Available online at www.ijrp.org

IJRP.ORG
International Journal of Research Publications

International Journal of Research Publications

Fiber to the home network (FTTX) Implementation and Feasibility in Sri Lanka

Sashna M.B.F

Faculty of Information Technology
University of Moratuwa
Sri Lanka

Abstract

In my research, mainly focus on Fiber to the home network implementation and feasibility in Sri Lanka. In Sri Lanka, every person faces the network problem. Therefore, this paper can give the best solution for the telecommunication industry. In presenting days, we can't get very user friendly network. Some time, we face so many issues while transferring the data. In here, we can use Fiber to the home network technology using Gigabit Passive Optical Network and Optical Access Network Architectures. When we use this technologies, want to use some of the specific equipment and materials also. There are two types of signal distribution methods. Those are Passive Optical network and Active Optical Network. In first option, it implements with point to multi point architecture. It can be used by more end users. In second option, it manages direct signals and some specific points. Here, we can select first option than second one. There are so many researchers going on transmitting materials. Some of the approaches are available to perform and exchange the data without less loss than now a day. Here, we can conclude the material with quantum fiber. Because, light can bend with different angles and can maintain privacy very highly. From this implementation, we can connect more people through Wild Area Network and can get low attenuation and high bandwidth connectivity. Advancing into fiber optic network will make a re-evaluation in telecommunication business industry.

Keywords- GPON; IPTV; Splitter; DSL; ADSL; FTTX; FTTH; FTTC; FDH; PON; ANO;

1. Introduction

Internet has become essential need of a human like how advanced human friendly technologies are available over the internet like video on demand, video conferencing, live time surgery, HD video streaming, IPTV

migration like HD to Ultra HD and online gaming. When we have these technologies available over the internet, but our subscribers of Sri Lanka their using DSL technologies. As a result of this, we are seen the imbalance between needs, supply and demand equivalents. To meet the demand of need, we have to upgrade the telecommunication infrastructure which are capable of delivering ultra-high speed of connectivity.

Telecommunication structure is divided as core network, transport network and access network. In Sri Lanka core and transport network were developed with fiber and access network was developed through copper medium. Therefore, it can implement further more from this. Because, most of the European and Middle East countries had been evolved such more. When we adopt those technologies, we can unlock a telecommunication era which we never dream. Fiber will deliver ultra-high speed broadband and amazing high definition TV and digital TV channels and terra bits of internet speed. Internet speeds up to 100 times faster than now a days speed. With this implementation the user can download, surf, stream or share almost everything online in absolutely no time. Fiber optic will enable new services that current home broadband (ADSL) is unable to deliver. Its services enabling high speed internet connection and IPTV for the user who were have not been able to receive services due to the distance from the exchange and streaming high definition IPTV content. Advancing into fiber optic network will make a re-evaluation in telecommunication business industry.

2. Background

Optical fiber is the medium in which in communication signal are transmitted from one location to another in the form of light guided through thin fibers of glass or plastic. FTTH is also called as FTTP (Fiber to the Premises). Its speed is very faster than DSL or Twisted pair or coaxial cables. When they use fiber optic as backbone, it causes low attenuation and high bandwidth. The single mode cables have the best performance.

2.1 Fiber Deployment

Telecom networks divided into 3 parts

- Core Network
- Transport Network
- Access Network

A fiber to the home (FTTH) network constitutes a fiber-based access network, connecting a large number of end users to a central point known as an access node or point of presence (POP). Each access mode connects equipment to provide the application and services, using optical fiber to the subscriber. These nodes can be large metropolitan or urban area. Depending on architecture and physical scenario implementation can be different:

- Fiber to The Home (FTTH) - Each subscriber is connected by a dedicated fiber to a port on the equipment in the POP, or to the optical splitter.
- Fiber to The Curb (FTTC) – Each optical termination box in the building is connected by a dedicated fiber to a port in the equipment in the POP, or to an optical splitter. From the termination box to subscriber can be connected with copper connectivity which can provide gigabit Ethernet connectivity.
- Fiber to The Curb (FTTC) – Each switch or DSL access multiplexer (DSLAM), often found in a street cabinet, is connected to the POP via a single fiber or a pair of fibers, carrying the aggregated traffic of the neighborhood via gigabit Ethernet or 10 gigabit Ethernet connection. The switches in the street cabinet are not fiber but can be copper based. This architecture is sometimes called “Active Ethernet” as it requires active network elements in the field.

