Avnu Alliance Certification Program

Test Plan for 802.1AS: Timing and Synchronization for Time-Sensitive Applications in Bridged Local Area Networks

Version 1.0.1

Technical Document

Abridged Version for Public Display

NOTICE: This document is an abbreviated version of the Avnu Alliance Test Plan.

The full table of contents from the test plan is shown. One representative complete test case is shown last.

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Introduction

The **Avnu Alliance** is a community creating an interoperable ecosystem of low-latency, time-synchronized, highly reliable networked devices using open standards. Avnu creates comprehensive certification programs to ensure interoperability of networked devices. The foundational technology enables deterministic synchronized networking based on IEEE Audio Video Bridging (AVB) / Time Sensitive Networking (TSN) base standards. The Alliance, in conjunction with other complimentary standards bodies and alliances, develops complete solutions in professional AV, automotive, industrial control and consumer segments.

These tests are designed to determine if a product conforms to specifications defined in the suite of standards known collectively as the Audio/Video Bridging (hereafter referred to as the "AVB") standards from the IEEE 802.1 Working Group. Successful completion of all tests contained in this suite does not guarantee that the tested device will successfully operate with other AVB products. However, when combined with a satisfactory level of interoperability testing, these tests provide a reasonable level of confidence that the Device Under Test (DUT) will function properly in many AVB environments.

The tests contained in this document are organized in order to simplify the identification of information related to a test, and to facilitate the actual testing process. Tests are separated into groups, primarily in order to reduce setup time in the lab environment, however the different groups typically also tend to focus on specific aspects of device functionality. A three-number, dot-notated naming system is used to catalog the tests (e.g., "Test 35.1.1 -Propagation of Talker Advertise Attributes"), where the first number always indicates the specific section of the referenced standard on which the test suite is based. The second and third numbers indicate the test's group number and test number within that group, respectively. This format allows for the addition of future tests in the appropriate groups without requiring the renumbering of subsequent un-related tests.

This test plan format is borrowed, with explicit permission, from the University of New Hampshire's Inter-Operability Laboratory (UNH-IOL).

The test definitions themselves are intended to provide a high-level description of the motivation, resources, procedures, and methodologies specific to each test. Formally, each test description contains the following sections:

Test Label: The test label and title constitute the first line of the test block. The test label is the concatenation of the short test suite name, group number, and the test number within the group, separated by periods

Purpose: The Purpose is a brief statement outlining what the test attempts to achieve. It is usually phrased as a simple assertion of the feature or capability to be tested.

Device Type Pre-Requisites, & Certification Classifier: The Device Type Pre-requisites and Certification Classifier section notes for each part of the test what the pre-requisite conditions are for the given Device Type. The Certification Classifier denotes whether the test part, for the identified Device Type meeting the identified pre-requisite onditions, is one of the following:

Classifier	Meaning
Mandatory	Test part is required if the DUT matches the Device Type.
Conditional Mandatory	Test part is required if the pre-requisite condition is true and the DUT matches the Device Type.
Optional	Test part has a pass/fail criteria, but failure does not imply the device will not be certified based on this result alone.
Informative	Test part has no pass/fail, but the observations may have value.

References: The References section specifies all reference material external to the test plan, including the specific references for the test in question, and any other references that might be helpful in understanding the test methodology and/or test results. External sources are always referenced by a bracketed number (e.g. [1]) when mentioned in the test description. Any other references in the test description that are not indicated in this manner refer to elements within the test suite document itself (e.g. "Appendix 5.A" or "Table 5.1.1-1").

Resource Requirements: The Resource Requirements section specifies the test hardware and/or software needed to perform the test. This is generally expressed in terms of minimum requirements for abstract test gear. In some cases precise equipment requirements may be provided with examples of specific manufacturer/model information provided.

Modification History: The Modification History logs the changes for this test since its introduction.

Discussion: The Discussion is a general discussion of the test and relevant section of the specification, including any assumptions made in the design or implementation of the test as well as known limitations.

Test Setup: The setup section describes the initial configuration of the test environment. Elements of the test procedure may change the test environment as the test progresses.

Procedure: The procedure section contains the systematic instructions for carrying out the test. It provides a cookbook approach to testing, and may be interspersed with requirements to record observable results. These procedures should be the ideal test methodology, independent of specific tool limitations or restrictions.

Observable Results: This section lists the specific observable items that can be examined by the tester in order to verify that the DUT is operating properly. When multiple values for an observable are possible, this section provides a short discussion on how to interpret them. The determination of a pass or fail outcome for a particular test is generally based on the successful (or unsuccessful) detection of a specific observable. A general note on scripting: *All tests are presumed to initially be considered **failing**, and remain so if any single fail-condition is met for the test part in question.* Only if no fail conditions are met, and the explicitly stated pass-conditions observed, will the test be deemed a pass.

If, for any reason, none of the conditions of a part of a test are met (either pass or fail) then that part of the test is considered a failure (exceptions only being for WARN or INFO conditions that are met).

A strong preference is to have any part of a test err on the side of falsely failing a device rather than falsely passing the device. Whether through automation or manual execution, tests can have only one of five outcomes:

Status	Meaning
PASS	Test part meets all PASS criteria, with no FAIL or WARN conditions met.
FAIL	Test part meets at least one FAIL criteria, or fails to meet any criteria.
N/A	Test part is Not Applicable to the device.
WARN	Test part does not meet a failing criteria, but behavior is not recommended and Warned against.
INFO	Test part has no pass/fail criteria, but the observation may have value to the device manufacturer or industry-at-large.

