CHAPTER I
INTRODUCTION

1.1 Background

Connectivity was important in this all-digital era. Communication, access to knowledge, learning process, payment, and so on require connectivity. This phenomenon has been far predicted by Cisco which predicts that in the 2016-2019 period data traffic in Indonesia will increase 8x[1]. However, based on the results of a survey by the Indonesian Internet Service Providers Association (APJII) the penetration of Indonesian internet users in Q2 (2019-2020) was 196.7 million out of 266 total population or around 73.7% of the Indonesian population had been connected to the internet, but the distribution of this figure is uneven, 55.7% of the data is on the island of Java while in the Papua region, there are still many areas where telecommunications infrastructure is not available so that they do not have access to telecommunications services. Not only in Papua there are many similar areas located in Frontier Outermos area. Various things continue to be pursued by the government to support equitable connectivity throughout Indonesia. On September 3, 2020, the Indonesian government started a new satellite project called the Satellite of the Republic of Indonesia (SATRIA-1).

Satria satellite is a multifunctional satellite (SMF) specifically designed for the internet with a transmission speed of 150Gbps. With Very high throughput technology that will cover 150 thousand points of public space with 93 thousand points in schools and islamic boarding schools. This satellite had planned to launch in the fourth quarter of 2023 in the 146 BT orbital slot. The slot is an extension of the practice period for the PSN-146E filing approved by the Radio Regulations Board (RBB) of the International Telecommunication Union (ITU). In the process of launching and commercial implementation, of course, there are various things that must be prepared by the Indonesian government. Through this research, the formulation of spectrum management for High Throughput Satellites in Indonesia will be carried out. In the process, a comparative analysis will be carried out on the Ka-band and Ku-band frequency bands to determine the most efficient frequencies used in Indonesia. The formulation of the spectrum will be adjusted to the regulations governing satellites in Indonesia through the regulation of the Minister of Communication and Informatics of the Republic of Indonesia Number 21 of 2014 concerning the Use of Radio Frequency Spectrum for Satellite Services and Satellite Orbits.

Specifically, the frequency bands used for HTS are Ku-band and Ka-band[2]. The efficiency of the limited spectrum will be maximized through the reuse frequency scheme used. In many cases, 4-color scenarios have the best compromise between system capacity and performance. However 3-colour and 7- scenarios color can also be used[19]

In its system, VHTS/HTS represents a new generation of satellite systems capable of providing large throughput compared to fixed, broadcast and mobile satellites[2]. This system uses multiple spot beam techniques on the antenna which are more efficient than wide beams to cover the desired service area. To achieve a high reuse frequency looping rate the coverage area is no longer covered by one large beam but is covered by several spot beams with high gain and overlapping each other[3]. With such a concept and combined with the use of dual polarization, it will produce a much larger capacity than conventional satellites.

The SATRIA-1 satellite project is an excellent step taken by the government because building a satellite with high throughput will be more efficient in operational costs[4]. In 5G research, several countries use Ka-band frequencies [5] so that convergence between mobile and satellite can occur which can add commercial value from the high throughput of satellites. In December 2010 the first two multi-band Ka- band sets were launched for the European region, but still have limited flexibility for payloads so they need some development in the future[3].

Some European and Asian countries have used High throughput satellites to support their broadband networks. Indonesia will follow this step but we need to make some preparations before including assessing the capabilities of Ka-band in tropical countries. In this study, a comparative analysis of the frequency of Ku-band and Ka-band will be carried out for use in high throughput satellites, the analysis will be seen in terms of throughput owned and its capabilities in Indonesian weather conditions. After conducting technical analysis on both frequency bands The next step is to review the regulations regarding satellites, and whether the existing regulations are relevant for regulating high throughput satellites or if we need new regulatory changes.

