
FRAGILE

Ultra Wideband Antenna – Senior Project

By: Ross Stange

Advisor: Dr. Prasad Shastry

Bradley University

Outline of Presentation

- Summary on Antennas and UWB
  - Introduction to Antennas
  - Introduction to UWB
- Deliverables Due during Fall Semester
- Final Block Diagram
- Picture of Reference Antenna
- Changes to be Made to Reference Antenna
- EE 409 (RF Comm Lab) Labs
- Simulations and Layouts
- Final Equipment List
- New Information Received from Cunningham Graphics 2/21
- Testing and Results
- Revised Tentative Schedule and Progress

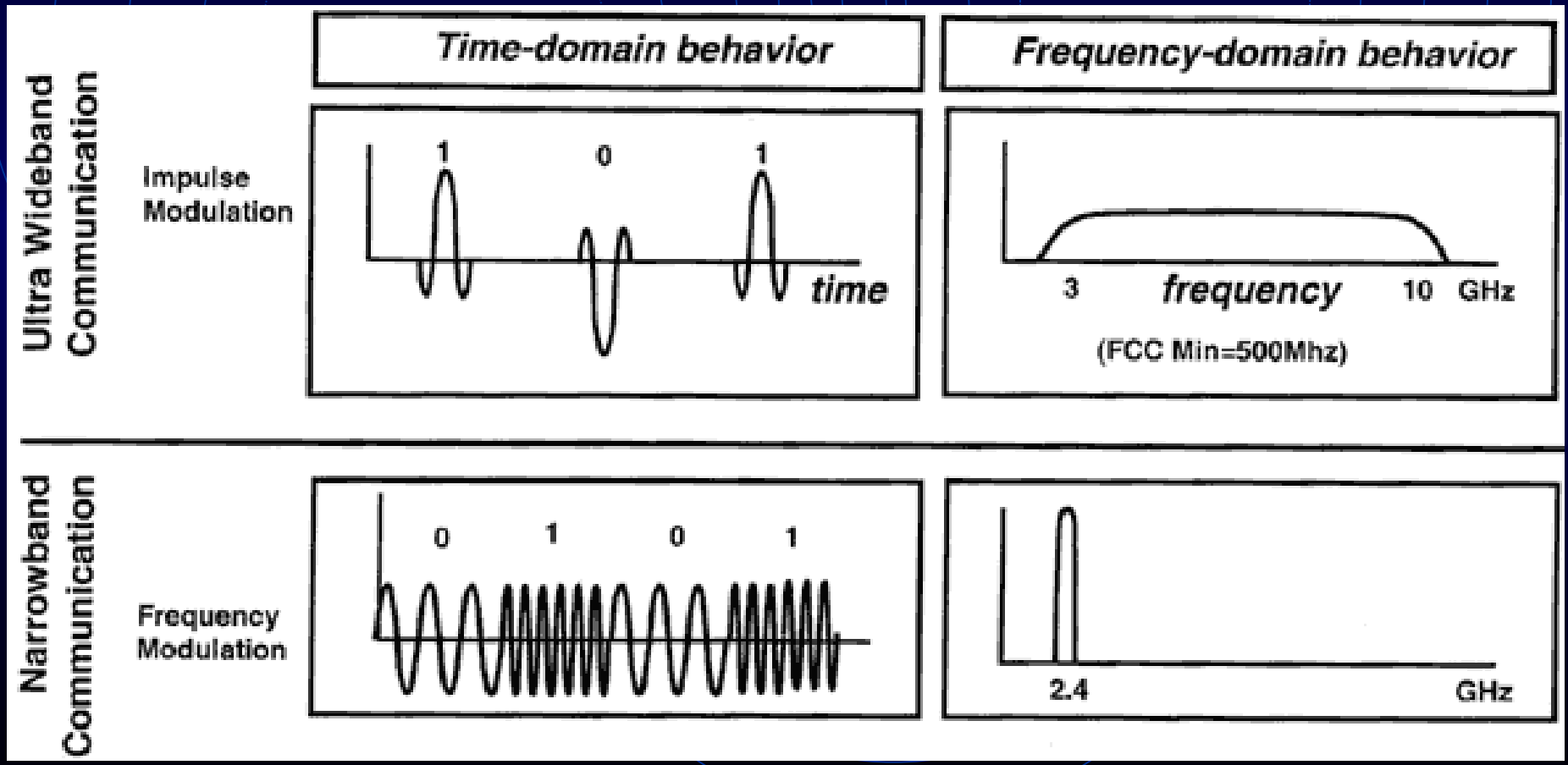
Intro to Antennas

- An antenna is a transducer between a guided wave propagating in a transmission line, and an electromagnetic wave propagating in an unbounded medium, like air.
- All antennas are both transmitting and receiving antennas.
- Car antenna mainly in receiving mode

Intro to UWB

- UWB is defined as a system having a bandwidth greater than 500 megahertz (MHz).
- UWB signals are pulse-based waveforms compressed in time, instead of sinusoidal waveforms compressed in frequency.

Intro to UWB (cont.)



Intro to UWB (cont.)

- Applications

- Low Energy (Power) Levels for Short-Range High Speed Radio Communications
- Range is about 10 meters maximum

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Deliverables Due during Fall Semester

- Functional Description and Block Diagram
- Functional Requirements List and Specifications
- Proposal
  - Paper Version
  - Presentation Version

