

IEEE 802.1DG Profile(s) for Time Sync



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September 23, 2019
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Automotive Profile – Time Sync

Scope of this presentation:

- Detailed description of .1AS, as it pertains to the current 802-1DG-d1-0, required in a Basic vs. Extended profiles

Not in Scope of this presentation:

- Coverage of all 802.1 TSN specification required in these profiles
- A “one-size fits all” pre-selection of 802.1 mechanisms

Automotive Profile - Sync

802.1AS-Rev (Time Synchronization) –

- BMCA (Best Master Clock Algorithm) (**for Extended Profile**)
 - Not needed for Basic Profile
 - .1AS compliant bridge required to support BMCA
 - *externalPortConfigurationEnabled* = TRUE
 - Announce messages still required for leap second notification, UTC offset and GM clock quality
 - *logTimeSyncInterval* = -128
 - *logAnnounceInterval* = -128 (ignored w/syncLocked 10.7.2.3)
 - Grand Master will be manually assigned

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802.1AS-Rev (Time Synchronization) –

- Sync messages
 - gPTP specifies that all local clock oscillators @ $\pm 100\text{PPM}$ with a total drift of $\pm 25\mu\text{s}$
 - Drift does not accumulate and is reset after each Sync message
 - To maintain a minimum drift margin Sync interval 8/sec or 125ms per sync period (default value) which equals $25\mu\text{s}$ drift per Sync message interval
 - Higher/faster Sync message intervals required for faster “network” sync start-up times without use of pDelay

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802.1AS-Rev (Time Synchronization) –

- pDelay messages
 - Not required for basic profile
 - *neighborRateRatio* tracks the difference between link partner local clocks
 - Needed for $\pm 1\mu\text{s}$ accuracy over 7 hops (**for Extended Profile**)
 - required *syncLocked* (10.2.5.15) to adjust for different link partner local clock Sync frequencies or *logMessageInterval*
 - 90% of the inter-message intervals are within $\pm 30\%$ of the value of $2^{\text{currentLogSyncInterval}}$ (10.7.2.3)

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802.1AS-Rev (Time Synchronization) –

- Notes to consider:

- *Though it may not be applicable based on Ethernet vs. CAN bus and desired implementation* - According to AUTOSAR 4.3.1 Document ID 674:

AUTOSAR_SWS_TimeSyncOverCAN

- Time Masters, Time Gateways and Time Slaves shall work with a Time Base reference clock with a worst-case accuracy of 10 μ s.
- This equals local clock oscillators @ ± 100 PPM minimum (which supports and is the basis of previous .1AS calculations)

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802.1AS-Rev (Time Synchronization) –

- Notes to consider:
 - One-Step vs. Two-Step ???
 - Two-Step uses S/W + same One-Step H/W accelerators but H/W doesn't have to update Sync message on fly (Two-Step matches *Sync* to *Follow-Up*)
 - H/W accelerator should be a requirement
 - Two-step requires a *Follow_Up* message for every *Sync* messages to report the time accuracy, but uses same *MDSendSync* TC structure as One-Step for compatibility and equal *cumulativeRateRatio* and *accuracy**
 - Not enough time for H/W to process and update One-step @ 10Gbps+ (@ 51.2ns /64 byte TX**) links
 - Recommend to use Two-Step approach

References:

* <http://www.ieee802.org/1/files/public/docs2015/asrev-mjt-one-step-details-0407-v03.pdf>

**<http://www.ieee802.org/1/files/public/docs2015/ASRev-pannell-To-1-step-or-not-0315-v1.pdf>

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802.1AS-Rev (Time Synchronization) –

- Notes to consider:
 - Time Domains ???
 - Allows for multiple time domains that require unique Sync requirements and have physical attributes
 - KISS principle for Basic profile use default domain “0”
 - Multiple time domains for Extended profile (e.g. Active Safety, Autonomous, Infotainment)
 - Can be used for GM Sync/redundancy
 - Possible Issue that needs resolution: Application Profile – move to SDV and integration with .1Qcc “God” box(es)

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802.1AS-Rev (Time Synchronization) –

- Notes to consider:
 - Redundancy???
 - Time Sync vs. FRER redundancy
 - Does Basic need “network” BMCA redundancy – probably not based on PPM/accuracy of local clocks and required/allowable drift margins
 - FRER w/BMCA configuration complicated

Thank You