In here, there are two types of signal distribution methods:

- PON (Passive Optical Network): This technology implements with point to multipoint architecture. This can be used by more end users. It may use without having individual fiber between hub and users.
- ANO (Active Optical Network): It manages direct signals and signal distribution to specify the customers. Only this wants the source and receiver side signals.

3. Methodology

3.1 Standards of Fiber to the home network (FTTX)

There can be use some of standards. Those are GPON Network Architecture in Figure-1 and Optical Access Network in Figure-3 [10].

- GPON Network Architecture

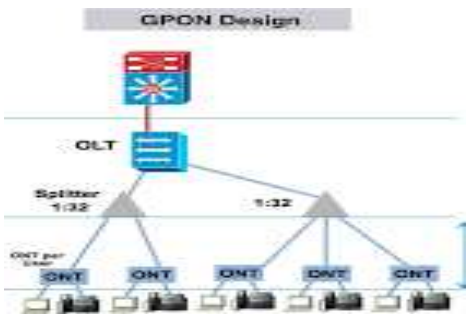

Figure 1

The objective is to develop a network, capable to deliver 100 Mbps per each tenant. To optimize the size of network and corresponding investment to match with the demand, the line plant shall be development, meeting the ultimate requirements.

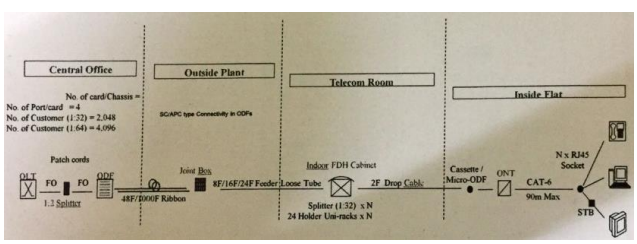

Figure 2

This Figure-2 architecture should enable to provide any single service to the customers from the service.

a) SFU- Single Family Unit
b) MDU- Multi Dowelling Unit
c) SBU- Single Business Unit
d) CBU- Central or Common Business Unit

- Architecture of Optical Access Network

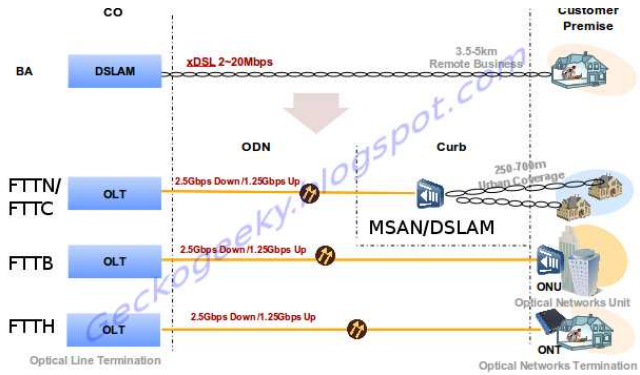

Figure 3

From the above diagram, some of the scenarios are followed:

a) BA Broad Band

Single pair copper lines are used to provide connection to DSL and VDSL maximum speed from 512 KB to 8 Mbps with limited distance.

b) FTTC & FTT Cab

As an access to the curb or the cabinet over fiber, Fiber to The Curb & Fiber to The Cabinet is for the Multi-Dwelling Unit (MDU), providing a comparatively larger number of ports.

c) FTTB

SBU: It provides a comparatively small number of ports.

MTU: It provides a comparatively larger number of ports.

d) FTTH

SFU: It provides a comparatively small number of ports.

The GPON family of specifications has been released by the International Telecommunication Union (ITU). It is not backward compatible to APON or BPON. A number of terminals at the customer side communicate with the same port of the Optical Line Terminal (OTL) in the central office. The full bandwidth of the port is shared between the connected Optical Network Terminals (ONTs).

