

5 Demands of Industry that Single-Pair Ethernet Addresses



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Industrial Single-Pair Ethernet (SPE) is the next evolution of Ethernet connectivity in automation, robotics, railway and other industrial applications. SPE is the transmission of Ethernet over one-pair of twisted wires, rather than two or four.

SPE has been used widely in the automotive industry for in-vehicle networking systems to replace CAN and other communication automotive solutions. The benefits of SPE have captured the attention of the Industrial Automation market, who worked with standardization bodies to create additional SPE standards to fulfill demands of the industrial market segments.

IEEE 802.3cg	10BASE-T1 – Single Pair Ethernet with 10Mbit/s up 1,000 m
IEEE 802.3bw	100BASE-T1 – Single Pair Ethernet with 100Mbit/s 15 m unshielded / 40 m shielded
IEEE 802.3bp	1000BASE-T1 – Single Pair Ethernet with 1Gbit/s 15 m unshielded / 40 m shielded
IEEE 802.3bu	Power over Data Line (PoDL) for SPE

SPE offers a comprehensive list of benefits for communication in Industrial environments. While other communication protocols may address one or two of these needs, it is the combined benefits offered by SPE that makes it the future of Industrial communications.

1. Unified, Standardized Communication Protocol for Ease of IT Integration

Ethernet is the most widely used type of wired data transmission in both IT/building and industrial environments. However, there is a gap in Ethernet usage at the edge of industrial networks when establishing connections to devices such as sensors, actuators or various peripheral devices. Instead, fieldbus systems were, and still are used due to lower cost and a longer link reach, as 2 or 4-pair Ethernet has a distance limitation of 100m while some of the fieldbus protocols can achieve communication distances of over 1,000m.

The use of fieldbus technology, however, presents some additional challenges when sending information between different levels of an industrial network. It is not possible to establish direct communication between fieldbus and Ethernet networks without a use of additional gateways or protocol translators. This adds additional cost and increases network complexity.

The development of Single-Pair Ethernet (SPE) technology addresses the main Ethernet pain point in the industrial field networks – the long data reach. With the data link extended to 1,000m, it is now possible to establish Ethernet communication from the enterprise level all the way to the sensor networks under one unified SPE protocol. Furthermore, as Single-Pair Ethernet technology is based on the standardized TCP/IP protocols, it offers possibility of utilizing various network diagnostic and monitoring protocols such as HTTP (hypertext transfer protocol), SNMP (simple network management protocol) or LLDP (link layer discovery protocol). By utilizing these tools, IT personnel and Engineers can easily monitor, diagnose and troubleshoot all devices and components on the network.

2. Lightweight, Compact and Economic Ethernet for Every Device on an Industrial Network

Ethernet has been used in Industrial environments for many years. Compared to other communication protocols, it offers several advantages, such as high speeds, high availability of standard cabling and networking hardware, and excellent interoperability between devices.

As SPE technology utilizes only one pair of copper wires, the weight of the raw cable is significantly reduced compared to the traditional Cat5 (4-wire) or Cat6A (8-wire) cables. Less

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copper in a cable translates into lower overall cabling cost, which means that utilizing Single-Pair Ethernet can decrease the cost of the cable deployment. A single-pair twisted pair cable also requires a connector with only two contacts. This means that SPE jacks require less real estate on a printed circuit board, which can provide substantial space saving for device manufacturers.



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Single-Pair Ethernet can provide excellent performance, while keeping the overall cost of deployment lower compared to the existing industrial 4 and 8-wire Ethernet solutions. Industrial Single-Pair Ethernet connectors can also be terminated onto already deployed 2-wire fieldbus cabling, which makes the transition from fieldbus protocols to SPE easy and cost effective.

3. High Speed, Bandwidth and Security for Real-time Applications

The amount of data produced by machines is increasing. Vision system cameras, for example, can produce HD video in real-time. Ability to send and receive data in real-time is also critical for many applications in an industrial network. While fieldbus protocols can provide

deterministic and reliable real-time communication, they lack the speed and bandwidth that Ethernet can provide. On the other hand, Ethernet had always struggled with real-time communication and was always labeled as less reliable compared to the fieldbus protocols in addressing real-time communication requirements.

The development of Ethernet Time Sensitive Network (TSN) technology, however, has changed the label of Ethernet as unreliable deterministic communication platform. With TSN, Ethernet can be utilized to provide very reliable, and deterministic communication that can support many mission critical applications and processes in automation networks. Ethernet can also provide superior cybersecurity compared to the bus communication protocols, as Ethernet data packets are significantly larger compared to data packets supported by fieldbus protocols. This allows Ethernet to have more encryption contained in each packet, and thus providing superior data security compared to the fieldbus technology.

Single-Pair Ethernet offers all the advantages of Ethernet, including high bandwidth and speed. SPE technology achieves a bandwidth of up to 600 MHz and is capable of Gigabit Ethernet (speed up to 1Gbit/s) making it perfectly suited for applications where a lot of data needs to be processed quickly.

4. Potential Simplification of Design, Purchasing, and Installation

Designing, building and installing a machine is a large task that requires a lot of people from engineering and supply chain. A machine is made from hundreds of components sourced from many suppliers, each with their own specifications, considerations, and lead times. Using different communication technologies creates unnecessary complexities in all stages

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of the build, such as:

- During design it means finding compatible devices to ensure interoperability or additional devices to convert data
- For purchasing it means more complex BOMs and additional components to source
- During installation it means more components to install, test, and possibly troubleshoot

Deploying an Ethernet network is also usually less expensive compared to deploying an equivalent fieldbus network. Ethernet network is typically easier to setup and it takes less time to configure and troubleshoot compared to the fieldbus technology, which translates into labor cost savings.

5. Compatible with Current and Future Network Infrastructures

Ethernet is ubiquitous and compatible with wide ranges of devices. It is the most universally used communication technology in IT environments and building networking, and it is widely used in industrial applications. Single-Pair Ethernet was developed in response to the universal use of Ethernet to fill the gap at the “edge”.

The trend of networking infrastructures is leaning towards interoperability – that is that all devices can communicate with one another. They will communicate via the existing Ethernet standard. Single-Pair Ethernet under IEEE standards will democratize Ethernet, making it available at all levels of the manufacturing floor.

Single-Pair Ethernet is the natural evolution of the technology, and adopting it reduces the risk of changing out fieldbus systems in the future.

Backed by International standards associations ISO, IEC, IEE, and TIA, Single-Pair Ethernet is set to become the go-to technology for communication in Industrial applications. In order to advance the deployment and adoption of Industrial Single-Pair Ethernet technology, several companies have joined to form the *SPE Industrial Partner Network*. This group is committed to providing transparent and clear recommendations for the development and implementation of Single Pair Ethernet.



The *SPE Industrial Partner Network* is working closely to ensure compatibility between all products in the SPE ecosystem.

As a founding member of the SPE Industrial Partner Network and developer of the T1 industrial SPE connector, HARTING is a go-to partner and source for all Industrial SPE connectivity solutions. Contact our technical experts at +1 847-741-1500 or via email at TechSupportUS@HARTING.com. You can also use our eChat function in the lower right corner of our website at HARTING.com.

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