Multi-Dwelling Unit Fiber Deployment

Billions of dollars are spent annually delivering high speed fiber networks to Multi-Dwelling Units (MDUs)—apartments, condos, and student-housing—across North America. Service providers recognize the rich potential returns on a fiber investment in such high-density markets. Fiber connections will bring fast, reliable, content-rich services to millions of households. However, poor planning of fiber network interfaces and service delivery to a consumer's media devices can leave everyone, from the builder/developer and building owner to the service provider and tenants/subscribers, frustrated.

The ideal solution is to work with a fiber network service provider to develop a design that meets not only the provider's service delivery needs, but also works with the unique requirements of the MDU. The tenant's interface with the technology should take priority as this can increase both demand for new services from the service provider as well as the value of the property itself. It will also be the source of most service problems.

Understanding Fiber Networks

There are a number of fiber network architectures that telcos and other service providers use for deployment of fiber-to-the-premise (FTTP) services. Passive Optical Network (PON) has been very successful in this application and is an excellent choice for implementing local wireline loops, given the cost of implementation can be offset by the revenue potential. Multi-Dwelling Units (MDUs) provide just such an opportunity, offering an excellent return on investment for delivery of "triple-play" services—multiple voice lines, high-speed internet, and high-definition (HD) TV/video programming—in a PON-based install.

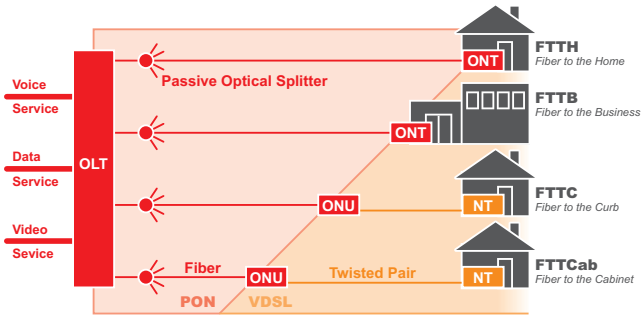
FTTP's wide bandwidth spectrum is ideal for delivery of triple-play services and other bandwidth-intensive applications to residential and business customers, and PON technology has a number of advantages over competing wireless, copper-based, and alternative fiber-based technologies.

PON technology is a point-to-multipoint FTTP network architecture and uses unpowered optical splitters that allow a single optical fiber to serve multiple premises. Being passive, a PON has no active electronics in the network loop, which significantly lowers maintenance costs. Also due to the reduced number of network elements there are fewer potential failure points minimizing operational expense. (see Fig 1)

PON Architecture

The PON architecture is relatively simple, consisting of:

- **an Optical Line Terminal (OLT) at the central office or access node**
- **splitters to divide the signals in the local network loop**
- **multiple Optical Network Terminals (ONTs) and/or Optical Network Units (ONUs) for the delivery of services at the customer premise**



Optical Distribution Network (ODN) [Fig 1]

Design Considerations

Many considerations impact the design of a network. It is important to recognize these factors in choosing the deployment methodology and product set for your implementation.

Greenfield vs. Brownfield

One of the primary design considerations of how fiber will be deployed to a building is whether the building already exists or is being built. New construction is referred to as "greenfield," while "brownfield" is a building that has already been built. Greenfield buildings provide easy access to cable pathways and allow relative flexibility in conduit placement when being designed, simplifying the FTTP implementation. In brownfield applications, installers may be faced with inflexible spaces and existing infrastructure that can be difficult to change. These can significantly increase the costs of both materials and labor.

Type of Building

BISCI's Residential Cabling Workbook classifies MDU's into three main categories: low-rise, mid-rise, and high-rise.

- Low-rise MDUs are buildings such as townhouses.
- Mid-rise MDUs include duplexes, two-story apartments, small shared-tenant services, and nursing homes, in which the units are stacked upon one another.
- High-rise MDUs more are typically very large multi-story buildings.

Types of ONTs (Residential Optical Network Terminals)

In an FTTP deployment, *the type of ONT and its location within the facility can impact long-term maintenance and operational costs.* There are two types of residential ONTs: a stand alone version designed for Single-Family Units (SFUs) but can be used in MDU applications, and a rack mountable version specifically designed for MDUs. Brownfield installations can use either type of ONT often depending on infrastructure criteria. Greenfield installations typically place an SFU ONT inside each living unit (although they may be located in a common utility area). SFU ONT devices are often used in greenfield MDU implementations because an MDU ONT must share bandwidth among the subscribers it serves. On the plus side, however, an MDU ONT provides network connections for a number of residential units all being serviced from a single, centralized location. Additional considerations in choosing an ONT include the location of the actual network equipment, maintenance issues, and electrical power.

