Software Defined WWV Receiver

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Presentation Agenda

- Brief Review of Last Year’s Presentation
- Discuss Research Goals
- Discuss of work done this year
- Discuss of future work

Last Year

- 5MHz & 10MHz WWV Receiver
  - Crystal Filter Bank
  - Direct Conversion Receiver
  - AM Envelope Detector / Demodulator
- Correlator for 5ms 1KHz tone burst
- Use difference from local CDMA 1PPS UTC to calculate path length from WWV to Datron
- Use path length and great circle distance to calculate Ionosphere Virtual Height

Research Goal

- Implement system at multiple sites capable of receiving WWV
- Gather long term data to support improved models of the ionosphere
- Investigate and develop statistical models for polarization distortion

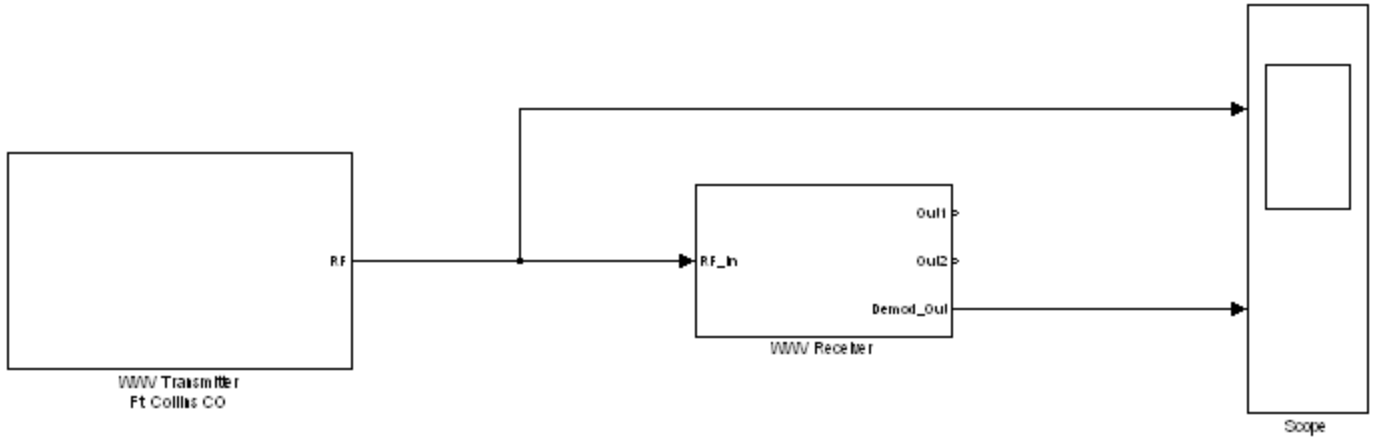
Chirp Sounders vs WWV

- Chirp Sounder
  - Frequency Sweep
  - Transmits at intervals of minutes
  - Unknown phase
- WWV
  - Selected frequencies across band
  - Transmits continuously
  - Sends 1PPS synched to UTC
  - Carrier frequency and phase is referenced

