SINGLE PAIR ETHERNET

Ethernet, specifically designed for harsh and weight-sensitive automotive, industrial, and smart building environments and use cases.

The data transmission over a single twisted pair with up to 1000m reach integrates established Ethernet technologies including cybersecurity, power transmission, and TSN.

SPE enables seamless sensor to cloud communication.

03/2023

KEY FEATURES

- Data transmission over a single twisted pair with data rates from 10Mbit/s to 10Gbit/s and above
- Powering of devices based on PoDL or hybrid power
- 10Base-T1L for reuse of existing field bus cable infrastructure
- Bus topology for 10Mbit/s allows an Ethernet connection half duplex for constrained devices and their powering

ADVANTAGES

- Today's installations often use a variety of proprietary communication technologies. The use of these different technologies results in the need for application-level gateways. SPE provides a single standardized technology that:
  - Integrates with existing Ethernet affording seamless visibility & connectivity
  - Harmonizes the lower communication layers thus increasing interoperability
  - Unifies configuration, operation & maintenance of the network as a whole
- The increased bandwidth to smart sensors enables the collection of process data for predictive maintenance and process optimizations
- The data transmission over a single twisted pair reduces weight and installation space

AFFECTED VERTICALS

Process Automation	Public Transport	Factory Automation	Smart Buildings	Power Gen. & Distribution

EXPECTED TIME OF ADOPTION

TECHNOLOGY MATURITY

- Several physical layer standards are finished, but some are still in progress e.g., 100Base-T1L
- User organizations are still in progress adopting the technology e.g., PI, ODVA and others
- Available PHYs and switches are still focused on the automotive market and are not yet mature regarding the industrial market
- First products and implementations outside of the automotive market are arising (farming vehicles, trucks, APL, first sensors and switches)

TECHNOLOGY CONTEXT

- OPC UA FX (Field eXchange)
- Time Synchronization and Time-Sensitive Networking (TSN)
- Cut-Through switching
- MQTT

WHY BELDEN

- Belden can offer cable, connectors and network devices – almost an entire single pair solution
- Belden has strong Ethernet expertise and the ability to develop SPE products
- Belden covers and penetrates all relevant verticals for SPE

