Analysis of Implementation of Branching Method in ODP in Fiber to The Home using Optisystem Case Study PT. MGN CORP

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***Abstract*— Fiber to the Home (FTTH) deployment efficiency critically depends on the Optical Distribution Point (ODP) installation method. Traditional closure-based branching requires precise and labor-intensive fiber splicing. This study analyzes an alternative branching method implemented directly at the ODP using passive splitters and drop cables, eliminating the need for field splicing. The research, conducted as a case study at PT. MGN CORP and simulated in Optisystem, evaluates a cascaded splitter architecture: a 1:4 splitter output from the Optical Distribution Cabinet (ODC) is connected to a 1:8 splitter at the ODP. Two ODP types—Pedestal and Pole—were tested. Results show downstream attenuation values of 18.93 dB for the Pedestal ODP and 19.03 dB for the Pole ODP at the customer premises, both compliant with the ITU-T G.984 standard. The analysis confirms a direct correlation between the ODC-ODP distance and link attenuation. The proposed method simplifies field installation, reduces deployment time and skill dependency, and maintains requisite signal quality, offering a viable solution for scalable and cost-effective FTTH network rollout.**

***Keywords*— Branching Method, FTTH, Passive Optical Splitter, ODP, OptiSystem Simulation, Attenuation Measurement.**

I. INTRODUCTION

Fiber to the Home (FTTH) has emerged as a cornerstone of next-generation broadband infrastructure, offering ultra-high bandwidth, minimal signal loss, and exceptional reliability over long distances [1]. By deploying optical fiber directly to residential premises, FTTH enables seamless support for bandwidth-intensive applications such as 4K/8K video streaming, telemedicine, smart home ecosystems, and immersive virtual reality experiences—services that demand consistent, low-latency connectivity [2]. As digital transformation accelerates across Indonesia, FTTH deployment has become a strategic priority for telecommunications providers, including private enterprises like PT. MGN CORP [3].

A critical component in FTTH architecture is the Optical Distribution Point (ODP), which serves as a passive junction for distributing optical signals from the central office (or feeder segment) to multiple end-users [4]. The ODP facilitates network scalability and cost efficiency by enabling a single fiber trunk to serve numerous subscribers through optical splitters—a configuration commonly referred to as the branching method [5]. This topology is widely adopted in Gigabit Passive Optical Network (GPON) systems, where a 1×N or cascaded splitter architecture allows up to 64 users to share a single feeder fiber [6].

However, the branching method introduces inherent trade-offs in optical power budgeting. Each splitting stage incurs insertion loss, typically ranging from 3.5 dB (1×2) to over 21 dB (1×64), which directly affects the received power at the Optical Network Unit (ONU) [7]. Uneven splitter ratios, suboptimal fiber splicing, and excessive link length can further degrade signal integrity, potentially violating the ITU-T G.984 and G.987 standards that define acceptable power ranges (e.g., −8 dBm to −28 dBm for GPON downstream) [8]. In dense or geographically complex service areas, these limitations may result in service instability, intermittent connectivity, or complete link failure if not properly modeled during the design phase [9].

To address these challenges, network planners increasingly rely on photonic simulation tools such as OptiSystem to predict system performance before physical deployment [10]. OptiSystem enables precise modeling of optical components—including splitters, fibers, connectors, and transceivers—and allows engineers to evaluate key metrics such as total link loss, power distribution uniformity, chromatic dispersion, and signal-to-noise ratio (SNR) under various branching configurations [11]. This simulation-driven approach not only reduces field trial costs but also supports compliance verification against international FTTH standards [12].

In the context of PT. MGN CORP's FTTH rollout in urban Indonesia, optimizing the ODP branching strategy is essential to balance cost, coverage, and quality of service. Empirical validation through simulation ensures that passive optical network (PON) designs maintain sufficient power margins across all subscriber endpoints, even under worst-case splitting conditions [13]. Furthermore, comparing simulated results with manual link budget calculations and real-world measurements enhances the robustness of network validation [14].