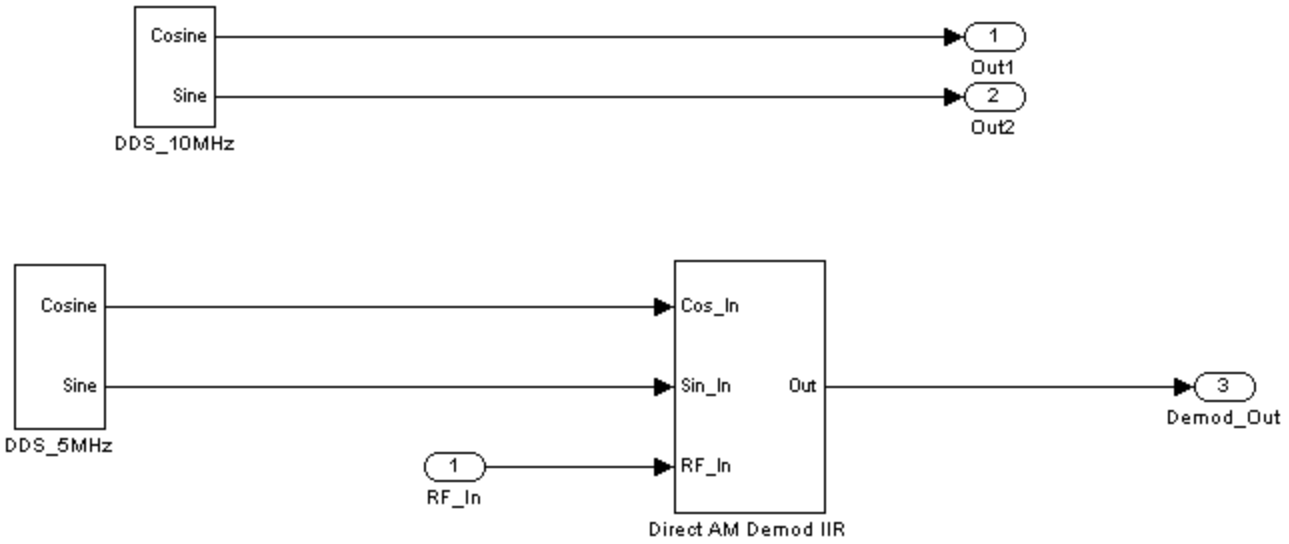
This Year

- Use Xilinx Virtex-4 SX35 FPGA to implement software defined versions of
  - Direct Conversion Receiver
  - AM Envelope Detector / Demodulator

