

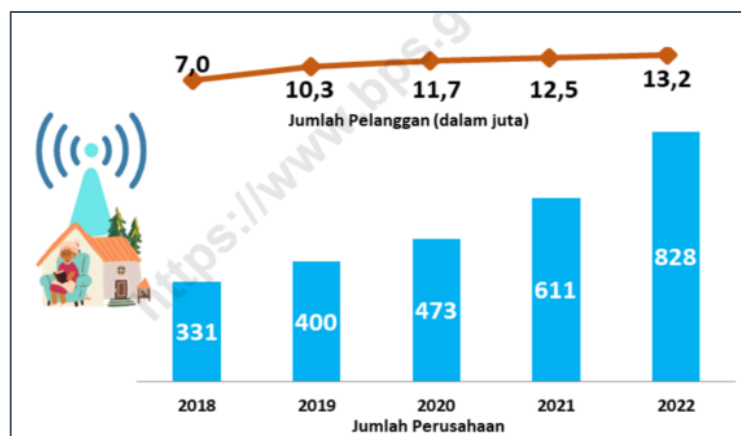
# CHAPTER I

## INTRODUCTION

### 1.1 Background

The paradigm of internet connectivity has changed in many sectors due to the rapid advancements in information and communication technology (ICT). This includes residential property, such as apartments and houses, where having a large bandwidth and high-speed internet connection has become essential for daily living. Fiber to the Home (FTTH) with Gigabit Passive Optical Network (GPON) technology is a fixed broadband service that is a perfect solution for Internet Service Providers (ISPs) to offer internet services for residential areas. This is because of the technology's future flexibility in supporting high Internet access speeds and large bandwidth on Triple Play services [1].

With a huge population and vast territory, Indonesia presents an appealing market and challenge for the telecom sector in this regard, allowing the number of telecom organizers and Internet service providers (ISP) to keep rising yearly. [2]. Data from the Central Statistics Agency (BPS) regarding the 2022 Indonesian Telecommunication Statistics Report shows that ISP operators in Indonesia grew by 35% in comparison to 2021. This growth was matched by an increase in ISP customers, which at the end of 2022 reached 13.2 million. Of these, 91.95% were individual customers, with the remaining 8.05% being businesses and internet cafes [2].



**Figure 1.1** Number of ISP Company & Customer, 2018-2022

Because each ISP operator is still building optical cable networks (FTTH) individually, the increasing number of ISP operators in Indonesia that are catering to users'

internet needs has indirectly resulted in an inefficient infrastructure for the optical cable network. To improve the effectiveness and efficiency of optical cable network infrastructure, several nations have already established open fiber network access regulation for multi-provider internet services [3].

According to statistics from CommunityNets.org, to foster a vibrant, inventive, and competitive market for telecommunications services, several nations have established Open Access laws allowing many ISP operators to use optical cable networks. The information below in Table 1.1 relates to several nations that have enacted Open Access laws allowing for the shared usage of optical cable networks or FTTH [4].

**Table 1.1** Open Access Fiber Optic Regulation in Others Country

No	Country	Open Access FO Provider	Sharing Infrastructure Regulatory	Homepass Coverage
1.	England	OpenReach	Owned subsidiary of BT Group Plc. Established	9 million, 25 million planned
2.	England	CityFibre	2 <sup>nd</sup> largest fiber provider in the UK, owned by a consortium of PE investors and investment funds	2 million, 8 million planned
3.	Brasil	V.tal	Largest neutral fiber provider that controlled by BTS pactual investment funds	20 million
4.	Italia	Open Fiber	JV between Italy utility & provider FTTH in urban & rural areas	13 million
5.	Singapore	NetLinkNBN	Listed nation-wide operator of FTTx network and has the sole mandate to deploy FTTx services	1.5 million

Open Access optical cable networks are defined by CommunityNets.org as configurations in which ISP operators are free to offer services over an optical cable network. [4]. For example, Triple-Play Internet, Phone, TV, as well as home security systems, smart homes, and other services, are just a few examples of the retail services that network owners frequently sell in bulk to service providers.

