



# 2015 ARRL/TAPR DCC

## Update on DATV-Express exciter for Digital-ATV

by

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# DATV-Express

**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....

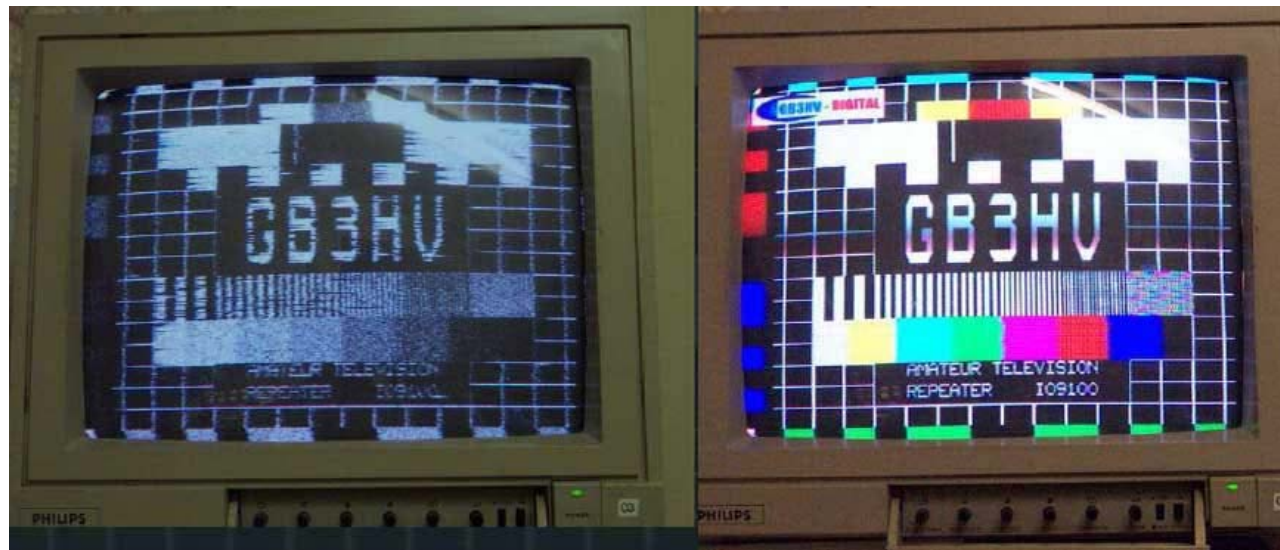


**Ken W6HHC**

# DATV-Express



**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

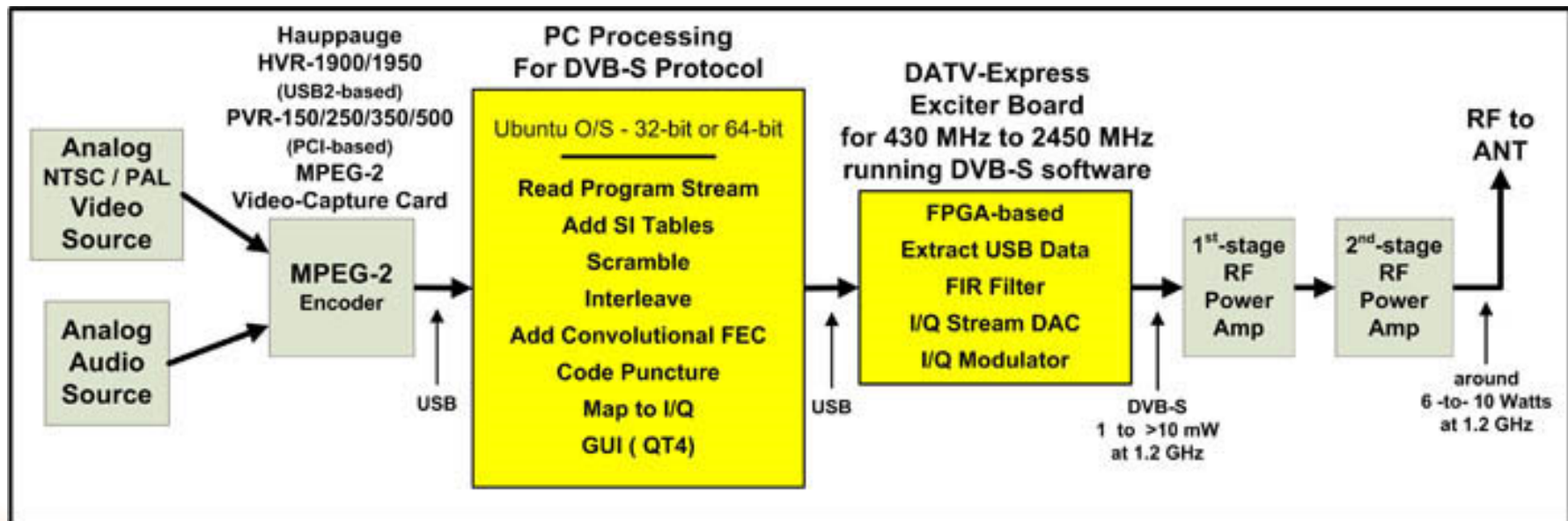






# DATV-Express

## Overview of DATV-Express System

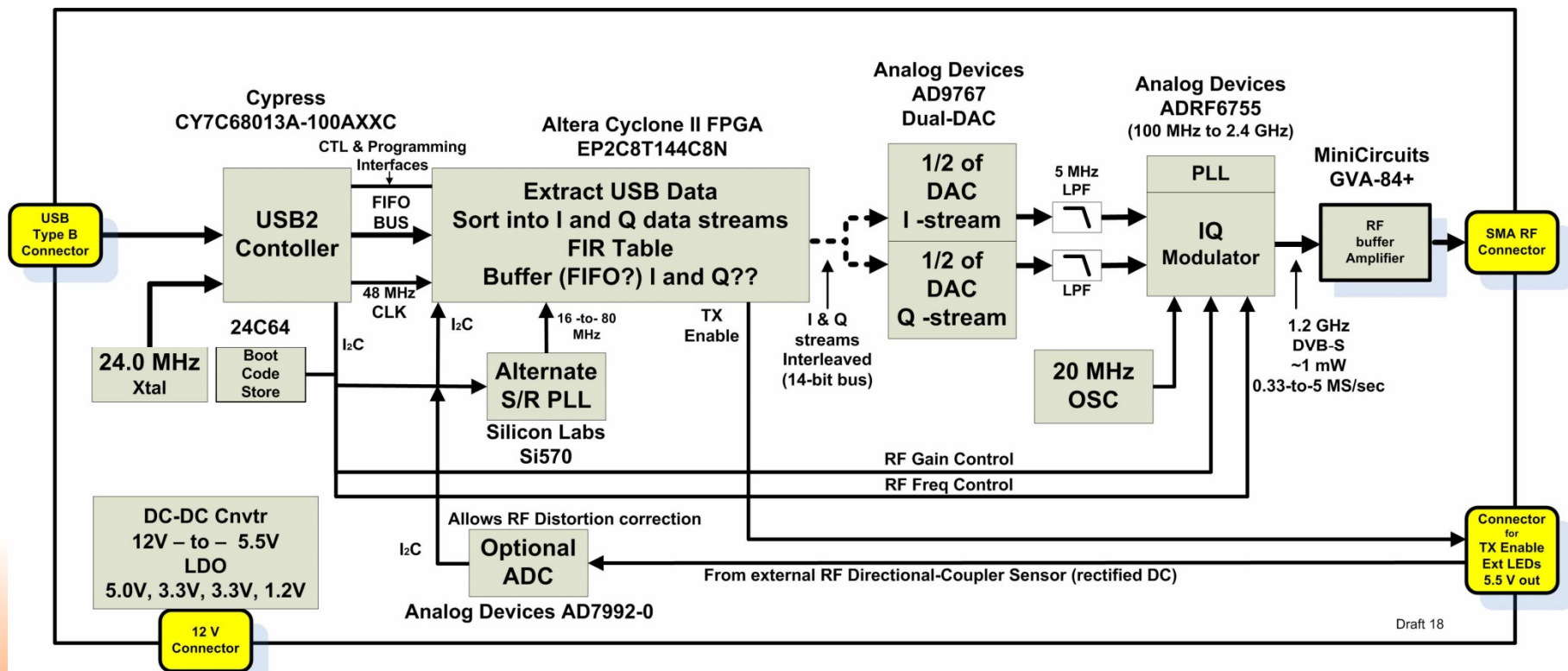


