



FTTX SOLUTION OVERVIEW

Achieving Maximum Performance and Reliability
for Fiber-to-the-Subscriber Deployment

TABLE OF CONTENTS

2	TABLE OF CONTENTS List of Illustrations and Acronyms	19	FIBER DISTRIBUTION POINTS Fiber Optic Interconnect Units (FIU) 400A FIU SlimBox™ Enclosure Solution
4	PURPOSE AND USE OF THIS GUIDE The Lightera Advantage	20	DROP TERMINALS, CABLES AND ASSEMBLIES Drop Network Cables AccuDry® Indoor/Outdoor Cable EZ-Bend® 4.8 Cable EZ-Bend 3.0 Cable EZ-Bend Toneable Cable Mini TB Flat Drop Assemblies Mini LT Flat Drop Cable Toneable Mini LT Flat Drop Cable Mini C2™ Drop Cable SlimBox Drop System
5	FTTx SOLUTION OFFERING Overview	24	MDU, BUSINESS, AND IN LIVING UNIT SOLUTIONS EZ-Bend Multifiber Drop Bundle V-Linx Spool and Play Solution for MDU and Business Bends in a Typical MDU Residence
7	CENTRAL OFFICE Optical Cable Entrance Facility (OCEF) MPO Splitter Modules Combination Shelves Jumpers	27	IN THE LIVING UNIT SlimBox Wall Plate InvisiLight® EZ-Hide Faceplate InvisiLight 80x80 Wall Module InvisiLight EZ-Connect Module SlimBox 4-Fiber Rosette SlimBox Customer Splice Point (CSP) EZ-Bend Optical Fiber InvisiLight Solution
8	OPTICAL FIBER AllWave® Zero Water Peak (ZWP) Family	30	WIRELESS CELL SITE AND SMALL CELL SOLUTIONS
9	FEEDER AND DISTRIBUTION NETWORK CABLES Fortex™ DT Cables AccuRibbon® DC Cables AccuRibbon LXE Armored Cables AccuTube® Ribbon Cable PowerGuide® Shortspan DT Cable PowerGuide TTH Cable MiDia® Loose Tube Microcables MiDia FX Fiber Optic Microcable AccuRibbon DuctSaver® Ribbon Microcables MiDia GX Fiber Optic Microcable AccuRibbon DuctSaver FX Microcables MiDia 2FX Microcable AccuRibbon DuctSaver DT Microcables	31	UTILITIES AND ALTERNATIVE ENERGY SOLUTIONS
13	FIBER DISTRIBUTION POINTS Splitter Architectures Fiber Optic Spliecs Closures Ruggedized PLC Splitters MPO Splitter Modules Direct Connect PLC Splitters Fiber Distribution Cabinets (FDC) ORBITAL™ Cabinets 432 FDC 144 Fiber Distribution Pedestal (FDP) V-Linx™ 144 iFDC 64 Indoor Fiber Distribution Cabinet	33	INDUSTRY STEWARDS

TABLE OF CONTENTS *Continued*

List of Illustrations

- 5** **FIGURE 1**
FTTx Solution Offering
- 6** **FIGURE 2**
FTTx Solution Overview
- 8** **FIGURE 3**
AllWave ZWP Optical Fibers for OSP Cables
- 9** **FIGURE 4**
Cable Application Guide
- 13** **FIGURE 5**
Centralized Splitting
- 14** **FIGURE 6**
Distributed Splitting
- 14** **FIGURE 7**
Distributed Cascaded Splitting
- 15** **FIGURE 8**
Choosing a Splitter Architecture
- 16** **FIGURE 9**
The Access Network
- 20** **FIGURE 10**
EZ-Bend® Optical Fiber Features
- 23** **FIGURE 11**
SlimBox™ Drop System
- 25** **FIGURE 12**
V-Linx MDU Solution Components
- 26** **FIGURE 13**
EZ-Bend® InvisiLight® Optical Solution
- 29** **FIGURE 14**
InvisiLight Solutions as Installed
- 30** **FIGURE 15**
Wireless Cell Site and Small Cell Solutions
- 31** **FIGURE 16**
Utilities and Alternative Energy Solutions

List of Acronyms

ADSS	All-Dielectric Self-Supporting
DAS	Distributed Antenna System
EPON	Ethernet Packet Optical Network
FSAN	Full Service Access Network
FIU	Fiber Optic Interconnect Unit
FDC	Fiber Distribution Cabinet
FDH	Fiber Distribution Hub
FDP	Fiber Distribution Pedestal
FTTB	Fiber-to-the-Business
FTTH	Fiber-to-the-Home
FTTN	Fiber-to-the-Node
FTTx	Fiber-to-the-Subscriber
iFDC	Indoor FDC
iFDH	Indoor FDH
LSZH	Low Smoke, Zero Halogen
GPON	Gigabit Packet Optical Network
MDU	Multi Dwelling Or Tenant Unit
MPO	Multifiber Push-On
OCEF	Optical Cable Entrance Facility
OLT	Optical Link Terminal
ONT	Optical Network Terminal
OSP	Outside Plant
PLC	Planar Lightwave Circuit
PMD	Polarization Maintaining Dispersion
PON	Packet Optical Network
SFU	Single Family Unit or Home
SME/SMB	Small to Medium Enterprise or Small to Medium Business
SMF	Single-mode Fiber
ZWP	Zero Water Peak

The Lightera Advantage

Fiber to the X (FTTx), whether to a home, business, small cell, video camera, or any end point requires expertise across several disciplines, including network architecture and systems, aerial and underground construction techniques, indoor installation, and testing. Furthermore, expertise in construction, network modeling, testing and installation is required for a comprehensive solution that exceeds business case objectives. Lightera has leveraged its expertise in all of these critical areas to create a comprehensive FTTx portfolio of passive optical fiber based solutions and products that provide significant advantages over conventional approaches.

The purpose of this guide is to explain Lightera FTTx Solutions at a high level so customers understand how to configure FTTx networks and help them make the right choices for their network. A series of more detailed Lightera FTTx Solution Ordering Guides provide additional detail along with ordering information for each solution set.

Lightera has a strong innovation and manufacturing heritage of over 100 years driven by a culture of innovation. The Lightera FTTx Solution portfolio of solutions, products and services can help customers meet their unique FTTx design and deployment needs. Flexibility, availability and reliability are the key benefits of the Lightera FTTx Solution Offering. In addition, Lightera is vertically integrated with fiber, cable, connectivity, and components designed, developed, and manufactured to work together, thus ensuring full control with high standards of quality and reliability for telecommunications. The Lightera approach to solutions is based on deep understanding of customer needs, standardization and interoperability.

With a global presence, regional distribution channels, partners and services, Lightera is your trusted partner to **Fiber Connect Your Community™**.

FTTx Solution Offering

The Lightera FTTx Solution offers end-to-end configurations of fiber, cable and connectivity optimized for deployment to the home, business or cell site. Solutions are included for greenfield or brownfield networks; and fiber installation to and inside multi-dwelling units (MDU), single family units (SFU), and cell-sites. The cityscape below shows an overview of the Lightera FTTx Solution Offering, covering all key segments of the network.

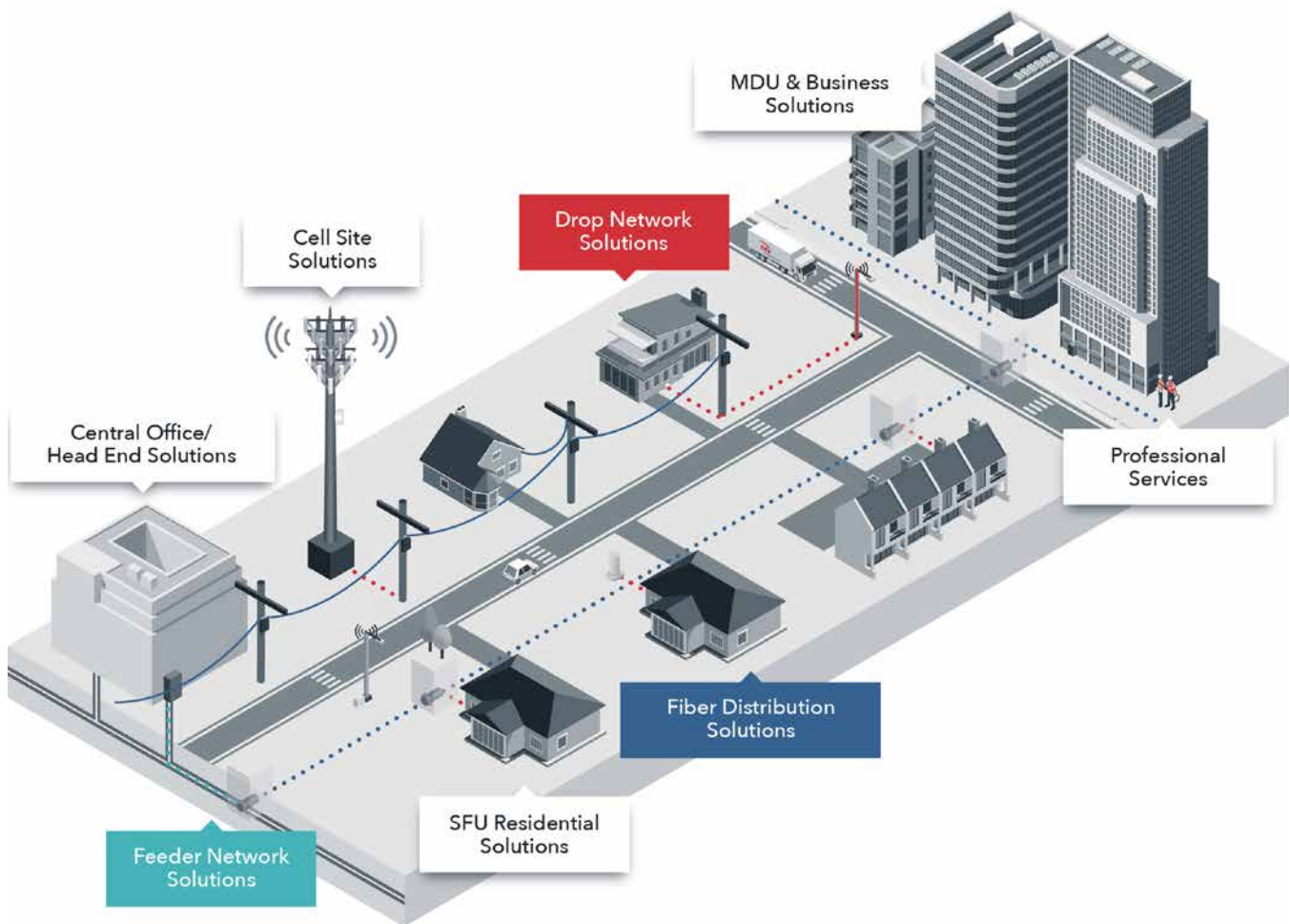


FIGURE 1: FTTx Solution Offering

FTTx Solution Overview

Starting from the central office to in-home and apartment sites, customers can choose an entire solution that meets their needs or, alternatively, can choose a specific area. For example, a service provider with a network in place and only upgrading MDUs can use an Lightera solution from Building Distribution below.