The implementation of Open Access legislation in the establishment of fixed broadband optical cable networks has demonstrated significant success in fostering competition and providing economic advantages in various nations, including Singapore through the Next Generation Nationwide Broadband Network (NGNBN) plan. Collaborative efforts across different telecommunications providers result in a significant reduction in network implementation expenses and expedited nationwide deployment, hence yielding advantages for both operators and customers. In addition to that, another instance of ISP operators collaborating on resources is the collaborative partnership between Telefónica and Vodafone in Spain. By adopting this collaborative approach, customer happiness is enhanced while simultaneously optimizing network rollout.

This data can truly be applied in Indonesia because it relates to various countries that have Open Access legislation addressing the usage of optical cable networks (fiber network sharing). Nonetheless, there is no explicit legislative policy governing fiber-network sharing, meaning that individual ISP operators are still responsible for building the optical cable or FTTH network equipment. This leads to many issues in residential areas, such as the need to repeatedly install poles or excavate subterranean cables for the installation of fiber optic cables, which may harm or disrupt nearby inhabitants. In addition, there have been multiple grievances from locals to real estate developers regarding its inability to select an internet service provider (ISP) for internet access due to an exclusive business model used by one of the ISP providers in the area [5].

The Open Access regulatory policy in Indonesia for fiber network sharing infrastructure for multi-provider services is not specifically regulated by the current regulations in force in Indonesia, PP number 46 of 2021 concerning Post, Telecommunications and Broadcasting and Minister of Communication and Information Regulation number 5 of 2021 concerning Telecommunications Operations. is applicable in a certain area. In addition, there are additional regulations pertaining to the minimum 5-year development commitment policy for telecommunications network operators that are burdensome for businesses other than ISP operators. These regulations are outlined in Minister of Communication and Information Regulation number 7 of 2018, which is about electronically integrated business licensing services in the communications and information technology field.

Several research journals have demonstrated that maximizing GPON technology on FTTH networks can effectively implement multi-provider regulations on a single optical cable network in a private network. This can be achieved by utilizing VLAN tagging on ONT modems on the end-user side [1], [6], [7], [8].

In Indonesia, there exists a potential for the implementation of FTTH sharing regulations by utilizing GPON technology as a fiber optic cable infrastructure solution. This could be achieved through the collaboration of multiple ISP operators in a specific region, with the aim of enhancing the effectiveness and efficiency of internet service provision to residents. From an economic perspective, numerous research papers have previously been published that focus on economic studies and feasibility studies pertaining to the utilization of GPON technology in FTTH networks [9], [10]. Assuming a sustained growth in the demand for high-speed, large-bandwidth internet, this option presents promising prospects for profitability.

The table 1.2 and table 1.3 presents a comprehensive overview of several research publications that serve as literature studies on the standardization of GPON technology utilized by ISP operators or as standalone providers to meet the internet requirements of customers. Several academic publications have also examined the potential of technology in facilitating multi-provider internet services. The use of VLAN-based GPON can enhance the efficiency of fiber-network sharing infrastructure.

**Table 1.2** GPON Single-Operator Research

Research	Type of GPON	Used for	Point of View	Research Method
Octavianus, Y et al. (2023) [11]	GPON-FTTB	Single Provider Hotel	ISP	Technical Design Analysis
Adiati, R et al. (2022) [12]	GPON-FTTH	Single Provider Residential	ISP	Technical Design Analysis
Abdellaoui Z et al (2021) [13]	GPON-FTTH	Single Provider Residential	ISP	Technical Design Analysis
Arya, M et al (2021) [14]	GPON-FTTH	Single Provider Residential	ISP	Technical Design Analysis
Budiyanto, S et al. (2020) [9]	GPON-FTTH	Single Provider Residential	ISP	Techno-Economic Analysis
Anggita T, et al. (2020) [15]	GPON-FTTB	Single Provider Office	ISP	Technical Design Analysis
Chantamunee, S et al (2017) [16]	GPON-FTTH	Single Provider Condominium	ISP	Technical Design Analysis
Azodolmolky, S et al (2008) [10]	GPON-FTTH	Single Provider Residential	ISP	Techno-Economic Analysis
Azodolmolky, S et al (2008) [17]	GPON-FTTB	Single Provider High Rise Building	ISP	Techno-Economic Analysis