Therefore, this study focuses on analyzing the impact of branching configurations at the ODP on overall FTTH performance using OptiSystem. The research evaluates critical parameters—including insertion loss, power distribution variance, and end-to-end attenuation—and assesses

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compliance with ITU-T GPON specifications. By doing so, it aims to provide actionable design guidelines for PT. MGN CORP and similar operators seeking to deploy scalable, high-performance FTTH networks in residential environments [15].

II. METHOD

A. Research Stages

In this research, a quantitative experimental research design is employed. Quantitative research is a scientific approach aimed at testing hypotheses or identifying cause-and-effect relationships between specific variables, using the collection of quantitative data through systematic observation and control of those variables.

The research design is created to provide a detailed outline of the research steps and data collection process for the study, leading to systematic testing to obtain orderly results. The research design to be used in the development of the system is illustrated in the image below:

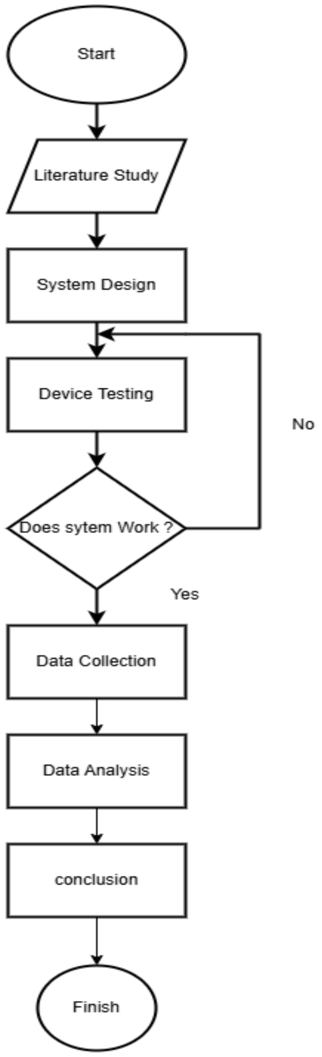

Figure 1. Flowchart of research stages

B. Equipment and Materials

The following is a list of tools and materials that will be used for data collection in the research, as shown in for hardware and software:

TABLE I
TABLE OF FTTH RESEARCH TOOLS AND EQUIPMENT

Name	Brand	Model / Series
OPM	Joinwit	JW3208
HLS	Joinwit	JW3109
Passive Splitter	Fiber Flash	SC/UPC 2.0 mm
Fiber Stripper	Joinwit	CFS-2
Fiber Cleaver	Skycom	T 208
Fiber Splicer	Skycom	T 208
Cutting Pliers	Monster	CFS-3
VLF	AMG	FP-LD
Sleeve Protection	–	–
ODP	Sentatle	Pole/Closure Area
ODC	PAZ	48 Core
Rosette (ROSET)	Telkom	–
ONT	ZTE	F906

In this research, there is a block diagram illustrating the working scheme of the ODP Pole solid system, shown in Fig. 3, and the working scheme of the ODP Pedestal system.

