10BASE-T1L/SPoE Switch and Remote Adapters Centralized Cabling: Intelligent Buildings, Data Centers, Commercial Buildings, and Outside Plant Applications

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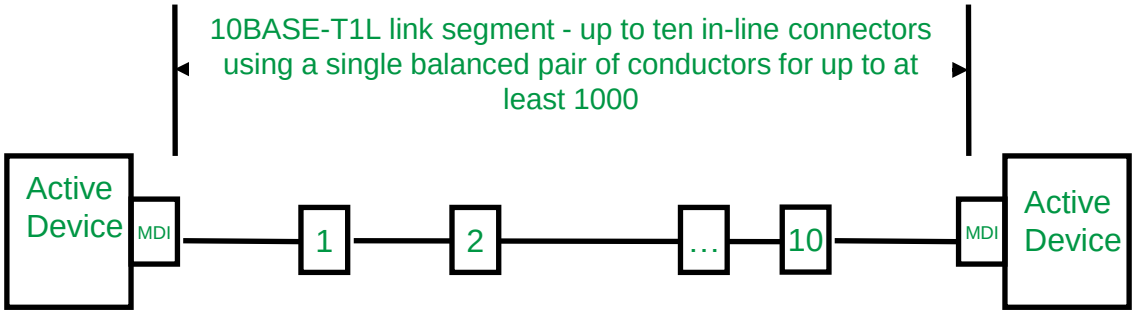
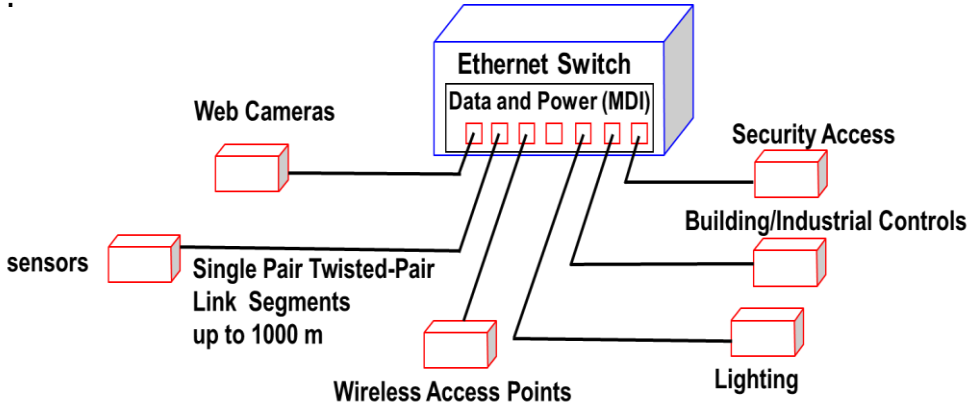
10BASE-T1L/SPoE Topology

- IEEE P802.3cg 10 Mb/s Single Pair Ethernet Task
  - 10BASE-T1L – 10 Mb/s operation over a long reach single balanced twisted-pair link segment supporting up to ten in-line connectors for up to at least 1000 m.
  - Optional: Serial communication classification protocol (SCCP) and power distribution
    + Classifies end device prior to application of power
    + Can measure cable resistance



- The SPE switch provides power and data through the medium dependent interface (MDI) over single pair twisted-pair link segments. Single pair power over Ethernet (SPoE) is used here to connotate the power over data lines (PoDL) implementation where end devices are classified prior to application of power via SCCP.

