# CHAPTER I
# INTRODUCTION

## 1.1. Background

The rapid growth of mobile services, increasing demand for multimedia applications and widespread use of mobile devices have led to impressive growth in data traffic volumes over the last few years. In more detail, there is an almost 11-fold increase in global mobile data traffic in the next five years, and it is predicted to reach 175 zettabytes per month by 2025 [17]. The current cellular network ecosystem is more competitive; on the other hand, there has been a very significant decrease in revenue for legacy services [6].

The growth in traffic and bandwidth on cellular networks is increasing significantly (forecast 175 ZettaByte, 2025, IDC Data Age Seagate) [17]. This is what causes cellular operators to spend very expensive investments (Capex) on building infrastructure capable of accommodating these bandwidth requirements. [6]. The current challenge is that each operator has to build their own infrastructure, and this condition is very inefficient from a business perspective. So that an infrastructure scheme for sharing 5G technology between Mobile Network Operators (MNO) is needed, which is expected to reduce Capex and Opex significantly and also to accelerate network development.[1][3][4][6]. Studies on sharing infrastructure for Mobile Network Operators have been extensively researched in order to reduce capex and opex (cost efficiency). Adaptive and custom schemes are also offered, starting from the type of resource to be shared (spectrum, capacity, hardware)[2][7][10], sharing Radio Access Network (RAN), *MOCN (Multi Operator Core Network)* [6][7] and sharing scheme (cost sharing and revenue sharing)[5][6]. Regulatory aspects and feasibility studies are also important factors in implementing sharing infrastructure.

In this thesis, the author has examined the feasibility of a 5G infrastructure sharing scheme for cellular operators in Indonesia using three aspects, namely technology, economy and regulation. From the technological aspect, the writer has analyzed the capacity approach and coverage approach. The economic aspect is

carried out to test the business feasibility of this RAN-frequency sharing scheme from the cellular operator's point of view. Meanwhile, regulatory analysis is used to determine the extent to which regulations have been implemented in Indonesia regarding infrastructure sharing. The research has been conducted in 2 types of areas, the urban city named Banjarmasin and the suburban city named Banjarbaru.

## 1.2. Problem Identification

The formulation of the problems examined in this thesis include:

1. 5G services have not yet been deployed in South Kalimantan, especially in Banjarmasin and Banjarbaru city. Operators will not be able to win the competition. And they will not be able to meet the increasing needs of the community for mobile broadband, which will eventually cause the country's economy not to grow.
2. Cellular operators find it difficult to deploy 5G networks due to investment costs very expensive. This causes the development of the 5G network to be delayed, which will eventually cause the country's digital economy not to grow.
3. Limited telecommunication resources such as frequency spectrum so that operators cannot meet the network capacity required by the community.
4. From the explanation of the problems above, a study about the feasibility of planning 5G network from a technical, economic and regulatory perspective is needed to solve the problems.

## 1.3. The Aims of Research

Based on the background behind this research, the objectives of this study were determined as follows:

1. Propose recommendations for Indonesian cellular operators (or other related parties) to adopt infrastructure sharing using the ran-spectrum sharing model with Standalone RAN elements and Non-Standalone core elements that can reduce Capex.

2. Analyzing implementation feasibility of Infrastructure Sharing with the RAN-Spectrum Sharing scheme in a techno-economy using the Sensitivity Analysis method.
3. Present potential business models in the Sharing era and their role in the Indonesian business ecosystem.

## 1.4. Hypothesis

The main problem faced by all cellular operators in Indonesia is the cost of infrastructure investment that very expensive [6]; another problem is capacity and coverage; limited telecommunication resources such as frequency causes operators who have a large user have difficulties in terms of fulfilling capacity, while for Operators that have a small customer base are facing problems with coverage, because they do not have BTS infrastructure assets as many as the big operators, but they have more excess frequency resources or even idle.

The problem of capacity can be solved by sharing frequency, while the problem of coverage can be solved by sharing Radio Access Network (RAN).

Based on various references, a hypothesis can be set that frequency sharing and RAN sharing can reduce capex and opex costs and overcome capacity and coverage problems of cellular operators in Indonesia [7].

The derivative hypothesis is as follows:

1. End user experience (capacity, coverage) during sharing has been maintained, and these two variables have been proven by a simulation scheme using atoll.
2. This RAN-spectrum sharing scheme has reduced cellular operators' Capex and Opex costs in building infrastructure, proofed by simulations of economic variables such as the Internal Rate of Return (IRR). Net Present Value (NPV) and Payback Period (PP) which analyzed using the Sensitivity Analysis (SA) method.

## 1.5. Research methods

In general, this research was conducted using the experimental method in the following order:

1. Study of Literature

   Study theories that are appropriate and related to 5G technology are needed through various references such as books, previous research papers, and journals that support the design of 5G telecommunication networks both technically and economically.

2. Data Collection and Processing

   After studying the literature, then continuing with the data collection process, data is collected from telecommunications service providers or other related parties. Data processing is carried out to determine the initial market capacity and projected an initial number of users from the design. Data collection includes data on existing infrastructure, market share, number of customers, market share, ARPU (Average Revenue Per User), total population, population density, population growth rate, and wide of area. In addition, several things need to be collected that regarding the current regulations related to this research

3. Technical Calculations

   After obtaining the data and processing the data that support the research, then proceed with the calculation process to identify the projected number of users, final market capacity, traffic demand requirements, spectral efficiency, link budget, coverage, and path loss. The approach is carried out in two ways, namely, the capacity approach and the coverage approach.

4. Network Planning and Simulation

   The design and simulation process using Atoll software which is used to simplify the calculation process and obtain the desired parameters, namely SINR to determine signal coverage and RSRP to determine signal quality.

5. Business Feasibility and Sensitivity Analysis

   The analysis is carried out after the calculation, design, and simulation processes have been completed. The analysis process is carried out to

discuss the economical deployment of 5G telecommunications networks with non-sharing scenarios and investment cost sharing for modeling in Banjarmasin City (Urban) and Banjarbaru City (Suburban), with the parameters Internal Rate of Return (IRR), Net Present Value (NPV), Payback Period (PP) and also Sensitivity Analysis (SA).

## 1.6. Scope of The Problem

To strengthen the points of concern, the various problems solved in this study are limited as follows:

1. The network sharing model that analyzed in this study is Core Network Sharing (CN Sharing).
2. The 5G NR scheme uses 5G RAN gNodeB, but it does not use 5G Core Network. The scheme still uses 4G Core Network.
3. The Radio Access Type that shared is 5G NR at frequency 2300 MHz.
4. The research object of this thesis is the Mobile Network Operator (MNO). The number of cellular operators is limited to 3 operators namely Telkomsel, Indosat Tri, XL.
5. The areas used in this study are urban namely Banjarmasin city and suburban areas namely Banjarbaru city.
6. Techno-economic calculations are performed using Net Present Value (NPV), Internal Rate of Return (IRR), Payback Period (PP), and Sensitivity Analysis (SA).