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FTTH Network Disturbance Analysis Based on Attenuation and Reception Power on The Indihome Singkawang Network

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ABSTRACT

Optical fiber is a transmission medium that allows it to meet human needs to be able to transfer data faster because it uses light as a conductor. There is a damping problem in optical fiber, it needs to be accommodated so as to minimize the occurrence of attenuation in optical fiber. With this research, it can be known the magnitude of the value of a fiber optic transmission attenuation through the method of measuring attenuation values and receiving power at the customer's home using OPM, identifying fiber optic channel attenuation that affects the quality of internet services, and knowing the comparison of OPM measurement results with OT data reading. This study uses an analytical descriptive approach where the research will describe what it is about a variable that is processed, as well as the symptoms and conditions to be identified. So the results of the study can be obtained, namely, the amount of attenuation measured in the customer's home is influenced by the attenuation measured in ODP. Attenuation at ODP is small with an average optical power value of -18.39 dB, this makes attenuation in customers' homes, namely ONT, tend to be smaller with an average optical power value of -20.04 dB. There is an additional value of -1.65 dB per transmission. So it is known that the longer the cable used for fiber optic transmission, the greater the attenuation produced so that the optical power emitted by the sender will weaken along with the length of the cable. This is what will affect the quality of internet services.

1. INTRODUCTION

In this 21st century, the world of telecommunications has become an unavoidable need for the wider community, especially in the digital era that enters the Industrial Era 4.0. Thus, telecommunication services are increasingly required to be able to reach all corners of the world with maximum performance, efficiency, and the best possible [1]. This underlies several telecommunication service companies to compete to provide excellent service in the telecommunications sector. The need for telecommunication services continues to grow every year, ranging from voice, data, to video [2]. In order for these services to be enjoyed by people at home, telecommunication service providers offer Fiber To The Home (FTTH) services. FTTH is a telecommunications infrastructure that uses fiber optic technology from the center to the customer's home [3].

Although the attenuation owned by optical fiber is relatively small, it still has a significant impact so that it must still be considered and needs maintenance and countermeasures, because this attenuation can cause obstacles in fiber optic transmission so that data transmission becomes hampered and affects the quality of internet services [5]. With this damping problem, it needs to be accommodated so as to minimize the occurrence of attenuation in fiber optic transmission caused by such factors. In this case, it is necessary to conduct a study to find out the attenuation on fiber optic transmission lines that work along fiber optic cables [9],[12].

This research is expected to help identify problems that occur in the field in order to facilitate and accelerate the handling of damping problems in fiber optic transmission. In addition, it is hoped that this study can answer questions regarding the effect of attenuation value on internet service quality. Based on the problems and benefits to be obtained, this thesis discusses a topic regarding the analysis of FTTH network interference based on attenuation and acceptability on the Indihome Singkawang network, where the parameters that become references are connectors, extreme curves and the number of connections in the fiber optic channel.

2. THEORETICAL FOUNDATIONS

2.1 Fiber Optic Network System

Optical fiber is a very clear transparent material made of glass fiber material so that it can be used to transmit waves in the form of light as a medium of conveying information. Fiber optic cables are designed to meet human needs in communication, where the communication used is not only voice communication, but penetrates into data and video communication. All information sought must be able to be sent in the same media in the form of sound, images, video and data. It takes a reliable transmission medium with a large capacity to be able to pass through these various services. The use of fiber optic cable is a solution because the cable is able to pass large capacity data at high speed and has a large bandwidth. [11],[14]

The application of optical fiber is very suitable for backbone communication (long distance). However, currently the use of optical cables is not only for backbone needs, but also has reached the access side (end-user) commonly referred to as the Fiber Optic to The Home (FTTH) network, where the technology commonly used is Gigabit Passive Optical Network (GPON) which is the standard device used. [3],[7],[8],[10]

2.2 Fiber To The Home

The optical network is located inside the customer's house, the customer terminal is connected to the optical network through Indoor copper cable or IKR up to several tens of meters, FTTH can be analogous to the Terminal Block (TB). [6]

