DRAFT IEEE SA blog post

Time-Sensitive Networking for Automotive In-Vehicle Communications

The IEEE Std 802.1DG™ standard defines a Time-Sensitive Networking (TSN) profile for automotive in-vehicle networks, ensuring deterministic, low-latency, and highly reliable communications over standard Ethernet.

Standard IEEE 802.3 Ethernet has been proven to be an efficient and cost-effective technology over multiple decades, e.g., due to the economies of scale and the knowledge base of a networking expert community of various industries. Ever since its foundation, Ethernet has been constantly evolving to address the needs arising in numerous application areas. As part of the evolution, IEEE 802.1 Time-Sensitive Networking (TSN) has been introduced to address time and/or mission critical applications, thus extending the useability of Ethernet networks, e.g., in automotive, aerospace, industrial automation, and professional Audio/Video deployments. In addition to the base standards specifying the technology, TSN profile specifications have been introduced to ease interoperability, deployment, and use of TSN in a given application area. IEEE 802.1DG™ is such a profile specification targeting the automotive industry.

Accurate timing and guaranteed data delivery are critical in the automotive environment. Solutions such as IEEE 1588™ based protocols (e.g., IEEE 802.1AS™) can provide timing accuracy in the sub-microsecond range. Such accuracy will be required as Ethernet usage grows within the vehicle. In addition, other IEEE and TSN standards provide secure, ultra-reliable, and bounded low-latency communications throughout the vehicle at multiple data rates. Because the in-vehicle wiring harness is a huge challenge with regards to weight and space coupled with higher throughput requirements for automotive Electronic Control Units (ECUs) and sensors, various PHYs targeting automotive are available today, including single twisted-pair 10 Mb/s (IEEE 802.3cg™), 100 Mb/s (IEEE 802.3bw™), 1 Gb/s (IEEE 802.3bp™) and 2.5/5/10 Gb/s (IEEE 802.3ch™).

The new standard: IEEE Std 802.1DG™-2025 – "IEEE Standard for Local and metropolitan area networks — Time-Sensitive Networking Profile for Automotive In-Vehicle Ethernet Communications" is the first available IEEE standard developed to specify the use of TSN over IEEE Std 802.3™ Ethernet for automotive in-vehicle networks.

IEEE Std 802.1DG specifies profiles for bounded latency in-vehicle communications based on IEEE 802.3 Ethernet and IEEE 802.1 TSN standards. IEEE Std 802.1DG harmonizes the existing IEEE 802.1 TSN standards into a unified framework to support scalable, interoperable, and cost-efficient automotive architectures based on standard Ethernet. The new standard provides information to automotive vendors and suppliers to help them with the design of vehicular systems enabling bounded latency in automotive in-vehicle networks. It also addresses the use of features from IEEE 802.1 standards to meet the bandwidth, latency, and synchronization needs for communications within automotive vehicles. As IEEE 802.1 standards are broad and intended for use in a variety of environments, this standard determines the features from IEEE 802.1 standards that are directly applicable to automotive in-vehicle networks and suggests how these features are used, including recommendations about how to configure optional parameters.

“IEEE Std 802.1DG is a key step forward to use standard Ethernet networks in the automotive industry,” said Glenn Parsons, chair, IEEE 802.1 Working Group. “This work facilitates the adoption of standard Ethernet bridged network in-vehicles to address industry demand on developments toward autonomous and software-defined vehicles.”

IEEE Std 802.1DG is available for purchase at the IEEE Standards Store. and at IEEE Xplore.