3.2 Fiber to the home network (FTTX) Materials and Equipment Description

a) Connectors

All connectivity options involve some optical power loss. Fusion splicing involves aligning, melting, and pushing together two fibers where the resulting optical loss is minimal (0.1 dB). Splicing is a labour-intensive operation and there are fiber cable types including ribbon cable that are designed to reduce splicing cost by allowing mass fusion splicing. Depending on the network segment, splicing may not be the most cost-efficient option. It involves highly skilled technicians travelling from location to location during one splice at a time.

While optical connectors are easy to use and require minimal skill to connect two fibers, they result in higher optical power loss (0.3 dB). Connectors are primarily used to connect optical fiber to optical-electronic

devices in a PON (OLT and ONT interfaces) as well as for the optical splitters. They can also be cost-effective in connecting the drop fiber to the distribution cable. In situations where connectors are used on both ends of a drop fiber, managing the drop fiber slack can become an issue provider must address. Distance from the drop box to the house may vary based on the size of the lot, ONT enclosure options must allow space for handling the slack.

Some types of connectors are color codes, SC, FC, LC, and ST. The color code can use to identify the mode. If, it is single mode, its color can be blue and if it is APC (angled) connector, it can be green. SC is a snap-in connector that latches with a simple push-pull motion. It is also available in a duplex configuration. FC was one of the most popular single mode connector. LC is a small form factor connector. It gives the good performance and highly favoured for single mode. ST is a most popular connector for multi-mode networks.

b) Cat 6 Cables

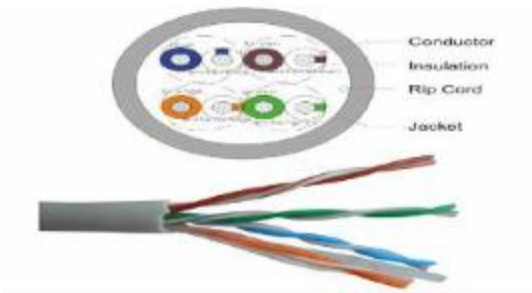

Figure 4

Category 6 (Figure 4) is used for data connection.

c) Cat 3 Cables

Figure 5

Category 3 (Figure 5) is used for telephone connection.

d) Access Point Router

Figure 6

It is (Figure 6) to distribute the internet using with a wire connection and produce a WiFi coverage.

e) Optical Network Terminal (ONT)

Figure 7

It's (Figure 7) generates the telephone and internet.

f) Optical Line Terminal –OLT

Figure 8

It is (Figure 8) the main equipment from the exchange.

g) Optical Distribution Frame-ODF

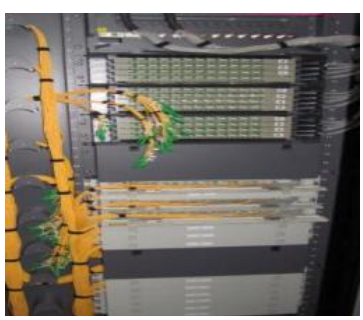

Figure 9

It is (Figure 9) used a terminal connection of fiber, and patching.

h) 1st Splitter

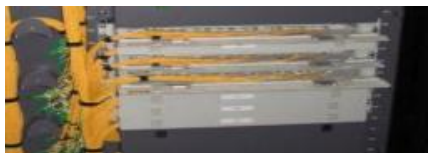

Figure 10

It is (Figure 10) equipment located inside the exchange and RLU.

i) 2nd Splitter

Figure 11

It is (Figure 11) equipment located nearest to the customer premises.

3.3 Application of Fiber to the home network (FTTX)

Fiber Distribution Hub (FDH) is the local convergence point (LCP) that serves as the splitter and connection point. It provides individual subscriber connectivity to splitter outputs and serves as demarcation between the feeder and distribution portions of the network.

The indoor FDH is designed to organize and administer fiber optic cables and passive optical splitters in an indoor environment typically suitable for high rise buildings, it is placed in the telecom room.

These FDHs are used to inter connect main cables and drop cables via optical splitters in a FTTH network application, within building environment. It is figure out in the figure 12.

