CHAPTER 1
INTRODUCTION

1.1 Background

Based on Cisco's forecasting about fixed traffic and mobile traffic growth [1], the United States of America (USA) has less mobile data traffic than fixed traffic. However, in other countries such as Japan, Korea, Canada, Australia, India, China, even Indonesia have more massive mobile traffic growth than fixed traffic. It is related to video usage on mobile. Furthermore, since Long Term Evolution (LTE) connectivity, the trend has shifted from web browsing to application and content [2]. It causes rapid growth in mobile broadband penetration. Indeed, the availability of frequency spectrum for mobile broadband plays a vital role in facing the explained case. Unfortunately, the availability of the International Mobile Telecommunications (IMT) spectrum frequency is not comparable with its rapid growth of mobile data usage. So, we face a problem named spectrum scarcity.

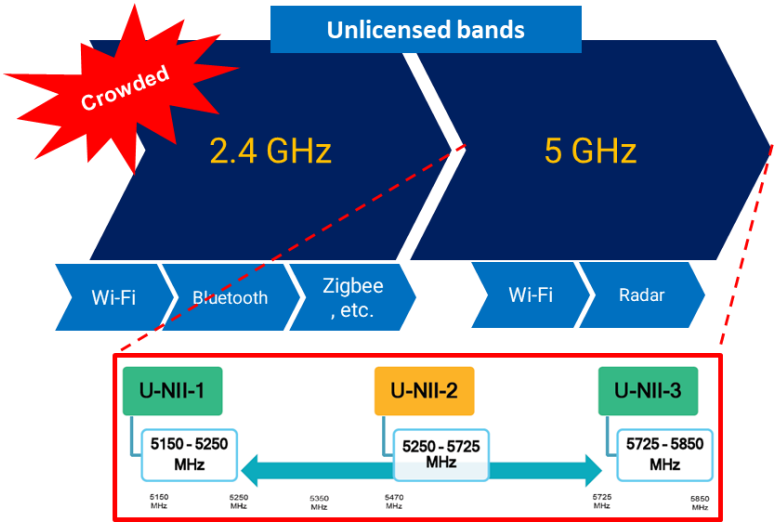

Figure 1.1 Unlicensed Band in 2.4 GHz is crowd while 5 GHz gives a chance

The desired solution is to utilize the unlicensed spectrum more efficiently by applying other wireless technology [3]. One example is Wi-Fi, which works in Industrial, Medical, and Scientific (ISM) 2,4 GHz dan 5,8 GHz frequency bands. However, the frequency band of 2 GHz has already been crowd, either for licensed band allocation or ISM 2.4 GHz for Wi-Fi, Bluetooth, Zigbee, and many more. However, a 5 GHz frequency band named Unlicensed Nasional Information

Infrastructure (U-NII) has been utilized just for radar system implementation and Wireless Local Area Network IEEE 802.11b/g/n/ac standard which is known as Wi-Fi [4].

Third Generation Partnership Project (3GPP) Release-13 standardization takes a look at this opportunity in the U-NII frequency band to enhance the capacity of LTE mobile broadband. It does introduce Licensed Assisted Access (LAA) concept. LAA is a way of Mobile Network Operator (MNO) to take some advantages of 5 GHz unlicensed frequency band portion or Band 46 based on 3GPP specification that has a role in 5150 MHz – 5925 MHz bands. LAA utilizes secondary cells as Supplemental Downlink (SDL) supported by the LTE frequency band as the primary carrier. It aims to improve spectral efficiency from the LTE air-interface by Carrier Aggregation (CA) [5].

