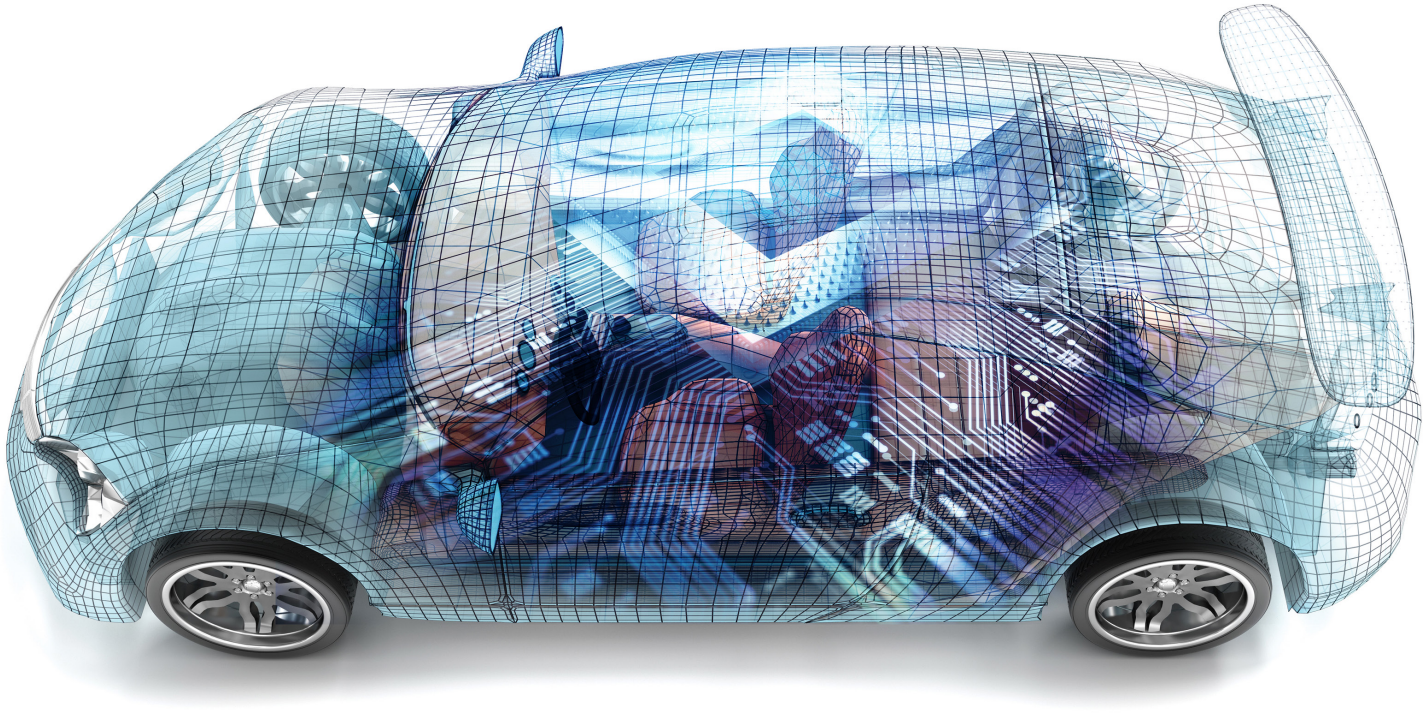
IEEE STANDARDS ASSOCIATION

IEEE

TSN for Automotive

IEEE 802 Standards for Time-Sensitive Networking



Implementing Time-Sensitive Networking (TSN) in Automobiles

Accurate timing and guaranteed data delivery are critical in the automotive environment. IEEE 802.1AS™ provides timing accuracy in the sub-microsecond range, which will be required as Ethernet usage grows within the vehicle. In addition, other IEEE and TSN standards provide secure, ultra-reliable, bounded low-latency communications throughout the vehicle at multiple data rates.

Because the in-vehicle wiring plant is a huge challenge with regards to weight and space coupled with higher throughput requirements for automotive sensors, various PHYs targeting automotive applications are available today, including 2-wire 100 Mbit/s (IEEE 802.3bw™) and 1 Gbit/s (IEEE 802.3bp™); furthermore, 10 Mbit/s (IEEE 802.3cg™) and 2.5/5/10 Gbit/s (IEEE 802.3ch™) PHYs are being developed.

