

Finding Interconnect Solutions for Rugged Environments

Greg MacDonald, Distribution Manager, Amphenol CS – Commercial/Industrial Business Unit

KEY TAKEAWAYS

- Industrial Ethernet is the protocol to achieve faster, better, less expensive production.
- The Ethernet factory model's single network automation streamlines operations.
- Modern manufacturing technology requires new interconnects.
- Key features of ix Industrial and SPE support high performance.
- Amphenol provides industrial Ethernet solutions for modern factories.

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OVERVIEW

Smart factories are integrating a wide range of sensors, actuators, displays, control interfaces, and other types of devices in manufacturing environments. Most of these are harsh environments with physical and electromagnetic demands that are uncommon in the home or office. The right interconnect solution will deliver highly reliable support in these environments while continuing to offer high performance as factories move toward Industry 4.0.

Amphenol offers competitively priced Ethernet interconnect solutions that support zero downtime and scalability. With all tooling done in-house, Amphenol is able to meet shorter lead times for product delivery and requires lower minimum order quantities than most other suppliers.

CONTEXT

Greg MacDonald discussed trends in the industrial automation sector and why industrial Ethernet is the protocol of choice to achieve Industry 4.0.

KEY TAKEAWAYS

Industrial Ethernet is the protocol to achieve faster, better, less expensive production.

Driving the need for more automation, real-time process control, zero-defect manufacturing, and efficiency improvements are continuing increases in demand, quality control requirements, lead-time extensions, and cost-reduction requirements. Behind these rapidly changing requirements are multiple trends in the industrial space, including:

- **Industry 4.0.** Also known as the next Industrial Revolution, the Industrial Internet of Things (IIoT) is focused on increased connectivity between devices and equipment on the factory floor and the cloud.
- **Single protocol.** Rather than multiple layers with different protocols, having a single protocol streamlines the communication channel between cloud and factory floor, creating a seamless connection.
- **Higher speeds, data rates, and scalability.** With a significantly increased number of connected devices, all operating at different speeds, products that can handle variation and volume will be necessary.
- **Greater port density.** More devices will require a greater port density to handle the increased connectivity.
- **Industrial-specific (rugged) form factors.** Factories can be harsh environments. Products need to be rugged and include protection against dust, water, and/or high temperature.
- **Power to the device.** Establishing and configuring power points is expensive. Delivering power to devices through the connecting cables, such as through power over Ethernet (PoE++) or power over data line (PoDL), can reduce associated costs.
- **Factory/data analytics.** Analytics help operations teams know if there is going to be a problem before it happens. With the full connectivity of IIoT, advanced notice of impending problems can help get corrective maintenance scheduled before failure.

- **Connectivity between new factory automation and legacy equipment.** The transition to Industry 4.0 will take time, making it critical to be able to connect new factory automation with heritage (old) equipment.