Location of the ONT

In a brownfield implementation, the MDU ONT is typically placed in the ground-floor utility space or in the telecommunication closets on individual floors. It can be fed with a single fiber drop, but the final links to residential units are a combination of coaxial and twisted-pair cables wired directly to each living unit. Cost of this approach will vary depending on the number of units served and the length of copper cabling runs to individual units.

In the greenfield PON configuration in figure 8 on page 5, typical of a mid- to high-rise installation, SFU ONTs are placed in individual residential units. The typical ONT location is in a coat closet or maintenance closet, with the network gear being either recessed into or surface-mounted onto the wall. *Recessed mounting saves space and can minimize service interruption.* If equipment is surface mounted in a closet, the ONT and the associated cables can be disturbed and can overheat due to contact with clothing and other items stored in the closet.

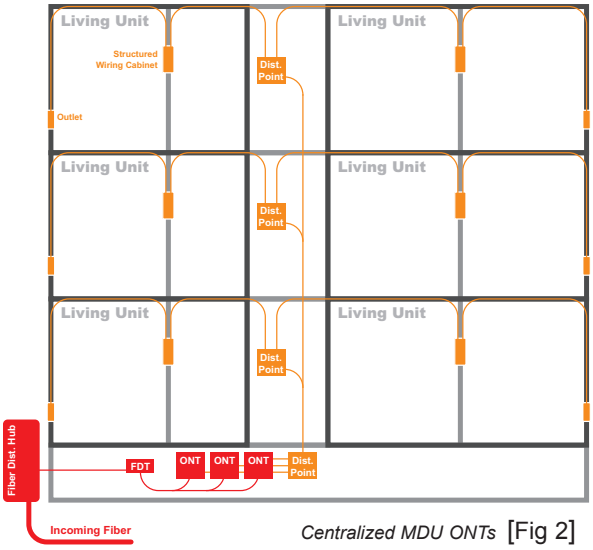
Power and Backup

Unlike the traditional all-copper telephone network, which receives its power from the telco's central office, the ONT requires power at the customer premise. For that reason it is equipped with a power supply unit with a battery backup unit (BBU) for voice service support in the event of a power outage. A power unit mounted in the subscriber's residence requires access to a standard 110v power outlet, which can mean having to pay for a new electrical outlet in the residence. Also, because the life of the backup battery is limited, it must be replaced periodically. Some providers make subscribers responsible for battery replacement. The carrier typically provides a free 12-volt sealed lead-acid battery when the system is installed. After that, the customer must periodically replace the battery, which is a standard unit that can be purchased at retail outlets.

Who pays for maintenance?

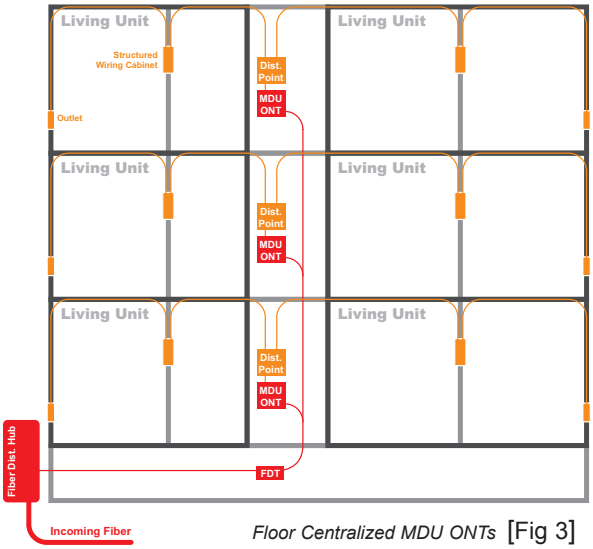
The location of the ONT typically determines who pays for its maintenance. The building owner typically pays for maintenance of an MDU ONT or an SFU ONT located in a common area. Maintenance of an SFU ONT located in a living unit is typically the responsibility of the tenant.

