

The Implementation of Dispersion Effect on Rise Time Budget and Power Link Budget on Optical Links at PT Telkom Akses Rungkut Surabaya Website Based

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Abstract— Along with the development of an increasingly rapid era, it is directly proportional to the development of technology. Optical fiber is a transmission medium used in telecommunications. The quality of information transmissions through this cable transmission medium is influenced by a number of variables, including attenuation and dispersion. The rising time budget value is determined by the dispersion, and the power link budget is determined by measuring the attenuation that influences the light's path during data transmission and causes dispersion. The results showed that the chromatic dispersion value of the measurement results on this optical link was influenced by bending, the length of the distance on the path, the splicing of optical fibers, and due to the deployment of optical fibers. The system still performs at the required levels, i.e., at a power link budget of less than -15 dBm and a rise time budget of less than 70 ps, hence the optical link results have no impact on the system's performance. The results of the implementation of the website in this study display the results of measurements and calculations that were previously carried out where the results of these measurements and calculations can be seen in a table that has been integrated between databases to store data values with an online map which is then displayed the value on the map or online maps on the website containing data from the measurement results and parameter calculations on optical fiber owned by PT. Telkom Access.

Keywords— Dispersion, Power Link Budget, Rise Time Budget, Optical Link, Website Based.

I. INTRODUCTION

Along with the development of an increasingly rapid era is directly proportional to the development of technology. To meet the increasingly diverse human needs, innovations in certain fields were born. As in the telecommunications sector, innovation in transmission media is the path used to transmit data or information from one place to another. Optical fibers are generally made of glass fibers where the light is difficult to get out because the refractive index of glass is greater than the refractive index of air. Optical fiber uses light to transmit data or information to get to its destination which can transmit light signals from one place to another up to a distance of 100 km and in transmitting data up to 1 Gbps. This cable is immune to interference (electricity) because optical fiber is not affected by electromagnetic and radio signals because it does not use electricity but uses plastic and light which is smaller, lighter, and cheaper than metal cables of the same capacity [1].

Dispersion is one of the factors that affect the performance of data transmission on fiber optic cables where the dispersion or spread of light will affect the quality of data transmission on optical fiber. This dispersion will cause the widening of the transmitted pulses at the end of the optical fiber. If the value of this dispersion is getting bigger it will make the quality of this optical signal transmission decrease. From this dispersion, a

rise time budget value will be obtained to determine the maximum limit of dispersion on optical fiber, then this power link budget is obtained from measurements which include attenuation or loss in fiber optic cables caused by connection loss or cable bending which can affect the path of the path. light at the time of data transmission which will result in dispersion. From these two parameters, it will be seen how the quality of data transmission on fiber optic cable before the optical path is filled by customers at PT Telkom Access Rungkut Surabaya. From the parameter data that has previously been obtained either through measurements or calculations, then the data is entered and displayed in a website-based application that will display the feasibility status of the quality of data transmission on the optical link path. In addition, the data from these parameters are entered into a database which is used to store the value of the data for these parameters and this will be displayed in an online map that has been integrated with the database used.

A. Optical Fiber

Optical fiber is a transmission medium that transmits data by converting electrical signals into light up to 50 kilometers without the need for a device to amplify the signal[2]. This fiber optic cable is made of glass fiber and also smooth plastic,

which is usually approximately 120 micrometers in size and in use is not susceptible to interference or interference. The material is made of silica glass which has clarity and high purity. And the shape is like a glass thread or string and in the form of a wave roof[3]. The basic concept used in its manufacture is the law of ordinary optics, on the basis that light can be sent through a certain medium [4].

The optical fiber is often seen as a perfect transmission medium with almost limitless bandwidth [5]. But in practice the propagation through optical fiber is affected with several limitations especially as distance is increased to multi-span amplified systems[6]. In fiber-optic communication lines (FOCL) with a single-mode optical fiber there are a number of factor that limit the speed of its transmission are considered [7] such as attenuation, chromatic an polarization mode dispersion and non-linear effects.

