

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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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.

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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.

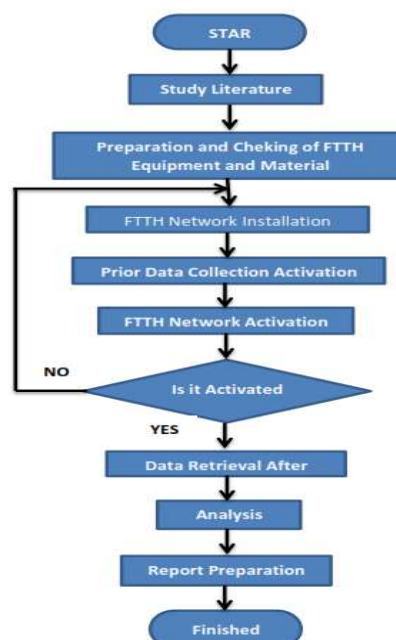


Figure 1. Research Flow Diagram

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

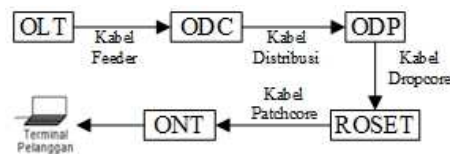


Figure 2. Diagram of FTTH Activation Steps

2.2 Activation Function

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

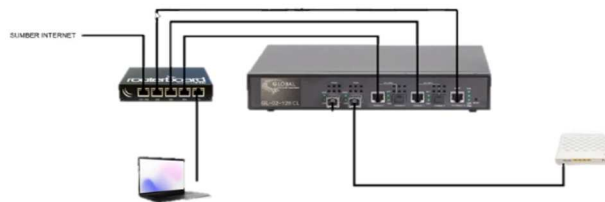


Figure 3. Device Port Path

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

$$\alpha_{Total} = L \cdot a_{serat} + N_c \cdot a_c + N_s \cdot a_s + N_a \cdot a_a + S_p \quad (1)$$

Information:

L : Distance (Km)

α_{Total} : Total Attenuation (dB)

a_{serat} : Optical Fiber Attenuation (dB/Km)

a_s : Connection Attenuation (dB/pc)

a_c : Connector Attenuation (dB/pair)

a_a : Adapter Attenuation (dB/pc)

N_a : Number of Adapters

N_c : 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
		01:08	Pcs	10,38	1
		01:16	Pcs	14,1	-
		01:32	Pcs	17,45	-
3	Connector	SC/UPC	Pcs	0,25	5
		SC/APC*	Pcs	0,25	2
		Di cable	Pcs	0,1	3
4	Connection	Feeder	Pcs	0,1	2
		Di cable Distribusi	Pcs	0,1	2
		Di Drop Cable	Pcs	0,1	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:

$$\begin{aligned}
 \alpha &= PRx - PTx \\
 &= -7.28 \text{ dBm} - (-35.92) \text{ dBm} \\
 &= 28.64 \text{ dB}
 \end{aligned}$$

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:

$$\begin{aligned}\alpha &= P_{Tx} - P_{Rx} \\ &= 7.98 \text{ dBm} - (-20.47) \text{ dBm} \\ &= 28.54 \text{ dB}\end{aligned}$$

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.

$$\begin{aligned}\alpha_{\text{Total}} &= . a_{\text{fiber}} + N_c . a_c + N_s . a_s + N_a . a_a + (S_{p1:4} + S_{p1:8} + S_{p1:4}) \\ \alpha_{\text{Total}} &= (0.318 \text{ km} . 0.35 \text{ dB/km}) + (14 . 0.25 \text{ dB}) + (4 . 0.1 \text{ dB}) + (6 . 0.5 \text{ dB} \\ &\quad + (7.25 \text{ dB} + 10.38 \text{ dB} + 7.25 \text{ dB})) \\ \alpha_{\text{Total}} &= 0.1113 \text{ dB} + 3.5 \text{ dB} + 0.4 \text{ dB} + 3 \text{ dB} + 24.88 \text{ dB} \\ \alpha_{\text{Total}} &= 31.89 \text{ dB}\end{aligned}$$

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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