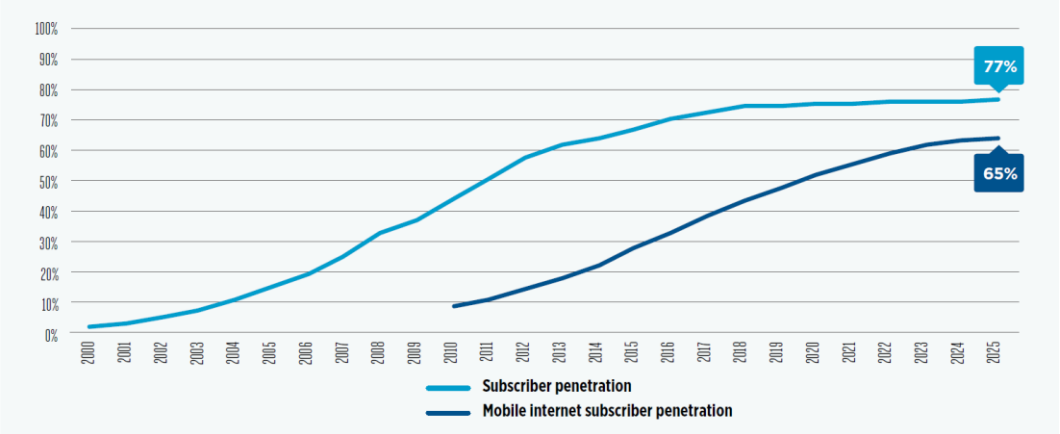

Figure 1.2 Massive internet penetration in Indonesia

Several countries in the world, such as Hong Kong, Italia, Rusia, and the USA, have launched and run LAA technology [6]. In South Africa, the existed technology is LTE-Unlicensed (LTE-U). It planned to operate LAA, which is on the national scale trial [6]. Otherwise, some other countries are doing each LAA trial agenda by their MNOs. They are India, Singapore, and including Indonesia [6].

Based on data from the Global System Mobile Association (GSMA) [7], Indonesia has 264 million population, and 39% of them are mobile internet penetration. It predicts that the amount of mobile internet penetration will be reaching 65% of the Indonesian population. Indonesia will be one of the biggest influences in the world of internet penetration growth in 2025 [7]. In the urban area

and the high density of mobile users, it is difficult to deploy more LTE sites due to the difficulty in the acquisition set. With its massive mobile internet penetration in Indonesia and high, the spectrum scarcity problem has to be a warning soon. One of its solutions is by deploying LAA technology in the urban area in Indonesia.

Research in [8] investigated network planning of LTE-Advanced Pro that contained LTE 1800 MHz and LAA 5 GHz. The advantage of the research is that the scenario gives the result of the quality of the network using simulation. The authors did a simulation of coverage prediction and capacity simulation using carrier aggregation as well. But, the research is only focused on the technical aspect. It is not discussing its economic and regulatory aspects of implementation in the case area. Therefore, we do study comprehensive about technical, economic, and regulatory analysis of LAA deployment in the urban area, in this case, MNO in Bandung, where has a high density of mobile user.

1.2 Problem Identification

Problem identification of this research are:

1. The necessity of LAA deployment in Indonesia is required to enhance capacity in the IMT frequency band, especially in the urban area.
2. Cost and Benefit Analysis of LAA deployment should be identified to do a business feasibility test.
3. Many countries in the world have already implemented and deploy LAA with their 5 GHz spectrum usage.

1.3 Objective

Objectives of this research are:

1. To calculate the technical requirements of LAA implementation in the urban area and high-density case in Indonesia and find out whether LAA can enhance LTE network capacity.
2. To find out whether LAA deployment in an urban area could be feasible in business from the MNO perspective by doing Cost-Benefit Analysis.

3. To analyze regulations from the benchmarks of other countries to provide recommendations to stakeholders related to LAA implementation in Indonesia.

1.4 Assumption and Problem Limitation

Assumption and problem limitation of this research are:

1. The network deployment considers outdoor and indoor areas in the urban area and high-density.
2. This study uses TR 36.889 3GPP Release-13 as its technical study to analyze the technical aspect.
3. Technical analysis will discuss only the implementation planning of LAA as far as coverage prediction.

1.5 Research Methodology

The method used in this research are:

1. Study of Literature

   Study of Literature does an observation by a study from several kinds of references like research paper academic journal, paper, textbook, a survey of association analysis, reports from government, and others that support this study.
2. Collecting Data

   Several data comes from the global association, which does cellular research, and parties related to LAA implementation over the world.
3. Calculate Technical Requirements

   This step began by doing network planning of microcell LAA. It will use coverage- and capacity planning.
4. Cost Benefit Analysis

   Analysis of investment value consists of capital expenditure (CAPEX), operational expenditure (OPEX), net present value (NPV), and potential model business implementation.
5. Conclusion

The analysis result will be concluded, becoming a conclusion to answer problem identification, so it will provide a recommendation or suggestion to determine its appropriate of LAA implementation in Indonesia.

1.6 Hypotheses

First, LAA deployment will increase the mobile network capacity in the urban area. LAA deployment will not be distributed in all area of the city, but in high-density spots which their more capacity requirement happen. It is due to so many mobile users tending to the spectrum scarcity. By deploying LAA, capacity will be enhanced due to its carrier aggregation both in the licensed and unlicensed band.

Second, the implementation of LAA technology that supports LTE will give more revenue to MNO. It is because the network capacity will increase, and MNO gets more resources so that it can handle more users in the network.

Third, the regulatory of LAA deployment will not need more validation in telecommunication operation license and standardization. It is due to the technology of LAA, which is not a stand-alone system, but it is the secondary of the existing LTE network.