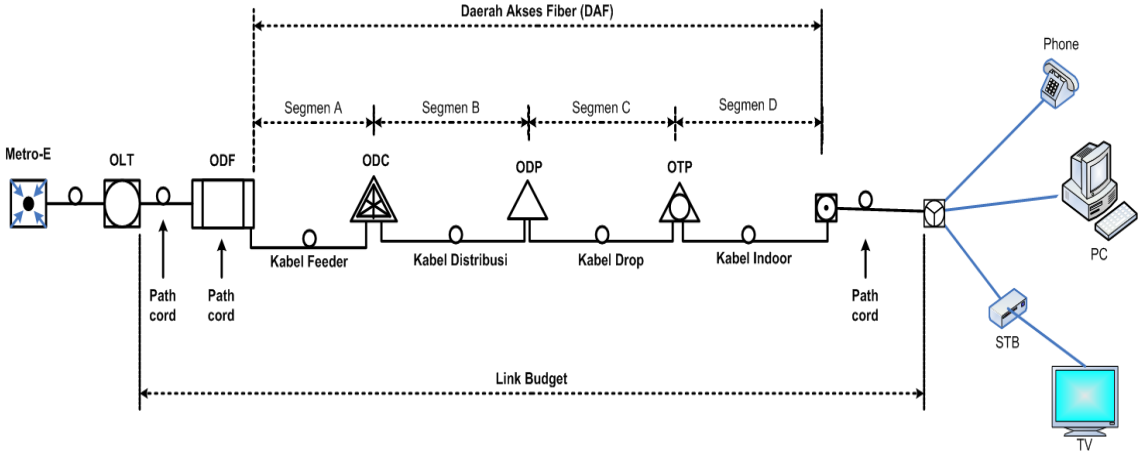

Figure 1. FTTH Network

FTTH is a network used by internet access service providers to channel internet access to residential or business premises, both single-unit occupancy and multi-unit occupancy such as apartments are counted as one place. On the FTTH network there are several terms that are often used, including:

1. Homes Passed

Homes passed is the number of potential homes or buildings where the telecommunications operator has the ability to connect the network to the area that wants the service.

2. Homes Connected

Homes connected is a network that is connected in several numbers of houses or buildings that are connected to the point of the customer's house.

3. Subscriber

A subscriber is a house or building connected to an FTTH network where the subscriber has access to services provided by the network service operator. [15]

2.3 Optical Distribution Point (ODP)

ODP is a device that functions as a cable termination as well as a place for distribution to several drop cables. It is in this ODP that the installation is carried out to distribute the network to homes. ODP is usually equipped with space for splicing as a place to connect, space for splitter as a place to distribute the network to customers, space for termination. [4]

Figure 2. Optical Distribution Point

The capacity of ODP varies according to needs, which are manufactured standardly, namely;

- Capacity 8 port
- Capacity 12 port
- Capacity 16 port
- Capacity 34 port
- Capacity 48 port

2.4 Optical Network Termination (ONT)

ONT is a device that provides an interface in the form of data, voice, and video that functions to receive traffic in optical format and then converted according to the desired form (data, voice and video). ONT can also be called a modem that functions as a device or device that connects network devices to internet services. [9]

2.5 Fiber Optic Transmission Loss

Loss in a fiber optic transmission system falls into the following 4 categories: [12], [13]

2.5.1 Material Losses

Material losses are basic losses that are common with optical fibers because they must occur along optical cables. Although the loss of this material is not large, it is only 3 dB per 1 kilometer or 0.003 dB per meter. The cause of this loss is absorption where impurities or impurity contained in the core material so that it will absorb part of the optical power that propagates into the fiber optic channel. Impurity occurs due to the manufacture of core materials with poor quality or uneven dough in making cores on optical fiber.

2.5.2 Bending Disadvantages

Bending losses occur when optical rays through a bent or curved fiber channel make optical reflections on fiber optic channels not occur perfectly. Power loss caused by indentation or bending in a series of short cables is much worse than all cables stretched 1 kilometer normally. Sharp indentations in optical fibers can cause serious power losses even under certain conditions can cause cores in optical fibers to break or break.

2.5.3 Splicing Losses

Connecting to fiber optic cables is common, related to distribution from ODP to drop cables or problems that arise along the path of the drop cable caused by indentation or bending that makes the cable break or break or other factors such as rat bites or being hit by tree branches. In fiber optic connection, the power loss produced is only 0.2 dB or about 1% of the total power. In the process of connecting fiber optic cables, it is necessary to be careful and disciplined at work. Related to the cores on optical fibers that are susceptible to contamination, dirt, and scratches during the connection process. This may affect the optical power transmitted.