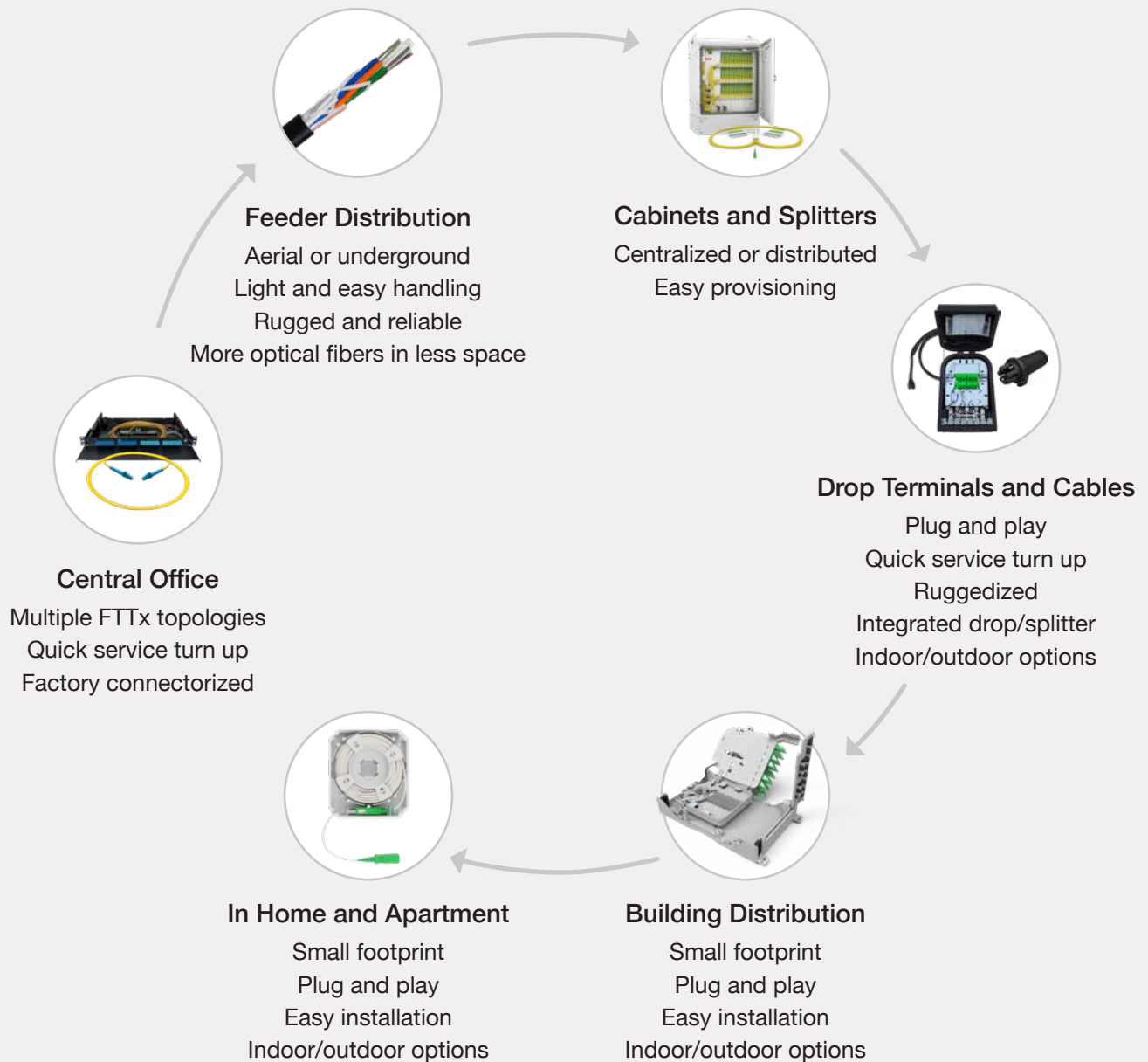
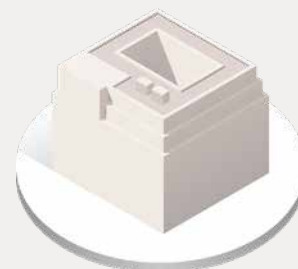


FIGURE 2: FTTx Solution Overview

Central Office

For the central office, Lightera offers a range of products such as shelves, combination panels, splitter modules, jumpers and cable assemblies.



Combination Shelves

The LGX® Combination Shelves are a versatile system of optical cable management boxes, which can be configured in many ways. These are factory pre-assembled and are available in 7-inch or 9-inch termination shelves with splice units and fanouts installed, which can be configured to accommodate from 12 to 864 fibers.



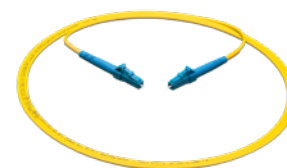
Optical Cable Entrance Facility (OCEF)

The OCEF-22 and OCEF-42 are robust steel cabinets designed to provide splice protection for transition splices between outside plant and building cables and hold thousands of spliced optical fibers. They are designed to resist dirt, dust and water spray. Secured with a lockable hinged door, the cabinets can be wall mounted. The two versions can accept up to 48 and 84 outside plant cables respectively, supporting over six thousand optical fibers (6480).



Jumpers and Multi-Fiber Cable Assemblies

AllWave® FLEX+ ZWP Jumpers offer highly reliable connectivity in the central office with low bending loss, which enables high performance in termination panels when combined with low loss LC or SC connectors. They also minimize heat generated from high power and tight fiber bends. Lightera multi-fiber cable assemblies utilize compact, flexible cables which are factory terminated and tested for reliable plug and play performance.



MPO Splitter Modules

The Multifiber Push-On (MPO) Splitter Modules combine splitter and connectivity technology for a unique, compact plug and play solution. Each of the four MPO fanouts per module supports up to 8 fibers, which can be customized in length and are available in SC or LC connectors. These splitter modules are packaged to fit the LGX fiber management panels and help reduce installation time due to simplified cable management.



Feeder and Distribution Optical Fiber

The Fiber is the Network™

The right optical fiber enables the cabling and connectivity solutions customers need for successful deployment. Customers may need to deploy cables in many different environments to meet their needs, including underground ducts and cables, direct buried cables or aerial cables. As an original inventor of optical fiber, Lightera and its predecessors have manufactured over 500 Million KM of fiber deployed globally over the past 40 years. The flexibility of Lightera solutions enables customers to use a variety of right of ways to help reduce costs and speed installation. The optical fiber used in FTTx networks is a tiny part of the total installed cost, but has a huge impact on the capacity, reliability, and durability of the network. All Lightera FTTx cables feature Lightera's award-winning AllWave Zero Water Peak Single-mode optical fiber.

Optical Fiber

AllWave® Zero Water Peak (ZWP) Family

The AllWave ZWP product portfolio consists of full-spectrum, single-mode (SM) fibers designed for optical transmission systems operating over the entire wavelength range from 1260 nm to 1625 nm. Lightera's patented process removes the water peak defect to

ensure low loss and stable performance in the 1360 to 1460 nm band, thus allowing network providers greater flexibility to provision services. AllWave Optical Fiber is ideally designed for use in metropolitan, local and access networks compared to ordinary SM fibers due to:

- Low optical loss, low bend loss, and low splice loss
- Tightest available geometry
- Lower attenuation than standard SMF
- Low polarization dispersion mode (PMD)
- Extends reach and improves reliability
- Speeds testing and lowers loss of splicing
- Lowers system cost
- Improves reach at high data rates

The AllWave family is composed of the following products, in order to increasing benefits:

- AllWave ZWP Optical Fiber
- AllWave+ ZWP Optical Fiber
- AllWave One ZWP Optical Fiber

Lightera also offers AllWave *FLEX* ZWP and AllWave *FLEX+* ZWP Optical Fibers for specialized feeder and distribution applications.

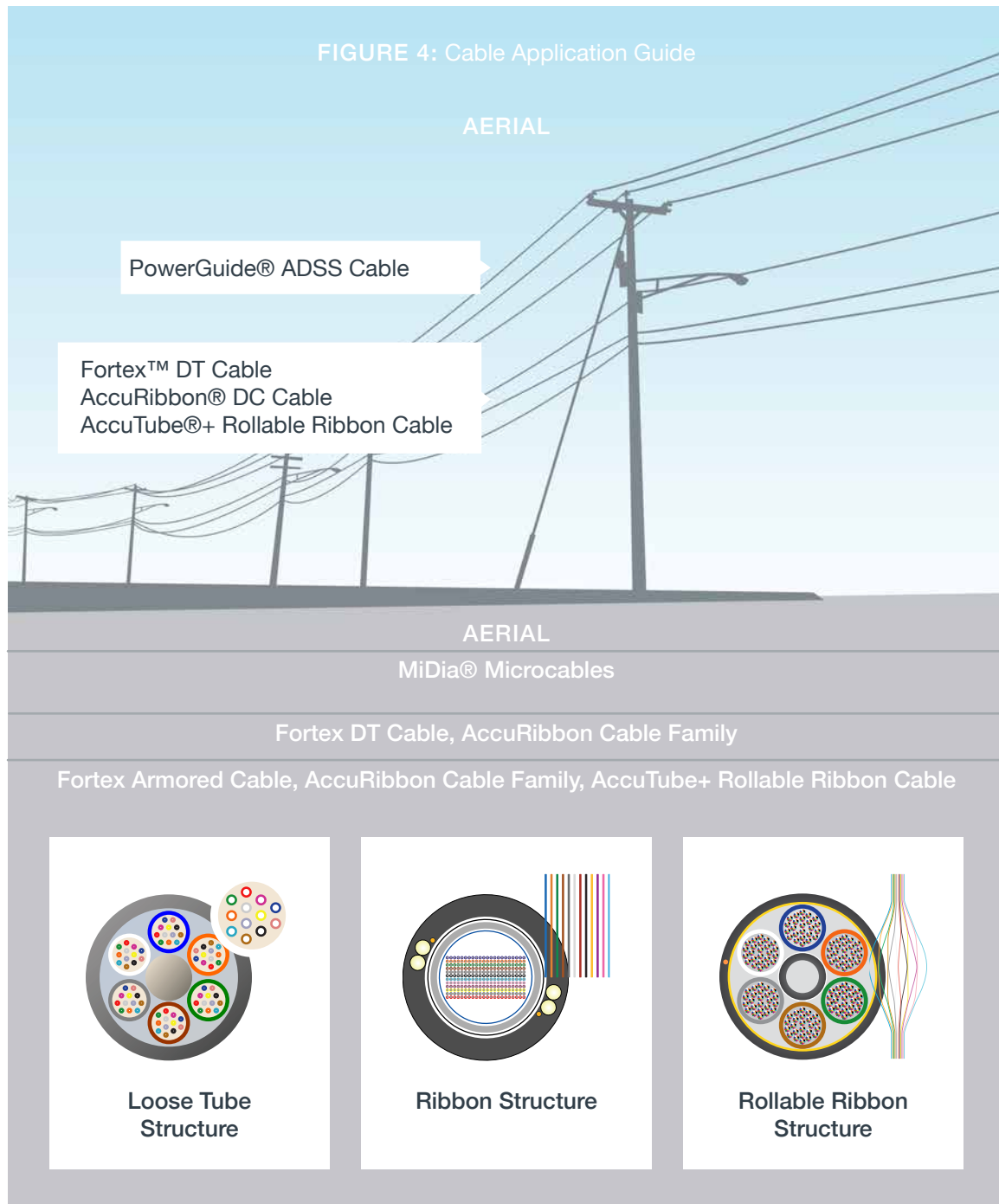
FIGURE 3 shows a comparison of the main AllWave products used in the outside plant.

