

IEEE Standard for Ethernet

Amendment 3: Physical Layer Specifications and Management Parameters for 40 Gb/s and 100 Gb/s Operation over Fiber Optic Cables

IEEE Computer Society

Sponsored by the
LAN/MAN Standards Committee

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(Amendment to
IEEE Std 802.3™-2012
as amended by IEEE Std 802.3bk™-2013
and IEEE Std 802.3bj™-2014)

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IEEE Computer Society

Approved 16 February 2015
IEEE-SA Standards Board

Abstract: Physical Layer specifications and management parameters for 40 Gb/s operation over single-mode fiber (40GBASE-ER4) and for 100 Gb/s operation over multimode fiber (100GBASE-SR4) are added by this amendment. This amendment also specifies a four-lane variant of the 100 Gigabit Attachment Unit Interface (CAUI-4) and optional Energy Efficient Ethernet (EEE) for 40 Gb/s and 100 Gb/s operation over fiber optic cables.

Keywords: 100 Gb/s Ethernet, 100GBASE-ER4, 100GBASE-LR4, 100GBASE-SR10, 100GBASE-SR4, 40 Gb/s Ethernet, 40GBASE-ER4, 40GBASE-FR, 40GBASE-LR4, 40GBASE-SR4, amendment, CAUI-4, Energy Efficient Ethernet (EEE), Ethernet, forward error correction (FEC), IEEE 802.3™, IEEE 802.3bm™, MMF, Physical Medium Dependent (PMD) sublayer, SMF

*Dedicated to the memory of our friend
and colleague Brian J. Misek*

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Introduction

This introduction is not part of IEEE Std 802.3bm-2015, IEEE Standard for Ethernet—Amendment 3: Physical Layer Specifications and Management Parameters for 40 Gb/s and 100 Gb/s Operation over Fiber Optic Cables.

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 802.3bm-2015).

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 802.3bm-2015 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 802.3bj™-2014

Amendment 2—This amendment includes changes to IEEE Std 802.3-2012 and adds Clause 91 through Clause 94 as well as associated annexes. This amendment adds 100 Gb/s Physical Layer (PHY) specifications and management parameters for operation on electrical backplanes and twinaxial copper cables. This amendment also specifies optional Energy Efficient Ethernet (EEE) for 40 Gb/s and 100 Gb/s operation over electrical backplanes and copper cables.

IEEE Std 802.3bm™-2015

Amendment 3—This amendment includes changes to IEEE Std 802.3-2012 and adds Clause 95 as well as associated annexes. This amendment adds Physical Layer (PHY) specifications and management parameters for 40 Gb/s operation over single-mode fiber (40GBASE-ER4) and for 100 Gb/s operation over multimode fiber (100GBASE-SR4). This amendment also specifies a four-lane variant of the 100 Gigabit Attachment Unit Interface (CAUI-4) and optional Energy Efficient Ethernet (EEE) for 40 Gb/s and 100 Gb/s operation over fiber optic cables.

A companion document IEEE Std 802.3.1™ describes Ethernet management information base (MIB) modules for use with the Simple Network Management Protocol (SNMP). IEEE Std 802.3.1 is updated to add management capability for enhancements to IEEE Std 802.3 after approval of the enhancements.

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.

