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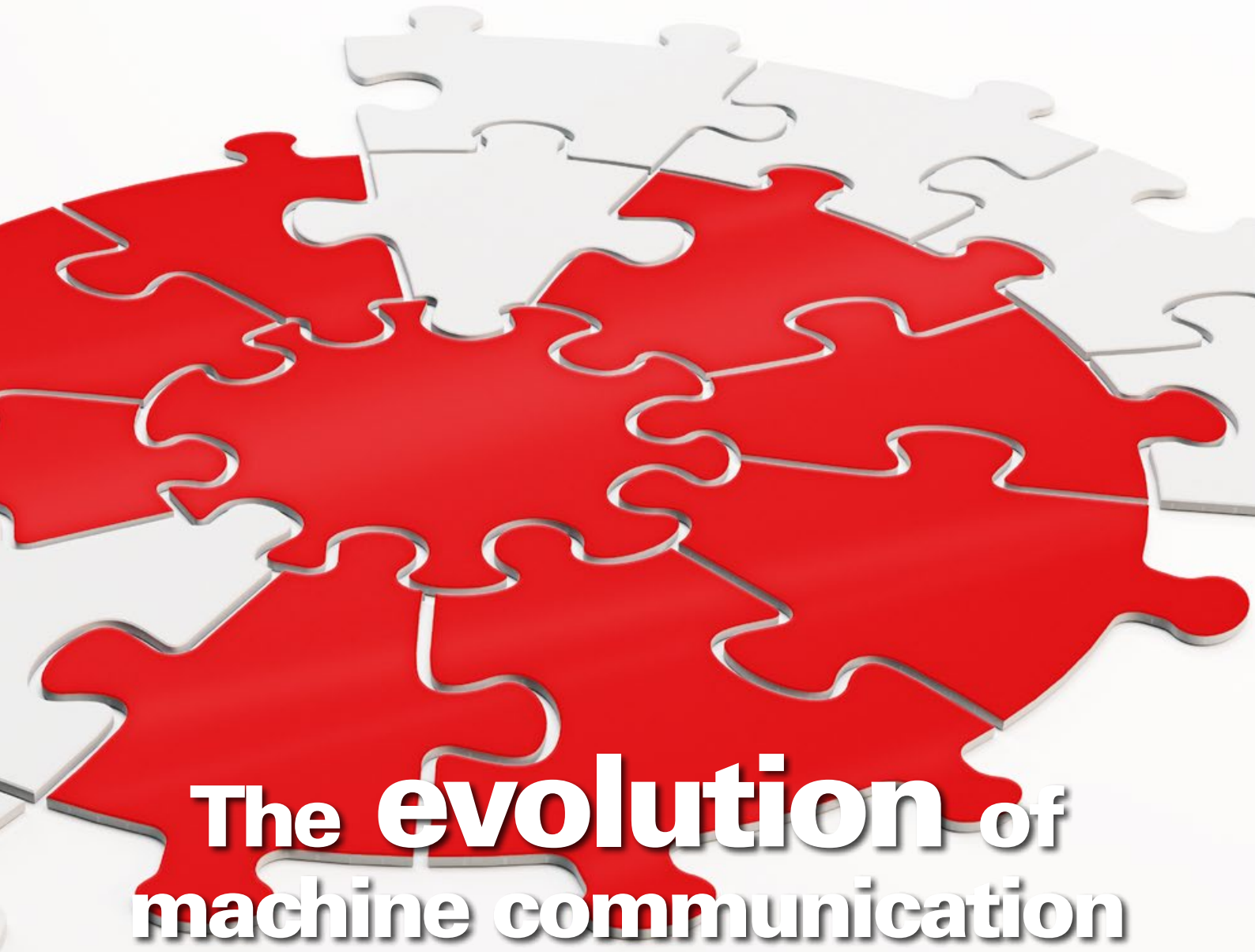


The evolution of machine communication

Ethernet TSN heralds a new era of industrial communication

Sercos TSN demonstrator
Premiere for Sercos over TSN

Sercos SoftMaster
Ready for production and available as open-source software free of charge

Application
Dynamic shaping process opens the door to "single-piece" flow production

Dear readers,

Ethernet TSN makes time-controlled and deterministic transmission of real-time-critical messages possible for the first time in the 43-year history of unmodified Ethernet. Ethernet TSN uses the principle of the time slot method or technique, which Sercos® has been using succesfully for more than 25 years for real-time communication in machine and plant construction and beyond. The advantages of using Ethernet TSN are obvious: Instead of special hardware, standard Ethernet components with integrated real-time capability can be used. This results not only in low costs, but also in the availability of a wide range of manufacturers and products. At the same time, manufacturers and users benefit from technical developments such as higher transmission rates. With TSN, the convergence of production and IT networks can be advanced, i.e. real-time communication and normal Ethernet communication can be transmitted via a uniform network standard. This constitutes an ideal basis for the implementation of Industry 4.0 and IIoT concepts.

Three exciting questions currently remain unanswered and will occupy users and manufacturers in the coming months and years:

1. How simply and comfortably can TSN networks be planned, configured and diagnosed?
2. How or how quickly are existing fieldbus and real-time Ethernet solutions migrating toward TSN? What role will OPC UA play?
3. Does TSN offer the opportunity of standardization of the variety of protocols and profiles, or will only the hardware be harmonized?

With the Sercos TSN demonstrator presented at the SPS IPC Drives show, Sercos took its first concrete step toward the convergence of conventional real-time Ethernet and Ethernet TSN. This proof of concept highlighted that Sercos devices can be operated in an Ethernet TSN network infrastructure jointly with other standard Ethernet and Ethernet TSN devices. Read more on page 10.

Happy reading,

Peter Lutz
Managing Director
Sercos International e. V.

Content

Sercos SoftMaster is now ready for production

Bosch Rexroth makes – as part of its Sercans XS package – the Sercos SoftMaster available as open-source software and free of charge.

On December 8, 2016, a new stage of availability of Sercos® technology for control systems began. On this date, the Sercos SoftMaster package was released on www.sourceforge.net/projects/sercos-softmaster-core, making it possible to equip any application with this technology free of charge.

Over the past three years, numerous prototype systems at over 15 evaluating companies and organizations worldwide were equipped with the precursors to the software package. This made it possible to ensure an extremely high quality level on the release date.

What is available?

With the Sercos SoftMaster package, over 95% of the Sercos Master solution is available. It is set up in such a way that the user does not have to make any code changes except for a few configuration steps.

The operating system abstraction and a test application are available free of charge as an example from Bosch Rexroth on request at Sercos@BoschRexroth.de. The following operating systems are supported and systematically incorporated into the release tests:

- Linux PREEMPT_RT (“OSADL Linux”)
- QNX Neutrino
- Windows Embedded Compact
- TenAsys INtime
- IntervalZero RTX /RTX64
- Wind River VxWorks
- Linux (standard Ubuntu 14 LTS)
- Windows Embedded Standard

The ANSI-C implementation is kept completely platform-independent and can thus be adapted to every operating system and every platform, meaning the user is free to choose the operating system.

The featured solution is scalable, as evidenced by the Sercans series for instance:

- For all entry-level solutions that already cover the requirements with bus cycle times of ≥500 µs and a line topology and synchronization between the system components in the microsecond range, an individual standard Ethernet controller combined with a suitable real-time operating system is already sufficient. It is estimated that this applies to at least 50% of all applications.

- For medium to high synchronization requirements in the range of <100 ns and bus cycle times ≥125 µs, the use of a TTS-capable Ethernet controller together with the suitable real-time system offers an excellent solution.

If two of these Ethernet controllers are synchronized, the support of ring architecture with seamless redundancy is also possible, meaning over 90% of applications are covered.

For all applications

- that have higher requirements in terms of bus cycle time or
- for which the hardware and operating system platform requirements cannot be met,

the familiar HardMaster solutions are still available.

Please continue on page 32

Invitation from Sercos International and the SPS-MAGAZIN to the 3rd Machine Communication Forum

Sercos International and the SPS-MAGAZIN, a media partner from TeDo publishing, are inviting users and providers from the machine and plant engineering sector as well as equipment and automation manufacturers to the 3rd Machine Communication Forum. The event will take place in Schlosshotel Steinburg in Würzburg on October 12, 2017, from 9 a.m. to 4.30 p.m.

Attendees can expect a diverse program covering many aspects of machine communication in the form of presentations, discussions and break-out sessions. There is, of course, sufficient time to network with colleagues, speakers, the team from Sercos International and from SPS-MAGAZIN.

“Real-time is our passion”

There are many Ethernet-based communication technologies used in production. In addition to general automation applications, Industrial Ethernet systems are also establishing themselves for special tasks. We asked Peter Lutz, Managing Director of Sercos International, what role the Ethernet-based Sercos III plays in relation to the smart factory.

Interview

Peter Lutz
Managing Director
Sercos International e.V.

Can you briefly explain what Sercos III is?

Peter Lutz: Sercos® III is one of the most powerful Ethernet-based real-time communications systems on the market and its characteristics meet the requirements of even the most high-end factory automation systems. As a universal automation bus, Sercos is used to interconnect a wide variety of automation devices, such as controls, servo drives, I/Os, and camera systems as well as gateways.

What do you define as real-time and what requirements are set by machinery and equipment manufacturers?

Peter Lutz: What is special about Sercos is the high real-time performance in conjunction with an efficient communication protocol, which minimizes processing times through the network and allows communication cycles of up to 31.25 µs. Usually, a synchronization accuracy of less than 1 µs is sufficient to implement even the most demanding applications in machine and plant construction. Sercos achieves a synchronization accuracy of 20 ns and a simultaneity of 100 ns, which is independent of the topology and the number of connected devices.

What are typical use scenarios for Sercos III?

Peter Lutz: Sercos is used mainly in demanding applications in machine and plant construction. These include printing machines, packaging machinery, robots, and machine tools. However, today, the range of applications goes far beyond the synchronization of servo drives. With the opportunity to transmit real-time, safety and Internet protocols via a common network infrastructure, Sercos is also excellently equipped for many applications outside of machine and plant construction. For instance, Sercos is also used in mobile applications and in driving and flight simulators.

What can Sercos III do that the competitors Ethercat and Profinet do not offer?

Peter Lutz: Sercos III stands out due to high performance, ease of use, and a high level of standardization. In addition, the universal alignment of Sercos III allows the integration of motion, safety and I/O as well as standard Ethernet in one single network. With Ethercat and Profinet, there are some significant limitations with regard to the aforementioned properties. To what extent these limitations are relevant cannot, of course, be answered on an across-the-board basis. Rather, it depends very much on the area of use and the requirements and/or expectations of the users.

Is the advantage of Sercos III coexistence with other Ethernet-based protocols?

Peter Lutz: The multiprotocol capability of Sercos, which enables coexistence with any number of other Ethernet protocols without hampering the transmission and real-time performance of the Sercos protocol, is a major advantage and is growing steadily in importance with a view to Industry 4.0. For example, it allows continuous communication down to the field level with the Internet Protocol (IP), the language of the Internet, without having to forgo the fast real-time communication with Sercos.

Sercos III is license-free and openly accessible. Can the protocol be adapted?

Peter Lutz: Sercos International supplies a variety of open-source software, including the Sercos III SoftMaster, which allows an implementation of a Sercos III master on the basis of common Ethernet hardware. This software can specifically be adapted specific to the manufacturer and the user. To ensure that the implementation is fully compatible and interoperable with other Sercos III devices, a conformity test is recommended, which is also the requirement for advertising devices which include the Sercos certification mark and the Sercos trademark.

Sercos III uses CIP Safety as its safety protocol. Is there also coexistence with AS-i Safety?

Peter Lutz: In principle, any safety protocol can be transmitted via the subordinate Sercos III protocol. In order to combine safety devices from various manufacturers with Sercos III, the safety protocol CIP Safety on Sercos is used. This is 100% compatible with CIP Safety on EtherNet/IP and CIP Safety on DeviceNet, which is of great benefit to users and manufacturers. In order to operate safe AS-i devices on Sercos III networks, gateway solutions are used, such as those offered by Bihl+Wiedemann.

“Sercos III allows the integration of drive, periphery, and safety bus as well as standard Ethernet in one single network.”

Peter Lutz, Managing Director of Sercos International

Is continuous communication from the sensor to the IT level possible with the Sercos technology?

Peter Lutz: Continuous communication from the IT level up to the sensor ideally takes place on the basis of IP-based protocols. Due to their large protocol overhead, IP-based protocols are not suitable for fast real-time communication or the efficient transmission of small data quantities. However, the Sercos’ multiprotocol capability allows IP-based protocols to be transmitted in parallel with and independent of the high-speed Sercos real-time communication. Thus, two birds can virtually be killed with one stone. In addition, gateways can be used to integrate simple sensor and actors into a Sercos network using IO-Link or AS-Interface.

Do you see OPC UA with TSN as a competitor to Sercos III?

Peter Lutz: Demanding applications in automation technology require bus systems with maximum protocol efficiency and very low cycle and processing times. Only fieldbus systems that are optimized for these, such as Sercos III, can cater fully to them. However, for less high-performance bus systems, OPC UA TSN represents competition to be taken seriously. By implication, this means that OPC UA TSN and Sercos are largely complementary technologies.

What is the market share of Sercos III in the area of Ethernet-based industrial networks?