Typical System Block Diagram for DATV-Express DVB-S DATV Transmitter

# 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 Ubuntu 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”

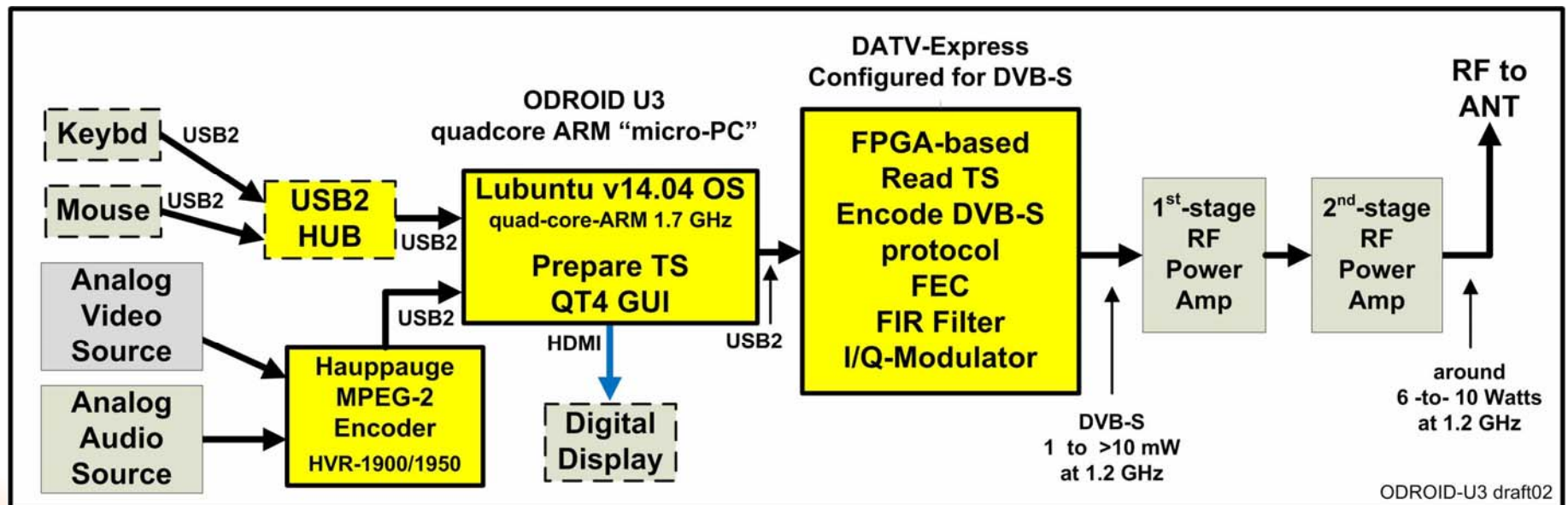


ODROID U3 is about the same size as Raspberry Pi

# DATV-Express



## Hardkernel ODROID U3



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

