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5 **Draft Standard for**
6 **Local and metropolitan area networks—**
7 **Timing and Synchronization for**
8 **Time-Sensitive Applications**

9 **Amendment: Support for the IEEE Std 802.3**
10 **Clause 4 Media Access Control (MAC) operating in**
11 **half-duplex**

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2 This draft standard is an amendment. The scope of changes to the base standard is thus strictly limited, as
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34 A vote of "Approve" on this draft is also an affirmation by the balloter that the PAR is still valid.

1 **Project Authorization Request, Scope, Purpose, and Criteria for Standards** 2 **Development (CSD)**

3 The complete amendment PAR, as approved by IEEE NesCom 23 February 2022, can be found at:

4 <https://development.standards.ieee.org/myproject-web/public/view.html#pardetail/9522>

5 The ‘Scope of the Proposed changes’ and the ‘Need for the Project’ specify the changes to be made by this
6 amendment (see below).

7 **Scope of the Proposed changes:**

8 This amendment specifies protocols, procedures, and managed objects that support IEEE Std 802.3 Clause
9 4 Media Access Control (MAC) operating in half-duplex while retaining existing functionality and backward
10 compatibility, and remaining a profile of IEEE Std 1588™-2019.

11 This amendment addresses errors and omissions in the description of existing functionality.

12 **Need for the Project:**

13 Support is needed in applications such as automotive in-vehicle networks and industrial automation networks
14 for the IEEE Std 802.3 Clause 4 MAC operating in half-duplex, including those using links with the
15 10BASE-T1S PHY in either point-to-point or multidrop half-duplex mode recently introduced by IEEE Std
16 802.3cg-2019.

17 **Criteria for Standards Development:**

18 The complete Criteria for Standards Development (CSD) can be found at:

19 <https://mentor.ieee.org/802-ec/dcn/21/ec-21-0308-00-ACSD-p802-1asds.pdf>

20

1

2 **Draft IEEE Standard for** 3 **Local and metropolitan area networks—**

4 **Timing and Synchronization for Time-** 5 **Sensitive Applications**

6 **Amendment: Support for the IEEE Std 802.3** 7 **Clause 4 Media Access Control (MAC) operating in** 8 **half-duplex**

9 [This amendment is based on IEEE Std 802.1AS™-20xx (IEEE Std 802.1AS™-2020 Revision).

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

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19 changes will be incorporated into the base standard.¹

20

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P802.1ASds/D0.5
June 17, 2024

(Amendment to IEEE Std 802.1AS™-202x)

Draft IEEE Standard for Local and metropolitan area networks—

Timing and Synchronization for Time-Sensitive Applications

Amendment: Support for the IEEE Std 802.3 Clause 4 Media Access Control (MAC) operating in half-duplex

Prepared by the
Time-Sensitive Networking (TSN) Task Group of IEEE 802.1

Sponsor
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1 **Abstract:** This amendment to IEEE Std 802.1AS™-2020 specifies protocols, procedures, and
2 managed objects that support IEEE Std 802.3 Clause 4 Media Access Control (MAC) operating in
3 half-duplex while retaining existing functionality and backward compatibility, and remaining a profile
4 of IEEE Std 1588™-2019.

5 This amendment addresses errors and omissions in the description of existing functionality.

6 **Keywords:** best timeTransmitter, frequency offset, Grandmaster Clock, Grandmaster PTP
7 Instance, PTP End Instance, PTP Relay Instance, IEEE 802.1AS™, phase offset, synchronization,
8 syntonization, time-aware system

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6 **János Farkas, *TSN Task Group Chair***
7 **Silvana Rodrigues, *Editor IEEE Std 802.1AS***
8 **Silvana Rodrigues, *Editor P802.1ASds***
9

10 The following members of the individual balloting committee voted on this standard. Balloters may have
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10

1 Introduction

This introduction is not part of IEEE Std 802.1ASdsTM-20xx, IEEE Standard for Local and metropolitan area networks—Timing and Synchronization for Time-Sensitive Applications—Amendment: Support for the IEEE Std 802.3 Clause 4 Media Access Control (MAC) operating in half-duplex

2 The first edition of IEEE Std 802.1AS was published in 2011. A first corrigendum, IEEE Std
3 802.1ASTM-2011/Cor1-2013, provided technical and editorial corrections. A second corrigendum, IEEE Std
4 802.1ASTM-2011/Cor2-2015 provided additional technical and editorial corrections.

5 The second edition, IEEE Std 802.1AS-2020, added support for multiple gPTP domains, Common Mean
6 Link Delay Service, external port configuration, and Fine Timing Measurement for 802.11 transport.
7 Backward compatibility with IEEE Std 802.1AS-2011 was maintained. A corrigendum, IEEE Std
8 802.1ASTM-2020/Cor1-2021, provides technical and editorial corrections.

9 The third edition, IEEE Std 802.1AS-202x is a roll-up of IEEE Std 802.1AS-2020 with the corrigendum
10 IEEE Std 802.1AS-2020/Cor1, and its amendments: IEEE Std 802.1ASdr, IEEE Std 802.1ASdn, and IEEE
11 Std 802.1ASdm.

12 This amendment to IEEE Std 802.1AS-202x specifies protocols, procedures, and managed objects that
13 support IEEE Std 802.3 Clause 4 Media Access Control (MAC) operating in half-duplex while retaining
14 existing functionality and backward compatibility, and remaining a profile of IEEE Std 1588TM-2019.

15 This amendment addresses errors and omissions in the description of existing functionality

16 <<Editor's note: P802.1ASds is an amendment to 802.1AS-2020-Rev>>

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2 **IEEE Standard for Local and** 3 **Metropolitan Area Networks —** 4 **Timing and Synchronization for Time-** 5 **Sensitive Applications**

6 **Amendment: Support for the IEEE Std** 7 **802.3 Clause 4 Media Access Control** 8 **(MAC) operating in half-duplex**

9 **1. Overview**

10 **1.1 Scope**

11 This standard specifies protocols, procedures, and managed objects used to ensure that the synchronization
12 requirements are met for time-sensitive applications, such as audio, video, and time-sensitive control, across
13 networks, for example, IEEE 802 and similar media. This includes the maintenance of synchronized time
14 during normal operation and following addition, removal, or failure of network components and network
15 reconfiguration. It specifies the use of IEEE Std 1588™ specifications where applicable in the context of
16 IEEE Std 802.1Q™-2018. Synchronization to an externally provided timing signal [e.g., a recognized
17 timing standard such as Coordinated Universal Time (UTC) or International Atomic Time (TAI)] is not part
18 of this standard but is not precluded.

19 **1.2 Purpose**

20 This standard enables systems to meet the respective jitter, wander, and time-synchronization requirements
21 for time-sensitive applications, including those that involve multiple streams delivered to multiple end
22 stations. To facilitate the widespread use of packet networks for these applications, synchronization
23 information is one of the components needed at each network element where time-sensitive application data
24 are mapped or demapped or a time-sensitive function is performed. This standard leverages the work of the
25 IEEE 1588 Working Group by developing the additional specifications needed to address these
26 requirements

1 1.3 Word usage

2 The word *shall* indicates mandatory requirements strictly to be followed in order to conform to the standard
3 and from which no deviation is permitted (*shall* equals *is required to*).^{1,2}

4 The word *should* indicates that among several possibilities one is recommended as particularly suitable,
5 without mentioning or excluding others; or that a certain course of action is preferred but not necessarily
6 required (*should* equals *is recommended that*).

7 The word *may* is used to indicate a course of action permissible within the limits of the standard (*may* equals
8 *is permitted to*).

9 The word *can* is used for statements of possibility and capability, whether material, physical, or causal (*can*
10 equals *is able to*).

11

¹ The use of the word *must* is deprecated and cannot be used when stating mandatory requirements; *must* is used only to describe unavoidable situations.

² The use of *will* is deprecated and cannot be used when stating mandatory requirements; *will* is only used in statements of fact.

3. Definitions

Insert the following definitions in Clause 3, and renumber the definitions as appropriate:

3.17 Half-duplex Ethernet: An Ethernet whose physical ports use the IEEE Std 802.3TM Clause 4 MAC in half-duplex mode, independent of the physical medium access method and independent of the physical topology of the shared medium connected.

