5G Hybrid Fiber Optic and Power Cable Applications

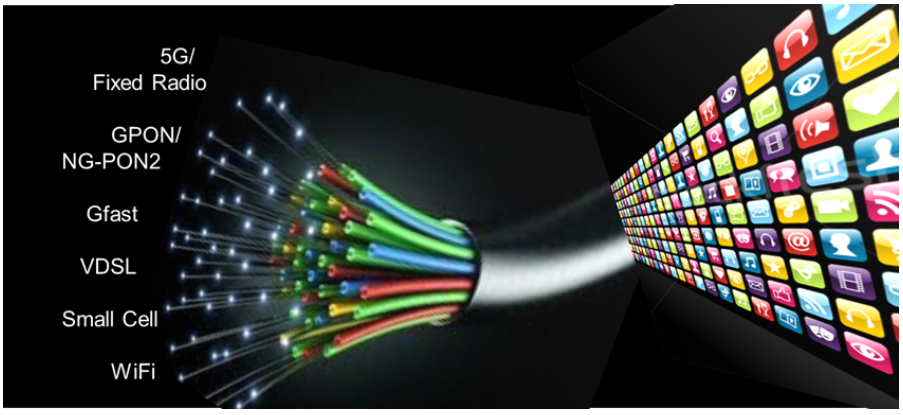
The 5G hybrid fiber optic and power cables incorporate both fiber and copper conductors in one cable. Ilt contains two or more copper conductors that deliver DC power and optical fiber strands that deliver data to a remote device through one medium. A single cable delivers 48-52 volts over a short distance (Macro Tower 300 feet) and 380 volts for long distance (small-cell remote power 3 km).

As the telecommunications and building industries converge on fiber optic cable, there will still be a need for copper cabling in certain situations. Superior Essex manufactures hybrid cables to assist builders to interconnect wireless applications on their premises. This Technical Guide provides solutions and cable designs using hybrid cables in the deployment of wireless applications.

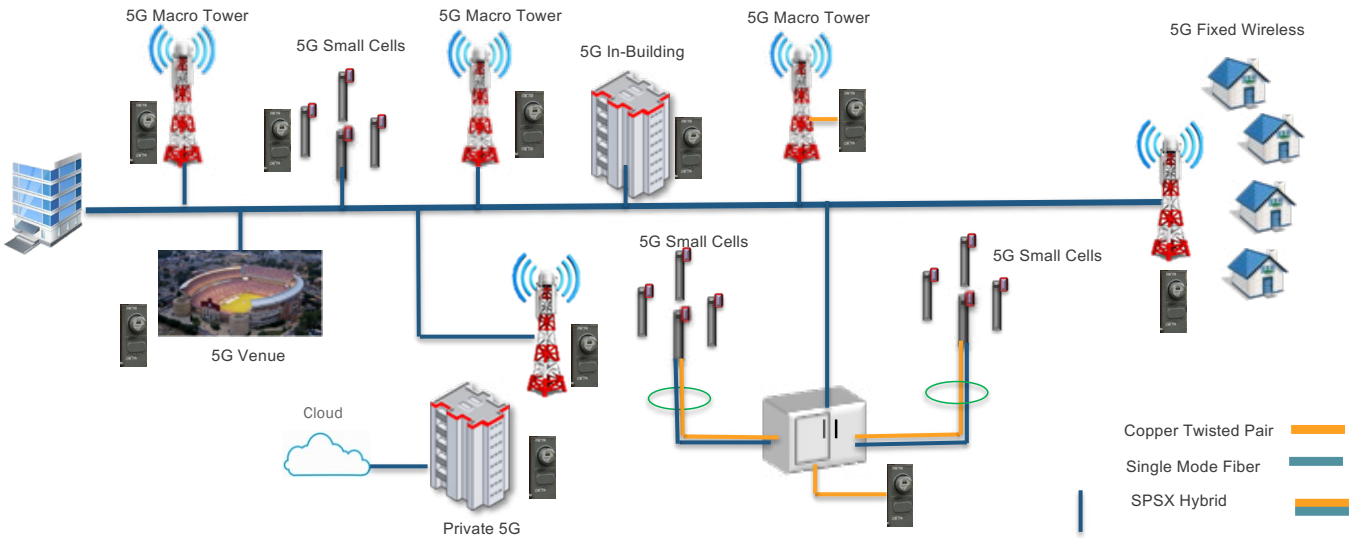
Fiber in the Broadband Network

Distributed networks are using "last-mile" access technologies that require gigabit speeds beyond Fiber to the X applications (FTTx). These include:

- Home
- Antenna (RRH)
- 5G Small Cell (Front Haul)
- Fixed Wireless Transmitter
- Small Cell (Front Haul)
- DSLAM (VDSL)
- Distribution Point (G.fast)
- PON Node (GPON,NG-PON2)
- WiFi Access Point



5G Architecture



Fiber cable is common to all 5G deployments. There are three different methods for building a 5G network, depending on the type of spectrum in which a wireless carrier has invested.

- Low-band network (wide coverage area but only about 20% faster than 4G) that use tower mounted assets.
- Mid-band network (balances speed and coverage) that use tower mounted assets.
- High-band network mmWave (superfast speeds but signals don't travel well and struggle to move through hard surfaces) that use tower mounted assets and dense small cells.

Powering Remote Devices

There are many challenges to powering remote devices on a premises. For starters, they need to connect to local power from the building. They are also likely always in use and therefore require reliable power and data transmission. Further complicating these devices is the existing cable; some builds have old copper cable installed while some only have fiber cables.