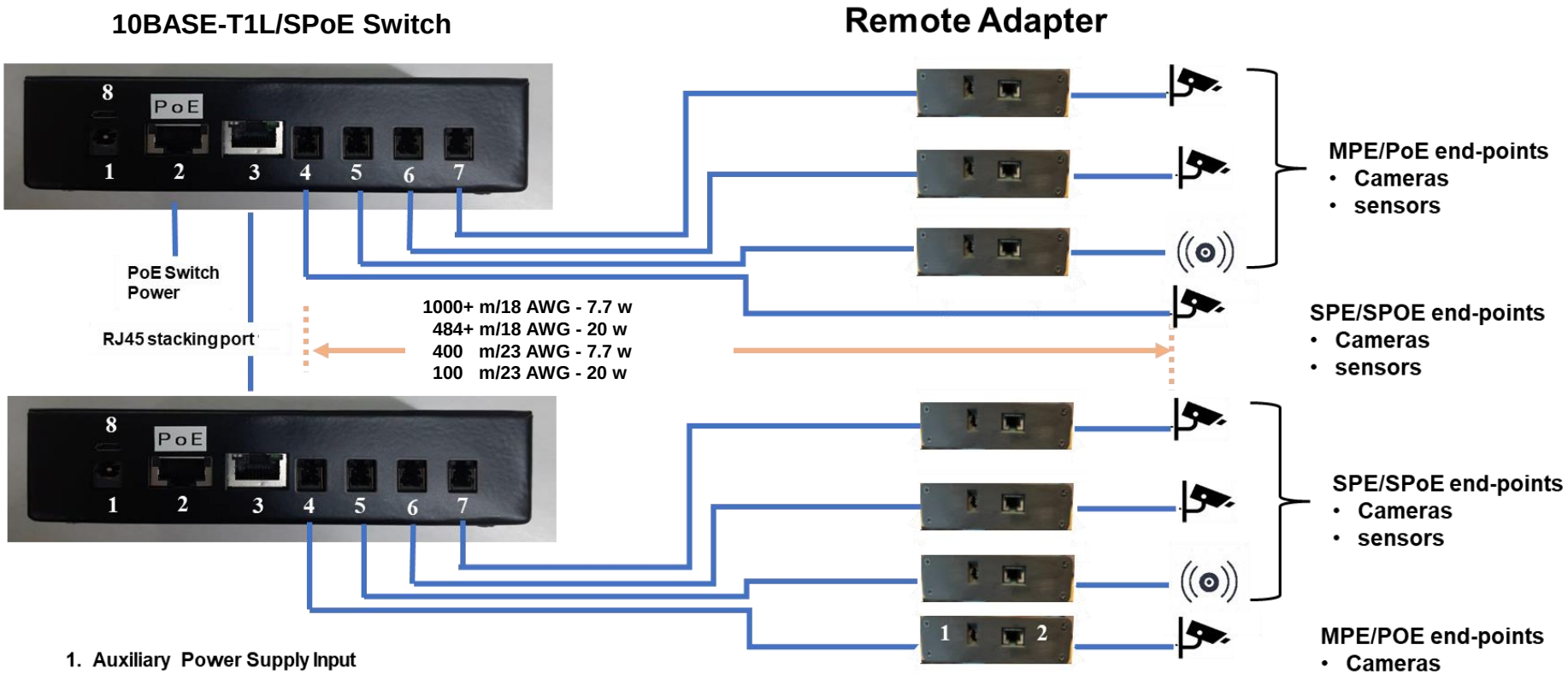


SPE - Standardized cabling, and field testing

- **ANSI/TIA-568.5 – Single Pair Cabling & Components - Published**
  - Specifications for cable, connectors, cords, and channels
  - General use environments ($M_1I_1C_1E_1$, IP20)
  - Cabling topologies
- **ANSI/TIA-568.7 – Single-Pair Cabling & Components for Industrial - Draft**
  - Harsher environments ($M_2I_2C_2E_2$ / $M_3I_3C_3E_3$, IP55+)
  - Cabling topologies for industrial and process control
- **ANSI/TIA-5071 –Single-Pair Cabling Field Testing - Published**
  - Reporting and accuracy requirements of SPE field test equipment
- **TSB 184-A-2 – Power Delivery over Balanced Single Twisted-Pair Cabling - Draft**
  - Addendum to TSB-184-A, to add single-pair cabling

10BASE-T1L/SPoE Switch and Remote Adapters

- Standardized: 10BASE-T1L devices, SPoE powering; adapters for MPE/POE<>SPE/SPoE



1. Auxiliary Power Supply Input
2. RJ45 10/100/1000 Port with 802.3bt PoE PD
3. RJ45 10/100/1000 port non-PoE - stacking port
4. SPE Port-1 (Class 13/14 PoDL PSE)
5. SPE Port-2 (Class 13/14 PoDLPSE)
6. SPE Port-3 (Class 13/14 PoDLPSE)
7. SPE Port-4 (Class 13/14 PoDLPSE)

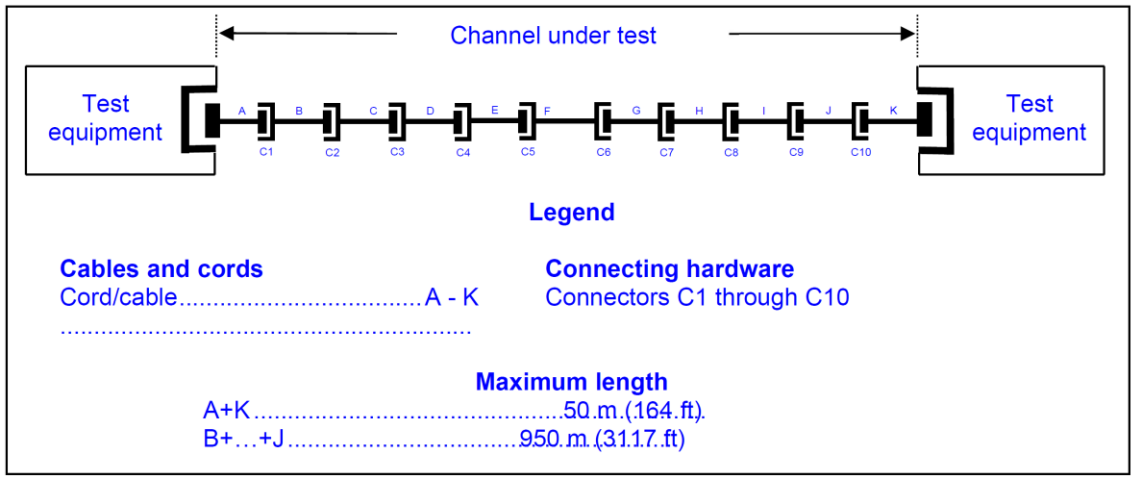
1. SPE Port-1 (Class 13/14 - PoDLPD)
2. RJ45 Port (PoE 802.3bt PSE)