1.2 Problem Identification

The Indonesian government does not yet have regulations governing high throughput satellites in Indonesia. In previous studies to support high throughput on HTS, Ka-band or Ku-band frequencies were used. So that through this research a comparative analysis will be carried out which will answer some of the following problem points:

- What are the efficient frequency bands used for HTS in Indonesia?
- Which frequency reuse scheme is better to use ?
- What are the rules for implementing HTS in Indonesia?
- How much does it cost to use the frequency spectrum for HTS satellites in Indonesia?

1.3 Objectives

Based on the problems behind this research, the objectives of this study are set as follows:

1. Analyze and examine existing regulations (national and international) governing satellites to become a reference for making regulations for HTS in Indonesia.
2. Create an HTS plan frequency scheme to see the available transponders.
3. Conduct Technical aspect analysis to compare the use of more efficient frequency bands for high throughput satellites in Indonesia.
4. Compare two frequency reuse schemes used to see how they affect the throughput.
5. Formulate a frequency spectrum price for high throughput satellites.

1.4 Hypothesis

Based on the formulation of the problem that has been given, the hypotheses expected in this study are:

- Ka-band will be more efficiently used on high throughput satellites. Based on previous research there is a decrease in C/N between Ku-band frequencies to Ka-band so the lower C/N results in lower throughput. Likewise with beamwidth, When the frequency emitted by the transmitter increases, the beamwidth will become narrower[avanti ku ka]. Not only

that the bandwidth of Ka-band is also much greater than Ku-band so it is likely that the cost per unit for Ka-band will be more efficient than Ku-band.

- Regulations to be made based on established regulations in Indonesia regarding the use of satellite communications with more specific details regarding spectrum pricing.

1.5 Methodology

The methodology of compiling this thesis will be compiled in several chapters as follows:

- CHAPTER I INTRODUCTION

  In this chapter, we will discuss the introduction, research background, problem identification, objectives, research methodology, and writing systematics

- CHAPTER II THEORETICAL FOUNDATIONS

  In this chapter, theoretical studies will be presented that will support and underlie this research. The theory that will be presented is about comparative analysis techniques, satellite communication systems, high throughput satellites, aspects of satellite regulation, engineering analysis which includes link budget, beamwidth, the concept of frequency reuse and multi-spot beam, as well as the satellite broadband market in Indonesia.

- CHAPTER III DESIGN

  This chapter will be explained the research scheme that will be carried out the process of data collection and analysis

- CHAPTER IV TECHNICAL COMPARATIVE COMPARISON OF FREQUENCY BANDS

  In this chapter, the results of a comparative analysis will be presented which includes plan frequency, capacity, coverage and frequency reuse scheme.

- CHAPTER V DRAFT REGULATION

  This chapter contains an explanation of regulations governing high throughput satellites in several countries as well as draft regulations for high throughput satellites in Indonesia. It will then close with conclusions and suggestions for the benefit of further research

1.6 Research Methods

In this study, the research method used is descriptive qualitative which the expected output is in the form of a solution description of the problem discussed. The research phase begins with collecting literature studies related to the problems discussed. Then continued by analyzing various data and references related to high throughput satellites, satellite existing regulations, spectrum management, frequency reuse scheme, and spectrum fee for satellite services.

The expected output is to obtain data on the influence of frequency bands, and the frequency reuse scheme on the resulting throughput and to see if the existing satellite regulation is still relevant for HTS or needs an update. For this reason, a study was carried out on these regulations including the rules regarding the pricing of the frequency spectrum.

1.7 Limitations of The Issue

To strengthen the scope of research points discussed in this study, problem limitations are given which include

1. The satellite technology used is a high throughput satellite (HTS)
2. Regulation focuses on HTS implementation rules in Indonesia
3. Frequency band analysis performed on Ku-band and Ka-band
4. Techno economics not discussed in this study because a comparison has been made in previous studies and will be used as a reference
5. The new formulation of the bandwidth cost index for the frequency spectrum price is only applicable for High throughput satellites.