CW, RTTY, WSPR, JT9/JT65 Spotting/Skimming using RTLSDR & Hermes Lite SDR's

Doug Theriault – NO1D

Prescott Hamfest

June 2016

Overview / Agenda

- What is Skimming, Spotting
  - Why is it interesting?
- Skimming Modes, Types of Spotting
- Software Applications and Spotting Sites
- Hardware configurations for multi-band spotting
  - Using RTLSDR
  - Hermes Lite SDR
  - NO1D *“SpotBox”* – Multi-Band Skimming Rx's
- Networking, Accuracy, Usage during Contesting
- Data Mining signal reports
- Hints, Kinks, Gotcha's
- Links/References

Skimming & Spotting

- Skimming: Automated decoding of signals
  - ***Skimmers operate on band segments, decoding multiple signals at once.***
  - ***Typical BW from 3khz to 192khz***
- Identification of stations calling CQ or Beacons
  - Can also include non-CQ exchanges
- Spotting: Publication of decodes to on-line sites/servers for multiple uses
  - Traditional DX cluster(s) spotting; Reporting a DX station on freq/mode
  - Identify Band openings
  - Propagation analysis; signal strengths vs time
  - Analysis of Antenna Performance
  - Space / Ionospheric Weather predictions

Skimming / Spotting Modes

- Spotting Manually can be “any” mode
- Skimming best suited for digital modes
  - CW, RTTY, PSK, WSPR, JT9/JT65
  - What about an AM/SSB/FM skimmer... Not yet...
  - Other modes?
- This talk focuses on Multi-Band, Automated decoding of CW, RTTY, WSPR, JT9/JT65 modes

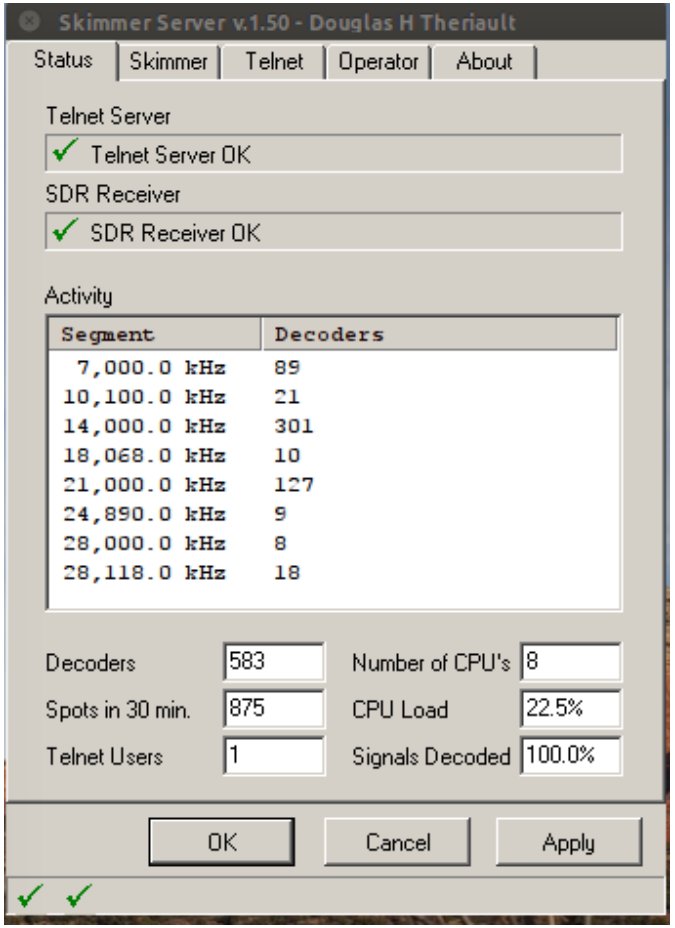
Software – in use by no1d today

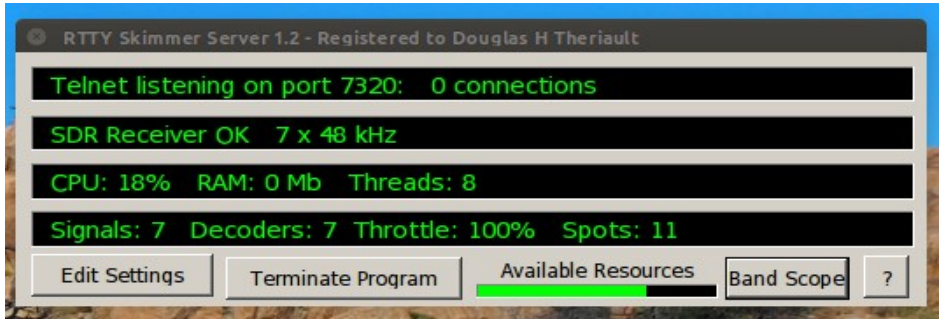
CW Decoding	CW SkimServer v1.5	VE3NEA, Alex, DX Atlas, $$$ *(30d free trial)* http://dxatlas.com
RTTY Decoding	RTTY SkimServer v1.2	VE3NEA, Alex, DX Atlas, $$$ *(30d free trial)* http://dxatlas.com
WSPR, JT9, JT65	HL Radio v0.132 (beta)	2E0NNB, Alan Hopper, free Note: Windows only today http://www.ihopper.org/radio/
DLL for CW, RTTY	HermesIntfc.dll	K3IT, Vasily, free OpenHPSDR protocol interface https://sourceforge.net/projects/hermesintf/files/
RBN Aggregator *CW and RTTY spots published to RBN*	V4.12	From Reverse Beacon downloads, free Note: Requires .NET 4.x http://reversebeacon.net
RTLSDR support (DVB-T/ RTL SDR USB sticks)	lib_rtlhpsdr	Rick (Author), N1GP, Doug NO1D, free http://github.com/n1gp/rtl_hpsdr http://github.com/dtheriault/hydra
OS Platform	Windows &/or Linux	Windows 8.x/10.x Ubuntu 14.04 LTS w/ Wine

CW & RTTY SkimServer(s)

- Originally designed for QS1R SDR hardware
  - *Several other SDR's now supported via additional .DLL*
- Up to 8 bands simultaneously @ up to 192Khz Rx bandwidth/band
  - *May support 10 bands w/ new QS1R box release later this year.*
- Windows, but can exec under Linux/Wine
  - *Requires x86 instruction set; SSE3*
- Performance, function of #CPU Cores/Memory
  - *NO1D using 12 core x86, 16G AMD @ 3.6Ghz Linux Ubuntu 14.04LTS / Wine*
  - *Utilizes ~ 30% of system resources during contests*

