"The data processing moves into the edge"

Should IoT be integrated directly into the device, into a machine part, or directly into the sensors and actuators? SYS TEC Electronic answered these questions in an interview.

IoT (Internet of Things) pursues the approach of using new technologies and communication concepts to make data available in a cloud, connect it, and to generate further benefits from this aggregated data. The most common methods here are data transmission via MQTT or the connection of data to the cloud via OPC UA. Current developments go one step further and regard edge computing as a way of automating and interconnect processes at the point of action, i.e. where data is generated - in industrial production environments, directly at the machine.

With which methods is it worth going one step further? Should IoT be integrated directly into the device, into a machine part, or directly into the sensors and actuators? Dr. Frank Jungandreas, Senior Engineer at SYS TEC Electronic and Nadine Mensdorf, Product Manager at SYS TEC Electronic answer these questions.

Q: How do you classify CANopen? What does SYS TEC Electronic connect with CANopen?

Nadine Mensdorf: CANopen has long since established itself as a replacement for proprietary backplane buses within devices. CANopen can be found on the market in special-purpose machines, in battery management systems, commercial vehicles, in the lift sector, and in the mobility sector. It combines sensors and actuators in one machine and transmits status values, process data, or triggers other actions. Just as CAN is used in the automotive industry, CANopen is used for special vehicle superstructures such as fire trucks, cranes, or agricultural machinery.

Ourselves as well as our customers have adapted the SYS TEC Electronic CANopen stack over many years for various controllers and terminal devices in various applications. Numerous customized developments and manufactured products contain our solution. We also use CANopen for current inquiries, projects, and customer solutions.

Our product portfolio includes our CANopen chip, the Sysworxx I/O modules based on it, and our industrial controllers. We offer terminal devices for use on the DIN rail, embedded control units, as well as customized individual solutions.

In addition to many other protocols, our CANopen implementation is used on all our IoT controllers with IEC 61131-3 PLC programming system for communication on the field level. This also applies to our edge controller Sysworxx CTR-700 as well as our single chip IoT controller Sysworxx CTR-100.

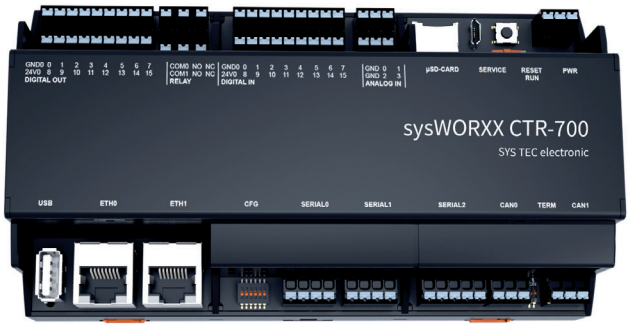

Figure 1: The edge controller Sysworxx CTR-700 uses the CANopen implementation for communication in the field level (Source: SYS TEC Electronic)

Q: CANopen and IoT - how does it fit together?

Dr. Frank Jungandreas: The IoT idea is often initially explained by connecting data with the cloud and the connection of devices to the cloud through protocols such as MQTT or OPC UA. But how do you effectively get cleansed, pre-processed data that is relevant for evaluation? If you look at a system as a whole, data can often be pushed directly to the cloud via its controller. This brings us to edge computing, i.e. decentralized data acquisition and processing, combined with gateway functionality, which serves as an interface to higher-level systems.

With this in mind, viewing a machine in the capital goods sector as a self-contained object is a very high-level approach. Internally, its functionality combines several executing and monitoring devices, sensors and actuators. The intelligence for the Internet of Things should start where the "things" are located - i.e. exactly where data is generated: within the industrial production processes, i.e. directly in the machine.

If we look at the "things" in detail as individual devices with a dedicated functionality, we have to begin to provide each object in the system with intelligence and link them together. Ethernet-based technologies clearly predominate on the level for connecting individual devices in industrial production environments. In contrast, this technology is rarely used within a machine on the fieldbus level. The reasons why it often makes more sense to rely on CANopen within a machine than to use IP-based technologies are manifold. On the one hand, the vast majority of microcontrollers used today in machine control systems already have one or more CAN interfaces integrated. The transmission of data via CAN requires significantly less energy than Ethernet-based systems, and there are numerous ▷

cost-effective tools on the market for commissioning and troubleshooting.

The automotive industry is a good example of how powerful CAN is. Within the vehicles, CAN is used to communicate the status of various components, transmit process data, and trigger actions. At the same time, CAN provides the external service interface, which can be used to read out error information and telemetry data.

CANopen offers just as many advantages in the field of automation for use within a machine. Lean, energy-efficient communication units can be quickly implemented with inexpensively available hardware.

Q: CANopen therefore migrates directly into the machines. Please explain this more in detail.