1 4. Acronyms and abbreviations

2 *Insert the following acronym in clause 4 as follows:*

3 HDE Half-duplex Ethernet

4

5. Conformance

Insert 5.9 as follows:

5.9 MAC-specific timing and synchronization methods for HDE links

An implementation of a time-aware system with IEEE 802.3 media access control (MAC) services to physical ports shall:

- a) Support half-duplex operation, as specified in Clause 4 of IEEE Std 802.3-2022.
- b) Support the requirements as specified in Clause 19.

1 7. Time-synchronization model for a packet network

2 7.2 Architecture of a time-aware network

3 7.2.1 General

4 *Add item g) after item f) in the lettered list in 7.2.1 as follows:*

- 5 g) IEEE 802.3 Clause 4 Media Access Control (MAC) operating in half-duplex (Clause 19)

6 7.3 Time synchronization

7 7.3.2 Delay measurement

8 *Add item e) after item d) in the lettered list in 7.3.2 as follows:*

- 9 e) HDE links use the same mechanism as full-duplex Ethernet

10 7.4 PTP Instance architecture

11 *Change the last paragraph of 7.4 as follows:*

12 For EPON, timing information is communicated using a “slow protocol” as defined in Clause 13. CSNs and
13 HDE links use the same communication system used by full-duplex Ethernet, as defined in Clause 16 and
14 Clause 19, respectively.

15 7.5 Differences between gPTP (IEEE Std 802.1AS) and PTP (IEEE Std 1588-2019)

16 *Change item e) and item f) in 7.5 as follows:*

- 17 e) For full-duplex Ethernet and HDE links, gPTP requires the use of the peer-to-peer delay mechanism,
18 while IEEE Std 1588-2019 also allows the use of end-to-end delay measurement.
- 19 f) For full-duplex Ethernet and HDE links, gPTP requires the use of two-step processing (use of
20 Follow_Up and Pdelay_Resp_Follow_Up messages to communicate timestamps), with an optional
21 one-step processing mode for full-duplex Ethernet that embeds timestamps in the Sync “on the fly”
22 as they are being transmitted (gPTP does not specify one-step processing for peer delay messages).
23 IEEE Std 1588-2019 allows either two-step or one-step processing to be required (for both Sync and
24 peer delay messages) depending on a specific profile.

1 8. IEEE 802.1AS concepts and terminology

2 8.5 Ports

3 8.5.1 General

4 *Change 8.5.1 as follows:*

5 The PTP Instances in a gPTP domain interface with the network media via physical ports. gPTP defines a
6 logical port, i.e., a PTP Port, in such a way that communication between PTP Instances is point-to-point or,
7 in the case of an HDE link (see Clause 19), point-to-multipoint. A logical port consists of one PortSync
8 entity and one media-dependent (MD) entity. Multiple PTP Ports can be associated with a single physical
9 port. even over physical ports that are attached to shared media. One For shared media, there are multiple
10 possibilities:

- 11 a) one logical port, consisting of one PortSync entity and one media-dependent (MD) entity, is can be
12 instantiated for each PTP Instance with which the PTP Instance communicates, i.e., the PTP
13 communication paths are logically point-to-point even though the physical port is attached to a
14 shared medium, e.g., CSN (see 16); or
15 b) the PTP communication path can be logically point-to-multipoint, e.g., for an HDE link (see 19). For
16 shared media, multiple logical ports can be associated with a single physical port.

17 Unless otherwise qualified, each instance of the term *port* refers to a *logical port*.

1 10. Media-independent layer specification

2 10.7 Protocol timing characterization

3 10.7.2 Message transmission intervals

4 10.7.2.1 General interval specification

5 *Change the second paragraph in 10.7.2.1 as follows:*

6 The mean time interval between the sending of successive time-synchronization event messages for full-
7 duplex point-to-point, IEEE 802.11, ~~and~~ CSN₂ ~~and~~ HDE links, and successive general messages containing
8 time-synchronization information for IEEE 802.3 EPON links, is known as the *sync interval*. The sync
9 interval shall be as specified in 10.7.2.3.

1 11. Media-dependent layer specification for full-duplex point-to-point links

2 11.1 Overview

3 11.1.1 General

4 *Add a NOTE at the end of 11.1.1 as follows:*

5 NOTE—PTP links using the IEEE 802.3 Clause 4 MAC operating in half-duplex mode are specified in Clause 19.

6 11.2 State machines for MD entity specific to full-duplex point-to-point links

7 11.2.2 Determination of asCapable and asCapableAcrossDomains

8 *Change 11.2.2 as follows:*

9 There is one instance of the global variable asCapable (see 10.2.5.1) per PTP Port, per domain. There is one
 10 instance of the global variable asCapableAcrossDomains (see 11.2.13.12), per port, that is common across,
 11 and accessible by, all the domains.

12 The per-PTP Port global variable asCapable (see 10.2.5.1) indicates whether the IEEE 802.1AS protocol is
 13 operating, in this domain, on the PTP Link attached to this PTP Port, and can provide the required time-
 14 synchronization performance ~~described in B.3~~. asCapable is used by the PortSync entity, which is media-
 15 independent; however, the determination of asCapable is media-dependent.

16 The per-port global variable asCapableAcrossDomains is set by the MDPdelayReq state machine
 17 (see 11.2.19 and Figure 11-9). For a port attached to a full-duplex point-to-point PTP Link or to an HDE
 18 link, asCapableAcrossDomains shall be set to TRUE if and only if either:

- 19 a) ~~It~~ is determined, via the transport-specific peer-to-peer delay mechanism or CMLDS, that the
 20 following conditions hold for the port:
- 21 1) ~~⊕~~ The port is exchanging peer delay messages with its neighbor,
 - 22 2) ~~⊕~~ The measured delay does not exceed meanLinkDelayThresh,
 - 23 3) ~~⊕~~ The port does not receive multiple Pdelay_Resp or Pdelay_Resp_Follow_Up messages in
 24 response to a single Pdelay_Req message, and
 - 25 4) ~~⊕~~ The port does not receive a response from itself or another PTP Port of the same PTP
 26 Instance.

27 or:

- 28 b) pdelayReqSendDisabled is set to TRUE

29 NOTE 1—If a PTP Instance implements only domain 0 and the MDPdelayReq and MDPdelayResp state machines are
 30 invoked on domain 0 (see 11.2.19), asCapableAcrossDomains is still set by the MDPdelayReq state machine.

31 The default value of meanLinkDelayThresh shall be set as specified in Table 11-1.

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Table 11-1—Value of meanLinkDelayThresh for various links

Link	Value of meanLinkDelayThresh (ns) (see NOTE)
100BASE-TX, 1000BASE-T	800 ₁₀
100BASE-FX, 1000BASE-X, <u>HDE</u>	FFFF FFFF FFFF FFFF FFFF FFFF ₁₆
NOTE—The actual propagation delay for 100BASE-TX and 1000BASE-T links is expected to be smaller than the above respective threshold. If the measured mean propagation delay (i.e., meanLinkDelay; see 10.2.5.8) exceeds this threshold, it is assumed that this is due to the presence of equipment that does not implement gPTP. For 100BASE-FX, and 1000BASE-X, <u>and HDE</u> links, the actual propagation delay can be on the order of, or larger than, the delay produced by equipment that does not implement gPTP; therefore, such equipment cannot be detected by comparing measured propagation delay with a threshold. In this case, meanLinkDelayThresh is set to the largest possible value (i.e., all 1s).	

1 <<Editor's note: Table 11-1 may need to be generalized.>>

2 The per-PTP Port, per-domain global variable asCapable shall be set to TRUE if and only if the following
 3 conditions hold:

- 4 c) ~~e~~ The value of asCapableAcrossDomains is TRUE, and
- 5 d) ~~f~~ One of the following conditions holds:
 - 6 1) The value of neighborGtpCapable for this PTP Port is TRUE, or
 - 7 2) The value of domainNumber is zero, and the value of sdoId for peer delay messages received
 8 on this PTP Port is 0x100.

