

Beacons – Reverse Beacons

What can I hear / who can hear me?

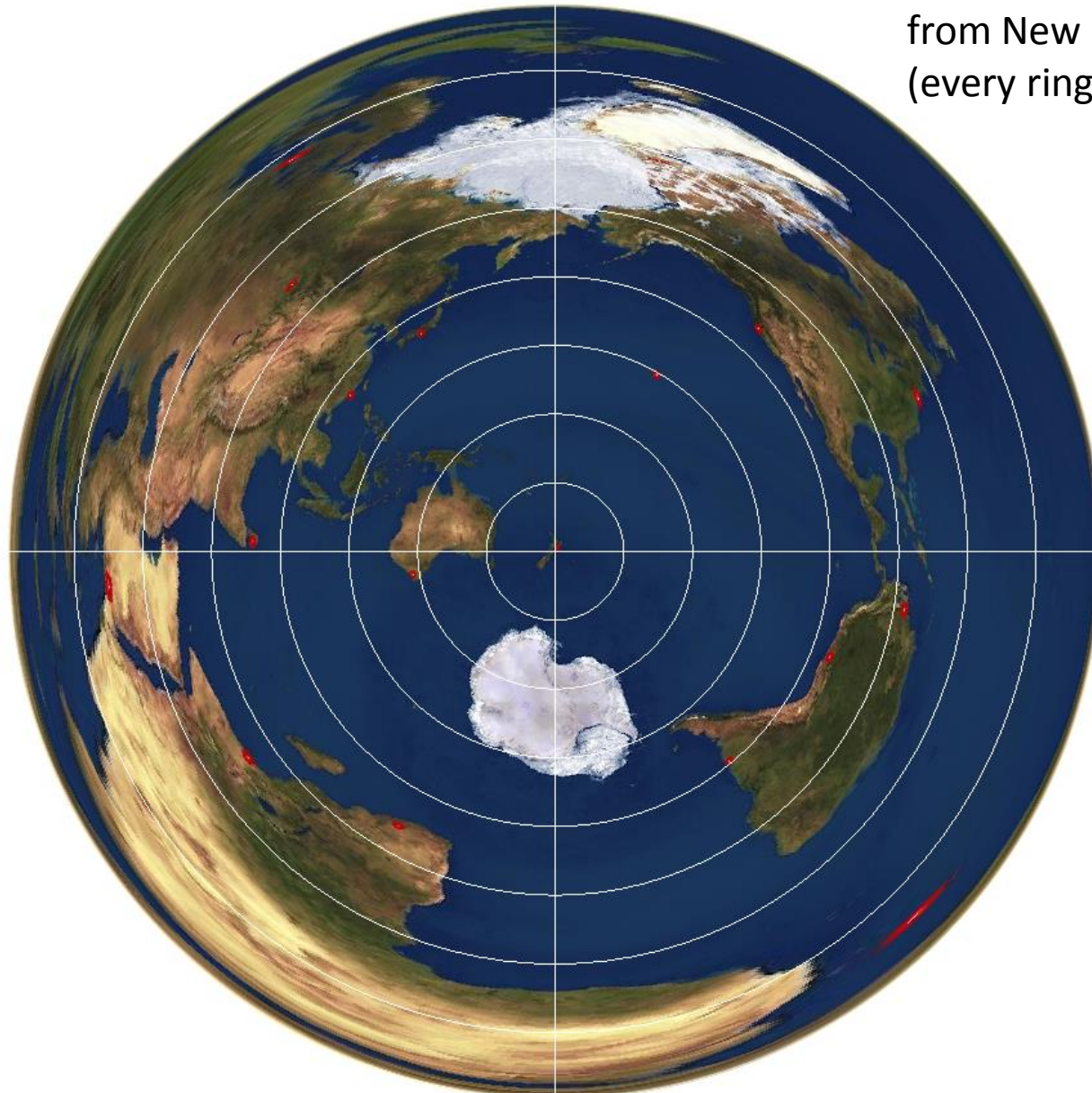
- How to test /check your radio system?

- What can I hear: tune around and see if there are any stations out there.
- Problems: nobody there (or everyone is listening only...., what power and antenna do they use, location)
- Solution: beacons, with defined powers and antennas.
- This system exists, with beacons transmitting in turn with known power into known antennas.
- But only on 20m and up, not on the lower bands.

Beacon locations of the **NCDXF/IARU International Beacon Project**
<http://www.ncdxf.org/pages/beacons.html>



Beacon locations as seen
from New Zealand
(every ring is 2500km wide)



If necessary, drag the world so the map is centered on your location.
Each ring is 2,500 km.

ZL2GVA, May 2019

- Each beacon transmits once on each band once every three minutes, 24 hours a day.
- A transmission consists of the callsign of the beacon sent in CW at 22 words per minute followed by four one-second dashes.
- The callsign and the first dash are sent at 100 watts. The remaining dashes are sent at 10 watts, 1 watt and 100 milliwatts.
- At the end of each 10 second transmission, the beacon steps to the next higher band and the next beacon in the sequence begins transmitting.

