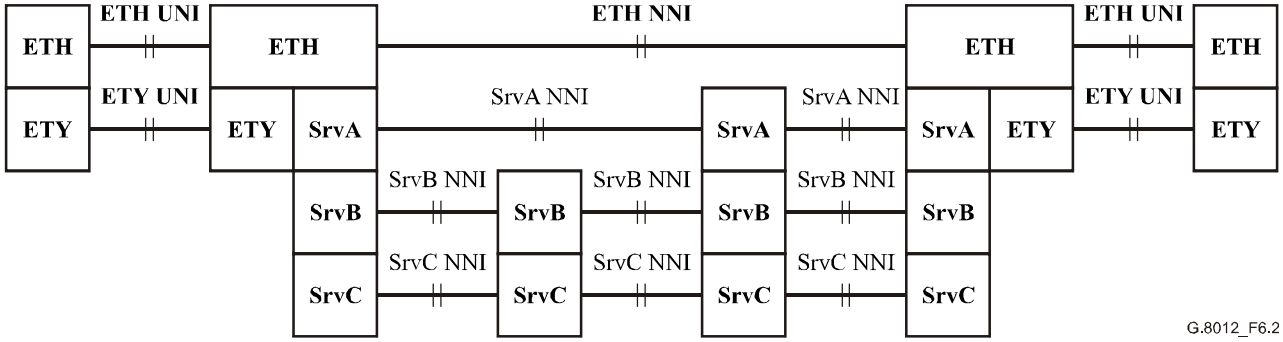

Figure 6-2/G.8012/Y.1308 – Example of layer networks in Ethernet UNI and NNI for case of pt-pt ETH layer connection

The Ethernet UNI could be used for the provision of an access link to a Service Node (SN), such as IP-Router, ASON switch, etc. In this case the Ety-UNI-C is terminated at the customer edge (CE) and the Ety-UNI-N is terminated at the NT. See Figure 6-3. It should be noted that a SN requires the support of SN specific protocols and may require the support of further layer networks. These SN related protocols and layer networks are outside the scope of this Recommendation and, therefore, not shown in the figure.

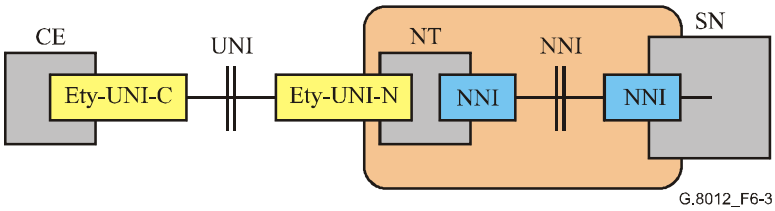

Figure 6-3/G.8012/Y.1308 – Locations of Ethernet Ety-UNI and NNI of an access link to an SN

The Ethernet UNI and NNI encompass multiple layer networks, each with its dedicated UNI and NNI (Figure 6-4).

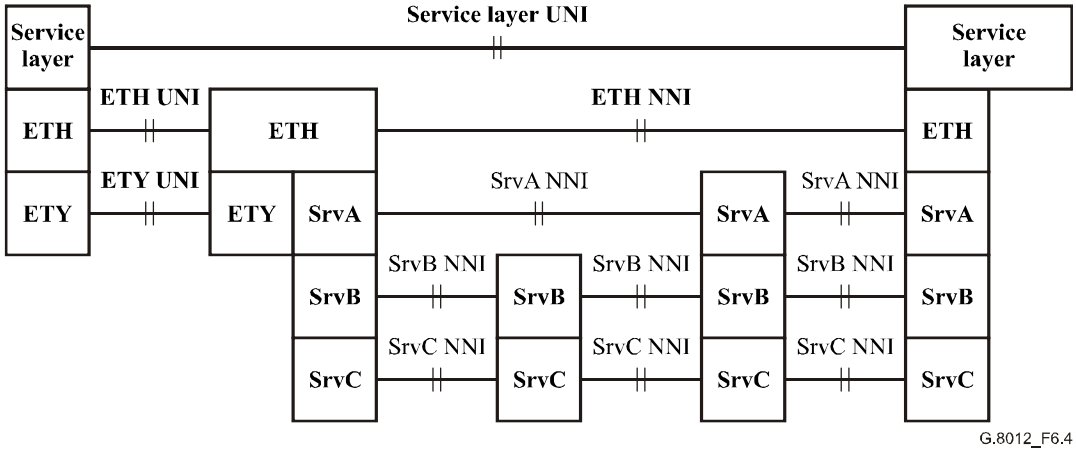

Figure 6-4/G.8012/Y.1308 – Example of layer networks in Ethernet UNI and NNI for case of access link to a client layer service node

The Ethernet connection may also be between two service nodes as shown in Figure 6-5.

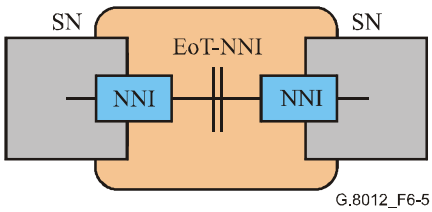

Figure 6-5/G.8012/Y.1308 – EoT-NNI between service nodes

The Ethernet NNI encompasses multiple layer networks, each with its dedicated NNI (Figure 6-6).

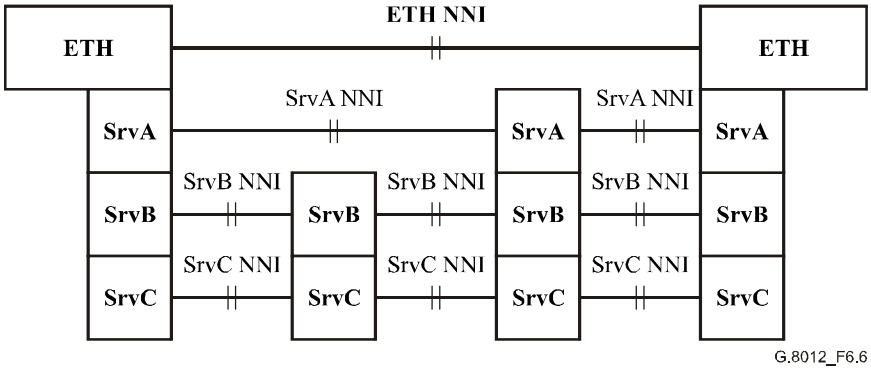

Figure 6-6/G.8012/Y.1308 – Example of layer networks in Ethernet NNI for case of interconnecting two ETH layer service nodes

Figure 6-7 shows the use of the Ethernet NNI (Ety-NNI or EoT-NNI) as an IaDI and an IrDI.

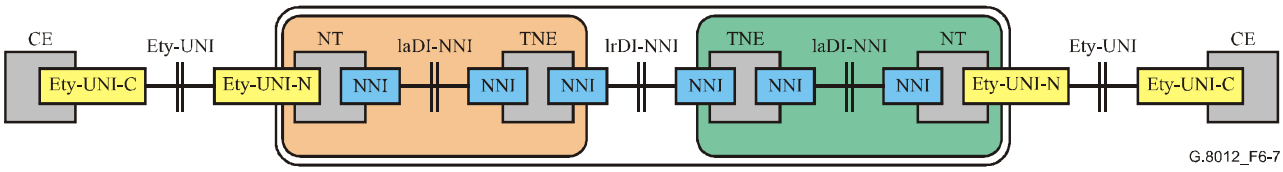

Figure 6-7/G.8012/Y.1308 – Locations of Ethernet UNI and NNI in a multi-operator network

This Recommendation specifies the ETH UNI, ETH NNI including the encapsulation into the ETH's server layer (SrvA in Figures 6-2, 6-4 and 6-6).

The Ethernet UNI and NNI may carry informational elements of three planes (Figure 6-8):

– Data (or User) Plane, optionally including a Data Communication Network (DCN) supporting management plane and control plane communications;

– Control Plane (e.g., related to BPDUs, ASON etc.);

– Management Plane.

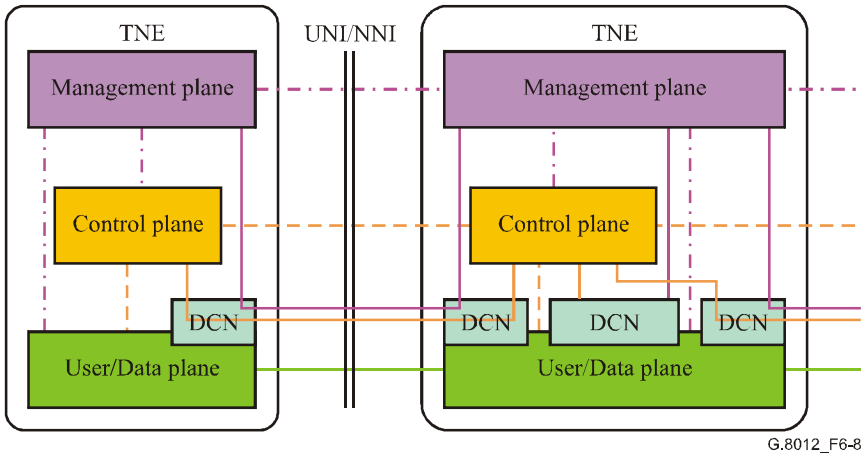

Figure 6-8/G.8012/Y.1308 – Three planes of Ethernet UNI and NNI

Each UNI or NNI is divided into three plane specific UNI/NNIs:

– UNI_D and NNI_D for the data plane informational elements, including OAM which is terminated in the layer's termination, adaptation and connection/flow forwarding functions;

– UNI_C and NNI_C for the control plane informational elements;

– UNI_M and NNI_M for the management plane informational elements.

