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Design of Point to Point Access Using Dense Wavelength Divison Multiplexing

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ABSTRACT

In this research, a point to point access is designed on an optical communication network to see the performance parameters of bit error rate and q-factor. The research was conducted using OptiSystem software version 17, with design specifications such as a wavelength of 1555 nm, a range of 100 km, a number of 40 channels, and a frequency of 100 GHz. In this study, the best BER (Bit Error Rate) value was 10-6. Meanwhile, the Q-factor value is 4.8, which means that the Q-factor value has met the standard if it is seen from the BER value obtained. There are several factors that have a major influence on the design of fiber optic networks, such as power, amplifier specifications and bandwidth values. To minimize the enlargement of the BER (Bit Error Rate) and Q-factor values that come out.

INTRODUCTION

In this thesis, the researcher designs an optical communication network using the Point To Point method with DWDM (Dense Wavelength Division Multiplex) technology. As we know that DWDM (Dense Wavelength Division Multiplex) is the best technology to increase channel capacity and support the growing bandwidth demands on optical communication. In this technology the signal will carry several streams of information. The effective wavelengths for this technology range from 1530 nm to 1565 nm for the C Band and 1565 nm to 1625 nm for the L Band. In a DWDM network we can expand the existing network without having to use a new optical cable [2].

In this optical communication network design, the researcher uses optisystem software simulation using a single optical cable with predetermined specifications for a length of 100 km at 1555 nm to reduce signal dispersion. This DWDM system analysis is expected to produce a good optical communication network design seen through the Q-factor and BER[2] parameters.

LITERATURE REVIEW

Point To Point is a direct connection condition where there are two nodes that are connected to each other without intermediaries or without involving other nodes. Point To Point network can connect two LAN lanes through bridge mode without going through the routing process. The directional antenna is an antenna that is suitable for Point To Point installation because it has a straight beam and does not spread [3]. It can provide connection authentication, transmission encryption (using ECP, RFC 1968) and compression. Point To Point is used across many types of physical networks including serial cables, telephone lines, trunk lines, cellular telephones, dedicated radio networks, and fiber optics such as SONET. PPP is also used over Internet Access connections (now marketed as "broadband").

DWDM (Dense Wavelength Division Multiplex) is a transmission technique that utilizes light with different wavelengths as information channels, so that after the multiplexing process all wavelengths can be transmitted via an optical fiber. The basic principles of DWDM are shown in Figure 1[5].

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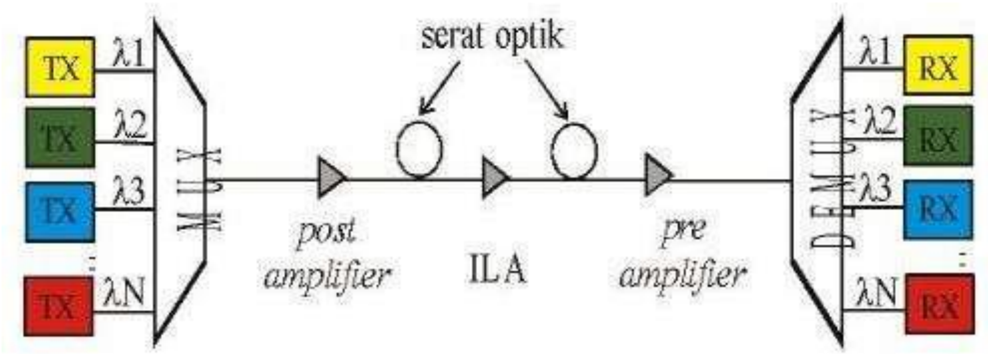

Figure 1. Basic Principles of DWDM

METHOD

The flowchart of this research can be seen in Figure 2.

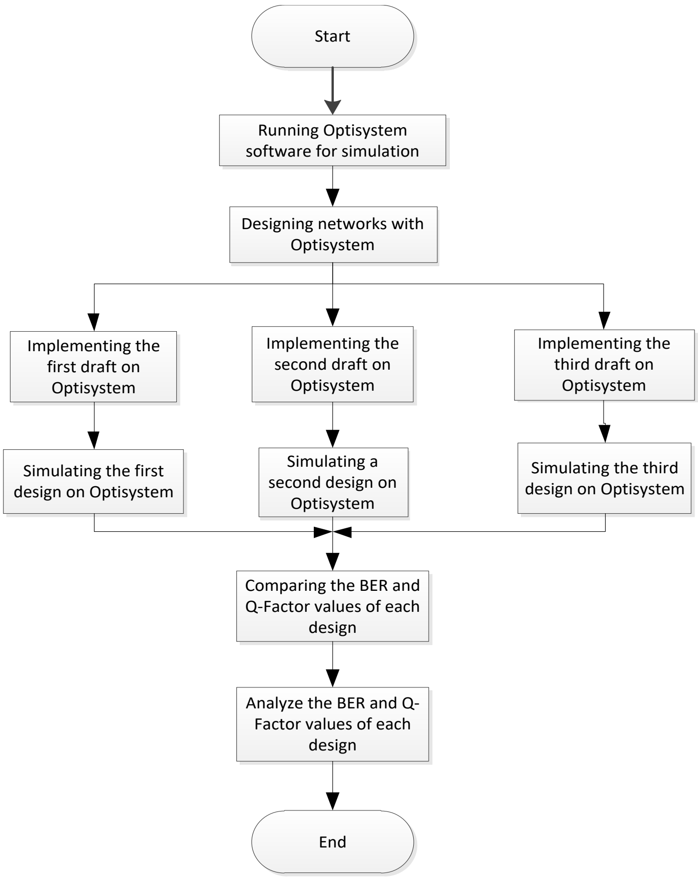

Figure 2. Research Flowchart

Each component used in designing an optical communication network has specifications with different values as shown in Table 1.

