Single Pair Ethernet Association



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Single Pair Ethernet: What It Is and Why It Matters

Technology Insight

Connecting the Industrial Edge

The factory floor is getting smarter. More-sophisticated sensors collect more information. Machines communicate with other machines. Buildings continuously monitor everything from temperature to energy use. And connected devices increasingly need to send information from the very edge of an operation into larger enterprise and cloud-based systems.

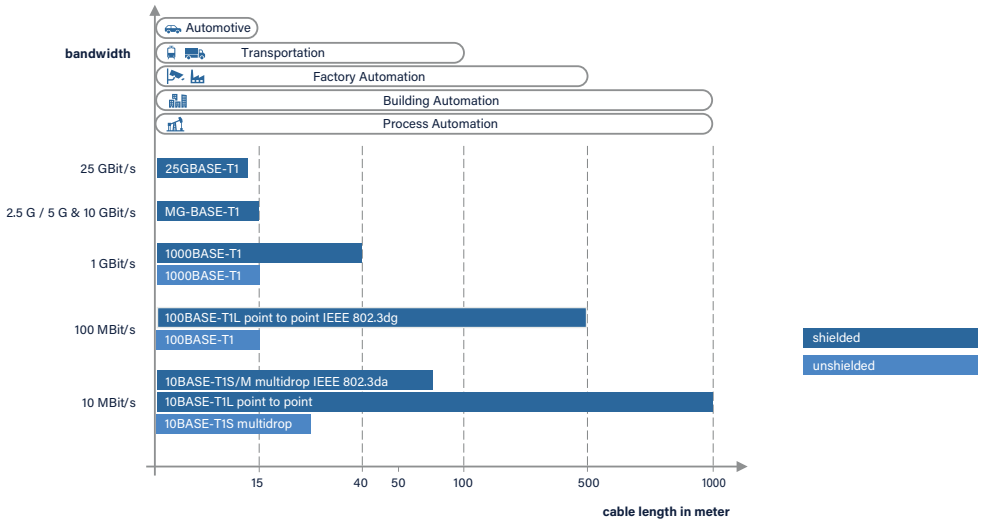


Figure 1: Different SPE topologies

In Operations Technology, the challenge is using technology that wasn't designed for industrial applications, leading to risks with interference from heavy machines, limited distance and difficulty in precisely connecting multiple wires. Fiber is often deployed as a costly workaround, but it can be fragile, difficult to retrofit with new connectors and expensive to install and maintain.

Single Pair Ethernet technology, or SPE, offers a new approach. Instead of the two or four pairs of wires used in conventional Ethernet, SPE transmits data via a **single twisted pair**. Depending on the application and standard, this emerging protocol can provide high-speed communications across distances ranging from a few meters to as much as 1,000 meters.

Its signaling is designed to withstand electrical noise and interference from heavy machinery over shorter distances, supporting reliable communication in industrial environments. SPE also simplifies installation and maintenance: its two wires can be connected in either orientation, many connectors require no tools, and its durable copper cabling is easier to repair or modify than fiber, without specialized equipment or training. With Power over Data Line (PoDL), the same pair can carry both data and electrical power.

What exactly is Single Pair Ethernet?

SPE represents the next generation of Ethernet standard as it delivers communication over one twisted pair of copper wires and designed with industrial environments in mind. This new physical connectivity extends all the desired benefits of conventional Ethernet to places where it might be too bulky or limited by distance. That physical layer is the only difference from classic Ethernet, as the protocols, transports and application remain the same.

Most importantly, this protocol - now a global industry-adopted uniform connection system – doesn't require another complete communications environment. Instead, it can be integrated into and support established Ethernet-based protocols, helping connect devices at the sensor and field level with the larger Ethernet network.

What makes SPE different?

Two capabilities stand out: distance and power.

Certain SPE standards can transmit data over distances up to 1,000 meters, a marked advantage over the 100-meter limit commonly associated with traditional copper Ethernet, along with improved reliability. On top of that, PoDL capability can simultaneously supply both communications and electrical power through that single pair of wires.

That combination can eliminate separate power cabling for many devices, including sensors. It also means fewer cables and connectors, less material (saving space and weight), and potentially simpler installation and maintenance. SPE is easier to work with than either traditional Ethernet or fiber.

Why does SPE matter for industrial automation and IIoT?

More connected devices mean more data, but collecting that data is only useful if it can reliably get where it needs to go.

In step with recent significant upticks in industrial use of Ethernet, SPE can extend Ethernet connectivity directly to sensors, actuators and other field devices without requiring additional gateways. That creates a more consistent communications path from the device level into IIoT and enterprise systems. The result can be easier access to real-time information for monitoring, diagnostics, process control and predictive maintenance.

SPE delivers end-to-end communications from the sensor to the cloud. In other words, it closes a communications gap between the factory floor and the rest of the digital enterprise.

Finally, the simplicity of installation and operational dependability is critical in an industry suffering from a shortage of skilled workers.

Who can benefit from SPE?

SPE originated in the automotive industry, where space and weight are at a premium, but its potential applications extend much further. They include industrial and factory automation, robotics, process industries, building automation, infrastructure, energy and IoT applications. Within those fields, SPE delivers game-changing connections that close the “last mile” of the plant environment.

The use cases are equally broad: sensors, cameras, barcode readers and robotic systems; HVAC, lighting and security systems in smart buildings; remote energy facilities; and infrastructure monitoring and control.

For device manufacturers, smaller connectors and reduced cabling can also create opportunities to design more compact, lighter and more efficient products.

What are the bigger benefits?

SPE is ultimately about doing more with less infrastructure. A single pair of wires can reduce cabling, connectors, installation requirements, space and weight while bringing Ethernet connectivity deeper into an operation. In addition to helping to simplify device design, fewer materials can also mean lower manufacturing, inventory and logistics requirements and a smaller physical footprint - ultimately leading to time and cost savings.

Just as important, SPE is built around industry standards designed to support interoperability. As connected devices proliferate, that common Ethernet foundation could make it easier to connect the physical world of sensors and machines with the digital systems that use their data - from the factory floor to smart homes.

That may be SPE’s biggest promise: not simply a new way to wire devices, but a simpler way to connect the increasingly connected industrial world.

Single Pair Ethernet Association

The perfect pair.

The Single Pair Ethernet Association is a global, open network of leading technology companies and partners from research and academia across various industries and application areas. Together, they pool their know-how and expertise to drive the further development and adoption of Single Pair Ethernet (SPE). Through cross-industry collaboration, the promotion of international standards, and practical solutions, the Association supports the widespread adoption of SPE as a forward-looking technology for a connected world.

To learn more about Single Pair Ethernet Association and the benefits of SPE technology, visit:

www.singlepairethernet.com/en/

Become a member

Single Pair Ethernet Association e.V.
De-Saint-Exupéry-Strasse 10
60549 Frankfurt am Main (Germany)
info@singlepairethernet.com

www.singlepairethernet.com

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