- The slot indicates the order of transmission. Each beacon transmission is staggered by 10 seconds so that no two beacons are on the same frequency at the same time.
- The beacons transmit on 5 frequencies: 14.100, 18.110, 21.150, 24.930, 28.200 MHz in a 3 minute cycle so that no two beacons transmit at the same time on the same frequency. The timing is shown on the [Beacon Transmission Schedule](http://www.ncdxf.org/beacon/index.html) page. <http://www.ncdxf.org/beacon/index.html>
- The beam heading and distance from your location to the beacons is shown on the [Beacon Azimuthal Map](#) page.

Beacon Controller Version 1



Beacon Controller 2.0



- Beacons are great, but have their limitations:
 - What if you can't listen on those frequencies
 - What if you want to know what's happening on the lower bands
 - What if you want to check your transmitter
- Ask someone to listen for your signals!
 - But, what if you haven't got any friends....
 - Or it's an awkward time of the day
 - Etc.
- Solution:

- The Reverse Beacon Network!
<http://reversebeacon.net/>
- Instead of transmitters around the globe, put receivers out there and get them to listen out for you.
- But on what frequency are they listening?
- All of them! any band, any time, any frequency (0.5 – 30 MHz)
- how does that work?

- Wide band Software Defined Receivers (SDR)
 - Internet connection to report received signals to a server
 - You transmit, then check via the server for reception reports
-
- How does the system know it's you?
 - Transmit in CW (*the simplest digital mode..*)

REVERSE BEACON NETWORK

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showing spots for DX call: ZL2GVA

search spot by callsign

rows to show: 100

de	dx	freq	cq/dx	snr	speed	time
VK4CT	 ZL2GVA	3520.0	CW CQ	24 dB	14 wpm	0748z 10 Apr
ZL4YL	 ZL2GVA	3520.0	CW CQ	14 dB	14 wpm	0748z 10 Apr
VK4CT	 ZL2GVA	7020.0	CW CQ	36 dB	14 wpm	0741z 10 Apr
VK4CT	 ZL2GVA	7023.0	CW CQ	36 dB	15 wpm	0730z 10 Apr
VK4CT	 ZL2GVA	7023.0	CW CQ	31 dB	14 wpm	0720z 10 Apr

- Great for seeing where you've been heard,
- But also to compare antennas, power levels etc.

- Filter for call signs so you can get an idea of who's out there.
- For example, show ZL stations only (ZL*):

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show/hide my last filters

showing spots for DX call: ZL*

search spot by callsign

rows to show: 15

de	dx	freq	cq/dx	snr	speed	time
ZL4YL	 ZL2GVA	3520.0	CW CQ	15 dB	15 wpm	0735z 07 May
VK4CT	 ZL1CV	3519.7	CW CQ	36 dB	14 wpm	0712z 07 May
ZL4YL	 ZL1CV	3519.7	CW CQ	22 dB	13 wpm	0712z 07 May
VK4CT	 ZL2MY	7011.0	CW CQ	25 dB	24 wpm	0627z 07 May
VE7CC	 ZL2MY	7011.0	CW CQ	14 dB	24 wpm	0625z 07 May
F6IIT	 ZL2MY	7011.1	CW CQ	15 dB	24 wpm	0623z 07 May
VK4CT	 ZL1CV	14025.0	CW CQ	25 dB	16 wpm	0617z 07 May
VK4RJ	 ZL1CV	14025.2	CW CQ	24 dB	15 wpm	0616z 07 May
ZL4YL	 ZL1CV	14025.0	CW CQ	13 dB	16 wpm	0616z 07 May
N7TR	 ZL2MY	7011.0	CW CQ	15 dB	24 wpm	0608z 07 May
DL8TG	 ZL2AP	10106.7	CW CQ	7 dB	24 wpm	0606z 07 May
G0LUJ	 ZL2AP	10106.7	CW CQ	4 dB	24 wpm	0606z 07 May
EA5WU	 ZL2AP	10106.7	CW CQ	8 dB	24 wpm	0606z 07 May
DL8LAS	 ZL2AP	10106.7	CW CQ	4 dB	25 wpm	0606z 07 May
ZL4YL	 ZL6B	14100.0	CW NCDXF	10 dB	21 wpm	0548z 07 May

ZL2GVA, May 2019

ZL2GVA, May 2019

General view of the reporting at any one time:

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What Happened to the Map?












Google changed its system and broke the website. They have also announced a big price jump on their map service, which would be prohibitive for us, so we're working on a new approach using open-source maps. It'll take a while, and in the meantime if you keep the map hidden, the other features will continue to work.

