IEEE 802.1DG Profile(s) for Time Sync

Michael Potts
September 23, 2019
Detroit Interim
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
Automotive Profile – Time Sync
802.1AS-Rev (Time Synchronization) –

- Sync messages
  - gPTP specifies that all local clock oscillators @ ±100PPM with a total drift of ± 25µs
  - 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 25µs drift per Sync message interval
  - Higher/faster Sync message intervals required for faster “network” sync start-up times without use of pDelay
Automotive Profile – Time Sync
802.1AS-Rev (Time Synchronization) –

- pDelay messages
  - Not required for basic profile
  - `neighborRateRatio` tracks the difference between link partner local clocks
  - Needed for ± 1µs 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 ±30% of the value of `2 * currentLogSyncInterval` (10.7.2.3)
Automotive Profile – Time Sync
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 10μs.
  - This equals local clock oscillators @ ±100PPM minimum (which supports and is the basis of previous .1AS calculations)
Automotive Profile – Time Sync
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:
Automotive Profile – Time Sync
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)
Automotive Profile – Time Sync
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