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Table 1. Component Specifications of Each Optical Communication Network Design

No	Channel	Parameter: Bit Error Rate (BER)	Parameter: Q-Factor
First Draft			
1	1	1	0
2	8	0.025	1.76
3	16	1	0
4	24	1	0
5	32	1	0
6	40	0.2	1.71
Second Draft			
1	1	0.00017	3.55
2	8	0.00018	3.54
3	16	0.00017	3.56
4	24	0.00015	3.69
5	32	0.00013	3.63
6	40	0.00011	3.68
Third Plan			
1	1	$3.1x10^{-6}$	4.51
2	8	$2.68x10^{-6}$	4.54
3	16	$2.14x10^{-6}$	4.59
4	24	$1.95x10^{-6}$	4.61
5	32	$1.59x10^{-6}$	4.65
6	40	$1.46x10^{-6}$	4.67

RESULT

The simulation results from each optical communication network design can be seen the difference through the recapitulation table which includes the results for each optical communication network design in Table 2.

Table 2. Simulation Results of Each Optical Communication Network Design

No	Channel	Parameter: Bit Error Rate (BER)	Parameter: Q-Factor
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1	1	1	0
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DISCUSSION

In the design of optical communication networks, there are several factors that influence the design results, such as power, amplifier specifications and bandwidth values (can be seen in Table 2). Although in optical communication theory there are several factors that affect the quality of optical communication networks such as Power, Noise Figure, or Gain, but after the design and simulation have been carried out, these three factors have a major influence in the design of optical communication networks. By using the same basic specifications in each design, such as length 100 km, wavelength 1555 nm, channel frequency 100 GHz and channel number 40, the researchers conducted several experiments by differentiating power, amplifier specifications and bandwidth values are factors that affect the performance of optical communication networks. From the three optical communication network designs, it can be concluded that the optical communication network design that is feasible to use is the third optical communication network design because it is in accordance with the standards for optical communication at ITU-T G.959.1 BER values with a range of 10-6 – 10- 12 and the optical communication standard ITU-T G.984 at a Q-factor value of 6 or BER = 10-9 with a BER value of 10-6, a Q-factor value of 4.8. For the value of the Q-factor itself, it meets the standard when viewed from the BER value obtained. BER and Q-factor on the third optical communication network design can be seen it can be concluded that the optical communication network design that is feasible to use is the third optical communication network design because it is in accordance with the standards for optical communication at ITU-T G.959.1 BER values with a range of 10-6 – 10-12 and optical communication standards ITU-T G.984 with a Q-factor value of 6 or BER = 10-9 with a BER value of 10-6, a Q-factor value of 4.8. For the Q-factor value itself, it already meets the standard if it is seen from the BER value obtained. BER and Q-factor on the third optical communication network design can be seen it can be concluded that the optical communication network design that is feasible to use is the third optical communication network design because it is in accordance with the standards for optical communication at ITU-T G.959.1 BER values with a range of 10-6 – 10-12 and optical communication standards ITU-T G.984 with a Q-factor value of 6 or BER = 10-9 with a BER value of 10-6, a Q-factor value of 4.8. For the value of the Q-factor itself, it meets the standard when viewed from the BER value obtained. BER and Q-factor on the third optical communication network design can be seen 984 with a Q-factor value of 6 or BER = 10-9 with a BER value of 10-6, a Q-factor value of 4.8. For the value of the Q-factor itself, it meets the standard when viewed from the BER value obtained. BER and Q-factor on the third optical communication network design can be seen 984 with a Q-factor value of 6 or BER = 10-9 with a BER value of 10-6, a Q-factor value of 4.8. For the value of the Q-factor itself, it meets the standard when viewed from the BER value obtained. BER and Q-factor on the third optical communication network design can be seen in the eye diagram in Figure 3. The wider the eye opening in the eye diagram, the better the performance of the optical communication network design.

