AVNET ABACUS

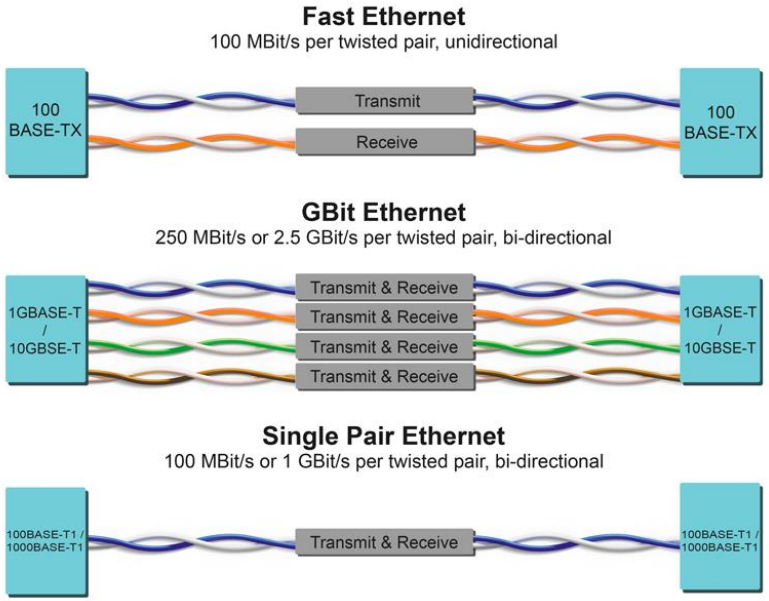
Single Pair Ethernet (SPE)

SPE overview

Background and key characteristics

Introduction to Single Pair Ethernet (SPE)

- Ethernet is one of the most widely used networking standards, defined by the IEEE 802.3 Ethernet working group
- Extensively developed to provide higher bandwidth over short distances in a 4-pair cable
- IoT applications in process, factory and building automation demand simpler Ethernet networking and require lower data rates
- SPE is a new IEEE 802.3 standard enabling Ethernet connectivity and integrated power over a single twisted pair, over long distances
- Key features of SPE:
  - simplified Ethernet connectivity from 10Mbps to 1Gbps
  - 10Mbps data rate over 1000m distance
  - lower cost, smaller, more robust cabling and connectors
  - power over Data Lines (PoDL) or hybrid power/data
  - point to point / multidrop configurations



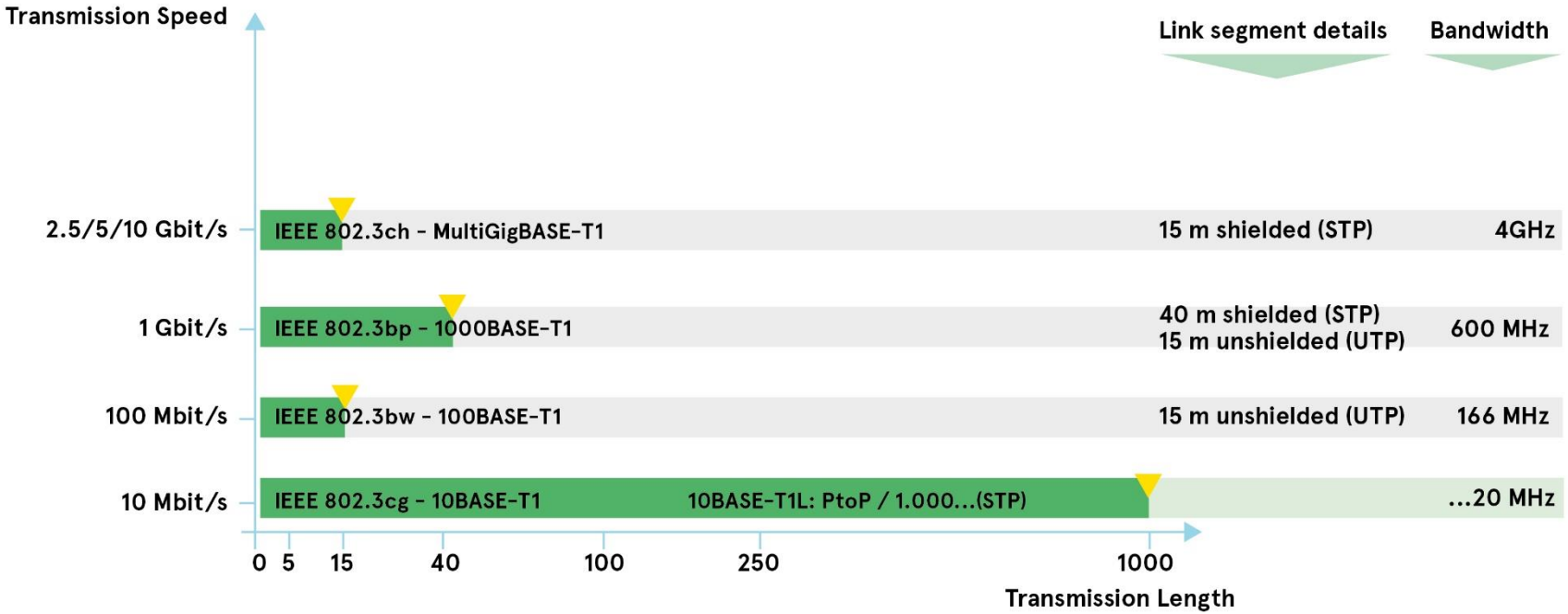
The need for SPE in Industrial IoT applications

