Time-Sensitive Networking (TSN) Standards - Official Technical Overview & Hardware Datasheet

TIME-SENSITIVE NETWORKING (TSN) STANDARDS

EXECUTIVE SUMMARY

As industrial automation, automotive Ethernet, and professional audio-video bridging converge toward deterministic networking, Time-Sensitive Networking (TSN) represents the definitive IEEE 802.1 standards suite for guaranteed low latency, bounded jitter, and zero packet loss over standard Ethernet infrastructure. This document provides the official technical overview and hardware datasheet for our TSN-compliant switching platform, engineered for converged IT/OT networks requiring real-time traffic coexistence with best-effort data flows.

The TSN standards transform conventional Ethernet from a best-effort medium into a carrier-grade deterministic transport fabric, enabling mixed criticality traffic to share a unified network without interference. Key amendments include IEEE 802.1AS (time synchronization), 802.1Qbv (time-aware shaping), 802.1Qbu & 802.3br (preemption), 802.1CB (redundancy), and 802.1Qci (per-stream filtering). Our hardware implementation achieves full compliance across all mandatory TSN clauses while delivering line-rate forwarding at 1/10/25/100 GbE densities.

ARCHITECTURE & CHASSIS DESIGN

The platform is architected around a non-blocking, cut-through switching fabric with hardware-accelerated TSN timing engine. The central component is the TSN Timing and Scheduling ASIC (T2-ASIC), which integrates a grandmaster-capable IEEE 1588v2/802.1AS clock with 8 programmable time gates per egress port. The chassis supports 8 to 48 TSN-enabled ports in 1RU and 2RU form factors, with field-swappable power supplies (1+1 or N+1) and hot-swappable fan trays.

All ports are capable of simultaneous TSN time-aware shaping (Qbv), credit-based shaping (Qav for AVB), and strict priority queuing. The backplane delivers up to 2.56 Tbps switching capacity, ensuring zero blocking when all

TSN streams are active at full line rate. A dedicated synchronization plane distributes the grandmaster clock to every line card with sub-10ns skew.

HARDWARE FEATURES

- TSN Feature Set: 802.1AS (gPTP), 802.1Qbv (TAS with up to 128 gates per egress), 802.1Qbu + 802.3br (express/preemptable frame preemption), 802.1CB (FRER seamless redundancy), 802.1Qci (PSFP ingress policing), 802.1Qcc (CNC discovery), 802.1AB (LLDP).
- Synchronization: Holdover performance < 1 us over 4 hours, 10ns synchronization accuracy between directly adjacent nodes.
- Port Configuration: 24x 10/100/1000BASE-T, 12x 1/10G SFP+, 4x 25G SFP28, and optional 2x 100G QSFP28 uplinks.
- Memory: 2 GB packet buffer, 8 GB control plane DRAM, 32 MB dedicated TSN stream database.
- Management: CLI, NETCONF/RESTCONF, SNMPv3, and Time-Sensitive Networking Configuration Interface (TCI).
- CPU: Dual-core 2.0 GHz ARM Cortex-A72 for control plane and PTP stack.

COMPLIANCE & STANDARDS

The platform is fully compliant with IEEE 802.1BA (Audio Video Bridging

systems), IEC 61850 (substation automation), and SAE AS6802 (time-triggered Ethernet for aerospace). Tested interoperability with leading TSN controllers from Cisco, Siemens, Belden, and National Instruments. Additionally, the hardware meets industrial temperature ratings (-40 ° C to +75 ° C), shock/vibration (IEC 60068-2), and EMI (FCC Part 15, EN 55032 Class A).

