Volume 3, Issue 8, August 2018 ISSN (online): 2456-0006

International Journal of Science Technology Management and Research

Available online at: www.ijstmr.com

Analysis and Implementation of Fiber to the Home Network Using Peace Estate, Lagos State, Nigeria as a Case Study

Victor O. Matthews
Department of Electrical and Information Engineering
Covenant University
Ota, Ogun State, Nigeria

Uzairue Stanley Idiake
Department of Electrical and Information Engineering
Covenant University
Ota, Ogun State, Nigeria

Etinosa Noma-Osaghae
Department of Electrical and Information Engineering
Covenant University
Ota, Ogun State, Nigeria

Frances Nwukor
Department of Electrical and Electronic Engineering
Petroleum Training Institute

Abstract: ***Fibre based access networks can deliver performance that can support the increasing demand for high speed connections. The conventional copper-based and coax solutions can no longer meet the increasing demand for high speed internet, hence the introduction of Fibre to the Home network. Fibre to the Home (FTTH) provides an excellent platform for ultra-high speed access technologies. This study takes a look at the design and implementation of a FTTH network using the point-to-point (P2P) architecture. Point-to-point architecture is one of the easiest methods of deploying fibre to the home. This paper also looks at the advantages of P2P architecture, the process involved in designing, selecting the equipment and deploying FTTH. The possible challenges that might be faced when deploying the network are also highlighted.***

Keywords: Fibre-to-the-Home; Optics; Point-to-point; Passive Optical Network; Performance

I. INTRODUCTION

Fibre optics is basically the science of light transmission through very fine glass or plastic fibres [1]. The fibre optic cable is recognized as an excellent transmission medium in telecommunication [2]. It used in telecommunication because of its flexibility, higher bandwidth, long distance communication and little attenuation compared to electrical cables [1]. With the headway in communications systems, there is a high demand for vast transmission capacity to send more information at higher speeds at lower costs. Advancing from copper wire to fibre optic cable increases our capacity to transmit data rapidly and over long distances. This has also expanded our technological development in all areas [3]. The FTTx network is a branch of fibre optics in telecommunications, which consists of the following networks:

- Fibre to the premises (FTTP)
- Fibre to the curb (FTTC)
- Fibre to the antenna (FTTA)
- Fibre to the business or building (FTTB)
- Fibre to the home (FTTH)
- Fibre to the node (FTTN)

FTTx networks are applicable in businesses, residences, triple play (voice, video, and data) and in the impact of internet protocol. FTTX networks have the following protocols all Passive Optical Network (PON) based:

- B-PON (ATM-PON).
- G-PON (Gigabit PON)
- 10G-PON (10 Gigabit PON)
- EPON (Ethernet PON)
- Active Ethernet (AE)
- 10GEPON (10 Gigabit Ethernet PON)

- RF overlay
- Radio frequency over glass (RFoG)
- Wavelength division multiplexed PON (WDM-PON)

Our focus would be on fibre to the home (FTTH) network. This research will analyse the FTTH from the theoretical, design and deployment aspect.

II. BACKGROUND OF STUDY

Fibre to the Home (FTTH) is a relatively new and fast-growing way of providing higher bandwidth to customers. It is basically the transfer of signals from switching equipment over optical fibre to homes and businesses [4]. Fibre to the Home (FTTH) provides an excellent platform for ultra-high speed access technologies. Both fixed access networks and advanced wireless networks benefit from FTTH solutions. [2] FTTH is now a reality with millions of subscribers worldwide, however it still faces strong competition from copper-based and coax solutions. Nevertheless, it is becoming more apparent that the migration to FTTH network is inevitable [5]. This is because it has large downlink speeds, superior Quality of Service (QoS), allows higher uplink speeds, and has lower latency and more economical upgrades. This makes FTTH technology the most competitive in years to come. Most operators are beginning to realize that FTTH is pivotal for achieving competitiveness in the long run [5]. Technology-wise, FTTH offers a wide range of solutions to cover different deployment scenarios, both for the active and passive parts of the network [5]. It is important to note that FTTH technology is not only limited to the "home" or to the end user [5]. With the introduction of new standards, FTTH networks will be able to take on more functions, such as mobile back and front haul, enterprise customers and cloud connectivity [5]. It is estimated that there would be a bandwidth demand of over 1Gbps around the year 2020 and over 10Gbps around 2030.

