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Technical article

The full bandwidth – Gigabit switches for automation networks

With digitalization, companies can significantly boost productivity, but it also entails fundamental changes. More and more products that provide data, such as high-performance, high-resolution cameras, are being used at all kinds of places in the production. Increasing data rates are thus expected – resulting in Gigabit establishing itself as the standard for a future-proof network architecture in production networks.

Cameras as driver for increasing data rates

A strong driver for higher data rates in the industrial communication are camera applications. IP cameras are increasingly used in the production for the monitoring and optimization of processes as well as for quality assurance. This also includes very data-intensive applications with cameras that measure production elements in 3D. In industry-related applications, high-resolution cameras are used, for example, for the precise control of cranes, and in tunnel applications for the live monitoring. IP cameras as communication participants generate considerably larger amounts of data compared to sources of pure automation and control data.

Therefore, a high-performance network infrastructure is required, in which the switches – in a first aggregation level – already possess gigabit ports. This ensures that the data can be quickly and efficiently forwarded.

For this, the SCALANCE XC-200 is available as managed Industrial Ethernet Layer 2 switch, with variants that support Gigabit across all ports.

Due to their high data rates and erratic transmission behavior of some IP cameras, detailed network planning is generally recommended when using IP cameras in a network. This planning is supported by the SINETPLAN tool, which can be used to model the transmission behavior of the cameras as well as the network with SCALANCE components.