Contents

1. Introduction.....	2
1.1 Overview.....	2
1.1.3 Architectural perspectives.....	2
1.1.3.2 Compatibility interfaces.....	2
1.3 Normative references.....	2
1.4 Definitions.....	2
1.5 Abbreviations.....	3
22. Reconciliation Sublayer (RS) and Media Independent Interface (MII).....	4
22.2 Functional specifications.....	4
22.2.4 Management functions.....	4
22.2.4.3 Extended capability registers.....	4
22.2.4.3.1 PHY Identifier (Registers 2 and 3).....	4
30. Management.....	5
30.5 Layer management for medium attachment units (MAUs).....	5
30.5.1 MAU managed object class.....	5
30.5.1.1 MAU attributes.....	5
30.5.1.1.2 aMAUType.....	5
45. Management Data Input/Output (MDIO) Interface.....	6
45.2 MDIO Interface Registers.....	6
45.2.1 PMA/PMD registers.....	6
45.2.1.3 PMA/PMD device identifier (Registers 1.2 and 1.3).....	6
45.2.1.6 PMA/PMD control 2 register (Register 1.7).....	6
45.2.1.7 PMA/PMD status 2 register (Register 1.8).....	8
45.2.1.7.4 Transmit fault (1.8.11).....	8
45.2.1.7.5 Receive fault (1.8.10).....	8
45.2.1.8 PMD transmit disable register (Register 1.9).....	9
45.2.1.12 40G/100G PMA/PMD extended ability register (Register 1.13).....	10
45.2.1.12.5a 100GBASE-SR4 ability (1.13.7).....	11
45.2.1.12.5b 40GBASE-ER4 ability (1.13.5).....	11
45.2.1.92aa CAUI-4 chip-to-module recommended CTLE register (Register 1.179).....	11
45.2.1.92aa.1 Recommended CTLE peaking (1.179.4:1).....	11
45.2.1.92ab CAUI-4 chip-to-chip transmitter equalization, receive direction, lane 0 register (Register 1.180).....	12
45.2.1.92ab.1 Request flag (1.180.15).....	13
45.2.1.92ab.2 Post-cursor request (1.180.14:12).....	13
45.2.1.92ab.3 Pre-cursor request (1.180.11:10).....	13
45.2.1.92ab.4 Post-cursor remote setting (1.180.9:7).....	13
45.2.1.92ab.5 Pre-cursor remote setting (1.180.6:5).....	13
45.2.1.92ab.6 Post-cursor local setting (1.180.4:2).....	13
45.2.1.92ab.7 Pre-cursor local setting (1.180.1:0).....	13
45.2.1.92ac CAUI-4 chip-to-chip transmitter equalization, receive direction, lane 1 through lane 3 registers (Registers 1.181, 1.182, 1.183).....	14
45.2.1.92ad CAUI-4 chip-to-chip transmitter equalization, transmit direction, lane 0 register (Register 1.184).....	14

45.2.1.92ad.1 Request flag (1.184.15)	15
45.2.1.92ad.2 Post-cursor request (1.184.14:12).....	15
45.2.1.92ad.3 Pre-cursor request (1.184.11:10)	15
45.2.1.92ad.4 Post-cursor remote setting (1.184.9:7)	15
45.2.1.92ad.5 Pre-cursor remote setting (1.184.6:5).....	16
45.2.1.92ad.6 Post-cursor local setting (1.184.4:2).....	16
45.2.1.92ad.7 Pre-cursor local setting (1.184.1:0)	16
45.2.1.92ae CAUI-4 chip-to-chip transmitter equalization, transmit direction, lane 1 through lane 3 registers (Registers 1.185, 1.186, 1.187)	16
45.2.3 PCS registers.....	16
45.2.3.46 Lane 0 mapping register (Register 3.400)	16
69. Introduction to Ethernet operation over electrical backplanes	17
69.1 Overview.....	17
69.1.2 Relationship of Backplane Ethernet to the ISO OSI reference model.....	17
69.2 Summary of Backplane Ethernet Sublayers	17
69.2.3 Physical Layer signaling systems	17
74. Forward Error Correction (FEC) sublayer for BASE-R PHYs	18
74.4 Inter-sublayer interfaces	18
74.5 FEC service interface.....	18
78. Energy-Efficient Ethernet (EEE).....	19
78.1 Overview.....	19
78.1.1 LPI Signaling	19
78.1.3 Reconciliation sublayer operation	19
78.1.3.3 PHY LPI operation	19
78.1.3.3.1 PHY LPI transmit operation	19
78.1.4 PHY types optionally supporting EEE	20
78.5 Communication link access latency.....	21
78.5.2 40 Gb/s and 100 Gb/s PHY extension using XLAUI or CAUI-n.....	22
80. Introduction to 40 Gb/s and 100 Gb/s networks	23
80.1 Overview.....	23
80.1.3 Relationship of 40 Gigabit and 100 Gigabit Ethernet to the ISO OSI reference model	23
80.1.4 Nomenclature.....	23
80.1.5 Physical Layer signaling systems	23
80.2 Summary of 40 Gigabit and 100 Gigabit Ethernet sublayers	25
80.2.3 Forward Error Correction (FEC) sublayers	25
80.2.5 Physical Medium Dependent (PMD) sublayer	25
80.4 Delay constraints.....	25
80.5 Skew constraints	26
80.7 Protocol implementation conformance statement (PICS) proforma.....	31
81. Reconciliation Sublayer (RS) and Media Independent Interface for 40 Gb/s and 100 Gb/s operation (XLGMII and CGMII).....	32
81.3a LPI Assertion and Detection.....	32
81.3a.2 Transmit LPI state diagram.....	32