**Table 1.3** GPON Multi-Provider Scenario Research

Research	Type of GPON	Used for	Research Method
Alvarado-Jaimes R, et al (2022) [6]	GPON-FTTx	Multi-Provider Scenario	Technical Design Analysis
Permana, I, et all (2017) [7]	GPON-FTTx	Multi-Provider Scenario	Technical Design Analysis
Van Der Wee, M et al (2015) [18]	GPON-FTTH	Multi-Provider Open Access	Techno-Economic Analysis
Benlamri, R et al (2013) [19]	GPON-FTTx	Multi-Provider Open Access	Technical Design Analysis
Sultan, DMS, et al (2011) [1]	GPON-FTTx	Multi-Provider Scenario	Technical Design Analysis
Boada, G et al (2008) [8]	GPON-FTTB	Multi-Provider High Rise Building	Technical Design Analysis

**Table 1.4** Proposed Research

Research	Type of GPON	Proposed Research	Point of View	Research Method
Feasibility Study and Study Case	GPON-FTTH	Fiber Network Sharing-Infrastructure using GPON which built by Property Developers	Property Developers	Techno-Economic Analysis with Regulatory Recommendation

According to table 1.4, this research will conduct technical research on the GPON-FTTH network topology constructed by real estate property developers. The goal is to enable them to link with many ISP operators and offer multi-provider services in its property areas. In addition to this, an examination of techno-economic factors will be conducted to assess the viability of investments using a Cost-Benefit Analysis, specifically focusing on real estate property developers.

Hence, the outcomes of this study are anticipated to offer a resolution for real estate developers in Indonesia to construct its own FTTH network utilizing GPON technology in its locality as a multi-provider service interconnection solution, thereby eliminating the need for redundant implementation of fiber optic cable networks in the region. Residents have the option to select and utilize many providers, and real-estate property developers can also avail themselves of commercial advantages through a revenue sharing cooperation program with these providers.

## 1.2 Problem Statement

Considering the information provided in the previous section, the adoption of fiber-network sharing in Indonesia using GPON technology on FTTH networks as a solution for multiple internet service providers is not yet widely implemented by real estate developers. As a result, each ISP operator is required to construct its own cable infrastructure and fiber optic services to cater to the needs of residents in the area. Thus, this research involves multiple stages and steps in problem conceptualization, which are outlined below:

1. This inquiry pertains to the viability of real estate property developers constructing its own Fiber-to-the-Home (FTTH) network utilizing VLAN-based GPON technology within its locality. The focus is on the technical aspects, specifically the network topology, architecture, and standardization required to ensure seamless integration of multi-provider services.
2. What are the potential economic benefits that real estate property developers could derive from implementing business governance through collaboration with internet service providers (ISPs) that offer internet services to local residents

3. The regulations and policies pertaining to shared infrastructure in Indonesia lack comprehensive guidelines on its implementation, particularly for non-ISP private business entities, such as property developers who construct telecommunications networks in its respective areas.

### **1.3 Research Objectives**

The objective of this study is to generate a techno-economic analysis for developers in the real estate industry, enabling them to establish its own Fiber to the Home (FTTH) networks based on GPON technology inside its own regions. This approach serves as a solution for interconnecting many internet service providers. The regulatory study entails providing policy recommendations to facilitate the ease of property developers in Indonesia while establishing shared infrastructure, including fiber network sharing, inside its designated zones.

### **1.4 Scope of Work**

The difficulty outlined in the preceding section necessitates the consideration of several limitations.