B. Dispersion in Optical Fiber

Dispersion is the broadening of a signal's pulses during transmission through an optical fiber; if this widening is excessive, it will be difficult to tell apart nearby pulses[8]. Dispersion occurs due to distortion in the form of widening pulses that propagate in the optical fiber. This widening will increase if the distance traveled is longer where previously each pulse that was narrow in shape would widen after traveling a certain distance where there could be a dilation that was too large so that adjacent pulses could no longer be distinguished from one another. Chromatic dispersion is caused by a light source that is not monochromatic (not single-frequency), therefore there are several frequencies that form a spectrum of $\Delta\lambda$ and have a center frequency with a wavelength of λ . To calculate the value of chromatic dispersion can be calculated using the formula:

$$D(\lambda) = \frac{S_0}{4} \left[\lambda - \frac{\lambda_0^4}{\lambda^3} \right] \quad (1)$$

Explanation:

$D(\lambda)$ = Chromatic dispersion at λ (ps/km.nm)

λ = Wavelength (nm)

λ_0 = Value of λ at the time of dispersion = 0 (nm)

S_0 = Value of Slope at the time of dispersion = 0 (ps/km.nm)

Then the formula for the total dispersion value is as follows:

$$D_t = D(\lambda) \times \sigma_\lambda \times L \quad (2)$$

Explanation:

D_t = Total Chromatic Dispersion (ps)

$D(\lambda)$ = Chromatic Dispersion Coefficient

σ_λ = Laser Spectral Width (nm)

L = Distance (km)

C. Rise Time Budget

Rise Time Budget is a method for determining the maximum dispersion limit on a transmission line, where the purpose of this calculation is to determine the maximum dispersion limit and analyze the overall system performance and fulfill the desired channel capacity. The goal of the rise time budget is to

guarantee that the transmission system can deliver enough bandwidth at the required bit rate[9]. The calculation of the Rise Time Budget is as follows:

$$t_{\text{sis}} = \sqrt{t_{\text{tx}}^2 + t_{\text{rx}}^2 + D_t^2} \quad (3)$$

Explanation:

t_{sis} = Rise Time Budget (ns)

t_{tx} = Rise Time Transmitter (ns)

t_{rx} = Rise Time Receiver (ns)

D_t = Total Chromatic Dispersion (ps)

D. Power Link Budget

Power Link Budget is a power calculation performed on a transmission system based on the characteristics of the optical fiber attenuation channel, optical source, and detector sensitivity. The calculation of the receiving power is formulated as follows in the equation:

$$\text{Loss Fiber } (L_f) = \alpha_f = L \times L_f \quad (4)$$

$$\text{Loss Splice } (L_s) = \alpha_s = N \times N_s \quad (5)$$

$$\text{Loss Connector } (L_c) = \alpha_c = N_c \times L_c \quad (6)$$

The calculation of the Power Link Budget is as follows:

$$P_r = P_t - \alpha_f - \alpha_s - \alpha_c \quad (7)$$

E. PHP

PHP is PHP (Hypertext Preprocessor) is a server-based web programming language (slide server) that is able to parse PHP code from code with PHP extensions so as to produce a dynamic website display on the client-side [10]. PHP is widely used for handling the creation and development of a website and can be used in conjunction with HTML.

F. MySQL

MySQL (My Structured Query Language) is database software, which is a relational data type, which means that MySQL stores its data in the form of interconnected tables [11]. MySQL is a database management system that uses the SQL language as a liaison language between the application software and the database server.

II. METHOD

A. Research Design

The research design in this paper is shown in Fig. 1. The beginning research started with data collection conducted at OTB (Optical Termination Block) at PT Telkom Access. In conducting data collection, the first thing to do is to connect the G.655 series optical fiber to the JDSU MTS 8000 where the other end is connected to the OTB (Optical Termination Block). Then measurements are taken from the OTB (Optical Termination Block) by taking the optical link path from 5 points, including Rungkut – Kebalen, Rungkut – Injoko, Rungkut – Dermo, Rungkut – Jagir, and Rungkut – Waru. The

data is displayed according to the graph that would appear on the JDSU MTS 8000. From this optical link path, the research parameters were recorded, including chromatic dispersion, and losses in fiber optic cables.

