



**IEEE Standard for
Information technology—
Telecommunications and information
exchange between systems—
Local and metropolitan area networks—
Specific requirements**

**Part 3: Carrier Sense Multiple Access with
Collision Detection (CSMA/CD) Access Method
and Physical Layer Specifications**

**Amendment 1: Physical Layer Specifications and Management
Parameters for 10 Gb/s Passive Optical Networks**

IEEE Computer Society

Sponsored by the
LAN/MAN Standards Committee

IEEE
3 Park Avenue
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(Amendment of
IEEE Std 802.3TM-2008)

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Approved 11 September 2009
IEEE-SA Standards Board

Abstract: This amendment to IEEE Std 802.3-2008 extends Ethernet Passive Optical Networks (EPONs) operation to 10 Gb/s providing both symmetric, 10 Gb/s downstream and upstream, and asymmetric, 10 Gb/s downstream and 1 Gb/s upstream, data rates. It specifies the 10 Gb/s EPON Reconciliation Sublayer, 10GBASE-PR symmetric and 10/1GBASE-PRX Physical Coding Sublayers (PCSs) and Physical Media Attachments (PMAs), and Physical Medium Dependent sublayers (PMDs) that support both symmetric and asymmetric data rates while maintaining complete backward compatibility with already deployed 1 Gb/s EPON equipment. The EPON operation is defined for distances of at least 10 km and at least 20 km, and for split ratios of 1:16 and 1:32.

An additional MAC Control opcode is also defined to provide organization specific extension operation.

Keywords: 10 Gb/s Ethernet Passive Optical Networks (10G-EPON), forward error correction (FEC), Multi-Point MAC Control (MPMC), Physical Coding Sublayer (PCS), Physical Media Attachment (PMA), Physical Medium Dependent (PMD), PON, Point to Multipoint (P2MP), Reconciliation Sublayer (RS)

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Introduction

This introduction is not part of IEEE Std 802.3av-2009, IEEE Standard for Information technology—Telecommunications and information exchange between systems—Local and metropolitan area networks—Specific requirements, Part 3: CSMA/CD Access Method and Physical Layer Specifications, Amendment 1: Physical Layer Specifications and Management Parameters for 10 Gb/s Passive Optical Networks.

IEEE Std 802.3™ was first published in 1985. Since the initial publication, many projects have added functionality or provided maintenance updates to the specifications and text included in the standard. Each IEEE 802.3 project/amendment is identified with a suffix (e.g., IEEE Std 802.3av-2009).

The Media Access Control (MAC) protocol specified in IEEE Std 802.3 is Carrier Sense Multiple Access with Collision Detection (CSMA/CD). This MAC protocol was included in the experimental Ethernet developed at Xerox Palo Alto Research Center. While the experimental Ethernet had a 2.94 Mb/s data rate, IEEE Std 802.3-1985 specified operation at 10 Mb/s. Since 1985 new media options, new speeds of operation, and new capabilities have been added to IEEE Std 802.3.

Some of the major additions to IEEE Std 802.3 are identified in the marketplace with their project number. This is most common for projects adding higher speeds of operation or new protocols. For example, IEEE Std 802.3u™ added 100 Mb/s operation (also called Fast Ethernet), IEEE Std 802.3x™ specified full duplex operation and a flow control protocol, IEEE Std 802.3z™ added 1000 Mb/s operation (also called Gigabit Ethernet), IEEE Std 802.3ae™ added 10 Gb/s operation (also called 10 Gigabit Ethernet) and IEEE Std 802.3ah™ specified access network Ethernet (also called Ethernet in the First Mile). These major additions are all now included in, and are superseded by, IEEE Std 802.3-2008 and are not maintained as separate documents.

At the date of IEEE Std 802.3av-2009 publication, IEEE Std 802.3 is comprised of the following documents:

IEEE Std 802.3-2008

Section One—Includes Clause 1 through Clause 20 and Annex A through Annex H and Annex 4A. Section One includes the specifications for 10 Mb/s operation and the MAC, frame formats and service interfaces used for all speeds of operation.

Section Two—Includes Clause 21 through Clause 33 and Annex 22A through Annex 33E. Section Two includes management attributes for multiple protocols and speed of operation as well as specifications for providing power over twisted pair cabling for multiple operational speeds. It also includes general information on 100 Mb/s operation as well as most of the 100 Mb/s Physical Layer specifications.

Section Three—Includes Clause 34 through Clause 43 and Annex 36A through Annex 43C. Section Three includes general information on 1000 Mb/s operation as well as most of the 1000 Mb/s Physical Layer specifications.

Section Four—Includes Clause 44 through Clause 55 and Annex 44A through Annex 55B. Section Four includes general information on 10 Gb/s operation as well as most of the 10 Gb/s Physical Layer specifications.

Section Five—Includes Clause 56 through Clause 74 and Annex 57A through Annex 74A. Clause 56 through Clause 67 and associated annexes specify subscriber access and other Physical Layers and sublayers for operation from 512 kb/s to 1000 Mb/s, and defines services and protocol elements that enable the exchange of IEEE Std 802.3 format frames between stations in a subscriber access network. Clause 68 specifies a 10 Gb/s Physical Layer specification. Clause 69 through Clause 74 and

associated annexes specify Ethernet operation over electrical backplanes at speeds of 1000 Mb/s and 10 Gb/s.

IEEE Std 802.3av-2009

This amendment includes changes to IEEE Std 802.3-2008 and adds Clause 75 through Clause 77 and Annex 75A through Annex 76A. This amendment adds new Physical Layers for 10 Gb/s operation on point-to-multipoint passive optical networks.

IEEE Std 802.3bc™-2009

This amendment includes changes to IEEE Std 802.3-2008 and adds Clause 79. This amendment moves the Ethernet Organizationally Specific Type, Length, Value (TLV) information elements that were specified in IEEE Std 802.1AB to IEEE Std 802.3.

IEEE Std 802.3at™-2009

This amendment includes changes to IEEE Std 802.3-2008. This amendment augments the capabilities of IEEE Std 802.3-2008 with higher power levels and improved power management information.

IEEE Std 802.3 will continue to evolve. New Ethernet capabilities are anticipated to be added within the next few years as amendments to this standard.

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List of special symbols

For the benefit of those who have received this document by electronic means, what follows is a list of special symbols and operators. If any of these symbols or operators fail to print out correctly on your machine, the editors apologize, and hope that this table will at least help you to sort out the meaning of the resulting funny-shaped blobs and strokes

Special symbols and operators

Printed character	Meaning	Font
*	Boolean AND	Symbol
+	Boolean OR, arithmetic addition	Symbol
^	Boolean XOR	Times New Roman
!	Boolean NOT	Symbol
×	Multiplication	Symbol
<	Less than	Symbol
≤	Less than or equal to	Symbol
>	Greater than	Symbol
≥	Greater than or equal to	Symbol
=	Equal to	Symbol
≠	Not equal to	Symbol
←	Assignment operator	Symbol
∈	Indicates membership	Symbol
∉	Indicates nonmembership	Symbol
±	Plus or minus (a tolerance)	Symbol
°	Degrees	Symbol
Σ	Summation	Symbol
√	Square root	Symbol
—	Big dash (em dash)	Times New Roman
–	Little dash (en dash), subtraction	Times New Roman
	Vertical bar	Times New Roman
†	Dagger	Times New Roman
‡	Double dagger	Times New Roman
α	Lower case alpha	Symbol
β	Lower case beta	Symbol
γ	Lower case gamma	Symbol
δ	Lower case delta	Symbol
ε	Lower case epsilon	Symbol
λ	Lambda	Symbol
μ	Micro	Times New Roman
Ω	Omega	Symbol

IEEE Standard for Information technology— Telecommunications and information exchange between systems— Local and metropolitan area networks— Specific requirements

Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications

Amendment 1: Physical Layer Specifications and Management Parameters for 10 Gb/s Passive Optical Networks

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[This amendment is based on IEEE Std 802.3-2008.]

NOTE—The editing instructions contained in this amendment define how to merge the material contained therein into the existing base standard and its amendments to form the comprehensive standard.