III. METHODOLOGY

Fibre optic network configuration shows the precise strategies for prompting the establishment of a fibre optic system. It consists of; the type of communication system(s), its scalability, the geographic design (premises, grounds, OSP etc.), the transmission equipment required and the fibre network over which it will work. The next step to take is thinking about the necessity for grants, easements, permissions and inspections. Here we think about genuine segment choice, arrangement, installation, testing and troubleshooting. Lastly, thoughts are given about documentation, upkeep and making arrangements for rebuilding in occasion of a blackout.

Peace Estate, Lagos Nigeria was used as a case study. This area is situated in the busy region of Lagos State in Nigeria; this area was picked due to the extensive number of loft in the bequest and the accomplice of the metro fibre course. The plans for the design are separated into three;

- The Backhaul Link Network Design: This contains the fibre arrangement originating from the base station (BTS) to the customer area. A single mode fibre of 96core was utilized.
- The Metro Fibre Link Network Design: This is also known as the internal network design for the picked area. The four-core multimode or single mode fibre is generally utilized in this part. The sort of fibre utilized as a part of this design, relies upon the distance of the apartment from the network room area. It was picked by the plan design and the estate administration. The design is usually has dynamic and two redundant parts. This is to prevent complete network breakdown in the event of any disappointment.
- Network Room Design: This is the place where the fibre originating from all the apartments are terminated and attached to a fibre patch panel.

IV. DESIGN AND RESULT ANALYSIS

Fibre Peace estate was chosen for this project because of its complex architectural design. This gives the study a strong foundation for the FTTH design and analysis. It is located in a very busy area of Lagos state, Nigeria. FTTH was deployed in the estate as the major means of communication both for data and voice.

- Total number of apartments = 116
- Total number of cabinets = 3 each of 96-fiber core
- Total number of drives (streets) = 9

As shown in the design in Figure 1, a 4-core single mode fibre (red) cable was used during the design the FTTH network, which comprises of two active ports and two redundant ports to ensure there is no breakdown in communication should any damage occur on the main active ports. The 4-core fibre are spliced at the client end, the cabinet and finally at the network room in order to have a free flow of light for communication. The port numbers are documented at the network room for patching and maintenance purposes. This is done for all the 115 apartments. There are three junction boxes for future connections to any company or clients who might be interested in connecting to the network. Figure 2 shows the backbone design for Peace estate. The red cable indicates the 96-core fibre cable. Figure 1 shows the network room diagram of a client. The diagram shows the schematic representation of the internal network diagram of the client. The symbols represented are explained as follows;

1: This is the router at the network room where the data coming from the BTS is terminated. This router also carries the same configuration with the one at the BTS.

2: This is the Cisco switch where the data from router 2 is re-distributed to all apartments as requested by the client. Each port on the switch is configured on different VLANs and these VLANs are linked to the IP addresses assigned to each apartment in the router configuration.

3: This is the Ethernet patch panel used to arrange the UTP cables during installation. It makes the location of faults and troubleshooting easy.

4: This is the media converter chassis where the fibre optic coming from the BTS is first terminated before it is transferred to router 1 in the network room. This conversion is necessary because data arriving as optical signals need to be converted back to electrical signals.
5: The Fibre Patch Panel where the fibre optic cable from each apartment is spliced and linked with a patch cord to the media converter chassis in order to supply internet services to the client.
6: This represents the router at the base station where the link configurations are carried out by the internet service provider. The bandwidth, the VLANS and the IP addresses are all configured and assigned to the client here for internet access.

