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DATVexpress - a Lower Cost Approach to DATV

by

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Status of Digital-ATV Today

• Video Quality of DATV far exceeds analog-ATV
• Very few hams transmitting DATV in USA today
• European DATV is very active and growing
• Australia/New Zealand has more DATV activity than USA
• Digital-ATV transmitters are currently expensive
• US$1,000-to-US$10K range for MPEG/DVB-S XMTR set
• Cost of DATV Transmitter is barrier to more ham use
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Goals of Project?

• Digital-ATV transmitters are currently too expensive
• Minimum US$1,000 for German MPEG/DVB-S board set
• Cutting that price by 2/3 will encourage more DATV use
• The software and hardware should be open-source
• Design source freely available without restrictions encourages others to contribute new functions and performance
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The DATVexpress Team

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Overview of DATVexpress System

• Video Capture card for MPEG-2 encoding
• PC (Linux or Win) performs DVB-S processing and outputs I/Q stream
• Simple Hardware board exciter preps I/Q stream and does QPSK modulation on 1.2 GHz
• Just add RF Power Amps and Antenna
Overview of DATVexpress System – cont’d

System Block Diagram for DATVexpress DATV Transmitter
Overview of PC Software

- Operating System - Linux 32/64-bit then Win32
- Load FX2 firmware
- Load FPGA firmware
- Control 1.3 GHz PLL
- Control symbol rate generator
- Control human peripheral device
Overview of PC Software – cont’d

• Take program/transport stream from capture card
• Convert to transport stream with correct PIDS
• Add SI Table information

• Add FEC
• Do interleaving
• Keep symbol rate constant, no overruns or underruns
• Generate IQ symbols
• Talk to exciter board via Hi speed USB interface
Overview of Hardware Board

• Single custom designed board preps IQ stream and provides QPSK modulation at 1.2 GHz
• Interfaces to PC processing by USB2
• Contains PLL for the 1.2 GHz frequency control
• Controls Symbol-Rate
• Provides small buffer-RF amplifier to ~10 mW
• DC-DC power supplies allows single 12V input
• Connect to RF Power Amp stages and antenna
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Overview of Hardware Board – cont’d

Block Diagram for DATVexpress Hardware Board
Overview of Hardware Board Coding

FX2 code (USB chip has 8051)
• Program FPGA
• Manage USB FIFO interface with FPGA
• I2C interface with 1.3 GHz PLL
• I2C interface with symbol rate generator
• General Housekeeping

FPGA code
• Interpolate symbols to final sample rate
• Channel filter
• Write to DAC
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DATVexpress System Specs

• DVB-S protocol
• QPSK modulation
• Frequency Range:
  – 1240–1300 MHz (allowed in USA)
  – 1240–1325 MHz (allowed in Europe)
• Symbol-Rate:
  – Adjustable: 1 MSymb/sec -to- 5 MSymb/sec
• Forward Error Correction is selectable
• RF output ~ 10 mW buffered (SMA connector)
• Video Capture card allows for NTSC or PAL
• Initially designed for one video stream
• Operating system – first Linux-32/64 then Win32
Current Project Status

- Architecture – completed
- Schematic Capture – completed in DXdesigner tool
- PCB Layout - nearing completion in PADS tool
- Next Step – design review of PCB layout, Gerbers, etc
- Then Fabricate first-article PCB blanks and stuff
- Then check-out and software integration begins
What about DVB-T or DVB-S2?

• “Yes, it is possible....”

• “But, the team has only committed to DVB-S”
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Conclusion and Plans

• Code written for the USRP2 needs porting
• Write FX2 loader code
• Write FPGA code
• Source files will be freely available with no restrictions (Software, FPGA, Schematic, PADS-files, etc)
• DATVexpress team on target for low-cost DVB-S board
Useful Links:

- Digital Video Broadcasting organization (DVB commercial standards)
  www.DVB.org
- Amateur Television of Central Ohio
  www.ATCO.TV
- British ATV Club - Digital Forum
  www.BATC.org.UK/forum/
- OCARC library of newsletter DATV articles
  www.W6ZE.org/DATV/
- Rob-MØDTS D-ATV site including details of F4DAY-design
  www.M0DTS.co.uk/datv.htm
- DigiLite Project for DATV (derivative of the “Poor Man's DATV”)
  www.G8AJN.tv/dlindex.html
- AGAF D-ATV components (Boards)
  www.datv-agaf.de and www.AGAF.de
- SR-Systems D-ATV components (Boards)
- Yahoo Group for Digital ATV
  http://groups.yahoo.com/group/DigitalATV/
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Proof-of-Progress – Top Etch Layer
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Proof-of-Progress – SilkScreen Layer