The editing instructions are shown in ***bold italic***. Four editing instructions are used: change, delete, insert, and replace. ***Change*** is used to make corrections in existing text or tables. The editing instruction specifies the location of the change and describes what is being changed by using ~~strike through~~ (to remove old material) and underscore (to add new material). ***Delete*** removes existing material. ***Insert*** adds new material without disturbing the existing material. Insertions may require renumbering. If so, renumbering instructions are given in the editing instruction. ***Replace*** is used to make changes in figures or equations by removing the existing figure or equation and replacing it with a new one. Editing instructions, change markings, and this NOTE will not be carried over into future editions because the changes will be incorporated into the base standard.¹

¹Notes in text, tables, and figures are given for information only and do not contain requirements needed to implement the standard.

1. Introduction

1.3 Normative references

Change the following reference as follows:

ITU-T Recommendation G.652, ~~2000~~2005—Characteristics of a single-mode optical fibre cable.

Insert the following new references in alphanumerical order:

IEC 61280-4-2:2000, Fibre optic communication subsystem basic test procedures; Fibre optic cable plant; Single-mode fibre optic cable plant attenuation.

ITU-T Recommendation G.650.1, 2004—Transmission media characteristics - Optical fibre cables.

ITU-T Recommendation G.671 am 1, 2006—Transmission characteristics of optical components and subsystems, Amendment 1.

ITU-T Recommendation G.657, 2006—Characteristics of a bending loss insensitive single mode optical fibre and cable for the access network.

ITU-T Recommendation G.983.1, 2005—Broadband optical access systems based on Passive Optical Networks (PON).

ITU-T Recommendation G.984.3, 2008—Gigabit-capable Passive Optical Networks (G-PON): Transmission convergence layer specification.

TIA-455-127-A:2006 FOTP-127-A Basic Spectral Characterization of Laser Diodes.

1.4 Definitions

Insert the following after 1.4.39 10GBASE-LX4 and renumber as appropriate:

1.4.40 10GBASE-PR: IEEE 802.3 Physical Layer specification for a 10 Gb/s (10/10G-EPON) point-to-multipoint link over one single-mode optical fiber.

NOTE—See IEEE 802.3 Clause 75, Clause 76, and Clause 77.

1.4.41 10/1GBASE-PRX: IEEE 802.3 Physical Layer specification for a 10 Gb/s downstream, 1 Gb/s upstream (10/1G-EPON) point-to-multipoint link over one single-mode optical fiber.

NOTE—See IEEE 802.3 Clause 75, Clause 76, and Clause 77.

Insert the following after 1.4.46 10GBASE-X and renumber as appropriate:

1.4.47 1G-EPON: An EPON architecture operating at 1 Gb/s in both downstream and upstream directions.

1.4.48 10G-EPON: An EPON architecture operating at 10 Gb/s in either downstream or both downstream and upstream directions. This term collectively refers to 10/10G-EPON and 10/1G-EPON architectures.

1.4.49 10/1G-EPON: An EPON architecture operating at 10 Gb/s in downstream direction and at 1 Gb/s data rate in upstream direction (asymmetric rate).

1.4.50 10/10G-EPON: An EPON architecture operating at 10 Gb/s in both downstream and upstream directions (symmetric rate).

Change subclause 1.4.95 as follows:

1.4.95 channel insertion loss: As used in IEEE 802.3 ~~Clause 38~~ for fiber optic links, the static loss of light through a link between a transmitter and receiver. It includes the loss of the fiber, connectors, and splices and, for EPON links, optional power splitter/combiner.

Insert the following after 1.4.253 `ordered_set` and renumber as appropriate:

1.4.254 Organizationally Unique Identifier: A unique number that defines a manufacturer or other organization.

NOTE—See <http://standards.ieee.org/regauth/index.html>.

Insert the following after 1.4.269 `pause` and renumber as appropriate:

1.4.270 `pause_quantum`: The unit of measurement for pause time specified; 512 MAC bit times.

NOTE—See IEEE Std 802.3, Annex 31B.

Insert the following after 1.4.342 `ternary symbol` and renumber as appropriate:

1.4.343 `time_quantum`: The unit of measurement for time related parameters specified in Multipoint MAC Control.

NOTE—See Clause 64 and Clause 77. The value of `time_quantum` is defined in 64.2.2.1.

1.5 Abbreviations

Insert the following new abbreviations in alphabetical order:

DFB	distributed feedback
EOB	end of burst delimiter
EPON	Ethernet Passive Optical Network
OUI	Organizationally Unique Identifier
SLD	Start of LLID Delimiter
TDMA	time division multiple access
TQ	<code>time_quantum</code>
WDM	wavelength division multiplexing

30. Management

30.2.2.1 Text description of managed objects

Insert new managed object oEXTENSION in 30.2.2.1 with the following definition, placing it between oGroup and oMACControlEntity managed object definitions:

oEXTENSION If implemented, oEXTENSION is contained within oMACControlEntity. The oEXTENSION managed object class provides the management controls necessary to allow an instance of the MAC Control EXTENSION function to be managed.

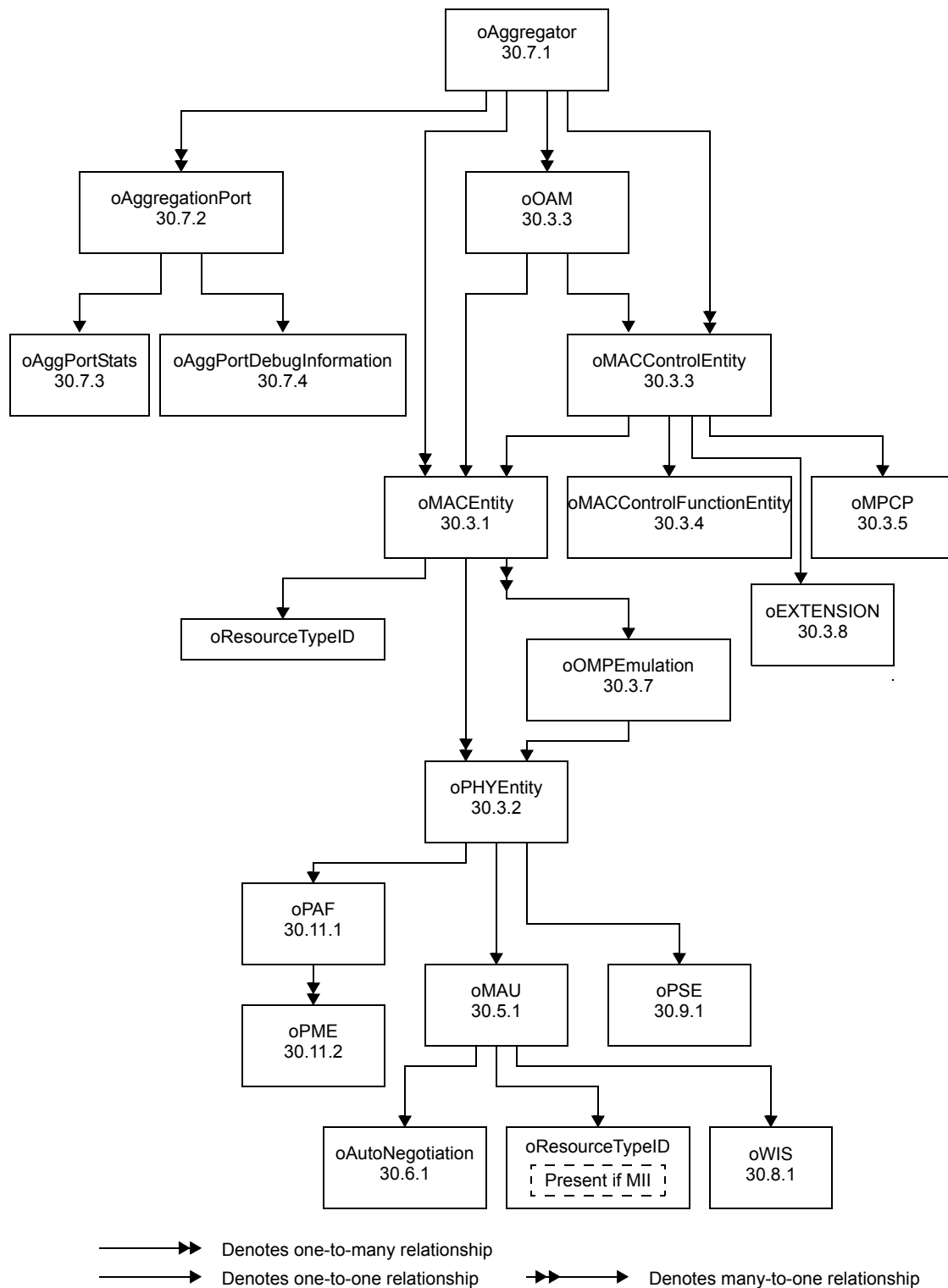
30.2.5 Capabilities

Change Table 30–1c, placing a new block of rows below oMACControlFunctionEntity block, as presented below:

Table 30-1c—Capabilities

										DTE	Repeater	MAU	
										Basic Package (mandatory)	Basic Control Capability (mandatory)	Basic Package (mandatory)	
										Mandatory Package (mandatory)	Performance Monitor Capability (optional)	MAU Control Package (optional)	
										Recommended Package (optional)	Address Tracking Capability (optional)	Media Loss Tracking Package (conditional)	
										Optional Package (optional)	100/1000 Mb/s Monitor Capability (optional)	Broadband DTE MAU Package (conditional)	
										Array Package (optional)	1000 Mb/s Burst Monitor Capability (optional)	MII Capability (conditional)	
										Excessive Deferral Package (optional)		PHY Error Monitor Capability (optional)	
										Multiple PHY Package (optional)		Auto-Negotiation Package (mandatory)	
										PHY Error Monitor Capability (optional)			
All the cells above without any changes													
aPAUSEMACCtrlFramesReceived	ATTRIBUTE	GET		X									
oEXTENSION managed object class (30.3.8)													
aEXTENSIONMACCtrlFramesTransmitted	ATTRIBUTE	GET		X									
aEXTENSIONMACCtrlFramesReceived	ATTRIBUTE	GET		X									
oRepeater managed object class (30.4.1)													
All the cells below without any changes													

Replace Figure 30–3 with that presented below:



NOTE—The objects oAggregator, oAggregationPort, oAggPortStats, and oAggPortDebugInformation are deprecated by IEEE Std 802.1AX-2008.

Figure 30–3— DTE System entity relationship diagram

30.3.1.1.2 aFramesTransmittedOK

Change first sentence under APPROPRIATE SYNTAX: to read as follows:

Generalized nonresettable counter.

30.3.2.1.2 aPhyType

Insert a new entry as follows:

10GBASE-PR Clause 76 10/10G-EPON 10 Gb/s 64B/66B

10/1GBASE-PRX Clause 76 10/1G-EPON 10 Gb/s 64B/66B downstream and 1 Gb/s 8B/10B upstream

30.3.2.1.3 aPhyTypeList

Insert a new entry as follows:

10GBASE-PR Clause 76 10/10G-EPON 10 Gb/s 64B/66B

10/1GBASE-PRX Clause 76 10/1G-EPON 10 Gb/s 64B/66B downstream and 1 Gb/s 8B/10B upstream

30.3.5.1.2 aMPCPAdminState

Change the behaviour definition to read as follows:

A read-only value that identifies the operational state of the Multipoint MAC Control sublayer. An interface which can provide the Multipoint MAC Control sublayer functions specified in Clause 64 or Clause 77 ~~will be~~ is enabled to do so when this attribute has the enumeration “enabled”. When this attribute has the enumeration “disabled” the interface ~~will~~ acts as it would if it had no Multipoint MAC Control sublayer. The operational state of the Multipoint MAC Control sublayer can be changed using the acMPCPAdminControl action.;

30.3.5.1.3 aMPCPMode

Change the behaviour definition to read as follows:

A read-only value that identifies the operational mode of the Multipoint MAC Control sublayer. An interface which can provide the Multipoint MAC Control sublayer functions specified in Clause 64 and Clause 77 ~~will operate~~ as an OLT when this attribute has the enumeration “OLT”. When this attribute has the enumeration “ONU” the interface ~~will~~ acts as an ONU.;

30.3.5.1.4 aMPCPLinkID

Change the behaviour definition to read as follows:

A read-only value that identifies the Logical Link identity (LLID) associated with the MAC port as specified in ~~65.1.2.3.2~~ 65.1.3.2.2 or 76.2.6.1.3.2, as appropriate.;

30.3.7.1.2 aOMPEmulationType

Change the behaviour definition to read as follows:

A read-only value that indicates ~~that the~~ mode of operation of the Reconciliation Sublayer for Point to Point Emulation (see 65.1.3.1 or 76.2.6.1.1, as appropriate).;

30.3.7.1.3 aSLDErrors

Change the behaviour definition to read as follows:

A count of frames received that do not contain a valid SLD field as defined in 65.1.3.3.1 or 76.2.6.1.3.1, as appropriate;

30.3.7.1.4 aCRC8Errors

Change the behaviour definition to read as follows:

A count of frames received that contain a valid SLD field, as defined in 65.1.3.3.1 or 76.2.6.1.3.1, as appropriate, but do not pass the CRC-8 check as defined in 65.1.3.3.3 or 76.2.6.1.3.3, as appropriate;

30.3.7.1.5 aGoodLLID

Change the behaviour definition to read as follows:

A count of frames received that contain a valid SLD field, as defined in 65.1.3.3.1 or 76.2.6.1.3.1, as appropriate, and pass the CRC-8 check as defined in 65.1.3.3.3 or 76.2.6.1.3.3, as appropriate;

30.3.7.1.6 aONUPONcastLLID

Change the behaviour definition to read as follows:

~~A count of frames received that contain a valid SLD field in an ONU, as defined in 65.1.3.3.1, passes the CRC-8 check, as defined in 65.1.3.3.3, and the frame meets the rule for acceptance defined in 65.1.3.3.2;~~

A count of frames received that: 1) contain a valid SLD field in an ONU, 2) meet the rules for frame acceptance, and 3) pass the CRC-8 check. The SLD is defined in 65.1.3.3.1 or 76.2.6.1.3.1, as appropriate. The rules for LLID acceptance are defined in 65.1.3.3.2 or 76.2.6.1.3.2, as appropriate. The CRC-8 check is defined in 65.1.3.3.3 or 76.2.6.1.3.3, as appropriate.

30.3.7.1.7 aOLTPONcastLLID

Change the behaviour definition to read as follows:

A count of frames received that contain a valid SLD field in an ONU, as defined in 65.1.3.3.1 or 76.2.6.1.3.1, as appropriate, and pass the CRC-8 check, as defined in 65.1.3.3.3 or 76.2.6.1.3.3, as appropriate, and meet the rule for acceptance defined in 65.1.3.3.2 or 76.2.6.1.3.2, as appropriate;

30.3.7.1.8 aBadLLID

Change the behaviour definition to read as follows:

~~A count of frames received that contain a valid SLD field in an OLT, as defined in 65.1.3.3.1, and pass the CRC-8 check, as defined in 65.1.3.3.3, but are discarded due to the LLID check as defined in 65.1.3.3.2;~~

A count of frames received that contain a valid SLD field in an OLT, and pass the CRC-8 check, but are discarded due to the LLID check. The SLD is defined in 65.1.3.3.1 or 76.2.6.1.3.1, as appropriate. The CRC-8 check is defined in 65.1.3.3.3 or 76.2.6.1.3.3, as appropriate. The LLID check is defined in 65.1.3.3.2 or 76.2.6.1.3.2, as appropriate.

Insert a new subclause 30.3.8, renumbering subsequent subclauses as appropriate, with the following contents:

30.3.8 EXTENSION entity managed object class

This subclause formally defines the behaviours for the oEXTENSION managed object class attributes.

