CHAPTER 1
INTRODUCTION

1.1 Background

The increasing number of users for communication services is increasing, especially for broadband services. Therefore, network providers are required to provide services with high capacity to ensure users get broadband services without any obstacles from traffic congestion. Long Term Evolution (LTE) service is a communication service network that provides high speed data access. Indonesia has implemented an LTE network at a frequency of 1800 MHz since 2015[1]. Although the LTE network has been implemented since 2015, not all areas can be covered by 4G networks, especially in big cities[2].

In the study of Techno-Economic Analysis in the Banten Area, it was carried out at a frequency of 1800 MHz with a bandwidth of 5MHz, 10 MHz and 15 MHz and used a capacity planning and coverage planning technique approach. These results are feasible to be implemented by calculating NPV, IRR, and Payback Period [3]. In another study, LTE network analysis was conducted at a frequency of 700 MHz and 1800 MHz with a bandwidth of 15 MHz in the Bekasi Regency area with a techno-economic approach, the results of this study at the 700 MHz frequency were produced with a total of 670 sites with a bandwidth of 15 MHz more feasible to implement than the frequency of 1800 MHz which requires 1110 sites for LTE network deployment [4]. There is a Comparison study of Network Costs and Feasibility of LTE Technology at 900 MHz, 1800 MHz, 2100 MHz, and 2300 MHz frequencies. From the results of these studies using the cost and benefit analysis method to determine the comparison of the feasibility of using appropriate frequencies for LTE network deployment [5]. From a number of studies that have been carried out previously, there is no study that compares alternative LTE candidate frequency bands as a whole at the frequencies that will be carried out in this study.

The proposed research is to compare the alternative candidate frequency bands of LTE that will be used for LTE network expansion, that is UHV (700 MHz), 3G

(2100 MHz), and WiMax. (2300 MHz). The comparison is carried out in the perspective of sensitivity analysis of the influence of LTE carrier frequency and the effect of bandwidth on CAPEX and OPEX costs in the research area for urban, suburban, and rural areas in Yogyakarta City. This research will conduct technical analysis by calculating capacity planning and coverage planning as well as techno-economic analysis. The results of this study will later be considered for the operator in terms of the cost difference in implementing each candidate frequency in the implementation of LTE network expansion to overcome traffic congestion by producing a study of the difference in the cost of implementing each candidate frequency for LTE networks.

1.2 Research Problem

The formulation of the problem in this study is the need for a study of the feasibility of candidate frequencies in the application of LTE networks to increase the capacity of the access network. Viewed from the operator's point of view, this study is useful in providing a concrete measure of the difference in implementation costs for alternative LTE frequency candidates which is carried out in the following stages.

a. How to design Long Term Evolution modeling at 700 MHz, 2100 MHz, and 2300 MHz frequencies?
b. How to do LTE network simulation for candidate frequency?
c. How the results of the design and technical analysis of the modeling design?
d. How is the sensitivity analysis to LTE candidate frequencies for network expansion?

1.3 Research Objectives

The purpose of this study is to provide recommendations for frequency candidates to be used on LTE networks in urban, suburban, and rural areas for the feasibility of implementing network applications. The sensitivity analysis method is used to determine the difference in the cost of implementing the LTE network by performing the following steps.

a. Designing LTE network modeling at a frequency of 700 MHz, 2100 MHz, and 2300 MHz.

b. Simulating LTE networks on candidate frequencies using software.

c. Perform technical analysis of LTE network design results from software. Perform sensitivity analysis to find differences from the implementation of LTE candidate frequencies.

1.4 Scope of Problem

This research has problem limitation as follows.

a. This study designs LTE networks for candidate frequencies of 700 MHz, 2100 MHz, and 2300 MHz.

b. Technical analysis is carried out with capacity planning and coverage planning.

c. The economic analysis in this study uses techno-economic analysis.

d. The sensitivity analysis carried out in this study was carried out on changes in the Net Present Value of changes in ARPU values and the number of users for each candidate frequency.

1.5 Research Methodology

This research has a workflow that is carried out in several stages:

1. Literature Study

   Literature studies are taken from books, results of previous research such as journals or papers, and other official sources for information in conducting this research.