UNI_C, UNI_M and NNI_C are optional elements within a UNI and NNI.

This Recommendation specifies the UNI_D and NNI_D.

6.1 UNI and NNI basic signal structure

The basic structure is shown in Figure 6-9. A client signal of the ETH layer network is mapped into the M_SDU by one of the four different encapsulations illustrated by the vertical line at the top of Figure 6-9.

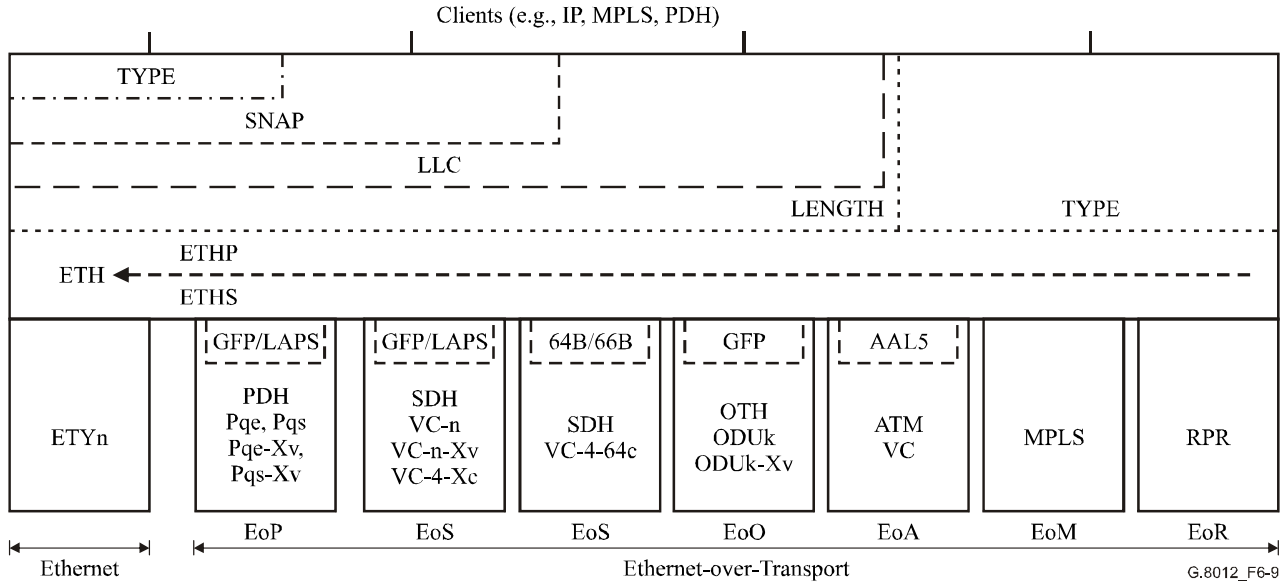

Figure 6-9/G.8012/Y.1308 – Structure of the ETH interfaces

6.1.1 ETH substructure

The ETH layer as defined in ITU-T Rec. G.8010/Y.1306 is further structured in sublayers in order to support the network management and supervision functionalities defined in ITU-T Recs G.8010/Y.1306 and Y.1730:

– segment monitoring (ETHS);

– end-to-end path supervision (ETHP);

– optional adaptation of client signals via Logical Link Control (LLC) and Sub-Network Access Protocol (SNAP).

6.1.2 Ethernet structure

The Ethernet interface consists of the Ethernet Physical (ETY) layer.

6.1.3 Ethernet-over-Transport structure

The Ethernet-over-Transport interface consists of the multiple layers, of which only the first one is illustrated in Figure 6-9. The next layers are outside the scope of this Recommendation; the reader is referred to the appropriate technology Recommendations (e.g., ITU-T Rec. G.707/Y.1322 for SDH).

There are a number of such EoT interfaces defined under this Recommendation as depicted in Figure 6-9:

- Ethernet-over-PDH (EoP);
- Ethernet-over-SDH (EoS);
- Ethernet-over-OTH (EoO);
- Ethernet-over-ATM (EoA);

- Ethernet-over-MPLS (EoM);
- Ethernet-over-RPR (EoR).

In the case of circuit switched transport, the payload bandwidths available are shown in Tables 6-1, 6-2 and 6-3, respectively, for PDH, SDH and OTH.

Table 6-1/G.8012/Y.1308 – Bandwidth of the payload of PDH path signals

PDH type	PDH payload (kbit/s)	In steps of (kbit/s)
P11s	1536 – (64/24) ≈ 1533	
P12s	1980	
P31s	33 856	
P32e	4696/4760 * 44 736 ≈ 44 134	
P11s-Xv, X = 1 to 16	≈ 1533 to ≈ 24 528	≈ 1533
P12s-Xv, X = 1 to 16	1980 to 31 680	1980
P31s-Xv, X = 1 to 8	33 856 to 270 848	33 856
P32e-Xv, X = 1 to 8	≈ 44 134 to ≈ 353 072	≈ 44 134

Table 6-2/G.8012/Y.1308 – Bandwidth of the payload of SDH VCs

VC type	VC payload (kbit/s)	In steps of (kbit/s)
VC-11	1600	
VC-12	2176	
VC-2	6784	
VC-3	48 384	
VC-4	149 760	
VC-4-4c	599 040	
VC-4-16c	2 396 160	
VC-4-64c	9 584 640	
VC-4-256c	38 338 560	
VC-11-Xv, X = 1 to 64	1600 to 102 400	1600
VC-12-Xv, X = 1 to 64	2176 to 139 264	2176
VC-2-Xv, X = 1 to 64	6784 to 434 176	6784
VC-3-Xv, X = 1 to 256	48 384 to 12 386 304	48 384
VC-4-Xv, X = 1 to 256	149 760 to 38 338 560	149 760

Table 6-3/G.8012/Y.1308 – Bandwidth of the OTH ODUs

ODU type	OPU payload (kbit/s)	In steps of (kbit/s)
ODU1	2 488 320	
ODU2	238/237 × 9 953 280 ≈ 9 995 277	
ODU3	238/236 × 39 813 120 ≈ 40 150 519	
ODU1-Xv, X = 1 to 256	2 488 320 to 637 009 920	2 488 320
ODU2-Xv, X = 1 to 256	≈ 9 995 277 to ≈ 2 558 709 902	≈ 9 995 277
ODU3-Xv, X = 1 to 256	≈ 40 150 519 to ≈ 10 278 532 946	≈ 40 150 519

6.2 Information structure for the ETH interfaces

The information structure for the ETH interfaces is represented by information containment relationships and flows. The principal information containment relationships are described in Figure 6-10.

6.2.1 ETH principle information containment relationship

The ETH_CI consists of a MAC Destination Address (DA), a MAC Source Address (SA), a MAC Service Data Unit (M_SDU) (see ITU-T Rec. G.8010/Y.1306 and IEEE 802.3ae, clause 2). The M_SDU may optionally include a Tag (see IEEE 802.1Q). A client signal of the ETH layer network is mapped into the M_SDU via one of four different encapsulations (see Figures 6-10 and 7-1):

– type encapsulation;

– length/LLC encapsulation;

– length/LLC/SNAP encapsulation;

– length/LLC/SNAP/Type encapsulation.

