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Update on DATV-Express exciter for Digital-ATV

by

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Abstract - The old technology of analog-ATV suffers from susceptibility to snow and multi-path ghost images. Digital-ATV (DATV) using new technologies like digital modulation, and Forward Error Correction (FEC) can result in robust video reception where analog-ATV fails, as well as providing more narrow bandwidths on the ham bands. This presentation will review progress by the DATV-Express Project Team since DCC2014. These new efforts include:

- Making the exciter more portable by Hardkernel ODROID U3 Single-Board-Computer
- Support of Narrow-BandWidth DATV down to 0.5 MHz
- Using Express_Server software to provide video by UDP
- DatvExpressServerApp software on Windows (no Linux)
- DatvExpressSdrApp software for FM and SSB (no Linux)
- A brief report on MiniTiouner USB-based Receiver Project
DATV-Express

The Presentation Author….

Ken W6HHC
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)
DATV-Express

Status of Digital-ATV Today
• DATV Video Quality can exceed analog ATV
• European DATV is very active and growing
• Australia/New Zealand have lots of DATV activity
• More hams transmit DATV in USA over last 2 years
• DATV Transmitter was a cost barrier for most in USA
• Was US$900 up for MPEG2/DVB-S Encoder/XMTRs
• HiDes DATV xmitter now $175, DATV-Express now $300
• Lot of focus today on “ham hackable” DATV Receivers
DATV-Express

The DATV-Express Team

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

DATV-Express Project

• Following 4 slides show the status at TAPR 2014
DATV-Express

DATV-Express SDR-based hardware board
DATV-Express

Overview of DATV-Express System

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

DATV-Express board internal block diagram

Block Diagram for DATV-Express Exciter Hardware Board
DATV-Express

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: 0.33 to 5 MSymb/second
• RF output ~ 1-20 mW buffered (SMA connector)
• USB Video Capture card for NTSC or PAL
• PC Operating System – first Ubuntu-32/64-bit
DATV-Express

DATV-Express Project

Six areas of progress:

• Software for quad-ARM ODROID now released
• Support of Narrow-BandWidth DATV down to 0.5 MHz
• UDP function using Express_Server software
• DatvExpressServerApp on Windows (no Linux)
• DatvExpressSdrApp for FM and SSB (no Linux)
• SIDE BAR - MiniTiouner USB-based Receiver Project
DATV-Express

DATV-Express software for ARM ODROID U3

• ODROID U3 is quad-ARM “micro-PC” at 1.7 GHz
• Comes with Lubuntu 14.4 LTS (LDE Desktop)
• DVB-S protocol is now created inside FPGA
  (off-loads the ODROID processing load)
• ODROID prepares the Transport Stream (TS) and hands off to the FPGA
• Charles G4GUO explains that now DATV-Express project has released for ARM…it should work OK with almost any ARM product
• HardKernel has replaced model U3 with C1+ & XU4
DATV-Express

Hardkernel ODROID U3 “micro-PC”

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

System Block Diagram for DATV-Express DVB-S with ODROID U3
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Narrow-Bandwidth DATV with DATV-Express

• UK OfCom has allowed temporary use DATV on 2M
• Previously unused 146.0-to-147.0 MHz now allows digital
• DATV is being sent with Symbol Rate typically 333 KSymb/s
• Typically use H.264 video compression for 15 - 20 Frames/sec
• RF BW allocated = 0.5 MHz - Typically centered 146.5 MHz
• Selectable DATV-Express FPGA code uses x64 interpolater for 100K to 400KSymb/sec
• Commercial DVB-S RCVRs only go down to 1 MSymb/sec
• New MiniTiouner RCVR project goes 125 KS/s to 27.5 MS/s (more details later in presentation)
DATV-Express

Narrow-Bandwidth DATV with DATV-Express

DATV-Express Narrow-Bandwidth DVB-S of 0.5 MHz
Spectrum Analyzer span is 2 MHz
(courtesy of G4GUO)
DATV-Express

UDP feature using Express_Server

• Express_Server software was written by Charles G4GUO
• Better control for the receiving of UDP packets by the computer connected to the DATV-Express transmitter board
• Configure DirectShow filters using GraphStudioNext graphs
• Can use Logitech C615 webcam on Windows
• MainConcepts filters provided MPEG-2 encoding
• Software encoder filters eliminate Hauppauge video-capture
• MajorUDP-Sender filter aims UDP to computer connected to DATV-Express
DATV-Express