	AllWave ZWP Optical Fiber	AllWave+ ZWP Optical Fiber	AllWave One ZWP Optical Fiber
15% Lower Loss for up to 15% Longer Reach			•
33% Lower Bend Loss than AllWave+ Fiber			•
G.657.A1 (67% Lower Bend Loss vs. AllWave Fiber)		•	•
40% Smaller Minimum Bend Radius (10 mm)		•	•
33% Better PMD LDV (0.04)		•	•
Full Spectrum Zero Water Peak	•	•	•
9.2 MFD for Seamless Splicing and Testing	•	•	•
100% Synthetic Silica Pure Reliable Glass (Core and Cladding)	•	•	•
13% - 33% Lower Loss than G.652.D	•	•	•
Compliant with ITU.T G.652.D	•	•	•

FIGURE 3: AllWave ZWP Optical Fibers for OSP Cables

Feeder and Distribution Network Fiber Optic Cables

Lightera offers a complete product line of dry fiber optic cables for outside plant feeder and distribution networks, that are designed to help reduce costs and speed installation. These cables are developed and manufactured with AllWave® ZWP Optical Fiber, as described earlier, to minimize loss over all wavelengths. The core products for feeder and distribution network solutions are described below.

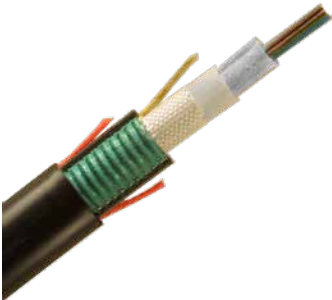


Feeder and Distribution Network Fiber Optic Cables *Continued*



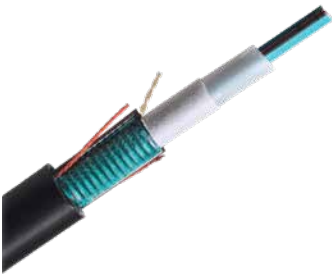
Fortex DT Fiber Optic Cables

Fortex DT Fiber Optic Cables are dry loose tube cables that meet the water-blocking requirements of ANSI/ICEA and Telcordia OSP cable standards. By eliminating gels and filling compounds, this cable offers virtually effortless splice preparation, while keeping tools, workspace, closures, and cabinets cleaner. Fortex DT Fiber Optic Cables are available in three designs: single jacket, light armor and armored, which are available with AllWave ZWP Optical Fibers.



AccuRibbon® DC Fiber Optic Cables

The AccuRibbon DC Fiber Optic Cables replace the gel inside the central tube of ordinary cables with a super-absorbent tape that provides water blocking “on demand.” The absence of gels allows almost effortless splice preparation and a lower overall cable weight. In addition to being gel free, AccuRibbon fiber units support mass-fusion splicing to speed fiber termination as well as maximize density with up to 864 optical fibers that can be deployed in available duct space. The AccuRibbon DC Fiber Optic Cables are offered with metallic or dielectric sheaths. A toneable version is also available with copper conductors to facilitate cable location, along with easier bonding and grounding.



AccuRibbon LXE Armored Fiber Optic Cables

The AccuRibbon LXE Armored Fiber Optic Cable is the next generation ribbon cable designed for use in outside plant applications. This family of products makes optimal use of existing duct space, reducing installation time and cost and enhancing field deployment productivity. The AccuRibbon LXE Armored Cable offers up to 864 optical fibers in an arrangement and leverages existing reliable cable design by incorporating a steel-armored sheath design with the popular AccuRibbon core.



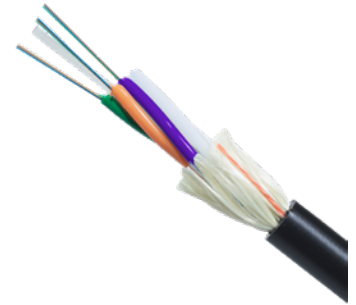
AccuTube®+ Rollable Ribbon Fiber Optic Cable

To form rollable ribbons, individual 250 μ m optical fibers are partially bonded to each other at predetermined points. This design allows for highly efficient ribbon splicing and easy individual fiber breakout. From 432 to 3456 fibers in a single cable, the AccuTube+ Rollable Ribbon Cable can help to double the fiber density in your existing network. Featuring Rollable Ribbons, the newest optical fiber design from Lightera, this cable is an excellent choice for connecting very large fiber distribution hubs as well as for use in data centers, FTTx and access networks.

Feeder and Distribution Network Fiber Optic Cables *Continued*

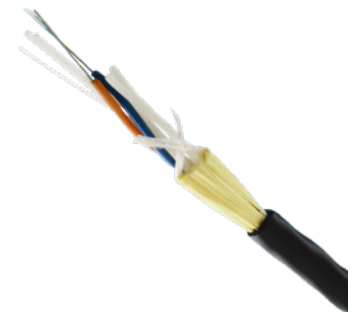
PowerGuide® Shortspan DT Fiber Optic Cable

The PowerGuide ShortSpan DT All-Dielectric, Self-Supporting (ADSS) Fiber Optic Cable is deployable in the utility space near power conductors, and offers an excellent solution for short aerial cable spans ranging up to 350 meters (1,150 feet), including distribution networks and duct installations. As the world's first gel-free ADSS cable, it is lighter weight than gel-filled designs, and provides all of the installation and cable preparation benefits of gel-free fiber optic cables. Available in optical fiber counts to 144, the PowerGuide ShortSpan DT Fiber Optic Cable is an excellent product for aerial networks where no strand is in place on the pole.



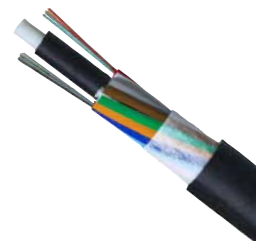
PowerGuide® TTH Fiber Optic Cable

PowerGuide To-The-Home (TTH) All-Dielectric Self-Supporting (ADSS) Loose Tube Fiber Optic Cable offers an excellent choice for short aerial cable spans ranging up to 346 feet (105 meters). This cable's compact size, low-cost installation and specialized design make it an ideal, easy to handle, cost-effective cabling solution for duct, Fiber-to-the-Home (FTTH) and shortspan aerial drop applications. The cable is lightweight with an optical fiber count up to 30 making it an excellent alternative.



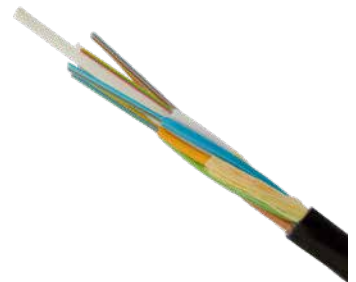
MiDia® Loose Tube Fiber Optic Microcables

For providers who prefer small diameter loose tube cables, Lightera offers the MiDia line of microcables. Specifically designed for exceptional air-blown installation performance, these microcables can help to lower deployment costs while increasing capacity and fiber density in limited spaces. By allowing providers to deploy optical fiber only as needed, MiDia microcables help to defer investment costs while providing the flexibility needed for future technology upgrades.

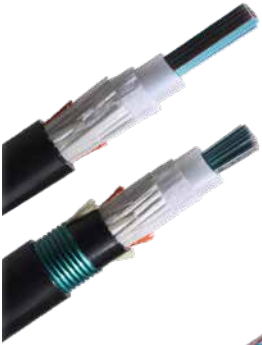


MiDia FX Fiber Optic Microcable

- Rifled outer jacket reduces friction for enhanced installation performance
- Optimized 1.7 mm buffer tubes and outer jacket thickness support long, continuous blowing distances
- Telcordia GR-20 compliant (as a special applications cable)
- Crush resistance equivalent to larger, heavier outside plant cables (200 N/cm)
- Fiber counts from 12 to 144



Feeder and Distribution Network Fiber Optic Cables *Continued*



AccuRibbon® DuctSaver® Ribbon Fiber Optic Microcables

For service providers who prefer ribbon cables and the benefits of mass fusion splicing, Lightera offers the AccuRibbon DuctSaver line of microcables. While making optimum use of valuable duct space, these microcables also help maximize the key advantages of air-blown microduct installation: rapid deployment and service activation.



