

IEEE Standard for Ethernet

Amendment 1: Physical Layer Specifications and Management Parameters for Extended Ethernet Passive Optical Networks

IEEE Computer Society

Sponsored by the
LAN/MAN Standards Committee

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USA

IEEE Std 802.3bk™-2013
(Amendment to
IEEE Std 802.3-2012)

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**LAN/MAN Standards Committee
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IEEE Computer Society**

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Abstract: This amendment to IEEE Std 802.3 defines the physical layer specifications and management parameters for EPON operation on point-to-multipoint passive optical networks supporting extended power budget classes of PX30, PX40, PRX40, and PR40 PMDs.

Keywords: Ethernet, extended EPON, IEEE 802.3™, IEEE 802.3bk™, PRX40, PR40, PX30, PX40

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Introduction

This introduction is not part of IEEE Std 802.3bk-2013, IEEE Standard for Ethernet—Amendment 1: Physical Layer Specifications and Management Parameters for Extended Ethernet 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 802.3ba™-2010).

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), IEEE Std 802.3ah™ specified access network Ethernet (also called Ethernet in the First Mile) and IEEE Std 802.3ba added 40 Gb/s operation (also called 40 Gigabit Ethernet) and 100 Gb/s operation (also called 100 Gigabit Ethernet). These major additions are all now included in and are superseded by IEEE Std 802.3-2012 and are not maintained as separate documents.

At the date of IEEE Std 802.3bk-2013 publication, IEEE Std 802.3 is comprised of the following documents:

IEEE Std 802.3-2012

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 77 and Annex 57A through Annex 76A. Clause 56 through Clause 67 and Clause 75 through Clause 77, as well as associated annexes, specify subscriber access and other Physical Layers and sublayers for operation from 512 kb/s to 10 Gb/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.

Section Six—Includes Clause 78 through Clause 90 and Annex 83A through Annex 86A. Clause 78 specifies Energy-Efficient Ethernet. Clause 79 specifies IEEE 802.3 Organizationally Specific Link Layer Discovery Protocol (LLDP) type, length, and value (TLV) information elements. Clause 80 through Clause 89 and associated annexes includes general information on 40 Gb/s and 100 Gb/s operation as well the 40 Gb/s and 100 Gb/s Physical Layer specifications. Clause 90 specifies Ethernet support for time synchronization protocols.

IEEE Std 802.3bk™-2013

Amendment 1—This amendment includes changes to EPON as defined in IEEE Std 802.3-2012 and adds the physical layer specifications and management parameters for EPON operation on point-to-multipoint passive optical networks supporting extended power budget classes of PX30 (29 dB for 1G-EPON), PX40 (33 dB for 1G-EPON), PRX40 (33 dB for 10/1G-EPON), and PR40 (33 dB for 10/10G-EPON).

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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IEEE Standard for Ethernet

Amendment 1: Physical Layer Specifications and Management Parameters for Extended Ethernet Passive Optical Networks

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(This amendment is based on IEEE Std 802.3™-2012.)

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.¹

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 underline (to add new material). ***Delete*** removes existing material. ***Insert*** adds new material without disturbing the existing material. Deletions and 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.

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

1. Introduction

Change the text of 1.4.26 and delete 1.4.27 as follows, properly renumbering the subsequent definitions:

1.4.26 1000BASE-PX40: A collection of IEEE 802.3 Physical Layer specifications for a 1000 Mb/s point-to-multipoint link over one single-mode optical fiber, with a reach of up to 10 km. (See IEEE Std 802.3, Table 56–1, Clause 60, Clause 65, and Clause 64~~Clause 66~~.)

~~**1.4.27 1000BASE-PX20:** IEEE 802.3 Physical Layer specification for a 1000 Mb/s point-to-multipoint link over one single-mode optical fiber, with a reach of up to 20 km. (See IEEE Std 802.3, Clause 60, Clause 65, and Clause 66.)~~

Change 1.4.41 and 1.4.42 (renumbered from 1.4.42 and 1.4.43, respectively, by the deletion of 1.4.27) as follows:

1.4.41 10GBASE-PR: A collection of IEEE 802.3 Physical Layer specifications for a 10 Gb/s (10/10G-EPON) point-to-multipoint link over one single-mode optical fiber. (See IEEE Std 802.3, Table 56–1, Clause 75, Clause 76, and Clause 77.)