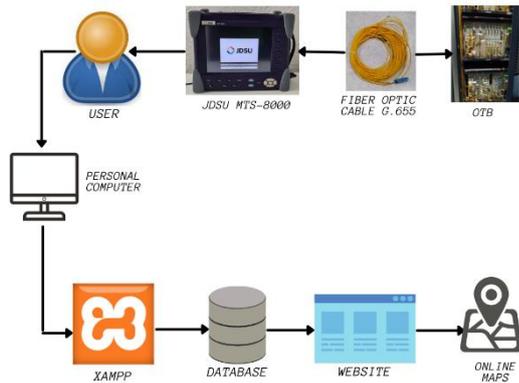


Figure 1. Block Diagram

From these data, calculations are then carried out using the formulas for the rise time budget and power link budget where the power link budget was previously calculated from the losses that occurred in the optical fiber, namely fiber losses, splicing losses, and connector losses. The data that was previously displayed on the JDSU MTS 8000 is then saved in the form of a file on the laptop as well as the data calculated through the formula. The data is then stored in a database which is then integrated with a website to display the results of the data that has previously been stored in a database. The data that has been stored in a database that is displayed on this website is integrated with an online map which is then used to display data from measurements and calculations carried out at PT. Telkom Access Rungkut Surabaya.

B. Fiber Optic Network Measurement Line

The measurement path in this research is the optical route in the Surabaya area with the links Rungkut – Kebalen, Rungkut – Injoko, Rungkut – Dermo, Rungkut – Jagir, and Rungkut – Waru. This measurement uses the JDSU MTS-8000 OTDR tool where this tool is made of anti-static packaging to connect the module to the base unit point-to-point.

C. Analysis Techniques or Data Processing

A simple regression analysis test is only used for one independent variable and one dependent variable. The purpose of this test is to predict or predict the value of the dependent variable which is influenced by the independent variable [12]. Hypotheses tested:

H₀: there is no effect between chromatic dispersion on the total dispersion on the rise time budget and fiber loss on the power link budget.

H₁: there is an effect between chromatic dispersion on the total dispersion on the rise time budget and fiber loss on the power link budget.

To determine the simple linear regression equation, the following formula is used [13]:

$$Y = a + bX \tag{8}$$

$$a = \frac{(\sum Y_i)(\sum X_i)^2 - (\sum X_i)(\sum X_i Y_i)}{n\sum X_i^2 - (\sum X_i)^2} \tag{9}$$

$$b = \frac{n(\sum X_i Y_i) - (\sum X_i)(\sum Y_i)}{n\sum X_i - (\sum X_i)^2} \tag{10}$$

Explanation:

Y = dependent variable

X = independent variable

a = regression constant

b = regression coefficient

n = amount of data

Y_i = the results of the observations on the i-th trial

X_i = a constant whose value is known, i.e. the level of the variable X in the i-th experiment

Meanwhile, for manual calculation of the effect of variable X on variable Y, the formula r product moment [14] is used:

$$r_{XY} = \frac{n(\sum X_i Y_i) - (\sum X_i)(\sum Y_i)}{\sqrt{[n\sum X_i^2 - (\sum X_i)^2][\sum Y_i^2 - (\sum Y_i)^2]}} \tag{11}$$

D. Web Planning Flowchart

The process of planning the creation of a website application system is carried out in several stages as shown in Fig. 2.

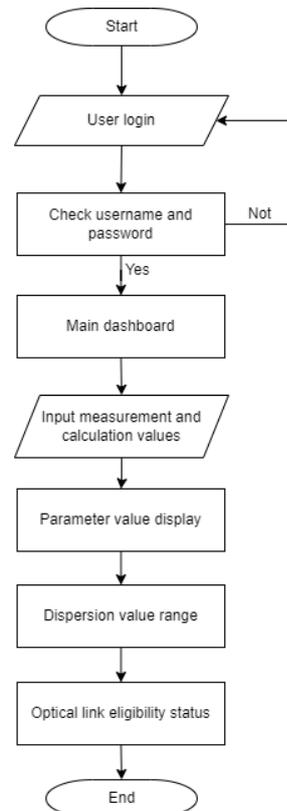


Figure 2. Web Planning Flowchart.