Previously known as the Audio Video Bridging (AVB) set of standards, which are successfully used in Automotive Infotainment systems today, AVB has evolved into Time-Sensitive Networking in order to reflect the expanded scope of work toward autonomous driving.

Get Connected

For more information on the IEEE 802.1 Working Group, visit: http://www.ieee802.org/1/tsn/

IEEE STANDARDS ASSOCIATION

IEEE

TSN for Automotive

TSN in Vehicles

In vehicles, TSN works in synchrony with other IEEE technologies to deliver:

- **TIME SYNCHRONIZATION:** IEEE 802.1AS maintains synchronized time (+/- 500 nsec worst case) and supports scheduling-bounded low-latency traffic through the network where required while also allowing asynchronous traffic.
- **VERY LOW JITTER:** IEEE 802.1AS reduces jitter associated with Audio/Video, command, sensor, and control packet delivery to upper layers.
- **BOUNDED LOW LATENCY:** Time scheduled traffic, preemption, and no need to compress video and other ADAS (Advanced Driver Assistance Systems) data (since speeds up to 10 Gbit/s allow multiple channels of high definition video) can help avoid the latency and processing power penalties associated with compressions and decompression.
- **ULTRA RELIABILITY:** TSN provides reliability in the network (frame replication and elimination), protection from errant devices (ingress policing), backup for network timing master (standby Grandmaster).
- **SECURITY:** Authentication of installed devices (secure device identity), segregation of traffic types and flows between authorized devices, message integrity, and authenticity.

Other Enhancements

- **FAST STARTUP:** Preconfigured values for timing and bandwidth reservation allows quick startup followed by optional transition to negotiated values for dynamic adjustments.
- **FASTER UPDATES:** Firmware updates are quicker with Ethernet's higher speed.
- **INFORMATION SHARING:** A homogeneous Ethernet network allows instant sharing of information between allowed devices without the delays and security risks associated with interconnecting different bus types through gateways.

For more information on the IEEE 802.1 Working Group, visit:

http://www.ieee802.org/1/tsn/

Projects currently in progress:

- **IEEE P802.1DG™ Draft Standard for Local and Metropolitan Area Networks -** Time-Sensitive Networking Profile for Automotive In-Vehicle Ethernet Communications
- **IEEE P802.1AS™-Rev Draft Standard for Local and Metropolitan Area Networks -** Timing and Synchronization for Time-Sensitive Applications
- **IEEE P802.1Qcr™ Draft Standard for Local and Metropolitan Area Networks -** Bridges and Bridged Networks Amendment: Asynchronous Traffic Shaping

Visit www.ieee802.org/1/tsn for a complete list of TSN projects.

Standards:

- **IEEE 802.1AS™-2011 Standard for Local and Metropolitan Area Networks -** Timing and Synchronization for Time-Sensitive Applications in Bridged Local Area Networks
- **IEEE 802.1CB-2017™ Standard for Local and Metropolitan Area Networks -** Frame Replication and Elimination for Reliability
- **IEEE 802.1Q™-2018 Standard for Local and Metropolitan Area Networks -** Bridges and Bridged Networks; which incorporates the amendments:
  - IEEE 802.1Qbv™-2015 Enhancements for Scheduled Traffic
  - IEEE 802.1Qbu™-2016 Frame Preemption
  - IEEE 802.1Qci™-2017 Per-Stream Filtering and Policing
  - IEEE 802.1Qch™-2017 Cyclic Queuing and Forwarding
- **IEEE 802.1Qcc™-2018 Standard for Local and Metropolitan Area Networks -** Bridges and Bridged Networks Amendment: Stream Reservation Protocol (SRP) Enhancements and Performance Improvements
- **IEEE 802.1AE™-2018 IEEE Standard for Local and Metropolitan Area Networks -** Media Access Control (MAC) Security
- **IEEE 802.1AR™-2018 Standard for Local and Metropolitan Area Networks -** Secure Device Identity

Visit standards.ieee.org/about/get/ for details.