1. The limitation of the techno-economic analysis and regulatory analysis in this research only on the real-estate property developers' side.
2. This study focuses on a case study of apartment who built by PT XYZ, one of real estate property developers in Indonesia.
3. This study focuses on the techno-economic analysis of the FTTH network topology with GPON technology, specifically examining its architectural design in accordance with ISP operator standards. The objective is to facilitate the integration of multiple providers through interconnection. Regarding the economic aspect, it is determined by utilizing the CAPEX and OPEX figures obtained from the GPON network architecture design constructed by the property developers. On the other hand, the income estimate is derived from the revenue share with the ISP.
4. A decision selection model is developed through techno-economic analysis, specifically by conducting a Cost Benefit Analysis from the standpoint of the property developers. This analysis considers the Net Present Value (NPV), Investment Return Rate (IRR), Payback Period (PP), and Profitability Index (PI) when evaluating the construction of a multi-provider GPON network in the area.
5. Conducting a regulatory analysis by scrutinizing various domestic and international regulations pertaining to shared infrastructure. The aim is to offer

policy recommendations in Indonesia regarding the adoption of shared infrastructure, particularly fiber-network sharing in specific regions. This can be facilitated for business entities other than ISP operators, such as real estate property developers, who can offer multi-provider services to residents in its areas.

## 1.5 Research Methodology

The research process and methodology employed in composing this thesis comprises multiple steps organized in a Work Breakdown Structure as follows:

### 1. Research Initiation

The initial phase of this research involves problem identification, which entails formulating the context of the topic. This involves identifying the existing difficulties and establishing the research objectives.

### 2. Research and Case Study

The research study stage encompasses literature reviews and case studies. Literature reviews involve the retrieval and examination of relevant research subjects, such as books, journals, scientific literature, and current regulations in Indonesia, to provide valuable information for the research process. Regarding the issues that will be examined in the study.

The purpose of the conducted case study is to gather information and data from PT. XYZ, a real-estate property developer in Indonesia. PT. XYZ has implemented GPON technology on the FTTH network to enable multi-provider services. This implementation involves a fiber network sharing scheme with ISP operators in specific areas, particularly in the vicinity of Apartment.

### 3. Technical Analysis

In terms of limiting the problems from the technical side that will be discussed in terms of the design of the GPON network architecture that was built, the integration of interconnections with several ISP operators for multi-provider services is in accordance with standardization.

### 4. Economic Analysis

Perform calculations and economic analysis to assess the viability of a business venture from the perspective of a real estate property developers. This involves examining various factors such as the market conditions, assets, capital expenditures (CAPEX), operational expenditures (OPEX), and revenue. The purpose of this analysis is to determine and evaluate the cost-benefit analysis, which calculation of Net Present Value (NPV), Investment Return Rate (IRR), and Payback Period (PP).

#### 5. Regulatory Analysis

In order to enhance policy suggestions for the implementation of sharing infrastructure in Indonesia, the regulatory analysis stage involves a comprehensive examination of the the latest telecommunication regulation from point of view real-estate property developers.

#### 6. Conclusions and Suggestions

The final stage involves the examination of the analysis results and the derivation of conclusions based on the findings of the comprehensive techno-economic calculations and regulatory analysis.

Those research methodology will be detailed as Work Breakdown Structure (WBS) Research in Figure 1.2.