CW & RTTY Skim Servers



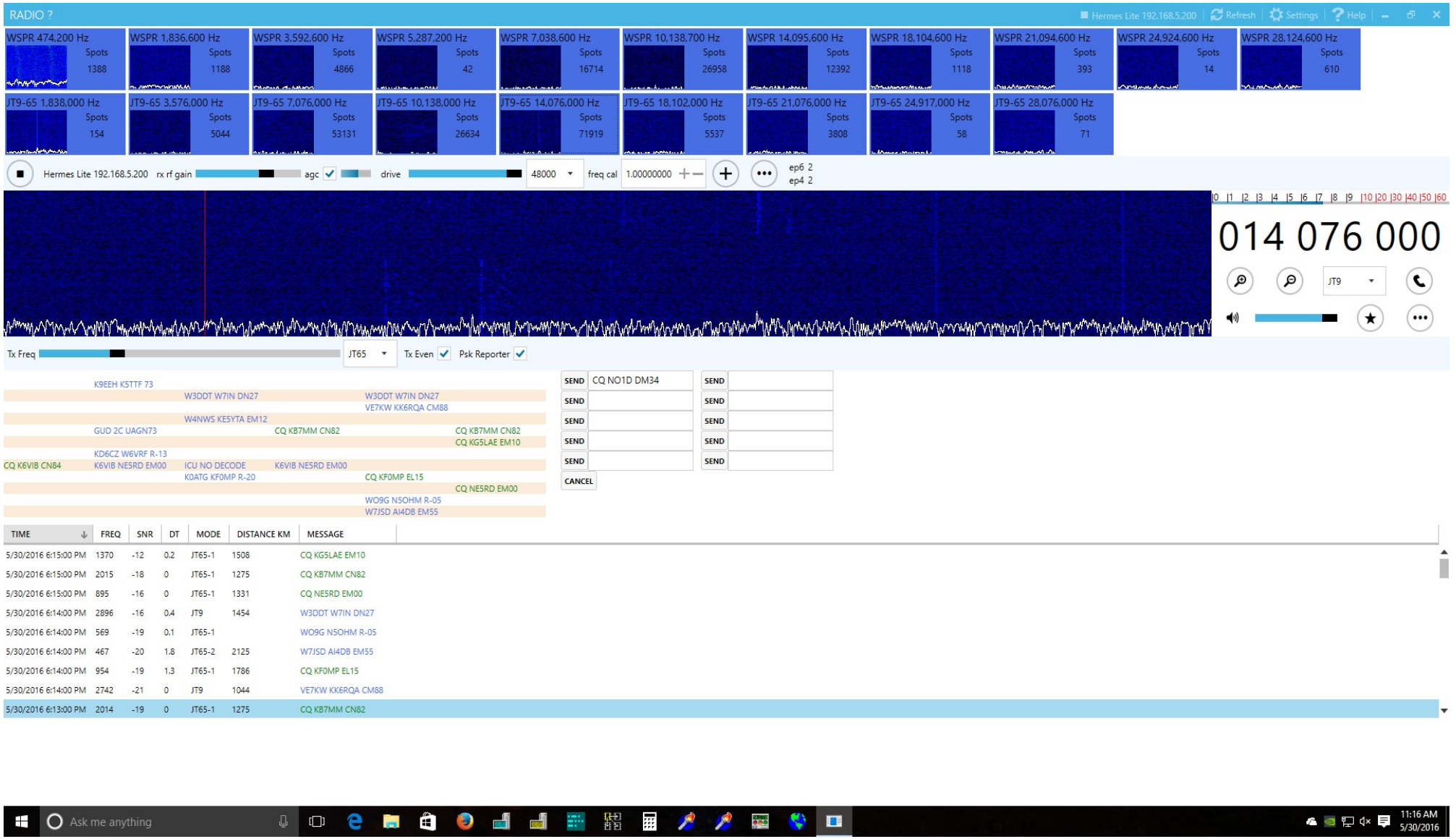



```
2016-05-29 23:58:36Z   14044.0  K9OM        29-May-2016 2358Z   37 dB  27 WPM               <NO1D-#>
2016-05-29 23:58:37Z   14043.7  N9NA        29-May-2016 2358Z   17 dB  25 WPM  CQ           <NO1D-#>
2016-05-29 23:58:39Z   14064.6  K8WSN       29-May-2016 2358Z   30 dB  25 WPM               <NO1D-#>
2016-05-29 23:58:41Z   14068.9  AE1T        29-May-2016 2358Z   20 dB  26 WPM               <NO1D-#>
2016-05-29 23:58:42Z   14026.4  NZ5A        29-May-2016 2358Z   20 dB  24 WPM               <NO1D-#>
2016-05-29 23:58:43Z   14000.9  ND2O        29-May-2016 2358Z   17 dB  25 WPM               <NO1D-#>
2016-05-29 23:58:44Z   14011.1  P40L        29-May-2016 2358Z   23 dB  32 WPM  CQ           <NO1D-#>
2016-05-29 23:58:45Z    7030.0  WN6K        29-May-2016 2358Z   27 dB  28 WPM  CQ           <NO1D-#>
2016-05-29 23:58:46Z    7047.5  PT2NP       29-May-2016 2358Z    8 dB  22 WPM               <NO1D-#>
2016-05-29 23:58:47Z   14005.2  NR4M        29-May-2016 2358Z   19 dB  25 WPM  CQ           <NO1D-#>
2016-05-29 23:58:47Z   14017.9  KB7H        29-May-2016 2358Z   13 dB  25 WPM               <NO1D-#>
2016-05-29 23:58:58Z   14006.5  WP4PGY      29-May-2016 2358Z   11 dB  27 WPM               <NO1D-#>
2016-05-29 23:58:58Z   14064.6  VE1AOE      29-May-2016 2358Z   22 dB  25 WPM  CQ           <NO1D-#>
2016-05-29 23:59:03Z   14062.3  KM4LAO      29-May-2016 2359Z   23 dB  18 WPM               <NO1D-#>
2016-05-29 23:59:05Z    7052.7  K4BAI       29-May-2016 2359Z    7 dB  26 WPM  CQ           <NO1D-#>
2016-05-29 23:59:07Z    7027.0  NA6O        29-May-2016 2359Z   30 dB  27 WPM  CQ           <NO1D-#>
2016-05-29 23:59:07Z   14040.7  NJ1T        29-May-2016 2359Z   10 dB  27 WPM               <NO1D-#>
2016-05-29 23:59:12Z   21015.5  NX6T        29-May-2016 2359Z   11 dB  27 WPM               <NO1D-#>
2016-05-29 23:59:16Z   14018.5  WA1Z        29-May-2016 2359Z   14 dB  30 WPM               <NO1D-#>
2016-05-29 23:59:18Z   14004.9  WH6YH       29-May-2016 2359Z   24 dB  27 WPM               <NO1D-#>
2016-05-29 23:59:18Z    7036.0  NR4M        29-May-2016 2359Z    6 dB  31 WPM               <NO1D-#>
2016-05-29 23:59:18Z    7046.4  KE1S        29-May-2016 2359Z    5 dB  25 WPM               <NO1D-#>
2016-05-29 23:59:19Z    7034.2  K9UIY       29-May-2016 2359Z    7 dB  29 WPM               <NO1D-#>
2016-05-29 23:59:20Z   14035.5  NN5N        29-May-2016 2359Z   11 dB  32 WPM  CQ           <NO1D-#>
2016-05-29 23:59:26Z   14048.1  II9P        29-May-2016 2359Z   23 dB  29 WPM               <NO1D-#>
2016-05-29 23:59:28Z   14027.1  WA8KAN      29-May-2016 2359Z   11 dB  26 WPM               <NO1D-#>
2016-05-29 23:59:28Z   14007.2  NA6O        29-May-2016 2359Z    7 dB  28 WPM               <NO1D-#>
2016-05-29 23:59:31Z   21002.2  NO6T        29-May-2016 2359Z    8 dB  25 WPM               <NO1D-#>
2016-05-29 23:59:39Z   14018.4  N4WO        29-May-2016 2359Z   12 dB  29 WPM               <NO1D-#>
2016-05-29 23:59:41Z    7029.3  WT2P        29-May-2016 2359Z   13 dB  39 WPM  CQ           <NO1D-#>
2016-05-29 23:59:43Z    7019.0  K9RM        29-May-2016 2359Z   25 dB  23 WPM  DE           <NO1D-#>
2016-05-29 23:59:44Z   21028.0  ZM1A        29-May-2016 2359Z   11 dB  29 WPM  CQ           <NO1D-#>
2016-05-29 23:59:45Z   14029.4  NO6T        29-May-2016 2359Z   11 dB  28 WPM  CQ           <NO1D-#>
2016-05-29 23:59:47Z    7015.0  P4/N4QS     29-May-2016 2359Z   12 dB  31 WPM  CQ           <NO1D-#>
2016-05-29 23:59:49Z    7007.2  WC3W        29-May-2016 2359Z    9 dB  22 WPM  CQ           <NO1D-#>
2016-05-29 23:59:52Z   14017.9  WA1Z        29-May-2016 2359Z   16 dB  29 WPM               <NO1D-#>
2016-05-30 00:00:02Z    7054.1  NA8U        30-May-2016 0000Z    5 dB  28 WPM  CQ           <NO1D-#>
2016-05-30 00:00:02Z   14069.4  N8DX        30-May-2016 0000Z   14 dB  21 WPM               <NO1D-#>
2016-05-30 00:00:03Z   14046.9  FM/DL7VOG   30-May-2016 0000Z   13 dB  31 WPM  CQ           <NO1D-#>
2016-05-30 00:00:11Z   14036.3  AI6N        30-May-2016 0000Z   12 dB  28 WPM               <NO1D-#>
2016-05-30 00:00:31Z   10113.1  W7KQU       30-May-2016 0000Z   15 dB  19 WPM               <NO1D-#>
2016-05-30 00:00:43Z    7019.0  K9RM        30-May-2016 0000Z   25 dB  23 WPM  CQ           <NO1D-#>
2016-05-30 00:00:54Z   14061.2  W0VLZ       30-May-2016 0000Z   16 dB  16 WPM  CQ           <NO1D-#>
2016-05-30 00:01:10Z    7025.7  W9YK        30-May-2016 0001Z   14 dB  23 WPM  CQ           <NO1D-#>
2016-05-30 00:01:19Z   14053.5  AK4NY       30-May-2016 0001Z   16 dB  14 WPM  DE           <NO1D-#>
2016-05-30 00:01:40Z   10123.0  K5KV        30-May-2016 0001Z   25 dB  22 WPM  CQ           <NO1D-#>
2016-05-30 00:01:45Z    7024.4  W5ZO        30-May-2016 0001Z   26 dB  22 WPM  CQ           <NO1D-#>
2016-05-30 00:01:57Z   14053.5  AK4NY       30-May-2016 0001Z   18 dB  15 WPM  CQ           <NO1D-#>
2016-05-30 00:02:56Z   10109.9  KD0V        30-May-2016 0002Z    9 dB  17 WPM               <NO1D-#>
2016-05-30 00:03:07Z    7051.0  K7URU       30-May-2016 0003Z   17 dB  18 WPM  DE           <NO1D-#>
2016-05-30 00:03:25Z   10110.7  K8JPM       30-May-2016 0003Z   11 dB  30 WPM  DE           <NO1D-#>
2016-05-30 00:03:49Z   14054.7  W0VLZ       30-May-2016 0003Z    8 dB  15 WPM  CQ           <NO1D-#>
2016-05-30 00:04:15Z   14020.0  AL1G        30-May-2016 0004Z    6 dB  26 WPM               <NO1D-#>
2016-05-30 00:04:49Z   14005.1  WR1A        30-May-2016 0004Z    8 dB  25 WPM  DE           <NO1D-#>
2016-05-30 00:05:13Z   18082.2  WT3I        30-May-2016 0005Z    7 dB  19 WPM               <NO1D-#>
2016-05-30 00:05:22Z   14052.5  W0VLZ       30-May-2016 0005Z   13 dB  15 WPM  CQ           <NO1D-#>
2016-05-30 00:05:33Z   10118.0  N7YT        30-May-2016 0005Z   14 dB  27 WPM  CQ           <NO1D-#>
2016-05-30 00:06:08Z   14057.0  KG5WY       30-May-2016 0006Z    8 dB  13 WPM  DE           <NO1D-#>
2016-05-30 00:06:09Z   18082.0  JA1KIH      30-May-2016 0006Z    3 dB  24 WPM  CQ           <NO1D-#>
2016-05-30 00:06:30Z   14045.0  WA9LDD      30-May-2016 0006Z   16 dB  15 WPM  CQ           <NO1D-#>
2016-05-30 00:06:31Z   10104.0  VE2MF       30-May-2016 0006Z    3 dB  22 WPM               <NO1D-#>
2016-05-30 00:06:37Z   18075.0  KK4IP       30-May-2016 0006Z   18 dB  16 WPM  CQ           <NO1D-#>
2016-05-30 00:08:31Z   10117.5  WB0CFF      30-May-2016 0008Z    5 dB  21 WPM  DE           <NO1D-#>
2016-05-30 00:09:30Z   14001.0  KK5I        30-May-2016 0009Z   13 dB  36 WPM               <NO1D-#>
doug@mugu:~/cw$
```

