



### Linux - HPSDR

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### GOORX/N6LYT

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- Existing software to support HPSDR
  - PowerSDR runs on Windows
    - Combination of C and C#
  - KISS Konsole runs on Windows
     C#





### • Goal

• Write Linux software for HPSDR





- HPSDR Hardware
  - Atlas Bus
  - Ozy/Magister USB I/O
  - Mercury receiver
  - Penelope transmitter
  - LPU Power Supply
  - Excalibur 10 MHz clock source
  - PennyWhistle RF Power Amplifier
  - Pandora Enclosure

- Coming soon ...
  - Alex RF Bandpass Filters
  - Ozy II Ethernet I/O
  - Hermes Single board HPSDR transceiver





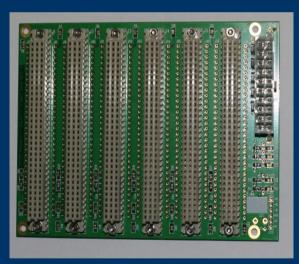


#### Mercury



#### Penelope

### • HPSDR Hardware



Atlas

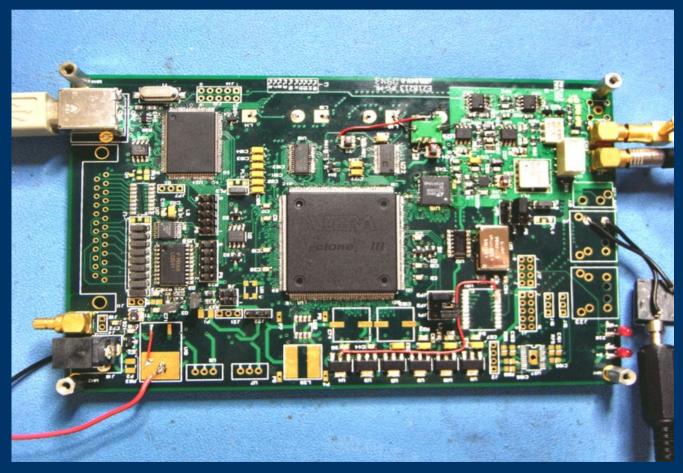


Ozy/Magister





### • HPSDR Hardware



Hermes





- HPSDR Hardware
  - FPGA on each card
    - Allows reprogramming of the hardware.
      - Original Mercury FPGA code implemented 1 receiver with either 48KHz, 96KHz or 192KHz bandwidth from anywhere within the 60MHz sampling range of the receiver.
      - New development to implement up to 8 receivers within a single Mercury card.

















- Software
  - USB interface to Ozy (packet rate for 48000 bps samples)
    - 512 byte packets
      - 8 byte header
        - Mox Frequency (Rx or Tx or Both) Full Duplex Rx speed (48000,96000,192000) Clock sources Rx preamp
      - 63 Tx I/Q samples and audio samples

         I and Q samples 16 bits each
         Audio samples are 2 channels of 16 bits





### • Software

- USB interface from Ozy (packet rate dependent on sample rate)
  - 512 byte packets
    - 8 byte header PTT Dash/Dot ADC overflow Software version of Ozy, Mercury, Penelope Forward power
    - 63 I/Q and Microphone samples I and Q samples 24 bits each Microphone sample 16 bits





### • Software

• USB bandscope interface from Ozy

4096 16 bit samples





### • Software

### • ghpsdr

- Written in C
- Uses DttSP for DSP functions
- Uses GTK+ for GUI





### • Software

- Multi threaded
  - thread to read USB I/Q and Microphone samples
  - thread to read USB bandscope samples
  - thread to process I/Q samples
  - thread to process bandscope smaples
  - thread for spectrum/waterfall display update
  - thread for bandscope display update





### • Software

#### • Modular source code

filter.c agc.c frequency.c audio.c audiostream.c hpsdr\_setup.c band.c bandscope.c libushio.c bandscope\_control.c main.c bandscope\_update.c meter.c command.c meter\_update.c display.c mode.c display\_setup.c\_ozy\_buffers.c

ozy.csozy\_ringbuffer.cspreamp.ctrproperty.cureceiver.cvsetup.cvsinewave.cxsoundcard.csspectrum\_buffers.csspectrum.cv

spectrum\_update.c subrx.c transmit.c util.c vfo.c volume.c xvtr\_setup.c





### • Software

#### ghpsdr

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### • Software

# SDR Forum Dayton 2010



ghpsdr

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HPSDR Display XVTR					
				Ozy FX2 version: XX090211	
				Ozy software version: 16	
				Mercury software version: 30	
				Penelope software version: 0	
Speed:	● 48K	○ 96K	○ 192K		
LT2208:	🥑 Dither	🧭 Random			
122.88MHz Clock Source:	O Penelope	Mercury			
10MHz Clock Source:	O Atlas	O Penelope	Mercury		
Mode:	Other	O Class E			
Mic Source:	🔿 Janus	Penelope			
Alex Attenuation:	ODb	0 10Db	O 20Db	O 30Db	
HPSDR Duplex:	Half	O Full			



• Software

# SDR Forum Dayton 2010



ghpsdr

😣 🛇 📀 HPSDR: setup	
HPSDR Display XVTR	
Spectrum High	
Spectrum Low	-180
Spectrum Step	
Spectrum Update Rate	15
Waterfall High	-110
Waterfall Low	-140
Bandscope High	
Bandscope Low	
CW Pitch	600
	Spectrum Averaging
SpectrumAverage Smoothing	0.4
	✓ Bandscope Averaging
Bandscope Average Smoothing	





• Software

But what about Mercury supporting multiple receivers?