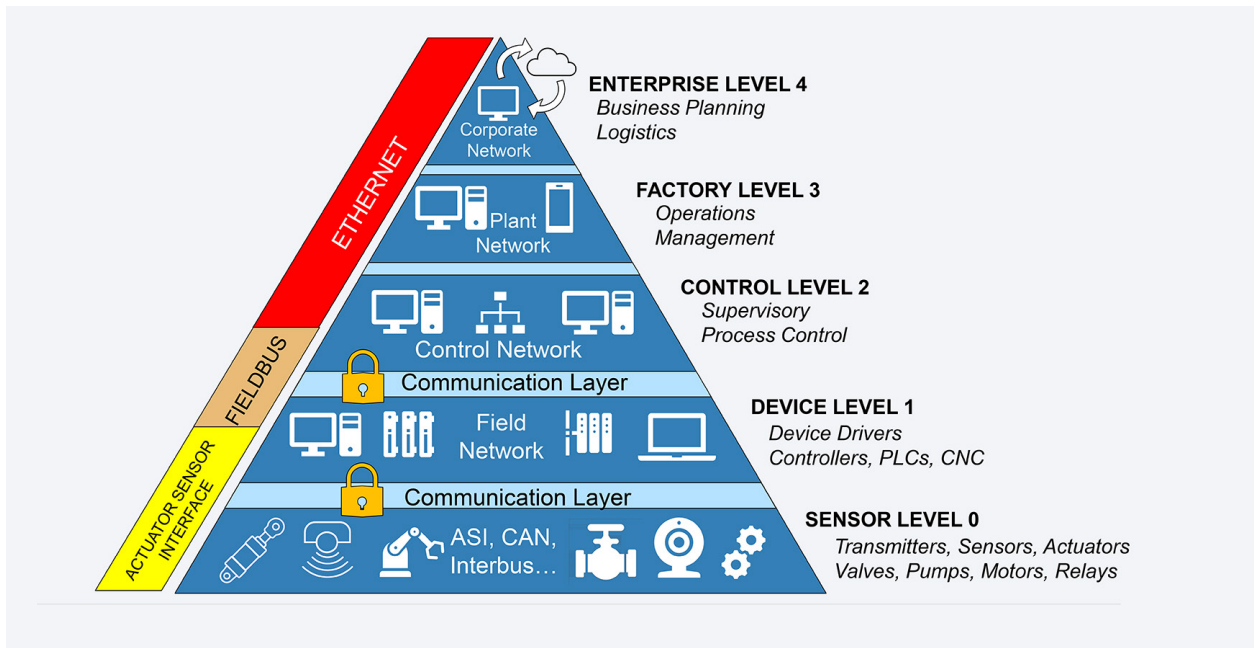
Industrial Ethernet is the protocol to enable and sustain these drivers and trends.

Greg MacDonald, Amphenol CS

The Ethernet factory model's single network automation streamlines operations.

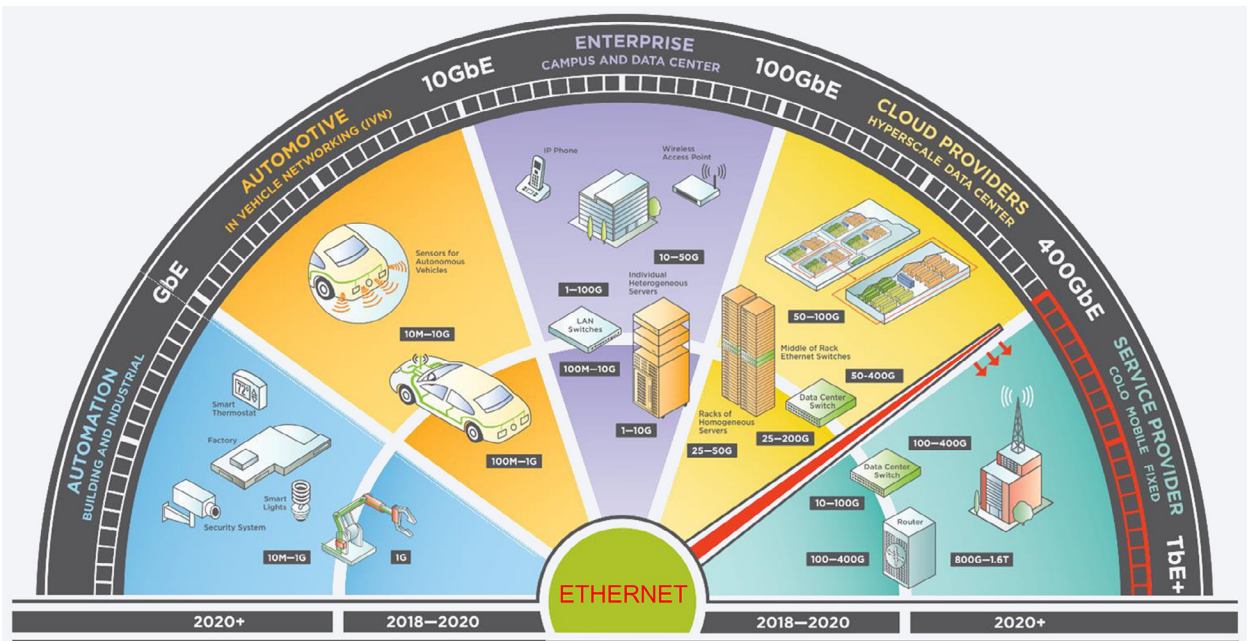
In a traditional factory automation communication system, Ethernet is used at the upper levels, but upon reaching the control network, moving down to the factory floor, that changes. Within that system, there tend to be multiple networks, protocols, and interfaces, requiring protocol conversion and gateway equipment to communicate between levels. This adds cost and latency and makes scaling challenging.

