To: Dr. Anakwa  
Dr. Shastry  

From: James Soon  

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Subject: Senior Project Functional Description  

Project Title: Reconfigurable Antenna  

Advisor: Dr. Shastry  

Introduction  

An increasing number of wireless products are being designed to operate in more than one frequency band. For example, Global Positioning System (GPS) applications communicate on 1.226 GHz, or low band and 1.575 GHz - high band, wireless local area networks (WLANs) operate on 2.4 and 5 GHz, a planned Air force satellite system will operate on 18 and 2.25 GHz, and 3rd generation cellular will require coverage at 1.8 through 2.1 GHz. Devices designed for these systems may find it more cost effective to operate with a single antenna rather than multiple antennas.

Objectives  

The objectives of this project are to: study published articles, analyze and design, fabricate and test a reconfigurable antenna. The specific focus of this project has not yet been determined, but will be limited to either frequency or polarization diversity.

Diversity refers to transmitting multiple copies of the same information via independent, redundant methods. Use of different diversity schemes can reduce the probability of receiving errored bits by sending the same information via parallel methods. Some common types of diversity include:

- time diversity - repeating information through different time slots,
- frequency diversity - repeating information across multiple frequencies,
- space diversity - repeating information over separate paths, and
- polarization diversity - repeating information over differently polarized antennas.
**Inputs/Outputs**

Two possible antenna configurations are shown in Figures 1 and 2.

**Figure 1** shows a single port frequency diverse device, with a DC bias voltage applied to the port and radio frequency signals flowing into and out of the port. The DC voltage is used to bias the PIN diode on or off, electrically changing the physical dimensions of the antenna’s radiating surface.

A PIN (positive-intrinsic-negative) diode contains a large, neutrally doped intrinsic region between the p-doped and n-doped semiconducting regions. PIN diode characteristics include small physical size, fast switching speed, rugged construction, high reliability and low distortion.

![Figure 1: Single Port Patch Antenna](image)

**Figure 2** shows a dual port polarization diverse device, with radio frequency signals flowing into and out of each port. An RF signal applied to the horizontal port causes the antenna to radiate with a horizontal orientation, while a signal applied to the vertical port causes the antenna to radiate with a vertical orientation.

![Figure 2: Dual Port Patch Antenna](image)
Modes of Operation

Each device will operate in the:

• transmit mode - converting an applied radio frequency signal to radiated signal, and
• receive mode - converting a radiated signal into a received radio frequency signal.

Methods

• CAD tools will be used to analyze, design and simulate proposed antennas.
• The Microwave Integrated Circuit fabrication laboratory will be used to manufacture the antennas.
• A Network Analyzer, Anechoic Chamber and Antenna data acquisition system will be used to determine performance of the antennas.