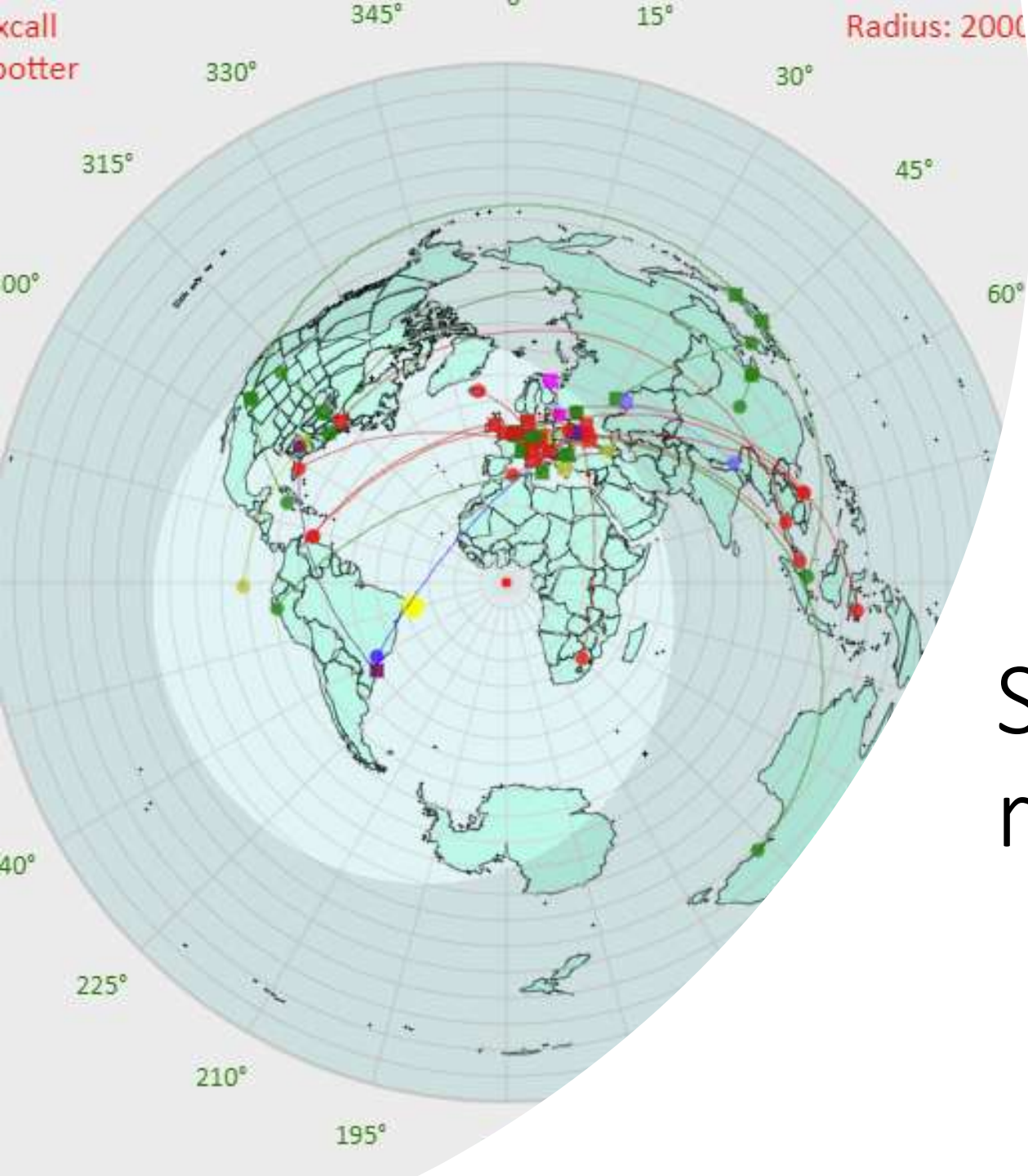




Shortwave robots and reverse beacons

Björn Ekelund - Ericsson Research



Tweet



A P R

@apr



My friend CX4AAU searching [@bjornekelund](#) SM7IUN's QSL from the 70s

Översätt tweeten



Tweeta ditt svar



SM7IUN

SCA: M1-03

WASM: M

WSA: 425

WAZ: 14 WAC: EU

DXCC: SWEDEN

To:	Date:	Time:	Band:	Mode:	Ur sigs.	PLUR.	QSL.
	Year. Month. Day	UT	MHZ	2x	RST	Watts	
CX4AAU	790917	1938	28	SSB SSB	58	25	PSE

Rig: Argonaut 509

Linear PA. Tube: 6DQ5

Antenna:

2 el. Quad, up 20'

o Dipole, up 20'

o GP, up 25'

Scag #313

Thanks for QSO!

de:

Björn

Björn Ekelund

Gruvgatan 4

26050 Billesholm

Sweden

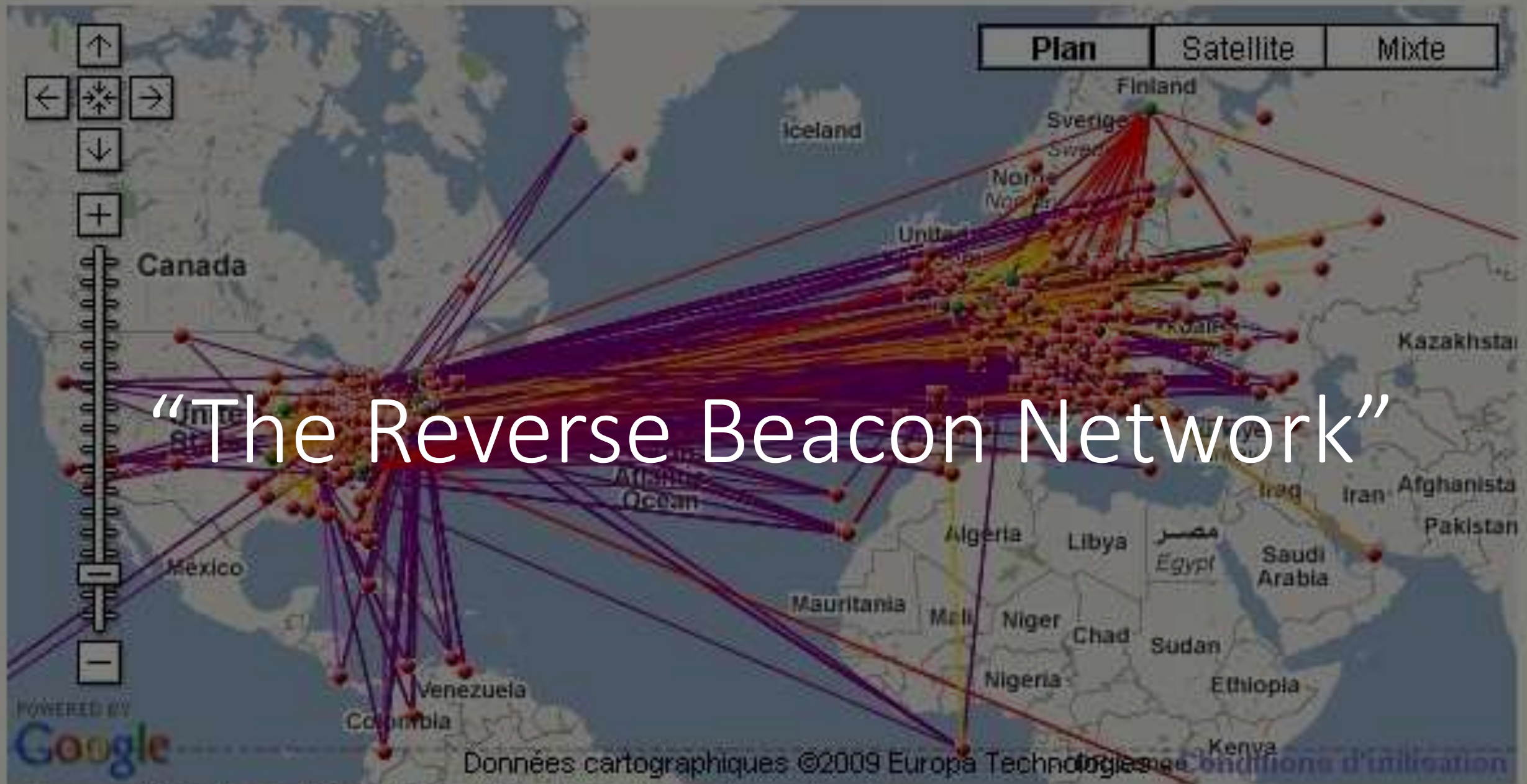


Beacons?

NCDXF/IARU International Beacon Project

Transmission Schedule

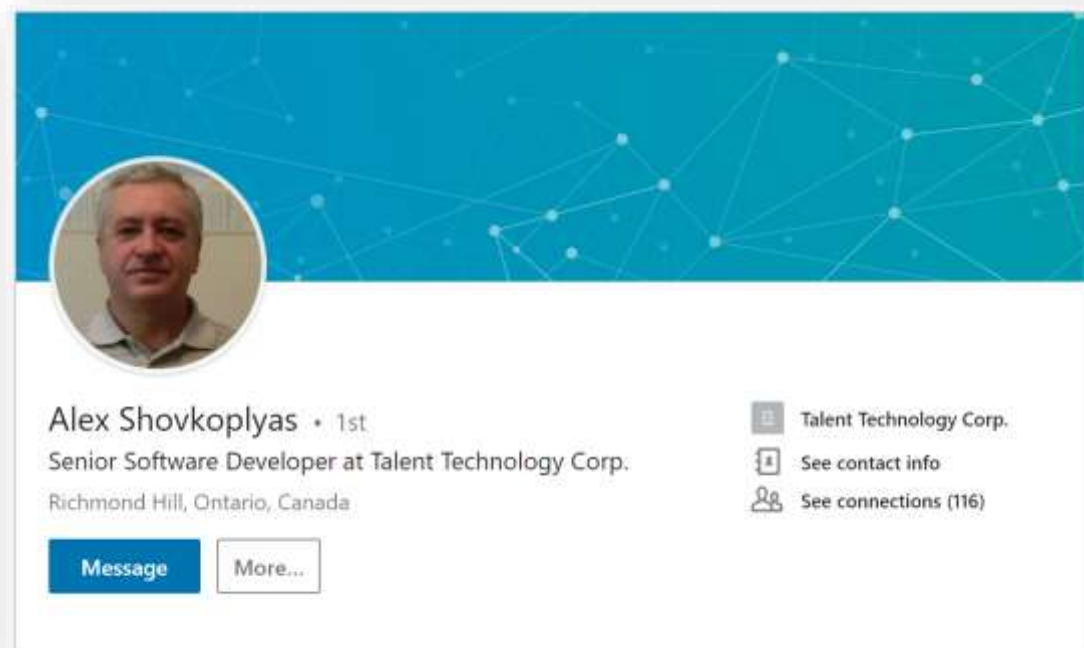
“The Reverse Beacon Network”