Dr. Frank Jungandreas: Exactly, many machines and devices use CANopen as internal machine bus, without this being visible from the outside. CANopen is much leaner, smaller, and at the same time more cost-effective than comparable IP-based communication. In addition, the power dissipation is also significantly lower than for example with Ethernet.

This makes CANopen ideal for autonomous, e.g. battery-powered devices. The number of applications in this area will increase considerably in the coming years.

A further field of application for CANopen is condition monitoring and predictive maintenance, i.e. the constant monitoring of device data in order to detect possible failures at an early stage and to maintain them proactively. Due to the integrated CAN interfaces, the simple wiring and low power and computing requirements, CANopen can be integrated at any place in a machine with little effort.

On this basis, our customers can implement intelligent "things" quickly and inexpensively. The necessary investment of time and money remains manageable and the technological risk is low. Established support tools are also available, for example for diagnosis or configuration.

Q: What does a typical use case for this scenario look like?

Nadine Mensdorf: Within a plant or machine there are several devices which have to be synchronized with each other. The individual actuators are interdependent. To ensure successful cooperation, the devices have to be able to exchange information about their process values such as availability, power consumption,, and maintenance data.

In the field of energy management, for example, current peaks can be distributed in a way that large consumers are only switched on consecutively instead of simultaneously, thus significantly reducing the current load on the system.

CANopen connects sensors and actuators purposefully, it transmits status values, process data, and triggers actions. There must be no detached communication unit. Rather, it should be integrated directly into the intelligent sensors and actuators.

Is a sensor ready for operation, overheated, or dirty? Which process is influenced by the availability of the sensor? Can another sensor take over the task or have the process values of the overall system, such as speed, etc., to be adjusted in this case?

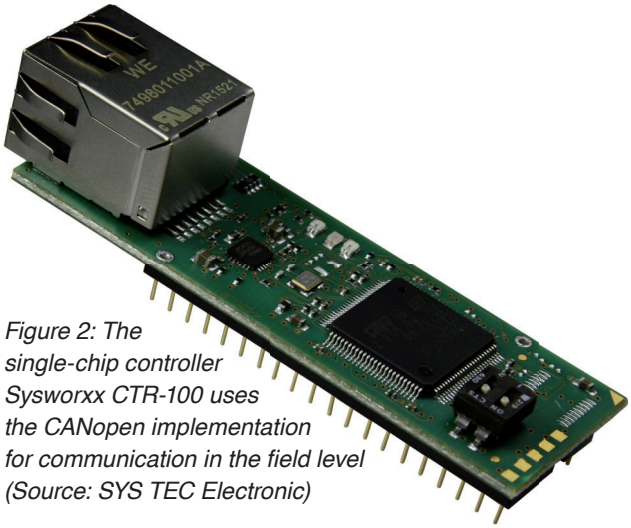

Figure 2: The single-chip controller Sysworxx CTR-100 uses the CANopen implementation for communication in the field level (Source: SYS TEC Electronic)

Such intelligent assemblies are a must-have for new machines and systems, as they form the basis for concepts such as predictive maintenance. A visible trend in the manufacturing industry is retrofitting, the upgrading of existing facilities with intelligent assemblies. For machine manufacturers, this opens up new fields of business, and for end users, it increases investment security - even for existing systems.

Machine manufacturers in the field of special-purpose machine construction, who currently see themselves as late adopters, are beginning to integrate intelligent assemblies into their machine concepts. Sensor and actuator manufacturers design the intelligence directly into their devices, which in turn serve as supplements for existing systems.

Q: Do you see increasing numbers of retrofit solutions on the market in the coming years?

Nadine Mensdorf: Certainly. The greater the investment in machinery, the longer it will typically be used. In these areas, the need for additional intelligence will grow.

Such a retrofit solution hast to be always considered in its entirety. Let us remember the key data and advantages of CANopen. Intelligent, CANopen-capable devices can be developed within a short time at low hardware costs. The components have a high technological maturity and thus entail a low technological risk - but also a high potential to generate new lines of business.

Increasing performance and cost pressure demand fast reaction as well as proactive instead of reactionary maintenance to generate savings. Innovative technologies are not used for their own sake, but to increase efficiency. The focus here is on uncovering hidden costs. If these can be made visible, it is possible to eliminate the issues associated with these costs.

How easily an intelligent CANopen device can be implemented can be demonstrated in just a few steps. Let's take our CANopen chip as the first example. This plug-in module can read and write analog and digital values in seven available I/O configurations. The device profile for CANopen I/O devices and the CANopen communication profile, i.e. the semantics of the unit, are components of the CANopen chip firmware. By integrating the CANopen chip into a controller, it can already communicate its process data semantically defined.

In a second example, let's start with our single chip controller, the Sysworxx CTR-100. In an intelligent machine environment, we only need a simple I/O interface and the CAN transceiver for communication. The Sysworxx CTR-100 chip already contains all the intelligence required to read process data via CANopen, process it locally and pass it on to a cloud via MQTT.

