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Multiple Solutions for Connecting Multiple Dwelling Units (MDUs)

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Abstract

Fiber-to-the-Premises (FTTP) networks increasingly include Multiple Dwelling Units (MDUs) such as apartments, condominiums and townhouses as part of the network build. Some estimates indicate that MDU structures may account for over one third of the target FTTP subscriber base. These MDU installations require special consideration for fiber cable interconnection to terminal equipment located at the premises. Connecting MDUs into the FTTP network requires an understanding of the wide diversity of structures and conditions found throughout the country. MDU connection strategies may also vary considerably depending on whether the structure already exists or is under construction/rehabilitation. A variety of solutions are required to support the many different connection scenarios. All dwellings require a connection from the FTTP cabling network. In some cases the connection may be via a feeder fiber directly from the central office/head end connected to a splitter hub on the premises. In other cases connections extend from distribution fibers directly from the Fiber Distribution Hub located in the network that are routed to a fiber terminal on the premises. Depending on the type and size of the MDU there may be a need for extensive fiber cabling and connections within the structure. Solutions for larger MDU structures may involve splitter hubs located inside the premises and then subtending riser and drop cable networks with intermediate fiber terminals located strategically throughout the building. Key building blocks include both indoor and outdoor Fiber Distribution Hubs and indoor and outdoor fiber distribution terminals. Additional drop cables, raceways and outlets are needed to support complete interconnection in many of the MDU environments.

Architecture

Some estimates indicate that more than one third of all US households are located in shared residential structures commonly referred to as Multiple Dwelling Units (MDUs). Furthermore demographic studies show that the MDU environment is a lucrative and competitive market for providers of broadband services. Each year new construction continues to bring more and more MDUs online. This target MDU market lies right in the heart of FTTP network builds across the country. Connecting MDUs into the FTTP network requires an understanding of the wide diversity of structures and conditions that may be encountered.

Metro High-Rise

In metropolitan areas high-rise dwellings including condominiums and apartments are the norm rather than the exception. High-rise residential dwellings present challenges and often require special planning to assure that FTTP networks can efficiently and reliably scale the heights involved across multiple floors. These structures have typically been designed and optimized for vertical living and as such have planned access for cabling networks through the various floors and sectionsv of the building. Because of the large number of living units in these buildings they are typically connected directly to serving FTTP equipment in the central office/head end. The feeder cable extending from the central office/head end is routed to the structure and connected to a Fiber Distribution Hub in the basement. The FDH provides optical splitting and connection for the network within the building. A cabling network of riser cables is distributed to the various floors through designated pathways either inside the building or outside the building. Riser cables are tapered as they traverse the vertical rise with segments of the cable dropped at each floor. Usually the riser cable is connected to a Fiber Distribution Terminal located at each floor. Drop cables are installed into each living unit and then routed to the Fiber Distribution Terminal corresponding to that floor. Interconnection takes place when the customer in the living unit requests service.

Mid-Rise

The mid-rise buildings are a major class of structures that include apartment and condominium living units spread across multiple floors. In many cases these are older residential buildings constructed as walk-ups and without provisions for new cabling networks. The challenge for FTTP network builders is to traverse this environment without incurring major cost. The mid-rise, like the high-rise, is often connected directly to the FTTP equipment in the central office/head end via a feeder cable routed directly to the building. The feeder cable is routed directly to the basement and terminated at a Fiber Distribution Hub that provides optical splitting and service connection for the entire building. The connection strategy for mid-rise includes routing riser cables to every floor where Fiber Distribution Terminals provide interconnection for drop cables. Drop cables are routed from the Fiber Distribution Terminals and connected to wall plates in the living units. The fiber drop cables are sometimes routed through hallways and protected with raceways or conduit. Mid-rise units raise an important challenge in finding space to install terminals and hubs and then overlaying riser and drop cables efficiently and aesthetically.

Garden Style

A significant amount of new construction for residential apartments and condominiums is occurring in Garden Style structures. These structures are typified by two or three story buildings often with walk-up access and multiple living units per floor. Often these structures are not designed with the forethought that cabling networks will be added at a later date and as such Garden Style structures present significant challenges installing FTTP network cabling.

Garden style structures tend to provide network interface between the outside plant and drop cables either on the exterior surface or just inside a building entrance closet. Often the FTTP network interface will be located at the spot on the building where other utilities are positioned. Routing the drop cables from the living units to the network interface is relatively simple in new construction. In new construction fiber drop cables can be routed through the framing structure before the walls are sealed. Drop cable installation techniques in new construction may include placing fiber drops in conduits or directly into the wall. Alternatively the new construction scenario lends itself to installing micro-ducts initially and then later blowing fiber into the living units as service is requested. Installing fibers into existing units is much more difficult. Often overlay installation involves routing drops through the attic, basement or around the exterior of the structure. These installations can be costly and time consuming. New cables have been developed such as indoor/outdoor cable to give the installer more flexibility in routing drops around and through existing structures. A variety of Fiber Distribution Terminals (FDTs) are also available to provide flexible options for connecting drop cables to the plant at the network interface. One typical FDT provides for standard connector interface on the exterior surface. The FDT may be supplied pre-terminated with standard connectors and supplied with pigtails to facilitate splicing to indoor/outdoor drop cables. Alternatively, external FDTs may be configured with rugged connectors to interface with rugged outdoor drop cables directly. Finally, FDTs may be configured as indoor enclosures with standard connectors and located immediately inside the building entrance to interface with drop cables routed inside the building.

