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SDR-based DATV-Express exciter for Digital-ATV

by

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DATV-Express

The Presentation Author....

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Digital-ATV technology allows Video Quality to exceed analog-ATV

Comparison of analog video and an DATV video using the same antennas with weak sigs
(courtesy of G7LWT & GB3HV)
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Status of Digital-ATV Today

• DATV Video Quality can exceed analog ATV
• Very few hams transmit DATV in USA today
• European DATV is very active and growing
• Australia/New Zealand has lots of DATV activity
• Currently Digital-ATV transmitters are expensive
• US $900 up for MPEG/DVB-S Encoder/Transmitters
• DATV Transmitter is cost barrier for most in USA
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Goals of the DATV-Express Project

• Significantly reduce price of Digital-ATV transmitters
• Provide Plug-and-Play hardware board to minimize home construction.
• Provide open platform for future DATV development
• Help educate community about new technologies
• Get more DATV stations on-air
• Encourage wider audience to get ham licensed
• Byproduct can be Software Defined Transmitter from 70 – 2450 MHz ham bands with a B/W of up to 8 MHz
The DATVexpress Team

- Charles Brain - G4GUO  Ferring, England
- Ken Konechy - W6HHC  Orange, CA, USA
- Art Towslee - WA8RMC  Columbus, OH, USA
- Tom Gould - WB6P  Portland, OR, USA
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Overview of DATV-Express System

Typical System Block Diagram for DATV-Express DVB-S DATV Transmitter
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DATV-Express Board features

• Single custom design board preps I/Q stream and provides QPSK RF output at 432-2450 MHz
• Interfaces to PC processing through USB2 port
• Contains PLL for the 70-to-2450 MHz freq control
• Controls Symbol-Rate
• SDR-based allows may modulations and protocols
• On board buffer-RF amplifier for 1 to 10+ mW
• DC-DC power supplies allows single 12V input
• SMA connection to RF Power Amp stages and antenna
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DATV-Express board internal block diagram

Block Diagram for DATV-Express Hardware Board
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DATV-Express hardware board
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DATV-Express System Specs

• DVB-S protocol is tested and released
• All IQ modulations (QPSK modulation was tested)
• Frequency Range:
  70–2450 MHz (Modulator chip specification)
• Symbol-Rate:
  – Adjustable: 1 to 5 MSymb/second
• Forward Error Correction is selectable
• RF output ~ 1-20 mW buffered (SMA connector)
• USB Video Capture card for NTSC or PAL
• Initially designed for one video stream
• PC Operating System – first Ubuntu-32/64-bit
  ➢ then quadcore-ARM ODROID U3 w/ Libuntu
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1st DVB-S Transmission on First prototype
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Clean DVB-S 1.2 GHz spectrum

Barefoot board RF output – has 47 configurable levels of RF output
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DATV-Express capable of other DATV protocols used by hams

Testing DVB-T (2K mode) protocol at 2 MHz bandwidth on 437 MHz (using 4096-point iFFT math - with NO alias spurs)
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DATV-Express capable of other DATV protocols used by hams – cont’d

Testing constellation for 16APSK digital modulation for DVB-S2 protocol
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SDR allows Lower-Side-Band for example

Unsuppressed carrier is down 60 dB
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Simple DATV-Express User Interface

Software User Interface uses Qt4 (screen is configured for DVB-S Protocol)
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GNU Radio with DATV-Express

- Alex OZ9AEC has developed gnuradio “sink” module for DATV-Express – (see Github URL at end)
- Ron W6RZ has adapted gnuradio to run DVB-S2 32APSK
- W6RZ uses DATV-Express DVB-S2 code and tested with BladeRF & Novra S300V DVB-S2 STB at up to 10 MSym/s.
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Current Project Status on PC

• DATV-Express production board released in Feb 2014
  ➢ Order at www.DATV-Express.com (PayPal)
  ➢ Order at BATC Online Shop https://BATC.org.uk/shop/
• DVB-S completed and stable
• As extra bonus, have tested board to transmit DVB-T 2K mode, however cannot guarantee performance
• DVB-S2 tested, but there are licensing issues
• Next development phase to eliminate bulky PC
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Go More Portable than bulky PC or Notebook

- Reduce Micro-PC load by using more FPGA functions
- Maybe Raspberry PI?
- or…RikoMagic MK802iv?
- or…Hardkernel ODROID U3?
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Raspberry PI

- Raspberry PI has singlecore-ARM at 700 MHz
- Raspberry PI typically uses Raspbian OS
- Originally designed for education market
- Raspberry PI is seriously under-powered for our app
- Raspbian source code repository is INCOMPLETE CAN NOT re-compile kernel
RikoMagic MK802iv

- MK802iv has quadcore-ARM at 1.4 GHz
- PicUntu OS is light-weight Ubuntu
- MK802iv as option to create “smart TV’s” for internet
- PicUntu source code repository is INCOMPLETE
  CAN NOT re-compile kernel
- Kernel does not use SMP to balance load on four cores
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RikoMagic MK802iv
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Hardkernel ODROID U3

• ODROID U3 has quadcore-ARM at 1.7 GHz
• Comes with Lubuntu 12.4 LTS (LDE Desktop)
• Single-board-computer designed for software developers
• Has very active software community for support
• Has complete source repository to re-compile kernel
• Charles G4GUO explains that once DATV-Express project is satisfied with release for ARM…it should work OK with almost any ARM product
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Hardkernel ODROID U3 “micro-PC”

ODROID U3 is about the same size as Raspberry Pi
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Hardkernel ODROID U3

Planned System Block Diagram for DATV-Express DVB-S with ODROID U3
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Conclusion and Plans

• Ubuntu 32/64 Code for PC is finished

• We need volunteers to help with software

• G4GUO reports “have had a few genuine offers of help but the problem is that those with the time don't have the experience and those with the experience don't have time.”

• Focus now is for replacing bulky PC with “ARM Micro-PC”

• Source files will be available
  (Software, FPGA coding, gerbers, etc.)

• Beginnings of source code repository at https://github.com/G4GUO/datvexpress_gui.git
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• British ATV Club - Digital Forum
  www.BATC.org.UK/forum/
• CQ-DATV online (free monthly) e-magazine (ePub format)
  www.CQ-DATV.mobi
• OCARC library of newsletter DATV articles
  www.W6ZE.org/DATV/
• TAPR Digital Communications Conference proceedings (free downloads)
  www.TAPR.org/pub_dcc.html
• Yahoo Group for Digital ATV
  http://groups.yahoo.com/group/DigitalATV/
• DATV-Express project website
  www.DATV-Express.com
• DigiLite Project for DATV (derivative of the “Poor Man's DATV”)
  www.G8AJN.tv/dlindex.html
• Hardkernel (Korea) for ODROID model U3 ARM-based “micro-PC”
  www.hardkernel.com
• Alex OZ9AEC GNURADIO “sink” module for DATV-Express
  https://github.com/csete/gr-datvexpress
• Ron W6RZ using GNURADIO with DATV-Express DVB-S2 code
  https://github.com/drmpeg/gr-dvbs2
• SR-Systems (Germany) D-ATV components(Boards)