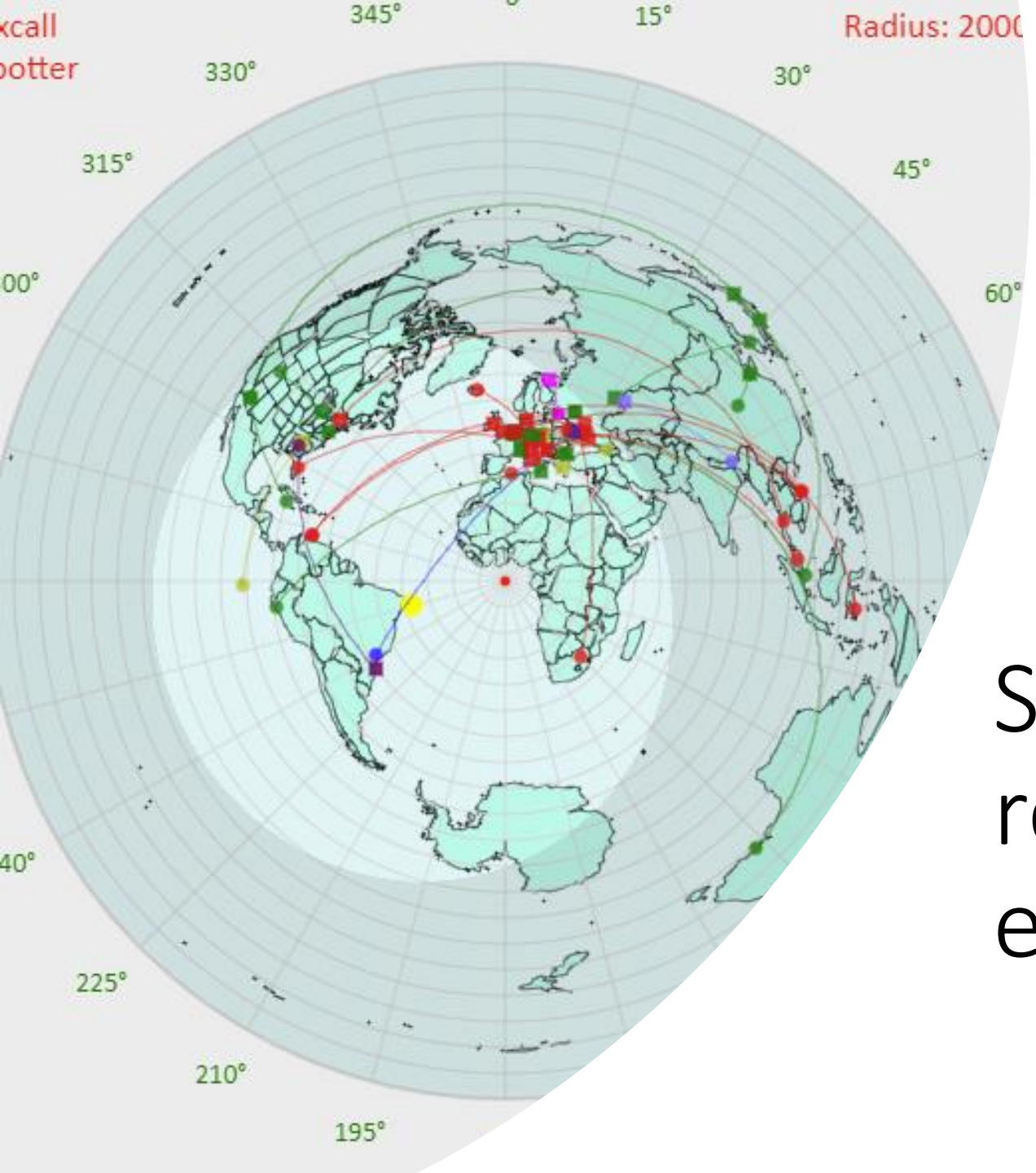
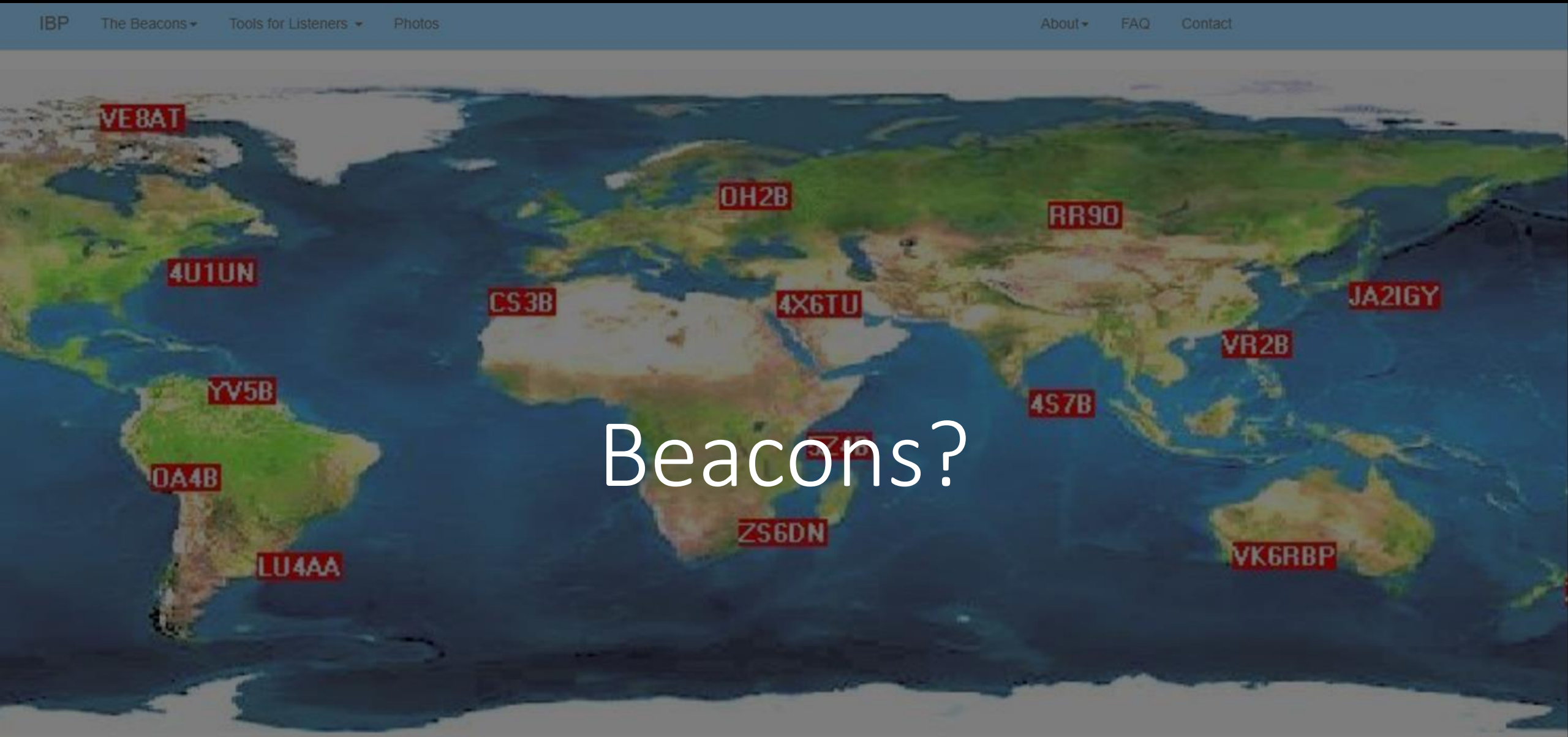
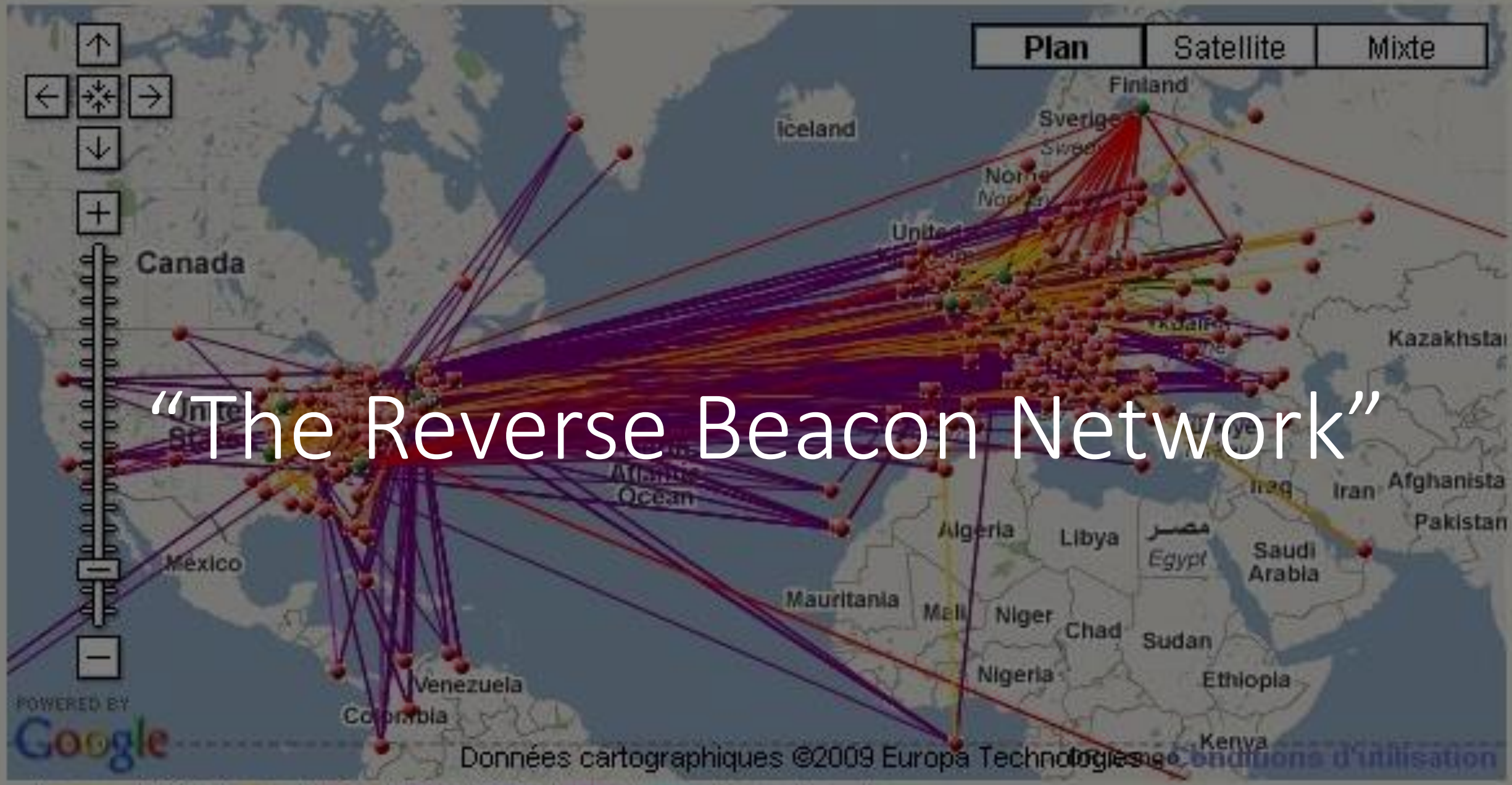


Shortwave robots, reverse beacons, and an exotic fruit

Björn Ekelund – SM7IUN


IBP
The Beacons
Tools for Listeners
Photos
About
FAQ
Contact
VE8AT
OH2B
RR9O
4U1UN
CS3B
4X6TU
JA2IGY
VR2B
YV5B
4S7B
Beacons?
OA4B
ZS6DN
VK6RBP
LU4AA
NCDXF/IARU International Beacon Project
Transmission Schedule

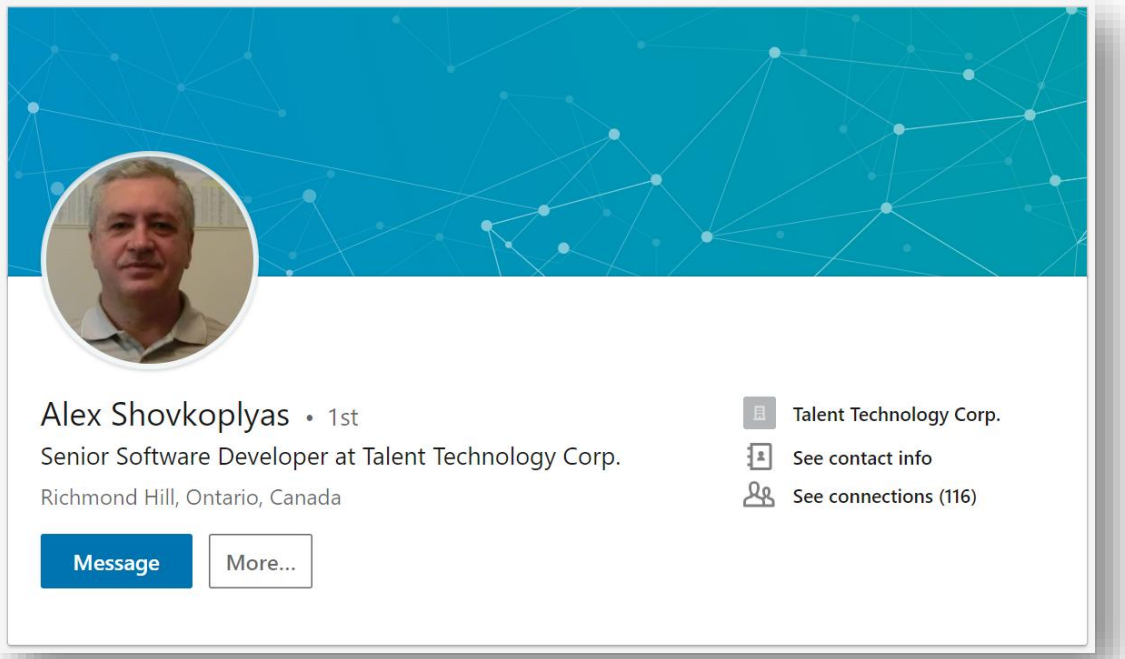


“The Reverse Beacon Network”

