
**Telecommunications and exchange
between information technology
systems — Requirements for local and
metropolitan area networks —**

**Part 3:
Standard for Ethernet**

**AMENDMENT 5: Physical layers
specifications and management
parameters for 10 Mb/s operation and
associated power delivery over a single
balanced pair of conductors**

*Télécommunications et échange entre systèmes informatiques —
Exigences pour les réseaux locaux et métropolitains —*

Partie 3: Norme pour Ethernet

*AMENDEMENT 5: Spécifications des couches physiques et paramètres
de gestion pour fonctionnement à 10 Mb/s et fourniture de puissance
associée sur une paire symétrique unique de conducteurs*



Reference number
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IEEE Standard for Ethernet

Amendment 5: Physical Layer Specifications and Management Parameters for 10 Mb/s Operation and Associated Power Delivery over a Single Balanced Pair of Conductors

Developed by the
LAN/MAN Standards Committee
of the
IEEE Computer Society

Approved 7 November 2019
IEEE SA Standards Board

Abstract: This amendment to IEEE Std 802.3-2018 specifies additions and appropriate modifications to add 10 Mb/s Physical Layer (PHY) specifications and management parameters for operation, and associated optional provision of power, over a single balanced pair of conductors.

Keywords: 10BASE-T1L, 10BASE-T1S, amendment, copper, Ethernet, IEEE 802.3™, IEEE 802.3cg™, MASTER-SLAVE, medium dependent interface, physical coding sublayer, Physical Layer, Physical Layer Collision Avoidance, PLCA, physical medium attachment

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Introduction

This introduction is not part of IEEE Std 802.3cg-2019, IEEE Standard for Ethernet—Amendment 5: Physical Layer Specifications and Management Parameters for 10 Mb/s Operation and Associated Power Delivery over a Single Balanced Pair of Conductors.

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 half duplex Media Access Control (MAC) protocol specified in IEEE Std 802.3-1985 is Carrier Sense Multiple Access with Collision Detection (CSMA/CD). This MAC protocol was key to the experimental Ethernet developed at Xerox Palo Alto Research Center, which had a 2.94 Mb/s data rate. Ethernet at 10 Mb/s was jointly released as a public specification by Digital Equipment Corporation (DEC), Intel and Xerox in 1980. Ethernet at 10 Mb/s was approved as an IEEE standard by the IEEE Standards Board in 1983 and subsequently published in 1985 as IEEE Std 802.3-1985. Since 1985, new media options, new speeds of operation, and new capabilities have been added to IEEE Std 802.3. A full duplex MAC protocol was added in 1997.

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 802.3z 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 802.3-2018 and are not maintained as separate documents.

At the date of publication for IEEE Std 802.3cg-2019, IEEE Std 802.3 was composed of the following documents:

IEEE Std 802.3-2018

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 95 and Annex 83A through Annex 93C. 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 95 and associated annexes include 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.

Section Seven—Includes Clause 96 through Clause 115 and Annex 97A through Annex 115A. Clause 96 through Clause 98, Clause 104, and associated annexes, specify Physical Layers and optional features for 100 Mb/s and 1000 Mb/s operation over a single twisted pair. Clause 100 through Clause 103, as well as associated annexes, specify Physical Layers for the operation of the EPON protocol over coaxial distribution networks. Clause 105 through Clause 114 and associated annexes include general information on 25 Gb/s operation as well as 25 Gb/s Physical Layer specifications. Clause 99 specifies a MAC merge sublayer for the interspersing of express traffic. Clause 115 and its associated annex specify a Physical Layer for 1000 Mb/s operation over plastic optical fiber.

Section Eight—Includes Clause 116 through Clause 126 and Annex 119A through Annex 120E. Clause 116 through Clause 124 and associated annexes include general information on 200 Gb/s and 400 Gb/s operation as well the 200 Gb/s and 400 Gb/s Physical Layer specifications. Clause 125 and Clause 126 include general information on 2.5 Gb/s and 5 Gb/s operation as well as 2.5 Gb/s and 5 Gb/s Physical Layer specifications.

IEEE Std 802.3cb™-2018

Amendment 1—This amendment includes changes to IEEE Std 802.3-2018 and its amendments and adds Clause 127 through Clause 130, Annex 127A, Annex 128A, Annex 128B, and Annex 130A. This amendment adds new Physical Layers for operation at 2.5 Gb/s and 5 Gb/s over electrical backplanes.

IEEE Std 802.3bt™-2018

Amendment 2—This amendment includes changes to IEEE Std 802.3-2018 and its amendments and adds Clause 145, Annex 145A, Annex 145B, and Annex 145C. This amendment adds power delivery using all four pairs in the structured wiring plant, resulting in greater power being available to end devices. This amendment also allows for lower standby power consumption in end devices and adds a mechanism to better manage the available power budget.

IEEE Std 802.3cd™-2018

Amendment 3—This amendment includes changes to IEEE Std 802.3-2018 and its amendments and adds Clause 131 through Clause 140 and Annex 135A through Annex 136D. This amendment adds MAC parameters, Physical Layers, and management parameters for the transfer of IEEE 802.3 format frames at 50 Gb/s, 100 Gb/s, and 200 Gb/s.

IEEE Std 802.3cn™-2019

Amendment 4—This amendment includes changes to IEEE Std 802.3-2018 and its amendments and adds 50 Gb/s, 200 Gb/s, and 400 Gb/s Physical Layer specifications and management parameters for operation over single-mode fiber with reaches of at least 40 km.

IEEE Std 802.3cg™-2019

Amendment 5—This amendment includes changes to IEEE Std 802.3-2018 and its amendments and adds Clause 146 through Clause 148 and Annex 146A and Annex 146B. This amendment adds 10 Mb/s Physical Layer specifications and management parameters for operation on a single balanced pair of conductors.

Two companion documents exist, IEEE Std 802.3.1 and IEEE Std 802.3.2. IEEE Std 802.3.1 describes Ethernet management information base (MIB) modules for use with the Simple Network Management Protocol (SNMP). IEEE Std 802.3.2 describes YANG data models for Ethernet. IEEE Std 802.3.1 and IEEE Std 802.3.2 are updated to add management capability for enhancements to IEEE Std 802.3 after approval of those 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.....	26
1.1	Overview.....	26
1.1.3	Architectural perspectives.....	26
1.3	Normative references.....	26
1.4	Definitions	27
1.5	Abbreviations.....	29
9.	Repeater unit for 10 Mb/s baseband networks.....	30
9.1	Overview.....	30
22.	Reconciliation Sublayer (RS) and Media Independent Interface (MII).....	31
22.1	Overview.....	31
22.2	Functional specifications	31
22.2.2	MII signal functional specifications	31
22.2.2.4	TXD (transmit data).....	31
22.2.2.5	TX_ER (transmit coding error)	32
22.2.2.8	RXD (receive data).....	32
22.8	Protocol implementation conformance statement (PICS) proforma for Clause 22, Reconciliation Sublayer (RS) and Media Independent Interface (MII)	33
22.8.2	Identification	33
22.8.2.3	Major capabilities/options	33
22.8.3	PICS proforma tables for reconciliation sublayer and media independent interface	33
22.8.3.2	MII signal functional specifications	33
30.	Management.....	34
30.2	Managed objects	34
30.2.2	Overview of managed objects.....	34
30.2.2.1	Text description of managed objects	34
30.2.3	Containment.....	35
30.2.5	Capabilities	36
30.3	Layer management for DTEs.....	36
30.3.2	PHY device managed object class	36
30.3.2.1	PHY device attributes.....	36
30.3.2.1.2	aPhyType	36
30.3.2.1.3	aPhyTypeList.....	37
30.5	Layer management for medium attachment units (MAUs)	37
30.5.1	MAU managed object class	37
30.5.1.1	MAU attributes	37
30.5.1.1.2	aMAUType	37
30.5.1.1.4	aMediaAvailable.....	37
30.6	Management for link Auto-Negotiation	37
30.6.1	Auto-Negotiation managed object class	37
30.6.1.1	Auto-Negotiation attributes	37
30.6.1.1.5	aAutoNegLocalTechnologyAbility	37
30.15	Layer management for Power over Data Lines (PoDL) of Single Balanced Twisted-Pair Ethernet	38
30.15.1	PoDL PSE managed object class	38

30.15.1.1	PoDL PSE attributes	38
30.15.1.1.4	aPoDLPSEType	38
30.15.1.1.5	aPoDLPSEDetectedPDType	38
30.15.1.1.6	aPoDLPSEDetectedPDPowerClass	38
30.16	Management for PLCA Reconciliation Sublayer	39
30.16.1	PLCA managed object class	39
30.16.1.1	PLCA attributes	39
30.16.1.1.1	aPLCAAdminState	39
30.16.1.1.2	aPLCAStatus	39
30.16.1.1.3	aPLCANodeCount	39
30.16.1.1.4	aPLCALocalNodeID	40
30.16.1.1.5	aPLCATransmitOpportunityTimer	40
30.16.1.1.6	aPLCAMaxBurstCount	40
30.16.1.1.7	aPLCABurstTimer	40
30.16.1.2	PLCA device actions	40
30.16.1.2.1	acPLCAAdminControl	40
30.16.1.2.2	acPLCAReset	41
45.	Management Data Input/Output (MDIO) Interface	42
45.2	MDIO Interface Registers	42
45.2.1	PMA/PMD registers	42
45.2.1.7	PMA/PMD status 2 register (Register 1.8)	42
45.2.1.7.4	Transmit fault (1.8.11)	42
45.2.1.7.5	Receive fault (1.8.10)	42
45.2.1.16	BASE-T1 PMA/PMD extended ability register (1.18)	43
45.2.1.185	BASE-T1 PMA/PMD control register (Register 1.2100)	43
45.2.1.185.2	Type selection (1.2100.3:0)	43
45.2.1.186a	10BASE-T1L PMA control register (Register 1.2294)	44
45.2.1.186a.1	PMA reset (1.2294.15)	44
45.2.1.186a.2	Transmit disable (1.2294.14)	45
45.2.1.186a.3	Transmit voltage amplitude control (1.2294.12)	45
45.2.1.186a.4	Low-power (1.2294.11)	45
45.2.1.186a.5	EEE enable (1.2294.10)	45
45.2.1.186a.6	Loopback (1.2294.0)	45
45.2.1.186b	10BASE-T1L PMA status register (Register 1.2295)	45
45.2.1.186b.1	Loopback ability (1.2295.13)	46
45.2.1.186b.2	2.4 Vpp operating mode ability (1.2295.12)	46
45.2.1.186b.3	Low-power ability (1.2295.11)	46
45.2.1.186b.4	EEE ability (1.2295.10)	47
45.2.1.186b.5	Receive fault ability (1.2295.9)	47
45.2.1.186b.6	Receive polarity (1.2295.2)	47
45.2.1.186b.7	Receive fault (1.2295.1)	47
45.2.1.186b.8	Receive link status (1.2295.0)	47
45.2.1.186c	10BASE-T1L test mode control register (Register 1.2296)	47
45.2.1.186c.1	Test mode control (1.2296.15:13)	48
45.2.1.186d	10BASE-T1S PMA control register (Register 1.2297)	48
45.2.1.186d.1	PMA reset (1.2297.15)	48
45.2.1.186d.2	Transmit disable (1.2297.14)	49
45.2.1.186d.3	Low-power (1.2297.11)	49
45.2.1.186d.4	Multidrop mode (1.2297.10)	49
45.2.1.186d.5	Loopback (1.2297.0)	49
45.2.1.186e	10BASE-T1S PMA status register (Register 1.2298)	49
45.2.1.186e.1	10BASE-T1S loopback ability (1.2298.13)	50

