



Version 1.17.0 - October 2023

Abstract

The IEEE 802.1AS-2011 is a crucial part of the IEEE AVB (Audio Video Bridging) group of standards, and has been further extended by the IEEE 802.1 TSN (Time-Sensitive Networking) Task Group. It specifies a profile for use of IEEE 1588-2008 for clock synchronization over a virtual bridged local area network (as defined by IEEE 802.1Q). In particular, 802.1AS-2011 defines how IEEE 802.3 (Ethernet), IEEE 802.11 (Wi-Fi), and MoCA can all be parts of the same PTP timing domain.

Note, this application note does not consider any other standard version but IEEE 802.1AS-2011.

Introduction

The syn1588® PTP Stack supports the great majority of the features defined in the IEEE 802.1AS-2011 standard (Timing and Synchronization for Time-Sensitive Applications in Bridged Local Area Networks).

Avnu Certification Testing following 802.1AS

The University of New Hampshire InterOperability Laboratory (UNH-IOL) in concert with the interests of the Avnu Technical Working Group (TWG), the Avnu testing staff have developed test suites which can be utilized by Avnu Members for conformance and interoperability test purposes.

The Avnu certification services test the standards regarding Time Sensitive Networks (formerly referred to as AVB - Audio/Video Bridging). This testing group focuses on providing validation and certification for Avnu alliance member products.

They provide test plans and services for the following standards:

- 802.1AS
- 802.1Q (MRP, MVRP, MSRP, FQTSS)
- 802.1BA
- 1722
- 1722.1

For further information about Avnu Certification Testing Services please refer to <https://www.iol.unh.edu/testing/switching/avnu>

syn1588[®] Implementation identification

The tables below show which features of 802.1AS-2011 are already implemented in our syn1588[®] products. All references used in this document refer to the standard document IEEE Std 802.1AS™ - 2011 (IEEE, 3 Park Avenue, New York, NY 10016-5997, USA) dated March 30th 2011, which can be found here:

<https://ieeexplore.ieee.org/document/5741898>

General abbreviations and color

N/A	not applicable
PICS	Protocol Implementation Conformance Statement

Green = Already Implemented

White = Implementation Pending

Yellow = Implemented but with remarks

Status symbols

M	mandatory
O	optional
O.n	optional, but support of at least one of the group of options labelled by the same numeral n is required
X	prohibited
pred:	conditional-item symbol, including predicate identification (see A.3.4)
¬	logical negation, applied to a conditional item's predicate

Major capabilities

Item	Feature	Status	References	Support
MIB	Is the IEEE 8021-AS-MIB module fully supported (per its MODULE COMPLIANCE)?	O	Clause 15	N/A
MINTA	Does the device support media independent slave functionality on at least one port?	M	10.02.2012	Yes
BMC	Does the device implement the best master clock algorithm?	M	10,3	Yes
SIG	Does the device transmit signalling messages?	O	10.05.2004	Yes
GMCAP	Is the device capable of acting as a grandmaster?	O	8.6.2.1, 10.1.2	Yes
BRDG	Does the device act as a time-aware Bridge on two or more ports?	O	10.02.2006	Yes
MIMSTR	Does the device support media independent master functionality on at least one port?	GMCAP or BRDG:M	10.02.2011	Yes
MDFDPP	Does the device support media dependent full-duplex, point-to-point functionality on one or more ports?	O.1	11,1	N/A
MDDOT11	Does the device support media dependent IEEE 802.11 link functionality on one or more ports?	O.1	12,1	N/A
MDEPON	Does the device support IEEE 802.3 Passive Optical Networking (EPON)	O.1	13,1	N/A
MDGHN	Does the device support media dependent G.hn functionality on one or more ports?	O.1	Annex E	N/A
MDMOCA	Does the device support media dependent MoCA functionality on one or more ports?	O.1	Annex E	N/A
MDCSN	Does the device support media dependent CSN functionality on one or more ports?	MDGHN or MDMOCA:M	Annex E	N/A
MGT	Is management of the timing synchronization in Bridges supported?	O	Clause 15	No

