Journal of Theoretical and Applied Information Technology
31st March 2021. Vol.99. No 6

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

BUSINESS STUDY OF NETWORK PROVIDER DEVELOPMENT IN XYZ INDUSTRY AREA WITH NNI MODELING (NETWORK TO NETWORK INTERFACE) AS A STAGE TOWARDS SMART INDUSTRIAL PARK

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ABSTRACT

Network to Network Interconnection business model to build a network provider in an industrial area requires careful calculation and design because it is related to multi-provider networks and, particularly, related to investments and operations that must be profitable in the future.It is adopting Metro Ethernet technology as the backbone and FTTX technology as the access transmission system of the Network to be interconnected. The data analysis using top-down with the business case as the objective and is translated into network design and interconnection modeling between providers from outside the industrial area, and is carried out qualitatively and quantitatively. The discussion starts with the needs of end customers, marketing strategies and is manifested in a network design that can answer all the requirements of tenants in industrial areas and support the acceleration of the smart industrial park.An accurate investment calculations, by selecting the right backbone technology and access can be a successful factor in building network provider in industrial estates.

Keywords : *Network Service Provider, Fiber Optics Networks, Business Modeling, Network To Network Interconnection, Financial Analysis, Service Level Agreement*

1. INTRODUCTION

1.1. Background

In development stage, industrial park have become synonymous with the industrialization process and are considered a powerful tool for generating employment, economic growth, and competitiveness. Industrial park, in particular, can foster a catch-up strategy by providing institutional frameworks, modern services, and infrastructure not available in other parts of the country[1]

Currently, industrial park are demanded not only to provide land, but the increasing number of tenants will also automatically increase the number of workers/laborers in the area. Besides, land tenants, mostly production centers or factories, need a connection to the head office outside the industrial area and should connect with suppliers and logistical networks in other locations. They need a guaranteed internet and intranet connection service to exchange data and send information deemed necessary in a sales production process. [2]

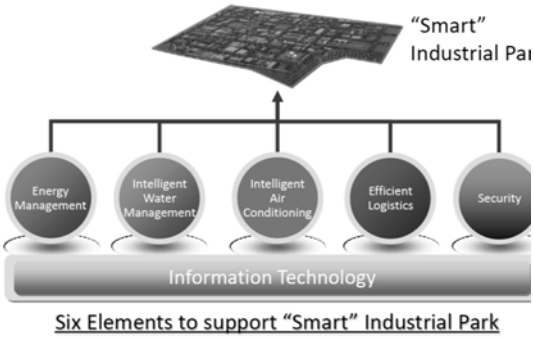


Figure 1. Six Element to support Smart Industrial Park

Smart Industrial Park is an integrated concept that includes at least six aspects [3], namely:
1. Energy Management
2. Intelligent Water Management
3. Intelligent Air Conditioning
4. Efficient Logistics
5. Security
6. Information Technology

The most important is the existence of a reliable Information Technology service. Because the main requirement to enable the Smart Industrial Park is the primary baseline for implementing integrated information technology.[4]
XYZ Industrial Park is one of Indonesia's leading industrial Park, especially in the West Java province. With a large enough area and occupied by quite well-known and multinational tenants. Every tenant currently needs a reliable telecommunication service with a high guarantee of services. Now, access media using Fiber Optic is the best solution to meet the needs of tenants and data communication speed in the XYZ Industrial Park.
Several network providers are available in this Industrial Park, and they have unplanned Fiber Optics implementation, making the utility network disorganized and chaotic. Utility networks concern public interest such as electricity, telecommunications, information, water pipes, oil, and gas. When done on public land, building and network construction utilities certainly need to be regulated to cause disturbance of order general and public convenience.[5]
In the XYZ Industrial Park, a Tier 4 Data Center with an area of 24 thousand m2 has also been established. It is the only data center in Indonesia with an electricity supply from two different electricity provider companies, namely PT PLN Persero and PT Cikarang Listrikindo [6]. With this data center, the XYZ Industrial Park is demanded to be increasingly ready to provide adequate, standardized infrastructure and scalability.
The XYZ Industrial Park will provide an information system network within the area in the form of fiber optic networks, IP backbone networks, and access networks which can be used to serve and fulfill and guarantee ICT services to tenants, and of course will interconnect with an existing network provider that meets with the SLA (Service Level Agreement).
To build fiber optic infrastructure and IP networks, requires a license to become a network provider. and this research discusses how to build a network provider that can guarantee service and still provide benefits for the holding company.

1.2. Problem

- How can the IP (Internet Protocol) backbone and access network design guarantee the expected SLA (Service Level Agreement)?
- How is the NNI (Network to Network Interface) method between these providers the optimal interconnection choice?
- How is the Business study feasible and profitable?