- Ethernet is widely used in industrial and building automation environments, but is not widely deployed to edge devices
- Legacy fieldbus systems are typically preferred to connect edge devices due to their simpler, lower cost implementations
- SPE reduces the cost & complexity of connecting edge devices, enabling the advantages of Ethernet connectivity to edge sensors and actuators
- SPE enables a simpler network, removing the requirement for gateways and translators between the industrial network and its edge devices
- SPE connectors and cables are lightweight, robust and smaller size than traditional Ethernet options

SPE standards

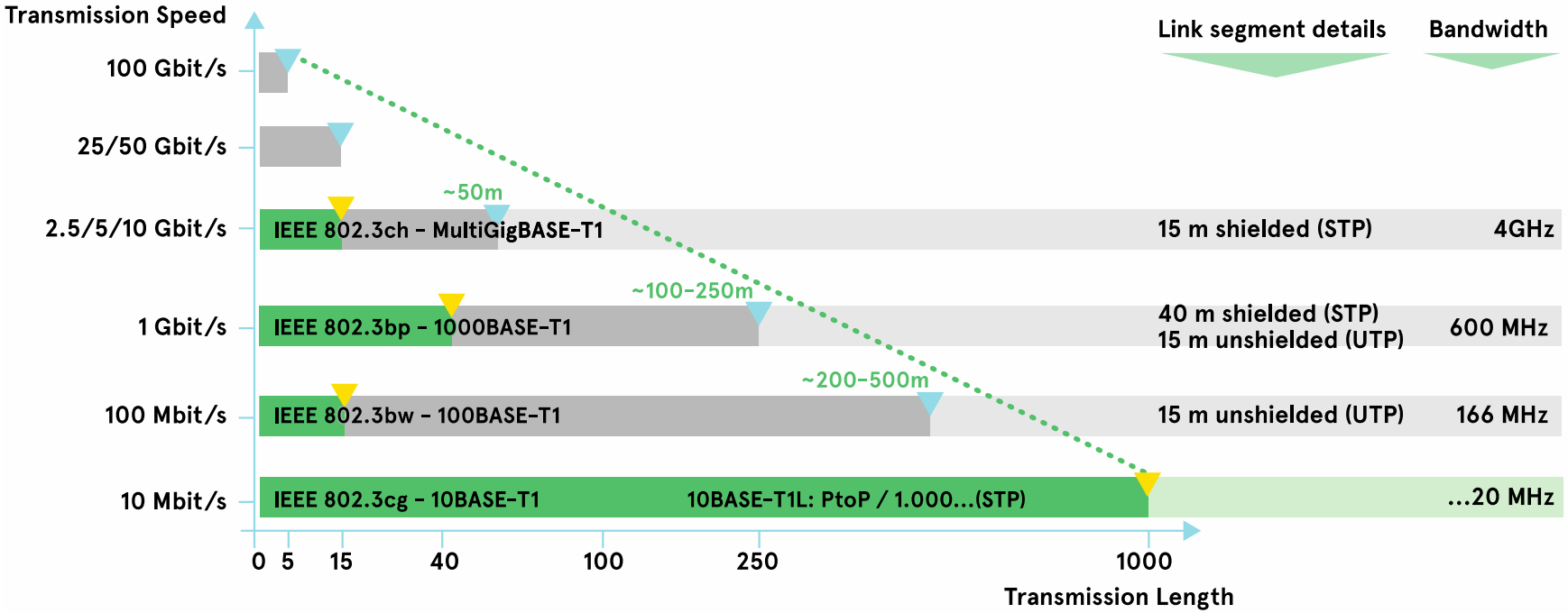
Specifications, roadmap & SPE Industrial Partner Network

