P802.1DP Monitoring for
Time Synchronization

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Objective

- **Review approach to monitoring and management for DP**

- **Discuss required monitoring objects for Time Synchronization**

- **Does not include monitoring objects for the FTTM introduced in DP Draft 1.1**

References:

- **P802.1DP Monitoring and Management, Jan 2023 Interim Session**
  https://www.ieee802.org/1/files/public/docs2023/dp-jabbar-monitoring-0123-v01.pdf

- **IEEE Std 802.1AS-2020**

- **IEEE Std 802.1ASdn Draft 2.0**

- **IEEE Std 802.1ASdm Draft 1.5**

Managed Objects for TSN Features – Proposed Aerospace Approach

- IEEE/IETF defines management objects for end stations and bridges, which can be categorized in to following categories:

    1. Identity and capability: information on the device attributes
       e.g. bridgeName, bridgeType, supportedListMax, supportedCycleMax

       > Defined offline via device datasheet

    2. Configuration: configure and/or query current configuration
       e.g. gateEnabled, adminControlList, operControlList

       > Abstracted via configuration models;
       > Config query useful in design phase

    3. Operational: status/statistics derived from operating conditions

       a. Status/health (capturing both normal and erroneous conditions)
          e.g. isSynched, GateClosedDueToOctetsExceeded,

          > Applicable during operation (flight)
          > Required to meet DAL certification
          > DP should mandate specific ones

       b. Statistics (capturing both normal and erroneous be
          e.g. passingFrameCount, notPassingSDUCount, redFramesCount

Supporting and exposing managed objects

- Conformance in clause 5, often (not always) mandates the support of the entire set of management objects

- Although the management objects should be "supported", the manner in which they are exposed is up to the implementation. DP can provide guidance to make all but specific operational metrics accessible via static configuration method so that they can be accessed during data loading phase and **not** during operation/flight

Time Synchronization management

Relevant Standards:

IEEE 802.1AS-2020 : Base Standard

IEEE 802.1ASdm (Draft 1.5)

IEEE 802.1ASdn (Draft 2.0)

Management Objects are defined in:

Clause 14. Timing and synchronization management

gPTP Node managed datasets

a)   instanceList[]

   1)   defaultDS

   2)   currentDS

   3)   parentDS

   4)   timePropertiesDS

   5)   pathTraceDS

   6)   acceptableTimeTransmitterTableDS

   7)   ptpInstanceSyncDS

   8)   driftTrackingDS

   9)   portList[]

      i)   portDS

      ii)   descriptionPortDS

      iii)   portStatisticsDS

      iv)   acceptableTimeTransmitterPortDS

      v)   externalPortConfigurationPortDS

      vi)   asymmetryMeasurementModeDS

      vii) commonServicesPortDS

~130 objects/parameters

b)   commonServices

   1)   commonMeanLinkDelayService

      i)   cmldsDefaultDS

      ii)   cmldsLinkPortList[]

         —   cmldsLinkPortDS

         —   cmldsLinkPortStatisticsDS

         —   cmldsAsymmetryMeasurementModeDS

   2)   hotStandbyService

      i)   hotStandbySystemList[]

         —   hotStandbySystemDS

         —   hotStandbySystemDescriptionDS

   3)   Future common services can follow.

Objective: Identify the monitoring objects that must be available during operation/flight to avoid silent failure or unknown erroneous state

Default Parameter Data Set (defaultDS)

The defaultDS represents the native capabilities of a PTP Instance, i.e., a PTP Relay Instance or a PTP End Instance.

14.2.2 clockIdentity
The value is the clockIdentity (see 8.5.2.2) of the PTP Instance. 8 Octet clockIdentity as per IEEE 1588-2009.

14.2.16 domainNumber
The value is the domainNumber of the gPTP domain for this instance of gPTP supported by the time-aware system.

Current Parameter Data Set (currentDS)

The currentDS represents the position of a local system and other information, relative to the Grandmaster PTP Instance.

14.3.3 offsetFromMaster
The value is an implementation-specific representation of the current value of the time difference between a slave and the Grandmaster Clock, as computed by the slave, and as specified in 10.2.10. The data type shall be TimeInterval. The default value is implementation specific

14.3.6 gmTimebaseIndicator
The value is the value of timeBaseIndicator of the current Grandmaster PTP Instance (see 9.2.2.3 and 9.6.2.3).
The timeBaseIndicator is a binary value that is set by the ClockSource entity. The ClockSource entity changes the value whenever its time base changes. The ClockSource entity shall change the value of timeBaseIndicator if and only if there is a phase or frequency change

The ClockSource entity ensures that timeBaseIndicator changes if the source of time is lost.