WSPR, JT9/JT65

- Alan Hopper, 2E0NNB/M6NNB; HL Radio v0.132 (beta)
- Leverages K1JT's WSJT software for decoding
- Supports Tx as well as Rx (JT9/JT65)
- Automatic upload spots to
  - *WSPRnet.org & PSKReporter.info*
- Support 'n' Rx instances (really mean 'n' !!)
  - *20 Simultaneous Rx in use today by NO1D*
  - *Each Rx slice 48Khz bandwidth from single SDR*
- Currently Windows only
- Eventually plans OpenSource version, if possible
- Specific to Hermes Lite (HPSDR protocol) SDR interface
  - *Does work with RTLSDR using N1GP software*

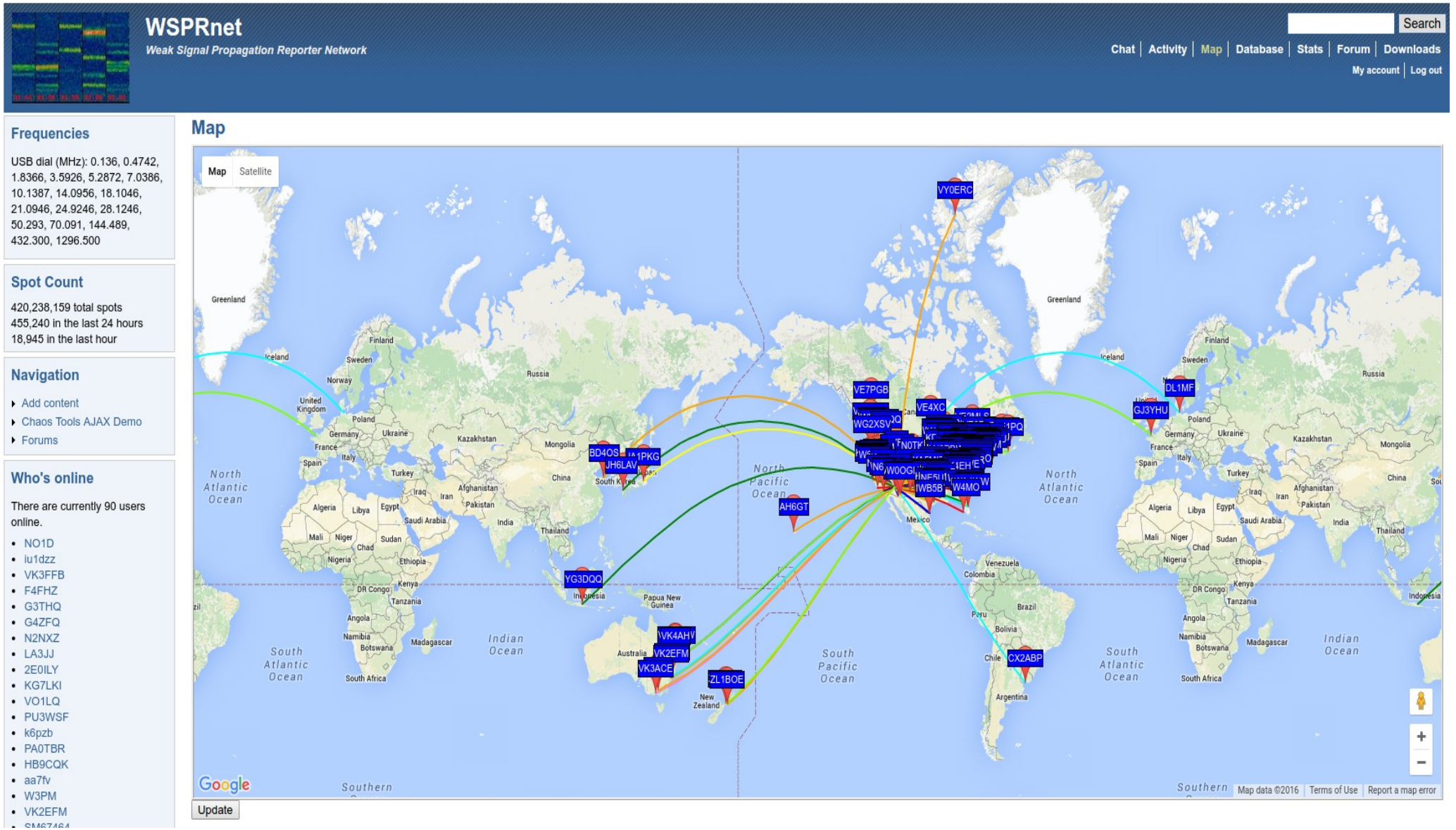
HL Radio v0.132 (beta)



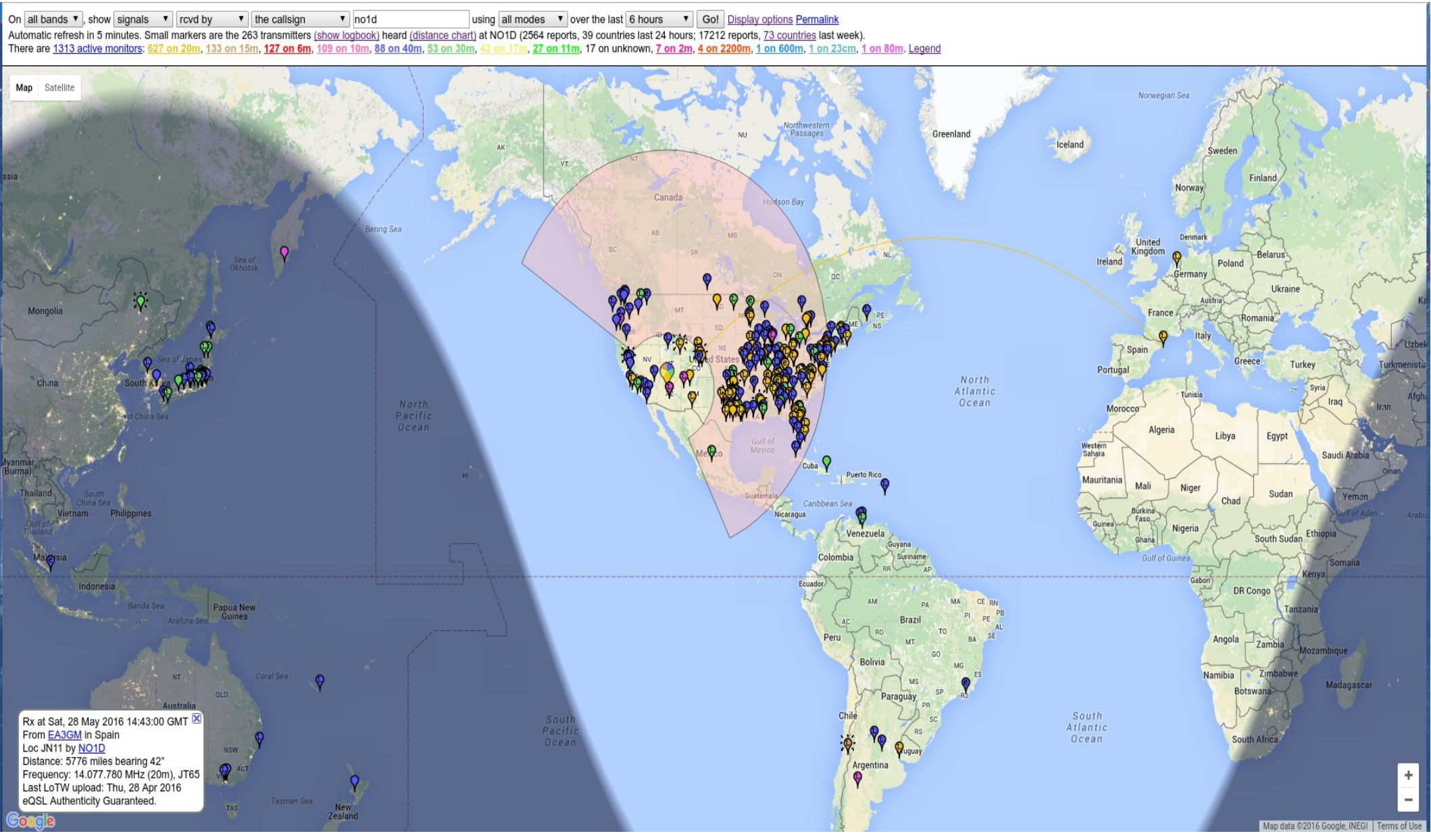
Spotting Sites/Services

Modes	Name	URL
CW, RTTY (psk)	Reverse Beacon Network	http://www.reversebeacon.net/
WSPR	WSPR Network Weak Signal Propogation reporter network	http://www.wsprnet.org
CW/RTTY, Digital	PSK Automatic Propogation Reporter	https://pskreporter.info
Many Digital Modes	Ham Spots	http://hamspots.net