Before entering the web application, the user will be directed to log in first. There is a process for checking the username and password of the user that is used to secure the data in the web application. After the user has logged in, he will be directed to the main dashboard on the web application which contains a menu to enter data that has been previously measured and calculated, display data on the optical link path, and the percentage comparison of measurement values and calculations. After measuring and calculating the optical link path, then the results of the measurements and calculations of these parameters are entered into the website application. Then the results will be displayed on the application website where it will be sorted based on the parameters on the optical link path. Furthermore, it can be seen the feasibility status of the optical link when the values of several parameters such as the power link budget and rise time budget are compared with the standard KPI at PT. Telkom Access.

E. Data Collection Techniques and Instruments

Data collection was carried out at PT. Telkom Access Rungkut Surabaya by using OTDR JDSU MTS-800. Patchcord will transmit the information which will then be seen through the OTDR JDSU MTS-8000. Collecting data from this study using notes in tables and attachments in the form of photos. The instrument used in this research is the OTDR JDSU MTS-8000.

F. Calculation of Power Link Budget, Chromatic Dispersion, and Rise Time Budget

Calculations on the Rungkut – Kebalen optical link.

$$\begin{aligned} \text{Loss Fiber (L}_f\text{): } \alpha_f &= L \times L_f \\ &= 19,007 \times 0,174 \\ &= 3,307 \text{ dB} \end{aligned}$$

$$\begin{aligned} \text{Loss Splice (L}_s\text{): } \alpha_s &= N_s \times L_s \\ &= 2 \times 0,124 \\ &= 0,248 \text{ dB} \end{aligned}$$

$$\begin{aligned} \text{Loss Connector (L}_c\text{): } \alpha_c &= N_c \times L_c \\ &= 2 \times 0,5 \\ &= 1 \text{ dB} \end{aligned}$$

$$\begin{aligned} \text{Power Link Budget: } P_r &= P_t - \alpha_f - \alpha_s - \alpha_c \\ &= 14,7 \text{ (dBm)} - 3,307 - 0,248 - 1 \\ &= 10,145 \text{ dBm} \end{aligned}$$

Calculation of chromatic dispersion on the Rungkut – Kebalen link path.

$$\begin{aligned} D(\lambda) &= \frac{s_0}{4} \left[\lambda - \frac{\lambda_0^4}{\lambda^3} \right] \\ &= \frac{0,072}{4} \left[1550 - \frac{1482^4}{1550^3} \right] \\ &= 0,018 [1550 - 1295,381588] \\ &= 4,583131407 \text{ ps/km.nm}^2 \end{aligned}$$

Calculation of total dispersion on the Rungkut – Kebalen link.

$$\begin{aligned} D_t &= D(\lambda) \times \sigma_\lambda \times L \\ D_t &= 4,583131407 \times 0,1 \times 19,007 \\ D_t &= 8,711157865 \text{ ps} \end{aligned}$$

Calculation of the rise time budget of Rungkut – Kebalen

$$\begin{aligned} t_{\text{sist}} &= \sqrt{t_{tx}^2 + t_{rx}^2 + D_t^2} \\ &= \sqrt{3,5^2 + 3,5^2 + 8,711157865^2} \\ &= \sqrt{100,3842713} \\ &= 10,01919514 \text{ ps} \end{aligned}$$

III. RESULTS AND DISCUSSION

In this study, the length of the G.655 optical fiber was measured using the OTDR on the JDSU MTS-8000 tool at PT. Telkom Access Rungkut Surabaya. From the data from the calculation of the power link budget on the 5 optical link paths, namely the Rungkut – Kebalen, Rungkut – Injoko, Rungkut – Dermo, Rungkut – Jagir, and Rungkut – Kebalen links, this link still meets the eligibility requirements for the optical fiber used by PT. Telkom Access because the value does not exceed the receiving power level, namely -15 dBm which is in accordance with the KPI (Key Performance Indicator) standard at PT. Telkom Access.