MiDia® GX Fiber Optic Microcable

- Small diameter, lightweight fiber optic cable helps save time and money while retaining ease of installation
- 1.5 mm buffer tubes and outer jacket designed to maximize air-blown installation performance (**NOTE:** not recommended for pedestal applications)
- High fiber density ratio helps further increase capacity in limited spaces
- Optical fiber counts of 24 to 288



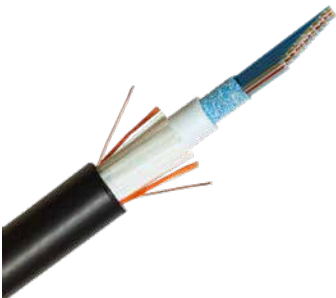
AccuRibbon DuctSaver FX Fiber Optic Microcables

- Supports mass fusion splicing for faster termination and more efficient use of space
- Outer jacket improves friction coefficient to optimize air-blown deployment
- Complies with ICEA, Telcordia and IEC specifications for reliable performance
- Optical fiber counts of 6 to 96



MiDia 2FX Fiber Optic Microcable

- Our highest fiber density in a microcable for even greater cost savings
- Space-efficient, 200 micron bend-optimized optical fibers create a more compact cable with a higher optical fiber count per buffer tube
- Up to double the fiber density per cable helps maximize network duct systems and infrastructure
- Outer jacket and 1.7 mm buffer tubes optimized for continuous, long blowing distances to reduce installation time
- Optical fiber counts of 96 to 288



AccuRibbon DuctSaver DT Fiber Optic Microcables

- Gel-free ribbon cable helps reduce cable end preparation time
- Helps minimize time spent on splicing and emergency restoration
- Removal of cable gels promotes faster splicing with higher first-pass yields (for a cleaner work environment)
- AccuRibbon units support mass fusion splicing
- Available with up to 144 optical fibers

FTTx PON Architectures

Centralized, Distributed and Distributed Cascaded Splitting

The Fiber Distribution Point aggregates many subscriber distribution optical fibers into few optical fibers in the feeder that connects to the CO or Head End, and consists of Cabinets, Pedestals and Splitters.

For PON networks, product selection is highly dependent on which splitter architecture is used in FTTx deployment. Guidance on splitter architecture selection is provided below. Lightera Solution Engineers are available to provide detailed guidance optimized for each customers' unique needs. For active Ethernet networks, a powered Ethernet switch is used in place of splitters, feeder cables connect to the switch in a cabinet, and distribution cables connect the switch to downstream end points.

Splitter Architectures

A typical PON network consists of the Optical Line Terminal (OLT) in a central office, head end or cabinet, connected by a feeder cable to optical splitters, and then to distribution cables downstream in the network.

Choosing the right architecture depends upon end-user density, projected subscription rates, and distance from the OLT. Splitter placement is important in FTTH design as it can significantly affect plant and electronic costs.

Three common types of splitter architectures used in FTTx deployments are:

- Centralized splitting
- Distributed splitting
- Distributed cascaded splitting

Centralized Splitting

Centralized architectures help to reduce total costs when relatively low take rates are expected. They can help defer capital costs by allowing for incremental OLT and splitter additions as subscriber counts increase.

Centralized architectures co-locate a number of splitters in a central location, such as a cabinet for subscribers farther from the Central Office (CO), or in the CO for nearby subscribers.

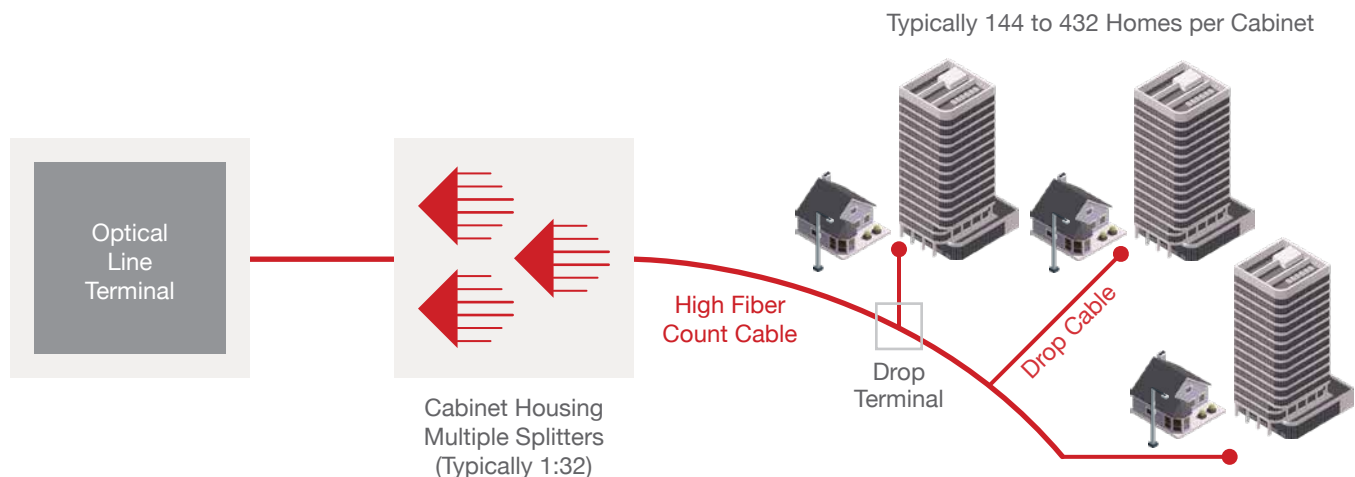


FIGURE 5: Centralized Splitting

Distributed Splitting

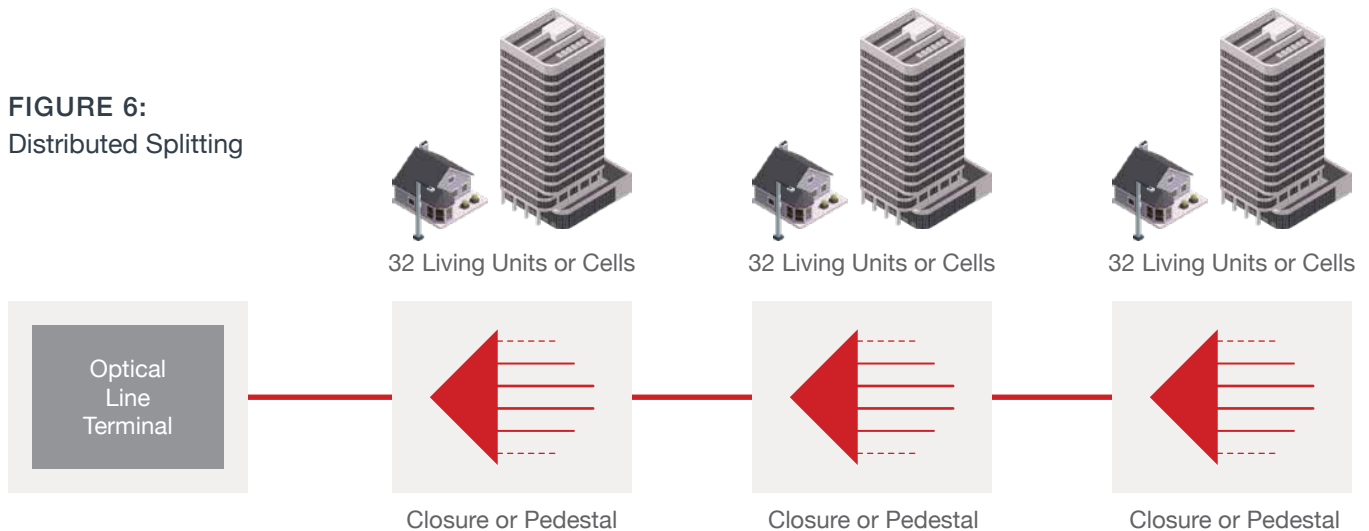
A distributed splitting architecture is cost optimized when medium to high subscription rates are expected. This architecture also has the added benefit of eliminating the need to find space for placing of cabinets.

Splitters are “distributed” throughout the network and placed in closures or pedestals in the field or in

buildings. At each splitter location, there will typically be one or (at most) two splitters.

This type of architecture typically uses lower fiber count cables and requires less splicing. It also results in lower plant costs but incurs higher electronics expenses.

FIGURE 6:
Distributed Splitting

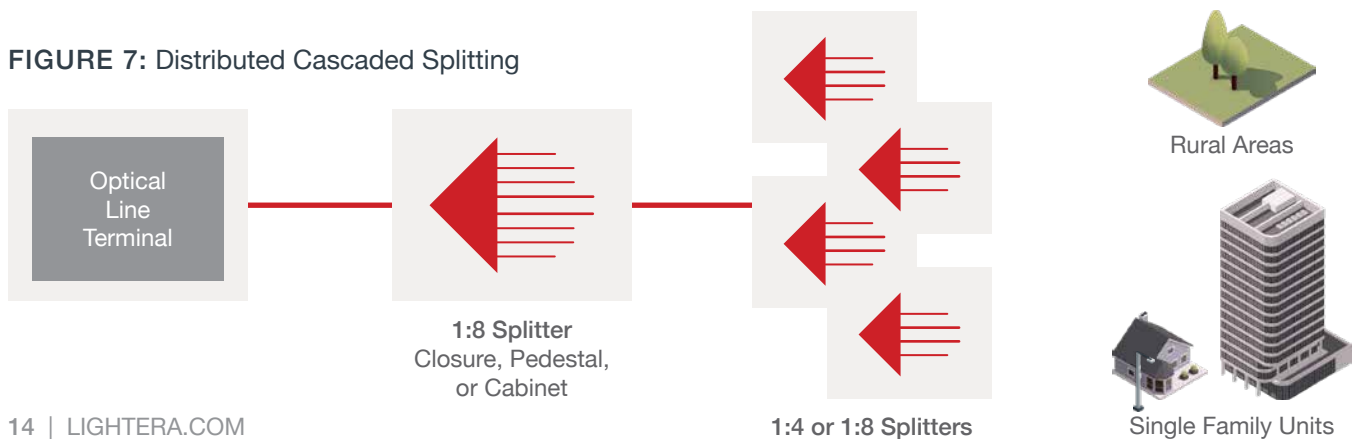


Distributed Cascaded Splitting

Distributed cascaded splitting, also called double star, is a form of distributed splitting with the splitters “cascaded” in the network. For example, a typical distributed split architecture may use a 1X32 splitter in a closure. However, the cascaded version may consist of a 1X8 splitter at one location feeding four 1X4 splitters downstream at different locations, to achieve a 1X32 split.

This architecture is most commonly used in rural areas with long distances from the OLT to the subscribers, and medium to low densities. It results in fiber savings by minimizing the fiber count of the cable needed to serve an area. Splice closures or pedestals are commonly used to house and protect the splitters in a distributed cascaded splitting architecture.