WSPRnet.org


WSPRnet
Weak Signal Propagation Reporter Network
Search
Chat | Activity | Map | Database | Stats | Forum | Downloads
My account | Log out
Frequencies
USB dial (MHz): 0.136, 0.4742, 1.8366, 3.5926, 5.2872, 7.0386, 10.1387, 14.0956, 18.1046, 21.0946, 24.9246, 28.1246, 50.293, 70.091, 144.489, 432.300, 1296.500
Spot Count
420,238,159 total spots
455,240 in the last 24 hours
18,945 in the last hour
Navigation
Add content
Chaos Tools AJAX Demo
Forums
Who's online
There are currently 90 users online.
NO1D
iu1dzz
VK3FFB
F4FHZ
G3THQ
G4ZFQ
N2NXZ
LA3JJ
2E0ILY
KG7LKI
VO1LQ
PU3WSF
k6pzb
PA0TBR
HB9CQK
aa7fv
W3PM
VK2EFM
Map
Map
Satellite
VY0ERC
VE7PGB
VE4XC
DL1MF
GJ3YHU
BD4OS
JH6LAV
AH6GT
YG3DQC
VK4AHV
VK2EFM
VK3ACE
ZL1BOE
CX2ABP
Google
Map data ©2016
Terms of Use
Report a map error
Update

PSK Reporter



Reverse Beacon Net

during CQ WPX Contest

/ 160m / 80m / 40m / 30m / 20m / 17m / 15m / 12m / 10m / 6m / 2m

world wide / zoom to US / zoom to Europe / zoom to North Atlantic

show/hide my last filters

showing spots for spotter call: NO1D

search spot by callsign

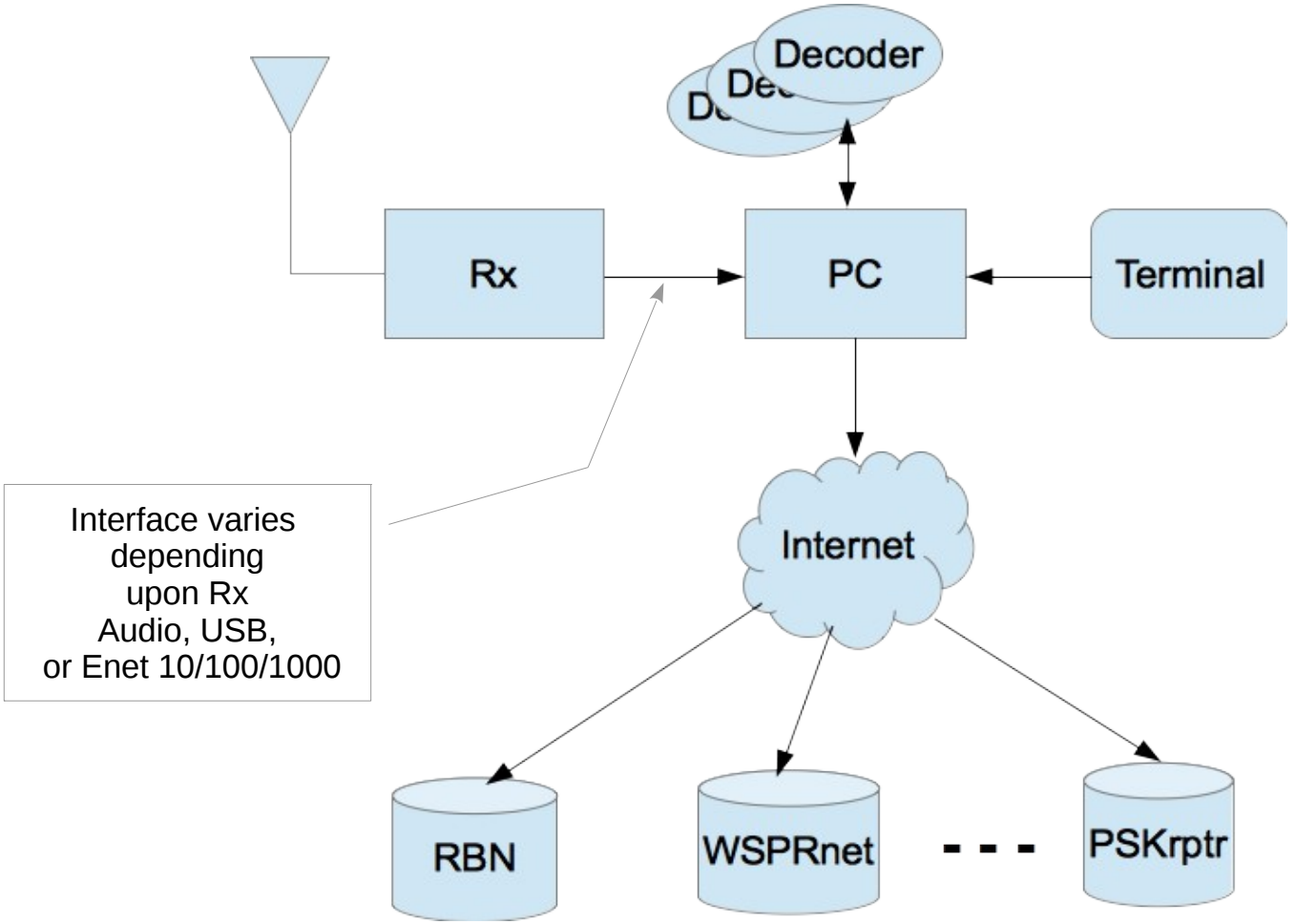
rows to show: 100

de	dx	freq	cq/dx	snr	speed	time
NO1D	W9RET	14023.8	CW CQ	12 dB	32 wpm	1532z 28 May
NO1D	W7AIT	7036.0	CW CQ	22 dB	16 wpm	1532z 28 May
NO1D	BY5CD	14012.6	CW CQ	10 dB	33 wpm	1532z 28 May
NO1D	NN5Z	21018.5	CW CQ [LoTW]	16 dB	29 wpm	1532z 28 May
NO1D	PP1CZ	21042.5	CW CQ [LoTW]	6 dB	32 wpm	1532z 28 May
NO1D	K5LG	10111.1	CW CQ [LoTW]	19 dB	21 wpm	1532z 28 May
NO1D	K0AD	14051.1	CW CQ [LoTW]	10 dB	31 wpm	1532z 28 May
NO1D	K0WA	14059.1	CW CQ [LoTW]	21 dB	29 wpm	1532z 28 May
NO1D	NR7DX	14029.4	CW CQ [LoTW]	29 dB	32 wpm	1532z 28 May
NO1D	W7SW	14006.6	CW CQ	11 dB	32 wpm	1532z 28 May

Hardware

- Almost any HF receiver/transciever
- FlexRadio or Apache Labs SDR's
  - Secondary Rx's can be configured for spotting
- Many smaller SDR's:
  - SoftRock's, QS1R's, RTLSDR, Hermes Lite, RedPitaya, SDR IQ, USRP...
  - Dedicated units so you don't tie up your primary rig
- PC for decoding – Windows / Linux
- Antenna
  - MF/HF Broadband for simultaneous multi-band op