# DATV-Express



## Narrow-Bandwidth DATV with DATV-Express

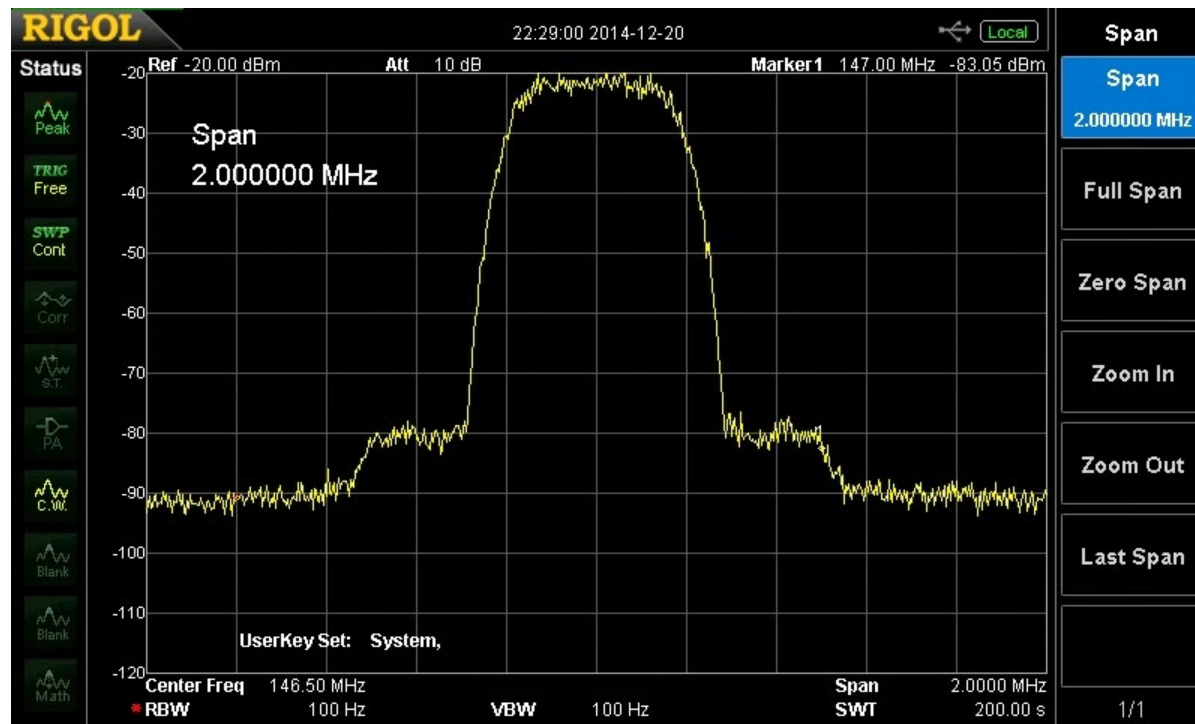
- UK OfCom has allowed temporary use DATV on 2M
- Previously unused 146.0-to-147.0 MHz now allows digital
- DATV is being sent with Symbol Rate typically 333 KSymb/s
- Typically use H.264 video compression for 15 - 20 Frames/sec
- RF BW<sub>allocated</sub> = 0.5 MHz - Typically centered 146.5 MHz
- Selectable 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