30.3.8.1 aEXTENSIONMACCtrlFramesTransmitted

ATTRIBUTE

APPROPRIATE SYNTAX:

Generalized nonresettable counter. This counter has a maximum increment rate of 1 600 000 counts per second at 1000 Mb/s

BEHAVIOUR DEFINED AS:

A count of EXTENSION frames passed to the MAC sublayer for transmission. This counter is incremented when a MA_CONTROL.request primitive is generated within the MAC Control sublayer with an opcode indicating the EXTENSION operation.;

30.3.8.2 aEXTENSIONMACCtrlFramesReceived

ATTRIBUTE

APPROPRIATE SYNTAX:

Generalized nonresettable counter. This counter has a maximum increment rate of 1 600 000 counts per second at 1000 Mb/s

BEHAVIOUR DEFINED AS:

A count of MAC Control frames passed by the MAC sublayer to the MAC Control sublayer. This counter is incremented when a ReceiveFrame function call returns a valid frame with: (1) a lengthOrType field value equal to the reserved Type for 802.3_MAC_Control as specified in 31.4.1.3, and (2) an opcode indicating the EXTENSION operation.;

30.5.1.1.2 aMAUType

Insert the following between 10GBASE-T and 802.9a:

- 10/1GBASE-PRX-D1 One single-mode fiber 10.3125 GBd continuous downstream / 1.25 GBd burst mode upstream OLT PHY as specified in Clause 75
- 10/1GBASE-PRX-D2 One single-mode fiber 10.3125 GBd continuous downstream / 1.25 GBd burst mode upstream OLT PHY as specified in Clause 75
- 10/1GBASE-PRX-D3 One single-mode fiber 10.3125 GBd continuous downstream / 1.25 GBd burst mode upstream OLT PHY as specified in Clause 75
- 10/1GBASE-PRX-U1 One single-mode fiber 10.3125 GBd continuous downstream / 1.25 GBd burst mode upstream ONU PHY as specified in Clause 75
- 10/1GBASE-PRX-U2 One single-mode fiber 10.3125 GBd continuous downstream / 1.25 GBd burst mode upstream ONU PHY as specified in Clause 75
- 10/1GBASE-PRX-U3 One single-mode fiber 10.3125 GBd continuous downstream / 1.25 GBd burst mode upstream ONU PHY as specified in Clause 75
- 10GBASE-PR-D1 One single-mode fiber 10.3125 GBd continuous downstream / burst mode upstream OLT PHY as specified in Clause 75
- 10GBASE-PR-D2 One single-mode fiber 10.3125 GBd continuous downstream / burst mode upstream OLT PHY as specified in Clause 75
- 10GBASE-PR-D3 One single-mode fiber 10.3125 GBd continuous downstream / burst mode upstream OLT PHY as specified in Clause 75
- 10GBASE-PR-U1 One single-mode fiber 10.3125 GBd continuous downstream / burst mode upstream ONU PHY as specified in Clause 75
- 10GBASE-PR-U3 One single-mode fiber 10.3125 GBd continuous downstream / burst mode upstream ONU PHY as specified in Clause 75

30.5.1.1.15 aFECCorrectedBlocks

Change the behaviour definition to read as follows:

For ~~1000BASE-PX-PHYs or~~ 10GBASE-R, 10GBASE-PR or 10/1GBASE-PRX PHYs, a count of corrected FEC codewords. This counter ~~will~~does not increment for other PHY types.

Increment the counter by one for each received block that is corrected by the FEC function in the PHY.

If a Clause 45 MDIO Interface to the PCS is present, then this attribute ~~will~~maps to the FEC corrected codewords counter (see 45.2.7.5 and 45.2.1.86 for 10GBASE-R, 45.2.3.32 for 10GBASE-PR and 10/1GBASE-PRX);

30.5.1.1.16 aFECUncorrectableBlocks

Change the behaviour definition to read as follows:

For ~~1000BASE-PX-PHYs or~~ 10GBASE-R, 10GBASE-PR or 10/1GBASE-PRX PHYs, a count of uncorrectable FEC codewords. This counter ~~will~~does not increment for other PHY types.

Increment the counter by one for each received block that is determined to be uncorrectable by the FEC function in the PHY.

If a Clause 45 MDIO Interface to the PCS is present, then this attribute ~~will~~maps to the FEC uncorrectable codewords counter (see 45.2.7.5 and 45.2.1.87 for 10GBASE-R, 45.2.3.33 for 10GBASE-PR and 10/1GBASE-PRX);

Annex 31A

(normative)

MAC Control opcode assignments

Change Table 31A–1 as follows:

Table 31A–1—MAC Control opcodes

Opcode (hexadecimal)	MAC Control function	Specified in	Value/Comment	Timestamp ^a
00-00	Reserved			
00-01	PAUSE	Annex 31B	Requests that the recipient stop transmitting non-control frames for a period of time indicated by the parameters of this function.	No
00-02	GATE	Clause 64 <u>Clause 77</u>	Request that the recipient allow transmission of frames at a time, and for a period of time indicated by the parameters of this function.	Yes
00-03	REPORT	Clause 64 <u>Clause 77</u>	Notify the recipient of pending transmission requests as indicated by the parameters of this function.	Yes
00-04	REGISTER_REQ	Clause 64 <u>Clause 77</u>	Request that the station be recognized by the protocol as participating in a gated transmission procedure as indicated by the parameters of this function.	Yes
00-05	REGISTER	Clause 64 <u>Clause 77</u>	Notify the recipient that the station is recognized by the protocol as participating in a gated transmission procedure as indicated by the parameters of this function.	Yes
00-06	REGISTER_ACK	Clause 64 <u>Clause 77</u>	Notify the recipient that the station acknowledges participation in a gated transmission procedure.	Yes
00-07 through FF-FFD	Reserved			
<u>FF-FE</u>	<u>EXTENSION</u>	<u>Annex 31C</u>	<u>This frame is used for Organization-Specific Extension. Upon reception of this message, the MAC Control generates MA_CONTROL.Indication informing the MAC Control Client to perform the relevant action.</u>	<u>No</u>
<u>FF-FF</u>	<u>Reserved</u>			

^aThe timestamp field is generated by MAC Control and is not exposed through the client interface.

Insert a new row to Table 31A-3 at the end of the table, as presented below:

Table 31A-3—GATE MAC Control indications

discoveryInformation ^a	16 bits	See Table 77-3 for the internal structure of the discoveryInformation field.
-----------------------------------	---------	--

^aOnly present in 10G-EPON GATE MAC Control indication (Clause 77).

Insert three new rows to Table 31A-5 at the end of the table, as presented below:

Table 31A-5—REGISTER_REQ MAC Control indications

laserOnTime ^a	8 bits	Indicates the Laser On Time characteristic for the given ONU transmitter, expressed in the units of time_quanta.
laserOffTime ^a	8 bits	Indicates the Laser Off Time characteristic for the given ONU transmitter, expressed in the units of time_quanta.
discoveryInformation ^a	16 bits	See Table 77-7 for the internal structure of the discoveryInformation field.

^aOnly present in 10G-EPON REGISTER_REQ MAC Control indication (Clause 77).

Insert two new rows to Table 31A-6 at the end of the table, as presented below:

Table 31A-6—REGISTER MAC Control indications

laserOnTime ^a	8 bits	Indicates the Laser On Time characteristic for the given ONU transmitter, expressed in the units of time_quanta.
laserOffTime ^a	8 bits	Indicates the Laser Off Time characteristic for the given ONU transmitter, expressed in the units of time_quanta.

^aOnly present in 10G-EPON REGISTER MAC Control indication (Clause 77).

Add a new Table 31A-8 after Table 31A-7 with the description of EXTENSION frame with the following contents:

Table 31A-8—EXTENSION MAC Control indications

EXTENSION (opcode 0xFFFE)		
indication_operand_list element	Value	Interpretation
OUI	24 bits	Organizationally-Unique Identifier that determines the format and semantics of the Value field and its subfields, if any are defined.
Value	Variable	Organization-specific value, distinguished by the OUI.

Insert a new annex as follows:

Annex 31C

(normative)

MAC Control organization specific extension operation

31C.1 Organization specific extension description

The extension operation is used to provide a standardized means for other standards development organizations, in particular ITU-T, to define their own MAC Control protocols outside the scope of this standard. The first application of this is to enable Physical Layer Operations, Administration, and Management (PLOAM) messages related to protection switching, low-level performance monitoring, and management channel set-up (see ITU-T G.984 and ITU-T G.983). The requirements defined in Clause 31 apply to these protocols.

