Deterministic Ethernet IP Solutions With Time-Sensitive Networking

Use Case: Deterministic Ethernet Solutions for Efficient In-Vehicle Networks

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Challenge

In a switched automotive Ethernet network each electronic control unit (ECU) requires a sufficient number of ports to connect it to other ECUs in the vehicle. Also within specific ECU variants - e.g. series and optional extras - there can be variations in port number requirements. This leads to demand for a highly efficient and scalable Ethernet switch solution in order to achieve a cost-optimized in-vehicle network topology. The final in-vehicle network architectures must fulfill stringent communication requirements in terms of performance, real-time, availability and reliability.
TTTech’s Deterministic Ethernet IP solutions are a flexible way to build in-vehicle automotive Ethernet networks. These solutions are available as switch IP or as switched endpoint IP.

The TTTech switch IP is designed to build Ethernet solutions with numerous switch ports - ideal for realizing star topologies. They are characterized by a MAC-interface to the central processing unit (CPU) and feature various xMII interfaces to connect integrated or external Ethernet PHYs (physical layer transceivers). The centerpiece of every switch is the Deterministic Ethernet switching engine which includes a wide range of IEEE standards such as Audio/Video Bridging (AVB) and Time-Sensitive Networking (TSN) to achieve Guarantee of Service for automotive Ethernet applications.

With switched endpoint IP, TTTech provides the most efficient way to tether a switching engine directly to a processing core. Hereby the traditional MAC from the CPU is replaced by a switched endpoint to offer the CPU two or even more Ethernet ports. This makes it ideal for use in daisy-chain stubs for in-vehicle networks topologies. Switched endpoints improve performance of handling Ethernet traffic in terms of direct memory access (via AXI) and software management (via APB). Here again, the Deterministic Ethernet switching engine offers automotive Ethernet features including AVB and TSN standards.
Deterministic Ethernet IP solutions from TTTech are ASIC-proven technology and are compliant to a set of IEEE standards for automotive applications with a very small footprint. TTTech’s switch IP and switched endpoint IP can also be easily integrated as vendor-specific encrypted IP components directly into FPGA/SoC designs to enable Deterministic Ethernet switching functionality.
Added Value of TSN Extensions

Deterministic Switch Architecture
TTTech’s Deterministic Ethernet IP solutions are designed with a strict upper limit of the internal forwarding delay. The Deterministic Ethernet switching engine provides a precise internal switch delay that makes it possible to build more accurate and performant network schedules.

Memory Partitioning
TTTech’s switch IP and switched endpoint IP include a memory partitioning function which guarantees traffic separation within the switch. This means that even packet storms within a traffic class cannot affect other classes by overloading switch buffers.

Per-Flow Time Aware Shaper
Standard TSN implementations are limited to only eight queues per egress port, potentially leading to interference on switches with multiple traffic data streams. TTTech’s Deterministic Ethernet switching engine supports up to 4096 flows which can handle a huge number of parallel data streams with varied and independent transmission properties.
Taking the Right Turn with Safe and Modular Solutions From TTTech

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