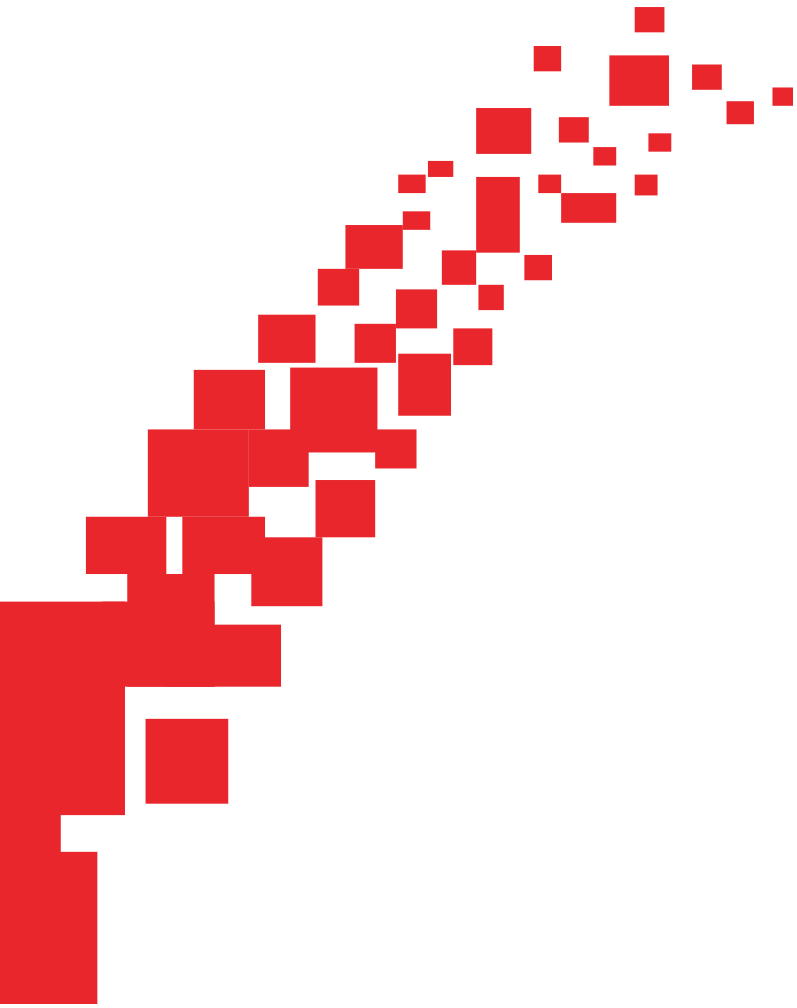
Solutions Addressing Fiber-To-The-Multi Dwelling Unit (FTTMDU) Deployment Challenges

A White Paper



ABSTRACT

Due to numerous bandwidth intensive applications, the demand for high-speed broadband is increasing rapidly. Many Telecom operators and Government organizations have taken initiations to deploying the fiber based (FTTx) national broadband projects and programs around the globe to meet the bandwidth needs. Service providers have realized their targeted market segments are Multi Dwelling Units (MDUs), which serve the ultra-fast broadband needs while telco operators increase revenue. Subsequently, fiber manufacturers and equipment vendors have introduced bend intensive (ITU-T, G.657x) and light weight fiber cables, connectors, and patch cords to meet the unique challenges of MDU deployments. However, the key considerations for MDU engineering, including analysis and designs, have not been considered while emerging the advanced infrastructure for the MDUs. One of the major concerns for many operators is to determine the multi-dwelling property information with limited or no availability of dwelling data. Another big challenge is deploying fiber infrastructure within Brownfield MDUs. Without proper solutions available in the market to leverage the advanced technologies for achieving higher bandwidth rates through FTTx networks in MDUs, global operators struggle to make strategic decisions for fiber deployments within MDUs.