Peter Lutz: Sercos III is one of the world’s leading Ethernet-based real-time communication systems in machine and plant construction, especially when it comes to demanding, highly dynamic, and highly precise applications. Here, the market share is approximately 20% to 30%. With reference to all Ethernet-based industrial networks and the entire range of automation technology, the market share is in the higher single-digit range.

What are the next steps in the development of Sercos?

Peter Lutz: The Sercos specifications are continuously adapted to the users’ requirements. A new version of the Sercos specifications, V1.3.2, will be approved near-term, in which expansions have been performed on the Sercos protocol and the Sercos profiles. All the expansions take place on a strictly backward-compatible basis, meaning that older devices can collaborate with newer devices without any problems. New technologies also impact the development of the Sercos technology. For example, we are currently evaluating how the future Ethernet TSN standard for Sercos can be used. In addition, Sercos International has released a Companion Specification for OPC UA, which specifies the mapping of OPC UA to Sercos and vice versa.

Ethernet TSN heralds a new era of industrial communication

For the first time in the more than 40-year history of Ethernet, Ethernet TSN allows a time-controlled and deterministic transmission of real-time-critical messages via standard hardware. A time slot method, which Sercos has been using for real-time communication for over 25 years, is used for this purpose. With TSN, the application spectrum of Ethernet is extended to real-time applications, e.g. in the automotive or in industrial plants. This is the beginning of a new era in industrial communication.

The benefits of using Ethernet TSN are obvious: standard hardware with integrated real-time capability can be used, resulting in low cost and broad vendor and product offerings. In addition, the TSN standard allows the convergence of production and IT networks, that is, real-time communication and normal Ethernet communication can be transmitted over a uniform network standard. This is an ideal basis for the implementation of Industry 4.0 and IIoT concepts.

Evolution of fieldbus systems

With the availability of Ethernet TSN, the evolution of the fieldbus systems continues.

Generation 1 fieldbuses were designed for dedicated purposes. Sercos®, for example, was developed as a drive bus in order to replace the analogue ± 10 V drive interface. In parallel, Profibus, Interbus or DeviceNet were developed as fieldbuses for I/O communication. At that time, Ethernet was not used at all at the field level but only when machines need to be integrated and connected to superior IT systems.

Fieldbus systems of the second generation are characterized by the fact that they are all based on Ethernet and therefore have a much higher bandwidth available. However, they need a special hardware support for functioning correctly and for achieving a corresponding transmission and real-time performance. As a result, these systems are not compliant with the IEEE 802.1 and 802.3 standards, which means that vertical and horizontal integration with Ethernet cannot be optimally implemented. Another complicating factor is that most real-time Ethernet protocols cannot coexist in a common network infrastructure without compromising performance and real-time performance. Various real-time Ethernet solutions even use the

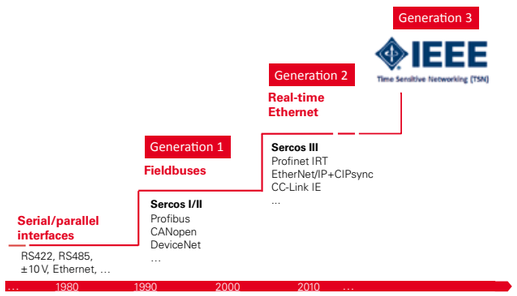


Figure 1: Evolution of fieldbus systems

network infrastructure exclusively, so that other protocols must be tunneled via the underlying real-time protocol (see figure 2a). However, this requires a fully-functioning real-time protocol to communicate with the devices at all. Another approach is to use real-time Ethernet solutions that support coexistence with other Ethernet protocols. In such an approach, other protocols can be used both with and without the respective real-time protocol (see figure 2b). Representatives of these real-time Ethernet solutions are e.g. Sercos III and Profinet IRT.

Ethernet TSN is now ringing in the third generation of fieldbuses, since this technology allows a time-controlled and deterministic transmission of real-time-critical messages via standard Ethernet hardware for the first time in the over 40-year history of Ethernet (figure 2c). Ethernet TSN uses the principle of a time slot method, which Sercos has been using for real-time communication for over 25 years. As Ethernet TSN allows real-time communication and normal Ethernet communication to be transmitted over a uniform network standard, future-oriented solutions can be implemented that facilitate the convergence of production and IT networks.

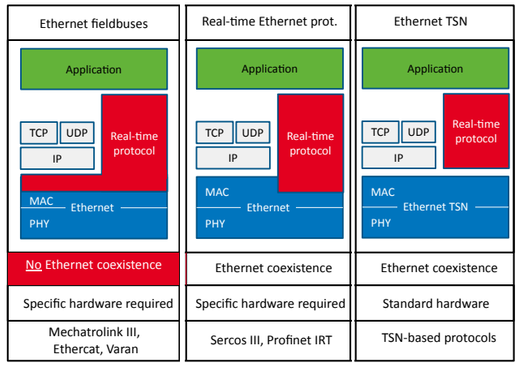


Figure 2a *Figure 2b* *Figure 2c*

Figure 2: Comparison of real-time Ethernet solutions

Sercos III in the context of Ethernet TSN

The Sercos' transmission method has been based on a time slot method and cyclic communication since the introduction of the first generation (Sercos I). Sercos III not only supports the transmission of real-time telegrams in the so-called real-time channel, but also allows the transmission of any other Ethernet protocols in the so-called UC channel (see figure 3 below).

Ethernet TSN has all the features and mechanisms to implement or replicate the Sercos transmission process with standard Ethernet hardware. The basis of Ethernet TSN is the IEEE 802.1Q standard, which specifies the division of physical networks into several logically separated, prioritized virtual networks. With various substandards, additional features are specified, which are explained in the following and are brought into the context of the transmission method of Sercos (see figure 3 below).

- Time synchronization: All connected network nodes have a common understanding of time. To this end, Ethernet TSN relies on IEEE 802.1ASrev and IEEE 1588 mechanisms. The protocol for time synchronization (PTP = Precision Time Protocol) described therein defines how spatially distributed real-time clocks are synchronized among themselves.
- Time slot method: Synchronous time slots allow the transmission of different traffic classes and a time-controlled data transmission. Ethernet TSN uses the IEEE 802.1Qbv substandard (enhancements for scheduled traffic).
- Scheduling and traffic shaping: All connected devices use the same rules to process and forward network packets. For this purpose, Ethernet TSN uses the substandard IEEE 802.1Qcc (stream reservation).
- Frame preemption: Telegrams can be interrupted and continued later. Ethernet uses the IEEE 802.1Qbu (frame preemption) substandard.

For real-time Ethernet protocols of the second fieldbus generation, interesting migration concepts for TSN-based networks exist. A Sercos TSN demonstrator was presented at SPS IPC Drives in November 2016 in which Sercos III devices and Ethernet devices are operated in a common TSN-based network infrastructure without impairing the real-time performance of Sercos III (see separate article on page 10).

With such an approach, a Sercos-driven machine can be connected to a TSN network infrastructure (factory network) and is remote-controlled by a TSN-based Sercos master that can be freely positioned in the TSN network ("edge cloud") to control the machine and at the same time interfacing to the connected IT systems.

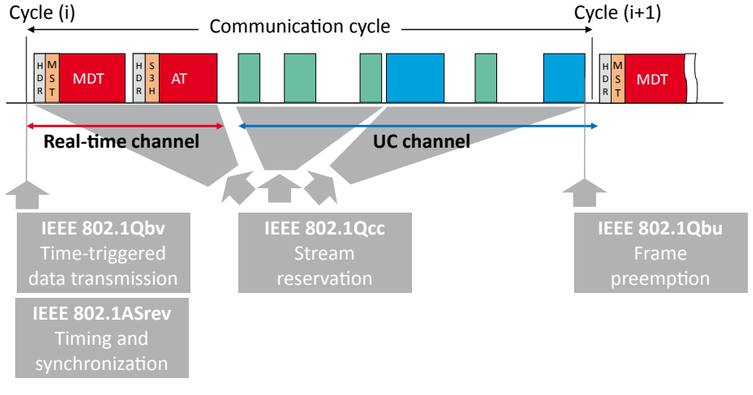


Figure 3: Transmission method of Sercos III in the context of Ethernet TSN

Sercos TSN demonstrator: Premiere for “Sercos over TSN” at SPS IPC Drives 2016

Sercos International showed the transmission of the Sercos III real-time protocol via IEEE 802.1 TSN (Time-Sensitive Networks) for the first time at SPS IPC Drives 2016.

The Sercos® TSN demonstrator was implemented at the Institute for Control Engineering of Machine Tools and Manufacturing Units (ISW) at the University of Stuttgart with the support of several industrial partners. It shows the possibilities for providing a real-time and multiprotocol-capable network infrastructure based on TSN for automation technology.

A TSN-based Sercos III SoftMaster with a Soft-CNC from Industrielle Steuerungstechnik GmbH (ISG) is used, which communicates with Sercos III servo drives from Bosch Rexroth via TSN switches from Hirschmann Automation & Control GmbH. At the same time, video streams from a webcam are transmitted to a remote display via the same TSN network infrastructure, but without hampering the characteristics and functionality of the Sercos real-time communication.

The demonstrator (figure 1) constitutes a proof of concept, with which the native real-time capability of Sercos within a TSN network is presented on an exemplary basis. Ethernet standard IEEE 802.1 brings with it mechanisms that ensure open, real-time-capable communication and also support high, future data rates. A key aspect here is the IEEE 802.1Q standard, which specifies the division of physical networks into several logically separated, prioritized virtual networks (VLANs). In turn, the VLAN priorities enable optimized scheduling of the packages from all virtual networks, with transmission safety and a deterministic latency. To create a uniform time base in the entire network and to transfer the traffic classes within synchronous time slots, mechanisms from IEEE 802.1-AS / IEEE 1588 (distributed clock synchronization) and IEEE 802.1Qbv (time-multiplex procedure) are used.

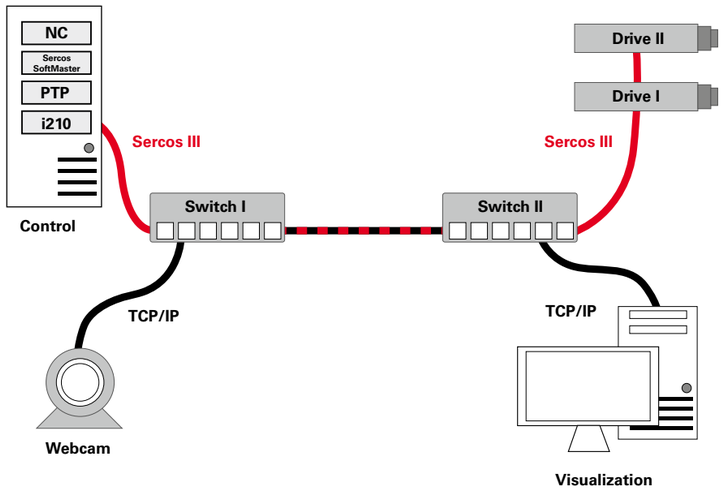


Figure 1: Sercos TSN test structure

The aim in designing the demonstrator was to expand a typical setup consisting of a numerical control and drives by adding an interposed, real-time-capable network. A key element here was the integration of the Precision Time Protocol (PTP) according to IEEE 1588 into the control, so that all network participants use a uniform time base. In the analysis of the real-time behavior, it was shown that the errors in the time synchronization were restricted to a two-digit nanosecond range, as shown in figure 2.

With this analysis, it could be proven that the synchronization, which is also contained in the TSN standard as IEEE 802.1-AS, achieves accuracy that is sufficient for demanding motion applications. Additional analyses on the demonstration system will establish the limits of real-time communication of Sercos via TSN by varying the cycle time and the number of participants.

“The Sercos TSN demonstrator provides practical proof that Sercos III devices can be integrated unchanged into a TSN network and can communicate with each other via TSN. Here, neither functionality nor real-time characteristics are restricted. In addition, existing tools, such as the Sercos Monitor, a diagnostic and analytical tool, can continue to be fully used,” says Peter Zahn, project manager for the Sercos TSN demonstrator at ISW.

Dr. Oliver Kleineberg, responsible for the Advance Development unit at Hirschmann Automation & Control, adds: “The implementation of TSN in products requires a solid technical platform in time synchronization. Thus, the Hirschmann RSP35 switches with their FPGAs and the comprehensive support for the IEEE 1588 protocol were the ideal carrier for a prototype development that, in all probability, will proceed to the stage of being ready for series production. In 2017, we expect the first results from our TSN development work. We are optimistic that this short time frame is realistic as the stability of the TSN prototypes is already very high, as is the development success. On the basis of the IEEE TSN standards, efficient and targeted development is possible today.”

Peter Lutz, Managing Director of Sercos International, adds: “The Sercos TSN demonstrator impressively highlights that Ethernet TSN allows the convergence of traditional real-time Ethernet solutions into a uniform, standardized and consistent network infrastructure. The Sercos technology benefits from TSN in several respects. For one thing, standard Ethernet components with integrated real-time capability can be used and thus flexible network topologies can be achieved. Additionally, higher transmission bandwidths are also available with Ethernet TSN.”

In the next step, the network will be converted from 100BASE-TX (100 Mbit/s) to 1000BASE-T (1Gbit/s) to enable even higher transmission rates. Additional portions of TSN standards, such as IEEE 802.1CB (use of redundant paths) or IEEE 802.1AS-res (redundant time synchronization), could also be integrated into the functionality of the demonstrator.

