

# 10BASE-T1L Single Pair Ethernet 1000 m Reach Networking and Power

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10BASE-T1L Single Pair Ethernet (SPE) combined with Single Pair Power over Ethernet (SPoE) specified in IEEE 802.3bu is the most cost-effective option for networking and powering 10 MB/s Ethernet devices to 1000 m and beyond. SPE will extend the plug and-play simplicity of Ethernet to 10 MB/s Ethernet devices located in large open floor spaces such as warehouses, parking garages, shopping malls, airports or to outdoor spaces for surveillance cameras and other smart remote devices up to and beyond 1000 m.

Building technologies, codes, standards and regulations have an enormous impact on the architect, the consulting engineer, the building owner and the building facility manager. An example of 10BASE-T1L/SPoE and 10BASE-T/PoE network over structured cabling is depicted in Figure 1 with a 10BASE-T/PoE switch powering a 10BASE-T1L/SPoE switch extending the 100 m reach to a 1000 m. In addition, PoE and SPoE powering classes are given as well as distances versus cable gauge.

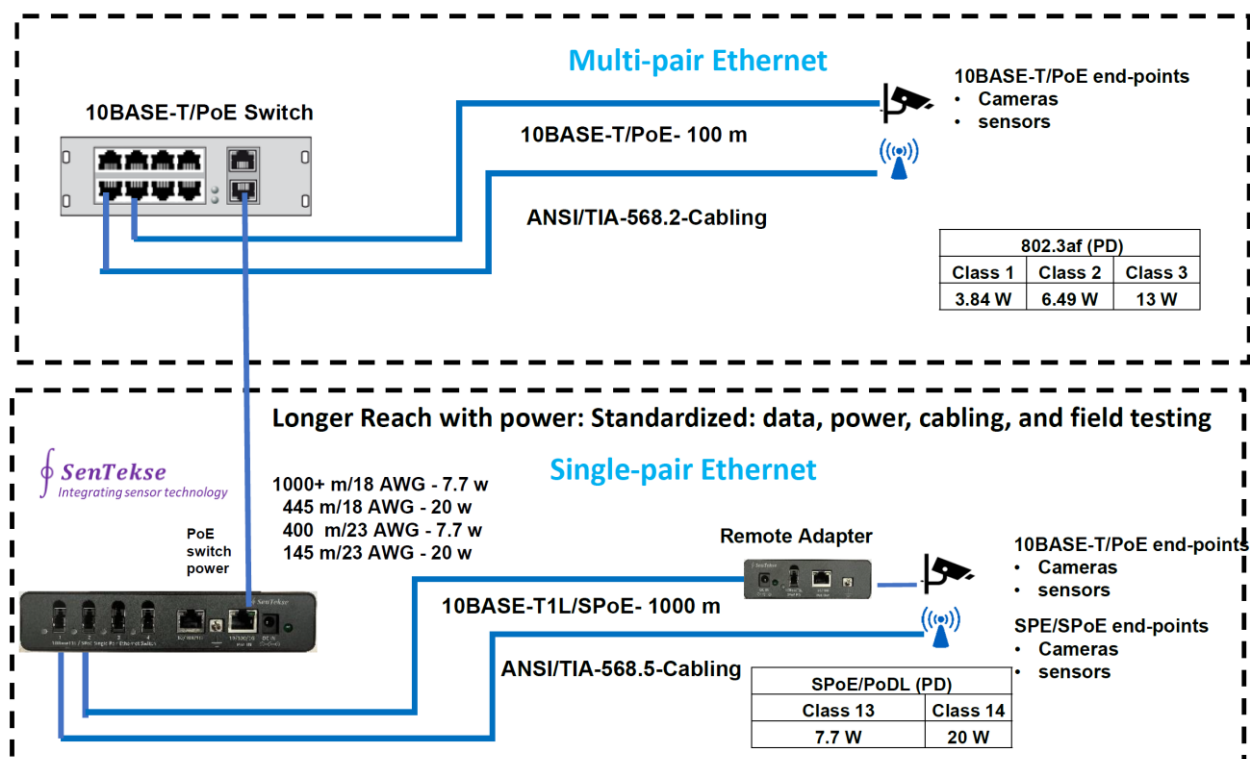
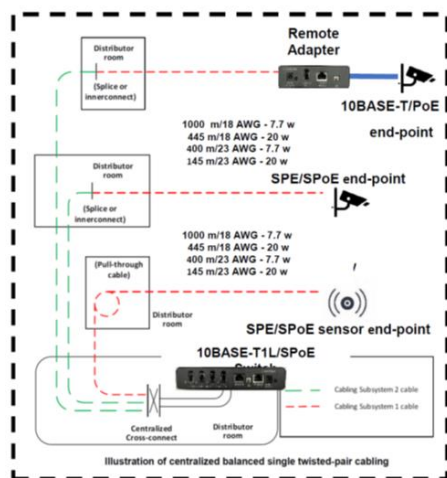