From the data from the calculation and measurement of chromatic dispersion, there are significant differences in values that can be caused by several factors when measuring using JDSU MTS 8000, namely due to bending, due to fiber optic splicing, and due to fiber optic deployment. Distance also affects the value of chromatic dispersion, the farther the distance from the optical fiber, the smaller the value of chromatic dispersion.

Then from the calculation of the rise time budget, it can be seen that the rise time budget does not exceed 70 ps which is still in accordance with the KPI (Key Performance Indicator) standard so it meets the requirements for the feasibility of optical fiber used by PT. Telkom Access and its value is still within normal limits and does not interfere with system performance on fiber optics.

A. The Effect of Chromatic Dispersion on the Total Dispersion on the Rise Time Budget

1) Simple Regression Analysis Test

TABLE I
SIMPLE REGRESSION ANALYSIS TEST DATA

Path	Chromatic Dispersion (X)	Total Dispersion (Y)
Rungkut – Kebalen (1550 nm)	4,409	8,3801
Rungkut – Kebalen (1490 nm)	0,568	1,0795
Rungkut – Injoko (1550 nm)	4,149	2,1155
Rungkut – Injoko (1490 nm)	5,886	3,0012
Rungkut – Dermo (1550 nm)	4,460	4,3841
Rungkut – Dermo (1490 nm)	1,240	1,2189
Rungkut – Jagir (1550 nm)	6,357	2,7741
Rungkut – Jagir (1490 nm)	3,370	1,4706
Rungkut – Waru (1550 nm)	7,822	7,5294
Rungkut – Waru (1490 nm)	1,998	1,9232

The regression coefficient b is determined using the given formula, namely:

$$b = \frac{n(\sum X_i Y_i) - (\sum X_i)(\sum Y_i)}{n\sum X_i - (\sum X_i)^2}$$

$$\begin{aligned}
 &= \frac{10(86,83983) - (20,787)(14,9162)}{10(118,4816) - (20,787)^2} \\
 &= \frac{868,3983 - 310,0630494}{1184,816 - 432,099369} \\
 &= \frac{558,3352506}{752,716631} \\
 &\cong 0,7417602157 \approx 0,742
 \end{aligned}$$

TABLE II
MANUAL CALCULATION DATA FOR SIMPLE REGRESSION ANALYSIS TEST

No	X	X ²	Y	Y ²	XY
1	4,409	19,43928	8,3801	70,22608	36,94786
2	0,568	0,322624	1,0795	1,16532	0,613156
3	4,149	17,2142	2,1155	4,47534	8,77721
4	5,886	34,645	3,0012	9,007201	17,66506
5	4,46	19,8916	4,3841	19,22033	19,55309
6	1,24	1,5376	1,2189	1,485717	1,511436
7	6,357	40,41145	2,7741	7,695631	17,63495
8	3,37	11,3569	1,4706	2,162664	4,955922
9	7,822	61,18368	7,5294	56,69186	58,89497
10	1,998	3,992004	1,9232	3,698698	3,842554
Σ	20,787	118,4816	14,9162	71,73457	86,83983

The constant a is determined using the formula:

$$\begin{aligned}
 a &= \frac{(\Sigma Y_i)(\Sigma X_i)^2 - (\Sigma X_i)(\Sigma X_i Y_i)}{n \Sigma X_i^2 - (\Sigma X_i)^2} \\
 &= \frac{(14,9162)(118,4816) - (20,787)(86,83983)}{10(118,4816) - (20,787)^2} \\
 &= \frac{1767,295242 - 1805,139546}{1184,816 - 432,099369} \\
 &= \frac{-37,84430429}{752,716631} \\
 &\cong -0,05027696 \approx -0,050
 \end{aligned}$$