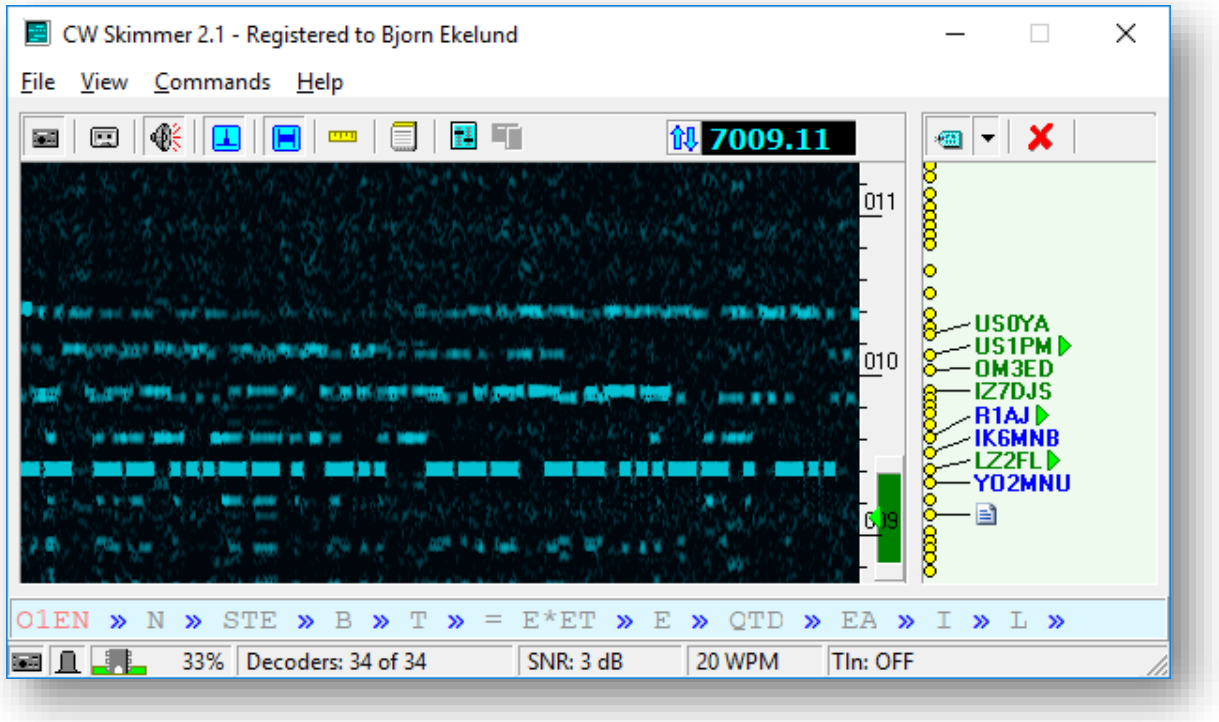
It started with one brilliant engineer…

Alex Shovkoplyas, VE3NEA (b. 1965, ex-UR5EMI, Canadian resident since 1998)

”Canadian ham of the year” 2014



Morse code decoder ”CW Skimmer”

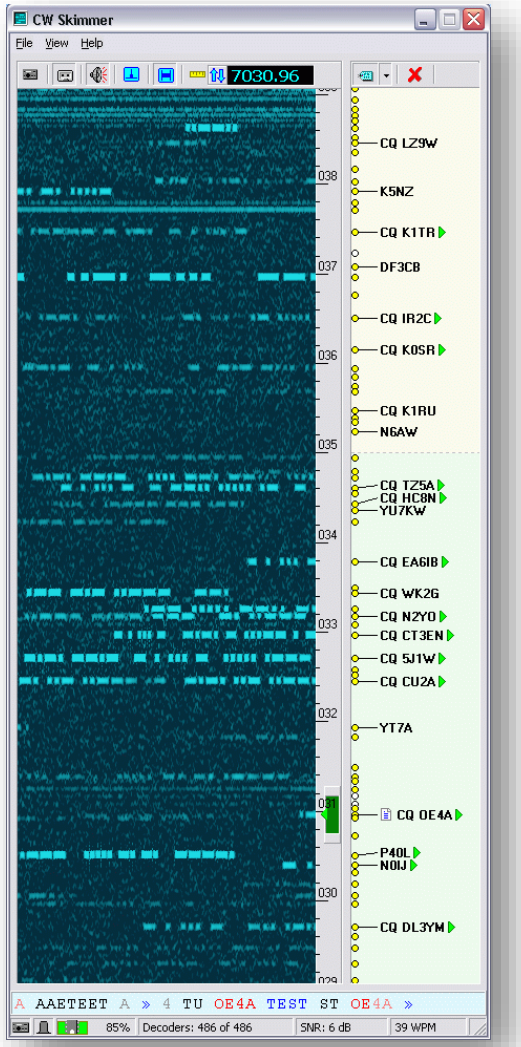


Published by Alex in 2008 after “seven years of thinking”.

Based on Bayesian statistics, a “kind of” AI.

Originally intended as a tool to manage DX pile-ups.

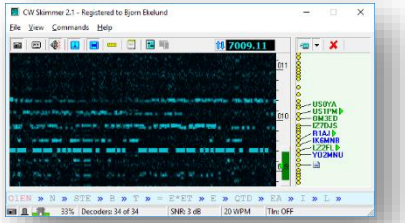
“CW Skimmer”



- 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

DX WATCH

Dick W3OA

Nick F5VIH

Pete N4ZR

Phil N8VB

REVERSE BEACON NETWORK

welcome | main | dx spots | skimmers | downloads | about | contact us

Map | Satellite | Hybrid

Norwegian Sea, Greenland, Iceland, Sweden, Finland, Norway, United Kingdom, Ireland, Denmark, Poland, Belarus, Germany, Ukraine, Austria, France, Romania, Bay of Biscay, Italy

POWERED BY Google Terms of Use

/ 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 DX call: LA3ZA

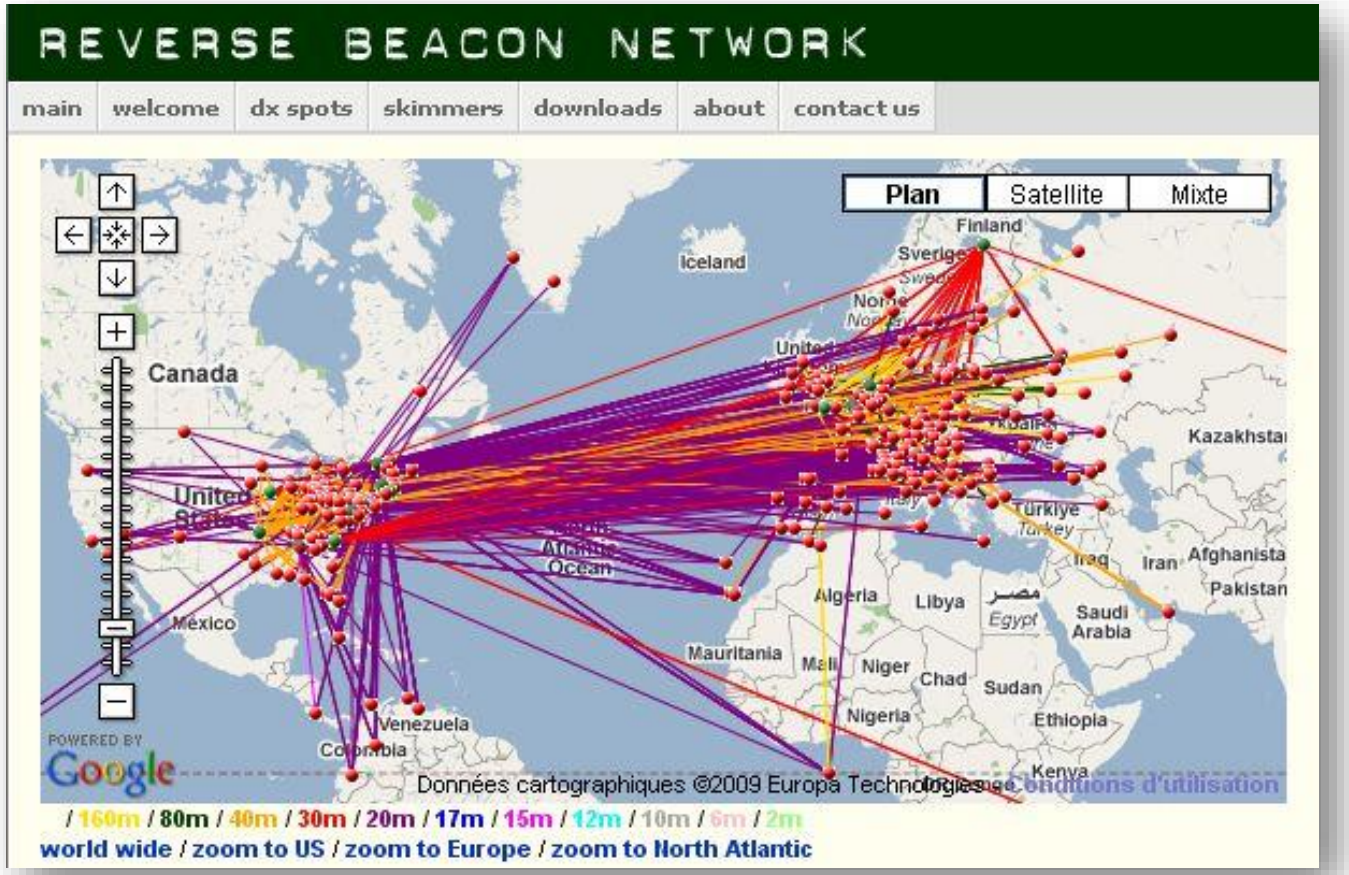
search spot by callsign

rows to show: 50

de	dx	freq	cq/dx	snr	speed	time
DL0LBS	LA3ZA	3534.4	CW CQ [LoTW]	19 dB	16 wpm	2031z 22 Apr
DL1EMY	LA3ZA	3534.3	CW CQ [LoTW]	29 dB	15 wpm	2028z 22 Apr
DR1A	LA3ZA	3534.3	CW CQ [LoTW]	23 dB	15 wpm	2028z 22 Apr
LA5EKA	LA3ZA	3534.3	CW CQ [LoTW]	16 dB	15 wpm	2016z 22 Apr
DF7GB	LA3ZA	3534.3	CW CQ [LoTW]	19 dB	15 wpm	2016z 22 Apr