Three general ways deploy fiber into a mid- to high-rise MDU:



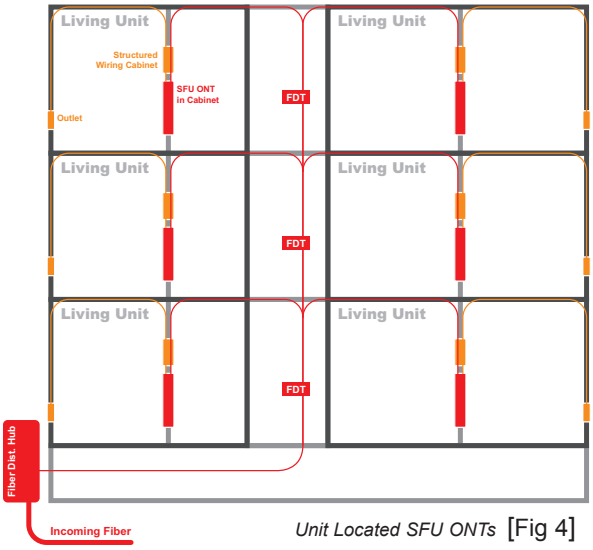
Centralized MDU ONTs [Fig 2]

The first way to deploy fiber in a mid- to high-rise MDU is to place the ONTs in one centralized location as in Fig. 2 to the left. Though this may reduce the amount of rewiring, this method often results in lower bandwidth due to limited copper network capacity. This model also places the cost responsibility for powering and maintaining the ONTs and their batteries with the building owner.



Floor Centralized MDU ONTs [Fig 3]

The second method of deploying fiber into an MDU is placing MDU ONTs in a central location on each floor of the building as in Fig. 3. Though this method pushes the fiber termination farther into the building, eliminating more of the limits of the copper network, multiple units are still sharing a single ONT and therefore sharing bandwidth. This model, like the previous one, places the cost responsibility for powering and maintaining the ONTs and their batteries with the building owner.

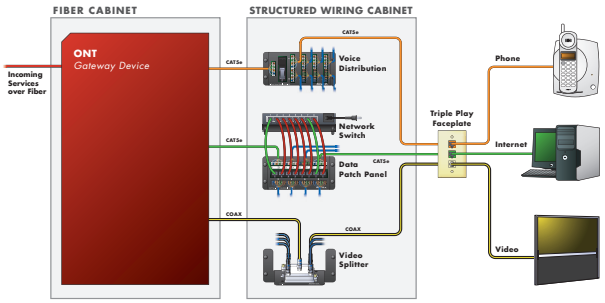


Unit Located SFU ONTs [Fig 4]

The third method for deploying fiber into an MDU is to run fiber to each unit, where it is terminated in an SFU ONT as in Fig. 4. Though this method requires longer fiber runs, which can be more complicated to manage, it pushes responsibility for powering and maintaining the ONTs and their batteries to the individual units. For this reason, in greenfield installations, this method is the most preferred for deploying fiber to the premise.

Where Fiber meets Copper

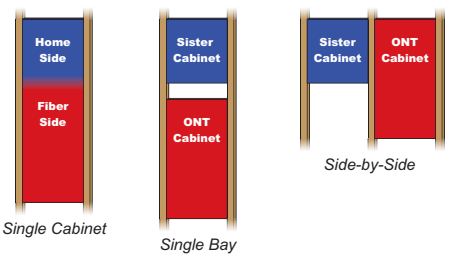
Where fiber meets the home's copper outlet wiring there must be some optical-to-electrical signal conversion as well as a physical distribution point. It is here that one signal is split or multiplied to several in order to serve the home's many outlets. In most cases, the incoming fiber is fed through a protective flex tube and enters the ONT or ONT enclosure. Once the optical signal is converted to an electrical one, the voice, data, and video signals are transported over twisted pair—CAT5e or CAT6 preferably—and coax. (See Fig. 3 below). As the ONT has a limited number of outputs, distribution to the home's outlets requires some additional premise distribution equipment. Whether a greenfield or a brownfield MDU, systems for either can be easily housed and managed within an enclosure or cabinet, such as a structured wiring enclosure.



Living Unit Network Topology [Fig 5]

The ONT handling the incoming fiber and the distribution modules handling the home's copper wiring should be located in close proximity, ideally in the same enclosure or cabinet. Another popular configuration places the ONT and distribution device in separate enclosures, either in the same stud bay or immediately next to it for separation of the wiring access. This enclosure is called a "sister cabinet". In addition to providing a central location for servicing and wiring access, it protects the equipment in a dedicated space, keeping it enclosed and out of sight. The enclosure should be UL rated and provide proper power and grounding options for active elements. (see Fig. 4 below)

Cabinet Configuration Options [Fig 6]

