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Ethernet becomes slimline and real-time capable

The proliferation of data transmission standards in factories is coming to an end. OPC-UA and TSN are making Ethernet real-time capable and are finally establishing a consistent standard. LAPP can supply the cables for this, including thinner and lower-cost single-pair cables.

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The automation pyramid is crumbling. The individual levels, from the ERP system at the top right down to the field level at the base, were once strictly separate. A level could only communicate with the one directly above or below it. This hierarchy is too outdated for the smart factory, where everything communicates with everything else. For example, an order in the online shop will immediately trigger the corresponding actions in the machine. And sensors in the machine report directly to the ERP system if there is a threat of production losses. It's all about predictive maintenance. The aim is clear: Batch size 1, where every customer receives a product that is tailored to them and made as cheaply as it would be if it were mass produced.

This has consequences for communication networks in factories. When the automation boom began in the 1980s and 1990s and the automation pyramid emerged, the data – which was still sparse at the time – flowed via fieldbus protocols. To cut their products off from competitors, many suppliers created their own fieldbus standard. And this continued in the same vein in the 2000s with Ethernet. Once again, suppliers managed to "bend" Ethernet so that there are now a dozen different versions that are all incompatible with one another.

But this may all be about to change. On the one hand, users have had enough of grappling with dozens of transmission standards, as it involves accepting a huge outlay for network planning and design. On the other hand, all standards have the same flaw: Standard Ethernet is not real-time capable. Thus proprietary real-time expansions that require special network components were developed. This has resulted in the network having "real-time islands", which restrict the consistent and coexistent transmission of real-time and non-real-time data.

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When everything exchanges data with everything else in a factory – from the online order page via the ERP and MES systems to the machine and each and every sensor, and then back to the cloud – there needs to be a consistent standard that transmits and processes information reliably and accurately in under a millisecond. This is the only way to make good on the key promises of Industry 4.0: batch size 1 and mass customisation.

Borrowing from technology used in concert halls

The various fieldbus standards are far from extinct, but they are losing so much ground to Ethernet, which has been the dominant force in office communications for decades. As the office and production line need to communicate seamlessly, it was only a matter of time until Ethernet wormed its way into factories. The flaw of insufficient real-time capability is remedied by Time-Sensitive Networking, or TSN for short. This set of standards is based on a proposal by the IEEE802.1 Ethernet working group. TSN is the outcome of the work by the IEEE's Audio Video Bridging Task Group and was originally designed for the synchronised transmission of audio signals in concert halls. Standardisation provides the basis for TSN becoming widespread and being supported by many manufacturers.

If automated, there would be many advantages to TSN. All participants in a TSN network are time-synchronised, so they perform the right action at precisely the right time. TSN has priority mechanisms that enable every application to receive their data on time. Important information that must not be delayed can be fast-tracked; bandwidth and time slots are reserved for this. Very high priority is given to drives, for example, that need to be supplied with the latest data in milliseconds. TSN is becoming a standardised expansion of standard Ethernet. The compatibility of the components of various manufacturers is currently ensured by interoperability testing in several global TSN testbeds. TSN is not yet available to purchase in products, but there were many demonstrations at last year's SPS IPC Drives trade fair.

OPC-UA gives new meaning to data

TSN ensures that data is transferred on time. However, it does not contain information on where it should go and what this data means. There is a second standard to handle this: OPC-UA, an open communication protocol for exchanging data from machine to machine and between machines, the ERP system and the cloud. OPC-UA is now accepted as a de facto standard in communications for Industry 4.0. And it has now become real-time capable with TSN, which enables data networks to be standardised and the flow of information from the base to the top of the automation pyramid to be unimpeded. With this, the pyramid disappears into thin air.