Solutions for Remote Devices:

- Centralized Line Powering
- Digital Electricity
- Telco Applications:
  - Remote IP68 PON Nodes
  - DSLAMs
  - G.fast distribution points
- Wireless Applications:
  - Small Cells
  - Fixed Wireless Transmitters

Advantages of Line Powering

- Proven Safe Technology
- Reduced Deployment Time
  - Avoid Electric Utility Coordination
  - No local AC power required at remote device
- Minimize truck rolls and OPEX
  - Low maintenance costs
  - No batteries required at the network edge
- Improved Network Reliability and Resiliency
  - Consolidated power located at the central office or remote location
    - AC Power
    - Batteries
    - Generators
    - Fuel Cells

Powering of Remote Devices and Fiber Optic Data Transmission

Single Mode Optical Fiber provides backbone and distribution solutions that offer:

- Extremely High Bandwidth
- Low Latency
- Fast Data Rates
- Long Link Lengths
- Low Attenuation dB/km
- Immune to Electromagnetic Interference

Power-carrying capabilities:

- VDC
- Watts
- Line powering

Remote Powering Technologies

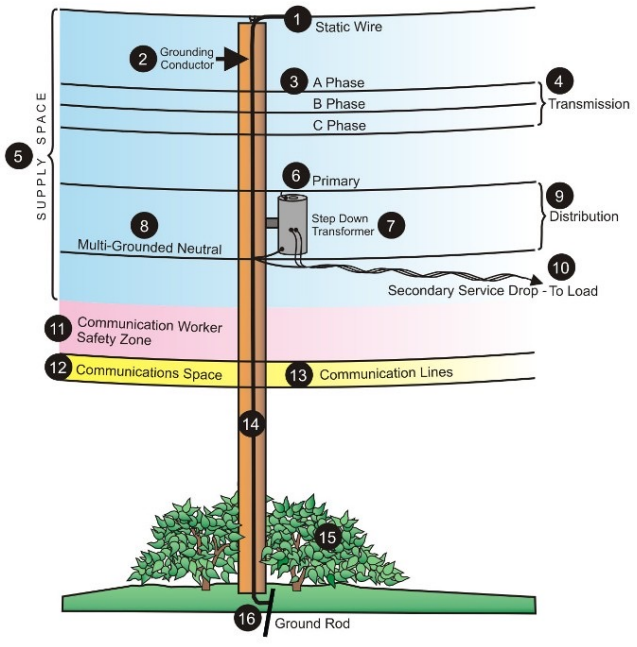
Line-Powering using OSP Communications Cable (Comm Space Deployment)

- Telcordia GR 1089-CORE
- ATIS -0600030.2016
- IEC 60950-21 RFT-V Remote Feeding Telecommunications Voltage Circuits
- Positive and Negative 190 Volts (380 V) per pair limited to 100 Watts
- 4 x 22 AWG pairs can deliver 300 watts over 3000 Meters

Telco Line Powering Hybrid Cable Designs

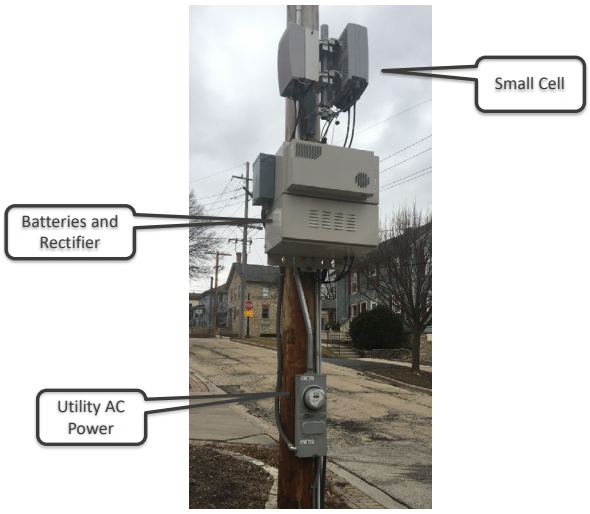
- 25-50 pairs of 22 AWG conductors
- 48- 192 SMF in a Loose Tube Configuration

