

Powered fiber cable system technical overview:
Hybrid optical fiber system for extending
Power over Ethernet (PoE)

This document is intended to describe the purpose and function of the CommScope powered fiber cable system used in conjunction with the PoE Extender. It will provide an overview of what options are available and highlight issues to consider for deployment.

Application

Deployment of HD cameras, Wi-Fi access points, optical network terminals, small cells (picocells, femtocells, metrocells, etc.) and other network access devices can be difficult, especially in outdoor environments. Many of these devices accept a Power over Ethernet (PoE) input for power and communications. However, the PoE distance limitation of 100 meters can cause difficulties with network planning. Also, power is not always readily available in the precise locations where device placement is needed to improve 4G LTE and/or 802.11ac Wi-Fi coverage for wireless networks, such as on the sides of buildings, lamp posts, etc. In these situations, it is typically needed to run power to the desired location prior to installing the devices. Also, any concern about who pays for that power and how it is monitored requires wireless network operators to negotiate with local utility companies and building owners. All of this adds time and money to the installation of network access devices.

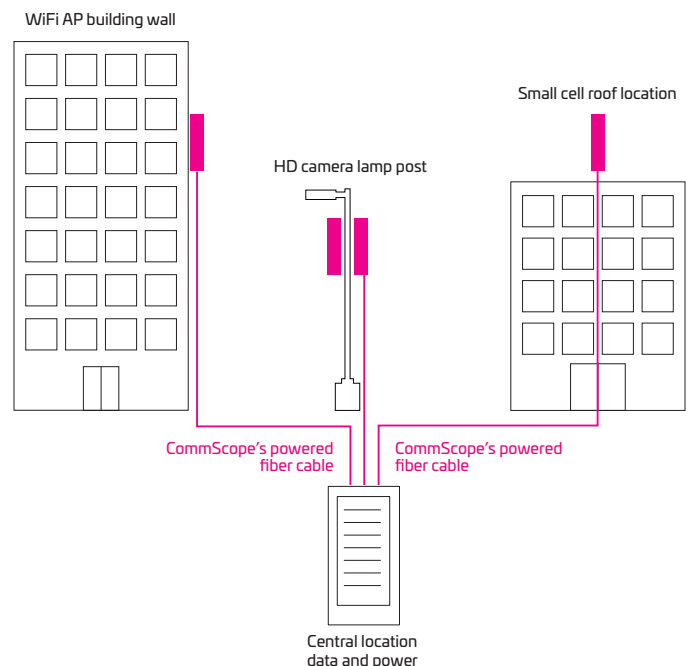
CommScope has developed a solution that combines power and optical fiber communications into one system, eliminating the hassles and extra expense associated with powering typical low-power network devices.

Features

- NEC Class II DC power supply
- Hybrid optical fiber and copper cabling with outdoor and indoor/outdoor versions
- Incorporates DC/DC conversion technology to eliminate DC line powering calculations
- Primary, secondary, and tertiary electrical protection
- Media converter for delivering PoE and PoE+ capability
- SELV and NEC Class II compliant

Applications

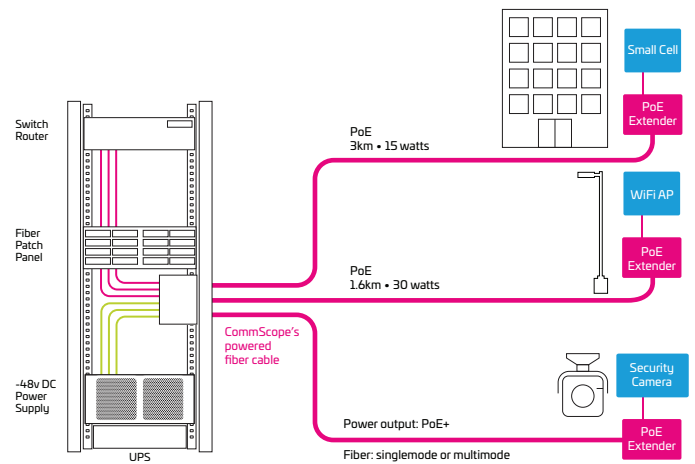
- Security cameras
- Wi-Fi access points
- Wireless network small cells
- Optical network terminals
- Digital signage
- Additional devices needing PoE or PoE+ signal