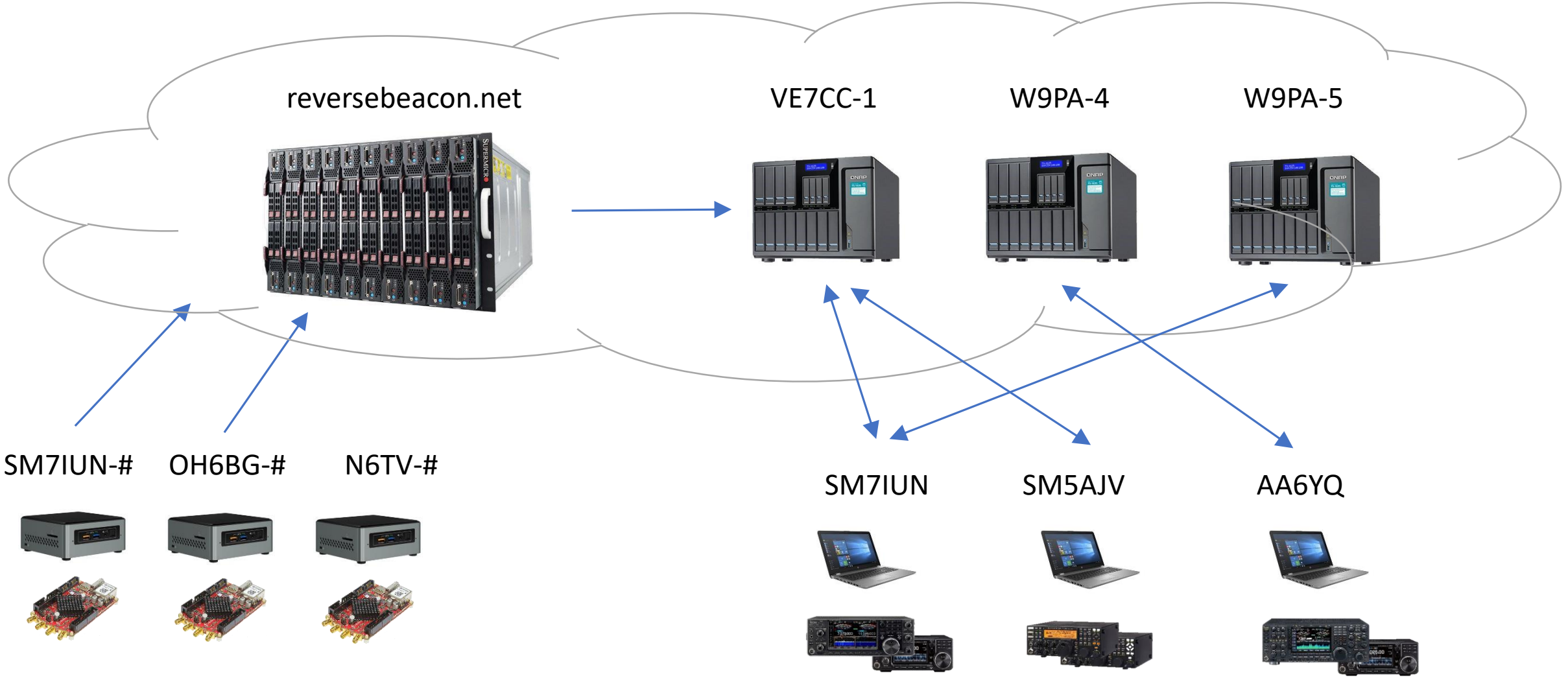
The Reverse Beacon network

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

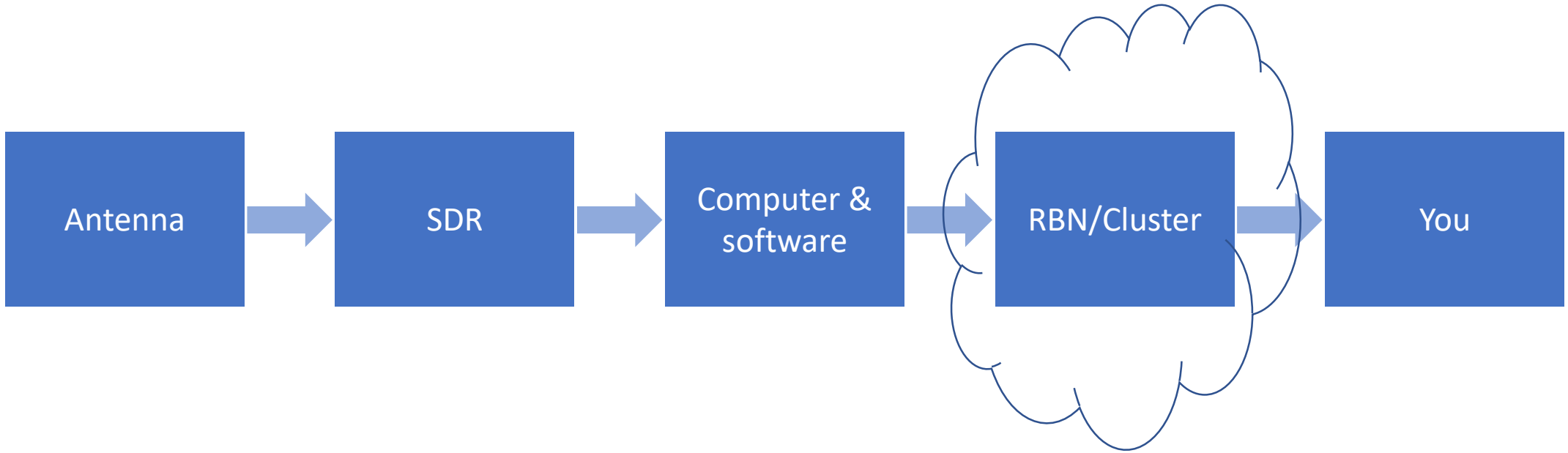


http://www.reversebeacon.net

Reverse beacon network & The DX cluster

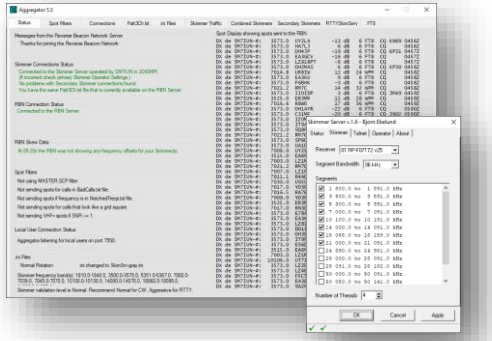


The whole chain

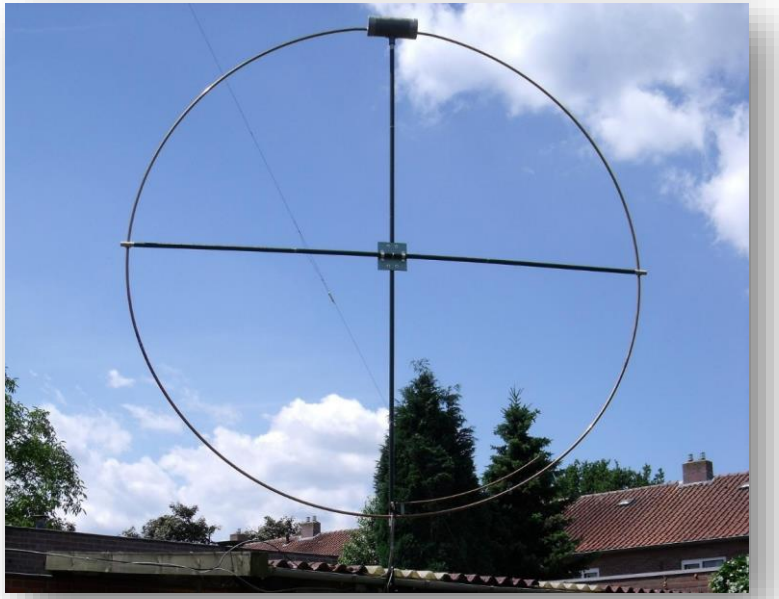


What are the parts in a skimmer?


```
for i in people.data.users:
    response = client.api.statuses.user_timeline.get(screen_name=i.scre
    print 'Got', len(response.data), 'tweets from', i.screen_name
    if len(response.data) != 0:
        ltdate = response.data[0]['created_at']
        ltdate2 = datetime.strptime(ltdate,'%a %b %d %H:%M:%S +0000 %Y'
        today = datetime.now()
        howlong = (today-ltdate2).days
        if howlong < daywindow:
            print i.screen_name, 'has tweeted in the past' , daywindow,
            totaltweets += len(response.data)
            for j in response.data:
                if j.entities.urls:
                    for k in j.entities.urls:
                        newurl = k['expanded_url']
                        urlset.add((newurl, j.user.screen_name))
        else:
            print i.screen_name, 'has not tweeted in the past', daywinde
```



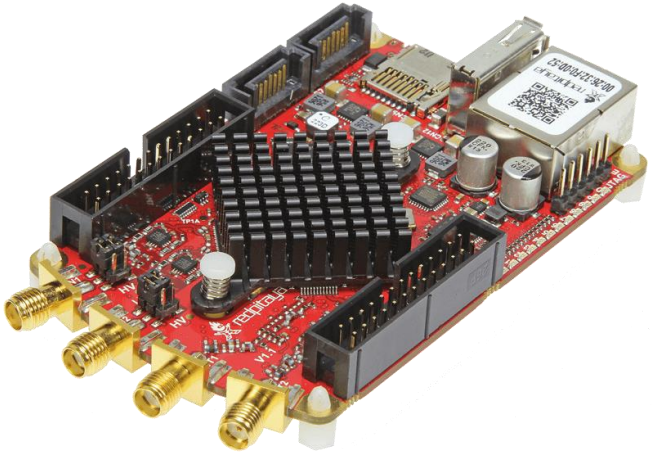
#1 Antenna



- 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)

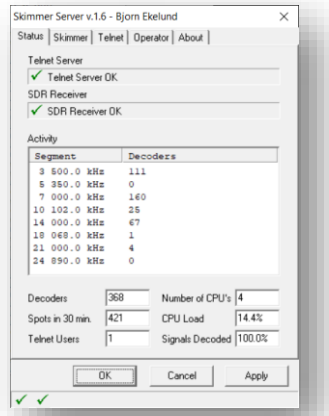


- Does not need
  - knobs and buttons
  - an audio chain

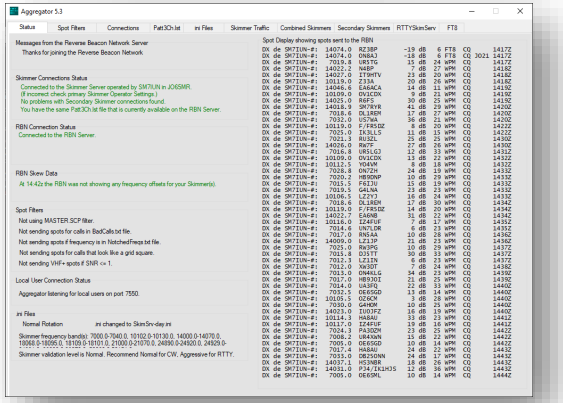
SDR receivers

#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

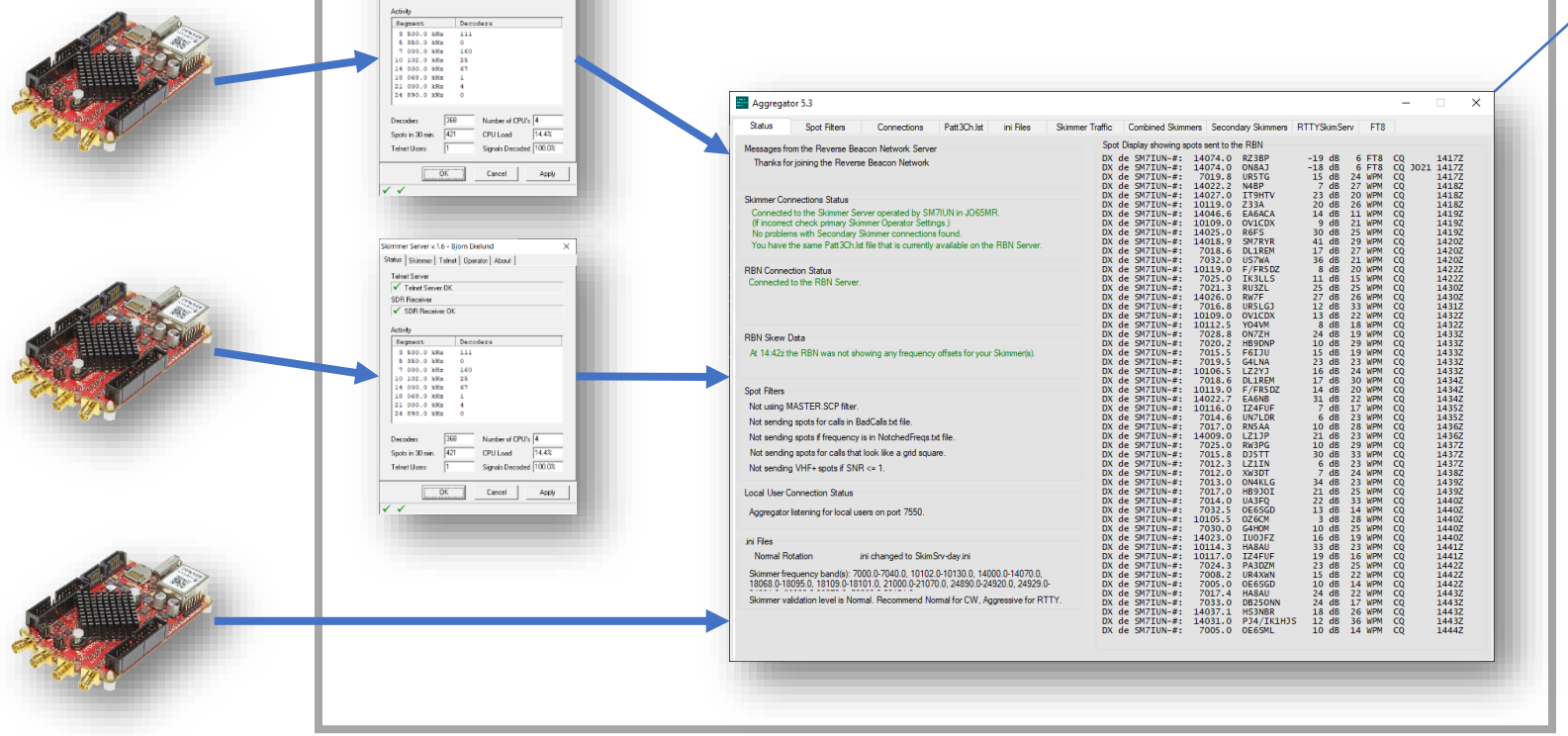


- **“RBN Aggregator”**
  - Consolidates and curates streams of decoded call signs from several radio front ends
  - Adds origin information
  - Controls daylight/twilight/night cycle
  - Etc. housekeeping



- Decoding of the FT8 digital transmission protocol is much less computationally intense and can be done in the radio front end.

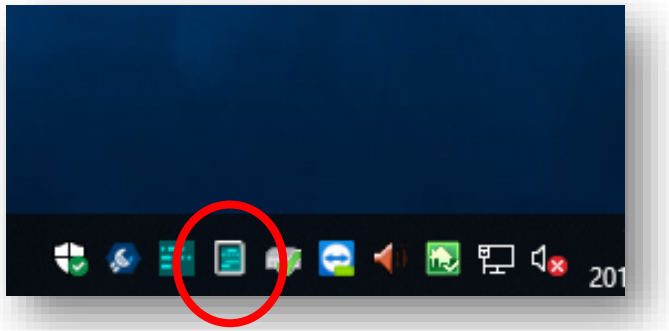
Skimmer “site architecture”