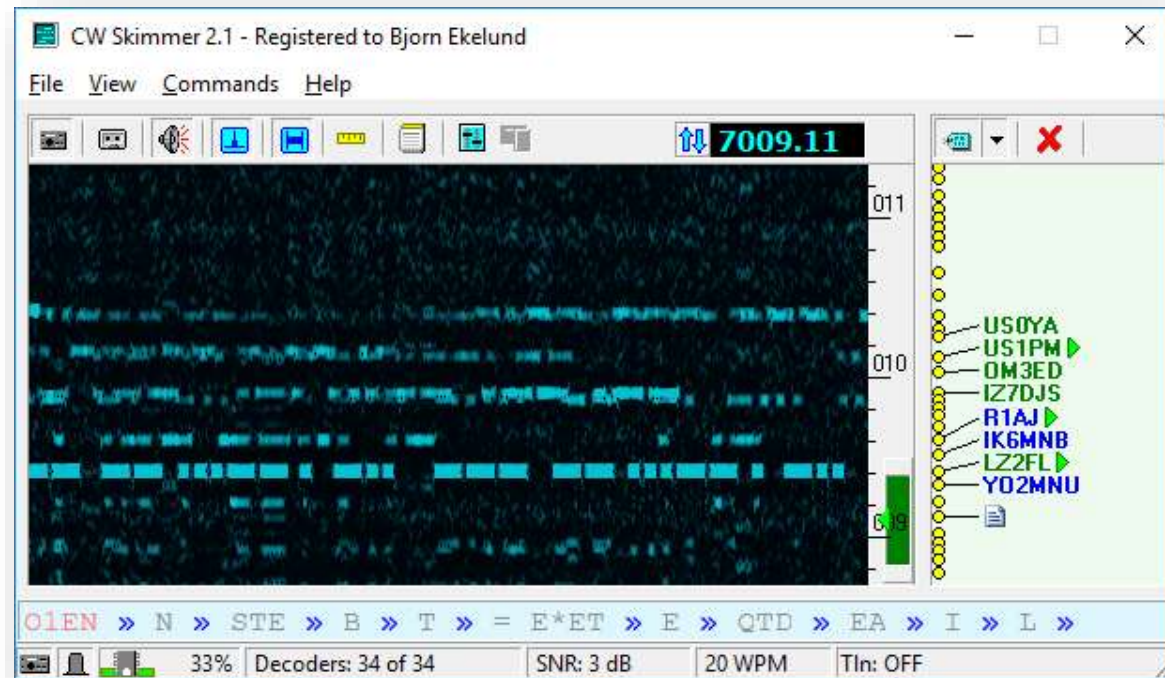
/ 160m / 80m / 40m / 30m / 20m / 17m / 15m / 12m / 10m / 5m / 2m
world wide / zoom to US / zoom to Europe / zoom to North Atlantic

It started with one brilliant engineer...

Alex Shovkoplyas, VE3NEA (b. 1965,
ex-UR5EMI, Canadian resident since 1998)
"Canadian ham of the year" 2014

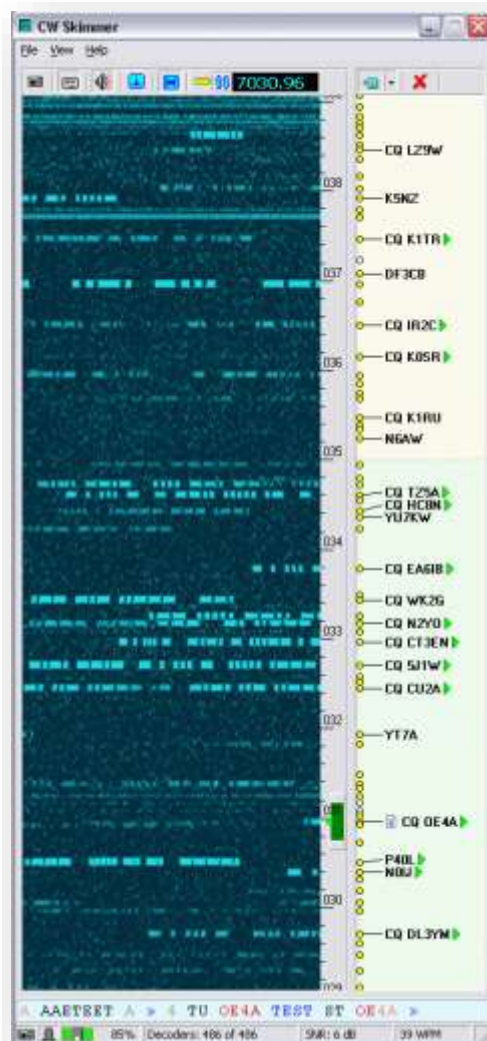


Morse code decoder "CW Skimmer"



Published by Alex in 2008 after “seven years of thinking”.
Based on Bayesian statistics, a “kind of” AI.
Originally intended as a tool to manage DX pile-ups.

“CW Skimmer”



- Works with a range of SDR front-ends
- Parallel decoding of Morse code signals across an entire passband
 - Standard 3.5kHz audio
 - Wideband I-Q up to 192kHz bandwidth
- Graphical “waterfall” illustration of signals
- Uses a recognized call sign data base for sanity checking

2008: The planets lined up...

