Deterministic Ethernet

for High-Availability, Safety-, and Mission-Critical Systems

• Ethernet/IEEE 802.3
• ARINC 664 p7
• SAE AS6802 / Time-Triggered Ethernet

www.tttech.com/aerospace
**Key Offering**

From lab to rugged to certified flight hardware

**Switches**

TTTech offers various switch solutions (LRM, LRU, 3U VPX, up to 24 ports) based on standard Ethernet, ARINC 664 p7 and Time-Triggered Ethernet. With up to 1 Gbit/s these switches enable the integration of standard, rate-constrained and time-triggered Ethernet traffic for mixed-criticality architectures like standard LAN, audio, video and critical controls in one network.

**End Systems**

TTTech offers ARINC 664 p7 and TTEthernet IP, PMC/XMC boards and middleware that can be used with commercial off-the-shelf solutions. VxWorks, QNX and Linux operating systems are supported. Chip IP is available for dedicated FPGA families.

**Software Tools**

The TTEthernet tool suite allows design, configuration, verification and validation of complex deterministic ARINC 664 p7 and TTEthernet networks. It supports full integration of customer-specific design process and tooling.
Key Capabilities

• Standard LAN and low-latency/μs-jitter applications in shared Ethernet networks
• Strictly Deterministic Ethernet, lossless operation, low-latency/μs-jitter
• Hard real-time and standard Ethernet communication for critical and highly available applications
• For automotive, energy, aerospace, process automation, robotics, medical, telecom, governmental applications, railway and other transportation applications

Features

• Synchronous (μs-jitter/fixed latency) and asynchronous traffic
• Robust emulation of TDM communication in asynchronous IEEE 802.3 networks
• Robust separation of critical and non-critical data streams
• Distributed, fault-tolerant system clock; guaranteed Quality of Service (QoS) under multiple faults
• Dynamic release (< 10 μs) of unused synchronous bandwidth
• Certification according to SIL 61508 and RTCA DO-254 (DAL A)

Ethernet LAN Compatibility

• Full compatibility with standard IEEE 802.3 Ethernet
• SAE AS6802 service added at OSI Layer 2 (network switch)
• No impact on existing UDP/TCP/IP and higher OSI layers and applications
• TTEthernet switch operates as IEEE 802.3 switch if SAE AS6802 service is not used
• Compatible with industry-specific Ethernet QoS enhancements (e.g. ARINC 664 p7)
What Makes TTTech Switches Unique?

1. TTTech switches support standard Ethernet, ARINC 664 p7 and inherently deterministic communication (time-triggered) and have been designed for safe and highly available real-time applications from the ground up.

2. TTTech switches provide support for system...
   • availability
   • safety and certification
   • scalable fault-tolerance
   • security and partitioning
   • soft to hard real-time operation
   • asynchronous and synchronous operation

3. TTTech switches are 100 % compatible with IEEE 802.3 Ethernet and COTS hardware. They integrate transparently with Ethernet networks.

4. TTTech switches enable convergence of hard real-time communication and standard Ethernet traffic in parallel on the same network.

Networks with TTTech’s TTEthernet products simplify the design of fault-tolerant and high-availability solutions and support seamless concurrent engineering in critical applications.

Technical Specification

• 100 Mbit/s / 1 Gbit/s – optical or copper physical layer (any IEEE 802.3 compliant physical layer supported)
• Tight system synchronization
• Fault-tolerant distributed clock synchronization
• Cycle time: min. < 100 μs (1 Gbit/s, 8 nodes), configurable cycle times
• Concurrent routing multiplies system data throughput (with 12 ports at 1 Gbit/s up to 24 Gbit/s), full concurrent line rate support on all lines
• Configurable speed conversion among 100 Mbit/s / 1 Gbit/s sub networks (buffered switch)
• Support for star incl. multi-hop and redundant stars; line and arbitrary tree
Key Benefits

TTEthernet products allow parallel use of standard LAN (Ethernet) applications in shared networks up to deterministic and robust hard real-time, high-integrity, highly available, fail-operational applications. Non-critical applications cannot influence operation of critical subsystems.

Modularity & Integration

- Modular and deterministic use of all computing/networking resources for non-critical and critical distributed functions
- Guaranteed integration due to 100 % determinism of the network
- Co-existence and integration of Ethernet, ARINC 664 p7 and Time-Triggered Ethernet

Scalability

- Scalable bandwidth: 100 Mbit/s, 1 Gbit/s
- Scalable network topology: star, line, tree, ring
- Scalable QoS and fault tolerance: single-, dual-, or triple-redundancy

Safety & Availability

- Supports safety and redundancy at the network level without application involvement
- Replicated synchronous communication guarantees transmission of messages without switch-over or communication recovery delays
- Fully supports DO-297 certification standard

Security

- Supports secure operation in critical networks; less critical functions cannot impact highly critical functions
- Synchronization, partitioning and deterministic performance support secure operation
- Supports integration of MILS layers
TTTech’s TTEthernet product line uniquely integrates standard Ethernet (IEEE 802.3), ARINC 664 p7 and Time-Triggered Ethernet (SAE AS6802) into one networking solution for critical systems.

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