

CHAPTER I

INTRODUCTION

1.1 Background

In the digital era, the need for fast, accurate, and reliable access to information, communication, and services is increasing [3]. Technological developments and a growing dependence on online systems for various community needs drive this trend. Despite these obstacles, many companies appear willing to work through the challenges to realize the transformational potential of private networks. There were 748 private network deployments in enterprises worldwide in January 2022, up roughly 14% since November 2021 and almost 43% since September 2021, according to the Global mobile Suppliers Association (GSA), which tracks private network deployments globally meeting these demands requires a network that enables secure access to information without compromising speed or reliability [4]. The availability of a stable and secure network is essential not only for individual users but also for organizations that rely on efficient data exchange in their daily operations.

A private network is a network that is exclusively managed and controlled by a company or organization to maintain security and control the data flowing within it. Unlike a public network, this network is equipped with additional layers of security, such as authentication, encryption, and access restrictions, which ensure that only certain users or business partners can access it [5]. With a private network, companies can set security policies as needed, enable secure data exchange, and monitor network activity in real-time to detect and prevent potential threats early on. These private networks are typically used for internal communications, remote server access, or data exchange between offices in different locations [6], so sensitive information remains protected and the risk of cyberattacks is minimized.

One effective method to support private networks on a large scale is a Software-Defined Wide Area Network (SD-WAN). According to IDC forecast data, the SD-WAN infrastructure market grew by 25.0% in 2022, and it is expected to continue expanding at a Compound Annual Growth Rate (CAGR) of 10.1% through 2027, ultimately reaching \$7.5 billion [7]. This software-defined solution enables data traffic management across multiple WAN lines in a more flexible and centralized manner [2]. It supports secure connections via a private network for each branch

of the company. With SD-WAN, companies can optimally utilize public and private internet connections, improving application performance and lowering overall WAN network operating costs [2]. SD-WAN offers advantages such as high network flexibility, cost efficiency, good reliability, and ease of network management and security. With a software-defined architecture, SD-WAN moves network control and management functions to a centralized controller that directly manages edge devices or Customer Premises Equipment (CPE) at various locations, eliminating the need for direct access to internal WAN devices such as routers or switches from service providers [8]. In addition, SD-WAN provides end-to-end encryption and centralized control, ensuring optimal data security between locations. One of the methods used in SD-WAN based VPN is the creation of a secure communication channel between two network points, such as routers or firewalls, referred to as tunnel endpoints [9].

This research proposes the implementation of SD-WAN to connect central and branch connections in XYZ Company. The analysis is conducted from three main perspectives: technical, economic, and regulatory. From the technical side, this research simulates a network topology that resembles real conditions in companies that have branch offices. This simulation includes device configuration to test the effectiveness of managing data traffic between locations and providing significant operational efficiency for companies in managing widespread networks.

From an economic perspective, this research analyzes the feasibility of implementing a private network using SD-WAN. This analysis aims to determine the cost efficiency and potential benefits of SD-WAN investment through a comprehensive evaluation of economic aspects. Calculations were made using the Capital Expenditure (CAPEX) and Operational Expenditure (OPEX) methods, as well as techno-economy analysis that includes Net Present Value (NPV), Internal Rate of Return (IRR), Profitability Index (PI), and Payback Period (PP) [10]. Through this approach, the research can assess whether the investment in SD-WAN provides significant financial benefits in the long term, as well as identify the optimal payback period.

From a regulatory perspective, Indonesia does not yet have specific rules governing the use of private networks by companies to connect internal systems with business partners. Currently, private networks used by companies or government agencies are not subject to Non-Tax State Revenue (PNBP), Right to Use Fee (BHP), or contribution for Universal Service Obligation (KPU/USO). In fact, these obligations are the main contributions that must be fulfilled by every telecommunications provider in accordance with Government Regulation Number 43 of 2023 and Minis-

ter of Communication and Information Technology Regulation Number 5 of 2021. However, private networks are treated like Special Telecommunication Networks (Telsus) as stipulated in Article 9 of Law Number 36 Year 1999. This causes a mismatch between the utilization of private networks and existing regulations. In addition to considering other regulations, such as Government Regulation Number 52 of 2000 concerning Telecommunications Implementation, Law Number 11 of 2020 concerning Job Creation, and Government Regulation Number 46 of 2021 concerning Post, Telecommunications, and Broadcasting.