MPE - Multipair Ethernet
SPE- single pair Ethernet
SPoE - single pair power over Ethernet (PoDL) with classification

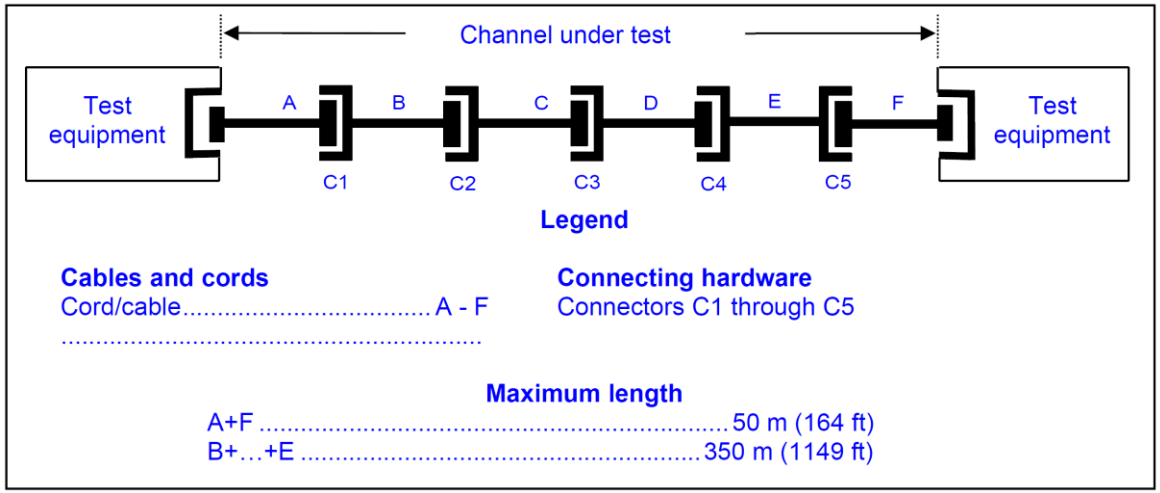
Class	$V_{PSE-Max}$ (V)	P_{PD-Max} (W)	Loop Resistance Ω
13	58	7.7	< 65
14	58	20	< 25

ANSI/TIA-568.5 - Balanced single twisted-pair cabling and components Standard

- **ANSI/TIA-568.5 Balanced single twisted-pair telecommunications cabling and components Standard**



SP1-1000 channel test configuration



SP1-400 channel test configuration

Power Delivery Single Twisted-Pair Cabling

TIA-PN-184-A-2-R2 - Addendum Power Delivery Over Balanced Single Twisted-Pair Cabling

Maximum dc loop resistance of channels aligned with UL 144

Category	Channel length m	DCR @ 20 ºC Ω
SP1-1000 (18 AWG)	1000	49.4 TBD
SP1-400 (23 AWG)	400	62.9 TBD

Nominal dc loop resistance of channels at 60 ºC

Category	Channel length m	DCR @ 60 ºC Ω
SP1-1000 (18 AWG)	1000	56.5 TBD
SP1-400 (23 AWG)	400	72.5 TBD

Reference: IEEE Std 802.3-2022: Clause 104

Class	$V_{PSE-Max}$ (V)	$V_{PSE-Min}$ (V)	$I_{P\ I}$ (mA)	$P_{Class-Min}$ (W)	V_{PD-Min} (V)	P_{PD-Max} (W)	Loop Resistance Ω
13	58	50	231	11.54	50	7.7	< 65
14	58	50	100	30	50	20	< 25

ANSI/TIA-Standards - Balanced Single Twisted-Pair Cabling

- ANSI/TIA-568.0-E-1 Generic Telecommunications Cabling for Customer Premises Addendum 1: Balanced Single Twisted-Pair Cabling
  - *Centralized cabling (Annex A) Centralized optical fiber or balanced single twisted-pair cabling*