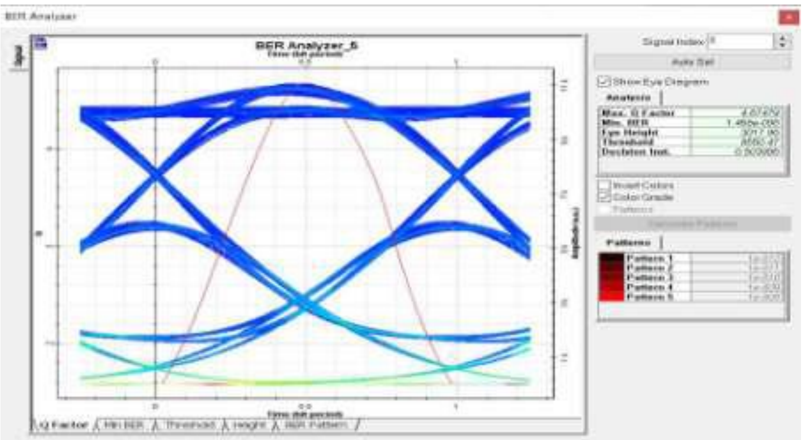

Figure 3. Eye Diagram

As for the second design, it can be seen in Figure 4, the results on each channel produce an average BER value of 10-4 and an average Qfactor value of 3.6 – 3.7 does not meet the ITU-T standard, namely for the BER value at optical communication according to ITU-T G.959.1 in the range 10-6 – 10-12 and for the value of Q-factor in optical communication according to ITU-T G.984 in the Qfactor value of 6 or BER = 10-9. BER and Q-factor in the second optical communication network design can be seen in the eye diagram in Figure 4. The wider the eye opening in the eye diagram, the better the performance of the optical communication network design.

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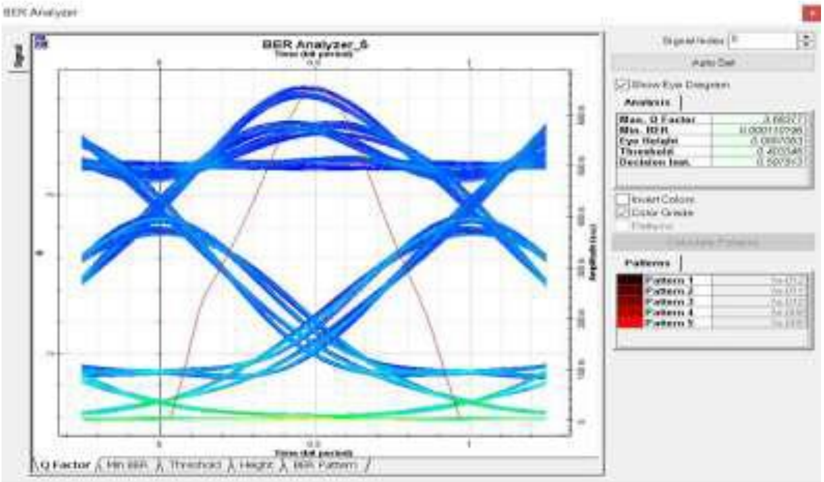

Figure 4. Eye Diagram of the Second Design

Eye opening (Eye height) on the first try is still not better than the third experiment. We can see in Figure 5 the eye diagram of the first experiment. Eye height on the first try is almost not formed at all. The results on each channel for the BER and Qfactor values do not meet the ITU-T standard, namely for the BER value in optical communication according to ITU-T G.959.1 in the range 10-6 – 10-12 and for the Q-factor value in optical communication according to ITU -T G.984 at the Q-factor value of 6 or BER = 10-9. This is why the first experiment was still so far from the established standard for optical communication.

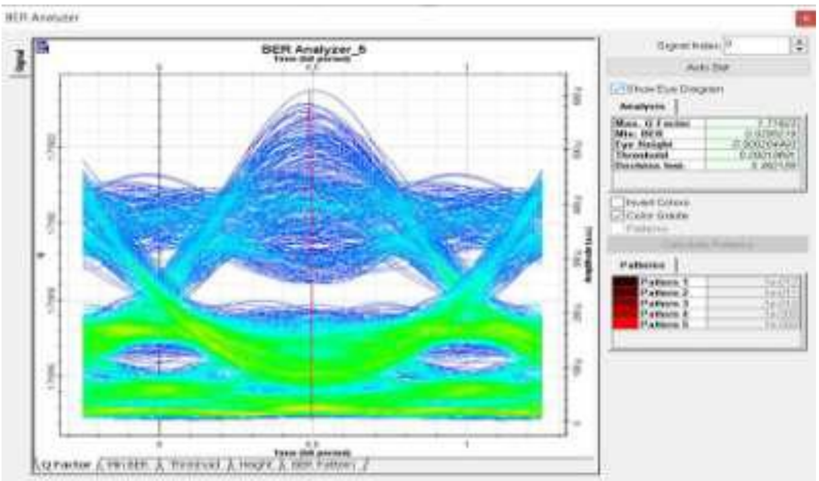

Figure 5. Experimental Eye Diagram

CONCLUSION

From the analysis that has been done, it can be concluded that;

1. To determine the quality of an optical communication network design that is feasible or not, it is necessary to pay attention to parameters such as BER (Bit Error Rate) and Q-Factor.
2. Power, amplifier specifications and bandwidth values are factors that influence the design results of optical communication networks.
3. To minimize the enlargement of the BER (Bit Error Rate) and Qfactor values that come out, it can be done by reducing the bandwidth value.

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