This research is expected to help the government formulate more specific and relevant regulations related to private networks. The regulation must include rules for secure external access and ensure tax obligations for private network operators. With clear rules in place, the potential misuse of private networks for commercial purposes can be prevented.

1.2 Problem Identification

The need for the internet and the implementation of private networks SD-WAN allow companies to connect central connections with branches efficiently and securely. However, implementing private networks using the SD-WAN various challenges, especially the need for reliable and efficient infrastructure, including cost and data protection. The ambiguity of regulations related to taxes and private network contributions creates legal uncertainty for companies. At the same time, sub-optimal monitoring mechanisms increase the risk of misuse for commercial purposes without tax obligations. To ensure that SD-WAN can be implemented effectively, a technical analysis is required to optimally and securely support the network's needs, and an economic analysis is to determine that the investment in this technology provides a worthwhile return. Through technology, economic, and regulatory analysis, SD-WAN implementation is expected to run optimally, sustainably, and in accordance with applicable regulations in Indonesia.

1.3 Objective and Contributions

This research evaluates the feasibility of implementing a private network using SD-WAN for a multi-branch company. This analysis covers three main aspects: technology, economic, and regulatory. From the technical aspect, the research will simulate network planning to ensure the network runs optimally. Meanwhile, from the economic side, investment feasibility is assessed using CAPEX and OPEX ap-

proaches and techno-economy analyses such as NPV, IRR, PI, and PP. On the regulatory side, this research reviews the rules governing private networks in Indonesia and provides policy recommendations that are in line with best practices. The results of this research are expected to help the government formulate and update policies related to private networks so that the implementation of SD-WAN becomes more efficient and relevant to industry developments and the needs of society.

1.4 Scope of Work

To keep the experiment from being too long, this thesis limits the works as follows:

1. This research will analyze the application of the private network SD-WAN method.
2. The implementation and application of the research are carried out under the assumption that the researcher acts as a technology provider.
3. The private network case study focuses on implementing the connecting structure between the company and branch connections.
4. The topology used in this simulation will illustrate the connecting structure between hub and branch office in XYZ Company.
5. Network simulation will be performed using a network emulator.
6. The technology analysis will concentrate on the implementation of a private network using the SD-WAN method.
7. The economic analysis will include feasibility calculations, considering CAPEX, OPEX, and techno-economy, including NPV, IRR, PI, and PP resulting from implementing the SD-WAN private network.
8. Given the absence of specific regulations governing the commercialization of this kind of private network, policy recommendations are needed to address potential discrepancies with applicable regulations.

1.5 Hypothesis

This research hypothesizes that implementing SD-WAN can improve the operational efficiency and security of enterprise networks with multiple branches and

provide significant economic benefits through reduced operational costs and more efficient investment. This is based on the results of previous research showing that SD-WAN deployments can optimize data traffic management between branches, improve application performance, and reduce dependence on traditional WAN networks that are more expensive and less flexible [2] [8]. Although regulations in Indonesia regarding the use of private networks are still incomplete, this research predicts that the need for clear and detailed regulations will become more urgent as more companies adopt SD-WAN technology. Therefore, more specific policies and clear regulations will be needed to govern the use and supervision of private networks.

1.6 Research Methodology

This research follows several methodological stages as explained in Fig 1.1 SD-WAN development research methodology flowchart and explanations are outlined below:

1. Problem Identification

This stage focuses on identifying the problems to be solved in this research, including challenges related to technology, economics, and regulation of the SD-WAN.

2. Study Literature

Various references, such as books, scientific journals, research reports, and other relevant sources, will be reviewed to understand the theories and best practices related to this research topic.

3. Data Collection

Relevant data will be gathered from specific sources, including interviews with parties involved in using private networks, such as those that connect hub and branch. Confidentiality policies may restrict some information, but the collected data is expected to provide a comprehensive overview.

4. Analysis

The analysis will cover technical, techno-economic, and regulatory aspects. Simulations and calculations will evaluate the feasibility and effectiveness of implementing the SD-WAN method.

