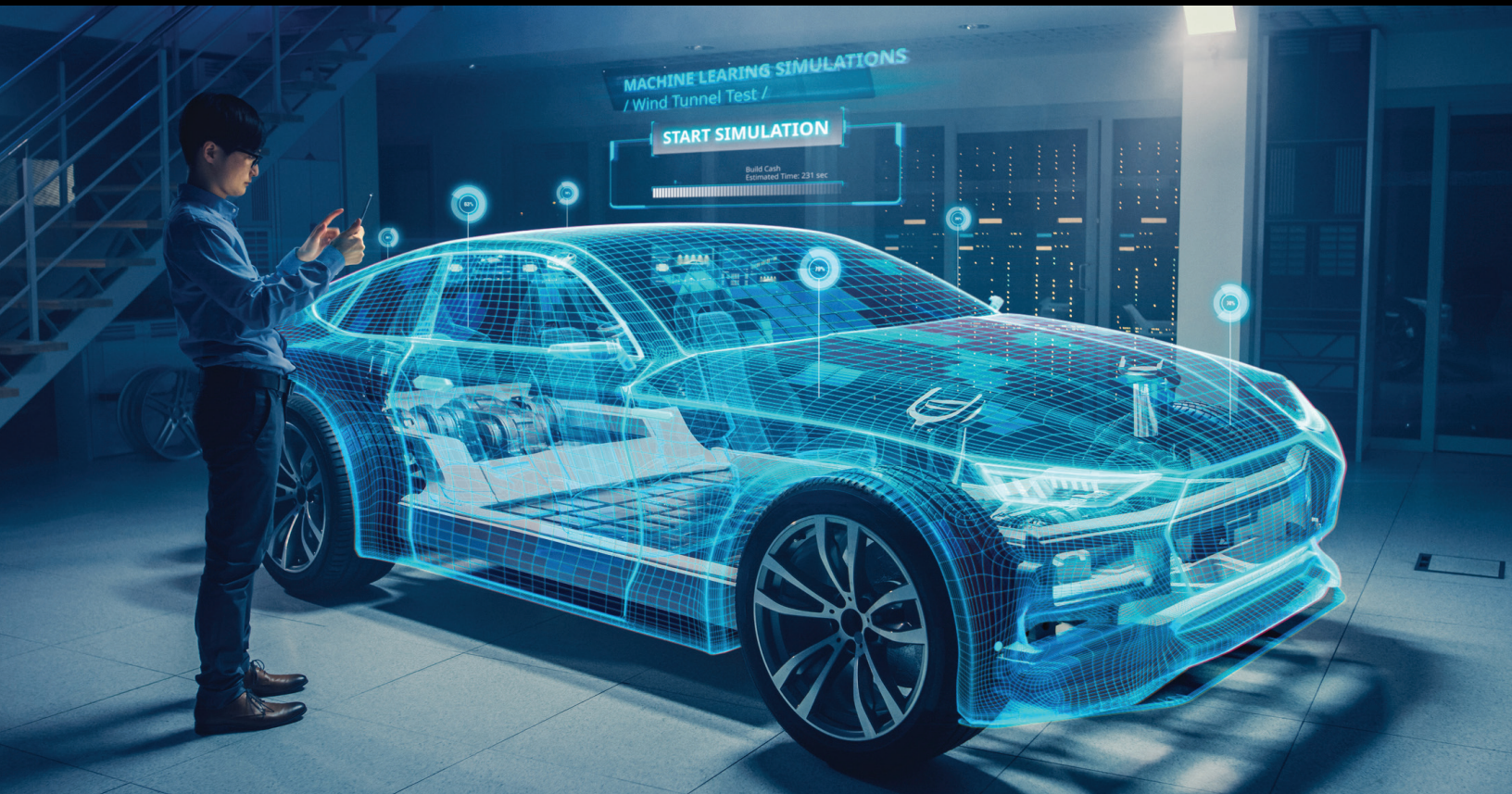


# TSN FOR AUTOMOTIVE

## 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, and 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 are available today, including

2-wire 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™). 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 to reflect the expanded scope of work in part toward autonomous driving. IEEE P802.1DG™ “Time-Sensitive Networking Profile for Automotive In-Vehicle Ethernet Communications” addresses the use of TSN techniques to meet the many automotive needs for communications within vehicles.

**TSN**  
Time-Sensitive Networking  
Powered by IEEE 802

For more information on the IEEE 802.1  
Working Group, visit [ieee802.org/1](http://ieee802.org/1)



## TSN IN VEHICLES

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

- **TIME SYNCHRONIZATION:** Synchronized time can be provided by a variant of the IEEE 1588 Precision Time Protocol (PTP) through the network where required, e.g., to support scheduling-bounded low-latency traffic, while also allowing asynchronous traffic.
- **VERY LOW JITTER:** IEEE TSN allows reducing jitter associated with audio/video, command, sensor, and control packet delivery to upper layers.
- **BOUNDED LOW LATENCY:** Time scheduled traffic, preemption, 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) avoid the latency and processing power penalties associated with compression and decompression.
- **ULTRA RELIABILITY:** Protection from errant devices (ingress policing), backup for network timing master (standby grandmaster).

### Other Enhancements

- **FAST STARTUP:** Preconfigured values for timing and bandwidth reservation allow 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 homogeneous sharing of information between allowed devices without the delays and security risks associated with interconnecting different bus types through gateways.

## 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 P802.1ASdm™-Draft Standard for Local and Metropolitan Area Networks–Timing and Synchronization for Time-Sensitive Applications Amendment: Hot Standby**

## STANDARDS

- **IEEE 1588™-2019 Standard for a Precision Clock Synchronization Protocol for Networked Measurement and Control Systems**
- **IEEE 802.1CB™-2017 Standard for Local and Metropolitan Area Networks–Frame Replication and Elimination for Reliability**
- **IEEE 802.1CBdb™-2021 Standard for Local and Metropolitan Area Networks–Frame Replication and Elimination for Reliability Amendment 2: Extended Stream Identification Functions**
- **IEEE 802.1Q™-2022 Standard for Local and Metropolitan Area Networks–Bridges and Bridged Networks**
- **IEEE 802.1AE™-2018 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 Standards**

For a complete list of TSN projects, visit [ieee802.org/1/tsn](https://ieee802.org/1/tsn)

After six months, IEEE 802® published standards are available via the GET Program.