So the simple regression equation is $Y = -0,50 + 0,742 X$

2) Correlation Coefficient (r)

This is used to measure the influence of the variable X on the variable Y, where the correlation analysis results are expressed by a number called the correlation coefficient.

$$\begin{aligned}
 r &= \frac{n(\Sigma X_i Y_i) - (\Sigma X_i)(\Sigma Y_i)}{\sqrt{[n \Sigma X_i^2 - (\Sigma X_i)^2][\Sigma Y_i^2 - (\Sigma Y_i)^2]}} \\
 &= \frac{10(86,83983) - (20,787)(14,9162)}{\sqrt{[10(118,4816) - (20,787)^2][10(71,73457) - (14,9162)^2]}} \\
 &= \frac{558,3352506}{610,3145421} \cong 0,914832 \approx 0,915
 \end{aligned}$$

Based on the calculation, it can be seen that the correlation or influence value shown by r is 0.915. According to Sugiyono guidelines for providing an interpretation of the correlation coefficient [14]. It was found that the relationship between chromatic dispersion and total dispersion on the rise time budget was very strong.

3) Coefficient of Determination (r²)

$$r = (0,914832)^2 = 0,8369175 \approx 0,837$$

This is used the value of R Square (r²) = 0.837 which is obtained shows the value of the coefficient of determination which implies that the effect of chromatic dispersion on the total dispersion on the rise time budget is 83.7%, while the remaining 16.6% is influenced by other variables.

After getting the coefficient of determination, then a significant test of the proposed hypothesis is carried out using the t-test, where the hypotheses are tested:

H₀ : β = 0; There is no significant effect between chromatic dispersion on the total dispersion on the rise time budget

H₁ : β ≠ 0; There is a significant effect of chromatic dispersion on the total dispersion on the rise time budget

The level of significance, α which is often used is α = 5% (α = 0,05)

$$\text{The value of t count, } t = t = \frac{r\sqrt{n-2}}{\sqrt{1-r^2}} = \frac{0,915\sqrt{10-2}}{\sqrt{1-0,837}} = \frac{2,588}{0,403} = 6,421; \text{ so t count} = 6,421$$

Degree of freedom, df = n - k = 10 - 2 = 8

By using the t-test table for the significant level α = 5% = 0,05 and df = 8, then the value of t in the table is obtained, namely: t tab = 2,306

Based on manual calculations obtained the value of t count = 6,421. While the value of t table for α = 0,05 and df = 8 is 2,306. Because the value of t_{count} = 6,421 > t_{table} = 2,306, then H₀ is rejected. So it can be concluded that there is a significant effect of chromatic dispersion on the total dispersion on the rise time budget.

B. The Effect of Chromatic Dispersion on the Fiber Loss on the Power Link Budget

1) Simple Regression Analysis Test

TABLE III
SIMPLE REGRESSION ANALYSIS TEST DATA

Path	Chromatic Dispersion (X)	Total Dispersion (Y)
Rungkut - Kebalen (1550 nm)	4,409	0,174
Rungkut - Injoko (1550 nm)	4,149	0,268
Rungkut - Dermo (1550 nm)	4,460	0,277
Rungkut - Jagir (1550 nm)	6,357	0,039
Rungkut - Waru (1550 nm)	7,822	0,411

TABLE IV
MANUAL CALCULATION DATA FOR SIMPLE REGRESSION ANALYSIS TEST

No	X	X ²	Y	Y ²	XY
1	4,409	19,43928	0,174	0,030276	0,767166
2	4,149	17,2142	0,268	0,071824	1,111932
3	4,460	19,8916	0,277	0,076729	1,23542
4	6,357	40,41145	0,039	0,001521	0,247923
5	7,822	61,18368	0,411	0,168921	3,214842
Σ	27,197	158,1402	1,169	0,349271	6,577283

