TIME-SENSITIVE NETWORKING AT THE INTELLIGENT EDGE

WIND RIVER SUPPORT WITH VXWORKS

Mission-critical systems increasingly rely on Ethernet connectivity between modules or devices. Traditional Ethernet (IEEE 802.3 and 802.1Q) had no concept of time regarding data delivery, and thus it was not possible to ensure that all real-time data would arrive at its destination on time — especially as data loads increased. Deterministic system behavior thus could not be achieved.

Time-Sensitive Networking (TSN) addresses this problem, guaranteeing minimal network latency and jitter, and it provides for bounded end-to-end delay and guaranteed message delivery time. TSN also allows the transmission of time-sensitive and non–time-sensitive data on the same network.

The VxWorks® real-time operating system (RTOS) brings this TSN capability to embedded systems software developers natively — meaning without the need for third-party add-ons. Further, VxWorks running as a guest OS on Wind River® Helix™ Virtualization Platform brings TSN capability to virtualized deployments.

>> Learn More About Time-Sensitive Networking

ADDRESSING DIVERSE INDUSTRY USE CASES

Industry-specific IEEE TSN profiles have been defined, enabling organizations to more easily navigate the evolving TSN landscape by using those standards applicable to their markets.

VxWorks and Helix Platform enable developers to cost-effectively implement TSN in their projects, addressing the key use cases within their industry.

AEROSPACE & DEFENSE	AUTOMOTIVE	INDUSTRIAL AUTOMATION
IEEE P802.1DP TSN for Aerospace Onboard Ethernet Communications	IEEE P802.1DG TSN for Automotive In-Vehicle Ethernet Communications	IEEE 60802 TSN for Industrial Automation
Flight Control, Weapons Control, Guidance Systems	Advanced Driver Assist Systems (ADAS)	Factory Automation, Robotics

Figure 1. Industry verticals, TSN profiles, and use cases

VXWORKS

VxWorks is the world's most widely deployed real-time operating system (RTOS).

It enables the cost-effective development of high-performance, reliable, secure, robust, safety-certified mission-critical systems, leveraging the latest processor advancements.

Development teams can use popular programming languages and integrate with the Wind River Studio DevSecOps solution for highly efficient development and testing. Deployment and updates can be delivered via OCI-compliant software container technology. These industry-leading capabilities significantly reduce time-to-market and drive innovation, new business, and revenue.

Learn More

Collaborative Industry Positioning Paper on TSN

VxWorks: Real-Time Operating System for the Intelligent Edge

SUPPORTED TSN STANDARDS

Synchronization

- IEEE 1588 – Precision Clock Synchronization Protocol for Networked Measurement and Control Systems
- IEEE 802.1AS-2020 – Timing and Synchronization for Time-Sensitive Applications

Latency

- IEEE 802.1Qav – Forwarding and Queueing Enhancements for Time-Sensitive Streams
- IEEE 802.1Qbv – Enhancements for Scheduled Traffic
- IEEE 802.1Qbu – Frame Preemption

Reliability

- IEEE 802.1CB – Frame Replication and Elimination for Reliability*

Figure 2. Supported TSN standards

*Coming soon

THE BENEFITS OF TSN WITH VXWORKS

Table 1: Benefits of TSN on VxWorks

Benefit	TSN Role Enabled by VxWorks
Reduced Complexity	Modular systems design makes development, testing, deployment, and upgrades less complex. Since Ethernet is commonly used for inter/intra-module communication, TSN is essential for real-time system determinism.
Improved Quality of Service (QoS)	TSN supports mechanisms to prioritize and schedule network traffic, which enhances the quality of service for critical applications.
Scalability	As networks of edge devices grow (with more distributed sensors or additional modules within a system), TSN ensures that the highest-priority time-sensitive data continues to be transferred.
Data Access	Data-centric applications and storage play an essential role in intelligent edge systems. TSN plays a crucial role in enabling low-latency, real-time data access in edge cloud environments.
Improved Monitoring, Fault Detection	Efficient prioritization and distribution of events notifications and corrective actions ensures less system downtime.
Better Cyber Resiliency	By using Ethernet, cybersecurity mechanisms already deployed in IT networks can be tailored and applied to systems with TSN, reducing vulnerabilities.
Medicine	Remote surgery, virtual consultation, remote health monitoring.
Modern Factories	Huge machines are connected to the cloud, and devices are connected through Wi-Fi within the factory.
Future-Proofing	Ethernet is incumbent and TSN on Ethernet provides vendor confidence that development efforts are not throwaway.
Convergence of IT and OT Networks	TSN facilitates the convergence of information technology and operational technology networks, providing a unified communication infrastructure for both enterprise and industrial systems.
Interoperability & Vendor Neutrality	TSN standards are designed to be open and interoperable, allowing different vendors' devices to work together seamlessly for an open, robust ecosystem.

HIGH PERFORMANCE, SCALABILITY, AND DETERMINISM

PROVEN SAFETY, SECURITY, AND RELIABILITY

REDUCED COST AND TIME-TO-MARKET

VxWorks supports TSN on Ethernet ports for hardware from Intel, NXP, Texas Instruments, Renesas, Xilinx, and Aptiv. Contact us at salesinquiry@windriver.com for more details.

WNDRVR

Wind River is a global leader of software for mission-critical intelligent systems. For 40 years, the company has been an innovator and pioneer, powering billions of devices and systems that require the highest levels of security, safety, and reliability. Wind River offers a comprehensive portfolio of software and expertise that are accelerating digital transformation across industries.

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