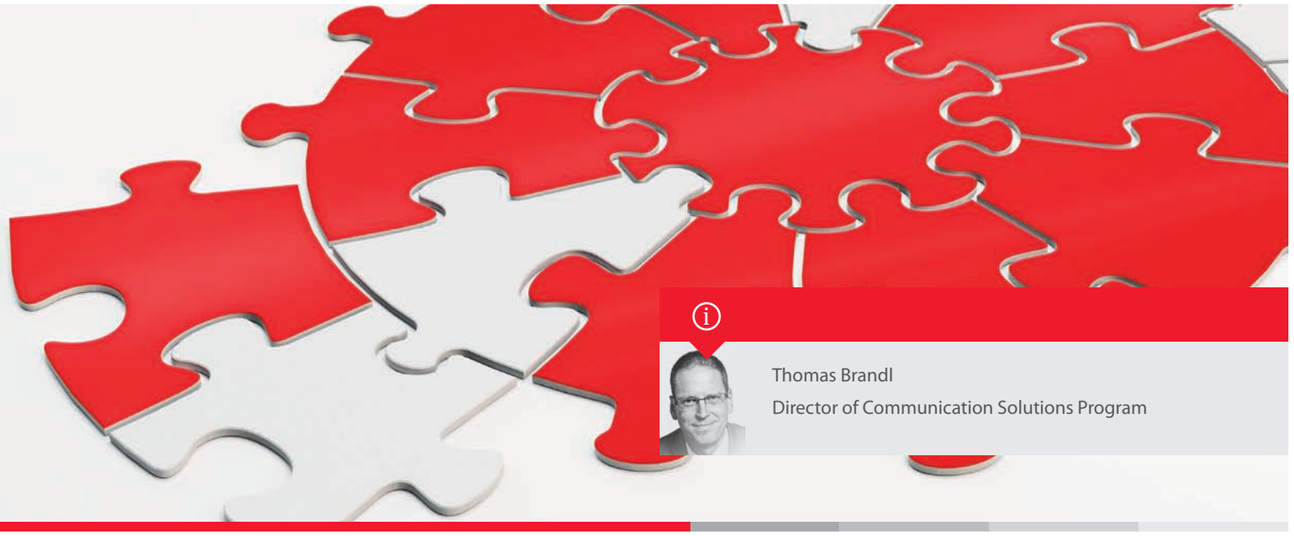

Thomas Brandl
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OPC UA and TSN – a common language for the future

Two key terms currently dominate discussions involving the topic of industrial communication: Time-Sensitive Networking, or TSN, and OPC UA. TSN is a set of extensions of the IEEE 802.1 industry standard which will enable Ethernet communication to fulfill real-time requirements without the need for special extensions in the future. By combining these new Ethernet features with the industry-wide OPC UA standard, a common language for the exchange of data between devices from different manufacturers seems to be possible.

The TSN standard

The initiative to add real-time mechanisms to the Ethernet standard came from the audio/video industry. Up until 2012, the respective working group of the IEEE called itself the Audio/Video Bridging Task Group (AVB). With the widening of the scope to include industrial, automotive and other segments, it was renamed the Time-Sensitive Networking Task Group.

Figure 1 makes it clear that the TSN standard consists of many elements. The following elements are the most relevant for the demands on industrial applications:

- AS: Time synchronization
- Qbv: Scheduling
- Qcc: Network configuration

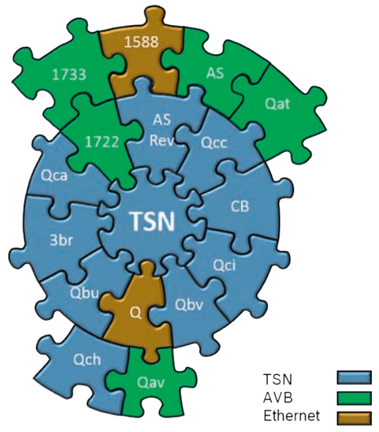

Figure 1: Elements of the IEEE 802.1 standard

A comprehensive standard like TSN allows the application some leeway in terms of interpretation. There are many ways to implement solutions that comply with the standard. Due to this large degree of freedom, it is necessary to define a unified communication profile based on the standard. Companies in the Avnu Alliance are working together to achieve this goal. A communications profile optimized for the respective application is being defined in the audio/video, automotive, and industrial working groups of the Avnu Alliance.