Table 6-4/G.8012/Y.1308 – Overview of encapsulated units

Encapsulation type	Reference
LLC/SNAP/EtherType client encapsulation	IEEE 802, subclause 10.5 RFC 2684, subclause 5.1
LLC/SNAP/PID client encapsulation	IEEE 802, subclause 10.3, RFC 2684, subclause 5.2
LLC encapsulated SNAP client	IEEE 802.2, clause 3, RFC 2684, subclause 5.1
LLC encapsulated non-SNAP client	IEEE 802.2, clause 3
Length encapsulated LLC client	IEEE 802.3, clause 3
EtherType encapsulated client	IEEE 802.3, clause 3
Tag	IEEE 802.1Q, subclause 9.3.2
ETH encapsulated MAC SDU	IEEE 802.3, clause 3 IEEE 802.3ae, clause 2
MAC encapsulated ETH	IEEE 802.3, clause 3

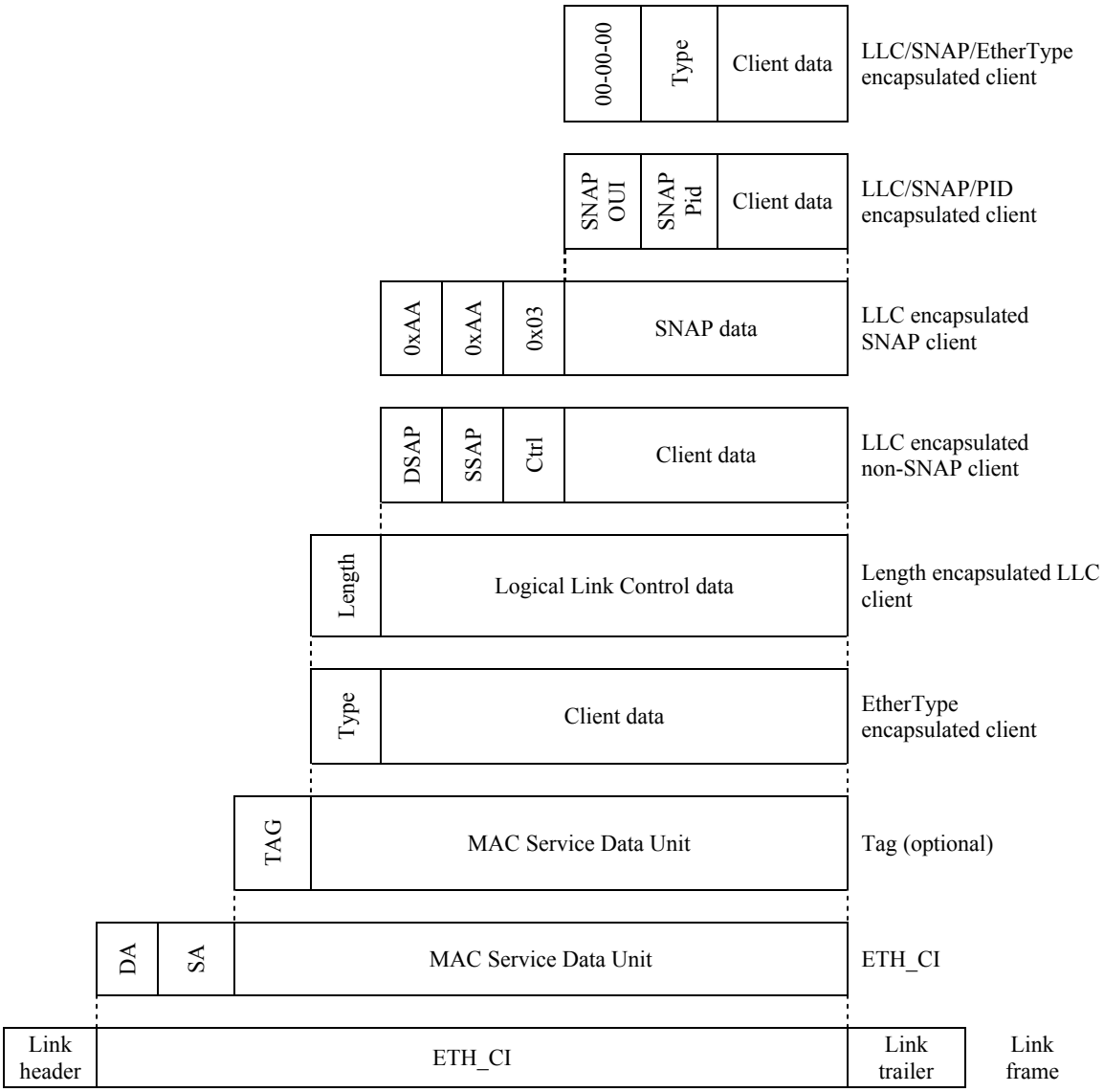

Figure 6-10/G.8012/Y.1308 – Ethernet principle information containment

6.2.1.1 ETY link frame

The ETH_CI is extended with a MAC FCS field and a Preamble (PA) and Start of Frame Delimiter (SFD). See Figure 6-11.

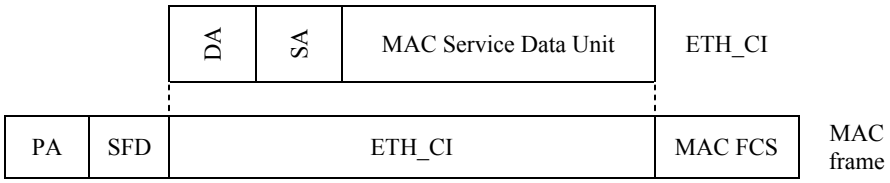

Figure 6-11/G.8012/Y.1308 – ETY link frame

6.2.1.2 GFP-F link frame

The ETH_CI is extended with a MAC FCS field and then mapped as specified in ITU-T Rec. G.7041/Y.1303 in the GFP Payload Information Field. 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 6-12. The maximum size of the GFP payload information field is specified in 6.1.2/G.7041/Y.1303.

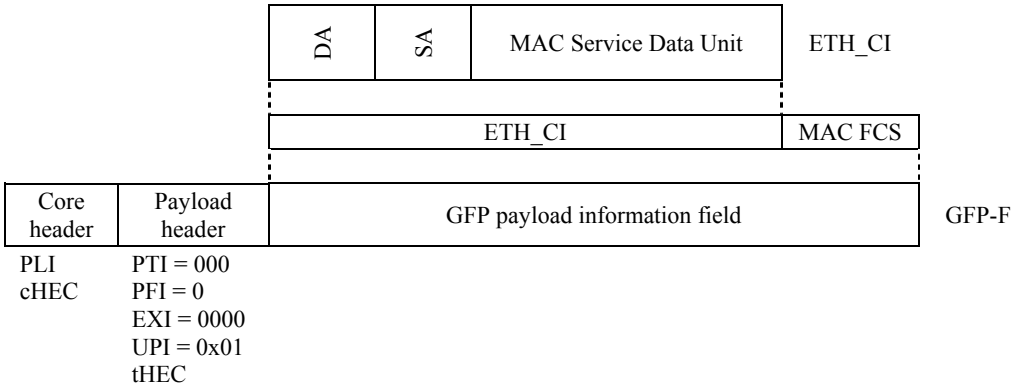

Figure 6-12/G.8012/Y.1308 – GFP-F link frame

6.2.1.3 64B/66B link frame

The ETH_CI is extended with a MAC FCS field and a Preamble (PA) and Start of Frame Delimiter (SFD) as shown in Figure 6-13. For encapsulation the MAC frame is further extended with an S, T and idles. The coding of S, T and idles and the minimum number of idles is specified in IEEE 802.3ae.

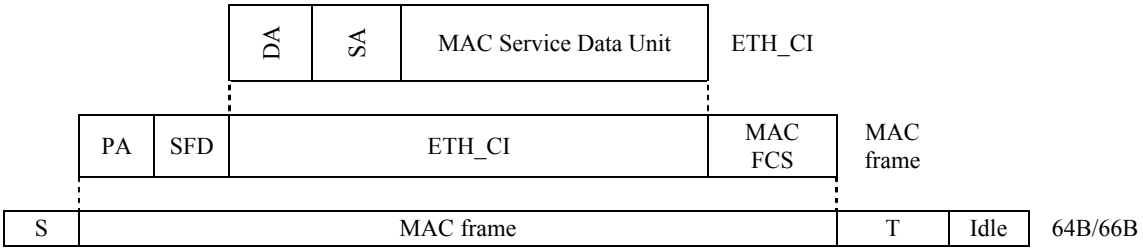

Figure 6-13/G.8012/Y.1308 – 64B/66B link frame

6.2.1.4 LAPS link frame

The ETH_CI is extended with a MAC FCS field and then mapped as specified in ITU-T Rec. X.86/Y.1323 in the LAPS Information Field. An Address field with value 0x04, a Control field with value 0x03, a SAPI field with value 0xfe01 are prepended and a LAPS FCS field is appended. See Figure 6-14.