45.2.1.186e.2	Low-power ability (1.2298.11).....	50
45.2.1.186e.3	Multidrop ability (1.2298.10)	50
45.2.1.186e.4	Receive fault ability (1.2298.9)	50
45.2.1.186e.5	Receive fault (1.2298.1).....	51
45.2.1.186f	10BASE-T1S test mode control register (Register 1.2299)	51
45.2.1.186f.1	Test mode control (1.2299.15:13).....	51
45.2.3	PCS registers.....	51
45.2.3.68a	10BASE-T1L PCS control register (Register 3.2278)	52
45.2.3.68a.1	PCS reset (3.2278.15)	52
45.2.3.68a.2	Loopback (3.2278.14).....	53
45.2.3.68b	10BASE-T1L PCS status register (Register 3.2279).....	53
45.2.3.68b.1	Tx LPI received (3.2279.11).....	54
45.2.3.68b.2	Rx LPI received (3.2279.10).....	54
45.2.3.68b.3	Tx LPI indication (3.2279.9)	54
45.2.3.68b.4	Rx LPI indication (3.2279.8)	54
45.2.3.68b.5	Fault (3.2279.7).....	54
45.2.3.68b.6	PCS receive link status (3.2279.2).....	54
45.2.3.68c	10BASE-T1S PCS control register (Register 3.2291).....	54
45.2.3.68c.1	PCS reset (3.2291.15)	55
45.2.3.68c.2	Loopback (3.2291.14).....	55
45.2.3.68c.3	Duplex mode (3.2291.8)	55
45.2.3.68d	10BASE-T1S PCS status register (Register 3.2292).....	56
45.2.3.68d.1	Fault (3.2292.7).....	56
45.2.3.68e	10BASE-T1S PCS diagnostic 1 (Register 3.2293)	56
45.2.3.68e.1	Remote jabber count (3.2293.15:0)	56
45.2.3.68f	10BASE-T1S PCS diagnostic 2 (Register 3.2294)	57
45.2.3.68f.1	CorruptedTxCnt (3.2294.15:0)	57
45.2.7	Auto-Negotiation registers.....	57
45.2.7.25	10BASE-T1 AN control register (Register 7.526)	57
45.2.7.25.1	10BASE-T1L capability advertisement (7.526.15)	58
45.2.7.25.2	10BASE-T1L EEE ability advertisement (7.526.14)	58
45.2.7.25.3	10BASE-T1L increased transmit/receive level ability advertisement (7.526.13)	58
45.2.7.25.4	10BASE-T1L increased transmit level request (7.526.12)....	59
45.2.7.25.5	10BASE-T1S full duplex ability advertisement (7.526.7)	59
45.2.7.25.6	10BASE-T1S half duplex capability advertisement (7.526.6).....	59
45.2.7.26	10BASE-T1 AN status register (Register 7.527)	59
45.2.9	Power Unit Registers	60
45.2.9.1	PoDL PSE Control register (Register 13.0).....	60
45.2.9.2	PoDL PSE Status 1 register (Register 13.1)	61
45.2.9.2.7	PSE Type (13.1.9:7).....	61
45.2.9.2.8	PD Class (13.1.6:3)	61
45.2.9.3	PoDL PSE Status 2 register (Register 13.2).....	62
45.2.9.3.1a	PD Extended Class (13.2.10:9).....	62
45.2.9.3.2	PD Type (13.2.2:0)	62
45.2.9.4	PoDL PSE Status 3 register (Register 13.3)	63
45.2.9.4.1	PD Assigned Power (13.3.11:0)	63
45.2.9.5	PoDL PSE Status 4 register (Register 13.4)	63
45.2.9.5.1	PD Requested Power (13.4.11:0).....	63
45.5	Protocol implementation conformance statement (PICS) proforma for Clause 45, Management Data Input/Output (MDIO) interface	64
45.5.3	PICS proforma tables for the Management Data Input Output (MDIO) interface	64
45.5.3.3	PMA/PMD management functions	64

45.5.3.7	PCS management functions.....	68
45.5.3.9	Auto-Negotiation management functions.....	70
78.	Energy-Efficient Ethernet (EEE).....	71
78.1	Overview.....	71
78.1.4	PHY types optionally supporting EEE.....	71
78.2	LPI mode timing parameters description.....	71
78.5	Communication link access latency.....	71
98.	Auto-Negotiation for single differential-pair media.....	72
98.2	Functional specifications.....	72
98.2.1	Transmit function requirements.....	72
98.2.1.1	DME transmission.....	72
98.2.1.1.1	DME page encoding.....	72
98.2.1.1.2	DME page timing.....	72
98.2.1.1.3	DME page Delimiters.....	73
98.5	Detailed functions and state diagrams.....	74
98.5.1	State diagram variables.....	74
98.5.2	State diagram timers.....	74
98.5.5	State diagrams.....	77
98.5.6	High-speed and low-speed Auto-Negotiation modes.....	81
98.5.6.1	Variables.....	81
98.5.6.2	Functions.....	82
98.5.6.3	Timers.....	82
98.6	Protocol implementation conformance statement (PICS) proforma for Clause 98, Auto-Negotiation for Single Differential-Pair Media.....	83
98.6.2a	Major capabilities/options.....	83
98.6.3	General.....	83
98.6.4	DME transmission.....	83
98.6.8	State diagram and variable definitions.....	84
98.6.9	High-speed and low-speed Auto-Negotiation modes.....	85
104.	Power over Data Lines (PoDL) of Single Balanced Twisted-Pair Ethernet.....	86
104.1	Overview.....	86
104.1.3	PoDL system types.....	86
104.2	Link segment.....	86
104.3	Class power requirements.....	87
104.4	Power Sourcing Equipment (PSE).....	87
104.4.1	PSE types.....	87
104.4.1a	PI pin assignments.....	87
104.4.3	PSE state diagram.....	88
104.4.3.3	Variables.....	88
104.4.3.5	Functions.....	89
104.4.4	PSE detection of a PD.....	89
104.4.4.1	Detection probe requirements.....	89
104.4.6	PSE output requirements.....	90
104.4.6.3	Power feeding ripple and transients.....	91
104.5	Powered Device (PD).....	91
104.5.1	PD types.....	91
104.5.1a	PD PI.....	92
104.5.3	PD state diagram.....	92

104.5.3.5	Functions	92
104.5.6	PD power	93
104.5.6.4	PD ripple and transients.....	94
104.6	Additional electrical specifications.....	94
104.6.2	Fault tolerance.....	94
104.7	Serial communication classification protocol (SCCP)	95
104.7.1	SCCP signaling	95
104.7.1.1	Initialization procedure—reset and presence pulses	95
104.7.1.2	Write time slots.....	95
104.7.1.3	Read time slots.....	96
104.7.1.4	Calculations for cable resistance	99
104.7.1.5	Calculations for power allocation.....	99
104.7.2	Serial communication classification protocols	100
104.7.2.4	Read_Scratchpad function command [0xAA].....	101
104.7.2.5	CRC8 field.....	101
104.7.2.6	Read_VOLT_INFO command [0xBB]	102
104.7.2.7	Read_POWER_INFO command [0x77]	103
104.7.2.8	Write_POWER_ASSIGN command [0x99]	103
104.7.2.9	Read_POWER_ASSIGN command [0x81]	103
104.9	Protocol implementation conformance statement (PICS) proforma for Clause 104, Power over Data Lines (PoDL) of Single Balanced Twisted-Pair Ethernet.....	104
104.9.1	Introduction.....	104
104.9.2	Identification	104
104.9.2.2	Protocol summary.....	104
104.9.3	Major capabilities/options.....	105
104.9.4	PICS proforma tables for Clause 104, Power over Data Lines (PoDL) of Single Balanced Twisted-Pair Ethernet	105
104.9.4.1	Link Segment.....	105
104.9.4.2	Power Sourcing Equipment (PSE)	106
104.9.4.3	Powered Device (PD)	106
104.9.4.7	SCCP	106
146.	Physical Coding Sublayer (PCS), Physical Medium Attachment (PMA) sublayer and baseband medium, type 10BASE-T1L	108
146.1	Overview	108
146.1.1	Relationship of 10BASE-T1L to other standards	108
146.1.2	Operation of 10BASE-T1L.....	108
146.1.2.1	Physical Coding Sublayer (PCS).....	109
146.1.2.2	Physical Medium Attachment (PMA) sublayer.....	110
146.1.2.3	EEE capability	110
146.1.2.4	Signaling.....	110
146.1.3	Conventions in this clause	111
146.1.3.1	State diagram notation	111
146.1.3.2	State diagram timer specifications.....	111
146.1.3.3	Service specifications	111
146.2	Service primitives and interfaces.....	111
146.2.1	PMA_LINK.request.....	112
146.2.1.1	Semantics of the primitive.....	112
146.2.1.2	When generated	113
146.2.1.3	Effect of receipt	113
146.2.2	PMA_LINK.indication	113
146.2.2.1	Semantics of the primitive	113
146.2.2.2	When generated	113