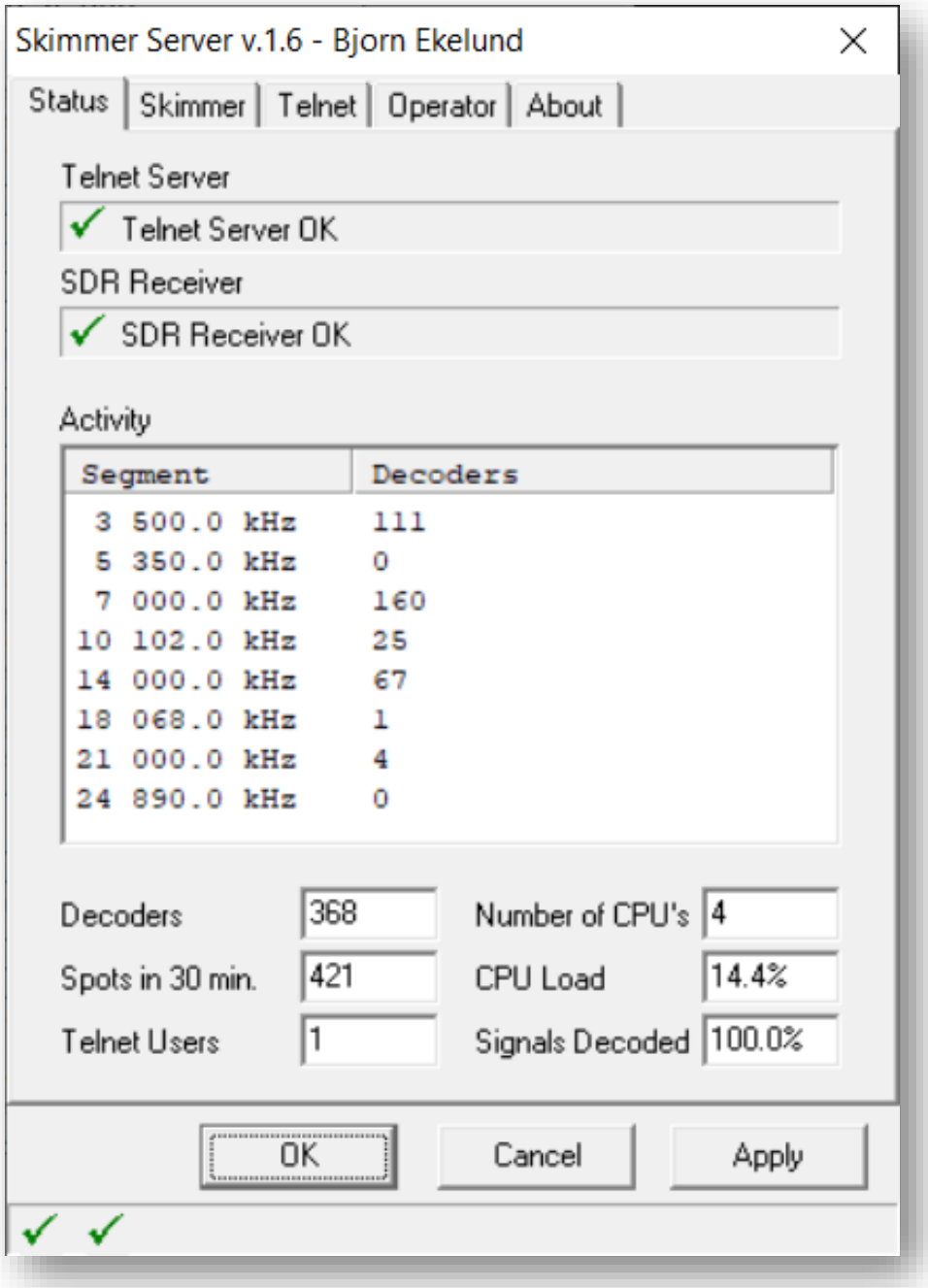
CW Skimmer Server

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

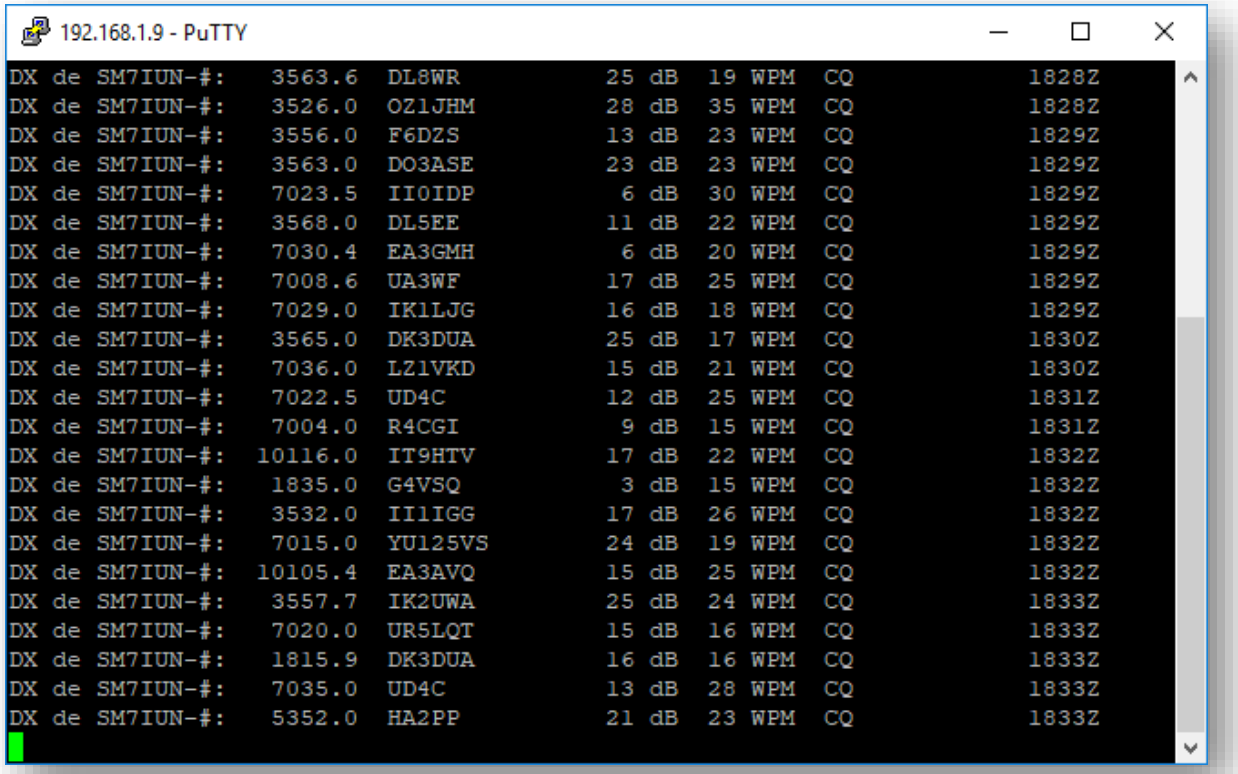


http://www.dxatlas.com/SkimServer



CW Skimmer Server

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

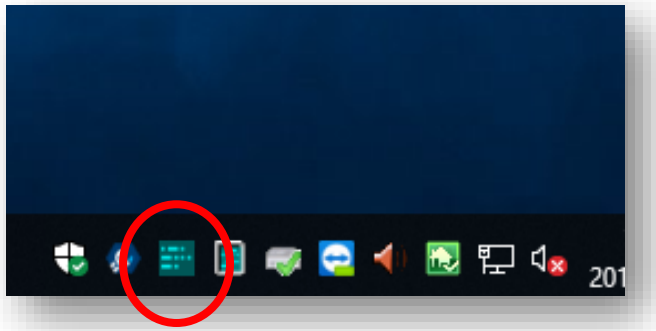


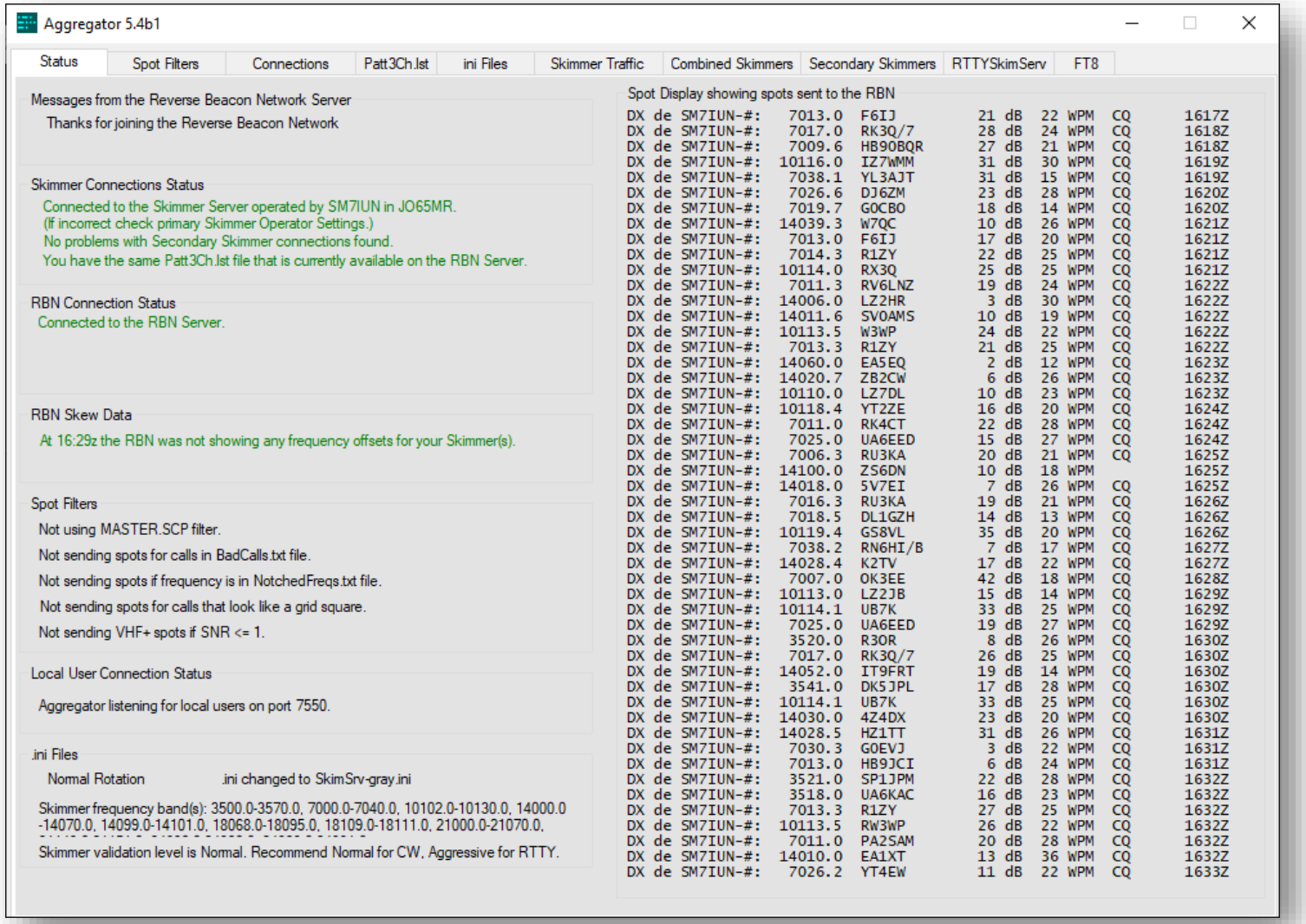
- Typically CW Skimmer Server does not report party stations, only “CQ-ers”
- Spotting keywords:
  CQ QRZ TEST NA SS FD UP
- Short call signs (e.g. SE5E) should be repeated for secure spotting
- Remember that spotting is not guaranteed even if propagation is sufficient, e.g. due to interference

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.

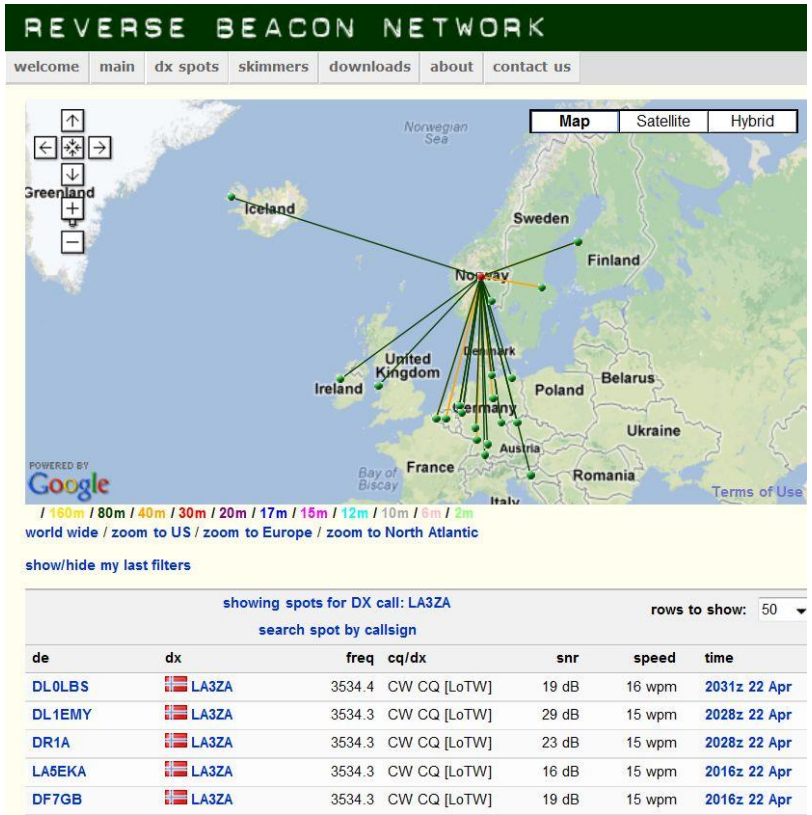


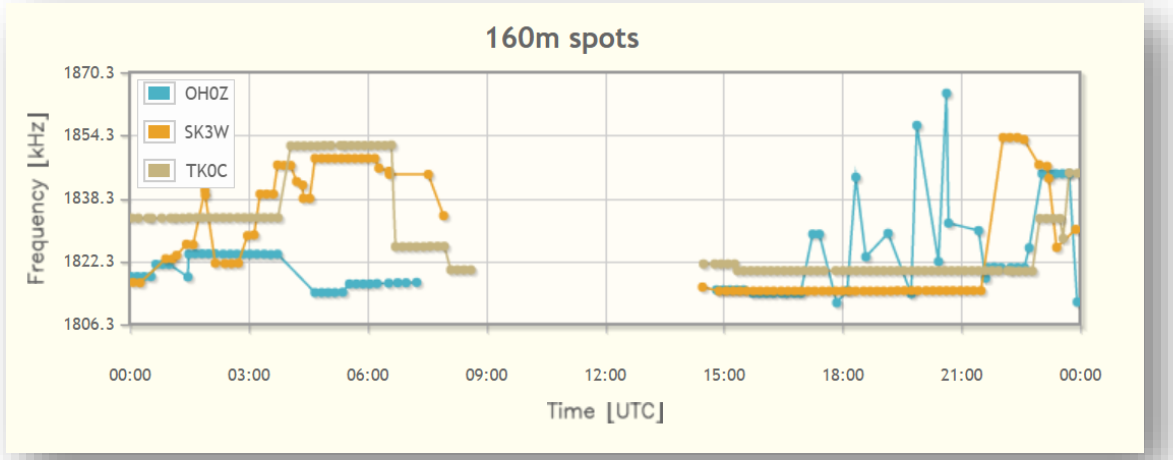


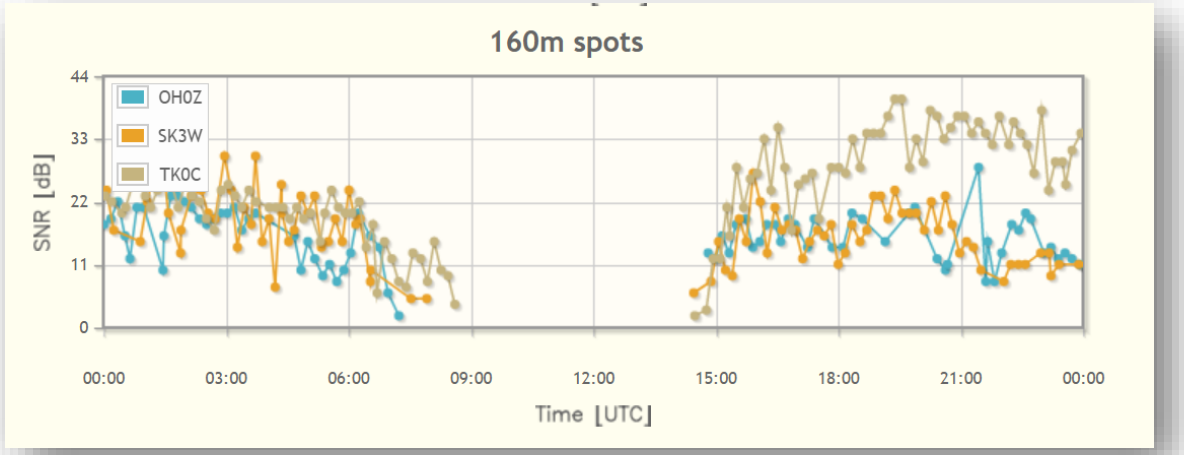
http://www.reversebeacon.net/pages/Aggregator+34