31C.2 Transmission of Extension MAC Control frame

Upon receipt of a MA_CONTROL.request primitive containing the EXTENSION opcode from a MAC client, the MAC control sublayer calls the MAC sublayer MAC:MA_DATA.request service primitive with the following parameters:

- a) The destination_address is set equal to the destination_address parameter of the MA_CONTROL.request primitive. This parameter is currently restricted to either the value 01-80-C2-00-00-01 or to the 48 bit individual address of the destination station.
- b) The source_address is set equal to the 48 bit individual address of the station.
- c) The length/type field (i.e., the first two octets) within the mac_service_data_unit parameter is set to the IEEE 802.3 MAC Control type value assigned in 31.4.1.3.
- d) The remainder of the mac_service_data_unit is set to the concatenation of the Extension Opcode, ITU-T's Organizationally Unique Identifier² (00-19-A7), and the organization-specific data.
- e) The frame_check_sequence is omitted.

31C.3 Receive operation

The opcode-independent MAC Control sublayer Receive state diagram accepts and parses valid frames received from the MAC sublayer. MAC Control sublayer entities that implement the EXTENSION operation shall implement the Receive state diagram specified in this subclause. The functions specified in this subclause are performed upon receipt of a valid Control frame containing the EXTENSION opcode and define the function called by the INITIATE MAC CONTROL FUNCTION state of Figure 31-4 (see 31.5.3).

²Details defining the format of OUIs can be found in IEEE Std 802-2001 Clause 9. Interested applicants should contact the IEEE Standards Department, Institute of Electrical and Electronics Engineers, <http://standards.ieee.org/regauth/index.html>, 445 Hoes Lane, Piscataway, NJ 08854, USA.

31C.3.1 Receive state diagram (INITIATE MAC CONTROL FUNCTION) for EXTENSION operation

Figure 31C–2 depicts the INITIATE MAC CONTROL FUNCTION for the EXTENSION operation (see 31.5.3). Upon reception of EXTENSION frames, the frame is sent to the MAC CONTROL client.

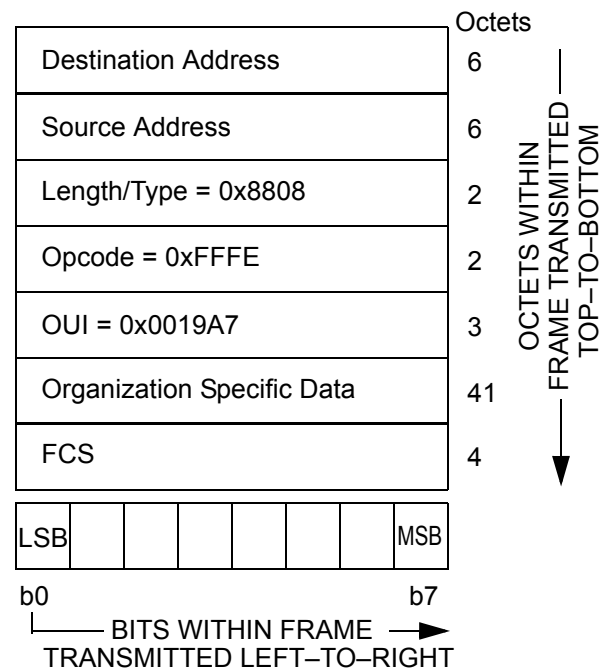


Figure 31C–1—MAC Control EXTENSION Frame

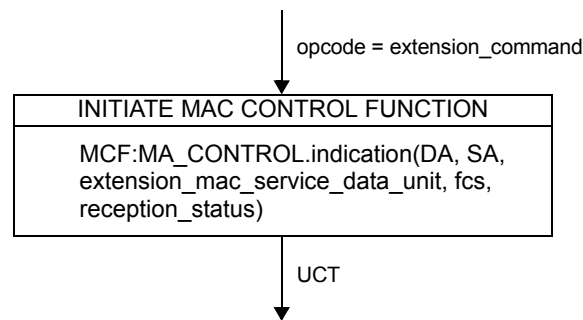


Figure 31C–2—EXTENSION receive function

31C.4 Protocol implementation conformance statement (PICS) proforma for MAC Control organization specific extension operation³

31C.4.1 Introduction

The supplier of a protocol implementation that is claimed to conform to Annex 31C, MAC Control organization specific extension operation, shall complete the following PICS proforma in addition to the PICS of Clause 31.

A detailed description of the symbols used in the PICS proforma, along with instructions for completing the PICS proforma, can be found in Clause 21.

31C.4.2 Identification

31C.4.2.1 Implementation identification

Supplier	
Contact point for queries about the PICS	
Implementation Name(s) and Version(s)	
Other information necessary for full identification— e.g., name(s) and version(s) for machines and/or operating systems; System Name(s)	
NOTE 1—Only the first three items are required for all implementations, other information may be completed as appropriate in meeting the requirements for the identification. NOTE 2—The terms Name and Version should be interpreted appropriately to correspond with a supplier's terminology (e.g., Type, Series, Model).	

31C.4.2.2 Protocol summary

Identification of protocol specification	IEEE Std 802.3av-2009, Annex 31C, MAC Control organization specific extension operation
Identification of amendments and corrigenda to this PICS proforma that have been completed as part of this PICS	
Have any Exception items been required? No ☐ Yes ☐ (See Clause 21; The answer Yes means that the implementation does not conform to IEEE Std 802.3av-2009)	

Date of Statement	
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³Copyright release for PICS proformas: Users of this standard may freely reproduce the PICS proforma in this annex so that it can be used for its intended purpose and may further publish the completed PICS.

31C.4.3 EXTENSION command state diagram requirements

Item	Feature	Subclause	Value/Comment	Status	Support
ESD1	Receive state diagram for EXTENSION operation	31C.3	Meets requirements of Figure 31C–2	M	Yes []

45. Management Data Input/Output (MDIO) Interface

45.2.1 PMA/PMD registers

Change Table 45-3 as follows:

Table 45–3—PMA/PMD registers

Register address	Register name	Subclause
~~1.12, 1.13~~	~~Reserved~~	
<u>1.12</u>	<u>P2MP ability register</u>	<u>45.2.1.11</u>
<u>1.13</u>	<u>Reserved</u>	<u>N/A</u>

45.2.1.1.4 PMA loopback (1.0.0)

Change first sentence in second paragraph as follows:

The loopback function is mandatory for the 1000BASE-KX, 10GBASE-KR, and 10GBASE-X port type and optional for all other port types, except 2BASE-TL, ~~and 10PASS-TS, and 10/1GBASE-PRX,~~ which do not support loopback.

45.2.1.4 PMA/PMD speed ability (Register 1.4)

Change Table 45-6 as follows (the entire table is not shown):

Table 45–6—PMA/PMD speed ability register bit definitions

Bit(s)	Name	Description	R/W ^a
~~1.4.15:78~~	~~Reserved for future speeds~~	~~Value always 0, writes ignored~~	~~RO~~
<u>1.4.7</u>	<u>10/1G capable</u>	<u>1 = PMA/PMD is capable of operating at 10 Gb/s downstream and 1 Gb/s upstream</u> <u>0 = PMA/PMD is not capable of operating at 10 Gb/s downstream and 1 Gb/s upstream.</u>	<u>RO</u>
1.4.6	10M capable	1 = PMA/PMD is capable of operating at 10 Mb/s 0 = PMA/PMD is not capable of operating as 10 Mb/s	RO

^aRO = Read only

Insert new subclause 45.2.1.4.1 as below renumbering remaining subclauses:

45.2.1.4.1 10/1G capable (1.4.7)

When read as a one, bit 1.4.7 indicates that the PMA/PMD is able to operate at a data rate of 10 Gb/s in the downstream direction and 1 Gb/s in the upstream direction. When read as a zero, bit 1.4.7 indicates that the PMA/PMD is not able to operate at a data rate of 10 Gb/s in the downstream direction and 1 Gb/s in the upstream direction.

