Installation and Activation of a Fiber To The Home (FTTH) Network With The Addition of Optical Distribution Point (ODP) Using The Branching Method

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ARTICLE INFO

Article history
Received August 20, 2023
Revised September 25, 2023
Accepted October 20, 2023

Keywords
ODP Branching
Activation
FTTH

ABSTRACT

FTTH is a concept that uses fiber optic networks. In the FTTH optical network, one of the devices is an Optical Distribution Point (ODP). There are 2 methods for installing ODP, namely connecting the direct area cable and branching the main distribution cable or branching. In previous studies, branching was only done from ODC to ONT and Optical Light Source (OLS) as a substitute for OLT, so there is no internet network that customers can directly access using ONT. In this study, the author discusses how to activate FTTH devices from OLT to ONT customers, with a comparison before and after activation using a 1:4 passive splitter. Then the attenuation that can be produced is 28.54. Therefore network activation on ODP Branching is very efficient because the resulting attenuation does not exceed 28dB, which is in accordance with PT Telecommunications ITU-T G.948 standards.

1. Introduction

As is known, in the current era of digitalization, people need fast internet access. Therefore, a new network technology is needed that can meet these needs, namely fiber optics [1]. Therefore, we need a network device with good performance, so we need a network architecture that supports this, namely Fiber to The Home (FTTH) [2]. FTTH is a new network concept that uses fiber optic cable as the delivery medium which has a large bandwidth so that it can provide telecommunications services more quickly and effectively. This is what gave rise to the transition from Cooper (copper) networks to fiber optics [3]. In designing this FTTH network, the author uses Metro Ethernet (ME), Optical Line Terminal (OLT) with the Internet as a transmitter source.

In FTTH optical network performance, one of the passive devices needed is an Optical Distribution Point (ODP). Use ODP as a termination point for fiber optic cables towards the customer's house and also as a distribution point into several fiber optic cable channels using a passive splitter. As time goes by and the increasing demand of citizens for internet services, sufficient and adequate devices are needed, one of which is ODP [7]. Over time, this will result in full ODP terminals or full terminals in the ODP [4]. In different conditions, home customers want to use fiber optic network services but the ODP distance to the customer's home is too far.

Installing an Optical Distribution Point (ODP) has 2 methods, first by picking one of the cores from the main distribution cable from the ODC which leads directly to the ODP and taking the cores in

sequence then inserting the cores into a passive splitter, the passive splitter used in the ODP is passive 1:8 [6]. The second method, namely branching, is a method of adding ODP by branching the main distribution cable. In other words, the main distribution cable will be branched due to customer needs [4]. Therefore, the author realizes that the need for internet services by the increasing number of people makes it necessary to expand the FTTH network [9]. Because 1 ODP uses a 1:8 passive splitter and can only accommodate a maximum of 8 customers. Therefore, it is necessary to build a new ODP.[9]

According to research [4] which discusses adding ODP using the branching method from the main ODP, this research only discusses adding ODP using the Branching method with a network path from the ODC to the ODP without activating the network so it cannot be accessed directly. directly by customers.

In this paper, we will discuss how to activate the FTTH network from the OLT ODC, ODP and ODP branching using the branching method to increase the number of user slots from the ODP to the customer's home ONT, so that it can be accessed directly by the customer. Then this research uses the link power budget calculation method [8] to find out whether the resulting attenuation is in accordance with the PT. Telekomunikasi ITU-T G.948 attenuation standard which is no more than -28dbB.[5].

2. Research Methodology

2.1 Research Flow

The following is the workflow for activating the ODP network using the branching method, as in Figure 1.

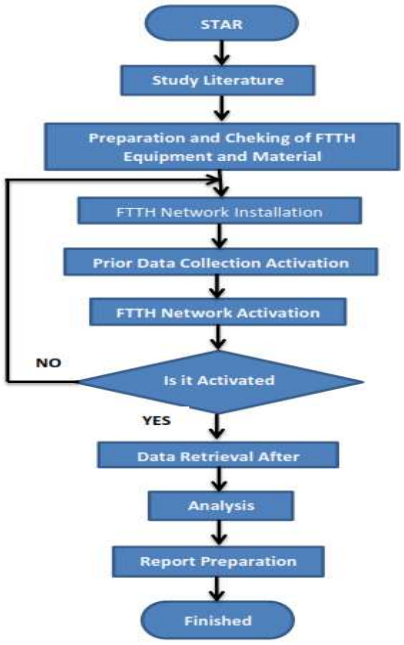

Figure 1. Research Flow Diagram

The FTTH block diagram that will be activated in this research is as shown in Figure 2.