Alex VE3NEA



Felipe PY1NB

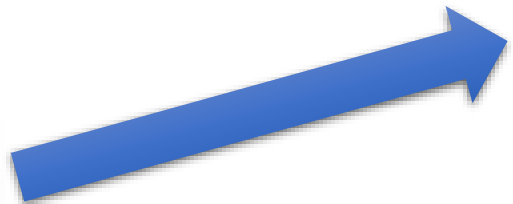


Dick W3OA

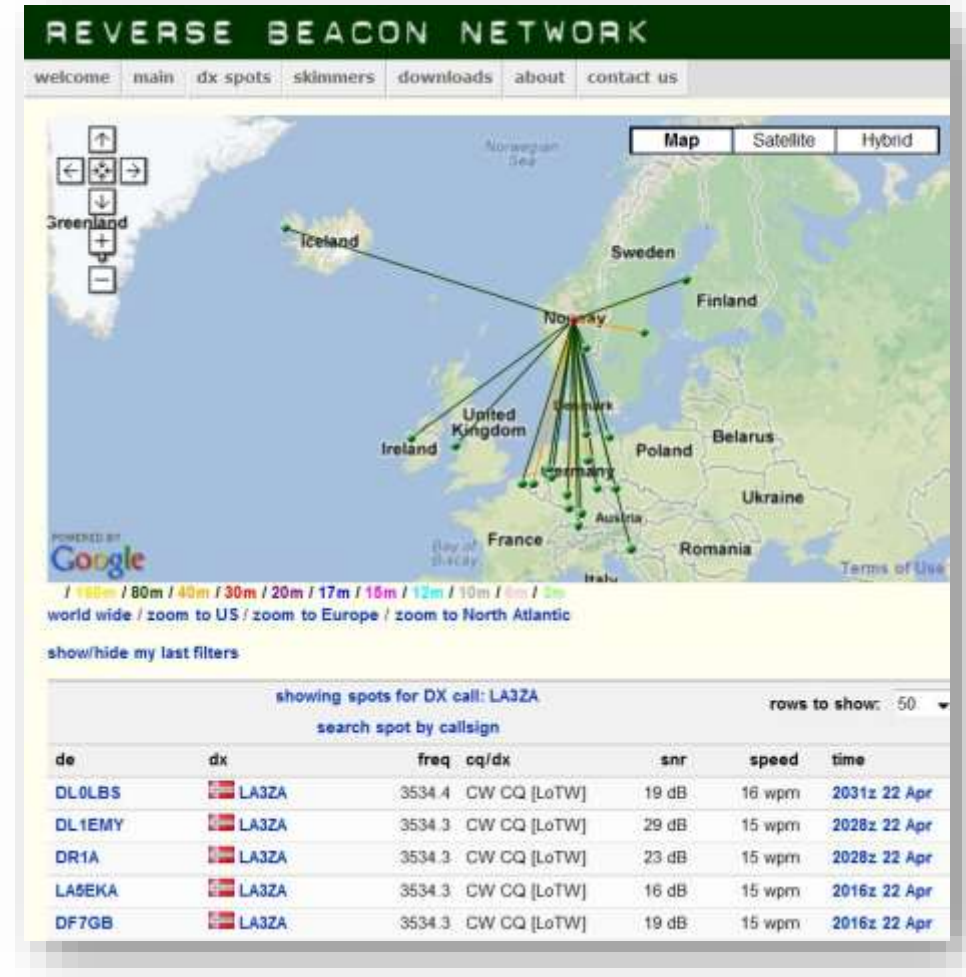


Nick F5VIH

Pete N4ZR



Phil N8VB

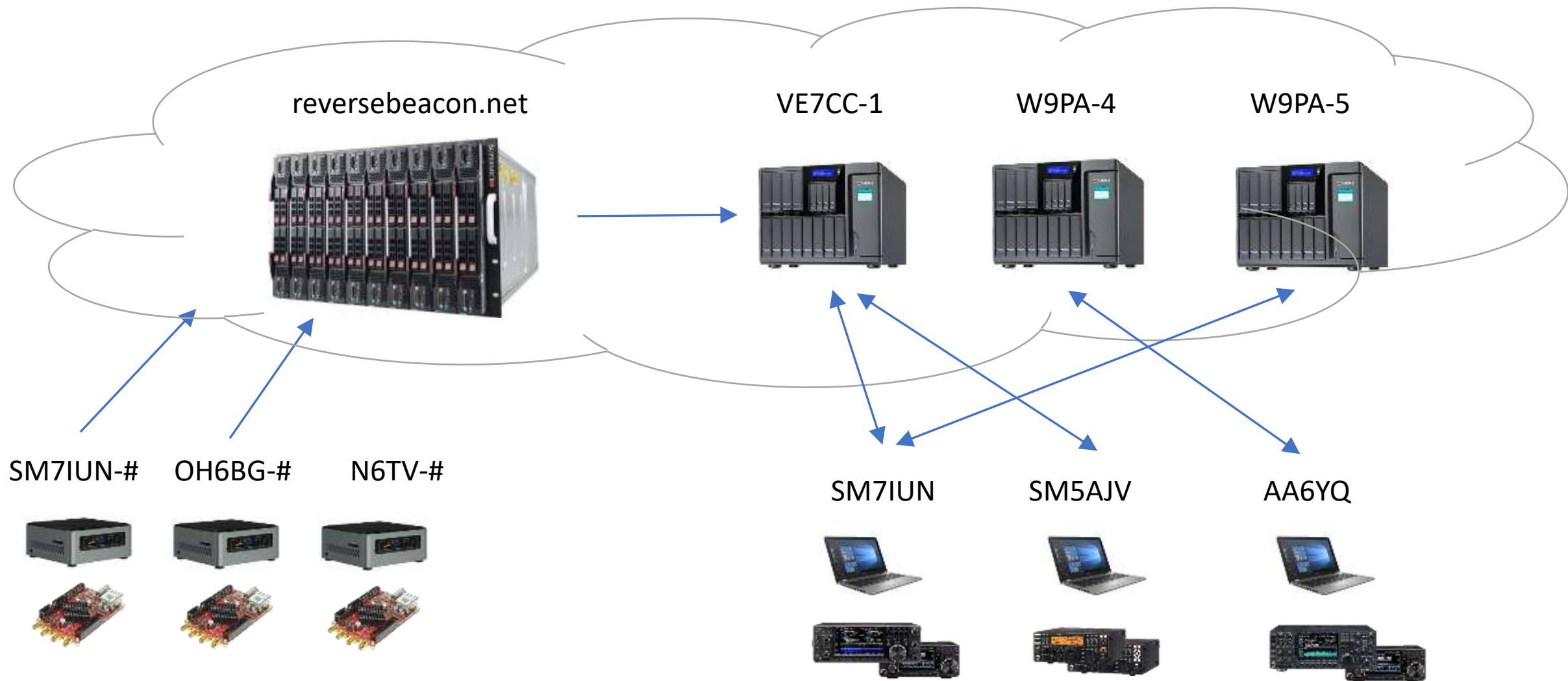


The Reverse Beacon network

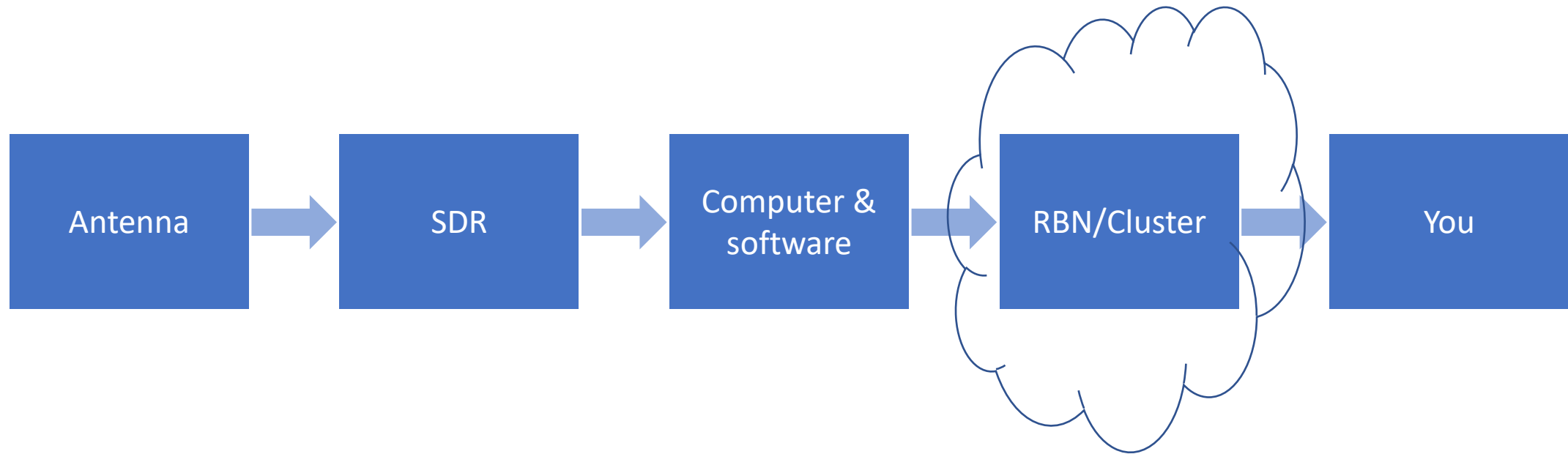
- A global network of skimmer receivers for both Morse code and digital protocols
- ~200 24/7 “skimmers”
- Global coverage
- Highest density in EU & NA



Reverse beacon network & The DX cluster



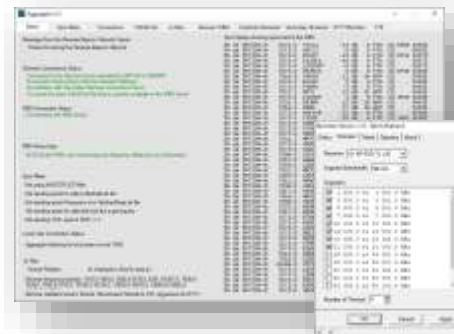
The whole chain



What are the parts in a skimmer?

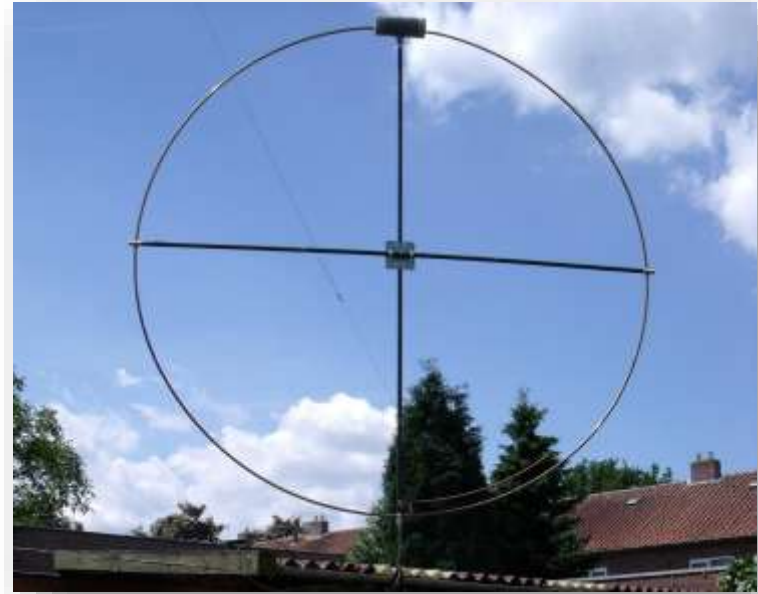


```
for i in $(cat /dev/urandom | fold -w 40 | uniq); do
  response=$(curl -s -X GET http://api.twitter.com/1/statuses/user_timeline.json?screen_name=$i&count=20)
  if [ $(echo $response | jq -r '.length') -gt 0 ]; then
    timestamp=$(echo $response | jq -r '.[0].created_at')
    today=$(date +%Y-%m-%d)
    howlong=$(date +%Y-%m-%d -d "$timestamp")
    if [ $(date +%Y-%m-%d -d "$howlong") -lt "$today" ]; then
      curl -s -X POST http://api.twitter.com/1/statuses/update.json?status=$i
    fi
  fi
done
```



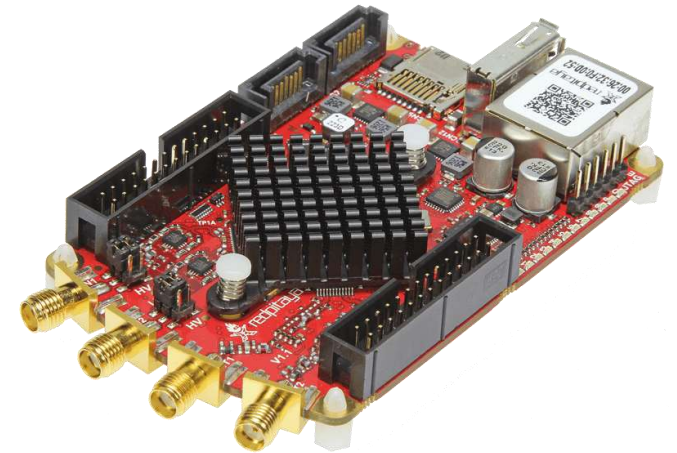
#1 Antenna

- Should be
 - broadband, preferably 1.8-50MHz
 - always connected
 - be immune to local noise or in a low noise environment
- Does not need
 - to work for transmission
 - to be very efficient, SNR is more important than RSSI
 - to be large



#2 Receiver

- Should
 - have a digital quadrature output sampled at 48, 96 or 192kHz
 - be wideband, preferably 1.8-50MHz
 - be support multiple receiver instances
 - preferably be networked (Ethernet)
- Does not need
 - knobs and buttons
 - an audio chain



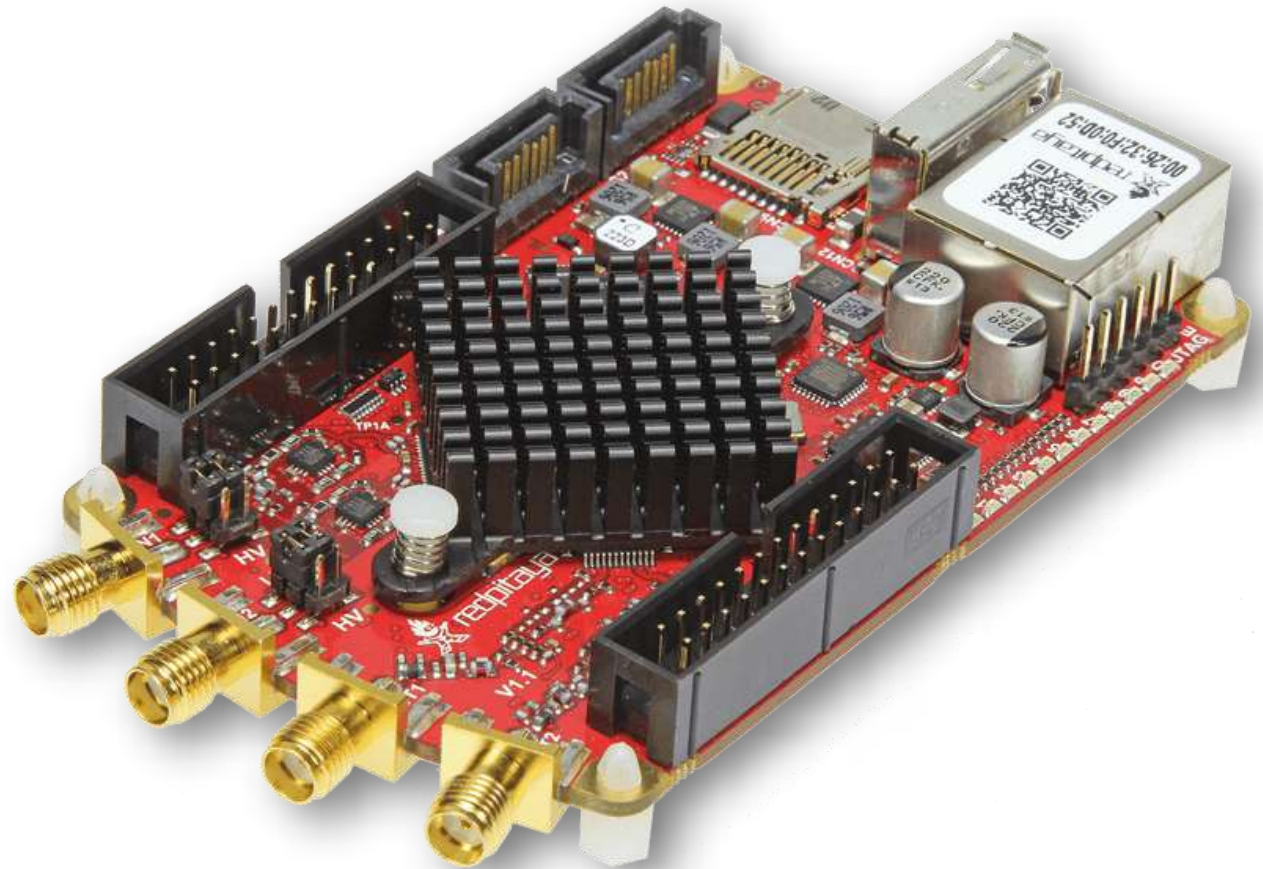
SDR receivers



“The Raspberry Pi of DSP”