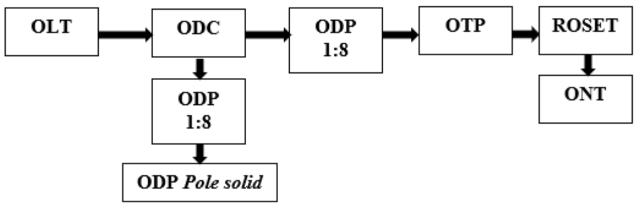

Figure 2. Working scheme of the ODP pole solid system

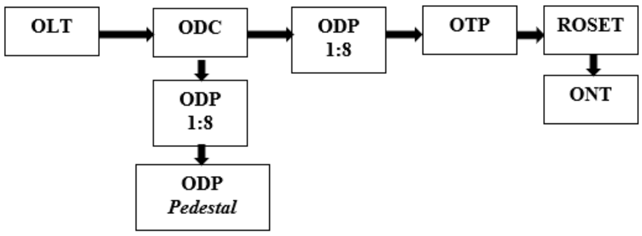

Figure 3. Working scheme of the ODP pedestal system

In this method, the researcher conducted the study using drop core cables for the branching of the Optical Distribution Point (ODP). The main ODP used is the ODP Pole Solid, which utilizes a passive splitter with a ratio of 1:8. The branching process is performed by connecting one of the output ports of the 1:4 passive splitter from the Optical Distribution Cabinet (ODC) to the input port of the 1:8 passive splitter on the new ODP, thereby creating a branching or addition of a new ODP

C. Testing Parameters

The parameters tested in the research on the testing of the Application of the Branching Method on ODP in Fiber To The Home Using OptiSystem are as follows:

1. Attenuation Value (dB)
2. Power Link Budget
3. Optical Power Meter

For this research, the testing will be conducted after obtaining the results of the attenuation measurement using two methods: one using an Optical Power Meter (OPM) and the other using results from simulations and manual calculations. These results will be compared with the cable length to observe the attenuation and power loss generated. Additionally, the study will examine whether the splitter has an influence on the output power to the customer's premises.

D. Link Power Budget

The calculation of the link power budget is performed to determine the allowable total attenuation between the transmitter output power and receiver sensitivity. The calculation is based on ITU-T G.984 standard and regulations implemented by PT. Telkom, with the constraint that the distance should not exceed 20 km, and the total attenuation should not exceed 28 dB or $P_r > -28$ dBm. The equation for total attenuation is as follows:

$$a_{tot} = L \cdot a_{serat} + N_C \cdot a_C + N_s \cdot a_s \cdot a_{sp} \qquad (1)$$

Description:
a_{tot} = Total attenuation (dB)
a_{serat} = Cable attenuation (dB/km)
L = Cable length (km)
N_c = Number of connectors (units)
a_c = Connector attenuation (dB)
N_s = Number of connections (units)
a_s = Connection attenuation (dB)
a_{sp} = Splitter attenuation (dB)

TABLE II
TABLE OF COMPONENTS OF TOTAL LINK ATTENUATION IN FTTH BRANCHING SYSTEM

Description	Unit	Standard Attenuation (dB)	Quantity	Total Attenuation (dB)
FO Cable	Km	0,35	17	5.95
Splitter 1:8	Bh	10,38	1	10.38
Splitter 1:4	Bh	7,25	1	7.25
SC/UPC Connector	Bh	0,25	6	0.5
Distribution Cable Splice	Bh	0,10	3	0.3
Dropcore Cable Splice	Bh	0,10	4	0.4
Total Attenuation				24.78

III. RESULTS AND DISCUSSION

The measurements are carried out on the ODP (Optical Distribution Point) and OTP (Optical Termination Point) or OTB (Optical Termination Box) to observe the values obtained in accordance with the ITU-T G.984 standard for total attenuation, which should not exceed 28dB. Measurements are conducted on the ODP to observe the impact of branching on the ODP, while on the OTP or OTB, the effect of branching on the power received by the customer's premises or total attenuation is examined.

A. Results of Measurement Results of ODP Pedestal Branching

The calculation of the optical fiber cable starts from the Optical Line Terminal (OLT) located at the Central Office (STO). It then connects to the Optical Distribution Cabinet (ODC) located at the site, followed by connecting to the ODP Pedestal situated at the ODP site, which is directly connected to the Optical Network Unit (ONU) installed at the user's FTTH network premises, where branching is implemented.

Figure 4. Fiber optic cable route from the ODP pedestal to the rustic market & café FTTH subscriber site

Calculation results on the Rustic Market & Cafe website using Optisystem.