Media access control methods

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

Minimal time-aware system

Item	Feature	Status	References	Support
MINTA-1	Does the device implement the functionality specified by the SiteSyncSync state machine in Figure 10-3 in compliance with the requirements of 10.2.6?	M	10.02.2006	Yes
MINTA-2	Does the device implement the functionality specified by the PortSyncSyncReceive state machine in Figure 10-4 on each port in compliance with the requirements of 10.2.7?	M	10.02.2007	Yes
MINTA-3	Does the device implement the functionality specified by the ClockSlaveSync state machine in Figure 10-9 in compliance with the requirements of 10.2.12?	M	10.02.2012	Yes
MINTA-4	Does the device port sending a Signalling message that contains a message interval request TLV adjust its syncReceiptTimeoutTimeInterval in compliance with the requirements of 10.5.4.3.7 and Table 10-12?	SIG:M	10.5.4.3.7	N/A
MINTA-5	Is the clockIdentity constructed in compliance with the requirements of 8.5.2.2, its subclauses, and Table 8-1?	M	8.5.2.2	Yes
MINTA-6	Is the domain number for all transmitted messages set to 0 in compliance with the requirements of 8.1?	M	8,1	Yes
MINTA-7	Is the IEEE 802.1AS time measured relative to the PTP epoch in compliance with the requirements of 8.2.2?	M	08.02.2002	Yes

MINTA-8	If path delay asymmetry is modelled by this device does it comply with the requirements of 8.3?	O	8,3	Yes
MINTA-9	Do all derived data types that are transmitted in IEEE 802.1AS messages and headers comply with 6.3.4?	M	06.03.2004	Yes
MINTA-10	Is the granularity of the local clock 40 ns or better in compliance with the requirements of B.1.2?	M	B.1.2	N/A
MINTA-11	Is the frequency of the local clock relative to TAI ± 100 ppm in compliance with the requirements of B.1.1?	M	B.1.1	N/A
MINTA-12	Does the time-aware system ignore TLVs, of Announce and Signalling messages, that it cannot parse and attempt to parse the next TLV, in compliance with the requirements of 10.5.1?	M	10.05.2001	Yes

Signaling

Item	Feature	Status	References	Support
SIG-1	Do the sequence numbers of Signalling messages comply with the requirements of 10.4.7?	SIG:M	10.04.2007	N/A
SIG-2	Does the Signalling message body comply with the requirements of 10.5.4.1 and Table 10-9?	SIG:M	10.5.4.1	N/A
SIG-3	Does the Signalling message header comply with the requirements of Table 10-4 and 10.5.2.1, including all of its subclauses (10.5.2.2.1–10.5.2.2.11)?	SIG:M	10.5.2.1	N/A
SIG-4	Are all Signalling message reserved fields equal to 0 in compliance with the requirements of 10.5.1?	SIG:M	10.05.2001	N/A
SIG-5	Is the destination MAC address for all Signalling messages equal to 01:80:C2:00:00:0E in compliance with the requirements of 10.4.3?	SIG:M	10.04.2003	N/A
SIG-6	Is the ethertype for all Signalling messages equal to 0x88F7 in compliance with the requirements of 10.4.4?	SIG:M	10.04.2004	N/A
SIG-7	Does the message interval request TLV for signalling messages comply with the requirements in 10.5.4.3.2 through 10.5.4.3.9 and Table 10-10?	SIG:M	10.5.4.3.2	N/A