[show/hide my last filters](#)

no filter selected, showing all spots

search spot by callsign

rows to show:

de	dx	freq	cq/dx	snr	speed	time
HA1VHF	 VE3NFN	14009.7	CW CQ	14 dB	29 wpm	2119z 11 Apr
N5RZ	 VE3NFN	14009.7	CW CQ	10 dB	30 wpm	2119z 11 Apr
ON5KQ	 9A3JH/QRP	7031.4	CW CQ	22 dB	22 wpm	2119z 11 Apr
SV8RV	 RN3CT	7030.4	CW CQ [LoTW]	1 dB	24 wpm	2119z 11 Apr
VE7CC	 W9IK	7031.0	CW CQ	5 dB	21 wpm	2119z 11 Apr
HB9DQM	 9A3JH/QRP	7031.3	CW CQ	27 dB	22 wpm	2119z 11 Apr
WE9V	 VE6QX	14016.5	CW CQ [LoTW]	15 dB	20 wpm	2119z 11 Apr
W8WVV	 VE6QX	14016.5	CW CQ [LoTW]	5 dB	20 wpm	2119z 11 Apr
OE6TZE	 IK6IJF	1825.0	CW CQ [LoTW]	12 dB	21 wpm	2119z 11 Apr
KM3T	 IK5OWC	14029.0	CW CQ [LoTW]	6 dB	21 wpm	2119z 11 Apr
W3OA	 VE6QX	14016.5	CW CQ [LoTW]	11 dB	20 wpm	2119z 11 Apr

options:
[show/hide](#)

news

[RBN blog: stay tuned!](#)

we have 158 skimmers online

skimmers online:

3B8CW - 40m
9A1CIG - 160m, 80m, 40m, 30m, 20m
9V1RM - no spot last 15min
AA4VV - 40m, 20m, 15m
AC0C - 40m, 20m
AD6DM - 40m
AE4PM - no spot last 15min
BD2FW - 40m
BD2RJ - 40m
BD4WN - no spot last 15min
BG4GOV - no spot last 15min
BG4GOV3 - 40m, 30m
BG7IBS - no spot last 15min
BG8FT - no spot last 15min
BG8PA - 40m
BH4BWX - no spot last 15min
BH4RRG - no spot last 15min

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Skimmers list

[Check here for detailed skimmers list](#)

[we have 157 skimmers online now](#)

[we have had 3 new skimmers in the last 7 days](#)

[we have had 160 skimmers online in the last hour](#)

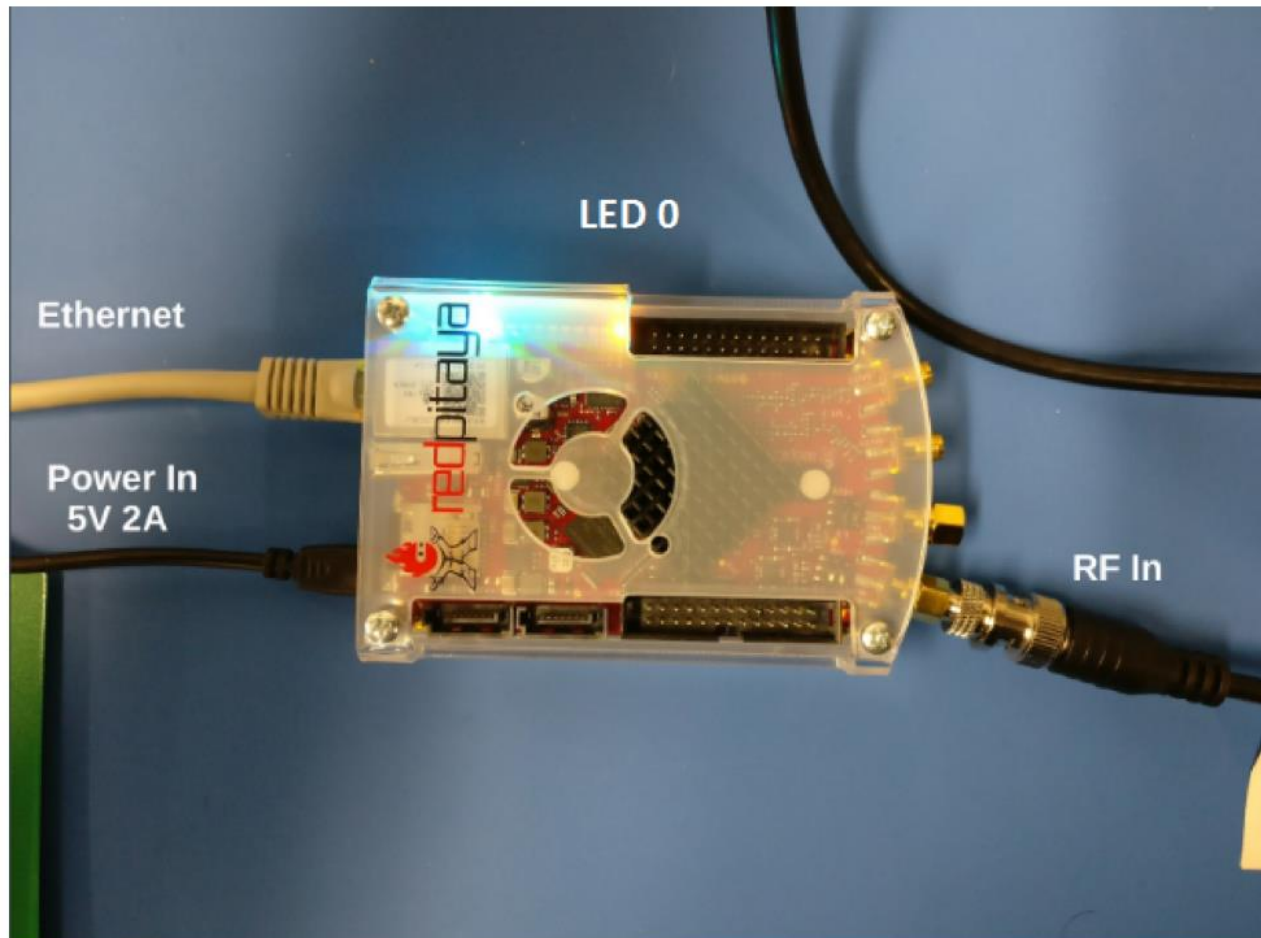
[we have had 178 skimmers online in the last 24 hours](#)

