A Practical Transmit/Receive System for Software Radio

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Overview

- The Design Task
- System Components
- Design Partitioning
- Test System
- Results and Conclusions
The Design Task

Design:
- Test system to switch between two disparate modulation schemes under software control

Evaluate:
- Design Partitioning
- Power Efficiency
- FPGA Usage
System Components

- **Digital RX/TX**
  - Reconfigurable
  - Flexible
  - Modular
    - Mezzanine card (PMC)
    - PCI Bus
- **Embedded DSP**
FPGA or DSP
- Flexibility vs Speed
- Power Considerations
  - Battery Restrictions
  - Conduction Cooled environment
- FPGA availability
- Data Rates
  - Decimation/Oversampling
Test System

- **Modulation:**
  - QAM and FSK
  - Widely used
  - Disparate schemes

- **Design:**
  - Maximum Use of PMCs
  - No complex coding
  - Command line control – via laptop.
Transmitter (1)

- **QAM**
  - DAC intrinsic capability
  - FPGA
    - Data generation
    - Symbol mapping
    - Interleaving
    - Pre-Conditioning

Slide 7
FSK
- Modulating internal NCO
- FPGA
  - Preset Frequencies
  - Generate Data
  - MSK
QAM demodulator
- Standard design
- Single channel, 16-bit, 66MHz Fs
- Decimation and filtering on-board
Receiver (2)

- MSK ‘demodulator’
  - could use QAM demod
- Straight digitizer
  - tests max data rates
Results

Power
- < 7W dissipation before modifications
- QAM demod exhibits most power dissipation
  - Maximum additional power 2W

Real Estate
- ~10% of 3M FPGA in use before modifications
- QAM demod largest circuit requirements
  - Adds 7% to circuit design

Signal Performance
Conclusions

- Signal conditioning required close to conversion
- Careful consideration of design partitioning
  - Speed
  - Flexibility
  - Power
  - Real-Estate
  - Available Time
- PMC format good vehicle to deliver digitising and conditioning
  - Multiple DSP/FPGA cards available in VME.
Contact Details

Doug Moore
Pentland Systems
1b Young Square
Brucefield Industry Park
Livingston
West Lothian    EH54 9BX

doug.moore@pentland.co.uk
http://www.pentlandsys.com

Tel: +44-1506-464666
Fax: +44-1506-463030

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