Minimal time-aware system

Item	Feature	Status	References	Support
BMC-1	Does the device implement the functionality specified by the PortAnnounceReceive state machine in Figure 10-12 on each port in compliance with the requirements of 10.3.10?	M	10.03.2010	Yes
BMC-2	Does the device implement the functionality specified by the PortAnnounceInformation state machine in Figure 10-13 on each port in compliance with the requirements of 10.3.11?	M	10.03.2011	Yes
BMC-3	Does the device implement the functionality specified by the PortRoleSelection state machine in Figure 10-14 on each port in compliance with the requirements of 10.3.12?	M	10.03.2012	Yes
BMC-4	If the value of clockA's SystemIdentity is less than that of clockB, is clockA selected as Grandmaster in compliance with the requirements of 10.3.2?	M	10.03.2002	Yes
BMC-5	Does the value of priority1 comply with the requirements of 8.6.2.1?	M	8.6.2.1	Yes
BMC-6	Does the value of clockClass comply with the requirements of 8.6.2.2?	M	8.6.2.2	Yes, remark ¹
BMC-7	Does the value of priority2 comply with the requirements of 8.6.2.5?	M	8.6.2.5	Yes
BMC-8	Does the value of clockAccuracy comply with requirements of 8.6.2.3?	M	8.6.2.3	Yes
BMC-9	Does the value of offsetScaledVariance comply with the requirements of 8.6.2.4?	M	8.6.2.4	Yes
BMC-10	Does the value of timeSource comply with requirements of 8.6.2.7 and Table 8-3?	M	8.6.2.7	Yes
BMC-11	Is the port number equal to 1 in compliance with the requirements of 8.5.2.3?	~BRDG:M	8.5.2.3	Yes
BMC-12	Are the ports numbered 1 through N for each of N ports in compliance with the requirements of 8.5.2.3?	M	8.5.2.3	Yes
BMC-13	Does the clockIdentity field comply with the requirements of 8.5.2.2?	M	8.5.2.2	Yes

¹ our implementation does NOT set the clock class to 255 if the gmCapable flag is set to FALSE)

BMC-14	When no grandmaster capable device is available does the behaviour of the device comply with the requirements of 10.2.12.2, i.e., the clockSlaveTime should be provided by the local clock?	M	10.2.12.2	Yes, remark ²
BMC-15	Does the value of announceReceiptTimeout comply with the requirements of 10.6.3.2?	M	10.6.3.2	Yes
BMC-16	Does the SlavePort remove the port from the BMC selection after announceReceiptTimeout expires in compliance with the requirements of 10.6.3.2?	M	10.6.3.2	Yes
BMC-17	Does the value of syncReceiptTimeout comply with the requirements of 10.6.3.1?	M	10.6.3.1	Yes
BMC-18	Does the SlavePort remove the port from the BMC selection after syncReceiptTimeout expires in compliance with 10.6.3.1?	M	10.6.3.1	N/A
BMC-19	Does the device port sending a message interval request signalling message adjust its announceReceiptTimeoutTimeInterval in compliance with the requirements of 10.5.4.3.8 and Table 10-13?	SIG:M	10.5.4.3.8	N/A
BMC-20	If the device implements the ClockSourceTime interface, does the value of lastGmPhaseChange comply with the requirements of 9.2.2 and 6.3.3.3?	O	09.02.2002	Yes
BMC-21	Does the transmitted timing information comply with the requirements of 10.3.1?	GMCAP:M	10.03.2001	Yes

² the clock provides the clockSlaveTime via the syn1588 interface, the master time is to be calculated from the information provided by the shared memory - we do not provide an interface for this

Grandmaster-capable system

Item	Feature	Status	References	Support
GMCAP-1	Does the device implement the functionality specified by the ClockMasterSyncSend state machine in compliance with the requirements of 10.2.8 and Figure 10-5?	GMCAP:M	10.02.2008	Yes
GMCAP-2	Does the device implement the functionality specified by the ClockMasterSyncOffset state machine in compliance with the requirements of 10.2.9 and Figure 10-6?	GMCAP:M	10.02.2009	Yes
GMCAP-3	Does the device implement the the functionality specified by the ClockMasterSyncReceive state machine in compliance with the requirements of 10.2.10 and Figure 10-7?	GMCAP:M	10.02.2010	Yes