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

1.4.42 10/1GBASE-PRX: A collection of IEEE 802.3 Physical Layer specifications for a 10 Gb/s downstream, 1 Gb/s upstream (10/1G-EPON) point-to-multipoint link over one single-mode optical fiber. (See IEEE Std 802.3, Table 56–1, Clause 75, Clause 76, and Clause 77.)

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

30. Management

Change Table 30–5 by deleting the table entry for aMACControlFunctionsSupported and changing the reference for oOAM managed object class as follows:

30.2.5 Capabilities

Table 30–5—EFM capabilities

				DTE	MAU	PME
				Multipoint Control Protocol Package (conditional)		
				Operation Administration Maintenance Package (conditional)		
				Optical Multipoint Emulation Package (conditional)		
				Optical Multipoint Emulation Monitor Package (optional)		
				PCS Code Error Monitor Package (optional)		
				Forward Error Correction Package (conditional)		
				Basic Package (mandatory)		
				PME Aggregation Package (optional)		
				10P/2B Package (mandatory)		
oMPCP managed object class (30.3.5)						
aMPCPID	ATTRIBUTE	GET	X			
aMPCPAdminState	ATTRIBUTE	GET	X			
aMPCPMode	ATTRIBUTE	GET	X			
aMPCPLinkID	ATTRIBUTE	GET	X			
aMPCPRemoteMACAddress	ATTRIBUTE	GET	X			
aMPCPRegistrationState	ATTRIBUTE	GET	X			
aMPCPMACCtrlFramesTransmitted	ATTRIBUTE	GET	X			
aMPCPMACCtrlFramesReceived	ATTRIBUTE	GET	X			
aMPCPTxGate	ATTRIBUTE	GET	X			
aMPCPTxRegAck	ATTRIBUTE	GET	X			
aMPCPTxRegister	ATTRIBUTE	GET	X			
aMPCPTxRegRequest	ATTRIBUTE	GET	X			
aMPCPTxReport	ATTRIBUTE	GET	X			
aMPCPRxGate	ATTRIBUTE	GET	X			
aMPCPRxRegAck	ATTRIBUTE	GET	X			
aMPCPRxRegister	ATTRIBUTE	GET	X			
aMPCPRxRegRequest	ATTRIBUTE	GET	X			
aMPCPRxReport	ATTRIBUTE	GET	X			
aMPCPTransmitElapsed	ATTRIBUTE	GET	X			
aMPCPReceiveElapsed	ATTRIBUTE	GET	X			
aMPCPRoundTripTime	ATTRIBUTE	GET	X			

Table 30–5—EFM capabilities (continued)

