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

Part 3: **Standard for Ethernet**

AMENDMENT 2: Physical layer and management parameters for power over Ethernet over 4 pairs

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

Partie 3: Norme pour Ethernet

AMENDEMENT 2: Couche physique et paramètres de gestion pour la puissance par ethernet sur 4 paires

Reference number
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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

Sponsor

LAN/MAN Standards Committee
of the
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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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

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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 ~~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.

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1. Introduction

1.3 Normative references

Insert the following reference into 1.3 in alphanumeric order:

ANSI/TIA-568.0-D, Generic Telecommunications Cabling for Customer Premises.[2]

1.4 Definitions

Insert the following new term and definition, 1.4.139a, after 1.4.139 "agile device":

1.4.139a ampacity: The maximum current, in ampere, that a conductor can carry continuously under the conditions of use without exceeding its temperature rating.

Insert the following new term and definition, 1.4.236a, after 1.4.236 "dual duplex":

1.4.236a dual-signature PD: A PD that has independent detection signatures, class signatures, and maintain power signatures on each pairset. (See IEEE Std 802.3, Clause 145.)

Insert the following new term and definition, 1.4.287a, after 1.4.287 "Idle mode":

1.4.287a IEEE 802.3 Power over Ethernet (IEEE 802.3 PoE): A system consisting of one PSE and one PD that provides power across balanced twisted-pair cabling. (See IEEE Std 802.3, Clause 33 and Clause 145.)

Change 1.4.308 as follows:

1.4.308 link section: ~~The point-to-point medium connection between the active PSE Power Interface (PI) and the PD PI.~~ The portion of the link between the PSE Power Interface (PI) and the PD PI.

Insert the following new term and definition, 1.4.374a, after 1.4.374 "page":

1.4.374a pairset: Either of the two valid 4-conductor connections, Alternative A or Alternative B, as listed in IEEE Std 802.3, 145.2.4. The PSE Alternative A and Alternative B connections are referred to as Mode A and Mode B, respectively, at the PD.

Change 1.4.407 as follows:

1.4.407 Power Sourcing Equipment (PSE): ~~A DTE or midspan device that provides the power to a single link section. PSEs are defined for use with two different types of balanced twisted-pair PHYs. When used with 2 or 4 pair balanced twisted-pair (BASE-T) PHYs, (see IEEE Std 802.3, Clause 33), DTE powering is intended to provide a single 10BASE-T, 100BASE-TX, or 1000BASE-T device with a unified interface for both the data it requires and the power to process these data. When used with single balanced twisted-pair (BASE-T1) PHYs (see IEEE Std 802.3, Clause 104), DTE powering is intended to provide a single 100BASE-T1 or 1000BASE-T1 device with a unified interface for both the data it requires and the power to process these data. A PSE used with balanced single twisted-pair PHYs is also referred to as a PoDL PSE.~~ A DTE or midspan device that provides power to a single link section, which may also carry data (for 2 or

[2] ANSI/TIA publications are available from the IHS Standards Store (http://global.ihs.com/) or from the Telecommunications Industry Association (http://www.tiaonline.org).

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4 pair systems, see IEEE Std 802.3, Clause 33 and Clause 145; for single pair systems, see IEEE Std 802.3, Clause 104).

Insert the following new term and definition, 1.4.453a, after 1.4.453 "single-port device":

1.4.453a single-signature PD: A PD that simultaneously shares the same detection signature, class signature, and maintain power signature between both pairsets. (See IEEE Std 802.3, Clause 145.)

Change 1.4.488, 1.4.489, 1.4.490, and 1.4.491 as follows:

1.4.488 Type 1 PD: A PD that ~~provides a Class 0, 1, 2, or 3 signature~~ requests Class 0 to Class 3 during Physical Layer classification, and that is not a PoDL PD. (See IEEE Std 802.3, Clause 33.)

1.4.489 Type 1 PSE: A PSE that supports ~~only a Type 1 PD~~ Class 0 to Class 3 power levels and provides power over 2 pairs. (See IEEE Std 802.3, Clause 33.)

1.4.490 Type 2 PD: A PD that ~~provides a Class 4 signature during Physical Layer classification, understands 2-Event classification, and is capable of Data Link Layer classification~~ requests Class 4 during Physical Layer classification, supports 2-Event Classification, and supports Data Link Layer classification. (See IEEE Std 802.3, Clause 33.)

1.4.491 Type 2 PSE: A PSE that supports ~~both a Type 1 and a Type 2 PD~~ Class 0 to Class 4 power levels and provides power over 2 pairs. (See IEEE Std 802.3, Clause 33.)

Insert the following new terms and definitions, 1.4.491a to 1.4.491d, after 1.4.491 "Type 2 PSE":

1.4.491a Type 3 PD: A single-signature PD that requests Class 1 to Class 6, or a dual-signature PD that requests Class 1 to Class 4 on both Modes, during Physical Layer classification. Additionally, the PD implements Multiple-Event classification and accepts power on both Modes simultaneously. (See IEEE Std 802.3, Clause 145.)

1.4.491b Type 3 PSE: A PSE that supports up to Class 6 power levels, supports short MPS, and may support 4-pair power. (See IEEE Std 802.3, Clause 145.)

1.4.491c Type 4 PD: A single-signature PD that requests Class 7 or Class 8, or a dual-signature PD that request Class 5 on at least one Mode, during Physical Layer classification. Additionally, the PD implements Multiple-Event classification, is capable of Data Link Layer classification, and accepts power on both Modes simultaneously. (See IEEE Std 802.3, Clause 145.)

1.4.491d Type 4 PSE: A PSE that supports at least Class 7 power levels, in addition to lower PD Classes, short MPS, and 4-pair power. (See IEEE Std 802.3, Clause 145.)

Delete the definitions for I_{Port} (1.4.294), V_{PD} (1.4.502), and V_{PSE} (1.4.503).

1.5 Abbreviations

Insert the following new abbreviation into 1.5 in alphabetic order:

PoE Power over Ethernet

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