The regression coefficient b is determined using the given formula, namely:

$$\begin{aligned}
 b &= \frac{n(\sum X_i Y_i) - (\sum X_i)(\sum Y_i)}{n\sum X_i^2 - (\sum X_i)^2} \\
 &= \frac{5(6,577283) - (27,197)(1,169)}{10(158,1402) - (27,197)^2} \\
 &= \frac{32,886415 - 31,793293}{790,701 - 439,676809} \\
 &= \frac{1,093122}{1,093122} \\
 &= \frac{51,024191}{51,024191} \\
 &\cong 0,0214236 \approx 0,0214
 \end{aligned}$$

The constant a is determined using the formula:

$$\begin{aligned}
 a &= \frac{(\sum Y_i)(\sum X_i)^2 - (\sum X_i)(\sum X_i Y_i)}{n\sum X_i^2 - (\sum X_i)^2} \\
 &= \frac{(1,169)(158,1402) - (27,197)(6,577283)}{5(158,1402) - (27,197)^2} \\
 &= \frac{184,8658938 - 31,793293}{790,701 - 439,676809} \\
 &= \frac{5,983528}{1,093122} \\
 &= \frac{51,024191}{51,024191} \\
 &\cong 0,117268 \approx 0,120
 \end{aligned}$$

So the simple regression equation is $Y = 0,120 + 0,0214 X$

2) Correlation Coefficient (r)

This is used to measure the influence of the variable X on the variable Y, where the correlation analysis results are expressed by a number called the correlation coefficient.

$$\begin{aligned}
 r &= \frac{n(\sum X_i Y_i) - (\sum X_i)(\sum Y_i)}{\sqrt{[n\sum X_i^2 - (\sum X_i)^2][\sum Y_i^2 - (\sum Y_i)^2]}} \\
 &= \frac{5(6,577283) - (27,197)(1,169)}{\sqrt{[5(158,1402) - (27,197)^2][5(0,349271) - (1,169)^2]}} \\
 &= \frac{32,886415 - 31,793293}{\sqrt{(51,024191)(2,38650)}} \\
 &= \frac{1,093122}{11,03490} \cong 0,09906 \approx 0,10
 \end{aligned}$$

Based on the calculation results, it can be seen that the correlation or influence value shown by r is 0.10. According to Sugiyono guidelines for providing an interpretation of the correlation coefficient [15]. The relationship between chromatic dispersion and total dispersion in the rising time budget is very low.

3) Coefficient of Determination (r²)

$$r = (0,09906)^2 = 0,00981288 \approx 0,0098$$

This is used the value of R Square (r²) = 0,0098 which is obtained shows the value of the coefficient of determination which implies that the effect of chromatic dispersion on fiber loss in the power link budget is 0,98 %, while the remaining 99.02% is influenced by other variables.

After getting the coefficient of determination, then a significant test of the proposed hypothesis is carried out using the t-test, where the hypotheses are tested:

H₀ : β = 0; There is no significant effect of chromatic dispersion on fiber loss in the power link budget

H₁ : β ≠ 0; There is a significant effect of chromatic dispersion on fiber loss in the power link budget

The level of significance, α which is often used is α = 5% (α = 0,05)

$$\text{The value of t count, } t = t = \frac{r\sqrt{n-2}}{\sqrt{1-r^2}} = \frac{0,10\sqrt{5-2}}{\sqrt{1-0,0098}} = \frac{0,1732}{0,9950} = 0,174$$

so t count = 1,74

Degree of freedom, df = n - k = 5 - 2 = 3

By using the t-test table for the significant level α = 5% = 0,05 and df = 3, then the value of t in the table is obtained, namely: t tab = 3,182

Based on manual calculations obtained the value of t count = 0,174. While the value of t table for α = 0,05 and df = 3 is 3,182. Because the value of t_{count} = 0,174 < t_{table} = 3,182, then H₁ is rejected. So it can be concluded that there is no significant effect between chromatic dispersion on fiber loss in the power link budget.

