IEEE STANDARDS ASSOCIATION

IEEE Standard for Ethernet

Amendment 1: Physical Layer Specifications and Management Parameters for 2.5 Gb/s and 5 Gb/s Operation over Backplane

IEEE Computer Society

Sponsored by the
LAN/MAN Standards Committee

IEEE
3 Park Avenue
New York, NY 10016-5997
USA

IEEE Std 802.3cb™-2018
(Amendment to IEEE Std 802.3™-2018)

IEEE Std 802.3cb™-2018
(Amendment to IEEE Std 802.3™-2018)

IEEE Standard for Ethernet

Amendment 1: Physical Layer Specifications and Management Parameters for 2.5 Gb/s and 5 Gb/s Operation over Backplane

Sponsor

LAN/MAN Standards Committee
of the
IEEE Computer Society

Approved 27 September 2018

IEEE-SA Standards Board

Abstract: Ethernet Media Access Control (MAC) parameters, Physical Layer specifications, and management objects for the serial transfer of Ethernet format frames at 2.5 Gb/s and 5 Gb/s over electrical backplanes are defined in this amendment to IEEE Std 802.3-2018.

Keywords: 2.5 Gigabit Ethernet, 5 Gigabit Ethernet, 2.5GBASE-KX, 2.5GBASE-X, 5GBASE-KR, 5GBASE-R, amendment, AN, Auto-Negotiation, Backplane Ethernet, BASE-R, BASE-X, EEE, Energy Efficient Ethernet, Ethernet, IEEE 802.3™, IEEE 802.3cb™

The Institute of Electrical and Electronics Engineers, Inc.
3 Park Avenue, New York, NY 10016-5997, USA

PDF: ISBN 978-1-5044-5278-6 STD23391
Print: ISBN 978-1-5044-5279-3 STDPD23391

Important Notices and Disclaimers Concerning IEEE Standards Documents

IEEE documents are made available for use subject to important notices and legal disclaimers. These notices and disclaimers, or a reference to this page, appear in all standards and may be found under the heading "Important Notices and Disclaimers Concerning IEEE Standards Documents." They can also be obtained on request from IEEE or viewed at http://standards.ieee.org/ipr/disclaimers.html.

Notice and Disclaimer of Liability Concerning the Use of IEEE Standards Documents

IEEE Standards documents (standards, recommended practices, and guides), both full-use and trial-use, are developed within IEEE Societies and the Standards Coordinating Committees of the IEEE Standards Association ("IEEE SA") Standards Board. IEEE ("the Institute") develops its standards through a consensus development process, approved by the American National Standards Institute ("ANSI"), which brings together volunteers representing varied viewpoints and interests to achieve the final product. IEEE Standards are documents developed through scientific, academic, and industry-based technical working groups. Volunteers in IEEE working groups are not necessarily members of the Institute and participate without compensation from IEEE. While IEEE administers the process and establishes rules to promote fairness in the consensus development process, IEEE does not independently evaluate, test, or verify the accuracy of any of the information or the soundness of any judgments contained in its standards.

IEEE Standards do not guarantee or ensure safety, security, health, or environmental protection, or ensure against interference with or from other devices or networks. Implementers and users of IEEE Standards documents are responsible for determining and complying with all appropriate safety, security, environmental, health, and interference protection practices and all applicable laws and regulations.

IEEE does not warrant or represent the accuracy or content of the material contained in its standards, and expressly disclaims all warranties (express, implied and statutory) not included in this or any other document relating to the standard, including, but not limited to, the warranties of: merchantability; fitness for a particular purpose; non-infringement; and quality, accuracy, effectiveness, currency, or completeness of material. In addition, IEEE disclaims any and all conditions relating to: results; and workmanlike effort. IEEE standards documents are supplied "AS IS" and "WITH ALL FAULTS."

Use of an IEEE standard is wholly voluntary. The existence of an IEEE standard does not imply that there are no other ways to produce, test, measure, purchase, market, or provide other goods and services related to the scope of the IEEE standard. Furthermore, the viewpoint expressed at the time a standard is approved and issued is subject to change brought about through developments in the state of the art and comments received from users of the standard.

In publishing and making its standards available, IEEE is not suggesting or rendering professional or other services for, or on behalf of, any person or entity, nor is IEEE undertaking to perform any duty owed by any other person or entity to another. Any person utilizing any IEEE Standards document, should rely upon his or her own independent judgment in the exercise of reasonable care in any given circumstances or, as appropriate, seek the advice of a competent professional in determining the appropriateness of a given IEEE standard.

IN NO EVENT SHALL IEEE BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO: PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE PUBLICATION, USE OF, OR RELIANCE UPON ANY STANDARD, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE AND REGARDLESS OF WHETHER SUCH DAMAGE WAS FORESEEABLE.