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





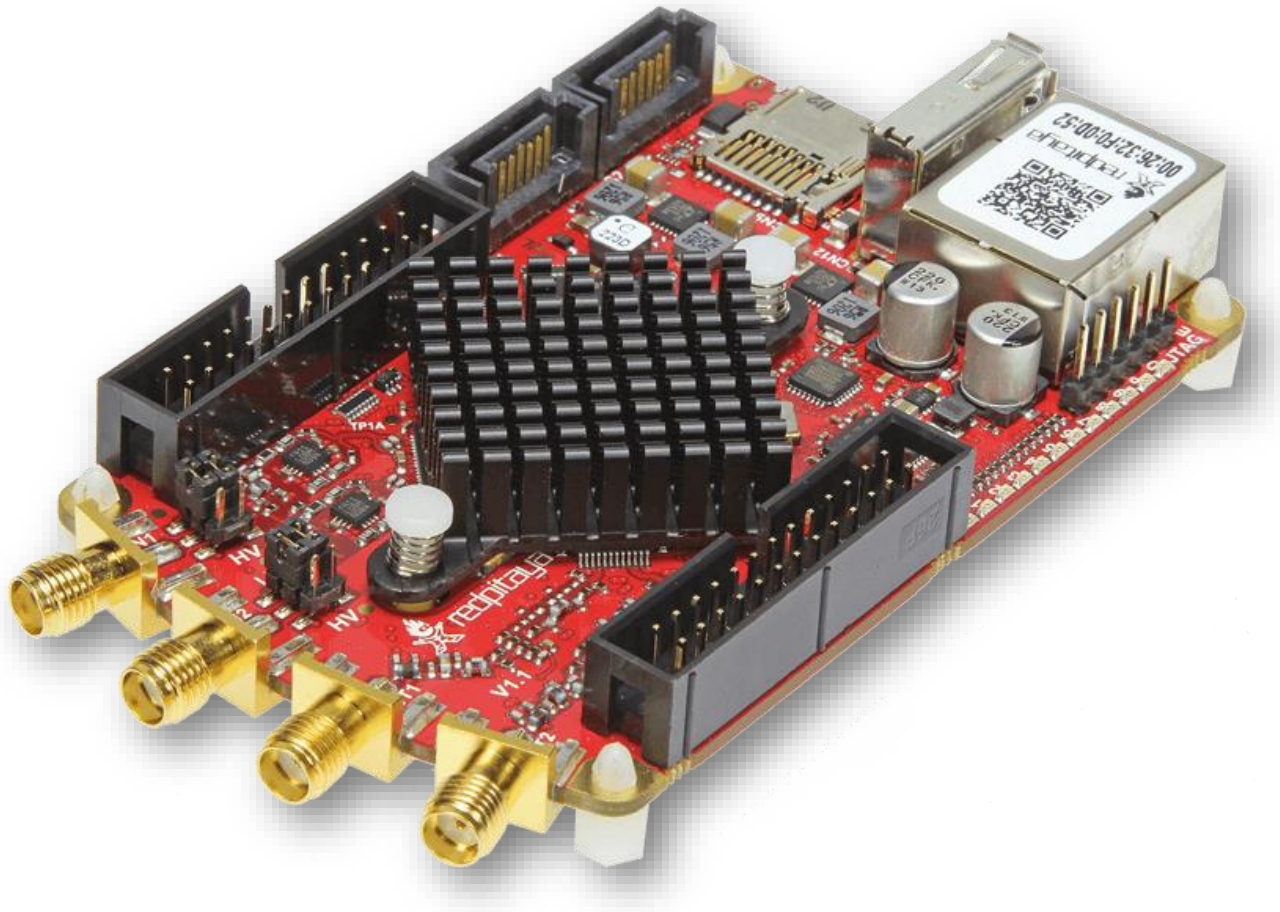


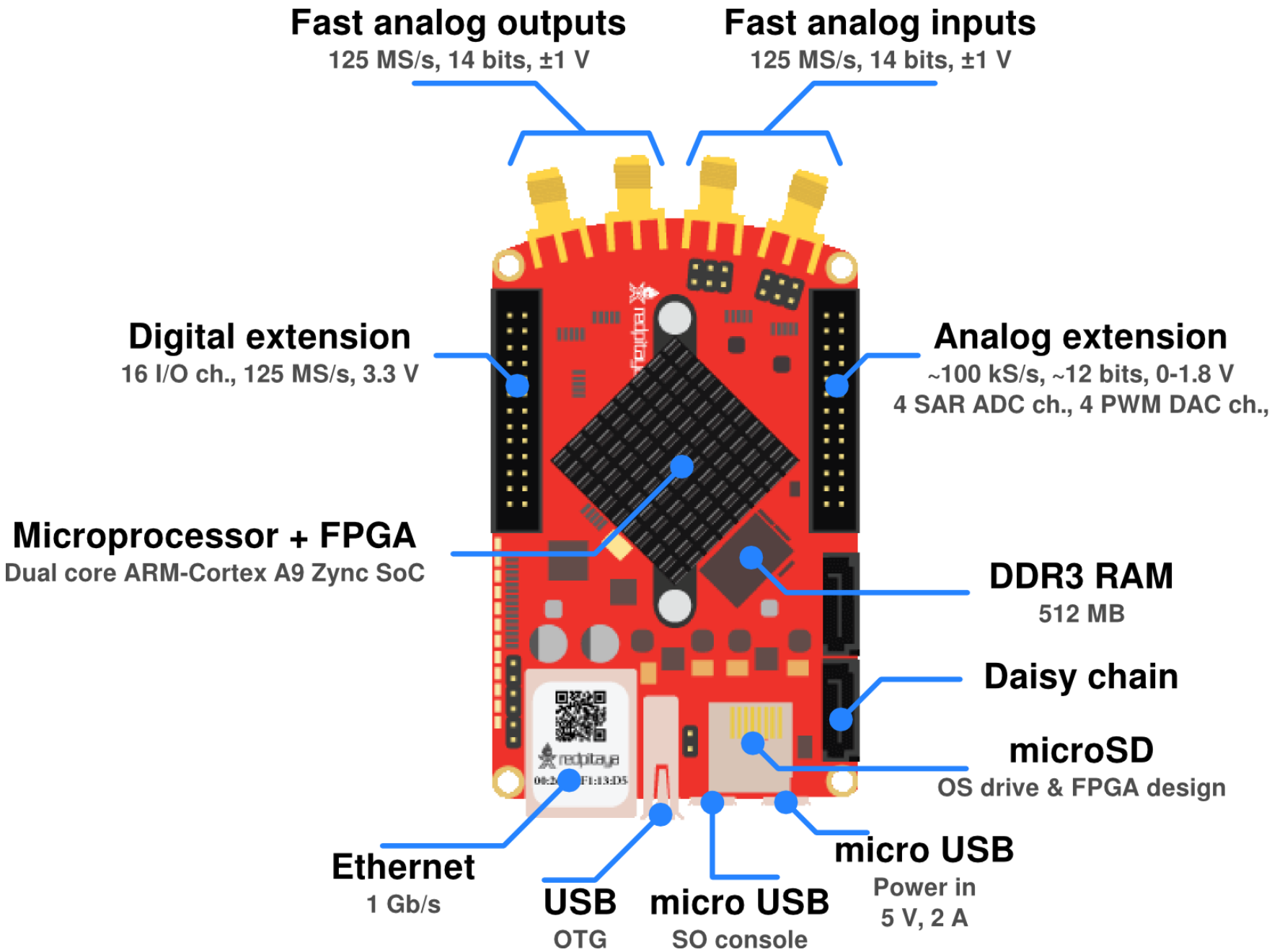
“The Raspberry Pi of DSP”

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

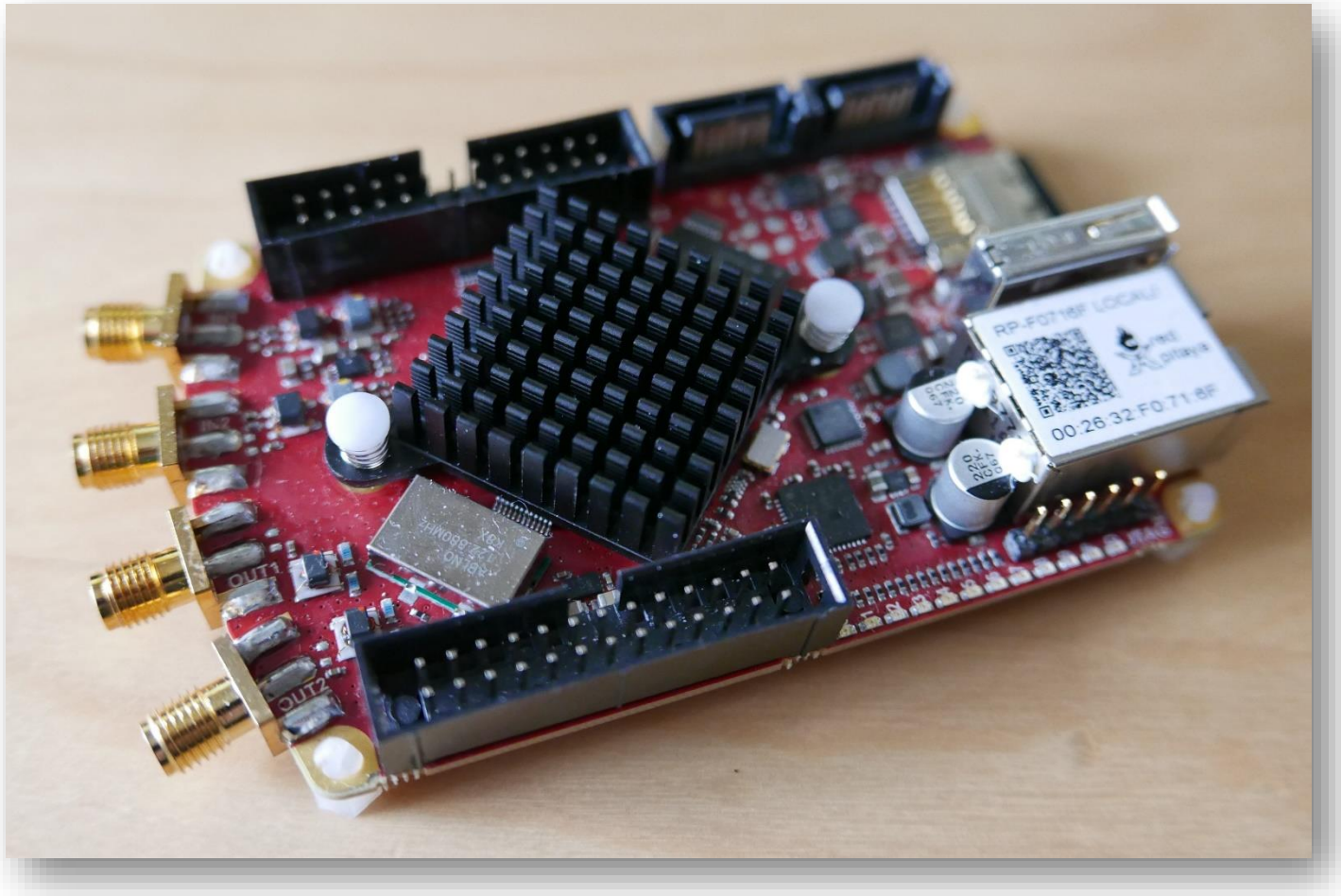


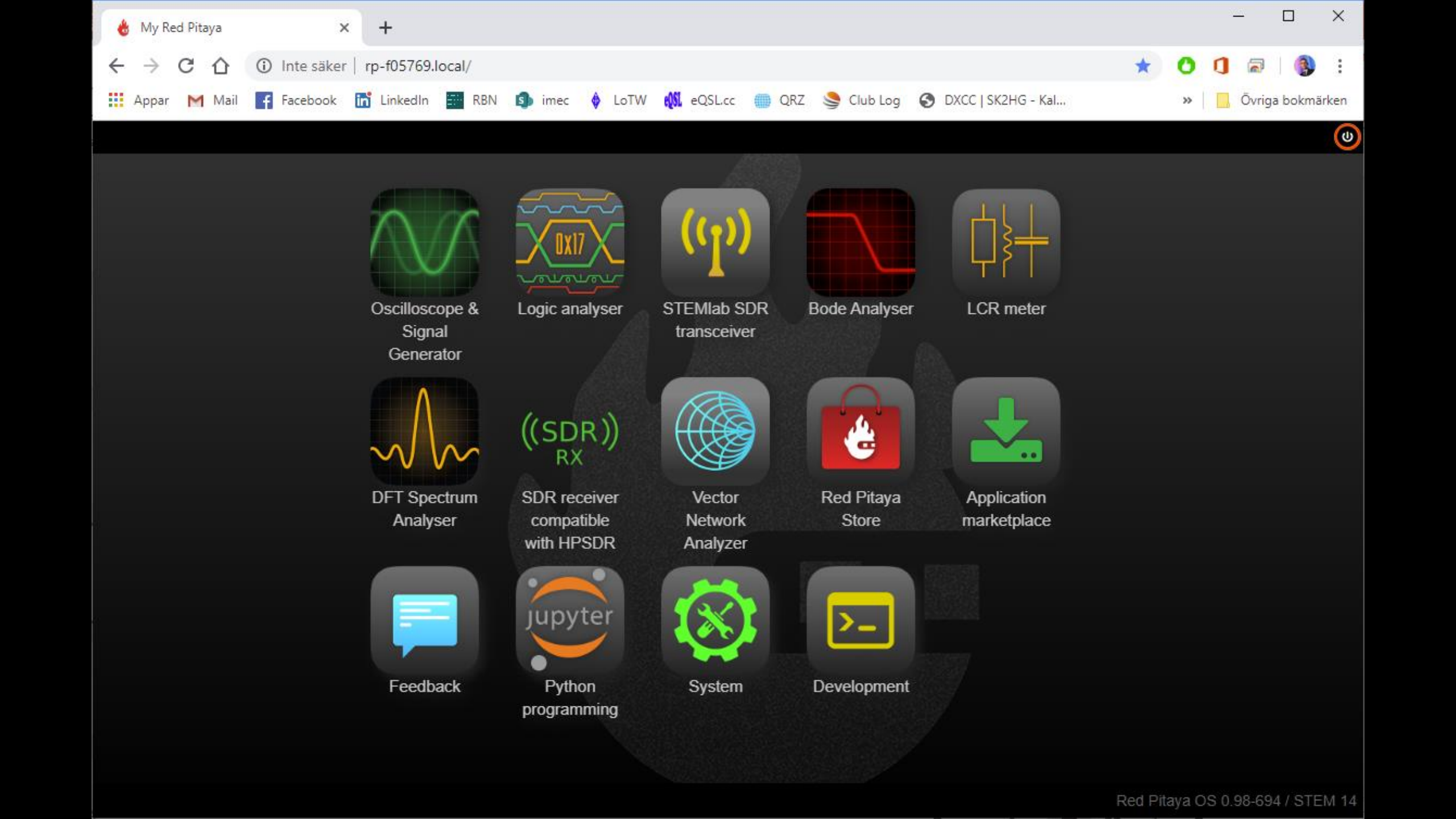

Fast analog outputs
125 MS/s, 14 bits, ±1 V
Fast analog inputs
125 MS/s, 14 bits, ±1 V
Digital extension
16 I/O ch., 125 MS/s, 3.3 V
Analog extension
~100 kS/s, ~12 bits, 0-1.8 V
4 SAR ADC ch., 4 PWM DAC ch.,
Microprocessor + FPGA
Dual core ARM-Cortex A9 Zync SoC
DDR3 RAM
512 MB
Daisy chain
microSD
OS drive & FPGA design
Ethernet
1 Gb/s
USB
OTG
micro USB
SO console
micro USB
Power in
5 V, 2 A