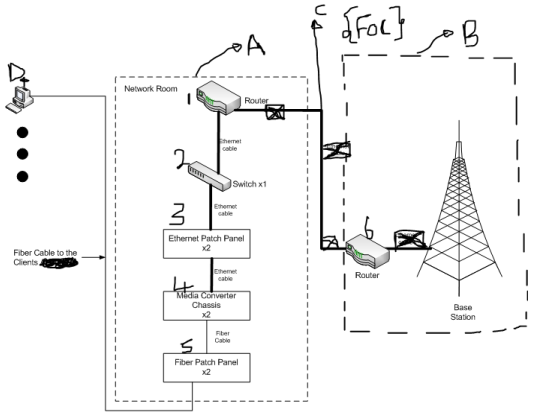

Fig. 1 Diagrammatic Representation of a Typical Network Room.

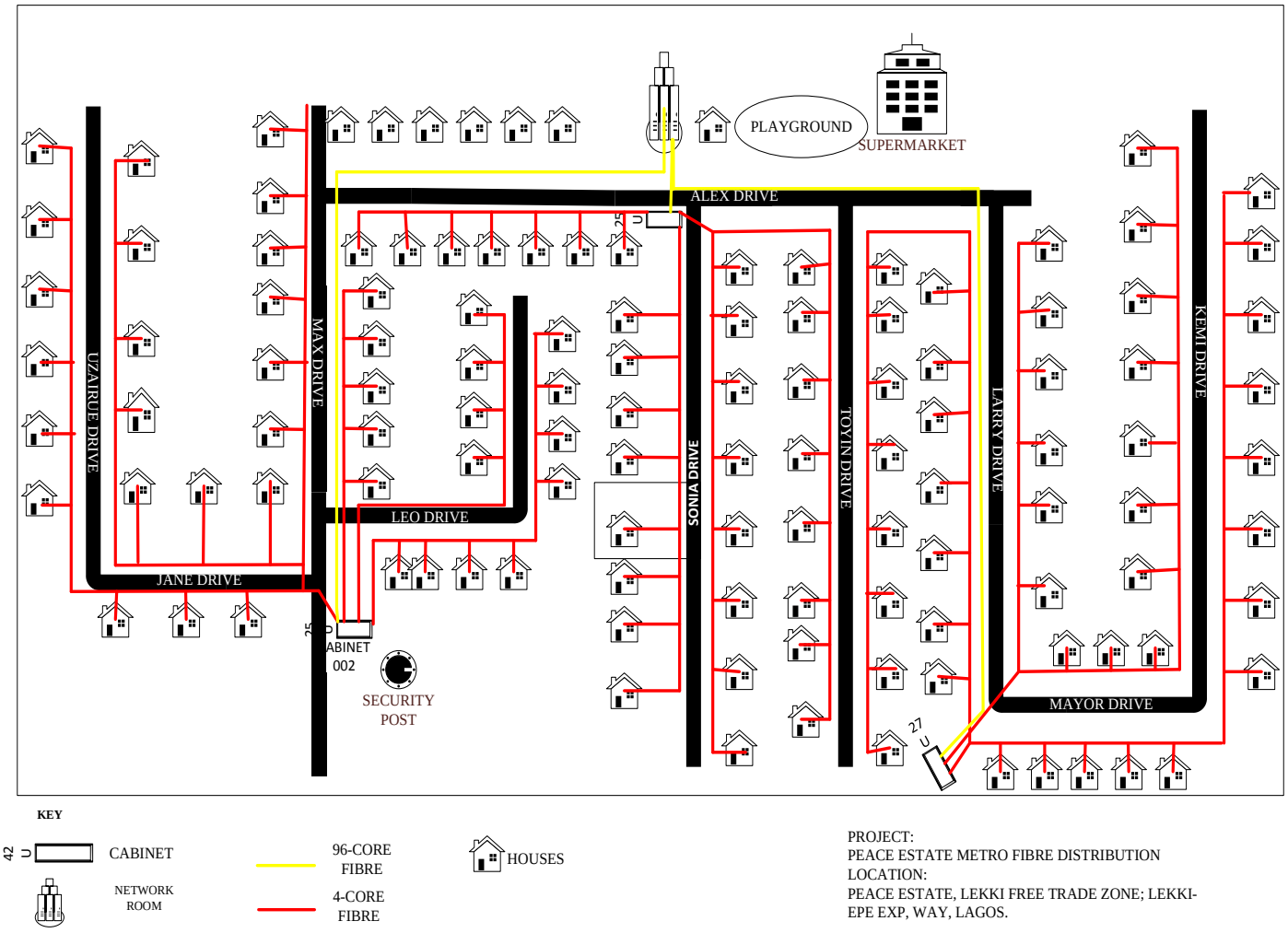

Fig. 2 Metro Fibre Network Design for Peace Estate

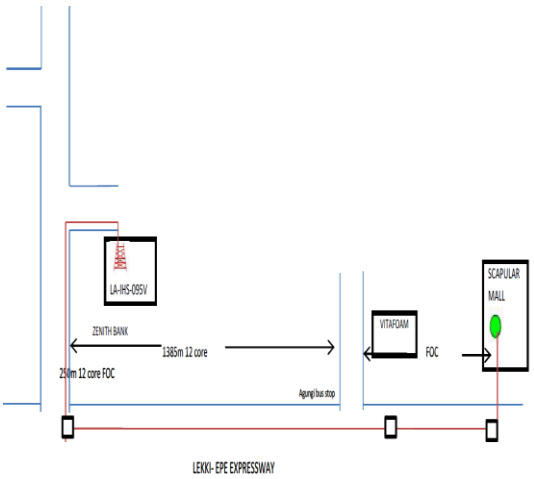

Fig. 3 Backbone Fibre Network Design for Peace Estate.

CONCLUSION

Although P2P is a very good and reliable method of deploying FTTH network, there are other technologies that are better than it. One of which is the P2MP architecture. P2P uses Ethernet technology while P2MP uses PON technology. PON is a passive type point-to-multipoint network having active points on the ends and passive assemblies (PLC splitters, fibre patch cords, fibre connectors, etc.) in between. There are two primary types of PON technologies, EPON and GPON. IEEE standardizes EPON and it is based on Ethernet technique. EPON combines the cost efficient Ethernet equipment and fibre infrastructure. It also transmits Ethernet data frames directly. It can give up to 1 Gbps capacity in both upstream and downstream directions and cover a distance of up to 20km. These features allow EPONs to transmit video, data and voice traffic efficiently in an integrated network. GPON can support higher data rates of up to 2.488 Gbps for both upstream and downstream and can cover a distance of up to 60km. Studies have also shown that the infrastructure deployment cost of P2MP is cheaper than that of P2P. All these features make P2MP (PON) architecture a huge subject for further research in the deployment of FTTH network in Nigeria.

FUTURE WORK