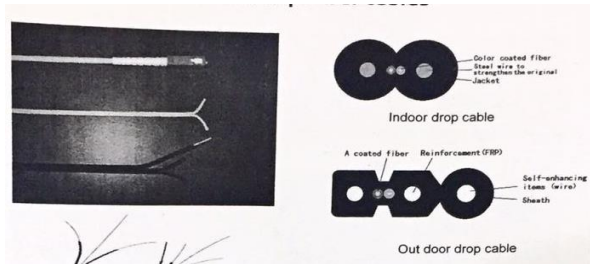

Figure 12

Fiber optic cables are low attenuation for single mode and high tensile rating with steel or aramid yarn strength and flexible in cable pulling. Different types of drop cables are available for indoor and outdoor application and in different sizes. In new buildings, the customers are expected to pre-wire the buildings with the indoor cables. These drop cables are very compact.

- Fiber attenuation and power budget

	Class - A	**Class - B**	**Class – B+**	**Class - C**
Minimum Loss	5 dB	10 dB	13 dB	15 dB
Maximum Loss	20 dB	25 dB	28 dB	30 dB

Figure 13

In figure 13 is defined about the fiber attenuation and power budget.

- Diagram of fiber optic connection inside the customer premises

Figure 14

In figure 14 is described about the fiber optic connection inside the customer understanding.

- Diagram of fiber optic connection from exchange to customer premises

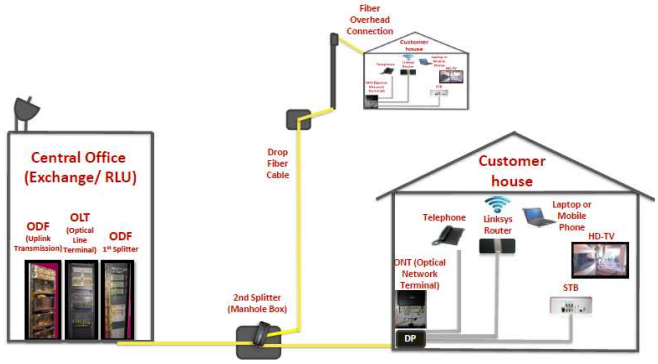

Figure 15

In the above figure 15 is described about fiber optic connection from exchange to customer needs.

4. Results and Discussion

In here, we can suggest the solution in both ways. Those are urban areas with huge building and sub-urban areas with houses. In the urban areas, we want to distribute the connection to greater than one floor (Figure 16). At the basement, it contains feeder cables and splitter. Feeder cables are used to extent the optical distribution from main office. These cables are connected through star topology in between building splitter to the customer premises. Splitters are used to split the power of the signal. We want to focus following specific characteristics high fiber throughput.

- Very lengthy wave length
- Low attenuation
- High performance
- High reliability
- Using network protection privacy

Urban Fiber Deployment Methods

In urban areas, it is distributed through this method.

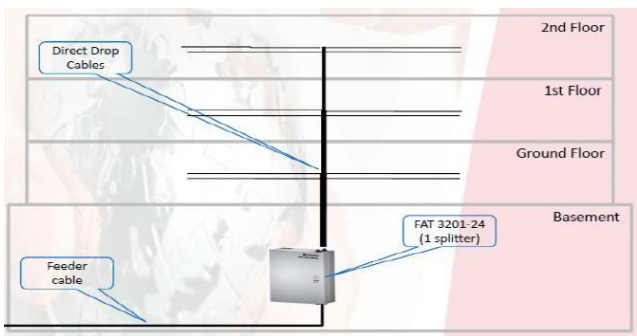

Figure 16

If the building is too much large, we can use sub splitters with main splitters. Raiser cables are used to connect splitter with sub-splitters. Each sub-splitter is distributed the signal to two floors (Figure 17).

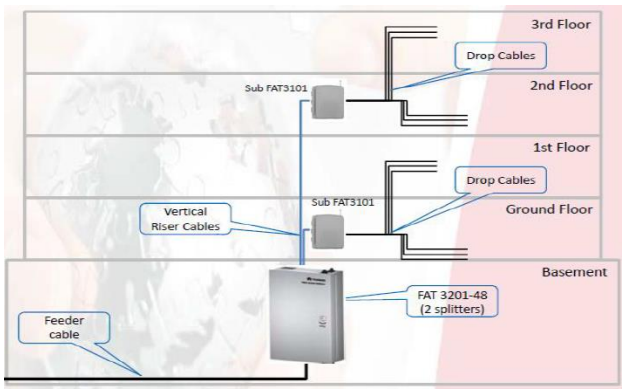

Figure 17

If one sub-splitter is servicing more than one floor, all flats from the same floor should be connected to the same sub-splitter only (Figure 18).