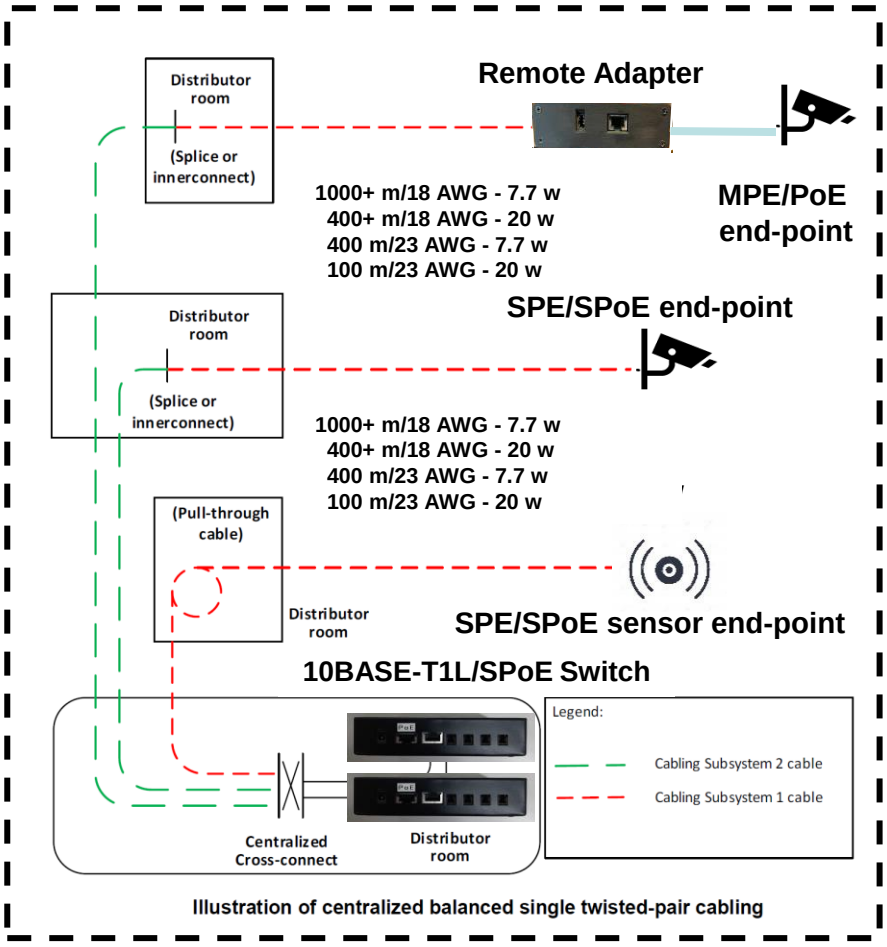


Illustration of centralized balanced single twisted-pair cabling

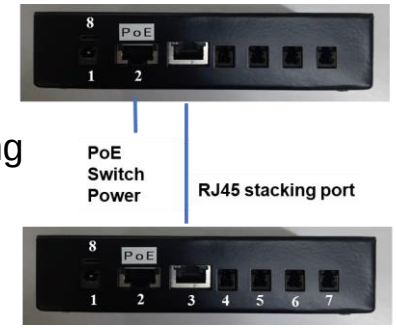
Balanced single twisted-pair cabling supportable distances

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

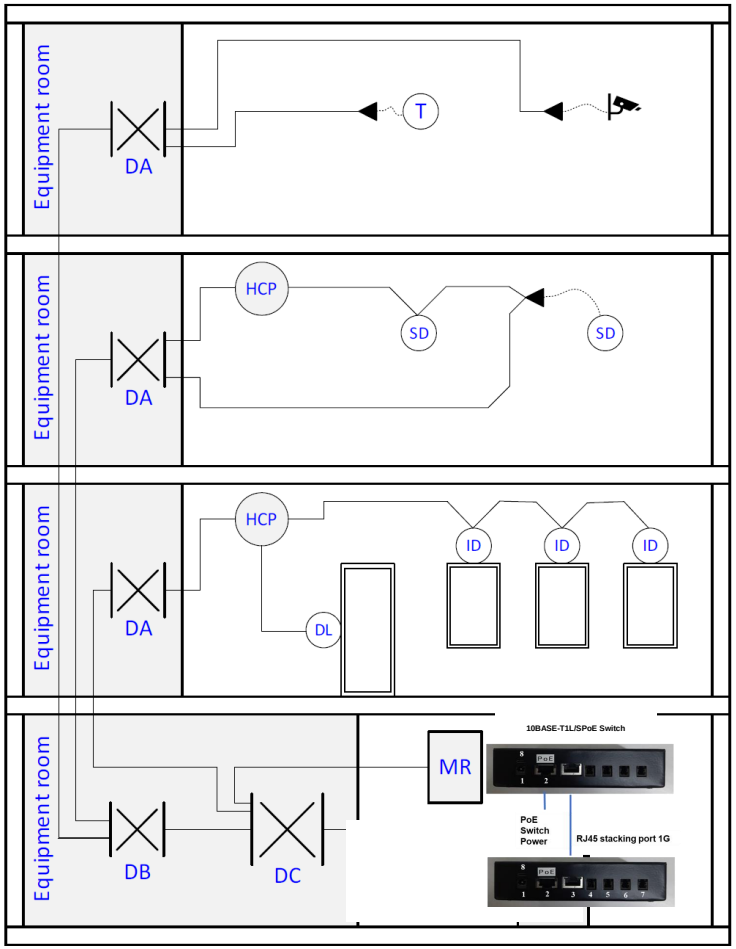
10BASE-T1L/SPoE Switch



Centralized Cabling Stacking Switch

ANSI/TIA-Standards - Balanced Single Twisted-Pair Cabling

- Structured Cabling Infrastructure Standard for Intelligent Building Systems - ANSI/TIA-PN-862-C-R1
  - *Refers to ANSI/TIA-568.0, ANSI/TIA-568.2, ANSI/TIA-568.3, ANSI/TIA-568.5, ANSI/TIA-1152 and ANSI/TIA-5071 for information regarding transmission and field test requirements.*