1.3. Scope of Research

- This business study conducted in a limited area of the XYZ Industrial Estate, West Java Indonesia
- The discussion consists of fiber optic network design, IP network design for both backbone and access without discussing the details of device configuration.
- Output from the financial analysis is limited to ROI (Return of Investment), IRR (Internal Rate Return) and NPV (Net Present Value) with a business calculation for three years.

2. METHODOLOGY

2.1. Related Work

In this study, the selected literature is research on ISP business models, both business plans and cooperation between ISPs and infrastructure development to support ISPs. Based to [7], they define how to create effective business planning and state that business planning is a key to run the business properly. [8] describe the components of the ISP business model reported in their research according to the scope. They also describe the ISP business model's three components, including essential resource, value configuration, and cost

structure, using Hedman and Kalling's ontology. In another research [9] examining the comparison of 4 business models of open cooperation between providers and local government. And the result is the number of network service providers playing an essential role in network profitability.

The other paper by [10] proposes an optimal business model for the effective exploitation of Greece's emerging broadband metropolitan area network. The result is those network providers should provide economic and competitive services without paying attention to broadband infrastructure development. From [11] they calculate in detail the infrastructure investment to serve a city, namely Culver, with only one established partner network provider, and they do not consider the SLA. [12]using data mining to analyze customer needs with a more innovative and competitive ISP product output. A similar research using an open-access method with other networks providers using NNI and UNI for integration between their interface by [13]. In this research we not only creating the business plan, but also consider the backbone and access technology including modelling for the interconnection using NNI.

2.2. Methodology

2.2.1. Top-Down Model Analysis

This research will use the Top-Down model analysis method . Top-down model analysis is a methodology for designing a network, where the network design must meet the company's business needs or organization concerned.

This model consists of five layers, where the top layer (Business layer) provides needs, which are the results of the analysis of the problems faced (requirements) that must be met by the layer below. The lowest layer offers solutions to problems given the layer above. The analysis process can be seen in the following figure:[14]

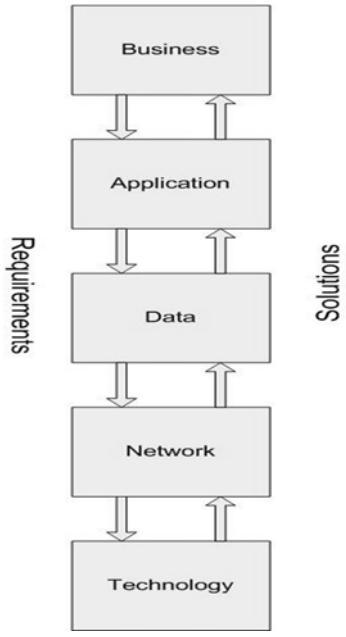


Figure 2. Top-Down Model Analysis

To be able to understand how to use this model correctly, we must see what is analyzed from each layer starting from the top :

1. Business Layer : This layer analyzes what a company (organization or individual) is trying to achieve by installing a network in its organization. Without understanding the business needs of the company, it is almost impossible to design and implement a network that will be successful (as desired).
2. Application Layer : This layer analyzes what computer systems on the network will run based on input from the business layer.
3. Data Layer: This layer analyzes what the application layer will generate data types. This layer generates a Data Traffic Analysis, which contains: Physical data location, Characteristics of data and, The amount of data generated and transmitted
4. Network Layer : This layer analyzes how data can be transmitted effectively, cheaply and promptly. The result of this layer is a logical network design.
5. Technology Layer : This layer analyzes what technology (hardware) is appropriate to make the network layer design work optimally. analysis at this layer results in a physical network design.

In this research, we only use three layers, which are the Business layer, Network Layer and Technology layer, and below process analysis that happens in each layer.

Table 1. Modification of Top Down Analysis

Layer	Analysis Process
Business Layer	- Financial Analysis - Business Model Canvas
Network Layer	- Network analysis and design - Logical network design - Network implementation plan - Network management and performance monitoring network
Technology layer	- Technology analysis - Physical network design - Physical network implementation - Connecting a physical network design with a logical network design

3. THEORY

3.1. Network

Network is a collection of two or more computers, independent and connected to each other through transmission media. The transmission media between computers is not limited to copper cables, but also via fiber optic, microwave, infrared, and even via satellite [15].

Technically, interconnection can be said to be a physical network connection that is traversed by a carrier with other networks. In other words, the carrier uses equipment and facilities that are not owned by the network of origin of the carrier [16]. Information and data travel through network transmission media, enabling computer network users to exchange documents and data and jointly use network-connected hardware or software. Every computer, both hardware and software connected to the network, is called a node. A computer network can have two, tens, thousands or even millions of nodes.