			DTE				MAU		PME	
			Multipoint Control Protocol Package (conditional)	Operation Administration Maintenance Package (conditional)	Optical Multipoint Emulation Package (conditional)	Optical Multipoint Emulation Monitor Package (optional)	PCS Code Error Monitor Package (optional)	Forward Error Correction Package (conditional)	Basic Package (mandatory)	PME Aggregation Package (optional)
										10P/2B Package (mandatory)
aMPCPDiscoveryWindowsSent	ATTRIBUTE	GET	X							
aMPCPDiscoveryTimeout	ATTRIBUTE	GET	X							
aMPCPMaximumPendingGrants	ATTRIBUTE	GET	X							
aMPCPRecognizedMulticastIDs	ATTRIBUTE	GET	X							
acMPCPAdminControl	ACTION		X							
oOAM managed object class (30.3.36)										
aMACControlID	ATTRIBUTE	GET	X							
aOAMAdminState	ATTRIBUTE	GET	X							
aMACControlFunctionsSupported	ATTRIBUTE	GET-SET	X							
aOAMDiscoveryState	ATTRIBUTE	GET	X							
aOAMRemoteMACAddress	ATTRIBUTE	GET	X							
aOAMLocalConfiguration	ATTRIBUTE	GET	X							
aOAMRemoteConfiguration	ATTRIBUTE	GET	X							
aOAMLocalPDUConfiguration	ATTRIBUTE	GET	X							
aOAMRemotePDUConfiguration	ATTRIBUTE	GET	X							
aOAMLocalFlagsField	ATTRIBUTE	GET	X							
aOAMRemoteFlagsField	ATTRIBUTE	GET	X							
aOAMLocalRevision	ATTRIBUTE	GET	X							
aOAMRemoteRevision	ATTRIBUTE	GET	X							
aOAMLocalState	ATTRIBUTE	GET	X							
aOAMRemoteState	ATTRIBUTE	GET	X							
aOAMRemoteVendorOUI	ATTRIBUTE	GET	X							
aOAMRemoteVendorSpecificInfo	ATTRIBUTE	GET	X							
aOAMUnsupportedCodesTx	ATTRIBUTE	GET	X							
aUnsupportedOpCodesReceived	ATTRIBUTE	GET	X							
aOAMInformationTx	ATTRIBUTE	GET	X							
aOAMInformationRx	ATTRIBUTE	GET	X							
aOAMUniqueEventNotificationTx	ATTRIBUTE	GET	X							
aOAMDuplicateEventNotificationTx	ATTRIBUTE	GET	X							
aOAMUniqueEventNotificationRx	ATTRIBUTE	GET	X							
aOAMDuplicateEventNotificationRx	ATTRIBUTE	GET	X							

Table 30–5—EFM capabilities (*continued*)

			DTE	MAU	PME
			Multipoint Control Protocol Package (conditional)		
			Operation Administration Maintenance Package (conditional)		
			Optical Multipoint Emulation Package (conditional)		
			Optical Multipoint Emulation Monitor Package (optional)		
			PCS Code Error Monitor Package (optional)		
			Forward Error Correction Package (conditional)		
			Basic Package (mandatory)		
			PME Aggregation Package (optional)		
			10P/2B Package (mandatory)		
aOAMLoopbackControlTx	ATTRIBUTE	GET	X		
aOAMLoopbackControlRx	ATTRIBUTE	GET	X		
aOAMVariableRequestTx	ATTRIBUTE	GET	X		
aOAMVariableRequestRx	ATTRIBUTE	GET	X		
aOAMVariableResponseTx	ATTRIBUTE	GET	X		
aOAMVariableResponseRx	ATTRIBUTE	GET	X		
aOAMOrganizationSpecificTx	ATTRIBUTE	GET	X		
aOAMOrganizationSpecificRx	ATTRIBUTE	GET	X		
aOAMLocalErrSymPeriodConfig	ATTRIBUTE	GET	X		
aOAMLocalErrSymPeriodEvent	ATTRIBUTE	GET	X		
aOAMLocalErrFrameConfig	ATTRIBUTE	GET	X		
aOAMLocalErrFrameEvent	ATTRIBUTE	GET	X		
aOAMLocalErrFramePeriodConfig	ATTRIBUTE	GET	X		
aOAMLocalErrFramePeriodEvent	ATTRIBUTE	GET	X		
aOAMLocalErrFrameSecsSummaryConfig	ATTRIBUTE	GET	X		
aOAMLocalErrFrameSecsSummaryEvent	ATTRIBUTE	GET	X		
aOAMRemoteErrSymPeriodEvent	ATTRIBUTE	GET	X		
aOAMRemoteErrFrameEvent	ATTRIBUTE	GET	X		
aOAMRemoteErrFramePeriodEvent	ATTRIBUTE	GET	X		
aOAMRemoteErrFrameSecsSummaryEvent	ATTRIBUTE	GET	X		
aFramesLostDueToOAMError	ATTRIBUTE	GET	X		
acOAMAdminControl	ACTION		X		
oOMPEmulation managed object class (30.3.7)					
aOMPEmulationID	ATTRIBUTE	GET		X	
aOMPEmulationType	ATTRIBUTE	GET		X	
aSLDErrors	ATTRIBUTE	GET		X	
aCRC8Errors	ATTRIBUTE	GET		X	
aGoodLLID	ATTRIBUTE	GET			X
aONUPONcastLLID	ATTRIBUTE	GET			X
aOLTPONcastLLID	ATTRIBUTE	GET			X
aBadLLID	ATTRIBUTE	GET			X