ANSI/TIA-568.0-E-1 Centralized single twisted-pair cabling

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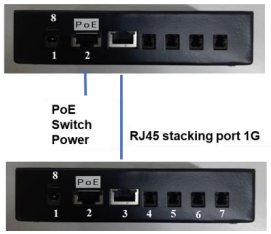
LEGEND

EF	Entrance facility
DA	Distributor A
DB	Distributor B
DC	Distributor C
DL	Door lock (security device)
HCP	Horizontal connection point
ID	Intrusion detector (security device)
MR	Mechanical room
SD	Smoke detector (IBS device)
T	Thermostat (IBS device)
◀	Equipment outlet
	Camera (security device)

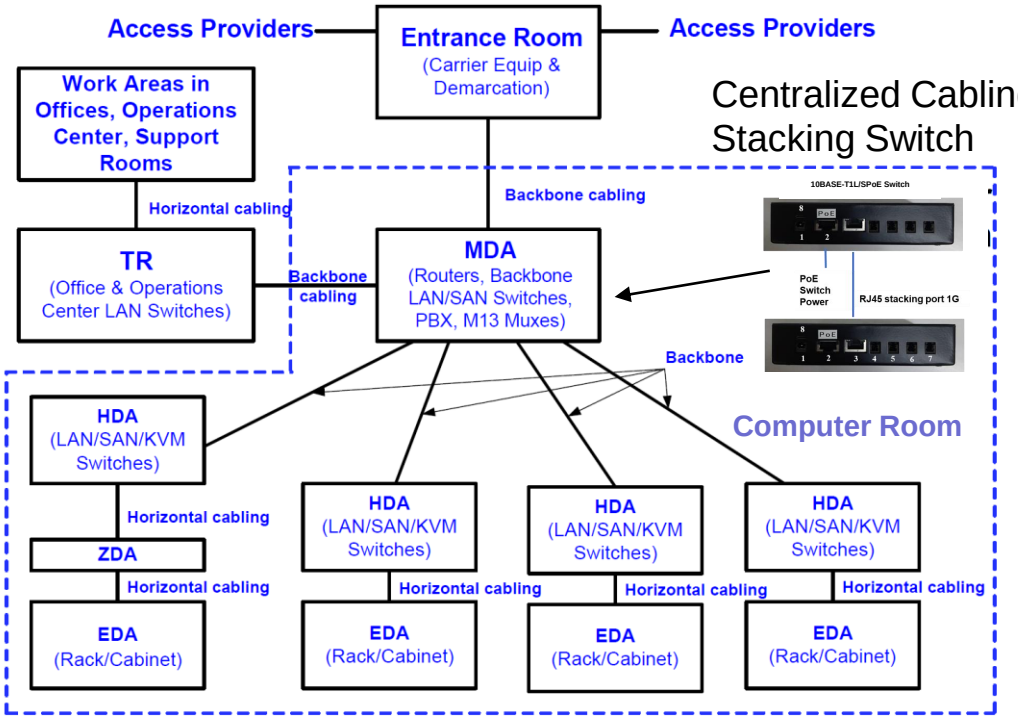
10BASE-T1L/SPoE Switch

Centralized Cabling Stacking Switch



ANSI/TIA-Standards - Balanced Single Twisted-Pair Cabling

- ANSI/TIA-PN-942-C - Telecommunications Infrastructure Standard for Data Centers
  - *Centralized cabling (Annex A) Centralized optical fiber or balanced single twisted-pair cabling*



Centralized Cabling Stacking Switch

Example of a basic data center topology

Centralized balanced single twisted-pair cabling meeting the requirements of ANSI/TIA-568.0 is allowed as an alternative to the cross-connection located in the HDA to utilize centralized electronics.

