Analysis of ICONNET fiber optic network improvement in cluster rayon panam at strategic business unit central sumatra PT PLN ICON PLUS

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Abstract: Optical fiber is a telecommunications transmission medium that has a large bandwidth and bit rate so that it can meet the needs of today's data services with great reliability and efficiency. Optical fiber applications continue to be broad and have included seabed networks, terrestrial networks, metropolitan and regional scope networks, and small-scale networks. Optical fiber communication systems have 2 factors that affect the quality of network performance, namely internal aspects and external aspects. These internal and external aspects can degrade the performance quality of the optical fiber used and can cause attenuation and other transmission losses. As an effort to prevent sudden and significant deterioration in the quality of a network, it is necessary to try regular maintenance activities such as scheduled fiber optic cable network service quality measurements. These maintenance activities can help ensure network capacity increase decisions. One of the quality of service parameters that is often measured is transmission attenuation and received signal energy (received power). This research examines increasing the bandwidth capacity of PT PLN ICON PLUS in the Central Sumatra region during a network anomaly, namely a slow internet connection in the Rayon Panam Cluster. The sample taken from one of the customers shows the results of measuring the internet speed of 4-5 Mbps only, while the service taken is 10 Mbps. The results of checking on the up-link side to OLT Rayon Panam found that the data output was close to its capacity, which was 940,919,000 bits/sec or 0.9 Gb/sec. Increasing bandwidth capacity is done by moving the OLT port on the up-link side from the gigabit ethernet port to the tengigabit ethernet port, then replacing the SR type SFP with SFP ER and adding fiber optic attenuators so that the speed test results on the customer side have returned to their original appearance., 10 Mbps.

Keywords*:* Bandwidth; Received power; Optical fiber; SFP; Internet connection

1. Introduction

PLN's business transformation continues. From previously focusing on the electricity business, PLN is now developing business outside electricity or beyond kWh. As a Beyond kWh Subholding, PLN Icon Plus takes strategic steps in developing the Beyond kWh business. Among them, presenting Broadband Internet products known as ICONNET.

Broadband Internet is a type of internet connection commonly used at home where the speed is divided equally according to the number of users or the density of internet usage in the area. As business grows, Broadband Internet will weaken if the number of subscribers in a coverage area starts to approach its maximum number. Increasing the up-link capacity and reliability of the fiber optic network is a solution to maintain the quality of the internet connection. Network up-link capacity can be increased by updating the bandwidth with a larger quota and improving the physical quality of the fiber optic network is done by improving Tx Power (Transmission Power) and Rx Power (Received Power) from transmission, distribution, feeder sessions to customer sessions.

2. Methods

The network quality improvement analysis was carried out based on bandwidth traffic congestion which resulted in a decrease in customer internet speed in Rayon Panam in the first week of April 2023. Then the improvement design is carried out starting from the readiness of tools and materials, calculating the affected customer services to scheduling with the Central team to carry out the configuration. The rollback option to the initial configuration will be carried out if the improvement fails and will be designed and rescheduled on another day.

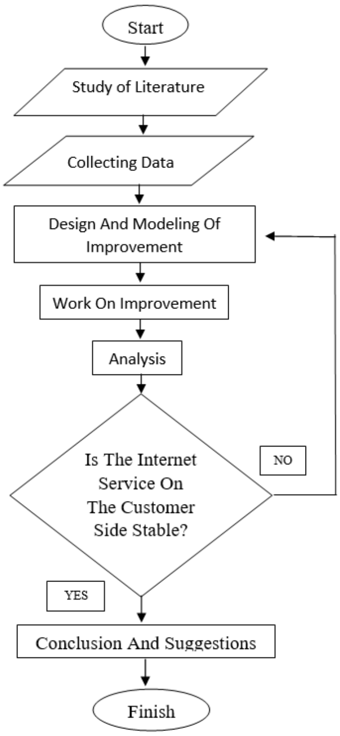

Figure 1. Flowchart of OLT bandwidth capacity improvement

Figure 2. Customer's speed test before improvement

Link power budget

Represents the total allowable attenuation between the transmitter output power and the receiver sensitivity. Equation 1 below is the total equation system damping (αtot) in dB:

$$\alpha tot = L.\, \alpha fiber + Nc.\, \alpha c + Ns.\, \alpha s + \alpha sp \quad (1)$$

