

ABSTRACT

The rail industry is shifting from the Global System for Mobile Communications-Railway (GSM-R) to the Future Railway Mobile Communications System (FRMCS), which leverages advanced 5G technology to overcome GSM-R's limitations and support modern railway needs. This thesis provides an in-depth analysis of spectrum utilization efficiency at 1900 MHz for 5G-Railways in Indonesia from regulatory, technological, and economic viewpoints. The regulatory analysis informs policy recommendations for the 1900 MHz, outlining benefits for the government, railway operators, and stakeholders. The technological perspective explores the challenges of implementing 5G-Railways (5G-R), while the economic perspective evaluates the balance between investment costs and spectrum efficiency.

This thesis examines the island of Java, which has Indonesia's longest railway track, as the study area. It focuses on analyzing the spectrum utilization efficiency (SUE) of the 1900 MHz band for 5G-Railway services in Indonesia. This thesis evaluates the availability of the 1900 MHz band for 5G-Railway within Indonesia's current radio-frequency spectrum allocation table. Furthermore, this thesis determines the maximum allowable path loss (MAPL) to estimate the necessary number of base stations and assess investment feasibility based on the current business conditions of railway operators.

This thesis analyzes the spectrum utilization efficiency (SUE) of the 1900 MHz band for FRMCS in Indonesia, revealing an inverse relationship between SUE, cell radius, and cluster size. The 1900 MHz spectrum is a good choice for FRMCS in Indonesia because it is available for use without requiring frequency exemption compensation. FRMCS will be economically viable and beneficial if key factors like steady revenue growth and reduced site expenses are properly managed. This thesis found that using the 1900 MHz spectrum as a class license improves investment feasibility, resulting in higher Net Present Value (NPV) and Internal Rate of Return (IRR) values, along with a shorter payback period (PP), compared to bandwidth and apparatus licenses. The results of this paper are expected to offer a reference for implementing FRMCS in Indonesia.

Keywords: 5G-Railway, FRMCS, SUE, GSM-R, investment feasibility.