Figure 1. 10BASE-T1L/SPoE and 10BASE-T/PoE network over structured cabling

The success of ANSI/TIA-568.2 structured cabling systems over which BASE-T/PoE is specified to operate, is unquestionable. However, the ANSI/TIA-568.2 cabling channels have a maximum length of 100 meters, limiting the reach to smart remote Ethernet devices or surveillance cameras located beyond 100 m. To extend this reach, the TIA-TR42 Engineering Committee TR-42 has published ANSI/TIA-568.5 Balanced single twisted-pair telecommunications cabling and components and ANSI/TIA-568.0-E Generic Telecommunications Cabling for Customer Premises. These Standard enable the planning and installation of a single pair structured cabling system supporting the 10BASE-T1L/SPoE single pair standards.



#### Balanced single twisted-pair cabling supportable distances

The table is based on the minimum performance requirements of specific balanced single twisted-pair cabling categories established by ANSI/TIA-568.5.

Maximum supportable distances for balanced single twisted-pair cabling applications

Application	Media	Distance m (ft)	Comments
Ethernet 10BASE-T1L	Category SP1-400	400 (1312)	Maximum 5 connections
Ethernet 10BASE-T1L	Category SP1-1000	1000 (3280)	Maximum 10 connections



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Figure 2. ANSI/TIA-568.5 and ANSI/TIA-568.0-E single pair cabling

## SPoE - More Power To You

SPoE provides reduction in energy consumption by minimizing the current and resultant cabling power dissipation by operating near the maximum allowable Safety Extra Low Voltage (SELV) power supply voltage of 60 volts. Voltage and power classification mechanisms exist via the Serial Communication Classification Protocol (SCCP) to provide the Power Source Equipment (PSE) with detailed information regarding the requirements of the Powered Device (PD) and vice versa.

The PSE provides power to the PD. The PSE's main functions are as follows:

- To search the link segment for a PD
- To supply power to a detected PD through the link segment
- To monitor the power applied to a link segment
- To remove the full operating voltage when no longer required, when transitioning to the SLEEP state, or when a short-circuit or other fault is detected

The PD is either drawing power or requesting power by participating in the PD detection or classification algorithms.

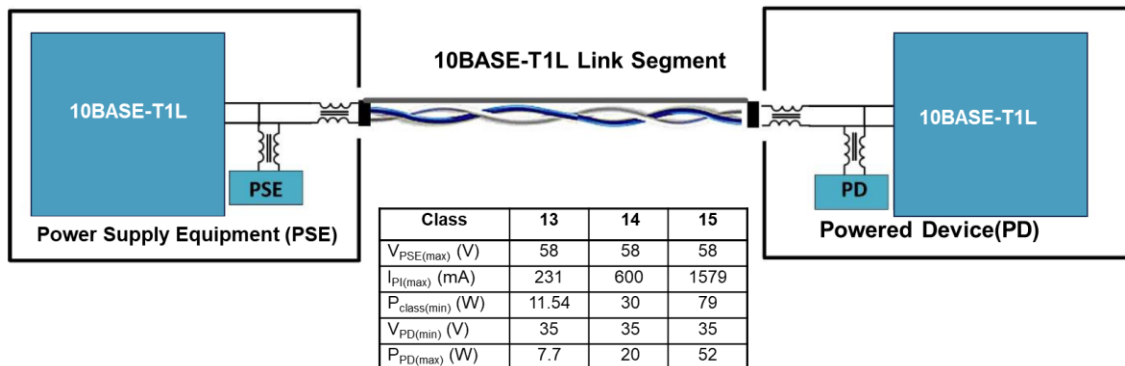


Table 1. Class Power Requirements

## 10BASE-T1L/SPoE – Connecting BASE-T/PoE end-points

One reason for the relatively slow adoption of Single Pair Ethernet (SPE) is the lack of SPE end-point devices. Media converters enable 10BASE-T1L/SPoE networking to BASE-T/PoE end-point devices providing the benefits of 10BASE-T1L 1000 m reach.