[we have had 221 skimmers online in the last 7 days](#)

[we have had 2320 skimmers online since we begin this!](#)

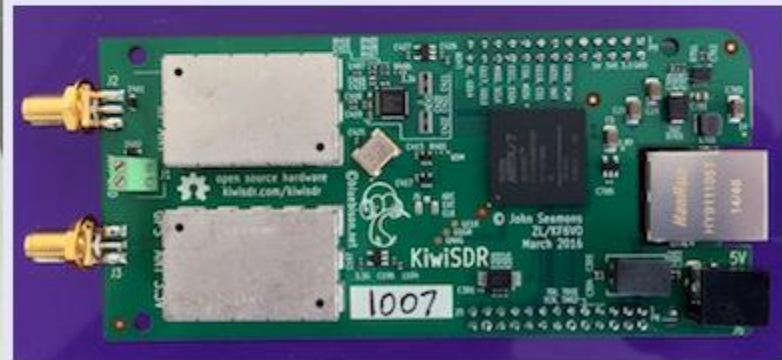
callsign	band	grid	dxcc	cont	itu	cq	first seen	last seen
K0KB		EN42PD	K	NA	7	4	116 days ago	online

RBN Receiver (Red Pitaya)



KiwiSDR

KiwiSDR: Wide-band SDR + GPS cape for the BeagleBone Black



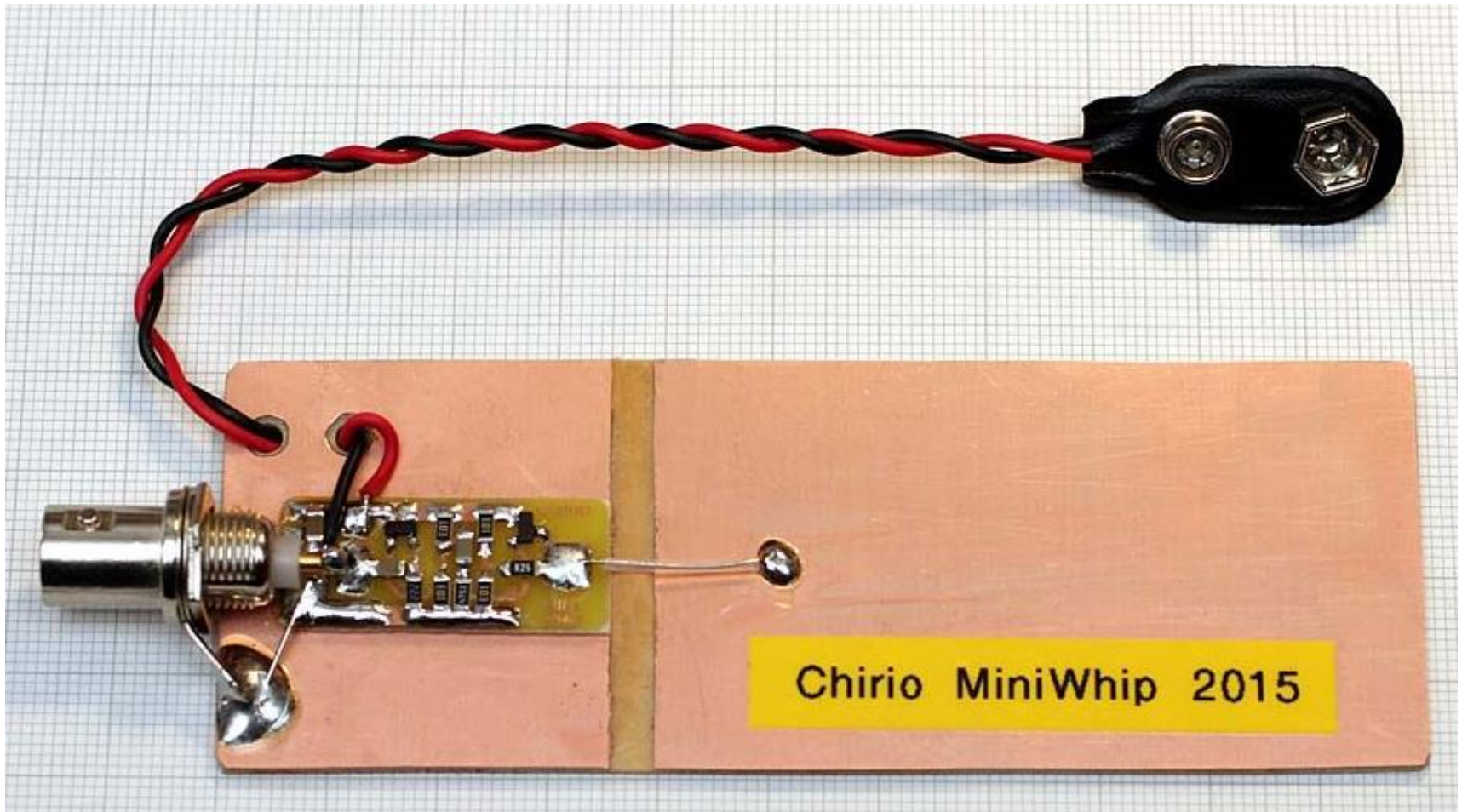
KiwiSDR Board for BeagleBone - Software-def