Current IEEE 802.3 Standards for SPE



10Mbps data rates over 1000m distances enable wide IIoT device deployment

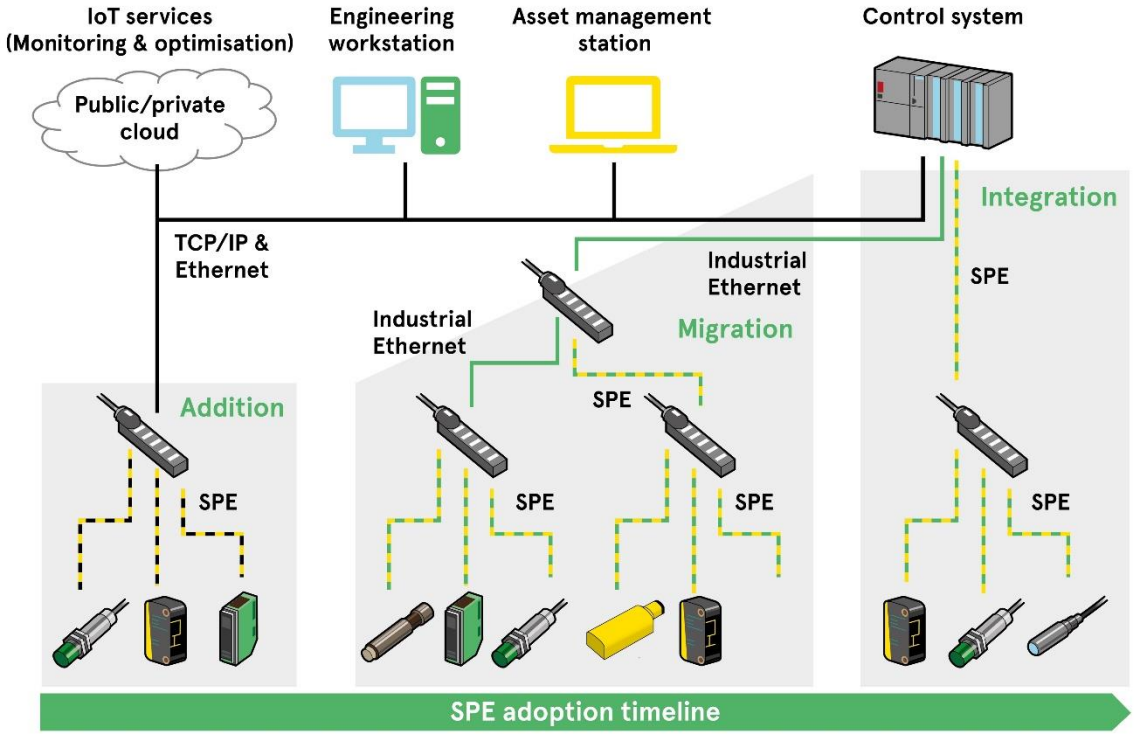
Future IEEE 802.3 standards for SPE



Future developments will enable increased speeds and cable lengths over a single twisted pair