FIGURE 7: Distributed Cascaded Splitting

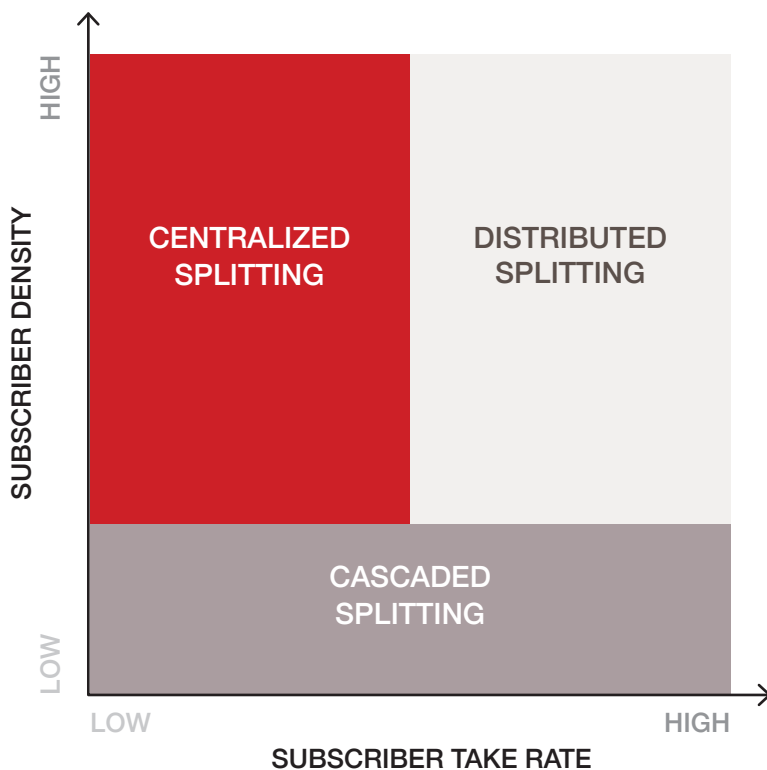


Choosing A Splitter Architecture

Optimized to Fit Your Deployment

The following matrix details the advantages of the three approaches to splitting architecture. The cross over points for subscriber density and take rate will vary depending on factors such as OLT port cost, labor cost, and others. Lightera Solution Engineers can provide more detailed guidance optimized for each customers' needs.

FIGURE 8: Choosing A Splitter Architecture



- + Defers electronic costs
- Higher OSP costs

- + Lower OSP costs through smaller count cables and less splicing
- + No space required for cabinets
- Higher electronic costs with low take rates
- + Fast to deploy

- + Lowest cost in outside plant for low density, long reach networks
- Difficult to troubleshoot
- Higher electronics costs with low take rates

The Distribution and Drop Network

Reaching and Connecting the Subscriber

Providers typically use a combination of aerial and underground solutions to connect the last mile in a network to individual homes, buildings, or cell sites. A variety of factors including climate and existing infrastructure can influence solution selection.

Lightera offers a complete portfolio of aerial and underground solutions including terminals, integrated splitters and drop cables to connect to the demarcation point of individual homes, buildings, or cell sites. From that location, a number of solutions can be leveraged to take optical fiber into the home or building to provide 100 times faster Internet.

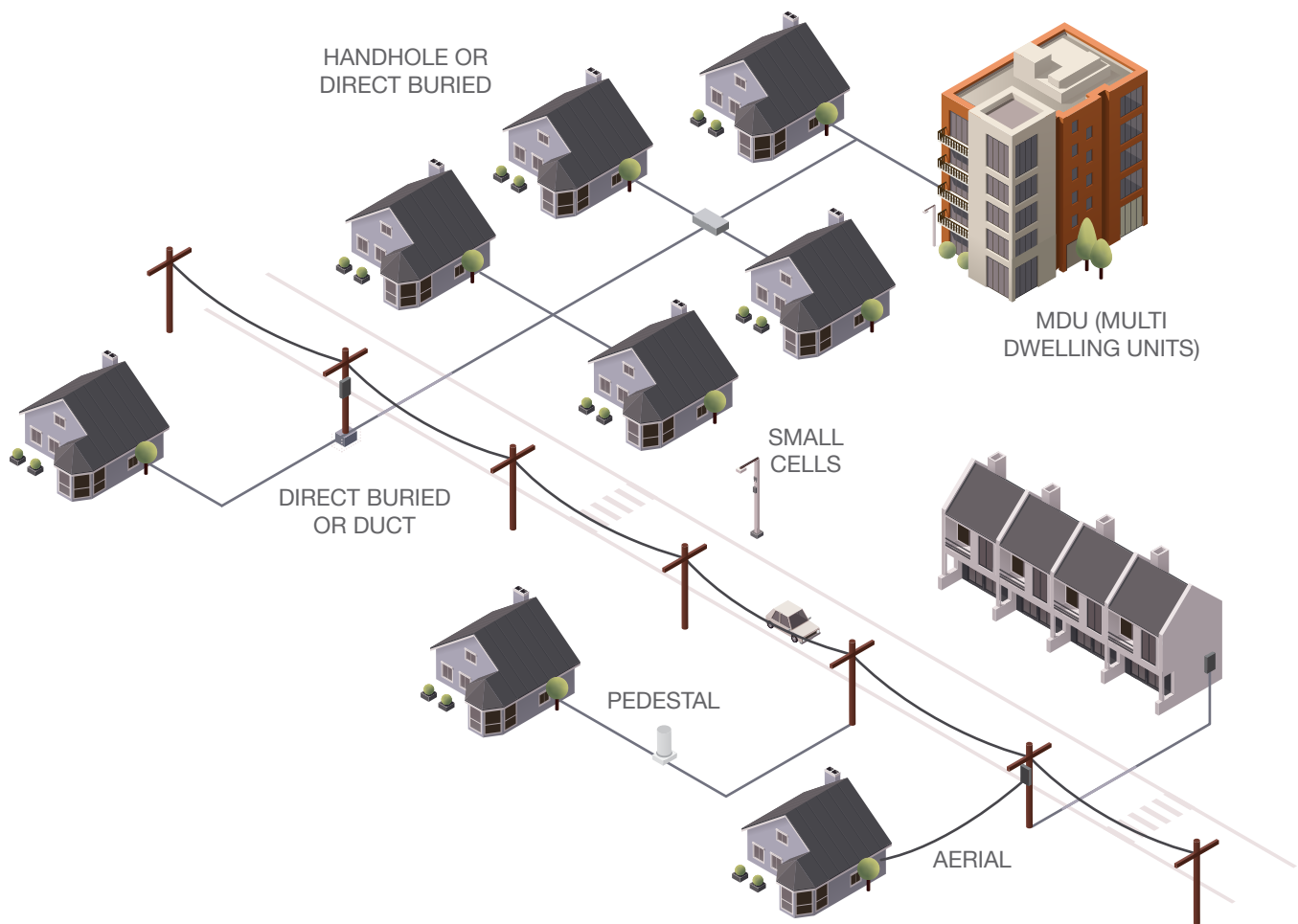


FIGURE 9: The Distribution and Drop Network

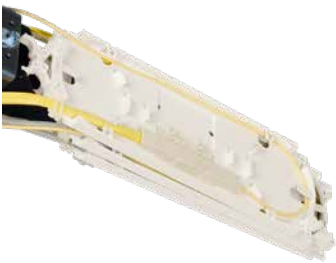
Fiber Distribution Point

Closures and Splitters



Fiber Optic Splice Closures

The Fiber Optic Splice Closure is a highly reliable outdoor rated enclosure which holds devices that join cables together. The closure may house and protect fusion splices, splitters, adapters, or connectors. It can be aerial or pole mounted and can also be direct buried. This closure accommodates factory terminated drop cables which can be plugged into splitters or distribution ports, and also can support branching to lower count cables, drop cables, or joining like count cables. With 6 cable ports, optional accessories and splitter trays, the closure supports up to a maximum of 96 splices.



Ruggedized PLC Splitters

Lightera combines optical splitter and packaging expertise in a compact, ruggedized planar lightwave circuit (PLC) Splitter for FTTx applications. These splitters offer excellent optical performance in a flexible and easy-to-manage package allowing for rapid installation into cabinets, pedestals or closure splice trays. The Ruggedized PLC Splitter may be snapped into existing splice trays and featuresunjacketed optical fibers to improve reliability vs. bare PLCs taped into trays with bare optical fibers. It allows reliable, cost effective incremental growth, and simplifies fiber routing. It is most commonly used in distributed split configurations.



MPO Splitter Modules

The MPO Optical Splitter Module combines splitter and connectivity technology into a high density, plug and play solution. MPO Splitter Modules utilize MPO-to-single-fiber fanouts to decrease installation time and simplify cable management. MPO splitters and fanouts can be quickly swapped for easy future upgrades. MPO splitter modules are most commonly used in centralized split configurations either in the central office or in the ORBITAL™ cabinet.



Direct Connect PLC Splitters

The Direct Connect PLC Splitters are some of the most compact connectorized splitters available. They consist of a Ruggedized PLC Splitter with factory terminated and tested connectors pre-installed on the optical fibers, and are used in numerous Lightera splitter cabinets and enclosures including the 432 FDC Cabinets and iFDH indoor cabinet, and are available in 1x8, 1x16 and 1x32 configurations.

Fiber Distribution Point

Fiber Distribution Cabinets (FDC)

Fiber distribution cabinets are used with centralized split architectures. Ruggedized for outdoor installation, they can also be used indoors. Multiple cabinet types are available for different applications.

ORBITAL™ Cabinets

The ORBITAL FDC series features a unique fiber management system designed to serve 160, 288 and 576 homes. The 160 and 288 versions are pad mounted and pole mountable, whereas the 576 version is only pad mountable. The ORBITAL Cabinet helps lower provisioning costs by speeding subscriber and splitter management, compared to conventional rectangular patching fields used in ordinary cabinets. All subscriber optical fibers are routed from the MPO Splitter Modules and to individual subscriber ports arranged in a circular array. The circular array and equal distance from the splitters to each distribution port simplifies fiber management and eliminates excess slack, to reduce fiber congestion and ease subscriber provisioning.

The ORBITAL Cabinet is available with factory installed and tested pre-connectorized cables to speed installation. It eases access to the optical fiber connections through a secured front door as well as a secured rear access panel. In addition, an optional adapter panel can be easily integrated to provide point-to-point service with dedicated connections to a maximum of 10 business locations or Cell Sites from the cabinet.



432 FDC

The 432 FDC is designed to serve up to 160, 288 or 432 homes using the familiar LGX fiber management system and Direct Connect PLC Splitters.

The 432 FDC is available with factory installed and tested pre-connectorized cables to speed installation. It eases access to the fiber connections through a secure front door as well as a secure rear access panel. In addition, an optional adapter panel can provide point-to-point service with dedicated connections to a maximum of 10 business locations or Cell Sites from the cabinet. With a rear cable storage vault, it also eliminates the need for an underground vault and closure.



144 Fiber Distribution Pedestal (FDP)

The 144 FDP is a rugged pedestal design that can serve up to 144 homes in existing neighborhoods or overbuild situations. Easy to handle, the 144 FDP can be base, vault or pole mounted. It combines simplified fiber routing management with excellent optical performance and reliability using the Direct Connect PLC Splitters.