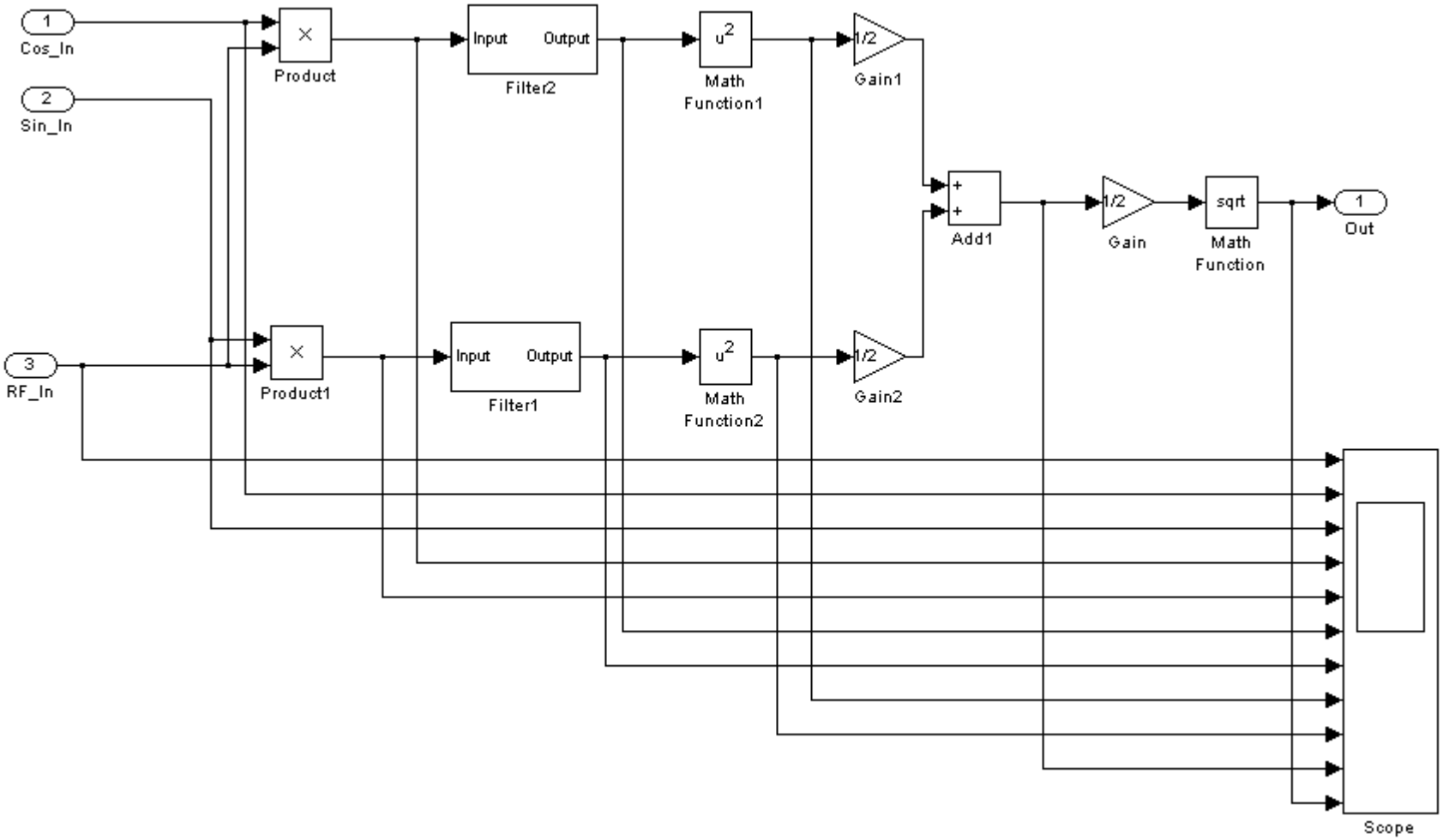
Top Level Model



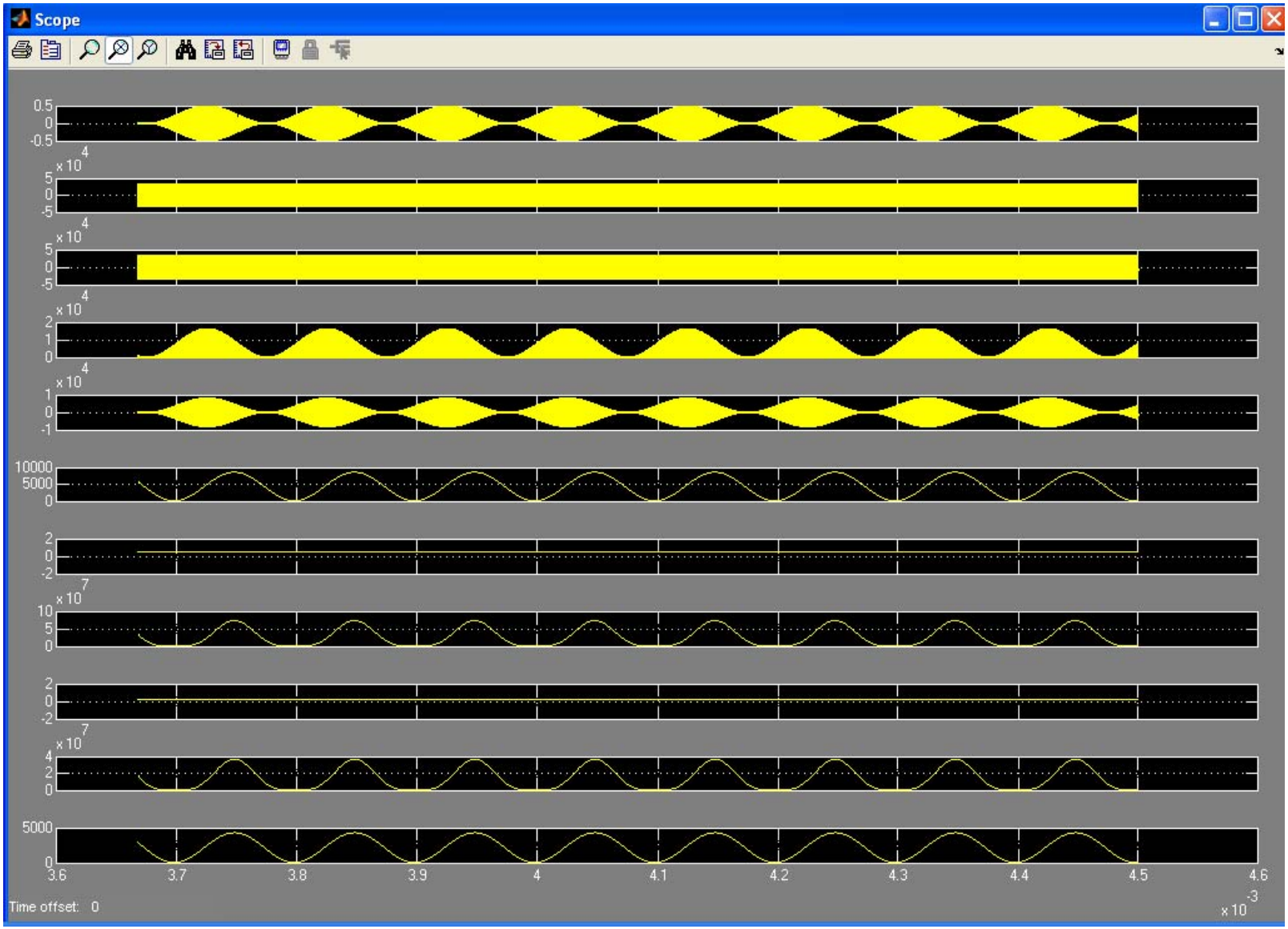
Receiver Block



Demodulator Block



Scope Block


Scope
0.5
0
-0.5
x 10^4
5
0
-5
x 10^4
5
0
-5
x 10^4
2
1
0
x 10^4
1
0
-1
10000
5000
0
2
0
-2
x 10^7
10
5
0
2
0
-2
x 10^7
4
2
0
5000
0
3.6
3.7
3.8
3.9
4
4.1
4.2
4.3
4.4
4.5
4.6
x 10^-3
Time offset: 0

VHDL Generation from Simulink

- VHDL is being generated from Simulink
- The VHDL is syntactically and functionally correct – very helpful
- Some minor VHDL hand edits are necessary to make all the modules match up
- Using Xilinx System Generator for DSP would help this situation

Future Goals

- Move to Virtex-5 FX with Power PC
- Run Linux
- Implement distributed network of receivers
- Collect and analyze data
- Develop and implement improved ionosphere channel models

Questions?