Change Table 45-7 as follows:

45.2.1.6 PMA/PMD control 2 register (Register 1.7)

Table 45–7—PMA/PMD control 2 register bit definitions

Bit(s)	Name	Description	R/W ^a
1.7.15:4 ~~5~~	Reserved	Value always 0, writes ignored	R/W
1.7.3 ~~4~~ :0	PMA/PMD type selection	4 3 2 1 0 <u>1 1 1 x x</u> = reserved <u>1 1 0 1 1</u> = reserved <u>1 1 0 1 0</u> = 10GBASE-PR-U3 <u>1 1 0 0 1</u> = 10GBASE-PR-U1 <u>1 1 0 0 0</u> = 10/1GBASE-PRX-U3 <u>1 0 1 1 1</u> = 10/1GBASE-PRX-U2 <u>1 0 1 1 0</u> = 10/1GBASE-PRX-U1 <u>1 0 1 0 1</u> = 10GBASE-PR-D3 <u>1 0 1 0 0</u> = 10GBASE-PR-D2 <u>1 0 0 1 1</u> = 10GBASE-PR-D1 <u>1 0 0 1 0</u> = 10/1GBASE-PRX-D3 <u>1 0 0 0 1</u> = 10/1GBASE-PRX-D2 <u>1 0 0 0 0</u> = 10/1GBASE-PRX-D1 <u>0 1 1 1 1</u> = 10BASE-T PMA/PMD type <u>0 1 1 1 0</u> = 100BASE-TX PMA/PMD type <u>0 1 1 0 1</u> = 1000BASE-KX PMA/PMD type <u>0 1 1 0 0</u> = 1000BASE-T PMA/PMD type <u>0 1 0 1 1</u> = 10GBASE-KR PMA/PMD type <u>0 1 0 1 0</u> = 10GBASE-KX4 PMA/PMD type <u>0 1 0 0 1</u> = 10GBASE-T PMA type <u>0 1 0 0 0</u> = 10GBASE-LRM PMA/PMD type <u>0 0 1 1 1</u> = 10GBASE-SR PMA/PMD type <u>0 0 1 1 0</u> = 10GBASE-LR PMA/PMD type <u>0 0 1 0 1</u> = 10GBASE-ER PMA/PMD type <u>0 0 1 0 0</u> = 10GBASE-LX4 PMA/PMD type <u>0 0 0 1 1</u> = 10GBASE-SW PMA/PMD type <u>0 0 0 1 0</u> = 10GBASE-LW PMA/PMD type <u>0 0 0 0 1</u> = 10GBASE-EW PMA/PMD type <u>0 0 0 0 0</u> = 10GBASE-CX4 PMA/PMD type	R/W

^aR/W = Read/Write

45.2.1.6.1 PMA/PMD type selection (1.7.34:0)

The PMA/PMD type of the PMA/PMD shall be selected using bits ~~3 through 4~~ to 0.

45.2.1.10 PMA/PMD extended ability register (Register 1.11)

Change Table 45–11 as follows:

Table 45–11—PMA/PMD Extended ability register bit definitions

Bit(s)	Name	Description	R/W ^a
1.11.15:10 ~~9~~	Reserved	Ignore on read	RO
~~1.11.9~~	~~P2MP ability~~	~~1 = PMA/PMD has P2MP abilities listed in register 1.12 0 = PMA/PMD does not have P2MP abilities~~	~~RO~~
1.11.8	10BASE-T ability	1 = PMA/PMD is able to perform 10BASE-T 0 = PMA/PMD is not able to perform 10BASE-T	RO
1.11.7	100BASE-TX ability	1 = PMA/PMD is able to perform 100BASE-TX 0 = PMA/PMD is not able to perform 100BASE-TX	RO
1.11.6	1000BASE-KX ability	1 = PMA/PMD is able to perform 1000BASE-KX 0 = PMA/PMD is not able to perform 1000BASE-KX	RO
1.11.5	1000BASE-T ability	1 = PMA/PMD is able to perform 1000BASE-T 0 = PMA/PMD is not able to perform 1000BASE-T	RO
1.11.4	10GBASE-KR ability	1 = PMA/PMD is able to perform 10GBASE-KR 0 = PMA/PMD is not able to perform 10GBASE-KR	RO
1.11.3	10GBASE-KX4 ability	1 = PMA/PMD is able to perform 10GBASE-KX4 0 = PMA/PMD is not able to perform 10GBASE-KX4	RO
1.11.2	10GBASE-T ability	1 = PMA/PMD is able to perform 10GBASE-T 0 = PMA/PMD is not able to perform 10GBASE-T	RO
1.11.1	10GBASE-LRM ability	1 = PMA/PMD is able to perform 10GBASE-LRM 0 = PMA/PMD is not able to perform 10GBASE-LRM	RO
1.11.0	10GBASE-CX4 ability	1 = PMA/PMD is able to perform 10GBASE-CX4 0 = PMA/PMD is not able to perform 10GBASE-CX4	RO

^aRO = Read only

Insert the following new subclause prior to 45.2.1.10.1 and renumber remaining subclauses in 45.2.1.10 as appropriate:

45.2.1.10.1 P2MP ability (1.11.9)

When read as a one, bit 1.11.9 indicates that the PMA/PMD has P2MP abilities listed in register 1.12. When read as a zero, bit 1.11.9 indicates that the PMA/PMD does not have P2MP abilities.

Insert new subclause 45.2.1.11 and Table 45-12 as follows; renumber succeeding paragraphs and tables.

45.2.1.11 10G-EPON PMA/PMD ability register (Register 1.12)

The assignment of bits in the 10G-EPON PMA/PMD ability register is shown in Table 45–12. All of the bits in the 10G-EPON PMA/PMD ability register are read only; a write to the 10G-EPON PMA/PMD ability register shall have no effect.

Table 45–12—10G-EPON PMA/PMD ability register bit definitions

Bit(s)	Name	Description	R/W ^a
1.12.15:11	Reserved	Ignore on read	RO
1.12.10	10/1GBASE-PRX-D1 ability	1 = PMA/PMD is able to perform 10/1GBASE-PRX-D1 0 = PMA/PMD is not able to perform 10/1GBASE-PRX-D1	RO
1.12.9	10/1GBASE-PRX-D2 ability	1 = PMA/PMD is able to perform 10/1GBASE-PRX-D2 0 = PMA/PMD is not able to perform 10/1GBASE-PRX-D2	RO
1.12.8	10/1GBASE-PRX-D3 ability	1 = PMA/PMD is able to perform 10/1GBASE-PRX-D3 0 = PMA/PMD is not able to perform 10/1GBASE-PRX-D3	RO
1.12.7	10GBASE-PR-D1 ability	1 = PMA/PMD is able to perform 10GBASE-PR-D1 0 = PMA/PMD is not able to perform 10GBASE-PR-D1	RO
1.12.6	10GBASE-PR-D2 ability	1 = PMA/PMD is able to perform 10GBASE-PR-D2 0 = PMA/PMD is not able to perform 10GBASE-PR-D2	RO
1.12.5	10GBASE-PR-D3 ability	1 = PMA/PMD is able to perform 10GBASE-PR-D3 0 = PMA/PMD is not able to perform 10GBASE-PR-D3	RO
1.12.4	10/1GBASE-PRX-U1 ability	1 = PMA/PMD is able to perform 10/1GBASE-PRX-U1 0 = PMA/PMD is not able to perform 10/1GBASE-PRX-U1	RO
1.12.3	10/1GBASE-PRX-U2 ability	1 = PMA/PMD is able to perform 10/1GBASE-PRX-U2 0 = PMA/PMD is not able to perform 10/1GBASE-PRX-U2	RO
1.12.2	10/1GBASE-PRX-U3 ability	1 = PMA/PMD is able to perform 10/1GBASE-PRX-U3 0 = PMA/PMD is not able to perform 10/1GBASE-PRX-U3	RO
1.12.1	10GBASE-PR-U1 ability	1 = PMA/PMD is able to perform 10GBASE-PR-U1 0 = PMA/PMD is not able to perform 10GBASE-PR-U1	RO
1.12.0	10GBASE-PR-U3 ability	1 = PMA/PMD is able to perform 10GBASE-PR-U3 0 = PMA/PMD is not able to perform 10GBASE-PR-U3	RO

^aRO = Read only**45.2.1.11.1 10/1GBASE-PRX-D1 ability (1.12.10)**

When read as a one, bit 1.12.10 indicates that the PMA/PMD is able to operate as a 10/1GBASE-PRX-D1 PMA/PMD type. When read as a zero, bit 1.12.10 indicates that the PMA/PMD is not able to operate as a 10/1GBASE-PRX-D1 PMA/PMD type.