System overview

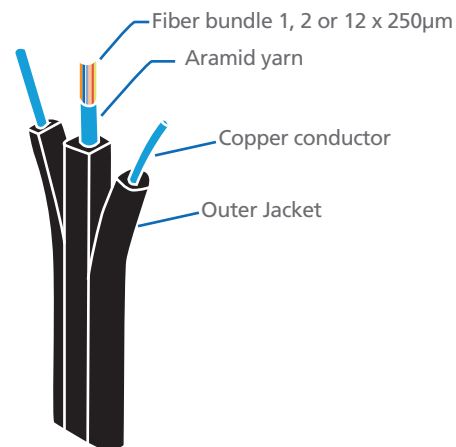
The CommScope powered fiber cable system is a hybrid fiber/copper system that installs like a “long extension cord” and is comprised of the following system elements:

- Hybrid cable
- PoE extender
- Safety & overload protection
- Power supply
- Power transmission management
- Cable/fiber management



Hybrid fiber/copper cabling

- 12 AWG (2mm) and 16 AWG (1.2mm) conductor size options
- From one to twelve optical fibers, G657 A2 single mode or OM3 multimode
- Outdoor rated polyethylene (PE) and indoor/outdoor low smoke zero halogen (LSZH/Riser) rated options
- No special cable access tools needed
- Uses commonly available flat cable installation hardware.



PoE extender

- DC/DC conversion electronics
- Eliminates electrical engineering calculations by converting the received voltage to the correct DC voltage level for PoE output (48VDC)
- Provides three separate levels of electrical protection per ITU.T K21 and Telcordia GR-1089 to protect the device (small cell, Wi-Fi AP, camera, etc.) and personnel
- SELV and NEC Class II compliant
- Outdoor rated
- Houses electronics, power termination, fiber management, and cable termination
- Unobtrusive installation
- Fits in one hand
- Provides a single PoE (IEEE 802.3af-2003) and PoE+ (IEEE 802.3at-2009) compliant output



Power and fiber distribution elements

- -48VDC power supply
- 1 rack unit height, 19" or 26" standard rack mounted
- Modular in units of eight cable outputs. Each output capable of powering a PoE+ (30W) device at distances of 2.5km
- Four modules total per power supply for a total of 32 cables per power supply

Cable and fiber management

- CommScope offers an array of cable and fiber management options to suit your network connection needs
- The combiner panel (P/N - BM0333-000) is available to provide rack-mounted separation and cable management of the power and optical fiber elements of the powered fiber cable

System configuration guidelines

The power supply should be installed in a safe location with access to the fiber optic network into which small cells or other network access devices are desired to be connected, and either 120VAC, 240VAC, or 48V UPS power available.

The system has been designed such that there is no need for DC voltage drop calculations and/or system input modifications in order to deliver the correct voltage and power levels to the network device.



Parameters requiring consideration to deploy the system are:

1. The distance from power supply to the network devices
 - a. Note: This is important to determine the cable conductor size.
2. The maximum power consumption of the network devices
 - a. Although the PoE and PoE+ standards allow for maximum device power consumption of 15.4 and 25.5W respectively, the actual power consumption of many devices may be less than these figures. Therefore, the maximum distances achievable for particular cameras, Wi-Fi APs, etc. may actually be greater than the precise PoE and PoE+ standards.
3. How many devices will be deployed
4. Installation considerations of the cable
 - a. Is indoor/outdoor LSZH/Riser cabling required for building entries, or is purely outdoor rated cable sufficient?
 - b. If the unsupported aerial span length is 10 meters or more, then the cable must be lashed or otherwise supported for aerial installation. Please contact CommScope for advice on the number of cables that can be lashed to a given strand, based on strand size/type and loading conditions.
 - c. Typically, it is easier to pull PE-jacketed cable through a duct as opposed to indoor/outdoor-rated LSZH/Riser cable.
5. Fiber management options
 - a. CommScope supports a complete portfolio of rack and wall mounted splice and patch solutions to connect the powered fiber cable system to your fiber network.