Possible Problems: This section contains a description of known issues with the test procedure, which may affect test results in certain situations.

Summary of Test Pre-requisites and Certification Classifiers

Test gPTP.com.c.1.1 — Effect of asCapable

Purpose: To verify the DUT behaves as expected when a DUT port's link partner is not asCapable and behaves properly when toggled.

Device Type Prerequisites and Certification Classifier:

Part	Applies To Device Type	Prerequisite Conditions	Classifier
A-B	Any gPTP Device	None.	**Conditional Mandatory**
C	Any gPTP Device	Grandmaster-capable.	**Conditional Mandatory**

Test gPTP.com.c.1.2 — Transmitted domainNumber

Purpose: To verify that the DUT sends all gPTP messages with domainNumber set to 0x00

Device Type Prerequisites and Certification Classifier:

Part	Applies To Device Type	Prerequisite Conditions	Classifier
A	Any gPTP Device	None	**Mandatory**
B	Any gPTP Device	Grandmaster-capable	**Conditional Mandatory**

Test gPTP.com.c.2.1 — SiteSyncSync: Receipt of Sync ignored on non-slavePort

Purpose: To verify that the DUT ignores the receipt of Sync messages received on non-slave Ports.

Device Type Prerequisites and Certification Classifier:

Part	Applies To Device Type	Prerequisite Conditions	Classifier
A	Any gPTP Device	Grandmaster-capable	**Conditional Mandatory**

Test gPTP.com.c.2.2 — SiteSyncSync: No Sync sent when gmPresent is FALSE

Purpose: To verify that the DUT does not send Sync when priority1 is set to 255.

Device Type Prerequisites and Certification Classifier:

Part	Applies To Device Type	Prerequisite Conditions	Classifier
A	Any gPTP Device	Grandmaster-capable and allows user to set priority1 to 255.	**Conditional Mandatory**

Test gPTP.com.c.3.1 — Proper syncReceiptTimeout

Purpose: To validate the DUT's syncReceiptTimeout value.

Device Type Prerequisites and Certification Classifier:

Part	Applies To Device Type	Prerequisite Conditions	Classifier
A-B	Any gPTP device	None	**Mandatory**

Test gPTP.com.c.4.1 — ClockSlaveSync: updateSlaveTime occurs properly

Purpose: To verify that the Slave properly locks to the grandmaster to within ±80ns.

Device Type Prerequisites and Certification Classifier:

Part	Applies To Device Type	Prerequisite Conditions	Classifier
A	Any gPTP Device	If external access to a signal locked to gPTP time is available (1PPS, 1PulsePer125µs, etc).	**Conditional Mandatory**

Test gPTP.com.c.5.1 — Proper priority1 and priority2 values

Purpose: To validate the DUT's priority1 and priority2 values.

Device Type Prerequisites and Certification Classifier:

Part	Applies To Device Type	Prerequisite Conditions	Classifier
A	Any gPTP Device	The DUT must be claimed to be either not GM capable; or, a time-aware system that is either Network infrastructure, Portable, or Other (priority1 of 246, 250 & 248 respectively).	**Mandatory**

Test gPTP.com.c.5.2 — Proper clockClass value

Purpose: To validate the DUT's clockClass value.

Device Type Prerequisites and Certification Classifier:

Part	Applies To Device Type	Prerequisite Conditions	Classifier
A	Any gPTP Device	None	**Mandatory**

Test gPTP.com.c.5.3 — Proper clockAccuracy value

Purpose: To validate the DUT's clockAccuracy value.

Device Type Prerequisites and Certification Classifier:

Part	Applies To Device Type	Prerequisite Conditions	Classifier
A	Any gPTP Device	None	**Mandatory**

Test gPTP.com.c.5.4 — Proper offsetScaledLogVariance value

Purpose: To validate that the DUT reports a valid offsetScaledLogVariance value.

Device Type Prerequisites and Certification Classifier:

Part	Applies To Device Type	Prerequisite Conditions	Classifier
A	Any gPTP Device	None	**Mandatory**

Test gPTP.com.c.5.5 — Proper timeSource

Purpose: To validate the DUT's timeSource value.

Device Type Prerequisites and Certification Classifier:

Part	Applies To Device Type	Prerequisite Conditions	Classifier
A	Any gPTP Device	The DUT timeSource must be claimed to be either ATOMIC CLOCK, GPS, TERRESTIAL RADIO, PTP, NTP, HANDSET, INTERNAL OSCILLATOR or OTHER	**Mandatory**

Test gPTP.com.c.5.6 — Proper portNumbers

Purpose: To validate the observed DUT's portNumber values are unique.

Device Type Prerequisites and Certification Classifier:

Part	Applies To Device Type	Prerequisite Conditions	Classifier
A	Any gPTP Device	None.	**Mandatory**

Test gPTP.com.c.6.1 — PortAnnounceReceive disqualification, by clockIdentity

Purpose: To validate the DUT's implementation of the PortAnnounceReceive state machine—in particular that it disqualifies Announce messages coming from itself.