Media-independent master

Item	Feature	Status	References	Support
MIMSTR-1	Does the device implement the functionality of the AnnounceIntervalSetting state machine in compliance with the requirements of 10.3.14 and Figure 10-16 on each port?	MIMSTR:M	10.03.2014	Yes, remark ³
MIMSTR-2	Does the device implement the functionality of the PortSyncSyncSend state machine in compliance with the requirements of 10.2.11 and Figure 10-8 on each port?	MIMSTR:M	10.02.2011	Yes
MIMSTR-3	Does the device implement the functionality of the PortAnnounceTransmit state machine in compliance with the requirements of 10.3.13 and Figure 10-15 on each port?	MIMSTR:M	10.03.2013	Yes, remark ⁴
MIMSTR-4	Does the destination MAC address of all Announce messages equal 01:80:C2:00:00:0E?	MIMSTR:M	10.04.2003	Yes
MIMSTR-5	Does the ethertype of all Announce messages equal 0x88F7?	MIMSTR:M	10.04.2004	Yes

³ we do _NOT_ support signalling for 802.1AS

⁴ some announces are sent not fully compliant to the standard

MIMSTR-6	Do the sequence numbers of Announce messages comply with the requirements of 10.4.7?	MIMSTR:M	10.04.2007	Yes
MIMSTR-7	Does the Announce message header comply with Table 10-4 and 10.5.2.2, including all of its subclauses (10.5.2.2.1–10.5.2.2.11)?	MIMSTR:M	10.5.2.1	Yes
MIMSTR-8	Does the Announce message body comply with the requirements in 10.5.3.1 and Table 10-7?	MIMSTR:M	10.5.3.1	Yes
MIMSTR-9	Are all Announce message reserved fields equal to 0?	MIMSTR:M	10.05.2001	Yes
MIMSTR-10	If it is not otherwise specified is the logAnnounceInterval equal to zero or within the allowed range?	MIMSTR:M	10.6.2.1	Yes
MIMSTR-11	Does the value of currentUtcOffset comply with the requirements of 8.2.3?	MIMSTR:M	08.02.2003	Yes
MIMSTR-12	Do the values of the leap59, leap61, and currentUtcOffsetValid flags comply with the requirements of 10.3.8?	MIMSTR:M	10.03.2008	Yes
MIMSTR-13	Does this device ensure that messages that traverse it or originate from it are not transmitted with VLAN tags in compliance with the requirements of 11.3.3?	MIMSTR:M	11.03.2003	N/A
MIMSTR-14	Is the computation of cumulative rateRatio in accordance with 10.2.7.3?	MIMSTR:M	10.2.7.3	Yes

Media-dependent, full-duplex, point-to-point link

Item	Feature	Status	References	Support
MDFDPP-1	Does this port implement the functionality of the MDSyncReceiveSM state machine in compliance with the requirements of 11.2.13 and Figure 11-6?	MDFDPP:M	11.02.2013	Yes
MDFDPP-2	Does this port implement the functionality of the MDSyncSendSM state machine in compliance with the requirements of 11.2.14 and Figure 11-7?	MIMSTR and MDFDPP:M	11.02.2014	Yes
MDFDPP-3	Does this port implement the functionality of the MDPdelayRequest state machine in compliance with requirements of 11.2.15 and Figure 11-8?	MDFDPP:M	11.02.2015	Yes
MDFDPP-4	Does this port implement the functionality of the MDPdelayResponse state machine in compliance with the requirements of 11.2.16.2 and Figure 11-9?	MDFDPP:M	11.2.16.2	Yes
MDFDPP-5	Does this port implement the functionality of the LinkDelaySyncIntervalSetting state machine in compliance with the requirements of 11.2.17 and Figure 11-10?	MDFDPP:M	11.02.2017	Yes, remark ⁵
MDFDPP-6	Does this port timestamp Sync messages on ingress with respect to the LocalClock in compliance with 11.3.2.1 and 11.3.9?	MDFDPP:M	11.3.2.1	Yes
MDFDPP-7	Does this port timestamp Sync messages on egress with respect to the LocalClock in compliance with the requirements of 11.3.2.1 and 11.3.9?	MIMSTR and MDFDPP:M	11.3.2.1	Yes
MDFDPP-8	Does this port timestamp Pdelay_Req messages on ingress and egress with respect to the LocalClock in compliance with the requirements of 11.3.2.1 and 11.3.9?	MDFDPP:M	11.3.2.1	Yes
MDFDPP-9	Does this port timestamp Pdelay_Resp messages on	MDFDPP:M	11.3.2.1	Yes