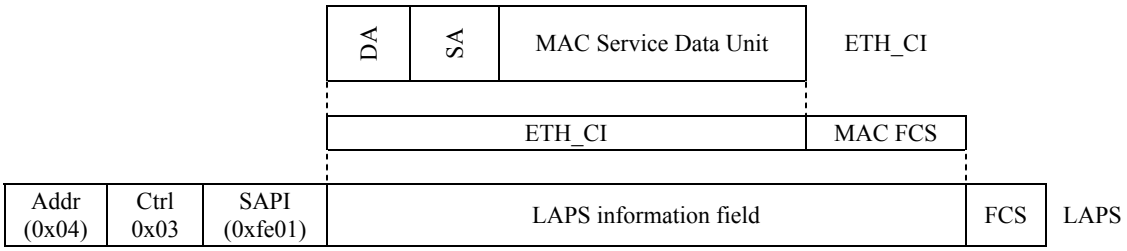

Figure 6-14/G.8012/Y.1308 – LAPS link frame

6.2.1.5 AAL5 CPCS-PDU link frame

6.2.1.5.1 LLC encapsulation based without MAC FCS

The ETH_CI is mapped as specified in RFC 2684 in the LLC encapsulation based AAL5 CPCS-PDU Payload field after Padding and SNAP and LLC encapsulation, optionally padded with an AAL5 CPCS-PDU PAD field. The LLC header value is fixed to 0xAA-AA-03. The SNAP header is fixed to 0x00-80-C2-00-07. A CPCS-UU field with undefined value, a CPI field with value 0x00, Length field and a CRC-32 field are added to complete the AAL5 CPCS-PDU as specified in ITU-T Rec. I.363.5. See Figure 6-15.

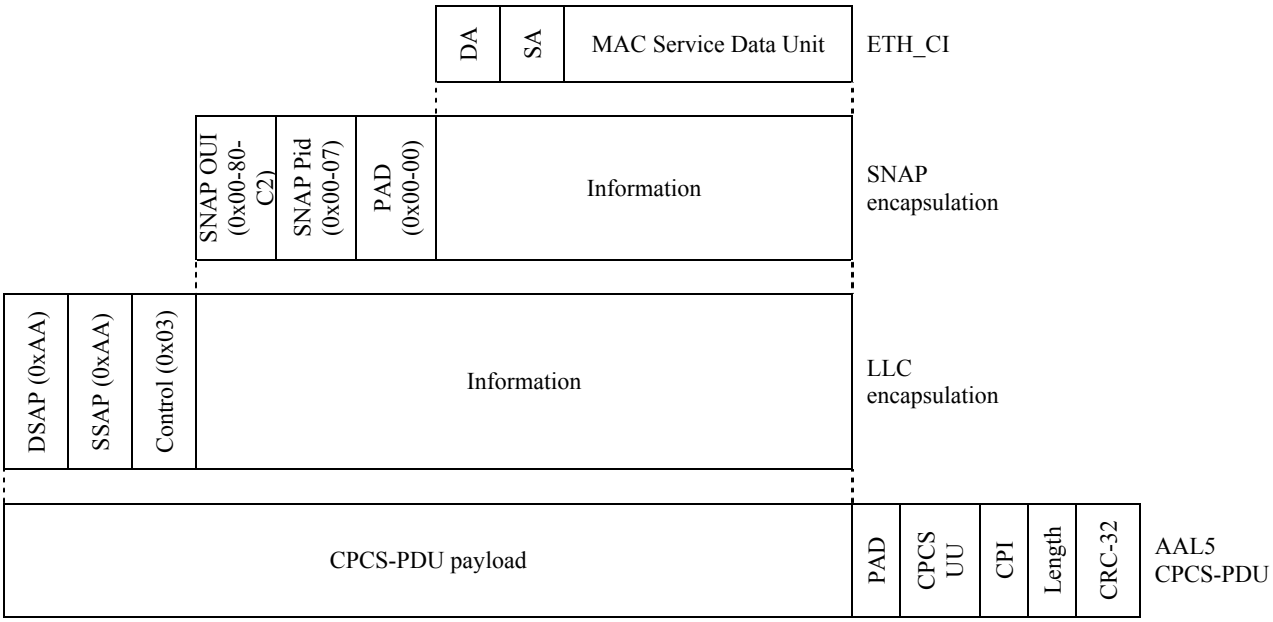

Figure 6-15/G.8012/Y.1308 – LLC encapsulation based AAL5 CPCS-PDU link frame without MAC FCS preservation

6.2.1.5.2 LLC encapsulation based with MAC FCS

The ETH_CI is extended with a MAC FCS field and then mapped as specified in RFC 2684 in the LLC encapsulation based AAL5 CPCS-PDU Payload field after Padding and SNAP and LLC encapsulation, optionally padded with an AAL5 CPCS-PDU PAD field. The LLC header value is fixed to 0xAA-AA-03. The SNAP header is fixed to 0x00-80-C2-00-01. A CPCS-UU field with

undefined value, a CPI field with value 0x00, Length field and a CRC-32 field are added to complete the AAL5 CPCS-PDU as specified in ITU-T Rec. I.363.5. See Figure 6-16.

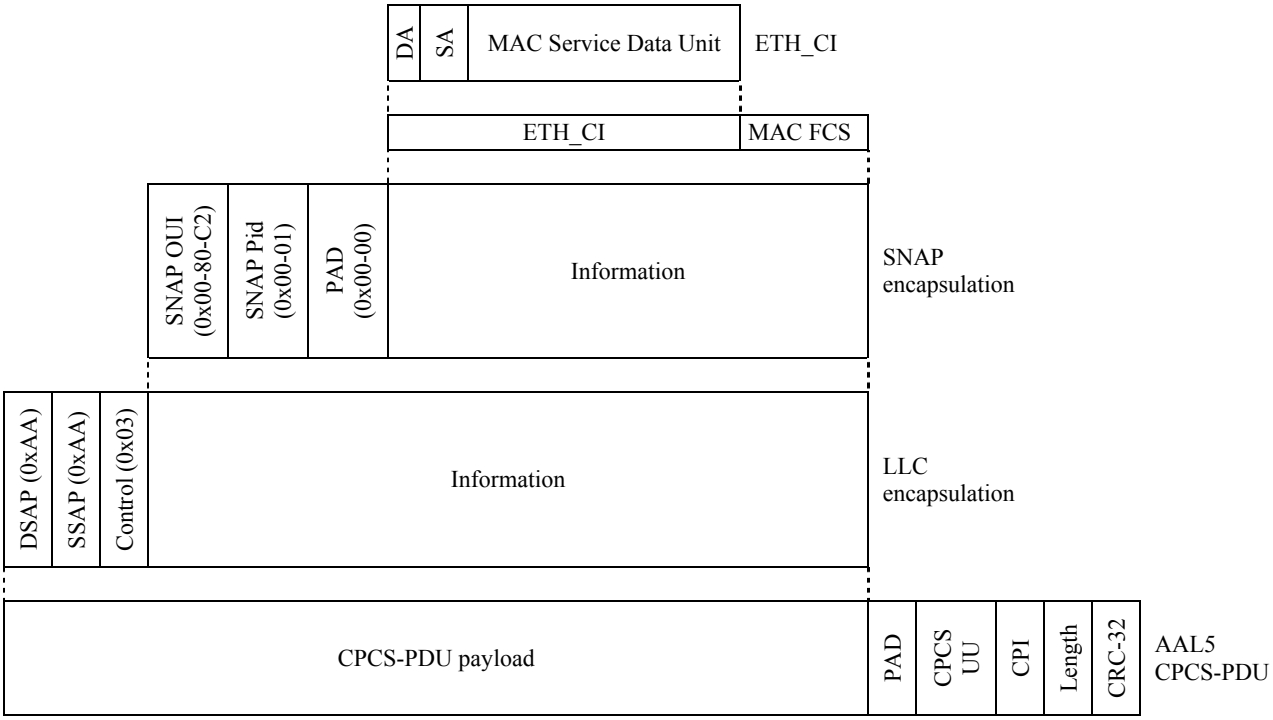

Figure 6-16/G.8012/Y.1308 – LLC encapsulation based AAL5 CPCS-PDU link frame with MAC FCS preservation

6.2.1.5.3 VC-multiplexing based without MAC FCS

The ETH_CI is mapped as specified in RFC 2684 in the VC-multiplexing based AAL5 CPCS-PDU Payload field optionally padded with an AAL5 CPCS-PDU PAD field. A CPCS-UU field with undefined value, a CPI field with value 0x00, Length field and a CRC-32 field are added to complete the AAL5 CPCS-PDU as specified in ITU-T Rec. I.363.5. See Figure 6-17.

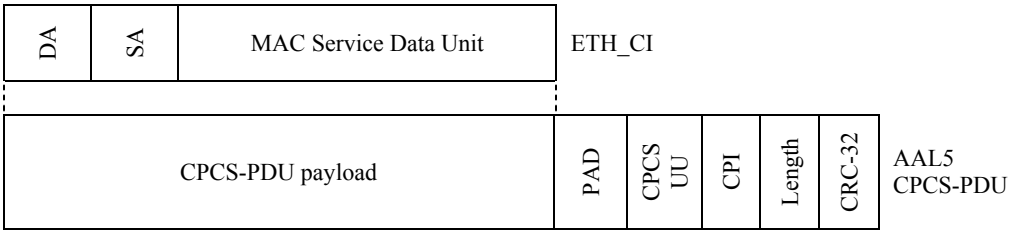

Figure 6-17/G.8012/Y.1308 – VC-multiplexing based AAL5CPCS-PDU link frame without MAC FCS preservation

6.2.1.5.4 VC-multiplexing based with MAC FCS

The ETH_CI is extended with a MAC FCS field and then mapped as specified in RFC 2684 in the VC-multiplexing based AAL5 CPCS-PDU Payload field optionally padded with an AAL5 CPCS-PDU PAD field. A CPCS-UU field with undefined value, a CPI field with value 0x00, Length field and a CRC-32 field are added to complete the AAL5 CPCS-PDU as specified in ITU-T Rec. I.363.5. See Figure 6-18.