In general, the network has several benefits. The benefits of building a network are as follows :

Sharing resources, communication media, data integration, development and maintenance, data security, more efficient resources and up to date information

Based on the type of transmission [15], the network can be divided into two major parts: broadcast and point-to-point. In broadcast networks, communication occurs in a shared communication channel, where data in the form of packets sent from a computer will be delivered to each computer on the network. The data packet will only be processed by the destination computer and discarded by the computer that is not the destination computer. Whereas in a point-to-point network, data communication occurs through several connections between a pair of computers, so that a packet may have to go through several computers to reach its destination. Therefore, in this type of network, choosing a suitable route determines whether the data connection is good or not.

3.2. Metropolitan Area Network (MAN)

MAN is a larger version of LAN and usually uses the same technology as LANs. MAN can include company offices close together or a city and can be used for privacy (private) or the public. MAN can support data and voice and can even be associated with cable television networks. MANs provide connectivity for LANs in metropolitan areas and connect them to broader area networks.

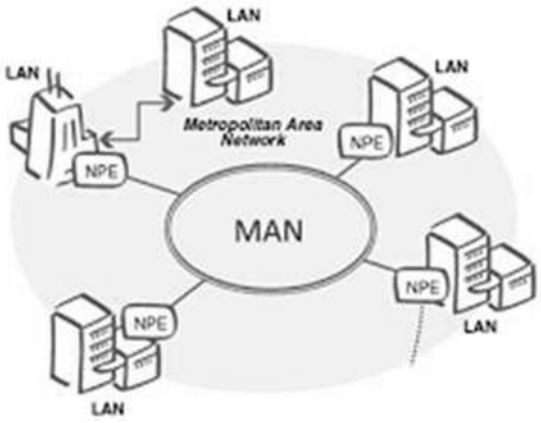


Figure 3. MAN topology

3.3. ISP (Internet Service Provider) and Network Provider

According to [17] an ISP is a company that provides access to the internet, both permanent connectivity and dial-up access. Some of the major providers are national and even multinational companies were serving hundreds of cities. Meanwhile, small providers may only be managed individually and only serve one area.

The ISP has the equipment and telecommunication link access required to establish a PoP (Post Office Protocol) in a specific geographic area. ISPs have high-speed leased lines, so they are not entirely dependent on telecommunication providers and can provide better service to customers.

Network Service Providers/network providers are service providers that include telecommunications companies, data carriers, ISPs, wireless-

communication service providers and cable operators that offer high-speed connections [18]. An ISP is connected to both domestic and international internet networks, so that customers or users of the links provided by the ISP can connect to the global internet network. The distribution of this internet network uses transmission media that can stream data in the form of cables (modems, cable leases, and broadband), radio, and VSAT.

The contents of this ISP are the people and equipment needed to provide internet connection services to its customers. This equipment is usually in the form of servers, routers, and so on. This ISP usually applies a monthly fee to its customers.

3.4. Ethernet

Ethernet is a type of LAN network architecture that functions to control computers in a network so that they can share bandwidth in the same network [19].

Ethernet uses the CSMA / CD protocol so that the sending of data packets will be arranged or queued, meaning that a data packet is being executed in a network. The other data sending process will be queued until the sending process is complete and then proceed to the next sending process.

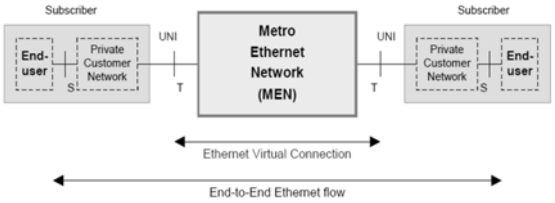
IEEE regulates ethernet standardization with IEEE 802.3 documents. The IEEE 802.3 document contains standards defining the physical layer and the Media Access Control sub-layer data-link layer of the wired Ethernet standard. The majority of IEEE 802.3 is Local Area Network (LAN) technologies, but some are Wide Area Network (WAN) technologies.

3.5. Metro Ethernet Network

Metro Ethernet Network is an ethernet technology that is implemented in a metropolitan area network. Metro Ethernet network is generally defined as a bridge from a network or connecting separate areas. It can also connect LANs with WANs or backbone networks, which are typically owned by service providers. Metro Ethernet networks provide services using Ethernet as the core protocol and broadband applications.