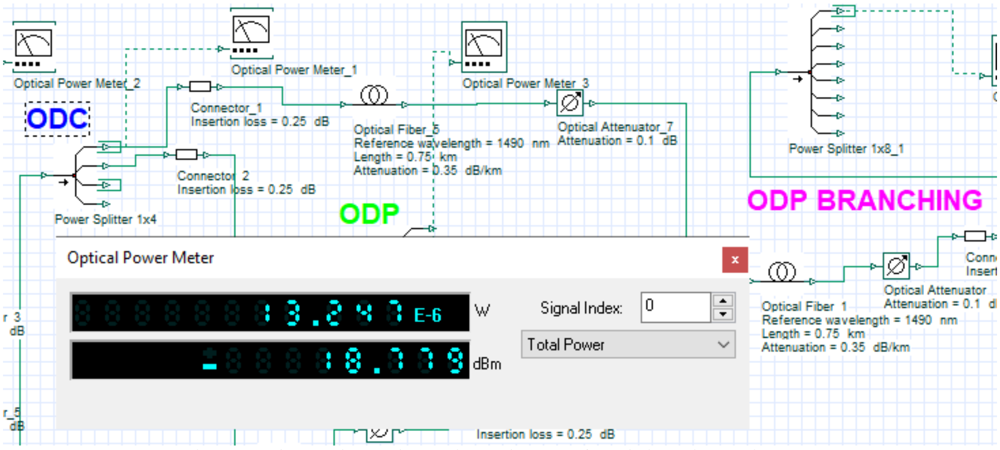

Figure 5. The results on the rustic market & cafe website using optisystem

Based on the measurement results displayed in the figure above, it is considered acceptable for use as the measured values do not exceed the maximum attenuation value as shown in Table III, where the maximum attenuation value is 19.68 dBm.

TABLE III
ATTENUATION CALCULATION FOR RUSTIC MARKET & CAFÉ SITE.

Attenuation Calculation for Rustic Market & Café Site			
OLT–ODC Cable Attenuation	Cable Length × OLT–ODC Cable Attenuation	3 km x 0.35 dB	1.05
ODC–ODP Cable Attenuation	Cable Length × ODC–ODP Cable Attenuation	0.8 km x 0.35 dB	0.28
ODP–ONU Cable Attenuation	Cable Length × ODP–ONU Cable Attenuation	0.07 km x 0.35 dB	0.02
ODC Splitter Attenuation	Standard attenuation of 1:4 splitter	7.25 dB	7.25
ODP Splitter Attenuation	Standard attenuation of 1:8 splitter	10.38 dB	10.38
Total Splice Attenuation	Number of splices × standard splice attenuation	0.10 dB x 7	0.7
TOTAL Branching Loss			**19.68 dB**

The attenuation obtained from the calculation is 19.68 dB, which complies with the ITU-T G.984 total attenuation standard of 15–28dB.

B. Results of Measurement Results of ODP Pole Solid Branching

The fiber optic cable calculation starts from the OLT located at the STO, then connects to the ODC at the site, continues to the ODP Pole Solid at the ODP site, and is directly connected to the ONU installed at the FTTH subscriber's house where branching is applied.

Figure 6. The fiber optic distribution route and ODP locations (ODP-KPO-FS/26 and ODP-KPO-FS/27) at the KPO-FS access segment

The calculation results at the D'Graha Artha Residential site using OptiSystem are shown in Fig. 7.