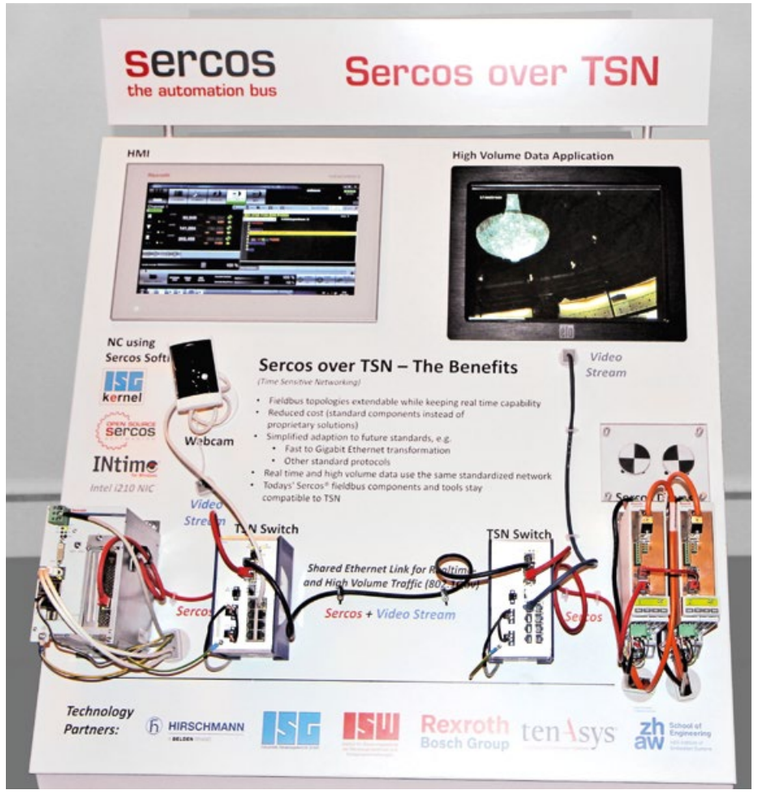


Figure 2: Sercos TSN demonstrator

The dissolution of the automation pyramid: Machine communication in the smart factory

Industry 4.0 is a "must" for German small to medium-sized enterprises. However, much is already present or easy to implement in mid-sized companies though there is currently no generally accepted definition of Industry 4.0. Rather various perspectives are discussed which highlight individual aspects.

Author

Prof. Dr.-Ing. Birgit Vogel-Heuser
Head of Chair and Director of Institute
Technical University of Munich, Germany

Industry 4.0 is not an end in itself; rather, it serves either to create a greater variety of products and of previously unknown products with the same production plant, or to produce products with better quality or more efficiently (energy, CO_2 emissions, etc.). Another aim is to increase overall equipment effectiveness (OEE). For the former, intelligent production units are required that know what they can and cannot produce, that can adapt to new products. For a more efficient production and better quality, data analysis processes are used with optimization processes, and consistent architecture is required as described in the RAMI reference model Industry 4.0.

Secure global communication between different machines or systems of a manufacturer or between systems that manufacture a product jointly is a requirement for Industry 4.0. Control and cloud providers are currently working intensively on safety mechanisms for Industry 4.0. Keeping track of things despite the many available information ensures competitiveness, also in countries without traditional specialist and technical training. To this end, machines must better inform their operators about the next possible production steps or steps to handle faults and their consequences.

From the automation pyramid to the automation diabolo

The information pyramid has been applied for more than 20 years in automation (figure 1 left). Because of increasingly intelligent field devices and the increasingly modular structure of machines, as well as the Ethernet-based bus systems (including the field level), the previously separate machine or system levels now often communicate via a fieldbus system (figure 1 right). The connection of

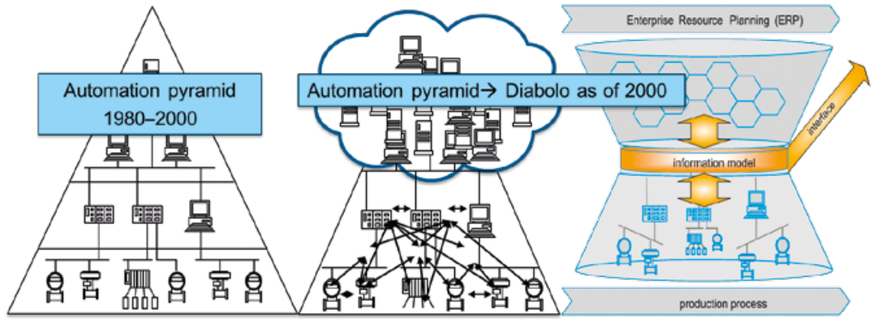


Figure 1: Replacement of the automation pyramid with the automation diabolo

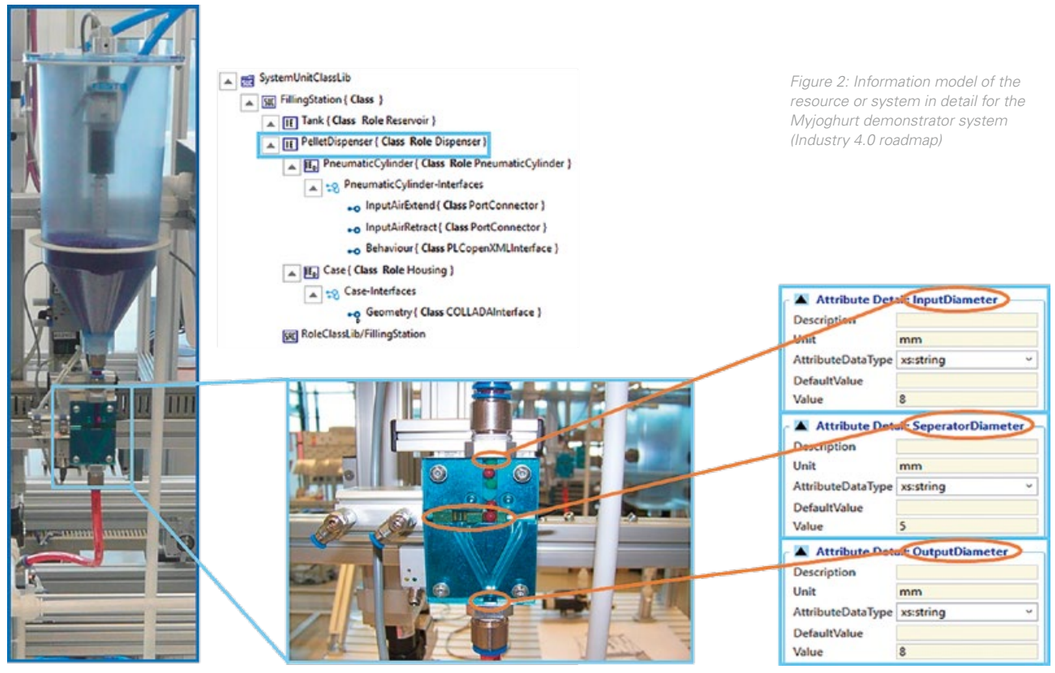


Figure 2: Information model of the resource or system in detail for the Myjoghurt demonstrator system (Industry 4.0 roadmap)

superordinate manufacturing execution systems (MES) and the ever-present enterprise resource planning systems to the production IT is now almost a matter of course; for example, for the procurement of spare parts and operating resources as well as handing over orders to production. In the last few years, a quasi-standard for the connecting information has emerged between the lower level of the diabolo, the production level, and the upper (MES) level, namely AutomationML and OPC UA already established in Germany and Europe.

The machine or system must know itself so precisely that it can decide whether and how it can produce a certain product "see link to MyJoghurt", at what price it can offer the product, depending on its capacity utilization and/or based on the market situation. For this, too, description tools such as AutomationML and interfaces such as OPC UA are used.

Information model based on AutomationML and OPC UA

A modular system structure is required for a component manufacturer, machine builder, or equipment manufacturer to provide such a flexible, adaptive, and intelligent system. A highly simplified example from our laboratory system for the production of yogurt incorporating fruit or chocolate balls highlights the benefit of AutomationML. The structure of the system is described with CAEX (a component of AutomationML), so the critical diameter for the balls in the system description (resource) is known (figure 2). In addition, a product description is available from which the desired diameter of the chocolate balls is known as a property. With so-called ontologies, the product requirements and the resource possibilities are now compared, and it is decided whether the desired yogurt can be produced by the system.

Modular software as a requirement for flexible, adaptive, and intelligent production systems

Structured software with streamlined software interfaces is a requirement for controlling multivariant components or machines and systems, especially when – as is almost always the case today – system improvements and software changes are necessary during the equipment life-span.

This requirement cannot be fulfilled quickly or easily because systems and software have grown historically for years or even decades, and the large number of variants and versions is difficult to manage and heavily dependent on mechanics and electrical construction. Established approaches from software engineering such as product line approaches, and code configuration from module libraries, or code generation from the ElectricalCAD, or component lists via module libraries are slowly finding their way into component development as well as the technical control software in machine and plant construction. For a machine or plant construction firm to be ready for changeable systems in line with Industry 4.0, the control software

must be hierarchically structured and, for example, fault reports must be handled accordingly in these levels and passed on upwards or downwards (figure 3).

The use of PackML state machines (figure 4), which so far have been used primarily in the packaging industry for food and luxury food, proves helpful here. This OMAC standard established certain operating modes so that machines from different manufacturers can be easily linked.

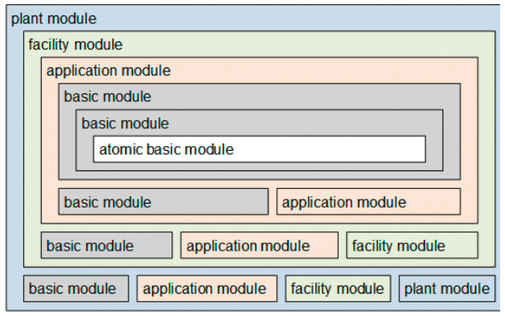


Figure 3: Hierarchical levels of control software in machine and plant construction

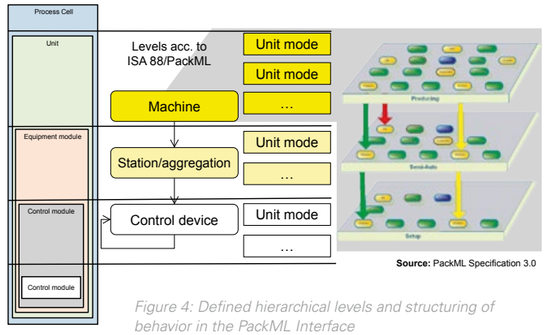


Figure 4: Defined hierarchical levels and structuring of behavior in the PackML Interface

From the machine-oriented to the technological operator interface

In the last few years, machines have become increasingly flexible and their possible uses more diverse. Often, this was made possible by setting parameters for the operator at the customer's premises. However, the increasing complexity causes problems, in particular outside Germany, as the dual education system is not customary and thus the specialist personnel are not available.

Rather, the operator of a machine or system wants to create a product with specific properties and not delve into the details of the machine settings, something a learning system has to take on. Based on the measurement of the quality properties and the knowledge of the parameters, the improved settings are to be optimized via learning algorithms for the current and the next product, and product parameters are to be converted automatically into machine settings. In the event of errors, too, the machine is to cure itself in the best case scenario, or propose alternative solutions based on its internal state.

Approach, opportunities, and risks

Industry 4.0 is no longer an option, but rather, it is already demanded by many customers on an international basis, even if it is often unclear what exactly is meant by it. Thus, Industry 4.0 is also a marketing argument. The trick is to select the characteristics or features of Industry 4.0 in such a way that customers will have the most benefit from it and the supplier wins a new customer.

Internationally, intensive work is currently being done with regard to Industry 4.0: In the US from the data perspective and in the field of additive production and robotics; in China and in many European countries on the whole spectrum of production. Here, the biggest risk is resting on a possible existing or perceived market advantage.

Links:
1. *AIS TUM: MyJoghurt, http://i40d.ais.mw.tum.de/*
2. *https://www.automationml.org/o.red.c/home.html*
3. *http://omac.org/workgroups/packaging-workgroup/*
4. *B. Vogel-Heuser, S. Rösch, J. Fischer, T. Simon, S. Ulewicz and J. Folmer. "Fault handling in PLC-based Industry 4.0 automated production systems as a basis for restart and self-configuration and its evaluation," in: Journal of Software Engineering and Applications, vol. 9, no. 1, pp. 1–43, Jan. 2016, http://file.scirp.org/pdf/JSEA_2016012714262700.pdf*

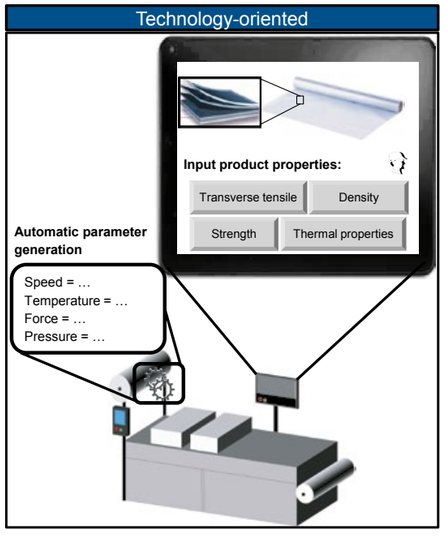


Figure 5: Transition from the machine-oriented to the technology-oriented human-machine interface

Author

Thomas Brandl
Director of Communication Solutions Program
Bosch Rexroth AG

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

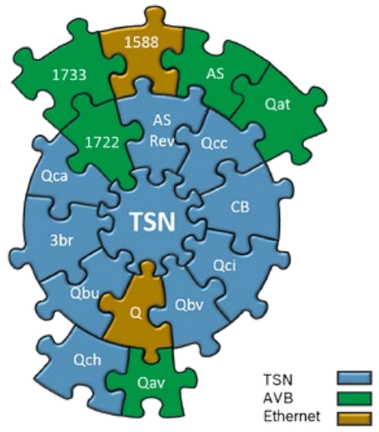


Figure 1: Elements of the IEEE 802.1 standard

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.