25/22
Pairs
192 Fibers



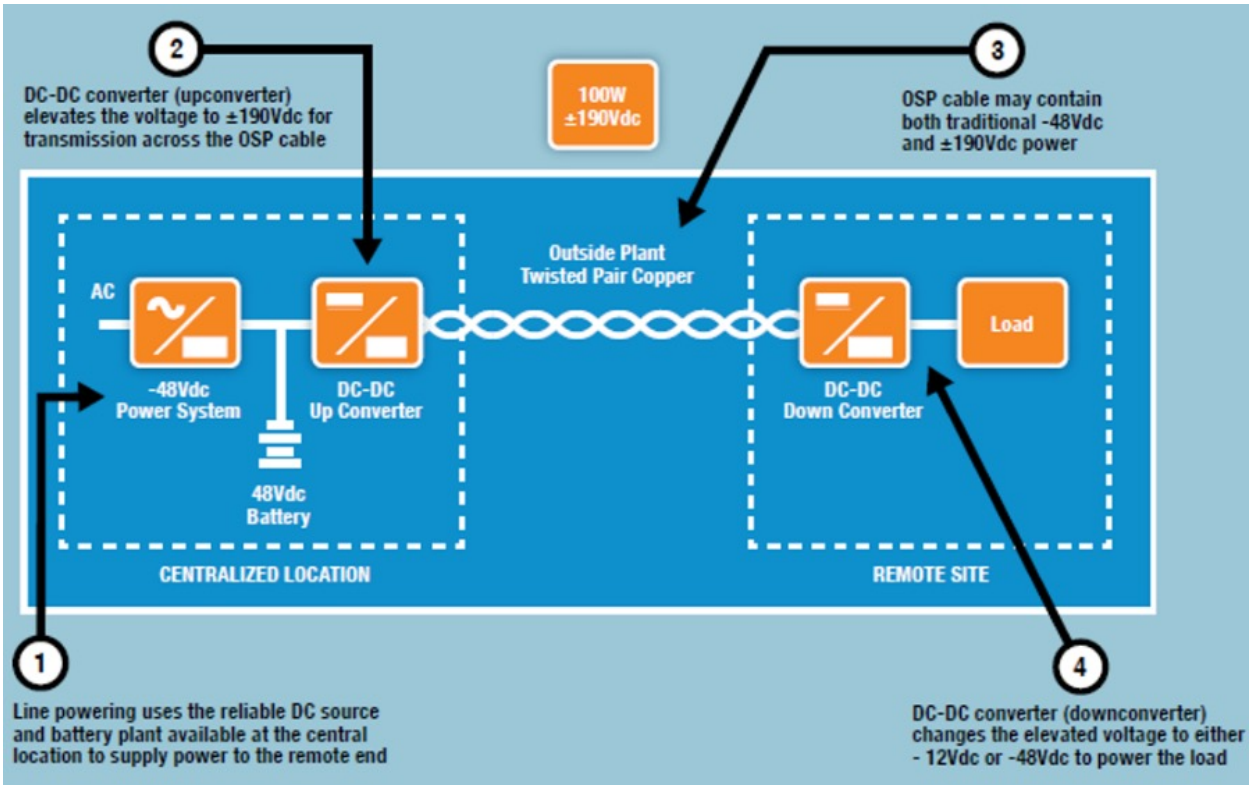
AC Powered Verses DC Remote Powering

High-cost AC powered Small Cell deployment – Pole mount

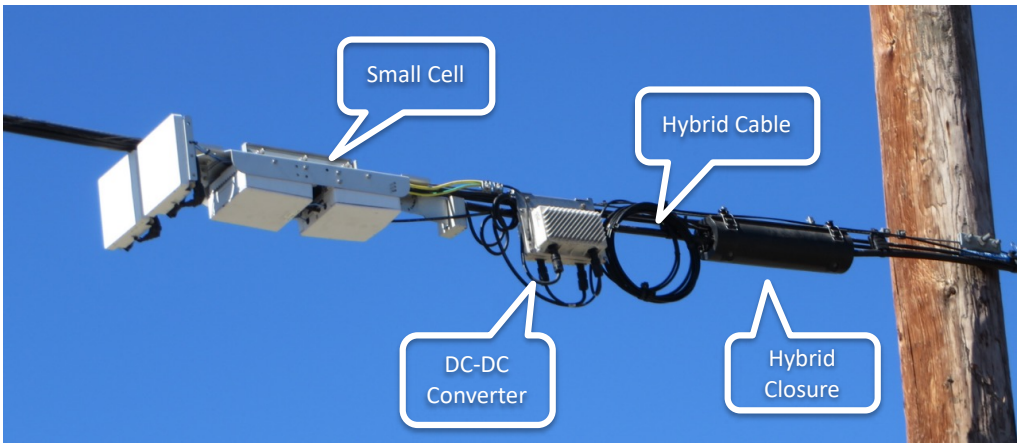


How Remote Line Powering Works

Remote line powering is a method of energizing remote devices using power delivered from a central source over copper cable. Conventional 48Vdc power at the central source is converted to ±190Vdc to extend the reach over the copper cable. At the remote end, the ±190Vdc voltage is converted back to -48Vdc or -12Vdc to power the remote load.



Next Generation Distributed Architecture



Small Cell Network Densification

- Remote Powered Strand Mounted Small Cells
- SPSX Telco Hybrid Cable

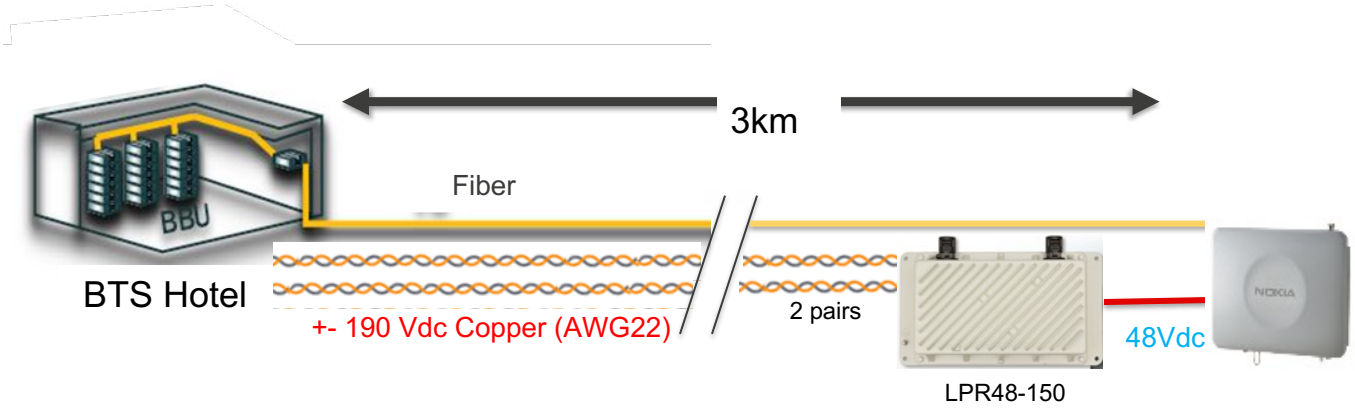
Line Powering Application

- 22AWG Twisted Pairs Conductors
- POWERPIC Copper Family
- 4, 8, 12, 25, 50, 100, 300 Pairs
- Telcordia Certified

Energizing 1 Small Cell (125 Watts)

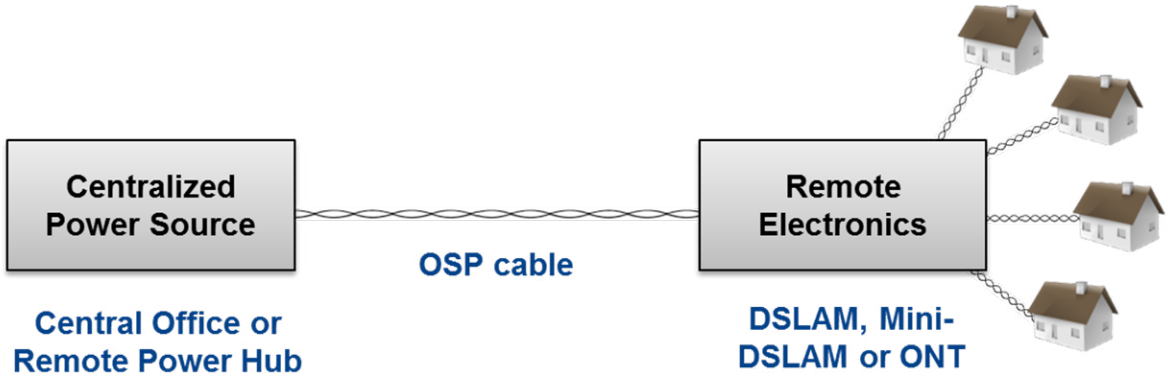
To energize one (1) small cell radio remotely up to 3 km, two (2) power pairs are required.