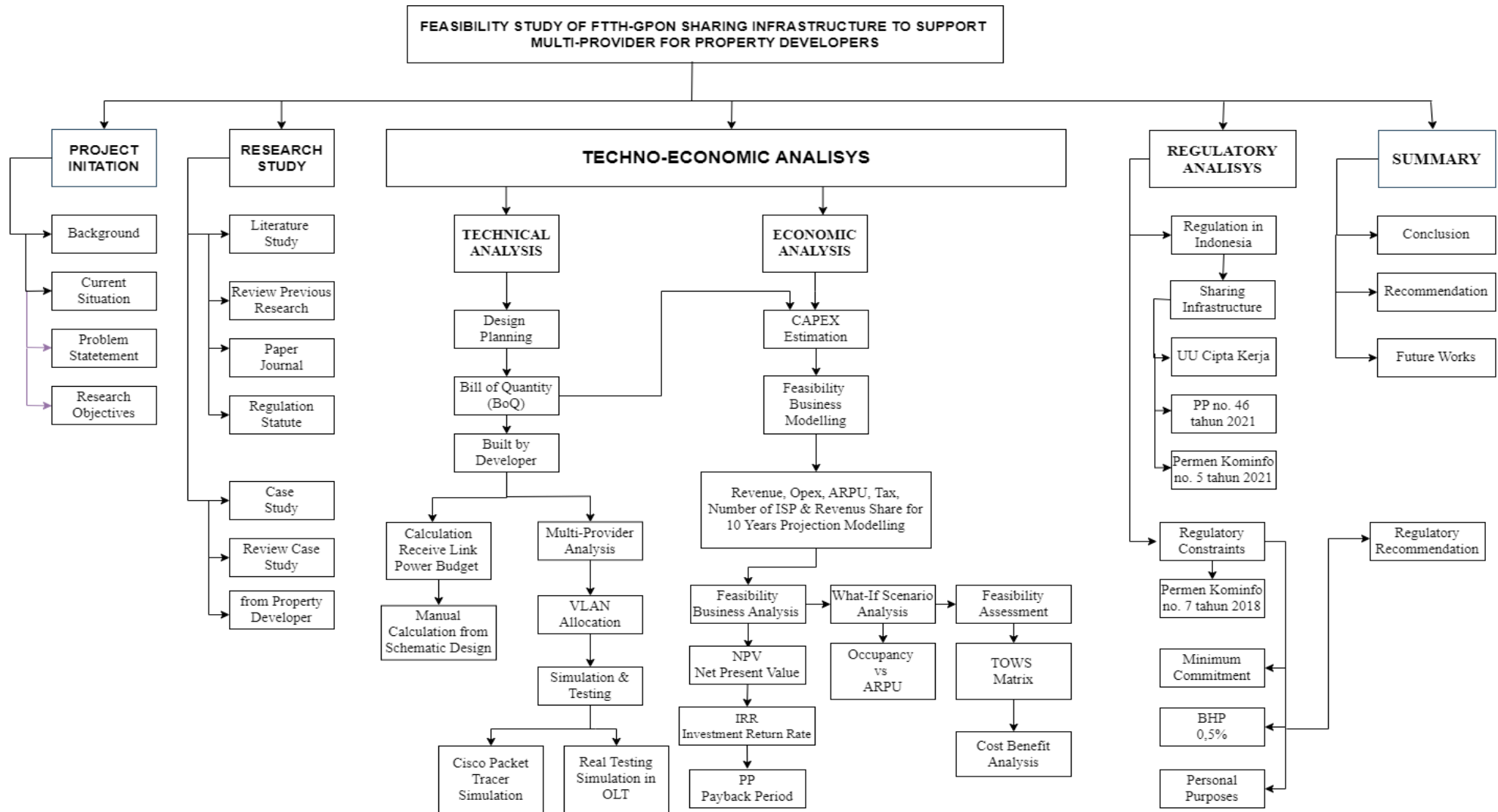


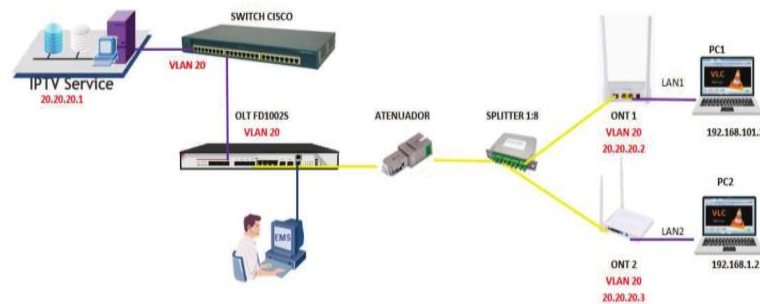
Figure 1.2 Work Breakdown Structure (WBS) Research