⁵ we do _NOT_ support signalling for 802.1AS

	ingress and egress with respect to the LocalClock in compliance with the requirements of 11.3.2.1 and 11.3.9?			
MDFDPP-10	Are all IEEE 802.1AS messages on this port sent without a Q-tag in compliance with the requirements of 11.3.3?	MDFDPP:M	11.03.2003	N/A
MDFDPP-11	Do all media-dependent messages transmitted on this port use a destination MAC address taken from Table 11-1 in compliance with the requirements of 11.3.4 [01-80-C2-00-00-0E]?	MDFDPP:M	11.03.2004	Yes
MDFDPP-12	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 11.3.4?	MDFDPP:M	11.03.2004	Yes
MDFDPP-13	Do all media-dependent message transmitted on this port us an ethertype specified in Table 11-2 [0x88F7]?	MDFDPP:M	11.03.2005	Yes
MDFDPP-14	Does the header of all the media dependent messages on this port comply with the requirements of the subclauses of 11.4.2 and Table 10-4?	MDFDPP:M	11.04.2002	Yes
MDFDPP-15	Does the body of Sync messages sent on this port comply with the requirements of 11.4.3 and Table 11-8?	MDFDPP:M	11.04.2003	Yes
MDFDPP-16	Does the body of Follow_Up messages sent on this port comply with the requirements of 11.4.4 and 6.3.3.3 (lastGmPhaseChange) and Table 11-9?	MDFDPP:M	11.04.2004	Yes
MDFDPP-17	Does the body of Pdelay_Req messages sent on this port comply with the requirements of 11.4.5 and Table 11-11?	MDFDPP:M	11.04.2005	Yes
MDFDPP-18	Does the body of Pdelay_Resp messages sent on this port comply with the requirements of 11.4.6 and Table 11-12?	MDFDPP:M	11.04.2006	Yes
MDFDPP-19	Does the body of Pdelay_Resp_Follow_Up messages sent on this port comply with the requirements of 11.4.7 and Table 11-13?	MDFDPP:M	11.04.2007	Yes
MDFDPP-20	Are all reserved fields in media-dependent messages sent on this port set to 0 in compliance	MDFDPP:M	11.04.2001	Yes

	with the requirements of 11.4.1?			
--	----------------------------------	--	--	--

MDFDPP-21	Do the Sync message sequence numbers comply with the requirements of 11.3.8?	MIMSTR and MDFDPP:M	11.03.2008	Yes
MDFDPP-22	Do the Pdelay_Req message sequence numbers comply with the requirements of 11.3.8?	MDFDPP:M	11.03.2008	Yes
MDFDPP-23	Does the Pdelay mean request transmission interval comply with the requirements of 11.5.2.2?	MDFDPP:M	11.5.2.2	Yes
MDFDPP-24	Does the Sync mean transmission interval comply with the requirements of 11.5.2.3?	MDFDPP:M	11.5.2.3	Yes
MDFDPP-25	Does the full-duplex, point-to-point media-dependent layer set the asCapable global variable in the media-independent PortSync entity in compliance with the requirements of 11.2.2?	MDFDPP:M	11.02.2002	Yes
MDFDPP-26	Does the device's use of flow control comply with the requirements of 11.2.3 and 11.2.4?	MDFDPP:M	11.2.3, 11.2.4	N/A
MDFDPP-27	Does the device consider the port to not be exchanging Pdelay messages when a valid response is not received in compliance with the requirements of 11.5.3?	MDFDPP:M	11.05.2003	Yes
MDFDPP-28	Does the time-aware system ignore TLVs, of PTP messages, that it cannot parse and attempt to parse the next TLV, in compliance with the requirements of 11.4.1?	MDFDPP:M	11.04.2001	Yes

