Ethernet through the ages

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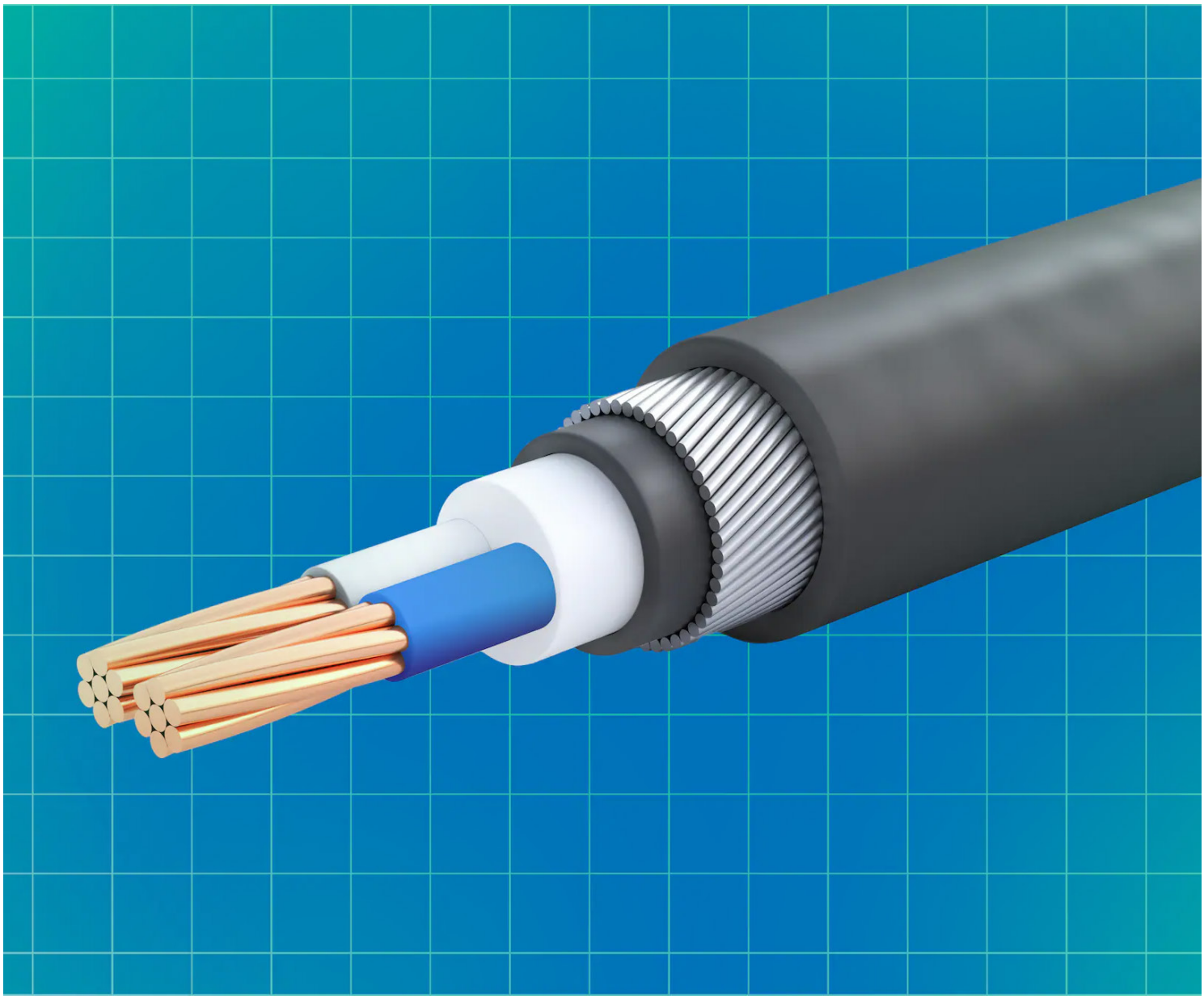

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Ethernet was commercially introduced in 1980 and first standardized in 1983 as IEEE 802.3. The technology has been refined to support higher bit rates, more nodes, and longer link distances but retains much backward compatibility. Over time, Ethernet has largely replaced competing wired LAN technologies such as Token Ring, FDDI and ARCNET.