146.2.2.3	Effect of receipt	113
146.2.3	PMA_TXMODE.indication.....	113
146.2.3.1	Semantics of the primitive	113
146.2.3.2	When generated	114
146.2.3.3	Effect of receipt	114
146.2.4	PMA_UNITDATA.indication	114
146.2.4.1	Semantics of the primitive	114
146.2.4.2	When generated	114
146.2.4.3	Effect of receipt	114
146.2.5	PMA_UNITDATA.request.....	114
146.2.5.1	Semantics of the primitive	114
146.2.5.2	When generated	114
146.2.5.3	Effect of receipt	114
146.2.6	PMA_RXSTATUS.indication	115
146.2.6.1	Semantics of the primitive	115
146.2.6.2	When generated	115
146.2.6.3	Effect of receipt	115
146.2.7	PMA_REMRXSTATUS.request	115
146.2.7.1	Semantics of the primitive	115
146.2.7.2	When generated	115
146.2.7.3	Effect of receipt	115
146.2.8	PMA_SCRSTATUS.request.....	116
146.2.8.1	Semantics of the primitive	116
146.2.8.2	When generated	116
146.2.8.3	Effect of receipt	116
146.2.9	PMA_TXEN.request (tx_enable_mii)	116
146.2.9.1	Semantics of the primitive	116
146.2.9.2	When generated	116
146.2.9.3	Effect of receipt	116
146.2.10	PMA_RX_LPI_STATUS.request (rx_lpi_active).....	117
146.2.10.1	Semantics of the primitive	117
146.2.10.2	When generated	117
146.2.10.3	Effect of receipt	117
146.2.11	PMA_TX_LPI_STATUS.request (tx_lpi_active)	117
146.2.11.1	Semantics of the primitive	117
146.2.11.2	When generated	117
146.2.11.3	Effect of receipt	117
146.2.12	PMA_TX_LPI_STATUS.indication	118
146.2.12.1	Semantics of the primitive	118
146.2.12.2	When generated	118
146.2.12.3	Effect of receipt	118
146.3	Physical Coding Sublayer (PCS) functions	118
146.3.1	PCS Reset function	118
146.3.2	PCS Data Transmission Enable	120
146.3.2.1	Variables	120
146.3.3	PCS Transmit	121
146.3.3.1	PCS Transmit state diagram	121
146.3.3.1.1	Variables	122
146.3.3.1.2	Functions	123
146.3.3.1.3	Timers	124
146.3.3.1.4	Abbreviations	124
146.3.3.1.5	Constants	124
146.3.3.1.6	State diagram	125
146.3.3.2	PCS Transmit multiplexer state diagram	126

146.3.3.2.1	Variables	126
146.3.3.2.2	Timers	126
146.3.3.2.3	Abbreviations	126
146.3.3.2.4	State diagram	127
146.3.3.3	PCS Transmit symbol generation	127
146.3.3.4	Data and idle stream scrambling	128
146.3.3.4.1	Side-stream scrambler polynomial	128
146.3.3.4.2	Generation of Syn[3:0]	128
146.3.3.4.3	Generation of scrambled bits Sdn[3:0]	129
146.3.3.5	Generation of code-groups	129
146.3.3.5.1	Generation of code-groups in mode SEND_N and SEND_I	129
146.3.3.5.2	Generation of code-groups in mode SEND_Z	131
146.3.4	PCS Receive	131
146.3.4.1	PCS Receive overview	131
146.3.4.1.1	Variables	132
146.3.4.1.2	Functions	133
146.3.4.1.3	Timers	134
146.3.4.1.4	Constants	134
146.3.4.1.5	State diagrams	134
146.3.4.2	PCS Receive symbol decoding	137
146.3.4.3	PCS Receive descrambler polynomial	138
146.3.4.4	PCS Receive automatic polarity detection	138
146.3.5	PCS loopback	138
146.4	Physical Medium Attachment (PMA) sublayer	138
146.4.1	PMA Reset function	140
146.4.2	PMA Transmit function	140
146.4.3	PMA Receive function	140
146.4.4	PHY Control function	141
146.4.4.1	Variables	142
146.4.4.2	Timers	143
146.4.4.3	State diagram	145
146.4.5	Link Monitor function	148
146.4.5.1	Variables	148
146.4.5.2	State diagram	148
146.4.6	PMA clock recovery	148
146.4.7	LPI quiet-refresh cycling	148
146.4.7.1	Variables	149
146.4.7.2	Timers	149
146.4.7.3	State diagram	150
146.5	PMA electrical specifications	151
146.5.1	EMC tests	151
146.5.1.1	Immunity—DPI test	151
146.5.1.2	Emission—Conducted emission test	151
146.5.2	Test modes	151
146.5.3	Test fixture	152
146.5.4	Transmitter electrical specifications	152
146.5.4.1	Transmitter output voltage	152
146.5.4.2	Transmitter output droop	153
146.5.4.3	Transmitter timing jitter	153
146.5.4.4	Transmitter Power Spectral Density (PSD) and power level	153
146.5.4.5	Transmit clock frequency	155
146.5.5	Receiver electrical specifications	155
146.5.5.1	Receiver differential input signals	155

146.5.5.2	Receiver frequency tolerance	155
146.5.5.3	Alien crosstalk noise rejection	155
146.5.6	PMA local loopback	156
146.6	Management interface	156
146.6.1	Support for Auto-Negotiation	156
146.6.2	MASTER-SLAVE configuration	156
146.6.3	PHY initialization	157
146.6.4	Increased transmit level configuration	157
146.6.5	EEE configuration	157
146.6.6	PMA and PCS MDIO function mapping	157
146.7	Link segment characteristics	158
146.7.1	Link transmission parameters for 10BASE-T1L	158
146.7.1.1	Insertion loss	159
146.7.1.1.1	Insertion loss for PHYs in the 2.4 Vpp operation mode	159
146.7.1.1.2	Insertion loss supported for PHYs in 1.0 Vpp operation mode	160
146.7.1.2	Return loss	160
146.7.1.3	Maximum link delay	161
146.7.1.4	Differential to common mode conversion	161
146.7.1.5	Coupling attenuation	161
146.7.1.6	Electromagnetic classifications	162
146.7.2	Coupling parameters between 10BASE-T1L link segments	162
146.7.2.1	Multiple disturber power sum alien near-end crosstalk (PSANEXT) loss	162
146.7.2.2	Multiple disturber power sum alien far-end crosstalk (PSAFEXT) loss	163
146.8	MDI specification	163
146.8.1	MDI connectors	163
146.8.2	MDI electrical specification	166
146.8.3	MDI return loss	166
146.8.4	MDI mode conversion loss	166
146.8.5	MDI DC power voltage tolerance	166
146.8.6	MDI fault tolerance	166
146.9	Environmental specifications	167
146.9.1	General safety	167
146.9.2	Network safety	167
146.9.2.1	Environmental safety	167
146.9.2.2	Electromagnetic compatibility	168
146.10	Delay constraints	168
146.11	Protocol implementation conformance statement (PICS) proforma for Clause 146, Physical Coding Sublayer (PCS), Physical Medium Attachment (PMA) sublayer and baseband medium, type 10BASE-T1L	169
146.11.1	Introduction	169
146.11.2	Identification	169
146.11.2.1	Implementation identification	169
146.11.2.2	Protocol summary	169
146.11.3	Major capabilities/options	170
146.11.4	PICS proforma tables for Physical Coding Sublayer (PCS), Physical Medium Attachment (PMA) sublayer and baseband medium, type 10BASE-T1L	170
146.11.4.1	Physical Coding Sublayer (PCS)	170
146.11.4.1.1	PCS Transmit	170
146.11.4.1.2	PCS Receive	171
146.11.4.1.3	PCS loopback	172
146.11.4.2	Physical Medium Attachment (PMA)	172
146.11.4.2.1	PMA function	172

146.11.4.2.2	PMA electrical specification	173
146.11.4.3	Management interface	175
146.11.4.4	Link Segment characteristics	176
146.11.4.5	MDI specifications	176
146.11.4.6	Environmental specifications	177
146.11.4.7	Delay constraints	177
147.	Physical Coding Sublayer (PCS), Physical Medium Attachment (PMA) sublayer and baseband medium, type 10BASE-T1S	178
147.1	Overview	178
147.1.1	Relationship of 10BASE-T1S to other standards	178
147.1.2	Operation of 10BASE-T1S	178
147.1.3	Conventions in this clause	179
147.1.3.1	State diagram notation	179
147.1.3.2	State diagram timer specifications	179
147.1.3.3	Service specifications	180
147.2	Service primitives and interfaces	180
147.2.1	PMA_UNITDATA.indication	181
147.2.1.1	Semantics of the primitive	181
147.2.1.2	When generated	181
147.2.1.3	Effect of receipt	181
147.2.2	PMA_UNITDATA.request	181
147.2.2.1	Semantics of the primitive	181
147.2.2.2	When generated	181
147.2.2.3	Effect of receipt	181
147.2.3	Mapping of PMA_CARRIER.indication	182
147.2.3.1	Function	182
147.2.3.2	Semantic of the service primitive	182
147.2.3.3	When generated	182
147.2.4	PMA_LINK.request	182
147.2.4.1	Semantics of the primitive	182
147.2.4.2	When generated	182
147.2.5	PMA_LINK.indication	182
147.2.5.1	Semantics of the primitive	182
147.2.5.2	When generated	183
147.2.5.3	Effect of receipt	183
147.2.6	PCS_STATUS.indication	183
147.2.6.1	Semantics of the primitive	183
147.2.6.2	When generated	183
147.2.6.3	Effect of receipt	183
147.3	Physical Coding Sublayer (PCS) functions	183
147.3.1	PCS Reset function	183
147.3.2	PCS Transmit	184
147.3.2.1	PCS Transmit overview	184
147.3.2.2	Variables	185
147.3.2.3	Constants	186
147.3.2.4	Functions	187
147.3.2.5	Abbreviations	188
147.3.2.6	Timers	188
147.3.2.7	State diagram	189
147.3.2.8	Self-synchronizing scrambler	190
147.3.2.9	Jabber functional requirements	191