Horizontal Style

A significant majority of new condominiums and town homes are constructed using a horizontal layout that very closely resembles the arrangement of single family homes. Because of the similarity of single family homes the FTTP connector scheme is often identically equivalent. Usually the network interface will be a Fiber Distribution Terminal located on the exterior surface of the structure. FTTP distribution fibers are allocated downstream from the FDH to a particular MDU structure. A Fiber Distribution Terminal located on the exterior surface of the structure may be outfitted with either rugged on non-rugged connectors. Rugged connectors are used when hardened fiber drops are routed along a path outside the structure and then connected directly to the ONT on the side of the individual dwelling. Alternatively, non-hardened indoor cabling may be routed via internal pathways from the FDT to ONT equipment in each unit.

Key Building Blocks

The key building blocks for MDU connectivity include Fiber Distribution Hubs, Fiber Distribution Terminals, Riser Cable, Drop Cable, Raceways and wall plates.

Outdoor Fiber Distribution Hub

The outdoor Fiber Distribution Hub enclosure provides for connections between fiber optic cables and passive optical splitters in the Outside Plant (OSP) environment. FDH enclosures are available in a range of sizes for terminating distribution cables, e.g. 144, 216, 288, 432, 576, 864 1152, etc. The enclosures utilize standard SC connectors (APC or UPC) to interconnect feeder and distribution cables via 1x32 optical splitters and connectors. The FDH enclosure is placed strategically in the FTTP network to facilitate service connection specified for a particular fiber serving area that may include MDU structures. These enclosures are either pole mounted or pad mounted and provide environmental and mechanical protection for cables, splices, connectors and passive optical splitters. The FDH is constructed from heavy gauge aluminum and provides the necessary protection against rain, wind, dust, rodents and other environmental contaminants. At the same time, it remains lightweight for easy installation, and breathable to prevent accumulation of moisture in the unit. The aluminum construction with heavy powder coat finish also provides for corrosion resistance. The enclosure is accessible through secure doors that are locked with a standard tool or padlock. All FDH enclosures are designed for ease of craft access and maintenance to ensure trouble free operation over time.

Indoor Fiber Distribution Hub

The indoor Fiber Distribution Hub is designed to organize and administer fiber optic cables and passive optical splitters in an inside plant environment typically found in an MDU closet or basement. These enclosures are used to connect feeder and distribution cables via optical splitters in a Fiber-to-the-Premises (FTTP) network application. The indoor FDH product provides a vital cross-connect/interconnect interface for optical transmission signals at the MDU. The enclosure provides mechanical protection for cables, splices, connectors and passive optical splitters. In addition, the indoor FDH is designed to accommodate a range of fiber counts and support factory installation of pigtails, fanouts, and splitters. The enclosures are available in a range of sizes; 72-, 144-, 216-, 432-fibers, etc.; and are designed for front access via a swing frame configuration so that they can be wall mounted, rack mounted or pedestal mounted.

Outdoor Fiber Distribution Terminal

The outdoor Fiber Distribution Terminals are designed to terminate, splice and interconnect fiber optic cables in an outdoor environment. This terminal is usually configured to support network interface to 12, 24, 48 etc. living units via standard SC (APC or UPC) connectors. Alternatively the outdoor FDT may be configured with rugged connectors to provide an interface to hardened drops. The FDT is mounted to the exterior surface of an MDU structure to provide connection between the distribution cable and drops routed to individual living units. The outdoor FDT is typically divided into sections with distribution cable routed into one section and drop cable routed into the other section. The cables meet at a central connector field that includes termination for the distribution cable and parking for the drop cables. Each side of the cabinet may be configured with splice trays for splicing the cable or the connector pigtails. The outdoor FDT may be pre-terminated on the distribution side with outside plant cable stubs so that the unit is quickly connected to the plant. The outdoor FDT may be pre-wired with pigtails on the drop side so that individual drops routed into the unit can be spliced to the connectorized pigtails. The unit accommodates a variety of OSP cable types via sealed grommet entry. Cables are secured with standard grip clamps to provide the required pull out strength. The enclosure provides grounding for metallic members and for the cabinet.