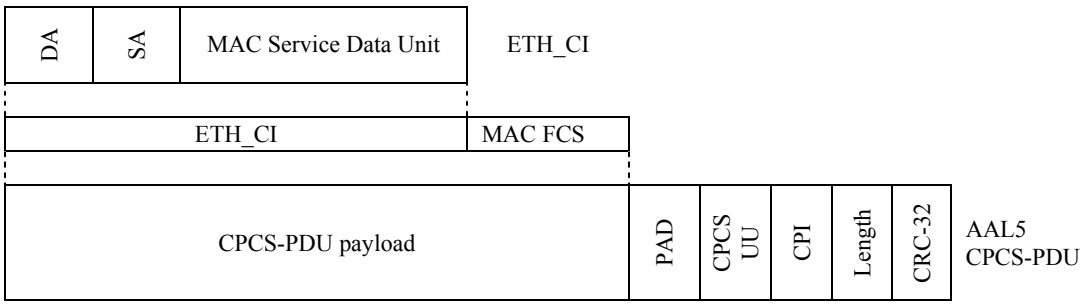

Figure 6-18/G.8012/Y.1308 – VC-multiplexing based AAL5 CPCS-PDU link frame with MAC FCS preservation

6.2.1.6 MPLS link frame

For further study.

6.2.1.7 RPR link frame

For further study.

6.2.2 Ethernet UNI

The Ethernet UNI is supported by the interfaces listed below.

NOTE – The Ethernet UNI may also be supported by a 10GBase-W interface using the link frame specified in 6.2.1.3.

6.2.2.1 Ety-UNI

The Ety-UNI deploys the ETY link frame as specified in 6.2.1.1.

6.2.2.2 EoS UNI

The Ethernet over SDH (EoS) UNI deploys the 64B/66B link frame as specified in 6.2.1.3. The mapping of the 64B/66B encoded bit stream is specified in Annex F/G.707/Y.1322. Path overhead of the VC-4-64c is specified in ITU-T Rec. G.707/Y.1322. The components of the Ethernet over SDH UNI are illustrated in Figure 6-22.

NOTE 1 – A 10GBASE-W interface can be deployed as an EoS UNI when its clock accuracy is ±4.6 ppm or better. Refer to Appendix II.

NOTE 2 – The deployment of other EoT interfaces as an Ethernet UNI is for further study.

6.2.3 Ethernet NNI

The Ethernet NNI is supported by the interfaces listed below.

6.2.3.1 Ety-NNI

The Ethernet NNI deploys the ETY link frame as specified in 6.2.1.1.

6.2.3.2 EoP NNI

The Ethernet over PDH NNI deploys either the GFP-F link frame as specified in 6.2.1.2, or the LAPS link frame as specified in 6.2.1.4. The mapping of the GFP-F link frames into P11s/P11s-Xv, P12s/P12s-Xv, P31s/P31s-Xv and P32e/P32-Xv is specified in ITU-T Rec. G.8040/Y.1340. The mapping of the LAPS link frames into P11s, P12s, P31s and P4s is specified in ITU-T Rec. X.85/Y.1321.

The frame structure of P11s, P12s, and P32e is specified in ITU-T Rec. G.704 and the frame structure of P12s is specified in ITU-T Rec. G.832. Virtual concatenation of these PDH signals is specified in ITU-T Rec. G.7043/Y.1343.

For the channelized P32e the direct multiplexing of P11s into P32 is specified in ANSI T1.107, subclause 9.3.

For interworking at administrative domain boundaries between GFP-F and LAPS link frames the following rule applies:

– At international boundaries, or at the boundaries between the networks of different operators, the GFP-F encapsulation defined in 6.2.1.2 shall be used unless otherwise mutually agreed by the operators providing the transport. Within a national network or within the domain of a single operator, LAPS encapsulation as defined in 6.2.1.4 may be used.

Figure 6-19 illustrates the relation of the components of Ethernet over PDH NNI using GFP-F encapsulation and Figure 6-20 the ones using LAPS.

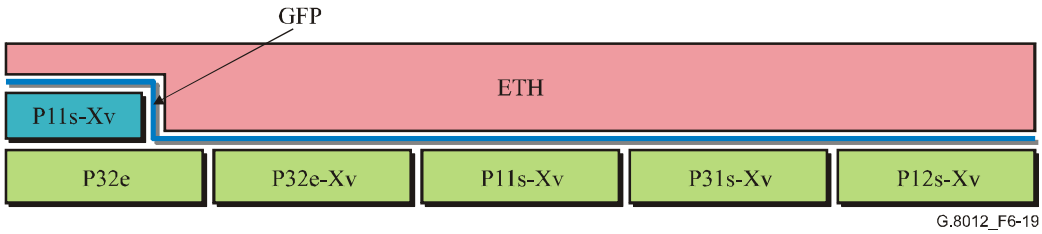

Figure 6-19/G.8012/Y.1308 – Components of the Ethernet over PDH NNI using GFP-F

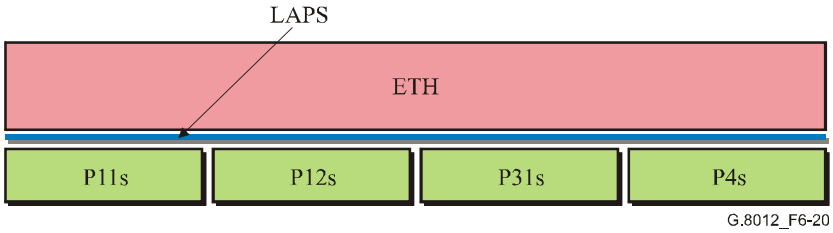

Figure 6-20/G.8012/Y.1308 – Components of the Ethernet over PDH NNI using LAPS

6.2.3.3 EoS NNI

The Ethernet over SDH (EoS) NNI deploys either the GFP-F link frame as specified in 6.2.1.2, or the LAPS link frame as specified in 6.2.1.4, or for the case of a VC-4-64c supported ETH topological link the 64B/66B link frame as specified in 6.2.1.3. The mapping of the GFP-F link frames and the mapping of LAPS link frames into V-C11/VC-11-Xv, VC-12/VC-12-Xv, VC-3/VC-3-Xv, VC-4/VC-4-Xv and VC-4-Xc is specified in 10.6 and 10.3 respectively of ITU-T Rec. G.707/Y.1322. The mapping of the 64B/66B encoded bit stream is specified in Annex F/G.707/Y.1322.

NOTE 1 – A 10GBASE-W interface can be deployed as an EoS NNI when its clock accuracy is ±4.6 ppm or better. Refer to Appendix II.

NOTE 2 – The special case of using a GFP-T link for 1 Gbit/s Ethernet (i.e., Type 2 Ethernet private line service as described in ITU-T Rec. G.8011.1/Y.1307.1) is specified in Annex A.

Path overhead and virtual concatenation of the VCs is specified in ITU-T Rec. G.707/Y.1322.

For interworking at administrative domain boundaries between GFP-F and LAPS and between GFP-F and 64B/66B link frames the following rules apply:

– GFP-F ⇔ LAPS: At international boundaries, or at the boundaries between the networks of different operators, the GFP-F encapsulation defined in 6.2.1.2 shall be used unless otherwise mutually agreed by the operators providing the transport. Within a national network or within the domain of a single operator, LAPS encapsulation as defined in 6.2.1.4 may be used.

– GFP-F ⇔ 64B/66B: At international boundaries, or at the boundaries between the networks of different operators, the 64B/66B encapsulation defined in 6.2.1.3 shall be used unless otherwise mutually agreed by the operators providing the transport. Within a national network or within the domain of a single operator, GFP-F encapsulation as defined in 6.2.1.2 may be used.

– LAPS ⇔ 64B/66B: At international boundaries, or at the boundaries between the networks of different operators, the 64B/66B encapsulation defined in 6.2.1.3 shall be used unless otherwise mutually agreed by the operators providing the transport. Within a national network or within the domain of a single operator, LAPS encapsulation as defined in 6.2.1.4 may be used.

The components of the Ethernet over SDH NNI using the default encapsulation are illustrated in Figures 6-21 and 6-22.

