

EVERY CONNECTION COUNTS



WHITE PAPER

FROM BOTTLENECKS TO BREAKTHROUGHS

*The Transformative
Impact of Single Pair
Ethernet (SPE)
on Industrial
Connectivity*

SPE IS TRANSFORMING HOW INDUSTRIAL DEVICES COMMUNICATE

In the rapidly evolving landscape of industrial automation, traditional connectivity methods are increasingly becoming bottlenecks to progress. While the Industrial Internet of Things (IIoT) promises a future of seamless data flow, many factories remain tethered to bulky legacy cabling and fragmented proprietary systems that require complex architectures and result in data silos.

This model struggles to meet the high-speed, real-time communication demands of modern smart manufacturing, where the sheer volume of networked sensors requires a more efficient approach to power and data transmission.

Though adoption is still in the early stages, SPE represents a breakthrough in overcoming these limitations by enabling high-bandwidth, real-time communication over a single pair of copper wires.

SPE transforms how industrial devices communicate, allowing manufacturers to extend Ethernet connectivity to the smallest edge devices and move beyond the traditional limitations of 4-pair Ethernet and RS-485 serial installations. There are many industrial applications — from discrete to process automation — where SPE offers benefits for simplified, standardized, and cost-effective communication.

3 KEY SPE TRENDS TO WATCH

By providing Ethernet communication over a single twisted pair of copper wires, SPE replaces bulky, legacy serial field installations like RS-485. As the demands of industrial automation change, three key trends are affecting the evolution of SPE technology.

1

Broad adoption across industries

SPE will gradually replace legacy cabling solutions — especially in those applications where space and efficiency matter. SPE offers a standardized single-pair infrastructure that supports both power and data over long distances with a minimal footprint. Modern industrial and IIoT applications can get improved capabilities **where space and efficiency matter**.

2

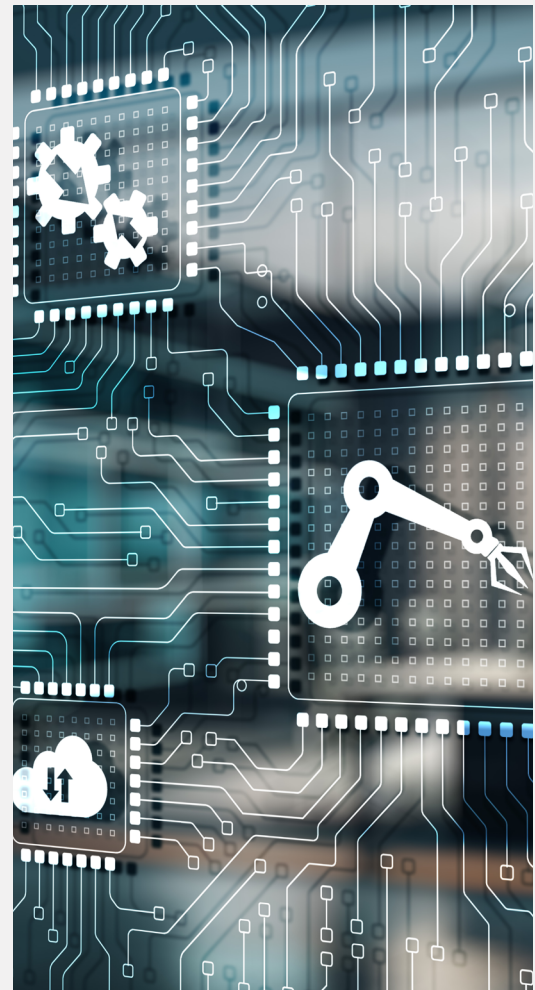
Integration with emerging technologies

SPE supports the high-bandwidth, real-time communication required for edge computing, Industry 4.0, and smart devices — enabling virtually seamless integration of sensors, actuators, and controllers across complex networks. This means smarter and more connected operations.

3

Ecosystem development and standards alignment

TE Connectivity (TE) has led the development of the IEC 63171-7 standard, which is now being adopted by partner networks to provide interoperability across devices and vendors. This helps ensure reliability in industrial environments. Ultimately, leveraging standards like IEC 63171-7 helps accelerate ecosystem adoption.