Indoor Fiber Distribution Terminal

The indoor Fiber Distribution Terminal provides for connecting between fiber cables within a building environment. One typical application may be as a primary network interface (as an alternative to outdoor FDT) inside the building. Another typical application is to support a tapered fiber distribution network within the building where FDTs are installed on the various floors. The indoor FDT utilizes a rugged design that effectively isolates the splicing and cable termination from the interconnection to the drop cables. Separating the cable splicing and drop cable termination into separate areas provides a space efficient and craft friendly interface unit. The indoor FDT provides easy access to all connections. The indoor FDT enclosure provides standard SC connections (APC or UPC) and may be equipped with parking for locating the staging drops prior to deployment. The indoor FDT products are designed to splice and terminate fibers in a range of sizes including 6, 12, 24, and 48 fibers. The indoor FDT enclosures are for indoor wall mount applications and provide complete access for maintenance and service provisioning. Secure doors are locked with a standard can wrench tool and may optionally be secured with a standard pad-lock to provide security for fiber connections within the building.

Indoor Drop Cables

Rugged high performance Indoor Drop Cables connect FTTP premises equipment and outside plant cabling systems in most MDU applications. These cables are typically routed from a Fiber Distribution Terminal (either indoor or outdoor) to each individual living unit. These drop cables meet standards set for indoor riser, plenum or indoor/outdoor applications so the appropriate cable is selected for the application. The indoor fiber drop cables are available in a variety of lengths with high performance SC connectors (APC or UPC) terminated on one or both ends. Fiber drop cables are certified to Telcordia GR-326 and are typically available in standard lengths of 50, 100, 150, 200, 250, and 300 feet. All fiber drops are packaged on convenient reels so that field deployment can be completed quickly and efficiently.

Outdoor Hardened Drop Cables

Some MDU configurations such as a horizontal outdoor cabling require hardened drops for routing around the exterior of the building. These drops are often buried in the front or back yard of the structure. Rugged Optical Connectors are used to connect Fiber Distribution Terminals typically located at the street or on the side of the dwelling with Optical Network Terminals (ONTs) located at the premises. The hardened fiber drop is typically terminated with a rugged outdoor connector on one or both ends and facilitates rapid service connection. The Rugged Connector and associated Rugged Drop Cable (RDC) assemblies provide a reliable interface for fiber drop cables in the outside plant environment. The rugged optical connector is hardened to protect against extreme temperature, moisture, UV, chemical exposure and other harsh conditions typically found in the outside plant. The rugged connector is usually provided as part of a drop cable assembly and the connector is sealed using O-Rings as it is installed into a rugged adapter. The rugged connector is also normally supplied with a protective cap which seals the connector and keeps the end-face clean until it is ready for use. Upon installation the protective cap is removed and the RDC can be connected to the rugged adapter. Outdoor Fiber Drop cables are available in dielectric flat, flat with toneable wire, and in Figure 8 configurations and with connectors on one end or both ends.

Drop Cable Installation

A wide range of cabling installation techniques may be used to route indoor drop cabling. Typical drop cables may be installed in raceway configured along the ceiling of the MDU hallway. An extension of the raceway may be used to cover existing cabling such as voice or CATV wiring. The raceway system may be provided with a decorative cover to provide an installation that appears like crown molding. Drop cable installation can be installed in overlay configurations.

In some new or rehab construction alternate techniques may be considered for drop cable installation. For instance drop cables may be installed along with conduit to provide a protective path from the FDT all the way to the living unit. The advantage to installing conduit is that fibers can be installed at any time after the conduit and a fiber cable can be replaced if needed. Another alternative is to utilize blown fiber techniques that involve installing micro-duct initially and then returning at a later date to blow fiber drops from the FDT into the living unit. Drop cable installation tends to be labor intensive and therefore overall efficiency and cost effectiveness will need to take individual building conditions into consideration when determining the effective drop cable installation technique.

Summary

Fiber-to-the-Premises (FTTP) networks increasingly include Multiple Dwelling Units (MDUs) such as apartments, condominiums and townhouses as part of the network build. MDU installations require special consideration for fiber cable interconnection to terminal equipment located at the premises. Connecting MDUs into the FTTP network requires an understanding of the wide diversity of structures such as high-rise, mid-rise, garden-style and horizontal building layouts. Once the structure is fully understood the connectivity plan can be developed and optimized for the structure. MDU connection strategies may also vary considerably depending on whether the structure already exists or is under construction/rehab. A variety of solutions are required to support the many different connection scenarios. Depending on the type and size of the MDU there may be a need for extensive fiber cabling and connections within the structure or on the exterior surface of the structure. Once the architecture is specified a variety of building blocks is available to support MDU connectivity. Key building blocks include outdoor Fiber Distribution Hubs, indoor Fiber Distribution Hubs, outdoor Fiber Distribution Terminals, indoor Fiber Distribution Terminals, outdoor Drop Cables, indoor Drop cables and miscellaneous raceway and wall plate hardware. These connectivity components are designed to provide multiple solutions for connecting MDU structures.

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