The primary focus of this paper is to discuss delivering the innovative deployment solutions that will support the telco operators, equipment vendors, and infrastructure companies who are engaging in MDU FTTp deployments. This paper will cover new desktop analysis methods to capture the unique property information while eliminating the field walkouts. In addition, this paper will demonstrates innovative multiple engineering and design methodologies that support the operators in strategic business decisions for ideal equipment locations (e.g. optimization of fiber infrastructure in high-rise vertical and horizontal buildings). The paper will conclude with delivering ground-breaking advanced solutions on mixing the latest technologies alongside leveraging the LTE / 4G / Wi-Fi wireless applications. This certainly will support the global operators to achieve the highest bandwidth rates in MDUs.

Infotech

Creating Business Impact

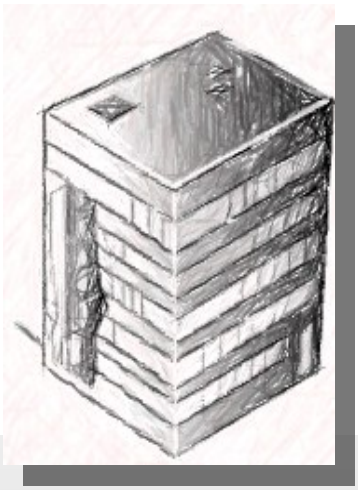
Introduction

FTTx harnesses the power and speed of light to bring multi-play services to the consumer with incredible possibilities and total convenience. When every home is connected with FTTx, the communication usage will increase tremendously. From lightning-fast downloads to seamless video conferencing, FTTx brings the world to the home through Fiber-To-The-Home (FTTH). MDUs, such as apartments, condominiums, residential hotel, and townhouses, play a huge part in the FTTH networks increase. The MDU market is growing rapidly due to the fact that it provides a densely concentrated service area for the communications service providers. The MDU business segment is also attracting property owners as a source of additional revenue generating areas.

Let's Classify the MDUs

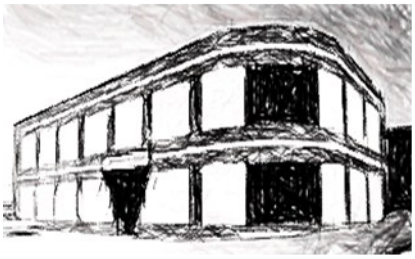
Telecommunication services distribution in shared residential buildings requires an understanding of the wide diversity of structures and conditions that may be encountered. There are a variety of MDUs available globally. Some may classify them based on the number of Living Units (LUs) and others may categorize them with reference to the building / real-estate construction type. For example, in North America, the MDUs are classified based on the construction types (i.e. high, medium and low-rise or garden style buildings) whereas most of the countries in Europe and APAC refer to them as horizontals, verticals, and mixed (hybrid).

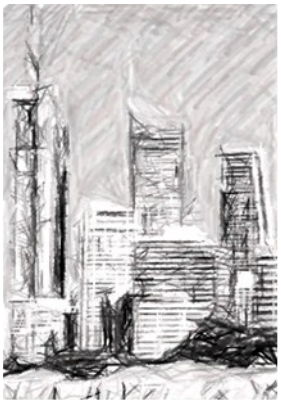
High-Rise MDU
Condo or Apartment
Leased or Owned
10+ Floors/Stories
128+ LU
Internal Residential Entry

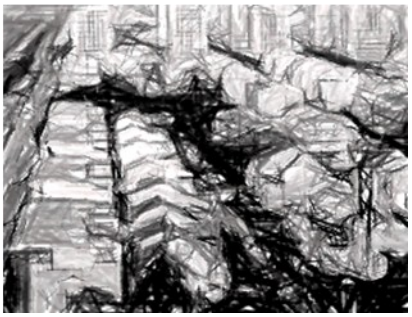


Medium-Rise MDU
Condo or Apartment
Leased or Owned
Up to 10 Floors/Stories
12 to 128 LU
Internal Residential Entry

Low-Rise MDU
Condo, Townhome or Apartment
Also called Garden Style or Horizontal Style
Leased or Owned
Up to 3 Floors/Stories
Up to 12 LU
External Residential Entry







Horizontal	Vertical	Hybrid (Mixed) or Garden Style
• Two or more adjoining premises • A single common building entrance • All premises have a ground floor	• Two or more premises where at least one does not have a ground floor • A multi-story apartment block or flat	• A combination of horizontal and vertical buildings • Retirement village or walled garden estate