9 NOTE 2—Condition ~~f~~d) 2) ensures backward compatibility with the 2011 edition of this standard. A PTP Instance
 10 compliant with the current edition of this standard that is attached, via a full-duplex point-to-point PTP Link, to a PTP
 11 Instance compliant with the 2011 edition of this standard will not receive Signaling messages that contain the gPTP
 12 capable TLV and will not set neighborGtpCapable to TRUE. However, condition ~~f~~d) 2) ensures that asCapable for this
 13 PTP Port and domain (i.e., domain 0) will still be set to TRUE if condition c) holds because the peer delay messages
 14 received from the time-aware system compliant with the 2011 edition of this standard will have sdoId set to 0x100.

15 11.2.13 MD entity global variables

16 *Change 11.2.13.12 as follows:*

17 **11.2.13.12 asCapableAcrossDomains:** A Boolean that is TRUE if and only if either: a) conditions 1a)
 18 through 4d) of 11.2.2 are satisfied, or b) condition b) of 11.2.2 is satisfied. ~~This Boolean~~
 19 asCapableAcrossDomains is set by the MDPdelayReq state machine and is used in determining asCapable
 20 for a port (see 11.2.2). There is one instance of this variable for all the domains (per port) for full-duplex
 21 point-to-point links. ~~And~~ the variable is accessible by all the domains. There is one instance of this variable
 22 per PTP Instance (i.e., per domain) for HDE links (see 19.2.2). When only one domain is active,
 23 asCapableAcrossDomains is equivalent to the variable asCapable (see 10.2.5.1).

24 11.2.19 MDPdelayReq state machine

25 11.2.19.2 State machine variables

26 *Change 11.2.19.2.2 as follows:*

1 **11.2.19.2.2 rcvdPdelayResp:** A Boolean variable that notifies the current state machine when a
2 Pdelay_Resp message is received and its requestingPortIdentity.clockIdentity is equal to the clockIdentity of
3 the current PTP Instance. This variable is reset by the current state machine.

4 *Change 11.2.19.2.4 as follows:*

5 **11.2.19.2.4 rcvdPdelayRespFollowUp:** A Boolean variable that notifies the current state machine when a
6 Pdelay_Resp_Follow_Up message is received and its requestingPortIdentity.clockIdentity is equal to the
7 clockIdentity of the current PTP instance. This variable is reset by the current state machine.

8 *Insert a new variable after 11.2.19.2.13 as follows:*

9 **11.2.19.2.14 pdelayReqSendDisabled:** A boolean that is administratively set to TRUE if Pdelay_Req
10 messages are not transmitted by this port. The default value for this variable shall be FALSE.

11 **11.2.19.4 State diagram**

12 *Replace Figure 11-9 with the following:.*

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1 **Add a NOTE after Figure 11-9 as follows:**

2 NOTE—A change in the value of the variable pdelayReqSendDisabled takes effect only when portEnabled0 (see
3 11.2.19.2.12) is FALSE.

4 11.2.20 MDPdelayResp state machine

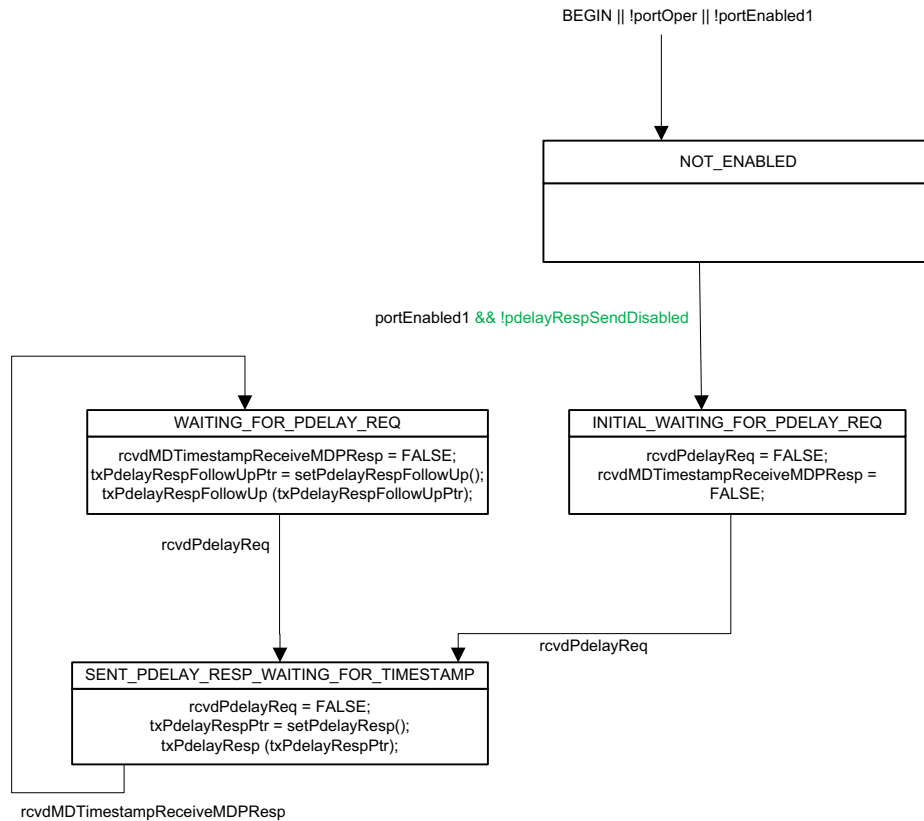
5 11.2.20.2 State machine variables

6 **Insert a new variable after 11.2.20.2.5 as follows:**

7 **11.2.20.2.6 pdelayRespSendDisabled:** A boolean that is administratively set to TRUE if Pdelay_Resp
8 messages are not transmitted by this port. The default value for this variable shall be FALSE.

9 11.2.20.4 State diagram

10 **Replace Figure 11-10 with the following:**



11 **Add a NOTE after Figure 11-10 as follows:**

12 NOTE—A change in the value of the variable pdelayRespSendDisabled takes effect only when portEnabled1 (see
13 11.2.20.2.5) is FALSE.

1 12. Media-independent layer specification

2 12.1 Overview

3 12.1.2 IEEE 802.11 Timing Measurement and Fine Timing Measurement procedures

4 12.1.2.2 Detailed description of Fine Timing Measurement (FTM)

5 *Change the last paragraph in 12.1.2.2 as follows:*

6 With the above procedure for FTM, the slave controls the rate at which time synchronization information is
7 sent from the master. This is different from TM, full-duplex IEEE 802.3, IEEE 802.3 EPON, ~~and CSN~~, and
8 HDE transports. In those cases, the sending of time synchronization information from the master to the slave
9 is controlled by the master; this is true for syncLocked (see 10.2.5.15) TRUE, in which case the information
10 is sent as soon as it is received from further upstream, and syncLocked FALSE, in which case it is sent
11 independently of information received from further upstream. For FTM, the slave requests time
12 synchronization information from the master at an average rate equal to the inverse of the current
13 synchronization message interval currentLogSyncInterval (see 12.8 and 14.8.18). In addition, the actual
14 intervals between successive requests by the slave for time synchronization information meet the
15 requirements of 10.7.2.3. Also, the value of syncLocked at the master port will not affect the sending of time
16 synchronization information from the master to the slave; the requests for time synchronization information
17 from the slave are asynchronous to the receipt of time synchronization information from upstream at the
18 node that contains the master port.

1 14. Timing and synchronization management

2 14.8 Port Parameter Data Set (portDS)

3 14.8.23 InitialLogPdelayReqInterval

4 *Change the first paragraph in 14.8.23 as follows:*

5 For full-duplex [and HDE](#) IEEE 802.3 media_a and for CSN media_a that use the peer-to-peer delay mechanism
6 to measure path delay (see 16.4.3.2), the value is the logarithm to base 2 of the Pdelay_Req message
7 transmission interval used when:

8 14.8.24 currentLogPdelayReqInterval

9 *Change the first paragraph in 14.8.24 as follows:*

10 For full-duplex [and HDE](#) IEEE 802.3 media_a and for CSN media_a that use the peer-to-peer delay mechanism
11 to measure path delay (see 16.4.3.2), the value is the logarithm to the base 2 of the current Pdelay_Req
12 message transmission interval (see 11.5.2.2).