Fiber Distribution Cabinets (FDC) *Continued*



V-Linx™ 144 iFDC

The V-Linx 144 iFDC is described in greater detail as part of the V-Linx Solution in the building distribution section later in this guide.



64 Indoor Fiber Distribution Cabinet (iFDC)

The 64 iFDC is ideal for tight spaces on the inside of the building entrance in MDU or business applications. It can house up to four Direct Connect PLC splitters, which are available in either 1x8, 1x16 or 1x32 split ratios, with SC-APC or LC-APC connectors. Input and output optical fibers are connectorized and stored on the left hand side of the enclosure. The enclosure can be mounted directly to the wall or on a plywood board. Splice trays are available for pigtail splicing or connectorized cables can be used for distribution routing.

Fiber Optic Interconnect Units (FIU)



SlimBox™ Indoor/Outdoor Enclosure (2,4,8, 12, 24, and 48-Fiber)

The SlimBox Indoor/Outdoor Enclosure is a termination box used to connect distribution cables in the outside plant network to FTTx networks drop cables. The applications include Fiber to the Home, From Building to MDU or Cell Site. It enables quick and easy connections of the drop cable through plug-and-play connectorized drops into the box or using fusion splicing. The internal connection is made through pre-terminated splitters or pre-connectorized pigtails.



SlimBox 12-Fiber Internal Wall Mount Module

The SlimBox 12-Fiber Wall Mount Module is both a termination and splice point for optical fiber in an indoor wall mounted environment. Cable enters from the bottom and the grommets allow for pass through of the fiber without splicing. The additional splice tray provides pigtail and fanout splicing (single fusion splicing). Various Panels come with the module for termination of SC, FC, ST and LC (duplex) connectors.



SlimBox Enclosure Solution

The SlimBox Solution includes a variety of enclosures used to connect drop cabling or building cabling to subscribers. The SlimBox 64 and SlimBox 24 can house splitters and adapters to interconnect building or OSP cables to drop cabling, either through fusion splicing or using Lightera factory tested and terminated cable assemblies. The SlimBox 12 Wall mount modules are available in a compact version with externally accessible adapters, or a larger version with protected internally accessible adapters. The SlimBox wall plate is a compact surface mountable drop outlet housing up to 2 splices and 2 SC-APC adapters, from which an EZ-Bend® cable can be plugged into an ONT or small cell.

Drop Terminals, Cables and Assemblies

Fiber Specifications Optimized to the Application

Installing optical fiber in buildings and homes often requires conforming the optical fiber around sharp corners. EZ-Bend® Single-mode Optical Fiber offers outstanding bend performance down to a 2.5 mm radius for the most challenging in-residence and MDU applications. Compatible with the installed base of conventional G.652.D single-mode optical fibers, the optical fiber meets and exceeds ITU-T G.657.B3 recommendations. EZ-Bend optical fiber uses Lightera's patented groundbreaking EZ-Bend Optical Technology to provide three times' lower loss at tight bends than competing G.657.B3 products.

Drop Cables

Drop cables make the final connection between the Distribution Cable and the customer equipment. Drop terminals house the connection or splice between the Distribution and Drop cables.

The optical fibers used in drop applications, in buildings and in homes need to bend around corners. Lightera offers EZ-Bend® Optical Fiber to meet the extreme bending challenges in these applications, and AllWave *FLEX+* ZWP Optical Fiber for less demanding requirements. The following drop cables are available as plug and play assemblies, with factory installed, factory tested connectors for reliable performance and fast installation.



FIGURE 10: EZ-Bend Optical Fiber Features

Plug and Play Drop Cables

The following drop cables are available as plug and play assemblies, with factory installed, factory tested connectors for reliable performance and fast installation.



EZ-Bend® 4.8 Fiber Optic Cable

EZ-Bend 4.8 Fiber Optic Cable is ruggedized for indoor/outdoor environments and can be installed easier than copper wire to help speed installation and lower costs. The fiber optic cable is ideal for buildings, homes, small and medium business or in-home wiring installations. The EZ-Bend 4.8 mm fiber optic cable features EZ-Bend Optical Fiber, enabling it to be stapled and bent around sharp corners down to a 2.5 mm radius with zero concern for bending loss. This cable is available as a factory terminated and tested assembly in various lengths for quick, reliable plug and play installation.



EZ-Bend 3.0 Fiber Optic Cable

EZ-Bend 3.0 Fiber Optic Cable offers the same benefits as EZ-Bend 4.8 Fiber Optic Cable and offers a bend radius as low as 2.5 mm in a cable with 61% less volume to lower visibility, ease slack management, and fit in smaller spaces. The ruggedized version allows for aggressive stapling. This cable is available as a factory terminated and tested assembly in various lengths for quick, reliable plug and play installation.



EZ-Bend Toneable Fiber Optic Cable

EZ-Bend Toneable Fiber Optic Cable and Drop Assemblies combine the EZ-Bend 4.8 mm optical cable with copper toning wire for locating purposes. They may be pulled through a duct or direct buried, and easily located underground using the integrated copper toning wire. These indoor/outdoor rated cables can be routed into a home or building and attached with staples or other fasteners with no bending issues. This cable is available as a factory terminated and tested assembly in various lengths for quick, reliable plug and play installation.



AccuDRY® Indoor/Outdoor Fiber Optic Cable

AccuDRY Indoor/Outdoor Fiber Optic Cable is an ideal solution for providers who need a low fiber count, indoor/outdoor cable that is compact and easy-to-install, yet durable enough to withstand exposure to the elements, including low temperatures.

Plug and Play Drop Cables *Continued*

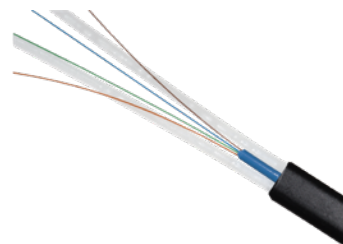
Mini TB Flat Drop Assemblies

Lightera' Mini-TB (Tight Buffer) Drop Assemblies are used in FTTx applications between a Network Interface Device (NID) and a Network Access Point (NAP) which could be an enclosure, closure, or pedestal. They consist of a flat outer sheath compatible with existing low cost aerial hardware, made robust with 2 solid strength members surrounding a 3 mm cord containing Lightera' EZ-Bend or AllWave *FLEX+* single-mode optical fiber and optical connectors on one or both ends. The EZ-Bend version may be extended into the home and building and stapled. These factory terminated and tested assemblies are delivered with the flat sheath and strength members removed at the ends, allowing for easy bending and storage for the 3 mm cordage.



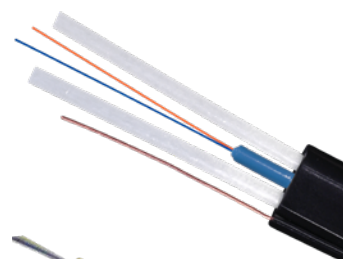
Mini LT Flat Fiber Optic Drop Cable

The all-dielectric Mini LT Flat Drop Fiber Optic Cable is a small lightweight and available in the smaller fiber counts needed in the drop sections of an FTTx network. Either 1, 2, 4, 6 or 12 optical fibers are placed in a gel-filled buffer tube to create a flexible and easy-to-access core. It is easy to handle and install in an aerial environment, eliminating the need for expensive bonding or grounding, and uses inexpensive common attachment hardware.



Toneable Mini LT Flat Fiber Optic Drop Cable

The Toneable Mini LT Flat Drop Fiber Optic Cable offers all of the benefits of the all-dielectric cable version along with the added advantage of a toning wire for easy cable location in ducts or open trenches.



Mini C2™ Fiber Optic Drop Cable

The Mini C2 Fiber Optic Drop Cable is suitable for the rigorous outside plant environment found in underground conduits or direct burials. Even though it is compact and lightweight, this cable can sustain 273 kg (600 lb) tensile loads. The design features corrugated steel armor and strength rods for added durability and strength.



Product	Mini LT Flat Drop Cable (Aerial, Self-Supporting)	Toneable Mini LT Flat Drop Cable (Aerial, Self Supporting)	Mini TB Cable (Aerial, Direct Buried)	PowerGuide® TTH ADSS Cable (Single Jacket)	EZ-Bend® Indoor/ Outdoor Drop Cable	Mini C2 Cable (Air Blown, Dielectric)
Fiber Count	Up to 12	Up to 12	1	Up to 30 (6 fibers/tube)	1	1 to 12

SlimBox™ Drop System

SlimBox Drop System

The SlimBox Drop System supports compact plug and play connections to homes, buildings, or small cells. **FIGURE 11** shows the various components used to install this system. As mentioned earlier, the SlimBox Drop Terminal can be pole, pedestal or aerial mounted to terminate outside plant cables. The end point can then be connected using EZ-Bend® 4.8 Cable Assemblies. As described earlier, the EZ-Bend 4.8 Cables can be used outside and in the building or home. Alternative solutions are available to deploy within a unit as described in a later section for In Unit and Apartment Installations.