Telecommunication room (TR) floor area space and ancillary equipment are minimized by radially distributing from a single TRs centralized electronics to remote powered devices such as surveillance cameras and monitoring sensor devices in large open floor spaces.

- 10BASE-T1L/SPoE – PoE Camera Applications
- 10BASE-T1L/SPoE - Monitoring and Sensor Devices

### Connecting BASE-T/PoE Cameras:

SPoE Class 13 (7.7 W) and SPoE Class 14 (20 W) can power commercially available PoE cameras via a media converter. Table 1 provides vendor information (without part numbers) for the maximum power specified for PoE cameras from one distributor; achievable lengths versus Class and cable wire gauge are given for each PoE camera power.

Camera Survey Max Power (W)	CL13/7.7W /58V/65Ω	CL13 - Length (m) 18 AWG	CL13-Length (m) 23 AWG	CL14/20W /58V/25Ω	CL14-Length (m) 18 AWG	CL14-Length (m) 23 AWG
4.50	4.50	1000	400	4.50	445	145
6.40	6.40	1000	400	6.40	445	145
11.00	NA	NA	NA	11.00	445	145
10.20	NA	NA	NA	10.20	445	145
11.50	NA	NA	NA	11.50	445	145
12.10	NA	NA	NA	12.10	445	145
7.10	7.10	1000	400	7.10	445	145
11.80	NA	NA	NA	11.80	445	145
17.00	NA	NA	NA	17.00	445	145
8.40	NA	NA	NA	8.40	445	145
8.40	NA	NA	NA	8.40	445	145
8.50	NA	NA	NA	8.50	445	145
6.30	6.30	1000	400	6.30	445	145
12.00	NA	NA	NA	12.00	445	145
7.20	7.20	1000	400	7.20	445	145
3.84	3.84	1000	400	3.84	445	145
3.84	3.84	1000	400	3.84	445	145
10.45	NA	NA	NA	10.45	445	145
20.00	NA	NA	NA	20.00	445	145
7.50	7.50	1000	400	7.50	445	145
12.95	NA	NA	NA	12.95	445	145
11.50	NA	NA	NA	11.50	445	145
12.95	NA	NA	NA	12.95	445	145
12.95	NA	NA	NA	12.95	445	145

Table 1. Camera survey maximum power (W) and reach (m)

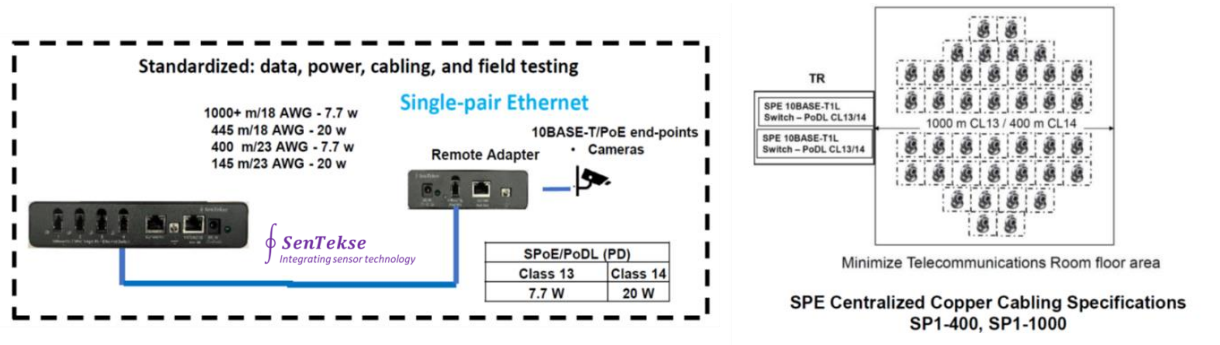


Figure 2. Single pair cabling camera application

Camera mounts with integrated media converters provide consistent environmental housings and ease of installation as original equipment manufacturer camera mounts.