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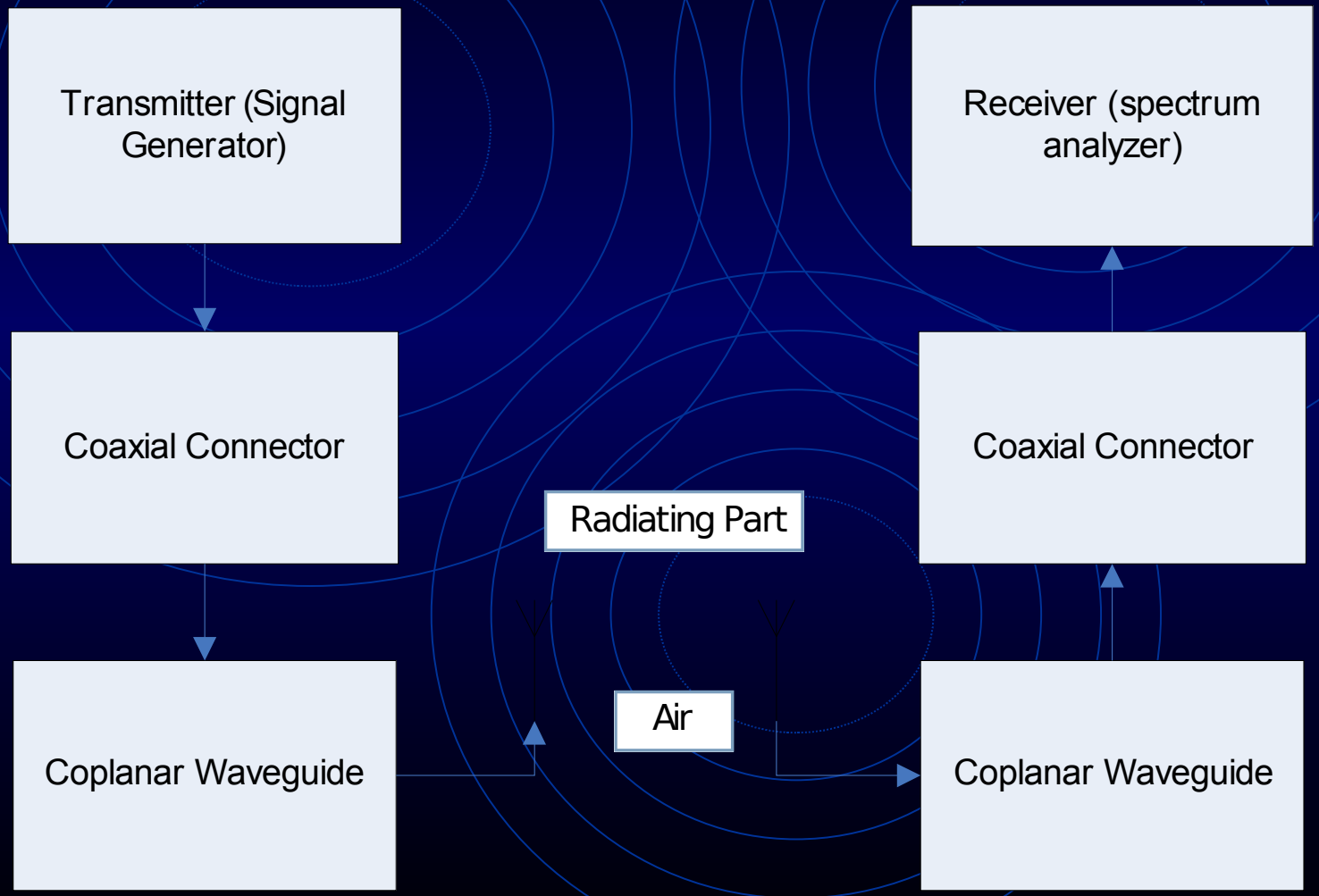
Final Block Diagram



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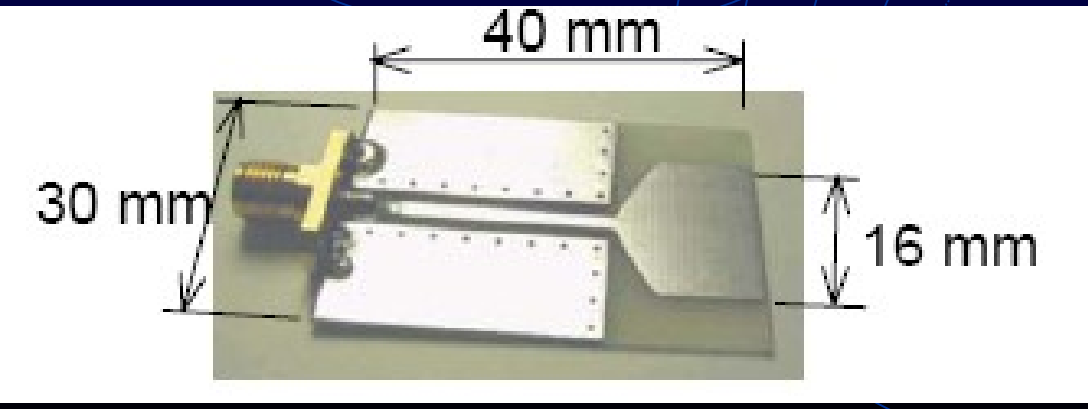
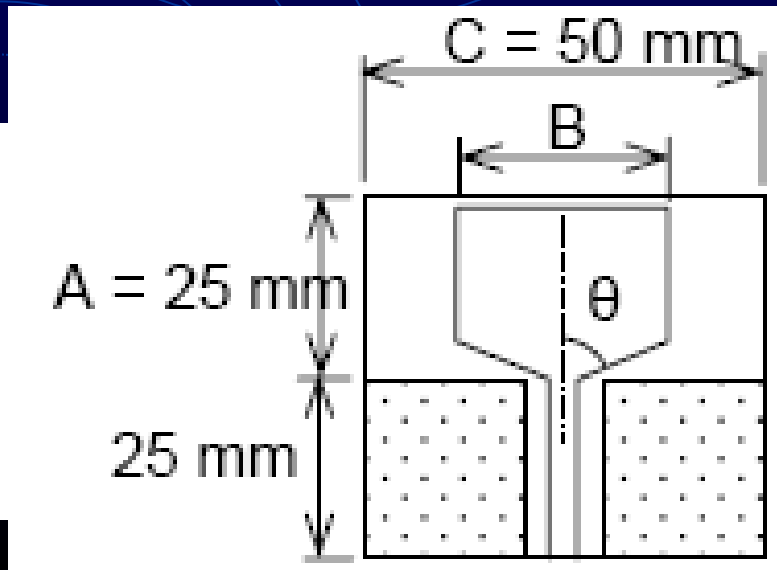
Reference Antenna

- Picture of a Monopole Antenna [Left = Final (Optimized) Result] [Right = Initial Set-Up
- Final Values: θ = 63° B = 16 mm
  A = 15 mm