Red Pitaya 125-14

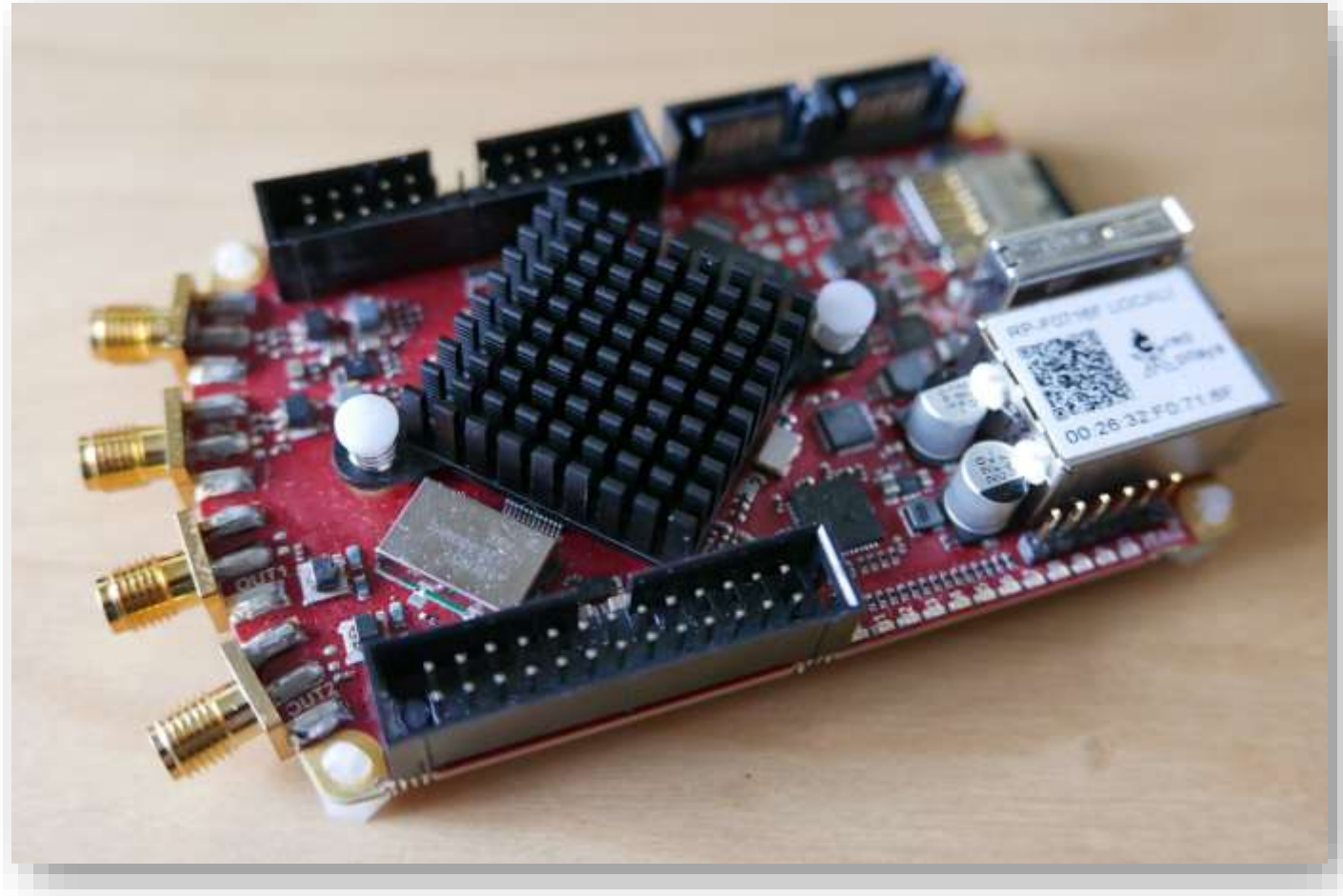
- Based on Xilinx Zynq 7010
 - 28,000 logical cells FPGA
 - 80 programmable DSP slices
 - 100 GMAC/s performance
 - 667MHz Cortex A9 MPcore with Neon and CoreSight
 - Two 125MHz 14 bit ADC/DAC
 - Four 100kHz ADC/DAC
 - 16 GPIO
-
- Started as a Kickstarter project
 - Over 30,000 sold
 - Base ports for Ubuntu and Alpine Linux
 - Free Xilinx Vivado tool suite



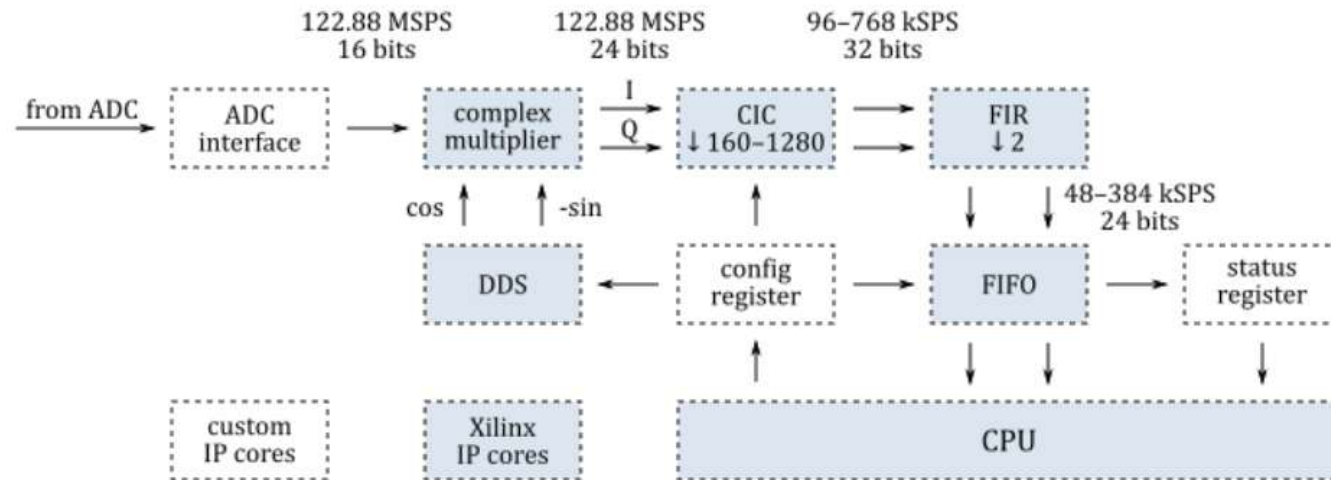
“The Raspberry Pi of DSP”

Red Pitaya 122.88-16

- Based on Xilinx Zynq 7020
- 85,000 logical cells FPGA
- 220 programmable DSP slices
- 276 GMAC/s performance
- 667MHz Cortex A9 MPcore with Neon and CoreSight
- Two 122.88MHz 16 bit ADC/DAC
- Four 100kHz ADC/DAC
- 16 GPIO
- ABLNO XO <50fs jitter



Pavel Demin @ KU Leuven



1. List of components
2. Links
3. Development machine
4. LED blinker
5. SDR receiver
6. SDR transceiver
7. SDR transceiver compatible with HPSDR
8. SDR receiver compatible with HPSDR
9. Embedded SDR transceiver
10. Wideband SDR transceiver
11. Multiband WSPR transceiver
12. Multiband FT8 transceiver
13. Pulsed Nuclear Magnetic Resonance
14. Multichannel Pulse Height Analyzer
15. Scanning system
16. Vector Network Analyzer
17. Alpine with pre-built applications



Pavel Demin • 1st

IT Engineer at Université catholique de Louvain
Brussels Area, Belgium

Message

More...

- Université catholique de Louvain
- Université Joseph Fourier - Grenoble 1
- See contact info
- See connections (94)

CW and FT8 skimmers @ SM7IUN

```
192.168.1.17 - PuTTY
login as: root
root@192.168.1.17's password:
Welcome to SM7IUN Red Pitaya SDR CW Skimmer!
HPSDR calibration factor = 0.99999268
FT8 calibration factor = -7.3ppm
Zynq 7020 die temperature = 63.61 C
sdr-f0716f:~# cd apps/sdr_receiver_hpsdr
sdr-f0716f:/media/mmcblk0p1/apps/sdr_receiver_hpsdr# ls
Makefile          sdr-receiver-hpsdr.c  stop.sh
index.html         sdr_receiver_hpsdr.bit
sdr-receiver-hpsdr start.sh
sdr-f0716f:/media/mmcblk0p1/apps/sdr_receiver_hpsdr# uptime
12:20:18 up 8 days, 21:08,  load average: 0.41, 0.54, 0.54
sdr-f0716f:/media/mmcblk0p1/apps/sdr_receiver_hpsdr# mpstat
Linux 4.14.101-xilinx (sdr-f0716f)      03/27/19      _armv7l_      (2 CPU)

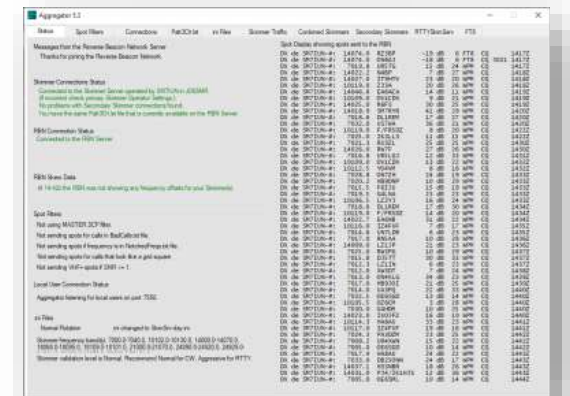
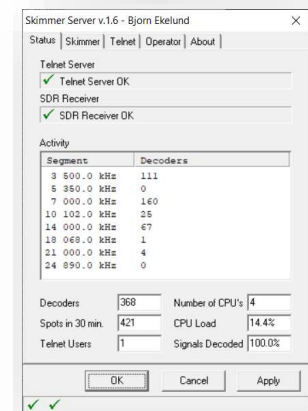
12:20:19      CPU      %usr   %nice    %sys %iowait    %irq   %soft  %steal  %guest   %idle
12:20:19    all     17.73    0.00   10.75    0.00    0.00    0.34    0.00    0.00   71.18
sdr-f0716f:/media/mmcblk0p1/apps/sdr_receiver_hpsdr#
```



#3 Host computer and software



- **“CW Skimmer Server” or “RTTY Skimmer Server”**
 - Decodes the Morse code transmissions in the passband of the radio front end
 - Computationally intense. RTTY more than CW.
 - CW is 5-25% on 2GHz Core i5 depending on bandwidth
- **“RBN Aggregator”**
 - Consolidates and curates streams of decoded call signs from several radio front ends
 - Adds origin information
 - Controls daylight/twilight/night cycle
 - Etc. housekeeping
- Decoding of the FT8 digital transmission protocol is much less computationally intense and can be done in the radio front end.