2.5.4 Disadvantages of Connectors and Splitters

The connector is one of the devices on optical fiber that functions as a liaison between optical fibers and connecting optical fibers to other optical devices. In the use of connectors on optical fibers, there is a possibility for power losses in fiber optic transmission. This power loss is called insertion where losses occur when using connectors on optical fibers. Insertion loss values range from 0.2 – 0.5 dB per connector pair, but international standards allow insertion losses up to a maximum of 0.75 dB.

Splitter is a device that serves to share optical signal information and distribute it to customers' homes. The distribution capacity of the splitter varies from 1: 2, 1: 4, 1: 8, 1: 16, 1: 32 and 1: 64 and needs to be considered in using a splitter, considering that the attenuation of the splitter is quite large. Improper use of

splitters can affect the quality of optical power received by customers. The damping of each splitter can be seen in the table below:

Table 1. Damping Size of Splitter

Network elemen	Limitation	Size
Splitter 1:2	Max	3,70 dB
Splitter 1:4	Max	7,25 dB
Splitter 1:8	Max	10,38 dB
Splitter 1:16	Max	14,10 dB
Splitter 1:32	Max	17,45 dB

3. RESEARCH METHODOLOGY

To get a complete results with this research, there is some method that can be used, there are with literature study to get some references regarding theories that related to this research and experiment to get several data samples by direct measurement using some equipments. The equipments that been used to do the research, are:

3.1 Place and Time of Research

The location of data collection in this study was carried out at the home of Indihome customers in the Telkom Singkawang area who experienced interference with the internet network. This research was conducted from 22 August 2022 to 28 August 2022.

3.2 Tools and Materials

The tools used for data collection and work on this study include :

- Optical Power Meter (OPM) is used to measure power in optical signals.

Figure 3. Optical Power Meter

- Mobile phone used to collect data on ONT through IP address.
- Google Maps app to see the location of a customer's home.
- TimeStamp Camera app to collect evidence.
- Laptop as a data processing tool.

3.3 Research Methods

The following are the stages or methods carried out in the research in this final project:

3.3.1 Literature study

The literature study in this study was conducted to find and collect theories about optical fibers, optical fiber transmission, and methods in taking measurement data using OPM. Literature studies refer to books and journals, internet media, research that has been made before, and articles that can support this research.

3.3.2 Data Collection

The data collection carried out in this study is to obtain data in the form of optical power measurement results in OPM, customer optical power measurement using OPM and ONT reading data.

3.3.3 Consultation and Discussion

This research runs while conducting consultations and discussions about research that is being carried out to field technicians, Supervisors and lecturers, seniors and fellow students who help in maximizing the results of this research.

3.3.4 Analytical Descriptive

Analytical descriptive is a research method where research will describe what it is about a variable that is processed, as well as the symptoms and conditions to be identified.

3.3.5 Conclusion Drawing

In this study, conclusions are drawn from the final results of the research analysis that has been carried out.

4. RESULTS AND DISCUSSION

In this section, it is explained the results of research and at the same time is given the comprehensive discussion.

4.1 Transmission Power Measurement Data

Fiber optic transmission power measurement aims to determine the attenuation that occurs along the cable from ODP to the customer's home. Based on the results to be achieved, damping measurements are carried out on ODP and attenuation on the customer's house using an Optical Power Meter, to find out the attenuation along the cable, the measurements needed are optical power on ODP taken from the ODP splitter and optical power at the customer's home taken from the optical cable connected to the ONT and find out how long the cable connects between ODP to the customer's house and the number of connections that exist in the fiber optic cable. [12]

4.2 ONT Reading Data

Performing data retrieval through ONT reading aims to determine the input power (Tx) sent by the server and the output power (Rx) received by Customer as a reference for the accuracy of the measurement results made. By taking this data , it can be known whether the optical power sent by the server can be sent properly and how large the range of input power with power output. Based on the results to be achieved, ONT reading data is retrieved through the IP Address and user page login as shown in figure 4. [9]

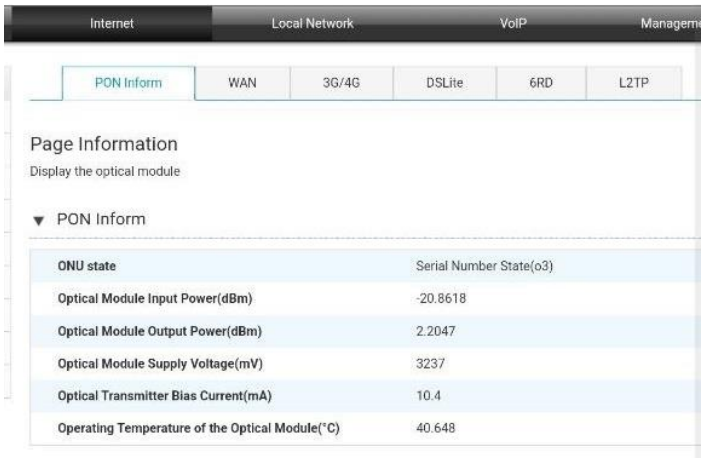

Figure 4. Fiber Optic Power Readings On ONT

From the two data collection techniques above, the results of the data capture that has been collected can be seen in table 2 which contains measurement data and ONT reading data on optical fibers.

