# Generic network start-up sequence

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# Overview

- To highlight the interdependency between TSN features, such as
  - IEEE802.1AS-REV (Timing and Synchronization for Time-Sensitive Applications)
  - IEEE802.1Qbv (Enhancements for Scheduled Traffic)
  - IEEE802.1Qch (Cyclic queuing and forwarding)
  - IEEE802.1Qci (Per-Stream Filtering and Policing) - time-based policing aspect
- Potential impact of these dependency on network start-up sequence
- Potential impact of these dependency on application start-up time

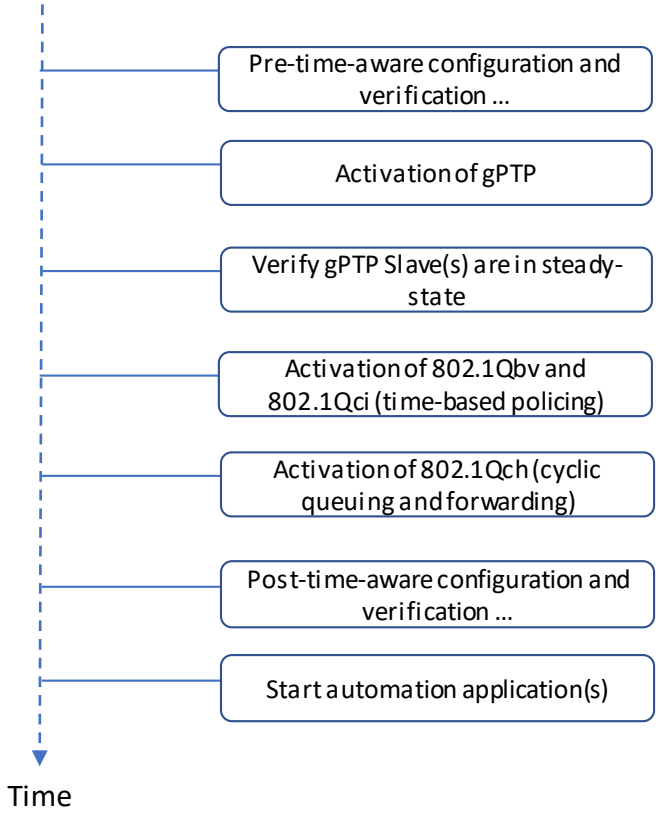
# Interdependent time aware TSN features

- IEEE802.1AS-REV (or IEEE1588): PTP to establish common view of network time
- IEEE802.1Qbv: allow transmission from each queue to be scheduled relative to a known timescale (i.e. timescale PTP). Scheduled traffic requires common view of network time to meet the overall latency and jitter that will be experienced as the frame is propagated to its destination
- IEEE802.1Qci: time-aware ingress policing requires the common view of network time to filter traffic based on the stream gate state
- IEEE802.1Qch: inherit infrastructure from IEEE802.1Qbv (Enhancements for Scheduled Traffic), IEEE802.1Qci …
- IEEE802.3br/IEEE802.1Qbu: scheduled traffic in combination with preemption (HOLD/RELEASE mechanism) to protect express traffic from interference from preemptible traffic as well as improves bandwidth availability for preemptible traffic

# Generic network start-up sequence

Phases (logical) 1 to 5 represents approximate infrastructure start-up time:

1. phase1-pre-time-aware-setup: phase1 ends once the system verify all desire resources to satisfy mandatory requirements related to target automation application(s) …
2. phase2-ptp-activation: Activation of PTP (gPTP)
3. phase3-ptp-steady-state: make sure that the PTP is in steady-state [(1)], i.e. the <offsetFromMaster> is within the desired range across the PTP domain.
4. phase4-activation-of-time-aware-feature-set [(2)]: Activation of time aware TSN features, such as enhancements for scheduled traffic, time-based ingress policing, cyclic queuing and forwarding, …
5. phase5-post-time-aware-setup: Any remaining infrastructure and/or endpoint(s) setup and verification …
6. phase6: Activation of automation application(s)




(1) Notion of steady-state is application dependent and will influence by factors such as required synchronization performance, number of hops in the network …

(2) TSN features are installation dependent

# Conclusions

- Generic aspects of network start-up sequence and its influence on application start-up time should be included in IEC/IEEE 60802 as an informational annex
- IEC/IEEE 60802 should prescribe a framework to monitor the performance of PTP (gPTP). PTP performance could be monitored via the following mechanism(s):
  i. IEEE1588-2018 D1.4V4_11 Clause 16.11 Slave Event Monitoring (i.e. SLAVE_RX_SYNC_COMPUTED_DATA TLV)
  ii. IEEE1588-2018 D1.4V4_11 Clause 16.12 Enhanced Synchronization Accuracy Metrics
  iii. IEEE1588-2018 D1.4V4_11 Annex M
  iv. SNMP(-trap)/NETCONF(-notification) <offsetFromMaster>

# Thank you

# References


- Time Sensitive Networks for Flexible Manufacturing Testbed Characterization and Mapping of Converged Traffic Types Version 1.0 2019-03-28
- IEC/IEEE 60802 D1.0
- IEEE802.1Q-2018
- http://www.ieee802.org/1/files/public/docs2018/60802-Steindl-Synchronization-0718-v02.pdf
- http://www.ieee802.org/1/files/public/docs2014/new-tsn-mjt-peristaltic-shaper-0114.pdf