TECHNICAL SPECIFICATIONS

Parameter	**Specification**
Form Factor	1RU (standard) / 2RU (high-density) / Fanless 1RU (industrial)
Switching Capacity	480 Gbps (1RU base) to 2.56 Tbps (2RU fully loaded)
Power Supply	1+1 Redundant AC (100-240V) or DC (-48V) / optional N+1 modular
Power Consumption	85W typical, 150W max (2RU chassis)
Operating Temperature	0°C to +50°C (commercial) / -40°C to +75°C (industrial extended)
Latency (cut-through)	< 5 microseconds (any port to any port, 64-byte frames)
Jitter (bound)	± 500 nanoseconds under full TSN scheduling load

Time Sync Accuracy	± 10 ns (adjacent nodes) / ± 100 ns (over 10 hops)
Streams Supported	Up to 8,192 concurrent TSN streams (configurable via database size)
MTBF (Telcordia SR-332)	520,000 hours (1RU) / 475,000 hours (2RU)
Management Interfaces	RJ45 console, USB-C, 1x 1G dedicated management port
Cooling	Front-to-back airflow, 3+1 redundant hot-swappable fans

ORDERING OPTIONS

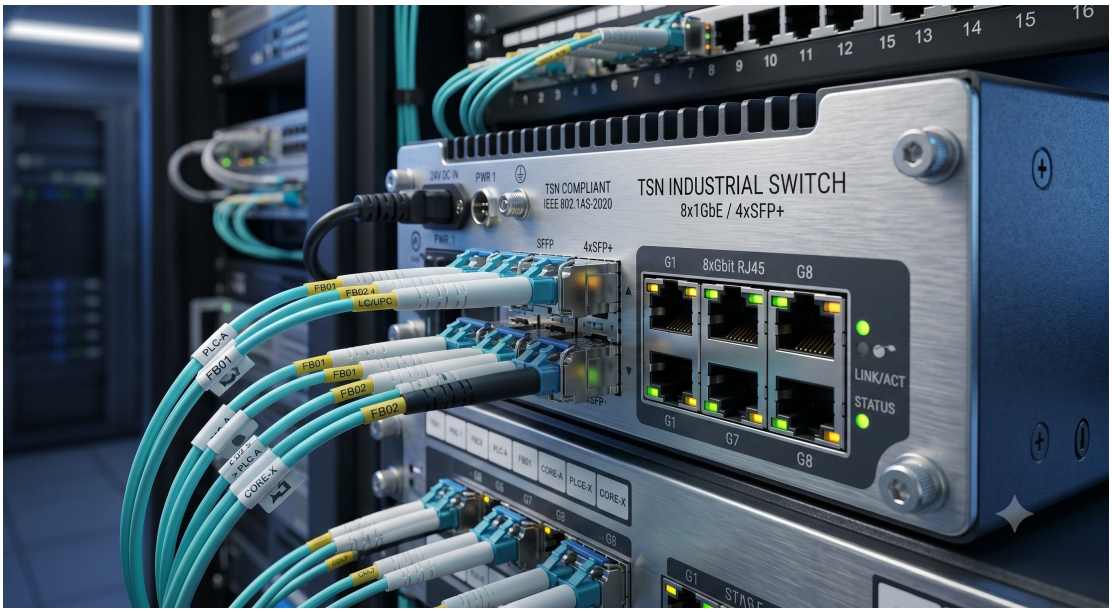
- TSN-2400-24T: 24x Gigabit RJ45, 4x 1G SFP, TSN-enabled, 1RU.

- TSN-2412-12S: 12x 1/10G SFP+, 2x 25G SFP28, enhanced TSN stream database, 1RU.

- TSN-4800-48C: 48x combo ports (RJ45/SFP), 4x 25G uplinks, N+1 PSU, 2RU.

- TSN-SW-UPG: Software license for full TSN suite on standard hardware.

- TSN-TEST-KIT: Portable TSN traffic generator and analyzer for field validation.



All TSN platforms are supplied with a 5-year limited hardware warranty and lifetime software updates for TSN protocol revisions. For deterministic Ethernet applications demanding sub-microsecond synchronization and zero-loss redundancy, this datasheet defines the reference implementation of the Time-Sensitive Networking standards suite.