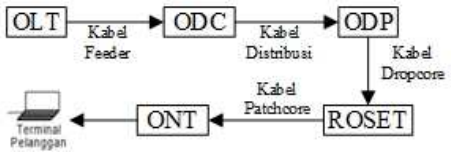

Figure 2. Diagram of FTTH Activation Steps

2.2 Activation Function

Activation of the FTTH network is carried out as in Figure 3.

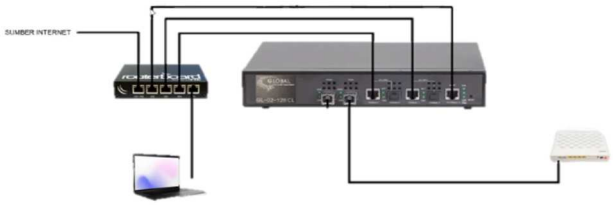

Figure 3. Device Port Path

In the activation process, port 1 on the proxy is connected to an internet source, port 2 of the proxy is connected to the MGMT port on the OLT, while port 3 of the proxy is connected to the UPLINK1 port on the OLT and port 5 on the proxy is connected to the desktop which is used to configure the proxy device as well as configure the OLT, then attach the SFP to the port on the OLT then connect it with a fiber cable to the FTTH network, at the end of the FTTH network attach the ONT using a patch core cable. The activation system uses the Winbox application to configure the Mikrotik, for the new Mikrotik it will be configured using the admin login and empty password then press connect.

2.3 Activation of Branching with Passive Splitter 1:4

The branching method for ODP is to produce a new ODP on the same aerial cable. In this research, the author used Solid Pole ODP as the main ODP and produced a new ODP branch, namely Closure Area ODP which was installed directly on the area cable. Then this branching is done by connecting the output

Passive splitter 1:8 with passive splitter 1:4 input in the ODP Closure Area using drop core cable and pigtail cable to connect the output of the passive splitter 1:8 and input to the passive splitter 1:4. Then, to be directly accessed by customers, activation is carried out using the internet as a Metro Ethernet (ME) and Optical Line Terminal (OLT) source so that it can be directly accessed by the customer's home using ONT.

2.4 Link Power Budget

$$\alpha Total = L.\ aserat + Nc\ .\ ac + Ns\ .\ as + \text{Na. aa} + Sp \quad (1)$$

Information:
L: Distance (Km)
$\alpha Total$: Total Attenuation (dB)
$aserat$: Optical Fiber Attenuation (dB/Km)
as: Connection Attenuation (dB/pc)
αc: Connector Attenuation (dB/pair)
αa: Adapter Attenuation (dB/pc)
Na: Number of Adapters
Nc: Number of Connectors
Ns: Number of Connections

Sp: Splitter Attenuation (dB)

The attenuation standards for each device to calculate the link power budget are shown in Table 1.

Table 1. Power Link Budget provisions

No	Description		Unit	Attenuation Standard (dB)	Volume	Total Attenuation (dB)
1	Cable FO		Km	0,35	17	5,95
2	Splitter	01:02	Pcs	3,7	-	-
		01:04	Pcs	7,25	1	7,25
		01:08	Pcs	10,38	1	10,38
		01:16	Pcs	14,1	-	-
		01:32	Pcs	17,45	-	-
3	Connector	SC/UPC	Pcs	0,25	5	1,25
		SC/APC*	Pcs	0,25	2	0,5
4	Connection	Di cable *Feeder*	Pcs	0,1	3	0,3
		Di cable Distribusi	Pcs	0,1	2	0,2
		Di *Drop Cable*	Pcs	0,1	2	0,2
	Total Pure Attenuation					26,03

3. Results and Discussion

Measurements in the FTTH network activation design where the measurement results obtained will be used to obtain link power budget measurement results and to ensure that the circuit created can run properly according to standards. Measurements were carried out on additional ODP or Branching ODP to see the effect of attenuation on the activation of the FTTH network to the customer's home after or before activation.

3.1. Branching Measurement Results Before Activation

The measurement results are carried out before the device is activated to see the power released without using branching or after using branching. The following are the results of data measurements before activation.