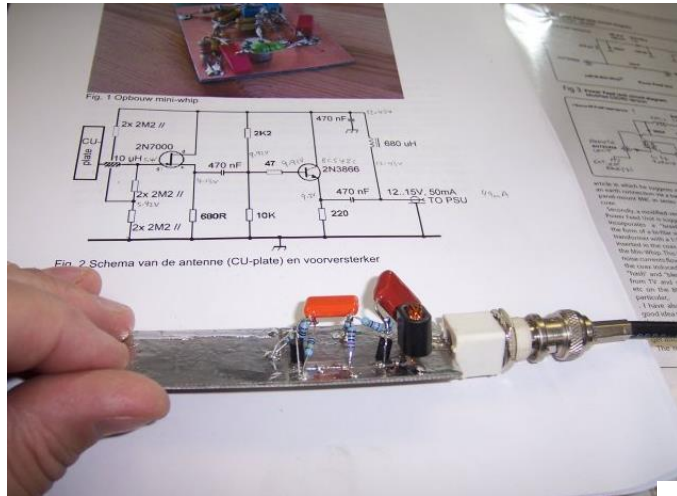
\$340.00

Inc. GST and shipping

The receivers usually use active antennas, to ensure good coverage of the bands (shown here a Mini Whip)



Active antennas are not that hard to make, can be done quite simple using standard parts.



Other uses of the reverse beacon system

- TDoA (Time Difference of Arrival)
- With accurate GPS timing you can get approximate location of transmitters.
- Intruder watch

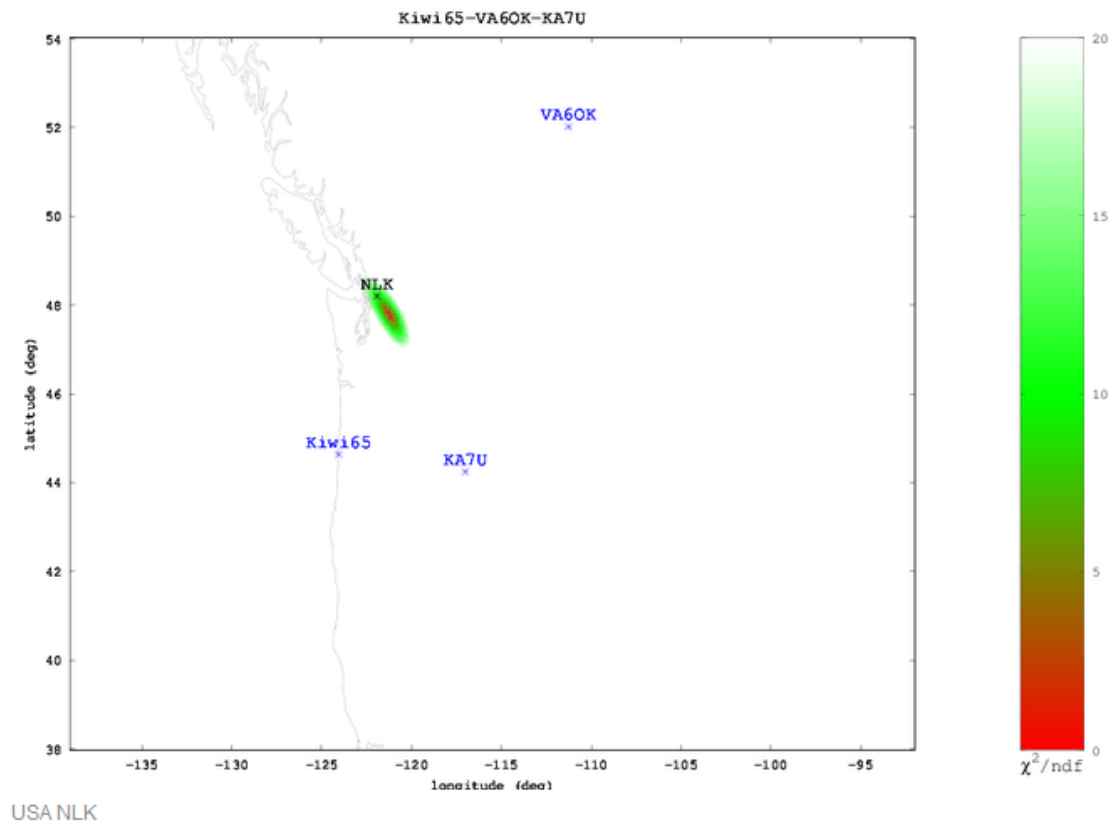
From: www.rtl-sdr.com/kiwisdr-tdoa-direction-finding-now-freely-available-for-public-use/

Results

We tested the new TDoA feature a few times. Below are some examples of the results we achieved.