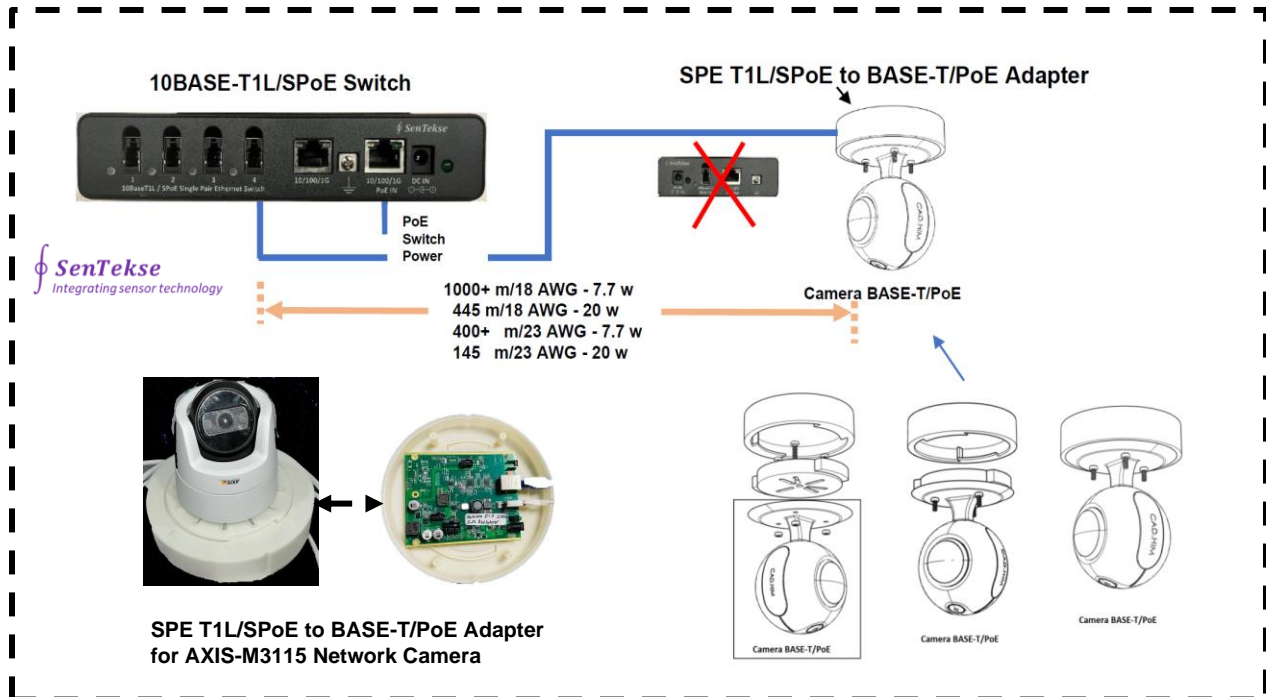


Figure 3. Media converter integrated into camera mounting base

### **Networking BASE-T/PoE Monitoring and Sensors Devices:**

Offering the benefits of extended reach and an alternative to battery operated wireless devices, SPoE Class 13 (7.7 W) with media converter can power a variety of commercially available PoE monitoring and sensor end-point devices. 10BASE-T1L/SPoE is easier to maintain, more reliable, and environmentally friendlier than battery operated wireless devices.

Commercially available PoE monitoring and sensor end-point devices can be networked with 10BASE-T1L/SPoE by radially distributing from a single TRs centralized electronics in large open floor spaces; airports, retail buildings, data centers, and manufacturing facilities.