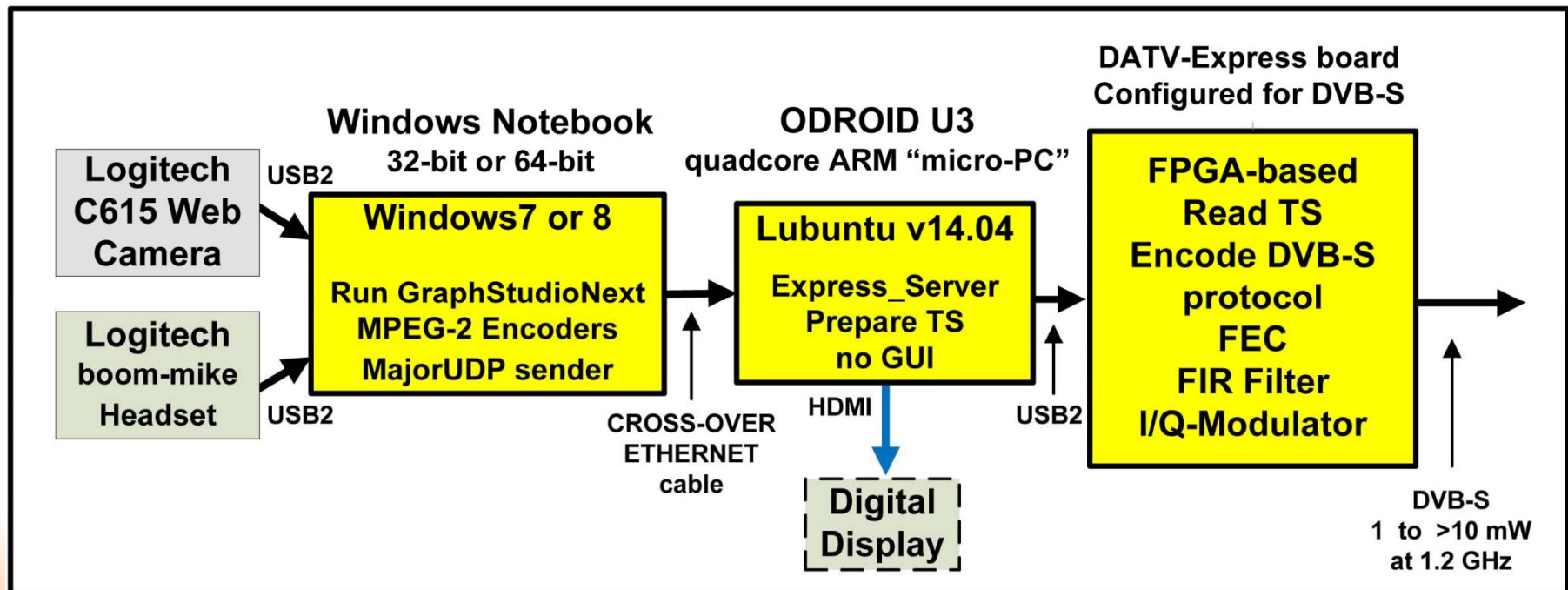
## UDP feature using Express\_Server

- 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

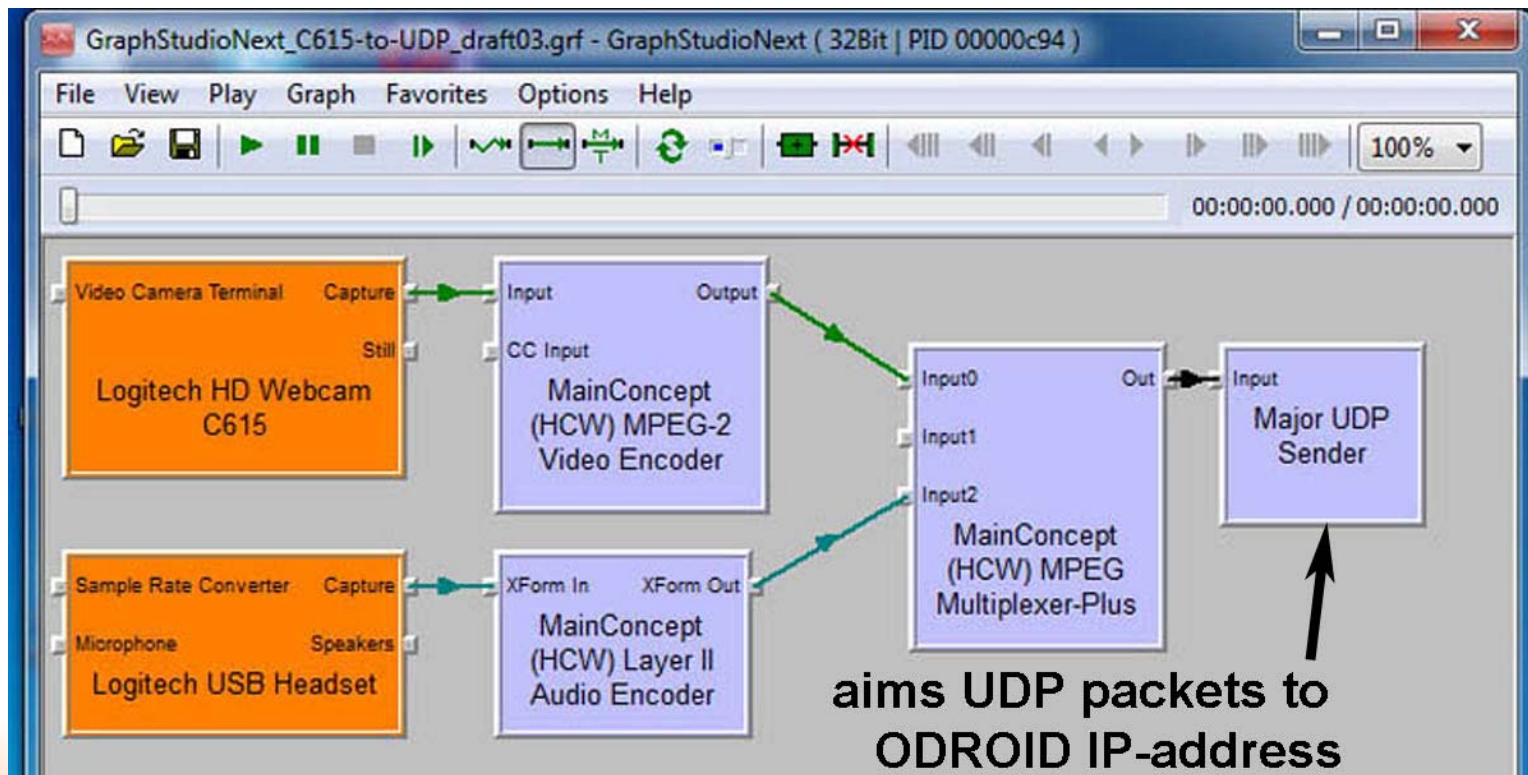