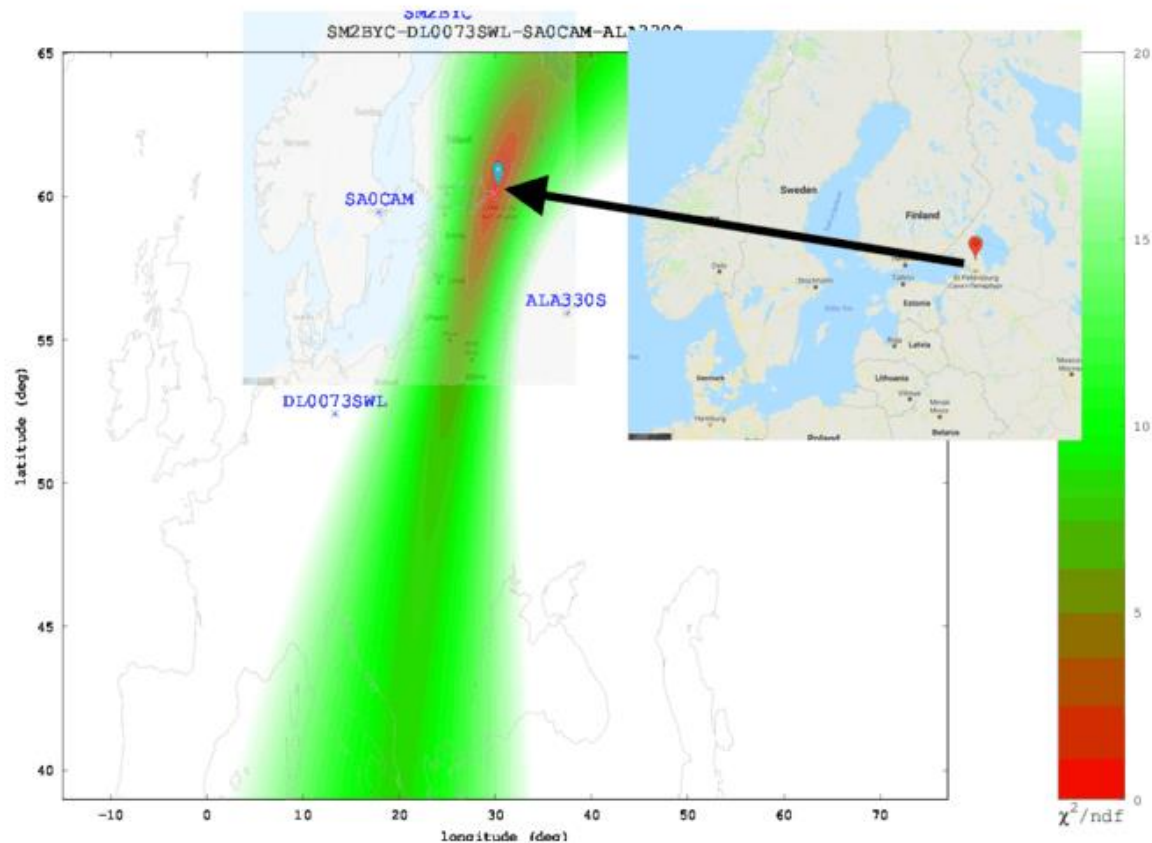
USA: NLK @ 24.6 kHz.

This is a Naval transmitter located in Seattle, Washington. With three receivers surrounding the transmitter, we were able to get a pretty close location marker, that is confirmed with the known location.



The Buzzer (UVB-76)