Device Type Prerequisites and Certification Classifier:

Part	Applies To Device Type	Prerequisite Conditions	Classifier
A	Any gPTP device	None	**Mandatory**

Test gPTP.com.c.6.2 — PortAnnounceReceive disqualification, by stepsRemoved

Purpose: To validate the DUT's implementation of the PortAnnounceReceive state machine—in particular that it disqualifies Announce messages with stepsRemoved ≥ 255.

Device Type Prerequisites and Certification Classifier:

Part	Applies To Device Type	Prerequisite Conditions	Classifier
A-B	Any gPTP device	None	**Mandatory**

Test gPTP.com.c.6.3 — PortAnnounceReceive disqualification, by path trace TLV

Purpose: To validate the DUT's implementation of the PortAnnounceReceive state machine—in particular that it disqualifies Announce messages whose path trace TLV contains the DUT's clockIdentity.

Device Type Prerequisites and Certification Classifier:

Part	Applies To Device Type	Prerequisite Conditions	Classifier
A	Any gPTP device	None	**Mandatory**

Test gPTP.com.c.7.1 — Proper announceReceiptTimeout

Purpose: To validate the DUT's announceReceiptTimeout value.

Device Type Prerequisites and Certification Classifier:

Part	Applies To Device Type	Prerequisite Conditions	Classifier
A	Any gPTP device	None	**Mandatory**

Test gPTP.com.c.7.2 — systemIdentity comparison: priority1 field

Purpose: To verify that the systemIdentity attributes of two time-aware systems are properly compared during best master clock selection.

Device Type Prerequisites and Certification Classifier:

Part	Applies To Device Type	Prerequisite Conditions	Classifier
A	Any gPTP Device	None	**Mandatory**
B-D	Any gPTP Device	Grandmaster-capable	**Conditional Mandatory**

Test gPTP.com.c.7.3 — systemIdentity comparison: clockClass field

Purpose: To verify that the systemIdentity attributes of two time-aware systems are properly compared during best master clock selection.

Device Type Prerequisites and Certification Classifier:

Part	Applies To Device Type	Prerequisite Conditions	Classifier
A	Any gPTP Device	None	**Mandatory**
B-D	Any gPTP Device	Grandmaster-capable	**Conditional Mandatory**

Test gPTP.com.c.7.4 — systemIdentity comparison: clockAccuracy field

Purpose: To verify that the systemIdentity attributes of two time-aware systems are properly compared during best master clock selection.

Device Type Prerequisites and Certification Classifier:

Part	Applies To Device Type	Prerequisite Conditions	Classifier
A-D	Any gPTP Device	None	**Mandatory**

Test gPTP.com.c.7.5 — systemIdentity comparison: offsetScaledLogVariance field

Purpose: To verify that the systemIdentity attributes of two time-aware systems are properly compared during best master clock selection.

Device Type Prerequisites and Certification Classifier:

Part	Applies To Device Type	Prerequisite Conditions	Classifier
A-D	Any gPTP Device	None	**Mandatory**

Test gPTP.com.c.7.6 — systemIdentity comparison: priority2 field

Purpose: To verify that the systemIdentity attributes of two time-aware systems are properly compared during best master clock selection.

Device Type Prerequisites and Certification Classifier:

Part	Applies To Device Type	Prerequisite Conditions	Classifier
A-D	Any gPTP Device	None	**Mandatory**

Test gPTP.com.c.7.7 — systemIdentity comparison: clockIdentity field

Purpose: To verify that the systemIdentity attributes of two time-aware systems are properly compared during best master clock selection.

Device Type Prerequisites and Certification Classifier:

Part	Applies To Device Type	Prerequisite Conditions	Classifier
A-B	Any gPTP Device	None	**Mandatory**

Test gPTP.com.c.8.1 — PortRoleSelectionSM: Proper pathTrace when grandmaster

Purpose: To verify that the DUT constructs the pathTrace TLV properly when grandmaster.

Device Type Prerequisites and Certification Classifier:

Part	Applies To Device Type	Prerequisite Conditions	Classifier
A	Any gPTP Device	Grandmaster-capable	**Conditional Mandatory**

Test gPTP.com.c.9.1 — ClockMasterSyncSend SM: Sync interval

Purpose: To verify that the DUT sends Sync messages at the proper interval

Device Type Prerequisites and Certification Classifier:

Part	Applies To Device Type	Prerequisite Conditions	Classifier
A	Any gPTP Device	Grandmaster-capable. Number of active streams supported must be provided.	**Conditional Mandatory**

Test gPTP.com.c.9.2 — ClockMasterSyncSend SM: Phase and frequency change

Purpose: To verify that a grandmaster-capable device alters its scaledLastGmFreqChange value when and only when it alters its frequency

Device Type Prerequisites and Certification Classifier:

Part	Applies To Device Type	Prerequisite Conditions	Classifier
A	Any gPTP Device	Grandmaster-capable	**Conditional Mandatory**

Test gPTP.com.c.10.1 — Announce message DA, EtherType and reserved fields

Purpose: To validate the destination address, Ethertype, and reserved fields in the DUT's Announce messages

Device Type Prerequisites and Certification Classifier:

Part	Applies To Device Type	Prerequisite Conditions	Classifier
A	Any gPTP Device	None	**Mandatory**

Test gPTP.com.c.10.2 — Announce message header and body

Purpose: To validate the header and body in the DUT's Announce messages

Device Type Prerequisites and Certification Classifier:

Part	Applies To Device Type	Prerequisite Conditions	Classifier
A	Any gPTP Device	None	**Mandatory**

Test gPTP.com.c.10.3 — Announce message sequenceId

Purpose: To validate the sequence numbers in the DUT's Announce messages

Device Type Prerequisites and Certification Classifier:

Part	Applies To Device Type	Prerequisite Conditions	Classifier
A	Any gPTP Device	None	**Mandatory**

Test gPTP.com.c.11.1 — Announce message interval

Purpose: To verify that the DUT's Announce message interval is within the permitted range.

