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DATV-Express – an Update

by

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DATV-Express

The Presentation Authors....

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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 the Project

• Significantly reduce the price of Digital-ATV transmitters
• Provide an open platform for future DATV development
• Help educate the community about new technologies
• Get more DATV stations on-air
• Encourage a wider diaspora to get licensed
• Byproduct will be a Software Defined Transmitter for the 23 cms band with a B/W of up to 8 MHz.
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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 at 1.3 GHz
• Just add RF Power Amps and Antenna
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Overview of DATVexpress System – cont’d

System Block Diagram for DATVexpress DATV Transmitter
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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
• I/Q offset calibration
• Provide GUI
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 by adding Null transport packets
- Generate either IQ symbols or a bitstream
- Talk to exciter board via Hi speed USB interface
Overview of Hardware Board

- Single custom designed board preps I/Q stream and provides QPSK modulation at 1.3 GHz
- Interfaces to PC processing by USB2
- Contains PLL for the 1.3 GHz frequency control
- Controls Symbol-Rate
- Provides small buffer-RF amplifier to ~20 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 DATV-Express 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
• I2C interface to FPGA
• General Housekeeping

FPGA code
• Interpolate symbols to final sample rate
• Channel filter
• Write to DAC
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DATV-Express System Specs

• DVB-S protocol
• QPSK modulation (will allow other modulations)
• Frequency Range:
  – 950–1575 MHz (allowed by ADRF6750 chip)
  – 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 ~ 20 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
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Current Project Status

• Architecture – completed
• Schematic Capture – completed in DXdesigner tool
• PCB Layout – first-pass completed in PADS tool
• Two prototype first-article boards are assembled
• Design check-out and software integration has begun
• FX2 loader code completed
• Initial DVB-S transmission tests completed
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Current Project Status – cont’d

- A few jumpers were needed to fix USB FIFO hookup
- Two components were missing in PLL stability loop
- RF etch can be laid-out better – was self-osc 1.8 GHz
- Large 65 kHz noise sidebands being investigated
- Will create second-pass etch to clean up layout
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Proof-of-Progress – First prototype
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Proof-of-Progress – 1st DVB-S Transmission
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DVB-S 1.2 GHz spectrum
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QPSK constellation with sideband noise
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DVB-S video on Satlink WS-6918P
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6 MHz DVB-T spectrum with I/Q balance problem & filter passband ripple
What about DVB-T, DVB-S2, 8VSB etc?

• “Yes, they are possible....”

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

• We do also have experimental support for Firewire/DV video input, text overlays, testcards, FFMPEG transcoding, 1080i HD and DVB-T.
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Conclusion and Plans

• Code written for the USRP2 needs porting finished

• Finish tweaking FPGA code

• Finish etch-clean-up layout

• Source files will be freely available with no restrictions (Software, FPGA, Schematic, PADS-files, etc)

• DATV-Express team on target for low-cost DVB-S board around Christmas time.
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Useful Links:

• 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/
• Charles-G4GUO blog on DATV-Express project development
  www.g4guo.blogspot.com/
• 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/