Media-dependent IEEE 802.11 link

Item	Feature	Status	References	Support
MDDOT11-1	Does the IEEE 802.11 MAC implement the master port functionality in compliance with the requirements of 12.4.1?	MDDOT11 and MIMSTR:M	12.04.2001	N/A
MDDOT11-2	Does the IEEE 802.11 MAC implement the master port functionality in compliance with the requirements of 12.4.2?	MDDOT11:M	12.04.2002	N/A
MDDOT11-3	Does the IEEE 802.11 MAC determine the value of asCapable in compliance with the requirements of 12.3?	MDDOT11:M	12,3	N/A
MDDOT11-4	Does the IEEE 802.11 MAC determine the value of mean time interval between synchronization messages in compliance with the requirements of 12.6?	MDDOT11 and MIMSTR:M	12,6	N/A

Media-dependent IEEE 802.3 EPON link

Item	Feature	Status	References	Support
MDEPON-1	Does the TIMESYNC message format comply with the requirements of 13.3 and Table 13-1?	MDEPON:M	13,3	N/A
MDEPON-2	Does the device implement the functionality specified by the requester state machine in compliance with the requirements of 13.8.1 and Figure 13-3?	MDEPON and MIMSTR:M	13.8.1.4	N/A
MDEPON-3	Does the device implement the functionality specified by the responder state machine in compliance with the requirements of 13.8.2 and Figure 13-4?	MDEPON:M	13.8.2.4	N/A
MDEPON-4	Does the TIMESYNC message transmission interval comply with the requirements of 13.9.1 and 13.9.2?	MDEPON:M	13.9.1, 13.9.2	N/A
MDEPON-5	Does the implementation of best master selection comply with the requirements of 13.1.3?	MDEPON:M	13.01.2003	N/A
MDEPON-6	Does the determination of the value of asCapable comply with the requirements of 13.4?	MDEPON:M	13,4	N/A

Media-dependent CSN link

Item	Feature	Status	References	Support
MDCSN-1	Does the device implement the functionality of the MDSyncSendSM state machine in compliance with 11.2.14?	MDCSN and MIMSTR:M	11.02.2014	N/A
MDCSN-2	Does the device implement the functionality of the MDSyncReceiveSM state machine in compliance with 11.2.13?	MDCSN:M	11.02.2013	N/A
MDCSN-3	Does the device calculate path delay in compliance with the requirement of E.4 and its subclauses?	MDCSN:M	E.4.1, E.4.2, E.4.3	N/A
MDCSN-4	Does the device propagate synchronized time in compliance with the requirements of E.5 and its subclauses?	MDCSN:M	E.5.1, E.5.2	N/A
MDCSN-5	Does the device act as grandmaster in compliance with the requirements of E.7 and its subclauses?	GMCAP and MDCSN:M	E.7	N/A
MDCSN-6	Does the device comply with the performance requirements of E.8?	GMCAP and MDCSN:M	E.8	N/A

Media-dependent MoCA link

Item	Feature	Status	References	Support
MDMOCA-1	Does the MoCA MD entity propagate Sync messages in compliance with the requirements of E.6.1?	MDMOCA:M	E.6.1	N/A

Media-dependent ITU-T G.hn link-

Item	Feature	Status	References	Support
MDGHN-1	Does the GHN MD entity propagate Sync messages in compliance with the requirements of E.6.2?	MDGHN:M	E.6.2	N/A