Device Type Prerequisites and Certification Classifier:

Part	Applies To Device Type	Prerequisite Conditions	Classifier
A	Any gPTP Device	Number of active streams supported must be provided.	**Mandatory**

Test gPTP.com.c.12.1 — Verification of Pdelay Turnaround Time

Purpose: To verify that the mean Pdelay turnaround time of the DUT is under 10 ms plus an acceptable error margin (+5 ms).

Device Type Prerequisites and Certification Classifier:

Part	Applies To Device Type	Prerequisite Conditions	Classifier
A	Any gPTP Device	None	**Mandatory**

Test gPTP.com.c.12.2 — Flow Control Behavior

Purpose: To verify that the DUT neither sends nor reacts to received Flow Control requests (PAUSE or PFC)

Device Type Prerequisites and Certification Classifier:

Part	Applies To Device Type	Prerequisite Conditions	Classifier
A-C	Any gPTP Device	None	**Mandatory**

Test gPTP.com.c.12.3 — Message format—no Q-tags

Purpose: To verify that the DUT does not send gPTP messages in Ethernet frames with Q-tags.

Device Type Prerequisites and Certification Classifier:

Part	Applies To Device Type	Prerequisite Conditions	Classifier
A	Any gPTP Device	None	**Mandatory**
B	Any gPTP Device	Grandmaster-capable	**Conditional Mandatory**

Test gPTP.com.c.12.4 — Media Dependent: Message format—Ethernet fields and reserved fields

Purpose: To validate the destination address, source address, Ethertype, and reserved fields in the DUT's messages.

Device Type Prerequisites and Certification Classifier:

Part	Applies To Device Type	Prerequisite Conditions	Classifier
A-B	Any gPTP Device	None	**Mandatory**
C	Any gPTP Device	Grandmaster-capable	**Conditional Mandatory**

Test gPTP.com.c.12.5 — Media Dependent: Message format—header

Purpose: To validate the header fields in the DUT's non-Announce messages.

Device Type Prerequisites and Certification Classifier:

Part	Applies To Device Type	Prerequisite Conditions	Classifier
A-B	Any gPTP Device	None	**Mandatory**
C	Any gPTP Device	Grandmaster-capable	**Conditional Mandatory**

Test gPTP.com.c.12.6 — Message body—Follow_Up

Purpose: To validate the body fields in the DUT's Follow_Up messages.

Device Type Prerequisites and Certification Classifier:

Part	Applies To Device Type	Prerequisite Conditions	Classifier
A	Any gPTP Device	Grandmaster-capable. If DUT uses PTP epoch, instructions required to properly sync DUT time.	**Conditional Mandatory**

Test gPTP.com.c.12.7 — Ignores Other transportSpecific Values

Purpose: To verify that the DUT properly ignores PTP messages with transportSpecific values other than 0x1.

Device Type Prerequisites and Certification Classifier:

Part	Applies To Device Type	Prerequisite Conditions	Classifier
A-C	Any gPTP Device	None	**Mandatory**

Test gPTP.com.c.12.8 — Ignores Unknown TLVs

Purpose: To verify that the DUT properly ignores unknown TLVs in received PTP messages.

Device Type Prerequisites and Certification Classifier:

Part	Applies To Device Type	Prerequisite Conditions	Classifier
A-H	Any gPTP Device	None	**Mandatory**

Test gPTP.com.c.13.1 — MDSyncReceiveSM: followUpReceiptTimeout verification

Purpose: To verify that the DUT's followUpReceiptTimeoutTime is 125ms (+50% -10%).

Device Type Prerequisites and Certification Classifier:

Part	Applies To Device Type	Prerequisite Conditions	Classifier
A-C	Any gPTP Device	None	**Mandatory**

Test gPTP.com.c.13.2 — MDSyncReceiveSM: followUp sequenceID Check

Purpose: To verify that the DUT's Follow_Up message's sequenceID's are checked to be consistent with the received Sync message.

Device Type Prerequisites and Certification Classifier:

Part	Applies To Device Type	Prerequisite Conditions	Classifier
A	Any gPTP Device	None	**Mandatory**

Test gPTP.com.c.14.1 — MDSyncSendSM: sequenceId

Purpose: To verify that the DUT properly implements the MDSyncSendSM state machine's handling of sequenceIds.

Device Type Prerequisites and Certification Classifier:

Part	Applies To Device Type	Prerequisite Conditions	Classifier
A	Any gPTP Device	Grandmaster-capable	**Conditional Mandatory**

Test gPTP.com.c.14.2 — MDSyncSendSM: correctionField of Follow_Up Messages

Purpose: To verify the Correction field of the Follow_Up Message sent by the grandmaster.