2. Data Retrieval

   Retrieval and collection of related data such as population data in Yogyakarta City from data from the Badan Pusat Statistik (BPS) and market share providers that are used to forecast users for the next few years..

3. Technical Analysis

   At this stage, calculations are carried out for LTE network design using capacity planning and coverage planning.

4. Economic Analysis

The economic analysis is carried out using a techno-economic model to determine the cost of operation and revenue for operators who will deploy LTE networks on each candidate frequency. Calculations that can be known include CAPEX, OPEX, Net Present Value (NPV), Internal Rate of Return (IRR), and Payback Period (PBP)..

5. Sensitivity Analysis

Sensitivity analysis in this study was conducted for the sensitivity of the NPV value to changes in the ARPU value and the number of users.

6. Conclusion

Conclusions are made based on the results of the data obtained in the study.

1.6 Research Roadmap

This research is divided into four stages, namely stage 1 regarding the proposal of the title and method to be used in this research as well as an explanation of the research flow or process, stage 2 is identifying and collecting design data and performing calculations from the technical side and economic assumptions. 3 perform design simulations using Atoll and perform techno-economic calculations, and in stage 4 perform a comparison of the results that have been obtained and analyzed using sensitivity analysis. The image of the research roadmap can be seen in Figure 1.1.
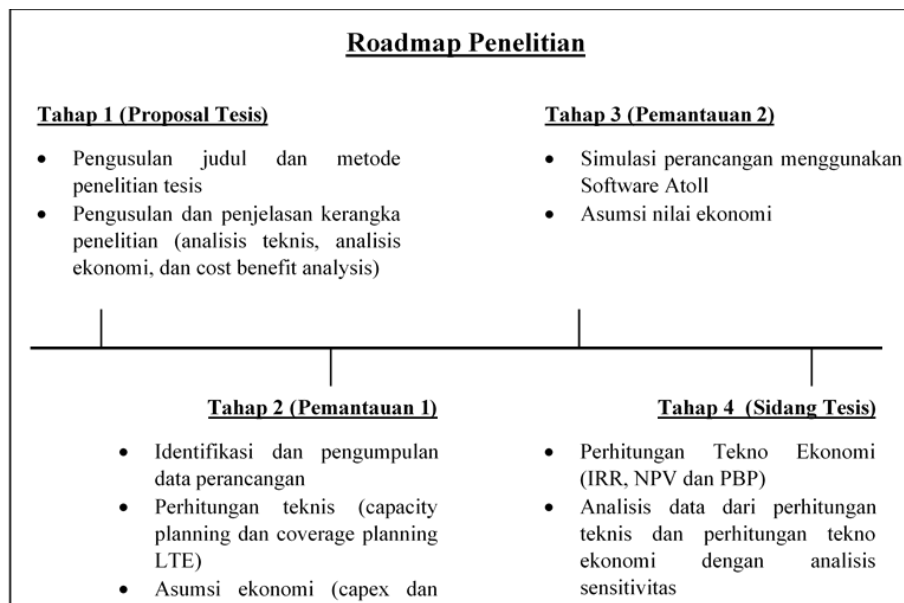
Roadmap Penelitian

Tahap 1 (Proposal Tesis)
- Pengusulan judul dan metode penelitian tesis
- Pengusulan dan penjelasan kerangka penelitian (analisis teknis, analisis ekonomi, dan cost benefit analysis)

Tahap 3 (Pemantauan 2)
- Simulasi perancangan menggunakan Software Atoll
- Asumsi nilai ekonomi

Tahap 2 (Pemantauan 1)
- Identifikasi dan pengumpulan data perancangan
- Perhitungan teknis (capacity planning dan coverage planning LTE)
- Asumsi ekonomi (capex dan

Tahap 4 (Sidang Tesis)
- Perhitungan Tekno Ekonomi (IRR, NPV dan PBP)
- Analisis data dari perhitungan teknis dan perhitungan tekno ekonomi dengan analisis sensitivitas

Figure 1. 1 Research Roadmap