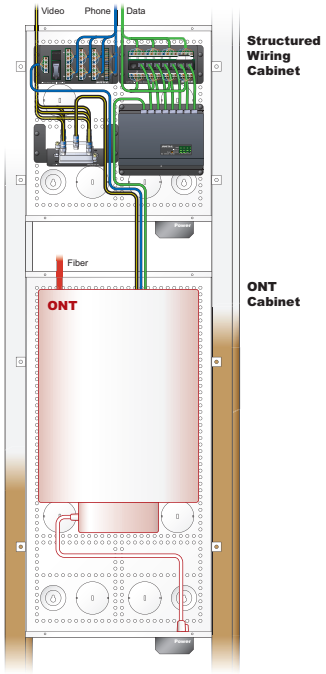


Single Cabinet *Single Bay* *Side-by-Side*

Wiring at the Living Unit

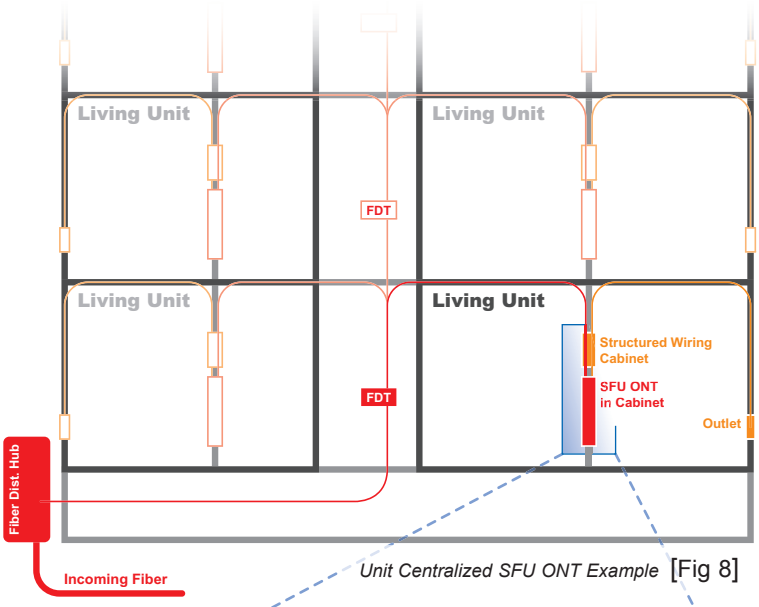
Another consideration is how the resident is ultimately served from the ONT through connections made to the jacks and ultimately the customer's multimedia devices. We are living a highly "connected" lifestyle, utilizing the internet for access to vast amounts of information, entertainment, and social networking. The number of consumer electronics devices requiring network connections is staggering, *making home connectivity solutions more critical than ever before.* This will only continue to increase in importance as the internet evolves. For this reason, builder/developers and building owners are wise to provide generous connectivity options to their residents.

In a new building internet, video, and phone wiring is most often managed within each unit via a structured wiring enclosure that distributes wiring to outlets or consumer electronics. The devices that distribute the wiring to multiple outlets are called distribution devices or modules. The most common building method today places these devices or modules in a recess or wall mounted enclosure (Note: This enclosure can be called the "structured wiring cabinet/panel", "common wiring panel," or "media panel"). This enclosure provides a clean, efficient, and serviceable location for moves, adds, changes, or repairs to the network.



[Fig 7]
Common Wiring Handoff at the Living Unit

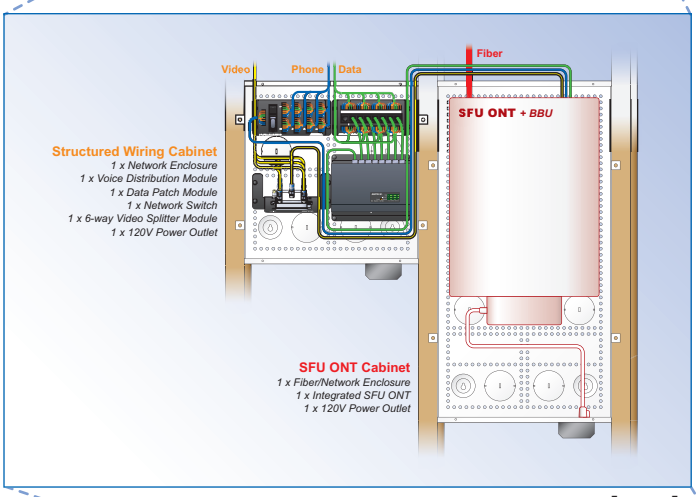
A Typical Mid- to High-rise Greenfield Installation



Unit Centralized SFU ONT Example [Fig 8]

Fiber Network

As is typical of medium to large MDUs, a Fiber Distribution Hub (FDH) is located in the basement or in a common equipment room. A fiber feeder cable from the central office services the FDH which, in turn, organizes and administers fiber optic cables and passive optical splitters. Because the FDH is indoors, it does not require the environmental protection that an outside-plant FDH would require. Here, the FDH is located at the utility entrance of the building with fiber distribution cables going to fiber distribution terminals (FDTs) on each floor. The FDT manages dedicated fiber drop cables to individual customer living units. The fiber is then fed to the ONT either at each unit or in the central wiring closet.