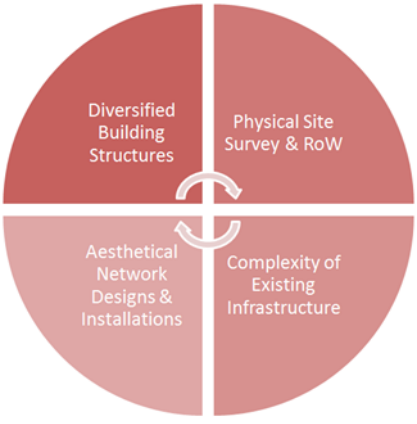
Let's Determine MDU Sizes

The MDU sizes are defined with reference to various aspects such as shared walls, common floors, number of LU and house / building groups. However, the MDU sizes should be determined based on the number of fiber cable networks. This helps the operators to accommodate proper designs and estimate the required infrastructure for the fiber network deployments. Considering this as the fundamental rule, below are the MDU size classifications (provided by an APAC operator):

MDU Sizes	Small	Medium	Large	Giant
Number of Living Units	2 - 20	21 – 50	51 - 100	101 - 200

Challenges – Fiber Deployment in MDUs

Connecting MDUs into the FTTP network requires an understanding of the wide diversity of structures and conditions found worldwide. MDU installations require special consideration, specifically for fiber cable interconnection to terminal equipment, located at the premises.



A variety of solutions are required to support the many different connection scenarios. 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. Solutions for larger MDU structures may involve splitter hubs (located inside the premises) and subtending riser and drop cable networks with intermediate fiber terminals located strategically throughout the building.

Key Challenges

There are two main challenges in deploying optical fibers within diversified MDU structures:

- MDU site survey and address verification
- Engineering and Design of FTTP network in MDUs

MDU Survey

- Finding the potential revenue generating MDU areas in Brown and Green fields is critical for the operators to get maximum ROI. There should be some useful solutions to address this challenge.
- To analyze potential MDU business needs, operators have to conduct an elaborate physical survey. This involves considerable amount of investment and is time-consuming. Need to minimize the truck rolls for the site surveys thus saving time and cost.
- Determination of optical fiber cable installations in MDUs is another critical challenge for the operators due to the fact that the operators have information related to the buildings. In addition, the installations become more critical if the existing telecom facilities can't accommodate the new FTTP cables. Again, a detailed survey, after obtaining permissions from the building owners / associations, will need to be conducted to determine the installation techniques.

Engineering and Designs

- From an engineering and design standpoint, every MDU is different and the concept is that "ONE DESIGN DOESN'T FIT ALL", although there are common themes and corresponding product solutions in the market. This requires special expertise and skills to solve the unique MDU design mysteries.
- Various technological solutions impact the topology that needs to be applied in MDUs, particularly in terms of capacity breaks. Prior planning is needed to develop the network topologies.
- Creation of MDU fiber cable engineering drawings are time consuming and laborious due to the fact that all MDUs structures are not similar and are complicated. This needs to be considered for the automation of the MDU engineering and design software / platforms.

Solutions – Fiber Deployment in MDUs

To help the telecom operators address the key challenges above, the following sections discuss the innovative solutions that have been developed exclusively for MDU optical fiber cable deployments. Various pioneering desktop survey solutions to minimize the physical field survey activities will be covered first. Further, robotic engineering and designs with spatial based cutting-edge automation tools (i.e. automated cable paths creation, equipment placements at feasible locations and generation of bill of materials, schematics, detailed splice drawings and construction drawings for quick deployments in MDUs) will be discussed.

MDU Survey – Desktop Survey Solutions

To minimize the cost and time associated with MDU physical field survey activities; this paper introduces a couple of innovative desktop survey methods.