If by definition [20] Metro Ethernet Network is an Ethernet Service Network owned by a network provider. The Metro Ethernet Forum has defined six types of services for Metro Ethernet providers, including Ethernet Private Line, Ethernet Relay, Ethernet Multipoint Services (Virtual Private LAN Service) Ethernet access to MPLS VPN.

Figure 4. Metro Ethernet Network



3.5.1. Network interface with user or user network interface

The UNI installed on the network is called UNI-N. The UNI installed on the customer side is called UNI-C. The relationship between a UNI and another UNI can be described as a virtual ethernet connection called EVC.

Based on the UNI connection, the metro ethernet service types consist of :

1. E-Line: provides point-to-point services for Ethernet Private Line (to replace TDM private line, PTP, and non multiplexed services, one EVC to one UNI), virtual Private Line (to replace Frame Relay or ATM, multiple EVCs for one UNI, One CPE connection for connection to multiple EVCs), ethernet Internet Access, Point-to-Point upper layer services transport (IP-VPNs etc.)
2. E-LAN: provides multipoint-to-multipoint services for Multipoint L2 VPNs, transparent LAN Service, multicast networks, point to multipoint for broadcast applications such as video distribution, e-learning, corporate training, healthcare, Picture Archiving & Storage Systems (PACS) etc.

Metro Ethernet designs should consider End-to-End QoS, Scalability, Protection, TDM Support, Multiprotocol convergence, which can handle all traffic.

3.5.2. NNI Framework

External Network to Network Interface (NNI) is a physical demarcation point between the one network responsible for the CEN (Carrier Ethernet Network) and another network at the administrator authorization level that is interconnected with other CENs.

An example of such an arrangement can be found on MEF 33, where the other network is an Internet Service Provider. However, this document is focused on using ENNI to support Ethernet Virtual Connections (EVCs) where an ENNI connects two CENs as shown in Figure 5.

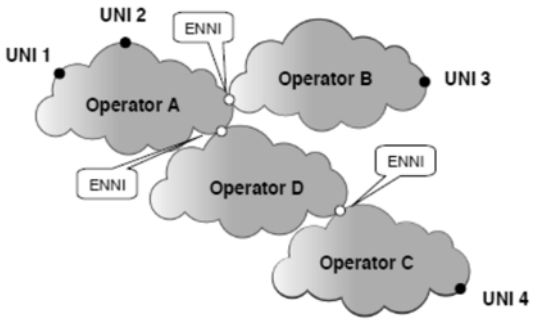


Figure 5. NNI Cloud Configuration Between Operator

3.6. Business Studies

A Business Plan is a written document prepared by a person about to start a business that describes all the relevant elements, both internally and externally, regarding the company. Usually contains integrated planning regarding marketing, capital, production and human resources [21].
The Business Review is a plan document as simple as it is for a new business establishment, not just limited to a business startup plan that helps management understand the company's current situation and future business projections. A Start-Up Business Study consists of the mission, vision, goals, and business activity plans for projections in the company's future years. A business study conducted when the company operates aims to determine how the company operates effectively, acquiring new customers, funding partners and so on.[21].
According to [22] business studies must cover at least two things, namely; organizational procedures to simplify and clarify business objectives and strategies and the second is a sales forecast document which can show that a product or service can generate profits and attract company funds and resources. By making this business study, an entrepreneur will have a better view of the business as to whether it can be profitable or not and what steps need to be taken to make it profitable.
A business review is a written summary of the entrepreneur's planned business scheme, its more detail about financial, effective promotion, opportunities and strategies, and also the leaders' management capabilities [23]. Making a business study is important because an entrepreneur needs to make a well-made and precise business plan to increase achievement.[24]

3.7. Financial Analysis

Financial analysis is made to determine estimates from the financial side in the form of costs and cash flow, so can be estimated whether the business is feasible or not. According to [25], financial analysis is an analysis that compares costs and benefits to determine whether a business will be profitable during the life of the business.
In this study, only three analyzes of financial feasibility were used, namely, Net Present Value (NPV), Internal Rate of Return (IRR), and Payback Period (PP).

3.7.1. Net Present Value (NPV)

Net Present Value (NPV) is the present value of the net benefits (additional net benefits) that will be obtained in the future, which is the difference between the present value of the benefit flows minus the present value of the cost flows [26].
The assessment criteria for Net Present Value (NPV) are as follows: If NPV> 0, then the business is run is feasible to run; if NPV <0, then the business is run is not feasible to run, If NPV = 0, then the business is run has no loss and no profit.