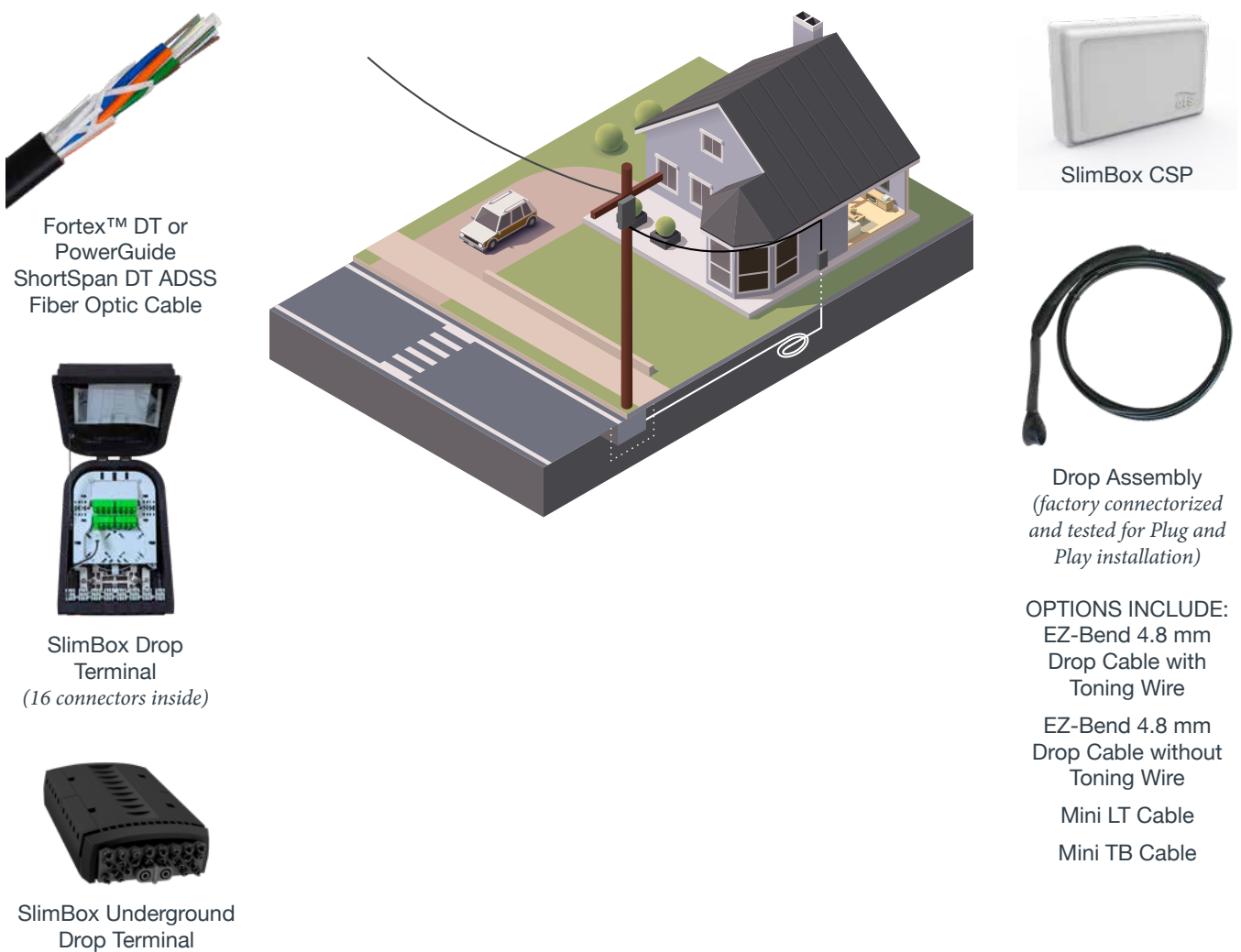
SlimBox Drop Terminal

The SlimBox Drop Terminal can be used with the EZ-Bend 4.8 mm or Mini LT Flat Drop Cables for an easy-to-deploy plug and play system.

It can accommodate up to 16 drop cables, and can hold up to a 1x16 splitter, making it an excellent choice for distributed split architectures. It can also function as a splice closure, holding up to 48 individual splices.

The terminal can be pole, pedestal or aerial mounted, but is not recommended for underground deployment in a handhole.

FIGURE 11: SlimBox Drop System



MDU, Business, and In Living Unit Solutions

EZ-Bend® Multifiber Drop Bundle



Buildings can present a multitude of challenges. Some buildings may lack pathways or risers, requiring expensive core drilling, or the pathways may be restricted in size or contain other wiring. In addition, building owners and residents want cables and components to be installed quickly and invisibly.

EZ-Bend® Multifiber Drop Bundle

The EZ-Bend Multifiber Drop Bundle is a facade cabling system that mounts on the outside of buildings then can reach inside to connect subscribers. It provides the high performance advantages of single optical fiber EZ-Bend assemblies with the added benefit of installing from 3 to 12 assemblies at one time. This solution is ideal for older buildings that would otherwise require expensive internal pathway creation, and can be up to 3 times faster and less expensive to install than interior cabling in such buildings.

After installation a factory installed and connectorized coil of EZ-Bend drop fiber optic cable will be near each subscriber entry point. When the subscriber requests service, the connector on the end of the coil can be pushed through the wall, stapled if needed, and plugged into the optical network terminal (ONT). The other end of the Bundle is unconnectorized for splicing into the Fiber Distribution Terminal (FDT) that is located at the ground floor (feed-up method) or top floor (feed-down) of the building. An additional strength member is installed in the feed-down method for weight management of the cable bundle.



MDU, Business, and In Living Unit Solutions

V-Linx Spool and Play Solution

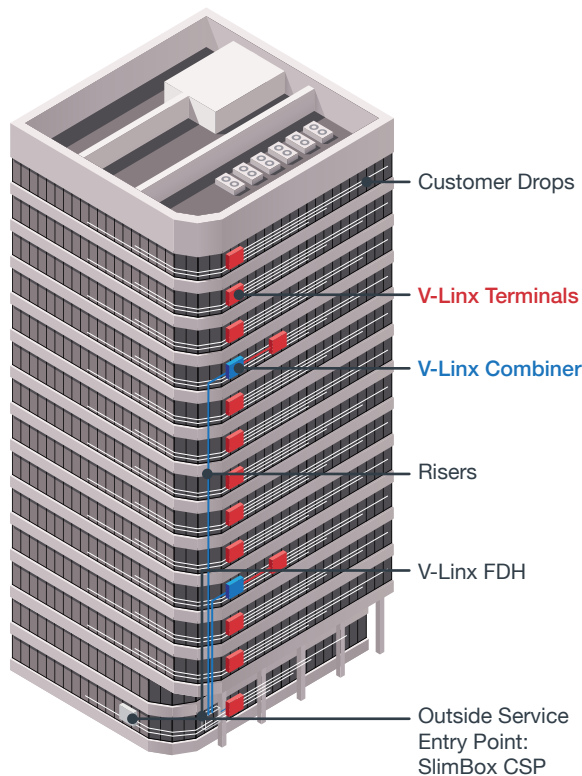


FIGURE 12: V-Linx MDU Solution Components



V-Linx Spool and Play Solution for MDU and Business

The V-Linx Spool and Play Solution is a versatile plug and play in building optical connectivity system that can be easily and cost-effectively scaled for medium to large buildings.

FIGURE 12 shows the various components used in the V-Linx Solution. From the building entrance, outside plant cables are connected to a wall-mounted V-Linx iFDH inside the building. The V-Linx FDH can support up to 144 individual optical fibers (using up to 4 1x32 splitters) with a single optical fiber per unit.

For medium sized buildings, a V-Linx Terminal is installed in the floor telecommunications closets. Each terminal can support up to 12 subscribers with SC connectors, or 24 subscribers with LC connectors. The terminals are equipped with a pre-terminated stub cable that is plugged into the V-Linx iFDH. A fiber management spool is included on the terminal to manage slack.

In large buildings, the V-Linx Combiner may be used to aggregate the V-Linx Terminals from up to six terminals or 72 individual optical fibers. The combiner is configured with factory pre-terminated and tested AccuFlex®+ Optical Ribbon Interconnect Cable Assemblies with MPO connectors.

The V-Linx Solution can be installed quickly without any fusion splicing, and uses less riser space than alternative solutions, making it ideal for MDU and Fiber-to-the-Business (FTTB) applications.

MDU, Business, and In Living Unit Solutions

EZ-Bend® Solutions

Bends in a Typical MDU Residence

Typical living units have many corners around which an optical fiber may need to be conformed to reach the ONT. Lightera EZ-Bend Solutions can be bent around up to 50 corners with negligible signal loss. Ordinary bend insensitive solutions may produce excessive loss with just a few bends. The fiber path shown below is an excellent application for the InvisiLight Solution, shown later in this Solutions Guide.

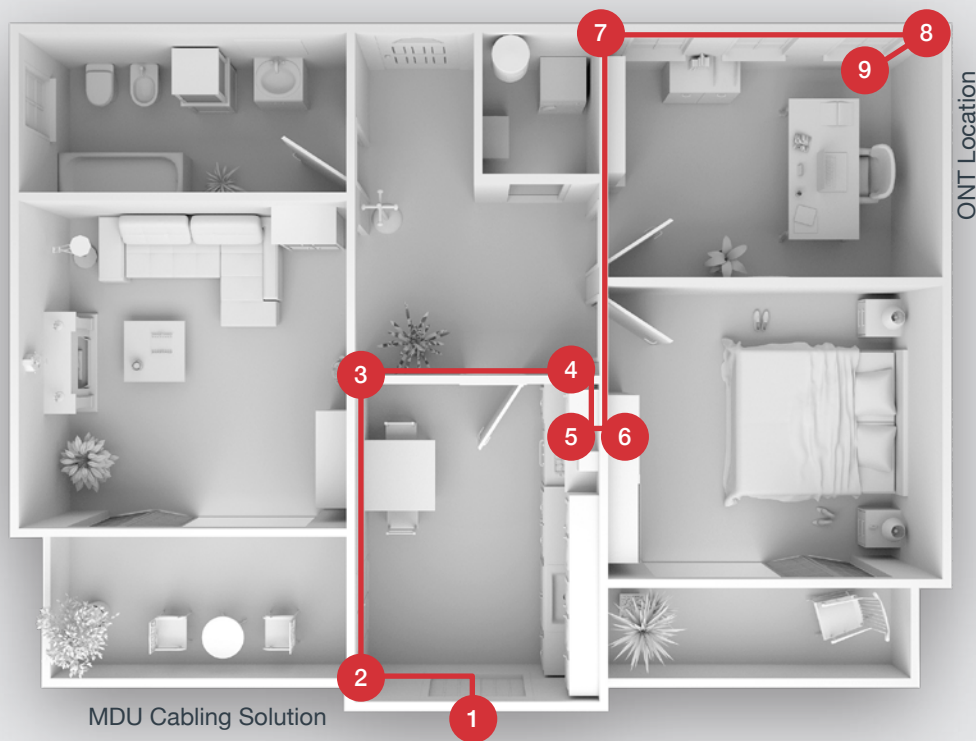


FIGURE 13: EZ-Bend® InvisiLight Optical Solution
Shown with exaggerated size and red color for illustration purposes only.

InvisiLight® Solutions

Virtually Invisible and Accepted by Customers



1 Install wall module.



2 Plan installation path.



3 Apply corner protectors.



4 Spool out InvisiLight® Fiber.



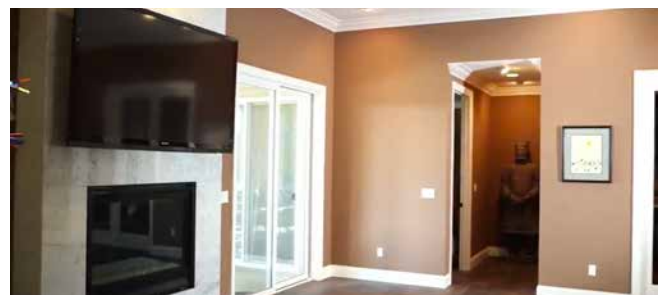
5 Apply adhesive.