Block Diagram for sending LogiTech web cam video by UDP to ODRROID running Express\_Server

# 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



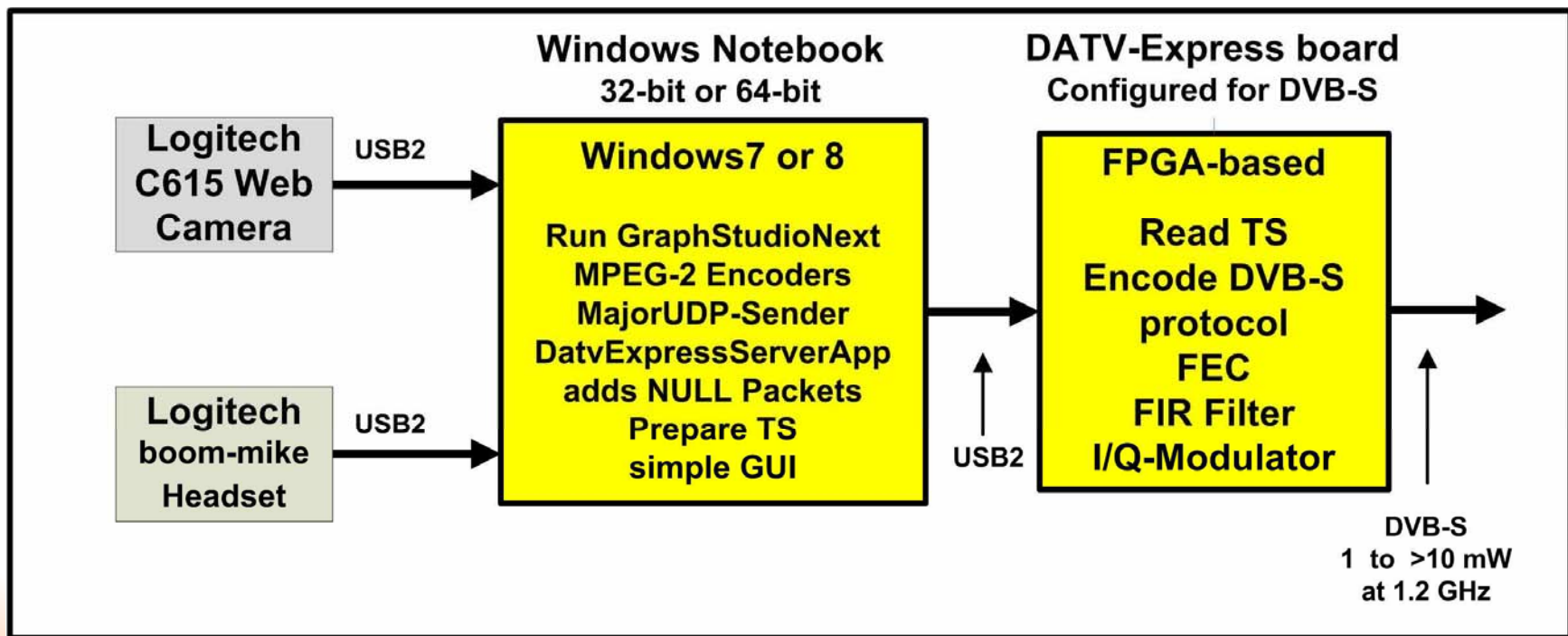
## Using DatvExpressServerApp on Windows