147.3.3	PCS Receive	191
147.3.3.1	PCS Receive overview	191
147.3.3.2	Variables	192
147.3.3.3	Constants	192
147.3.3.4	Functions	193
147.3.3.5	Abbreviations.....	193
147.3.3.6	Timers.....	193
147.3.3.7	State diagrams.....	194
147.3.3.8	Self-synchronizing descrambler	196
147.3.3.9	Jabber diagnostics.....	196
147.3.4	PCS loopback.....	196
147.3.5	Collision detection	196
147.3.6	Carrier sense	197
147.3.7	Support for PCS status generation	197
147.3.7.1	Heartbeat transmit overview.....	197
147.3.7.1.1	Variables	197
147.3.7.1.2	Timers	198
147.3.7.1.3	State diagram	199
147.3.7.2	Heartbeat receive overview	200
147.3.7.2.1	Variables	200
147.3.7.2.2	Constants.....	201
147.3.7.2.3	Timers	201
147.3.7.2.4	State diagram	201
147.4	Physical Medium Attachment (PMA) sublayer.....	202
147.4.1	PMA Reset function.....	202
147.4.2	PMA Transmit function	202
147.4.3	PMA Receive function.....	203
147.4.4	Link Monitor function	204
147.4.4.1	Link Monitor overview.....	204
147.4.4.2	Variables	204
147.5	PMA electrical specifications	205
147.5.1	EMC tests.....	205
147.5.1.1	Immunity—DPI test	205
147.5.1.2	Emission—Conducted emission test	205
147.5.2	Test modes	205
147.5.3	Test fixtures	206
147.5.4	Transmitter electrical specification.....	207
147.5.4.1	Transmitter output voltage.....	207
147.5.4.2	Transmitter output droop	207
147.5.4.3	Transmitter timing jitter.....	207
147.5.4.4	Transmitter Power Spectral Density (PSD).....	208
147.5.4.4.1	Upper PSD	208
147.5.4.4.2	PSD mask	208
147.5.4.5	Transmitter high impedance mode	209
147.5.5	Receiver electrical specifications.....	209
147.5.5.1	Receiver differential input signals.....	209
147.5.5.2	Alien crosstalk noise rejection.....	209
147.5.6	PMA local loopback	209
147.6	Management interface.....	210
147.6.1	Support for Auto-Negotiation	210
147.7	Point-to-point link segment characteristics.....	210
147.7.1	Insertion loss	210
147.7.2	Return loss	210
147.7.3	Mode conversion loss	211

147.7.4	Power sum alien near-end crosstalk (PSANEXT).....	211
147.7.5	Power sum alien attenuation to crosstalk ratio far-end (PSAACRF)	211
147.8	Mixing segment characteristics	211
147.8.1	Insertion loss	212
147.8.2	Return loss	212
147.8.3	Mode conversion loss	212
147.9	MDI specification	212
147.9.1	MDI connectors	212
147.9.2	MDI electrical specification.....	215
147.9.3	MDI line powering voltage tolerance	215
147.9.4	MDI fault tolerance.....	215
147.10	Environmental specifications.....	216
147.10.1	General safety	216
147.10.2	Network safety	216
147.10.2.1	Environmental safety	216
147.10.2.2	Electromagnetic compatibility.....	217
147.11	Delay constraints.....	217
147.12	Protocol implementation conformance statement (PICS) proforma for Clause 147, Physical Coding Sublayer (PCS), Physical Medium Attachment (PMA) sublayer and baseband medium, type 10BASE-T1S.....	218
147.12.1	Introduction.....	218
147.12.2	Identification	218
147.12.2.1	Implementation identification.....	218
147.12.2.2	Protocol summary.....	218
147.12.3	Major capabilities/options.....	219
147.12.4	PICS proforma tables for Physical Medium Attachment (PMA) sublayer and baseband medium, type 10BASE-T1S	219
147.12.4.1	PCS Transmit.....	219
147.12.4.2	PCS Receive	220
147.12.4.3	PCS loopback	220
147.12.4.4	Collision detection	221
147.12.4.5	Support for PCS status generation.....	221
147.12.4.6	Physical Medium Attachment (PMA)	221
147.12.4.6.1	PMA function	221
147.12.4.6.2	PMA electrical specification.....	222
147.12.4.7	Point-to-point link Segment characteristics.....	224
147.12.4.8	Mixing Segment characteristics.....	224
147.12.4.9	MDI specification	225
147.12.4.10	Delay constraints	225
148.	PLCA Reconciliation Sublayer (RS)	226
148.1	Introduction.....	226
148.1.1	Conventions in this clause	226
148.1.1.1	State diagram notation	226
148.1.1.2	State diagram timer specifications.....	226
148.1.1.3	Service specifications	226
148.2	Overview.....	226
148.3	Relationship with other IEEE standards	227
148.4	PLCA Reconciliation Sublayer operation.....	228
148.4.1	General.....	228
148.4.2	Mapping of MII signals to PLS service primitives and PLCA functions	228
148.4.2.1	Mapping of PLS_DATA.request	228
148.4.2.1.1	Function	228

148.4.2.1.2	Semantic of the service primitive	229
148.4.2.1.3	When generated	229
148.4.2.2	Mapping of PLS_DATA.indication	229
148.4.2.3	Mapping of PLS_CARRIER.indication	229
148.4.2.3.1	Function	229
148.4.2.3.2	Semantic of the service primitive	229
148.4.2.3.3	When generated	229
148.4.2.4	Mapping of PLS_SIGNAL.indication	229
148.4.2.4.1	Function	229
148.4.2.4.2	Semantic of the service primitive	230
148.4.2.4.3	When generated	230
148.4.2.5	Mapping of PLS_DATA_VALID.indication	230
148.4.2.6	Generation of TX_ER	230
148.4.2.7	Response to RX_ER indication	230
148.4.3	Requirements for the PHY	230
148.4.3.1	PHY response to PLCA commands and notifications	230
148.4.3.1.1	BEACON request	230
148.4.3.1.2	COMMIT request	230
148.4.3.2	Mapping of MII signals to PLCA variables	231
148.4.3.2.1	BEACON indication	231
148.4.3.2.2	COMMIT indication	231
148.4.4	PLCA Control	231
148.4.4.1	PLCA Control state diagram	231
148.4.4.2	PLCA Control variables	232
148.4.4.3	Functions	234
148.4.4.4	Timers	234
148.4.4.5	Abbreviations	235
148.4.4.6	State diagram	236
148.4.5	PLCA Data	238
148.4.5.1	PLCA Data state diagram	238
148.4.5.2	Variables	239
148.4.5.3	Functions	240
148.4.5.4	Timers	240
148.4.5.5	Abbreviations	240
148.4.5.6	Constants	240
148.4.5.7	State diagram	241
148.4.6	PLCA Status	243
148.4.6.1	PLCA Status state diagram	243
148.4.6.2	PLCA Status variables	243
148.4.6.3	Functions	243
148.4.6.4	Timers	243
148.4.6.5	State diagram	244
148.5	Protocol implementation conformance statement (PICS) proforma for Clause 148, PLCA Reconciliation Sublayer (RS)	245
148.5.1	Introduction	245
148.5.2	Identification	245
148.5.2.1	Implementation identification	245
148.5.2.2	Protocol summary	245
148.5.3	PICS proforma tables for PLCA Reconciliation Sublayer (RS)	246
148.5.3.1	Reconciliation Sublayer	246
148.5.3.2	Mapping of MII signals to PLS service primitives and PLCA functions	246
148.5.3.3	Specific RS and PHY specification	247
148.5.3.4	PLCA Control	247

148.5.3.5	PLCA Data	247
148.5.3.6	PLCA Status	247
Annex A (informative) Bibliography		248
Annex 98B (normative) IEEE 802.3 Selector Base Page definition		249
98B.3	Technology Ability Field bit assignments	249
98B.3.1	10BASE-T1L-specific bit assignments	249
98B.4	Priority Resolution	249
Annex 146A (informative) Guidelines for implementation of the 10BASE-T1L PHY in an intrinsically safe application		250
Annex 146B (informative) Optional power distribution		253
146B.1	Overview	253
146B.2	Point-to-point powering topologies	253
146B.3	Powered trunk cable topologies	254

IEEE Standard for Ethernet

Amendment 5: Physical Layer Specifications and Management Parameters for 10 Mb/s Operation and Associated Power Delivery over a Single Balanced Pair of Conductors

(This amendment is based on IEEE Std 802.3™-2018 as amended by IEEE Std 802.3cb™-2018, IEEE Std 802.3bt™-2018, IEEE Std 802.3cd™-2018, and IEEE Std 802.3cn™-2019.)

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. 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.

Cross references that refer to clauses, tables, equations, or figures not covered by this amendment are highlighted in green.¹

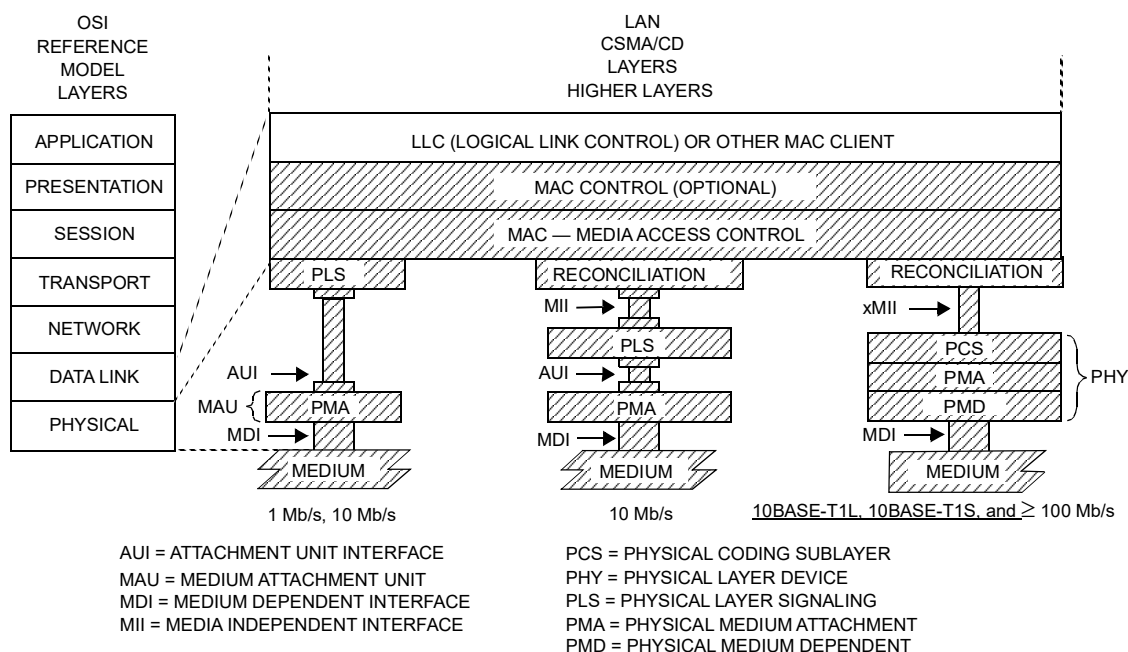
¹ Notes in text, tables, and figures are given for information only and do not contain requirements needed to implement the standard.