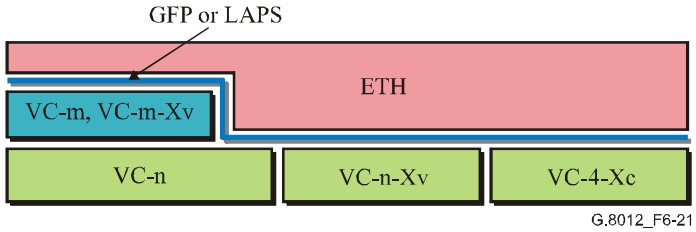

Figure 6-21/G.8012/Y.1308 – Components of the Ethernet over SDH NNI using GFP-F or LAPS encapsulation

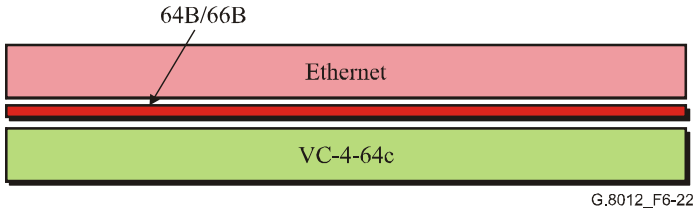

Figure 6-22/G.8012/Y.1308 – Components of the Ethernet over SDH UNI and NNI when using 64B/66B encapsulation

6.2.3.4 EoO NNI

The Ethernet over OTH NNI deploys the GFP-F link frame as specified in 6.2.1.2 and its components are illustrated in Figure 6-23. The mapping of the GFP-F link frame into ODUj/ODUk and ODUj-Xv is specified in 17.3 and 18.2.4 respectively of ITU-T Rec. G.709/Y.1331.

Path overhead and virtual concatenation of the ODUs is specified in ITU-T Rec. G.709/Y.1331.

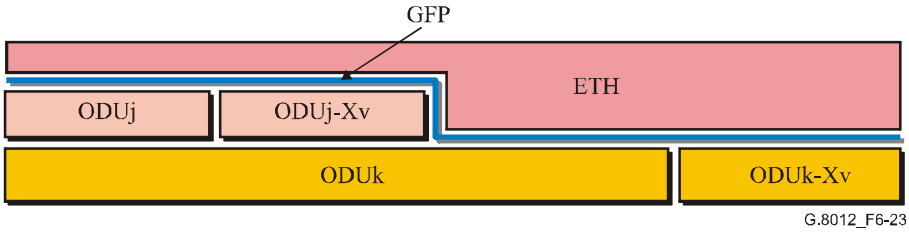

Figure 6-23/G.8012/Y.1308 – Components of the Ethernet over OTH NNI

6.2.3.5 EoA NNI

The Ethernet over ATM NNI deploys either the LLC-encapsulation, or VC-multiplexing based AAL5 CPCS-CPU link frame as specified in 6.2.1.5. The mapping of AAL5 CPCS-CPU link frame into a VC is specified in ITU-T Rec. I.363.5.

The components of the Ethernet over ATM NNI are illustrated in Figure 6-24.

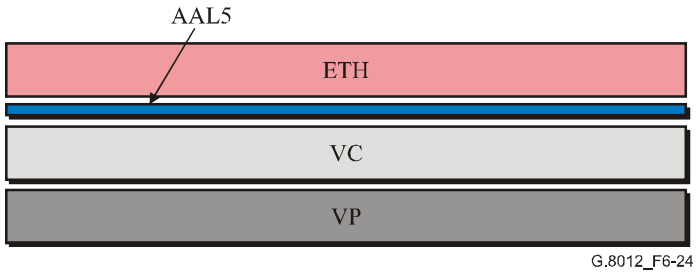

Figure 6-24/G.8012/Y.1308 – Components of the Ethernet over ATM NNI

6.2.3.6 EoM NNI

For further study.

6.2.3.7 EoR NNI

For further study.

6.3 MAC address

The Ethernet frame includes two 48-bit MAC addresses: MAC Destination Address (DA) and MAC Source Address (SA) (as specified in IEEE 802.3). Any of these addresses could occur at the Ety-UNI and NNI.

The set of 2^{48} MAC addresses (Figure 6-25) 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).

Thirty-three of the group MAC addresses are defined as *control frames* (IEEE 802.1D, IEEE 802.1Q):

– All bridges address (01-80-C2-00-00-10).

– Reserved addresses (01-80-C2-00-00-00 to 01-80-C2-00-00-0F).

– GARP Application addresses (01-80-C2-00-00-20 to 01-80-C2-00-00-2F).

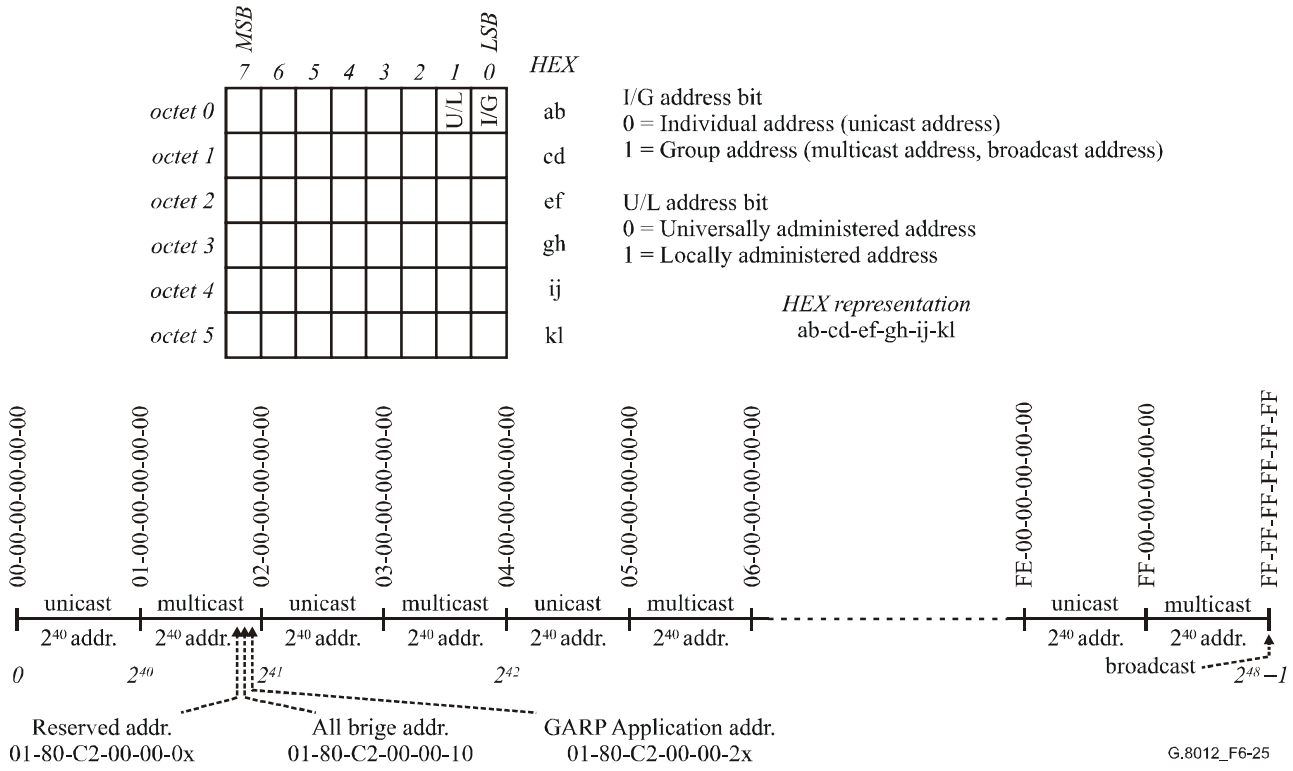

Figure 6-25/G.8012/Y.1308 – MAC address structure

6.4 Tag

The Ethernet frame optionally includes a Tag as specified in IEEE 802.1Q, clause 9. The Tag control information (TCI) contains a 3-bit user priority field that can take 8 values 0 to 7.

The TCI also includes a VLAN ID as specified in IEEE 802.1Q, clause 9. Note that VLAN ID is defined to be between 1 and 4094. A VLAN ID = 0, indicates the Tag that only contains user priority. The CFI bit of the TCI field is ignored.

These tags are present at the Ety-UNI, the Ety-NNI and the EoT-NNI.

