

10Mb/s SINGLE PAIR ETHERNET AT A GLANCE

SINGLE-PAIR POWER OVER ETHERNET

Single Pair Ethernet (SPE) and Single-pair Power over Ethernet (SPoE) combine to enable data and power at reaches of up to one kilometer.

WHAT IS SINGLE-PAIR POWER OVER ETHERNET?

Operational Technology (OT) devices require both data and power to perform their target functions. Power is not always available at the device's installed location. Further, battery-powered installations create significant maintenance and reliability issues.

Single-pair Power over Ethernet (SPoE), like traditional PoE solves these problems by providing power over the existing data cabling. SPoE enables remote placement of end devices, liberating installations from the expense and hassle of local device power.

SPoE builds on traditional PoE and can be easily installed and maintained. SPoE-compliant switches and endpoints ensure network additions and upgrades are simple and fast.

TELL ME MORE

SPoE is specifically defined to work with the 10BASE-T1L 10Mb/s protocol. Combined, these new Ethernet protocols are poised to revolutionize the OT world, just as traditional Ethernet took the IT world by storm in the 1990s.

KEY BENEFITS:

- Standards-based interoperability
- Ease of installation
- Power and data over single pair
- SPoE provides between 1.23W and 52W, depending on output voltage, cable length and power demand
- Enables resilient power architectures
- LPS/SELV/NEC Class 2

SINGLE-PAIR POWER OVER ETHERNET OVERVIEW

IEEE 802.3 originally standardized powering over a single pair of conductors at 100Mb/s and 1000Mb/s in IEEE 802.3bu, known as Power over Data Lines (PoDL). IEEE 802.3cg extended the specification to support 10Mb/s for OT environments. In practice there are two variants of single-pair powering, SPoE and PoDL. SPoE is used to describe the classification-based implementation utilized in OT networks while PoDL is used in engineered networks, e.g., in-car networks.

SPoE – OPERATIONAL TECHNOLOGIES:

- Classifies end device prior to application of power
- Can measure cable resistance
- 24V, 55V ranges as demanded by OT systems
- Can deliver power up to 1km
- Increased power delivery at shorter distances



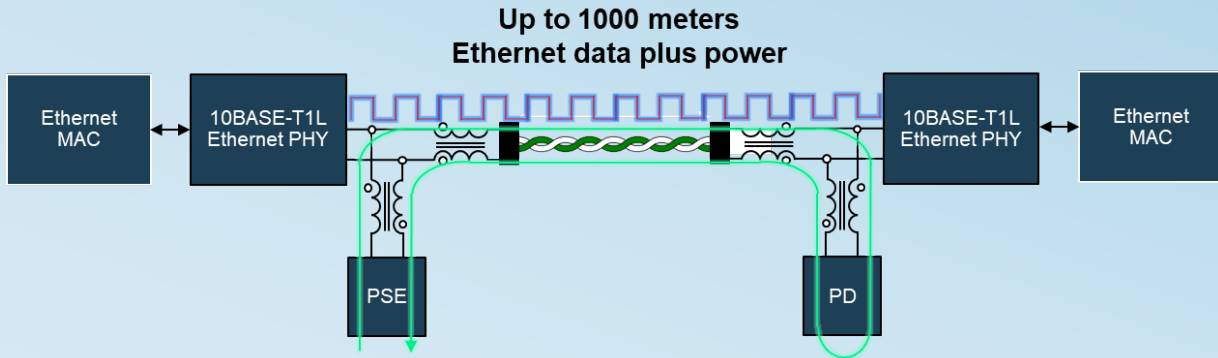
PoDL – AUTOMOTIVE & ENGINEERED SYSTEMS:

- Extremely fast detection of end device prior to application of power
- No classification, appropriate for engineered systems
- 12V, 24V, or 48V ranges
- 15 and 40 meter cable reaches



Existing building automation network protocols provide both data and power. However, the current solutions are fragmented between a multitude of competing protocols. Replacing these incumbent protocols will require integrated data and power solutions, thus allowing the smart building network to seamlessly integrate with companion IT networks.

The ability to send power over an Ethernet cable was an evolutionary step for traditional 4-pair Ethernet but is a core requirement for SPE.



SPoE KEY CHARACTERISTICS

SPoE deploys the following key tactics:

1. Full voltage is not applied unless a PD is connected
2. Full voltage is removed quickly when the PD is disconnected
3. Full voltage is removed very quickly in the event of a fault (e.g., short-circuit)

Prior to the application of power, a short exchange of information takes place between the power source (the PSE) and the power load (the PD). This process is known as classification and allows PSEs and PDs to determine if their voltage and power requirements are mutually compatible. Multiple voltage and power levels are defined in IEEE 802.3.

Low power standby requirements apply to many OT markets and applications. Government and industry mandated standby requirements have steadily become more rigorous and will continue to do so. SPoE enables multiple levels of low power standby modes to ensure standby requirements can be met both today and in the future.

SPoE KEY CAPABILITIES

Today, OT deployments often use a 24V DC supply voltage. However, power delivery on long cables at this voltage is subject to significant losses due to cable resistance. Power delivery efficiency is maximized when the voltage is raised near the SELV maximum, 60V DC. As shown below, SPoE provides two distinct operating voltages: 24V and 55V DC.

| | Class 10 | 11 | 12 | 13 | 14 | 15 |
|-------------------------------|----------|-----|-----|----------|-----|------|
| V_{PSE} (V, min/typ/max) | 20/24/30 | | | 50/55/58 | | |
| I_{CABLE} (mA, max) | 92 | 240 | 632 | 231 | 600 | 1579 |
| P_{PD} (W, max) | 1.23 | 3.2 | 8.4 | 7.7 | 20 | 52 |
| R_{CABLE} (Ohms, max) | 65 | 25 | 9.5 | 65 | 25 | 9.5 |

Six unique classes are defined for OT networks. Classes 10, 11, and 12 enable 24V DC power delivery over long, medium, and short cables respectively. Likewise, Classes 13, 14, and 15 enable 54V DC power delivery over long, medium, and short cables respectively.

For example, at 55V and 1000m, 7.7W can be delivered to the endpoint. At shorter distances, 55V and 150m, 52W can be delivered to the endpoint.

ABOUT THE ETHERNET ALLIANCE

The Ethernet Alliance is a global consortium that includes system and component vendors, industry experts, and university and government professionals who are committed to the continued success and expansion of Ethernet technology. The Ethernet Alliance takes Ethernet standards to market by supporting activities that span from incubation of new Ethernet technologies to interoperability demonstrations and education. The organization’s plans for 2021 may be found on the [Events](#) page of its website.