Table 30–5—EFM capabilities (continued)

			DTE	MAU	PME
			Multipoint Control Protocol Package (conditional)		
			Operation Administration Maintenance Package (conditional)		
			Optical Multipoint Emulation Package (conditional)		
			Optical Multipoint Emulation Monitor Package (optional)		
			PCS Code Error Monitor Package (optional)		
			Forward Error Correction Package (conditional)		
			Basic Package (mandatory)		
			PME Aggregation Package (optional)		
			10P/2B Package (mandatory)		
oMAU managed object class (30.5.1)					
aPCSCodingViolation	ATTRIBUTE	GET		X	
aFECAbility	ATTRIBUTE	GET		X	
aFECmode	ATTRIBUTE	GET-SET		X	
aFECCorrectedBlocks	ATTRIBUTE	GET		X	
aFECUncorrectableBlocks	ATTRIBUTE	GET		X	
oPAF managed object class (30.11.1)					
aPAFID	ATTRIBUTE	GET			X
aPhyEnd	ATTRIBUTE	GET			X
aPHYCurrentStatus	ATTRIBUTE	GET			X
aPAFSupported	ATTRIBUTE	GET			X
aPAFAdminState	ATTRIBUTE	GET-SET			X
aLocalPAFCapacity	ATTRIBUTE	GET			X
aLocalPMEAvailable	ATTRIBUTE	GET			X
aLocalPMEAggregate	ATTRIBUTE	GET			X
aRemotePAFSupported	ATTRIBUTE	GET			X
aRemotePAFCapacity	ATTRIBUTE	GET			X
aRemotePMEAggregate	ATTRIBUTE	GET			X
oPME managed object class (30.11.2)					
aPMEID	ATTRIBUTE	GET			X
aPMEAdminState	ATTRIBUTE	GET-SET			X
aPMEStatus	ATTRIBUTE	GET			X
aPMESNRMgn	ATTRIBUTE	GET			X
aTCCodingViolations	ATTRIBUTE	GET			X
aProfileSelect	ATTRIBUTE	GET-SET			X
aOperatingProfile	ATTRIBUTE	GET			X
aPMEFECCorrectedBlocks	ATTRIBUTE	GET			X
aPMEFEUCorrectableBlocks	ATTRIBUTE	GET			X
aTCCRCErrors	ATTRIBUTE	GET			X
Common Attributes Template					
aCMCounter	ATTRIBUTE	GET	X	X	X

Change the list of MAU types in 30.5.1.1.2, inserting new PMD types in the appropriate locations, as follows. Change the formatting in 30.5.1.1.2 so that each listed value is followed by at least one tab and then by the value description.

30.5.1.1.2 aMAUType

ATTRIBUTE

APPROPRIATE SYNTAX:

A GET-SET ENUMERATION that meets the requirements of the following description:

global	undefined
other	See 30.2.5
unknown	Initializing, true state or type not yet known
AUI	no internal MAU, view from AUI
2BASE-TL	Voice grade twisted-pair cabling PHY as specified in Clause 61 and 63
10BASE5	Thick coax MAU as specified in Clause 8
FOIRL	FOIRL MAU as specified in 9.9
10BASE2	Thin coax MAU as specified in Clause 10
10BROAD36	Broadband DTE MAU as specified in Clause 11
10BASE-T	Twisted-pair cabling MAU as specified in Clause 14, duplex mode unknown
10BASE-THD	Twisted-pair cabling MAU as specified in Clause 14, half duplex mode
10BASE-TFD	Twisted-pair cabling MAU as specified in Clause 14, full duplex mode
10PASS-TS	Voice grade twisted-pair cabling PHY as specified in Clause 61 and 62
10BASE-FP	Passive fiber MAU as specified in Clause 16
10BASE-FB	Synchronous fiber MAU as specified in Clause 17
10BASE-FL	Asynchronous fiber MAU as specified in Clause 18, duplex mode unknown
10BASE-FLHD	Asynchronous fiber MAU as specified in Clause 18, half duplex mode
10BASE-FLFD	Asynchronous fiber MAU as specified in Clause 18, full duplex mode
100BASE-T4	Four-pair Category 3 twisted-pair cabling as specified in Clause 23
100BASE-TX	Two-pair Category 5 twisted-pair cabling as specified in Clause 25, duplex mode unknown
100BASE-TXHD	Two-pair Category 5 twisted-pair cabling as specified in Clause 25, half duplex mode
100BASE-TXFD	Two-pair Category 5 twisted-pair cabling as specified in Clause 25, full duplex mode
100BASE-BX10D	One single-mode fiber OLT PHY as specified in Clause 58
100BASE-BX10U	One single-mode fiber ONU PHY as specified in Clause 58
100BASE-FX	X fiber over PMD as specified in Clause 26, duplex mode unknown
100BASE-FXHD	X fiber over PMD as specified in Clause 26, half duplex mode
100BASE-FXFD	X fiber over PMD as specified in Clause 26, full duplex mode
100BASE-LX10	Two fiber PHY as specified in Clause 58
100BASE-T2	Two-pair Category 3 twisted-pair cabling as specified in Clause 32, duplex mode unknown
100BASE-T2HD	Two-pair Category 3 twisted-pair cabling as specified in Clause 32, half duplex mode
100BASE-T2FD	Two-pair Category 3 twisted-pair cabling as specified in Clause 32, full duplex mode
1000BASE-X	X PCS/PMA as specified in Clause 36 over undefined PMD, duplex mode unknown
1000BASE-BX10D	One single-mode fiber OLT PHY as specified in Clause 59
1000BASE-BX10U	One single-mode fiber ONU PHY as specified in Clause 59

1000BASE-XHD	X PCS/PMA as specified in Clause 36 over undefined PMD, half duplex mode
1000BASE-XFD	X PCS/PMA as specified in Clause 36 over undefined PMD, full duplex mode
1000BASE-LX	X fiber over long-wavelength laser PMD as specified in Clause 38, duplex mode unknown
1000BASE-LXHD	X fiber over long-wavelength laser PMD as specified in Clause 38, half duplex mode
1000BASE-LXFD	X fiber over long-wavelength laser PMD as specified in Clause 38, full duplex mode
1000BASE-LX10	Two fiber 10 km PHY as specified in Clause 59
1000BASE-PX10-D	One single-mode fiber OMP OLT ~~10 km~~ PHY, as specified in Clause 60, <u>supporting a distance of at least 10 km, and a split of at least 1:16</u>
1000BASE-PX10-U	One single-mode fiber OMP ONU ~~10 km~~ PHY, as specified in Clause 60, <u>supporting a distance of at least 10 km, and a split of at least 1:16</u>
1000BASE-PX20-D	One single-mode fiber OMP OLT ~~20 km~~ PHY, as specified in Clause 60, <u>supporting a distance of at least 20 km, and a split of at least 1:16</u>
1000BASE-PX20-U	One single-mode fiber OMP ONU ~~20 km~~ PHY, as specified in Clause 60, <u>supporting a distance of at least 20 km, and a split of at least 1:16</u>
1000BASE-PX30-D	One single-mode fiber OMP OLT PHY, as specified in Clause 60, <u>supporting a distance of at least 20 km, and a split of at least 1:32</u>
1000BASE-PX30-U	One single-mode fiber OMP ONU PHY, as specified in Clause 60, <u>supporting a distance of at least 20 km, and a split of at least 1:32</u>
1000BASE-PX40-D	One single-mode fiber OMP OLT PHY as specified in Clause 60, <u>supporting a distance of at least 20 km, and a split of at least 1:64</u>
1000BASE-PX40-U	One single-mode fiber OMP ONU PHY as specified in Clause 60, <u>supporting a distance of at least 20 km, and a split of at least 1:64</u>
1000BASE-SX	X fiber over short-wavelength laser PMD as specified in Clause 38, duplex mode unknown
1000BASE-SXHD	X fiber over short-wavelength laser PMD as specified in Clause 38, half duplex mode
1000BASE-SXFD	X fiber over short-wavelength laser PMD as specified in Clause 38, full duplex mode
1000BASE-CX	X copper over 150-Ohm balanced cable PMD as specified in Clause 39, duplex mode unknown
1000BASE-CXHD	X copper over 150-Ohm balanced cable PMD as specified in Clause 39, half duplex mode
1000BASE-CXFD	X copper over 150-Ohm balanced cable PMD as specified in Clause 39, full duplex mode
1000BASE-KX	X PCS/PMA over an electrical backplane PMD as specified in Clause 70
1000BASE-T	Four-pair Category 5 twisted-pair cabling PHY to be specified in Clause 40, duplex mode unknown
1000BASE-THD	Four-pair Category 5 twisted-pair cabling PHY to be specified in Clause 40, half duplex mode
1000BASE-TFD	Four-pair Category 5 twisted-pair cabling PHY to be specified in Clause 40, full duplex mode
10GBASE-X	X PCS/PMA as specified in Clause 48 over undefined PMD
10GBASE-LX4	X fiber over 4 lane 1310nm optics as specified in Clause 53
10GBASE-CX4	X copper over 8 pair 100-Ohm balanced cable as specified in Clause 54
10GBASE-KX4	X PCS/PMA over an electrical backplane PMD as specified in Clause 71
10GBASE-R	R PCS/PMA as specified in Clause 49 over undefined PMD
10GBASE-ER	R fiber over 1550nm optics as specified in Clause 52
10GBASE-LR	R fiber over 1310nm optics as specified in Clause 52

