# CHAPTER I
# INTRODUCTION

## 1.1 Background

Progress technology is one influencing factor development of infrastructure telecommunication. One technology medium new crowded discussed all over the world Open RAN (Open Radio Access Network) technology. Open RAN is the separation of device hardware and devices, that is, device hard RRU / RRH to be device hard GPP or COTS based, which can be bought from the device vendor hardware ODM, OEM, or RAN. Open RAN explained that the interface between BBU and RRU / RRH is interface open, so the device soft from any vendor works on open RRU / RRH [1].

Differences between Open RAN compared with Traditional RAN i.e., Open RAN does tie to one vendor but can use several vendors due to an open interface, so costs are cheaper than traditional RAN [2]. With the implementation of the Open RAN on 2G and 4G networks, then comparison from side technical and business between Open RAN and Existing RAN. Comparison is done with a few stages that, link budget calculation, capacity dimensioning, and gNodeB throughput. One most important calculation stage namely capacity and coverage analysis [2].

From several studies that discuss 5G, Open RAN is the answer main of 5G because 5G requires low latency [ 3]. Open RAN can create low latency using combined RAN virtualization with SDN. Combination virtualization (NFV and containers) and this SDN are used for enabling configuration, optimization, and control of RAN infrastructure [4][6]. Here's what will create the Radio Intelligent Controller (RIC). RIC provides functionality control level further, which gives enhancement efficiency and management source more radio power ok. Functionality control: This utilizes approach analytics and data-driven level ML/AI tools to increase data transmission's ability to be two-part, namely near-real Time and non-real-time [6].

Open RAN create RAN architecture, being an open interface from facet components, software, and hardware. Open RAN can minimize CAPEX and OPEX because The Open RAN architecture consists of RRU, centralized unit (CU) and distributed unit (DU). In traditional RAN, CU and DU are combined from BBU; in Open RAN, CU and DU are separated with a maximum distance of 5 KM [3]. Separation of CU and DU can lower CAPEX and OPEX because one CU can use some RRU, and one DU can be used for some CUs. So that RAN architecture can become more flexible [4]. Besides more flexible Because CU and DU devices also work by optimizing performance in real-time, improving quality of service, and having low latency Because already implementing it Radio Intelligent Controller (RIC).

Research This study studies the appropriateness 5G network using Open RAN, which will compare with the usual Traditional RAN with analyze facet techno-economics with a case study in the South Jakarta area. The results of this thesis can give recommendations for telecommunications operators to roll out 5G networks by implementing Open RAN in Dense Urban areas and throughout Indonesia.

## 1.2 Objective

There is Objective from study:

1. Count needs gNodeB to use coverage and capacity planning.
2. Get results CU and DU needs of results calculation coverage and capacity planning for shows Open RAN can efficiently need midhaul and backhaul.
3. Count and analyze based on analysis techno-economics using IRR, NPV, PBP and sensitivity calculation tools to compare CAPEX and OPEX based on the architecture feasibility of Open RAN and traditional RAN. So that expected can give recommendations for telecommunications operators to roll out 5G using the Open RAN method.
4. Conducted Open RAN technical tests that demonstrated Can multivendor integration.

## 1.3 Scope Of Problem

Research focuses on the comparison of RAN infrastructure with Open RAN from a corner view techno-economic regarding the need for 5G technology and the obstacles it faces in 5G implementation. The scenario used is Centralized RAN. Besides that, calculating capacity and coverage becomes a solution to overcome comparison. Based on the background, the issues discussed in the study are the need for infrastructure network telecommunications in Dense Urban areas, aspects of economy development, and recommendations for regulation related to Open RAN in Indonesia.

## 1.4 Scope Of Work

Assumptions and limitations problem used in the study This is as follows:

1. The area to implement the 5G network using Open RAN is the City of South Jakarta, which will later compared to with implementation of the traditional RAN.
2. 5G frequency used is mid-band frequency at 2.3 GHz.
3. Focused 5G scenario that is Centralized RAN
4. Design 5G network uses coverage planning and capacity planning.
5. Calculation techno-economics carried out using IRR, NPV, PB and sensitivity tools.
6. Use Wireshark as a tool for testing Open RAN integration.