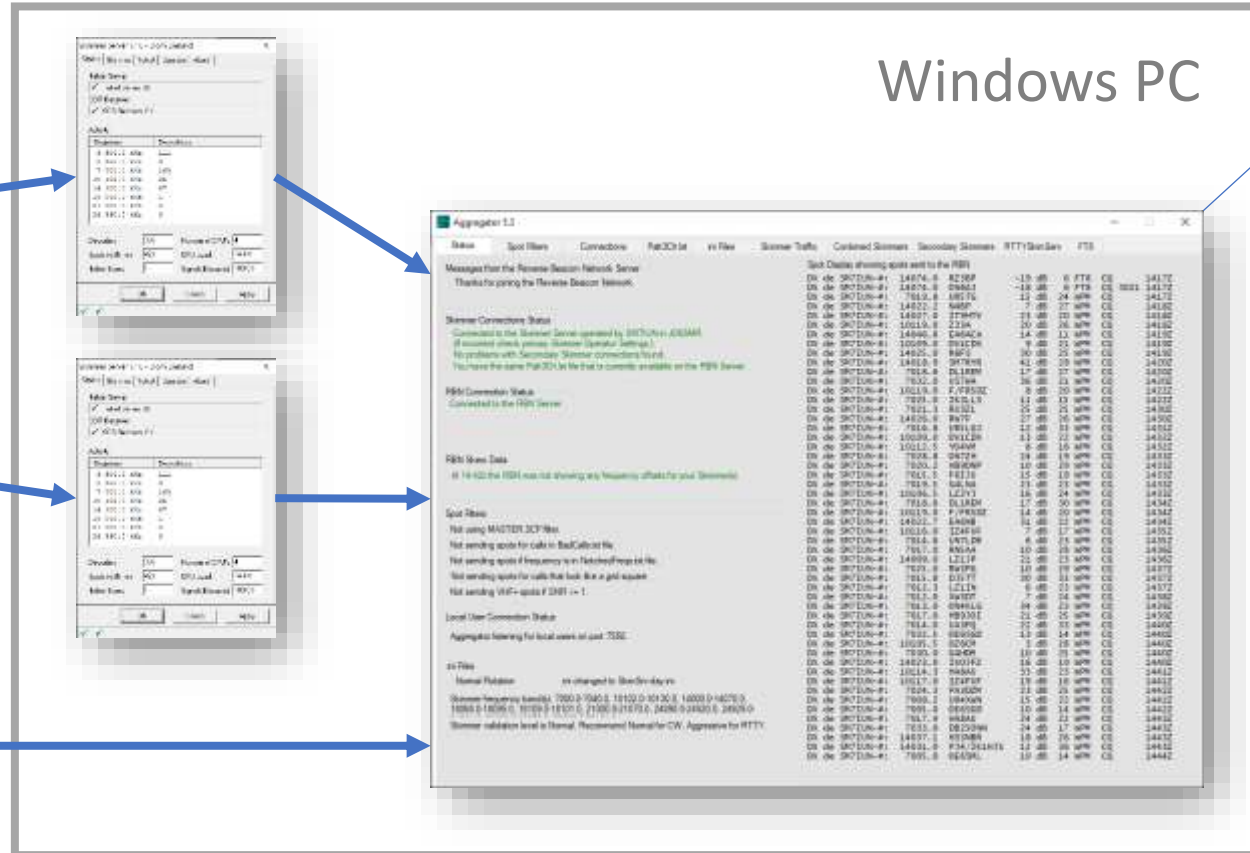
Skimmer “site architecture”

RBN

Morse
code

Radio
Teletype

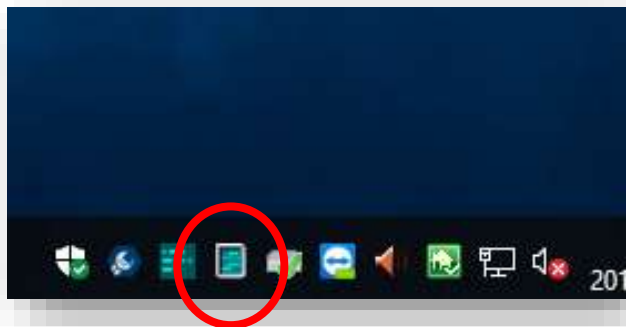
Digital
FT8



CW Skimmer Server

An “embedded” CW Skimmer with Telnet interface for RBN Aggregator or a DX cluster node

8 × 91kHz segments shortwave bands = 10-15% CPU load on 2GHz Core i5



<http://www.dxatlas.com/SkimServer>

Skimmer Server v.1.6 - Bjorn Ekelund

Status | Skimmer | Telnet | Operator | About

Telnet Server

✓ Telnet Server OK

SDR Receiver

✓ SDR Receiver OK

Activity

Segment	Decoders
3 500.0 kHz	111
5 350.0 kHz	0
7 000.0 kHz	160
10 102.0 kHz	25
14 000.0 kHz	67
18 068.0 kHz	1
21 000.0 kHz	4
24 890.0 kHz	0

Decoders 368 Number of CPU's 4

Spots in 30 min. 421 CPU Load 14.4%

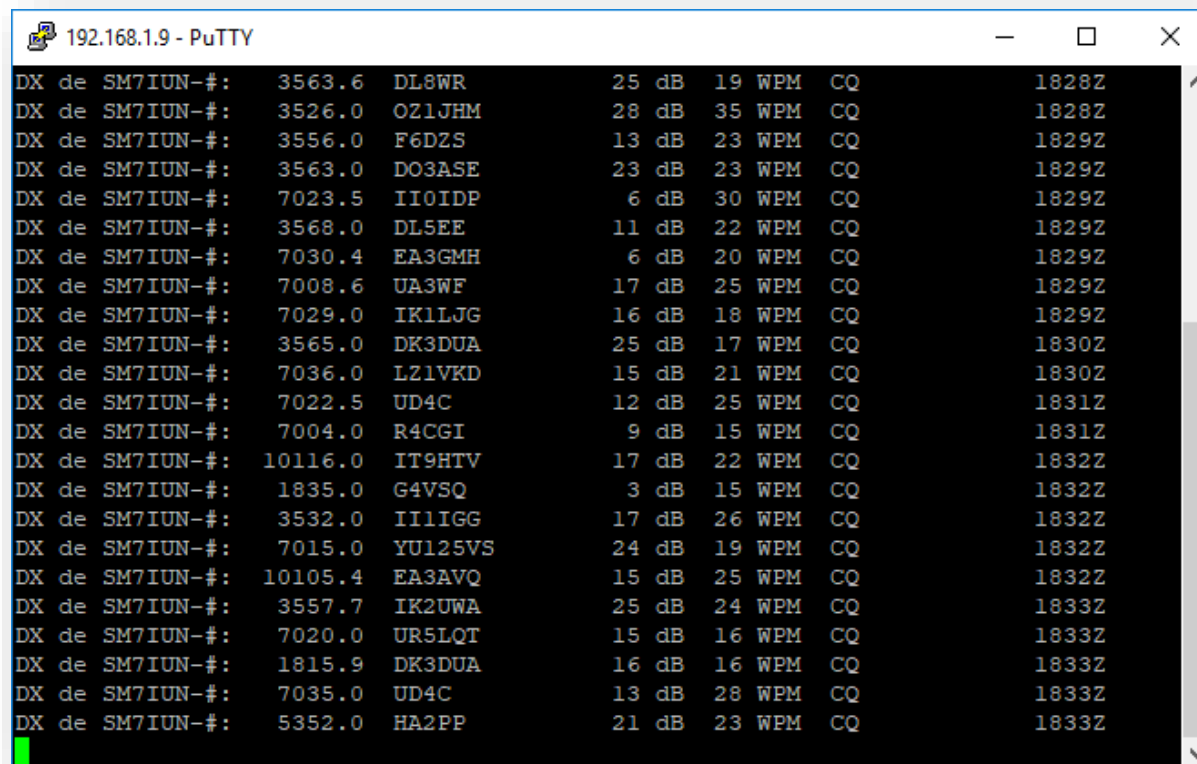
Telnet Users 1 Signals Decoded 100.0%

OK Cancel Apply

✓ ✓

CW Skimmer Server

Simple Telnet feed with frequency, call sign, SNR, transmission speed and time



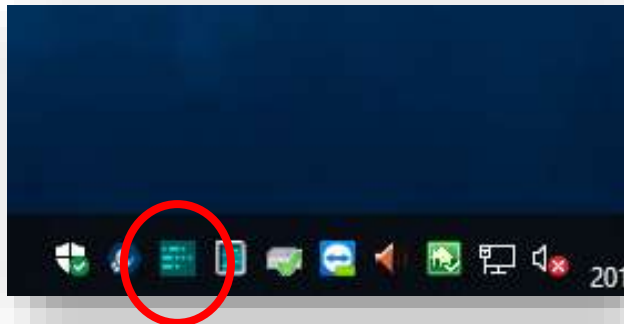
DX de SM7IUN-#:	3563.6	DL8WR	25 dB	19 WPM	CQ	1828Z
DX de SM7IUN-#:	3526.0	OZ1JHM	28 dB	35 WPM	CQ	1828Z
DX de SM7IUN-#:	3556.0	F6DZS	13 dB	23 WPM	CQ	1829Z
DX de SM7IUN-#:	3563.0	DO3ASE	23 dB	23 WPM	CQ	1829Z
DX de SM7IUN-#:	7023.5	II0IDP	6 dB	30 WPM	CQ	1829Z
DX de SM7IUN-#:	3568.0	DL5EE	11 dB	22 WPM	CQ	1829Z
DX de SM7IUN-#:	7030.4	EA3GMH	6 dB	20 WPM	CQ	1829Z
DX de SM7IUN-#:	7008.6	UA3WF	17 dB	25 WPM	CQ	1829Z
DX de SM7IUN-#:	7029.0	IK1LJG	16 dB	18 WPM	CQ	1829Z
DX de SM7IUN-#:	3565.0	DK3DUA	25 dB	17 WPM	CQ	1830Z
DX de SM7IUN-#:	7036.0	LZ1VKD	15 dB	21 WPM	CQ	1830Z
DX de SM7IUN-#:	7022.5	UD4C	12 dB	25 WPM	CQ	1831Z
DX de SM7IUN-#:	7004.0	R4CGI	9 dB	15 WPM	CQ	1831Z
DX de SM7IUN-#:	10116.0	IT9HTV	17 dB	22 WPM	CQ	1832Z
DX de SM7IUN-#:	1835.0	G4VSQ	3 dB	15 WPM	CQ	1832Z
DX de SM7IUN-#:	3532.0	II1IGG	17 dB	26 WPM	CQ	1832Z
DX de SM7IUN-#:	7015.0	YU125VS	24 dB	19 WPM	CQ	1832Z
DX de SM7IUN-#:	10105.4	EA3AVQ	15 dB	25 WPM	CQ	1832Z
DX de SM7IUN-#:	3557.7	IK2UWA	25 dB	24 WPM	CQ	1833Z
DX de SM7IUN-#:	7020.0	UR5LQT	15 dB	16 WPM	CQ	1833Z
DX de SM7IUN-#:	1815.9	DK3DUA	16 dB	16 WPM	CQ	1833Z
DX de SM7IUN-#:	7035.0	UD4C	13 dB	28 WPM	CQ	1833Z
DX de SM7IUN-#:	5352.0	HA2PP	21 dB	23 WPM	CQ	1833Z

- Typically CW Skimmer Server does not report party stations, only “CQ-ers”
- Spotting keywords:
CQ QRZ TEST NA SS FD UP
- Short call signs (e.g. SE5E) should be repeated for secure spotting
- Remember that spotting is not guaranteed even if propagation is sufficient, e.g. due to interference

RBN Aggregator

Curates and aggregates spots before uploading to RBN cloud.
Negligible CPU load on host.