- People Flow Sensors and Occupant Sensors
  - Airport
  - Commercial/Retail Buildings
- Monitoring
  - Data Center, Intelligent Buildings Systems (IBS), Warehouse and Manufacturing
    - Environmental systems monitoring and control
    - Physical security and safety monitoring

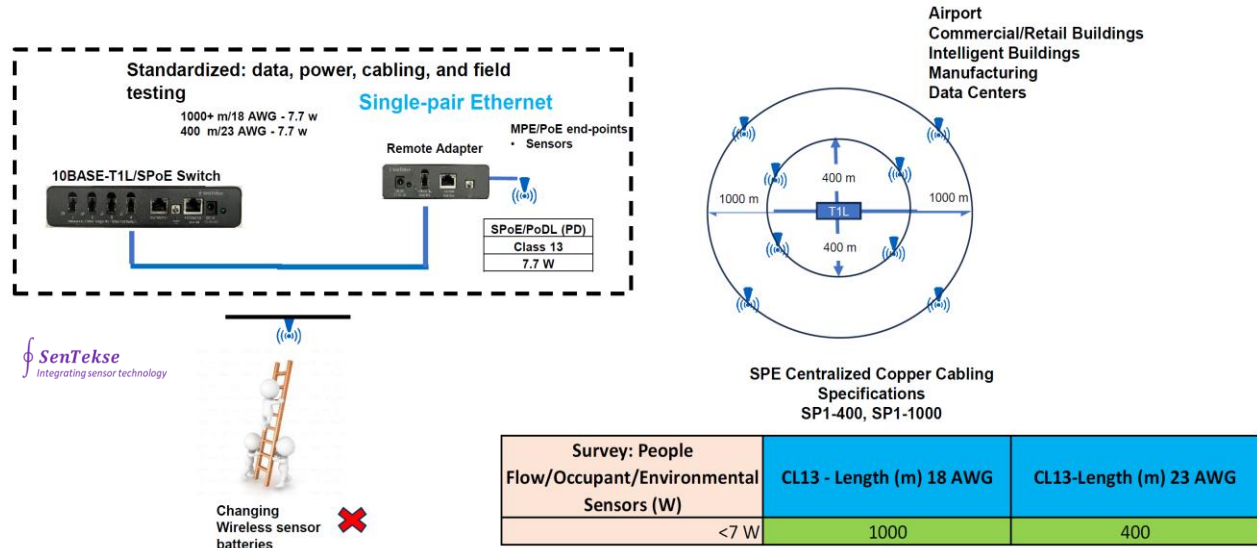


Figure 4. Networking Monitoring and Sensor End-points to 1000 m

## Other 10 MB/s Extended Reach Options

### Extending ANSI/TIA-568.2 cabling channels:

ANSI/TIA-568.2 cabling channels are limited to a maximum length of 100 meters; with cable lengths limited to 90 m. Cabling lengths beyond 100 m can be achieved by enabling cable terminations with a cross-connection facility above ceiling or in floor area equipment racks.

### Extending copper cable lengths beyond 100 m non-standard:

A variety of commercially available cabling offerings claim performance exceeding standard category cabling to lengths longer than 100 m. Two examples are given in Table 3 illustrating the cable length and gauge differences. Lacking adherence to standards the market information can be confusing and, in some instances, amount to unsupported performance claims. The plug-and-play simplicity of Ethernet is denigrated to plug-and-pray with engineered systems requiring expertise to assess detailed technical specifications. Given the availability of standardized SPE cabling and network devices (switches, media converters), the technical risks in deploying non-standard extended-reach 4-pair for 10 Mb/s devices are unnecessary.



Network	Horizontal Length	Cable
10BASE-T	185 m (606 ft.)	4-pair 23 AWG
10BASE-T	260 m (850 ft.)	4-pair 22 AWG

Table 3. Extended Reach Cable Length and Gauge Differences

Note that the cable outer diameter factors directly into conduit sizing and other pathways and spaces requirements. Using a 4-pair 22 AWG cable versus 1-pair can unnecessarily double the pathway and space area and associated costs.