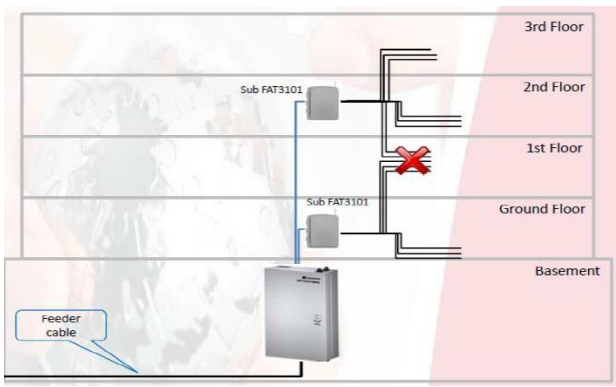

Figure 18

If the number of sub-splitters are equal to number of splitters, and free splitter ports are available, it is possible to use direct drops from splitter to the same floor (Figure 19).

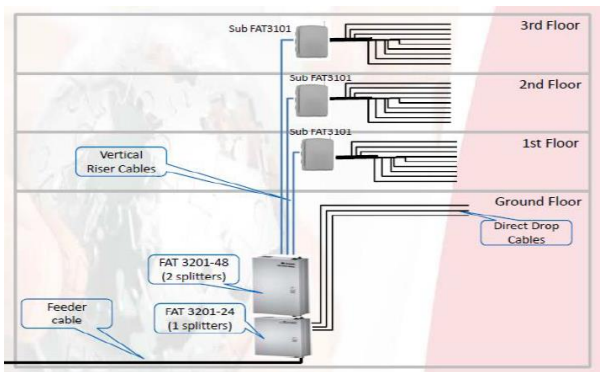

Figure 19

In the sub-urban areas, we can suggest the solution with the following diagram (Figure 20):

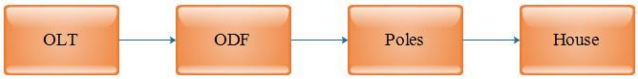

Figure 20

OLT is in telecom. From the OLT signal is passed to ODF. The central office consists with OLT optical light. FDH (Fiber Distribution Hub) consist with incoming ODF (Optical Distributed Frame), splitter modules, and drop fiber terminations. The pole gets the signal from ODF. Through the pole, the particular home will get the signal.

In the further advancement of Fiber to the Home network, quantum fiber optic technology can be integrated with conventional fiber network. Because fiber optic network integration, we can utilize the following advantages:

- Can utilize the usage of the medium. For example, normally data is represented with 8-bits. But, we can represent the data with 1-bit with quantum fiber. When, we use this type of fiber, can get more data transmission.
- Now a day, the internet connection is very privacy. In here, we can get more secure, while transmitting the data for the quantum fiber integration.

There are so much of researches going on. Some of the approaches are available to perform and exchange the quantum information in between light and matter-based memories. It gives the efficiency for store and retrieve the information. Although researches have demonstrated that atoms can be controlled and efficiently coupled to glass fibers, the suitability of the atoms for strong quantum information and for long-distance quantum communication has remained an open question. Now the researchers have experimentally demonstrated. The atoms quantum coupled mechanically to glass fibers. That are capable of strong quantum information long enough.

This technology still on researching process. In future, we can migrate from copper based network technology into fiber access network technology. Therefore, we can easily adopt those amazing quantum fiber optic technology in future.

5. Conclusion

When we implement this technology in Sri Lanka, can face some of the challenges in here. Optical fiber is passed through underground (UG). In here some of the urban areas have the underground way, but sub-urban areas have polls on the road, therefore we want to use poll feeder cables. In the high windy or dry or rainy seasons, can bend or break the fiber optical cables. It wants high cost, most of the well-professional persons in this area and also want to know how install and maintain the software. It is the passive network system. Therefore, wants to get power supply from the customer place but Sri Lanka doesn't have power stable and also service only gives the network.