NETWORK TOPOLOGY
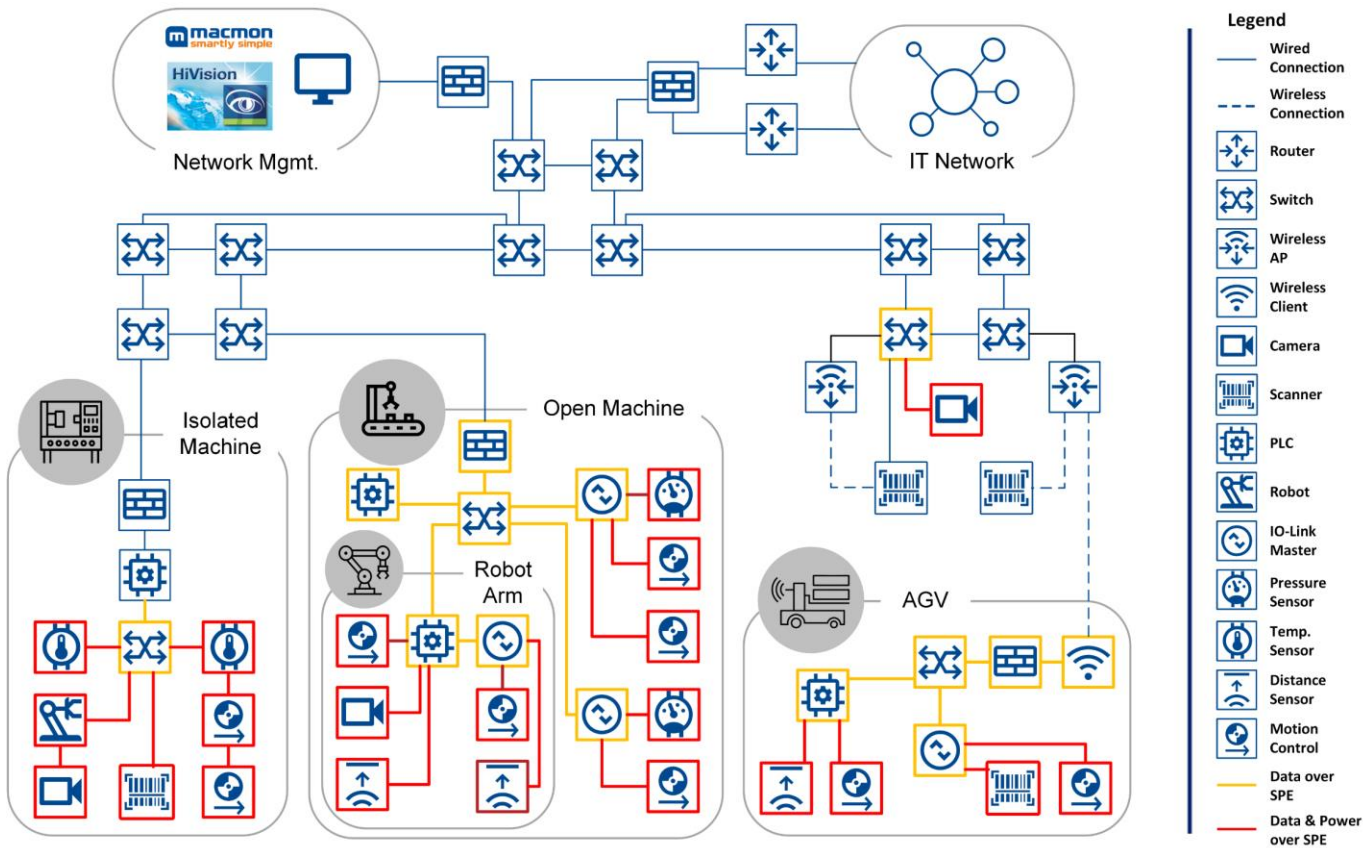
CURRENT NETWORK CHALLENGES

- Bandwidth restrictions for field device connections
- Insufficient cable length (IO-Link)
- No ethernet communication compliant to the intrinsic safe requirements of some use cases
- Small installation room (multi pair ethernet connectors are too large and too expensive)
- No visibility of the devices in the network due to gateways
- Huge effort for maintenance and configuration of the network due to different technologies in use e.g., Profibus, CAN, IO-Link, Ethernet etc.