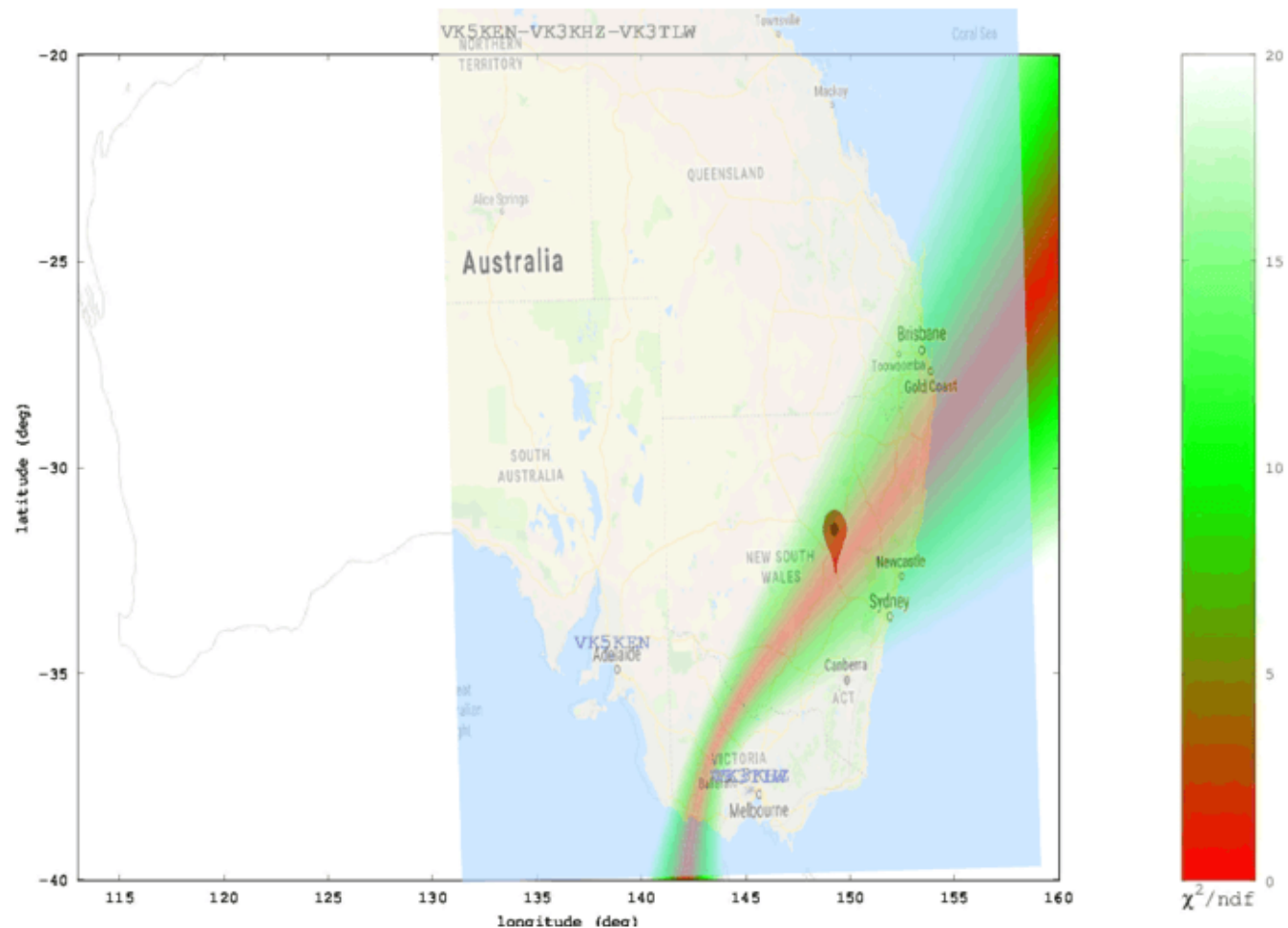
Using the just previously mentioned technique we attempted to locate the source of the Buzzer (UVB-76), a Russian numbers station at 4.625 MHz. Eventually we came to the results shown below. According to the heat map the buzzer appears to be located somewhere in the vicinity of St. Petersburg. Back in 2014 the numbers station researchers at priyom.org [received an anonymous tip](#) from a member citing a transmitter [location](#) just north of St. Petersburg. The TDoA heat map results seem to confirm that the anonymous tipper is correct.



The Buzzer (UVB-76) TDoA Heatmap compared against the known location

Australia: Local MW Radio Station @ 549 kHz.

Here we tried to locate an Australian MW station. Unfortunately in Australia there is a lack of KiwiSDRs, and of the ones that are there, only three had GPS enabled and could receive the MW station, and two of those were right next to each other. With only effectively two stations we could only obtain a line of possible locations. Comparing with the known location plotted on Google Maps we confirmed that the transmitter is indeed located on the line.



ABC Western Plains Australian MW Radio Station

ZL2GVA, May 2019

Now: live demonstration
(if at all works....)