3.7.2. Internal Rate of Return (IRR)

Internal Rate of Return (IRR) is the maximum interest rate that can be paid by a business for the resources used because the business needs more funds for operating and investment costs and new business reaches the rate of return on capital [26]
Meanwhile, according to [27] the Internal Rate of Return (IRR) is used to find an interest rate that equates to the present value of expected future cash flows, or cash receipts, by issuing the initial investment.
If the IRR is the same as the discount rate, the business cannot gain or lose, but if IRR <the discount rate, it is not worth running, whereas if the IRR> is the discount rate, the business is feasible to run.

3.7.3. Payback Period (PP)

Payback Period (PP) is used to calculate the payback period for investment capital used to finance the business. The payback period is a period that shows how long the capital invested in the business can be returned.

In this study, the CAPEX calculation includes all investments related to the purchase of Fiber optic and its accessories, network devices such as switches, OLT, and all equipment installed in the Meet me room. Including installation services, configuration, and all costs incurred in connection with this project at the start. Whereas Opex costs

(operational expenditure) defines all routine monthly or annual expenses related to land rent, space rental, employee salaries, maintenance costs, and all routine operational costs. Income projections are calculated using assumptions obtained from questionnaires distributed to customers regarding the capacity and type of service rented.

4. ANALYSIS DATA

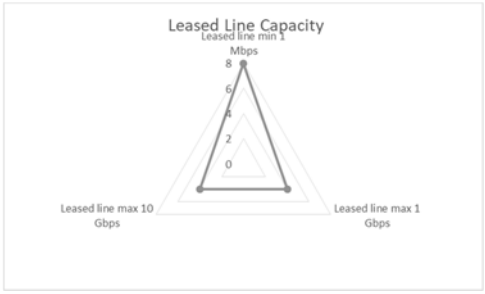
4.1. Data Collection

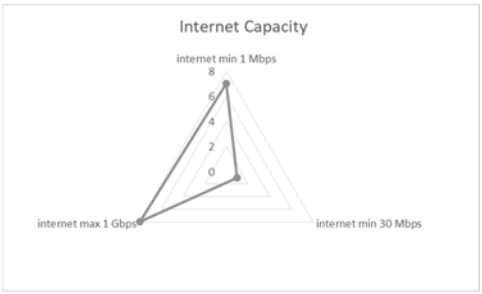
To collect data, using two methods, namely distributing questionnaires and interviews. Questionnaires are distributed to end-users tenants in the XYZ Industrial area via email to each tenant's IT division. This questionnaire contains several questions which are divided into several sections: User and capacity: contains questions regarding the number of employees using laptops / pc, LAN connection, LAN network type, the connection between head office and branch Network Services: includes questions regarding the specifications of the intranet and internet leased via the existing network provider, the bandwidth capacity rented, and the name of the provider serving. Network service usage satisfaction: contains questions regarding satisfaction responses to the network provider's service quality, namely the order handling process, the activation process, the disturbance handling process, and the bandwidth suitability.

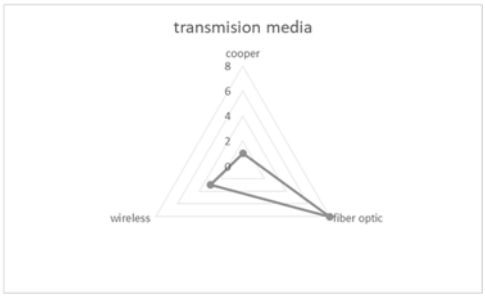
Meanwhile, interviews were conducted with existing Network Providers and network providers who will join and make interconnections with the fiber-optic network built. Interviews were conducted by sending a list of questions to the PIC of the designated network providers first, then clarifying the answers to these questions.

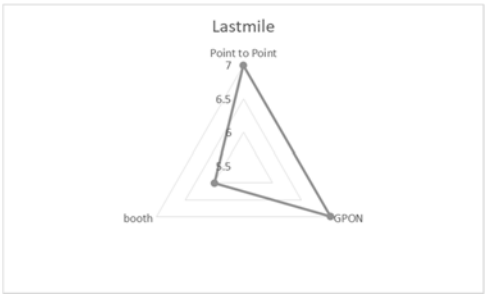
The questions in the interview sheet consist of 9 parts: 1. A number of subscribers, ask the number of existing customers in the xyz industrial area who subscribe to the network provider; 2. Type of product contains questions about the type of product to be sold and offered to prospective customers with a choice of Leased line, internet and other services; 3. Product capacity contains questions related to the capacity of products and services sold in Mbps units; 4. Transmission media contains questions regarding the transmission media used in delivering services to customers with a choice of Copper, Fiber Optic or Wireless; 5. Lastmile technology: contains questions about the technology used in delivering services to customers with a choice of point to point and GPON; 6. Service level agreement (SLA): provides information about the agreed Service Level Agreement to customers; 7. Delivery time is the length of time to prepare the service from the purchase order to the service activation; 8. Network specifications; 9. The closest location to the cable belonging to the network provider to the XYZ industrial area.