Telnet client for CW and RTTY skimmers.
UDP broadcast listener for FT8 skimmers.



Aggregator 5.4b1

Status Spot Filters Connections Patt3Ch.lst ini Files Skimmer Traffic Combined Skimmers Secondary Skimmers RTTYSkimServ FT8

Messages from the Reverse Beacon Network Server
Thanks for joining the Reverse Beacon Network

Skimmer Connections Status
Connected to the Skimmer Server operated by SM7IUN in JO65MR.
(If incorrect check primary Skimmer Operator Settings.)
No problems with Secondary Skimmer connections found.
You have the same Patt3Ch.lst file that is currently available on the RBN Server.

RBN Connection Status
Connected to the RBN Server.

RBN Skew Data
At 16:29z the RBN was not showing any frequency offsets for your Skimmer(s).

Spot Filters
Not using MASTER.SCP filter.
Not sending spots for calls in BadCalls.txt file.
Not sending spots if frequency is in NotchedFreqs.txt file.
Not sending spots for calls that look like a grid square.
Not sending VHF+ spots if SNR <= 1.

Local User Connection Status
Aggregator listening for local users on port 7550.

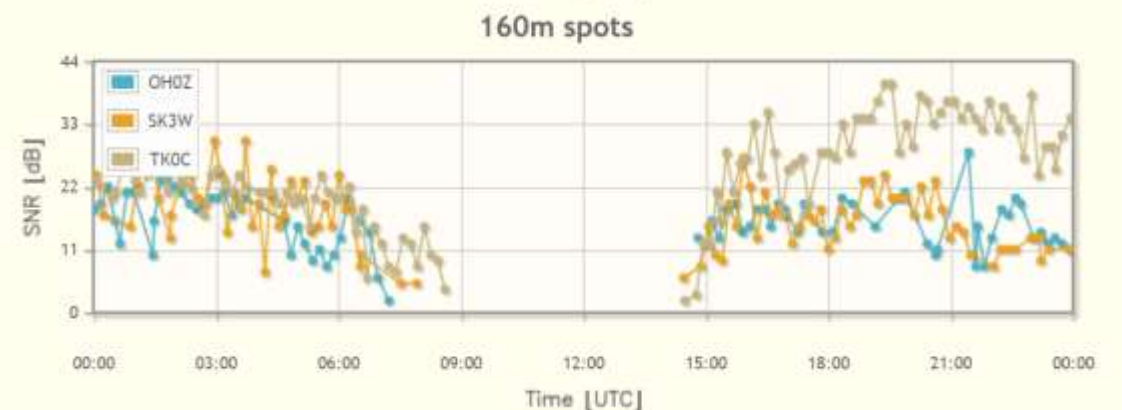
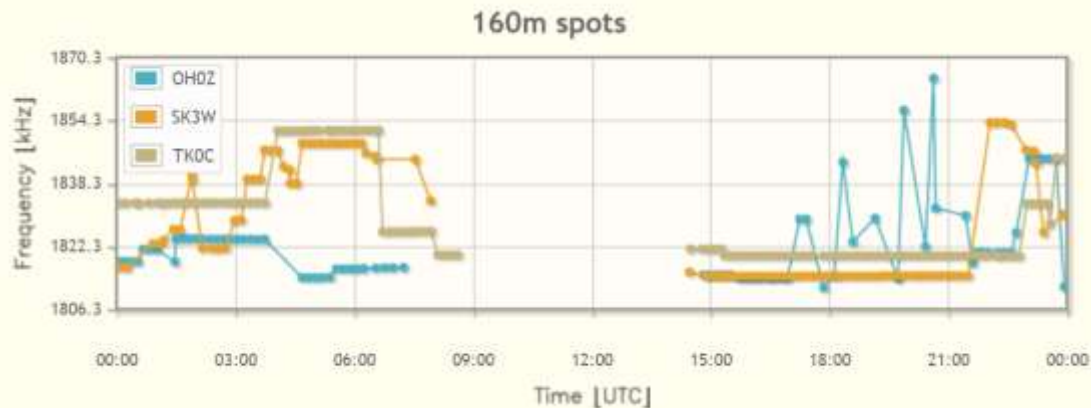
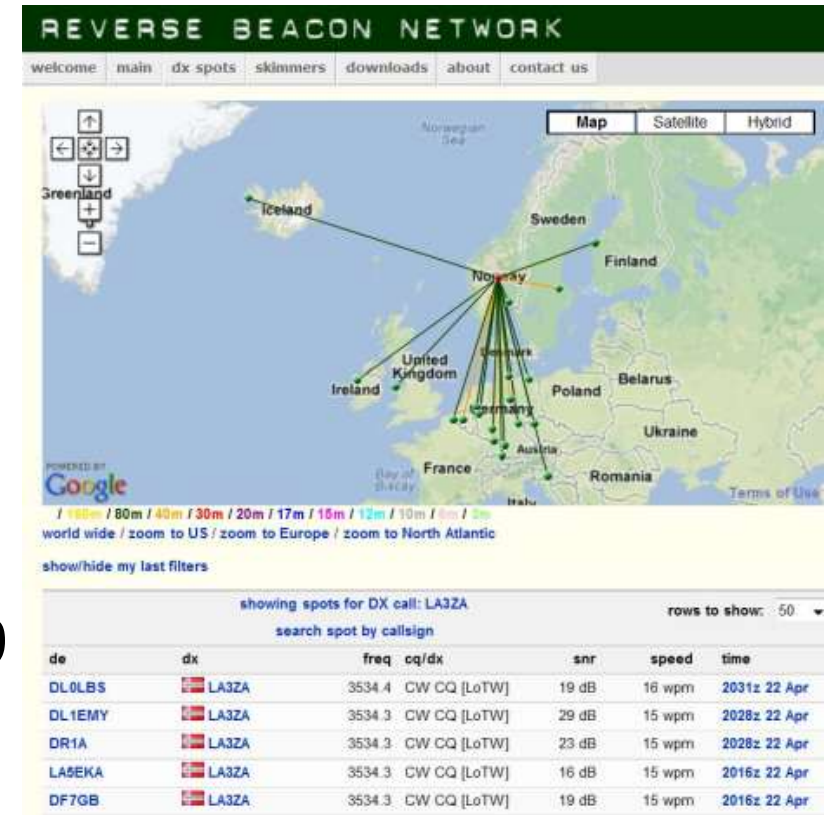
ini Files
Normal Rotation ini changed to SkimSrv-gray.ini
Skimmer frequency band(s): 3500.0-3570.0, 7000.0-7040.0, 10102.0-10130.0, 14000.0-14070.0, 14099.0-14101.0, 18068.0-18095.0, 18109.0-18111.0, 21000.0-21070.0,
Skimmer validation level is Normal. Recommend Normal for CW, Aggressive for RTTY.