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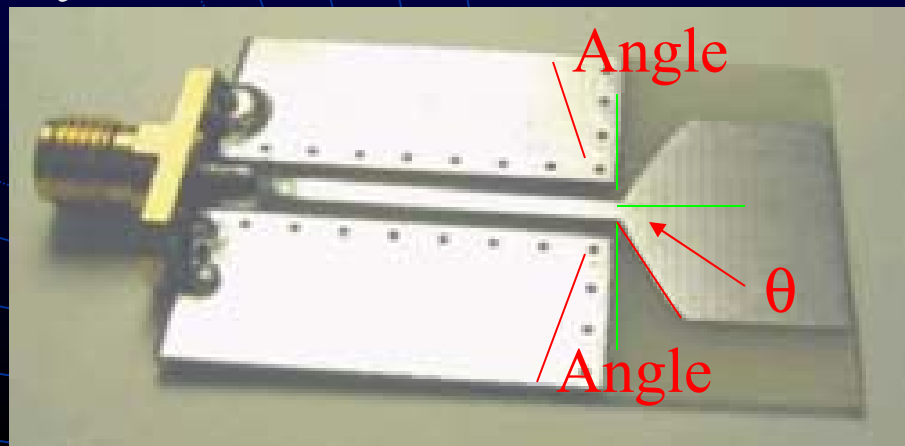
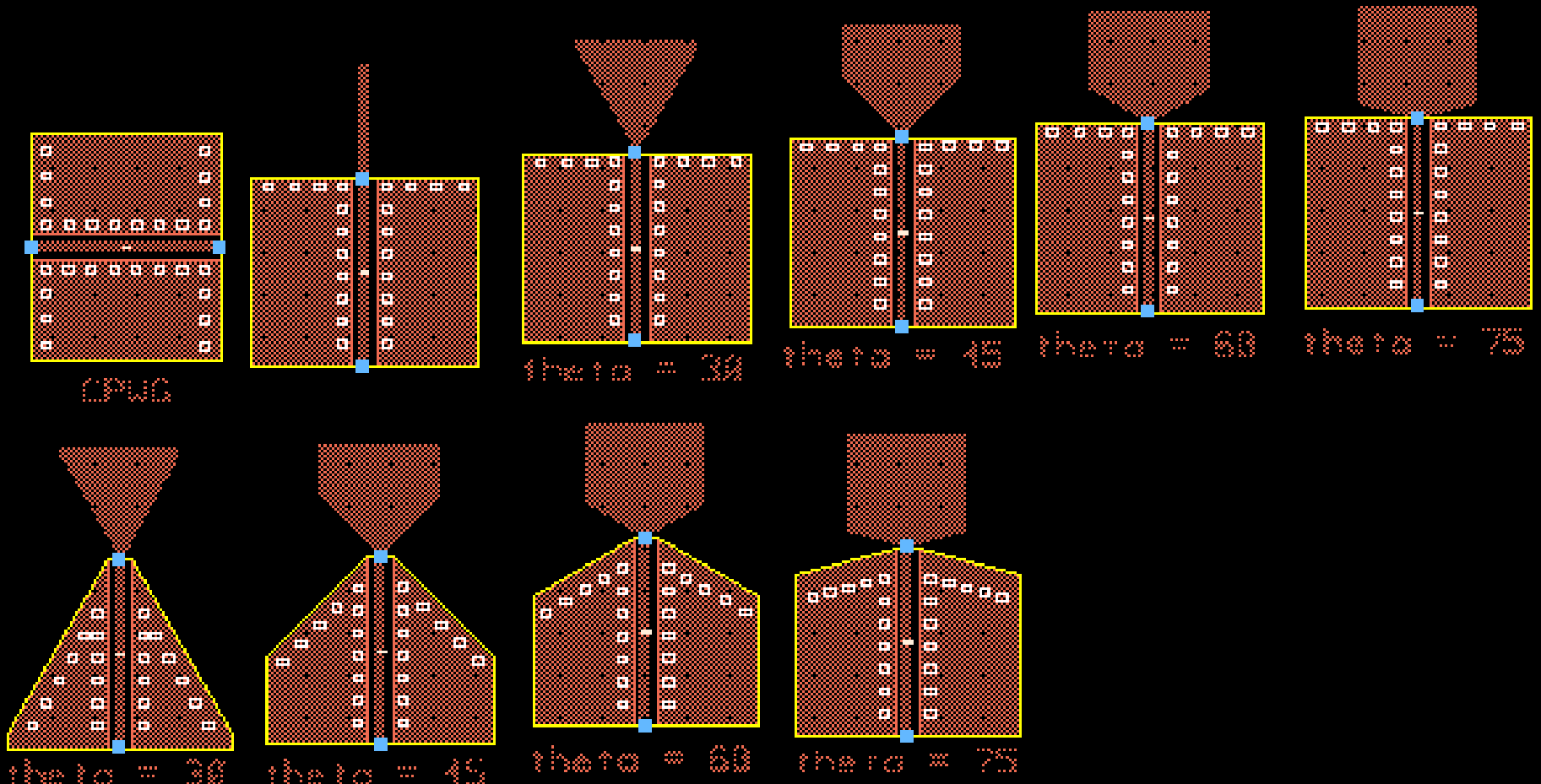
Changes to be Made to Reference Antenna

- Reference Antenna to be designed first
- ∀ θ = 63° (Original Value)
  - Will be changed to 0°, 30 °, 45 °, 60°, and 75 °.
- Change shape of Coplanar Waveguide
  - Trapezoidal (Angle = 90 - θ)
- Test Coplanar Waveguide by itself
  - At 0°



Changes to be Made to Reference Antenna



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EE 409 (RF Comm Lab) Labs

- Network Analyzer
- ADS Lab
- Antenna Measurements (Not Finished!)
- Microstrip LPF Fabrication and Measurements (Not Finished!)