Although P2P is a very good and reliable method of deploying FTTH network, there are other technologies that are better than it. One of which is the P2MP architecture. P2P uses Ethernet technology while P2MP uses PON technology. PON is a passive type point-to-multipoint network having active points on the ends and passive assemblies (PLC splitters, fibre patch cords, fibre connectors, etc.) in between. There are two primary types of PON technologies, EPON and GPON. IEEE standardizes EPON and it is based on Ethernet technique. EPON combines the cost efficient Ethernet equipment and fibre infrastructure. It also transmits Ethernet data frames directly. It can give up to 1 Gbps capacity in both upstream and downstream directions and cover a distance of up to 20km. These features allow EPONs to transmit video, data and voice traffic efficiently in an integrated network. GPON can support higher data rates of up to 2.488 Gbps for both upstream and downstream and can cover a distance of up to 60km. Studies have also shown that the infrastructure deployment cost of P2MP is cheaper than that of P2P. All these features make P2MP (PON) architecture a huge subject for further research in the deployment of FTTH network in Nigeria.

REFERENCES

1. “Basics of Fiber Optics” by Mark Curran and Brian Shirk
2. Analysis and measurement of fiber to the home (FTTH) as an Access technology in fiber-optic communication link” by Loh Mun Yee
3. “Investigation of FTTH Architectures Based on Passive Optical Networks” by Deeksha Kocher
4. FTTH Q&A from “Building Fiber to the Home Communities Togther” by FTTH council
5. K. O. Okokpujie, E. C. Chukwu, E. Noma-Osaghae, and I. P. Okokpujie, "Novel Active Queue Management Scheme for Routers in Wireless Networks," International Journal on Communications Antenna and Propagation (I. Re. CAP), vol. 8, pp. 53-61, 2018.
.