Figure 1: Traditional factory automation communication hierarchy



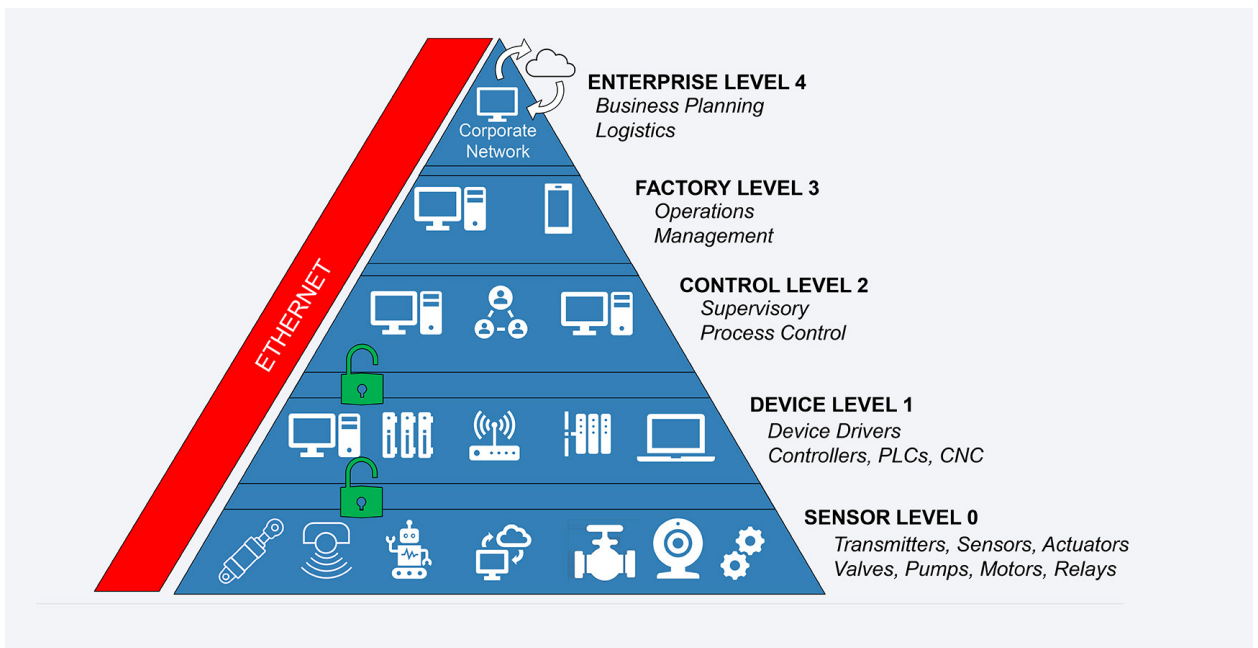
This is where Ethernet protocol comes into play. Although there are different types of Ethernet based on operating speed and type of media being used, all versions of Ethernet are compatible with each other. Ethernet is used across a wide variety of industries. Compared to other industries, Ethernet adoption has been relatively slow in the industrial and building automation spaces, primarily due to the lower rate of connectivity within those segments. However, as Industry 4.0 grows, Ethernet is rapidly being adopted as the protocol of choice in industrial automation systems.

Figure 2: Ethernet protocol is used in a broad spectrum of industries and applications



In an Ethernet factory model, the same Ethernet protocol is used from the cloud to the factory floor. With a single network, single protocol, and common interfaces, protocol conversion is not required, contributing to reduced costs, real-time data speeds, and improved scalability. And because every device is addressed, the Ethernet factory model enables a virtual factory (digital twin) setup for running simulations before going live with a test system.