Translations

The IEEE consensus development process involves the review of documents in English only. In the event that an IEEE standard is translated, only the English version published by IEEE should be considered the approved IEEE standard.

Official statements

A statement, written or oral, that is not processed in accordance with the IEEE-SA Standards Board Operations Manual shall not be considered or inferred to be the official position of IEEE or any of its committees and shall not be considered to be, or be relied upon as, a formal position of IEEE. At lectures, symposia, seminars, or educational courses, an individual presenting information on IEEE standards shall make it clear that his or her views should be considered the personal views of that individual rather than the formal position of IEEE.

Comments on standards

Comments for revision of IEEE Standards documents are welcome from any interested party, regardless of membership affiliation with IEEE. However, IEEE does not provide consulting information or advice pertaining to IEEE Standards documents. Suggestions for changes in documents should be in the form of a proposed change of text, together with appropriate supporting comments. Since IEEE standards represent a consensus of concerned interests, it is important that any responses to comments and questions also receive the concurrence of a balance of interests. For this reason, IEEE and the members of its societies and Standards Coordinating Committees are not able to provide an instant response to comments or questions except in those cases where the matter has previously been addressed. For the same reason, IEEE does not respond to interpretation requests. Any person who would like to participate in revisions to an IEEE standard is welcome to join the relevant IEEE working group.

Comments on standards should be submitted to the following address:

Secretary, IEEE-SA Standards Board
445 Hoes Lane
Piscataway, NJ 08854 USA

Laws and regulations

Users of IEEE Standards documents should consult all applicable laws and regulations. Compliance with the provisions of any IEEE Standards document does not imply compliance to any applicable regulatory requirements. Implementers of the standard are responsible for observing or referring to the applicable regulatory requirements. IEEE does not, by the publication of its standards, intend to urge action that is not in compliance with applicable laws, and these documents may not be construed as doing so.

Copyrights

IEEE draft and approved standards are copyrighted by IEEE under U.S. and international copyright laws. They are made available by IEEE and are adopted for a wide variety of both public and private uses. These include both use, by reference, in laws and regulations, and use in private self-regulation, standardization, and the promotion of engineering practices and methods. By making these documents available for use and adoption by public authorities and private users, IEEE does not waive any rights in copyright to the documents.

Photocopies

Subject to payment of the appropriate fee, IEEE will grant users a limited, non-exclusive license to photocopy portions of any individual standard for company or organizational internal use or individual, non-commercial use only. To arrange for payment of licensing fees, please contact Copyright Clearance Center, Customer Service, 222 Rosewood Drive, Danvers, MA 01923 USA; +1 978 750 8400. Permission to photocopy portions of any individual standard for educational classroom use can also be obtained through the Copyright Clearance Center.

Updating of IEEE Standards documents

Users of IEEE Standards documents should be aware that these documents may be superseded at any time by the issuance of new editions or may be amended from time to time through the issuance of amendments, corrigenda, or errata. An official IEEE document at any point in time consists of the current edition of the document together with any amendments, corrigenda, or errata then in effect.

Every IEEE standard is subjected to review at least every ten years. When a document is more than ten years old and has not undergone a revision process, it is reasonable to conclude that its contents, although still of some value, do not wholly reflect the present state of the art. Users are cautioned to check to determine that they have the latest edition of any IEEE standard.

In order to determine whether a given document is the current edition and whether it has been amended through the issuance of amendments, corrigenda, or errata, visit the IEEE-SA Website at http://ieeexplore.ieee.org or contact IEEE at the address listed previously. For more information about the IEEE SA or IEEE's standards development process, visit the IEEE-SA Website at http://standards.ieee.org.

Errata

Errata, if any, for all IEEE standards can be accessed on the IEEE-SA Website at the following URL: http://standards.ieee.org/findstds/errata/index.html. Users are encouraged to check this URL for errata periodically.

Patents

Attention is called to the possibility that implementation of this standard may require use of subject matter covered by patent rights. By publication of this standard, no position is taken by the IEEE with respect to the existence or validity of any patent rights in connection therewith. If a patent holder or patent applicant has filed a statement of assurance via an Accepted Letter of Assurance, then the statement is listed on the IEEE-SA Website at http://standards.ieee.org/about/sasb/patcom/patents.html. Letters of Assurance may indicate whether the Submitter is willing or unwilling to grant licenses under patent rights without compensation or under reasonable rates, with reasonable terms and conditions that are demonstrably free of any unfair discrimination to applicants desiring to obtain such licenses.

