EtherCAT and TSN: the perfect match

What is TSN?

TSN (Time-Sensitive Networking) is a set of standards to improve the real-time features of today's commercial (IEEE 802.1) networks through advanced synchronization, availability, guaranteed resources and rapid response. These standards can be supported by switches and end stations. The TSN task group is part of the IEEE 802.1 working group, which is responsible for bridged (switched) networks.

Communication with improved real-time characteristics runs parallel to classic communication methods according to the best effort principle, in which the data exchange works as quickly as possible, depending on the network traffic situation.

The TSN standard does not define how to use the enhancements in combination with application tasks.

How does TSN work?

Unlike many networking standards, TSN does not communicate in an ad hoc fashion, but rather through data streams. A stream is a data channel with a defined bandwidth from a sender (talker) to a group of recipients (listeners). Streams are bundled in traffic classes by the networking components and forwarded with low latency.

Synchronization of all network components is the most exceptional feature of TSN. This allows automation systems to interact with outstanding precision.
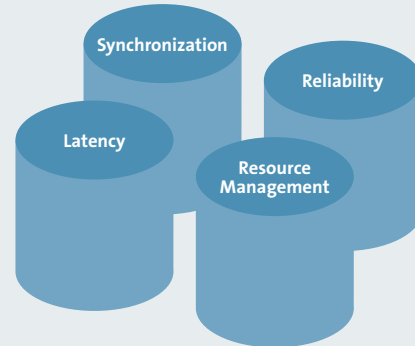
EtherCAT communication with TSN

Using TSN, it is possible to communicate via an IEEE 802.1 network with predictable delay. This makes it possible to run a variety of tasks with a single high-speed Ethernet interface:

- operate **several** slave segments
- communicate with a higher-level controller
- connect video cameras
- ...

Groups of EtherCAT devices are connected as one segment to the TSN domain. From an EtherCAT point of view, a TSN domain can essentially be regarded as a large switch that acts as a port multiplier for a control system. The adjustment is made via an adaptation function. A software layer can enable this in the master, as well as in the switch or the first slave of the EtherCAT segment. The EtherCAT slaves remain unchanged by this functionality.
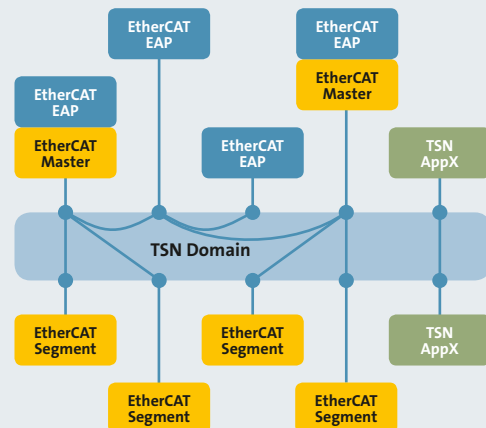
TSN key elements

TSN communication via streams
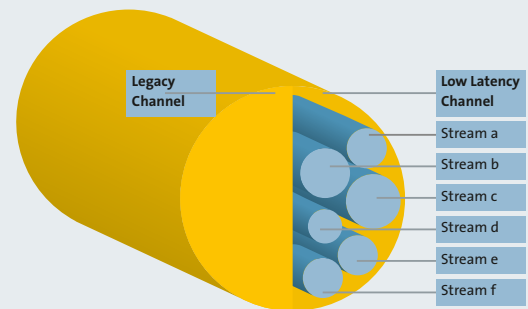
EtherCAT and TSN network example

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Useful network combinations aided by TSN

Of course, it is still possible to separate internal machine communication from higher-level communication. Cross-cell interactions over TSN can take place with significantly improved precision compared to traditional switched networks.

EtherCAT master-slave communication can be operated via TSN. The EtherCAT master implementation also remains unchanged and a multiplex layer is installed in the Ethernet driver, which allows the operation of several EtherCAT segments with access for other applications.

The **adaptation between TSN and EtherCAT** can be integrated either into an EtherCAT slave device or into a TSN-capable switch.

The TSN backbone may consist of a number of components from different switch manufacturers (e.g. Hilscher, Hirschmann-Belden, Moxa, Xilinx/SoC-e). Additional TSN components can be added if they support the TSN subset required by the EtherCAT TSN profile definition ETG.1700.

EtherCAT TSN profile

- integration into heterogeneous networks
- no change in the EtherCAT slaves
- easy implementation in the EtherCAT master
- easy handling in TSN through efficient Ethernet frame resource usage
- ETG liaison with IEEE 802.1

Stream adaptation
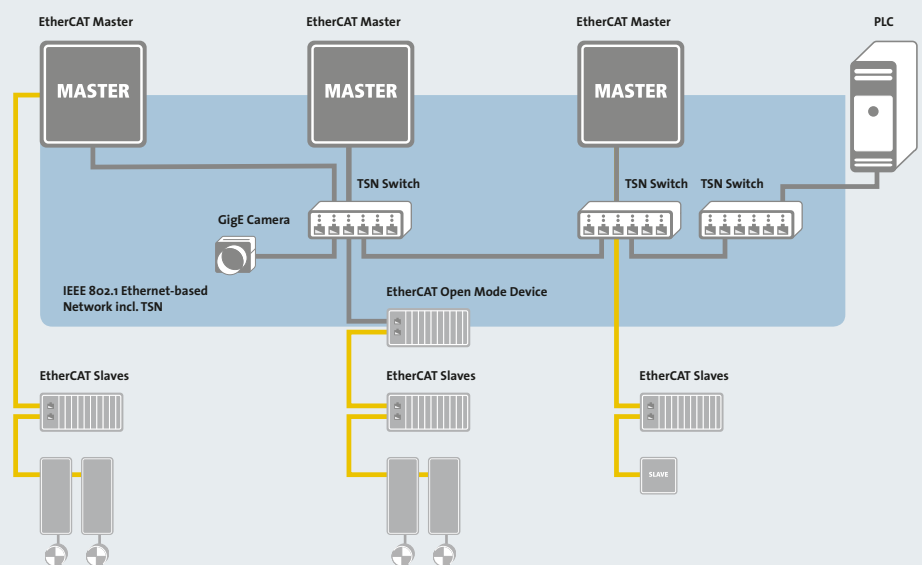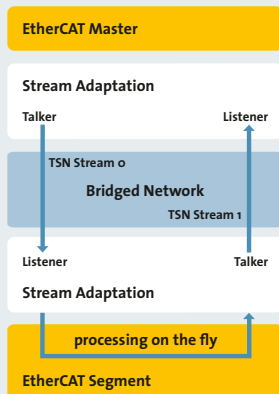
What is EtherCAT?

EtherCAT (Ethernet for Control Automation Technology) is an open Industrial-Ethernet solution. EtherCAT sets new standards with respect to real-time performance, low costs, flexible topology and ease of use.

www.ethercat.org

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