## 1.6 Research Method

This thesis research employs a combination of techno-economic analysis and regulatory analysis to examine the feasibility of real estate property developers in implementing multi-provider internet services for residents. The objective is to investigate the feasibility of constructing its own Fiber-to-the-Home (FTTH) network sharing infrastructure using GPON technology will be implemented in the following area:

### 1. Techno-Economic Analysis

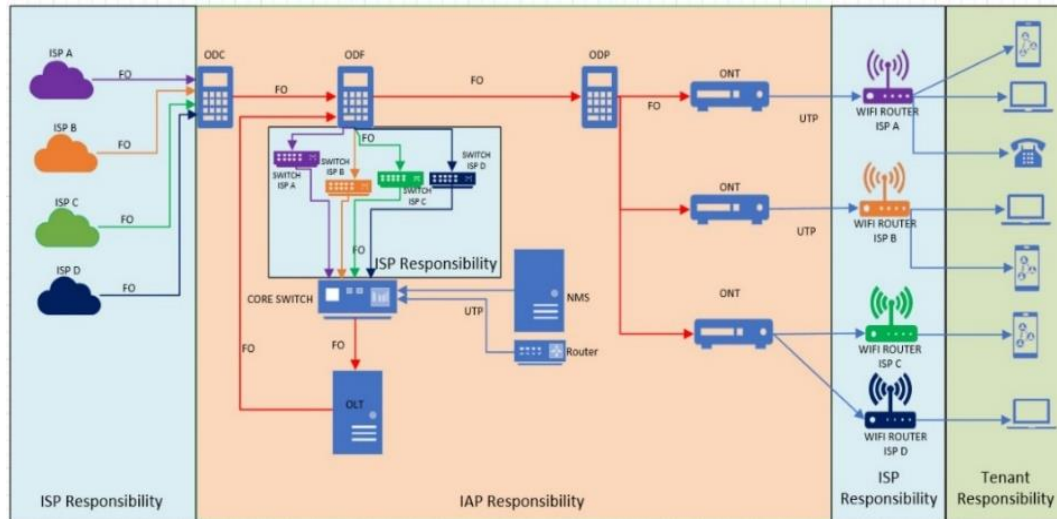
The potential for multi-provider internet services has been investigated using GPON technology to simulate test scenarios on FTTH networks. The research used internet service configurations from one provider that are routed through one core to the switch, which is then distributed to the OLT to two ONTs using two VLANs for two distinct internet services, as shown in the Figure 1.3 [6] :



**Figure 1.3** Multicast Service by VLAN using GPON technology

Research simulation scenario on Figure 1.3 demonstrates how optimal use of VLAN-based GPON technology can enable internet services from many Internet Service Providers (ISP) on FTTH networks in a private network [6]. Thus, fiber network sharing infrastructure with many ISPs on the FTTH network in a some region area offers an effective and efficient way to create FTTH network infrastructure in Indonesia.

In the meantime, one of these providers is PT. XYZ, an Indonesian real-estate property developer that operates in numerous regions, particularly the apartment market has implemented multi-provider regulations using GPON technology by built fiber network sharing infrastructure in its owned property area. This allows each resident to subscribe to multiple providers utilizing a single core and ONT which installed in its property unit as topology design network in Figure 1.4.



**Figure 1.4** GPON Network Topology in PT. XYZ for Multi-Provider

The techno-economic analysis of the network topology configuration will focus on how PT XYZ to design a fiber network sharing infrastructure using GPON for multi-provider services in line with standards. In the meantime, the research will examine how the feasibility study for putting in place a FTTH network sharing infrastructure using GPON technology was created by real estate developers by estimating the costs of CAPEX, OPEX, and revenue from working with multiple ISP operators to determine a number of economic factors, like calculate Net Present Value (NPV), Investment Return Rate (IRR), and Payback Period (PP).