Load (Watts	Max Distance to Small Cell Node		
	Cable Gauge (AWG)		
	26	24	22
125	3800 ft (1.1 km)	6000 ft (1.8 km)	9500 ft (3 km)



Line Powering Over Copper Cable

- A technique for energizing remote electronics over Telco twisted pair copper delivered from a centralized source.
- Uses a consolidated DC power system, batteries and/or generators at central locations that can be easily maintained
- Can reach more than 15kft on a single 22AWG cable pair to power a typical high bandwidth, sealed DSLAM



Superior Essex Hybrid Cabling Products

POWERPIC-FSF Line Powering OSP Copper Cable

OSP Copper Cable

- Solid Annealed 22 AWG Copper Conductors
- Foam skin filled Polyolefin Insulation
- PFM Gel Filled Core
- Corrugated Coated 8 mil Aluminum Shield
- Black Polyethylene Jacket

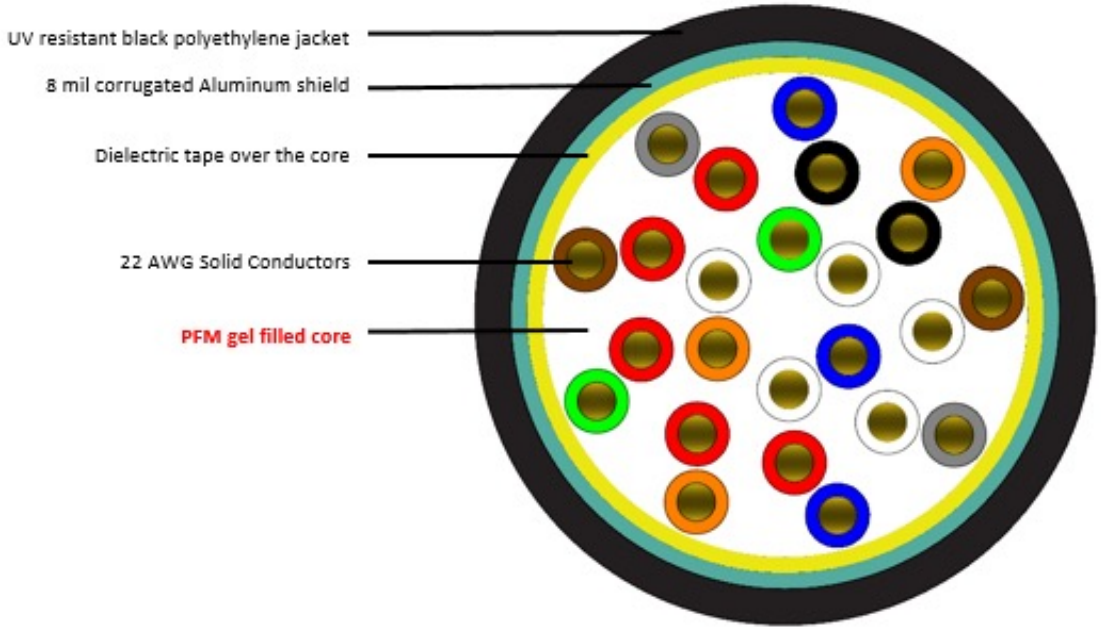
Application: Telco Class 2 Line Powering

Environmental Specifications

- Operation/Storage: -40°C to +70°C
- Installation: -30°C to +60°C

Standards Compliance

- ANSI/ICEA S -84-608-2017
- RDUP 7 CFR 1755.890
- Telcordia GR-1089
- ATIS
- RoHS-compliant



OSP Telco Hybrid Family

Application: Line Powering and Data over Fiber

Standards

- Telcordia GR-1089-CORE Electromagnetic Compatibility and Electrical Safety Generic Criteria for Network Telecommunications Equipment
- IEC 60950-21 RFT-V Remote Feeding Telecommunications Voltage Circuit

Components

- Standard Solid Copper Telco #22 AWG Twisted Pairs
- Water Blocking Elements
- Fiber – SM 657.A1 fibers in polypropylene buffer tubes
- Corrugated Coated Steel/Aluminum
- MDPE Jacket

OSP Rated Telco Hybrid Cables

Greenfield Application

- Line powering small cells, remote PON and DSLAMs
  - o +/- 190 Volts powering, data over fiber (Ethernet)

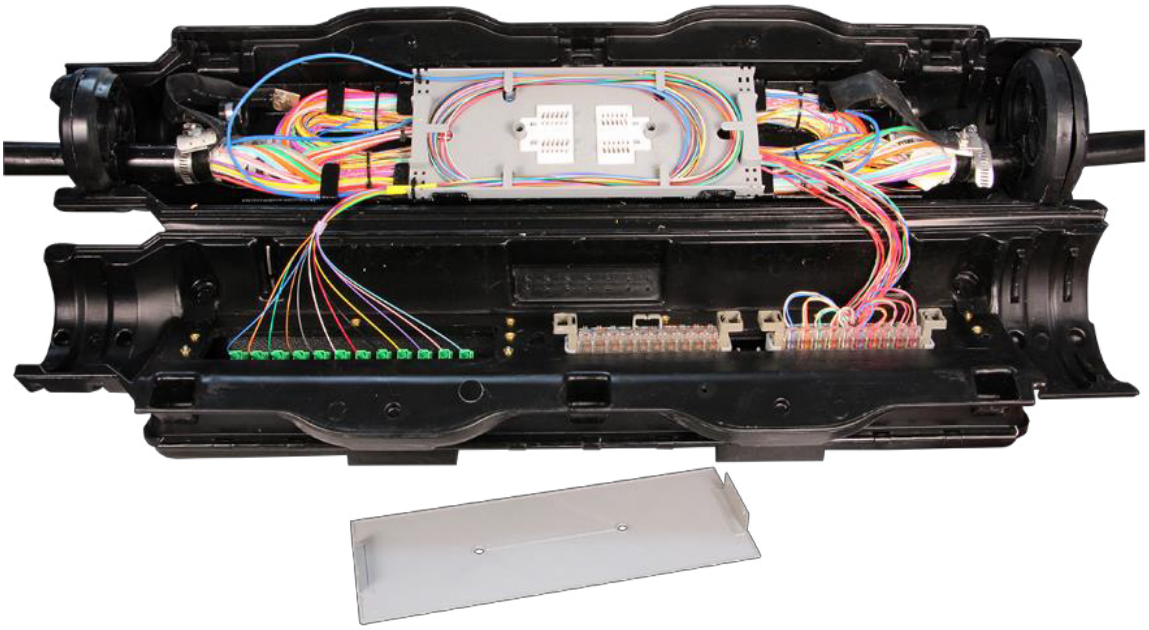
Components

- Twisted Pair Copper Conductors
  - o Solid or Foam Skinned (standard industry color code)
  - o #22-24 AWG
- **Fiber**
  - o SM 657.A1 fibers in polypropylene buffer tubes
- **Shield**
  - o Corrugated Coated Steel
- **Jacket**
  - o MDPE

