Project Goal

Develop a platform for visualizing the radio frequency spectrum using software-defined radio.
Project Objectives

- Using ORBIT, configure radio receiver(s) to collect IQ time samples
- Process the samples to obtain frequency-domain data
- Analyze frequency data to identify any unknown signals
- Repeat with modified receiver carrier frequency, sampling rate, etc. to scan the available frequency spectrum for signals
- Implement methods above in real-time on CPU and FPGA
Current Progress

CPU Implementation

- Browser-based visualization using Wt C++ library
- Configured Sandbox 7 and Grid consoles
- Plan to use TCP sockets to send FFT data from receiver node to console
- Console will display data in web browser
Current Progress

FPGA Implementation

- Spectrum Sensing Application (Sensing across a large bandwidth)
- Design of PFU (Packet Fragmentation Unit)
- Implementation of state machines in VHDL
- The final project goal is to use Octave in Linux to detect the spectrum

```vhdl
WHEN ST_DATA =>
o_busy <= '0';
IF(sig_valid = '1') THEN
  IF(UNSIGNED(wrd_cnt) = 0) THEN
    o_sof <= '1';
  END IF;
  IF(i_eof = '1') THEN
    sig_busy <= '1';
    sig_last_pkt <= '1';
    current_state <= ST_LAST_WORD;
  ELSE
    IF(UNSIGNED(wrd_cnt) = X"FE") THEN
      sig_busy <= '1';
      current_state <= ST_LAST_WORD;
    END IF;
  END IF;
o_data <= i_data;
o_data_en <= i_data_en;
wrd_cnt <= STD_LOGIC_VECTOR(UNSIGNED(wrd_cnt)+ 1);
END IF;
```
Achievements

- Design of ORBIT Grid Experiments using OEDL scripts
- Development of MATLAB Spectrogram Toolkit for post-processing signals
- Development of Real-Time Plotting Module in C++ for the Wiserd Framework
- Browser-based Visualization for plotting module
- Design of a Mealy finite-state machine of the PFU using VHDL code
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