IEEE SA STANDARDS ASSOCIATION

TSN FOR AEROSPACE

IEEE 802 Standards for Time-Sensitive Networking

Evolution of Aerospace Onboard Networks with Time-Sensitive Networking (TSN)

Modern aircraft depend on real-time onboard communications to perform critical vehicle and mission functions. The aerospace industry recognizes a need for an open standards-based, high-performance solution to interconnect an increasing number of digital components including sensors, actuators, controllers, processors, displays and data concentrators. IEEE 802.1 Time-Sensitive Networking (TSN) provides a standard Ethernet-based deterministic solution to not only enable higher quality-of-service, but also lower the size, weight, and power with a converged zonal architecture. TSN meets the modularity and open systems requirements essential to the evolution of the data distribution digital backbone in modern aerospace platforms.

To address the use of TSN for aerospace applications, the IEEE Standards Association (IEEE SA) and SAE International have established a Joint Project to develop the IEEE 802.1DP / SAE AS6675 "Time-Sensitive Networking for Aerospace Onboard Ethernet Communications" Profile specification.

This Joint Project brings aerospace industry and networking experts together to define a profile of TSN to meet the unique requirements for aerospace applications and to help interoperability and testing.

By selecting TSN features, defaults, and a common configuration scheme, the IEEE 802.1DP/SAE AS6675 standard will benefit the developers of TSN products, OEMs integrating TSN in aerospace platforms, and ultimately the aerospace vehicle users.

TSN Time-Sensitive Networking *Powered by IEEE 802*

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

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TSN FOR INDUSTRIAL AEROSPACE

CONVERGED DIGITAL BACKBONE FOR AEROSPACE PLATFORMS

TSN provides high-bandwidth, high-reliability, zero congestion loss, bounded low latency, bounded low latency variation (jitter), and stream isolation necessary to enable converged aerospace networks.

- **TIME SYNCHRONIZATION:** IEEE 802.1AS provides fault-tolerant time synchronization (sub-microsecond) across all devices on the network without the need for separate discrete signaling. Synchronized time can be used by network functions (e.g., time-based scheduling) to provide Quality of Service (QoS) guarantees as well as by applications to ensure end-to-end data and temporal integrity.
- **LOW LATENCY AND JITTER:** TSN includes traffic shaping mechanisms (e.g., credit-based shaper, time-based scheduling) and QoS provisioning which, along with resource management, provide bounded low latency and reduced packet delay variation (jitter).
- **SCALABLE HIGH BANDWIDTH:** TSN operates over multiple physical layer mediums (e.g., fiber, copper) and multiple physical layer rates (e.g., 10Mbs, 100 Mbps, 1 Gbps, 10 Gbps) to meet various aerospace application requirements.
- **HIGH AVAILABILITY/ULTRA-RELIABILITY:** TSN provides ultra reliability and high availability in the network for seamless communication over redundant paths (frame replication and elimination), protection from errant devices (ingress policing), and fault-tolerant time synchronization (redundant time sources and distribution paths)
- **UNIFIED MANAGEMENT:** Standardized management for bridges and end stations allows network convergence via standard protocols, data models, and interfaces. This reduces the complexity and effort of integrating aerospace systems with components from multiple vendors.
- **CONVERGED NETWORK:** TSN supports multiple traffic classes with different requirements on a converged network via quality-of-service differentiation and strict stream isolation. Thus, mixed-criticality aerospace applications can share a common network infrastructure (digital backbone).
- **INTEROPERABILITY:** TSN leverages the interoperability of existing IEEE Std 802.3 Ethernet across multiple link speeds, media types, and feature sets. A common information model for the network resources and harmonized interfaces for stream setup support interoperability. IEEE 802.1DP/SAE AS6675 further specifies a common feature set along with defaults and configuration data models to enable multi-vendor solution on any given aerospace platform.

For a complete list of TSN projects, visit ieee802.org/1/tsn

PROJECTS CURRENTLY IN PROGRESS

- **IEEE P802.1DP™/SAE AS6675 -**Draft Standard for Local and Metropolitan Area Networks: Time-Sensitive Networking Profile for Aerospace Onboard Ethernet Communications
- **IEEE P802.1ASed™-**Draft Standard for Local and Metropolitan Area Networks: Timing and Synchronization for Time-Sensitive Applications Amendment – Fault-Tolerant Timing with Time Integrity
- **IEEE P802.1ASdn™-**Draft Standard for Local and Metropolitan Area Networks–Timing and Synchronization for Time-Sensitive Applications Amendment: YANG Data Model

STANDARDS

- **IEEE 802.1Q™-2022** Standard for Local and Metropolitan Area Networks–Bridges and Bridged Networks
- **IEEE 802.1Qcw™-2023** Standard for Local and Metropolitan Area Networks–Bridges and Bridged Networks Amendment: YANG Data Models for Scheduled Traffic, Frame Preemption, and Per-Stream Filtering and Policing
- **IEEE 802.1Qdj™-2024** Standard for Local and Metropolitan Area Networks–Bridges and Bridged Networks Amendment: Configuration Enhancements for Time-Sensitive Networking
- **IEEE 802.1Qdx™-2024** Standard for Local and Metropolitan Area Networks–Bridges and Bridged Networks Amendment: YANG Data Models for the Credit-Based Shaper
- **IEEE 802.1AS™-2020** Standard for Local and Metropolitan Area Networks–Timing and Synchronization for Time-Sensitive Applications
- **IEEE 802.1CB™-2017** Standard for Local and Metropolitan Area Networks–Frame Replication and Elimination for Reliability
- **IEEE 802.1CBcv™-2021** Standard for Local and Metropolitan Area Networks–Frame Replication and Elimination for Reliability Amendment 1: Information Model, YANG Data Model and Management Information Base Module
- **IEEE 802.1CBdb™-2021** Standard for Local and Metropolitan Area Networks–Frame Replication and Elimination for Reliability Amendment 2: Extended Stream Identification Functions

Visit standards.ieee.org for more information.