1. Introduction

1.1 Overview

1.1.3 Architectural perspectives

Change Figure 1–1 as follows (see changes at the bottom of the right column and in the note):



NOTE—In this figure, the xMII is used as a generic term for the Media Independent Interfaces for implementations of 10BASE-T1L, 10BASE-T1S, and 100 Mb/s and above. For example: for 100 Mb/s implementations this interface is called MII; for 1 Gb/s implementations it is called GMII; for 10 Gb/s implementations it is called XGMII; etc.

Figure 1–1—IEEE 802.3 standard relationship to the ISO/IEC Open Systems Interconnection (OSI) reference model

1.3 Normative references

Insert the following references in alphanumeric order:

IEC 60068-2-2:2007, Environmental testing—Part 2-2: Tests—Test B: Dry heat.²

IEC 60068-2-6:2007, Environmental testing—Part 2-6: Tests—Test Fc: Vibration (sinusoidal).

IEC 60068-2-14:2009, Environmental testing—Part 2-14: Tests—Test N: Change of temperature.

IEC 60068-2-31:2008, Environmental testing—Part 2-31: Tests—Test Ec: Rough handling shocks, primarily for equipment-type specimens.

²IEC publications are available from the International Electrotechnical Commission (<http://www.iec.ch/>). IEC publications are also available in the United States from the American National Standards Institute (<http://www.ansi.org>).

IEC 60079-0:2017, Explosive atmospheres—Part 0: Equipment—General requirements.

IEC 60079-11:2011, Explosive Atmospheres—Part 11: Equipment protection by intrinsic safety.

IEC 60529:2013, Degrees of Protection Provided by Enclosures (IP Code).

IEC 61000-4-4:2012, Electromagnetic compatibility (EMC)—Part 4-4: Testing and measurement techniques—Electrical fast transient/burst immunity test.

IEC 61000-4-5:2017, Electromagnetic compatibility (EMC)—Part 4-5: Testing and measurement techniques—Surge immunity test.

IEC 61000-4-6:2013, Electromagnetic compatibility (EMC)—Part 4-6: Testing and measurement techniques—Immunity to conducted disturbances, induced by radio-frequency fields.

IEC 61000-6-4:2018, Electromagnetic compatibility (EMC)—Part 6-4: Generic standards—Emission standard for industrial environments.

IEC 61010-1:2017, Safety requirements for electrical equipment for measurement, control, and laboratory use—Part 1: General requirements.

IEC 61326-1:2012, Electrical equipment for measurement, control and laboratory use—EMC requirements—Part 1: General requirements.

IEC 62368-1:2014, Audio/video, information and communication technology equipment—Part 1: Safety requirements.

ISO 4892:1982, Plastics—Methods of exposure to laboratory light.³

NAMUR NE 021:2017, Electromagnetic Compatibility of Equipment for Industrial Processes and Laboratory.⁴

1.4 Definitions

Insert the following new definitions after 1.4.50 “10BASE-T”:

1.4.50a 10BASE-T1L: IEEE 802.3 Physical Layer specification for a 10 Mb/s Ethernet local area network over a single balanced pair of conductors up to at least 1000 m reach. (See IEEE Std 802.3, Clause 146.)

1.4.50b 10BASE-T1S: IEEE 802.3 Physical Layer specification for a 10 Mb/s Ethernet local area network over a single balanced pair of conductors up to at least 15 m reach. (See IEEE Std 802.3, Clause 147.)

Change 1.4.151 as follows:

1.4.151 BASE-T1: PHYs that belong to the set of specific Ethernet PCS/PMA/PMDs that operate on a single twisted-pair copper cable, including 10BASE-T1L, 10BASE-T1S, 100BASE-T1, and 1000BASE-T1. (See IEEE Std 802.3, Clause 96, and Clause 97, Clause 146, and Clause 147.)

³ISO publications are available from the International Organization for Standardization (<http://www.iso.ch/>). ISO publications are also available in the United States from the American National Standards Institute (<http://www ansi.org/>).

⁴NAMUR publications are available from the User Association of Automation Technology in Process Industries (<http://www.namur.net>).

Change 1.4.198 as follows:

1.4.198 code-group: For IEEE 802.3, a set of encoded symbols representing encoded data or control information. For 100BASE-T4, a set of six ternary symbols that, when representing data, conveys an octet. For 100BASE-TX and 100BASE-FX, a set of five code-bits that, when representing data, conveys a nibble. For 100BASE-T2, a pair of PAM5×5 symbols that, when representing data, conveys a nibble. For 1000BASE-X, a set of ten bits that, when representing data, conveys an octet. For 1000BASE-T, a vector of four 8B1Q4 coded quinary symbols that, when representing data, conveys an octet. For 100BASE-T1, a set of ternary symbols that, when representing data, conveys three bits, as defined in 96.3. For 10BASE-T1L, a set of three ternary symbols that, when representing data, conveys a nibble, as defined in 146.3. (See IEEE Std 802.3, [Clause 23](#), [Clause 24](#), [Clause 32](#), [Clause 36](#), [Clause 40](#), ~~and Clause 96~~, and [Clause 146](#).)

Change 1.4.319 as follows:

1.4.319 master Physical Layer (PHY): Within IEEE 802.3, in a 100BASE-T2 ~~or 1000BASE-T~~, 10BASE-T1L, 100BASE-T1, 1000BASE-T1, or any MultiGBASE-T link containing a pair of PHYs, the PHY that uses an external clock for generating its clock signals to determine the timing of transmitter and receiver operations. It also uses the master transmit scrambler generator polynomial for side-stream scrambling. Master and slave PHY status is determined during the Auto-Negotiation process that takes place prior to establishing the transmission link, or in the case of a PHY where Auto-Negotiation is optional and not used, master and slave PHY status is determined by management or hardware configuration. See also: **slave Physical Layer (PHY).**

Insert the following new definition after 1.4.390 “physical header subframe (PHS)”:

1.4.390a Physical Layer Collision Avoidance (PLCA): A method for generating transmit opportunities for 10BASE-T1S operating on mixing segments. (See IEEE Std 802.3, Clause 148.)

Change 1.4.456 as follows:

1.4.456 slave Physical Layer (PHY): Within IEEE 802.3, in a 100BASE-T2 ~~or 1000BASE-T~~, 10BASE-T1L, 100BASE-T1, 1000BASE-T1, or any MultiGBASE-T link containing a pair of PHYs, the PHY that recovers its clock from the received signal and uses it to determine the timing of transmitter operations. It also uses the slave transmit scrambler generator polynomial for side-stream scrambling. Master and slave PHY status is determined during the Auto-Negotiation process that takes place prior to establishing the transmission link, or in the case of a PHY where Auto-Negotiation is optional and not used, master and slave PHY status is determined by management or hardware configuration. See also: **master Physical Layer (PHY).**

Change 1.4.471 as follows:

1.4.471 ternary symbol: In 10BASE-T1L, 100BASE-T4, and 100BASE-T1, a ternary data element. A ternary symbol can have one of three values: −1, 0, or +1. (See IEEE Std 802.3, [Clause 23](#) ~~and~~, [Clause 96](#), and [Clause 146](#).)

Insert the following new definition after 1.4.495 “Type D PoDL System”:

1.4.495a Type E PoDL System: A system comprising a PoDL PSE, link section, and PD that are compatible with 10BASE-T1L PHYs.

1.5 Abbreviations

Insert the following new abbreviations into the list, in alphanumeric order:

DCR	direct current resistance
FSM	Finite State Machine
PLCA	Physical Layer Collision Avoidance

9. Repeater unit for 10 Mb/s baseband networks

9.1 Overview

Change the first paragraph of 9.1 as follows:

This clause specifies a repeater for use with IEEE 802.3 10 Mb/s baseband networks, with the exceptions of 10BASE-T1L (Clause 146) and 10BASE-T1S (Clause 147). A repeater for any other IEEE 802.3 network type is beyond the scope of this clause.