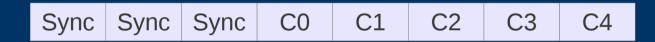


### • Software

USB I/Q Data Stream

USB data is transferred in 512 byte packets.

8 bytes of header data.

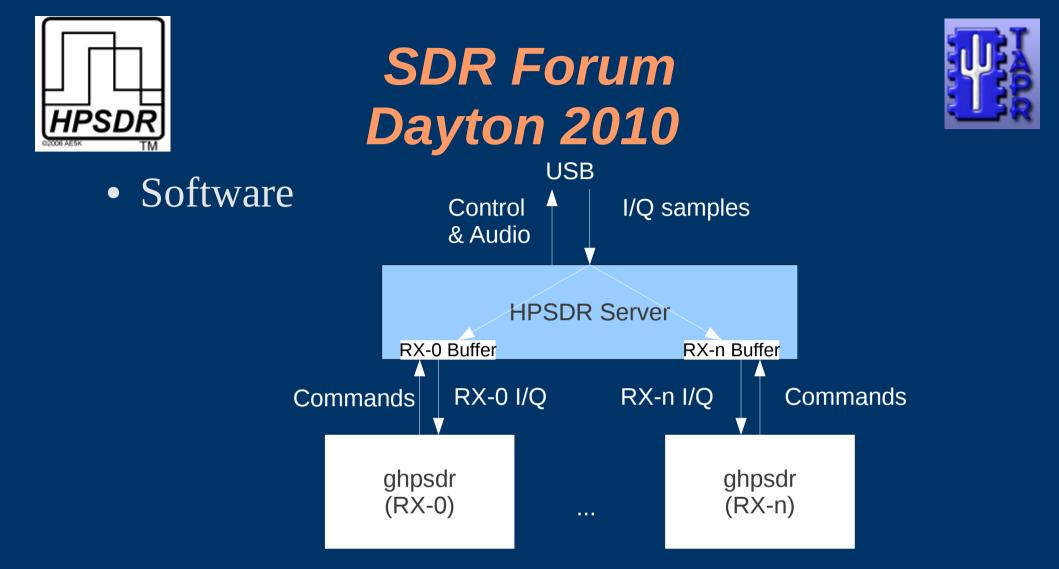


Receiver I/Q data and Mic sample.



I and Q samples are 24 bits (3 bytes). Microphone samples are 16 bits (2 bytes).

Number of samples per packet varies depending on number of receivers.



TCP connection for Commands I/Q data sent over UDP





### • Software

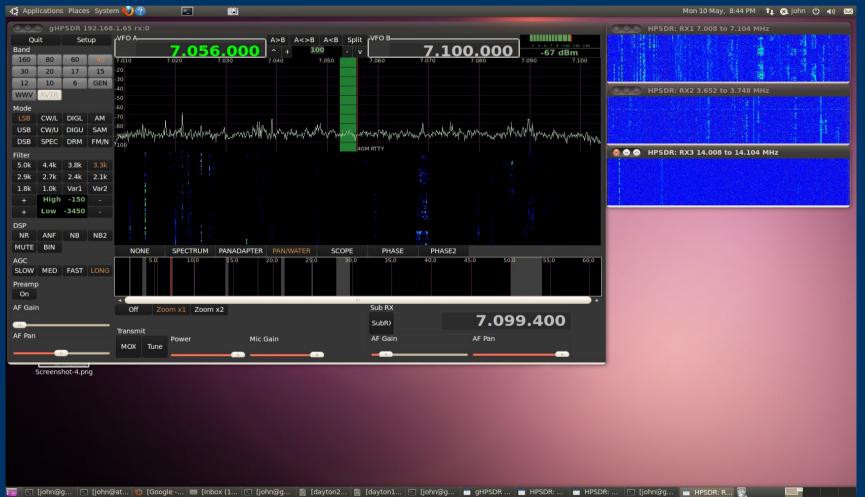
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Filter 2.9k 2.7k 2.4k 2.1k	
5.0k 4.4k 3.8k 3.3k	
2.9k 2.7k 2.4k 2.1k + High 1.50 -	
1.8k 1.0k Var1 Var2 + Low -2850 -	
+ High -150 - I - DSP	
+ Low -5150 - NR ANF NB NB2	
DSP NONE SPECTRUM PANADAPTER PAN/WATER SCOPE	PHASE PHASE2
NR ANF NB NB2 20,0 25,0 30,0 30,0 30,0 30,0 30,0 30,0 30,0 3	0 35.0 40.0 45.0 50.0 55.0 60.0
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• Software