81.3a.2.1	Variables and counters	32
81.3a.4	Considerations for receive system behavior	32
82.	Physical Coding Sublayer (PCS) for 64B/66B, type 40GBASE-R and 100GBASE-R	33
82.1	Overview	33
82.1.4	Inter-sublayer interfaces	33
82.2	Physical Coding Sublayer (PCS)	33
82.2.6	Block distribution	33
83.	Physical Medium Attachment (PMA) sublayer, type 40GBASE-R and 100GBASE-R	34
83.1	Overview	34
83.1.1	Scope	34
83.1.4	PMA sublayer positioning	34
83.2	PMA Interfaces	36
83.3	PMA service interface	37
83.4	Service interface below PMA	37
83.5	Functions within the PMA	37
83.5.1	Per input-lane clock and data recovery	37
83.5.3	Skew and Skew Variation	37
83.5.3.a	Skew generation toward SP0	37
83.5.3.1	Skew generation toward SP1	38
83.5.3.2	Skew tolerance at SP1	38
83.5.3.3	Skew generation toward SP2	38
83.5.3.5	Skew generation at SP6	38
83.5.3.6	Skew tolerance at SP6	38
83.5.3.7	Skew generation towards SP7	38
83.5.6	Signal drivers	39
83.5.10	PMA test patterns (optional)	39
83.5.11	Energy Efficient Ethernet	39
83.5.11.3	Additional transmit functions in the Tx direction	39
83.5.11.4	Additional receive functions in the Tx direction	40
83.5.11.5	Additional transmit functions in the Rx direction	40
83.5.11.6	Additional receive functions in the Rx direction	40
83.7	Protocol implementation conformance statement (PICS) proforma for Clause 83, Physical Medium Attachment (PMA) sublayer, type 40GBASE-R and 100GBASE-R	41
83.7.3	Major capabilities/options	41
83.7.5	Test patterns	42
83.7.7	EEE deep sleep with XLAUI/CAUI-n	42
85.	Physical Medium Dependent sublayer and baseband medium, type 40GBASE-CR4 and 100GBASE-CR10	43
85.1	Overview	43
85.3	PCS requirements for Auto-Negotiation (AN) service interface	43
85.13	Protocol implementation conformance statement (PICS) proforma for Clause 85, Physical Medium Dependent (PMD) sublayer and baseband medium, type 40GBASE-CR4 and 100GBASE-CR10	43
85.13.3	Major capabilities/options	43
86.	Physical Medium Dependent (PMD) sublayer and medium, type 40GBASE-SR4 and 100GBASE-SR10	44