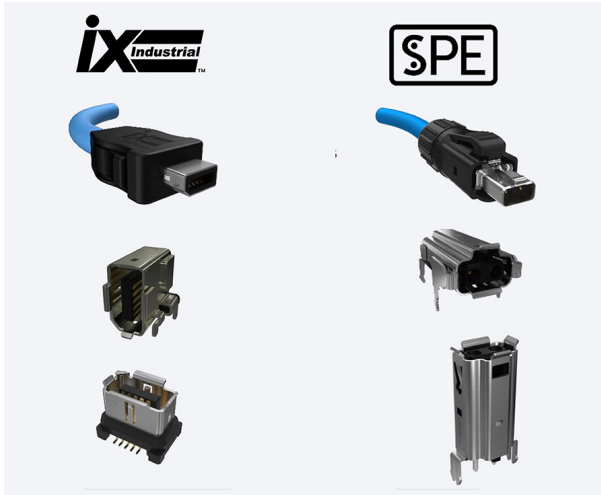
Figure 3: Ethernet factory automation communication hierarchy



Modern manufacturing technology requires new interconnects.

The explosion of manufacturing technology has resulted in a notable variety of interconnects, but as technology continues to evolve, some connector types that have been in use for a long time, such as the RJ45s, can no longer fit the requirements of next-generation applications. For new technology and in Ethernet-connected factories, newer interfaces, including the **ix Industrial** and the **Single Pair Ethernet (SPE)**, are providing significant improvements and advantages.

Figure 4: ix Industrial and SPE interconnects

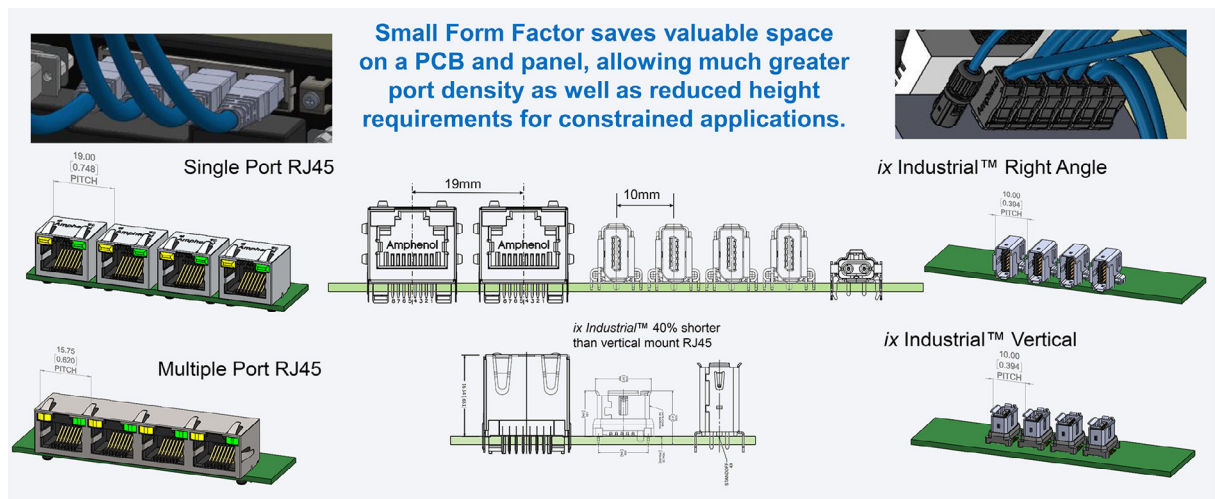


Advantages of ix Industrial and SPE interconnects

Characteristic	Description
Small form factor	High port density for device proliferation and scalability* Perfect for small devices such as sensors and cameras
Speed/EMI	Supports and protects operating speeds in complex network environments
Ethernet protocol	Eliminates protocol conversions for factory automation and robotics
Familiarity/ease of design	Same silicon and magnetics as mod-jacks
Supports power to devices	Eliminates the need for power outlets
Standards group acceptance	Meets Cat6a per TIA568.2-D and PROFINET standards
Data analytics	Facilitates cloud-to-sensor data analytics for the IIoT factory
IP-rated	Both IP20 touchproof and IP67 dust- and moisture-compliant solutions
Rugged/field terminable	Designed specifically for industrial applications
Broad solution portfolio	Vertical and R/A board connectors, cables, and more
Multi-sourced	Assures continuity of supply
Two-wire solution	Reduces cable bulk, lighter, facilitates tighter bends, and lowers cost

*The ix Industrial and SPE interconnects are 75% smaller than a standard RJ45 modular jack, meaning that almost double the number of ports can be accommodated within the same physical space.