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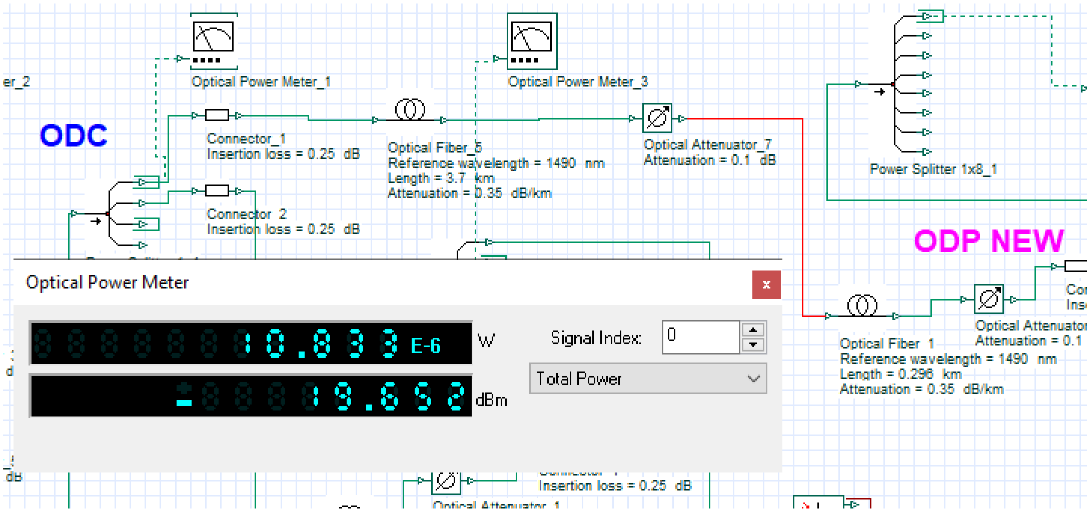

Figure 7. The results at the D'Graha artha residential site using optisystem

The measurement results displayed in the figure above indicate that the measured values are considered acceptable for use because they do not exceed the maximum attenuation value as shown in Table IV where the maximum attenuation value is 21.18 dBm.

TABLE IV
THE MAXIMUM ATTENUATION VALUE IS 19.68 DBM.

Attenuation Calculation for Rustic Market & Café Site			
OLT–ODC Cable Attenuation	Cable Length × OLT–ODC Cable Attenuation	3 km x 0.35 dB	1.05
ODC–ODP Cable Attenuation	Cable Length × ODC–ODP Cable Attenuation	0.8 km x 0.35 dB	0.28
ODP–ONU Cable Attenuation	Cable Length × ODP–ONU Cable Attenuation	0.07 km x 0.35 dB	0.02
ODC Splitter Attenuation	Standard attenuation of 1:4 splitter	7.25 dB	7.25
ODP Splitter Attenuation	Standard attenuation of 1:8 splitter	10.38 dB	10.38
Total Splice Attenuation	Number of splices × standard splice attenuation	0.10 dB x 7	0.7
TOTAL Branching Loss			**21.18 dB**

The attenuation obtained from the calculation is 21.18 dB, which complies with the ITU-T G.984 total attenuation standard of 15–28dB.

C. ODP Pole Solid Branching Measurement Results

Before branching with the drop core cable, the attenuation measurement will be conducted first on the ODP and ONT, as shown in Table V.

TABLE V
ODP-BLB-FBR/41 PORT ATTENUATION VALUES BEFORE BRANCHING

Unit	Port	Attenuation (dBm)
ODP	1	18.48

In Table V, it is known that before branching, the ODP and ONT devices have attenuation values that are still within the standard range.

Next, branching is performed on the ODC using drop core cable that leads to the ODP Pole Solid with a 1:8 splitter. Subsequently, measurements are conducted on the ODP and ONT to observe the attenuation resulting from the branching, as shown in Table VI.

TABLE VI
ODP-BLB-FBR/41 PORT ATTENUATION VALUES AFTER BRANCHING

Unit	Port	Attenuation (dBm)
ODP	1	18.48

As seen in Table VI, when branching is performed, both the ODP and ONT have attenuation values that are still within the standard range, indicating that the ODP Pole Solid is a suitable medium for branching.