OPC UA for control-to-control communication

When it comes to communication between controllers and HMI systems, OPC UA has been a multivendor solution for many years. Nearly every control manufacturer offers an OPC server for its products. All leading HMI systems contain an OPC client as a counterpart that can be used to read the data from the controls. This type of crossvendor communication is currently not real-time-capable and is characterized by the fact that exactly two participants are involved in the exchange of information.

Both restrictions are presently being lifted by the working groups of the OPC Foundation. The OPC UA pub/sub standard allows a device to provide information to all other communication participants in the network. The specification is expected to be released in the first half of 2017. At the same time, the TSN working group in the OPC Foundation is working on combining OPC communication with the real-time mechanisms of TSN. This will lay the foundations for real-time, multivendor data exchange between controllers, e.g. in order to synchronize machine modules at manufacturing facilities as shown in figure 2.

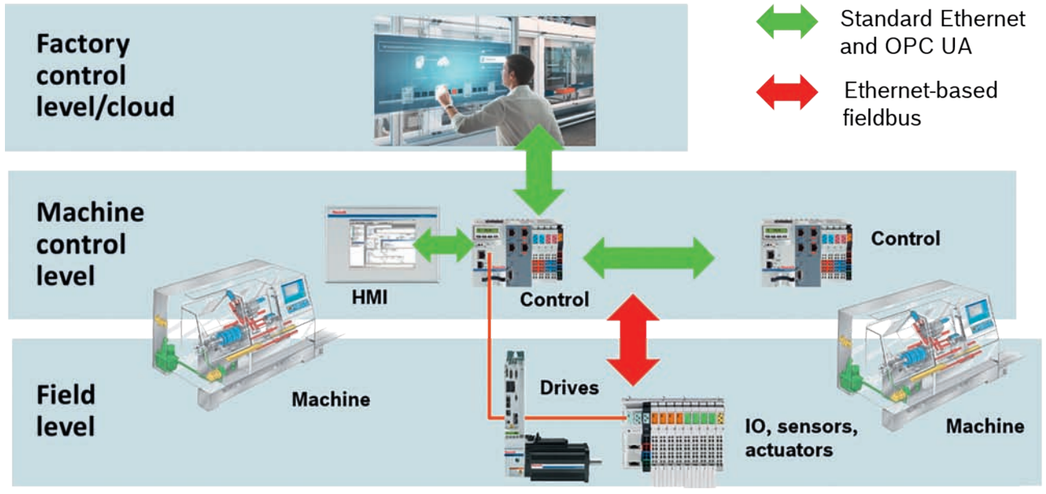

Figure 2: The communication levels in industrial automation

The TSN manufacturing testbed of the IIC

In order that users benefit from new standards, they first need to be supported and verified by several manufacturers. With its testbeds, the Industrial Internet Consortium (IIC) provides a platform for testing multivendor solutions already at the prototype stage. In the TSN manufacturing testbed, more than ten companies are working toward the goal of making controllers communicate with each other by means of OPC UA pub/sub and TSN. The Consortium presented its first demonstrator at the SPS IPC Drives 2016 fair in Nuremberg (figure 3).

In a highly publicized press conference, ABB, Bosch Rexroth, B&R, CISCO, General Electric, KUKA, National Instruments, Parker Hannifin, Schneider Electric, SEW-EURODRIVE and TTTech announced their common objective of supporting OPC UA and TSN in future generations of their products. They see in it a unified communications solution in the Industrial Internet of Things (IIoT) all the way down to the control level.