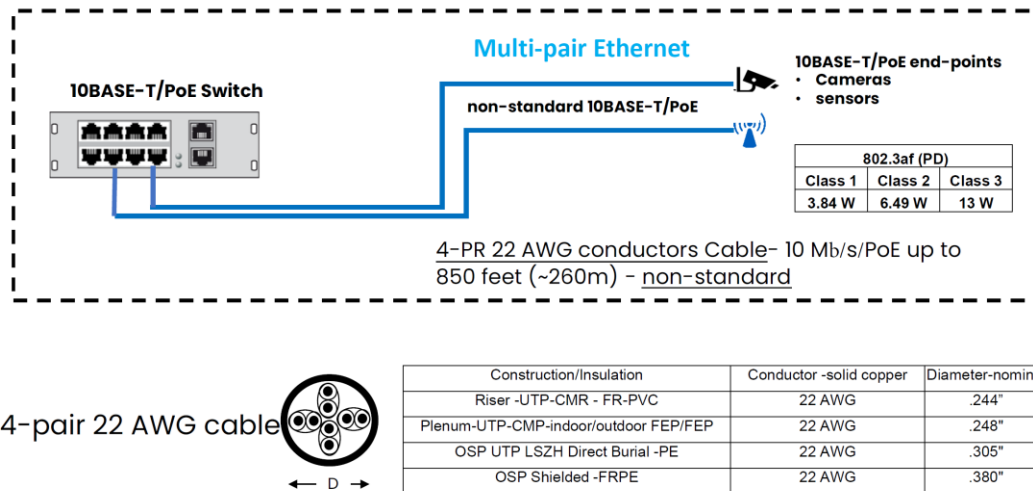


Figure 5. Examples of 4-pair 22 AWG cable outer diameters

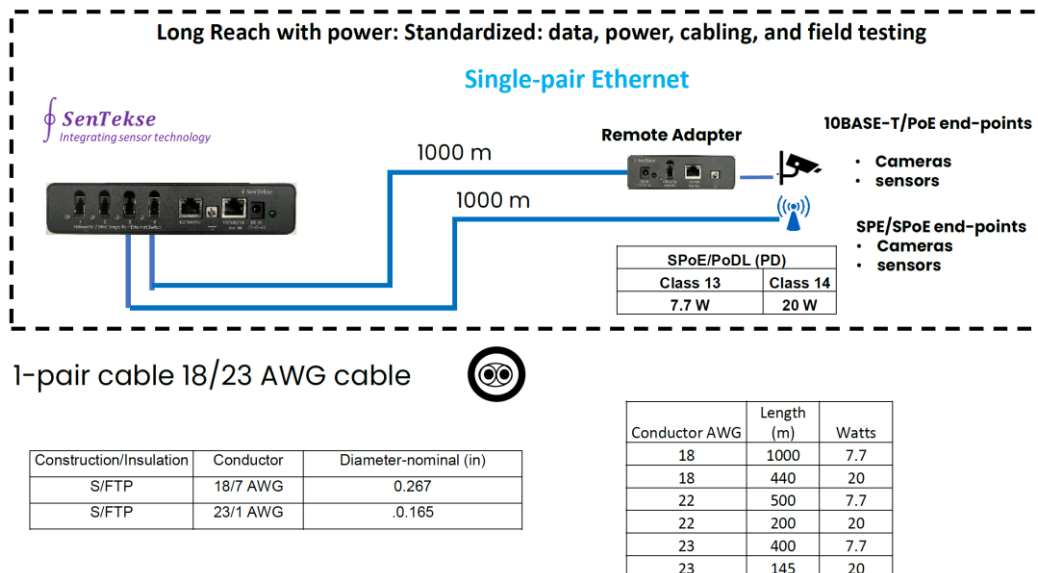


Figure 6. Examples of 1-pair cable outer diameters

### Hybrid copper-fiber cable:

The use of fiber for data and copper for power can enable longer reach but it is essentially an engineered solution with powering via non-PoE Class 2 limited power source (LPS). The powering distances are predicated on the copper gauges with typical conductor sizes ranging to 12 AWG; this is not structured cabling, supporting moves, adds, and changes.