MDU Location Analysis Method

The major challenge for the operators is to locate the MDU building and verification of the building address along with other details (i.e. postal data verification, area, street routes and main entrance / exit paths). Generally, the operator appoints the field survey contractor to obtain such information, but it is a very time consuming and expensive job. Following the MDU location analysis method, will avoid the field survey problems. This desktop survey method resolves the challenges related to various survey activities including:

- Identification of the MDU location along with postal address verification
- Determination of the MDU building / property type, number of floors and living units
- Documentation of MDU property attributes zoning, lot plans, ownership details and snapshots
- Router from OSP cabinet

Post Box Analysis Method

It is very important to determine the number of fiber required to build the FTTp network for the MDUs. To find the number of fiber requirements, the operators should get the information related to the number of LUs / flats. This method introduces desktop based analysis to determine the number of LUs by counting the post boxes available at the main gate / entrance of the MDU building.

Door Analysis Method

The door analysis methodology solves the problem of identifying the number of LUs available in a MDU. Sometimes it is very difficult to look into the post boxes through desktop survey solutions when analyzing the number of LUs / flats. This is because, the visibility of the buildings from the spatial websites in all areas may not be clear. Hence, the door analysis method provides information related to the number of LUs by looking at the main door available for each apartment / high-rise buildings.

Window Analysis Method

This method is similar to the door analysis method. However, it follows the windows of the MDU whenever it is difficult to determine the number of LUs through the main doors.

Balcony Analysis Method

As an alternative; the balcony analysis method determines the number of LUs or flats available in each MDU building when there is no possibility to determine the LUs / flats from the post-box, door, and window analysis methods.

Electrical Feeder Cable Analysis Method

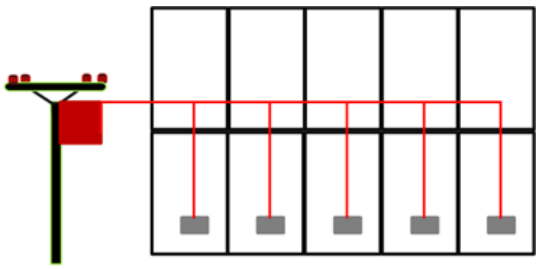
This method is useful when there is no possibility to determine the number of LUs / flats from all the above analysis methods. This method provides easy and quick results in determining the number of optical fiber cables required to install by looking at the number of electrical feeder cables.

MDU Scoping and Design

MDU scoping and designs require special consideration for fiber cable interconnection to terminal equipment located at the premises. 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. With proven experience in MDU designs, a couple of design scenarios are shown below:

Design Scenario #1 – Overhead Pole Feeding

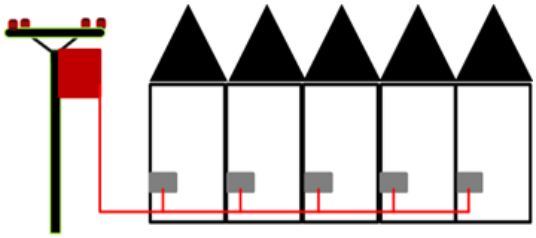
This scenario illustrates the fiber design methodology in an MDU installation serving from the overhead pole distribution box. Below are the design factors for this scenario:



- Placement of the distribution box on the outside power pole
- Drops placed from the pole DP
- No permissions required prior to installation
- ONTs can be inside or outside of the unit

Design Scenario #2 – Overhead Pole Feeding for Garden Style MDU

This scenario illustrates the fiber design in an MDU installation for garden style MDU serving from an overhead pole distribution box. Below are the design factors for this scenario:

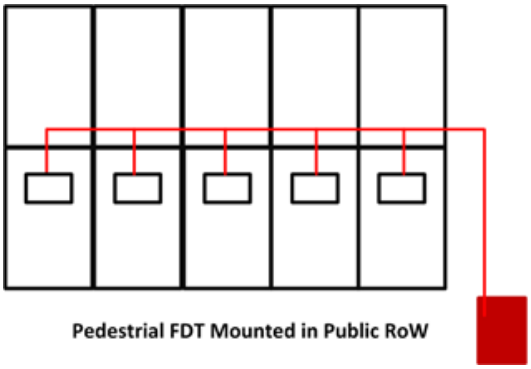


- Placement of the distribution box on the outside power pole
- Drops placed from the pole DP
- No permissions required prior to installation
- ONTs can be inside or outside of the unit