Fiber/Copper Splicing Solutions

Tii Technologies AT Series Splice Closure Solution for 192F/25 Pair Copper

- Internal tube accessed only at initial install
- Central tube stores fiber and copper cable slack for midspan access (or butt splicing)
- Fiber splice tray supports up to 48 single fusion splices, or 192 mass
- Internal copper connections utilize tool-less IDC connections



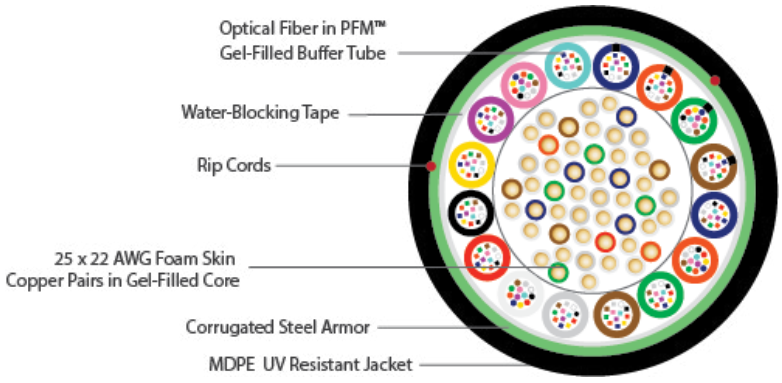
Series MR Telco OSP Hybrid Cable

Description

- 48 -192 RWP SM fibers
- 25/22 and 50/22 copper Core

Design

- Stranded loose tube
- Easy mid-span access for power and fiber



Environmental Specifications	
Operation/Storage	-40°C to +70°C
Installation	-30°C to +70°C

Part Number and Physical Characteristics

				Maximum Tensile Loading		Minimum Bend Radius	
Part Number	**Fiber Count**	**Nominal Diameter in (mm)**	**Approx. Weight lbs/kft (kg/km)**	**Install lbs (N)**	**Long Term lbs (N)**	**Install lbs (N)**	**Long Term lbs (N)**
FG21-192U10-E991-C0F	192	0.799 (20.3)	290 (431.5)	600 (2700)	200 (890)	15.98 (406)	7.99 (203)

Series 72S Telco OSP Hybrid Cable

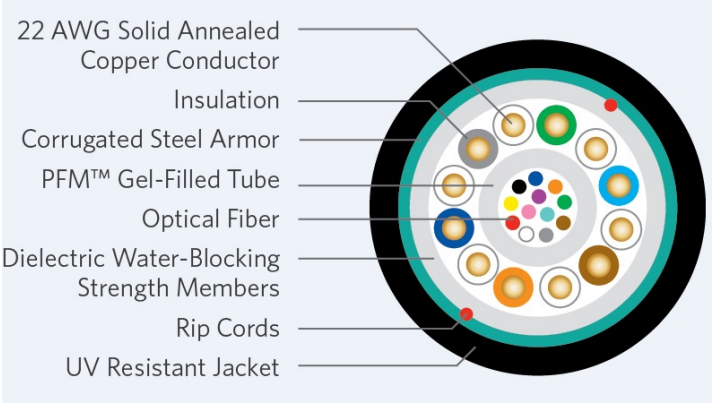
Description

- 2 -12 RWP SM fibers
- 6 Pairs 22 AWG copper

Design

- Central fiber tube
- Home run powering solution

Environmental Specifications	
Operation/Storage	-40°C to +70°C
Installation	-30°C to +70°C



Part Number and Physical Characteristics

					Maximum Tensile Loading		Minimum Bend Radius	
Part Number	**Fiber Count**	**Pair Count**	**Nominal Diameter in (mm)**	**Approx. Weight lbs/kft (kg/km)**	**Install lbs (N)**	**Long Term lbs (N)**	**Install lbs (N)**	**Long Term lbs (N)**
7200XK36S	2-12	6/22	0.44 (11.1)	75 (111)	300 (1335)	100 (445)	8.8 (222)	4.4 (111)

PowerWise OSP Hybrids

Application

- Fixed Radio Transmitters (Tower Mounted)
- O-DAS, Digital Signage, O-Wi-Fi
- VoltServer Digital Electricity
  - Powering, Data / RF over fiber

Components

- Copper Power Conductors (2 per device typically)
- 300 Volt PVC stranded tinned/ non tinned
- #12-18 AWG

Fiber (2 per device, typically)