86.1	Overview	44
86.8	Definitions of optical and dual-use parameters and measurement methods.....	45
86.8.4	Optical parameter definitions.....	45
86.8.4.7	Stressed receiver sensitivity.....	45
86.10	Optical channel	45
86.10.1	Fiber optic cabling model	45
87.	Physical Medium Dependent (PMD) sublayer and medium, type 40GBASE–LR4 and 40GBASE–ER4	46
87.1	Overview.....	46
87.2	Physical Medium Dependent (PMD) service interface	47
87.3	Delay and Skew	48
87.3.1	Delay constraints.....	48
87.5	PMD functional specifications.....	48
87.5.1	PMD block diagram.....	48
87.6	Wavelength-division-multiplexed lane assignments	49
87.7	PMD to MDI optical specifications for 40GBASE–LR4 and 40GBASE–ER4	49
87.7.1	40GBASE–LR4 and 40GBASE–ER4 transmitter optical specifications	50
87.7.2	40GBASE–LR4 and 40GBASE–ER4 receive optical specifications.....	51
87.7.3	40GBASE–LR4 and 40GBASE–ER4 illustrative link power budgets	52
87.8	Definition of optical parameters and measurement methods.....	52
87.8.1	Test patterns for optical parameters.....	52
87.8.4	Average optical power	53
87.8.6	Transmitter and dispersion penalty.....	53
87.8.6.2	Channel requirements	53
87.8.7	Extinction ratio	54
87.8.11	Stressed receiver sensitivity.....	54
87.8.11.5	Stressed receiver conformance test procedure for WDM conformance testing	54
87.9	Safety, installation, environment, and labeling.....	54
87.9.2	Laser safety	54
87.9.4	Environment.....	55
87.9.4.1	Electromagnetic emission	55
87.10	Fiber optic cabling model	55
87.11	Characteristics of the fiber optic cabling (channel).....	55
87.11.1	Optical fiber cable.....	56
87.11.3	Medium Dependent Interface (MDI) requirements	56
87.12	Requirements for interoperation between 40GBASE-LR4 and 40GBASE-ER4	56
87.13	Protocol implementation conformance statement (PICS) proforma for Clause 87, Physical Medium Dependent (PMD) sublayer and medium, type 40GBASE-LR4 and 40GBASE-ER4	57
87.13.1	Introduction.....	57
87.13.2	Identification	57
87.13.2.2	Protocol summary	57
87.13.3	Major capabilities/options.....	57
87.13.4	PICS proforma tables for Physical Medium Dependent (PMD) sublayer and medium, type 40GBASE-LR4 and 40GBASE-ER4.....	57
87.13.4.3	PMD to MDI optical specifications for 40GBASE-LR4.....	58
87.13.4.3a	PMD to MDI optical specifications for 40GBASE-ER4.....	58
88.	Physical Medium Dependent (PMD) sublayer and medium, type 100GBASE–LR4 and 100GBASE–ER4	59
88.1	Overview.....	59

89. Physical Medium Dependent (PMD) sublayer and medium, type 40GBASE-FR	60
89.1 Overview	60
91. Reed-Solomon Forward Error Correction (RS-FEC) sublayer for 100GBASE-R PHYs	61
91.2 FEC service interface	61
91.3 PMA compatibility	61
91.5 Functions within the RS-FEC sublayer	61
91.5.2 Transmit function	61
91.5.2.7 Reed-Solomon encoder	61
91.5.3 Receive function	61
91.5.3.3 Reed-Solomon decoder	61
91.7 Protocol implementation conformance statement (PICS) proforma for Clause 91, Reed-Solomon Forward Error Correction (RS-FEC) sublayer for 100GBASE-R PHYs	62
91.7.3 Major capabilities/options	62
91.7.4 PICS proforma tables for Reed-Solomon Forward Error Correction (RS-FEC) sublayer for 100GBASE-R PHYs	62
91.7.4.1 Transmit function	62
91.7.4.2 Receive function	63
92. Physical Medium Dependent (PMD) sublayer and baseband medium, type 100GBASE-CR4	64
92.1 Overview	64
92.3 PCS requirements for Auto-Negotiation (AN) service interface	64
92.14 Protocol implementation conformance statement (PICS) proforma for Clause 92, Physical Medium Dependent (PMD) sublayer and baseband medium, type 100GBASE-CR4	64
92.14.3 Major capabilities/options	64
93. Physical Medium Dependent (PMD) sublayer and baseband medium, type 100GBASE-KR4	65
93.1 Overview	65
93.3 PCS requirements for Auto-Negotiation (AN) service interface	65
93.11 Protocol implementation conformance statement (PICS) proforma for Clause 93, Physical Medium Dependent (PMD) sublayer and baseband medium, type 100GBASE-KR4	65
93.11.3 Major capabilities/options	65
94. Physical Medium Attachment (PMA) sublayer, Physical Medium Dependent (PMD) sublayer, and baseband medium, type 100GBASE-KP4	66
94.1 Overview	66
94.3 Physical Medium Dependent (PMD) Sublayer	66
94.3.2 PCS requirements for Auto-Negotiation (AN) service interface	66
94.6 Protocol implementation conformance statement (PICS) proforma for Clause 94, Physical Medium Attachment (PMA) and Physical Medium Dependent (PMD) sublayer and baseband medium, type 100GBASE-KP4	66
94.6.3 Major capabilities/options	66
95. Physical Medium Dependent (PMD) sublayer and medium, type 100GBASE-SR4	67
95.1 Overview	67
95.1.1 Bit error ratio	68
95.2 Physical Medium Dependent (PMD) service interface	68
95.3 Delay and Skew	69