Comparing whether the FTTH network infrastructure in a property area was constructed by the property developers and ISP operator themselves served as the techno-economic study for this thesis project. Consequently, this comparison will result in a way of decision-making from the viewpoint of the real estate developers.

## 2. Regulatory Analysis

To conduct regulatory analysis and provide valuable policy recommendations for real estate property developers to build telecommunications network infrastructure in its owned areas, the regulations that apply in Indonesia are reviewed and benchmarks are compared with existing regulations in other nations. The regulatory in Indonesia which have related with research have listed in Table 1.5 that include requirements for non-Internet Service Provider (ISP) businesses to establish telecommunications network infrastructure, especially for sharing infrastructure which shown that regulatory in Indonesia are over-regulated which some policy in the new regulation has not changed or revised other before regulation and it will be assessment in this research.

**Table 1.5** Regulatory in Indonesia related with Research

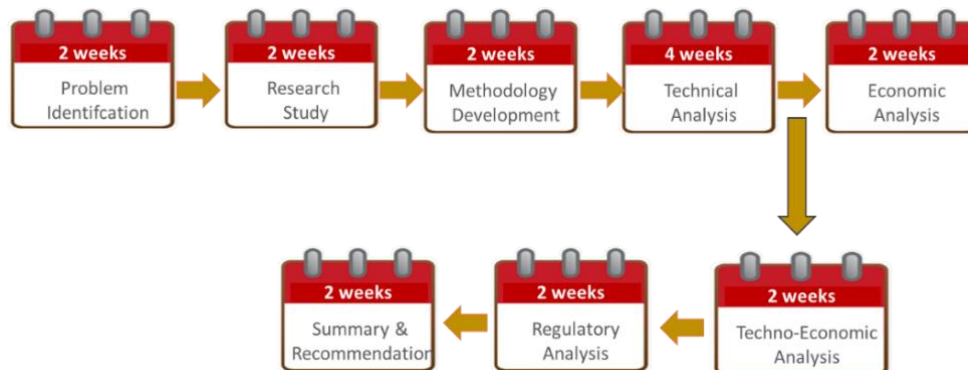
Regulation	About	Used for	Focus Area
PP nomor 46 tahun 2021	Pos, Telekomunikasi, Penyiaran	Telecommunication New Law Regulation	Sharing Infrastructure
Permen Kominfo nomor 5 tahun 2021	Penyelenggaraan Telekomunikasi	Telecommunication New Law Regulation	Sharing Infrastructure
UU nomor 6 tahun 2023 jo Perppu nomor 2 tahun 2022 jo UU nomor 11 tahun 2020	Penetapan Perppu pengganti UU Cipta Kerja	<ul style="list-style-type: none"> <li>• Anti-Monopoly</li> <li>• Simplification for Business</li> </ul>	Sharing Infrastructure
Permen Kominfo nomor 7 tahun 2018	Pelayanan Perizinan Berusaha Terintegrasi Elektronik Bidang Komunikasi & Informatika	Telecommunication Network Infrastructure Permit	Minimum Deployment Commitment

## 1.7 Hypothesis

The efficient establishment of FTTH telecommunications network infrastructure in a region to accommodate multiple internet service providers can be achieved by leveraging fiber network sharing infrastructure and optimizing GPON technology on FTTH networks constructed by real estate property developers. In addition, real estate property developers could develop a lucrative business venture by engaging in revenue sharing arrangements with Internet Service Provider (ISP). This collaboration would enable them to promote enhancements in joint infrastructure policy regulations, specifically in the realm of fiber network sharing infrastructure within real estate property areas in Indonesia.

## 1.8 Research Timeline

The research for this thesis will be conducted in accordance with the predetermined timeline to ensure timely completion. Figure 1.5 displays the sequence of stages and description of research efforts in this thesis.

**Figure 1.5** Research's Timeline