Table 2. Branching Before Activation

Input Power (dBm)	PRx Without Using Branching (dBm)	PRx Using PS 1:4 Branching (dBm)
-7,28	-29,65	-35,92

Measurements were carried out by branching before activation which resulted in additional ODP, namely ODP Closure Area using a 1:4 passive splitter and going directly to the ONT with a drop core cable at the customer's house. Then the damping calculation can be carried out as follows:

α = PRx – PTx

= -7.28 dBm – (-35.92)dBm

= 28.64 dB

3.2. Branching Measurement Results After Activation

The measurement results are carried out on the device after activation to see the output power released without using branching or after using branching. Following are the results of data measurements after activation.

Table 3. Branching After Activation

Input Power (dBm)	PRx Without Using Branching (dBm)	PRx Using PS 1:4 Branching (dBm)
7,98	-15,81	-20,47

In the branching method after activation, the power output by the ONT is measured at the customer's house with an additional ODP, namely ODP Closure Area of -20.47 dBm with SFP input on the OLT device. Then the attenuation calculation is carried out with the data taken as follows:

α = PTx – PRx

= 7.98 dBm – (-20.47) dBm

= 28.54 dB

3.3. Link Budget Calculation

After carrying out the attenuation calculation with a result of 28.54 dB, as a comparison, the link power budget (1) is also calculated as follows.

αTotal = . αfiber + Nc . αc + Ns . αs + Na . αa + (Sp1:4 + Sp1:8 + Sp1:4)

αTotal = (0.318 km . 0.35 dB/km) + (14 . 0.25 dB) + (4 . 0.1 dB) + (6 . 0.5 dB

+ (7.25 dB + 10.38 dB + 7.25dB)

αTotal = 0.1113 dB + 3.5 dB + 0.4 dB + 3 dB + 24.88 dB

αTotal = 31.89 dB

So the attenuation result is 28.54 dB and the link power budget is 31.89 dB, so the attenuation produced by the ODP Closure Area as a result of branching does not affect the network quality according to the established standards.

4. Conclusion

FTTH network activation starts from the OLT to the ONT in the fiber optic laboratory by carrying out configuration steps on the Mikrotik, OLT and ONT devices.

The branching method in the FTTH network is for adding users if the user has full ODP usage, because the attenuation produced before activation meets the requirements for activation and can access the internet network.

The branching method has good network performance for use on FTTH networks because the attenuation results produced by branching on FTTH network performance meet the standard of 28dB. So this branching method can be used on FTTH networks

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Acknowledgment

The author would like to express his thanks very much to Padang State Polytechnic, because of research has been funded by DIPA funds in 2023 with no Contract Number: 157 /PL9.15/PG/2023

References

[1] Aprinal A.A, Popy M, Yustini, Putri A.H "*Designing a Pigtail Type Single Mode Optical Cable Transmission Attenuation Measurement System*", Electron Scientific Journal Sinta 4 11 (Vol 2), 56-62

[2] K. Mardhatillah, A. A. Asril, Yustini and Yulindon, *"Analysis of Drop Core Cable Connection Losses on Optical Network Performance in Building G, 3rd Floor, Padang State Polytechnic*," Electrode Focus Journal, vol. 7(3), pp. 172 -177, 202

[3] *Designing a Fiber Access Network to the Home for Harmony Residence Jangli Housing Using the K-Means Clustering Algorithm.* TRANSIENTS, VOL. 8, NO. 2, JUNE 2019, e-ISSN:2685-0206, 8(2), 1–8. https://ejournal3.undip.ac.id/index.php/transient/article/download/23916/pdf.

[4] Afrie and Yuliarman. (2022). Olt1 Journal. 11(2), 156–161.

[5] Albar, R., & Rizki, Z. M. (2020). *Analysis of the Effect of Mechanical Splice Techniques and Fiber Optic Splice Fusion on Attenuation (dB) in Pt. Telkom Indonesia Regional I Witel – ACEH The Analysis Of The Effect Of Mechanical And Splice Engineering Splice Fusion Fiber Optic Against Attention (Db) At Pt. Telkom Indonesia Regional I Witel - Aceh*. 6(2), 74–79.

[6] Aulia, N., & Nurcahyani, I. (2017). *FTTH Design Using Ethernet Passive Optical Network (EPON) at the Network Layer on the Islamic University of Indonesia Campus*.