13 14.8.32 currentComputeNeighborRateRatio

14 *Change the first paragraph in 14.8.32 as follows:*

15 For full-duplex [and HDE](#) IEEE 802.3 media_a and for CSN media_a that use the peer-to-peer delay mechanism
16 to measure path delay (see 16.4.3.2), the value is the current value of computeNeighborRateRatio.

17 14.8.36 currentComputeMeanLinkDelay

18 *Change the first paragraph in 14.8.36 as follows:*

19 For full-duplex [and HDE](#) IEEE 802.3 media_a and for CSN media_a that use the peer-to-peer delay mechanism
20 to measure path delay (see 16.4.3.2), the value is the current value of computeMeanLinkDelay.

21 14.8.53 pdelayTruncatedTimestampsArray

22 *Change the first paragraph in 14.8.53 as follows:*

23 For full-duplex [and HDE](#) IEEE 802.3 media_a and for CSN media_a that use the peer-to-peer delay mechanism
24 to measure path delay (see 16.4.3.2), the values of the four elements of this array are as described in Table
25 14-9. For all other media, the values are zero. Array elements 0, 1, 2, and 3 correspond to the timestamps t1,
26 t2, t3, and t4, respectively, in Figure 11-1 and are expressed in units of 2–16 ns (i.e., the value of each array
27 element is equal to the remainder obtained upon dividing the respective timestamp, expressed in units of 2–
28 16 ns, by 248). At any given time, the timestamp values stored in the array are for the same, and most
29 recently completed, peer delay message exchange.

30 14.8.55 portDS table

31 *Insert the following items after the final item of Table 14-10:*

32

Table 14-10—portDS table

Name	Data type	Operations supported ^a	References
pdelayReqSendDisabled	Boolean	RW	14.8.60
pdelayRespSendDisabled	Boolean	RW	14.8.61

^a R = Read only access; RW = Read/write access.

Insert 14.8.60 and 14.8.61 as follows:

14.8.60 pdelayReqSendDisabled

The value is equal to the value of the per-PTP Port global variable pdelayReqSendDisabled (see 11.2.19.2.14). If its value is TRUE, Pdelay_Req messages are not transmitted by the PTP Port. The default value for this variable shall be FALSE.

14.8.61 pdelayRespSendDisabled

The value is equal to the value of the per-PTP Port global variable pdelayRespSendDisabled (see 11.2.20.2.6). If its value is TRUE, Pdelay_Resp messages are not transmitted by the PTP Port. The default value for this variable shall be FALSE.

1 17. YANG Data Model

2 <<Editor’s note: P802.1ASDs is an amendment to P802.1AS-2020-Rev, therefore this clause may need
3 to be aligned once 802.1ASdn and 802.1ASdm are roll up into the revision of IEEE 802.1AS-2020.>>

4 17.1 YANG framework

5 *Change 17.1.1 as follows:*

6 17.1.1 Relationship to the IEEE Std 1588 data model

7 *Change the first paragraph in 17.1.1 as follows:*

8 The YANG data models specified in this standard are based on, and augment, those specified in IEEE Std
9 1588. In particular the ieee802-dot1as-gtp.yang module imports the ieee1588-tt module as a whole,
10 augmenting that module as necessary to meet the requirements of this standard. In addition, the ieee802-
11 dot1as-hd.yang module imports the ieee1588-ptp-tt and ieee802-dot1as-gtp modules as a whole,
12 augmenting those modules as necessary to to meet the requirements of this standard.

13 *Change the fourth paragraph in 17.1.1 as follows:*

14 The YANG modules of this clause (ieee802-dot1as-gtp.yang and ieee802-dot1as-hd.yang) use the YANG
15 “import” statement to import the YANG module of IEEE Std 1588e. This effectively uses the IEEE Std 1588
16 YANG tree as the foundation of the IEEE Std 802.1AS YANG tree. By importing the tree and its data set
17 containers, all members from Clause 14 that are derived from IEEE Std 1588 are also imported.

18 17.2 IEEE 802.1AS YANG models

19 *Replace Figure 17-3 with the following:*

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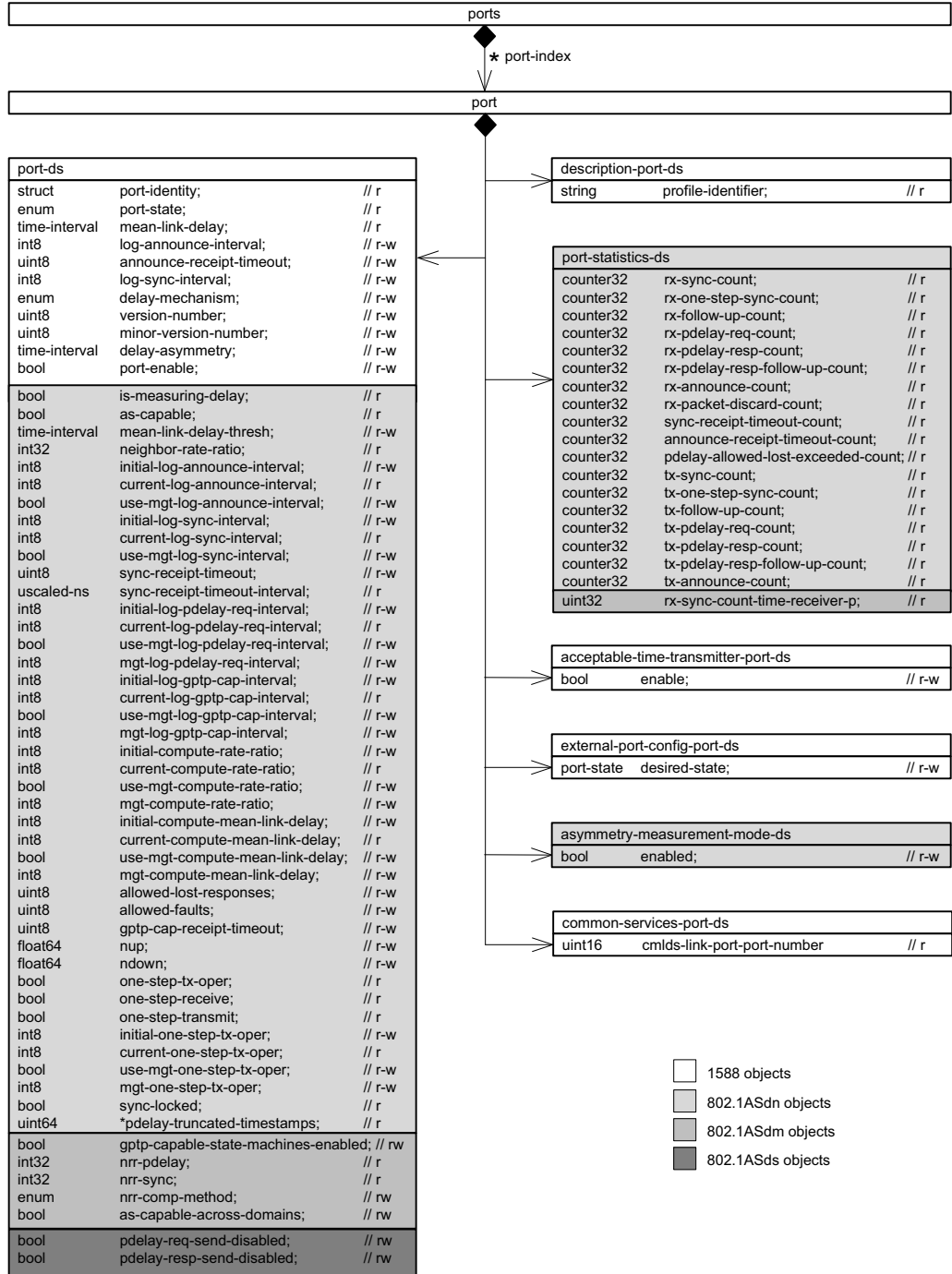
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NOTE 3—This figure differs from the 202x edition of this standard in that managed objects needed for the HDE are added.