TABLE VII
ODP-BLB-FBR/41 PORT ATTENUATION VALUES AFTER BRANCHING

ODC Site Name	ODP Site Name	Port	Attenuation Value (dBm)
ODC-BLB-FBR ODC-C-288	**ODP-BLB-FBR/41 RUSTIC CAFÉ AND MARKET**	1	-18.83 dBm
		2	-18.79 dBm
		3	-18.48 dBm
		4	-19.03 dBm
		5	-13.91 dBm
		6	-13.33 dBm
		7	-15.39 dBm
		8	-13.69 dBm

From the table VII, it is shown that the passive splitter used in the construction of the new ODP is a 1:8 passive splitter. A

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total of 8 ports were measured, and the measurement results from port 1 to 8 are presented in the table above. It is stated that the results passed or are deemed suitable for sale to new customers.

D. ODP Pedestal Branching Measurement Results

Before branching with the drop core cable, the attenuation measurement will be conducted first on the ODP and ONT, as shown in Table VIII.

TABLE VIII
ODP PEDESTAL ATTENUATION BEFORE BRANCHING

Unit	Port	Attenuation (dBm)
ODP	1	19.16

In Table VIII, it is known that before branching, the ODP and ONT devices have attenuation values that are still within the standard range.

Next, branching is performed on the ODC using drop core cable that leads to the ODP Pole Solid with a 1:8 splitter. Subsequently, measurements are conducted on the ODP and ONT to observe the attenuation resulting from the branching, as shown in Table VIII.

TABLE IX
ODP PEDESTAL ATTENUATION AFTER BRANCHING

Unit	Port	Attenuation (dBm)
ODP	1	18.38

TABLE X
ATTENUATION MEASUREMENT RESULTS AT ODP-KPO-FS/27 (JL. PERUM D'GRAHA ARTHA)

ODC Site Name	ODP Site Name	Port	Attenuation Value (dBm)
ODC-KPO-FS ODC-C-288 JL.RAYA KEPUHARJO	**ODP-KPO-FS/27(14) JL. PERUM D'GRAHA ARTHA**	1	-19.07 dBm
		2	-19.16 dBm
		3	-19.22 dBm
		4	-18.86 dBm
		5	-19.25 dBm
		6	-19.13 dBm
		7	-18.83 dBm
		8	-18.79 dBm

From the table X, it is shown that the passive splitter used in the construction of the new ODP is a 1:8 passive splitter, so a total of 8 ports were measured, and the measurement results from port 1 to 8 are presented in the table above. It is stated that the results passed or are deemed suitable for sale to new customers.

E. Link Power Budget

In this subsection, the Power Link Budget calculation will be discussed. This calculation serves as a determinant of whether a fiber optic communication system can function effectively or not. The Power Link Budget ensures that the receiver can receive the required optical signal power.

1. The results of the Total Fiber Optic Attenuation Calculation at the ODP using the manually calculated Power Link Budget for ODP Pole Solid.

a_{serat} = 0.35 dB/km
L = 0.3 km
N_c = 2 units
a_c = 0.25 dB
N_s = 2 units
a_s = 0.1 dB

$$a_{sp} = \frac{\text{Splitter 1:4 = 7,48 dB}}{\text{Splitter 1:8 = 10,38 dB}} + S_p = 17{,}86$$

$$a_{tot} = L \cdot a_{serat} + N_C \cdot a_C + N_s \cdot a_s + a_{sp}$$
$$= (0,3 * 0{,}35) + (2 * 0.25) + (2 * 0.1) * 17{,}86$$
$$= 0{,}105 + 0{,}5 + 0{,}2 + 17{,}86$$
$$= 18{,}66 \text{ dB}$$

The results of the calculation above get the same total loss value where the total loss value is 18.66 Db on the ODP Pole Solid.