- **A Short History of the Reverse Beacon Network**
- **(originally published in the US National Contest Journal, September-October 2012)**
- In only 6 years, the Reverse Beacon Network (RBN) has become an established part of the contesting universe. No serious assisted or multiop contest station can afford not to use RBN spots, which now are distributed via more than 100 DX cluster nodes worldwide.
- **The Beginning**
- *CW Skimmer*, software capable of decoding many CW signals at once, was released in early 2008. At the time, the author “Alex, VE3NEA” viewed it primarily as a DXing tool, permitting efficient monitoring of pileups. It’s no surprise that testers soon saw how they could use it to increase their scores, and controversy quickly erupted as to whether contest rules should permit the use of skimmers. After Alex added telnet capability, potentially permitting a local skimmer to feed spots directly to contest logging software, the debate took over the CQ-Contest reflector. Was this “assistance,” like the DX cluster? Should its use be permitted at all?
- Meanwhile, the idea of a Reverse Beacon Network arose out of an e-mail exchange in March 2008 between PY1NB and me. Felipe had been running a unique DX Web site, **DXWatch.com**, for several years. It offered DX spot filtering tools and mapped spotted contacts on a world map. I had been working with VE3NEA since late 2007 to test, develop and refine *CW Skimmer*. Felipe saw a way in which the basic framework of DXWatch could be adapted to display skimmer spots.
- Also in March 2008, Felipe wrote the first aggregator software, intended to receive spots from skimmers telnet servers and transmit them to the Web site for display. The Web site was initially the *only* way to view skimmer spots, and at first we thought of it primarily as a tool for viewing and studying propagation. We began recruiting testers and DXers to act as reverse beacons in late March, and the RBN was born.
- Through the spring and summer of 2008, controversy raged in the contesting community over whether non-assisted single operators should be allowed to take advantage of this new technology. Just in time for the fall contest season, opinion coalesced around putting *CW Skimmer* and the RBN in the same category as traditional DX cluster spots, limiting their use in contests to the assisted and multiop categories.
- For the remainder of 2008 and through 2009, the RBN focused on developing its network of stations distributed around the globe. Nick, F5VIH/SV3SJ, joined the RBN team in 2010. His computer science background was a great asset, and in March, he rolled out the *Signal Analysis Tool*, a way to graphically compare signals of multiple stations on multiple bands, as heard by a single skimmer anywhere in the world.
- **Growth Spurt**
- A couple of key hardware and software developments added momentum to the RBN’s development. The SDR-IQ receiver offered by RFSpace (www.rfspace.com), especially when used with W3OA’s *SkimScan* software, made multiband spotting with a single receiver possible for the first time. Then, Phil, N8VB, released the QS1R software-defined receiver, with a large field-programmable gate array. In summer 2009, VE3NEA released *Skimmer Server*, software that could simultaneously decode a swath of up to 192 kHz on up to seven bands, using the QS1R. It was, and remains, a programming *tour de force*.
- As more and more of these receivers made their way into the field, the number of RBN stations continued to grow, and because of these developments, the number of spots received grew almost exponentially. By spring 2010, the RBN was feeling serious growing pains. During the ARRL International DX CW that February, the database server was unable to handle the sheer volume of spots, and it crashed repeatedly.
- **Adding Telnet**
- At about the same time “neither memories nor records are quite clear” it occurred to us that it might be beneficial to provide RBN-derived DX spots to the worldwide contest and DX community through a telnet server, using DX cluster software. Initially, we were very concerned that the large volume of RBN spots would “leak” inadvertently into the traditional DX cluster network, provoking a worldwide backlash, but we decided that, if worst came to worst, we could always shut down the server.
- The potential benefit of providing spots in a format usable by any contest logging software was just too tempting not to try it, so Nick wrote software to link the RBN’s database server with a Telnet server. In April 2010 the RBN Telnet node debuted, on a server provided by Rick, K4TD. Almost immediately, it proved very popular, to the point where the server quickly reached full capacity. During the 2010 ARRL November Sweepstakes CW, it collapsed under the load, and many spots were never forwarded.
- This would not do. As a stopgap, we added a second temporary server, using *AR Cluster* software and running on a laptop in my shack. In November 2010, just in time for the CW World Wide CW, Dave, KM3T, joined the RBN team, and George, K5TR, contributed an additional server. Nick made important changes to the server and database infrastructure, and Dave, Nick and Felipe worked hard to ensure that the RBN servers would not fail during the contest. They succeeded, and in 48 hours the telnet servers delivered more than 1.7 million spots from 60 to 70 skimmers, without serious incident.
- What really saved our bacon, though, was the decision by DX cluster software developers to support “skimmer” and “non-skimmer” modes, so RBN spots could be distributed by many cluster nodes, rather than directly from the RBN. In September 2010, VE7CC and VE1DX began distributing RBN spots through their cluster servers. Shortly after that, *AR Cluster* version 6 was released in *beta* with similar provisions and an advanced filtering scheme. In March 2011, a telnet server using *AR Cluster* version 6, donated by Jamie, W2QO, was added to the RBN’s facilities, spreading the load and allowing for easy distribution of skimmer spots to *AR Cluster* version 6 clusters worldwide.
- **Today**
- In September 2011, Dick, W3OA, joined the team and produced the first Windows aggregator. The *beta* was a big success, and in succeeding months he delivered increasingly sophisticated versions of the software, which is now in release 2.6, with 3.0 currently in beta. The RBN delivered close to 100 million spots in 2013. Another omen “the number of Skimmers online with the RBN on a typical non-contest weekday rarely dips below 100, and something over 150 different Skimmers were on the network during CQWW CW. .
- **What’s Next?**
- As far as hardware is concerned, we’re in a period of watchful waiting. At some point the database server will max out. This probably will make it necessary to separate it from the Web server, but we seem to have a little way to go yet.
- After CQWW 2013, we replaced the original DXSpider Telnet server with another instance of ARCluster V6, because the older, single-threaded software is no longer capable of handling the volume. Felipe is working on a new GUI for the website, to permit more flexible searching and better performance in general.
- While the total number of skimmers is growing satisfactorily, we continue to need more coverage in some areas. 2013 saw Chinese amateurs put three new nodes on the air, including one in Urumchi, close to the most remote spot on earth.
- Also, in 2013, the Yasme Foundation graciously funded the establishment of a full-capability node in Bangalore, India. We are currently working with IARU Region 1 to secure one or more additional nodes in equatorial Africa. There is no shortage of things to do.
- **Lessons Learned**
- Probably the most important lesson we all learned is that technological breakthroughs can have entirely unexpected consequences, but that, in the end, the genie cannot be put back in the bottle. Nobody knew that Alex’s *CW Skimmer* would have such an impact. My e-mail exchanges with him at that time make interesting reading, if only to demonstrate how little we understood where the technology would take us. Each advance in the use of *CW Skimmer* and the RBN has been due to the willingness of all those involved to “go with the flow.”