[7] Aulia, S., Fitri, S., & Asril, A. A. (2021). *Design and Measurement of Fiber Network Performance to the Home Using Gigabit Passive Optical Network Technology Using the Optisystem Application in Surau Gadang Subdistrict*. Amplifier Journal: Scientific Journal of Electrical and Computer Engineering, 11(2), 22–27. https://doi.org/10.33369/jamplifier.v11i2.19079

[8] Di, T., & Inti, P. T. (2017). *Design of a Fiber Access Network to the Home (Ftth) Using Gigabit-Capable Passive Optical Network (GPON) Technology in the Sarirasa 3 Area, Ledeng Subdistrict, Cicadap Sarijadi District, Bandung in the Project*. 3(2), 1075–1093.

[9] Dwi, W., Hafidudin, & Tatang, W. (2019). *At Royal Kopo Bandung Housing Design of Fiber To the Home Access Network Using*. 5(2), 1644–1660.

[10] Hanif, I., & Arnaldy, D. (2017). *Analysis of Connecting Access Fiber Optic Cables with Backbone Fiber Optic Cables in the Indosat Jabodetabek Area. Multinetics*, 3(2), 12.

[11] Ridho, S., Nur Aulia Yusuf, A., Syaniri, A., Nikken Sulastrie Sirin, D., & Apriono, C. (2020). *Fiber to the Home (FTTH) Network Design in Housing in Urban Areas.* National Journal of Electrical Engineering and Information Technology, 9(1), 94–103.

[12] Santosa, N. H., & F, Y. A. (2022). *Terminating and Splicing Fiber Optic Cables at Bts Sub376-Sancasubang*. 7(1), 33–41 https://doi.org/10.32897/infotronik.2022.7.1.1429

[13] Silalahi, Y. N. (2023). *Use of Fiber Optic Cables. Use of Fiber Optic Cables.*

[14] Syahputra, R. R., Bagaswara, M., & Santoso, D. B. (2021). *Analysis of Average Attenuation (Loss) in the Ftth Network in Btr Blok O Bekasi*. Power Electronics: Journal of Electrical Engineering, 10(2), 80. https://doi.org/10.30591/polektro.v10i2.2586

[15] Yuseliani, R. D. (2022). *Addition of an Optical Distribution Point (ODP) Using the Branching Method in the Design of the Fiber To The Home (FTTH) Network in Building G, 3rd Floor, Padang State Polytechnic.* Poly Engineering Scientific Journal, 17(2), 58. https://doi.org/10.30630/jipr.17.2.236

[16] Sudrajat, I., Huda, Y., & Faiza, D. (2018). *Analysis of Fiber Optic Attenuation on SKSO Performance Using the Link Power Budget Method* (case study on the Padang-Bukittinggi link at PT. Telkom Padang). VoteTEKNIKA: Vocational Journal of Electronics and Informatics Engineering, 2(2).

[17] Muliandhi, P., Faradiba, E. H., & Nugroho, B. A. (2020). *Analysis of FTTH Network Configuration*

withMini OLT Devices for Indihome Services at PT. Telkom Access Witel Semarang. Elektrika, 12(1), 7-14

[18] S. Khairunnisa, H. Octavia, V. Veronica and A. A. Asril, "*Design of a Transmission Attenuation Measurement System in Single Mode and Multi Mode Optical Cables Due to Bending with a Radius Factor Using OPM and OTDR Measuring Instruments*," Journal Poly Engineering Sciences, vol. 15(1), pp. 27-38, 2019

[19] Ketty Siti Salamah, Trie Maya Kadarina, and Zendi Ilmua, *"Introduction to Mit Inventor for Students in the North Development Region*," J. Abdi Masy., pp. 5–9, 2020.

[20] E. A. W. Sanad, "*Utilization of Realtime Database on the Firebase Platform in the Nabire Regency E-Tourism Application,*" J. Perelit. Enj., vol. 22, no. 1, pp. 20–26, 2019, doi: 10.25042/jpe.052018.04

[21] Electro..., p. 1–74, 2021, [Online]. Available at: https://escri.usm.ac.id/detail-C41A-549.html. [15]. R. R. Syahputra, M. Bagaswara, and D. B. Santoso, "*Average Attenuation (Loss) Analysis in the Ftth Network in Btr Block O Bekasi,*" Power Elektron. J. Electro People, vol. 10, no. 2, p 80, 2021, doi:10.30591/polektro.v10i2.2586