Spot Display showing spots sent to the RBN

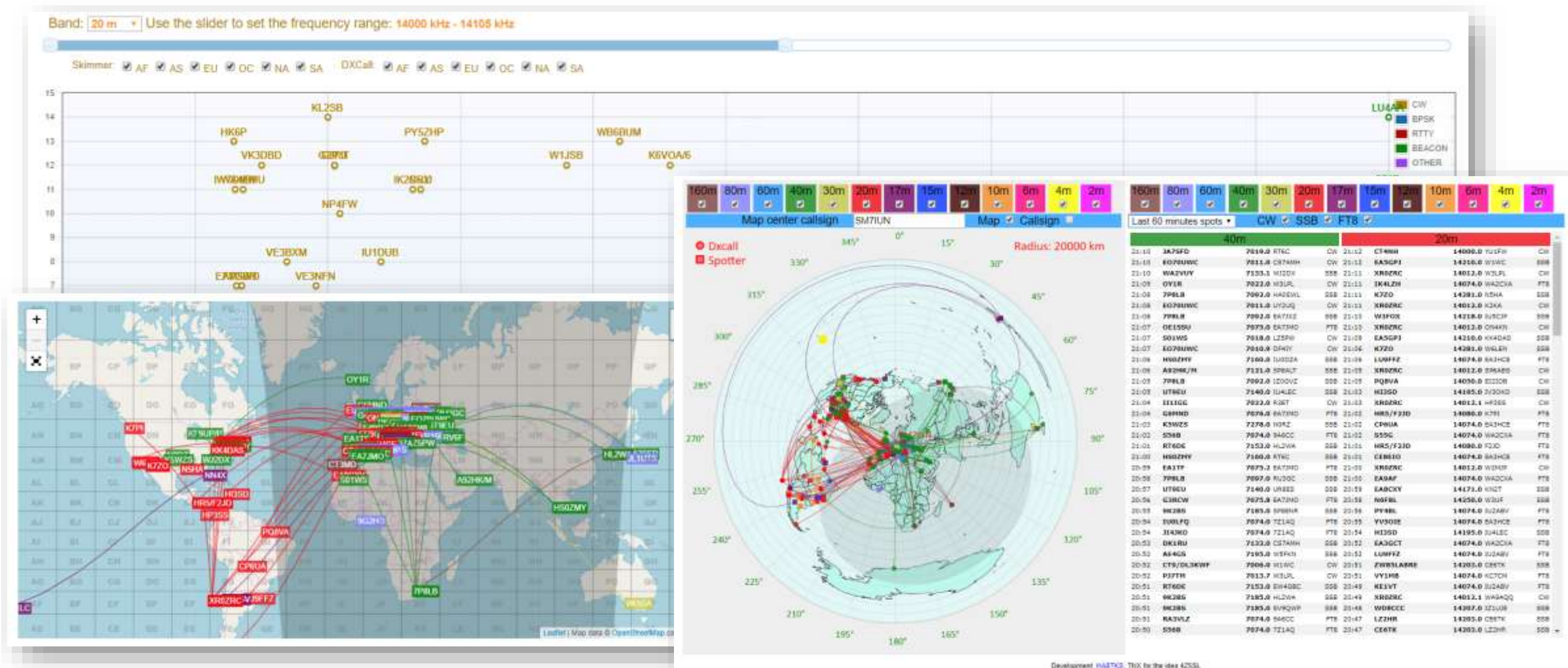
DX de SM7IUN-#:	7013.0	F6IJ	21 dB	22 WPM	CQ	1617Z
DX de SM7IUN-#:	7017.0	RK3Q/7	28 dB	24 WPM	CQ	1618Z
DX de SM7IUN-#:	7009.6	HB90BQR	27 dB	21 WPM	CQ	1618Z
DX de SM7IUN-#:	10116.0	I27WMM	31 dB	30 WPM	CQ	1619Z
DX de SM7IUN-#:	7038.1	YL3AJT	31 dB	15 WPM	CQ	1619Z
DX de SM7IUN-#:	7026.6	D36ZM	23 dB	28 WPM	CQ	1620Z
DX de SM7IUN-#:	7019.7	GOCBO	18 dB	14 WPM	CQ	1620Z
DX de SM7IUN-#:	14039.3	W7QC	10 dB	26 WPM	CQ	1621Z
DX de SM7IUN-#:	7013.0	F6IJ	17 dB	20 WPM	CQ	1621Z
DX de SM7IUN-#:	7014.3	R1ZY	22 dB	25 WPM	CQ	1621Z
DX de SM7IUN-#:	10114.0	RX3Q	25 dB	25 WPM	CQ	1621Z
DX de SM7IUN-#:	7011.3	RV6LNZ	19 dB	24 WPM	CQ	1622Z
DX de SM7IUN-#:	14006.0	LZ2HR	3 dB	30 WPM	CQ	1622Z
DX de SM7IUN-#:	14011.6	SV0AMS	10 dB	19 WPM	CQ	1622Z
DX de SM7IUN-#:	10113.5	W3WP	24 dB	22 WPM	CQ	1622Z
DX de SM7IUN-#:	7013.3	R1ZY	21 dB	25 WPM	CQ	1622Z
DX de SM7IUN-#:	14060.0	EA5EQ	2 dB	12 WPM	CQ	1623Z
DX de SM7IUN-#:	14020.7	ZB2CW	6 dB	26 WPM	CQ	1623Z
DX de SM7IUN-#:	10110.0	LZ7DL	10 dB	23 WPM	CQ	1623Z
DX de SM7IUN-#:	10118.4	YT2ZE	16 dB	20 WPM	CQ	1624Z
DX de SM7IUN-#:	7011.0	RK4CT	22 dB	28 WPM	CQ	1624Z
DX de SM7IUN-#:	7025.0	UA6EED	15 dB	27 WPM	CQ	1624Z
DX de SM7IUN-#:	7006.3	RU3KA	20 dB	21 WPM	CQ	1625Z
DX de SM7IUN-#:	14100.0	Z56DN	10 dB	18 WPM	CQ	1625Z
DX de SM7IUN-#:	14018.0	5V7EI	7 dB	26 WPM	CQ	1625Z
DX de SM7IUN-#:	7016.3	RU3KA	19 dB	21 WPM	CQ	1626Z
DX de SM7IUN-#:	7018.5	DL1GZH	14 dB	13 WPM	CQ	1626Z
DX de SM7IUN-#:	10119.4	G58VL	35 dB	20 WPM	CQ	1626Z
DX de SM7IUN-#:	7038.2	RN6HI/B	7 dB	17 WPM	CQ	1627Z
DX de SM7IUN-#:	14028.4	K2TV	17 dB	22 WPM	CQ	1627Z
DX de SM7IUN-#:	7007.0	OK3EE	42 dB	18 WPM	CQ	1628Z
DX de SM7IUN-#:	10113.0	LZ2JB	15 dB	14 WPM	CQ	1629Z
DX de SM7IUN-#:	10114.1	UB7K	33 dB	25 WPM	CQ	1629Z
DX de SM7IUN-#:	7025.0	UA6EED	19 dB	27 WPM	CQ	1629Z
DX de SM7IUN-#:	3520.0	R3OR	8 dB	26 WPM	CQ	1630Z
DX de SM7IUN-#:	7017.0	RK3Q/7	26 dB	25 WPM	CQ	1630Z
DX de SM7IUN-#:	14052.0	IT9FRT	19 dB	14 WPM	CQ	1630Z
DX de SM7IUN-#:	3541.0	DK5JPL	17 dB	28 WPM	CQ	1630Z
DX de SM7IUN-#:	10114.1	UB7K	33 dB	25 WPM	CQ	1630Z
DX de SM7IUN-#:	14030.0	4Z4DX	23 dB	20 WPM	CQ	1630Z
DX de SM7IUN-#:	14028.5	HZ1TT	31 dB	26 WPM	CQ	1631Z
DX de SM7IUN-#:	7030.3	G0EVJ	3 dB	22 WPM	CQ	1631Z
DX de SM7IUN-#:	7013.0	HB9JCI	6 dB	24 WPM	CQ	1631Z
DX de SM7IUN-#:	3521.0	SP1JPM	22 dB	28 WPM	CQ	1632Z
DX de SM7IUN-#:	3518.0	UA6KAC	16 dB	23 WPM	CQ	1632Z
DX de SM7IUN-#:	7013.3	R1ZY	27 dB	25 WPM	CQ	1632Z
DX de SM7IUN-#:	10113.5	RW3WP	26 dB	22 WPM	CQ	1632Z
DX de SM7IUN-#:	7011.0	PA2SAM	20 dB	28 WPM	CQ	1632Z
DX de SM7IUN-#:	14010.0	EA1XT	13 dB	36 WPM	CQ	1632Z
DX de SM7IUN-#:	7026.2	YT4EW	11 dB	22 WPM	CQ	1633Z

The Reverse Beacon network

- A cloud service
- “A shortwave communications data lake”
 - All data available for download
- 300,000,000+ data points collected since 2009
- Extensive suite of online analysis tools

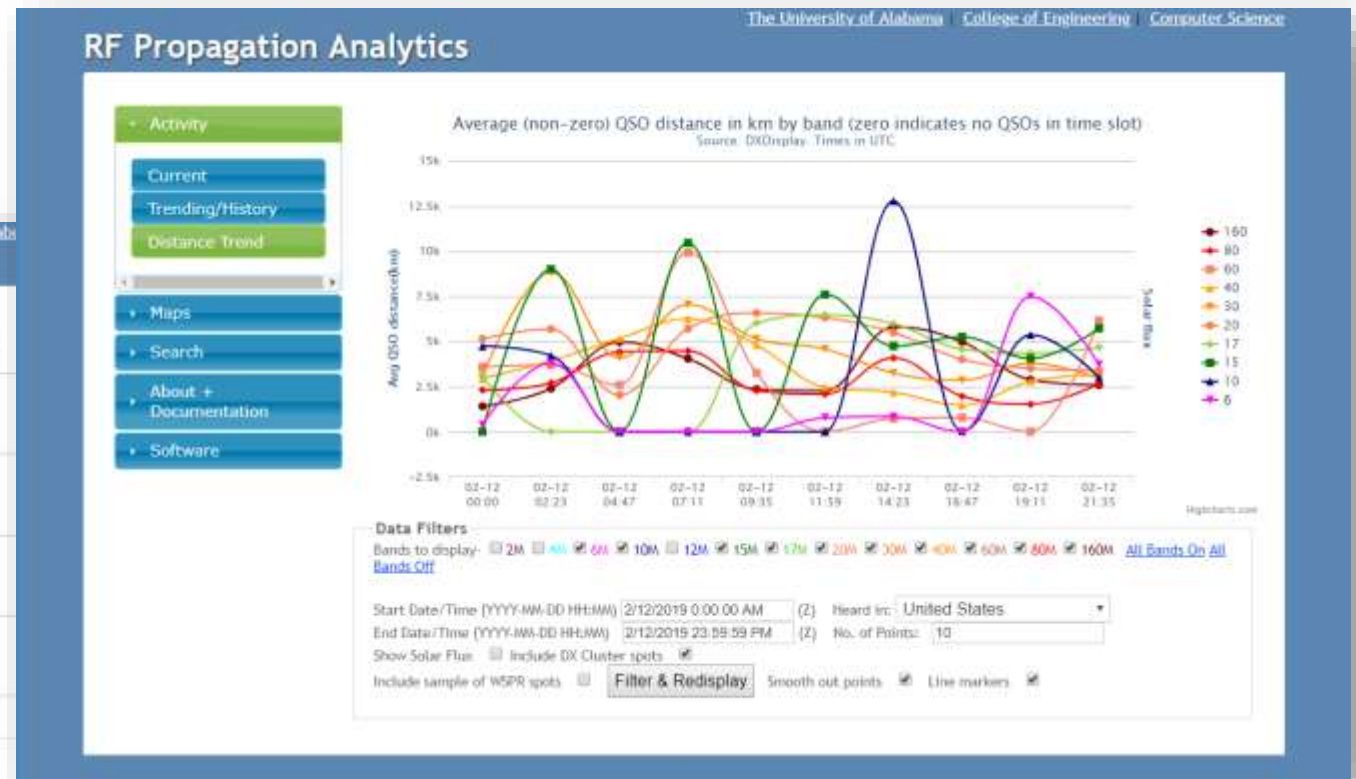
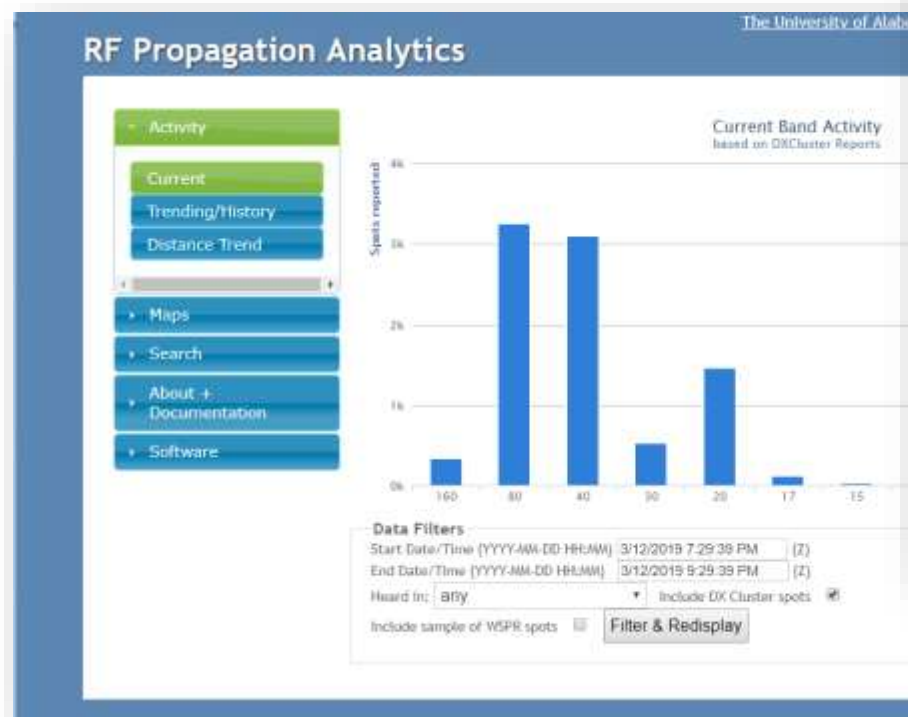