- 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

The screenshot shows a Windows desktop environment. The main window is GraphStudioNext, displaying a signal flow graph with the following components: Logitech HD Webcam C615 (Video Camera Terminal), MainConcept (HCW) MPEG-2 Video Encoder (CC Input), MainConcept (HCW) Layer II Audio Encoder (XForm In), MainConcept (HCW) MPEG Multiplexer-Plus (Input1), and Major UDP Sender (Input). A red arrow points from the text 'DatvExpressServerApp GUI' to the Major UDP Sender block. A black arrow points from the text 'UDP addr is set to loopback 127.0.0.1' to the Major UDP Sender block. In the bottom right corner, the DatvExpressServerApp Configuration dialog is open, showing the following settings:

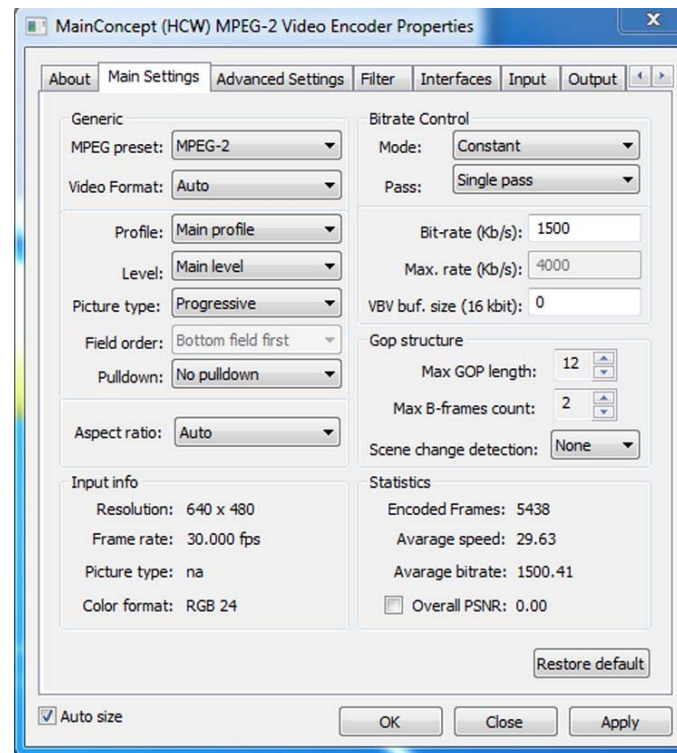
Configuration	
Frequency	1290000000
Symbol rate	2200000
FEC	1/2
Level	40
Network Socket	1958
Status	Transmit
<input type="checkbox"/> Carrier	
<input checked="" type="checkbox"/> Transmit	

Windows running GraphStudioNext graphs and simple GUI for DatvExpressServerApp

# DATV-Express



## Using DatvExpressServerApp on Windows



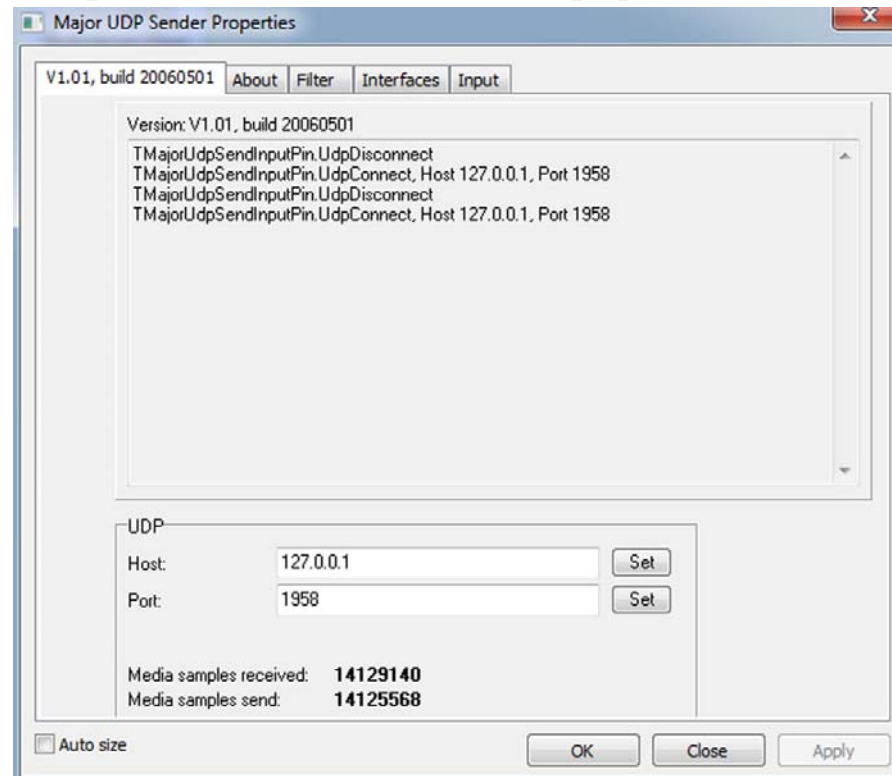
**Properties of MainConcept video encoder filter using  
ConstantBitRate (CBR)**