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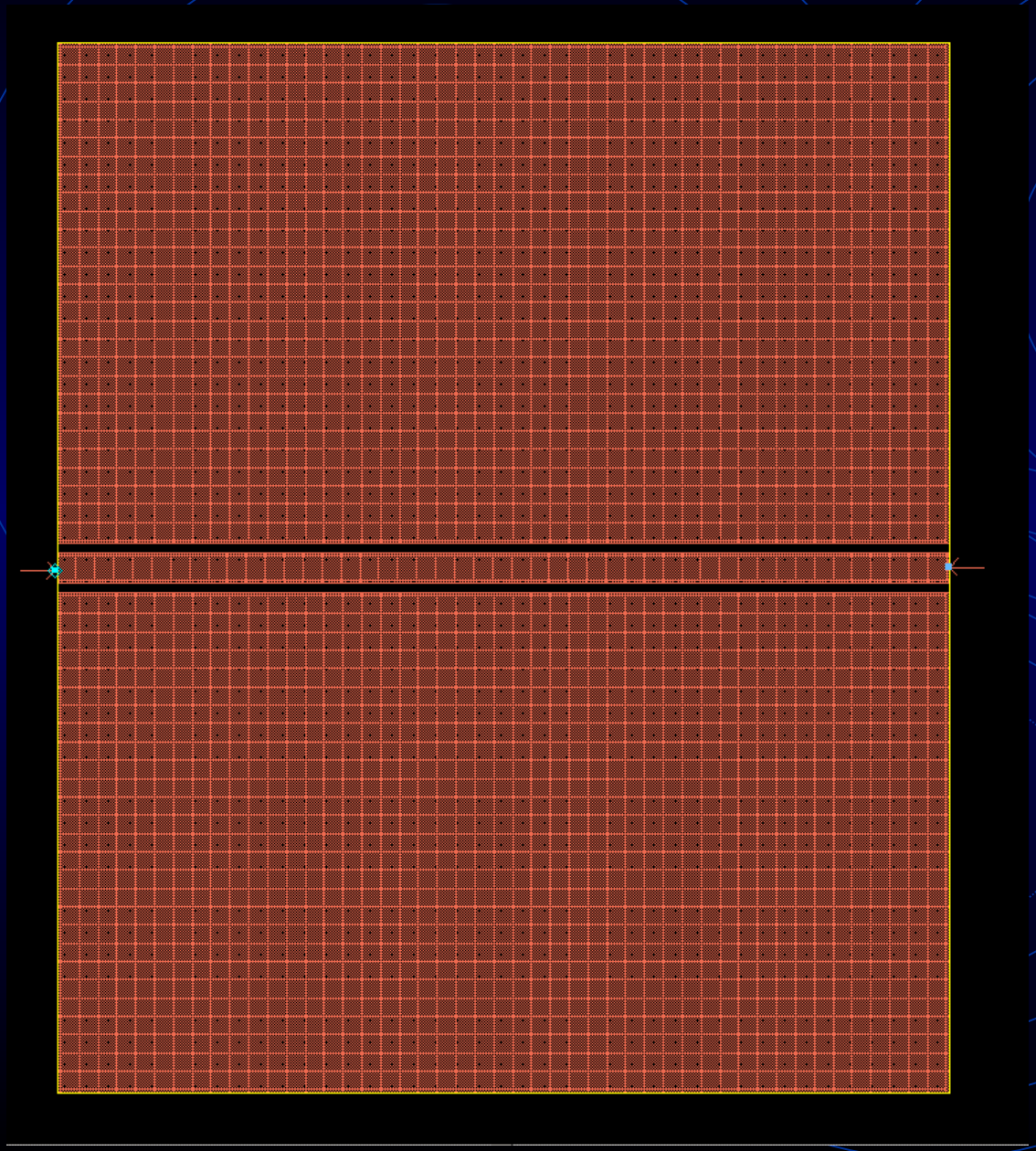
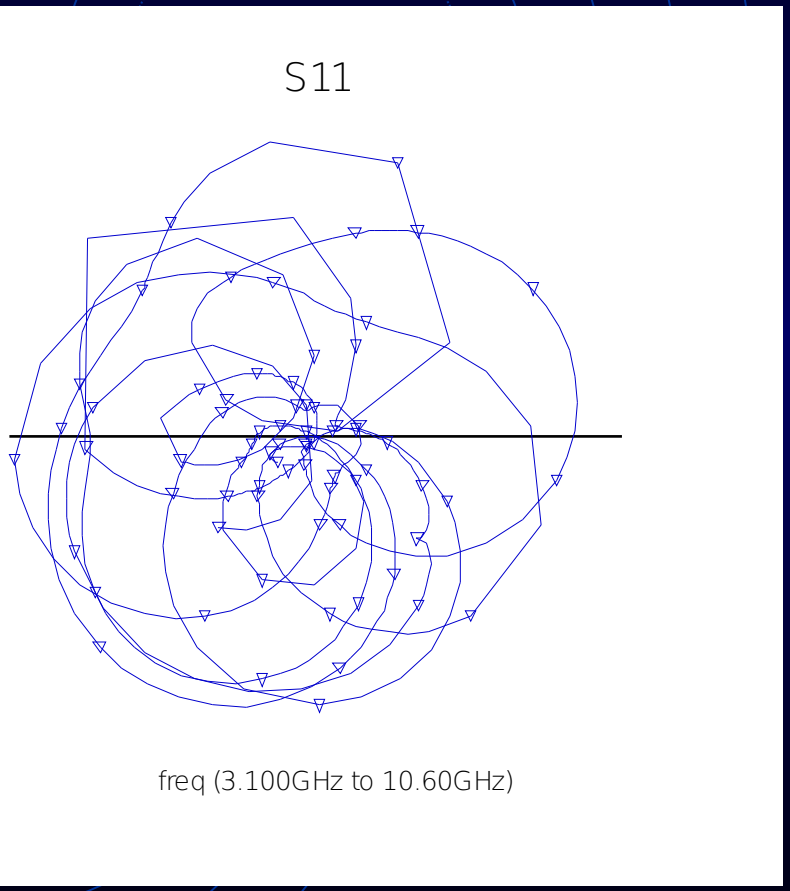
Simulation and Layouts (Early Results)



Coplanar Waveguide
for Simulation 1

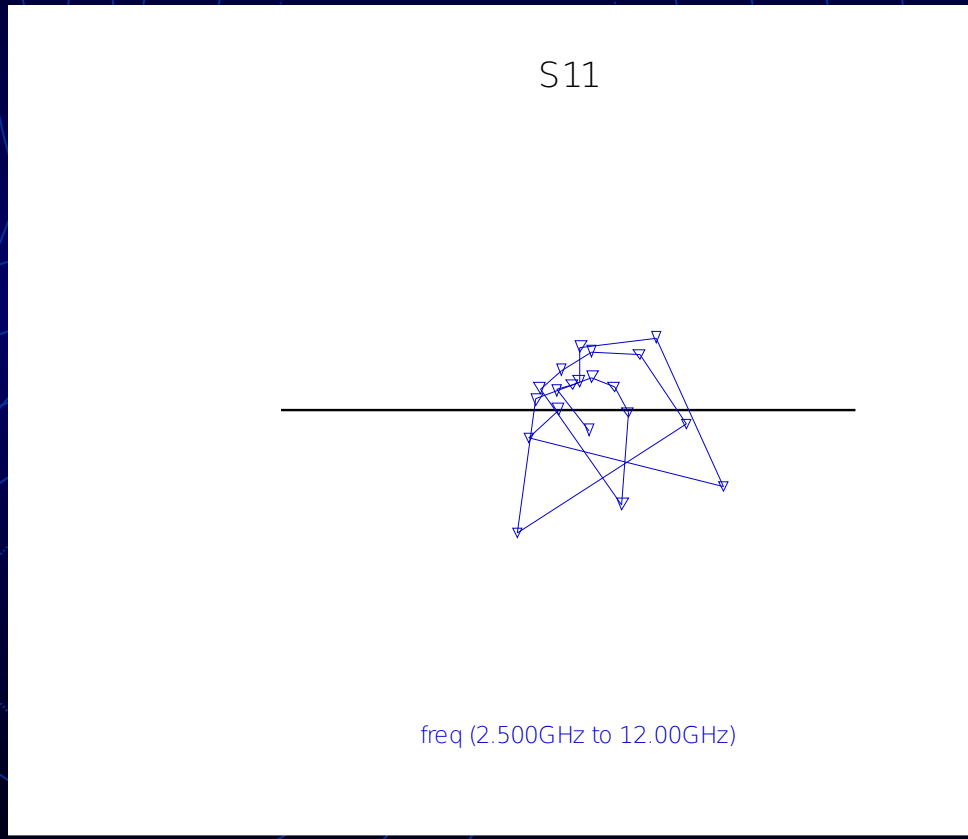
Simulation and Layouts (Early Results)