4.2. Result of Interview with Network Provider









Journal of Theoretical and Applied Information Technology
31st March 2021. Vol.99. No 6

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

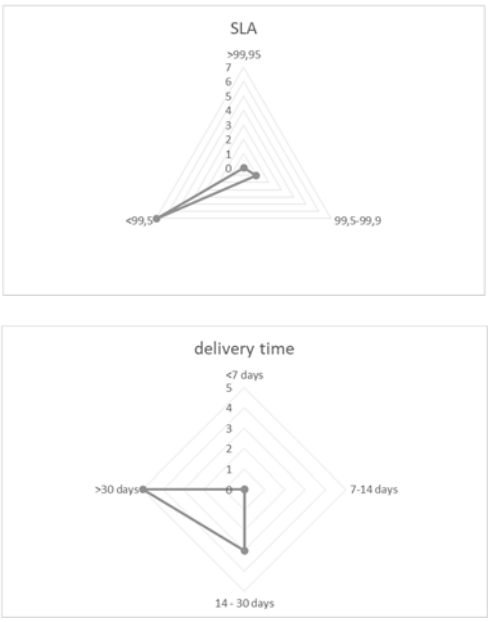


Figure 6. Graphic Result From Interview With Network Provider

From the interviews with network providers, several conclusions were obtained as guidelines for network design in the XYZ area. Among others : There are two variants of providers' products, namely the Leased Line and the Internet. The smallest minimum capacity is 1 Mbps, and the maximum capacity is 10 Gbps. The transmission medium used for Lastmile is Optical Fiber, with only two providers using other media such as wireless and copper. Last-mile technology used 90% uses GPON, and only one provider uses point to point. Service Level Agreement from 90% of providers is only promising at 99%, with the interpretation that the maximum downtime allowed is an average of 3.5 days a year or around 87.6 hours a year. For average delivery commitments, providers only agree on 14-30 days as 70% and the remaining 7-14 days.

From several interviews with the existing network providers, it becomes one of the basic considerations in determining the network design in the XYZ industrial area, namely : transmission media : optical Fiber, Lastmile technology: GPON, backbone capacity: n x 10 Gb, redundant last mile: not required to achieve SLA as above, the delivery commitment is represented by the termination location closest to the tenant in the area which must be reached within a maximum of 14 days.

Currently, fiber optic is the best choice for data transmission because it has the lowest delay and maximum latency [28]. As for last-mile technology, there is a point to point and point to multipoint, usually represented by GPON technology. GPON technology has a high economic value [29]. With services delivered that must reach 10 Gbps, the technology that can be adopted is Metro [30]. In leased line and internet services that use fiber optic media, the customer's last-mile point becomes a single point of failure and puts SLAs at risk of not being achieved [31].