Design Scenario #3 – Underground Feeding from RoW

This design scenario illustrates the fiber design in an MDU installation for high-rise MDU serving from underground right of way fiber distribution terminal. Below are the design factors for this scenario:

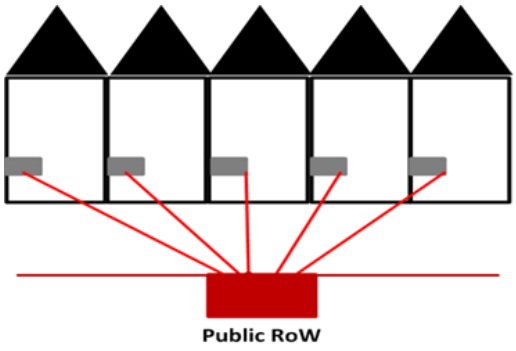
- Fiber terminal will be from underground (pit required)
- Trench to the property required
- Pre-place drops or paths creation is required
- Permissions required prior to installation
- Additional work required prior to installation



Design Scenario #4 – Underground Feeding from Public RoW

This design scenario illustrates the fiber design in an MDU installation for high-rise MDUs serving from the underground public right of way fiber distribution terminal. Below are the design factors for this scenario:

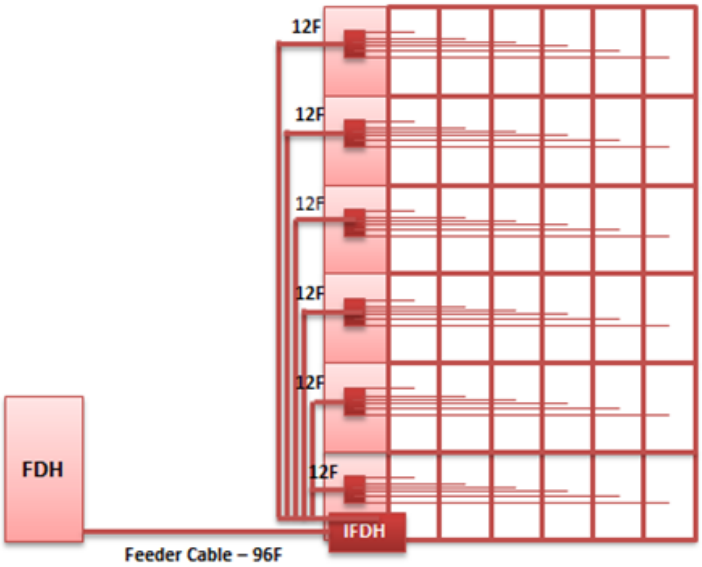
- Fiber terminal will be from underground (pit required)
- Trench to the property required
- Pre-place drops or paths creation is required
- Permissions required prior to installation
- Additional work required prior to installation



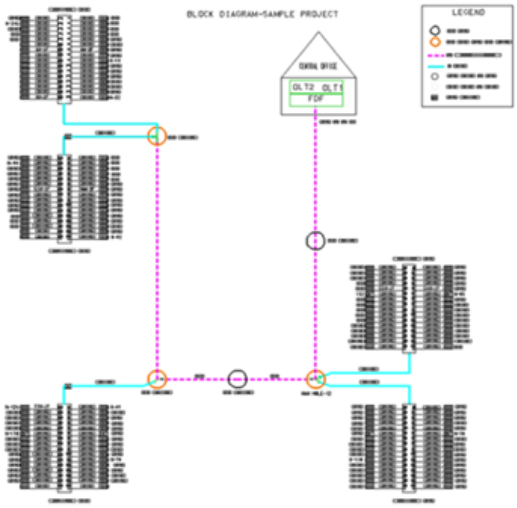
Design Scenario #5 – Multi Floor MDU Design

This design scenario illustrates the fiber design in an MDU installation for high-rise MDUs serving from an underground fiber distribution hub to each floor with different fiber cables. A main distribution cable will be installed to the ground floor distribution point. Then each dedicated fiber will be installed from the IDP to each floor distribution point from where connectivity can benefit till the end ONT.