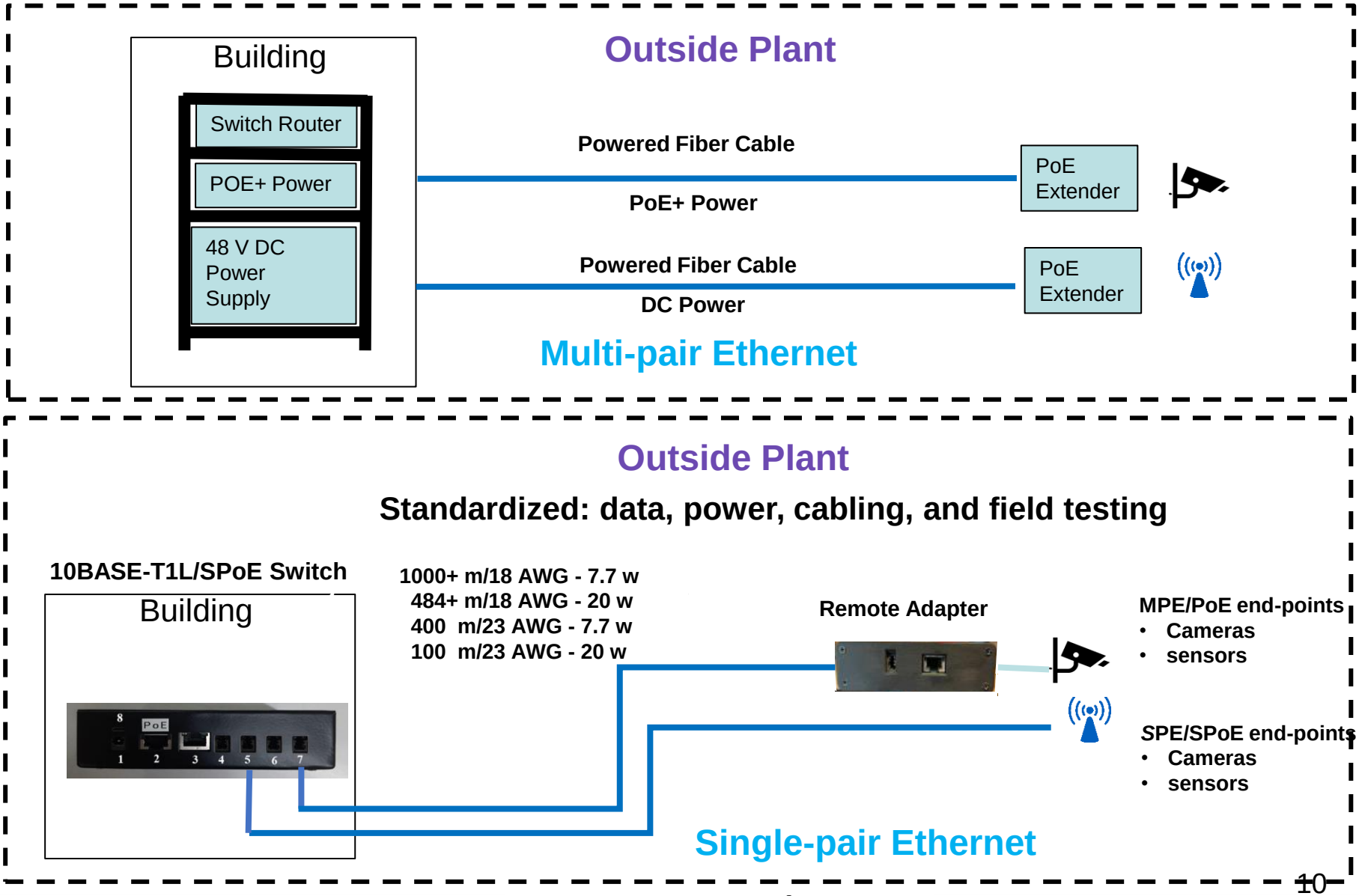
Electrical monitoring
- •Power systems

Environmental systems monitoring and control
- • Temperature and humidity readings
- •Ventilation or cooling equipment status
- •Corrosion Rate
- •Differential pressure across filters
- •Water intrusion
- •Other

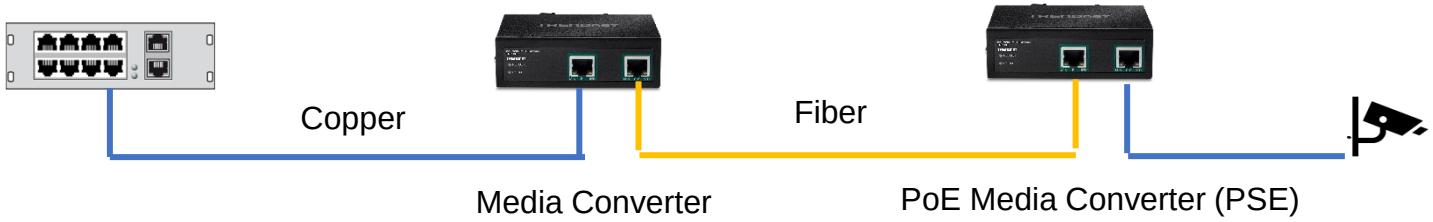
Physical security and safety monitoring
- •Surveillance systems (e.g., cameras, motion/occupancy sensors, forced entry detection, etc.)
- •Enclosure/cabinet access systems (e.g., biometric, electronic locks, door position, etc.)
- •Lighting system
- •Smoke/fire detection system
- •Suppression system notifications (if present)
- •Leak detection system
- •Patch panel port sensing for unauthorized changes to patch cord connectivity.