10GBASE-SR	R fiber over 850nm optics as specified in Clause 52
10GBASE-LRM	R fiber over 1310 nm optics as specified in Clause 68
10GBASE-KR	R PCS/PMA over an electrical backplane PMD as specified in Clause 72
10GBASE-W	W PCS/PMA as specified in Clauses 49 and 50 over undefined PMD
10GBASE-EW	W fiber over 1550nm optics as specified in Clause 52
10GBASE-LW	W fiber over 1310nm optics as specified in Clause 52
10GBASE-SW	W fiber over 850nm optics as specified in Clause 52
10GBASE-T	Four-pair twisted-pair balanced copper cabling PHY as specified in Clause 55
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
<u>10/1GBASE-PRX-D4</u>	<u>One single-mode fiber 10.3125 GBd continuous downstream / 1.25 GBd burst mode upstream OLT PHY as specified in Clause 75</u>
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
<u>10/1GBASE-PRX-U4</u>	<u>One single-mode fiber 10.3125 GBd continuous downstream / 1.25 GBd burst mode upstream ONU PHY as specified in Clause 75</u>
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
<u>10GBASE-PR-D4</u>	<u>One single-mode fiber 10.3125 GBd continuous downstream / burst mode upstream OLT PHY as specified in Clause 75</u>
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
<u>10GBASE-PR-U4</u>	<u>One single-mode fiber 10.3125 GBd continuous downstream / burst mode upstream ONU PHY as specified in Clause 75</u>
40GBASE-R	Multi-lane PCS as specified in Clause 82 over undefined PMA/PMD
40GBASE-KR4	40GBASE-R PCS/PMA over an electrical backplane PMD as specified in Clause 84
40GBASE-CR4	40GBASE-R PCS/PMA over 4 lane shielded copper balanced cable PMD as specified in Clause 85
40GBASE-SR4	40GBASE-R PCS/PMA over 4 lane multimode fiber PMD as specified in Clause 86
40GBASE-LR4	40GBASE-R PCS/PMA over 4 WDM lane single mode fiber PMD, with long reach, as specified in Clause 87
40GBASE-FR	40GBASE-R PCS/PMA over single mode fiber PMD as specified in Clause 89
100GBASE-R	Multi-lane PCS as specified in Clause 82 over undefined PMA/PMD
100GBASE-CR10	100GBASE-R PCS/PMA over 10 lane shielded copper balanced cable PMD as specified in Clause 85