Cloud-to-cloud: HA8TKS



<https://dxcluster.ha8tk.s.hu>

Cloud-to-cloud: University of Alabama



Cloud-to-cloud: DX maps

The screenshot displays the DXMAPS 4.0 interface, which provides real-time information on QSO/SWL activity. The top navigation bar includes links for Site, Personal, Radio, Software, DX maps, DX news, and a search bar. The main header reads "DXMAPS 4.0 - QSO/SWL real time information". Below this, there are tabs for Map, List, Graph, and Chat, along with a "LF-HF" and "VHF & up" filter. A sidebar on the left offers various audio and video options, including "ROYALTY FREE AUDIO TRACKS", "FREE FILES", "CORPORATE MUSIC", "SOUND EFFECTS", "BACKGROUND MUSIC", "MUSIC FOR VIDEOS", and "AND MORE!". The central map shows a world map with a grid overlay, displaying numerous QSO/SWL connections as lines between various locations. A sidebar on the right lists active stations, including "WWW.DXMAPS.COM 18:57z" and "WWW info: SFI-70 A-12 K-2-Unsettled SWX-Minor storm". The bottom of the page features a "START NOW" button.

<https://www.dxmaps.com>

Cloud-to-cloud: VOACAP

VOACAP Quick Guide

HF Propagation Prediction and Ionospheric Communications Analysis

by Jari Perkkio, OH5BG/OC6G

What is VOACAP?

VOACAP (Voice of America Coverage Analysis Program) is free professional high-frequency (HF) propagation prediction software from NTIA-ITS, originally developed for Voice of America (VOA).

This 'work-in-progress' guide should get you well started with the software. A more comprehensive discussion about the finer details of using the software can be found in George Lane's book [Signal-to-Noise Predictions Using VOACAP: A User's Guide](#). The book is now available on CD-ROM.

There is now also [The Official VOACAP Blog](#) - well, it's not too official.

NOTE: Running automated scripts to access VOACAP services is strictly prohibited unless agreed upon in advance.

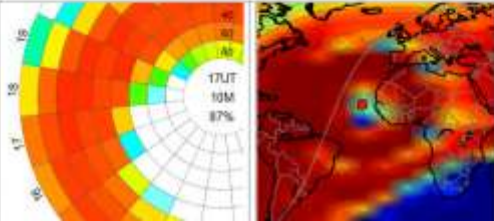
FOLLOW ME ON TWITTER FOR THE LATEST NEWS

If you wish to keep abreast of the latest developments on the site, follow me on Twitter at: [twitter.com/VOACAP](#)

VOACAP PREDICTIONS FOR MARITIME HF

Using Maritime HF SSB transceivers? I have now launched a VOACAP HF propagation prediction site for M: [http://voacap.com/marine](#) - work's in progress still. Comments & suggestions welcome.

VOACAP Online Prediction Services



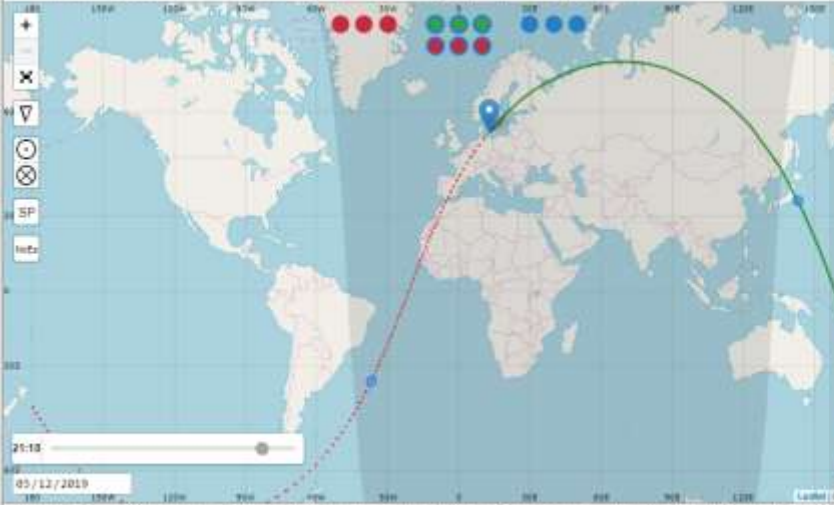
VOACAP Online HF Predictions (Amateur Radio) - 21:19:43 UTC (10:19 PM)

Select TX QTH: or Select a location: or Set QTH: or Set QTH:

Select RX QTH: or Select a location: or Set QTH: or Set QTH:

or Latitude: Longitude:

or Latitude: Longitude:



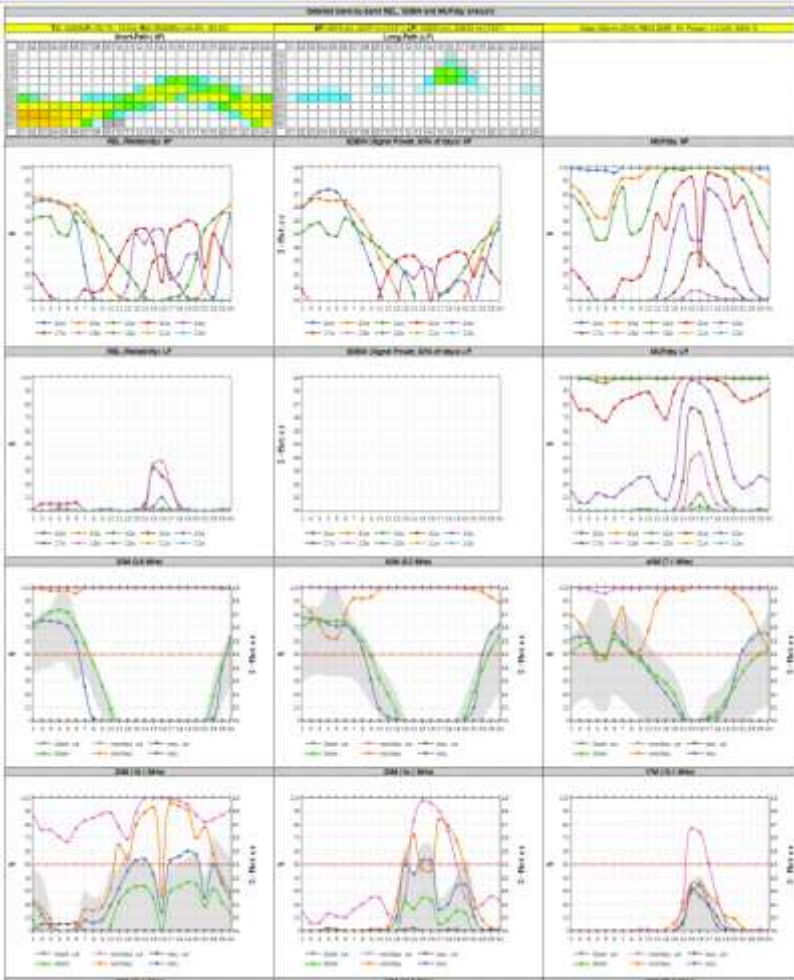
21:19

05/12/2019

TX: 48.25, 178.03 (RX: 55.38, 12.82) (Dist: 17783 km - 11049 mi) (35° - 38°) (Lat: 23.4618, (48.0179) Long: 22223 km - (13810 mi) (153° - 219°) (Lat: -33.4438, -36.8)

Send by Band Prediction Send by F1070 F5 & F3000 No year Prediction QSO Window Distance Pathmap F1070 Graph Spectrum F1070 Map Station Map

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<http://www.voacap.com>

Client software: SpotCollector

Part of the larger DXLab radio station management suite.

Integration with propagation prediction tools, call sign data base, station logbook, awards rule base, etc.

SpotCollector 8.3.0 @ 2019-03-12 21:52 Z [CC,DXK,PF,DXV,PV] 6 entries (log: SM7IUN.mdb)

WWV 03-12 2106 Z
SFI 71 History
Q: 6 A 9 1 K

Outgoing spot
Call CT1ILT 1 840,0 Freq Cluster
Notes X Local

Spot source status
Report Stats Prop Config Help

	Freq	Call	DXCCCountry	Mode	LastTime	Notes	Source	Network	LastOr	NA	SA	EU	AF	AS	Odx	State	Need	SPS	SPPro
	1 820,6	3B8XF	Mauritius Islan	CW	2019-03-12 2144	QX 1822.25	DL1ROJ	EI7MRE	EU			Y			359		DZ		
	1 824,6	JA5DQH	Japan	CW	2019-03-12 2142	CW 18 dB 22 WPM CQ	JF2IWL-#	VE7CC	AS			Y		Y	1270		DZ		
	1 840,0	7P8LB	Lesotho	FT8	2019-03-12 2141	FT8 normal	EU0EU-@	CQDX	EU			Y	Y		897		DZ		
	7 092,0	7P8LB	Lesotho	SSB	2019-03-12 2142	only Ja	IV3RJT	CQDX	EU			Y			630		D	3	
	10 110,0	XR0ZRC	Juan Fernandi	CW	2019-03-12 2145	QX 10111.88 IOTA SAC	EA4ZK	EI7MRE	EU		Y	Y		Y	936		DZ	-8	3
	14 012,0	XR0ZRC	Juan Fernandi	CW	2019-03-12 2149	still 569 here	DM5EM	EI7MRE	EU	Y	Y	Y			538		D	7	38

Sort
☐ First ☐ Call
☐ Last ☒ Freq
☐ Rcv ☐ Az

Filter: SQL [Need F]
ce2sv X AutoHide Need Call DXCC Freq Tag Band Mode Cont Origin
Audio Age LoTW eQSL Mrthn S
Need F Need C N+ EU CWops Unkwn Need S My spot Myneed

Color codes
verified unneeded unconfmd unwrkd B or M unwrkd counter special tag

What use is the RBN for me?

Contesting



- Band openings
- Band-map filler
- Spots you
- Find clear spots
- Strategizing
- Benchmarking competition

DX-ing



- Band openings
- Alerts for rare stations
- Propagation reports

Antenna experiments



- Antenna directivity
- Radiation angle
- A-B testing