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Input to P802.1DGei – Automotive Time Synchronization

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P802.1DGei Current Status

- ✓ **In July 2026 IEEE802.1 Plenary, P802.1DGei PAR was approved to forwarding to NesCom.**

  https://www.ieee802.org/1/files/public/docs2026/ei-PAR-0726-v01.pdf

- ✓ **The approved CSD document is available at:**

  https://www.ieee802.org/1/files/public/docs2026/ei-CSD-0726-v01.pdf

- ✓ **The PAR was subsequently approved by the IEEE-SA Standards Board.**

- ✓ **P802.1DGei page is now under TSN Taskgroup.**

  https://1.ieee802.org/tsn/802-1dgei/

Background: Why Time Synchronization Matters in a Vehicle



01 COORDINATED EXPERIENCE

Synchronized Lighting

Multiple lights change at the same instant, creating a seamless cabin-wide visual effect.



02 COHERENT MEDIA PLAYBACK

Audio / Video Alignment

The display and distributed speakers present synchronized video and audio.



03 DETERMINISTIC SENSE AND ACT

Automated Driving

Time-aligned sensors support correct fusion and coordinated control of vehicle actuators.

Need and Purpose of P802.1DGei

Need for the Project

- ✓ IEEE Std 802.1DG allows multiple time synchronization mechanisms, including IEEE Std 802.1AS, other IEEE 1588 profiles, and other domain-specific solutions.
- ✓ This causes stakeholder fragmentation, reduces interoperability, increases validation efforts, and increases costs for car manufacturers and suppliers in automotive systems.
- ✓ There is a need to provide specific profile for the use of IEEE Std 802.1AS for automotive in-vehicle networks.

Purpose of P802.1DGei

- ✓ P802.1DGei aims to define profiles for designers and implementers of automotive IEEE 802.3 Ethernet networks that support a wide range of in-vehicle applications.
- ✓ This will help achieve standardized, consistent, deterministic time synchronization behavior, ensure interoperable implementations across vendors, and facilitate integration and validation for time-sensitive applications in automotive in-vehicle networks.
- ✓ P802.1DGei is focusing on automotive in-vehicle Ethernet and aiming to define profiles based on characteristics of automotive in-vehicle Ethernet.
- ✓ P802.1DGei does avoid adding new mechanisms or features and rather will constrain options without changing the base IEEE Std 802.1AS.

In-Vehicle Network Structure

- ✓ In-Vehicle network topology is statically fixed during system design phase.
- ✓ The network topology is relatively simple, and the physical network size is relatively small..
  - ✓ 2 to 3 hops
  - ✓ up to around 100 nodes (ECUs)
  - ✓ connections 15 meters at maximum.
- ✓ Reusing ECUs across different vehicle models is important. Standardization of inter-ECU interfaces is necessary.
- ✓ To reduce costs, functions are carefully trimmed. Weight and energy consumption are also key considerations.
- ✓ For safety reasons, once a configuration is established, it is usually considered immutable.

- ✓ From the conditions above and with less necessity of having multiple time domains, it is beneficial to have a simpler time synchronization profile, best suited to automotive in-Vehicle networks.

Scope Limited to IEEE Std 802.1DG

✓ The amendment applies only to IEEE Std 802.1DG, focusing on the automotive TSN profile without changing the base IEEE Std 802.1AS.

Ensuring Backward Compatibility

✓ Limiting scope ensures backward compatibility and prevents unintended effects on non-automotive IEEE 802.1AS implementations.

No Impact on Non-Automotive Applications

✓ The amendment is optional for non-automotive TSN deployments, preserving existing enterprise and industrial network behaviors.

Alignment with IEEE Best Practices

✓ A clear and focused scope aligns with IEEE best amendment practices, reducing risk and complexity for acceptance.

JASPAR Proposed Design Principles Guiding the Automotive Profile

Standards Compliance

✓ Ensures compatibility with IEEE Std 802.1AS-2011, IEEE Std 802.1AS-2020, and existing automotive silicon and software stacks.

Minimized Implementation Complexity

✓ Removes unnecessary optional features to reduce resource use and validation effort in static in-vehicle networks.

Interoperability Focus

✓ Supports coexistence between IEEE and non-IEEE ecosystems like AUTOSAR and AVnu automotive profiles.

Safety and Predictability

✓ Prioritizes deterministic and safety-conscious network behavior over dynamic optimization.

Input to the Automotive Profile (1): Grandmaster Selection and BMCA

Static Grandmaster Configuration

- ✓ In automotive applications, the topology is established during system design.
  The Grandmaster(GM), timeTransmitter port, and timeReceiver port are also fixed.
- ✓ Static configuration aligns with safety practices, enhancing predictability and interoperability in automotive systems.

No need for the BMCA

- ✓ The Best Master Clock Algorithm is not necessary for the static configured network.
- ✓ The BMCA should not be supported to reduce complexity, to reduce protocol traffic, and to avoid startup ambiguity.

Input to the Automotive Profile (2): General Messages, gPTP Messages

No need for Announce and Signaling messages

- ✓ Announce and Signaling messages are prohibited and must be discarded if received to reduce protocol complexity.
- ✓ If an Announce message or a Signaling message is received, it should be discarded without processing.

gPTP Messages

- ✓ Sync and Follow_Up messages shall comply fully with IEEE Std 802.1AS-2011 for standards conformance.

Pdelay Measurement

- ✓ Only timeReceiver ports should transmit Pdelay_Request messages.
- ✓ Both timeTransmitter ports and timeReceiver ports should respond to a Pdelay_Request.

Input to the Automotive Profile (3): VLAN Tagging for Time synchronization messages

VLAN Tagging

- ✓ Time synchronization messages shall not be VLAN-tagged to simplify network configuration and prevent interference.

Compatibility Considerations

- ✓ Implementations may accept VLAN-tagged gPTP frames for compatibility, but it should not be mandatory.

Input to the Automotive Profile(4): Flow Control, Performance, and Parameter Flexibility

Flow Control Management

✓ PAUSE frames are not transmitted or processed to avoid disrupting time synchronization in the system.

Performance Flexibility

✓ The amendment avoids fixed transmission intervals, allowing flexibility for different automotive performance needs.

OEM Parameter Discretion

✓ OEMs retain control over specific performance parameters to accommodate diverse operating environments and use cases.

✓ OEM-specific processing and tuning are excluded from normative content to preserve implementation freedom where interoperability is unaffected.

Industry Adoption Balance

✓ Separating core requirements from configurable settings enables broad adoption without excessive constraints.

Conclusion

The IEEE802.1DGei project targets to fill the key gaps in IEEE 802.1DG by defining a specific automotive time synchronization profile

It would be best if the details are finalized around or by the end of 2027.

JASPAR is ready to contribute to the IEEE802.1DGei project by participating the regular meetings.