LAPP supports OPC-UA and TSN and can supply the appropriate cables. The cables will not change for now as an Ethernet cable does not care which protocol it carries. High quality is what's important – perfect shielding, for example, so that the data arrives without disruption. Nevertheless, the new transmission standards presents an opportunity for LAPP to reflect on whether its broad range of Ethernet cables really does cover all user requirements. The company came to the conclusion that it may be worth slowing down. How so? Well, so far the suppliers of these kinds of cables have been developing them along the lines of "higher,

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faster, further". Ethernet cables are now available in Cat.7 versions at up to 10 Gbit/s, and even faster versions are about to come onto the market. But is this always necessary? No. Only a few applications – digital image processing being one of them – generate such huge data volumes. It is often the case that "slow" Cat.5 cables can do the same job at 1 Gbit/s.

Slimming is the new black

Downsizing is one trend that LAPP has identified. Fast Ethernet cables have four pairs of conductors. Why not just do without three of the pairs? Just one pair of conductors is all it takes to transmit data, which can still be done at 1Gbit/s. Of course, compatible terminal devices with new, already available PHY chips are required here. These single-pair Ethernet cables will become more important in future, especially when connecting sensors. The cables are thin, light, robust, fit into tight spaces and can even achieve a range of up to 1200m at 10 Mbit/s. And, of course, they are excellent value for money as they are cheaper to buy and easier to install. After all, technicians only need to connect two cores rather than eight here. LAPP is currently developing these kinds of cables.

For users who do actually require the highest transfer rates of 10 Gbit/s, LAPP makes the ETHERLINE® PN CAT.6_A Fast Connect. Inside the cable is a plastic cross separating the four pairs of conductors. It also features an inner sheath with overall shielding rather than four individual shields for each pair of conductors, as was the design in previous cables. This makes processing so much easier. The fitter no longer needs to remove a foil shield from each of the four pairs of conductors. It saves up to 50 percent of the time. LAPP also supplies a tool with several knife blades and an adjustable penetration depth. It prepares the cable for connector assembly in just one step. This once again saves time and protects the cores when stripping. The inner sheath on the Fast Connect cable also prevents the core insulation from being cut when removing the shielding.

TSN-capable switches in sight

OPC-UA with TSN and single-pair cables make Ethernet fit for the smart factory. But one thing is still missing: TSN-capable active components, such as switches. Especially as switches do care which protocols run through them. New, real-time capable hardware is required here, which inter alia LAPP will launch within the next two years. At the moment, their standards are still being fine-tuned. LAPP does not just see itself as a pure cable manufacturer – but instead as a supplier of integrated connection solutions, being a global market leader in this field. Wherever data needs to flow from A to B, LAPP is there, providing a reliable connection.

Many sensors in the smart factory of the future will be connected with single-pair Ethernet cables. They are thin, light, fit in tight spaces, they are robust and can even reach ranges of up to 1200m at 10 Mbps. For the highest data rates, there are ETHERLINE® Cat.7 cables.
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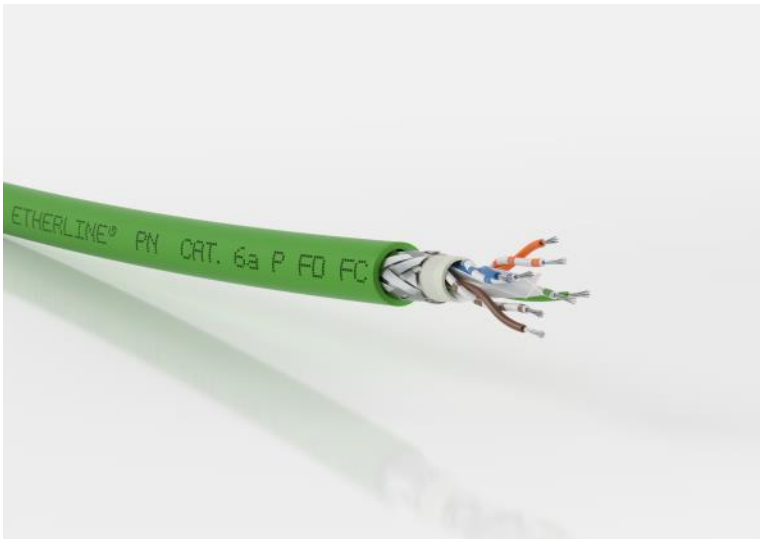

ETHERLINE® cables with FastConnect technology make installation faster and easier.