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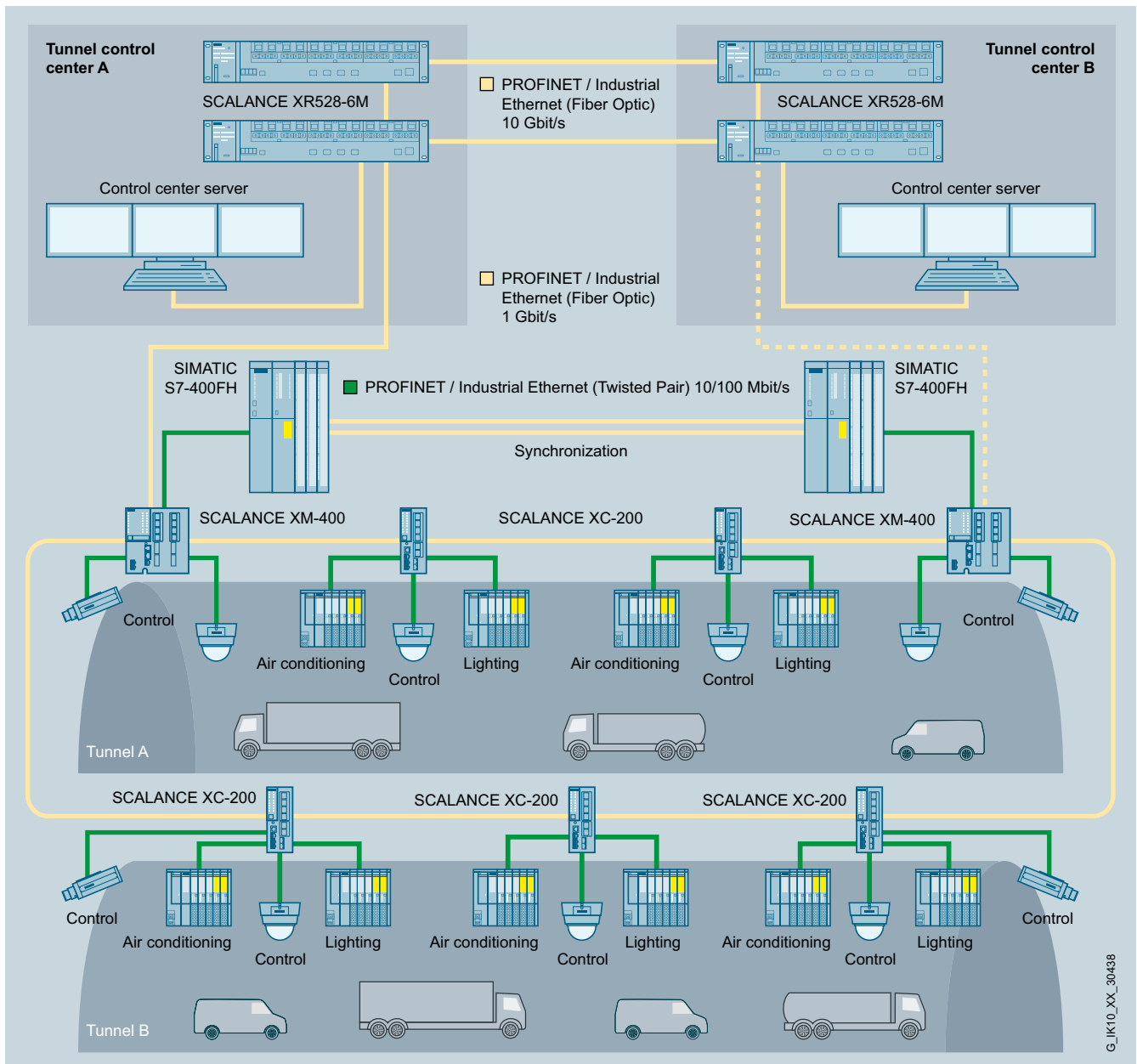
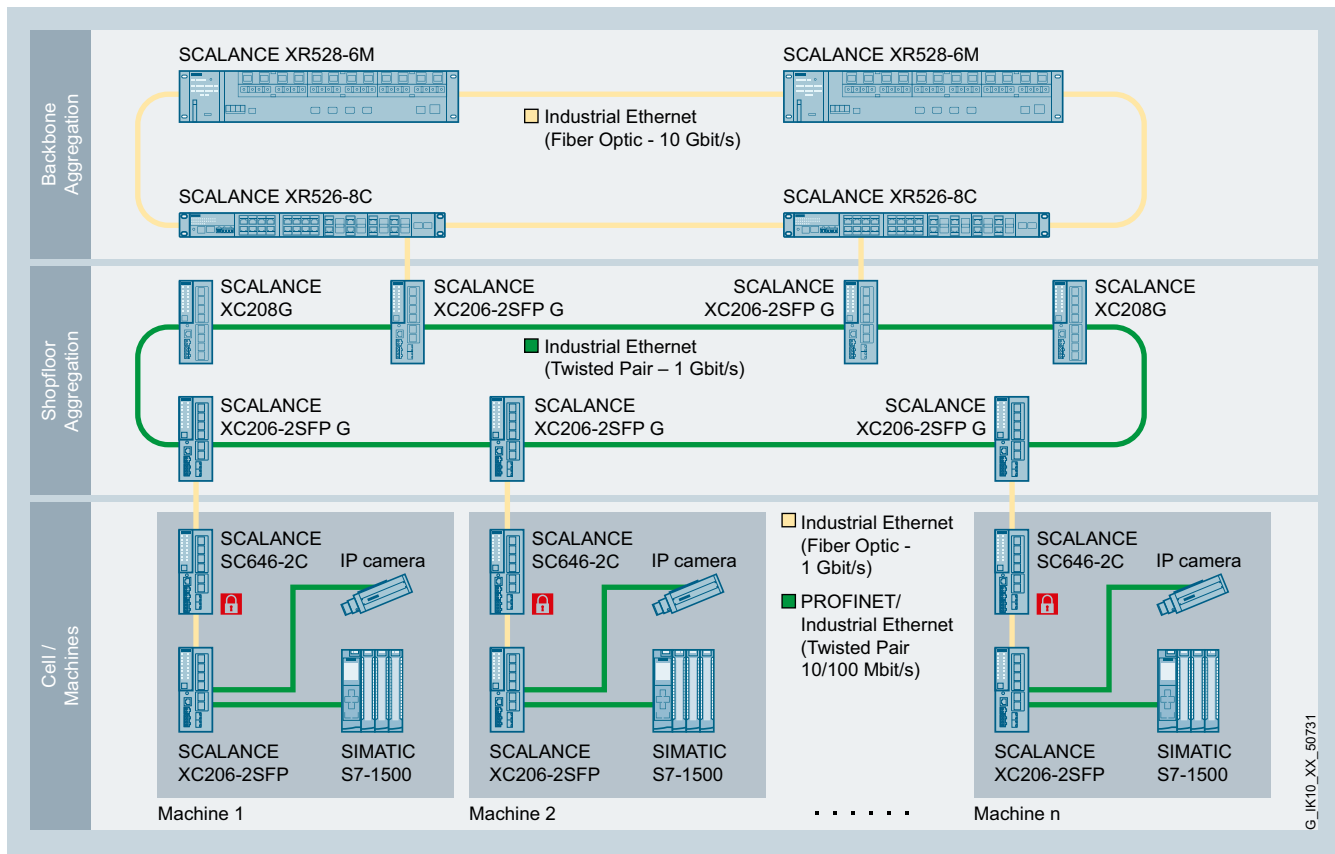Network structure with IP cameras in a tunnel

Order is essential

In addition to high data rates for the transmission in the network, clarity and simple administration are crucial factors for the smooth operation of the network.

To this end, the network is typically divided into different levels that are based on the data streams and the tasks. At the machine/cell level, the end devices – such as controllers, field devices, or HMI panels – are connected with Industrial Ethernet protocols – such as PROFINET – via switches. In addition, as mentioned above, IP cameras are integrated into the network. Via the Ethernet cable, these cameras not only can be supplied with data, but also with electricity by means of Power over Ethernet (PoE).

Since there are often several cells per production hall, they are brought together in a hall network for structuring purposes (shop floor aggregation). The various hall networks are then combined further at a higher level termed the backbone aggregation, which provides a secure connection to the office IT.

For smaller machine networks, the integrated switching functionality can be utilized. For the machine-oriented networking, unmanaged switches can be used. XC-200 switches can be used to establish fast Gigabit connections for the networking within a cell or for the networking between multiple cells (shop floor aggregation).