45.2.1.11.2 10/1GBASE-PRX-D2 ability (1.12.9)

When read as a one, bit 1.12.9 indicates that the PMA/PMD is able to operate as a 10/1GBASE-PRX-D2 PMA/PMD type. When read as a zero, bit 1.12.9 indicates that the PMA/PMD is not able to operate as a 10/1GBASE-PRX-D2 PMA/PMD type.

45.2.1.11.3 10/1GBASE-PRX-D3 ability (1.12.8)

When read as a one, bit 1.12.8 indicates that the PMA/PMD is able to operate as a 10/1GBASE-PRX-D3 PMA/PMD type. When read as a zero, bit 1.12.8 indicates that the PMA/PMD is not able to operate as a 10/1GBASE-PRX-D3 PMA/PMD type.

45.2.1.11.4 10GBASE-PR-D1 ability (1.12.7)

When read as a one, bit 1.12.7 indicates that the PMA/PMD is able to operate as a 10GBASE-PR-D1 PMA/PMD type. When read as a zero, bit 1.12.7 indicates that the PMA/PMD is not able to operate as a 10GBASE-PR-D1 PMA/PMD type.

45.2.1.11.5 10GBASE-PR-D2 ability (1.12.6)

When read as a one, bit 1.12.6 indicates that the PMA/PMD is able to operate as a 10GBASE-PR-D2 PMA/PMD type. When read as a zero, bit 1.12.6 indicates that the PMA/PMD is not able to operate as a 10GBASE-PR-D2 PMA/PMD type.

45.2.1.11.6 10GBASE-PR-D3 ability (1.12.5)

When read as a one, bit 1.12.5 indicates that the PMA/PMD is able to operate as a 10GBASE-PR-D3 PMA/PMD type. When read as a zero, bit 1.12.5 indicates that the PMA/PMD is not able to operate as a 10GBASE-PR-D3 PMA/PMD type.

45.2.1.11.7 10/1GBASE-PRX-U1 ability (1.12.4)

When read as a one, bit 1.12.4 indicates that the PMA/PMD is able to operate as a 10/1GBASE-PRX-U1 PMA/PMD type. When read as a zero, bit 1.12.4 indicates that the PMA/PMD is not able to operate as a 10/1GBASE-PRX-U1 PMA/PMD type.

45.2.1.11.8 10/1GBASE-PRX-U2 ability (1.12.3)

When read as a one, bit 1.12.3 indicates that the PMA/PMD is able to operate as a 10/1GBASE-PRX-U2 PMA/PMD type. When read as a zero, bit 1.12.3 indicates that the PMA/PMD is not able to operate as a 10/1GBASE-PRX-U2 PMA/PMD type.

45.2.1.11.9 10/1GBASE-PRX-U3 ability (1.12.2)

When read as a one, bit 1.12.2 indicates that the PMA/PMD is able to operate as a 10/1GBASE-PRX-U3 PMA/PMD type. When read as a zero, bit 1.12.2 indicates that the PMA/PMD is not able to operate as a 10/1GBASE-PRX-U3 PMA/PMD type.

45.2.1.11.10 10GBASE-PR-U1 ability (1.12.1)

When read as a one, bit 1.12.1 indicates that the PMA/PMD is able to operate as a 10GBASE-PR-U1 PMA/PMD type. When read as a zero, bit 1.12.1 indicates that the PMA/PMD is not able to operate as a 10GBASE-PR-U1 PMA/PMD type.

45.2.1.11.11 10GBASE-PR-U3 ability (1.12.0)

When read as a one, bit 1.12.0 indicates that the PMA/PMD is able to operate as a 10GBASE-PR-U3 PMA/PMD type. When read as a zero, bit 1.12.0 indicates that the PMA/PMD is not able to operate as a 10GBASE-PR-U3 PMA/PMD type.

45.2.3 PCS registers

Change last rows of Table 45-82:

Register address	Register name
<u>3.74</u>	<u>10GBASE-PR and 10/1GBASE-PRX FEC ability register</u>
<u>3.75</u>	<u>10GBASE-PR and 10/1GBASE-PRX FEC control register</u>
<u>3.76, 3.77</u>	<u>10/1GBASE-PRX and 10GBASE-PR corrected FEC codewords counter</u>
<u>3.78, 3.79</u>	<u>10/1GBASE-PRX and 10GBASE-PR uncorrected FEC codewords counter</u>
<u>3.80</u>	<u>10GBASE-PR and 10/1GBASE-PRX BER monitor timer control</u>
<u>3.81</u>	<u>10GBASE-PR and 10/1GBASE-PRX BER monitor status</u>
<u>3.82</u>	<u>10GBASE-PR and 10/1GBASE-PRX BER monitor threshold control</u>
~~3.74~~ <u>3.83</u> through 3.32 767	Reserved
3.32 768 through 3.65 535	Vendor specific

Change row 8 (not including header) of Table 45-83 as follows:

3.0.5:2	Speed selection	$\begin{array}{cccc} \bar{5} & \bar{4} & \bar{3} & \bar{2} \\ 1 & x & x & x = \text{Reserved} \\ x & 1 & x & x = \text{Reserved} \\ x & x & 1 & \bar{x} = \text{Reserved} \\ \underline{0} & \underline{0} & \underline{1} & \underline{0} = 10/1 \text{ Gb/s} \\ 0 & 0 & 0 & 1 = 10\text{PASS-TS}/2\text{BASE-TL} \\ 0 & 0 & 0 & 0 = 10 \text{ Gb/s} \end{array}$	R/W
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Insert the following new subclause after subclause 45.2.3.28:

45.2.3.29 10GBASE-PR and 10/1GBASE-PRX FEC ability register (Register 3.74)

The assignment of bits in the 10GBASE-PR and 10/1GBASE-PRX FEC ability register is shown in Table 45-107.

Table 45-107—10GBASE-PR and 10/1GBASE-PRX FEC ability register bit definitions

Bit(s)	Name	Description	R/W ^a
3.74.15:1	Reserved	Value always zero, writes ignored	RO
3.74.0	10 Gb/s FEC ability	A read of 1 in this bit indicates that the PCS supports the 10/1GBASE-PRX or 10GBASE-PR 10 Gb/s FEC (always reads as 1 for 10/1GBASE-PRX or 10GBASE-PR).	RO

^aRO = Read only

45.2.3.30 10GBASE-PR and 10/1GBASE-PRX FEC control register (Register 3.75)

The assignment of bits in the 10GBASE-PR FEC control register is shown in Table 45–108.

Table 45–108—10GBASE-PR and 10/1GBASE-PRX FEC control register bit definitions

Bit(s)	Name	Description	R/W ^a
3.75.15:2	Reserved	Value always zero, writes ignored	RO
3.75.1	Enable FEC error indication	A write of 1 to this bit configures the 10 Gb/s FEC decoder to indicate uncorrectable codeword errors to the higher layer. In a 10/1GBASE-PRX OLT, this bit is undefined.	R/W
3.75.0	10 Gb/s FEC enable	Always reads as 1 for 10/1GBASE-PRX or 10GBASE-PR since 10 Gb/s FEC is always enabled	RO

^aRO = Read only, R/W = Read/Write

45.2.3.30.1 FEC enable error indication (3.75.1)

This bit instructs the 10 Gb/s FEC decoder component of the 10GBASE-PR and 10/1GBASE-PRX PCS to indicate decoding errors to the upper layers (see 45.2.3.30 and 76.3.3.3).

When written as a one, the receiving PCS invalidates 66 bit blocks received in uncorrectable FEC codewords. As a consequence, the receiving MAC discards any packet which includes data that was received in an uncorrectable FEC codeword (even though the packet itself might or might not contain errors).