100GBASE-SR10	100GBASE-R PCS/PMA over 10 lane multimode fiber PMD as specified in Clause 86
100GBASE-LR4	100GBASE-R PCS/PMA over 4 WDM lane single mode fiber PMD, with long reach, as specified in Clause 88
100GBASE-ER4	100GBASE-R PCS/PMA over 4 WDM lane single mode fiber PMD, with extended reach, as specified in Clause 88
802.9a	Integrated services MAU as specified in IEEE Std 802.9a-1995 (withdrawn)

BEHAVIOUR DEFINED AS:

Returns a value that identifies the internal MAU type. If an AUI is to be identified to access an external MAU, the type “AUI” is returned. A SET operation to one of the possible enumerations indicated by aMAUTypeList will force the MAU into the new operating mode. If a Clause 22 MII or Clause 35 GMII is present, then this will map to the mode force bits specified in 22.2.4.1. If a Clause 45 MDIO Interface is present, then this will map to the PCS type selection bit(s) in the 10G WIS Control 2 register specified in 45.2.2.6.6, the PCS Control 2 register specified in 45.2.3.6.1, the PMA/PMD type selection bits in the PMA/PMD Control 2 register specified in 45.2.1.6.1, the PMA/PMD control 1 register specified in 45.2.1.1, and the PCS control 1 register 45.2.3.1. If Clause 28, Clause 37, or Clause 73 Auto-Negotiation is operational, then this will change the advertised ability to the single enumeration specified in the SET operation, and cause an immediate link renegotiation. A change in the MAU type will also be reflected in aPHYType.

The enumerations 1000BASE-X, 1000BASE-XHD, 1000BASE-XFD, 10GBASE-X, 10GBASE-R, 10GBASE-W, 40GBASE-R, and 100GBASE-R shall only be returned if the underlying PMD type is unknown.;

Change the text of 30.5.1.1.17 and 30.5.1.1.18 as follows:

30.5.1.1.17 aFECCorrectedBlocks

ATTRIBUTE

APPROPRIATE SYNTAX:

A SEQUENCE of generalized nonresettable counters. Each counter has a maximum increment rate of 1 200 000 counts per second for 1000 Mb/s implementations, 5 000 000 counts per second for 10 Gb/s and 40 Gb/s implementations, and 2 500 000 counts per second for 100 Gb/s implementations.

BEHAVIOUR DEFINED AS:

For 1000BASE-PX, 10/40/100GBASE-R, 10GBASE-PR, or 10/1GBASE-PRX PHYs, an array of corrected FEC block counters. The counters ~~will~~do not increment for other PHY types. The indices of this array (0 to N – 1) denote the PCS lane number where N is the number of PCS lanes in use. The number of PCS lanes in use is set to one for PHYs that do not use PCS lanes. Each element of this array contains a count of corrected FEC blocks for that PCS lane.

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

If a Clause 45 MDIO Interface to the PCS is present, then this attribute

maps to the FEC corrected blocks counter(s) (see 45.2.87.5; and 45.2.1.91 for 10GBASE-R, 45.2.3.39 for 10GBASE-PR and 10/1GBASE-PRX, and 45.2.1.93 for BASE-R).;

30.5.1.1.18 aFECUncorrectableBlocks

ATTRIBUTE

APPROPRIATE SYNTAX:

A SEQUENCE of generalized nonresettable counters. Each counter has a maximum increment rate of 1 200 000 counts per second for 1000 Mb/s implementations, and 5 000 000 counts per second for 10 Gb/s and 40 Gb/s implementations, and 2 500 000 counts per second for 100 Gb/s implementations.

BEHAVIOUR DEFINED AS:

For 1000BASE-PX-~~PHYs or~~ 10/40/100GBASE-R, 10GBASE-PR, or 10/1GBASE-PRX PHYs, an array of uncorrectable FEC block counters. The counters ~~will~~do not increment for other PHY types. The indices of this array (0 to N – 1) denote the PCS lane number where N is the number of PCS lanes in use. The number of PCS lanes in use is set to one for PHYs that do not use PCS lanes. Each element of this array contains a count of uncorrectable FEC blocks for that PCS lane.