Figure 17-3—PTP Port detail

1 17.3 Structure of YANG models

2 *Change Table 17-1 as follows:*

Table 17-1—Summary of the YANG modules

Module	Managed functionality	YANG specification notes
ietf-yang-types	Type definitions	IETF RFC 6991 - Common YANG Data Types.
ieee1588-ntp-tt	Clause 14	IEEE Std 1588e - MIB and YANG Data Models. IEEE Std 802.1ASdn imports this YANG module as its foundational tree, including a subset of members from Clause 14.
ieee802-dot1as-gtp	Clause 14	IEEE Std 802.1ASdn - YANG Data Model. The YANG module of this clause uses YANG augments to add members from Clause 14 that are unique to IEEE Std 802.1AS.
ieee802-dot1as-hs	Clause 14	IEEE Std 802.1ASdm - YANG Data Model. The YANG module of this clause uses YANG augments to add members from Clause 14 that are unique to IEEE Std 802.1ASdm.
<u>ieee802-dot1as-hd</u>	<u>Clause 14</u>	<u>IEEE Std 802.1ASds - YANG Data Model.</u> <u>The YANG module of this clause uses YANG augments to add members from Clause 14 that unique to IEEE Std 802.1ASds</u>

3 17.5 YANG schema tree definitions

4 *Insert 17.5.3 and renumber subsequent subclauses as appropriate:*

5 17.5.3 Tree diagram for ieee802-dot1as-hd.yang

```

6 module: ieee802-dot1as-hd
7
8     augment    /ptp-tt:ptp/ptp-tt:instances/ptp-tt:instance/ptp-tt:ports/ptp-tt:port/ptp-
9 tt:port-ds:
10     +--rw pdelay-req-send-disabled?    boolean
11     +--rw pdelay-resp-send-disabled?    boolean
12

```

13 17.6 YANG modules^{1 2}

15 *Insert 17.6.3 and renumber subsequent subclauses as appropriate:*

16 17.6.3 Module ieee802-dot1as-hd.yang

```

17 module ieee802-dot1as-hd {
18   yang-version 1.1;

```

¹Copyright release for YANG modules: Users of this standard may freely reproduce the YANG modules contained in this subclause so that they can be used for their intended purpose.

²An ASCII version of the YANG modules are attached to the PDF version of this standard, and can be obtained by Web browser from the IEEE 802.1 Website at <https://1.ieee802.org/yang-modules/>.

IEEE Standard for Local and Metropolitan Area Networks—Timing and Synchronization for Time-Sensitive Applications —
Amendment: Support for the IEEE Std 802.3 Clause 4 Media Access Control (MAC) operating in half-duplex

```

1 namespace "urn:ieee:std:802.1AS:yang:ieee802-dot1as-hd";
2 prefix dot1as-hd;
3
4 import ieee1588-ptp-tt {
5     prefix ptp-tt;
6 }
7 import ieee802-dot1as-gptp {
8     prefix dot1as-gptp;
9 }
10
11 organization
12     "IEEE 802.1 Working Group";
13 contact
14     "WG-URL: http://ieee802.org/1/
15     WG-EMail: stds-802-1-l@ieee.org
16
17     Contact: IEEE 802.1 Working Group Chair
18             Postal: C/O IEEE 802.1 Working Group
19             IEEE Standards Association
20             445 Hoes Lane
21             Piscataway, NJ 08854
22             USA
23
24     E-mail: stds-802-1-chairs@ieee.org";
25 description
26     "Management objects that control MAC operating in half-duplex as
27     specified in IEEE Std 802.1ASds.
28
29     References in this YANG module to IEEE Std 802.1AS are to
30     IEEE Std 802.1AS-2020 as modified by
31     IEEE Std 802.1AS-2020/Cor-1-2021, and amended by
32     IEEE Std 802.1ASdr, IEEE Std 802.1ASdn,
33     IEEE Std 802.1ASdm, and IEEE Std 802.1ASds.
34
35     Copyright (C) IEEE (2024).
36     This version of this YANG module is part of IEEE Std 802.1AS;
37     see the standard itself for full legal notices.";
38
39 revision 2024-06-11 {
40     description
41         "Published as part of IEEE Std 802.1ASds-2024.
42         Initial version.";
43     reference
44         "IEEE Std 802.1AS - YANG Data Model";
45 }
46
47 augment "/ptp-tt:ptp/ptp-tt:instances/ptp-tt:instance"
48     + "/ptp-tt:ports/ptp-tt:port/ptp-tt:port-ds" {
49     description
50         "Augment IEEE Std 1588 portDS.";
51     leaf pdelay-req-send-disabled {
52         type boolean;
53         description
54             "A boolean that is administratively set to TRUE
55             if Pdelay_Req messages are not transmitted by this port.
56             The default value for this variable shall be FALSE.";
57         reference
58             "11.2.19.2.14 of IEEE Std 802.1ASds";
59     }
60     leaf pdelay-resp-send-disabled {
61         type boolean;
62         description
63             "A boolean that is administratively set to TRUE
64             if Pdelay_Resp messages are not transmitted by this port.
65             The default value for this variable shall be FALSE.";

```

IEEE Standard for Local and Metropolitan Area Networks—Timing and Synchronization for Time-Sensitive Applications —
Amendment: Support for the IEEE Std 802.3 Clause 4 Media Access Control (MAC) operating in half-duplex

```
1      reference
2      "11.2.20.2.6 of IEEE Std 802.1ASds";
3    }
4  }
5 }
6
7
```

1 Insert the following new Clause 19:

2 19. Media-dependent layer specification for IEEE 802.3 Clause 4 Media
3 Access Control (MAC) operating in half-duplex

4 19.1 Overview

5 19.1.1 General

6 Accurate synchronized time is distributed throughout a gPTP domain through time measurements between
7 adjacent PTP Relay Instances or PTP End Instances in a packet network. Time is communicated from the
8 root of the clock spanning tree (i.e., the Grandmaster PTP Instance) toward the leaves of the tree (i.e., from
9 leaf-facing timeTransmitter ports to root-facing timeReceiver ports) through measurements made across the
10 links connecting the PTP Instances. While the semantics of time transfer are consistent across the time-
11 aware packet network, the method for communicating synchronized time from a timeTransmitter port to its
12 immediate downstream link partner(s) varies depending on the type of link interconnecting the two or more
13 PTP Instances. This clause specifies the protocol that provides accurate synchronized time across links that
14 use IEEE 802.3 (Ethernet) Clause 4 MACs operating in half-duplex mode as part of a packet network.

15 19.1.1.1 Half-duplex Ethernet (HDE) characteristics

16 The Ethernet IEEE 802.3 Clause 4 MAC can operate in either full-duplex or half-duplex mode. When this
17 MAC is operating in full-duplex, its media-dependent specification for gPTP is covered in Clause 11 of this
18 standard. The present clause is used when the 802.3 Clause 4 MAC is operating in half-duplex. This mode
19 necessitates additional managed object settings and frame processing due to the effects of the shared media
20 this mode supports, which are described in this clause.

21 NOTE—Shared media allow multiple devices to be connected to the same physical wire without the need of
22 bridges or PTP Relay Instances between them, as shown in Figure 19-1.

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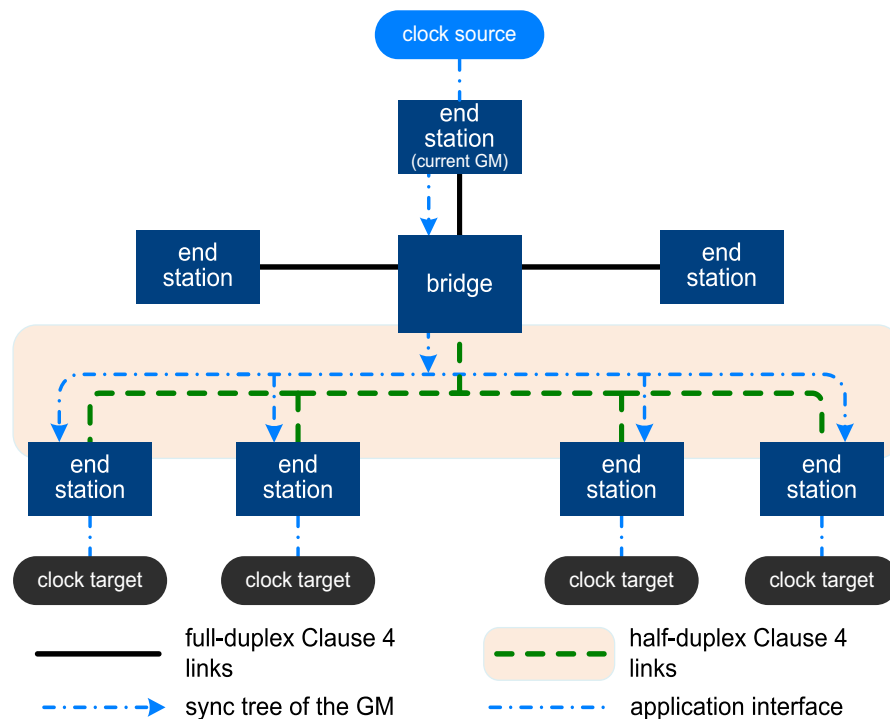
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Note 1: The “bridge” in this figure is an example of a time-aware system that contains a PTP Relay Instance, and the end stations with clock targets are examples of time-aware systems that contain PTP End Instances.