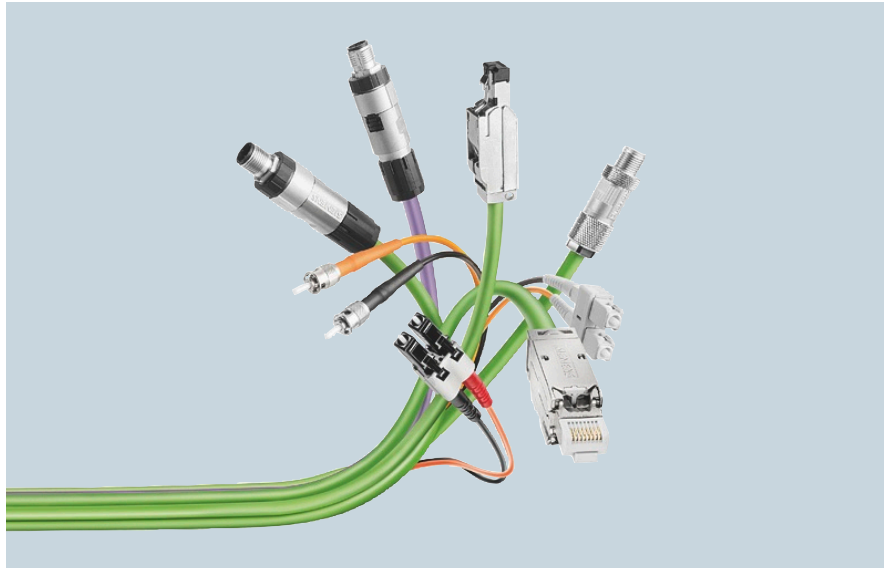Structuring of an industrial network – even with IP cameras

To handle the increasingly complex networks, greater functionality and more comprehensive diagnostic capabilities are required in addition to the data rate. These are offered by the SCALANCE XC-200 in the form of a managed Industrial Ethernet Layer 2 switch.The XC-200 switch features Virtual LANs (VLANs) for the structured division of large networks into smaller, logical subnetworks. Through the logical separation, the broadcast load can be reduced, sensitive areas be separated from the main network, or the network be split into logical work groups. Furthermore, when using multicast protocols, e.g., for video applications or with EtherNet/IP, the multicast load on the network can be effectively reduced. In doing so, the switch can learn multicast sources and targets through IGMP snooping (Internet Group Management Protocol) – thus filtering the multicast data traffic and limiting the load on the network.

Even with large amounts of data:
Easy configuration and diagnosis

With the ever increasing amounts of data, which is processed by the Gigabit infrastructure, a comprehensive network management becomes essential. This is performed by the network management software SINEMA Server, which provides monitoring and transparent diagnostic capabilities for the network infrastructure.

The use of the managed Layer 2 switches as PROFINET devices and the seamless integration into the central TIA Portal engineering software allow for an easy configuration, with which the automation specialist is already familiar from other SIMATIC components. For the implementation of a plant configuration consisting of controller, I/Os and end devices, the SCALANCE XC-200 switches can be very easily incorporated into the project and be centrally managed via the TIA Portal. The real-time protocol most frequently used for this, PROFINET, is likewise supported. Its versatile application is further enhanced through the support of the EtherNet/IP profile and the integration into the EtherNet/IP diagnosis. Variants with pre-parameterization for EtherNet/IP networks reduce the commissioning effort.

An increasingly important aspect focused on by the industry is the simple and intuitive operation – usability in the technical jargon – which in the private sector is expected as a matter of course. Exposed LEDs provide for a quick diagnosis at a glance. On the software side, the configuration is supported not only by the text-based CLI interface, but also by a web server, in which the settings can be made intuitively.

Cabling for the full bandwidth – from 10 Mbps up to 10 Gbps

Connecting the full bandwidth: electrically or optically

Gigabit connections can be set up electrically or optically. In contrast to the four-wire copper connections for Fast Ethernet (100 Mbps), Gigabit requires eight-wire copper cables (Cat5e or higher). Lower data rates, such as 10 Mbps and 100 Mbps, can also be transported via this cable. The data rate is then dynamically negotiated and set between network participants by means of auto-negotiation. For optical connections, two-wire fibers are typically used: one for the transmitting direction and one for the receiving direction. In this case, the data rate cannot be set – as it is permanently defined by the optics of the transceiver.

For the quick and individual commissioning of electrical Gigabit connections, quick assembly systems provide assistance. Without special knowledge, the FastConnect quick assembly system can be used to fabricate eight-wire Gigabit connections at the required length and establish the connection.

The Gigabit FastConnect plug provides effective strain and bending relief by latching onto the retaining collar of the SCALANCE XC-200. The wide selection of FastConnect cabling technology delivers a coordinated, industrial-grade portfolio of cables for the connection of Gigabit ports.

Gigabit is becoming the standard in production networks due to the increasing number of communication participants in the network and the simultaneously growing demand for bandwidth, e.g., resulting from the widespread use of IP cameras. Thanks to the Gigabit variants and the broad range of functions, the SCALANCE XC-200 switches meet the requirements for a future-proof, industrial-grade Industrial Ethernet switch on the cell level and in the hall network. Furthermore, the XC-200 switches provide investment protection – as the hardware is prepared for future technologies.

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