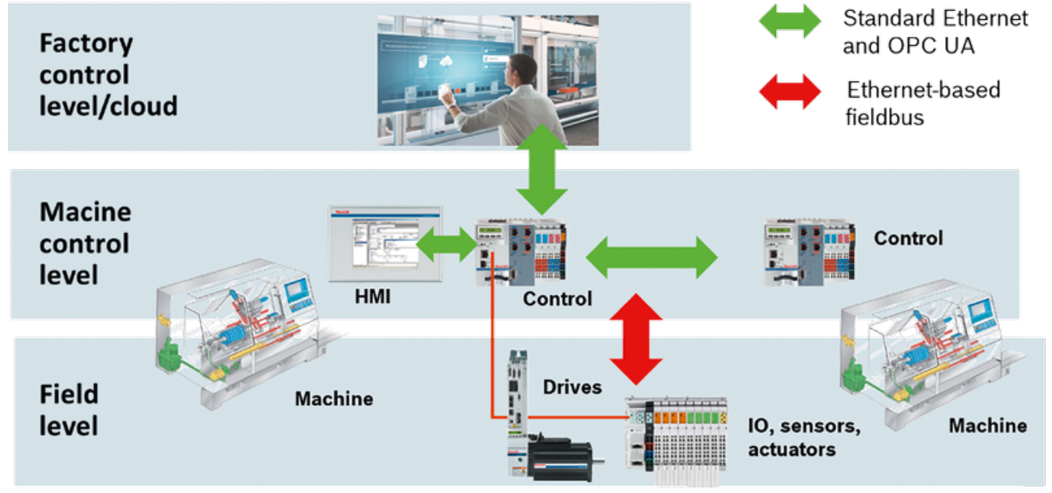


Figure 2: The communication levels in industrial automation

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.

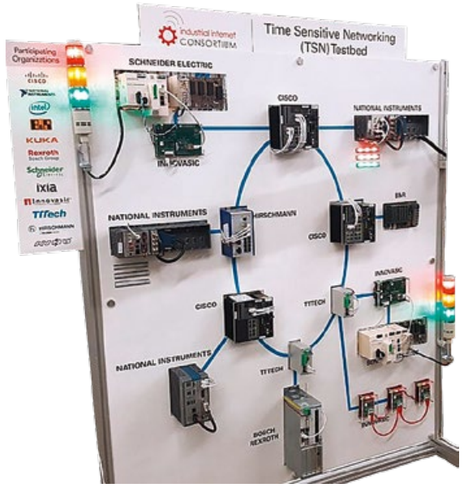


Figure 3: The demonstrator of the TSN manufacturing testbed at the SPS IPC Drives

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).

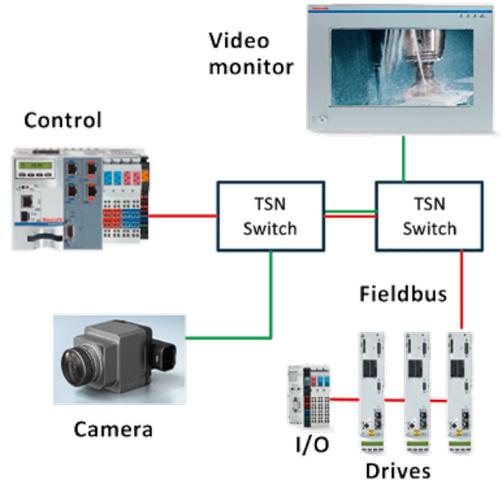


Figure 5: Topology extension for Sercos networks

Wireless data transmission in the factory

New “low power wide area” wireless technologies are predestined for applications in the industrial environment. They offer diverse possibilities for the wireless connection of any automation devices with IT platforms – in some cases even without a SIM card or a cellular radio system provider.

Author

Klaus-Dieter Walter
CEO
SSV Software Systems GmbH

Until recently, the world of wireless communication solutions that could be considered for wide area networks in the world of industrial automation was quite transparent. One could purchase a cellular radio or M2M SIM card for the network of the desired cellular operator, put it into a 2G, 3G or LTE cellular modem, and get started. The decision-making criteria were straightforward. In addition to the operating costs due to the monthly subscriber fees per modem only a few aspects needed to be considered: the standard – GSM/GPRS or LTE? –, the network coverage on the floor, which was still insufficient, as well as the associated antenna problem.

Now, all has changed. Due to the disruptive developments in the license-free bands – for example, LoRa and Sigfox for 868 MHz in Europe and 915 MHz in the USA – it became clear that long-range wireless can be implemented relatively easy and, with regard to operating costs in particular, a lot less expensive for the (I)IoT, and without a cellular operator as well. In addition to the insufficient 2G/3G/4G network coverage, LoRa and the like simultaneously solved another problem: Most IIoT applications transfer only very small data quantities, for example, the filling level of a container to an ERP system per day. This does not necessitate superfast LTE, but often the option of operating a (low-power) transmitter for many years with a single battery. Thus, users concentrated on “Kbps” (kilobits per second) instead of “Gbps” (gigabits per second), i.e., low data rate instead of high speed. The whole thing was called “low power wide area” (LPWA). Long range (point-to-point connections over 10 km), low power (battery lifespan of up to 10 years), and low data rate are the pillars.

However, LoRa, Sigfox, and other license-free LPWA approaches are now a real threat to the entire cellular radio value chain in the frequency bands for which a license is required. Especially, since they could ensure that the established cellular providers are excluded from the device/subscriber growth through IIoT applications. In the medium term, this would be existence-threatening, especially since practically no more growth is to be achieved in the industrialized nations with traditional cellular radio. So remarkably quick action was taken. Via specifications release 13 with LTE-M or LTE-MTC (collective term for machine type communication), the 3rd Generation Partnership Project (3GPP), a global partnership of various standardization bodies for cellular radio, approved standards for the IIoT that are now available and are being tested in practice.

When several automation technology elements such as sensors, actuators or controls (the OT domain; see C&A M2M Hotspot August 2016 at https://goo.gl/QztHZe) that now and again have to send a few status data to a cloud by radio are found on large industrial premises, significant cost savings for SIM card fees can be achieved through the use of license-free LPWA wireless technology. A LoRa gateway with a SIM card suffices, for example, to enable many hundreds of sensors to forward data to the cloud. Due to the low current consumption, the devices can be operated with a single battery for many years.

New M2M and IoT standards

In the future, an increasing number of systems will have an ex-works-integrated and completely preconfigured LPWA wireless interface, and will take up the first wireless contact with the cloud or the respective manufacturer as early as when they are put into operation. For this, the following standards, among others, play a role:

LoRa: This is a low-power wireless network technology for license-free ISM frequencies – for instance, 868 MHz in Europe. Small (adaptive) data rates are used. LoRa enables point-to-point connections extending across 2 km (in urban areas), 15 km (in suburban areas) or 40 km (in very rural areas). The user can develop the necessary infrastructure with the connection to the Internet himself via his own gateways (for example, LoRa to LTE). However, there will also be LoRa service providers that take on this task. In some countries, these are even the established cellular radio companies, who offer their own IoT network access via LoRa technology.

Sigfox: Also uses license-free ISM frequencies and is technologically very similar to LoRa. The entire Sigfox technology is driven by a single company, which was founded in 2009 and was equipped by investors with comprehensive funds. Together with partners, this company wants to develop the necessary infrastructure for Sigfox as well.

NB-IoT (LTE Cat-NB1): Narrowband IoT or LTE Cat-NB1, based on 3GPP release 13. This is a particularly electricity-saving LTE-MTC technology with a small transmission bandwidth (180 kHz) in LTE frequencies that are subject to license. In Europe, it is becoming probably the most important LPWA technology of the established cellular radio network operators. NB-IoT does not require a new infrastructure, but rather only software updates of the existing network access points.

eMTC (LTE Cat-M1): Also a machine-type LTE standard for LTE frequencies subject to a license on the basis of 3GPP release 13. Has a higher transmission bandwidth (1.4 MHz) than NB-IoT and is also suitable for speech transmission. For eMTC, wide support from all well-known network providers is also to be anticipated within Europe. To use the eMTC technology, it is generally sufficient to equip the existing cellular radio points with software updates.

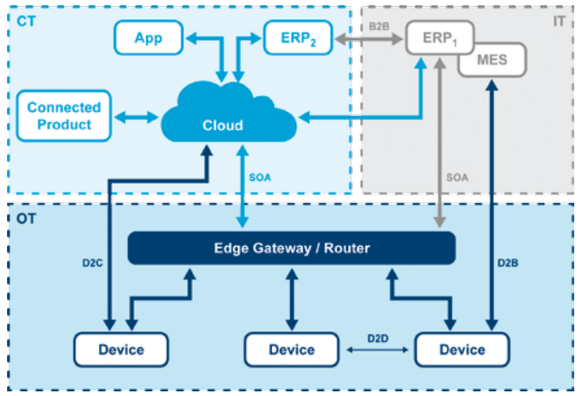


Figure 1: The communication links of an IIoT or Industry 4.0-based smart factory are no longer based on a hierarchically organized pyramid structure. Rather, in the future, the individual systems will be grouped into different communication domains (e.g., one OT, IT and CT domain each). There are various connections between the domains. In the future, the entire automation technology (sensors, actuators, controls, edge gateway, etc.) is to be found in the OT domain (OT = operational technology). ERP and MES are found in the IT (IT = information technology) domain; external systems are found in the CT domain (CT = cloud technology).

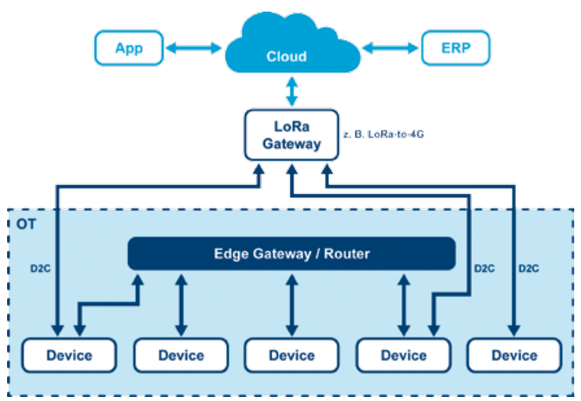


Figure 2: When several systems that periodically have to send a few status data to a cloud by radio are found within the OT domain on large industrial premises, significant cost savings for SIM card fees can be achieved through the use of license-free LPWA wireless technology. A single LoRa gateway with a SIM card suffices, for example, to enable many hundreds of sensors to forward data to the cloud. Due to the low current consumption, the devices can be operated with a single battery for many years.

Data as key to success in Industry 4.0 and the Internet of Things

In the production industry in particular, it is necessary to raise quality and productivity, but also to keep maintenance costs as low as possible. In the process, it is highly beneficial to operate in a forward-looking manner. Because, once damage has occurred, in addition to the actual repair costs, there are additional matters of expense for downtime, delay, and image damage. Predictive analytics, i.e., reacting proactively to an event that will probably occur, is one of the core topics that Industry 4.0 and IoT focus on. The aim is to optimize production to achieve longer operating times for machines and to reduce unplanned downtimes.

Stream processing as a central component for smart analytics

In this connection, stream processing acquires central importance. It was designed in order to analyze data streams in real-time and to immediately react to events. Tasks include filtering, aggregating, and correlating data. The core task in stream processing is streaming analytics – a term coined by analyst firms such as Gartner and Forrester. Here, queries are defined once and are then calculated continuously "on the fly" within the stream in order to correlate data. Since purely processing Big Data is no longer sufficient, demand for stream processing is increasing enormously. Data streams must be processed immediately in real-time (fast data) to be able to react to the flexibility that continuous digital processes require today.

From a technical perspective, the following procedure is usually followed in predictive analysis for stream processing: First, historical data (e.g., stored in the Data Warehouse, in Hadoop, or in a NoSQL database) is analyzed using business intelligence/data discovery software such as Tableau or TIBCO Spotfire in order to detect patterns. Secondly, the patterns are implemented in a stream processing platform in order to react proactively to new results in the proper context in real-time. In addition, the application can store this data in another database, so that the cycle closes in: existing patterns can be optimized and new patterns can be found.

Author

Kai Wähner
Technology Evangelist
TIBCO

With regard to the Internet of Things, predictive fault management in particular is very exciting. Here, components that with high probability will soon fail, will be replaced before they cause damage. For example, an oil platform, on which various sensors send data streams in mass quantity, can monitor the hardware via predictive fault management and replace parts for small amounts in the thousands before they (with a certain probability) soon explode due to problems and cause far higher damage in the million range.