- Today's Data Center monitoring predominately battery operated sensors networked with wireless connectivity
- SPoE easier to maintain, more reliable , and environmentally friendly than batteries

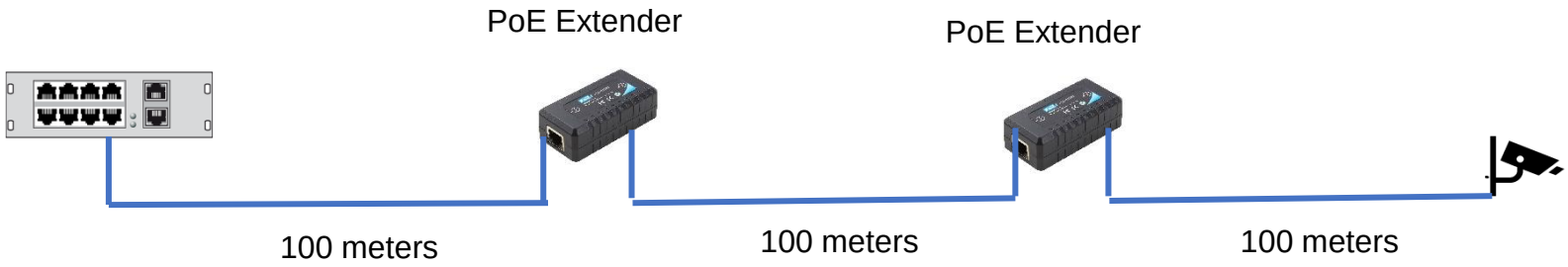
Outside Plant Comparisons - MPE/PoE-SPE/SPoE



Extended Reach Applications - Comparisons - MPE/PoE-SPE/SPoE



Multi-pair Ethernet



Standardized: data, power, cabling, and field testing

1000+ m/18 AWG - 7.7 w
484+ m/18 AWG - 20 w
400 m/23 AWG - 7.7 w
100 m/23 AWG - 20 w