- SM 657.A1 fibers
- 250 micron or 900 micron

Shield

- Corrugated Copper/Aluminum

Jacket

- PVC / MDPE

Central strength member

12-18 AWG conductors

Premises 900-micron fiber components

Copper/aluminum shield

OSP PowerWise®DE Hybrid

6 stranded pairs #16 AWG PVC conductors

EnduraLite 12 x 250-micron fibers

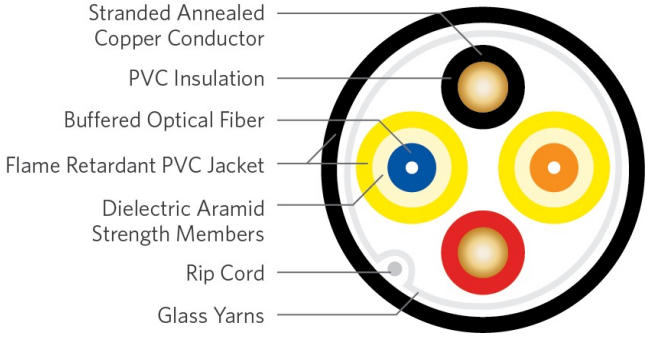
Copper/aluminum shield

Fixed Radio

2 x 12-18 AWG conductors

Premises 900-micron fiber components

No shield



PowerWise Hybrid Cabling Products

Applications

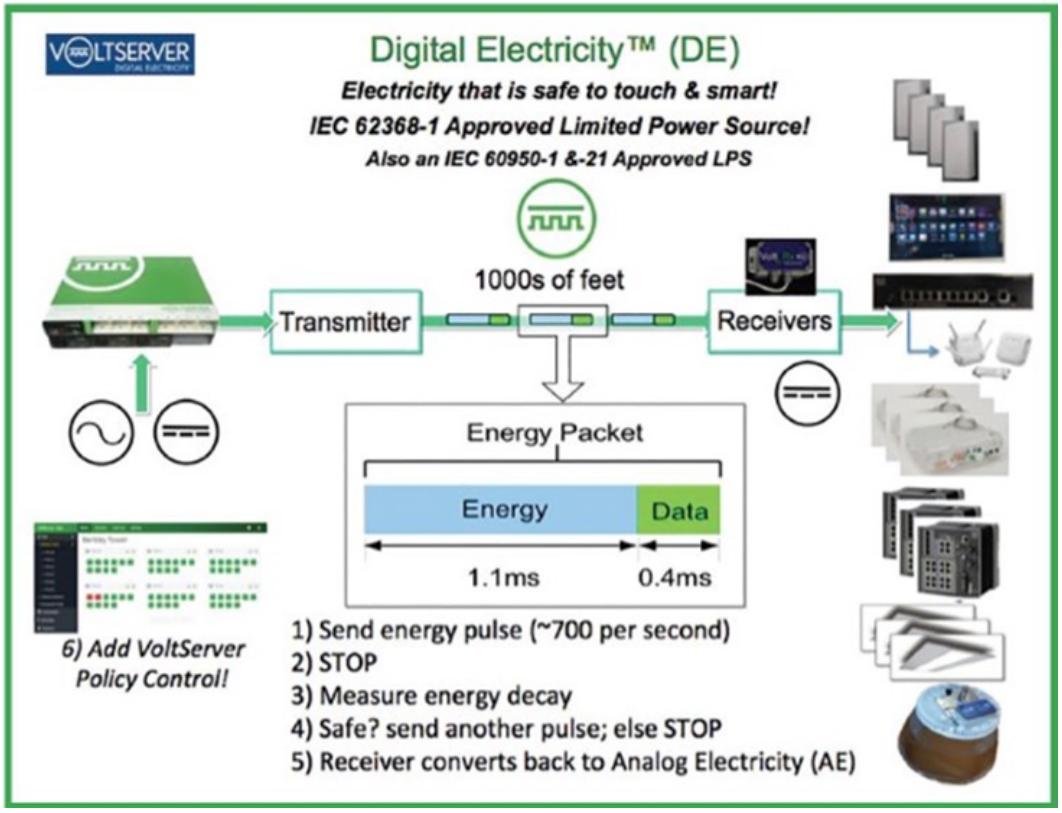
12 – 18 AWG Conductors

- Stadium and in-building small cell deployment
- HD security cameras
- Digital electricity (DE) powering
- Deployments with major telecom providers

Centralized Powering of Remote Devices

Line powering is a means of energizing remote equipment, from a centralized location, over structured copper cable. Digital Electricity™ offers the convenience and safety of low-voltage, like Power over Ethernet (PoE), with the power and distance capabilities of AC.

- OEM – VoltServer 364 Volt Square Wave Pulses
- Makes use of 12-18 AWG stranded copper conductors twisted into pairs



DE™ Powering

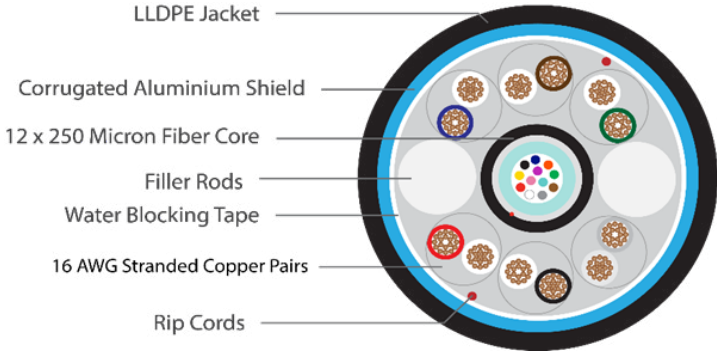
Small Cell - Remote Powering Hybrid Cables

Digital Electricity™

- 364 volts square wave pulses delivering dc power and data sensing packets
- 2,000 watts over 2000 meters 16 AWG conductor pair
- Safety smart sensing circuit cuts power when the following conditions are detected:
  - o Ground faults, arc faults and touch hazards
- Stadium small cell deployment

Digital Electricity™ Hybrid Cable Designs

- 6 pairs of 16 AWG stranded conductors
- 12 SMF in a central loose-tube configuration
- Low pair-to-pair capacitance critical greater than 29pf/mile



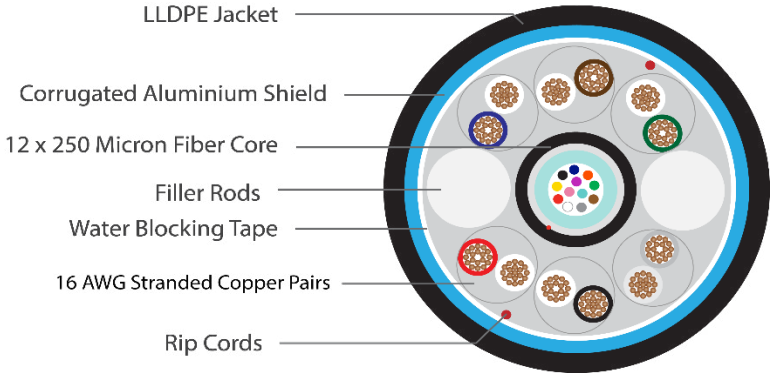
OSP PowerWise® DE Hybrid

Description

- 12 X 250-micron RWP SM fibers
- 6 pairs of 16 AWG stranded copper conductors

Design

- Central fiber tube
- Low pair-to-pair mutual capacitance
- Designed for powering with Digital Electricity
- Great for home run powering



Environmental Specifications

- Operation/storage: -40°C to +70°C
- Installation: 0°C to +70°C

				Maximum Tensile Loading		Minimum Bend Radius	
Part Number	Fiber Count	Nominal Diameter in (mm)	Nominal Weight lbs/kft (kg/km)	Install lbs (N)	Long Term lbs (N)	Install lbs (N)	Long Term lbs (N)
FG41-012C10-E991-CEC	12	0.67 (17.0)	213 (316.9)	300 (2700)	100 (445)	13.4 (340)	6.7 (170)

