

# IEEE Standard for Ethernet

## Amendment 2: Physical Layer and Management Parameters for Power over Ethernet over 4 pairs

IEEE Computer Society

Sponsored by the  
LAN/MAN Standards Committee

**IEEE Std 802.3bt™-2018**  
(Amendment to IEEE Std 802.3™-2018  
as amended by IEEE Std 802.3cb™-2018)

# **IEEE Standard for Ethernet**

## **Amendment 2: Physical Layer and Management Parameters for Power over Ethernet over 4 Pairs**

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

Approved 27 September 2018

**IEEE-SA Standards Board**

**Abstract:** The maximum Powered Device (PD) power available is increased by this amendment to IEEE Std 802.3-2018 by utilizing all four pairs in the specified structured wiring plant. This represents a substantial change to the capabilities of Ethernet with standardized power. The power classification information exchanged during negotiation is extended to allow meaningful power management capability. These enhancements solve the problem of higher power and more efficient standardized Power over Ethernet (PoE) delivery systems.

**Keywords:** amendment, DTE power via MDI, Ethernet, IEEE 802.3™, IEEE 802.3bt™, PoE, Power over Ethernet

*This standard is dedicated to the memory  
of our friend and colleague Martin Patoka.*

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**Pete 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*

**Chad Jones**, *IEEE P802.3bt DTE Power via MDI over 4-Pair Task Force Chair*  
**Koussalya Balasubramanian**<sup>1</sup>, *IEEE P802.3bt DTE Power via MDI over 4-Pair Task Force  
Chief Editor (1st phase)*

**Lennart Yseboodt**, *IEEE P802.3bt DTE Power via MDI over 4-Pair Task Force  
Chief Editor (2nd phase)*

**David Abramson**, *IEEE P802.3bt DTE Power via MDI over 4-Pair Task Force Comment Editor*

Justin Abbott	Yair Darshan	Rita Horner
Shadi Abughazaleh	Piers Dawe	Bernd Horrmeyer
Mohammad Ahmed	Fred Dawson	Victor Hou
Eric Baden	Wael Diab	Yasuhiro Hyakutake
Amrik Bains	Eric DiBiaso	Hideki Isono
Thananya Baldwin	John Dillard	Tom Issenhuth
Denis Beaudoin	Daniel Dillow	Kenneth Jackson
Christian Beia	Thuyen Dinh	Andrew Jimenez
Michael Bennett	Curtis Donahue	Peter Jones
Vipul Bhatt	Dan Dove	Manabu Kagami
William Bliss	Mike Dudek	Upen Kareti
Brad Booth	David Dwelley	Keisuke Kawahara
Martin Bouda	Frank Effenberger	Yasuaki Kawatsu
Ralf-Peter Braun	Hesham Elbakoury	Michael Kelsen
Theodore Brillhart	David Estes	Scott Kipp
Paul Brooks	John Ewen	Michael Klempa
Alan Brown	Ramin Farjad	Curtis Knittle
Matthew Brown	Shahar Feldman	Shigeru Kobayashi
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Jairo Bustos Heredia	Alan Flatman	Paul Kolesar
Adrian Butter	Matthias Fritsche	Tom Kolze
Francesco Caggioni	Richard Frosch	Glen Kramer
Anthony Calbone	Andrew Gardner	Hans Lackner
Clark Carty	Claude Gauthier	Jeffrey Lapak
Craig Chabot	Ali Ghiasi	Mark Laubach
Geoffrey Chacon Simon	Joel Goergen	Han Hyub Lee
Mandeep Chadha	Volker Goetzfried	David Lewis
David Chalupsky	Zhigang Gong	Jon Lewis
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Keng Hua Chuang	Marek Hajduczenia	Hai-Feng Liu
Christopher R. Cole	Takehiro Hayashi	William Lo
John D'Ambrosia	Yasuo Hidaka	Miklos Lukacs
		Kent Lusted

<sup>1</sup>Not a member of the IEEE 802.3 working group at the beginning of the working group ballot.

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  
Dale Murray  
Henry Muysshondt  
James Nadolny  
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Gary Nicholl  
Kevin Noll  
Mark Nowell  
David Ofelt  
Thomas Palkert  
Hui Pan  
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Vasu Parthasarathy  
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Salvatore Rotolo  
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Sam Sambasivan  
Edward Sayre  
Dieter Schicketanz  
Fred Schindler  
Hossein Sedarat  
Naoshi Serizawa  
Masood Shariff  
ramin Shirani  
Tom Skaar  
Jeff Slavick  
Daniel Smith  
Scott Sommers  
Yoshiaki Sone  
Tom Souvignier  
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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  
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Dylan Walker  
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Tongtong Wang  
Xinyuan Wang  
Matthias Wendt  
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Ludwig Winkel  
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Dayin Xu  
Yu Xu  
Jun Yi  
Hayato Yuki  
Andrew Zambell  
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George Zimmerman

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Iwan Adhicandra	Atsushi Ito	Maximilian Riegel
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Chris Bullock	Joris Lemahieu	Kohichi Tamura
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## Introduction

This introduction is not part of IEEE Std 802.3bt-2018, IEEE Standard for Ethernet—Amendment 2: Physical Layer and Management Parameters for Power over Ethernet over 4 Pairs.

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 802.3bt-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 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 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.

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

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# IEEE Standard for Ethernet

## Amendment 2: Physical Layer and Management Parameters for Power over Ethernet over 4 Pairs

[This amendment is based on IEEE Std 802.3™-2018 as amended by IEEE Std 802.3cb™-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 ~~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.<sup>1</sup>

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