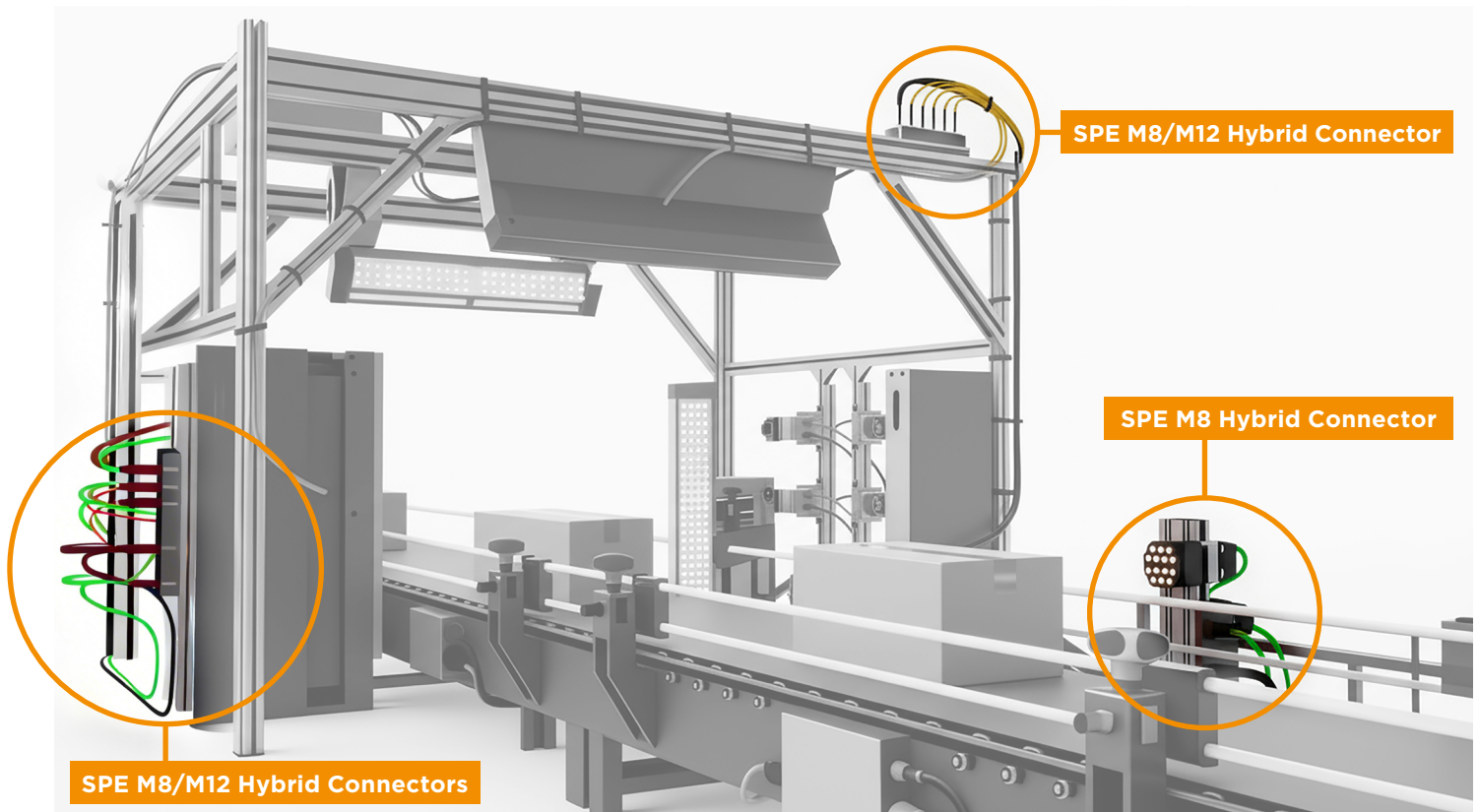
APPLICATIONS THAT CAN BENEFIT NOW FROM SPE ADOPTION

While SPE adoption is still in the early stages, there are numerous applications that can benefit now from a transition. There are two common camps in industrial automation: open systems and intra-machine connectivity. **SPE adoption is currently highest in intra-machine applications. This is due in part to M12 and M8 hybrid technology, which supports for consolidated control of all internal nodes.** Examples of applications that offer good use cases for SPE adoption include automated guided vehicles (AGVs), autonomous mobile robots (AMRs), and automated storage and retrieval systems (ASRS) that uses three-dimensional robots. In these applications, SPE via M12 and M8 hybrid connectors can simplify cabling and help reduce an operation's carbon footprint.

Warehouse management systems exemplify this architecture, integrating various sensors to identify materials in transit — whether on conveyor belts or AGVs. These sensors perform diverse functions, including handling, analyzing, and transferring real-time data for each part or package. SPE is one of the keys to transferring that data directly into the system so it is

available immediately all over the world.

Ultimately, automation OEMs want to reduce materials cost, simplify internal design, and increase reliability by using fewer parts. They can rely on SPE to accomplish that without needing to deploy an additional ecosystem.



HOW SPE ADDRESSES CHALLENGES AND OFFERS A BREAKTHROUGH FOR INDUSTRIAL AUTOMATION

Modern smart manufacturing requires real-time communication across thousands of nodes, but legacy infrastructure systems come with numerous challenges that hinder this goal. SPE can help address those challenges and deliver benefits. It is becoming the backbone of industrial connectivity for IIoT, in part because it reduces complexity in the field for these applications.