# 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**

# DATV-Express



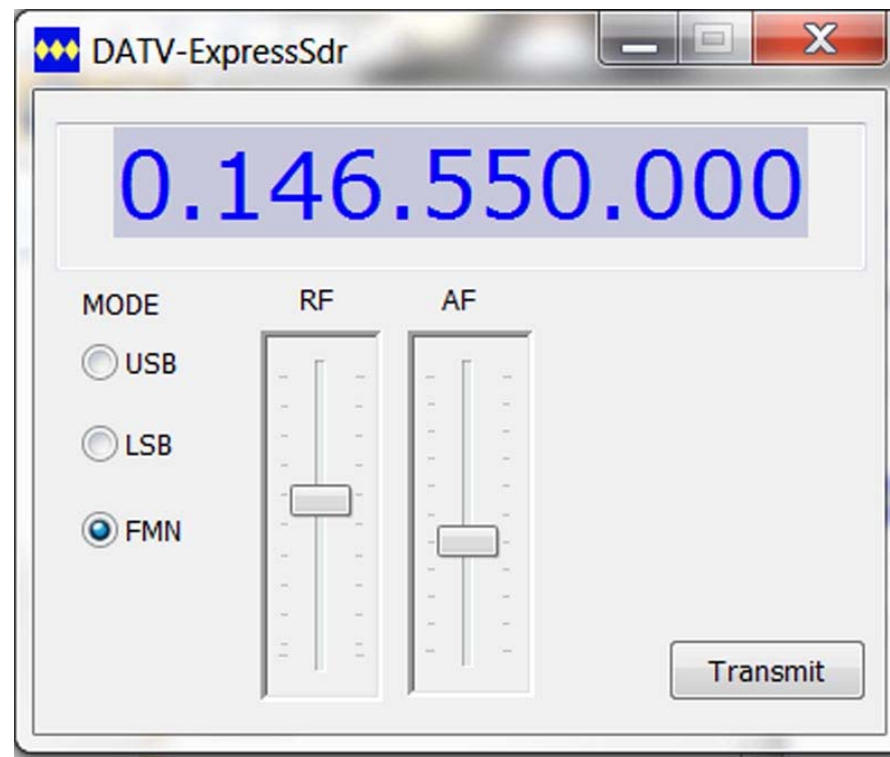
## Working on DatvExpressSdrApp on Windows