22. Reconciliation Sublayer (RS) and Media Independent Interface (MII)

22.1 Overview

Change Figure 22-1 as follows (see changes at the bottom of the right column):

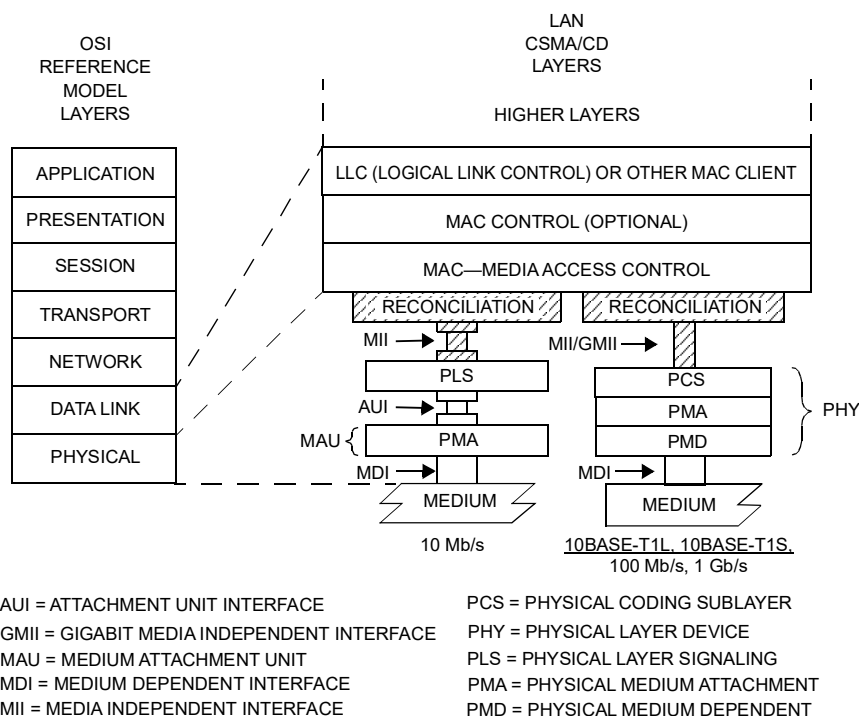


Figure 22-1—MII relationship to the ISO/IEC Open Systems Interconnection (OSI) reference model and the IEEE 802.3 CSMA/CD LAN model

22.2 Functional specifications

22.2.2 MII signal functional specifications

22.2.2.4 TXD (transmit data)

Change the second paragraph in 22.2.2.4 as follows:

For EEE capability, the RS shall use the combination of TX_EN deasserted, TX_ER asserted, and TXD<3:0> equal to 0001 as shown in Table 22-1 as a request to enter, or remain in a low power state. ~~Other values of TXD<3:0> with this combination of TX_EN and TX_ER shall have no effect upon the PHY.~~

Insert the following new paragraphs after the second paragraph in 22.2.2.4:

When PLCA capability is supported and enabled (see 30.16.1.1.1), the RS shall use the combination of TX_EN deasserted, TX_ER asserted, and TXD<3:0> equal to 0010 or 0011 as shown in Table 22-1 to send respectively a BEACON request or a COMMIT request as defined in 148.4.4.1.

When TX_EN is deasserted and TX_ER is asserted, values of TXD<3:0> other than 0001, 0010, and 0011 shall have no effect upon the PHY.

Change Table 22-1 as follows (unchanged rows not shown):

Table 22–1—Permissible encodings of TXD<3:0>, TX_EN, and TX_ER

TX_EN	TX_ER	TXD<3:0>	Indication
...			
<u>0</u>	<u>1</u>	<u>0010</u>	<u>PLCA BEACON request</u>
<u>0</u>	<u>1</u>	<u>0011</u>	<u>PLCA COMMIT request</u>
0	1	0010 0100 through 1111	Reserved
...			

22.2.2.5 TX_ER (transmit coding error)

Change the second paragraph in 22.2.2.5 as follows:

Assertion of the TX_ER signal shall not affect the transmission of data when TX_EN is deasserted. Additionally, the assertion of TX_ER signal shall not affect the transmission of data when a PHY is operating at 10 Mb/s, or when TX_EN is deasserted, with the exception of 10BASE-T1L (see 146.3.3.1) and 10BASE-T1S (see 147.3.2.1, Figure 147–4).

22.2.2.8 RXD (receive data)

Insert the following new paragraph into 22.2.2.8 after the third paragraph (“For EEE capability, the PHY....”):

When PLCA capability is supported and enabled, the PHY indicates that it is receiving a BEACON or COMMIT by asserting the RX_ER signal and driving respectively the values 0010 or 0011 onto RXD<3:0> while RX_DV is deasserted. See 148.4.4.1 for the definition and usage of PLCA BEACON and COMMIT.

Change Table 22-2 as follows (unchanged rows not shown):

Table 22–2—Permissible encoding of RXD<3:0>, RX_ER, and RX_DV

RX_DV	RX_ER	RXD<3:0>	Indication
...			
<u>0</u>	<u>1</u>	<u>0010</u>	<u>PLCA BEACON indication</u>
<u>0</u>	<u>1</u>	<u>0011</u>	<u>PLCA COMMIT indication</u>
0	1	0010 0100 through 1101	Reserved
...			

**22.8 Protocol implementation conformance statement (PICS) proforma for
Clause 22, Reconciliation Sublayer (RS) and Media Independent Interface (MII)⁵****22.8.2 Identification****22.8.2.3 Major capabilities/options***Insert the following new row at the end of the table in 22.8.2.3:*

Item	Feature	Subclause	Status	Support	Value/Comment
*PLCA	Implementation of PLCA	22.2.2.4	O		

22.8.3 PICS proforma tables for reconciliation sublayer and media independent interface**22.8.3.2 MII signal functional specifications***Change the table in 22.8.3.2 as follows (unchanged rows not shown):*

Item	Feature	Subclause	Status	Support	Value/Comment
...					
SF15	TXD<3:0> effect on PHY while TX_EN is deasserted	22.2.2.4	M		No effect
...					
SF18	TX_ER effect on PHY while operating at 10 Mb/s (with the exception of 10BASE-T1S and 10BASE-T1L), or when TX_EN is deasserted	22.2.2.5	M		No effect on PHY
...					
SF39	Effect on PHY while TXD<3:0> is 0010, and TX_EN is deasserted, and TX_ER is asserted	22.2.2.4	PLCA: M		RS sends BEACON request
SF40	Effect on PHY while TXD<3:0> is 0011, and TX_EN is deasserted, and TX_ER is asserted	22.2.2.4	PLCA: M		RS sends COMMIT request
SF41	Effect on PHY while TXD<3:0> is any value other than 0010 or 0011, and TX_EN is deasserted, and TX_ER is asserted	22.2.2.4	PLCA: M		No effect

⁵Copyright release for PICS proformas: Users of this standard may freely reproduce the PICS proforma in this subclause so that it can be used for its intended purpose and may further publish the completed PICS.

30. Management

30.2 Managed objects

30.2.2 Overview of managed objects

30.2.2.1 Text description of managed objects

Change the description for oPHYEntity in 30.2.2.1 as follows:

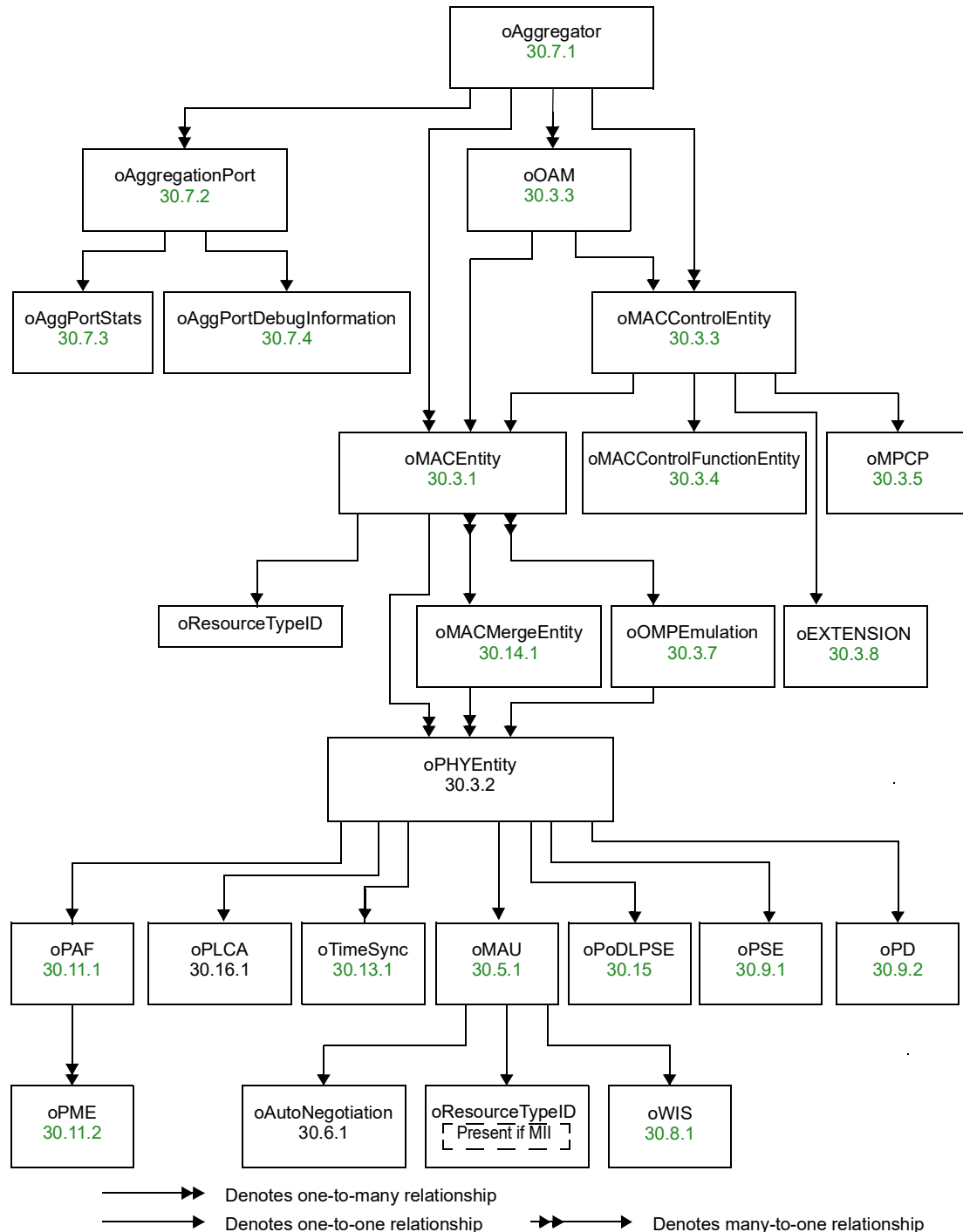
oPHYEntity	If oOMPEmulation is implemented, oPHYEntity is contained within oOMPEmulation. If oMACMergeEntity is implemented, oPHYEntity is contained within oMACMergeEntity. Otherwise oPHYEntity is contained within oMACEntity. Many instances of oPHYEntity may coexist within one instance of oMACEntity or oMACMergeEntity; however, only one PHY may be active for data transfer to and from the MAC at any one time. oPHYEntity is the managed object that contains the MAU, PAF, <u>PLCA</u> , PSE, and PoDLPSE managed objects in a DTE.
-------------------	--

Insert the following description for oPLCA into 30.2.2.1 (as amended by IEEE Std 802.3bt-2018) after the description for oPAF:

oPLCA	If implemented, oPLCA is contained within oPHYEntity. The oPLCA managed object class provides the management controls necessary to allow an instance of a PLCA RS to be managed.
--------------	--

30.2.3 Containment

Replace Figure 30-3 with the following figure (which includes oPLCA):



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

Figure 30-3—DTE System entity relationship diagram

30.2.5 Capabilities

Change the last sentence of the first paragraph of 30.2.5 as follows:

The capabilities and packages for IEEE 802.3 Management are specified in Table 30-1a through ~~Table 30-10~~ Table 30-11.