Device Type Prerequisites and Certification Classifier:

Part	Applies To Device Type	Prerequisite Conditions	Classifier
A	Any gPTP Device	Grandmaster-capable without a sub-nanosecond accurate clock	**Mandatory**

Test gPTP.com.c.15.1 — MDPdelayReqSM: DUT reports proper delay

Purpose: To verify that the DUT reports the proper peer delay for two cables of known length.

Device Type Prerequisites and Certification Classifier:

Part	Applies To Device Type	Prerequisite Conditions	Classifier
A,B	Any gPTP Device	If the DUT supports the optional ability to report Pdelay length of attached cable	**Conditional Mandatory**

Test gPTP.com.c.15.2 — MDPdelayReq SM: sequenceId

Purpose: To verify that the DUT properly implements the MDPdelayReq State Machine's handling of sequenceIds.

Device Type Prerequisites and Certification Classifier:

Part	Applies To Device Type	Prerequisite Conditions	Classifier
A-C	Any gPTP Device	None	**Mandatory**

Test gPTP.com.c.15.3 — MDPdelayReq SM: Lost and Late responses

Purpose: To verify that when responses to the DUT's Pdelay_Reqs are lost or late, the DUT responds properly.

Device Type Prerequisites and Certification Classifier:

Part	Applies To Device Type	Prerequisite Conditions	Classifier
A-D	Any gPTP Device	None	**Mandatory**
E	Any gPTP Device	None	**Informative**

Test gPTP.com.c.15.4 — MDPdelayReq SM: Invalid responses

Purpose: To verify that when responses to the DUT's Pdelay_Reqs are invalid the DUT responds properly.

Device Type Prerequisites and Certification Classifier:

Part	Applies To Device Type	Prerequisite Conditions	Classifier
A-F	Any gPTP Device	None	**Mandatory**

Test gPTP.com.c.15.5 — MDPdelayReq SM: asCapable conditions, Exchange of peer delay messages

Purpose: To verify that the DUT's ports are not asCapable when not exchanging Pdelay messages with its link partner.

Device Type Prerequisites and Certification Classifier:

Part	Applies To Device Type	Prerequisite Conditions	Classifier
A, B	Any gPTP Device	None	**Mandatory**

Test gPTP.com.c.15.6 — MDPdelayReq SM: asCapable conditions, neighborPropDelay

Purpose: To verify that the DUT's ports are not asCapable when neighborPropDelay is too large.

Device Type Prerequisites and Certification Classifier:

Part	Applies To Device Type	Prerequisite Conditions	Classifier
A,B,E	Any gPTP Device	DUT has ports using copper cabling.	**Conditional Mandatory**
C,D	Any gPTP Device	DUT has ports using fiber cabling.	**Conditional Mandatory**
F	Any gPTP Device	Support for AVnu_PTP-6 is implemented.	**Mandatory**
G	Any gPTP Device	None.	**Mandatory**

Test gPTP.com.c.15.7 — MDPdelayReq SM: asCapable conditions, receipt of multiple responses to Pdelay_Req

Purpose: To verify that the DUT's ports are not asCapable when multiple Pdelay_Resp messages are received.

Device Type Prerequisites and Certification Classifier:

Part	Applies To Device Type	Prerequisite Conditions	Classifier
A, B	Any gPTP Device	None	**Mandatory**

Test gPTP.com.c.15.8 — MDPdelayReq SM: asCapable conditions, sourcePortIdentity

Purpose: To verify that the DUT's ports are not asCapable when the sourcePortIdentity of Pdelay_Resp messages is that of the DUT.

Device Type Prerequisites and Certification Classifier:

Part	Applies To Device Type	Prerequisite Conditions	Classifier
A, B	Any gPTP Device	None	**Mandatory**

Test gPTP.com.c.15.9 — MDPdelayReq SM: asCapable conditions, neighborRateRatioValid

Purpose: To verify that the DUT's sets neighborRateRatioValid only after 2 and no more than 10 Pdelay_Req messages.

Device Type Prerequisites and Certification Classifier:

Part	Applies To Device Type	Prerequisite Conditions	Classifier
A	Any gPTP Device	None	**Mandatory**

Test gPTP.com.c.15.10 — MDPdelayReq SM: Pdelay_Req interval

Purpose: To verify that the DUT sends Pdelay_Req messages at the proper interval.

Device Type Prerequisites and Certification Classifier:

Part	Applies To Device Type	Prerequisite Conditions	Classifier
A,C	Any gPTP Device	None.	**Mandatory**
B	Any gPTP Device	Number of active streams supported must be provided.	**Mandatory**

Test gPTP.com.c.16.1 — MDPdelayResp SM: field values

Purpose: To verify that the DUT properly implements the MDPdelayResp state machine's setPdelayResp() and setPdelayRespFollowUp() functions.

Device Type Prerequisites and Certification Classifier:

Part	Applies To Device Type	Prerequisite Conditions	Classifier
A	Any gPTP Device	None	**Mandatory**

Test gPTP.com.c.17.1 — Effect of portEnabled

Purpose: To verify that the DUT does not source gPTP traffic nor react to received gPTP traffic when *portEnabled* is FALSE and behaves properly when toggled.