Integrated into a sensor, it provides the capabilities for self-diagnosis - it can process self-generated values and data as well as environmental data, control them via CANopen, control functionally adjacent units, but also push pre-processed values via MQTT to a higher-level edge controller.

The data processing moves more and more into the edge, i.e. directly into the machine on the shop floor - and of course into the "things". Only through targeted networking of the individual "things" useful data can be generated. A cloud alone is not enough - the application only becomes a business model when it is fed with corresponding data which is interconnected.

The Sysworxx CTR-700 edge controller allows data to be recorded directly from the field level via CANopen and preprocessed locally. This information can then be forwarded via MQTT or OPC UA and transferred directly to a cloud. Of course, other systems can also be connected, such as process control systems, which record, analyze, and visualize the machine data in an appealing way. The data records directly from the machine can be supplemented with additional information. For example, with environmental data to generate an image of the overall situation of a plant. This makes it possible to monitor and control entire plant systems very efficiently. ◀

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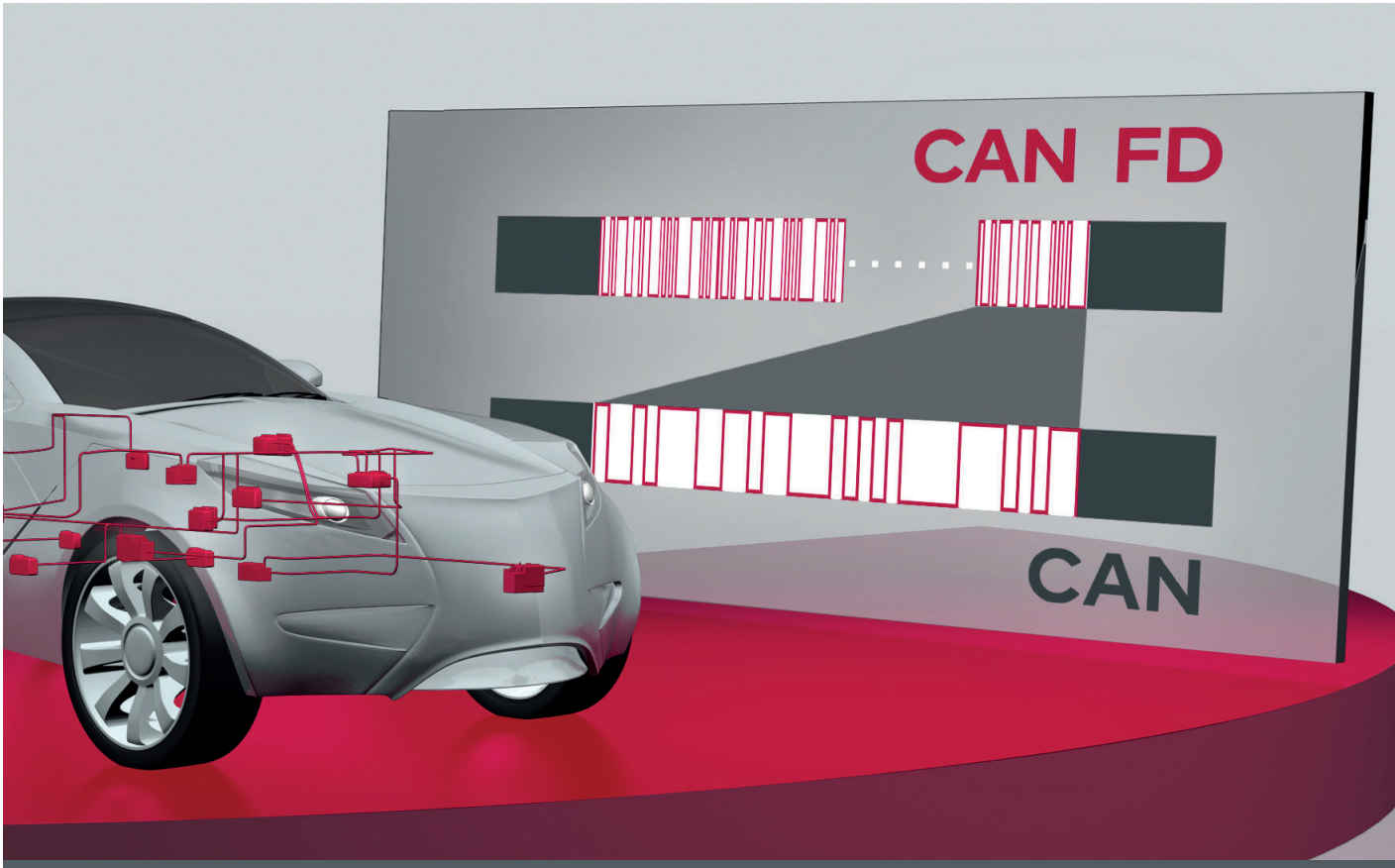

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