Figure 5: Comparing the form factor of ix Industrial to RJ45 interconnects



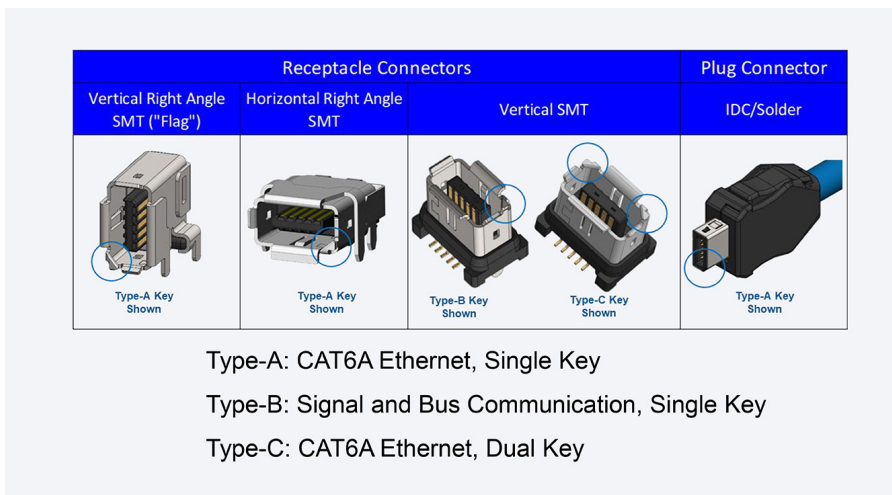
Key features of ix Industrial and SPE support high performance.

The ix Industrial and SPE interconnects are ideal for data networks, robotics, automation, edge equipment, and other industrial applications. These new interconnects have a compact design and standardized interface for a variety of industrial environments, and offer high performance across multiple areas, including:

Optimized cabling

The SPE uses two wires, which reduces cable size, weight, and cost. The SPE operates at a lower speed for single devices. The ix Industrial has four pairs (eight wires) for higher-speed applications and ten positions with five-pair capability, supporting four-pair Ethernet with two remaining wires that can be used for additional signal or power if needed. The SPE and ix products are easily connectable to the end of a cable. Amphenol also offers pre-made cable assemblies for ease of sourcing and quick connections.

Figure 6: ix Industrial keyed housing



Signal integrity and shielding

Both SPE and ix meet the insertion and return loss requirements for signal integrity. SPE can achieve 1Gbps to 40 meters, or 10Mbps out to one kilometer, of cable length, and ix is rated at 10Gbps out to 100 meters. Both are also full-metal shielded through the mated pair to ensure protection from radiated emissions to maintain signal integrity.

Electrical

SPE uses PoDL, while ix uses PoE++, which is the highest power level of the spec. Both interconnects can accommodate more power than what the spec defines, which provides excellent plug-and-play connectivity, making it easy to scale up a factory automation process when adding new devices.