USE CASE DEEP DIVE

- The connection to the field devices, as a first step, would make the data availabile for predictive maintenance and process optimization
- Further steps to replace multi pair ethernet (MPE) or fiber optics with SPE are related to the longer cable reach standards for SPE. These standards will save costs and simplify the cable assembly
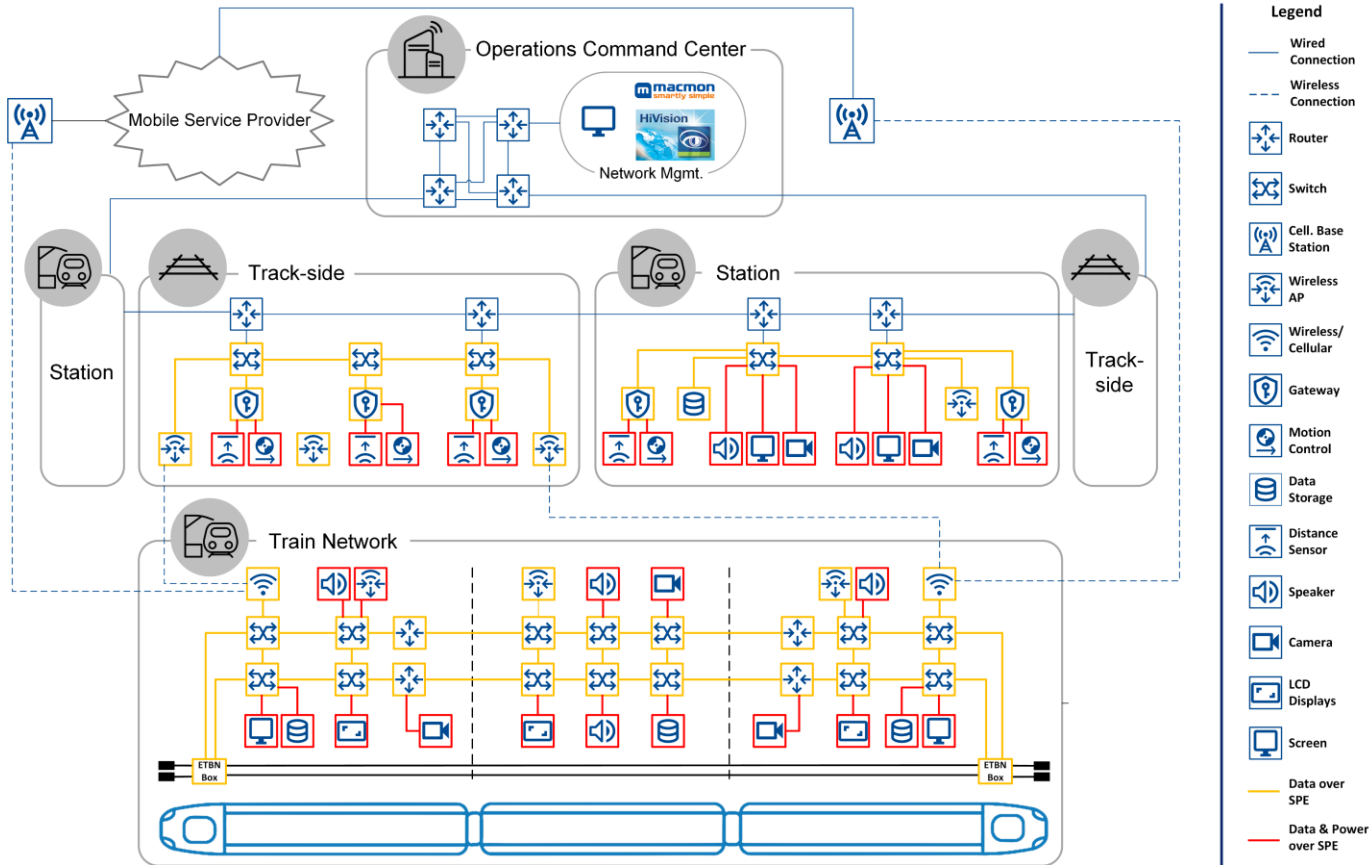
TECHNOLOGY COMPETITION

- In some use cases, IO-Link+ can be seen as a competitive technology for ProfiNet over SPE or EthernetIP over SPE.
- In some use cases multi pair ethernet will remain the leading technology

NETWORK TOPOLOGY

CURRENT NETWORK CHALLENGES

- The customer intends to upgrade a train 2-3 times during its lifetime with new/more features, therefore, weight and installation room becomes critical.
- Cable assembly for multi pair cables is more complex and fault-prone
- The current bandwidth of the backbone (100Mbit/s) is not future proof - higher bandwidth is needed. There are limitations caused by the car coupling connector.
- Missing security features of RS485 and other bus technologies.

USE CASE DEEP DIVE

- Replacement of MPE PoE by SPE with PoDL or hybrid power for e.g., bigger displays
- Replacement of Gateways / RS485 by 10Mbit/s SPE point to point or multidrop
- Easier cable assembly (1 pair instead of 2 or 4 pairs)
- EMI requirements for train applications are a challenge for SPE links with 1 Gbit/s and above
- Car coupling connector is not designed for high frequency applications

TECHNOLOGY COMPETITION

- Currently MPE or RS485, CAN or other bus systems are in use
- No other competing technology is known