6 Secure InvisiLight Fiber.



7 Close cover.



“NOT SEEING IS BELIEVING”

In the Living Unit

InvisiLight® Solution

The Lightera InvisiLight Solution, launched in 2012, is a revolutionary system that enables fast, easy-to-install and almost invisible fiber drop connection to and within the indoor living unit (ILU) or businesses for fiber-to-the-desk (FTTD) services. Lightera's EZ-Bend® Optical Fiber used in all InvisiLight products enables worry-free bending around the many tight corners typically found inside buildings and rooms. These optical fibers surpass the G.657.B3 technical standard, with negligible loss at a 2.5 mm minimum bend radius, helping to ensure reliable, ultra-high-speed services.

The InvisiLight Solution is available in a multiple fiber version for multi-dwelling unit (MDU) hallway and riser applications. Leveraging this same proven technology, the InvisiLight MDU Solution helps make optical fiber easily available to each building tenant. The InvisiLight Facade Solution offers a virtually invisible building exterior solution consisting of 12 and 24 fiber cords that can be attached to the building facade and routed indoors to connect subscribers with InvisiLight MDU and ILU Solutions. InvisiLight Solutions can help sell fiber optic services by increasing owner and tenant acceptance compared to traditional methods, while lowering costs and speeding installation.

FIGURE 14: InvisiLight Solutions as Installed

Complete kits and tools are available to complete a quick and easy installation.



In the Living Unit

SlimBox™ Wall Plate

The SlimBox Wall Plate serves as a termination point or a demarcation point for optical fiber indoors. It supports pre-connected fiber optic cables, fusion splicing or a mechanical splice to a pigtail. An EZ-Bend® jumper would connect the SlimBox Wall Plate to a desktop ONT and the InvisiLight® ILU Solution or an EZ-Bend fiber optic cable may be used to reach the wall plate.



InvisiLight® EZ-Hide Faceplate

The InvisiLight EZ-Hide Faceplate provides a flush and integrated behind-the-wall concept in order to offer an optical connection point. Product set is composed of a deep faceplate with jumper storage, an adapter plate accepting one SC adapter slot and 2 splices, and an optional InvisiLight two layer spool with bracket fixation.



InvisiLight 80x80 Wall Module

The InvisiLight 80x80 Wall Module is provided with an SC APC external shuttered adapter. There are two ports of entry at the bottom of the module. The InvisiLight Fiber exits on the left-hand side and the patch cord is attached to the shuttered adapter on the right-hand side of the module.



InvisiLight EZ-Connect Module

The InvisiLight EZ-Connect Module is provided with an integrated jumper to connect to the ONT. This jumper is available in two versions: 2 mm or 3 mm Outside Diameter with 2.5 and 1.5 meter lengths respectively. The internal spool allows slack management of the tight buffer and jumper and may be locked in order to spool out by hand the desired length of jumper.



SlimBox Rosette

The SlimBox 4-Fiber Rosette Module is used as a splice or connection point for optical fiber indoors to an ONT or drop cable. It supports pre-connected cables, fusion splicing or a mechanical splice to a pigtail. The module can accept up to four cables in home or small business applications for multiple fiber connections.



SlimBox Customer Splice Point (CSP)

The SlimBox CSP module is used as an indoor or outdoor demarcation point. The module design resembles typical wall outlets seen in apartments or homes as it is small and inconspicuous. The module protects the fiber splice sleeves and connectors inside. When used with EZ-Bend cables or the EZ-Bend InvisiLight Solution, the module provides subscribers with a clean, professional-looking installation. A sealed cover is available for the outdoor version offering additional protection.



EZ-Bend Optical Fiber

EZ-Bend 4.8 Cables and EZ-Bend 3.0 Cables and cable assemblies described earlier can be used to install optical fiber to inside a premise.



Wireless Cell Site and Small Cell Solutions

FIGURE 15



Wireless networks are rapidly evolving with new standards for higher speeds. These faster speeds allow subscribers to use a wide array of mobile devices to stream media, participate in social networks and use cloud computing.

Network traffic from cell towers, Distributed Antenna Systems (DAS) and WiFi require wireless backhaul over optical fiber for high bandwidth, reliability and flexibility.

The Lightera FTTx Solutions described throughout this guide can be quickly installed to provide reliable fiber connectivity to small cells, macrocells, and DAS nodes.

Cell Tower Assemblies featuring AccuDRY® Indoor/Outdoor Cable

- Pre-connectorized with all main connector types
- Designed for the elements; temperature hardened to -40 °C (contact us for colder climates) and UV stabilized for long life
- Riser, plenum and LSZH options
- Customized lengths available

Multifiber Drop Bundle

Multifiber pre-connectorized bundles for easy deployment to multiple remote radio heads or antenna assemblies. Simply uncoil and plug in. No junction boxes or terminals needed.

Racks, Junction Boxes and Shelves to House Splices and Connectors

SlimBox Wall Mount Module

1RU Shelf

Connectors (LC, ST, SMA)

- GR-326 compliant connectors
- All major types available
- Low insertion loss

Utilities and Alternative Energy Solutions

Solutions Connecting the Transmission and Distribution Networks:

- PowerGuide® AccuTube® ADSS Cable featuring AccuRibbon® Optical Ribbon
- PowerGuide DT (Dry Tube) Short Span ADSS Cable
- PowerGuide ADSS Cable
- PowerGuide TR (Tracking Resistant) ADSS Cable
- Pole line attachment hardware and accessories

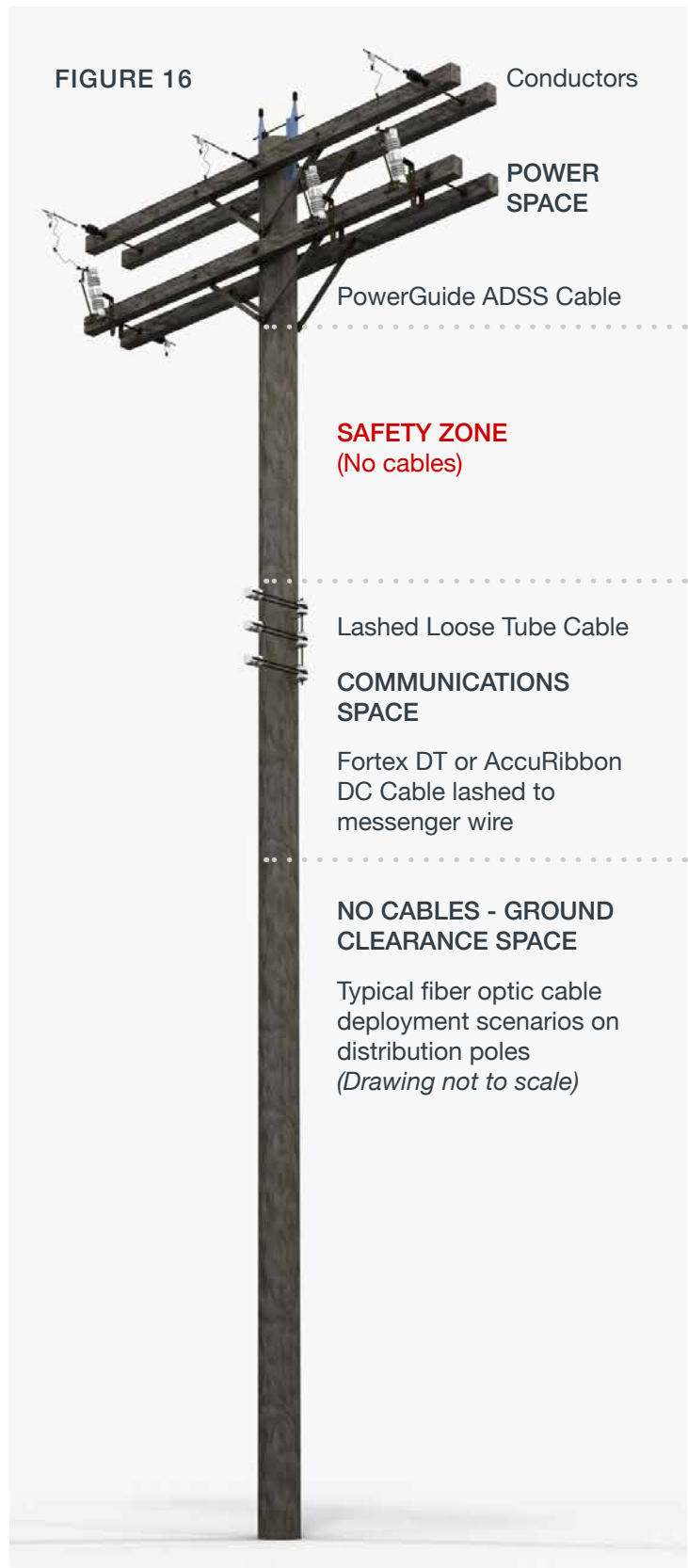
Solutions for the Substation:

- OPTION1™ DT Outdoor/Indoor Cable
- Jumpers and pigtails
- Wall Mount Units
- Shelves
- SlimBox™ Modules
- Mechanical Splice-On Connector (MSOC) and Fusion Splice-On Connector (FSOC)
- Fiber Optic Splice Closure
- Mini LT and Mini TB Drop Cables and Assemblies

Solutions for the Wind and Solar Farm:

- Fortex™ DT (Dry Tube) Loose Tube Cable
- SlimBox 12-Fiber Wall Mount Module
- Jumpers and pigtails

For more on our Utilities and Alternative Energy Solutions, visit our website at LIGHTERA.COM or Download our Utilities and Alternative Energy Solutions Guide.



Professional Services

FTTx network planning and deployment can be challenging. Networks architecture and product choices can make the difference between a successful project and a struggling one.

With deep experience building FTTx to millions of homes to date, the Lightera Professional Services team can be a trusted partner to build a complete turn-key FTTx passive network all the way to the home, MDU, business, or cell site. Services offered include:

- Consulting
- Training and Certification
- Technical Support
- Network Design, Modeling, and Costing
- Lab Setup and Testing
- Engineering
- Construction
- Project Management

Lightera FTTx Solution fiber optic components are system agnostic, and Lightera collaborates with other suppliers including system vendors, network designers and suppliers to design and manufacture products compatible with a wide range of FTTx electronics.



Industry Stewards

Committed to Industry Change, Viability, and Innovation

As an industry leader, Lightera participates in various Standards organizations including IEEE, ITU, IEC and the Fiber Broadband Association, along with Full Service Access Network (FSAN), to develop appropriate standards in support of our customers' efforts to build next-generation fiber optic networks.

For additional information please contact your sales representative.

You can also visit our website at www.lightera.com or call 1-888-fiberhelp (1-888-342-3743) USA or 1-770-798-5555 outside the USA.



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Lightera Marketing Communications
Date: 06/25

**For a full list of our
certifications, visit our website.**

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