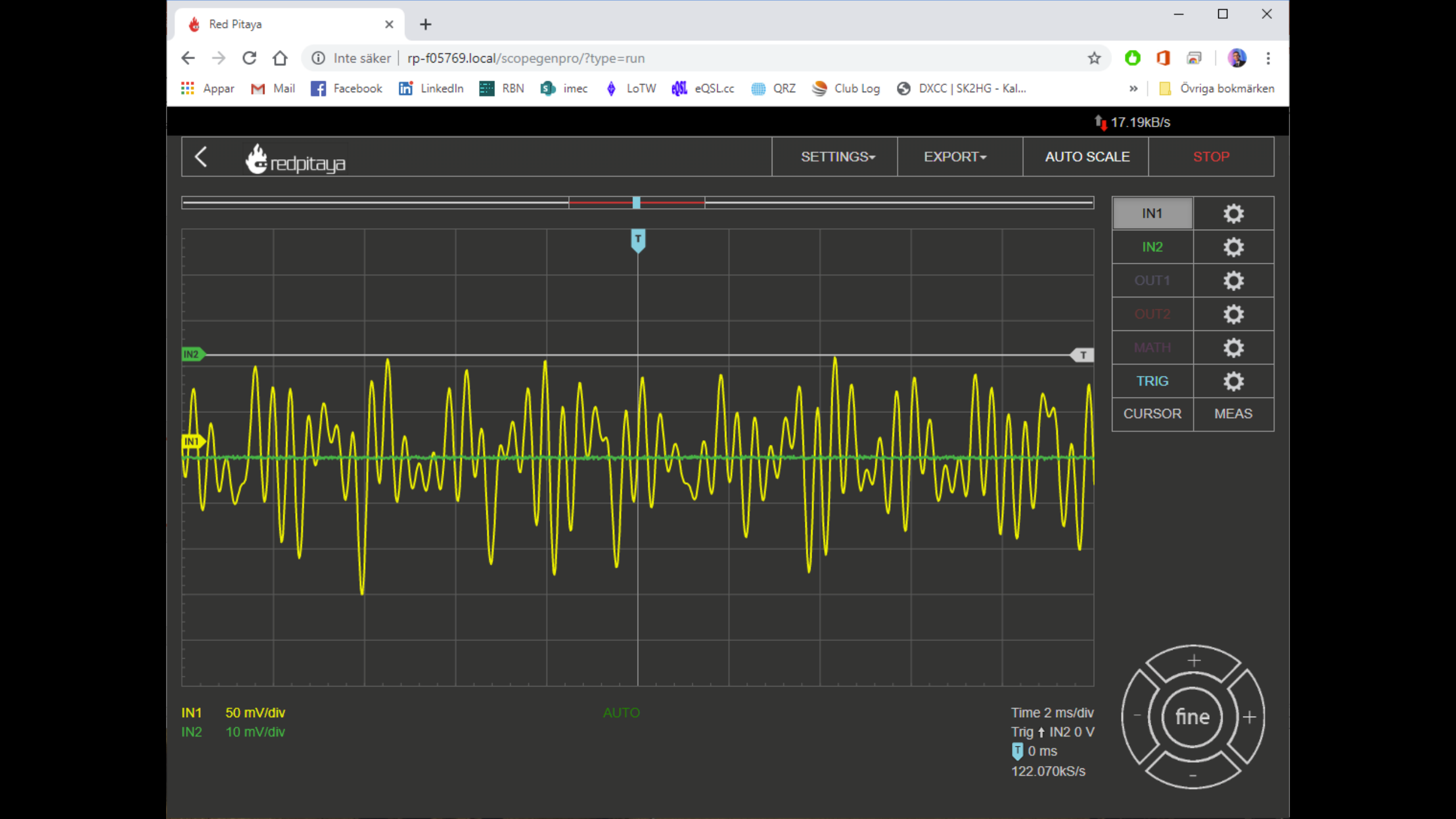
“The Raspberry Pi of DSP”

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
- Two 122.88MHz 14 bit DAC
- Four 100kHz ADC/DAC
- 16 GPIO
- ABLNO XO <50fs jitter




My Red Pitaya
Inte säker | rp-f05769.local/
Appar
Mail
Facebook
LinkedIn
RBN
imec
LoTW
eQSL.cc
QRZ
Club Log
DXCC | SK2HG - Kal...
Övriga bokmärken
Oscilloscope & Signal Generator
Logic analyser
STEMlab SDR transceiver
Bode Analyser
LCR meter
DFT Spectrum Analyser
SDR receiver compatible with HPSDR
Vector Network Analyzer
Red Pitaya Store
Application marketplace
Feedback
Python programming
System
Development
Red Pitaya OS 0.98-694 / STEM 14


Red Pitaya
Inte säker | rp-f05769.local/scopegenpro/?type=run
Appar
Mail
Facebook
LinkedIn
RBN
imec
LoTW
eQSL.cc
QRZ
Club Log
DXCC | SK2HG - Kal...
Övriga bokmärken
17.19kB/s
redpitaya
SETTINGS
EXPORT
AUTO SCALE
STOP
IN1
IN2
OUT1
OUT2
MATH
TRIG
CURSOR
MEAS
T
IN2
IN1
IN1 50 mV/div
IN2 10 mV/div
AUTO
Time 2 ms/div
Trig IN2 0 V
0 ms
122.070kS/s
fine

Red Pitaya

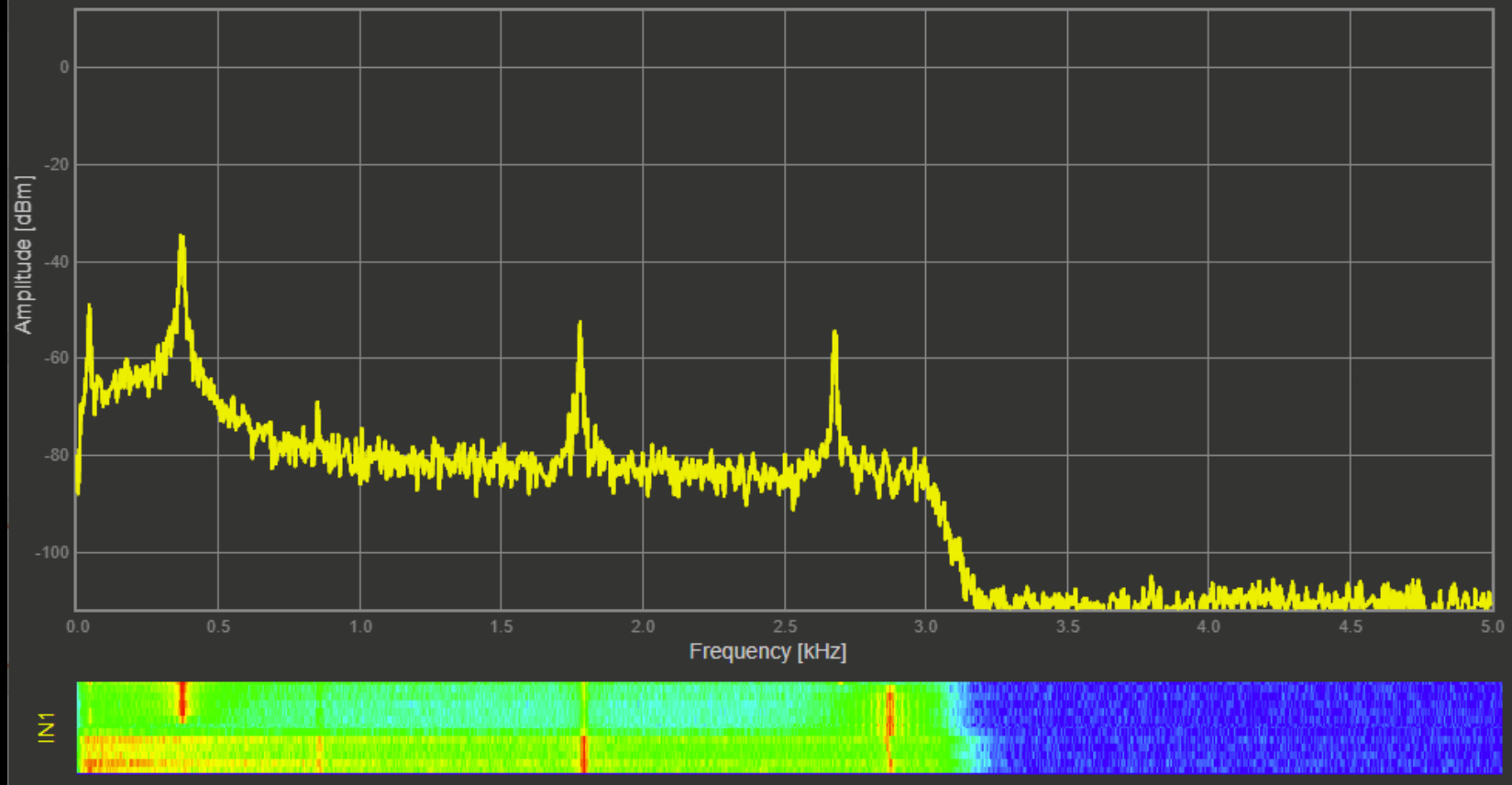
Inte säker | rp-f05769.local/spectrumpro/?type=run

Appar Mail Facebook LinkedIn RBN imec LoTW eQSL.cc QRZ Club Log DXCC | SK2HG - Kal... Övriga bokmärken

