Project Description

Project Background:
This project is the second project with Anaren Microwave, Inc. The previous project during the 2007-2008 school year designed, simulated, built and tested a modified Wilkinson power divider. This project will design, simulate, build and test two 4x4 X-Band Butler Matrices used for antenna beamforming.

Problem Statement:
This project will design, simulate, build and test two 4x4 X-Band Butler Matrices used for antenna beamforming. There will be two different layouts explored through this project incorporating four subsystems. The subsystems are a 180° hybrid coupler (Knöchel model), a 90° hybrid coupler (Branchline), a 45° phase shifter (Schiffman) and an SMA connector launch. A choice of two stackup options for the board is given and one will be used for manufacturing. Manufacturing constraints will also need to be considered.

Objectives/Scope:
1. Choose a board stackup for manufacturing
2. Develop ideal models for the Butler Matrices systems
3. Design two couplers, a phase shifter and connector launch
4. Develop two system level designs without trace crossover
5. Design a layout that can be manufactured
6. Perform test and verification on the completed project

Deliverables:
- Design documentation for the four components and system level designs
- Simulation and analysis results for the four components and system level designs
- Layouts for the system level design to be submitted for manufacturing
- Test results and analysis for the four components and system level design
- Weekly status reports.

Expected Project Benefits:
- Anaren Microwave will receive information about the use of a 180° Knöchel hybrid coupler, a 90° branchline hybrid coupler, a 45° Schiffman phase shifter, an SMA connector launch and two system design utilizing these components as 4x4 X-Band Butler Matrices
- A functional 4x4 X-Band Butler Matrices that can be used for antenna beamforming

Core Team Members:
- Joel Barry
- Amanda Kristoff
- Mia Mujezinovic – Team Lead
- Michael Pecoraro

Strategy & Approach

Assumptions & Constraints:
1. The subsystem models to be used are:
   a. 180° hybrid coupler - Knöchel
   b. 90° hybrid coupler – Branchline
   c. 45° phase shifter – Schiffman
   d. Vertical SMA connector launch
2. The stackup will either be a 61.5 mil stackup or a 121.5 mil stackup
3. The minimum desired linewidth and gap is 10 +/-0.5 mils for manufacturability
4. The system topology must not contain trace crossovers
5. Both systems, the two couplers and shifter must be able to be manufactured on the same board, size to be determined
6. The couplers and shifter will operate from 10-12GHz
7. The connector launch will operate from DC to 18GHz

Issues & Risks:
- Understanding and learning the theory and models behind the components
- Understanding customer expectations/needs
- Learning Ansoft HFSS
- Understanding ideal simulation tool in Ansoft Designer
- Methodology of parameter selections
- Vertical mount documentation and theory, in a timely manner to incorporate into system design
Senior Design Project Data Sheet

- Completion of system design to allow manufacturing lead time of 6 weeks
- Getting board by Friday April 10 to allow adequate time for test/verification
- Launch may need adjustments depending on manufacturability
- Layout methodology will be successful