- 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



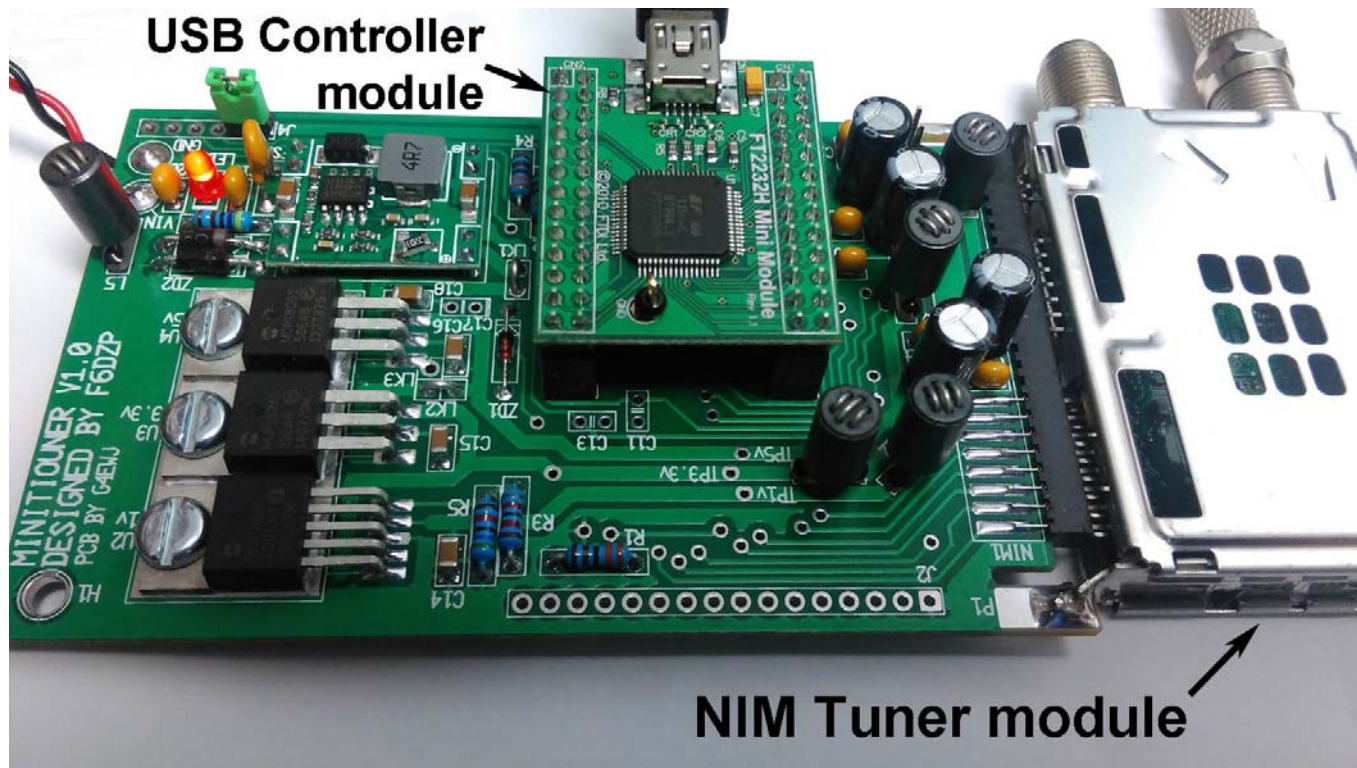
## MiniTiouner USB-based Receiver Project

- 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 KSymb/s to 27.5 MSymb/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



## MiniTioner USB-based Receiver Project



**MiniTioner USB-based Receiver is “ham hackable”**  
(photo courtesy of G4KLB)

# DATV-Express



## MiniTiouner USB-based Receiver Project

The screenshot displays the MiniTiouner software interface. The central window shows a live video feed of a man wearing a headset, sitting at a desk with a laptop and a globe. The video feed has a yellow 'W6HHC Orange CA' watermark. Below the video, the text 'Digital-ATV DVB-S SR=2.2M FEC=1/2' is visible.

The interface is divided into several panels:

- Top Left:** SR (KS) and Freq (kHz) fields showing 02200 and 01292000. Below are frequency selection buttons for SR=2200, SR2000, SR4000, SR6250, and SR27500. There are also FEC and LNB selection options.
- Top Right:** 'PIDs to decode' section with a 'Pid from .ini' button and a list of PIDs: W6HHC-Mpeg (AutoPID), F6DZP-H264 (PID Video 65535), HDlowSR (PID audio 65535), France24 (PID audio 65535), and QZR DX (Code: demo BBC). There are also format and zoom settings.
- Bottom Left:** 'Web Station ID:1' section showing 'W6HHC' and 'Orange, CA USA DM13CS'. It includes antenna direction and gain settings.
- Bottom Center:** A row of five meters: Carrier Lock (126), Timing Lock (126), Power RF (-60 dBm), S/N MER (15 dB), and Constellations (a constellation diagram).
- Bottom Right:** 'TS Status' section showing Viterbi error (0), Vber (0%), Fec (1/2), and TS Status (0). It also includes 'Recvd Packets: 6836', 'Overtaken: 0', and 'delta 109 mser'. There are buttons for 'IN', 'channel', and 'OUT'.

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/](http://www.BATC.org.UK/forum/)**
- CQ-DATV online (free monthly) e-magazine (ePub format)  
**[www.CQ-DATV.mobi](http://www.CQ-DATV.mobi)**
- OCARC library of newsletter DATV articles  
**[www.W6ZE.org/DATV/](http://www.W6ZE.org/DATV/)**
- TAPR Digital Communications Conference proceedings (free downloads)  
**[www.TAPR.org/pub\\_dcc.html](http://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](http://www.DATV-Express.com)**
- G4GUO github for DATV-Express source code  
**[https://github.com/G4GUO/datvexpress\\_gui.git](https://github.com/G4GUO/datvexpress_gui.git)**
- G4GUO github for express\_server source code  
**[https://github.com/G4GUO/express\\_server.git](https://github.com/G4GUO/express_server.git)**
- Hardkernel (Korea) for ODROID model U3 ARM-based “micro-PC”  
**[www.hardkernel.com](http://www.hardkernel.com)**
- Jean Pierre F6DZP web site for TuTioune and MiniTiouner  
**<http://vivadatv.org>**