Device Type Prerequisites and Certification Classifier:

Part	Applies To Device Type	Prerequisite Conditions	Classifier
A-B	Any gPTP Device	The port can be administratively disabled.	**Conditional Mandatory**
C	Any gPTP Device	Grandmaster-capable and the port can be administratively disabled.	**Conditional Mandatory**

Test gPTP.com.c.17.2 — Effect of pttPortEnabled

Purpose: To verify that the DUT does not source gPTP traffic nor react to received gPTP traffic when *pttPortEnabled* is FALSE and behaves properly when toggled.

Device Type Prerequisites and Certification Classifier:

Part	Applies To Device Type	Prerequisite Conditions	Classifier
A-B	Any gPTP Device	The gPTP use on the port can be administratively disabled.	**Conditional Mandatory**
C	Any gPTP Device	Grandmaster-capable and gPTP use on the port can be administratively disabled.	**Conditional Mandatory**

Test gPTP.com.c.18.1 — AVnuSpecific: Cease Pdelay_Req TX after RX of multiple responses to Pdelay_Req

Purpose: To verify that the DUT's ceases Pdelay_Req transmission after receipt of multiple responses to Pdelay_Req messages.

Device Type Prerequisites and Certification Classifier:

Part	Applies To Device Type	Prerequisite Conditions	Classifier
A-C	End-Stations	None	**Mandatory**
A-C	Bridges	None	**Optional**

Test gPTP.com.c.18.2 — AVnuSpecific: Std.Dev of Pdelay_Resp and Pdelay_Resp_Follow_Up T2 & T3 values

Purpose: To verify that the standard deviation of the (T4-T1)-(T3-T2) values sent in the DUT's Pdelay_Resp and Pdelay_Resp_Follow_Up messages is within acceptable tolerances.

Device Type Prerequisites and Certification Classifier:

Part	Applies To Device Type	Prerequisite Conditions	Classifier
A	Any gPTP Device	None	**Mandatory**

Test gPTP.br.c.19.1 — SiteSyncSync: Not GM: Tx Sync reflects Rx Sync values from GM

Purpose: To verify that a bridge, not acting as the grandmaster, properly generates the new PortSyncSync structure from the PortSyncSync structure received from the SlavePort.

Device Type Prerequisites and Certification Classifier:

Part	Applies To Device Type	Prerequisite Conditions	Classifier
A	Bridge	None	**Mandatory**

Test gPTP.br.c.19.2 — SiteSyncSync: Not GM: Tx Sync not changed when Rx Sync on non-Slave Port

Purpose: To verify that the bridge continues to send properly encoded Sync messages, without change, even if Sync Messages are improperly being received on non-Slave ports of the bridge.

Device Type Prerequisites and Certification Classifier:

Part	Applies To Device Type	Prerequisite Conditions	Classifier
A	Bridge	DUT must have three external ports	**Conditional Mandatory**

Test gPTP.br.c.20.1 — Bridge BMCA: RSTP does not interfere with gPTP

Purpose: To verify that Bridge gPTP TX and RX capability is not impacted by the Bridge port's RSTP port state.

Device Type Prerequisites and Certification Classifier:

Part	Applies To Device Type	Prerequisite Conditions	Classifier
A-B	Bridge	None	**Mandatory**

Test gPTP.br.c.21.1 — PortAnnounceReceive appending path trace TLV

Purpose: To validate the DUT's implementation of the PortAnnounceReceive state machine—in particular that it properly appends a path trace TLV to Announce messages.

Device Type Prerequisites and Certification Classifier:

Part	Applies To Device Type	Prerequisite Conditions	Classifier
A	Bridge	None	**Mandatory**

Test gPTP.br.c.22.1 — PortRoleSelectionSM updtRolesTree properly updates MasterStepsRemoved

Purpose: To validate the DUT's PortRoleSelection state machine's updtRolesTree function properly updates MasterStepsRemoved.

Device Type Prerequisites and Certification Classifier:

Part	Applies To Device Type	Prerequisite Conditions	Classifier
A-B	Bridge	None	**Mandatory**

Test gPTP.br.c.22.2 — PortRoleSelectionSM: Passive Ports

Purpose: To verify that the bridge properly determines which port is Passive.

Device Type Prerequisites and Certification Classifier:

Part	Applies To Device Type	Prerequisite Conditions	Classifier
A-B	Bridge	DUT must have three external ports	**Conditional Mandatory**

Test gPTP.br.c.23.1 — PortSyncSyncSend SM: Sync interval after syncReceiptTimeoutTime

Purpose: To verify that the DUT sends Sync messages at the proper interval in the absence of received Sync messages prior to syncReceiptTimeoutTime.

Device Type Prerequisites and Certification Classifier:

Part	Applies To Device Type	Prerequisite Conditions	Classifier
A	Bridge	None	**Mandatory**

Test gPTP.br.c.24.1 — PortAnnounceTransmit: Bridge truncates path trace TLV appropriately

Purpose: To validate the DUT properly appends a path trace TLV to Announce messages containing the Bridge's identity, unless the resulting frame would be too large.

Device Type Prerequisites and Certification Classifier:

Part	Applies To Device Type	Prerequisite Conditions	Classifier
A-B	Bridge	None	**Mandatory**

Test gPTP.br.c.25.1 — Message format—no Q-tags from Bridge

Purpose: To verify that the DUT does not send gPTP messages in Ethernet frames with Q-tags.