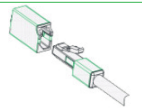
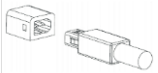
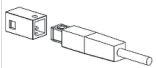
Adoption timeline of SPE

- Early adoption cases include the addition of new sensor and actuator nodes and the migration of legacy fieldbus networks to SPE
- An Ethernet based standard removes the requirement for gateways between nodes and the TCP/IP network
- Provision of power over SPE cabling enables wide deployment of new nodes
- Higher data rates will accelerate deployment of SPE in preference to and alongside other industrial Ethernet options



SPE Connector Standards

- For all industrial use cases the IEC 63171-6 connector must be used for the cabling infrastructure according to ISO/IEC 11801-3 and TIA 42
- The standard specifies SPE interfaces from an IP20 interface up to several IP65/67 M8 and M12 versions

IEC 63171	Connectors for electrical and electronic equipment – shielded or unshielded free and fixed connectors for balanced single-pair data transmission with current carrying capacity; **General requirements and tests** **Note:** Up to 2500MHz (ffs), current carrying cap classes I (2A at 60°C) / II (4A at 60°C)		**48B/2776/CDV** 2020-01-17
-1	Part 1: Detail specification for 2-way, shielded or unshielded, free and fixed connectors: mechanical mating information, pin assignment and additional requirements for **type 1 / Copper LC Style** **Note:** Up to 600MHz, up to 1,4A at 60°C		**Published 2020-04-14**
-2	Part 2: Detail specification for 2-way, shielded or unshielded, free and fixed connectors: mechanical mating information, pin assignment and additional requirements for **type 2** **Note:** Up to 600MHz ffs, class II current carrying capability		**48B/2786/CDV**
-4	Part 4: Detail specification for 2- way, shielded or unshielded, free and fixed connectors: mechanical mating information, pin assignment and additional requirements for **type 4** **Note:** Up to 3000MHz ffs, **current carrying cap class II**		**48B/2724/CD** 48B/2795/CC
-5	Part 5: Detail specification for circular connectors with up to 8 ways, shielded or unshielded, free and fixed connectors: mechanical mating information, pin assignment and additional requirements for **type 5** **Note:** Up to 600MHz ffs, **current carrying cap class II**		**48B/2733/CD** 48B/2805/CC
-6	Part 1: Detail specification for 2-way and 4-way (data/power), shielded, free and fixed connectors for transmission capability and power supply capability with frequencies up to 600MHz **Note:** Up to 4A / 8A at 60°C		**Published 2020-01-20**

SPE Industrial Partner Network

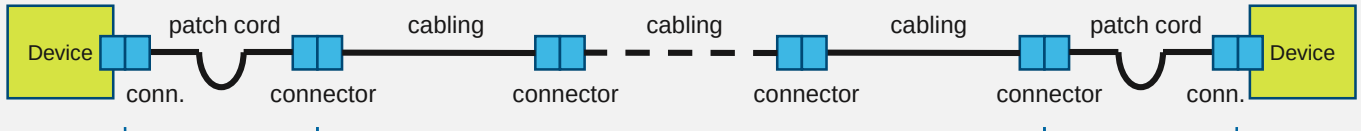
- Committed to enabling the deployment of SPE
- Provides the technologies, standardisation and guidance for the development of Industrial IoT applications
- Supports the development of the T1 Industrial interface according to IEC 63171-6