## 1.5 Research Methods

Technique method used in study This is as follows:

1. Method Open RAN

   Comparison of existing Traditional RAN infrastructure. There is with Open RAN
2. Capital Budgeting

   Capital Budgeting is a method for estimating the appropriateness of financial capital investment during the investment period.

3. Benchmarking

The benchmarking method is activities an organization or agency carries out to determine performance achieved and improve performance. Activity This is done by comparing processes and practices existing work with organizations or other agencies with the same work process.

## 1.6 Hypothesis

Based on research results that have been done, 5G using Open RAN will reduce CAPEX and OPEX costs with flexible architecture and open interface. 5G network planning and analysis research scheme techno-economics in this thesis shows whether the proposed technology is worthy of application [8][9]. So, the expected hypothesis in this thesis is study. This can test eligibility and deliver recommendations from analysis of techno-economics for 5G deployment using Open RAN, which will conducted in South Jakarta.

Tabel 1. 1 State Of The Art

| No | Writer | Year | Title | Problem | Methode | Result |
|---|---|---|---|---|---|---|
| 1 | Muhammad Adam N, Muhammad Imam N, Putri Rahmawati | 2022 | An Assessment of 5G NR Network Planning for Dense Urban Scenario: Study Case of Jakarta City | Assessing the Capacity and Coverage needs of the 5G network for the Jakarta area | gNodeB calculations use Capacity and Coverage for 2021 to 2026 | Capacity planning requires 203 gNodeB. In comparison, coverage planning requires 194 gNodeB. Meanwhile, the total required gNodeB and generated traffic demand forecast for all municipalities in Jakarta city is 778 gNodeB and 17.68 |

| No | Writer | Year | Title | Problem | Methode | Result |
|---|---|---|---|---|---|---|
| | | | | | | Gbps/km2, respectively |
| 2 | Yudha Aprilianto, Muhammad Asrol, Fergyanto E Gunawan | 2021 | Economic Feasibility Analysis in Developing 5G Infrastructure and Locations in Indonesia | Calculating the feasibility of 5G infrastructure | Calculation of 5G Capacity and Coverage from a technical perspective and sensitivity from an economic perspective | The DSS will possibly provide a quick analysis to assist managers to decide which locations and criteria to be considered in developing 5G technology in the future. |
| 3 | Grochla K, Kovtun V | 2022 | Investigation of the competitive nature of eMBB and mMTC 5G services in conditions of limited communication resource | The main issue discussed is how to manage resource allocation between eMBB and mMTC service customers. Consider three different management schemes, namely balanced, competitive and prospective. Each scheme has different implications in resource allocation and use. | This article uses the Markov model as the basis for analysis. Markov models are mathematical tools used to model stochastic processes in which the current state depends only on the previous state. The development of a Markov model may involve creating various states or states that may occur in the resource allocation process. | The presented model allows to estimate in the time domain the values of characteristic parameters such as the average duration of IoT sessions, the average number of active multimedia/IoT sessions, the average number of channel resource units used by multimedia/IoT traffic, and the average number of resource blocks used by multimedia/IoT traffic. |

## 1.7 Research Methodology

Steps research used in the Study This is as follows:

1. Literature Study

   Studies literature do observation with method study various type references like paper research, journal academic, papers, textbooks, surveys analysis associations, reports from government, and others support Study This

2. Collecting Data

   Data collection includes data on existing infrastructure, market share, amount customers, and some operator's properties.

3. 5G NR Network planning for determining the number of sites.

   Counting some sites with consider capacity and area coverage. The amount end site is obtained by choosing and comparing several sites from coverage planning and capacity planning.

4. Simulation and Analysis of the Results

   I am using software to simulate results calculation of coverage and capacity planning.

5. Result validation uses techno-economic analysis

   I am using the cost-benefit analysis model for test eligibility application network private 5G from prospective investment. The parameters used are revenue, CAPEX and OPEX.