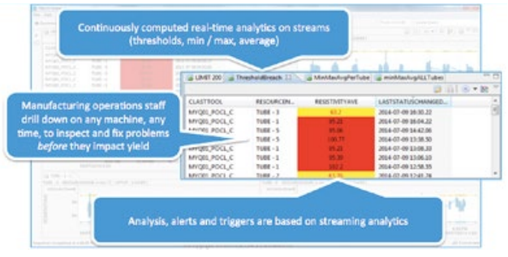


Figure 1: Real-time monitoring

Figure 2: TIBCO Live Datamart

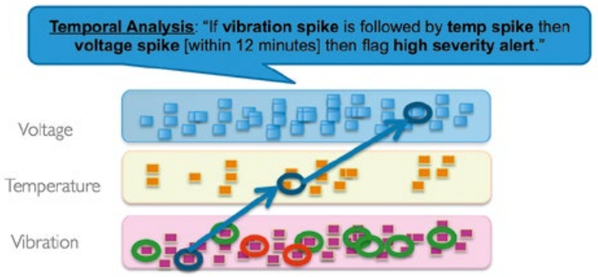


Figure 3: Example: Analysis of sensor data

Operational analytics: Output optimization in production

In addition to predictive maintenance, there are other possible uses of stream processing in production. A problem is often the relatively high output of defective parts, for example in the high-tech environment. Here, production is hugely complex. Previously, analysis showed only after production which parts lie under a certain threshold value and must therefore be scrapped. Even a reduction of the error rate by just one percentage point can increase a company's profits by several million euro. Therefore, using operational analytics, production routines are monitored in real-time in order to operate on time, for example by changing certain variables in real-time during production.

Stream processing is indispensable for the Internet of Things

Stream processing is used today to process data streams with billions of datasets in real-time. Therefore, in the age of the Internet of Things, this concept is becoming more relevant every year with greater distribution. Numerous frameworks and products are available on the market. However, many solutions are not yet fully developed and there is a lack of good tool support.

If coding is desired but tool support and commercial support are not the highest priority, numerous open-source alternatives such as Apache Storm, Flink, Apex, and Samza are available for collecting and processing large data streams. Apache Spark is also becoming increasingly relevant; however, it focuses more on topics such as analytics (as a replacement for MapReduce) and machine learning. Nevertheless, Spark also offers a streaming component.

Products such as IBM Streams and TIBCO StreamBase are sophisticated products with graphical tool support, simple integration into the company environment, and global support as well as consulting.

In addition to automated processing, a real-time interface also enables proactive human interactions. Since all the frameworks and products have virtually identical features and advantages, a detailed evaluation and/or a proof of concept regarding expense, usability, time to market, and total costs is strongly recommended.

Stream processing often creates added value for a business; not alone, but in cooperation with other concepts such as Data Warehouse, Big Data, NoSQL, machine learning or operational analytics. With a clean architecture and the right interplay of the various concepts, added value can be created with stream processing in almost all industrial sectors.

Dynamic shaping process opens the door to “single-piece” flow production

With its roll-forming system for manufacturing truck chassis rails, data M has achieved every production manager’s dream: the ability to manufacture a variety of different geometries and shapes without retooling! A CAD file from a library – in future perhaps even from the cloud – serves as the database for the servo-based shaping process. For the automation solution, data M is relying upon Schneider Electric and its PacDrive motion control technology.

Data M Sheet Metal Solutions GmbH specializes in software development and engineering services for the sheet metal processing industry. Founded in 1987 and headquartered in the Bavarian town of Valley, data M has created CAD solutions for developing tools to produce special profile sections, pipes, and even wire material. It also designs software to simulate shaping processes as well as upstream and downstream production processes. The company’s products include the well-known COPRA® RF software. Leading automotive suppliers worldwide use COPRA® RF to plan their roll-forming processes and conduct shaping simulations in their production processes.

data M recently introduced its own machine solution for the manufacture of three-dimensional rolled steel sections. The system, created for an Asian truck manufacturer, is designed for manufacturing truck chassis rails. Beginning with sheet metal blanks up to 7 mm thickness, it produces three-dimensional sections in a single pass, with profile cross sections that vary along their longitudinal axis.

Comment

“We are very happy with this partnership, even beyond the development phase, because it allows us to ensure spare parts availability and technical support for these systems around the world.”

Albert Sedlmaier
CEO data M, Holzkirchen

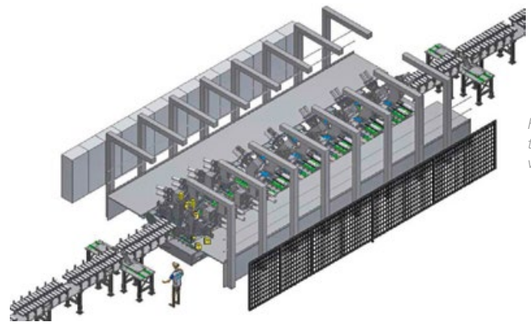


Figure 1: The CAD drawing shows the overall dimensions of the system, which is more than 30 m long.

This type of roll-forming system offers significant advantages over traditional pressing methods. The elimination of mold construction is only one positive effect – the greatest advantage lies in a more flexible production. data M CEO Albert Sedlmaier describes the impressive possibilities: “Our system can use the same tool set to manufacture variable truck chassis rails in a variety of different geometries and shapes, without any retooling.”

The smooth and extremely energy-efficient shaping process is carried out by ten facing roll-forming units positioned along the length of the work area. Each of these units can be moved independently of the other units by means of multiple servo drives. Parallel kinematic elements in the bases of the units allow the shaping frames to be both rotated and translated, while two other drives enable individual adjustment of the rotational speeds in the upper and lower forming rollers. Through synchronous interaction of movements during the shaping process, the forming rollers in each unit create the three-dimensional frame section from the sheet metal blank as it passes through the system.

Automation, engineering, and global technical support from Schneider Electric

The system combines sophisticated roll forming and high-end simulation know-how with an automation solution that is no less complex. To create its automation solution, data M brought Schneider Electric on board, both as a vendor of hardware and software solutions and for its engineering services. Based upon the specifications provided by data M, Schneider Electric’s European FlexCenter handled the engineering involved in creating the circuit diagram as well as the control cabinet layout and construction.

Sedlmaier emphasizes what he sees as the critical significance of the partnership with Schneider Electric: “The support we received from Schneider Electric was a decisive factor in our success. Our own development capabilities would not have been sufficient to develop the type of control technology required for this project. We are very happy with this partnership, even beyond the development phase, because it allows us to ensure spare parts availability and technical support for these systems around the world.”

All of the CAD data processing and simulation, which occurs upstream of the forming process itself, is performed on a PC: The installed data M software generates a DXF file, which is then used to calculate the curve data for the

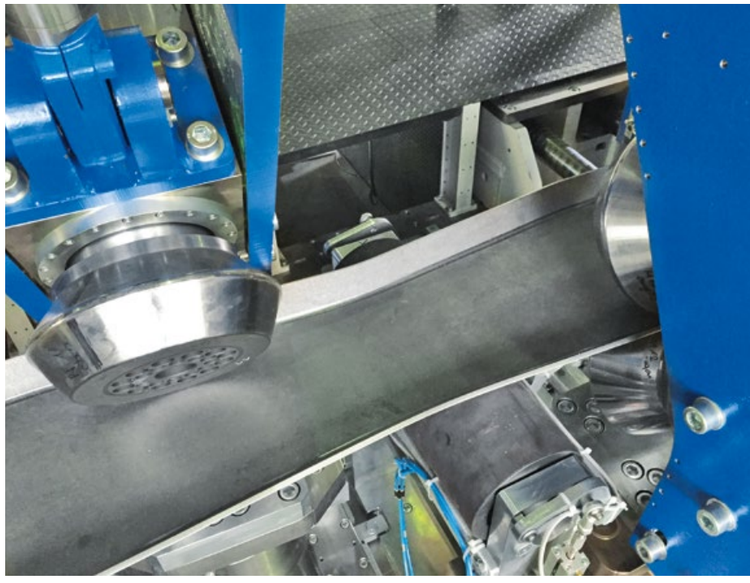


Figure 2: The section passes through the system during the forming process.

Figure 3: The entire system is controlled with two PacDrive 3 LMC controllers operating in parallel, below are two safety controllers with a mixed I/O field.

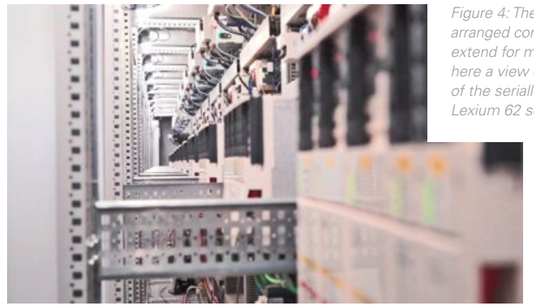


Figure 4: The consecutively arranged control cabinets extend for more than 16 m, here a view of one section of the serially mounted Lexium 62 servo drives.

controller. Following a simulated collision test, the curve data are then transferred directly to the machine controller.

The system's automation solution is based upon Schneider Electric's PacDrive motion control technology. With a worldwide reputation as one of the leading automation solutions in packaging machines for more than 15 years, PacDrive is building on the success of its servo technology and is now increasingly used in processing, production, and assembly processes as well.

100 servo axes receive information via Sercos in millisecond intervals

The solution created for data M is extremely impressive: The 100 servo axes that turn and move the roll-forming units or rotate the forming rollers are all connected via Sercos with two PacDrive controllers, which share the control of the system.

For this function, data M developed a special machine program with a modular design to allow easy use in other types of roll-forming systems as well. Approximately 1,000 I/O points distributed across 50 I/O islands installed along the entire system can also be connected to the controller via Sercos.

The overall servo solution is based upon Lexium 62 series multiaxis servo drives. It was specially developed for PacDrive in order to reduce the space required in the control cabinet, as well as installation times, for high numbers of servo drives through serial assembly with shared power supply and electrical integration via front-side quick-connects. The electronic name plates on the variable frequency drives and the connected servo motors allow automatic configuration and firmware comparison in interaction with the PacDrive controllers for easier commissioning, diagnostics, and maintenance.

During the shaping process, the PacDrive servo drives send a positional set point value to each axis every millisecond, and then read the resulting motor current data. The controller then uses special algorithms to independently optimize the speed of the forming rollers and thus the shaping process in terms of energy consumption and surface quality.

The required functionality for safety automation is provided by two Modicon TM5 SLC safety controllers. As part of an embedded safety solution, they use a parallel safety protocol to communicate with the two PacDrive controllers, the servo drives, and the safety I/Os via the standard Sercos® bus. Some of the I/Os are "unmixed," but some are also integrated into Sercos communication in I/O islands with mixed aggregates of safety and non-safety I/Os using standard bus couplers.

Implementation in Industry 4.0-supported processes

Seen as a whole, data M's flexible roll-forming system is more than just a step towards maximal flexibility for production down to the level of single-piece flow: In principle, it is a CNC solution that can precisely replicate the production of any desired pieces from a prespecified repertoire without retooling operations or fine adjustments. Complex processes have been consistently encapsulated in software, and system operation has been simplified. Advanced simulation as well as online monitoring and correction during the shaping process create sufficient process safety to allow production without specialists on site, using simple CAD files. The system's motion control technology employs a sophisticated system-internal communication design with autoconfiguration mechanisms to simplify component exchange during maintenance activities. This creates all the conditions for a physical separation of parts design, production control, and materials management, as well as their linkage via Internet-based information technologies – for production à la Industry 4.0!

Ultimate drive technology

With linear motors, filling, closing, and packaging processes designs can be much more dynamic, precise, and especially flexible than with pneumatic cylinders. Ever since Chocolat Frey AG recently expanded their production of the highly popular Napolitains, this large Swiss chocolate maker has benefited from the advantages of advanced technology, producing a wide assortment of very small chocolate wafers with even greater quality, process reliability, and productivity.

Figure 1: The traditional company Chocolat Frey AG produces almost 2,500 different chocolate products in Switzerland.

When Manfred Leuenberger from Chocolat Frey AG extends the invitation to visit his company's most recent expansion, visitors are caressed by the aroma of fresh chocolate the moment they enter the production hall of the traditional Swiss company, which opens into a glass-enclosed hallway. No wonder, as the passage leads through the area where the raw chocolate mixture for the chocolatier's 2,500 or so products are freshly prepared and stored in tanks, as the technical manager of the confectionary division explains. But before the visitor can get a look at the latest machine acquisition – a highly modern system for producing small chocolate wafers known as Napoiltains – a stop in the changing room is needed to put on hygienic clothing. Then it's just a few steps downstairs and the visitor stands in front of the new machine, which is nearly as tempting to the visitor as the products that are made on it.

Production capacity for Napolitains increased fivefold

The starting signal for this new system was given back in 2013, when the little chocolate wafers began to show great success. Two older lines, built in 1988 and 1990 and used through the present day, were already running at full capacity.

Figure 2: Chocolat Frey AG responded to the rising demand by commissioning a new production line and increasing production capacity fivefold.