SPE networking

Point to Point, Multidrop, PoDL and hybrid data/power

Industrial SPE Network Options

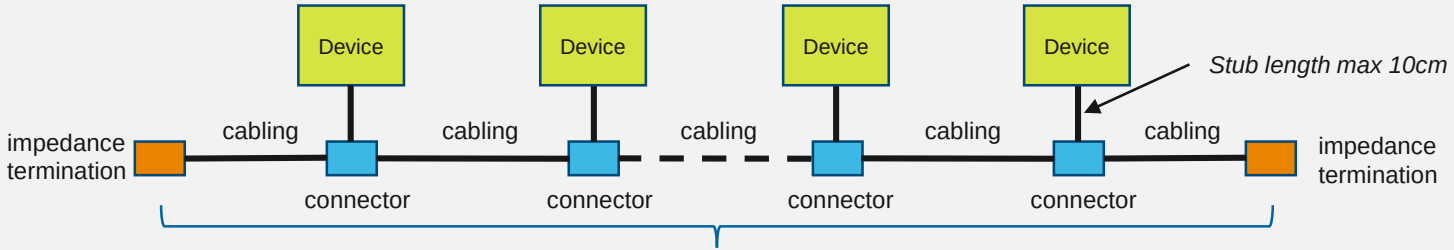
Point-to-point



1000BASE-T1 STP of max 36 m, typ. AWG 22
Up to 4 in-line connectors and 2 device connectors

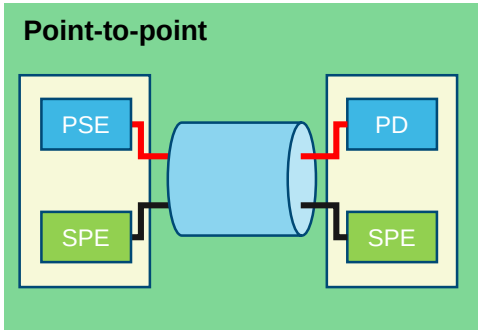
10BASE-T1L STP of max 996 m, typ. AWG 18
Up to 10 in-line connectors and 2 device connectors

Multidrop



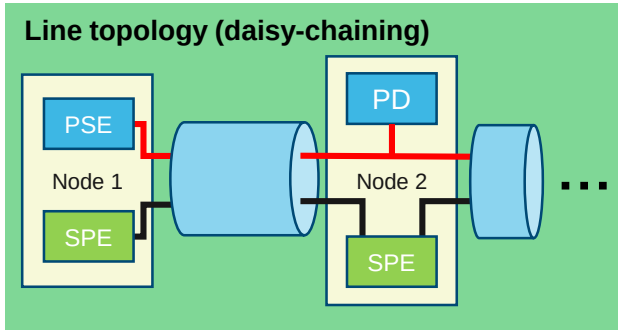
10BASE-T1S Unshielded wire of max 25 m
Up to (>)8 in-line connectors/devices

SPE Architectures



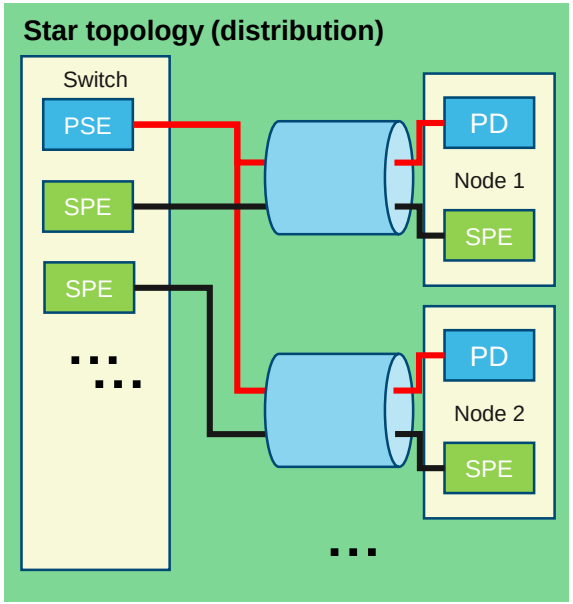
Power
One PD powered by one PSE (PoDL)

Data
Point-to-point



Power
Cascaded PDs powered by one PSE

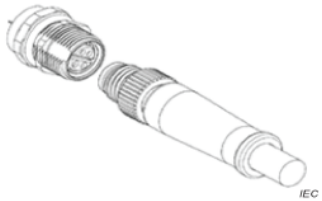
Data
Multiple SPE nodes in series either through
1. Integrated switches per node
2. Multidrop



