CHAPTER I

INTRODUCTION

1.1 Background

The advancement of satellite technology has become one of the main drivers in the provision of global communication services, especially in areas that are very difficult to reach by terrestrial infrastructure. Indonesia, which is a large archipelagic country, still has complex problems in the distribution of broadband access, while Indonesia must be able to meet broadband [1] needs to strengthen digital connectivity.In this context, satellite technology is a very important solution because until June 2023, Indonesia has operated 10 active satellites, consisting of 6 GSO satellites and 4 Non-Geostationary Orbit (NGSO) satellites. In addition, the need for national satellite capacity is projected to reach 1 Tbps by 2030. One type of satellite that is expected to be a solution to this problem is the Geostationary Satellite Orbit (GSO) satellite [2]. This satellite has advantages in orbital stability and wide coverage, which allows for more reliable connectivity compared to ground-based systems. The GSO satellite has an orbital position of around 35,786 km above the equator, so it is able to provide communication services with a fixed range [3]. GSO satellites can also operate multiple frequencies simultaneously, allowing for more diverse and efficient use of services. One of them is the Ku-band frequency on the GSO satellite, which offers high efficiency, is key to supporting digital transformation in Indonesia, as seen in the report on optimizing satellite regulations for developing countries [4].

One of the real implementations of GSO technology is BRIsat, a satellite owned by PT Bank Rakyat Indonesia (Persero) Tbk. This satellite was launched in 2016 [5], and BRIsat is specifically designed to support BRI banking services throughout

Indonesia, including in areas that are difficult to reach by conventional communication networks [6]. By using Ku-band frequencies, BRIsat is able to provide reliable and efficient communication services, thereby improving the quality of BRI's services to its customers. Frequency management by GSO satellites in Indonesia cannot be separated from the implementation of telecommunications regulations that have been regulated in Government Regulation No. 53 of 2000 [7]. This regulation establishes the principle of spectrum allocation based on efficiency and coordination with the Radio Regulations of the International Telecommunication Union (ITU).

However, regulation remains a major challenge in the operation of satellites such as BRIsat. As a non-commercial satellite, BRIsat must comply with special telecommunications regulations in Indonesia, such as the Regulation of the Minister of Communication and Information Technology No. 12 of 2018 [8], which includes regulations on licensing the use of Ku-band frequencies. According to the ITU report, regulation is often a major obstacle to satellite market access, especially for developing countries that do not yet have a mature regulatory framework [9]. In its operations, BRIsat faces technical and regulatory challenges, especially related to frequency interference with JCsat-1C and the need for spectrum coordination at the international level. A spectrum interference analysis model is needed to explain how the Ku-Band spectrum in Indonesia is used by BRIsat and JCsat-1C and the potential for spectrum overlap. This model is important for understanding the impact of interference on system performance, which can be measured through the Carrier-to-Noise (C/N) and Carrier-to-Interference (C/I) calculation models, which provide an overview of the quality of service and throughput of the BRIsat system. [10].

From a policy perspective The ITU highlights that spectrum harmonization and coordination across countries are crucial elements to ensure efficient orbit and spectrum management and minimize potential interference between satellites [11]. Therefore, a market access regulation model is needed, which aims to understand

how spectrum regulation is applied in Indonesia in the context of BRIsat operations and its impact on GSO satellite market access. The methodology used in this study includes a quantitative approach, by conducting numerical analysis of C/N, C/I, Bit Error Rate (BER), throughput, jitter, and latency, to see the impact of interference on BRIsat capacity. In addition, regulatory analysis is conducted to examine spectrum access policies in Indonesia, including a comparison with JCsat-1C as a comparator, to assess the effectiveness of spectrum use implemented by BRIsat compared to other satellites operating in the same region.

This thesis research aims to conduct technical, regulatory, and coordination analysis of BRIsat as a GSO satellite and JCsat-1C in Indonesia, particularly focusing on the Ku-Band frequency. This study will examine the interference between BRIsat and JCsat by analyzing parameters such as C/N, C/I, C/N+I, and the impact of the interference. In this study, we provide an overview of the latest regulations issued by ITU-R. Furthermore, this study also assesses the effectiveness of the applicable regulations in supporting the operation of BRIsat as a special telecommunications satellite, so that it can provide relevant policy recommendations, both in technical and regulatory aspects, to improve the operational efficiency of the satellite and support digital inclusion in Indonesia. With this approach, it is hoped that the results of the study can provide real contributions to the development of national policies related to the management of GSO satellites and the Ku-band frequency spectrum in Indonesia.