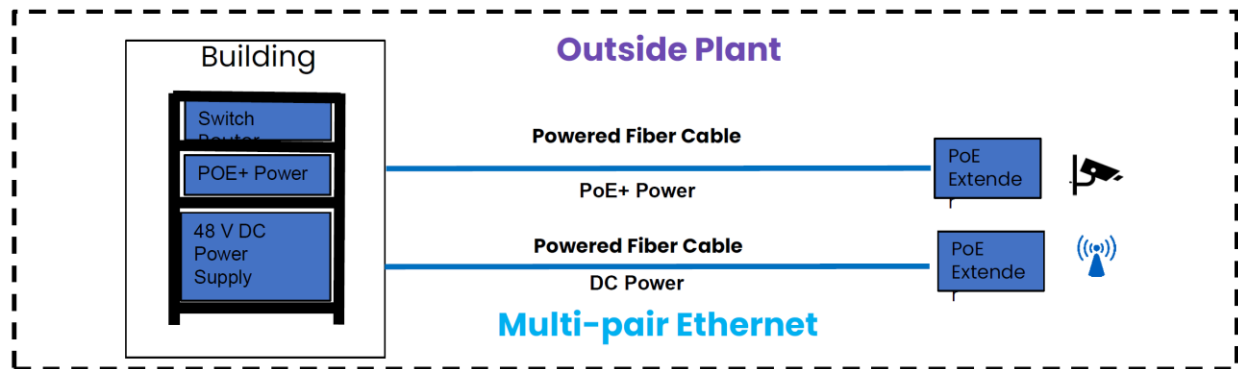


Figure 7. Hybrid Copper-fiber Cabling

### Extender devices:

Copper-to-fiber media conversion allows for longer than 100 m data reach but adding a media converter in the horizontal cabling requires local power and space planning. Troubleshooting points of failure, with mid-span media converters can be time consuming, and costly. PSE to PoE power management is limited to PoE end-point media converter patch cord.

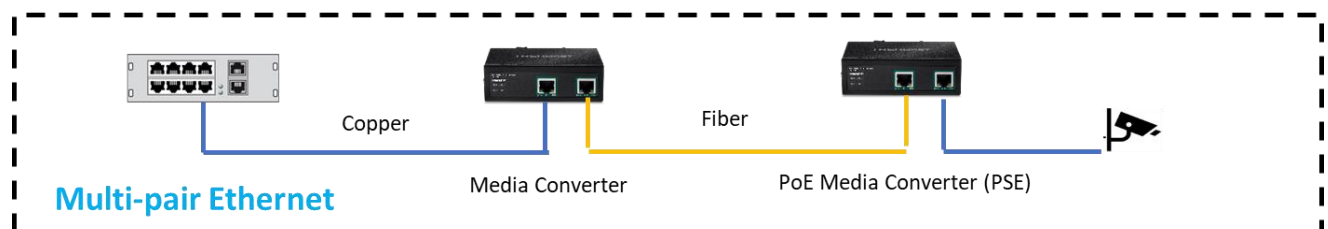


Figure 8. Copper-to-fiber media conversions

Copper-to-copper PoE Extenders allow for longer than 100 m data reach but also add a media converter in the cabling requiring local power and space planning. Again, fault isolation, troubleshooting network points of failure, with PoE extenders can be time consuming, and costly. PSE to PoE power management is eliminated.



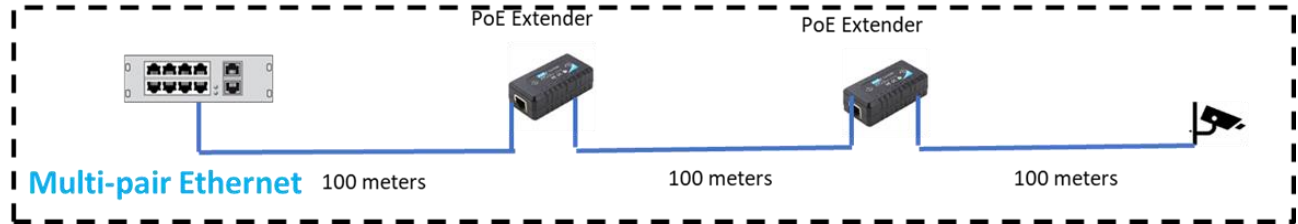


Figure 9. PoE extenders

### **Summary:**

10BASE-T1L Single Pair Ethernet (SPE) combined with Single Pair Power over Ethernet (SPoE) specified in IEEE 802.3bu is the most *“cost-effective option”* for networking and powering *“10 MB/s”* Ethernet devices to *“1000 m”* and beyond. SPE will extend the plug and-play simplicity of Ethernet to 10 MB/s Ethernet devices located in large open floor spaces such as warehouses, parking garages, shopping malls, airports or to outdoor spaces for surveillance cameras and other smart remote devices up to and beyond 1000 m.