But SPE is not only about data and power transmission over a single cable. It is also about speaking the same protocol among every device that uses it, with built-in cybersecurity to avoid data silos. This delivers benefits that help solve the bottlenecks posed by legacy system architectures, including:



CYBERSECURITY

Legacy systems increased exposure to attacks and posed challenges for integration. SPE provides secure protocol support and easy segmentation.



SUSTAINABILITY

SPE requires lower material use and less cabling compared to legacy systems, providing greater ease of installation.



RELIABILITY

Legacy systems involve aging infrastructure and interoperability risks. SPE helps enable future-ready automation, with fewer failure points in the system.



DATA MANAGEMENT

SPE operates under a unified protocol for simplified architecture and interoperability compared to legacy systems, where data management required more attention and resources due to system complexity and data silos.

In the field, colors indicate the various protocols (such as green for PROFINET, red for Sercos or EtherCAT). When you look inside a machine and see different cables, it's an indicator of which "language" the system speaks. As the number of connections continues to increase, SPE reduces complexity by reducing the cables required. This also decreases a system's size and weight, which is an important benefit in space-critical environments.

HYBRID CONNECTIVITY: A BRIDGE SOLUTION

The development of hybrid connectivity solutions helps more operations to implement SPE into their existing ecosystems. TE Connectivity (TE) has introduced SPE M12 Hybrid and M8 Hybrid connectors. Both offer a standardized, single-interface solution for simultaneous power and data transmission. In addition, SPE M12 Hybrid connectors comply with the latest revision of the IEC 63171-7 standards. TE hybrid solutions include:



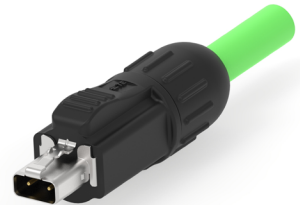
SPE M8 Hybrid Connectors

Compact 0.8 mm pitch for space-sensitive tubular sensor setups.



SPE M12 Hybrid Connectors

Standardized per IEC 63171-7; high-power delivery (up to 11 kW) for cascaded devices.



IP20 Connectors

Rectangular connectors designed for the PCB on the transmission side.

The SPE M12 Hybrid connector is designed to handle both data and high-power delivery (up to 11 kW and 16 A) within a single interface; this solution helps simplify cabling while increasing overall system reliability. By aligning with the latest IEC 63171-7 standards, TE provides an ecosystem that helps ensure global interoperability across devices and vendors. This helps allow manufacturers to transition from conservative legacy systems to agile, responsive manufacturing environments.

The goal for TE is to provide an end-to-end solution from a controlling device to a device located in the field. Circular connectors (M8/M12) are for more rugged field

conditions, while the IP20 connector option is designed for less harsh environments, like a cabinet inside a facility or protected areas of a machine.

It is critical for automation OEMs and industrial operations that want to implement SPE architecture to choose connectors that are designed to meet the latest IEC 63171-7 standards. Solutions that do not meet the standards provide no guarantee of interoperability and could result in device failures. Interoperability is the key to standardization, which is why TE has provided leadership in the evolving IEC 63171-7 standard to help ensure that end users invest in interoperable ecosystems for the future.

EXPLORE THE POTENTIAL OF SPE

The future of SPE will involve applications that we cannot currently conceive of; however, the footprint for SPE adoption in many industrial automation applications is already here thanks to M12 and M8 Hybrid Connectors. This technology is feasible and standardized, supporting OEMs and operations so they can begin deploying it in their systems.

SPE technology can move smart manufacturing forward with reliability and real-time connectivity that support the future of industrial automation. At TE, we are helping drive innovation in a fast-changing connectivity ecosystem across many industrial applications.



Read more insights From TE's experts:

Learn more about [SPE M12](#)
[Hybrid Connectors for](#)
[High-Speed Data](#)
[in Harsh Environments](#)



Learn more about [SPE M8](#)
[Hybrid Connectors](#)



Learn more about the [Benefits](#)
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About TE

TE Connectivity plc (NYSE: TEL) is a global industrial technology leader creating a safer, sustainable, productive, and connected future. As a trusted innovation partner, our broad range of connectivity and sensor solutions enable the distribution of power, signal and data to advance next-generation transportation, energy networks, automated factories, data centers enabling artificial intelligence, and more.

Our more than 90,000 employees, including 10,000 engineers, work alongside customers in approximately 130 countries. In a world that is racing ahead, TE ensures that EVERY CONNECTION COUNTS. Learn more at www.te.com and on [LinkedIn](#), [Facebook](#), [WeChat](#) and [Instagram](#).

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