Basic Block Diagram

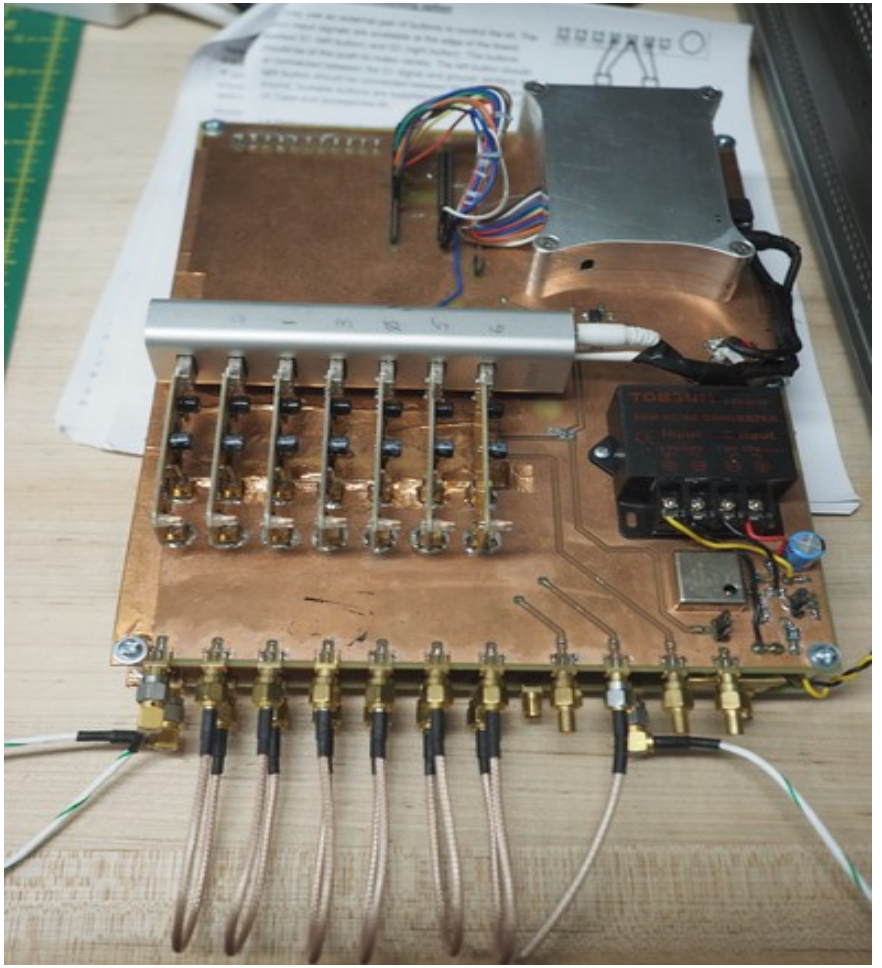


How to do Multi-Band Spotting

- Use single Rx and band-switch
- Use Multiple Rx and Aggregate
  - Up to '7' RTLSDR (DVB-T) sticks
  - librtl_hpsdr and hermesIntfc.dll needed to aggregate I/Q streams (formats into hpsdr packets)
- Use HW which can instantiate multiple Rx's
  - Flex, QS1R, Apache Labs, USRP; can be pricey
  - Hermes Lite SDR's; < ~$250 for 32 Rx !!!
  - Typically FPGA based platforms supporting multiple Rx slices

Spotting w/ Hydra RTLSDR

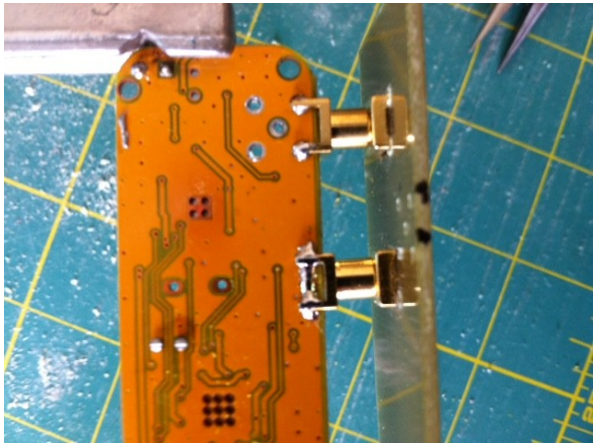
- Well known DVB-T sticks
- Using RTLSDR software stack
- 8-bit A/D for reasonable DNR
- Great entry device for getting into SDR
- Lots of Software available
- Yes, you can aggregate several sticks for multi-band spotting
- N1GP librtlhpsdr software makes this all possible !
- Shown is Hydra, 7 stick RTLSDR Spotting Rx.
- Utilizes oDroid C1 embedded ARMv7 CPU

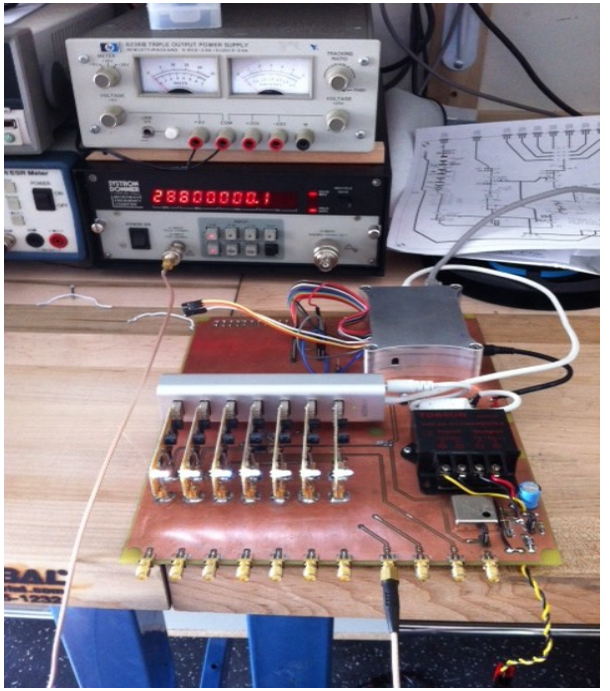


- Sticks Rx from ~20mhz to 1.7Ghz, so for HF, requires up-converter mixer
- Shown is (2) board set, mixer on bottom

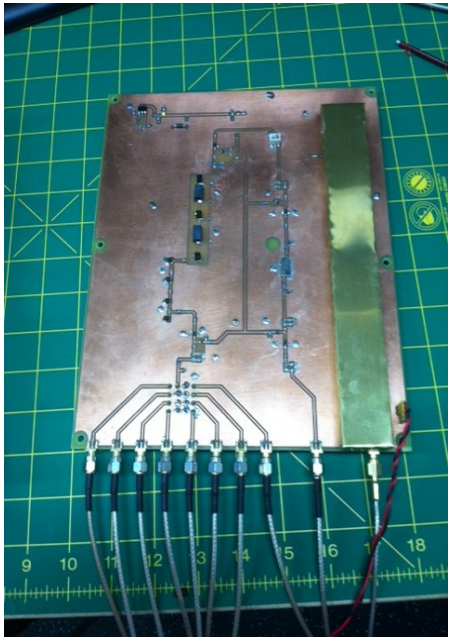
RTLSDR - limitations

- 8-bit A/D limits DNR
- USB interface limits overall bandwidth 'n' sticks can be processed by CPU
- Sampling rate (28.8Mhz) accuracy varies; due to ppm of crystal or xtal osc chip.
- Power hungry, each stick, 500ma
- Embedded system; oDroid C1 w/ Gbe was best compared to rPI, Jetston TK1, other oDroids
- Software utilizes x86 or ARM NEON intrinsics instructions for fp/vector processing; FIR filter processing limits # sticks which can be processed.
- Main bd. Implements PLL to generate 28.8mhz and 125Mhz LO clocks





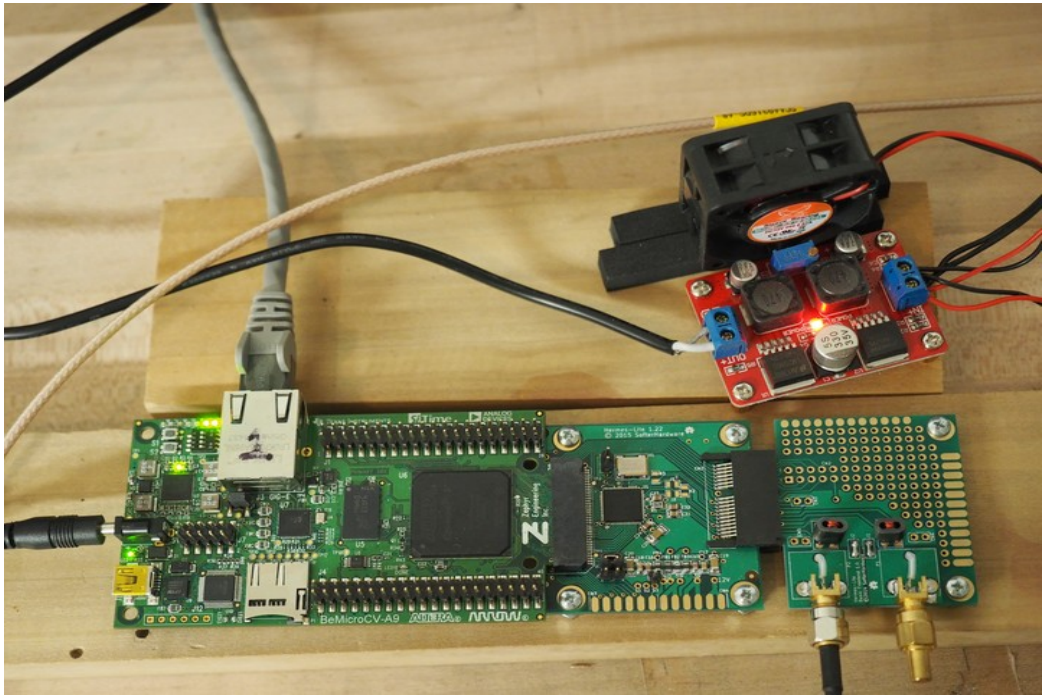
RTLSDR – mixer.



- Initial prototype used a HamItUp converter
- Developed Mixer w/ filters and multi-port coupler
- LPF, BCB filter on front end
- 125Mhz LO w/ SAW filter
- ADE6+ Mixer
- IF Filtering, MMIC's to overcome losses into mini-circuits Multi-Coupler
- Home brew 2-sided PCB
- Not as flat across HF as designed, Need 4-layer PCB to get 50/75ohm transmission lines
- Good Learning Experience !
- More bands @ low cost... how...?

Hermes Lite SDR

- FPGA Based SDR
- Based off openHPSDR.org Hermes project
- Lead by Steve Haynal KF7O
- OpenSource effort with many famous hams contributing
- Direct conversion/sampling SDR; minimal front end
- Supports Tx as well as Rx
- 12-bit AD9866 A/D converter used in set-top boxes; good to 36Mhz
- Uses COTS FPGA engine, BeMicroCVA9 shown here...
- With CVA9, can instantiate 32Rx on single board !!! Wow !!!