Table 2. Measurement Data and ONT Reading Data

No	ODP	Address	Longitude	Latitude	Cable Length (m)	Lots of Splices	Optical Power Measurement			ONT Reading	
							ODP (dB)	Customer (dB)	Power Difference (dB)	Power Tx (dB)	Power Rx (dB)
1	ODP-SNW-FAC/084	Demang Akub Street	-0,94242	109,0099	150	2	-19,34	-20,93	1,59	2,2	-20,86

2	ODP-SNW-FX/157	Sungai Garam Hilir Street	-0,93640	108,9819	300	3	-16,72	-20,91	4,19	1,94	-20,46
3	ODP-SNW-FAC/069	Pramuka Street	-0,93214	109,0079	200	2	-17,63	-20,48	2,85	1,94	-20,45
4	ODP-SNW-FAE/018	Ko Pi San Street	-0,86353	108,9696	150	2	-17,78	-18,56	0,78	1,97	-18,79
5	ODP-SNW-FAF/010	Malindo Street	-0,86563	108,9172	150	2	-21,03	-22,16	1,13	2,01	-22,92
6	ODP-SNW-FAF/006	Pendidikan Street, Sedau	-0,86450	108,9180	250	2	-20,29	-22,99	2,7	2,01	-23,09
7	ODP-SNW-FK/120	Hermansyah Street	-0,90902	108,9852	100	2	-19,67	-21,14	1,47	2,36	-21,74
8	ODP-SNW-FAB/021	Semai Street	-0,94039	108,9838	50	2	-18,19	-19,53	1,34	2,28	-19,28
9	ODP-SNW-FS/088	Yohana Godang Street	-0,89490	108,9784	100	2	-18,09	-19,1	1,01	2,31	-17,09
10	ODP-SNW-FAC/029	Senen Street	-0,95882	109,0220	100	2	-17,47	-19,01	1,54	2,04	-17,07
11	ODP-SNW-FAB/022	Semai Street	-0,94095	108,9837	150	2	-16,79	-17,91	1,12	2,31	-17,87
12	ODP-SNW-FAC/080	STKIP Street	-0,94103	109,0175	200	2	-19,14	-20,8	1,66	2,01	-22,52
13	ODP-SNW-FAB/020	Semai Street	-0,94214	108,9872	250	2	-17,51	-18,4	0,89	2,34	-16,75
14	ODP-SNW-FV/162	Karya Street, Pasiran	-0,89340	108,9864	50	2	-18,05	-19,47	1,42	2,35	-16,98
15	ODP-SNW-FAC/087	Trisula Street	-0,94197	109,0079	100	2	-18,27	-19,23	0,96	2,19	-16,94

5. CONCLUSION

Provide a statement that what is expected, as stated in the "INTRODUCTION" section can ultimately result in "RESULTS AND DISCUSSION" section, so there is compatibility. Moreover, it can also be added the prospect of the development of research results and application prospects of further studies into the next (based on result and discussion).

Based on the results obtained from the measurements and analyzes that have been carried out, it can be concluded that the measurement of ODP optical power is smaller than the measured optical power in the customer's home due to attenuation that occurs along the fiber optic cable from ODP to ONT. Then there are four variables that affect the magnitude of a damping, namely, cable length, lots of splices, lots of connectors, and type of splitter used. Based on the results of processing measurement data, the factor that makes the optical power received by customers is small value, namely the optical power received by ODP is small with an average optical power value of -18.39 dB, this makes the optical power in the customer's home, namely ONT, tend to be smaller with an average optical power value of -20.04 dB. There is an additional value of -1.65 dB per transmission. And the customer's home ONT device receives a maximum power of 25 dB. If the receiving power is more than or equal to the maximum power that has been determined, there will be a failure in the connection, so that it cannot be used for internet.

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