Insert the following new table (Table 30-11) after Table 30-10:

Table 30-11—PLCA capabilities

			PLCA capability (optional)
oPLCA managed object class (30.16.1)			
aPLCAAdminState	ATTRIBUTE	GET	X
aPLCAStatus	ATTRIBUTE	GET	X
aPLCABurstTimer	ATTRIBUTE	GET-SET	X
aPLCALocalNodeID	ATTRIBUTE	GET-SET	X
aPLCAMaxBurstCount	ATTRIBUTE	GET-SET	X
aPLCANodeCount	ATTRIBUTE	GET-SET	X
aPLCATransmitOpportunityTimer	ATTRIBUTE	GET-SET	X
acPLCAAdminControl	ACTION		X
acPLCAReset	ACTION		X

30.3 Layer management for DTEs

30.3.2 PHY device managed object class

30.3.2.1 PHY device attributes

30.3.2.1.2 aPhyType

Insert the following new entries in the APPROPRIATE SYNTAX section of 30.3.2.1.2 after the entry for “10 Mb/s”:

10BASE-T1L Clause 146 10 Mb/s PAM3
 10BASE-T1S Clause 147 10 Mb/s DME

30.3.2.1.3 aPhyTypeList

Insert the following new entries in the APPROPRIATE SYNTAX section of 30.3.2.1.3 after the entry for “10 Mb/s”:

10BASE-T1L Clause 146 10 Mb/s PAM3
 10BASE-T1S Clause 147 10 Mb/s DME

30.5 Layer management for medium attachment units (MAUs)

30.5.1 MAU managed object class

30.5.1.1 MAU attributes

30.5.1.1.2 aMAUType

Insert the following new entries in the APPROPRIATE SYNTAX section of 30.5.1.1.2 after the entry for “10BASE-FLFD”:

10BASE-T1L	Single balanced pair PHY as specified in Clause 146
10BASE-T1SHD	Single balanced pair PHY as specified in Clause 147, half duplex mode
10BASE-T1SMD	Single balanced pair PHY as specified in Clause 147, multidrop mode
10BASE-T1SFD	Single balanced pair PHY as specified in Clause 147, full duplex mode

30.5.1.1.4 aMediaAvailable

Change the fourth sentence of the third paragraph of the BEHAVIOUR DEFINED AS section of 30.5.1.1.4 as follows:

For 10BASE-T1L and 100BASE-T1, a link_status of OK maps to the enumeration “available”.

30.6 Management for link Auto-Negotiation

30.6.1 Auto-Negotiation managed object class

30.6.1.1 Auto-Negotiation attributes

30.6.1.1.5 aAutoNegLocalTechnologyAbility

Insert the following new entries in APPROPRIATE SYNTAX section of 30.6.1.1.5 after the entry for “10BASE-T”:

10BASE-T1L	10BASE-T1L as specified in Clause 146
10BASE-T1S	10BASE-T1S as specified in Clause 147

30.15 Layer management for Power over Data Lines (PoDL) of Single Balanced Twisted-Pair Ethernet

30.15.1 PoDL PSE managed object class

30.15.1.1 PoDL PSE attributes

30.15.1.1.4 aPoDLPSEType

Insert the following new entry in the APPROPRIATE SYNTAX section of 30.15.1.1.4 after the entry for “typeD”:

typeE	Type E PoDL PSE
-------	-----------------

30.15.1.1.5 aPoDLPSEDetectedPDType

Insert the following new entry in the APPROPRIATE SYNTAX section of 30.15.1.1.5 after the entry for “typeD”:

typeE	Type E PoDL PD
-------	----------------

30.15.1.1.6 aPoDLPSEDetectedPDPowerClass

Insert the following new entries in the APPROPRIATE SYNTAX section of 30.15.1.1.6 after the entry for “class 9”:

class10	Class 10 PoDL PD
class11	Class 11 PoDL PD
class12	Class 12 PoDL PD
class13	Class 13 PoDL PD
class14	Class 14 PoDL PD
class15	Class 15 PoDL PD

Change text of BEHAVIOUR DEFINED AS section of 30.15.1.1.6 as shown:

BEHAVIOUR DEFINED AS:

A read-only value that indicates the class of the detected PoDL PD as specified in [Table 104-1](#) and [Table 104-1a](#). This value is only valid while a PD is being powered, that is the attribute aPoDLPSEPowerDetectionStatus is reporting the enumeration “deliveringPower”.

If a Clause 45 MDIO Interface to the PoDL PSE function is present, then this attribute may be derived from the PD Class [and PD Extended Class](#) bits specified in 45.2.9.2.8 [and 45.2.9.3.1a](#);

Insert the following new subclauses (30.16 through 30.16.1.2.2) after 30.15 (and its subclauses):

30.16 Management for PLCA Reconciliation Sublayer

30.16.1 PLCA managed object class

This subclause formally defines the behaviours for the oPLCA managed object class attributes and actions.

30.16.1.1 PLCA attributes

30.16.1.1.1 aPLCAAdminState

ATTRIBUTE

APPROPRIATE SYNTAX:

An ENUMERATED VALUE that has the following entries:

disabled

enabled

BEHAVIOUR DEFINED AS:

A read-only value that indicates the mode of operation of the Reconciliation Sublayer for PLCA operation. When PLCA is enabled, the Reconciliation Sublayer functions in PLCA mode, whose operation is defined by Clause 148. When PLCA functions are not supported or are disabled by the management interface (plca_en = FALSE), RS operation shall conform to the RS definition in Clause 22. By default, PLCA is disabled.;

30.16.1.1.2 aPLCAStatus

ATTRIBUTE

APPROPRIATE SYNTAX:

An ENUMERATED VALUE that has the following entries:

TRUE

FALSE

BEHAVIOUR DEFINED AS:

A read-only value that indicates whether PLCA Control state diagram is receiving BEACON indication or transmitting BEACON request. This parameter maps to the plca_status variable in 148.4.6.2.;

30.16.1.1.3 aPLCANodeCount

ATTRIBUTE

APPROPRIATE SYNTAX:

INTEGER

BEHAVIOUR DEFINED AS:

This value is assigned to define the number of nodes getting a transmit opportunity before a new BEACON is generated. Valid range is 0 to 255, inclusive. The default value is 8.;

30.16.1.1.4 aPLCALocalNodeID

ATTRIBUTE

APPROPRIATE SYNTAX:

INTEGER

BEHAVIOUR DEFINED AS:

This value is assigned to define the ID of the local node on the PLCA network. The default value is 255. Value range is 0 to 255, inclusive.;

30.16.1.1.5 aPLCATransmitOpportunityTimer

ATTRIBUTE

APPROPRIATE SYNTAX:

INTEGER

BEHAVIOUR DEFINED AS:

This value is assigned to define the time between PLCA transmit opportunities for the node. aPLCATransmitOpportunityTimer maps to the duration of the timer to_timer. The value of aPLCATransmitOpportunityTimer represents the duration of to_timer in bit times. Valid range is 1 to 255, inclusive. The default value is 32. See 148.4.4.4.;

30.16.1.1.6 aPLCAMaxBurstCount

ATTRIBUTE

APPROPRIATE SYNTAX:

INTEGER

BEHAVIOUR DEFINED AS:

Maximum number of additional packets the node is allowed to transmit in a single transmit opportunity as specified in 148.4.4.1 and 148.4.4.2. Valid range is 0 to 255, inclusive. The default value is 0.;

30.16.1.1.7 aPLCABurstTimer

ATTRIBUTE

APPROPRIATE SYNTAX:

INTEGER

BEHAVIOUR DEFINED AS:

This value sets the maximum number of bit-times PLCA waits for the MAC to send a new packet before yielding the transmit opportunity. See definition in 148.4.4.1 and 148.4.4.2. Valid range is 0 to 255, inclusive. The default value is 128.;

30.16.1.2 PLCA device actions

30.16.1.2.1 acPLCAAdminControl

ACTION

APPROPRIATE SYNTAX:

An ENUMERATED VALUE that has the following entries:

disabled

enabled

BEHAVIOUR DEFINED AS:

This action provides a means to alter aPLCAAdminState. Setting acPLCAAdminControl to the disabled state sets the variable plca_en to FALSE and disables the PLCA functionality specified in Clause 148. Setting acPLCAAdminControl to the enabled state sets the variable plca_en to TRUE in Figure 148–3, Figure 148–4, Figure 148–5, Figure 148–6, and Figure 148–7.;

30.16.1.2.2 acPLCAReset

ACTION

APPROPRIATE SYNTAX:

An ENUMERATED VALUE that has the following entries:

reset
normal

BEHAVIOUR DEFINED AS:

This action provides a means to reset the PLCA Reconciliation Sublayer functions. See 148.4.4.2.;

45. Management Data Input/Output (MDIO) Interface

45.2 MDIO Interface Registers

45.2.1 PMA/PMD registers

Change Table 45–3 as follows (unchanged rows not shown):

Table 45–3—PMA/PMD registers

Register address	Register name	Subclause
...		
1.2103 through 1.2293 303	Reserved	
<u>1.2294</u>	<u>10BASE-T1L PMA control</u>	<u>45.2.1.186a</u>
<u>1.2295</u>	<u>10BASE-T1L PMA status</u>	<u>45.2.1.186b</u>
<u>1.2296</u>	<u>10BASE-T1L test mode control</u>	<u>45.2.1.186c</u>
<u>1.2297</u>	<u>10BASE-T1S PMA control</u>	<u>45.2.1.186d</u>
<u>1.2298</u>	<u>10BASE-T1S PMA status</u>	<u>45.2.1.186e</u>
<u>1.2299</u>	<u>10BASE-T1S test mode control</u>	<u>45.2.1.186f</u>
1.2300 through 1.2303	Reserved	
...		