L : fiber optic length (km)
$\alpha fiber$: attenuation of fiber optic (dB/km)
Nc and Ns : Number of connectors and number of splices
αc and αs : connector attenuation (dB / piece) and splice attenuation (dB / connection)
αsp : splitter attenuation

Next is Prx, which is the power at the detector (dBm).

$$Prx = Ptx - \alpha tot - Ms \quad (2)$$

Power margin (M) which is the remaining power of the transmit power. This margin should be positive, where the system gain is less than the total loss.

$$M = (Pt - Pr) - \alpha tot - Ms \quad (3)$$

With information:

Pr : power at the detector (dBm)
Pt : optical source output power (dBm)
Ms : system margin (between 6 - 8 dB)
M : power margin calculation
Pt : maximum power sensitivity

Table 1. Link budget deployment

Item	Quantities	Rx Power Standart (dB)
Fiber Optic Cable	1 Km	-0.35
Splitter 1:2	1 pcs	-3.70
Splitter 1:4	1 pcs	-7.25
Splitter 1:8	1 pcs	-10.38
Splitter 1:16	1 pcs	-14.10
Connector SC/UPC	1 pcs	-0.25
Connector SC/APC*	1 pcs	-0.35
Jointing / Splicing	once	-0.10

$$\alpha tot = L.\, \alpha fiber + Nc.\, \alpha c + Ns.\, \alpha s + \alpha sp \quad (1)$$

αtot = 3.2 Km x 0.35 dB + 4 x 0.25 dB + 5 x 0.10 dB + 7.25 dB + 14.10 dB
αtot = 1.12 dB + 1 dB + 0.5 dB + 21.35 dB
αtot = 23.97 dB

$Prx = Pt - \alpha tot - Ms$ (2)
Prx = 5 dB – 23.97 dB – 6 dB
Prx = - 24.97 dBm

$$M = (Pt - Pr) - \alpha tot - Ms \tag{3}$$

M = (5 – (-28)) – (-24.97) – 6
M = 33 – 30.97
M = 2.03 dBm

Tx power(dBm)	2.13
Receive power(dBm)	-20.26

Figure 3. Customer's Rx Power by System

Based on the ITU-T G.948 standard, the total attenuation is no more than 28 dB or Pr > -28 dBm. that means the attenuation on current customers can be said to be good, not causing the internet to slow down.

OLT Up-link checking

The above is the OLT up-link monitor table checked through the ODC, where the OLT is installed. The Value column shows the current value, HighAlarm as the highest limit parameter, HighWarn as the highest limit warning parameter, LowWarn as the lowest limit parameter value, and Low Alarm as the lowest limit parameter value as well as Status to show the result of the current condition of the OLT.

```
===============================================================================
Transceiver Digital Diagnostic Monitoring (DDM), Internally Calibrated
=============|=================================================================
Card3-Port5  +                Value  HighAlarm HighWarn LowWarn  LowAlarm Status
-------------|-----------------------------------------------------------------
Temperature(C)               33.843  80.000    70.000    0.000   -10.000 Normal
Supply Voltage(V)             3.360   3.600     3.450    3.150     3.000 Normal
Tx Bias(mA)                  49.408 100.000    80.000   20.000    10.000 Normal
Tx Power(avg dBm)             3.051   5.000     4.000   -5.999    -7.000 Normal
Rx Power(avg dBm)            -7.288   0.999     0.499  -18.013   -18.996 Normal
```