Device Type Prerequisites and Certification Classifier:

Part	Applies To Device Type	Prerequisite Conditions	Classifier
A	Bridge	None	**Mandatory**

Test gPTP.br.c.26.1 — MDSyncSendSM: correctionField of Follow_Up Messages for Bridges

Purpose: To verify that the Correction field of the Follow_Up Message sent by the Bridge is computed properly.

Device Type Prerequisites and Certification Classifier:

Part	Applies To Device Type	Prerequisite Conditions	Classifier
A-B	Bridge	None	**Mandatory**

Test gPTP.br.c.27.1 — MDPdelayReq: cumulativeScaledRateOffset shows proper neighborRateRatio calc

Purpose: To verify that the Bridge properly calculates the neighborRateRatio.

Device Type Prerequisites and Certification Classifier:

Part	Applies To Device Type	Prerequisite Conditions	Classifier
A	Bridge	None	**Mandatory**

Test gPTP.br.c.28.1 — AVnuSpecific: Bridge impact on End-Station Accuracy

Purpose: To verify that a reference Slave properly locks to a reference grandmaster to within 1µs when connected through the Bridge.

Device Type Prerequisites and Certification Classifier:

Part	Applies To Device Type	Prerequisite Conditions	Classifier
A	Bridge	None.	**Mandatory**

Complete Unabridged Test Case Follows:

Test gPTP.com.c.26.1 — MDSyncSendSM: correctionField of Follow_Up Messages for Bridges Purpose:

To verify that the Correction field of the Follow_Up Message sent by the Bridge is computed properly.

Device Type Prerequisites and Certification Classifier:

Part	Applies To Device Type	Prerequisite Conditions	Classifier
A-B	Bridge	None	**Mandatory**

References:
[1] IEEE Std 802.1AS-2011 subclause 11.2.13.2.1
[2] *Ibid.*: subclause 10.2.3.12
[3] *Ibid.*: subclause 10.2.3.19
[4] *Ibid.*: Figure 11-7
[5] *Ibid.*: subclause 11.2.14.2.3
[6] *Ibid.*: subclause B.2.4
[7] *Ibid.*, PICS Item MDFDPP-2
[8] *Ibid.*, PICS Item AVnu_PTP-9
[9] *Ibid.*, PICS Item AVnu_MDFDPP-6-9

Resource Requirements: Two test stations capable of acting as both a *Traffic Generator* and *Traffic Monitor*.
Traffic Generator capable of arbitrary frame generation with hardware timestamping of transmitted frames.
Traffic Monitor capable of capturing traffic and hardware timestamping of received frames.
Two-link Precision Full-Duplex In-line Traffic Monitor capable of time-stamping received frames on two different ports with the same time-base, with sub-40ns granularity (functionality may be equivalently achieved if both test stations share a common time-base.)

Modification History:
2015-07-28 — Adopted Errata #7771
2014-10-28 — Adopted Errata #6231
2013-10-29 — Adopted Errata #3203, #3214, #3215, #3651
2013-02-25 — 2nd AVnu TWG Ballot
2012-12-11 — Initial AVnu TWG Ballot

Discussion: When a Bridge not acting as grandmaster sets the Correction field in a Follow_Up message, it adds the correctionField value from the received Follow_Up message on its Slave port to the quantity rateRatio × (syncEventEgressTimeStamp - upstreamTxTime[3]). In this test, the DUT's neighborRateRatio is presumed to be worstcase or less (1.0002001), corresponding to 200.1ppm (.1ppm due to [6]). This test also investigates the requirements of [9] but only achieves the verification that the observed Pdelay value changes by at least 100ns (both cables are 300ns different, allowing each measurement to be worse case (+100ns and -100ns) such that a change of at least 100ns is expected to be seen. Refer to **??**: **??** for additional coverage of [9].

Test Setup: Refer to **??**: **??**. Note: The path connecting TS1 to DUT.TS1 must have precisely known delay. If *Two-link Precision Full-Duplex In-line Traffic Monitor* is employed, it must be connected to DUT.TS1 and DUT.TS2 with cables that are as short as possible (1-2m max). For twisted-pair connections, all cables >2m must be low-skew. If *Two-link Precision Full-Duplex In-line Traffic Monitor* is **not** employed, then TS1 and TS2 must share a common time-base.

Test Procedure:

Part A: *Observe Follow_Up correctionField value*

A:1 Connect TS1 to DUT.TS1 using a Short-Cable with precisely known delay. Two cables (designated Short-Cable and Long-Cable) will be used, with approximately 300ns or more difference in latency.

A:2 Begin Pdelay Emulation at TS1 and TS2.

A:3 Wait at most 12 seconds for TS1 to receive an Announce message, and observe its priority1 value.

A:4 From TS1, send an Announce message every second with a lower (better) priority1 value so that the DUT becomes a slave to TS1.

A:5 From TS1, send valid Sync and Follow_Up messages every 125ms. Follow_Up message's correctionField value (XXXX) is initially 3,000 (0xBB8) and cumulativeScaledRateOffset value (YYYY) of 0.

A:6 Wait 1 second.