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

If a Clause 45 MDIO Interface to the PCS is present, then this attribute will map to the FEC uncorrectable blocks counter(s) (see 45.2.87.65; and 45.2.1.92 for 10GBASE-R, 45.2.3.40 for 10GBASE-PR and 10/1GBASE-PRX, and 45.2.1.94 for BASE-R).;

45. Management Data Input/Output (MDIO) Interface

45.2.1.6 PMA/PMD control 2 register (Register 1.7)

Change the content of Table 45–7, adding entries for 10GBASE-PR-D4, 10/1GBASE-PRX-D4, 10GBASE-PR-U4, and 10/1GBASE-PRX-U4, replacing the reserved entry 1 1 1 x x, as follows:

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

Bit(s)	Name	Description	R/W ^a
1.7.15:6	Reserved	Value always 0, writes ignored	R/W
1.7.5:0	PMA/PMD type selection	5 4 3 2 1 0 1 1 x x x x = reserved for future use 1 0 1 1 x x = reserved for future use 1 0 1 0 1 1 = 100GBASE-ER4 PMA/PMD 1 0 1 0 1 0 = 100GBASE-LR4 PMA/PMD 1 0 1 0 0 1 = 100GBASE-SR10 PMA/PMD 1 0 1 0 0 0 = 100GBASE-CR10 PMA/PMD 1 0 0 1 1 x = reserved for future use 1 0 0 1 0 1 = reserved for future use 1 0 0 1 0 0 = 40GBASE-FR PMA/PMD 1 0 0 0 1 1 = 40GBASE-LR4 PMA/PMD 1 0 0 0 1 0 = 40GBASE-SR4 PMA/PMD 1 0 0 0 0 1 = 40GBASE-CR4 PMA/PMD 1 0 0 0 0 0 = 40GBASE-KR4 PMA/PMD <u>0 1 1 1 1 1 = 10/1GBASE-PRX-U4</u> <u>0 1 1 1 1 0 = 10GBASE-PR-U4</u> <u>0 1 1 1 0 1 = 10/1GBASE-PRX-D4</u> <u>0 1 1 1 0 0 = 10GBASE-PR-D4</u> ~~0 1 1 1 x x = reserved~~ 0 1 1 0 1 1 = reserved 0 1 1 0 1 0 = 10GBASE-PR-U3 0 1 1 0 0 1 = 10GBASE-PR-U1 0 1 1 0 0 0 = 10/1GBASE-PRX-U3 0 1 0 1 1 1 = 10/1GBASE-PRX-U2 0 1 0 1 1 0 = 10/1GBASE-PRX-U1 0 1 0 1 0 1 = 10GBASE-PR-D3 0 1 0 1 0 0 = 10GBASE-PR-D2 0 1 0 0 1 1 = 10GBASE-PR-D1 0 1 0 0 1 0 = 10/1GBASE-PRX-D3 0 1 0 0 0 1 = 10/1GBASE-PRX-D2 0 1 0 0 0 0 = 10/1GBASE-PRX-D1 0 0 1 1 1 1 = 10BASE-T PMA/PMD 0 0 1 1 1 0 = 100BASE-TX PMA/PMD 0 0 1 1 0 1 = 1000BASE-KX PMA/PMD 0 0 1 1 0 0 = 1000BASE-T PMA/PMD 0 0 1 0 1 1 = 10GBASE-KR PMA/PMD 0 0 1 0 1 0 = 10GBASE-KX4 PMA/PMD 0 0 1 0 0 1 = 10GBASE-T PMA 0 0 1 0 0 0 = 10GBASE-LRM PMA/PMD 0 0 0 1 1 1 = 10GBASE-SR PMA/PMD 0 0 0 1 1 0 = 10GBASE-LR PMA/PMD 0 0 0 1 0 1 = 10GBASE-ER PMA/PMD 0 0 0 1 0 0 = 10GBASE-LX4 PMA/PMD 0 0 0 0 1 1 = 10GBASE-SW PMA/PMD 0 0 0 0 1 0 = 10GBASE-LW PMA/PMD 0 0 0 0 0 1 = 10GBASE-EW PMA/PMD 0 0 0 0 0 0 = 10GBASE-CX4 PMA/PMD	R/W

^aR/W = Read/Write