Due to the growth in demand, a central requirement in the specification for the molding line was substantially higher output compared with the previous systems. While the latter can produce a maximum of 400 kg of filled or unfilled Napolitains per hour, the new system needed to handle up to 2 t, or around 6,000 wafers, in the same time.

The machine builder that had been responsible for the older lines met these requirements by applying the latest technology. A linear motor from LinMot plays a central role, fulfilling the task of lifting up the plastic molds, about 850 x 380 in size with cavities for 225 wafers (25 x 9), from the transport belt to the stationary dispensing nozzles.

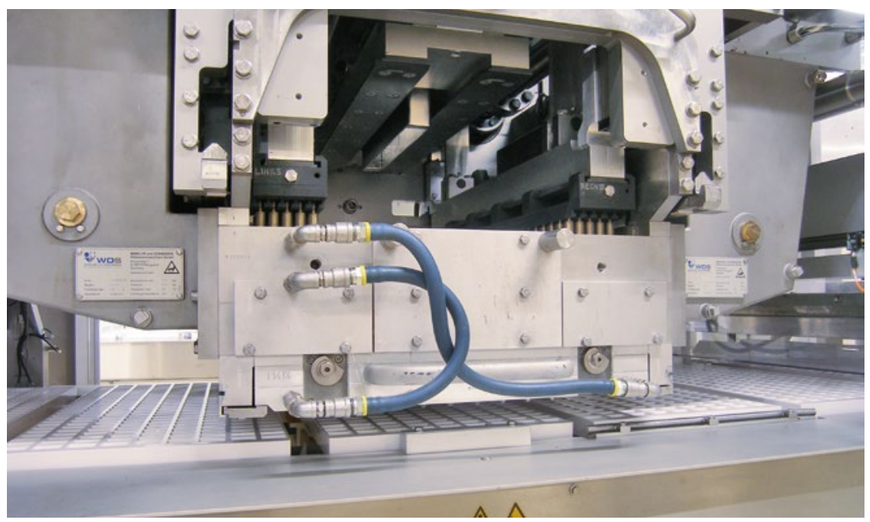
Molding with no bubbles or spatter

"When the molding system pours the liquid chocolate into the mold, the latter is raised to keep the distance between the filling level and the dispensing nozzle to a minimum," explains Leuenberger. "This is how we prevent air bubbles and spatter."

On the older lines, a pneumatic cylinder raises the molds. A first glance at this process, however, reveals the weakness of the cylinders powered by compressed air. The motion is jerky, and the mold drops rather roughly back onto the conveyor rails.

With a linear motor, in contrast, the entire motion sequence is more gentle, despite the increased dynamic requirements, which protects the mechanism and the product. Less obvious, though no less significant, is another advantage of the electrical direct drive technology for the end

Figure 3: The molds are raised slightly toward the stationary dispensing nozzles in order to prevent undesired spatter and air bubbles.



user. “With its integrated measurement system, the linear motor allows significantly greater accuracy in positioning the mold, so that we know precisely where the mold is located at every moment,” explains Manfred Leuenberger. This has made it possible to exactly maintain the optimal distance between the fill level and the mold at all times, with a precision in the range of tenths of millimeters.

Customized motion profiles protect product and mechanism

Different motion profiles can also be implemented without a problem, matched precisely to the individual requirements of the product and the filling process. “This is not possible with pneumatics, but it is a real advantage, especially for filled products, as it allows us to distribute the chocolate mixture optimally in the mold. This improves the reliability of the process and gives us greater freedom in designing the production process,” adds the Chocolat Frey AG technical specialist. The ability to individually adapt the motion profile can also be used to minimize the loads on the product and the mechanism during the production process. Since the direct electric drives have been in use, it has also been possible to switch between different profiles at the push of a button. This means that product changes take less time.

Powerful linear motors from LinMot

The designers of the molding machine decided to use a tubular linear motor from the LinMot P10-70 series, with a stroke of 90 mm. The PS10-70x160U-BL-QJ stator with encoder and the PL10-28x390/340 slider are combined with a matching mounting flange that also serves as a heat sink. Because the motor is mounted outside of the hygienic area, it does not have a higher protection class. For more challenging applications, however, LinMot also has INOX and ATEX versions available.

The machine builder chose the P10-70 series for a good reason. The motors in this series have a three-phase winding and are the most powerful motors in the LinMot catalog. They can produce a peak force of up to 2,500 N. Thanks to their modular design, their strokes can range between 10 and 1,770 mm. Speeds of over 5 m/s and accelerations of over 100 g guarantee very short positioning times and high cycle counts. By eliminating the play from mechanical components such as gearboxes or gear racks, linear motors with measurement systems of appropriate resolution can not only be positioned precisely but also require substantially less maintenance than pneumatic cylinders or brushed motors. Unlike pneumatic solutions, the force of the linear motor does not drop off over time, so that maintenance work is needed only at longer intervals.

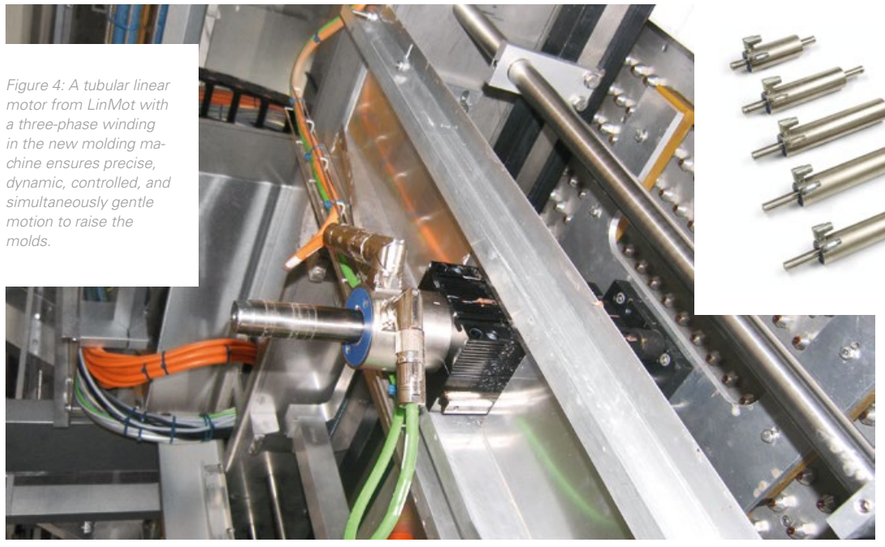


Figure 4: A tubular linear motor from LinMot with a three-phase winding in the new molding machine ensures precise, dynamic, controlled, and simultaneously gentle motion to raise the molds.

Figure 5: The linear motors in the P10-70 series are the most powerful motors in the LinMot catalog, with peak forces of up to 2,500 N. Thanks to their modular design, their strokes can range between 10 and 1,770 mm.

Figure 6: The E1400 controller with direct feed supplies the P10-70 linear motor with sufficient power. Various interfaces, such as Sercos III (shown here), Profinet, or Powerlink are available for connecting to the motion control system.

Optimally tuned combination of controller and motor

Power is supplied to the linear motor on the Swiss chocolatier's molding machine by a LinMot E1400 servo controller with a direct 400 V feed. LinMot has made sure, however, that the motors also work just as well in combination with various high-performance drives from other manufacturers. The builder of the molding machine, however, used a customized E1400 with an integrated Sercos® III interface to connect to a Bosch Rexroth IndraControl L65 motion controller with a configurable Sercos III interface. The machine controller in this configuration calculates tailored motion profiles for the individual products and molding processes, so that the requirements of all the various products can be met with the greatest flexibility at the push of a button. This guarantees gentle handling of the delicate products with problem-free, gentle motion sequences.

The LinMot controller gives the machine builder great freedom in selecting the control system manufacturer, as variants of the E1400 are available for other common industrial bus systems such as Ethercat, Powerlink, Profinet, Profibus, or Ethernet/IP.

Reliable and efficient in action

“After over a year in action, I can say that the linear motor solution from LinMot has proven it’s worth,” says Leuenberger in conclusion. Visibly impressed by the potential of the direct drive technology, the technical manager of the confectionary at Chocolat Frey sees a positive future for LinMot linear motors in his plant. “There are still a few applications, for example in the filling area for packaged finished products, where it makes sense to replace the usual pneumatic cylinders with linear motors.”

Figure 7: A controller from Bosch Rexroth (IndraControl L65) handles the coordination of the numerous axes on the new molding machine, as well as calculating the motion profiles of the LinMot linear motors. This allows Chocolat Frey to react rapidly and flexibly to new product requirements.

Continued from PAGE 04

Sercos SoftMaster is now ready for production

Bosch Rexroth makes – as part of its Sercans XS package – the Sercos SoftMaster available as open-source software and free of charge.

	Sercans XS Economy (SoftMaster)	Sercans XS Basic (SoftMaster)	Sercos FPGA/Sercans S, M, L (HardMaster)
Architecture	RTOS: Host application, Master stack, CoSeMa, SoftMaster, RTOS alloc, std. Eth. HW	RTOS: Host application, Master stack, CoSeMa, SoftMaster, RTOS alloc, 2 * NIC (TTS)	RTOS1 Host: Host application; HW: DP-RAM; RTOS2 Core: Master stack, CoSeMa; HW: S3M FPGA, Ethernet PHYs
Hardware (HW)	1 x standard Ethernet controller	2 x Intel i210 Ethernet controller TI Sitara PRU-ICSS (TTS-capable HW	Sercos FPGA/ Sercans PC board; 2 x Ethernet PHY
Cycle time	500 µs *	125 µs *	31.25 µs FPGA/62.5 µs; 125 µs; 2 ms (Sercans L, M, S)
No. devices	Only limited by host	Only limited by host	511* / 255, 128, 16 (Sercans L, M, S)
Synchronization	20–50 µs (~1 µs by device PLL)	20–40 ns	20–40 ns
Topology	Line	Ring (redundancy), line, dual line	Ring (redundancy), line, dual line
UCC	Within line	Routing@Master, within ring/line	Routing@Master, within ring/line
CPU load	<5% load on host	<5% load on host	Minimum load on host

NIC: Network Interface Controller (precise timing) *** TTS:** Time-triggered send ***:** Depends on host system

Figure 1: The Sercans XS extension levels Economy and Basic extend the range of solutions to cover cost-efficient and compact solutions for more simple requirements as well. (Source: Bosch Rexroth AG)

The package includes the following Ethernet modes, which correspond to the extension levels:

Economy: In the generic Ethernet mode, the cyclic telegram transmission is triggered by an operating system timer. In conjunction with a data packet supply via raw sockets, operation with every Ethernet controller is hereby facilitated.

Basic: In Time-triggered send (TTS) mode, hardware support is required. Here, the application provides the data packet to be sent well in advance in a prioritized queue, and the Ethernet controller carries out the transmission at precisely the right time. The Intel i210 controller already has these features. It has already been integrated into a multitude of industrial products as a standard Ethernet controller. It is expected that many Texas Instruments Sitara processors will also have these functions on board in the future via the real-time processing units PRU-ICSS.

By means of the generic mode, virtually every Ethernet controller is suitable for use with the Sercos SoftMaster. However, the synchronization accuracy is reduced by the telegram jitter caused by this. For higher requirements in terms of synchronization and cycle time, the NIC/TTS mode is available. Here, the Ethernet controller (NIC) precisely determines the telegram transmission using its own timer, and software is decoupled by means of an early provision.

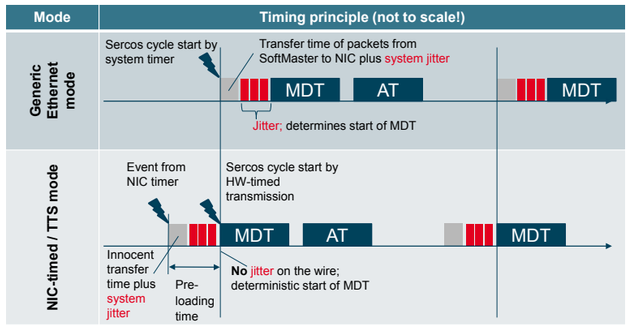


Figure 2: In generic mode, the jitter present in the real-time system is visible 1:1 as telegram jitter, while in NIC/TTS mode, the timer of the Ethernet controller is used for a precise telegram transmission, thus ensuring maximum synchronization. (Source: Bosch Rexroth AG)

With the release in December 2016, the status of the following functions has changed from "prototypical" to "supported":

- Several connections per slave
- Support of direct cross communication (CC)
- Ring topology
- Time-triggered send (TTS) and NIC timing (based on Network Interface Controller)

Suitable for evaluation tests – still with prototypical status – the following additional functions are included:

- Standard Ethernet communication (Unified Communication Channel, UCC) via the master (not to be confused with the same function within the line or the ring that is always available)
- Redundancy and ring recovery

```
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/**
 * \file      SIII_nnn.c
 *
 * \brief     Sercos III SoftMaster Stack - nnn
 *
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 * \author    nnn
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Figure 3: License conditions and license text according to MIT

Which license model applies and which business models are possible?

Despite the easy access to software technologies, many industrial users are nevertheless worried that when using open-source software in embedded systems, such as automation solutions, the applicable license conditions could force them to disclose their expertise. This aspect was taken into account with a conversion of the license model from LGPL (https://opensource.org/licenses/lgpl-license) to an MIT license (https://opensource.org/licenses/MIT).

Thanks to the license model, potential uses are offering approaches for a wide range of business models and to all interested companies and organizations. Here are a few examples:

- Bosch Rexroth itself provides the sources free of charge and offers free sample code and integration assistance as part of the Sercans XS solution package. This way, the support of users is guaranteed in all important global markets. In doing so, Bosch Rexroth is not only supporting its own Sercos-based components, but also ensures that every Sercos-compliant product can be operated with it.
- Every automation software manufacturer for PLC, motion and robot control, or CNC solutions can also integrate the technology in his own solutions and market it as desired in conjunction with their own products.
- Companies whose business model consists in providing software services can use this technology in order to extend their customers' solutions.
- So there is nothing to stop machine manufacturers with their own control solutions from easily integrating the Sercos technology into their OEM solution.

Interested companies can book integration training via Sercos International (p.lutz@sercos.de) or Bosch Rexroth (Sercos@BoschRexroth.de).

In this way, users not only have the outstanding functions of the Sercos technology at their disposal, but can also use all of the over 240 Sercos III products with this fully open and free software module. This provides a scope for comprehensive and cost-efficient Sercos-based solutions that has never been possible before.

What experiences did users already make?

The users' projects are in different stages of integration. In the following, a few examples will illustrate the experiences and the wide range of possible applications.

Machine tools – MachineKit/LinuxCNC

The open-source software MachineKit has developed as a branch and an advancement of the software LinuxCNC. This has the advantage that a simple real-time kernel extension can also be used. This means MachineKit is open for a lot of platforms, such as PC, embedded PC or ARM single board computer.

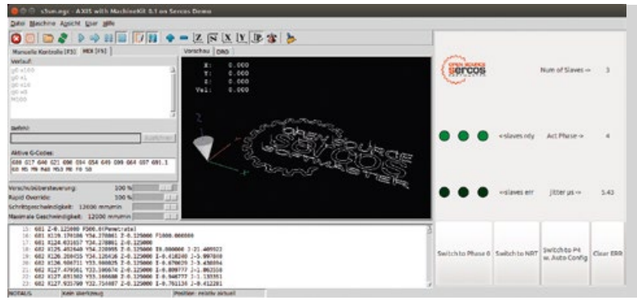

Figure 4: Screenshot of the operating interface of MachineKit with Sercos SoftMaster (Source: Dr. Schiffler)

Thanks to its independence from operating systems, the open-source Sercos SoftMaster can be ideally integrated on the one hand into a real-time Linux operating system and on the other hand into highly versatile software such as MachineKit. The integration must take place at two points. Firstly, at the point at which the real-time operating system abstracts the access to the standard Ethernet hardware, and secondly, at the top application layer. This approach has now been adopted in the open-source community and is showing its first demonstrative approaches, see links to Sercos SoftMaster on Dr. Schiffler's YouTube channel: https://www.youtube.com/watch?v=Sw9DAKn6hoY, the MachineKit website: http://www.machinekit.io/, GITHUB for MachineKit / LinuxCNC Sercos3: https://github.com/aschiffler/linuxcnc-sercos3).

Dr. Schiffler, one of the developers, says: "The use of Sercos technology as a practical SoftMaster with standard Ethernet hardware and PC provides countless possibilities, ranging from simple automation tasks, including CNC axes, right up to IoT applications. The latter in particular is brilliantly facilitated by the Sercos bus, as standard Ethernet and Sercos telegrams pass through the same line. The first exemplary implementation in the software MachineKit can certainly provide impetus for more exciting developments here. Maybe we will be seeing the CNC control system on a NanoPi soon."

Info

Dr. Andreas Schiffler,
one of the developers of the open-source CNC solution MachineKit/LinuxCNC

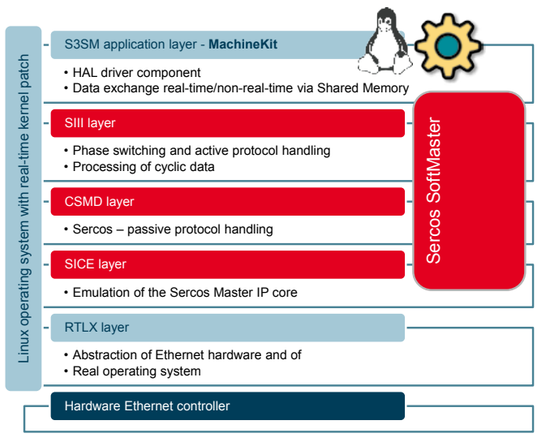

Figure 5: Integration (operating system and application) of the Sercos SoftMaster in MachineKit/LinuxCNC (Source: Dr. Schiffler)

Packaging technology – Rovema

Rovema GmbH supplies packaging solutions and has been relying on Sercos since the introduction of industrial Ethernet technology.

Already in 2015, Rovema GmbH began integrating the Sercos SoftMaster technology and is about to proceed with the product launch.

Figure 6: Tubular bag machine series BV from Rovema GmbH, which could be adapted to better meet customer requirements using the Sercos SoftMaster technology. (Source: Rovema GmbH)

Siegfried Wacker, Head of Product Development, talks about the objectives and experiences: "We made a conscious decision in favor of the Sercos technology as a system bus in our equipment, as it brings crucial advantages with respect to determinism and interoperability. In particular, the high degree of functional standardization makes it possible to use equipment from different manufacturers alternatively without any limitations in functionality.

The integration of the Sercos SoftMaster technology has enabled us to reduce hardware components and costs further, which is of great importance especially in the entry-level segment (e.g. our tubular bag machine type BVK)."

Info

Siegfried Wacker
Head of Product Development
Rovema GmbH

Food processing – machine manufacturer (OEM)

For many decades, an American machine building company has been providing its products and services in the field of meat and fish processing, and has now started integrating the open-source Sercos SoftMaster technology with the assistance of Bosch Rexroth AG.

The responsible software developer talks about the first steps of the integration and the experiences in the support of the technology: "We feel especially encouraged using the Sercos SoftMaster technology, knowing that this technology is based on a knowledgeable and competent software engineering team at Bosch Rexroth, that stands for sustainable support of the technology. During the training we learned a lot and will soon be implementing our next iteration prototype system. We expect the system to work very well and meet all of our requirements."

Machine tools and robotics – ISG-kernel

Industrielle Steuerungstechnik GmbH develops and integrates NC and robotic control solutions into their customers' control systems in the form of the software component ISG-kernel. In addition, the company provides a real-time simulation system, ISG-virtuos, which can be integrated into customer solutions and is suitable as a hardware-in-the-loop (HiL) system for virtual commissioning.

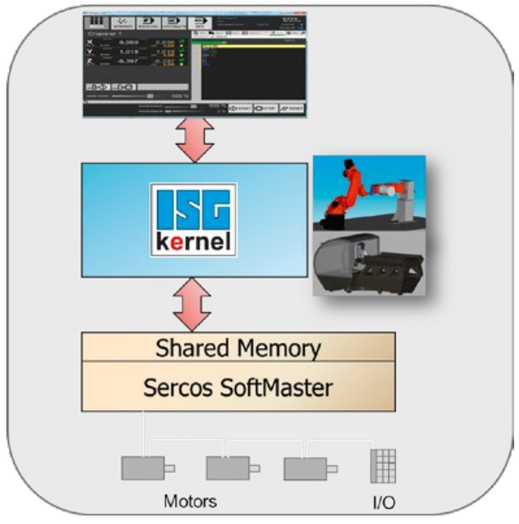

Figure 7: ISG-kernel in use with the Sercos SoftMaster (Source: ISG Industrielle Steuerungstechnik GmbH)

Info

Hannes Richter
Business Development Manager
ISG Industrielle Steuerungstechnik GmbH

During the evaluation, several demonstration systems were realized using both products in cooperation with TenAsys, Phoenix Contact, the Institute for Control Engineering of the University of Stuttgart, and Bosch Rexroth AG.

Hannes Richter, Business Development Manager, talks about his experiences with the technology: "The NC kernel product is ideal for the integration of fieldbus interfaces. Use of the Sercos SoftMaster is characterized by particularly simple interfaces that are perfectly suited to our Shared Memory concept.

We intend to include the technology with the availability of the released software package as an option for our ISG-kernel product."

Summary

The requirements for implementation of the Sercos SoftMaster technology in a broad field of application – conservatively estimated, over 90% of all fieldbus applications are covered – are met thanks to

- the sustainable anchoring of the technology as an open-source project and in the solution package Sercans XS from Bosch Rexroth,
- and the license model according to MIT.

With the integration of the Sercos SoftMaster into the open-source CNC solution MachineKit/LinuxCNC, a free evaluation platform is available for motion control with I/O auxiliary functions. Based on the demonstration systems that were set up with ISG Industrielle Steuerungstechnik GmbH and additional evaluation projects, it can be deduced that integration into every available automation system with a fieldbus interface designed for this purpose is possible within four to eight weeks.

The framework conditions described in this article demonstrate that nothing stands in the way of industrial application regardless of location and industry sector.

System configuration without stress and errors

Intelligent hardware meets intuitive software: While the Safety Gateway BWU3160 can safely control and monitor servo drives as an originator in CIP Safety on Sercos, the intuitive ASIMON360 software from Bihl+Wiedemann makes child's play of configuration and commissioning. The user navigates – without any special expert knowledge – automatically to errorless, safe drive monitoring.

Figure 1: Intelligent hardware meets intuitive software: All-round carefree configuration and commissioning of AS-i Safety Gateway, CIP Safety on Sercos (BWU3160) with ASIMON360 from Bihl+Wiedemann

All-round carefree and stressfree – that was the approach in developing the ASIMON360 configuration and commissioning software. First it was conceived for safe AS-i networks – so that the arguably most layout- and user-friendly safety bus AS-i Safety at Work can also be configured with corresponding ease. Since the CIP Safety Gateway (BWU3160) is an AS-i Gateway, too, ASIMON360 can also be used to set up safe drive controllers based on CIP Safety on Sercos®. Especially notable are the hardware catalog integrated into the software as well as the user-friendly commissioning wizard: both reduce the complexity and ensure that even safety newbies can configure a safe drive controller quickly and without mistakes.

The starting point: AS-i Gateway for CIP Safety on Sercos

The AS-i 3.0 Sercos Gateway BWU3160 allows you to safely control and monitor drives directly with the help of CIP Safety on Sercos – without the need for an additional safety PLC. As for functionality, the Gateway for CIP Safety is a true jack-of-all-trades. Among other things it combines two AS-i masters for two AS-i networks. This provides up to 62 two-channel safe inputs – in addition to the three which are already integrated in the device. Six fast electronic safe outputs also in the Gateway ensure that the technological bridge from AS-Interface to CIP Safety meets the strict requirements of high-performance servo-drive technology.

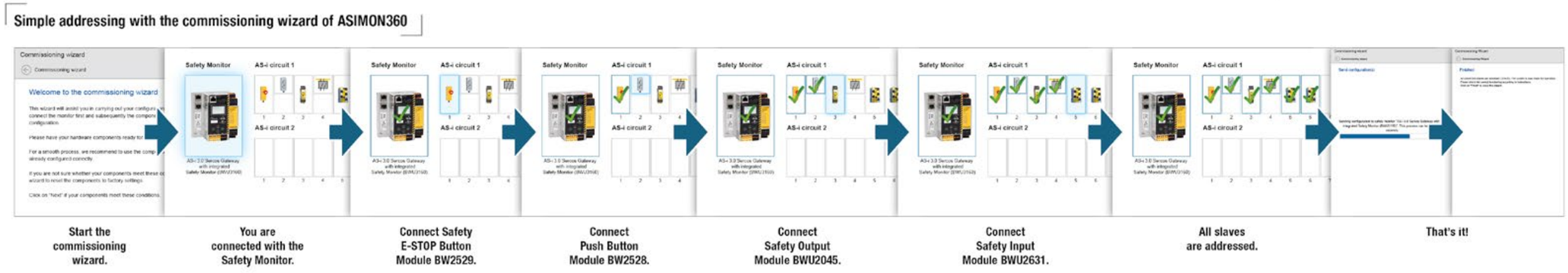

Figure 2: Simple addressing and with the commissioning wizard of ASIMON360

The safe Gateway becomes even more performant with Safe Link, the safe coupling from Bihl+Wiedemann that permits expansion by nearly 2,000 safe in- and outputs. Users of CIP Safety on Sercos profit in several ways from the Gateway. For example they can use the BWU3160 as a so-called CIP Safety Originator without the need for an additional host controller – it functions itself as a safety PLC and can independently take over safe control tasks related to drive technology. On one hand you can monitor safe servo drives simply and cost-effectively. And on the other it allows you to enjoy the benefits of AS-i in networking standard sensors and actuators, such as for simultaneous transmission of safety and nonsafety data over the same Sercos cable.

ASIMON360: All-round carefree software for safety newbies