95.3.1	Delay constraints.....	69
95.3.2	Skew constraints	69
95.4	PMD MDIO function mapping.....	70
95.5	PMD functional specifications.....	70
95.5.1	PMD block diagram.....	71
95.5.2	PMD transmit function	71
95.5.3	PMD receive function	71
95.5.4	PMD global signal detect function	72
95.5.5	PMD lane-by-lane signal detect function	72
95.5.6	PMD reset function.....	72
95.5.7	PMD global transmit disable function (optional)	73
95.5.8	PMD lane-by-lane transmit disable function (optional)	73
95.5.9	PMD fault function (optional)	73
95.5.10	PMD transmit fault function (optional)	73
95.5.11	PMD receive fault function (optional).....	73
95.6	Lane assignments.....	73
95.7	PMD to MDI optical specifications for 100GBASE-SR4.....	74
95.7.1	100GBASE-SR4 transmitter optical specifications.....	74
95.7.2	100GBASE-SR4 receive optical specifications.....	75
95.7.3	100GBASE-SR4 illustrative link power budget.....	75
95.8	Definition of optical parameters and measurement methods.....	75
95.8.1	Test patterns for optical parameters.....	76
95.8.1.1	Multi-lane testing considerations.....	77
95.8.2	Center wavelength and spectral width	77
95.8.3	Average optical power	77
95.8.4	Optical Modulation Amplitude (OMA).....	77
95.8.5	Transmitter and dispersion eye closure (TDEC)	78
95.8.5.1	TDEC conformance test setup	78
95.8.5.2	TDEC measurement method.....	78
95.8.6	Extinction ratio	80
95.8.7	Transmitter optical waveform (transmit eye)	81
95.8.8	Stressed receiver sensitivity.....	81
95.8.8.1	Stressed receiver conformance test block diagram.....	81
95.8.8.2	Stressed receiver conformance test signal characteristics and calibration	83
95.8.8.3	J2 and J4 Jitter.....	83
95.8.8.4	Stressed receiver conformance test signal verification.....	84
95.8.8.5	Sinusoidal jitter for receiver conformance test	84
95.9	Safety, installation, environment, and labeling.....	84
95.9.1	General safety	84
95.9.2	Laser safety	85
95.9.3	Installation	85
95.9.4	Environment.....	85
95.9.5	Electromagnetic emission	85
95.9.6	Temperature, humidity, and handling	85
95.9.7	PMD labeling requirements	85
95.10	Fiber optic cabling model	86
95.11	Characteristics of the fiber optic cabling (channel).....	86
95.11.1	Optical fiber cable.....	86
95.11.2	Optical fiber connection.....	87
95.11.2.1	Connection insertion loss.....	87
95.11.2.2	Maximum discrete reflectance	87
95.11.3	Medium Dependent Interface (MDI).....	87
95.11.3.1	Optical lane assignments	87
95.11.3.2	Medium Dependent Interface (MDI) requirements	88