C. Web Implementation Results

The function of this website is used for users to be able to find out information on measurement data from chromatic dispersion and attenuation as well as the results of calculating chromatic dispersion, rise time budget, and power link budget. Here is how the web page looks to the user:

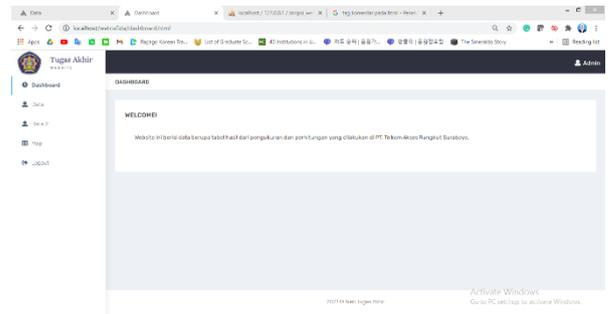


Figure 3. Dashboard Pages on the Web.

Data	Power (mW)	Chromatic Dispersion (ps/nm.km)	Total Dispersion (ps/nm.km)	Power Link Budget (dBm)	Rise Time Budget (ps)	Status	Action
1. Ringkasan	15,507	4,407	4,5833	10,143	10,050	OK	[Icons]
2. Ringkasan	1,969	0,585	10,700	1,034	10,000	OK	[Icons]
3. Ringkasan	1,853	0,584	9,5063	7,000	10,000	OK	[Icons]
4. Ringkasan	9,626	3,822	7,9244	2,044	10,000	OK	[Icons]

Figure 4. Data Pages on the Web.

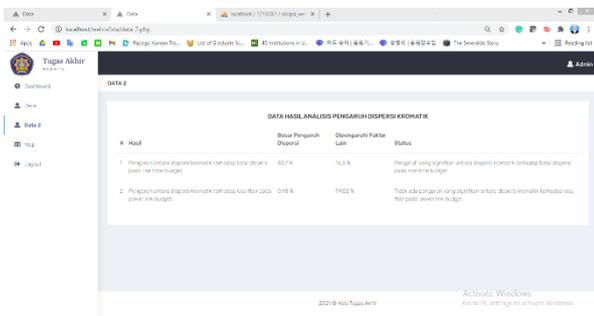


Figure 5. Data Pages of Results of Analysis of the Effect of Chromatic Dispersion on the Web.

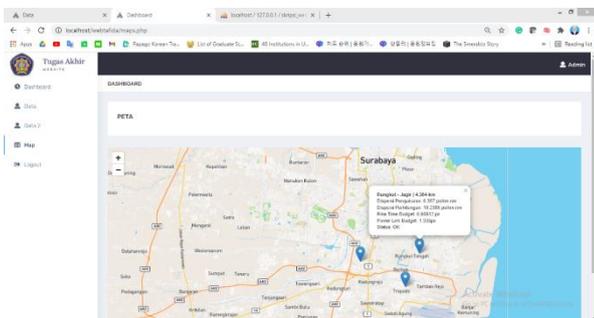


Figure 6 .Map Pages on the Web.

IV. CONCLUSIONS

The results of the analysis show that the optical fiber G.655 at PT Telkom Access Rungkut Surabaya has a significant effect on the chromatic dispersion on the total dispersion in the rise time budget. There is no significant effect of chromatic dispersion on fiber loss in the power link budget. The effect of chromatic dispersion on the total dispersion in the rise time budget is 83.7%. This value is obtained from the value of r square (r^2) of 0.837. This shows that the total dispersion in the rise time budget of 83.7% is influenced by chromatic dispersion while 16.6% is influenced by other factors. Then the effect of chromatic dispersion on fiber loss on the power link budget is 0.98%. This value is obtained from the value of r square (r^2) of 0.0098. This shows that fiber loss in the power link budget of 0.98% is influenced by chromatic dispersion, while 99.02% is influenced by other factors. The results of the implementation of the website in this study are able to display the results of measurements and calculations previously carried out at PT. Telkom Access Surabaya where the results of these measurements and calculations can be seen in a table that has been integrated between the database to store the value of these data with an online map which is then displayed on a map or online map on the website. This website only contains data from measurement results and parameter calculations on optical fiber owned by PT. Telkom Access.

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