45.2.1.7 PMA/PMD status 2 register (Register 1.8)

45.2.1.7.4 Transmit fault (1.8.11)

Insert the following new row at the beginning of Table 45–9:

Table 45–9—Transmit fault description location

PMA/PMD	Description location
10BASE-T1L	146.4.2

45.2.1.7.5 Receive fault (1.8.10)

Insert the following new row at the beginning of Table 45–10:

Table 45–10—Receive fault description location

PMA/PMD	Description location
10BASE-T1L	146.4.3

45.2.1.16 BASE-T1 PMA/PMD extended ability register (1.18)*Change Table 45-19 as follows (unchanged rows not shown):***Table 45-19—BASE-T1 PMA/PMD extended ability register bit definitions**

Bit(s)	Name	Description	R/W ^a
1.18.15:24	Reserved	Value always 0	RO
1.18.3	10BASE-T1S ability	1 = PMA/PMD is able to perform 10BASE-T1S 0 = PMA/PMD is not able to perform 10BASE-T1S	RO
1.18.2	10BASE-T1L ability	1 = PMA/PMD is able to perform 10BASE-T1L 0 = PMA/PMD is not able to perform 10BASE-T1L	RO
...			

^aRO = Read only**45.2.1.185 BASE-T1 PMA/PMD control register (Register 1.2100)***Change Table 45-149 as follows (unchanged rows not shown):***Table 45-149—BASE-T1 PMA/PMD control register bit definitions**

Bit(s)	Name	Description	R/W ^a
...			
1.2100.3:0	Type Selection	3 2 1 0 1 x x x = Reserved 0 1 x x = Reserved <u>0 0 1 1 = 10BASE-T1S</u> 0 0 1 x = Reserved 0 0 0 1 = 1000BASE-T1 0 0 0 0 = 100BASE-T1	R/W

^aRO = Read only, R/W = Read/Write**45.2.1.185.2 Type selection (1.2100.3:0)***Change 45.1.185.2 as follows:*

Bits 1.2100.3:0 are used to set the mode of operation when Auto-Negotiation enable bit 7.512.12 is set to zero, or if Auto-Negotiation is not implemented. When these bits are set to 0000, the mode of operation is 100BASE-T1. When these bits are set to 0001, the mode of operation is 1000BASE-T1. When these bits are set to 0010, the mode of operation is 10BASE-T1L. When these bits are set to 0011, the mode of operation is 10BASE-T1S. These bits shall be ignored when the Auto-Negotiation enable bit 7.512.12 is set to one.

Insert the following new subclauses (45.2.1.186a through 45.2.1.186f.1, including Table 45-150a through Table 45-150f) after 45.2.1.186.1:

45.2.1.186a 10BASE-T1L PMA control register (Register 1.2294)

The assignment of bits in the 10BASE-T1L PMA control register is shown in Table 45-150a.

Table 45-150a—10BASE-T1L PMA control register bit definitions

Bit(s)	Name	Description	R/W ^a
1.2294.15	PMA reset	1 = PMA reset 0 = Normal operation	R/W, SC
1.2294.14	Transmit disable	1 = Transmit disable 0 = Normal operation	R/W
1.2294.13	Reserved	Value always zero	RO
1.2294.12	Transmit voltage amplitude control	1 = Enable 2.4 Vpp operating mode 0 = Enable 1.0 Vpp operating mode	R/W
1.2294.11	Low-power	1 = Low-power mode 0 = Normal operation	R/W
1.2294.10	EEE enable	1 = Enable EEE mode 0 = Disable EEE mode	R/W
1.2294.9:1	Reserved	Value always 0	RO
1.2294.0	Loopback	1 = Enable loopback mode 0 = Disable loopback mode	R/W

^aRO = Read only, R/W = Read/Write, SC = Self-clearing

45.2.1.186a.1 PMA reset (1.2294.15)

Resetting the 10BASE-T1L PMA is accomplished by setting bit 1.2294.15 to one. This action shall set all 10BASE-T1L PMA registers to their default states. As a consequence, this action may change the internal state of the 10BASE-T1L PMA and the state of the physical link. This action may also initiate a reset in any other MMDs that are instantiated in the same package. This bit is self-clearing, and the 10BASE-T1L PMA shall return a value of one in bit 1.2294.15 when a reset is in progress; otherwise, it shall return a value of zero. The 10BASE-T1L PMA is not required to accept a write transaction to any of its registers until the reset process is completed. The control and management interface shall be restored to operation within 0.5 s from the setting of bit 1.2294.15.

During a reset, the 10BASE-T1L PMA shall respond to reads from bits 1.2294.15, 1.8.15:14, and 1.0.15. Reads for all other bits are indeterminate, and the values are invalid.

NOTE—This operation may interrupt data communication.

Bit 1.2294.15 is a copy of bit 1.0.15, and setting or clearing either bit shall set or clear the other bit. Setting either bit shall reset the 10BASE-T1L PMA.

45.2.1.186a.2 Transmit disable (1.2294.14)

When bit 1.2294.14 is set to one, the PMA shall disable output on the transmit path. When bit 1.2294.14 is set to zero, the PMA shall enable output on the transmit path.

Bit 1.2294.14 is a copy of bit 1.9.0, and setting or clearing either bit shall set or clear the other bit. Setting either bit shall disable the transmitter.

45.2.1.186a.3 Transmit voltage amplitude control (1.2294.12)

Bit 1.2294.12 is used to set the 2.4 Vpp operating mode when Auto-Negotiation enable bit 7.512.12 is set to zero or if Auto-Negotiation is not implemented. If bit 1.2294.12 is set to one, the PHY shall operate in 2.4 Vpp operating mode according to 146.5.4.1. If bit 1.2294.12 is set to zero, the PHY shall operate in 1.0 Vpp operating mode according to 146.5.4.1. The default value of bit 1.2294.12 is zero. This bit shall be ignored when the Auto-Negotiation enable bit 7.512.12 is set to one.

45.2.1.186a.4 Low-power (1.2294.11)

When the low-power ability is supported, the 10BASE-T1L PMA may be placed into a low-power mode by setting bit 1.2294.11 to one. This action may also initiate a low-power mode in any other MMDs that are instantiated in the same package. The low-power mode is exited by resetting the 10BASE-T1L PMA. The behavior of the 10BASE-T1L PMA in transition to and from the low-power mode is implementation specific, and any interface signals should not be relied upon. While in the low-power mode, the device shall, as a minimum, respond to management transactions necessary to exit the low-power mode. The default value of bit 1.2294.11 is zero.

NOTE—This operation may interrupt data communication. The data path of the 10BASE-T1L PMA, depending on implementation, may take many seconds to run at optimum error ratio after exiting from reset or low-power mode.

Bit 1.2294.11 is a copy of bit 1.0.11, and setting or clearing either bit shall set or clear the other bit. Setting either bit shall put the 10BASE-T1L PMA in low-power mode.

45.2.1.186a.5 EEE enable (1.2294.10)

Bit 1.2294.10 is used to enable EEE functionality when Auto-Negotiation enable bit 7.512.12 is set to zero or if Auto-Negotiation is not implemented. If bit 1.2294.10 is set to one, the PHY shall operate with EEE enabled. If bit 1.2294.10 is set to zero, the PHY shall operate with EEE disabled. This bit shall be ignored when the Auto-Negotiation enable bit 7.512.12 is set to one. The default value of bit 1.2294.10 is zero.

45.2.1.186a.6 Loopback (1.2294.0)

The 10BASE-T1L PMA shall be placed in near-end loopback mode of operation when bit 1.2294.0 is set to one. When in loopback mode, the 10BASE-T1L PMA shall accept data on the transmit path and return it on the receive path. The default value of bit 1.2294.0 is zero. Bit 1.2294.0 is a copy of 1.0.0, and setting or clearing either bit shall set or clear the other bit. Setting either bit shall enable loopback.

45.2.1.186b 10BASE-T1L PMA status register (Register 1.2295)

The assignment of bits in the 10BASE-T1L PMA status register is shown in Table 45–150b.

Table 45–150b—10BASE-T1L PMA status register bit definitions

Bit(s)	Name	Description	R/W ^a
1.2295.15:14	Reserved	Value always 0	RO
1.2295.13	Loopback ability	1 = PHY has loopback ability 0 = PHY has no loopback ability	RO
1.2295.12	2.4 Vpp operating mode ability	1 = PHY has 2.4 Vpp operating mode ability 0 = PHY does not have 2.4 Vpp operating mode ability	RO
1.2295.11	Low-power ability	1 = PMA has low-power ability 0 = PMA does not have low-power ability	RO
1.2295.10	EEE ability	1 = PHY has EEE ability 0 = PHY does not have EEE ability	RO
1.2295.9	Receive fault ability	1 = PMA has the ability to detect a fault condition on the receive path 0 = PMA does not have the ability to detect a fault condition on the receive path	RO
1.2295.8:3	Reserved	Value always 0	RO
1.2295.2	Receive polarity	1 = Receive polarity is reversed 0 = Receive polarity is not reversed	RO
1.2295.1	Receive fault	1 = Fault condition detected 0 = Fault condition not detected	RO/LH
1.2295.0	Receive link status	1 = PMA receive link up 0 = PMA receive link down	RO/LL

^aRO = Read only, LL = Latching low, LH = Latching high**45.2.1.186b.1 Loopback ability (1.2295.13)**

When read as a one, this bit indicates that the 10BASE-T1L PHY supports PMA loopback. When read as a zero, this bit indicates that the 10BASE-T1L PHY does not support PMA loopback.

45.2.1.186b.2 2.4 Vpp operating mode ability (1.2295.12)

When read as a one, this bit indicates that the 10BASE-T1L PHY supports a transmit level of 2.4 Vpp. When read as a zero, this bit indicates that the 10BASE-T1L PHY does not support a transmit level of 2.4 Vpp.

45.2.1.186b.3 Low-power ability (1.2295.11)

When read as a one, bit 1.2295.11 indicates that the 10BASE-T1L PMA supports the low-power ability. When read as a zero, bit 1.2295.11 indicates that the 10BASE-T1L PMA does not support the low-power ability. If the 10BASE-T1L PMA supports the low-power ability, then it is controlled using either bit 1.2294.11 or bit 1.0.11.