95.12 Protocol implementation conformance statement (PICS) proforma for Clause 95, Physical Medium Dependent (PMD) sublayer and medium, type 100GBASE-SR4.....	89
95.12.1 Introduction.....	89
95.12.2 Identification.....	89
95.12.2.1 Implementation identification.....	89
95.12.2.2 Protocol summary.....	89
95.12.4 PICS proforma tables for Physical Medium Dependent (PMD) sublayer and medium, type 100GBASE-SR4.....	90
95.12.4.1 PMD functional specifications.....	90
95.12.3 Major capabilities/options.....	90
95.12.4.2 Management functions.....	91
95.12.4.3 PMD to MDI optical specifications for 100GBASE-SR4.....	92
95.12.4.4 Optical measurement methods.....	92
95.12.4.5 Environmental specifications.....	92
95.12.4.6 Characteristics of the fiber optic cabling and MDI.....	93
 Annex A (informative) Bibliography.....	 94
 Annex 83A (normative) 40 Gb/s Attachment Unit Interface (XLAUI) and 100 Gb/s ten-lane Attachment Unit Interface (CAUI-10).....	 95
83A.1 Overview.....	95
83A.1.1 Summary of major concepts.....	96
83A.1.2 Rate of operation.....	96
83A.2 XLAUI/CAUI-10 link block diagram.....	96
83A.3 XLAUI/CAUI-10 electrical characteristics.....	97
83A.3.1 Signal levels.....	97
83A.3.2 Signal paths.....	97
83A.3.2a EEE operation.....	97
83A.3.3 Transmitter characteristics.....	98
83A.3.3.1 Output amplitude.....	98
83A.3.3.1.1 Amplitude and swing.....	98
83A.3.3.6 Global transmit disable function.....	98
83A.3.4 Receiver characteristics.....	99
83A.3.4.2 Input signal definition.....	99
83A.3.4.5 AC coupling.....	99
83A.3.4.6 Jitter tolerance.....	99
83A.3.4.7 Global energy detect function.....	99
83A.4 Interconnect characteristics.....	100
83A.5 Electrical parameter measurement methods.....	100
83A.5.1 Transmit jitter.....	100
83A.5.2 Receiver tolerance.....	100
83A.6 Environmental specifications.....	101
83A.6.4 Electromagnetic compatibility.....	101
83A.6.5 Temperature and humidity.....	101
83A.7 Protocol implementation conformance statement (PICS) proforma for Annex 83A, 40 Gb/s Attachment Unit Interface (XLAUI) and 100 Gb/s ten-lane Attachment Unit Interface (CAUI-10).....	102
83A.7.1 Introduction.....	102
83A.7.2 Identification.....	102
83A.7.2.2 Protocol summary.....	102
83A.7.3 Major capabilities/options.....	102
83A.7.4 XLAUI/CAUI-10 transmitter requirements.....	103
83A.7.5 XLAUI/CAUI-10 receiver requirements.....	103

83A.7.6	Electrical measurement methods	103
Annex 83B (normative) Chip-to-module 40 Gb/s Attachment Unit Interface (XLAUI) and 100 Gb/s ten-lane Attachment Unit Interface (CAUI-10).....		
		104
83B.1	Overview	104
83B.2	Compliance point specifications for chip-to-module XLAUI/CAUI-10	105
83B.2.1	Module specifications	105
83B.2.2	Host specifications	106
83B.2.3	Host input signal tolerance	106
83B.3	Environmental specifications	107
83B.3.4	Electromagnetic compatibility	107
83B.3.5	Temperature and humidity	107
83B.4	Protocol implementation conformance statement (PICS) proforma for Annex 83B, Chip-to-module 40 Gb/s Attachment Unit Interface (XLAUI) and 100 Gb/s ten-lane Attachment Unit Interface (CAUI-10)	107
83B.4.1	Introduction	107
83B.4.2	Identification	107
83B.4.2.2	Protocol summary	107
83B.4.3	Major capabilities/options	108
83B.4.4	Module requirements	108
83B.4.5	Host requirements	108
Annex 83C (normative) PMA sublayer partitioning examples		
		109
83C.1	Partitioning examples with FEC	109
83C.1.2	FEC implemented with PMD	109
83C.1a	Partitioning examples with RS-FEC	110
83C.1a.2	Single CAUI-10 with RS-FEC	110
83C.2	Partitioning examples without FEC	111
83C.2.2	Single XLAUI/CAUI-4 without FEC	111
83C.2.3	Separate SERDES for optical module interface	112
Annex 83D (normative) Chip-to-chip 100 Gb/s four-lane Attachment Unit Interface (CAUI-4).....		
		113
83D.1	Overview	113
83D.2	CAUI-4 chip-to-chip compliance point definition	115
83D.3	CAUI-4 chip-to-chip electrical characteristics	115
83D.3.1	CAUI-4 transmitter characteristics	115
83D.3.1.1	Transmitter equalization settings	116
83D.3.2	Optional EEE operation	117
83D.3.3	CAUI-4 receiver characteristics	118
83D.3.3.1	Receiver interference tolerance	118
83D.3.3.2	Transmitter equalization feedback (optional)	119
83D.3.4	Global energy detect function for optional EEE operation	119
83D.4	CAUI-4 chip-to-chip channel characteristics	119
83D.5	Example usage of the optional transmitter equalization feedback	121
83D.5.1	Overview	121
83D.5.2	Tuning equalization settings on lane 0 in the transmit direction	122
83D.5.3	Tuning equalization settings on lane 0 in the receive direction	122
83D.6	Protocol implementation conformance statement (PICS) proforma for Annex 83D, Chip-to-chip 100 Gb/s four-lane Attachment Unit Interface (CAUI-4)	123
83D.6.1	Introduction	123
83D.6.2	Identification	123