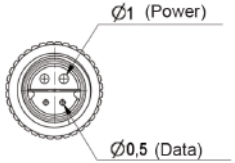
Power
- Downstream PDs powered by switch

Data
- Downstream SPE nodes connected to switch / multiple PHYs

IP65/67 M8 Hybrid (4-Pin Data/Power) Connector

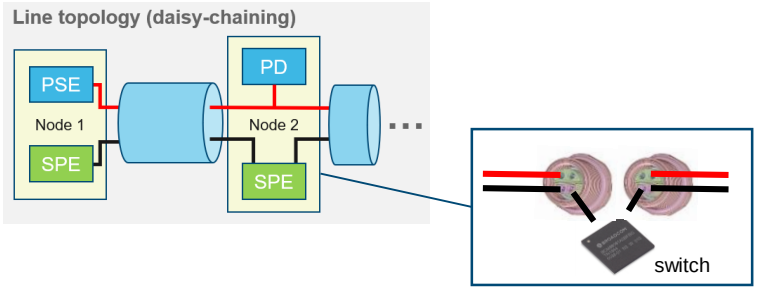


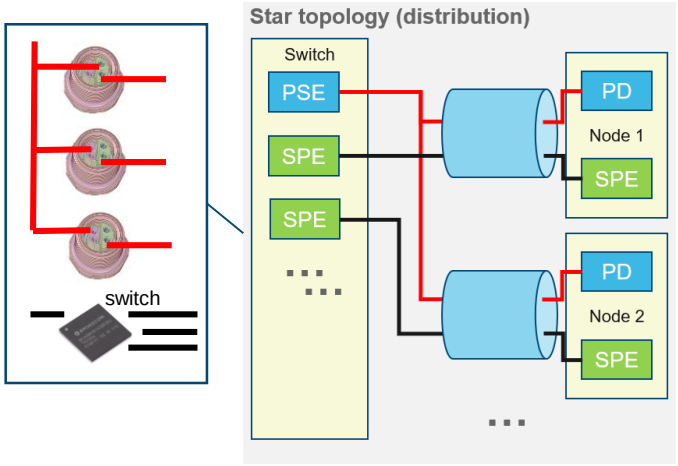
- Standardized in IEC 63171-6
- Enables powering of cascaded devices
- Provides up to 8A (power pins)
- Hybrid cable AWG18/AWG22 (power/data



PoDL vs. separate Power

PoDL	Separate Power
+ Lower cable weight	+ Higher currents / power
+ Smaller and cost-effective cable	+ Support of multiple topologies
- Point-to-point only	- Higher cable weight
- Low noise limits for power signal	- Cable costs
- Special circuitry required	





SPE Solutions

IEC 63171-6 connectors and cables

TE Connectivity SPE IP65/67 M8 Hybrid T1 Roadmap

Connectors

Female Vertical

Female Right-Angle

FI Male Plug, Straight

T-Splitter, Multidrop

Male Vertical

Male Right-Angle

FI Female Socket, Straight

Cable Assemblies

Cable Plug, Male Straight

Cable Socket, Female Straight

Cable Assembly,
Male-to-Female Straight

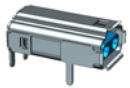
Cable Assemblies, Various Configuration

Static Cables, High-Flex,
Drag-Chain Cable Options

TE Connectivity SPE T1 IP20 Roadmap

Connectors

Female Right-Angle



Female Vertical

FI Male Plug, Straight

FI Female Socket, Straight

Cable Assemblies

Cable Plug, Male Straight

Cable Plug, Male & Female Angled

Cable Socket, Female Straight

Cable Assembly, Male-to-Male Straight & Male-to-Female Straight

Cable Assembly, Male-to-Male Angled & Male-to-Female Angled

Cable Assemblies, Various Configurations

Static Cables, High-Flex, Drag-Chain Cable Options

Get started today

- Sample kits available now to develop SPE IIoT applications
- Discuss your design requirements with our engineers
- Visit the Avnet Abacus Single Pair Ethernet web page for further technical information, white papers and webinars