Essential Patent Claims may exist for which a Letter of Assurance has not been received. The IEEE is not responsible for identifying Essential Patent Claims for which a license may be required, for conducting inquiries into the legal validity or scope of Patents Claims, or determining whether any licensing terms or conditions provided in connection with submission of a Letter of Assurance, if any, or in any licensing agreements are reasonable or non-discriminatory. Users of this standard are expressly advised that determination of the validity of any patent rights, and the risk of infringement of such rights, is entirely their own responsibility. Further information may be obtained from the IEEE Standards Association.

Participants

The following individuals were officers and members of the IEEE 802.3 Working Group at the beginning of the IEEE P802.3cb Working Group ballot.

David J. Law, *IEEE 802.3 Working Group Chair*
Adam Healey, *IEEE 802.3 Working Group Vice-Chair*
Peter Anslow, *IEEE 802.3 Working Group Secretary*
Steven B. Carlson, *IEEE 802.3 Working Group Executive Secretary*
Valerie Maguire, *IEEE 802.3 Working Group Treasurer*

Yong Kim, *IEEE P802.3cb Task Force Chair, Phase 1**
Daniel F. Smith, *IEEE P802.3cb Task Force Chair, Phase 2*
William Lo, *IEEE P802.3cb Task Force Editor-in-Chief, Phase 1*
Daniel F. Smith, *IEEE P802.3cb Task Force Editor-in-Chief, Phase 2*
Jim Hatfield, *IEEE P802.3cb Task Force Editor, Phase 2**

Justin Abbott
David Abramson
Shadi Abughazaleh
Mohammad Ahmed
Eric Baden
Amrik Bains
Thananya Baldwin
Denis Beaudoin
Christian Beia
Michael Bennett
Vipul Bhatt
William Bliss
Brad Booth
Martin Bouda
Ralf-Peter Braun
Theodore Brillhart
Paul Brooks
Alan Brown
Matthew Brown
Chris Bullock
Jairo Bustos Heredia
Adrian Butter
Francesco Caggioni
Anthony Calbone
Clark Carty
Craig Chabot
Geoffrey Chace Simpson
Mandeep Chadha
David Chalupsky
Jacky Chang
Xin Chang
Ahmad Chini
Keng Hua Chuang
Christopher R. Cole
John D'Ambrosia
Yair Darshan
Piers Dawe
Fred Dawson
Wael Diab
Eric DiBiaso
John Dillard
Daniel Dillow
Thuyen Dinh
Curtis Donahue
Dan Dove
Mike Dudek
David Dwelley
Frank Effenberger
Hesham Elbakoury
David Estes
John Ewen
Ramin Farjad
Shahar Feldman
James Fife
Alan Flatman
Matthias Fritsche
Richard Frosch
Andrew Gardner
Claude Gauthier
Ali Ghiasi
Joel Goergen
Volker Goetzfried
Zhigang Gong
Steven Gorshe
Robert Grow
Mark Gustlin
Marek Hajduczenia
Takehiro Hayashi
Yasuo Hidaka
Rita Horner
Bernd Horrmeyer
Victor Hou
Yasuhiro Hyakutake
Hideki Isono
Tom Issenhuth
Kenneth Jackson
Andrew Jimenez
Chad Jones
Peter Jones
Manabu Kagami
Ukon Kanai
Keisuke Kawahara
Takaki Kawatsu
Michael Kelsen
Scott Kipp
Michael Klempa
Curtis Knittle
Shigeru Kobayashi
Daniel Koehler
Paul Kolesar
Tom Kolze
Glen Kramer
Hans Lackner
Jeffrey Lapak
Mark Laubach
Han Hyub Lee
David Lewis
Jon Lewis
Mike Peng Li
Jane Lim
Dekun Liu
Hai-Feng Liu
Miklos Lukacs
Kent Lusted
Jeffery Maki
David Malicoat
Yonatan Malkiman
Arthur Marris
Takeo Masuda
Erdem Matoglu
Naoki Matsuda
Mick McCarthy
Brett McClellan
Thomas McDermott
John McDonough
Larry McMillan
Richard Mei
Richard Mellitz
Bryan Moffitt
Ardeshir Mohammadian
Paul Mooney

* Not a member of the IEEE 802.3 working group at the beginning of the working group ballot.

