Potential deviation from IEEE802-1AS-REV (Draft D8.0) end-to-end performance

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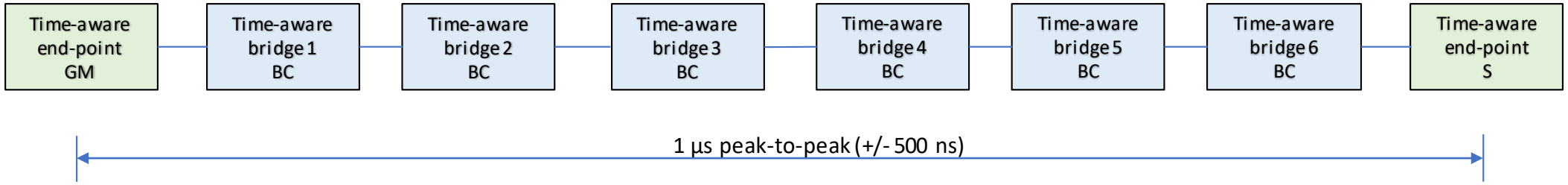
Overview

- It seems that “IEC/IEEE 60802 D1.0 TSN Profile for Industrial Automation” table 14 and 15 specifications are deviating from IEEE802.1AS-REV D8.0 Annex B.3 End-to-end time-synchronization performance

- Assumption: Usage of Synchronous Ethernet (SyncE) is outside the scope

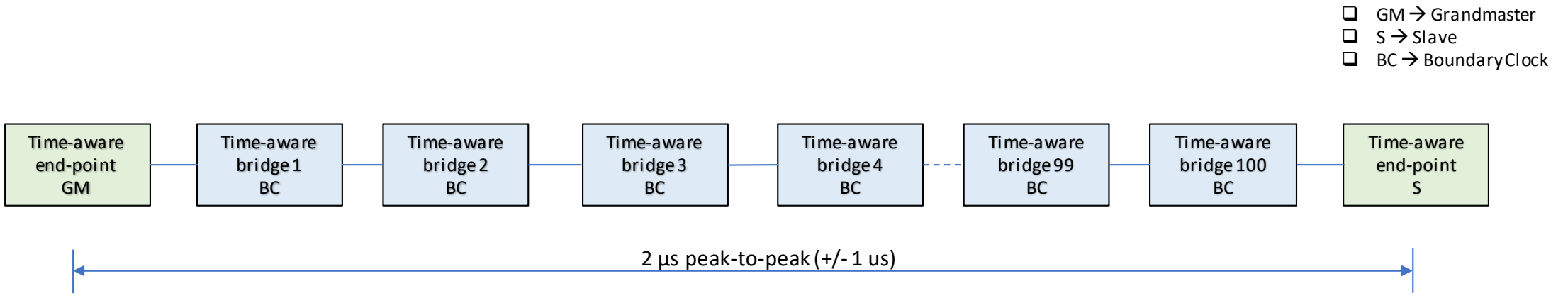
IEEE802.1AS-REV D8.0 end-to-end time-synchronization performance

- GM → Grandmaster
- S → Slave
- BC → Boundary Clock



- IEEE802.1AS-REV D8.0 Annex B.3 “The requirements of this standard and of standards referenced for each medium ensure that any two PTP Instances separated by six or fewer PTP Instances (i.e., seven or fewer hops) will be synchronized to within 1 µs peak-to-peak of each other during steady-state operation …
- It seems that usage of term “hops” in IEEE802.1AS-REV D8.0 Annex B.3 is bit confusing. Here “hops” represents “number of PTP Communication Paths”.
- IEEE802.1AS-REV D8.0 Annex F.3 “The physical adjustment of the frequency of the LocalClock entity (i.e., physical syntonization) is allowed but not required”

IEC/IEEE 60802 D1.0 (table 13 and 14) end-to-end time-synchronization performance – Working Clock



- Table 13 – Working Clock maximum deviation within 2 µs (+/- 1 µs)
- Notion of PTP steady-state operation is missing
- It seems that, in the context of IEC/IEEE 60802 the number of hops represents number of time-aware bridges, not the number of PTP Communication Paths.

IEEE802.1AS-REV impact on network start-up time

- Propagation delay per time-aware bridge
  - IEEE802.1AS-REV D8.0 Annex B.2.2: Residence time → up to 10 ms
  - IEEE802.1AS-REV D8.0 Annex B.2.3: Pdelay turnaround time → up to 10 ms

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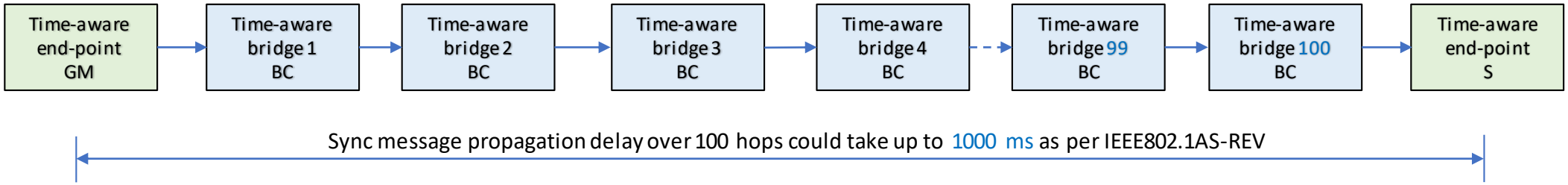

- There is a correlation between the time required to achieve the network steady-state and network span
- Some automation applications may need tighter constraints on Residence time and Pdelay turnaround time to improve network convergence time

Conclusions

- Well defined subset of IEEE802.1AS-REV is required to optimally span the TSN network to accommodate IEC/IEEE 60802 requirements
- Propagation delay related to Sync and Follow_Up messages from GM to leaf Slave will increase with the number of hops. There will be an impact on network convergence time (i.e. to achieve steady-state) as well as on application start-up time. IEC/IEEE 60802 should capture such information in an informational annex
- Factors such as temperature which may cause random drift within a sync interval should take into account [IEEE1588-2018 D1.4V4_11 Annex A.5.5 Stability issues]
- IEC/IEEE 60802 D1.0 is missing the clock holdover specification. For example, under holdover state the time aware system should remain within the “error tolerance” for at least “N” seconds
- IEC/IEEE 60802 should use more consistent language to describe “maximum deviation”, such as 2 µs peak-to-peak

Thank you

References

- IEC/IEEE 60802 D1.0
- Joint ITU-T/IEEE Workshop on The Future of Ethernet Transport. (Geneva, 28 May 2010). IEEE 802 1AS Network Performance - Geoffrey M. Garner
- IEEE1588-2018 D1.4V4_11 draft standard
- IEEE802.1AS-REV D8.0 draft standard
- http://www.ieee802.org/1/files/public/docs2018/60802-Steindl-Synchronization-0718-v02.pdf