Environmental and Mechanical

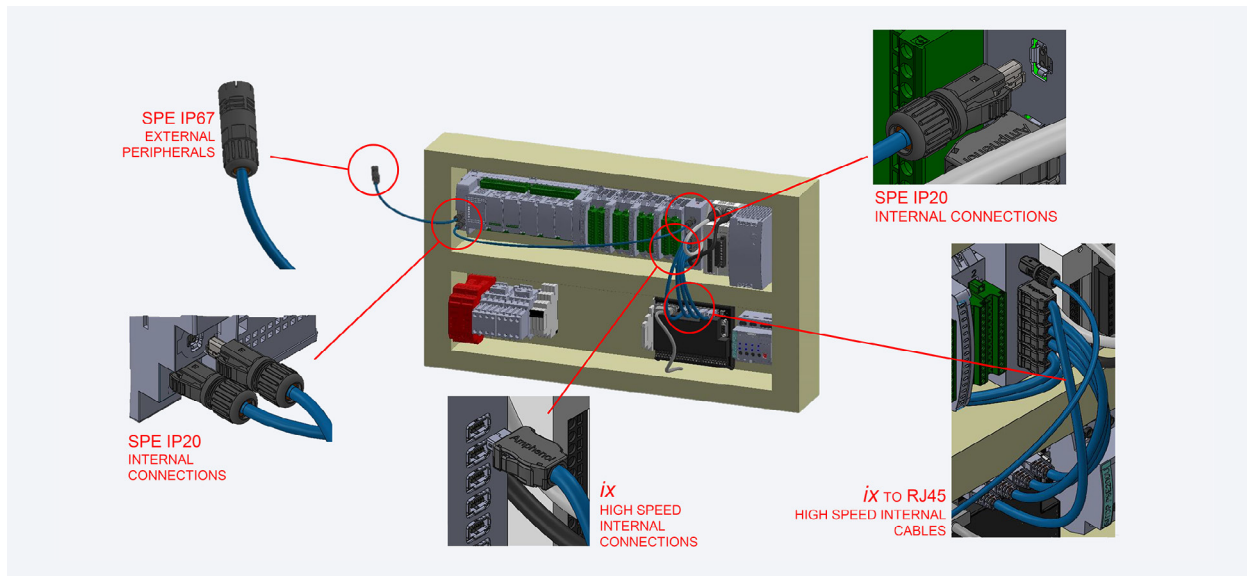
The SPE has a single metal latch for a strong, durable connection. The ix Industrial has a pair of latches on either side, providing good retention to the mating connector. Both types use the IP20 finger-proof design with recessed pins and sockets to ensure safety and protect contacts from damage over a temperature range. (IP6X versions are also available.) The contact design of both types ensures long mating life.

Figure 7: 3M Twin Axial External Assembly cable portfolio



Standardization

The standards governing SPE and ix are supported by multiple suppliers, which makes it easy to connect across manufacturers and devices. Particularly as factories adopt new technology, interconnection will become increasingly important. In an industrial control cabinet, for example, there will be multiple connections required, including a programmable logic controller, input/output ports, Ethernet switch, sensor control, power supplies, vision system, controller, and relays. All of these connections, whether internal or external, can be made using SPE or ix connectors.

Figure 8: Connections to, from, and within an industrial control cabinet

Amphenol provides industrial Ethernet solutions for modern factories.

Amphenol is committed to being one of the premier suppliers offering industrial Ethernet interconnect solutions. Its products are fully tooled and interchangeable with one another, and Amphenol does not outsource its products or tools, which allows the company to offer lower pricing than its competitors with a shorter lead time, with lower minimum order quantity.

The new **ix-MAG** connector is a product unique to Amphenol. Integrating magnetics into the connector, rather than on the PCB, which saves valuable PCB real estate for other components. The ix-MAG maintains the same 10-millimeter spacing as the ix Industrial for increased port density and is also PoE++ compatible. The ix-MAG is available in single port configuration, with different plating options.

We have a strong product portfolio that has expanded to keep up with the rapidly growing industrial Ethernet market and we have a proven record of being first to market with products for evolving industrial standards and with innovative solutions for future needs of the industry.

Greg MacDonald, Amphenol CS

ADDITIONAL INFORMATION

Learn more [TTI & Amphenol](#)

BIOGRAPHY



Greg MacDonald

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Greg MacDonald is Amphenol CS's Distribution Manager for the Commercial/Industrial business unit (BU). With over 25 years of experience in the electronics component and interconnect industry, his knowledge of the diverse product portfolio helps customers identify the right interconnect solution for the application. Greg works very closely with the Product Management, Engineering, and Global Sales Team, to address customer requests and share the latest interconnect technology from Amphenol CS.