- Fiber terminal will be from underground (pit required)
- Trench to the property required
- Pre-place drops or paths creation is required
- Internal (IFDHs) required
- Each floor termination boxes required
- Permissions required prior to installation
- Additional work for interior is required prior to installation



Construction Pack Creation



Subsequent to the MDU scoping and designs, the construction pack will be created with various reports required for MDU deployment on the field. Below are key reports, which have been delivered along with MDU designs:

- Bill of Material (BoM) along with Quantities (BoQ)
- Schematic Designs (network overview)
- Detailed civil drawings and reports
- Link budget analysis reports
- Layout reports creation

As-built Recording

As-built is a hard copy indicating the work as executed on the field. After the field engineer converts the work order to an as-built state, the planning department converts the pre-posting status to an as-built state in the database. Different devices such as scan and cameras can be used to make as-built database updates for cable code sketch, cable schema, joint details, logical connection detail, etc. The following deciding factors will be determined during the as-built process:

- Were there any variations and why?
- Were there any issues with the overall field implementation?
- Are there any suggestions to improve the design?

MDU Structural Automation Tools

In view of process automation and efficient designs, there are a couple of key automation engineering tools invented. Key tools include the property mapping, LUs classification, feeder / drop cables automation, multi-flat / floor cable design generation and auto equipments placements. These tools use the spatial capabilities and address the operator's needs of planning, design, construction drawing creations and as-built process recording. The main objective of developing the automated engineering tools is to cut down the production time, avoid the repetitive jobs, save cost for man hours, eliminate manual errors, while ensuring to deliver the effective network designs.

Business Benefits

These spatial based innovative approaches which have been described in this paper provides the below business benefits to the Telco operators:

- Quick desktop solutions to help the operators minimize costs associated with field surveys
- Optimized and automated engineering process for rapid network deployment in MDUs
- Reduces overall engineering cost which lowers the CapEx and OpEx
- Provides optimization engineering designs by leveraging the geospatial automation
- Follows the business rules to provide improved quality designs

Conclusion

Successful optical fiber deployment in MDU applications is measured in many ways. The goals include achieving minimum deployment cycle, maximum ROI, and achieve higher business benefits. With these goals in mind, unique processes have been developed by leveraging the geospatial automation engineering capabilities including the seamless operational processes. Effective MDU designs in both new and existing MDU structures will ensure easy deployment process, simple routing paths, and improved maintenance capabilities. The innovative MDU desktop survey and design provisioning methods, which are discussed in this white paper, are proven and aim to produce effective and efficient designs based on industry best practices supported by the expertise in automation tools, systems, and applications required for delivery.

Author

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Kiran Solipuram has over 14 years of experience in planning, design, installation, construction, and operations of Telecom network infrastructure with various multinational Telecom operators. He is highly skilled in FTTx networks for Green and Brownfield architectures including active and Passive Optical Networks (PON). His innovative solutions on FTTx networks have been recognized globally benefiting many operators. Kiran has in-depth experience on SDH, ATM, IP/Ethernet Switching, xDSL / Broadband, Metro-Ethernet, and IPTV technologies. He has managed large-scale LTE and FTTx projects delivering on time and within budget with the utmost quality. He is a regular speaker presenting at many global conferences throughout his career.

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Kevin Challen, Global Telecom Business Unit Head at Infotech has more than 20 years of experience in the Telecommunications field where he has helped Telco's design and deploy sophisticated Geospatial Information Systems in support of their push towards integrated inventories. Under Kevin's leadership, the business has expanded in terms of services and clients, with Infotech as one of the leading providers of inventory data services and engineering to many Telco service providers. Kevin has published many telecom related publications and is a regular speaker presenting at many global GIS/Telecom conferences.

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Ravi Jasupaul, with over 20 years of experience, has managed large scale data migration projects for prominent Tier 1 and Tier 2 telecom majors. Ravi has been spearheading telecom engineering for more than five years at Infotech. During this period, he has been continuously supporting the acquisition of telecom domain expertise. He is always looking to provide innovative and economical services for CSPs for all their inventory and engineering business issues.

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