Tower Hybrids OSP Rated Applications

Application

- Remote radio head LTE & 5G (tower mounted)
- Powering 48 volts, alarms and RF over fiber common public radio interface (CPRI)

Components

- Copper Power Conductors (2 per RRH red and black)
  - 600 Volt THHN/THWN-2/TelcoFlex stranded tinned / non tinned
  - #6-8 AWG
- Copper Alarm Conductors (2-12 optional)
  - 600 Volt THHN/THWN-2
  - #18 AWG
- Fiber (2 per RRH): SM 657.A1 fibers in either 11 or 51 series loose tube cable
- Shield: Corrugated Copper/Aluminum
- Jacket: PVC/MDPE

Macro Tower Hybrid Cables

5G Technology Trends

- Transitioning from RRH to active antennas deploying massive MIMO and beam steering
- 50% more power and fiber required per active antenna
- Hybrid cables desired
- Pre-terminated for plug and play

Hybrid Design Trends

- UL-1277 tray cable (TC-OF and TC-ER-OF) replacing traditional OSP rated cables
  - 600-volt THHN/THWN-2 Conductors 90°C Wet/Dry Locations
- 12 - 18 x 4 AWG conductors and 48 SMF cable designs

Tower Hybrid Family

RRH and Active Antenna Connectivity

- 4, 6, 8, 10 AWG conductors
- UL 1277 Listed Designs
- OSP designs
- New families available
  - 2 Conductor 2-6 fiber
  - 4 Conductor 12 fiber
  - 6 Conductor 12-48 fiber
  - 12 Conductor 12-48 fiber