83D.6.2.1	Implementation identification	123
83D.6.2.2	Protocol summary	123
83D.6.3	Major capabilities/options	124
83D.6.4	PICS proforma tables for chip-to-chip 100 Gb/s four-lane Attachment Unit Interface (CAUI-4)	124
83D.6.4.1	Transmitter	124
83D.6.4.2	Receiver	125
83D.6.4.3	Channel	125
Annex 83E (normative) Chip-to-module 100 Gb/s four-lane Attachment Unit Interface (CAUI-4)		126
83E.1	Overview	126
83E.1.1	Bit error ratio	127
83E.2	CAUI-4 chip-to-module compliance point definitions	128
83E.3	CAUI-4 chip-to-module electrical characteristics	129
83E.3.1	CAUI-4 host output characteristics	129
83E.3.1.1	Signaling rate and range	129
83E.3.1.2	Signal levels	129
83E.3.1.3	Output return loss	130
83E.3.1.4	Differential termination mismatch	131
83E.3.1.5	Transition time	131
83E.3.1.6	Host output eye width and eye height	131
83E.3.1.6.1	Reference receiver for host output eye width and eye height evaluation	132
83E.3.2	CAUI-4 module output characteristics	134
83E.3.2.1	Module output eye width and eye height	134
83E.3.2.1.1	Reference receiver for module output eye width and eye height evaluation	134
83E.3.3	CAUI-4 host input characteristics	135
83E.3.3.1	Input return loss	136
83E.3.3.2	Host stressed input test	137
83E.3.3.2.1	Host stressed input test procedure	137
83E.3.4	CAUI-4 module input characteristics	139
83E.3.4.1	Module stressed input test	140
83E.3.4.1.1	Module stressed input test procedure	140
83E.4	CAUI-4 measurement methodology	142
83E.4.1	HCB/MCB characteristics	142
83E.4.2	Eye width and eye height measurement method	142
83E.4.2.1	Vertical eye closure	143
83E.5	Protocol implementation conformance statement (PICS) proforma for Annex 83E, Chip-to-module 100 Gb/s four-lane Attachment Unit Interface (CAUI-4)	144
83E.5.1	Introduction	144
83E.5.2	Identification	144
83E.5.2.1	Implementation identification	144
83E.5.2.2	Protocol summary	144
83E.5.3	Major capabilities/options	145
83E.5.4	PICS proforma tables for chip-to-module 100 Gb/s four-lane Attachment Unit Interface (CAUI-4)	145
83E.5.4.1	Host output	145
83E.5.4.2	Module output	146
83E.5.4.3	Host input	146
83E.5.4.4	Module input	146
Annex 93A (normative) Specification methods for electrical channels		147

93A.1 Channel Operating Margin..... 147