Ensuring that the high functionality of the Safety Gateway for CIP Safety on Sercos does not come at the cost of great complexity in configuration and commissioning is what lies behind the new ASIMON360 software. On the contrary: The program has been specifically conceived as an all-round carefree software – its powerful content, such as illustration of the complete product range of Bihl+Wiedemann in a hardware catalog, or the ability to incorporate the numerous AS-i components from other manufacturers even more simply, underlies the intuitive, efficiently visualized and user-friendly user interface of the commissioning wizard. Safety beginners were the inspiration when developing this useful tool: ASIMON360 guides you through the configuration without worry or stress. Just clicking on the needed device displays it in the configuration window while all the possible settings for this constellation are loaded and opened. The user then first sets the CIP Safety connection parameters for the Safety Gateway BWU3160 before selecting from the drop-down menu which components to incorporate as AS-i slaves in which of the two available AS-i networks. Universal modules in the software make it simple to integrate devices from other vendors and when needed store product-specific settings in the user catalog. After the hardware configuration is finished the software itself creates a basic setup that already contains all the logic devices resulting from the previously made hardware settings. If for example an E-STOP needs to be connected to a particular slave, just this device – and no other – is offered. There is no way to assign incorrect modules, and connection errors are prevented as well.

Commissioning wizard: Errorless addressing step-by-step

Once the overall configuration of the drive monitoring is created using CIP Safety on Sercos, the commissioning wizard guides you through addressing and configurating of the connected modules. Starting with the Safety Monitor of the Safety Gateway each individual device to be used for the system is connected in succession using drag and drop and applied to the CIP Safety inputs. In the same manner the safe outputs are assigned to the desired location in the configuration. Incorporating the CIP Safety bits into the input and output configuration is therefore extremely easy – and should problems arise at any point, the software provides easily understandable explanations and proposes specific remedies. At the conclusion of the overall configuration all the addresses are set without error and loaded into the devices. Even if this is the user's first experience with CIP Safety on Sercos, he will have created a ready-to-use application.

Enthusiasm instead of anxiety

Sercos – the globally standardized digital interface for communication between controllers and fieldbus nodes – is supported internationally by over 50 controller manufacturers, over 30 drive manufacturers, and more than 40 manufacturers of other devices. The installed base of this open protocol is currently more than 5 million installed Sercos nodes in more than 600,000 applications worldwide – and continues to grow. Still, until now especially newbies to safety from the previous world of parallel wiring were often anxious when it came to actual implementation because the subject seemed difficult and complicated. Software tools such as ASIMON360 from Bihl+Wiedemann offer this group in particular the simplicity and security for making the implementation of safe, motion-control-based automation systems based on the safe network protocol CIP Safety on Sercos a painless and rewarding process. So that the number of users continues to grow along with the installed base.

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netTAP 151: Data converter for real-time Ethernet networks

The gateway netTAP 151 transmits I/O data bidirectionally between any two industrial real-time Ethernet networks. It is the ideal solution for installations with heterogenous networks or such of the same kind to exchange data across given network boundaries. With more than 25 different combinations of the protocols Sercos®, Profinet, Ethercat, EtherNet/IP and Powerlink, the device series provides a solution for any conversion.

The integration as simple I/O device into the primary network makes the converter compatible with any common PLC. On the secondary side it works either as I/O device too, or controls a subordinate network as a bus master. The length of the I/O data can be scaled to any application, and the data in between can be mapped on byte level arbitrarily.

Secure network separation is provided by two Ethernet controllers, each connected to a dual Ethernet port with integrated switch. That allows realizing star, ring and inline network topologies without further peripherals. Both controllers handle the protocols independent from each other and exchange only the I/O data across a data buffer. An overall data processing time lower than 10 ms is achieved.

KUNBUS GmbH

Heerweg 15 C | 73770 Denkendorf | Germany
: +49 (0)711 3409-7093 | : +49 (0)711 340 99 291 | www.kunbus.de

Kunbus Gateways

Kunbus Gateways enable continuous and reliable communication between different networks and systems. The Kunbus Gateway converts all data that the target network can transfer.

It omits nontransferrable data and adds necessary data in the new network. Thus, the operators can transfer all necessary data from one closed network to another.

With this gateway series Kunbus offers a protocol converter that can be attached to DIN rails and detached again easily by means of plug and play. The protocols themselves are located in compact modules, whose housings are just 22.5 x 101.4 x 115 in size. The modules are connected via a jumper to a gateway. The user can exchange the protocol modules easily and conveniently to connect one network to another. Customized solutions are also possible. The Kunbus Gateways are equipped with an integrated web server; program parts are updated via FTP server. The maximum output of the series is 3 W; the voltage tolerance ranges from –15% to +20%.

The modular system allows simple configuration of our gateways by plug-in linkage or adaption by exchanging the module. By using a jumper you connect two protocolls to a complete gateway.

A big advantage of the Kunbus Gateways is the reducing of stock costs. Due to the modular structure you can wait with the configuration till the time of delivery to your customer.

MEN Mikro Elektronik GmbH

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Small and power-saving: Box PC BE10A for IoT inside industrial automation

The mini box PC is equipped with a Sitara™ AM57x processor from Texas Instruments.

The box easily manages demanding processing and communication tasks despite its low power consumption of a maximum of 15 W at an operating temperature of up to 60°C and can be handled without fans.

The BE10A can be used in PC-based process automation and robotics control, or handles the communication between sensors, servers and the cloud, or exchanges data with the control center as a gateway device. In HMI applications it is interfacing between the screen and the peripheral devices.

One slot each for mSATA, microSD, PCI Express Mini Card und microSIM offer flexible expansion options for wireless functionality or storage.

Thanks to the PRU, the programmable real-time unit, which is integrated in the TI Sitara™ processors, the BE10A supports several industrial protocols like Sercos®, Ethercat, EtherNet/IP, Powerlink or Profinet.

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Spinner rotary couplings for maintenance-free, fault-proof data and power transmission

Contactless rotating interfaces from Spinner meet this need by permitting error-free transmission of Sercos® III data at a rate of 100 Mbit/s and very fast rotational speeds up to 3,000 rpm.

This puts an end to transmission errors and lost data packets, problems that can afflict slip ring systems. Spinner rotary couplings are also available for combined contactless transmission of both power and data. They permit the transmission of up to 300 W at an input/output voltage of 24 V.

Texas Instruments Germany

Haggertystrasse 1 | 85356 Freising | Germany
: +49 (0)8161 800 | www.ti.com

66AK2Gx Industrial Communication Engine (K2GICE)

Multiprotocol cost and form-factor optimized reference design for programmable logic controllers, I/O devices and sensors. The KeyStone II 66AK2Gx family with Multicore C66x DSP and ARM® Cortex™-A15 microprocessors include two programmable real-time unit and industrial communication subsystem (PRU-ICSS) interfaces created specifically to enable real-time industrial communications capability (master and slave) supporting popular protocols, such as Sercos® III.

Into the future with Sercos and TSN

At the recent SPS IPC Drives show, Sercos International showed that Sercos is a secure investment in the future.

Sercos International introduced the transmission of Sercos® III real-time protocols via IEEE 802.1 TSN (Time-Sensitive Networks) in a Sercos TSN demonstrator. This demonstrator was created by the Institute for Control Engineering of Machine Tools and Manufacturing Units (ISW, University of Stuttgart) with support of several industry partners. It shows a real-time, multiprotocol-capable network infrastructure based on TSN for automation technology.

The German magazine ke NEXT was also present and introduced the Sercos over TSN demo in its exhibition coverage. A short video sequence (in German) can be found on Sercos International's YouTube channel.

Another highlight was the Sercos SoftMaster demo, which offers high speed and hard real-time using a standard Ethernet controller instead of dedicated hardware. ISG Industrielle Steuerungstechnik showed a PC-based pick-and-place robotics application using the Sercos SoftMaster based on a TenAsys "INtime for Windows" real-time operating systems platform. Motion programming is done via a PLCopen module using the Multiprog PLC program environment.

Another attraction was Sercos slave prototyping using the EasySlave Kit for Arduino. Steinbeis Embedded Systems Technologies has developed a Sercos III product that uses an Arduino board as a rapid prototype platform for the application and a corresponding shield with a Sercos EasySlave FPGA as well as other peripheral components. With these compact elements, the developer uses free and freely available software tools to create a prototype Sercos application, from which corresponding Sercos III devices are then derived and implemented.

Additional demos and numerous components from Bihl+Wiedemann, Bosch Rexroth, BWO Elektronik, Cannon-Automata, Phoenix Contact, Schneider Electric Automation, Texas Instruments and Vision & Control completed the Sercos exhibition presence.

"Sercos over TSN was the main topic at our booth," said Peter Lutz, Managing Director at Sercos International. "Many questions showed the need for additional information, and we are happy there is such an interest in our technology."

Machine Communication Forum scored with a wide range of subjects and networking opportunities

Sercos International and TeDo publishing's SPS-MAGAZIN from the TeDo publishing firm held the 2nd Machine Communication Forum in Würzburg, Germany, on October 13, 2016.

Users and providers from the machine and plant engineering sector as well as equipment and automation manufacturers attended the event and were particularly enthused by the wide range of subjects and the opportunities to network.

The keynote addressed legal challenges of digitalization and inspired many attendees to get a deeper knowledge of the legal aspects in order to find solutions. The main speech by Prof. Dr.-Ing. Birgit Vogel-Heuser from Technical University Munich gave an insight into the dissolution of the automation pyramid and its consequences.

The subsequent presentations dealt not only with technological trends such as TSN and OPC UA, but also with market trends. Markets for the machinery industry which are likely to be of interest in the future, were discussed as well as those that will remain or become difficult in the near to medium future.

The afternoon started with a podium discussion with members from the communication/IT industry, university, machinery and automation section. Each participant stated his/her view on IoT, what's already reality and what will be likely to be realized in the near future.

The rest of the day was devoted entirely to break-out sessions and networking.

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Publisher
Sercos International e. V.
Kueblerstrasse 1
73079 Suessen
Germany

: +49 (0)7162 9468-65
: +49 (0)7162 9468-66
info@sercos.de
www.sercos.org

Editing and Design
MILANO medien GmbH
Hanauer Landstrasse 196A
60314 Frankfurt am Main
Germany

: +49 (0)69 4800054-0
: +49 (0)69 4800054-9
info@milanomedien.com
www.milanomedien.com

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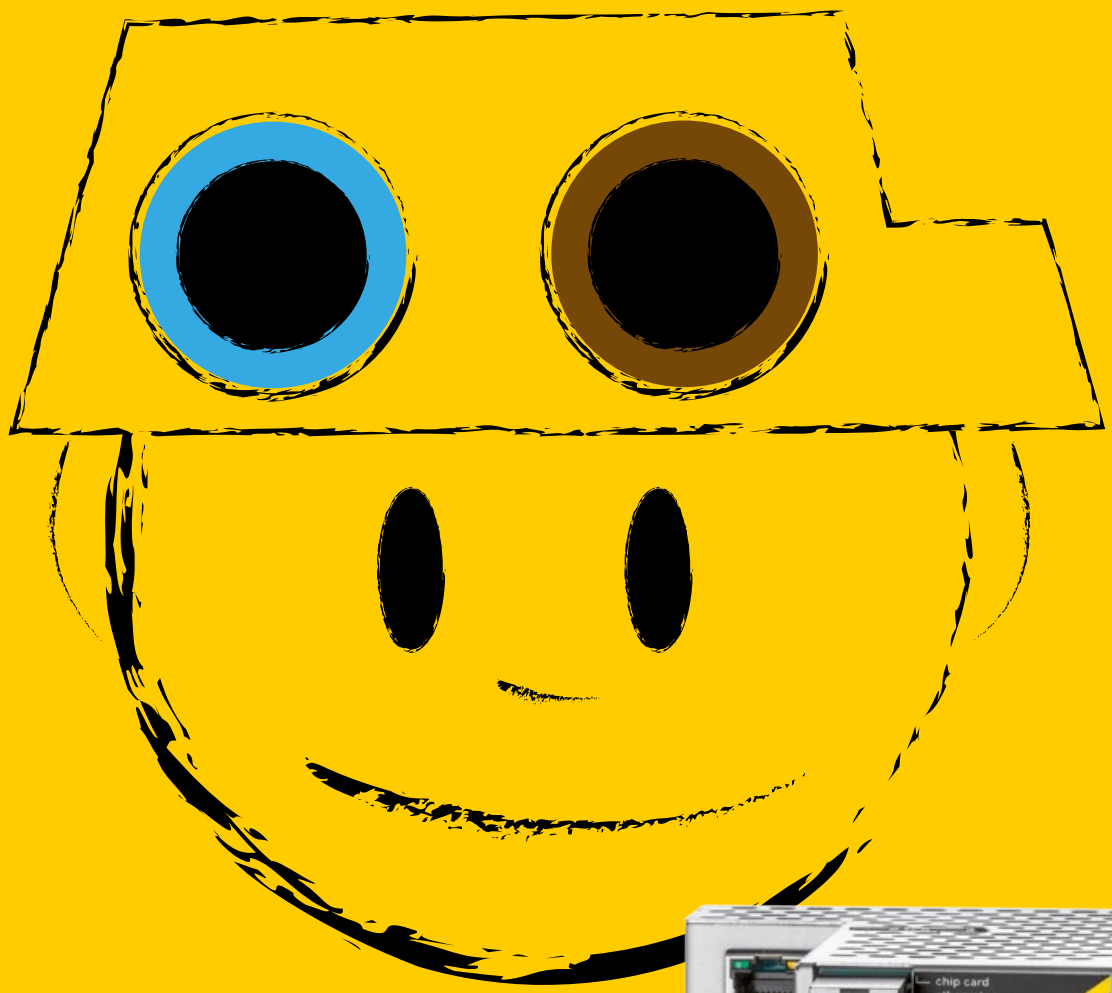

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