2. Here are the results of the Total Fiber Optic Attenuation Calculation at the ODP using the manually calculated Power Link Budget for ODP Pedestal.

a_{serat} = 0.35 dB/km
L = 0.29 km
N_c = 2 units
a_c = 0.25 dB
N_s = 2 units
a_s = 0.1 dB

$$a_{sp} = \frac{\text{Splitter 1:4 = 7,48 dB}}{\text{Splitter 1:8 = 10,38 dB}} + Sp = 17{,}86$$

$$a_{tot} = L \cdot a_{serat} + N_C \cdot a_C + N_s \cdot a_s + a_{sp}$$
$$= (0,3 * 0{,}35) + (2 * 0.25) + (2 * 0.1) * 17{,}86$$
$$= 0{,}105 + 0{,}5 + 0{,}2 + 17{,}86$$
$$= 18{,}66 \text{ dB}$$

The results of the calculation above get the same total loss value where the total loss value is 18.66 Db on the ODP Pole Solid.

F. Data Comparison

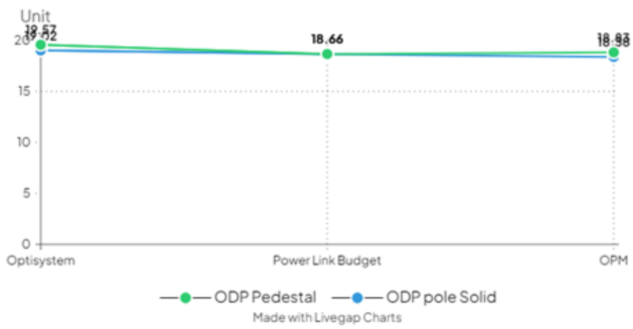

Figure 8. Data comparison

It can be concluded from the graph that the calculations and measurements for each ODP Pole Solid and ODP Pedestal have values that are very close to the calculations and simulations performed.

It can be concluded from the graph that the calculations and measurements for each ODP Pole Solid and ODP Pedestal have values that are almost the same as the calculations and simulations performed.

G. Branching Result Analysis

Using the Branching Method in expanding the Distribution Network is very useful and here are some of the benefits of the Branching method in expanding the Distribution Network.

- In terms of time, where the time spent in work time can be said to be fast, in this case it can be said that work using methods really saves time.
- In terms of materials, the material used in this work requires material that is slightly visible from the need for cables and pole accessories needed not so much.
- In terms of neatness, using this method can be considered to reduce the occurrence of a lot of cable overlap in one Telkom pole.
- From the results of measurements via OPM and OptiSystem, there is an equation where the farther the distance, the higher or worse the attenuation value and the transition from a 1:4 passive splitter to a 1:8 passive splitter experiences such a large change in the attenuation value, this happens because the attenuation value on passive 1:4 is -7.25 dBm and passive 1:8 has a damping value of -10.38 dBm, this is what causes the change in the attenuation value on the Optical Fiber.
- From the measurement results via the OPM it is stated that it is feasible, this is because the attenuation value displayed on the OPM does not exceed or exceed the maximum total attenuation value

III. CONCLUSION

Based on the research conducted at the Kayangan STO Senggigi location regarding the design of the distribution network expansion using Optical Distribution Point (ODP) branching and FO analysis, it can be concluded that the network expansion design requires a cable length of 296 meters for the construction of a new ODP, with a distance of 1.9 km from the ODC to the ODP. The power source for the new ODP construction is taken from an existing ODP. The technical data for the core used in this ODP branching indicates distribution to 4 points. By using the ODP Branching Technique, time and the amount of material needed for the project can be saved or reduced significantly. The simulation results using OptiSystem for the new ODP show a received power (Pr) value of -19.02 dBm, while the calculation results using Power Link Budget (PLB) yield a total received power value (Pr) of -18.66 dBm, and the measurement result using OPM (Pr) is -18.38 dBm (as a sample).

The measurement and calculation results show a correlation where the further the distance between the ODC and ODP, the greater the received power or attenuation value. In this research, data collection from various locations and geographical areas is necessary to enable result comparison. Additionally, a comprehensive total attenuation measurement will be performed. Moreover, new methods will be added to support the Fiber Optic calculations to achieve more optimal results.

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