- Simulation 1 – Bad Data
- Z0=50 Ohms (for all simulations)



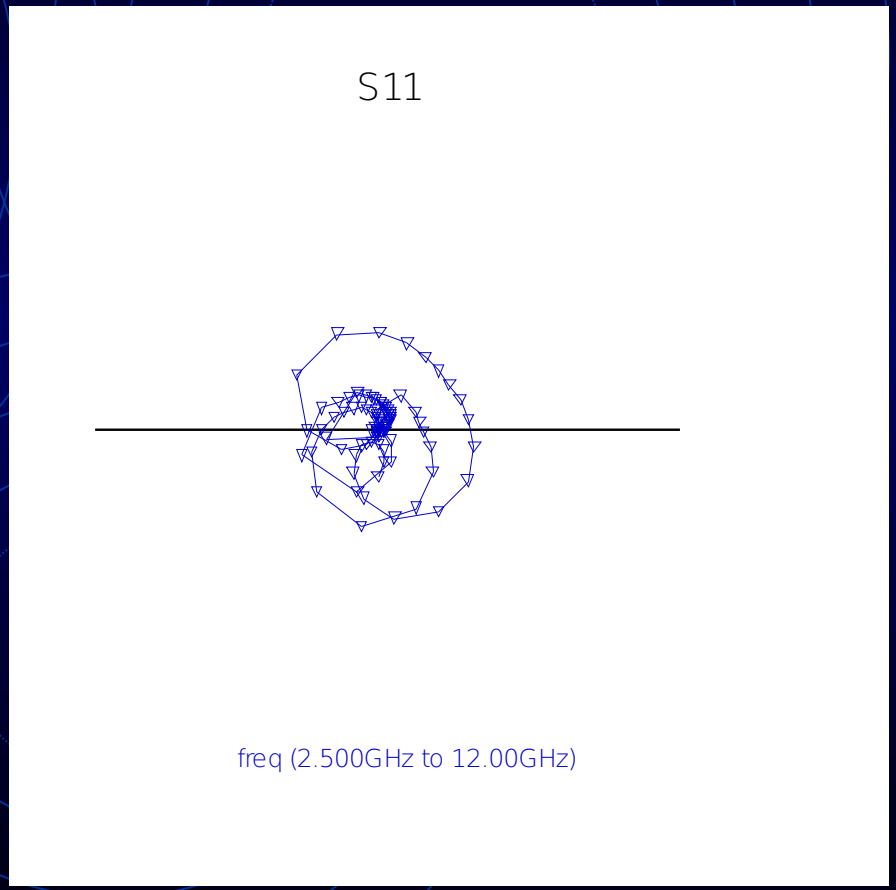
Simulation and Layouts (Early Results)

- Simulation 2 – better results
- Date Simulation Done – 3/6/2008
- Center Conductor Width and Gap Changed



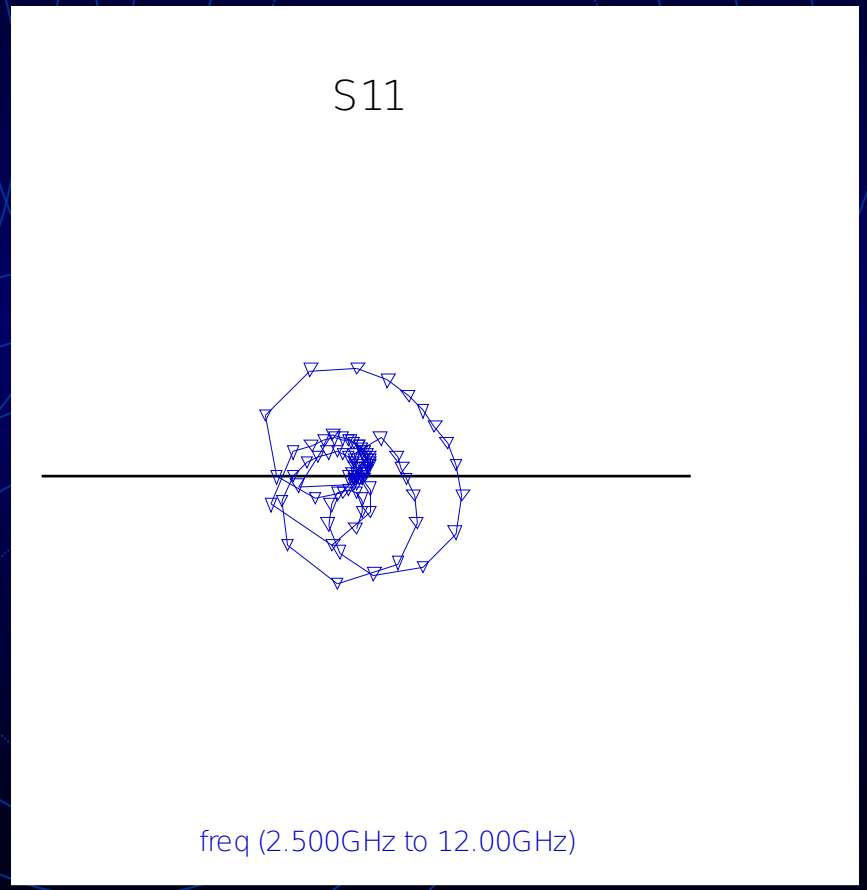
Simulation and Layouts (Early Results)

- Simulation 3
- Date Simulation Done – 3/13/2008
- Thickness of copper = 1 oz., which is different to Simulations 1 and 2



