UHF SDR TRANSCEIVER AND RADIO SYSTEM

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Agenda

• Advanced IC and SDR technology: UHF SDR project description

• SDR project details and performance data

• The journey to a UHF SDR system: perspective from traditional analog systems and opportunities with SDR designs
Advanced IC and SDR Technology

UHF Multi-mode Direct Conversion SDR Transceiver

Single board solution with open source DSP software
SDR Project Description

**Hardware**

Ettus Research B200 SDR transceiver
- single board solution
- highly quality PLL frequency synthesizer
- Tx >5 dBm RF output, RX ~2 dB NF

**Software**

GNU Radio open source software
- Linux, Ubuntu OS platform
- Graphical DSP authoring
Advanced SDR Hardware

Ettus USRP B200 SDR Transceiver
Advanced SDR Hardware

Ettus USRP B200 SDR Transceiver
Advanced SDR Hardware

Analog Devices 9364 RFIC
‘Advanced’ DSP Software

GNU Radio

• Open source DSP library, (Linux, Ubuntu OS)
• Graphical DSP authoring
• Optimized for ‘real time’ signal processing (VOLK, C++)
• Supports transmit and receive DSP
• Developed and maintained in conjunction with Ettus USRP via UHD (Universal Hardware Driver) interface
GNU Radio DSP Flow Graph

Phasing Transmitter DSP
GNU Radio DSP GUI
Typical Analog UHF System

- High performance HF transceiver
- Outboard Linear Upconverter per band
- Custom per band antenna ‘interface’
Transition from Analog to SDR

The analog system leverages highly developed,

• high performance HF transceivers
• sophisticated UHF filter, LNA, and power amplifier technology
• and proven overall system design

Question?

• Why not improve transceiver performance and operating flexibility with SDR?
• Why not build on the proven analog system approach with SDR?
Advanced SDR UHF Radio System

- High performance direct conversion SDR transceiver
- Custom per band antenna ‘interface’
VHF/UHF SDR System

VHF/UHF SDR Transceiver and ½ W Interface
UHF/Microwave SDR System

UHF/Microwave SDR Transceiver and Antenna
Performance Measures

Receiver Filter Bandwidth optimized for UHF operation

Transmitter Spurious Output and Phase Noise
Receiver Bandwidth Spectrum

Receiver Bandwidth 3 kHz

[Graph showing frequency spectrum with labels for LSB, Bandpass FFT, and USB.]
Microwave Spectral Purity

Transmit Spectrum at 5.6 GHz
Microwave Phase Noise

Transmit Phase Noise at 1.2 GHz
SDR: The New Normal?

- Near ideal signal processing ability: ‘digital determinism’
- Unlimited design flexibility
- Integrates well with existing RF systems
- Compact and lightweight
In Conclusion

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Down the Slippery Slope…

More information about DSP and SDR

www.w7fu.com

Additional learning opportunity with the SDR-SIG
Meets on the odd month, third Tuesday 6:00-7:30
Facebook: PNW SDR SIG
(SDR-SIG information)
FAQ’s: Hardware

Q: Are there UHF/ Microwave SDR transceiver hardware alternatives?
A: Yes, a number of them with more to come:

Q: Isn’t the Ham Shield Arduino (VHF/UHF transceiver) a SDR?
A: Yes, by all means. Wonderful design, with a different purpose, not compatible with GNU Radio
FAQ’s: Software

Q: Does GNU Radio function with a Windows OS?
A: “Sorta”, hard work with significant limitations. They are working on it. The GNU Radio developers are primarily oriented to Linux OS.

Q: How do I get started with GNU Radio?
A: That is what www.Gnuradio.org/ and www.w7fu.com is all about. GRC DSP information oriented to beginners.
FAQ’s: General

Q: What about homebrew UHF SDRs?
A: Yes. You can make the software and analog interface system. The FPGAs and RFICs require automated assembly.

Q: Where do I turn for more information on VHF/Microwave opportunities in our area?
A: PNW VHF Society is very active locally, sponsors a wide range of operating activities, and a source of good technical information:
http://www.pnvwvhfs.org/
Additional Questions?

Hardware?

Software?

Other related topics?