7 Multiplexing/mapping principles

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

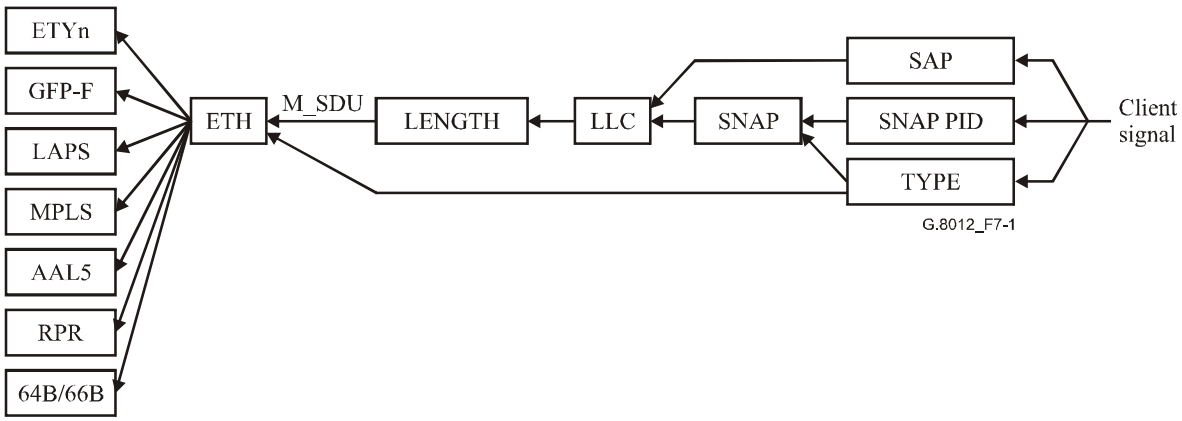

Figure 7-1/G.8012/Y.1308 – Ethernet mapping and multiplexing

7.1 Mapping

The client signal is mapped into the ETH signal (frame) directly via TYPE encapsulation, or indirectly via LENGTH encapsulation. With LENGTH encapsulation one or more additional encapsulation steps are present: a Logical Link Control (LLC) with SAP encapsulation, a LLC with Sub-Network Access Protocol (SNAP) and PID encapsulation, or a LLC/SNAP with TYPE encapsulation. Refer to 6.2.1.

The ETH signal (frame) is then mapped into the applicable link frame and those link frames are transported over an ETH topological link.

7.2 ETH single level VID multiplex

Figure 7-2 illustrates a single level multiplexing of up to 4094 ETH signals into an ETH topological link. The ETH_CI traffic unit is for that purpose extended with a C-Tag including a VLAN Identifier (C-VID) (Figure 7-3), as specified in IEEE 802.1Q and then multiplexed into an Ethernet Unit Group level 1. This multiplexing structure is applicable for the Ethernet UNI and the NNI.

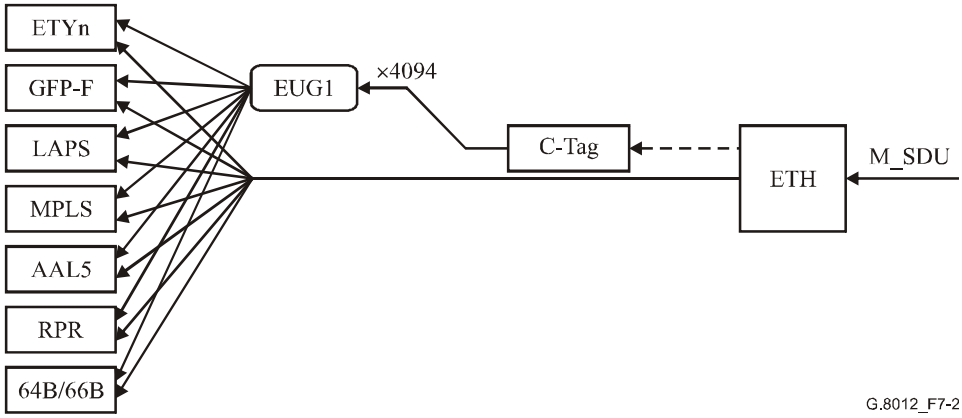

Figure 7-2/G.8012/Y.1308 – Ethernet single level multiplexing

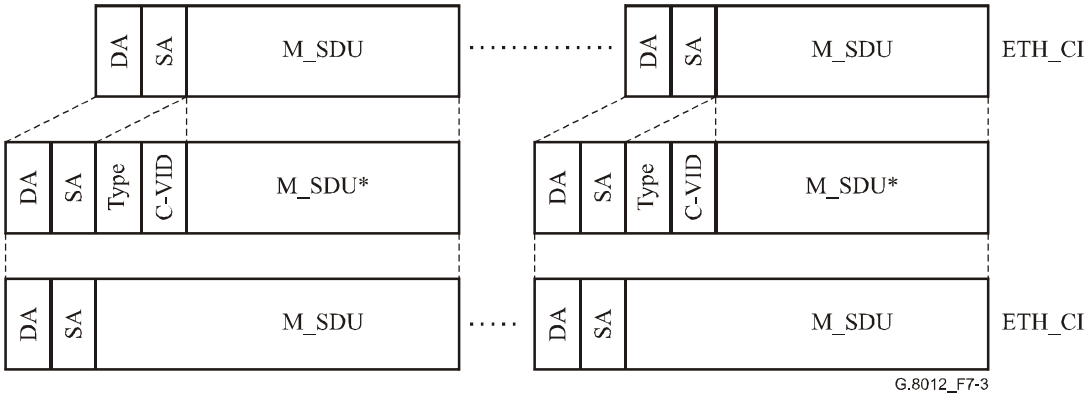

Figure 7-3/G.8012/Y.1308 – Ethernet single level multiplexing method

7.3 ETH two level VID multiplex

The specification of a two-level multiplexing is currently under development in project IEEE P802.1ad. See Appendix I.

8 Physical specification of the Ethernet interfaces

References for the physical characteristics of the Ety-UNI and Ety-NNI are given in Table 8-1 and for EoT-UNI and EoT-NNI in Table 8-2.

Table 8-1/G.8012/Y.1308 – Ety interfaces for Ethernet over Transport

Ethernet interface	Reference
10BASE-T	IEEE 802.3, clause 14
100BASE-T	IEEE 802.3, clause 25
1000BASE-SX	IEEE 802.3, clause 38
1000BASE-LX	IEEE 802.3, clause 38
10GBASE-SR	IEEE 802.3ae, clauses 49 and 52
10GBASE-LR	IEEE 802.3ae, clauses 49 and 52
10GBASE-ER	IEEE 802.3ae, clauses 49 and 52

Table 8-2/G.8012/Y.1308 – EoT interfaces for Ethernet over Transport

Ethernet interface	Reference
10GBASE-SW (Note)	IEEE 802.3ae, clauses 50 and 52
10GBASE-LW (Note)	IEEE 802.3ae, clauses 50 and 52
10GBASE-EW (Note)	IEEE 802.3ae, clauses 50 and 52
NOTE – The differences between the 10GBASE-W based Ety-UNI, a 10GBase-W based Ety-NNI and 10G EoS NNI are described in Appendix II.	

Annex A

ETC point-to-point connection

An ETC point-to-point connection is provided by means of a Type 2 Ethernet private line service specified in ITU-T Rec. G.8011.1/Y.1307.1, 1 Gbit/s Ethernet, the CI of the individual 8B/10B line code characters (ETC_CI) is carried by mapping them into GFP-T, as specified in ITU-T Rec. G.7041/Y.1303. As shown in Figure A.1, the information from eight 8B/10B characters is mapped into a 64B/65B block code, eight of which are mapped into a superblock. At least 95 superblocks are then mapped into a GFP-T frame. The GFP PTI subfield has value 000, the PFI subfield has value 0, the EXI subfield has value 0000 and the UPI subfield has value 0x06. The maximum size of the GFP payload information field is specified in 6.1.2/G.7041/Y.1303.