A:7 Capture all Sync and Follow_Up messages from TS1 and sent by DUT.TS2 on a common time base. This can be done using the *Two-link Precision Full-Duplex In-line Traffic Monitor* or just TS1 and TS2 if they share a common time-base.

A:8 From the captures made in step A:7:

a) Calculate ZZZZ as the residence time that a Sync message takes to traverse the bridge. Time from the first Sync message sent from TS1 to the first Sync message sent by DUT.TS2 and continue in this manner for each subsequent set of Sync messages. Informatively report *Observed Residency Time*[8]

b) Add to ZZZZ the known cable delay of the cable between TS1 and DUT.TS1

c) Set $UpperLimit = ZZZZ + 80ns$ and $LowerLimit = ZZZZ - 80ns$ to allow for possible traffic monitor timestamp error

d) Set $UpperLimit = UpperLimit + 100ns$ and $LowerLimit = LowerLimit - 100ns$ due to allowable error in DUT's Pdelay measurement.

e) Multiply by the worst-case permissible neighborRateRatio (1.0002001 (200.1ppm)). $UpperLimit = UpperLimit * 1.0002001$ and $LowerLimit = LowerLimit/1.0002001$

f) Convert to ScaledNS (Multiply *UpperLimit* and *LowerLimit* by 2^{16}.)

g) Add the value XXXX in the Follow_Up message sent by TS1 (initially 0xBB8) to both *UpperLimit* and *LowerLimit*.

h) Compare the correctionField value (call this: $RcvdCorrField$) sent in the Follow_Up message from port DUT.TS2. Value is acceptable if within $UpperLimit \geq RcvdCorrField \geq LowerLimit$

i) Do this calculation for at least 3 sets of Sync and Follow_Up messages.

A:9 Repeat steps A:5 through A:8, where:

a) XXXX is now 0x 0000 0001 0000 0000 (4294967296) **32bit scaledns boundary**

b) XXXX is now 0x 0001 0000 0000 0000 (281474976710656) **48bit scaledns boundary (32-bit seconds boundary)**

c) XXXX is now 0x 0010 0000 0000 0000 (4503599627370496) **52bit scaledns boundary (68.719seconds)**

d) XXXX is now 0x 1000 0000 0000 0000 (1152921504606846976) **60bit scaledns boundary (293.203minutes)**

e) XXXX is now 0x 7FE0 0000 0000 0000 (9214364837600034816) **Bits 53-63 set, 64th is sign bit (39 hours)**

Observable Results:

Part:Step	Status	Description
A:8	FAIL	Any observed Follow_Up message's correctionField value must never exceed the calculated value of *UpperLimit* from step A:8.
A:8	FAIL	Any observed Follow_Up message's correctionField value is ever below the calculated value of *LowerLimit* from step A:8.
A:8:(a)	INFO	The *Observed Residency Times*[8] are reported.
A:8	PASS	All observed Follow_Up message's correctionField values do not exceed the *UpperLimit* and *LowerLimit*.

Part B: *Repeat with late Pdelay responses*

B:1 Connect TS1 to DUT.TS1 using a Short-Cable with precisely known delay.

B:2 Begin Pdelay Emulation at TS1 and TS2.

B:3 Wait at most 12 seconds for TS1 to receive an Announce message, and observe its priority1 value.

B:4 From TS1, send an Announce message every second with a lower (better) priority1 value so that the DUT becomes a slave to TS1.

B:5 From TS1, send valid Sync and Follow_Up messages every 125ms. Follow_Up message's correction-Field value (XXXX) is 3,000 (0xBB8) and cumulativeScaledRateOffset value (YYYY) of 0.

B:6 Wait 1 second.

B:7 Capture all Sync and Follow_Up messages from TS1 and sent by DUT.TS2 on a common time base. This can be done using the *Two-link Precision Full-Duplex In-line Traffic Monitor* or just TS1 and TS2 if they share a common time-base.

B:8 From TS1, modify the timing of every third Pdelay_Resp sent from TS1 in response to DUT.TS1's Pdelay_Req message. Delay the Pdelay_Resp messages by more than 300ms but less than 500ms. Thus, for every 3 Pdelay exchanges, the third will include a late Pdelay_Resp.

B:9 Wait 2 second, continuing to observe the Sync and Follow_Up messages. Note if Sync or Follow_Up message transmission ceases or experiences an increase in gap greater than 50%.

B:10 Repeat the calculations from step A:8 using at least three consecutive Sync and Follow_Up messages captured during step B:9.

B:11 Compare the results of calculations in Part A A:8, vs Part B B:10.

Observable Results:

Part:Step	Status	Description
B:9	FAIL	Any increase in the interval between Sync messages or Follow_Up messages is observed, where the increase is 50% or more; or, Sync and/or Follow_Up message transmission from DUT.TS2 cease entirely.
B:11	FAIL	Any observed Follow_Up message's correctionField values exceeds the values observed in Part A A:8 by an order of magnitude. (Part B B:10 > 10x(Part A A:8). Note: 10x is chosen as a reasonable indicator of overflow in Pdelay calculations due to late arriving Pdelay_Resp frames.
B:11	PASS	All observed Follow_Up message's correctionField values are within an order of magnitude from the values observed in Part A A:8 (Part B B:10 ≤ 10x(Part A A:8).

Possible Problems: None.