28.91kB/s

redpitaya

EXPORT CLEAR STOP



Range

Freq. unit: kHz

Start freq. 0

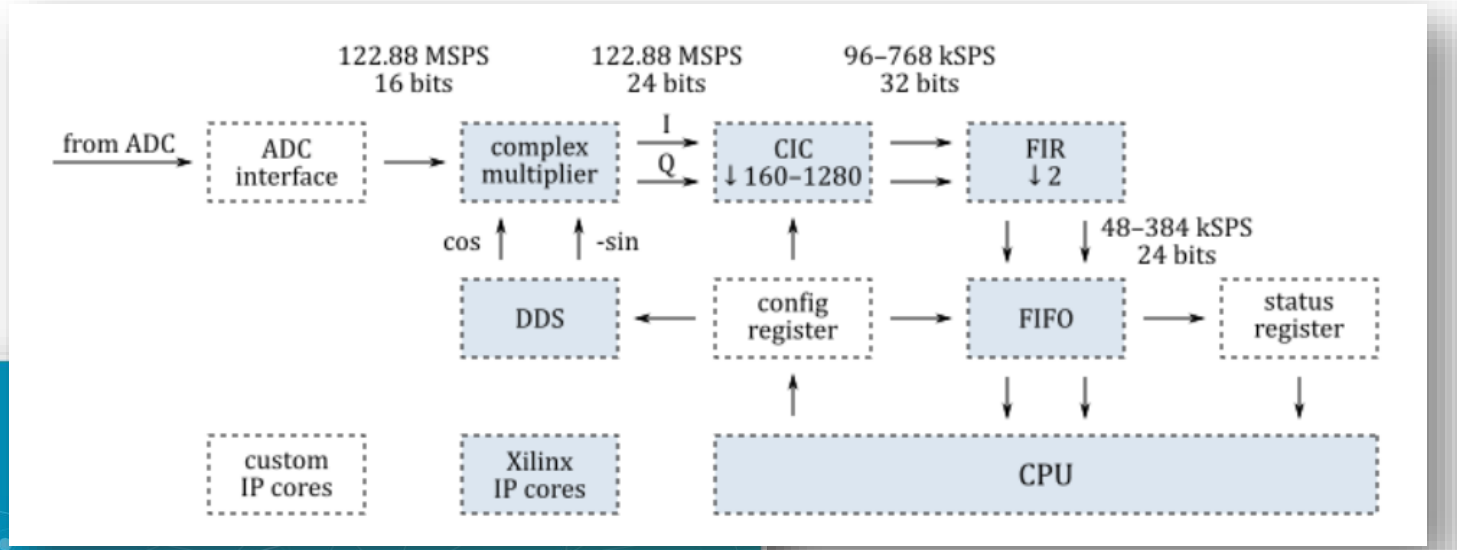
End freq. 5

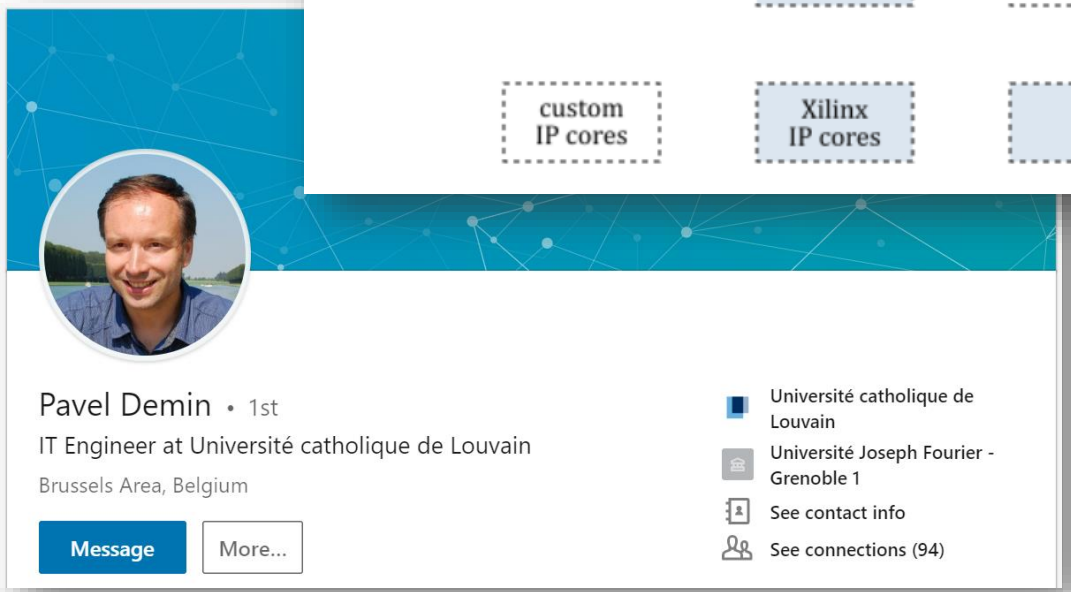
Peak Ch1: -34,685 dBm @ 0,37 kHz

Peak Ch2: OVER RANGE


PowerSDR™ OpenHPSDR mRX PS - Charly 25 / HAMlab / STEMlab SDR Edition - Release Version: 2017-07-20 - Commit: 7989e51
Setup
Memory
Wave
Equalizer
XVTRs
CWX
Diversity
Collapse
Linearity
RA
POWER
RX2
MON
TUN
MOX
ALEX
DUP
PS-A
REC
PLAY
VFO A
7,012 044
40M CW
TX
VFO Sync
VFO Lock
10,120000
Tune Step:
25Hz
Save
Restore
VFO B
50,049 925
TX
6M Beacon Sub-Band
RX1 Meter
TX Meter
Signal
Fwd Pwr
-126 dBm
1 3 5 7 9 +20 +40 +60
7,000
7,0 025
7,005
7,0 075
7,010
7,0 125
7,015
7,0 175
7,020
7,0 225
-40
-60
-80
-100
-120
-G
-1450,9Hz
-130,5dBm
7,009 993 MHz
Pan:
Center
Zoom:
0.5x
1x
2x
4x
Master AF: 29
RX1 AF: 0
RX2 AF: 4
AGC Gain: 120
Drive: 100
AGC
ATT
Med
0dB
SQL: -160
2019-10-15
LOC 20:46:52
CPU% 51
SPLT
A > B
0 Beat
A < B
IF->V
A <> B
RIT 0
XIT 0
0
0
Sync
VAC1
VAC2
NR
ANF
NB
SNB
MUT
BIN
MNF
Vol
Pan
Vol
MultiRX
Swap
Panafall
AVG
Peak
CTUN
Speed: 30 WPM
Iambic
Sidetone
Show TX CW Frequency
Show CW Zero Line
APF
Tune: 0
Bandwidth: 150
RX1
Gain: 3
CW Break In
Semi Break-In
Delay (ms)
300
Pitch Freq (Hz):
600
160
80
60
40
30
20
17
15
12
10
6
LFMF
VHF+
WWV
GEN
LSB
USB
DSB
CWL
CWU
FM
AM
SAM
SPEC
DIGL
DIGU
DRM
1.0k
800
750
600
500
400
250
100
50
25
Var 1
Var 2
Width:
Shift:
Reset
Low
481
High
731

Pavel Demin @ KU Leuven

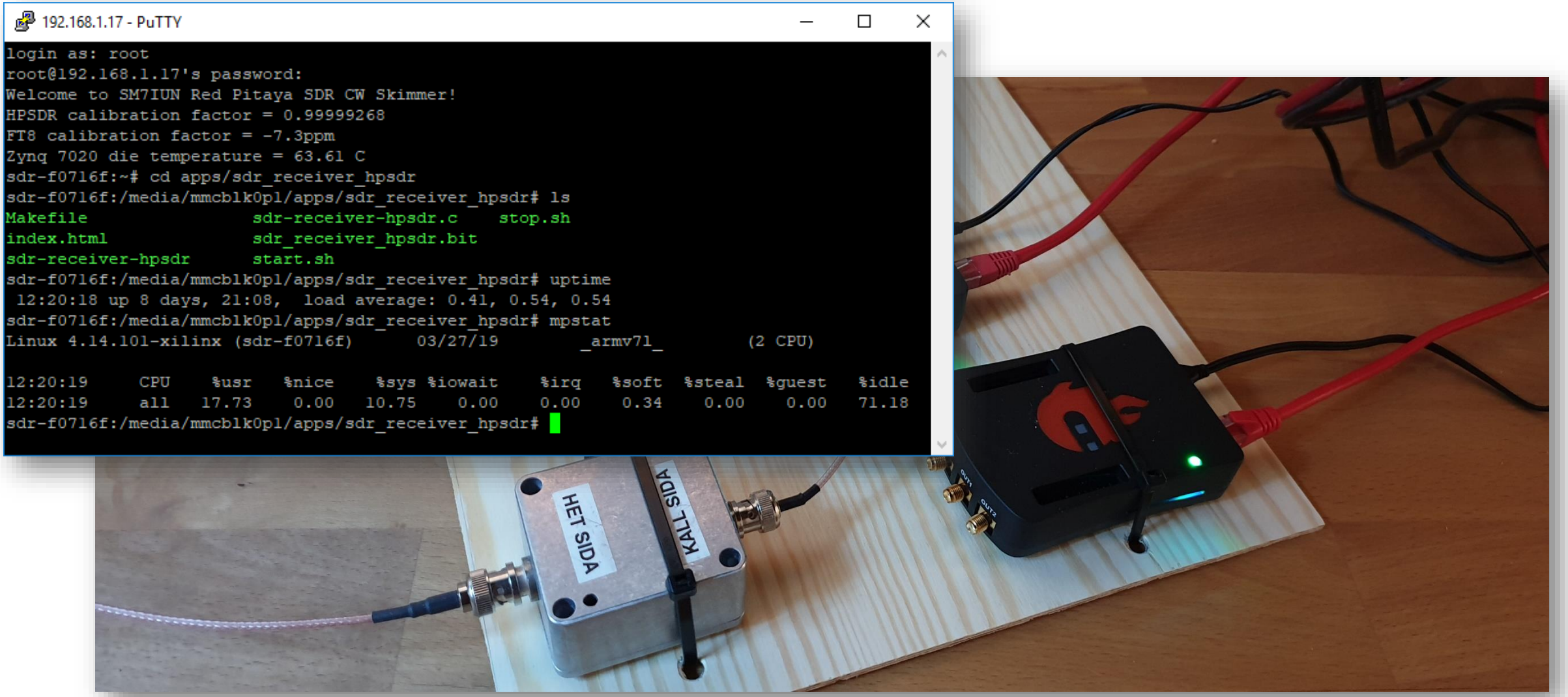




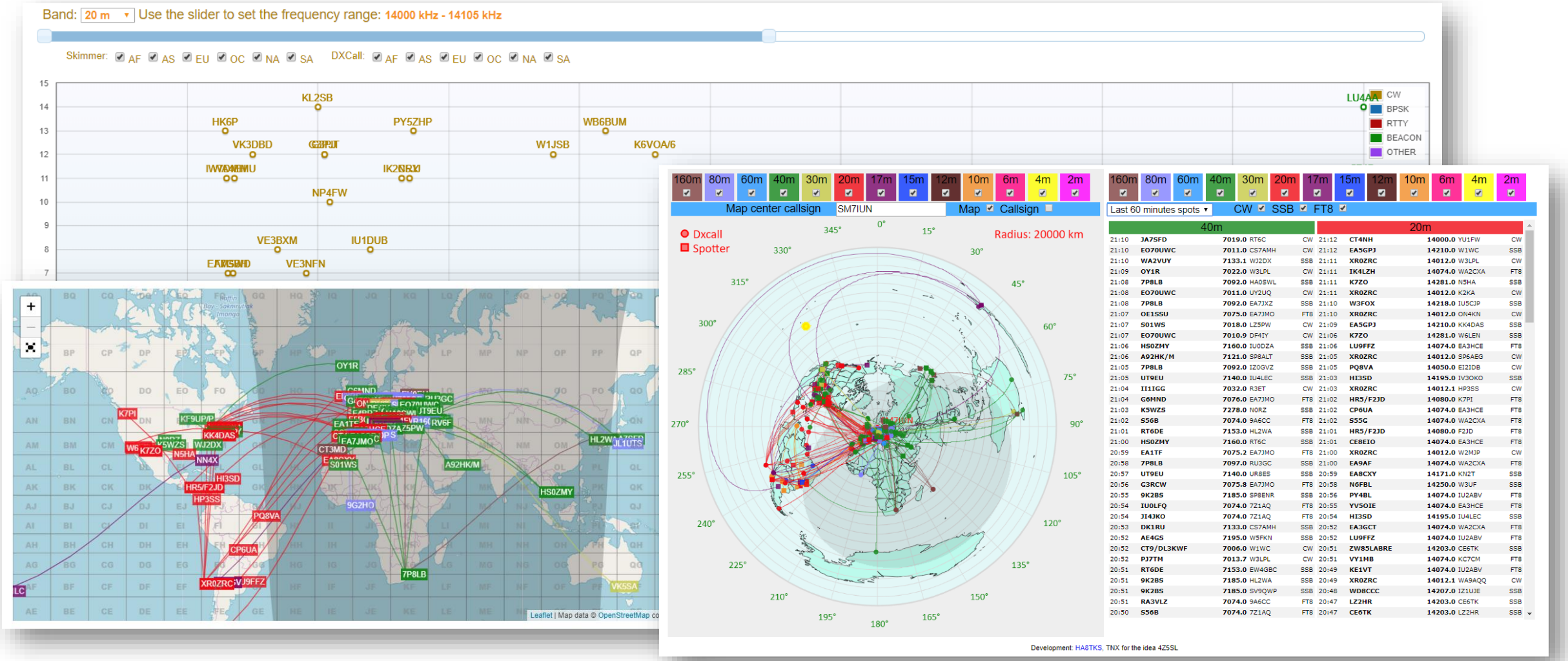
1. List of components
2. Links
3. Development machine
4. LED blinker
5. SDR receiver
6. SDR transceiver
7. SDR transceiver compatible with HPSDR
8. SDR receiver compatible with HPSDR
9. Embedded SDR transceiver
10. Wideband SDR transceiver
11. Multiband WSPR transceiver
12. Multiband FT8 transceiver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