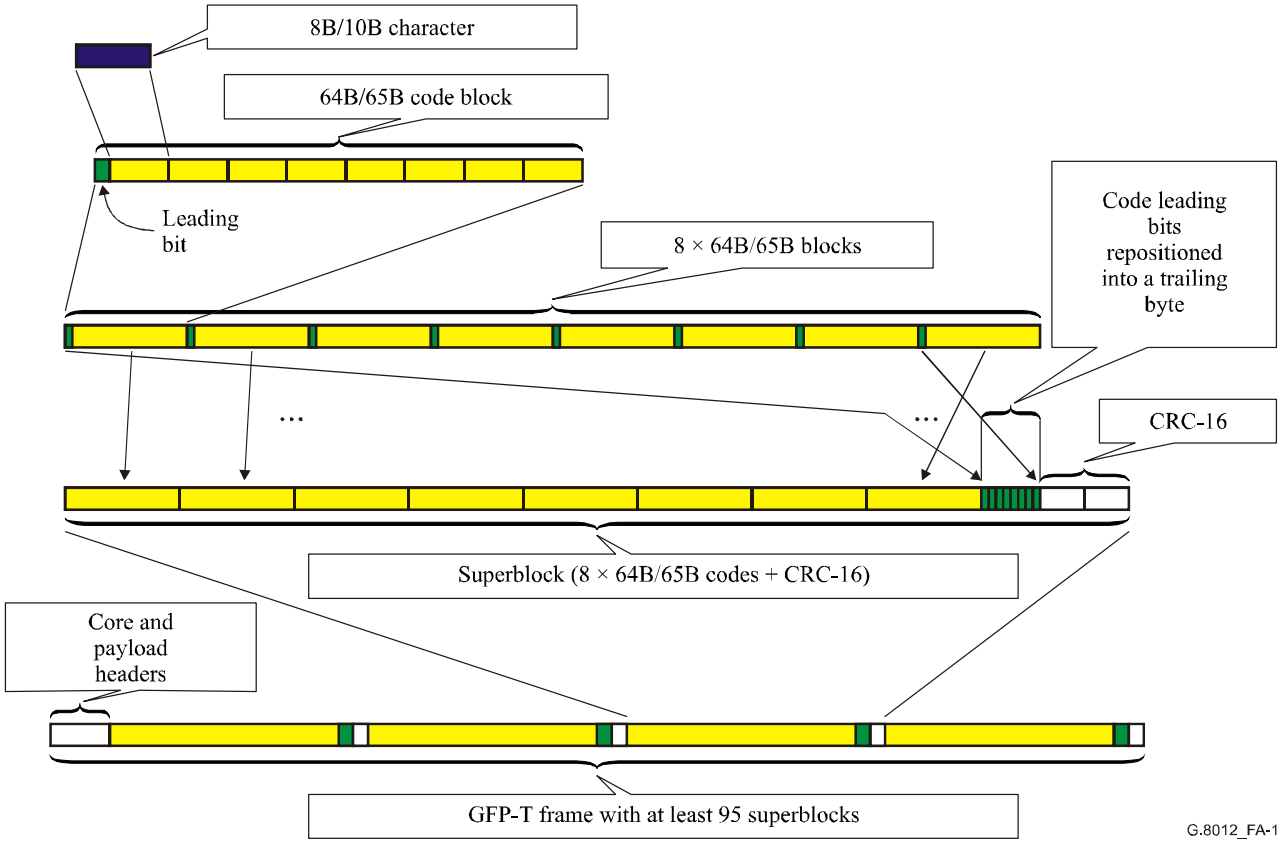

Figure A.1/G.8012/Y.1308 – GFP-T mapping for 8B/10B encoded 1 Gbit/s Ethernet

Appendix I

Ethernet multiplexing

I.1 ETH two level VLAN Multiplex

Figure I.1 illustrates a two-level multiplexing of up to M × 4094 ETH signals into an ETH topological link. The ETH_CI traffic unit is for that purpose extended with a first level C-Tag including a C-VID as specified in IEEE 802.1Q and then multiplexed into an Ethernet Unit Group level 1. The EUG1 is extended with a second level S-Tag including also an S-VID (Figure I.2) and then multiplexed into an Ethernet Unit Group level 2.

The structure of the S-Tag and the value of M are currently being defined as part of the provider bridgework currently under way in the IEEE P802.1ad task force. It is anticipated that the structure of the S-Tag will be similar to the structure of the existing C-Tag.

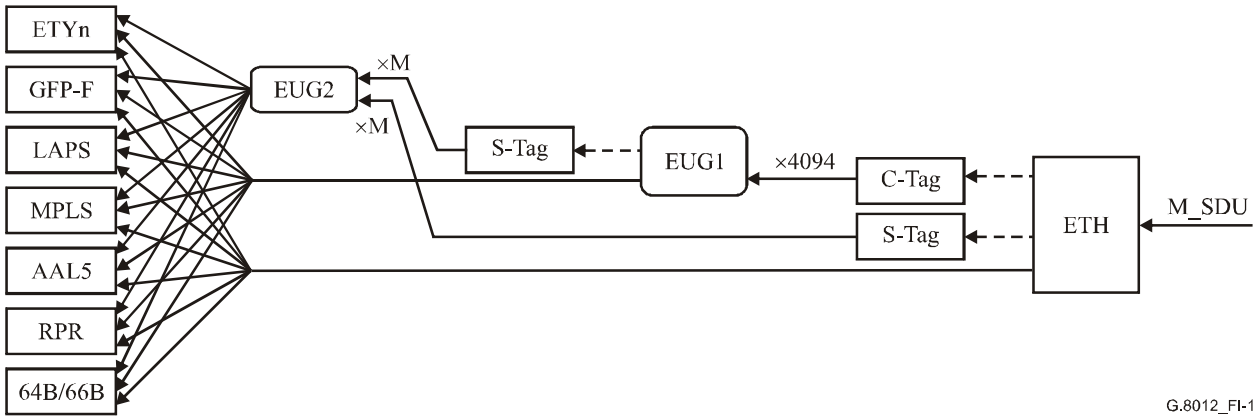

Figure I.1/G.8012/Y.1308 – Ethernet two-level multiplexing

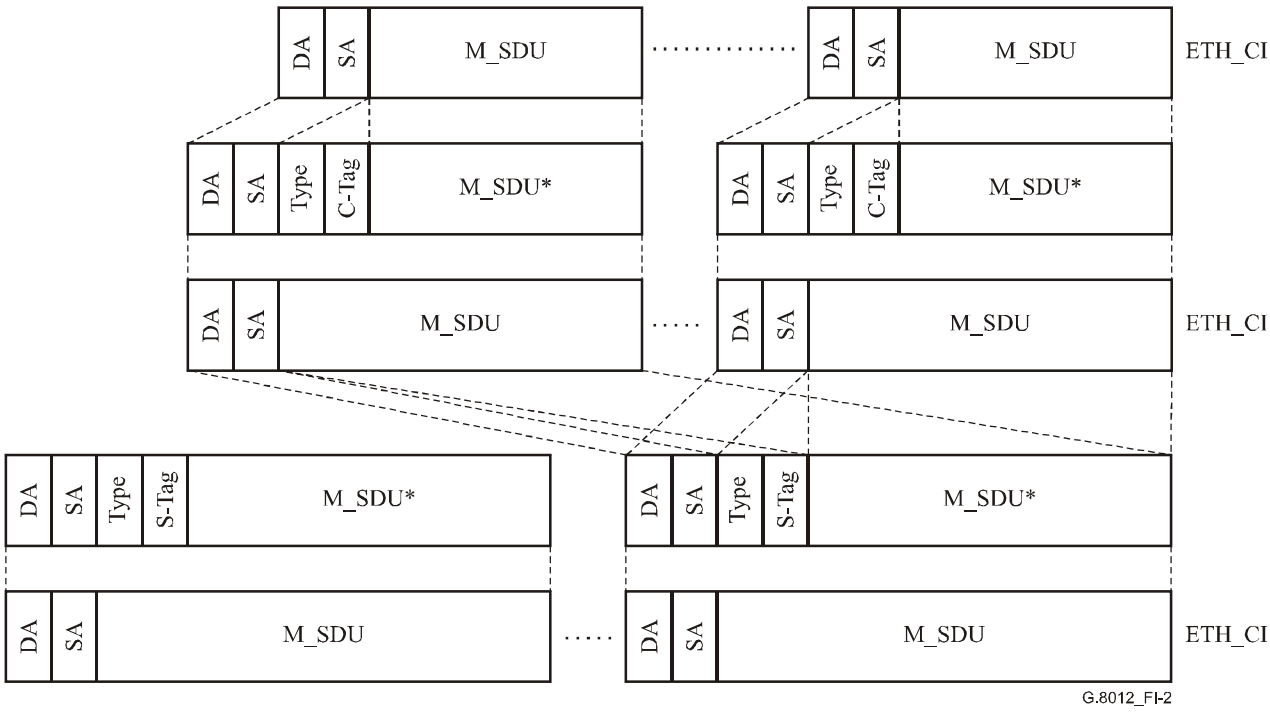

Figure I.2/G.8012/Y.1308 – Ethernet two-level multiplexing method

Appendix II

64B/66B link frames over 10GBASE-W and STM-64

II.1 64B/66B link frame over STM-64

Annex F/G.707/Y.1322 specifies the Mapping of a 64B/66B-encoded signal into VC-4-64c. Any optical STM-N interface specified in ITU-T Rec. G.691 could be used for the Ethernet NNI.

II.2 64B/66B link frame over 10GBASE-W

IEEE 803.3ae specifies the 64B/66B coding, the use of overhead of the VC-4-64c, MS64 and RS64, the timing of the interface and the optical characteristics of the 10GBASE-W type Ethernet interfaces.

II.3 Differences between 64B/66B link frame over STM-64 and 10GBASE-W

The specification for the 10GBASE-W type Ety and 10G EoS differ in respect of:

– coding of the Overhead of the RS64;

– timing of the SDH signal;

– set of optical interfaces.

BIBLIOGRAPHY

– IEEE Standards Association Project Authorization Request, Project P802.1ad (C/LM) *Standard for Local and Metropolitan Area Networks – Virtual Bridged Local Area Networks – Amendment 4: Provider Bridges*. http://standards.ieee.org/board/nes/1-999.html

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