Power supply options

The CommScope recommended power supply is modular, with expansion capability to four modules. Each module can support powering up to eight hybrid cables. If eight or fewer devices are to be deployed initially, then only one module is needed. To power up to 16 devices, add a second module. Three modules are required for up to 24 devices. Four modules are required for up to 32 devices.

Although CommScope has thoroughly evaluated and tested one particular power supply from a major manufacturer, other power supplies from different vendors may be used. Please consult

CommScope before utilizing such power supplies, as the voltage output of these may vary, affecting the maximum system distance achievable.

Determine the correct rack width, 19" or 26".

Cable options

Based on parameters one (max distance) and two (power needed), the cable wire gauge (12AWG or 16AWG) may be selected based on the table below.

Case 1: A single PoE Extender



Input voltage	Cable gauge (AWG)	PoE/PoE+	Max recommended cable length (meters)
Maximum (57V)	12	PoE	3040
	12	PoE+	1560
	16	PoE	1190
	16	PoE+	610

When using the CommScope recommended power supply, the maximum (57VDC) voltage from the power supply may be assumed for determining distances supported.

Input voltage	Cable gauge (AWG)	PoE/PoE+	Max recommended cable length (meters)
Nominal (48V)	12	PoE	2150
	12	PoE+	1100
	16	PoE	850
	16	PoE+	430

If another 48VDC power supply is used refer to the distances listed for nominal (48V).

Input voltage	Cable gauge (AWG)	PoE/PoE+	Max recommended cable length (meters)
Minimum (40.5V)	12	PoE	1530
	12	PoE+	780
	16	PoE	600
	16	PoE+	310

The minimum (40.5V) is only shown for those customers who utilize an unregulated power supply directly from a UPS source. This is not recommended by CommScope, but provided for illustrative purposes only.

Note: CommScope has specifically chosen a power supply that keeps the system within the SELV and NEC Class II (<=60V DC, supply limited to <=100VA per output channel) requirements for easy installation. Table 1 represents the resulting system limits. However, if longer distances or higher power devices than higher voltage, non SELV and/or NEC Class II power supplies may be selected. The powered fiber cable is designed to support significantly longer distances and greater power with such input sources. Please consult with CommScope before attempting to utilize such power supplies.

The option of LSZH/Riser for indoor/outdoor use may be selected as needed.

PoE extender

The PoE extender is designed to eliminate the electrical calculations normally needed for determining power level versus distance, copper conductor sizes, etc. When the PoE extender is installed with the powered fiber cable, simply follow the maximum rated distances. The DC/DC conversion circuit in the PoE extender automatically compensates for line voltage drop and corrects to proper PoE output.

The PoE extender is designed to accept any typically available SFP module for fiber termination and has been successfully tested with many. If OM3 multimode fiber is selected in the cable, then matching duplex OM3 SFP modules should be used. If singlemode cable is selected, then either simplex SMF SFPs or duplex SMF SFPs may be used as desired.

A single PoE and PoE+ compliant hardened RJ45 port is provided for output. CommScope has designed to power/communicate for a full 100 meters from this port, as specified in the PoE standards IEEE 802.3af and 802.3at. So, the PoE extender may be located anywhere up to this distance from the device to be powered and still function properly.

CommScope has worked with companies such as Aruba Networks to design the PoE extender to fit inside the brackets which hold various access devices. This creates a more aesthetically appealing solution for Wi-Fi access point deployment in urban situations, hiding the PoE extender unobtrusively inside the bracket.

Installation considerations

Cable access

The powered fiber cable is designed to access using only a typical pair of wire strippers and, optionally, a wire cutter or snip. To access the cable, follow these recommendations:

1. Snip the cable end in two places – at the indentations in the cable jacket between the center fiber element and the two outer conductor elements.
2. Using bare hands, first peel one conductor side away to the desired length.
3. While holding the center fiber element in as straight a line as possible, peel the second conductor element away to the desired length.
4. For the 12 AWG cable, use a proper 12 AWG or 2MM diameter wire stripper. For the 16AWG, use a 16 AWG or 1.2mm wire diameter stripper.