Our subscribers of Sri Lanka their using DSL technologies. As a result of this, we are seen the imbalance between the need, supply and demand. To meet the demand of need, we have to upgrade the telecommunication infrastructure which are capable of delivering ultra-high speed of connectivity. A fiber to the home network constitutes a fiber-based access network, connecting a large number of end users to a central point known as an access node or point of presence (POP). Each access mode connects equipment to provide the application and services, using optical fiber to the subscriber. These nodes can be large metropolitan or urban area.

Acknowledgements

Sincere thanks to my supervisor for this study Mr. Firdhous Mohamed who helped me in finding out the facts and guided me to work learning the appropriate things to fulfil the requirement for this research. Also, thanks to the lecturers who were in our faculty, helped me to improve my work on this study. I would also like to thank my brother Mr. Mohamed Sabith, who is highly acknowledged for his support to help me in choosing the topic and helped me in finding the reading materials.

References

S. Telecom, "Smartline (FTTx) - Packages".

Commscope, Enterprise Design Guide, 2007.

P. M. C. E. Natascha Weinstabl, Creating a Bright Future, 2012.

Guide-Lines-for-GPON-Planning, Etisalate.

Fuel Your Senses,Qtel Annual Report, Qtel.

M. M. Al-Quzwini, "Design and Implementation of a Fiber to the Home FTTH Access Network based on GPON," *International Journal of Computer Applications,* vol. 92, no. 6, p. 13, April 2014.

E. Chai Chuan, "THE FEASIBILITY STUDY OF IMPLEMENTING A FIBER," in *NAVAL POSTGRADUATE SCHOOL*, MONTEREY, CALIFORNIA, March 2004.

B. D. M. J. V. X. Q. J. B. a. K. V. R. W. Chen, "An experimental set-up for the feasibility study of embedded optical fiber monitoring," *IEEE/LEOS Benelux Chapter,* p. 4, 2005.

K. WILLY, Optic fiber network optimization with FTTH implementation in Rwanda, Rwanda: Global Information and Telecommunication Technology Program, 2015.

M. A. a. K. Elleithy, "Quantum Entanglement Distribution for Secret Key," p. 8.

G. L. M. a. C. G. P. Richard J. Hughes, "Practical quantum key distribution over a 48-km optical fiber network," p. 13.

FTTH council, Fiber to the home Advantages of optical access.

R. J. Y. a. P. D. T. Iris Choi, "Quantum information to the home," *New Journal of Physics,* vol. 063039, no. 13, p. 14, 23 June 2011.

P. I. L. Dan Pecur M.Sc, "FTTH TECHNOLOGIES AND ACCESS USO," p. 12.

N. A.-R. H. Dheyaa Jasim Kadhim, "Design and Implementation of a Practical FTTH Network," *International Journal of Computer Applications,* vol. 72, no. 12, p. 7, June 2013.

B. N. a. K. J. Mohammad Syuhaimi Ab-Rahman, "Visual Basic Software Tool for FTTH Network Management System: SANTAD," *IJCSNS International Journal of Computer Science and Network Security,* vol. 9, no. 2, p. 8, February 2009.

P. C. R. D. J. F. G. F. A. K. S. W. J. Prat, "Long-term Evolution of Passive Optical Networks," p. 4.

M. A. S. Anupam Banerjee, Towards Technologically and Competitively Neutral Fiber to the Home (FTTH) Infrastructure, Chlamtac , I., Gumaste, A. and Czabo, C., eds, Broadband Services: Business Models and Technologies for Community Networks,, 2005.

FTTH Business Guide, FTTH Council Europe, 2010.

J. R. S. a. Y. Xiong, "Cost Analysis of Network Sharing in FTTH/PONs," *Article published in IEEE Communications Magazine,* vol. 52, no. 8, p. 23, August 2014.

B. F. A. Z. V. D. T. Florian Kaiser, "A fully guided-wave squeezing experiment for fiber," *Optical Society of America,* vol. 3, no. 4, p. 7, 8 Apr 2016.