Parent Parameter Data Set (parentDS)

The parentDS represents capabilities of the upstream system, toward the Grandmaster PTP Instance, as measured at a local system

14.4.3 cumulativeRateRatio
The value is an estimate of the ratio of the frequency of the Grandmaster Clock to the frequency of the LocalClock entity of this PTP Instance. cumulativeRateRatio is expressed as the fractional frequency offset multiplied by 2^{41}, i.e., the quantity $(rateRatio - 1.0)(2^{41})$, where rateRatio is computed by the PortSyncSyncReceive state machine (see 10.2.8.1.4).

14.4.4 grandmasterIdentity
The value is the clockIdentity attribute (see 8.5.2.2) of the Grandmaster PTP Instance.
The default value is the value of defaultDS.clockIdentity (14.2.2).

Port Parameter Data Set (portDS)

The portDS represents PTP Port time-aware capabilities for a PTP Instance of a time-aware system.

14.8.2 portIdentity
The value is the portIdentity attribute of the local PTP Port (see 8.5.2)

14.8.7 asCapable
The value is equal to the value of the Boolean asCapable (see 10.2.5.1). A Boolean that is TRUE if and only if it is determined that this PTP Instance and the PTP Instance at the other end of the link attached to this PTP Port can interoperate with each other via the IEEE 802.1AS protocol

14.8.8 meanLinkDelay
The value is equal to the value of the per-PTP Port global variable meanLinkDelay (see 10.2.5.8). It is an estimate of the current one-way propagation time on the link attached to this PTP Port, measured as specified for the respective medium

14.8.11 neighborRateRatio
The value is an estimate of the ratio of the frequency of the LocalClock entity of the PTP Instance at the other end of the link attached to this PTP Port, to the frequency of the LocalClock entity of this PTP Instance

Port Parameter Statistics Data Set (portStatisticsDS)

For the single PTP Port of a PTP End Instance and for each PTP Port of a PTP Relay Instance, the portStatisticsDS provides counters associated with PTP Port capabilities at a given PTP Instance.

14.10.9 rxPTPPacketDiscardCount
This counter increments every time a PTP message of the respective PTP Instance is discarded, caused by the occurrence of a) unqualified Announce message reception, b) A Follow_Up message not received, c) A Pdelay_Resp message is not received, d) A Pdelay_Resp_Follow_Up message is not Received
14.10.10 syncReceiptTimeoutCount
This counter increments every time sync receipt timeout occurs
14.10.12 pdelayAllowedLostResponsesExceededCount
This counter increments every time the value of the variable lostResponses (see 11.2.19.2.9) exceeds the value of the variable allowedLostResponses
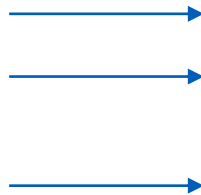
Full portStatisticsDS Table

Discussion Point:
Only 3 highlighted statistics counters are being proposed as required for in flight monitoring.

Should more statistics be required?

Table 14-12—portStatisticsDS table

Name	Data type	Operations supported[a]	References
rxSyncCount	UInteger32	R	14.10.2
rxOneStepSyncCount	UInteger32	R	14.10.3
rxFollowUpCount	UInteger32	R	14.10.4
rxPdelayRequestCount	UInteger32	R	14.10.5
rxPdelayResponseCount	UInteger32	R	14.10.6
rxPdelayResponseFollowUpCount	UInteger32	R	14.10.7
rxAnnounceCount	UInteger32	R	14.10.8
rxPTPPacketDiscardCount	UInteger32	R	14.10.9
syncReceiptTimeoutCount	UInteger32	R	14.10.10
announceReceiptTimeoutCount	UInteger32	R	14.10.11
pdelayAllowedLostResponsesExceededCount	UInteger32	R	14.10.12
txSyncCount	UInteger32	R	14.10.13
txOneStepSyncCount	UInteger32	R	14.10.14
txFollowUpCount	UInteger32	R	14.10.15
txPdelayRequestCount	UInteger32	R	14.10.16
txPdelayResponseCount	UInteger32	R	14.10.17
txPdelayResponseFollowUpCount	UInteger32	R	14.10.18
txAnnounceCount	UInteger32	R	14.10.19

Common Services Port Parameter Data Set (commonServicesPortDS)

The commonServicesPortDS enables a PTP Port of a PTP Instance to determine which port of the respective common service corresponds to that PTP Port.

If Common Mean Link Delay Service is being used support

14.14.2 cmldsLinkPortPortNumber
The value is the portNumber attribute of the cmldsLinkPortDS.portIdentity (see 14.16.2) of the Link Port that corresponds to this PTP Port.

AND

All the same defaultDS, portDS, and portStatisticsDS parameters as those of individual PTP instances

Summary

- First attempt at identifying management objects for time synchronization function to be monitored during operation/flight

  - Identified 14 out of 130+ available objects

- Proposal is to make these objects mandatory in 802.1DP for network monitoring and health management

- Additional objects might be required to support fault tolerant timing module as introduced in P802.1DP draft 1.1