PoE extender pictured with Aruba AP275 Wi-Fi access point

5. Strip the two copper elements to an appropriate length, just as accessing any copper cable.
6. For the center fiber element, simply place the strippers at the desired strip location, close the wire strippers fully once, then open. Now, by hand you may pull the center element jacket off, revealing the aramid and optical fiber(s).
7. Clip away excess aramid as desired for termination.

Cable installation

For duct installation, the PE-jacketed outdoor-only rated cable is recommended. The LSZH/riser rated indoor/outdoor cable may also be installed in ducts - however, frictional forces are greater for the indoor/outdoor cable and, therefore, achievable distances may be less. Standard cable lubricants may be used to assist with the indoor/outdoor cable for duct installation.

When installing in ducts, care should be given to avoid cable twisting. This is easily achieved by paying off the cable from a reel. Never pull cable into ducts/conduit with twists as this reduces the achievable installation length. If it is not practical to bring a reel of cable to the installation site, then utilize a standard figure 8 procedure to lay the cable out prior to pulling in duct. This helps avoid cable twisting.

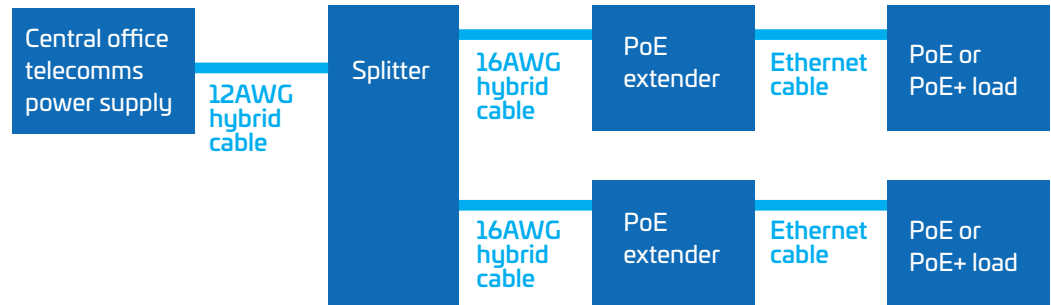
The PE-jacketed outdoor cable is rated for direct burial. However, CommScope recommends always installing below-ground cables in conduit/ducts, as this is better for long-term reliability.

For long aerial installation, cable lashing is recommended. The powered fiber cable is not rated for aerial self-support.

Using one 12 AWG “backbone” cable to feed two PoE extenders

In some cases, it is desired to minimize the number of cables leading from a head end. It is possible to use one 12 AWG “backbone” cable and branch into two 16 AWG “feeder” cables, each feeder cable then powering a PoE extender.

Case 2: A 12AWG hybrid cable backbone, which splits to two 16AWG feeders, each with a PoE extender



In this scenario, the overall distance supported is reduced. However, this may still be an attractive option for some installations. In this scenario, refer to the following distance table:

Input voltage	16AWG feeder cable length (meters)	Load PoE/PoE+	Max recommended 12AWG backbone cable length (meters)
Maximum (57V)	50	PoE	1460
	100	PoE	1410
	150	PoE	1360
	50	PoE+	440
	100	PoE+	390
	150	PoE+	340

Input voltage	16AWG feeder cable length (meters)	Load PoE/PoE+	Max recommended 12AWG backbone cable length (meters)
Nominal (48V)	50	PoE	1020
	100	PoE	970
	150	PoE	920
	50	PoE+	300
	100	PoE+	250
	150	PoE+	190

Input voltage	16AWG feeder cable length (meters)	Load PoE/PoE+	Max recommended 12AWG backbone cable length (meters)
Minimum (40.5V)	50	PoE	710
	100	PoE	660
	150	PoE	610
	50	PoE+	200
	100	PoE+	150
	150	PoE+	90

To terminate the splicing point (“splitter” in the Case 2 diagram), CommScope recommends using the CommScope FOSC 450A closure. This closure has provisions for proper sealing of flat cables, such as the powered fiber cable.

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