UDP feature using Express_Server

Block Diagram for sending Logitech web cam video by UDP to ODROID running Express_Server
DATV-Express

UDP feature using Express_Server

GraphStudioNext filters for using C615 webcam on Windows
MajorUDP-Sender software block is aiming packets to ODROID IP address
DATV-Express

Using DatvExpressServerApp on Windows

• DatvExpressServerApp software written by Charles G4GUO
• DatvExpressServerApp runs on Windows system
• **NO LINUX** involved
• Use DirectShow filters using GraphStudioNext graphs
• Can use Logitech C615 webcam on Windows
• MainConcepts filters provided MPEG-2 encoding
• MajorUDP-Sender filter aims UDP to loop-back IP-address
• DatvExpressServerApp provides a simple GUI
• DatvExpressServerApp software is still in a highly “experimental stage”
DATV-Express

Using DatvExpressServerApp on Windows

Block Diagram showing the DatvExpressServerApp software runs completely on Windows machine and connects to DATV-Express board
DATV-Express

Using DatvExpressServerApp on Windows

Windows running GraphStudioNext graphs and simple GUI for DatvExpressServerApp

UDP addr is set to loopback 127.0.0.1
DATV-Express

Using DatvExpressServerApp on Windows

Properties of MainConcept video encoder filter using ConstantBitRate (CBR)
DATV-Express

Using DatvExpressServerApp on Windows

Properties of MajorUDP-Sender software with IP destination address aimed at loopback 127.0.0.1 and socket chosen for an arbitrary 1958
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Working on DatvExpressSdrApp on Windows

• SDR allows FM and SSB signals to be sent to DATV-Express
• PC Sound-Card to prepare audio for DATV-Express IQ modulator
• Run on Windows OS
• Uses microphone plugged into PC (head-set, etc)
• Current software provides FM and USB/LSB SSB
• Any ham band from 144 MHz to 2.4 GHz directly from board
• Still in works…. slight tone on SSB at the carrier frequency, due to the DC offset in the Digital-Analog-Convertors
DATV-Express

Working on DatvExpressSdrApp on Windows

Simple User GUI for FM or SSB
DATV-Express

MiniTiouner USB-based Receiver Project

• Jean Pierre F6DZP created DVB-S/S2 analyzer software
• “Digital transmissions are not really all-or-nothing - in between there are many things that can happen” – F6DZP
• Original TuTioune software used PCI-based hardware
• New MiniTiouner receiver project is USB-based
• Software is “ham hackable” to allow fitting DATV needs
• Symbol Rates can be from 125 KSymbol/s to 27.5 MSymbol/s
• Jean Pierre F6DZP created software and schematic design
• Brian G4EWJ prepared PCB layout and gerber files
• BATC team sells kits on BATC Online Store
DATV-Express

MiniTiouner USB-based Receiver Project

MiniTiouner USB-based Receiver is “ham hackable”

(photo courtesy of G4KLB)
DATV-Express

MiniTiouner USB-based Receiver Project

TiTioune is DVB-S/DVB-S2 quality analyzer
DATV-Express

Conclusion and Plans

• DATV-Express is now released for ODROID ARM CPU’s
• There were “handcuffs” that limited interest and applications:
  • Linux – steep learning curve or hams with “no interest”
  • NTSC/PAL cameras were old (becoming obsolete)
  • Hauppauge HW video encoders are difficult today (no linux)
• DatvExpressServerApp on Windows allows “escape handcuffs”
• New cameras (webcams, etc) can be selected for GraphStudioNext
• UDP opens many opportunities for remote video streams
• USB-based MiniTiouner RCVR project solves DATV problems
• Open project source code repository - - see URLs at end
• PLANS ? – “so many ideas, so little time”
DATV-Express

• 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
• G4GUO github for DATV-Express source code
  https://github.com/G4GUO/datvexpress_gui.git
• G4GUO github for express_server source code
  https://github.com/G4GUO/express_server.git
• Hardkernel (Korea) for ODROID model U3 ARM-based “micro-PC”
  www.hardkernel.com
• Jean Pierre F6DZP web site for TuTioune and MiniTiouner
  http://vivadatv.org