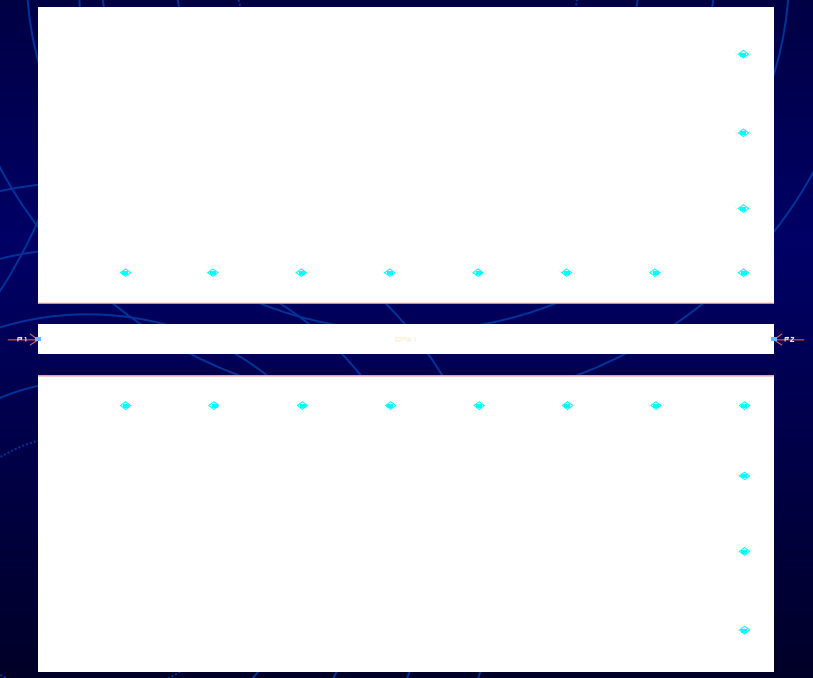
Simulation and Layouts (Early Results)

- Simulation 4
- Date Simulation Done – 3/14/2008
- Simulation 4 similar to Simulation 3 because only width and gap change.



Simulations and Layouts (Final Decisions)

- Final Layout of Coplanar Waveguide
- Width = 52.6 mils = 1.336 mm
- Gap = 38 mils = 0.965 mm
- Side Plane = 626.25 mils = 13.37 mm
- Width + 2(Gap) + 2(Side Plane) = 30 mm
- 1.336 mm + 2(0.965 mm) + 2(13.37 mm) = 30.006 mm
- 30.006 mm is very close to 30 mm



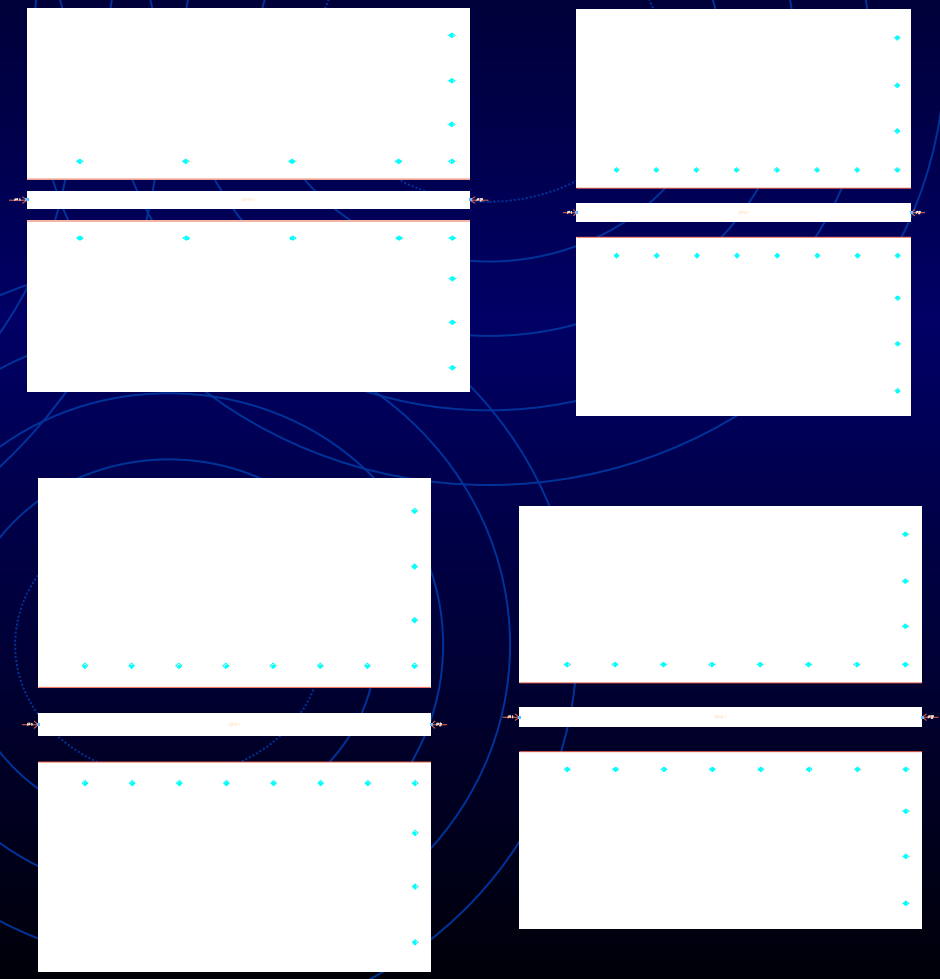
Simulations and Layouts (Final Decisions)

- Results from final layout of coplanar waveguide
- 9GHz – only questionable spot

freq	Zreal	Zimg
3.000 GHz	49.067	2.548
3.500 GHz	50.438	2.301
4.000 GHz	52.014	2.513
4.500 GHz	53.215	1.370
5.000 GHz	53.308	-0.310
5.500 GHz	52.912	-1.954
6.000 GHz	44.660	6.011
6.500 GHz	49.662	2.117
7.000 GHz	50.505	1.398
7.500 GHz	50.368	0.297
8.000 GHz	49.132	-0.275
8.500 GHz	50.295	-0.106
9.000 GHz	5.944	-20.212
9.500 GHz	47.456	4.187
10.00 GHz	49.934	1.162
10.50 GHz	48.151	-3.199
11.00 GHz	47.305	-2.876

Simulations and Layouts (Final Decisions)

- Other Layouts to choose from
  - Less via holes (top left)
  - Gap=45 mils
    Width=54.2mils (top right)
  - Gap=65mils
    Width=57.15mils
    (bottom left)
  - Gap=73.28mils
    Width=58mils
    (bottom right)



Simulations and Layouts (Final Decisions)