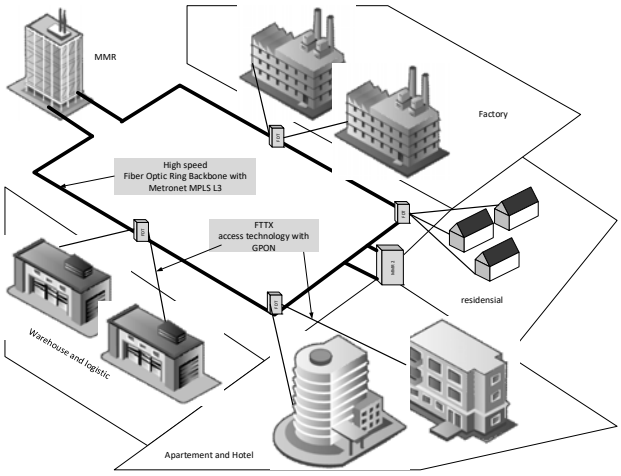


Figure 7. Global Network Configuration Design

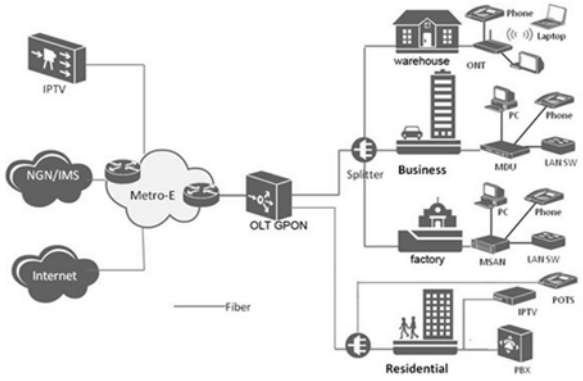


Figure 8. Network Logic Design

4.3 NNI Configuration

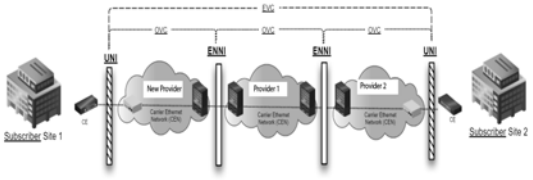


Figure 9. NNI Link Configuration

The diagram show us that there are two types of provider interconnections in a service that crosses a multi-CEN network. One type of provider contain an UNI and an ENNI. The other type of provider has two ENNIs–this is a transit operator. (Note that each operator could have more than one UNI and/or more than one ENNI supporting a multipoint service).

Each provider will carry out the interconnection process between one another at a point agreed upon with a compatible protocol.

ENNI-N has the following functions: Manage and maintain ENNI links (resilience, fault management): format frames sent and received from ENNI Contains multiple OVC endpoints, and participates in the OAM Service process (MIP, MEP), optionally performs redirecting switch routes, and including enforcing bandwidth profiles at ENNI. In this case, the NNI only happens between the multi-operator to the new network provider.

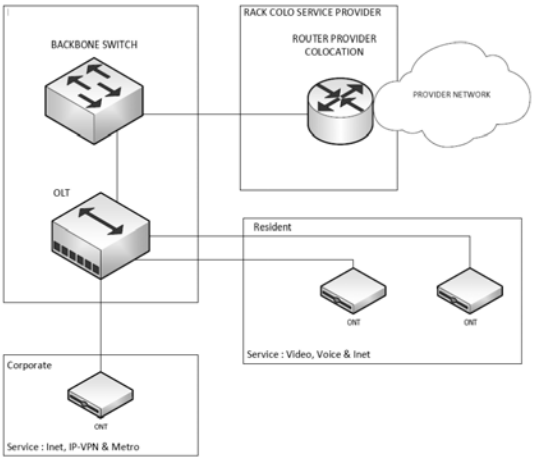


Figure 10. NNI by equipment in the MMR room

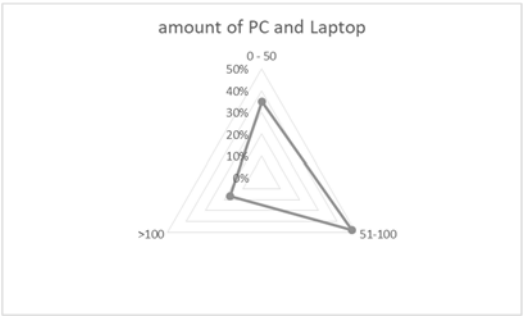
4. 4. SLA Calculation

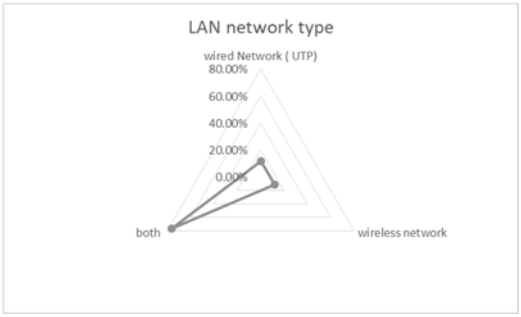
Based on [32], there are parameters for calculating SLA and the table below comparing the standard and our research.

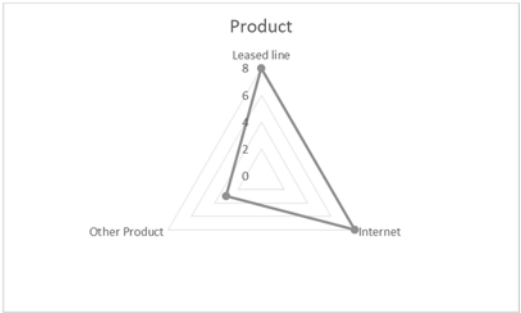
Table 2. SLA Compliance

No	Availability Standard	Design on research	Compliance
1	Redundancy equipment	Metro Switch using L3 MPLS in two diferrent POP	Comply
2	Redundancy network	Fiber Optical ring backbone	Comply
3	Protocol	TCP IP in backbone and access	Comply
4	Transport choices	Metro Ethernet (Standard MEF 33) with RPR protection	Comply

