SPECTRUM ACCESS FOR FIRST RESPONDERS: IMPLEMENTATION

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2007 Software Defined Radio Technical Conference (Denver, Colorado)

Architecture Platform

SFF SDR platform: provided by Lyrtech and Texas Instruments
Division of tasks: signal processing functions divided between the FPGA and the DSP, ARM9 used for overall system control
Video Processing Sub-system (VPSS) and custom registers are used to interface DSP and FPGA.

Development Tools

Simulink: used to simulate a working transceiver system before implementation.
System for DSP: Xilinx add-on to Simulink, used to create the FPGA blocks in collaboration with Xilinx ISE.
RealTime Workshop (RTW): used only for rapid prototyping & testing.
Code Composer Studio (CCS): used to generate the code of the complete DSP subsystem.

Development Methodology

Simulink & RTW: used for development and testing of some individual modules and subsystems.
MATLAB and novel HIL interface: used for system integration, optimization and final implementation.
DEVSJava MATLAB Combination: used for developing networking functionality.

Transceiver Implementation

Modules developed and tested on the hardware include:
- Timing & Carrier Recovery in DSP
- Combined Pulse Shaper and CIC (CPSCIC) in FPGA
- Packet detection in DSP
- Symbol Mapping/Demapping in DSP
- Channel Coding in FPGA
- CVSD Voice Codec in DSP

Cognition system Implementation

- Incoming sensing information demodulated in FPGA using DDS centered at the IF frequency.
- Demodulated signal downsampled and filtered in FPGA
- Filterbank Sensing method implemented in DSP.
- Sensing activated periodically
- Transmission is halted while sensing is performed.
- The spectrum is time tagged and weighted to find a suitable band to transmit on.

Hardware Demo: Sensing

- A complete simulation is performed first in MATLAB.
- ESG signal generator is then used to emulate PU traffic.
- Real time Filterbank sensing is performed on the board.
- FFT & FFT with Hanning window are performed in MATLAB
- The results are presented using MATLAB

Hardware Demo: Cognition

- Voice is transmitted between two boards.
- The Tx board performs sensing and transmission.
- The cognitive radio switches to an unoccupied band when it detects interference on its carrier.
- The interface to the board is developed using Java and MATLAB compiler for Java.
- A third board is used to sense, the results are reported in Java for demonstration purposes.