Note 2: GM denotes Grandmaster PTP Instance

Figure 19-1— Time-aware network example where the four end stations near the bottom of the figure are connected to the bridge via an HDE link

1 When using HDE links, the use of “neighbor” refers to a device or to devices (end station or bridge) that is/
2 are the intended recipient(s) of a transmitted PTP message. The intended recipient need not be the next
3 physically closest device that is attached to the shared medium..

4 19.1.1.2 Half-duplex Ethernet (HDE) using PLCA (10BASE-T1S) PHYs

5 IEEE 802.3 PHYs that support Physical Layer Collision Avoidance (PLCA) form deterministic links by
6 avoiding the MAC's random back-off caused by collisions (see Clause 148 of IEEE Std 802.3-2022). Simply
7 stated, collisions are avoided by assigning local_nodeIDs, each of which represents a device's transmit
8 opportunity number. One of the devices on the link sends out a BEACON, which starts the transmit
9 opportunity cycle. Following each BEACON, the lowest local_nodeID gets to transmit first (assuming it has
10 a frame ready to transmit) followed by the next higher local_nodeID, etc., until all the link's local_nodeIDs
11 have been given a transmit opportunity. Then the process is repeated with another BEACON.

12 NOTE 1—In IEEE Std 802.3-2022, the only PHY that supports PLCA is 10BASE-T1S, which is specified in Clause 147
13 of IEEE Std 802.3-2022.

14 NOTE 2—Configuration of PLCA local_nodeID numbers, etc., are out of scope of this standard.

15 19.1.1.3 Overview of the major differences and restrictions of using HDE

16 The present clause uses Clause 11 in its entirety with the following major differences and restrictions
17 (complete details follow starting in 19.1.2):

- 1 a) The peer delay initiator is restricted to timeReceivers only (see 19.1.2).
- 2 b) One-step time transport is not supported (see 19.1.3 and 19.2.16)
- 3 c) CMLDS is not supported (see 19.2.17)
- 4 d) External port configuration mode is the only mode supported (see 19.8)
- 5 e) The use of Signaling messages is not specified (see 19.8)
- 6 f) Hot Standby is not supported (see 19.8)

7 **19.1.2 Propagation delay measurement over links**

8 The measurement of propagation delay on an HDE PTP Link using the peer-to-peer delay mechanism is
9 illustrated in Figure 11-1 and is described in 11.1.2, with the exception that the peer delay initiator is
10 restricted to each timeReceiver port (i.e., an end station, or a timeReceiver port on a PTP Relay Instance))
11 and the timeTransmitter port does not initiate the peer-to-peer delay mechanism. Therefore,
12 pdelayReqSendDisabled and pdelayRespSendDisabled are set as follows:

- 13 a) pdelayReqSendDisabled shall be set to TRUE for a timeTransmitter port or a PassivePort.
- 14 b) pdelayRespSendDisabled shall be set to TRUE for a timeReceiver port or a PassivePort.

15 **19.1.3 Transport of time-synchronization information**

16 The transport of time-synchronization information by a PTP Instance, using Sync and Follow_Up messages,
17 is illustrated in Figure 11-2.

18 HDE links shall use two-step time transport as described in clause 11.1.3.

19 **19.1.4 Model of operation**

20 A PTP Instance contains one MD entity per PTP Instance, per PTP Port. This entity contains functions
21 generic to all media, which are described in Clause 10, and functions specific to the respective medium for
22 the PTP Link. Functions specific to HDE links are described in the current clause.

23 The model for a PTP Instance of a time-aware system with full-duplex point-to-point links is shown in
24 Figure 11-3. This (HDE) Clause reuses Figure 11-3 (as its structure is unchanged for this clause), where all
25 references to clause 11 in Figure 11-3 are to be replaced by references to clause 19 (this clause). The
26 presence of one HDE MD entity per PTP Port is assumed. The media-independent entities shown in Figure
27 11-3 are described in 10.1.2.

28 A general, media-independent description of the generation of timestamps is given in 8.4.3. A more specific
29 description for PTP event messages is given in 11.3.2.1. A PTP event message is timestamped relative to the
30 LocalClock entity when the message timestamp point (see 3.17) crosses the timestamp measurement plane
31 (see 3.33). The timestamp is corrected for any ingressLatency or egressLatency (see 8.4.3) to produce a
32 timestamp relative to the reference plane (see 3.26). The corrected timestamp value is provided to the MD
33 entity.

34 The MD entity behavior and detailed state machines specific to full-duplex point-to-point links, which are
35 described in 11.2, are reused for HDE links subject to the conditions defined in 19.2. The behavior of the
36 MD entity that is generic to all media is described in Clause 10.

37 **19.2 State machines for HDE links**

38 <<Editor's note: Need to check the changes made in P802.1ASdm to clause 11.2 and its subclauses
39 whether or not they have any implications for HDE.>>

1 19.2.1 General

2 The state machines for HDE links are described in 11.2.1.

3 19.2.2 Determination of asCapable and asCapableAcrossDomains

4 Determination of asCapableAcrossDomains shall be as specified in 11.2.13.12.

5 NOTE: For full-duplex point-to-point links, asCapableAcrossDomains is a global variable for all domains
6 per linkport. For HDE links, asCapableAcrossDomains is a global variable per PTP Instance (i.e., per
7 domain), the name asCapableAcrossDomains has been kept for backwards compatibility with existing
8 implementations.

9 19.2.3 Use of MAC Control PAUSE operation

10 This is not applicable when the IEEE 802.3 Clause 4 MAC is in half-duplex mode (see Clause 1.4.458 in
11 Annex 31B of IEEE Std 802.3-2022).

12 19.2.4 Use of priority-based flow control

13 This is not applicable when the IEEE 802.3 Clause 4 MAC is in half-duplex mode (see Clause 1.4.489 of
14 IEEE Std 802.3-2022).

15 19.2.5 Use of link aggregation

16 This is not applicable when the IEEE 802.3 Clause 4 MAC is in half-duplex mode (see Introduction in IEEE
17 Std 802.1AX-2020).

**18 19.2.6 Service interface primitives and data structures communicated between state
19 machines**

20 The following subclauses describe the service primitives and data structures communicated between the
21 time-synchronization state machines of the MD entity. First the service primitives are described, followed by
22 the data structures.

23 19.2.7 DL-UNITDATA.request

24 This service primitive is described in 2.2.1.1.1 of ISO/IEC 8802-2:1998 [B16].

25 19.2.8 DL-UNITDATA.indication

26 This service primitive is described in 2.2.1.1.1 of ISO/IEC 8802-2:1998 [B16].

27 19.2.9 MDTimestampReceive

28 This structure shall be as specified in 11.2.9.

29 19.2.10 MDSyncReceive

30 This structure shall be as specified in 10.2.2.2.

31 19.2.11 MDSyncSend

32 This structure shall be as specified in 10.2.2.1.

1 19.2.12 Overview of MD entity global variables

2 The overview of MD entity global variables is given in 11.2.12.

3 19.2.13 MD entity global variables

4 19.2.13.1 **currentLogPdelayReqInterval**: This variable shall be as specified in 11.2.13.1.

5 19.2.13.2 **initialLogPdelayReqInterval**: This variable shall be as specified in 11.2.13.2.

6 19.2.13.3 **pdelayReqInterval**: This variable shall be as specified in 11.2.13.3.

