10BASE-T1S support in P802.1ASds
A proposed way forward

Don Pannell, Fellow
Automotive Ethernet Networking, NXP Semiconductor

IEEE Plenary – March 2022

SECURE CONNECTIONS
FOR A SMARTER WORLD

P802.1ASds Background

- Amendment's Title: "Support for the IEEE Std 802.3 Clause 4 Media Access Control (MAC) operating in half-duplex"
- Amendment's Need: "Support is needed in applications such as automotive in-vehicle networks and industrial automation networks for the IEEE Std 802.3 Clause 4 MAC operating in half-duplex, including those using links with the 10BASE-T1S PHY…"
  - Automotive has been the main driving force that generated the start of this project
  - And many presentations, during and after the PAR & CSD process, have already focused on Automotive use cases, but none yet for other use cases
- This presentation is my personal view on the key points that have been presented so far and a proposed way forward based on this information
  - The goal here is to explore areas where consensus may already exist
  - And so that others with alternate needs are energized to present their data at the next interim

Summary of Needs – From Past Presentations

- Devices (some end nodes & most bridges) will likely have a multiplicity of ports
  - Some ports will be full-duplex gPTP Ethernet ports that are already supported by 802.1AS-2020
  - Other ports will be half-duplex gPTP Ethernet ports (10BASE-T1S) that need to be supported too
  - The CPU's in these devices are generally constrained with on-die RAM used for its code
  - Need: The footprint (size) of the gPTP code cannot get much bigger than it already is
    - Result: ASds needs to support 10BASE-T1S with minimal logic changes without requiring new mathematical calculations (like neighbor rate ratio calculations done from Sync instead of Pdelay)
- 10BASE-T1S links will be used to connect to low-cost devices at the edge
  - These devices are typically simple sensors (e.g., ultrasonic) or simple actuators (e.g., door locks)
    - 10 Mbit/sec shared links simply can't support high bandwidth applications!
  - Redundancy, if needed at all, will be covered by using a separate low-cost 10BASE-T1S link to redundant (and separate) sensors and actuators (in case it's the sensor or actuator that fails!)
  - Need: Support for redundancy on 10BASE-T1S links is NOT a high priority for Automotive
    - Result: Do not focus on redundancy, if it comes for free, great. But it is not needed at the edge

Summary of Needs – From Past Experience

- Don’t overoptimize
  - There is an understandable tendency to reduce the bandwidth needed for an application (gPTP in this case) on low bandwidth links (like 10BASE-T1S)
    - But this should be left to the Profiles and not the base standard as there are tradeoffs!
      - If redundancy is not needed on some links (e.g., on the edge), AS-2020 can be engineered to send Pdelay in only one direction (as the Avnu Automotive AVB profile defined years ago)
      - Save bandwidth by disabling Announce messages (as the Avnu Automotive AVB profile defined years ago), and this is already supported in AS-2020
      - If clock accuracy can be lower than the AVB use-case’s, reducing the rates of Pdelay and Sync messages can also save bandwidth, and this too is already supported in AS-2020
  - Need: Keep AS-2020’s mechanisms consistent for all use cases and move optional optimizations to the Profiles
    - Result: Focus only on the changes needed to allow “IEEE Std 802.3 Clause 4 Media Access Control (MACs) operating in half-duplex” to work

Summary of Needs – From Past Experience

- Time to STD! is important
  - Re-inventing already known and working mechanisms is time consuming and risky
    - Some of us remember the “Let’s put one-step in the (AS) draft to see how it goes”
    - Due to the neighbor rate ratio enhancements made in 802.1AS-2011, one-step can’t be used on Pdelay
    - Trying to add one-step clearly delayed the 802.1AS-2020 standard competition significantly w/ little benefit
  - Need: Re-use existing 802.1AS-2020 state machines, algorithms, etc. to the greatest extent
    - Result: Don’t create new methods to compute (neighbor) rate ratio – who is going to sponsor all the simulations that will need to be run & what delay for the results? Look at the recent 100-hop simulations.
- Working solutions exist
  - This project’s approved CSD states under 1.2.4 Technical Feasibility
    - Supporting the IEEE 802.3 Clause 4 MAC operating in half-duplex with IEEE 802.1AS has been feasibly demonstrated (see https://www.ieee802.org/1/files/public/docs2017/tsn-cgunther-802-3cg-multidrop-0917-v01.pdf).
  - Need: Don’t re-invent the wheel! It is wise to verify that it is good enough for the job, however!
    - Result: Propose to start with the Unicast Pdelay solution as a baseline as this is the problem area

Why Unicast Pdelay – As a Baseline

- It is known solution that works
  - Multiple independent iterations of Unicast Pdelay, beyond the reference in the CSD, are being developed and demonstrated on 10BASE-T1S links
    - A STD! solution is preferred and wanted, but in the meantime, customers are demanding to see gPTP working on 10BASE-T1S links now so they can test and evaluate this technology
      - It is always good news when a customer wants something – so consider this project "customer driven"
      - And we would be remiss if we don't pay attention to what is happening in the market
- It meets the constrained device criteria
  - It is simple code changes that have nothing to do with complex mathematical calculations
    - And its size increase is acceptable
- Can it support redundancy for those that may need it?
  - This fits in the "It is wise to verify" category
  - The fewer & simpler the changes made for 10BASE-T1S, the more likely all the previous and future features of gPTP can and will also be supported on these links

Why Unicast Pdelay – As a Baseline

- Should 10BASE-T1S be done with a new Media Dependent Clause?
  - It is probably too early to answer this question
  - Since 10BASE-T1S is Ethernet, I propose that we start out by trying to fit this support into gPTP's Ethernet dependent clause
    - This will help in the future when new features are added to gPTP
      - As the (hopefully minor) changes made to support 10BASE-T1S will be more obvious (i.e., not buried and/or forgotten in a separate clause), ensuring the new features will work with and not break gPTP on 10BASE-T1S links

Summary

- Keep the changes simple, so it can be done quickly and fit into constrained devices
- Focus on “Support for the IEEE Std 802.3 Clause 4 Media Access Control (MAC) operating in half-duplex” only
- Keep bandwidth overhead, required clock performance, and redundancy requirements to use-case specific Profiles
- Start with a known working, public solution, that was specifically designed to get gPTP working on “IEEE Std 802.3 Clause 4 Media Access Control (MACs) operating in half-duplex”

- Proposal: Start working on integrating the Unicast Pdelay mechanism into the current Ethernet media dependent clause
  - Then these changes can be reviewed and verified to ensure the needs are met

- Presentations on other use cases are welcome, but time is limited

Questions and Feedback

- I have a question: What in this presentation do we have consensus on?

- This was presented & there were no dissenting opinions. Therefore, I recommend that we proceeded down this path to see what needs to be modified in AS-2020 as proposed.

- However, the following additional questions were brought up & discussed:
  - When a node wakes up, how does it get the unicast address of the link's master port? Can it be locked down, or does it issue a message (Announce or Signaling?) to get a reply from the link's master? If Announce is used it would support redundancy for free.
  - Alternatively, IEEE 1588-2019 supports Unicast negotiation & discovery that we should be aware of as a possible alternative:
    - Subclause 16.1 Unicast Negotiation
    - Subclause 17.4 Unicast Discovery

SECURE CONNECTIONS
FOR A SMARTER WORLD