OSP Rated Tower Hybrids

THHN conductors 6-8 AWG

11 Series fiber component

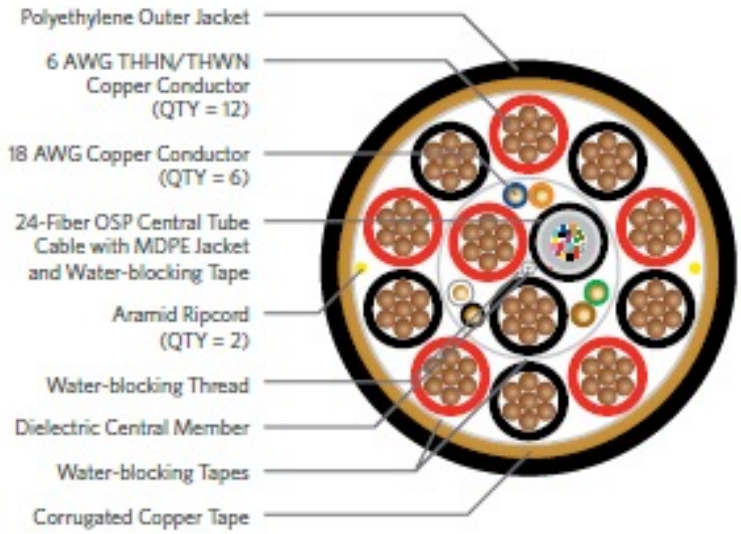
Copper shield

THHN conductors 6-8AWG

51/53 Series fiber component

Copper shield

THHN 12X6 Conductor Design

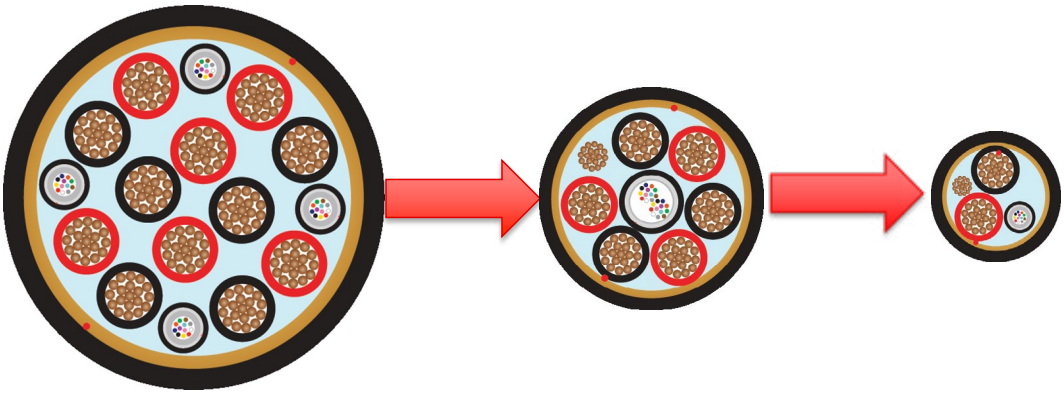


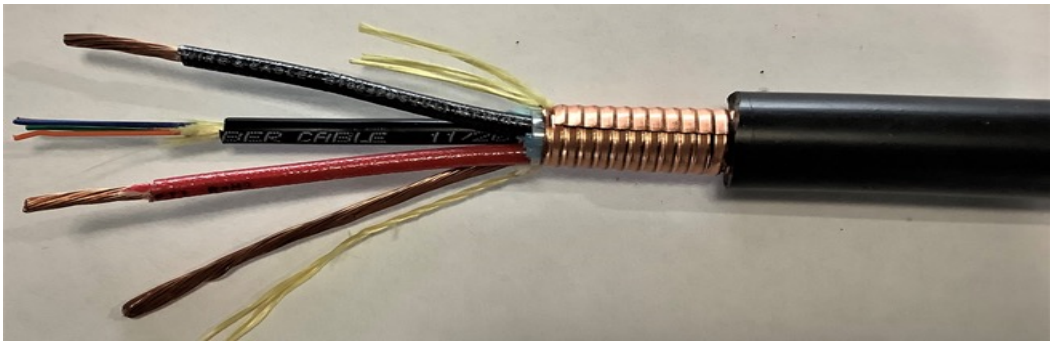
Hybrid Cable Review

Tower Hybrids

UL 1277 Listed and OSP Rated Family Now Available

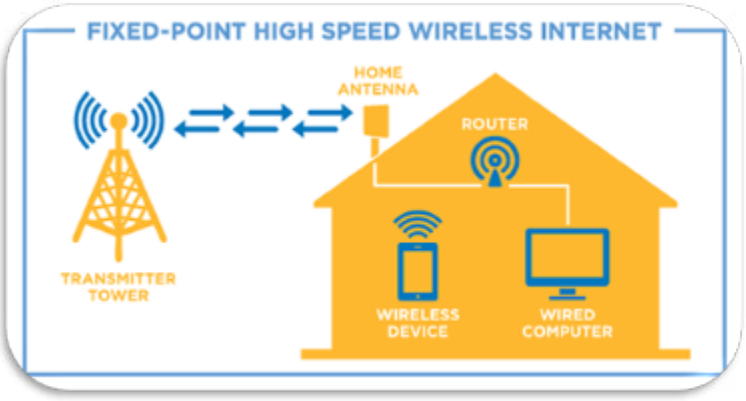
- 12 conductors (#4 - #8 AWG /48 fiber in 12 fiber tubes)
- 6 conductors (#6 - # 8 AWG / 12 -24 fiber central tube)
- 2 conductors (#12 - # 8 AWG /4 SM 900-micron fiber tube)





Wireless Installation

Fixed Radio Installation: Wireless Internet Service Provider (WISP)

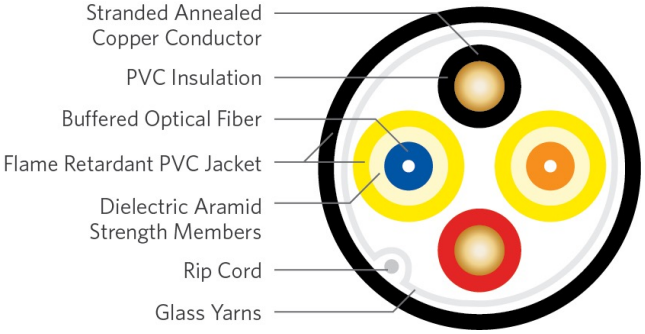


Tower

- Hybrid Fiber Copper Cables
  - -48 VDC powering
  - Baseband over fiber

Home

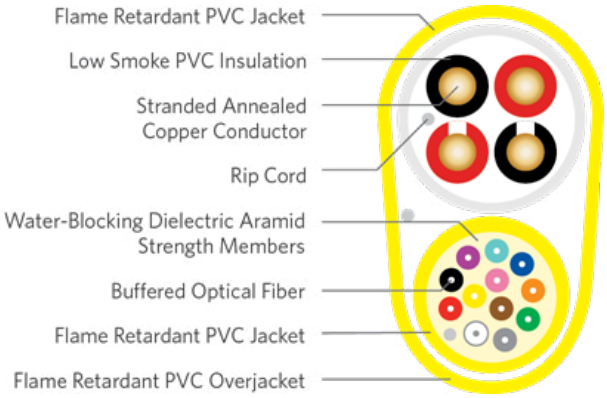
- CAT 5e / CAT 6 CMX/CMR

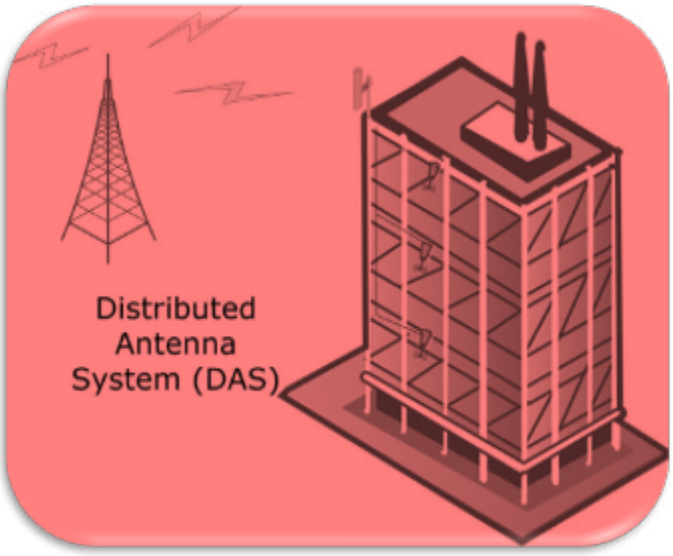


IDAS/ODAS Installation

Distributed Antenna System (DAS)

- RF over fiber
- Centralized power
- CMP Hybrid fiber copper
- 2 discrete cables under 1 jacket
- NEC Class 2 power, CL2P rating





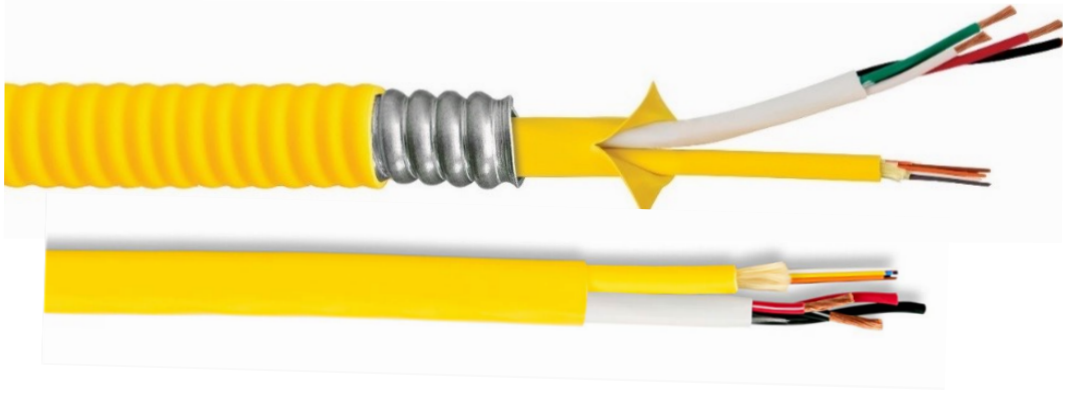
Standard Configurations

12 Fibers + 4 Copper Conductors @ 12 AWG

24 Fibers + 12 Copper Conductors @ 12 AWG

12 Fibers + 4 Copper Conductors @ 14 AWG

24 Fibers + 12 Copper Conductors @ 14 AWG



Technical Support

Technical Support

Phone: 1.877.263.2818

Fax: 770.657.6244

Email: tech.support@spsx.com

Product Sales

Phone: 1.800.551.8948