Figure 4. Up-Link status OLT

The above is the OLT up-link monitor table checked through the ODC, where the OLT is installed. The Value column shows the current value, HighAlarm as the highest limit parameter, HighWarn as the highest limit warning parameter, LowWarn as the lowest limit parameter value, and Low Alarm as the lowest limit parameter value as well as Status to show the result of the current condition of the OLT.

```
30 second input rate 103254000 bits/sec, 53761 packets/sec
30 second output rate 940919000 bits/sec, 97146 packets/sec
```

Figure 5. Bandwidth of OLT cluster Rayon Panam

The data above shows that the OLT Cluster Rayon Panam bandwidth capacity is almost full, it is observed that the data output has reached 940,919,000 bits/sec or the equivalent of 0.9 Gb.

Improvement modeling

By exchanging SFP from 1 Gb to 10 Gb on the up-link side and OLT side at their respective ports. Then move the OLT port configuration on the up-link from a gigabit ethernet port to a tengigabit ethernet port.

Topology before:

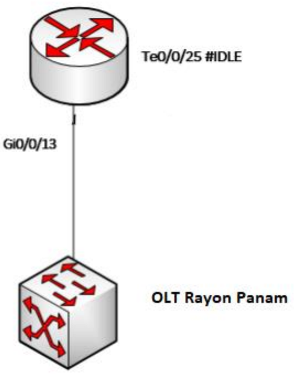

Figure 6. Initial topology planned topology

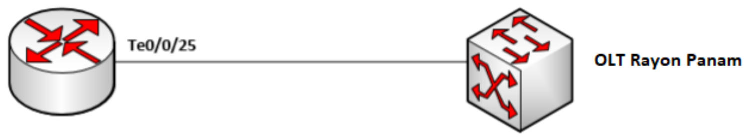

Figure 7. Planned topology

3. Results and discussion

From the data Fifure 8, we can see that the data output from OLT has reached 1,256,031,678 bits/sec or equivalent to 1.2 gigabits/sec. This shows that the OLT bandwidth capacity has exceeded the previous capacity of only 1 Gb.

```
Last 300 seconds input rate: 71940413 bits/sec, 37950 packets/sec
Last 300 seconds output rate: 849261068 bits/sec, 84548 packets/sec
Input peak rate 160059092 bits/sec, Record time: 2023-06-01 12:33:30+07:00
Output peak rate 1256031678 bits/sec, Record time: 2023-06-10 19:32:06+07:00
```

Figure 8. Bandwidth of OLT cluster Rayon Panam

Figure 9. Speed test results on customer

Based on QoS (Quality of Service) parameters, current customer's speed test results show:

1. Bandwidth: With an upload of 54.6 Mb/sec and a download of 10.2 Mb/sec, is the best result with the Very Good category.
2. Packet Loss: With the results of the speed test that is in accordance with the services taken by customers of 10 Mbps, indicating that customers have received a 1:1 or 0% packet loss service. service that is 1:1 or 0% packet loss. This is included in the QoS parameter by Very Good category
3. Delay: With a jitter result of 9 ms and throughput with a percentage of 75%, this result falls into theGood category on the QoS parameter.

Based on this research, it can be concluded that Rx Power or link power budget is not the only benchmark for assessing internet network quality. Bandwidth capacity also needs to be maintained to avoid full traffic due to heavy usage by customers, especially during peak hour which usually starts from 19.00 WIB to 21.00 WIB. And The Qos (Quality of Service), indicates the ability of a network to provide better service for the traffic that passes through it. Capabilities QoS is a collection of several technical quantity parameters, namely:

1. Throughput is the effective data transfer rate, measured in bits/s. Throughput is the total number of successful packet arrivals observed. at the destination during a specific time interval divided by the duration of that time interval. duration of that time interval.
2. Delay is the time delay of a packet caused by the transmission process from one point to another point that is the destination.
4. Jitter is a variation of end-to-end delay. A high level of jitter in a user datagram protocol (UDP)-based application is an unacceptable situation where the application is a real time application, such as a signalized signal. unacceptable where the application is a real time application, such as audio and video signaling. audio and video signals.
5. Packet loss is defined as the failure of an IP packet transmission to reach its its destination. The failure of the packet to reach its destination can be caused by several possibilities, namely the occurrence of traffic overload in the network, congestion in the network, errors that occur on the physical media, failures that occur on the receiving side can be caused by, among others overflow that occurs in the buffer.