4.5. Result of Tenant Questioner







ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

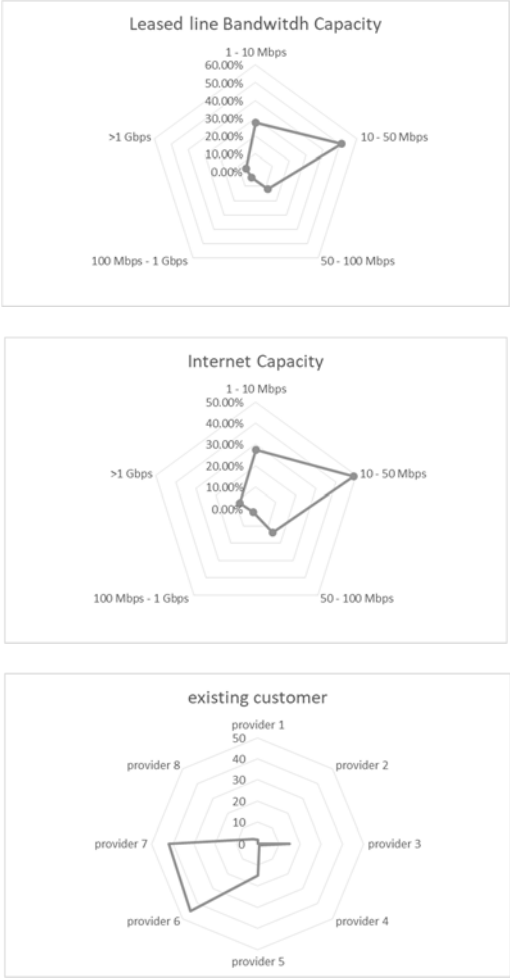


Figure 11. Graphic of Tenant Questioner Result

From the diagram above, some data can be taken to be used as input in the preparation of the right product: the number of laptops or PCs connected to the internet network is around 50-100 units every tenant, about 80% of tenants use LAN and WIFI as connections in their offices, the most network products used are leased lines and the internet, most of the tenants in the XYZ Industrial area rent networks with a capacity of 10-50 Mbps, for internet capacity, more than 50% of the tenants also use a bandwidth of 10-50Mbps, the sixth graph shows the name of the network provider used by tenants in the XYZ industrial area.These results are used to calculate the bandwidth assumptions that are widely used by tenants in the industrial park, and include the choice of products used.

4.6. Financial Analysis Calculation

In this study, the CAPEX calculation includes all investments related to the purchase of Fiber optic and its accessories, network devices such as switches, OLT, and all equipment installed in the Meet me room. Including installation services, configuration, and all costs incurred in connection with this project, with a total amount about Whereas Opex costs (operational expenditure) defines all routine monthly or annual expenses related to land rent, space rental, employee salaries, maintenance costs, and all regular operating costs. Income projections are calculated using assumptions obtained from questionnaires distributed to customers regarding the capacity and type of service rented. The total Capex is about 15,879,772,174 IDR, including primary equipment material (fiber optic, subduct and equipment) and the installation service cost.
Operational and maintenance cost is shown at Table 3.
Maintenance and operational costs(OPEX) using 3% of annual revenue and 1% for spare parts calculation. The most significant Opex needs are for operational staff and human resources. Because maintaining the SLA quality is important, the portion of NOC staff's human resources is made in shift mode with a day divided by three shifts.

4.7. Revenue Plan

The revenue plan above is based on the following assumptions: The price of the leased line product is the price for bandwidth with a capacity of 10-20 Mbps, which is the BW most rented by tenants based on the results of the questionnaire, Network providers that interconnect in MMR are eight network providers, the growth in the number of subscribers in the first year was obtained from existing three network provider customers who moved last-mile, and the addition each year is 80, assuming each network provider adds ten subscribers each year.

Revenue planning for project period is shown at Table 4.

Year	2021	2022	2023	2024	2025	2026	2027	2028	2029
Total Cost	3,484	5,211	7,355	8,811	10,766	11,209	12,209	12,209	12,209

Table 3. Operational and Maintenance Cost

(in million)

Table 4. Revenue Planning for Project Period

Year	2021	2022	2023	2024	2025	2026	2027	2028	2029
Revenue	4,705,014	7,440,903	10,898,222	14,194,074	17,489,925	19,014,257	19,014,257	19,014,257	19,014,257

(in thousand)

4.8. Financial Analysis Result

Table 5. Feasibility Analysis

IRR - Project		**19.80%**
NPV - Project		**4,134,843**
Profitability Index (PI)		4.39

5. CONCLUSION

The conclusion drawn from all of the above is that with the applied network design, the estimated SLA calculation will follow the standards of using Metro Ethernet technology, and the NNI interconnection model is indeed the right choice for the interconnection process with other network providers. Likewise, with the calculation of the Financial Analysis, the numbers were positive, and this project is worth continuing.

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