Bandwidth Requirements

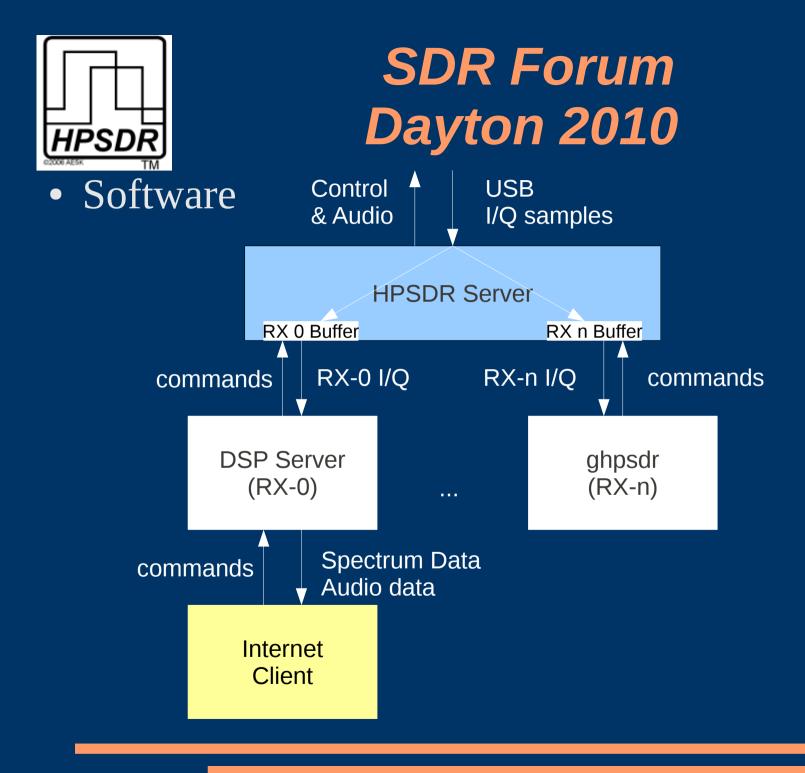
24 bit I samples24 bit Q samples

48000 samples per second = 2304000 bits per second 96000 samples per second = 4608000 bits per second 192000 samples per second = 9216000 bits per second

For just 1 receiver!

8 receivers at 192000 = **73728000** bits per second

My broadband uplink speed is 360 Kbps









- Software
  - Bandwidth requirements per internet receiver
    - Spectrum data sent as 8 bit values
    - Client requests number of samples currently 480 at 10 requests per second.
    - Audio data sent as 8-bit aLaw at 8000 samples per second.
    - Spectrum data = 480\*10\*8 = 34800 bits per second
    - Audio data =8000\*8 = 64000 bits per second
    - 98800 bits per second per receiver





• Software

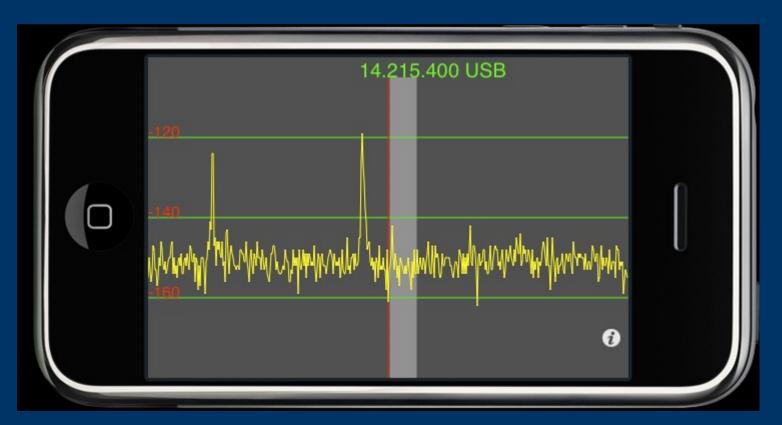
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- Software
  - iPhone client







- Software
  - Android Client

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• Software

Ongoing development to support other hardware

SDR1000 server Softrock server (both fixed Xtal and Si570) UHFSDR server





### Thanks

- HPSDR Group
- TAPR Group
- Phil Harman VK6APH
- Bob McGwier N4HY
- Frank Brickle AB2KT
- Ken Hopper N9VV
- Kirk Weedman KD7IRS
- Bruce Walker W1BW





- References
  - Source code in HPSDR svn repository:

svn://64.245.179.219/svn/repos\_sdr\_hpsdr/trunk/N6LYT