http://pavel-demin.github.io/red-pitaya-notes/

CW and FT8 skimmers @ SM7IUN

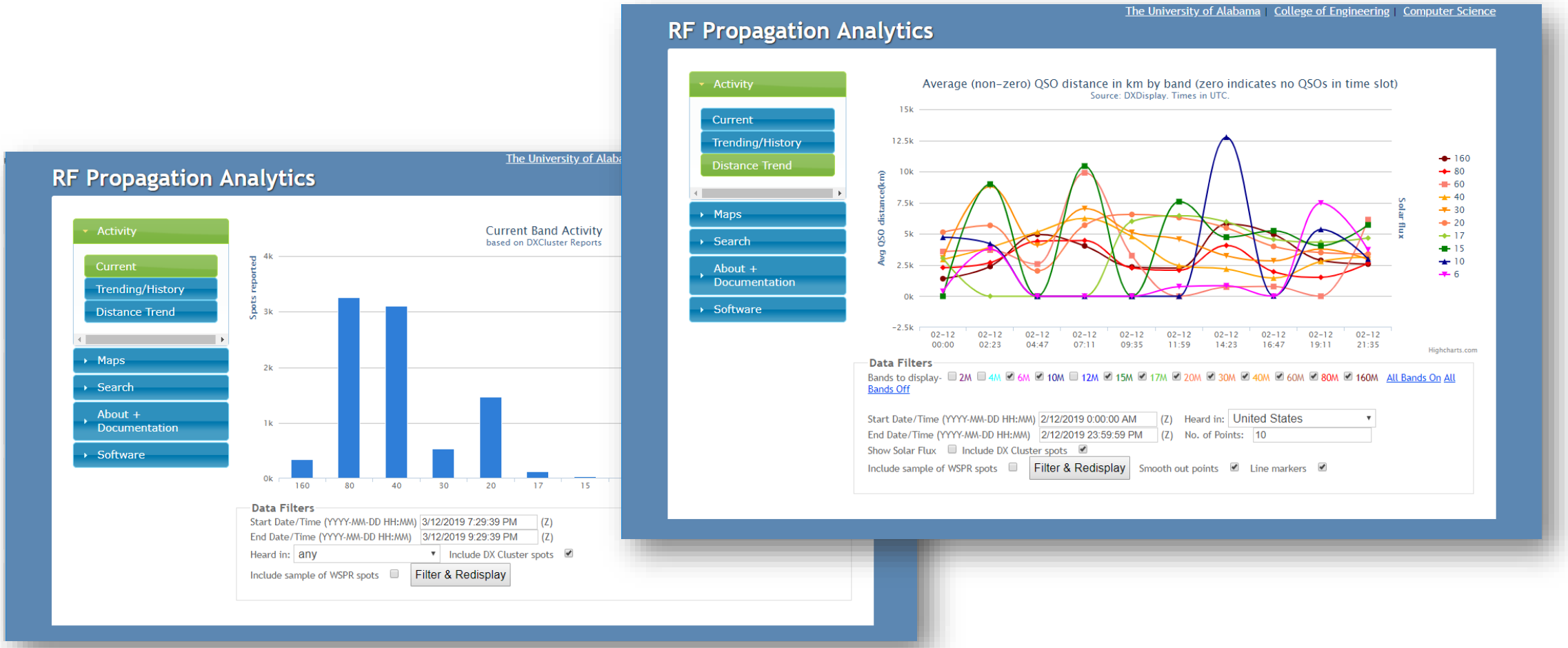


Cloud-to-cloud: HA8TKS



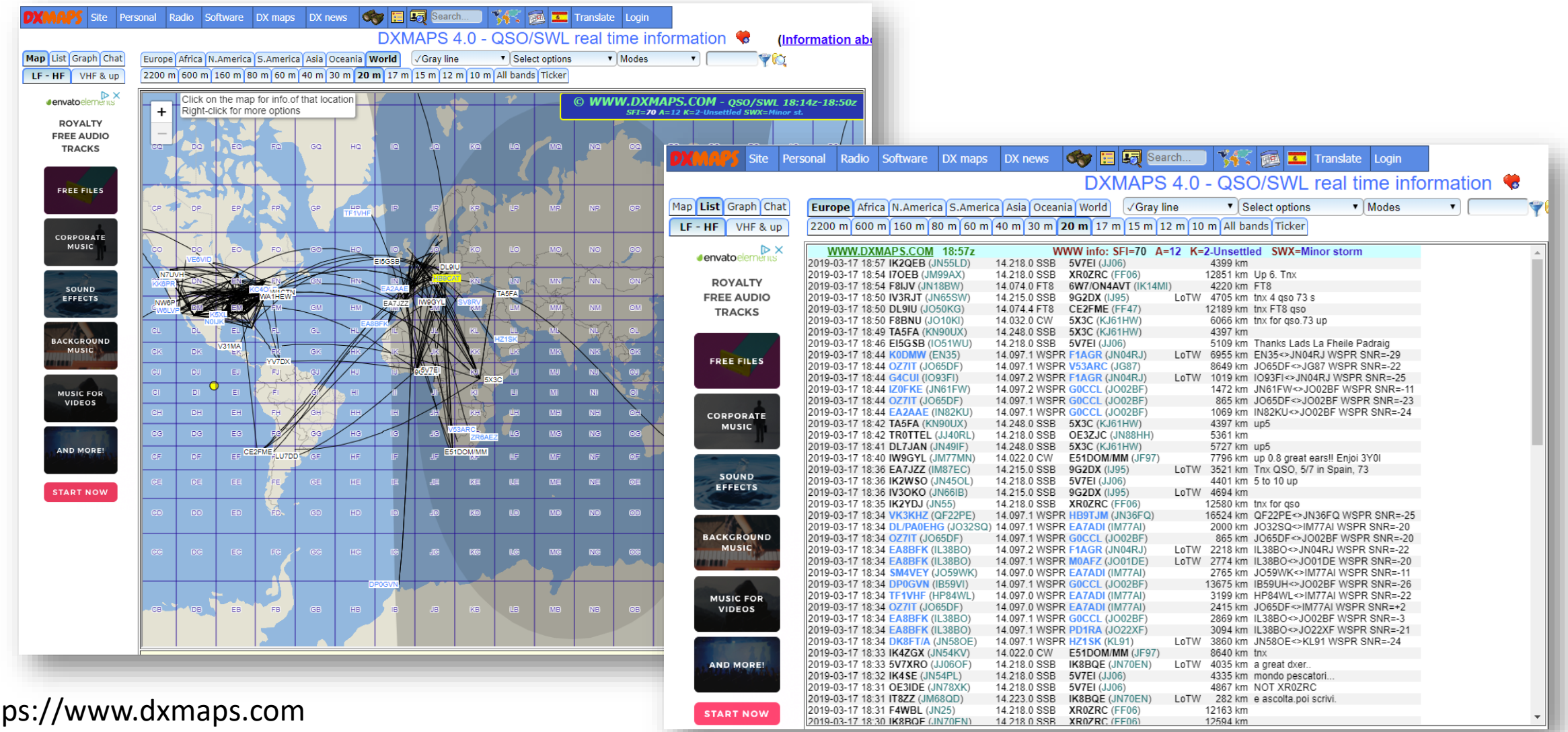
https://dxcluster.ha8tks.hu

Cloud-to-cloud: University of Alabama



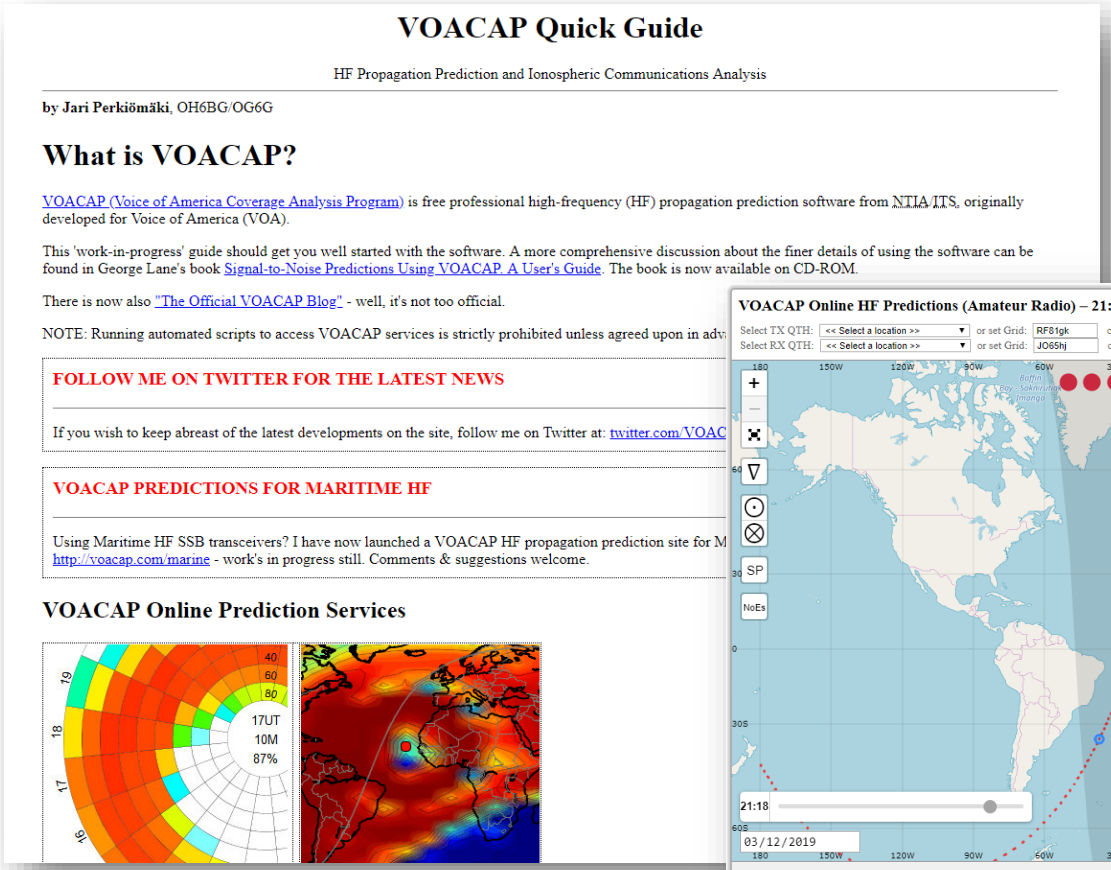
https://dxdisplay.caps.ua.edu

Cloud-to-cloud: DX maps



https://www.dxmaps.com

Cloud-to-cloud: VOACAP



VOACAP Quick Guide

HF Propagation Prediction and Ionospheric Communications Analysis

by **Jari Perkiömäki**, OH6BG/OG6G

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 adv

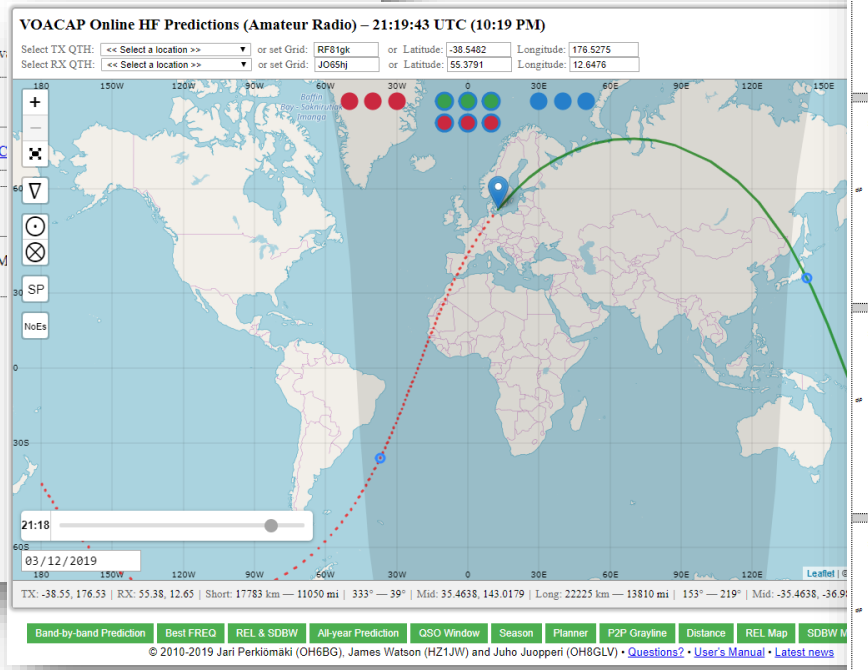
FOLLOW ME ON TWITTER FOR THE LATEST NEWS

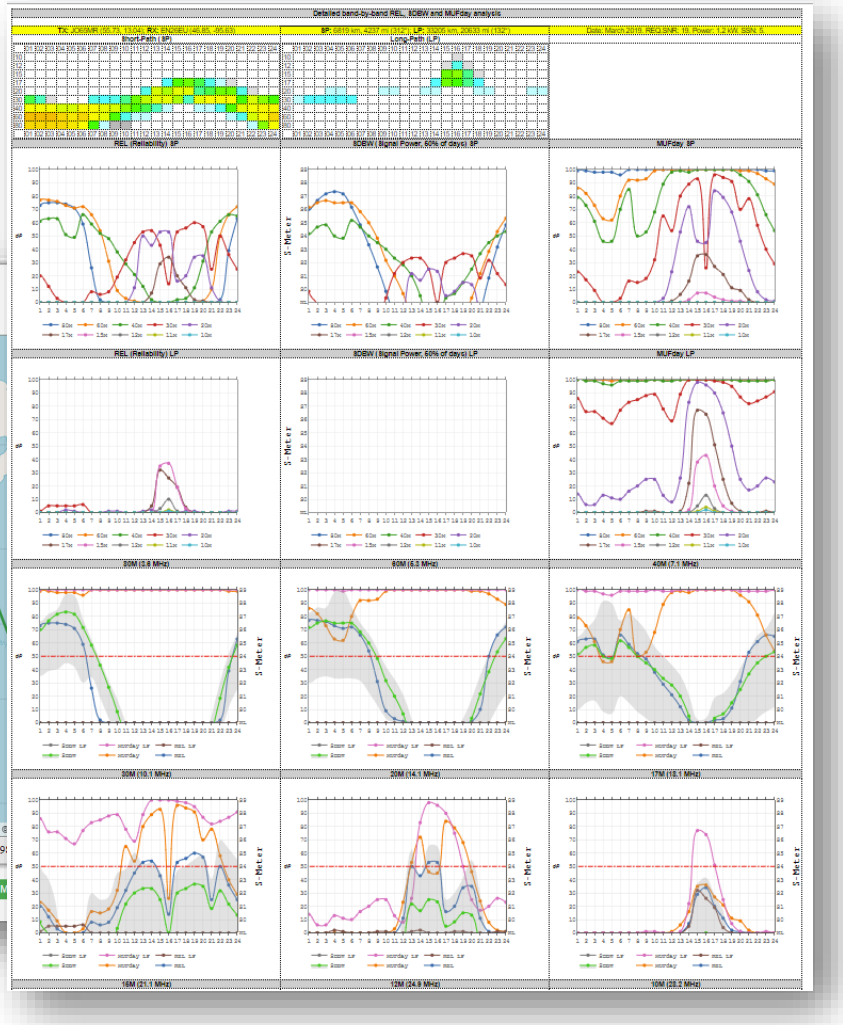
If you wish to keep abreast of the latest developments on the site, follow me on Twitter at: twitter.com/VOAC

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

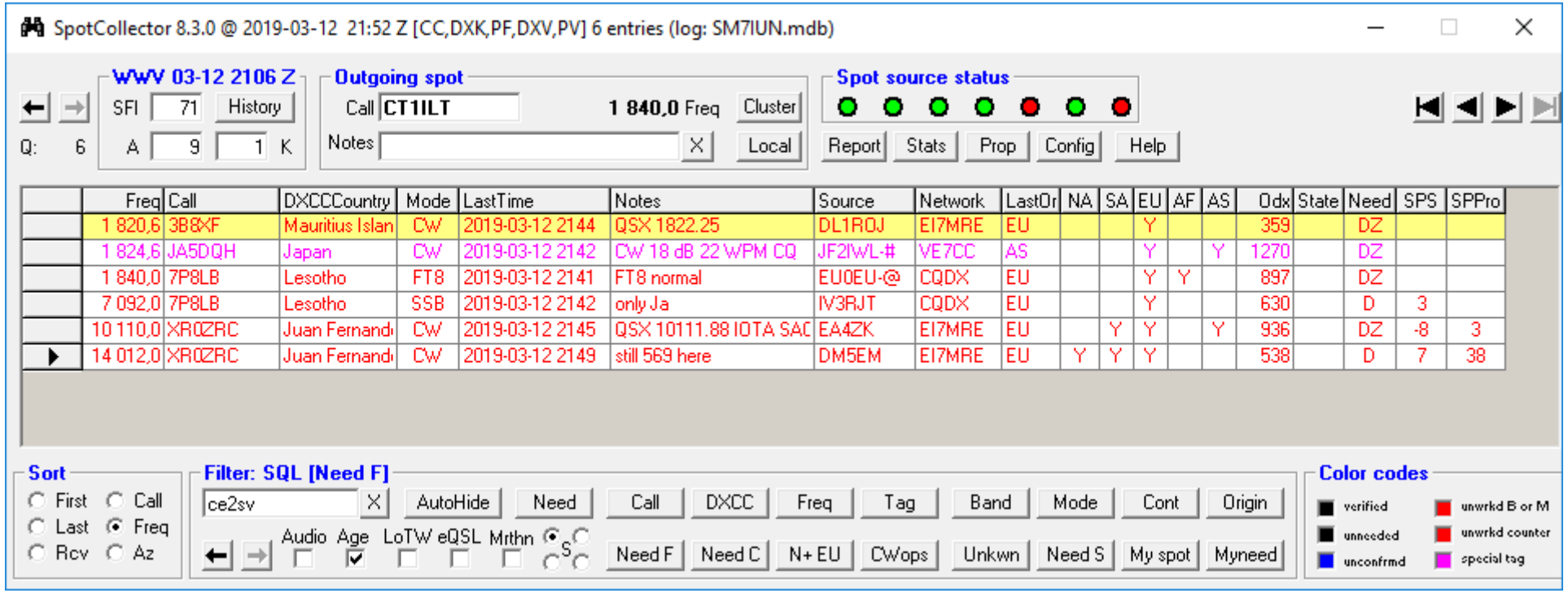




http://www.voacap.com

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.



http://www.dxlabsuite.com

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

2018 Jeep Compass

SAND
SNOW
RIVERS
ROCKS