7 19.2.13.4 **allowedLostResponses**: This variable shall be as specified in 11.2.13.4.

8 19.2.13.5 **allowedFaults**: This variable shall be as specified in 11.2.13.5.

9 19.2.13.6 **isMeasuringDelay**: This variable shall be as specified in 11.2.13.6.

10 19.2.13.7 **meanLinkDelayThresh**: This variable shall be as specified in 11.2.13.7.

11 19.2.13.8 **syncSequenceId**: This variable shall be as specified in 11.2.13.8.

12 19.2.13.9 **oneStepReceive**: This variable shall be as specified in 11.2.13.9. It shall be set to FALSE for
13 HDE.

14 19.2.13.10 **oneStepTransmit**: This variable shall be as specified in 11.2.13.10. It shall be set to FALSE for
15 HDE.

16 19.2.13.11 **oneStepTxOper**: This variable shall be as specified in 11.2.13.11. It shall be set to FALSE for
17 HDE.

18 19.2.13.12 **asCapableAcrossDomains**: This variable shall be as specified in 11.2.13.12.

19 19.2.13.13 **nrrPdelay**: This variable shall be as specified in 11.2.13.13.

20 19.2.13.14 **nrrSync**: This variable shall be as specified in 11.2.13.14.

21 19.2.13.15 **nrrCompMethod**: This variable shall be as specified in 11.2.13.15.

22 19.2.14 MDSyncReceiveSM state machine

23 The MDSyncReceiveSM state machine shall be as specified in 11.2.14.

24 19.2.15 MDSyncSendSM state machine

25 The MDSyncSendSM state machine shall be as specified in 11.2.15.

26 19.2.16 OneStepTxOperSetting state machine

27 This state machine is not used for HDE.

28 19.2.17 Common Mean Link Delay Service (CMLDS)

29 The Common Mean Link Delay Service (CMLDS) shall not be used for HDE.

1 HDE uses the transport-specific peer-to-peer delay mechanism for all domains. Therefore, if the time-aware
2 system implements multiple domains on an HDE link, all the domains use the transport-specific peer-to-peer
3 delay mechanism on that link regardless of the domain numbers. However, if the time-aware system
4 implements other PTP Ports that are full-duplex, point-to-point, those PTP Ports can use the transport-
5 specific peer-to-peer delay mechanism or CMLDS as allowed by Clause 11.

6 If multiple TimeTransmitter ports are present on an HDE link, they are in different gPTP domains. CMLDS
7 cannot be used because, in general, the TimeTransmitter ports can be on physical ports of different time-
8 aware systems (i.e., different bridges). In this case, both meanLinkDelay and neighborRateRatio between a
9 PTP End Instance in one of the domains and the TimeTransmitter it is communicating with can be different
10 from meanLinkDelay and neighborRateRatio between a PTP End Instance in another domain on the same
11 end station and the TimeTransmitter that PTP End Instance is communicating with.

12 **19.2.18 Common Mean Link Delay Service (CMLDS) global variables**

13 The Common Mean Link Delay Service (CMLDS) global variables are not used for HDE links.

14 **19.2.19 MDPdelayReq state machine**

15 The MDPdelayReq state machine shall be as specified in 11.2.19.

16 The variable pdelayReqSendDisabled is set per 19.1.2.

17 **19.2.20 MDPdelayResp state machine**

18 The MDPdelayResp state machine shall be as specified in 11.2.20.

19 The variable pdelayRespSendDisabled is set per 19.1.2.

20 **19.2.21 LinkDelayIntervalSetting state machine**

21 This state machine is not used for HDE.

22 **19.3 Message attributes**

23 Message attributes shall be as specified in 11.3.

24 **19.4 Message formats**

25 Message formats shall be as specified in 11.4, except for 11.4.2.4, where the domainNumber for
26 Pdelay_Req, Pdelay_Resp, and Pdelay_Resp_Follow_Up messages shall be the domain number of the HDE
27 gPTP domain used by the transport-specific peer delay mechanism. The domainNumber for all other PTP
28 messages is as specified in 10.6.2.2.6.

29 **19.5 Protocol timing characterization**

30 **19.5.1 General**

31 This subclause specifies timing attributes for the media-dependent sublayer specified in this clause.

1 19.5.2 Message transmission intervals

2 19.5.2.1 General interval specification

3 The mean time interval between successive Pdelay_Req messages is represented as the logarithm to the
4 base 2 of this time interval measured in seconds. The value of this logarithmic attribute shall be as specified
5 in 19.5.2.2.

6 The mean time interval between successive Sync messages shall be as specified in 10.7.2.1, 10.7.2.3, and
7 19.5.2.3.

8 19.5.2.2 Pdelay_Req message transmission interval

9 Pdelay_Req message transmission interval is specified in 11.5.2.2. The variable
10 useMgtSettableLogPdelayReqInterval shall be set to TRUE.

11 19.5.2.3 Sync message transmission interval default value

12 The Sync message transmission interval default value shall be as specified in 11.5.2.3.

13 In the case of non-deterministic behavior (see IEEE Std 802.3) in an HDE link, the nondeterministic
14 behavior needs to be considered in determining whether the requirements of 10.7.2.3 for the Sync message
15 transmission interval are met.

16 19.5.3 allowedLostResponses

17 The variable allowedLostResponses shall be as specified in 11.5.3.

18 19.5.4 allowedFaults

19 The variable allowedFaults shall be as specified in 11.5.4.

20 19.6 Control of computation of neighborRateRatio

21 The control of computation of neighborRateRatio shall be as specified in 11.6.

22 19.7 Control of computation of meanLinkDelay

23 The control of computation of meanLinkDelay shall be as specified in 11.7.

24 19.8 HDE settings and configuration

25 This clause provides settings and configurations that are specific for HDE.

26 The per PTP Instance global variable externalPortConfigurationEnabled shall be set to TRUE for HDE.

27 Both GtpCapableTransmit and GtpCapableReceive state machines shall be disabled for HDE, and
28 therefore gtpCapableStateMachinesEnabled shall be set to FALSE (see 10.4.1). According to 10.4.1, if the
29 managed object gtpCapableStateMachinesEnabled is FALSE, the global variable neighborGtpCapable for
30 the port (see 10.2.5.16) is set to TRUE.

1 <<Editor's note: The ability to disable GptpCapableTransmit and GptpCapableReceive state
2 machines are specified in clause 10.4.1 in P802.1ASdm, however P802.1ASds is an amendment of
3 IEEE 802.1AS-2020-Rev then P802.1ASdm is not mentioned in the paragraph above, as it will be
4 rolled up in IEEE 802.1AS-2020-Rev>>

5 The use of Signaling messages on HDE links is not specified by this standard.

6 Hot Standby (see Clause 18) is not supported on HDE links.

7 The SyncIntervalSetting and the AnnounceIntervalSetting state machines are not used for HDE. The
8 variables useMgtSettableLogSyncInterval and useMgtSettableLogAnnounceInterval shall be set to TRUE.

Annex A

(normative)

Protocol Implementation Conformance Statement (PICS)
proforma³

Add a row at the end of Table A.5 as follows:

A.5 Major Capabilities

Item	Feature	Status	References	Support
MDHDE	Does the PTP Instance support media-dependent HDE link functionality on one or more PTP Ports?	O:1	5.9, 11, 19, A.6, A.22	Yes [] No []

Change A.6 as follows:

A.6 Media access control methods

Item	Feature	Status	References	Support
MAC-IEEE-802.3	Which MAC methods are implemented in conformance with the relevant MAC standards?	O:2	11.1 19.1	Yes [] No [] Yes [] No []
MAC-IEEE-802.11		O:2	12.1	Yes [] No []
MAC-1	Has a PICS been completed for each of the MAC methods implemented as required by the relevant MAC Standards?	M		Yes []
MAC-2	Do all the MAC methods implemented support the MAC Timing aware Service as specified?	M	Clause 11 Clause 12 Clause 13 Clause 19	Yes []

³ Copyright release for PICS proformas: Users of this standard may freely reproduce the PICS proforma in this annex so that it can be used for its intended purpose and may further publish the completed PICS.

