CHAPTER 1
INTRODUCTION

1.1 Background

To be able to realize the communication system on a fast train or high speed train with good service quality there are several problems that must be faced. One problem is the handoff process. The handoff process occurs because the train moves from one base station (cell) coverage to another base station coverage. This can not be avoided from a mobile communication system especially with a wide area coverage coupled with train speeds above 300 km/h, the handoff process will often occur. Bad handoff process will cause low in the quality of communication until the communication is cut off. This is a problem in realizing a good quality of communication on the fast train.

Broadly speaking, the current communication system on trains uses the GSM-R and TETRA systems. GSM-R will evolve into LTE-R along with high data access requests while TETRA evolves to TETRA 2 (TEDS). Every system has advantages and disadvantages. However, the two systems are inseparable from the parameters of the handoff, especially if implemented on the fast train system (HST). If it is applied to the HST, a transmitter and receiver / transceiver device is needed that is able to operate mobile and fast. Antenna is one part of the transceiver that is placed on the base station and the outside of the HST. Its function is to connect between the HST and the base station by emitting and receiving electromagnet signals. A good communication can be determined from the choice of antenna type used, so its function is crucial. At present the antennas used on the railroad side have omnidirectional transmit patterns or spread in all directions. The advantage of this transmit pattern is that it can be placed or directed anywhere because it has the same transmit pattern so that with a fast train that is mobile it is expected that communication with the base station will continue. However, the disadvantages of this antenna are

relatively smaller gain so that its range is limited and affects the received signal power apart from the effect of propagation attenuation and the Doppler effect. With limited coverage and small received signal power, it can have an impact on the handoff process especially at high speed. Meanwhile, if you use an antenna that has a large gain with certain transmit patterns such as directional antennas, it is expected that a large reception signal and a better handoff process [3]. But the problem is faced is how to determine the direction and position of the antenna in the HST state while the position of the base station is different from each other. It is expected that the next technology application is how to design an antenna that can adjust the beam pattern (beam) following the movement of the fast train (HST).

As an answer to that need, a multibeam antenna was developed with beam switching capability. Multibeam antennas are antennas that have more than one radiation pattern and produce high gain. With the beam switching method, this antenna can follow the movement of the fast train.

1.2 Problem Identification

Basically, the beam switch antenna is a stacking antenna that is integrated with a feed that has the ability to produce multiple beam directions. There are several ways for the pencat can produce many files including using the Rotman Lens, blass matrix, Nolen matrix and Butler Matrix. But what is used in this research is Butler Matrix because of a simpler design with low power loss. Therefore the formulas of the problem in this study are:

a. How to design a Butler Matrix that produces multibeam radiation patterns
b. Does the resulting antenna have a high gain?
c. How to design RF switches based on microcontrollers
d. How to integrate Matiks butler with antenna array

e. How antennas with multibeam radiation patterns can follow the movement of fast trains

1.3 Objective

The purpose of this study is to propose an antenna system that has the ability to reconfigurable radiation patterns. The resulting radiation pattern is a switch beam and with this radiation pattern can overcome the decrease in Signal to Noise Ratio (SNR) due to the movement of the fast train. The beamforming concept formulation will then be tested and proven its scientific validity through a series of research stages.

1.4 Scope of Work

The limitation of the problem in this study is that the research focuses on the 4x4 matrix butler rationing method that produces a beam switch with the integration of stacked microstrip antenna using a 2.1 GHz center frequency. The beam switch is generated by using an RF Switch based on a microcontroller.

1.5 Research Metodology

This research activity is a Butler Matrix innovation study that has the ability to switch based on the movement of the high speed train. This research method is also still guided by fundamental studies and theoretical analysis in designing dimensions of Butler Matrix and Antennas using simulation software. The switching method is also based on theoretical and implementation using Arduino microcontroller.

1.6 Structure

In general, the overal of Thesis is divided into five chapter's discussion. the explanation is as follows :

- CHAPTER 1 INTRODUCTION This chapter consist of background, problem definition and objective, scope of work, hypothesis, research methodology and writing systematic.

- CHAPTER 2 REVIEW OF LITERATURE AND STUDIES This chapter contains the basic concepts and theories related to this research .
- CHAPTER 3 EXPERIMENTAL DESIGN AND SIMULATION This chapter consist of flowchart system as follow design of butler matrix withit's component, design of single-array antenna, integration butler matrix-antenna, RF switch design
- CHAPTER 4 RESULT AND ANALYSIS This chapter consist of simulation result of the antenna and analysis the result of simulation. The simulation of the system is run based on the scenarios that has been design to analyze the proposed system in high mobility condition.
- CHAPTER 5 CONCLUSION AND FUTURE RESEARCH This chapter consist of the conclusion of this research and the advice to develop the research.