Dale Murray
Henry Muyshondt
James Nadolny
Edward Nakamoto
Gary Nicholl
Kevin Noll
Mark Nowell
David Ofelt
Thomas Palkert
Hui Pan
Sesha Panguluri
Vasu Parthasarathy
Petar Pepeljugoski
Gerald Pepper
Ruben Perez De Aranda Alonso
Michael Peters
Phong Pham
Jean Picard
William Powell
Rick Rabinovich
Adee Ran
Alon Regev
Duane Remein
Victor Renteria
Christopher Roth
Salvatore Rotolo
Toshiaki Sakai
Jorge Salinger
Sam Sambasivan
Edward Sayre
Dieter Schicketanz
Fred Schindler
Hossein Sedarat
Naoshi Serizawa
Masood Shariff
Ramin Shirani
Tom Skaar
Jeff Slavick
Scott Sommers
Yoshiaki Sone
Tom Souvignier
Peter Stassar
Heath Stewart
Robert Stone
David Stover
Junqing Sun
Ken-Ichi Suzuki
Steve Swanson
Andre Szczepanek
William Szeto
Bharat Tailor
Takayuki Tajima
Satoshi Takahashi
Kohichi Tamura
Brian Teipen
Geoffrey Thompson
Pirooz Tooyserkani
Albert Tretter
Stephen Trowbridge
Yoshihiro Tsukamoto
Ed Ulrichs
Alexander Umnov
Sterling A. Vaden
Stefano Valle
Paul Vanderlaan
Robert Wagner
Dylan Walker
Haifei Wang
Roy Wang
Tongtong Wang
Xinyuan Wang
Matthias Wendt
Oded Wertheim
Natalie Wienckowski
Ludwig Winkel
Peter Wu
Dayin Xu
Yu Xu
Jun Xu
Lennart Yseboodt
Hayato Yuki
Andrew Zambell
Yan Zhuang
George Zimmerman

The following members of the individual balloting committee voted on this amendment. Balloters may have voted for approval, disapproval, or abstention.

Shadi Abughazaleh
Thomas Alexander
Peter Anslow
Butch Anton
Amrik Bains
Ralf-Peter Braun
Nancy Bravin
Theodore Brillhart
Matthew Brown
Demetrio Bucaneg
Jairo Bustos Heredia
William Byrd
Steven B. Carlson
Juan Carreon
Mandeep Chadha
Keith Chow
Keng Hua Chuang
Charles Cook
Rodney Cummings
Sourav Dutta
Michael Fischer
Matthias Fritsche
Yukihiro Fujimoto
Zhigang Gong
James Graba
Eric W. Gray
Randall Groves
Robert Grow
Michael Gundlach
Marek Hajduczenia
Adam Healey
Marco Hernandez
David Hess
Werner Hoelzl
Rita Horner
C. Huntley
Noriyuki Ikeuchi
Atsushi Ito
Raj Jain
SangKwon Jeong
Piotr Karocki
Stuart Kerry
Yong Kim
Mark Laubach
David J. Law
Jon Lewis
Mike Peng Li
Elvis Maculuba
Valerie Maguire
Jeffery Maki
Arthur Marris
Mick McCarthy
Brett McClellan
Thomas McDermott
Larry McMillan
Richard Mellitz
Charles Moorwood
Michael Newman
Nick S. A. Nikjoo
Paul Nikolich
Satoshi Obara
Thomas Palkert
Bansi Patel
Arumugam Paventhan
Michael Peters
Rick Pimpinella
Adee Ran
Alon Regev
Maximilian Riegel
Robert Robinson
Benjamin Rolfe
Daniel F. Smith
Thomas Starai
Walter Struppler
Mitsutoshi Sugawara
Junqing Sun
Geoffrey Thompson
Michael Thompson
Steven Tilden
David Tremblay
Mark-Rene Uchida
Alexander Umnov
Paul Vanderlaan
George Vlantis
Khurram Waheed
Lisa Ward
Karl Weber
Andreas Wolf
Peter Wu
Jun Xu
Oren Yuen
Zhen Zhou

When the IEEE-SA Standards Board approved this amendment on 27 September 2018, it had the following membership:

Jean-Philippe Faure, *Chair*
Gary Hoffman, *Vice Chair*
John D. Kulick, *Past Chair*
Konstantinos Karachalios, *Secretary*

Ted Burse
Guido R. Hiertz
Christel Hunter
Joseph L. Koepfinger*
Thomas Koshy
Hung Ling
Dong Liu
Xiaohui Liu
Kevin Lu
Daleep Mohla
Andrew Myles
Paul Nikolich
Ronald C. Petersen
Annette D. Reilly
Robby Robson
Dorothy Stanley
Mehmet Ulema
Phil Wennblom
Philip Winston
Howard Wolfman
Jingyi Zhou

*Member Emeritus

Introduction

This introduction is not part of IEEE Std 802.3cb-2018, IEEE Standard for Ethernet—Amendment 1: Physical Layer Specifications and Management Parameters for 2.5 Gb/s and 5 Gb/s Operation over Backplane.

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 802.3cb-2018, 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 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.

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.

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

IEEE Standard for Ethernet

Amendment 1: Physical Layer Specifications and Management Parameters for 2.5 Gb/s and 5 Gb/s Operation over Backplane

[This amendment is based on IEEE Std 802.3™-2018.]

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. 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.