- Results from other layouts

Less via holes

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11.00 GHz	47.305	-2.876

Gap = 45 mils

freq	Zr	Zi
3.000 GHz	49.209	2.274
3.500 GHz	50.355	1.687
4.000 GHz	51.330	1.562
4.500 GHz	51.797	0.691
5.000 GHz	51.583	-0.204
5.500 GHz	51.609	-1.121
6.000 GHz	45.558	5.333
6.500 GHz	49.747	1.848
7.000 GHz	50.165	0.414
7.500 GHz	49.122	-0.795
8.000 GHz	47.123	-0.731
8.500 GHz	48.209	0.355
9.000 GHz	7.116	-17.221
9.500 GHz	47.639	4.124
10.00 GHz	49.951	0.440
10.50 GHz	47.400	-4.211
11.00 GHz	46.425	-2.795

Gap = 65 mils

freq	Zr	Zi
3.000 GHz	49.453	1.737
3.500 GHz	50.133	0.506
4.000 GHz	49.896	-0.198
4.500 GHz	49.028	-0.456
5.000 GHz	48.345	0.091
5.500 GHz	48.967	0.591
6.000 GHz	46.883	4.261
6.500 GHz	49.882	1.101
7.000 GHz	49.332	-1.470
7.500 GHz	46.656	-2.633
8.000 GHz	43.650	-1.325
8.500 GHz	44.323	1.292
9.000 GHz	11.769	-11.140
9.500 GHz	47.905	4.047
10.00 GHz	49.883	-0.785
10.50 GHz	46.123	-5.713
11.00 GHz	43.000	-4.402

Gap = 73.28 mils

freq	Zr	Zi
3.000 GHz	49.510	1.600
3.500 GHz	50.055	0.167
4.000 GHz	49.450	-0.694
4.500 GHz	48.212	-0.757
5.000 GHz	47.418	0.194
5.500 GHz	48.184	1.094
6.000 GHz	47.157	4.029
6.500 GHz	49.907	0.878
7.000 GHz	49.061	-1.992
7.500 GHz	45.944	-3.104
8.000 GHz	42.749	-1.452
8.500 GHz	43.238	1.563
9.000 GHz	14.201	-9.009
9.500 GHz	47.939	4.074
10.00 GHz	49.848	-1.082
10.50 GHz	45.794	-6.070
11.00 GHz	41.861	-4.908

Simulations and Layouts (Final Decisions)

- Reasons for choosing Gap = 38 mils Width = 52.6 mils
  - Number of via holes equals reference antenna's amount
  - Time constraint
    - Side plane values are ready calculated
    - Simulation of coplanar waveguide without via holes already done
  - Gap = 65 mils and Gap = 73.28 mils are becoming to large

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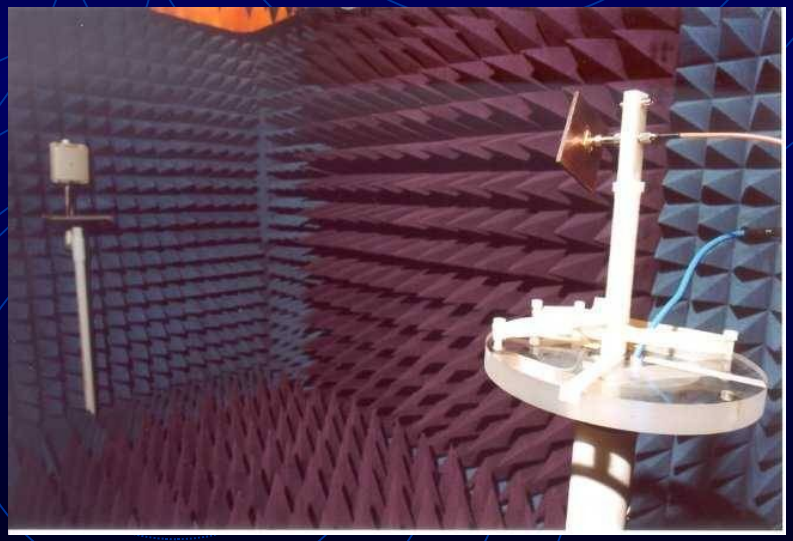
Equipment List

- Network analyzer - HP8722C or HP8410C
- Spectrum analyzer - HP8593E or HP8559A
- Signal generator - HPE4433B (May be used instead of Pulse Generator)
- Agilent Advanced Design System - ADS
- Anechoic Chamber
- Pulse Generator – HP8011A (New! – Possibility the Signal Generator)