*Change A.21 as follows:***A.21 External port configuration**

Item	Feature	Status	References	Support
	If item EXT is not supported, mark N/A.			NA []
EXT-1	Does the PTP Instance support the specifications for externalPortConfigurationEnabled value of true?	EXT:M	10.3.1 19.8	Yes []
EXT-2	Does the PTP Instance support the PortAnnounceInformationExt state machine?	EXT:M	10.3.14	Yes []
EXT-3	Does the PTP Instance support the PortStateSettingExt state machine?	EXT:M	10.3.15	Yes []

<<Editor's note: Table A.22 is based on Table A.13 for full-duplex point-to-point link. Please, check.>

*Insert Table A.22 as follows:***A.22 Media-dependent, HDE link**

Item	Feature	Status	References	Support
MDHDE-1	Does this PTP Port implement the functionality of the MDSyncReceiveSM state machine in compliance with the requirements of 19.2.14, 11.2.14 and Figure 11-6?	MDHDE:M	19.2.14, 11.2.14	Yes []
MDHDE-2	Does this PTP Port implement the functionality of the MDSyncSendSM state machine in compliance with the requirements of 19.2.15, 11.2.15 and Figure 11-7?	MIMSTR and MDHDE:M	19.2.15, 11.2.15	Yes []
MDHDE-3	Does this port implement the functionality of the MDPdelayRequest state machine in compliance with the requirements of 19.1.2, 19.2.19, 11.2.19 and Figure 11-9?	MDHDE:M	19.1.2, 19.2.19, 11.2.19	Yes []
MDHDE-4	Does this port implement the functionality of the MDPdelayResponse state machine in compliance with the requirements of 19.1.2, 19.2.20, 11.2.20 and Figure 11-10?	MDHDE:M,	19.2.20 19.1.2 11.2.20	Yes []
MDHDE-5	Does this PTP Port timestamp Sync messages on ingress with respect to the LocalClock in compliance with 19.3, 11.3.2.1 and 11.3.9?	MDHDE:M	19.3, 11.3.2.1	Yes []
MDHDE-6	Does this PTP Port timestamp Sync messages on egress with respect to the LocalClock in compliance with the requirements of 19.3, 11.3.2.1 and 11.3.9?	MIMSTR and MDHDE:M	19.3 11.3.2.1	Yes []
MDHDE-7	Does this port timestamp Pdelay_Req messages on ingress and egress with respect to the LocalClock in compliance with the requirements of 19.3, 11.3.2.1 and 11.3.9?	MDHDE:M	19.3, 11.3.2.1	Yes []

A.22 Media-dependent, HDE link (continued)

Item	Feature	Status	References	Support
MDHDE-8	Does this port timestamp Pdelay_Resp messages on ingress and egress with respect to the LocalClock in compliance with the requirements of 19.3, 11.3.2.1 and 11.3.9?	MDHDE:M	19.3, 11.3.2.1	Yes []
MDHDE-9	Are all IEEE 802.1AS messages on this port sent without a Q-tag in compliance with the requirements of 19.3, 11.3.3?	MDHDE:M	19.3, 11.3.3	Yes []
MDHDE-10	Do all media-dependent messages transmitted on this port use a destination MAC address taken from Table 11-3 in compliance with the requirements of 19.3 and 11.3.4 [01-80-C2-00-00-0E]?	MDHDE:M	19.3, 11.3.4	Yes []
MDHDE-11	Do all media-dependent messages transmitted on this port use a source MAC address that is assigned to that port in compliance with the requirements of 19.3 and 11.3.4?	MDHDE:M	19.3, 11.3.4	Yes []
MDHDE-12	Do all media-dependent message transmitted on this port use an EtherType specified in Table 11-4 [88-F7]?	MDHDE:M	19.3, 11.3.5	Yes []
MDHDE-13	Does the header of all the media-dependent messages on this port comply with the requirements of 19.4, 11.4.2 and Table 10-7?	MDHDE:M	19.4, 11.4.2	Yes [] N/A []
MDHDE-14	Does the body of Sync messages sent on this PTP Port comply with the requirements of 19.4, 11.4.3, Table 11-8, and Table 11-9?	MDHDE:M	19.4, 11.4.3	Yes []
MDHDE-15	Does the body of Follow_Up messages sent on this PTP Port comply with the requirements of 19.4, 11.4.4, 6.4.3.3 (lastGmPhaseChange), and Table 11-10?	MDHDE:M	19.4, 11.4.4, 6.4.3.3	Yes []
MDHDE-16	Does the body of Pdelay_Req messages sent on this port comply with the requirements of 19.4, 11.4.5 and Table 11-12?	MDHDE:M	19.4, 11.4.5	Yes []
MDHDE-17	Does the body of Pdelay_Resp messages sent on this port comply with the requirements of 19.4, 11.4.6 and Table 11-13?	MDHDE:M	19.4, 11.4.6	Yes []
MDHDE-18	Does the body of Pdelay_Resp_Follow_Up messages sent on this port comply with the requirements of 19.4, 11.4.7 and Table 11-14?	MDHDE:M	19.4, 11.4.7	Yes []
MDHDE-19	Are all reserved fields in media-dependent messages sent on this port set to 0 in compliance with the requirements of 19.4, 11.4.1?	MDHDE:M	19.4, 11.4.1	Yes []
MDHDE-20	Do the Sync message sequence numbers comply with the requirements of 19.3, 11.3.8?	MIMSTR and MDHDE:M	19.3, 11.3.8	Yes [] N/A []

A.22 Media-dependent, HDE link (*continued*)

Item	Feature	Status	References	Support
MDHDE-21	Do the Pdelay_Req message sequence numbers comply with the requirements of 19.3 and 11.3.8?	MDHDE:M	19.3, 11.3.8	Yes []
MDHDE-22	Does the Pdelay mean request transmission interval comply with the requirements of 19.5.2.2 and 11.5.2.2?	MDHDE:M	19.5.2.2, 11.5.2.2	Yes []
MDHDE-23	Does the Sync mean transmission interval comply with the requirements of 19.5.2.3 and 11.5.2.3?	MDHDE:M	19.5.2.3, 11.5.2.3	Yes []
MDHDE-24	Does the HDE media-dependent layer set the asCapable global variable in the media-independent PortSync entity in compliance with the requirements of 19.2.2 and 11.2.2?	MDHDE:M	19.2.2, 11.2.2	Yes []
MDHDE-25	Does the PTP Instance consider the PTP Port or Link Port, respectively, to not be exchanging Pdelay messages when a valid response is not received in compliance with the requirements of 19.5.3 and 11.5.3?	MDHDE:M	19.5.3, 11.5.3	Yes []
MDHDE-26	Does the PTP Instance ignore TLVs, of PTP messages, that it cannot parse and attempt to parse the next TLV, in compliance with the requirements of 19.4 and 11.4.1?	MDHDE:M	19.4, 11.4.1	Yes []
MDHDE-27	Does the time-aware system initialize meanLinkDelayThresh as specified in 19.2.2 and 11.2.2?	MDHDE:M	19.2.2, 11.2.2	Yes []
MDHDE-28	Does this port support propagation delay averaging?	MDHDE:O	19.2.19, 11.2.19.3.4	Yes [] No []
MDHDE-29	Does this port support two-step capability on receive?	MDHDE:M	19.2.14, 11.2.14, item d) of 5.5	Yes []
MDHDE-30	Does this port support two-step capability on transmit?	MDHDE:M	19.2.15, 11.2.15, item e) of 5.5	Yes []
MDHDE-31	Is the transport-specific peer-to-peer delay mechanism supported?	MDHDE:M	19.2.17	Yes []

Annex F

(informative)

PTP profile included in this standard

F.1 General

Change the paragraph in F.1 as follows:

The specification in this standard of synchronized time transport over a full-duplex point-to-point link includes a PTP profile. The information contained in a PTP profile is described in 20.3 of IEEE Std 1588-2019. This annex summarizes the PTP profile for transport of timing over full-duplex point-to-point links. This PTP profile is also used [in the transport of timing over HDE \(see Clause 19\)](#), and in the transport of timing over CSN when a CSN clock reference is not present (see Clause 16). This PTP profile is not used in the transport of timing over IEEE 802.11 links and IEEE 802.3 EPON links; both these transports use native timing mechanisms to assist in the synchronized time transport.

13