- V1.22 shown here, 2x board set available off Tindie
- PCB only, but easy to assemble if not adverse to SMD construction
- Next gen v2.0 in development

Hermes Lite – Low cost Performer !

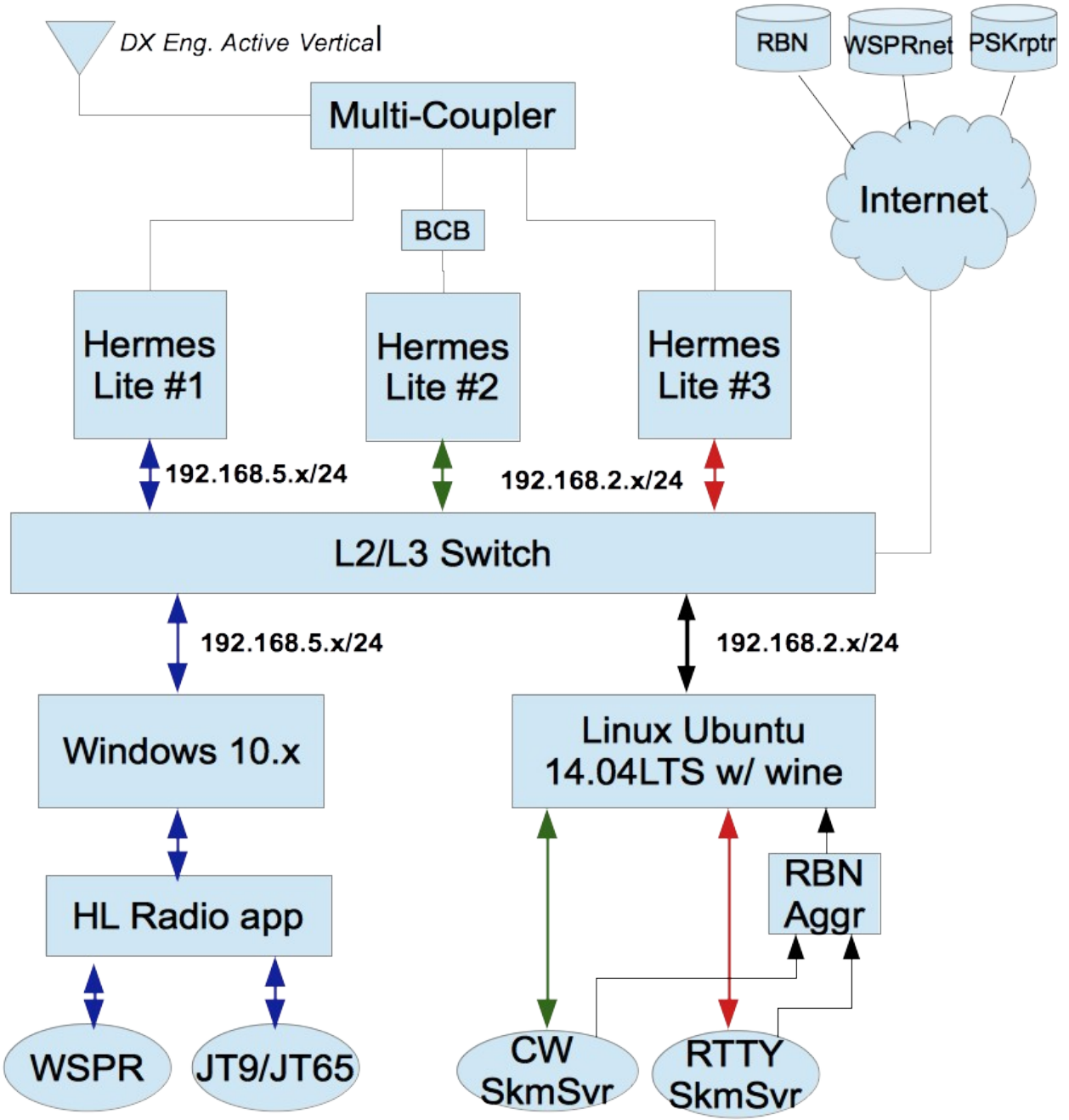
- FPGA implements a minimal networking stack
  - HW supports Gbe speeds
- Software limitations experienced in oDroid are overcome by fast FPGA processing
- Direct Sampling A/D means no mixer challenges
- Lower power draw per Rx slice
- Supports HPSDR protocol
- Can be used as VNA
- Depending upon FPGA engine selected, can scale up to 32 Rx slices
- World wide OpenSource project; hams from many continents supporting effort.
- Verilog and PCB files available
  - *Purchase from Tindie, OSH Park*
- V2.0 goal uses Altera Max10 FPGA for more integrated solution.

NO1D
spotting config

33 – 34

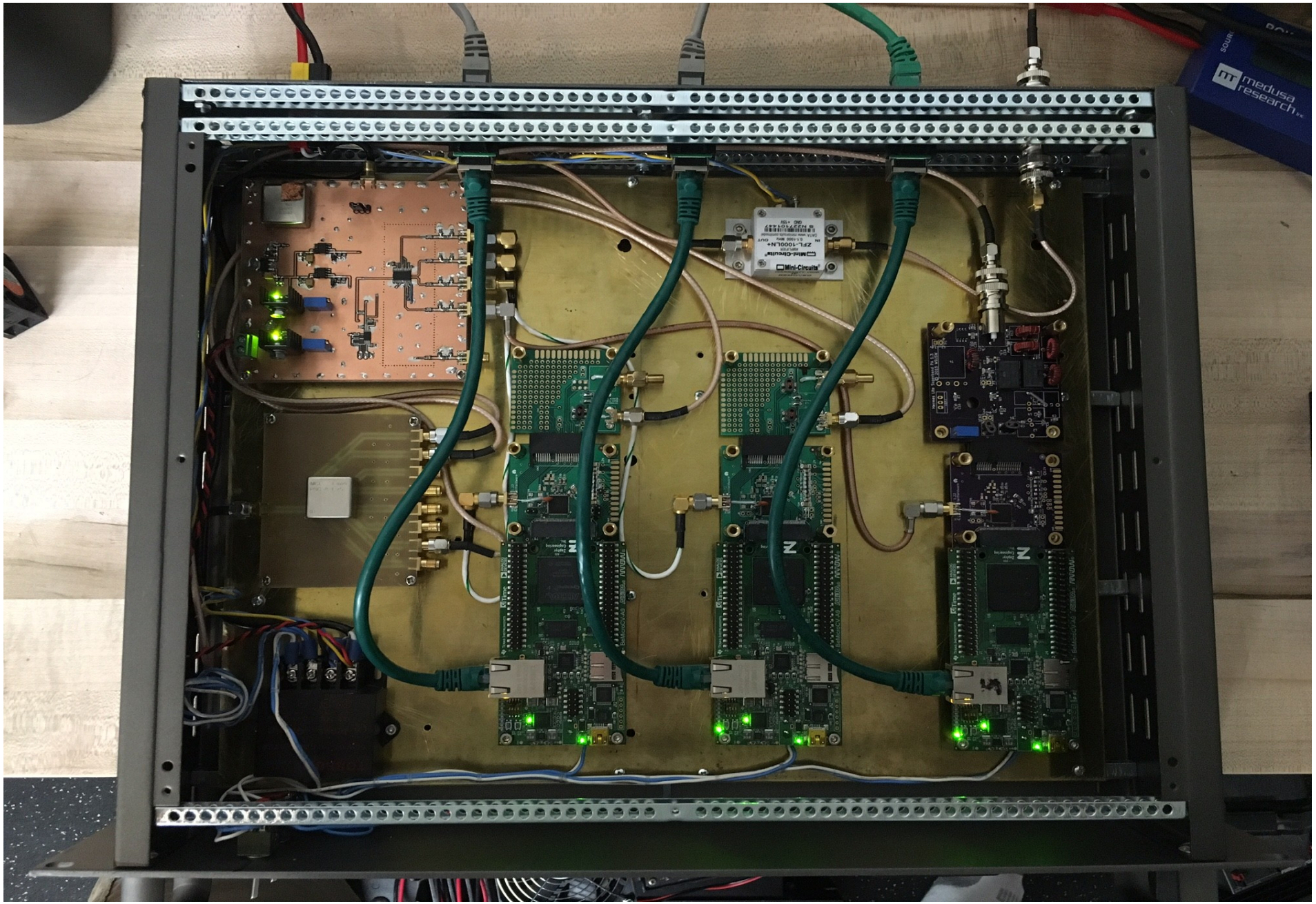
Active Rx's !!