Some Pictures of the Equipment

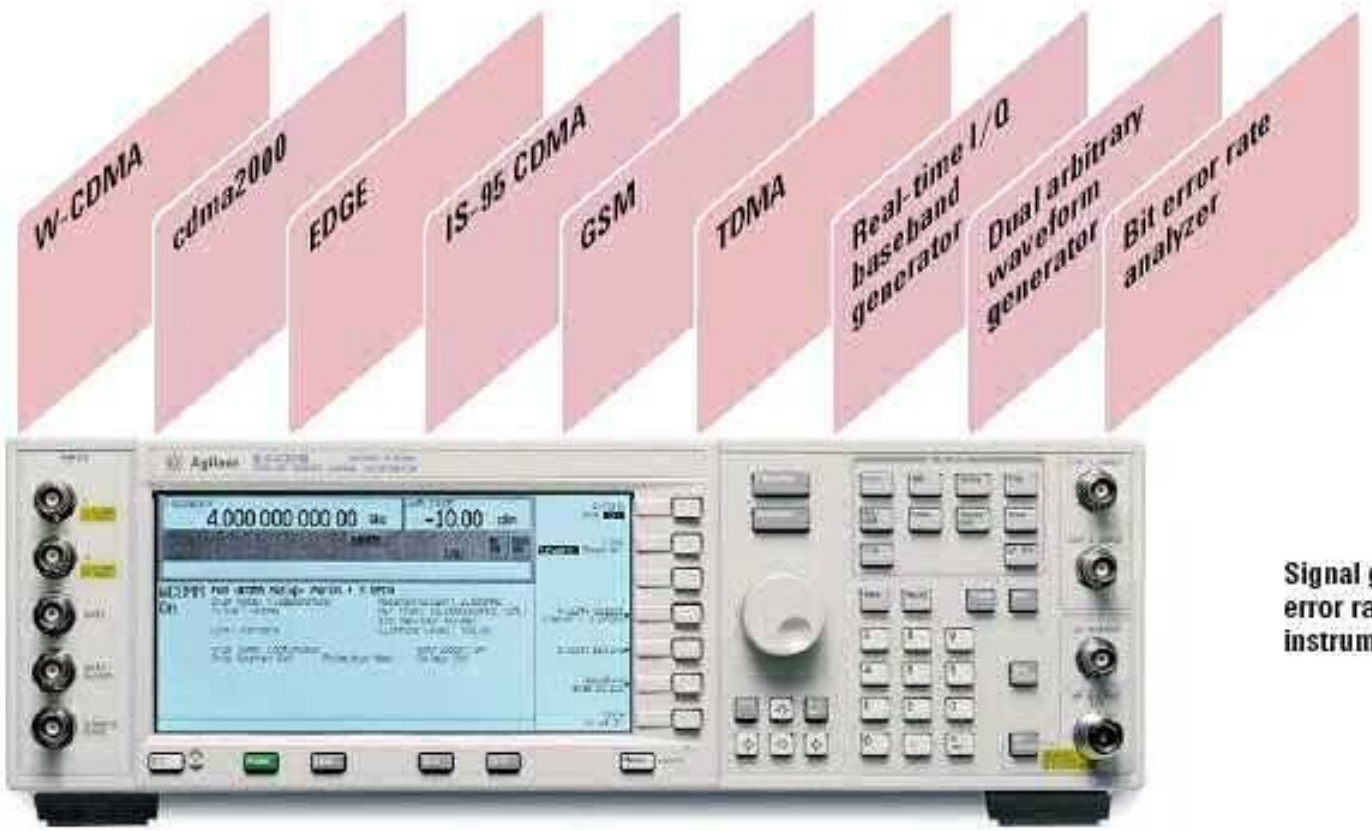
Spectrum Analyzer

Anechoic Chamber



Some Pictures of Equipment

Signal Generator



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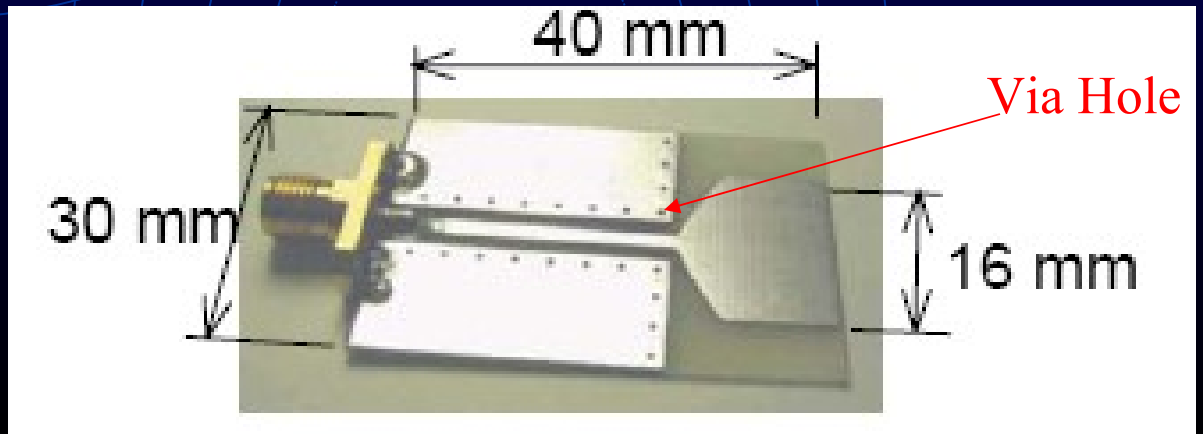
New Info from Cunningham Graphics

- Printed Circuit Board – 31 mil thickness
- 1 Oz. Copper thickness [Will increase due to electro-platting which was necessary due to via holes (platted-through holes)]
- Where antennas will be fabricated (with via holes)
- Via holes are used to connect the ground plate to upper conductor plate so it wouldn't create a T-line



New Info from Cunningham Graphics

- Telephone Conference with Bob Modica
- Possible Problem because of glass fiber amount
  - Each Company uses a different amount of glass fiber and epoxy
  - Just because the printed circuit board is a FR-4, does not mean it is exactly the same
  - Loss, dielectric constant can change

New Info from Cunningham Graphics

- From Cunningham Graphics, actual specs:
  - FR-4 Printed Circuit Board will have a 30 mil core, 4.6 dielectric constant, copper plating of 2.6 mil, 100 micro-inches of electroless nickel, 3-5 micro-inches of immersion gold
  - Fabrication Process 2 weeks
  - Fit 25-30 antennas on one sheet

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Testing and Results

- No testing have been done yet because antenna is being fabricated.

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Tentative Schedule

Schedule for UWB Antenna Senior Project					
Week	**Date**	**Objective**		**% of Project**	**Completion**
Pre-work	14-Jan-08 to 18-Jan-08	Network Analyzer Lab (EE 409 Lab)		5.00%	100%
1	24-Jan-08	Obtain Reference Paper and Learn about Signal Generator		5.00%	100%
2	31-Jan-08	Learn about Signal Generator		4.00%	100%
3	7-Feb-08	ADS Lab (EE 409 Lab)		5.00%	100%
4	14-Feb-08	ADS Lab (EE 409 Lab)		5.00%	100%
5	21-Feb-08	Design and Simulate Coplanar Waveguide in ADS		5.00%	100%
6	28-Feb-08	Give Monthly Presentation and Simulate CPWG		5.00%	100%
7	6-Mar-08	Simulate CPWG		5.00%	100%
8	13-Mar-08	Design Many Antennas in Gerber File		5.00%	100%
9	20-Mar-08	Spring Break		1.00%	100%
10	27-Mar-08	Design Many Antennas in Gerber File		5.00%	100%
11	3-Apr-08	Antenna being Fabricated at Cunningham Graphics/Do EE 409 Labs		7.50%	75%
12	10-Apr-08	Antenna being Fabricated at Cunningham Graphics/Do EE 409 Labs		7.50%	0%
13	17-Apr-08	Testing and Recording (Anechoic Chamber)		7.50%	0%
14	24-Apr-08	Testing and Recording (Anechoic Chamber)		7.50%	0%
15	1-May-08	Final Report and Presentation		10.00%	100%
16	8-May-08	Final Report and Presentation		10.00%	0%
16	8-May-08	Project 100% Completed		100.00%	70%

Special Thanks

- Special thanks to Bob Modica (Cunningham Graphics)
- Suresh Sundaram (Validus) and Bala Sundaram (Validus)
- Divya Gamini (Grad Student)

Questions ?

- I’m sorry; you did not answer in the form of a question.