When written as a zero, the receiving PCS does not modify 66 bit blocks received in uncorrectable FEC codewords. As a consequence, the receiving MAC performs regular processing on a packet that includes data that was received in an uncorrectable FEC codeword (though the packet itself may contain errors which might or might not be detected by the MAC FCS)

45.2.3.30.2 10 Gb/s FEC Enable (3.75.0)

This bit indicates whether 10 Gb/s FEC is enabled in the 10GBASE-PR and 10/1GBASE-PRX PCS and always reads as one.

The register for enabling and disabling forward error correction in the 10/1GBASE-PRX upstream is specified in 45.2.8.3.

45.2.3.31 10/1GBASE-PRX and 10GBASE-PR corrected FEC codewords counter (Register 3.76, 3.77)

The assignment of bits in the 10/1GBASE-PRX and 10GBASE-PR corrected FEC codewords counter register is shown in Table 45–109. See 76.3.3.3.2 for a definition of this counter. These bits shall be reset to

all zeros when the register is read by the management function or upon PCS reset. These bits shall be held at all ones in the case of overflow.

Table 45–109—10GBASE-PR corrected FEC codewords counter register bit definitions

Bit(s)	Name	Description	R/W ^a
3.76.15:0	corrected FEC codewords lower	corrected_FEC_codewords_counter[15:0]	RO, MW, NR
3.77.15:0	corrected FEC codewords upper	corrected_FEC_codewords_counter[31:16]	RO, MW, NR

^aRO = Read only, MW = Multi-word, NR = Non Roll-over

45.2.3.32 10/1GBASE-PRX and 10GBASE-PR uncorrected FEC codewords counter (Register 3.78, 3.79)

The assignment of bits in the 10/1GBASE-PRX and 10GBASE-PR uncorrected FEC codewords counter register is shown in Table 45–110. See 76.3.3.3.2 for a definition of this counter. These bits shall be reset to all zeros when the register is read by the management function or upon PCS reset. These bits shall be held at all ones in the case of overflow.

Table 45–110—10GBASE-PR uncorrected FEC codewords counter register bit definitions

Bit(s)	Name	Description	R/W ^a
3.78.15:0	uncorrected FEC codewords lower	uncorrected_FEC_codewords_counter[15:0]	RO, MW, NR
3.79.15:0	uncorrected FEC codewords lower	uncorrected_FEC_codewords_counter[32:16]	RO, MW, NR

^aRO = Read only, MW = Multi-word, NR = Non Roll-over

45.2.3.33 10GBASE-PR and 10/1GBASE-PRX BER monitor timer control register (Register 3.80)

The assignment of bits in the 10GBASE-PR and 10/1GBASE-PRX BER monitor timer control register is shown in Table 45–111. This register is defined only when 10GBASE-PR or 10/1GBASE-PRX ONU capability is supported. The 10G-EPON BER monitor is described in 76.3.3.4.

Table 45–111—10GBASE-PR and 10/1GBASE-PRX BER monitor timer control register bit definitions

Bit(s)	Name	Description	R/W ^a
3.80.7:0	10G-EPON BER monitor timer	Duration (in units of 5 microseconds) of the timer used by the 10G-EPON BER monitor function. Default value is 25 (i.e., 125 microseconds). A value of 0 indicates that the BER monitor function is disabled.	R/W

^aR/W = Read/Write

45.2.3.34 10GBASE-PR and 10/1GBASE-PRX BER monitor status (Register 3.81)

The assignments of bits in the 10GBASE-PR and 10/1GBASE-PRX BER monitor status register is shown in Table 45–112. This register is defined only when 10GBASE-PR or 10/1GBASE-PRX ONU capability is supported.

Table 45–112—10GBASE-PR and 10/1GBASE-PRX BER monitor status Register

Bit(s)	Name	Description	R/W ^a
3.81.7:2	Reserved	Value always zero, writes ignored	RO
3.81.1	Latched high BER	1 = 10GBASE-PR or 10/1GBASE-PRX PCS reported a high BER. 0 = 10GBASE-PR or 10/1GBASE-PRX PCS did not report a high BER.	RO, LH
3.81.0	high BER	1 = 10GBASE-PR or 10/1GBASE-PRX PCS reporting a high BER. 0 = 10GBASE-PR or 10/1GBASE-PRX PCS not reporting a high BER.	RO

^aRO Read only, LH = Latching high

45.2.3.34.1 10GBASE-PR and 10/1GBASE-PRX PCS high BER (3.81.0)

In the 10GBASE-PR and 10/1GBASE-PRX PCS, when read as a one, bit 3.81.0 indicates that the receiver is detecting a BER greater than the configurable threshold (high BER state). When read as a zero, bit 3.81.0 indicates that the receiver is detecting a BER lower than the configurable threshold (low BER state). This bit mirrors the state of the hi_ber variable, defined in 76.3.3.4.

45.2.3.34.2 10GBASE-PR and 10/1GBASE-PRX PCS latched high BER (3.81.1)

In the 10GBASE-PR and 10/1GBASE-PRX PCS, when read as a one, bit 3.81.1 indicates that the receiver detected a BER greater than the configurable threshold (high BER state). When read as a zero, bit 3.81.1 indicates that the receiver detected BER lower than the configurable threshold (low BER state).

This bit is a latching high version of the 10GBASE-PR and 10/1GBASE-PRX high BER status bit (3.81.0).

**45.2.3.35 10GBASE-PR and 10/1GBASE-PRX BER monitor threshold control
(Register 3.82)**

The assignment of bits in the 10GBASE-PR and 10/1GBASE-PRX BER monitor threshold control register is shown in Table 45–113. This register is defined only when 10GBASE-PR or 10/1GBASE-PRX ONU capability is supported. The 10G-EPON BER monitor is described in 76.3.3.4.

**Table 45–113—10GBASE-PR and 10/1GBASE-PRX BER monitor threshold control
register bit definitions**

Bit(s)	Name	Description	R/W ^a
3.82.15:0	10G-EPON BER monitor threshold	Number of sync header errors within a timer interval that triggers a high BER condition for the 10G-EPON BER monitor function. Default value is 1600. A value of 0 indicates that the BER monitor function is disabled.	R/W

^aR/W = Read/Write

45.5 Protocol implementation conformance statement (PICS) proforma for Clause 45, MDIO interface

Insert the following row at the end of table 45.5.3.3 PMA/PMD management functions:

Item	Feature	Subclause	Value/Comment	Status	Support
<u>MM119</u>	<u>Writes to this register have no effect</u>	<u>45.2.1.11</u>		<u>PMA:M</u>	<u>Yes</u> ☐ <u>No</u> ☐ <u>N/A</u> ☐

Insert the following row at the end of table 45.5.3.6 PCS options:

Item	Feature	Subclause	Value/Comment	Status	Support
<u>*CPR</u>	<u>Implementation of 10GBASE-PR or 10/1GBASE-PRX PCS</u>	<u>45.2.3</u>		<u>PCS:O</u>	<u>Yes</u> ☐ <u>No</u> ☐ <u>N/A</u> ☐

Insert the following rows at the end of table 45.5.3.7 PCS management functions:

Item	Feature	Subclause	Value/Comment	Status	Support
<u>RM79</u>	<u>corrected FEC codeword counter is reset when read or upon PHY reset.</u>	<u>45.2.3.31</u>		<u>CPR:M</u>	<u>Yes</u> ☐ <u>No</u> ☐ <u>N/A</u> ☐
<u>RM80</u>	<u>corrected FEC codeword counter is held at all ones in the case of overflow</u>	<u>45.2.3.31</u>		<u>CPR:M</u>	<u>Yes</u> ☐ <u>No</u> ☐ <u>N/A</u> ☐
<u>RM81</u>	<u>uncorrected FEC codeword counter is reset when read or upon PHY reset.</u>	<u>45.2.3.32</u>		<u>CPR:M</u>	<u>Yes</u> ☐ <u>No</u> ☐ <u>N/A</u> ☐
<u>RM82</u>	<u>uncorrected FEC codeword counter is held at all ones in the case of overflow</u>	<u>45.2.3.32</u>		<u>CPR:M</u>	<u>Yes</u> ☐ <u>No</u> ☐ <u>N/A</u> ☐