6. Conclusion

Based on the data analysis and calculation results in this study, it can be concluded that the performance of the power plant, especially when viewed from the emission rate produced for each pollutant, dramatically influences the magnitude of the estimated results of public health impacts and externality costs. The higher the emission rate, the greater the externality costs, and vice versa. Not only based on plant characteristics, receptor conditions, and meteorological conditions, the use of assumptions such as the type of health impact and the type of pollutant being analyzed also influences the results of calculating public health impacts and externality costs. It is hoped that future research will determine externality cost estimates for other power plants in Indonesia, both fossil-fuel power plants and renewable energy, and also develop other calculation methods that can provide better results.

References

Büke, T., & Köne, A. Ç. (2011). Estimation of The Health Benefits of Controlling Air Pollution from the Yataĝan Coal-Fired Power Plant. *Environmental Science and Policy*, *14*(8), 1113–1120. https://doi.org/10.1016/j.envsci.2011.05.014

Casas-Ledon, Y., Arteaga-Perez, L. E., Dewulf, J., Morales, M. C., Rosa, E., Peralta-Suáreza, L. M., & Van Langenhove, H. (2014). Health External Costs Associated to the Integration of Solid Oxide Fuel Cell in a Sugar-Ethanol Factory. *Applied Energy*, *113*, 1283–1292. https://doi.org/10.1016/j.apenergy.2013.08.090

Jorli, M., Van Passel, S., Sadeghi, H., Nasseri, A., & Agheli, L. (2017). Estimating Human Health Impacts and Costs Due to Iranian Fossil Fuel Power Plant Emissions through the Impact Pathway Approach. *Energies*, *10*(12), 1–29. https://doi.org/10.3390/en10122136

Kusumawati, W., Sugiyono, A., & Bongaerts, J. C. (2010). Using the QUERI Model-AirPacts Program to Assess the External Costs of Three Power Plants in Indonesia with Three Different Energy Sources. *The IMRE Journal*, *4*(1), 1–19. http://wordpress.hrz.tu-freiberg.de/wordpress-mu/journal/

Liun, E. (2012). *Perhitungan Biaya Eksternal Pembangkit Listrik Dengan Model Simpacts*. 307–321.

Mayasari, F. (2013). Analisis Perhitungan Eksternalitas Pada PLTU Muara Karang Dengan Penggunaan Flue Gas Desulphurization. *Jurnal Ristek*, *2*(1), 38–42. www.jurnal-ristek.org

Ministry of Energy and Mineral Resources of the Republic of Indonesia. (2022). *Capaian Kinerja KESDM 2021 Capaian kinerja sektor ESDM tahun 2021*.

Owen, A. (2004). Environmental Externalities, Market Distortions and the Economics of Renewable Energy Technologies. *The Energy Journal*, *25*(3), 127–156. https://doi.org/10.2307/41323045

Rokhmawati, A., Sugiyono, A., Efni, Y., & Wasnury, R. (2023). Quantifying social costs of coal-fired power plant generation. *Geography and Sustainability*, *4*(1), 39–48. https://doi.org/10.1016/j.geosus.2022.12.004

Sugiyono, A. (n.d.). *Biaya Eksternal dari Pembangkit Listrik Batubara*.

Szpunar, C. B., & Gillette, J. L. (1992). *Environmental Externalities: Applying the Concept to Asian Coal-Based Power Generation*.

Zyśk, J., Wyrwa, A., Pluta, M., Olkuski, T., Suwała, W., & Raczyński, M. (2021). The Health Impact and External Cost of Electricity Production. *Energies*, *14*(24), 1–19. https://doi.org/10.3390/en14248263