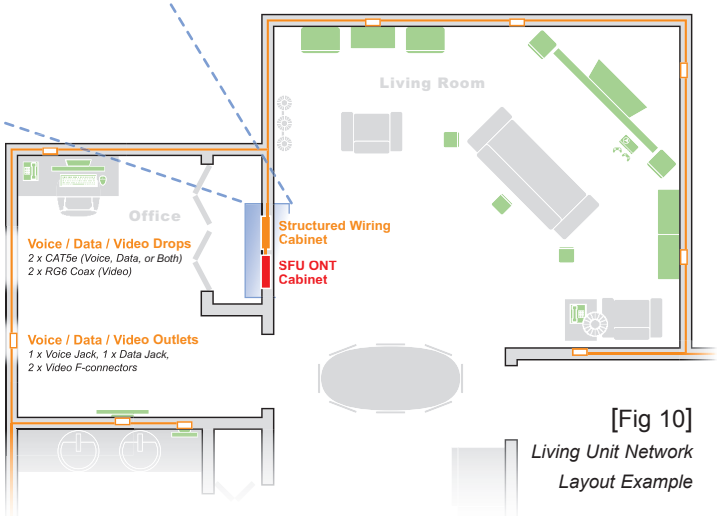
Fiber Handoff and Copper Network Distribution Example [Fig 9]

Fiber to Copper and Distribution

Once the fiber is terminated to the ONT, the incoming optical signal is then converted into an electrical signal and must then be distributed throughout the living unit. In this case, all three services (phone, internet, and video) are run from the ONT Cabinet to the adjacent Structured Wiring Cabinet where each service is then connected to the appropriate distribution module which, in turn, splits or multiplies their respective signal to all wallplates throughout the residence.

Delivery of Services

To ensure the residential network can be utilized to its full potential, the cable runs and outlets have been configured robustly. Each cable drop is made up of 2 CAT5e cables for phone or internet, and 2 RG6 coax cables for video. There are multiple wallplates in every room and each location has has 1 phone jack, 1 data jack, and 2 video connectors.



[Fig 10]
Living Unit Network Layout Example

Guidelines & Standards

The primary industry resource for wiring standards best practices is the TIA standards group. These standards define the best practices for design and implementation of copper and fiber cabling systems for commercial and residential dwellings. These standards deliver specific information on cabling types, distances, connectors, installation requirements, performance characteristics, and testing.

It is important that The National Electrical Code is followed for all installations because a copper network can carry electrical current in the case of a lightning strike. It is also very important that the products selected comply with Underwriters Laboratory (UL). This ensures that the selected product has been tested and meets applicable industry standards since the equipment is located inside a wall in many circumstances.

TIA 570B Standard

Grade 1 cabling meets the minimum requirements for basic telecommunication services. It supports basic services including telephone, satellite, CATV, and data service. Briefly, it outlines:

a) One 14" (or larger) enclosure from which to star-wire the home, with a surge protected electrical outlet.

b) One CAT 5e (or CAT 6 recommended) and one coax cable and connectors to every outlet in the home.

Grade 2 is a better cabling system that meets minimum requirements for basic services plus advanced telecommunication services including high-speed internet access and video services.
Briefly, it outlines:

a) One 28" (or larger) enclosure from which to star-wire the home with an surge-protected electrical outlet required

b) Two CAT 5e (or CAT 6 recommended) and two 75Ω coax cables and connectors to every outlet in the home.

The Suttle Difference

Suttle provides a variety of wall-to-wall solutions for delivery of triple-play services to the residence. Our SOHO Access™ brand enclosures and modules provide the backbone of our premise-wiring system. These dependable, cost-effective products are among the most installer-friendly on the market for termination and management of voice, data, and video connections. The UL-rated metal enclosures are designed with a grid pattern that enables the installer to mount the distribution module vertically or horizontally. The enclosures provide a central location for easy moves, adds, and changes. SOHO Access™ offers unmatched ease of installation and configuration while meeting all of the user's wiring needs. In addition to enclosures and modules, Suttle also offers a variety of jacks and faceplates to ensure effective delivery of the carrier's voice, data, and video services. Their high-quality construction maximizes lifespan while reducing the need to dispatch technicians for repair or replacement.

Product information and technical specification sheets are available at Suttle's website, www.suttleonline.com. For information on our entire product suite, please contact us at 1-800-852-8662.