Industrial requirements

The adoption in many industrial environments has never been free from trouble, however. Industrial control poses some requirements that are difficult to meet for a communication system that by design brings some degree of latency and lacks prioritization in its elementary protocols. This led to an interesting situation in the 20th century; where many enterprises used Ethernet only in the administrative area and various types of Fieldbus technologies on the manufacturing floor. Obviously, this was an obstacle to higher degrees of integrated automation control. For that reason, various industrial initiatives competed with each other in the 1990s to find a new standard combining the advantages of Ethernet with the real-time and deterministic demands of industrial communication.

While there was no clear winner among these long-forgotten initiatives, a few Ethernet sub-standards have emerged, mainly LANified Fieldbuses. Protocols for Industrial Ethernet include EtherCAT, EtherNet/IP, PROFINET, POWERLINK, SERCOS III, CC-Link IE, and Modbus TCP. Many industrial Ethernet protocols use a modified MAC layer to provide low latency and determinism. Components used in plant process areas must be designed to work in harsh environments where extreme temperatures, humidity, and vibration exceed the ranges for information technology equipment intended for installation in controlled environments. The use of fibre-optic Ethernet variants reduces the problems of electrical noise and provides electrical isolation.

A less rigorous definition of Industrial Ethernet uses standard Ethernet protocols with rugged connectors and extended temperature switches in an industrial environment for automation or process control. This makes sense, as standard Ethernet makes systems like Programmable Logic Controllers (PLCs) more interoperable and allows for enterprise level communication.

Flexible, ruggedized, and interoperable

In current industrial environments, a mix of both approaches is used, combining rugged hardware with ruggedized protocols. This type of industrial Ethernet combines physical data layers based on standard Ethernet protocols, networking and transport layers based on internet protocols, and an application layer ensuring real-time data transmission for specific operations.

Industrial Ethernet is also the basis for implementing the digital industrialization known as Industry 4.0. With better interoperability, the ability to use peer-to-peer architectures, have more than two nodes on a link, and use standard networking hardware, Industrial Ethernet networks can be the backbone of the communication system. It can connect a variety of different systems and machines, ranging from nanosensors to enterprise-level machinery as well as users in distributed locations. With increased speed and the ability to use universal high performance (Cat5e/Cat6) cables, Industrial Ethernet has the potential to improve network and system performance allowing it to catch up with the developments happening within the technology.

Today industrial Ethernet has more or less become the de facto communication in modern digitalized manufacturing sectors. Industry 4.0 and IIoT are enabling a shift from a hierarchical automation model (with independent communication systems at the device, cell, control, and enterprise Levels) to automation in a decentralized network, where all connected devices have IP addresses as per Industrial Ethernet protocol. Implementing Industrial Ethernet in demanding conditions requires the use of advanced cables and connectors that can withstand harsh conditions like vibration, liquids, dust, chemical ingress, and electromagnetic interference.

Apart from Industrial Ethernet connectors and cable systems, the quality and reliability of all the system components are deciding factors in determining how quickly systems can be upgraded and adopt Industrial Ethernet.

Single-pair Ethernet connections

Single Pair Ethernet or SPE is the next-generation Industrial Ethernet, replacing the traditional co-axial twisted cable lines. The Single Pair Ethernet Connector eliminates the need for two or four pairs of cables to just a single pair, thus saving space and enabling a comprehensive and cost-effective array of standardized communication protocols. SPE Connectors can rely on existing architectures and extend connection up to 1000 meters with PoDL (Power over Data Line) capability guaranteeing maximum flexibility. SPE eliminates slow, expensive and complex Fieldbus protocols and connections by simplifying and standardizing existing and new industrial network systems.

In this way, SPE connectors for Industrial applications bring direct Ethernet connectivity to peripheral devices like sensors, actuators, and vision system cameras that operate at speeds up to 1GBit/s. The infrastructure support for the next generation of automation technologies like IIoT and Industry 4.0 is simplified with SPE.

Figure 1: Amphenol ICC Single Pair Ethernet IP20 Connectors *(Source: Amphenol)*

These **IEC63171-6 compliant industrial Ethernet connectors** from **Amphenol ICC** are rated IP20, with sealed IP65/IP67 versions coming soon, are mechanically robust and feature secure latching with 360° shielding for excellent performance in harsh environments. They come with current handling up to 4A in the right angle and vertical PCB mount versions. The SPE jacks mate to field terminable plugs, also available as factory assembled finished cable assemblies providing a complete shielded interface with metal latching features and easy installation. Amphenol ICC´s SPE connectors are compatible with other SPE Industrial partner network products and provide innovative, flexible solutions.