802.3ba™

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

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

Amendment 4: Media Access Control Parameters, Physical Layers and Management Parameters for 40 Gb/s and 100 Gb/s Operation

IEEE Computer Society

Sponsored by the
LAN/MAN Standards Committee

IEEE
3 Park Avenue
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22 June 2010

IEEE Std 802.3ba™-2010
(Amendment to
IEEE Std 802.3™-2008)

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LAN/MAN Standards Committee
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IEEE Computer Society

Approved 17 June 2010
IEEE-SA Standards Board

Abstract: This amendment to IEEE Std 802.3-2008 includes changes to IEEE Std 802.3-2008 and adds Clause 80 through Clause 88, Annex 83A through Annex 83C, Annex 85A, and Annex 86A. This amendment includes IEEE 802.3 Media Access Control (MAC) parameters, Physical Layer specifications, and management parameters for the transfer of IEEE 802.3 format frames at 40 Gb/s and 100 Gb/s.

Keywords: 802.3ba, 40 Gb/s Ethernet, 40GBASE-CR4, 40GBASE-KR4, 40GBASE-LR4, 40GBASE-R, 40GBASE-SR4, 100 Gb/s Ethernet, 100GBASE-CR10, 100GBASE-ER4, 100GBASE-LR4, 100GBASE-R, 100GBASE-SR10, AN, Auto-Negotiation, Backplane, BP, CAUI, CGMII, CPPI, FEC, MMF, SMF, Optical Transport Network, OTN, XLAUI, XLGMII, XLPPI

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PDF: ISBN 978-0-7381-6322-2 STD96079
Print: ISBN 978-0-7381-6323-9 STDPD96079

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Introduction

This introduction is not part of IEEE Std 802.3ba-2010, IEEE Standard for Information technology—Telecommunications and information exchange between systems—Local and metropolitan area networks—Specific requirements, Part 3: CSMA/CD Access Method and Physical Layer Specifications, Amendment 4: Media Access Control Parameters, Physical Layers and Management Parameters for 40 Gb/s and 100 Gb/s Operation.

IEEE Std 802.3™ was first published in 1985. Since the initial publication, many projects have added functionality or provided maintenance updates to the specifications and text included in the standard. Each IEEE 802.3 project/amendment is identified with a suffix (e.g., IEEE Std 802.3ba-2010).

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

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

At the date of IEEE Std 802.3ba-2010 publication, IEEE Std 802.3 is comprised of the following documents:

IEEE Std 802.3-2008

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

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

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

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

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

Clause 68 specifies a 10 Gb/s Physical Layer specification. Clause 69 through Clause 74 and associated annexes specify Ethernet operation over electrical backplanes at speeds of 1000 Mb/s and 10 Gb/s.

IEEE Std 802.3av™-2009

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

IEEE Std 802.3bc™-2009

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

IEEE Std 802.3at™-2009

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

IEEE Std 802.3-2008™/Cor 1-2009

This corrigendum corrects the PAUSE reaction timing delay value for the 10GBASE-T PHY type.

IEEE Std 802.3ba™-2010

This amendment includes changes to IEEE Std 802.3-2008 and adds Clause 80 through Clause 88 and Annex 83A through Annex 83C, Annex 85A, and Annex 86A. This amendment adds MAC parameters, Physical Layers, and management parameters for the transfer of IEEE 802.3 format frames at 40 Gb/s and 100 Gb/s.

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

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Special symbols and operators

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

Contents

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

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

Amendment 4: Media Access Control Parameters, Physical Layers, and Management Parameters for 40 Gb/s and 100 Gb/s Operation

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

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

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

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

1. Introduction

1.1.3.2 Compatibility interfaces

Insert the following new compatibility interfaces to the end of the list as follows:

i) *40 Gigabit Media Independent Interface (XLGMII).* The XLGMII is designed to connect a 40 Gb/s capable MAC to a 40 Gb/s PHY. While conformance with implementation of this interface is not necessary to ensure communication, it allows flexibility in intermixing PHYs and DTEs at 40 Gb/s speeds. The XLGMII is a logical interconnection intended for use as an intra-chip interface. No mechanical connector is specified for use with the XLGMII. The XLGMII is optional.

j) *40 Gigabit Attachment Unit Interface (XLAUI).* The XLAUI is a physical instantiation of the PMA service interface to extend the connection between 40 Gb/s capable PMAs. While conformance with implementation of this interface is not necessary to ensure communication, it is recommended, since it allows maximum flexibility in intermixing PHYs and DTEs at 40 Gb/s speeds. The XLAUI is intended for use as a chip-to-chip or a chip-to-module interface. No mechanical connector is specified for use with the XLAUI. The XLAUI is optional.

k) *40 Gigabit Parallel Physical Interface (XLPPI)*. The XLPPI is provided as a physical instantiation of the PMD service interface for 40GBASE-SR4 and 40GBASE-LR4 PMDs. The XLPPI has four lanes. While conformance with implementation of this interface is not necessary to ensure communication, it allows flexibility in connecting the 40GBASE-SR4 or 40GBASE-LR4 PMDs. The XLPPI is intended for use as a chip-to-module interface. No mechanical connector is specified for use with the XLPPI. The XLPPI is optional.

l) *100 Gigabit Media Independent Interface (CGMII).* The CGMII is designed to connect a 100 Gb/s capable MAC to a 100 Gb/s PHY. While conformance with implementation of this interface is not necessary to ensure communication, it allows flexibility in intermixing PHYs and DTEs at 100 Gb/s speeds. The CGMII is a logical interconnection intended for use as an intra-chip interface. No mechanical connector is specified for use with the CGMII. The CGMII is optional.

m) *100 Gigabit Attachment Unit Interface (CAUI).* The CAUI is a physical instantiation of the PMA service interface to extend the connection between 100 Gb/s capable PMAs. While conformance with implementation of this interface is not necessary to ensure communication, it is recommended, since it allows maximum flexibility in intermixing PHYs and DTEs at 100 Gb/s speeds. The CAUI is intended for use as a chip-to-chip or a chip-to-module interface. No mechanical connector is specified for use with the CAUI. The CAUI is optional.

n) *100 Gigabit Parallel Physical Interface (CPPI)*. The CPPI is provided as a physical instantiation of the PMD service interface for 100GBASE-SR10 PMDs. The CPPI has ten lanes. While conformance with implementation of this interface is not necessary to ensure communication, it allows flexibility in connecting the 100GBASE-SR10 PMDs. The CPPI is intended for use as a chip-to-module interface. No mechanical connector is specified for use with the CPPI. The CPPI is optional.

1.2.3 Physical Layer and media notation

Change the example in last paragraph of 1.2.3 as follows:

The data rate, if only a number, is in Mb/s, and if suffixed by a "G", is in Gb/s. The modulation type (e.g., BASE) indicates how encoded data is transmitted on the medium. The additional distinction may identify characteristics of transmission or medium and, in some cases, the type of PCS encoding used (~~e.g., examples~~ of additional distinctions are "T" for twisted pair, ~~"S"~~ "B" for ~~short wavelength~~ bidirectional optics, and "X" for a block PCS coding used for that speed of operation). Expansions for defined Physical Layer types are included in 1.4.