MF thru 10m



HL1: WSPR – MF, 160,80,60,40,30,20,17,15,12,10 – 48Khz/band
JT9/JT65 – 160,80,40,30,20,17,15,12,10 – 48Khz/band
HL2: CW – 160/80,40,30,20,17,15,12,10 – 192Khz/band
HL3: RTTY – 80,40,20,15,10 – 96 Khz/band

NO1D SpotBox v1.0

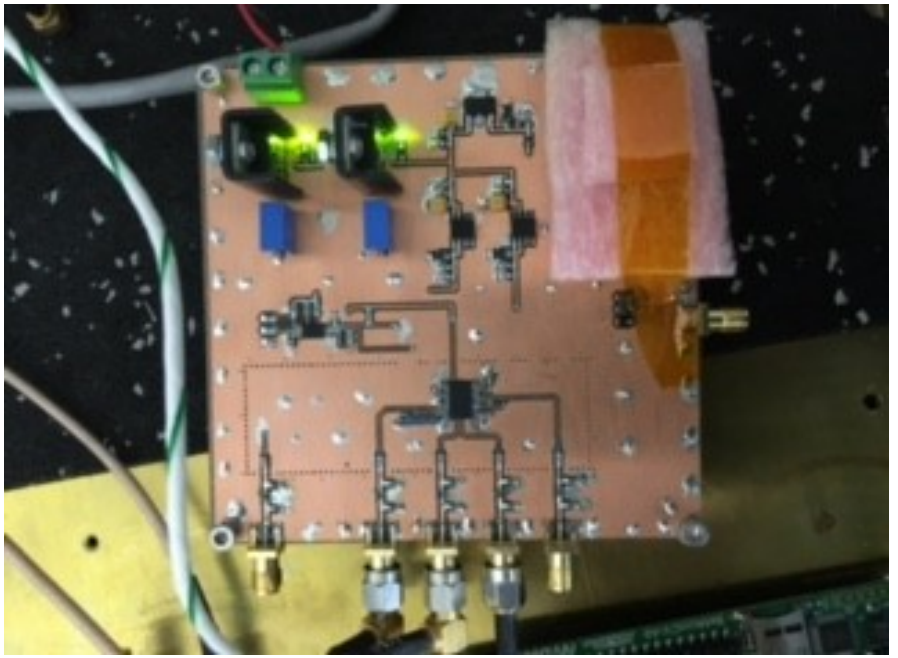


Networking Bandwidth

- WSPR, JT9/JT65 with 19 Rx slices @ 48Khz bandwidth generates solid 48Mb/s
- CW w/ 8 bands @ 192 Khz; ~46Mb/s
- RTTY w/ 7 bands @ 48Khz; ~ 36Mb/s
- Primarily 1 way traffic; initial 2 way required during discovery & configuration
- UDP, can be lossy over poor network infrastructures.
- Several hundred Mb/s capability needed by your PC and infrastructure
- You may see issues running over wifi
- NO1D setup utilizes L2/L3 router to split and segment traffic
  - *Not a requirement, useful to me during development*

Frequency Accuracy

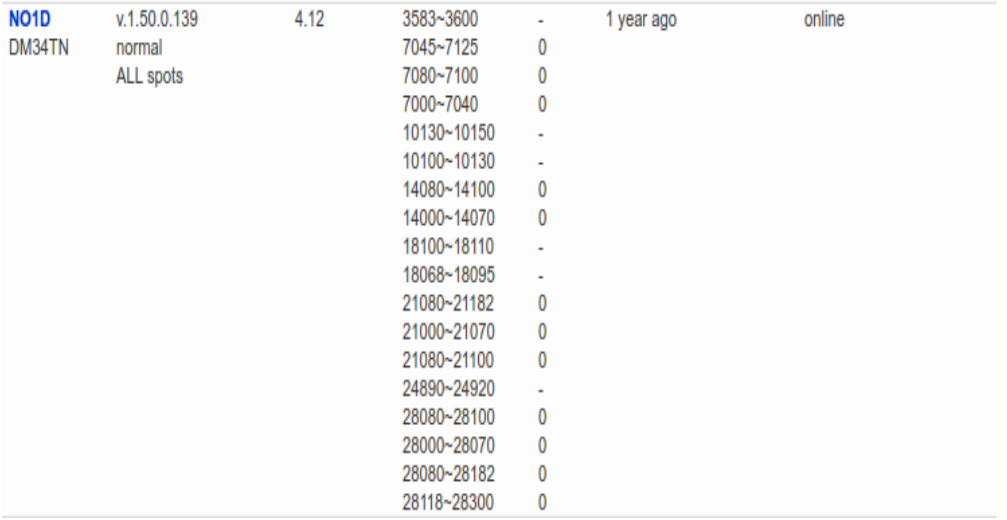
- RBN checks for +/- 100hz
  - *Measured against well known stations running GPSDO clocked nodes*
- RBN RTTY measures down to 10hz resolution
- WSPR decoding w/ .1 Hz resolution !
- Highly accurate & stable, SDR sampling rates desired
- Should not drift over temperature changes in environment
- HL Clock varied w/ temperature
- Spotting users really want accurate frequencies !
- Aliasing issues with RTLSDR's



- Prototype PLL using TCXO
- Can be fed from Rb standard
- Spots w/in +/- .5Hz
- TCXO still bit weak, varied w/ temperature (hot garage)
- Next prototype true GPSDO

RBN Detail Report

- Lists RBN active and inactive spotters
- Lists SW versions used, spotter's grid square
- Band segments configured
- And +/- freq. 100hz resolution.



NO1D	v.1.50.0.139	4.12	3583~3600	-	1 year ago	online
DM34TN	normal		7045~7125	0		
	ALL spots		7080~7100	0		
			7000~7040	0		
			10130~10150	-		
			10100~10130	-		
			14080~14100	0		
			14000~14070	0		
			18100~18110	-		
			18068~18095	-		
			21080~21182	0		
			21000~21070	0		
			21080~21100	0		
			24890~24920	-		
			28080~28100	0		
			28000~28070	0		
			28080~28182	0		
			28118~28300	0		

Measuring Performance

- Consider joining RBN operators list if you publish spots to RBN
  - Several members publish performance data after contests
- RBN and WSPRnet.org offer raw data downloads
- Nightly processing of raw CW and RTTY data performed
- Looking for # Spots which are “unique”; as indication of accuracy
- Ie: I received station, but nobody else did, chances may be its bad callsign. Not perfect as you may be only one to Rx that callsign; 10m and above

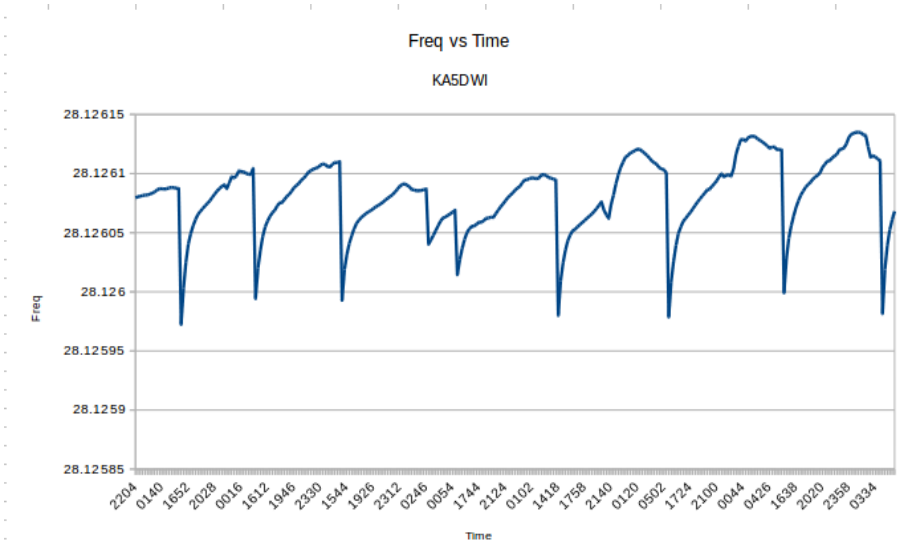
From Doug Theriault <no1d.doug@gmail.com>
Subject **RBN RTTY Results: 20160528**
To no1d.doug@gmail.com

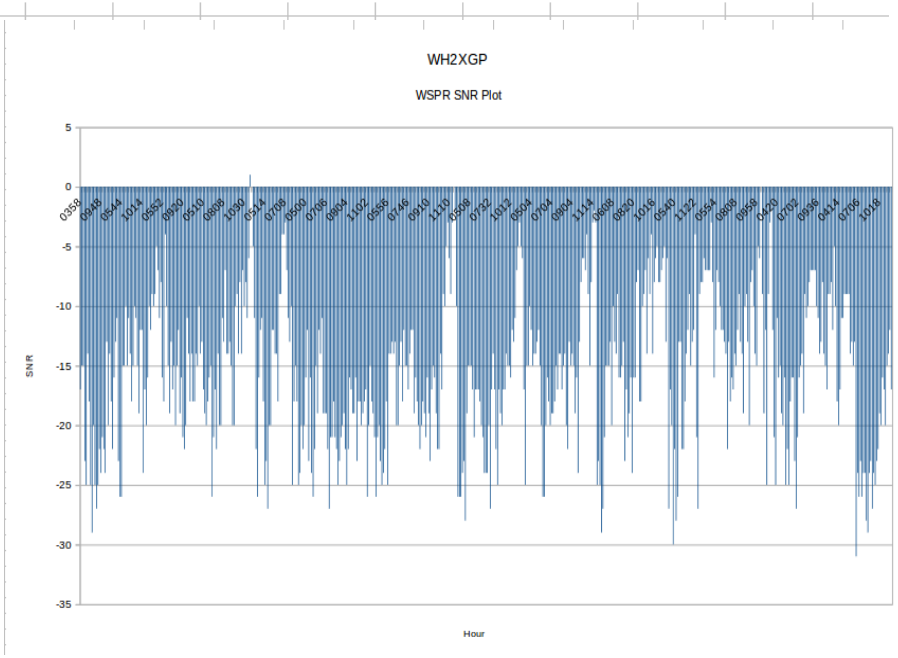
Callsign	Total	Singles	Rate	%	
DL4RCK	1	0	0	%	
F5RRS	91	0	0	%	
JK4USW	3	0	0	%	
K1TTT	44	0	0	%	
K7EG	5	0	0	%	
KM3T	60	0	0	%	
KS4XQ	23	0	0	%	
KU7T	17	0	0	%	
N2QT	18	0	0	%	
N2WQ	21	0	0	%	
N7TR	41	0	0	%	
NN3RP	8	0	0	%	
NO1D	17	0	0	%	<=====
VU2PTT	7	0	0	%	
WZ7I	69	0	0	%	
EA5WU	77	1	1.3	%	
KO7SS	33	1	3.0	%	
LA6TPA	28	1	3.6	%	
NC7J	26	1	3.8	%	
WA7LNW	75	3	4.0	%	
JG1VGX	22	1	4.5	%	
S50ARX	108	7	6.5	%	
SV8RV	43	5	11.6	%	
I2DMI	79	10	12.7	%	
W3LPL	129	17	13.2	%	
DL6KBG	48	9	18.8	%	
JA4ZRK	73	24	32.9	%	

- Typically compare myself to WA7LNW Utah who uses QS1R and much better antenna system !
- Work in process, need to put raw data in db for more complicated searches
- Todays scripts (linux) can take several days to run after a major contest !