1.2 Problem Identification

The identification of the problems in this thesis research is shown below :

1. What are the conditions of Ku-band spectrum usage in Indonesia in the context of GSO satellite market access, especially for BRIsat?

2. How does JCsat-1C interference affect BRIsat's performance based on tech-

nical parameters, such as C/N, C/I, BER, throughput, jitter, and latency?

3. How can radio regulations be optimized to support the efficiency and sustainability of GSO satellite communication services?

4. What interference mitigation and regulatory optimization strategies can be implemented to improve BRIsat's spectrum efficiency and service quality?

1.3 Objectives

Based on the background and identification of the fundamental problems of this thesis research, the objectives can be explained as follows :

1. Identifying challenges faced in spectrum management for GSO satellites, especially BRIsat.

2. Evaluating the impact of JCsat-1C interference on BRIsat's technical performance through analysis of C/N, C/I, BER, throughput, jitter, and latency parameters.

3. Identifying and reviewing spectrum access regulations and satellite markets in Indonesia in the context of BRIsat's operations.

4. Developing interference mitigation, spectrum usage optimization, and regulatory improvements to support the efficiency and sustainability of GSO satellite communication services.

1.4 Scope of Work

To focus the thesis research so that it remains focused, not too broad, and remains relevant to the objectives to be achieved. The following are the limitations of the problems that will be given:

1. Reviewing satellite regulations in force in Indonesia, including national policies such as Regulation of the Minister of Communication and Information No. 12 of 2018 for special telecommunications regulations, as well as the compliance of these regulations with international standards set by the International Telecommunication Union (ITU).

2. The BRIsat satellite which will be used as a case study as a non-commercial satellite, and how the special needs of this satellite are accommodated within the national regulatory framework.

3. Includes technical analysis, such as efforts to mitigate interference with foreign satellites anchored in Indonesia with the same frequency or adjacent orbits

4. Evaluating the role of international coordination in preventing and overcoming interference between BRIsat and foreign satellites, and how the spectrum and orbit harmonization process can support the sustainability of satellite operations

5. Includes an in-depth study of market access policies for non-commercial satellites in Indonesia, such as the licensing process, regulatory harmonization, and coordination process.

1.5 Hypothesis

1. Main Hypothesis

   The current regulation of GSO satellite market access on Ku-band frequencies in Indonesia does not fully support the operation of non-commercial satellites such as BRIsat, so a more flexible and adaptive policy update is needed to accommodate the needs of satellites with special functions.

2. Technical Hypothesis

The management of the Ku-band frequency spectrum in Indonesia still faces significant challenges, such as the potential for interference with other satellites in close orbits, and the success of interference mitigation is highly dependent on effective international coordination.

3. Regulatory Hypothesis

   The regulatory framework for market access in Indonesia tends to be more oriented towards commercial satellites, so that regulations for non-commercial satellites such as BRIsat are not yet optimal in supporting operational efficiency and its strategic objectives as a supporter of banking telecommunications services.

4. Implementation Hypothesis

   With the development of more comprehensive regulatory policies and better spectrum harmonization, satellite operations such as BRIsat can become more efficient and contribute significantly to increasing digital inclusion in remote areas in Indonesia.

1.6 Research Methodology

1. Literature Study

   This process studies the theories needed to understand and support research on implementation. Sources of related theories are obtained from books, conference proceedings, research journals, etc.

2. Data Collection

   Data is collected from related research journals, satellite operators, manufacturers, and other parties related to satellite operations and related to the implementation of BRIsat and JCSat-1C.

3. Technical Analysis

   Identifying the technical needs of interference that can be provided by the

satellite to be considered in implementing both satellites in real-world conditions.

4. Regulatory Analysis

   The analysis is carried out based on the results of the technical analysis that can be used as a reference for special satellite cases, namely in the Regulation of the Minister of Communication and Information No. 12 of 2018