10BASE-T1L/SPoE Switch

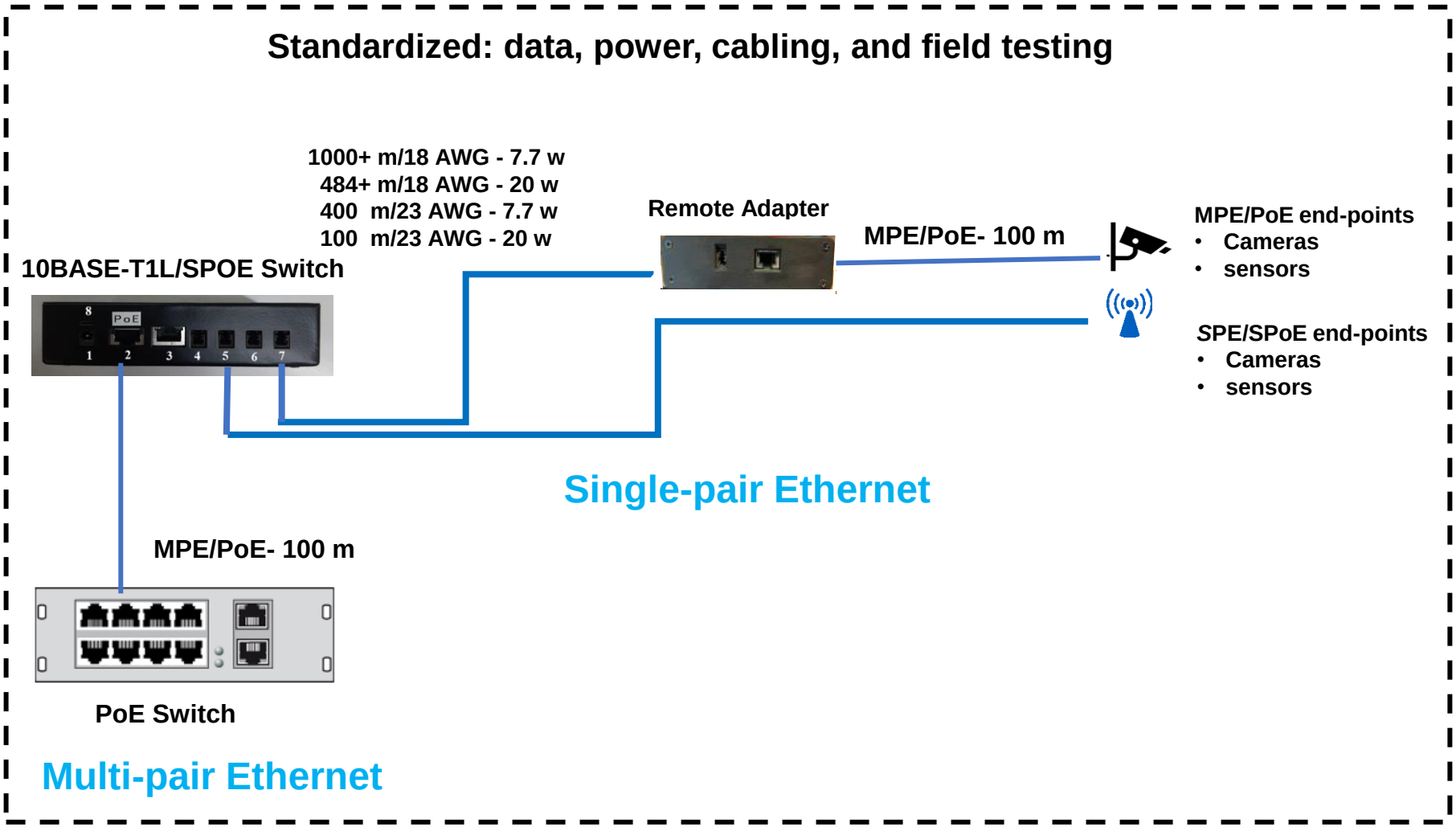
Remote Adapter

MPE/PoE end-points
- **Cameras**
- **sensors**

SPE/SPoE end-points
- **Cameras**
- **sensors**

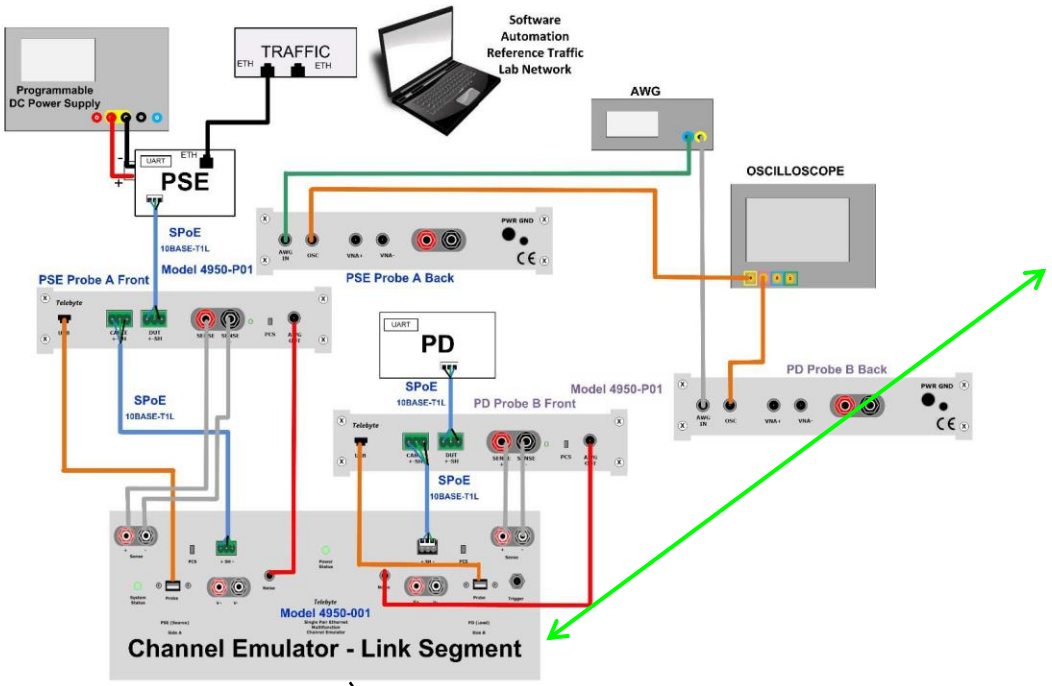
Single-pair Ethernet

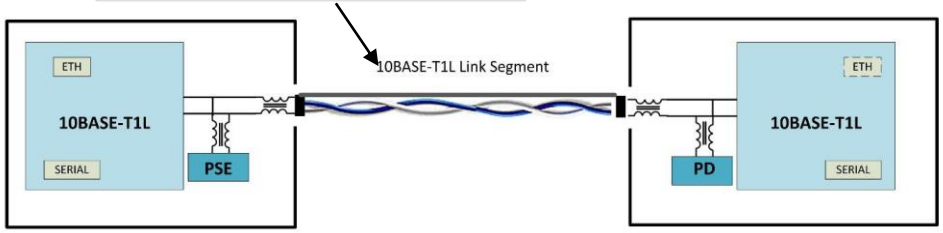
Extended Reach Applications - SPE/MPE Topology



10BASE-T1L 3rd Party Testing - Telebyte / UL Testing

Telebyte Sample Wiring Diagram for 10BASE-T1L PSE and PD with Test Instruments





10BASE-T1L PSE

10BASE-T1L PD

<u>The Link Segment Channel Emulator</u> enables the PSE and PD to be tested over different Unshielded Twisted Pair (UTP) or Shielded Twisted Pair (STP) link segments of varying types (Size and Insertion Loss), Delay (Latency), DC Resistance and length.

Integration of test instruments enables seamless compliance testing without reconfiguring.