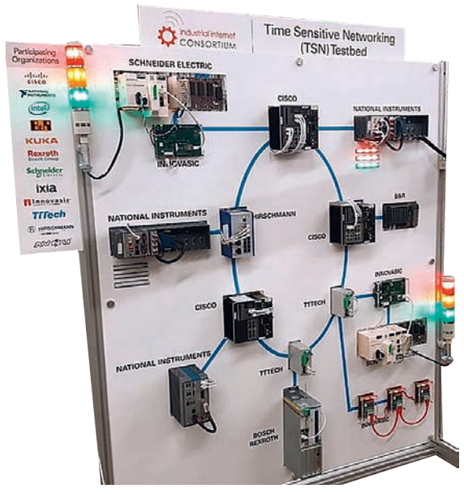

Figure 3: The demonstrator of the TSN manufacturing testbed at the SPS IPC Drives

Interoperability requires a common language

With the integration of OPC UA and TSN in products, it is possible to establish real-time communication connections between controllers from different manufacturers. However, this is still not enough to provide for crossvendor information exchange. Similar to a telephone conversation, a common language is also required in addition to having a working connection (figure 4). When it comes to industrial communication, application profiles represent the common language. Examples include application profiles for drive data, I/O, and safety.

Due to their detailed semantic specifications, Sercos® profiles provide for excellent interoperability. Sercos International therefore developed an OPC companion standard at an early stage. This companion standard defines the use of the Sercos profiles in communication based on OPC. The release procedure is currently underway at the OPC Foundation.

Figure 4: The importance of the communication profile and application profiles

The benefit for users

Standardizing communication between controllers has advantages for machine operators, machine manufacturers, and also for automation providers. The effort needed today to integrate machines in project-specific solutions is thus considerably reduced. It is no longer necessary to build up specific expertise for proprietary solutions. In addition to lower engineering costs, this results in shorter machine start-up times. Since an integrated solution is used for communicating between the control unit and HMI devices, the control level and other machine controls, the cost of maintenance is reduced.

Today, automation providers must support a variety of different communication links. This results in higher development costs without a direct benefit for end users. The focus on a unified communication solution saves resources that can be used to increase the pace of innovation.

How Sercos and TSN fit together

Sercos and its users will benefit from TSN in several ways. The synchronization mechanisms in current Ethernet controllers allow for the realization of Sercos masters without a specific hardware extension. The performance that is thus attainable covers a wide range of applications.

Standard switches will be offered with built-in TSN mechanism in the future. With these switches, the topology of Sercos networks can be designed flexibly. As was already shown in a demonstrator at the SPS IPC Drives, volume data such as video streams can be transmitted in such a network without disrupting the real-time behavior of the Sercos communication. The currently available field devices do not need to be modified to do this.

The standard IP communication which is part of the Sercos specification allows for direct access to field instruments via the network infrastructure. A gateway function in the control is not required. Sercos and TSN bring users a step closer to converged networks at the company level (IT networks) and at the field level (OT networks).

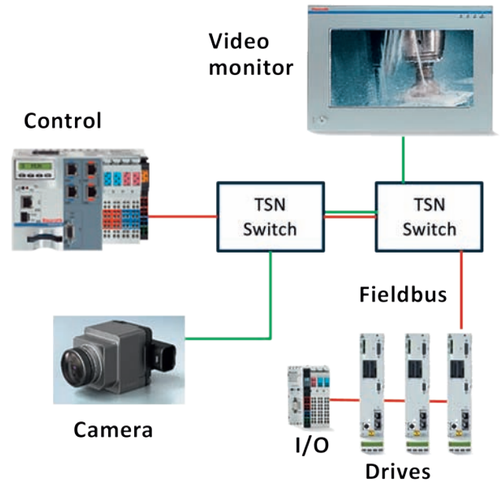

Figure 5: Topology extension for Sercos networks