5. Results, Recommendations, and Conclusions

Based on the analysis, the research will present findings regarding the fea-

sibility and effectiveness of implementing the SD-WAN. Recommendations will be provided to support the optimal implementation of private networks, including suggestions for simplification or regulatory proposals. Conclusions will be drawn from the analysis results, with recommendations offered to ensure the effective implementation of private networks in Indonesia.

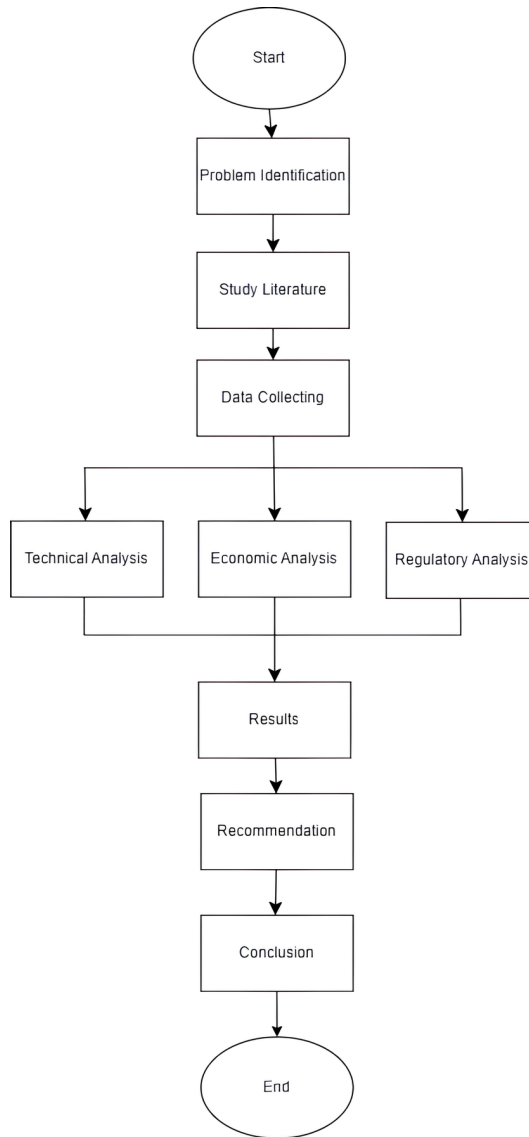


Fig 1.1 SD-WAN Development Research Methodology Flowchart

1.7 Research Plan and Action Point

This thesis research will be carried out according to the planned timeline so that it can be completed on time. Fig 1.2 shows research timeline of SD-WAN development flowchart.

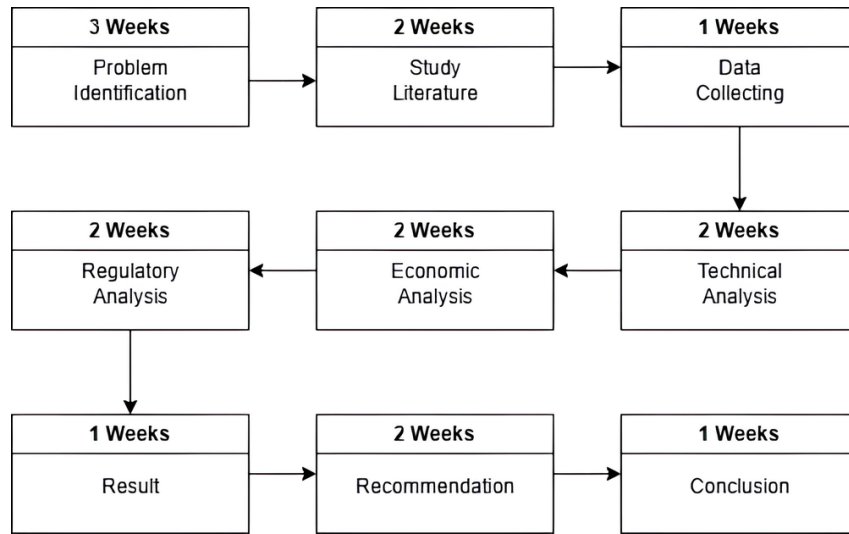


Fig 1.2 Research Timeline of SD-WAN Development Flowchart