Data Mining

- Raw data contains frequency and SNR readings per spot
- Example KA5DWI, 10m WSPR beacon frequency over time
  - *Noticed strange freq shift*
  - *Turned out to be A/C unit turning on in afternoon*
- WH2XGP, 630M SNR plot over time.
- MF beacon propagation over multiple days.
  - Correlate w/ space wx data sets for further analysis
- Have had many MF and Beacon users email/thank me for spotting their stations over time.





Hints/Kinks, Gotcha's

- CW/RTTY band segment configurations can be tricky
- Null out frequencies that are problematic
- Watch contest calendar and update band segments.
- Consider turning off RTTY during CW, or CW during RTTY or config band segments so they don't overlap
- Use aggressive mode esp. for RTTY to prevent bad spots.
- You may need a BCB filter if you're not spotting on MF and experience overloading
- Don't overload Rx front ends.
- If you Tx and intend to spot, mute/turn off spotting Rx while xmitting.
- RTLSDR weak FIR filter can result in Aliasing errors; esp. seen on 10m beacons !
  - *Spots off by Nyquist rates.*
- Watch out for harmonics/aliasing across HF bands
  - *Ran WSPR beacon while spotting and Tx would overload my Rx*
- Some Rx/Decoders will mis-spot calls on wrong bands. Mis-configs. Check your spots against others to see if you're accurate.

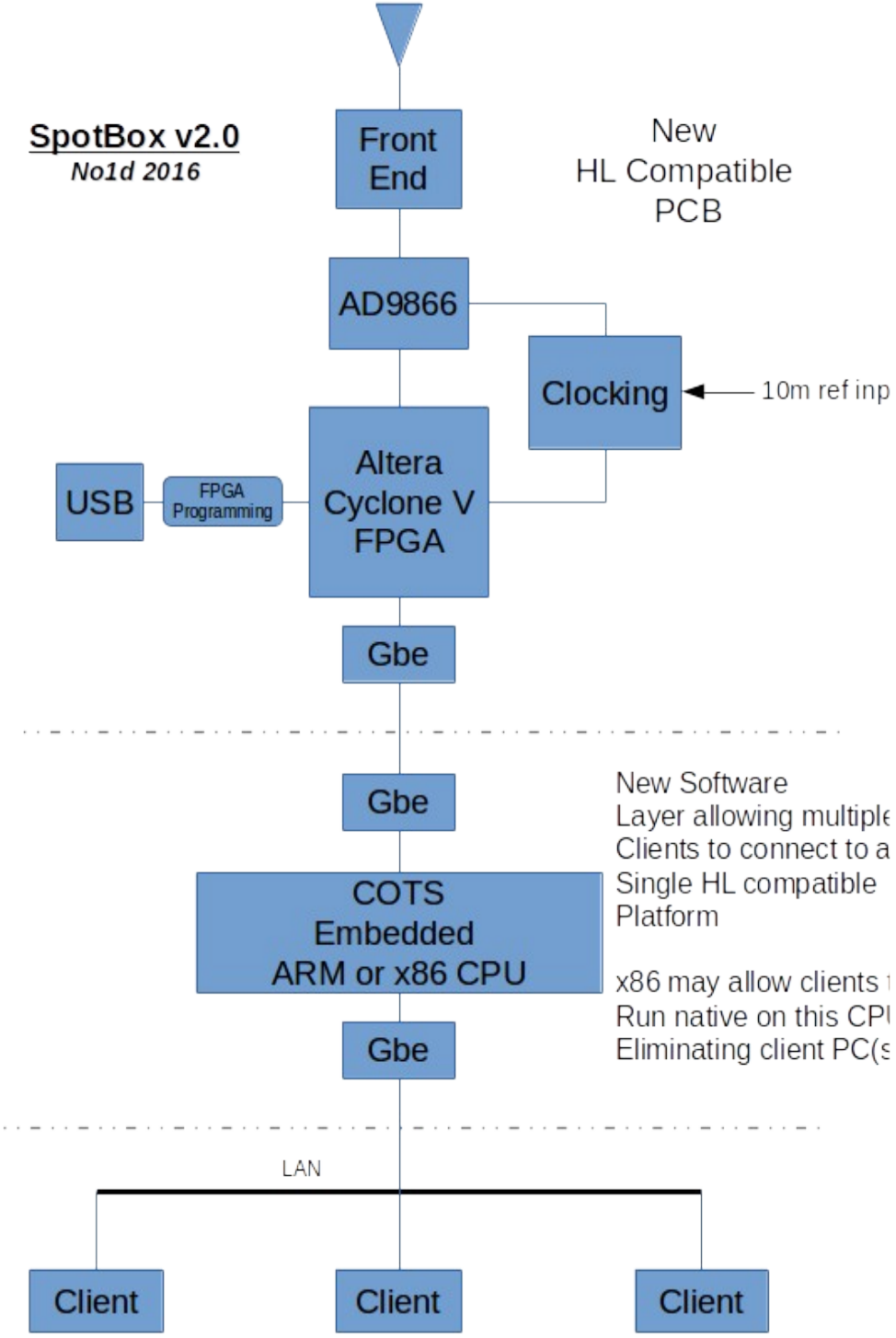
CuSDR - Visualization GUI

- One of many GUI's
  - *Supporting HPSDR protocol*
  - *7 Rx's across HF*
  - *Wideband FFT*
- Visualize quality of bands
  - *Esp. during contests and sprints*
- Identify problems in Rx path

Futures – NO1D SpotBox v2.0

- Build a HL compatible Rx platform specific to Spotting activities
- Reduce need for multiple HL boards
- Include lessons learned during past year; clocking stability...
- Eliminate need for BeMicro CVA9 board(s); getting difficult to source
  - Single PCB w/ Altera Cyclone V, Gbe, AD9866 and Front End...
  - Include GPSDO or 10Mhz input clock
- Keep it low cost
- If using CycloneV, BGA package FPGA... would be built board, not in kit form
- Trick clients into thinking there are multiple HL boards
  - Similar to 'Tee' SW used today for CW/RTTY skimmers on Windows
- Leverage Multi-Netting and implement as middle-ware SW solution
  - Use a 2x Gbe embedded board to host code
- Or... modify CVA9 Verilog/RTL to implement this approach in HW.
- In addition, learn/build a solution for 6m, 2m bands

Spot Box Block Diagram - prelim



- Looking for 2x Gbe Embedded CPU; low cost ideally
  - UDOO Kickstarter project perhaps
- Would be used to develop SW and possible use in end solution
- X86 platform might allow clients to execute natively and eliminate separate PCs need in the shack.
- A single box solution for integrated spotting solution...

A Few URL's

What	Where
Hermes Lite Project	https://github.com/softerhardware/Hermes-Lite
BeMicro CVA9	https://www.arrow.com/en/products/search?q=BeMicro&filters=
HL Radio	http://www.ihopper.org/radio/
Skimmer Server SW	http://www.dxatlas.com/ (includes download info for K3IT's HermesIntfc.dll)
Spotting Sites	http://www.reversebeacon.net/ (includes download for rbn aggregator app) https://pskreporter.info/ http://wsprnet.org/drupal/ http://hamspots.net/
Hermes Lite Boards	https://www.tindie.com/ (search for Hermes Lite)
RTLSDR software	https://github.com/n1gp/rtl_hpsdr (orig code, bit old now) https://github.com/dtheriault/hydra (contact me for help on using this suite)
HPSDR GUI client (Rx only)	https://github.com/n1gp/cudaSDR (fork from vk5abn) https://github.com/dtheriault/hydra (cuSDR from n1gp w/ earlier HL mods)

Closing, Contact Info

- Contact me if interested in experimenting with HL, RTLSDR or spotting. Glad to talk further...
  - *Esp. if you want to collaborate on building a SpotBox...*
- Spotting can be fun for those of us living in tight HOA developments w/ limiting Tx capabilities.
  - *Although I'm committed to getting on air with JT9/JT65 this year with 1-5W . Perhaps using Rich K8NDS very cool loops !*

- QRZ.com/no1d
- Email: no1d.doug@gmail.com