PSKReporter Then & Now

Philip Gladstone -- N1DQ

17 October 2024

History

Feb 2007, FCC dropped morse requirements.

Mar 2007, I passed general/extra and got N1DQ, a IC-706-MkII-G and a stack of QSL cards

PSK31 was the hotness of the day (DM780 & HRD). Few people would return my CQ! But why?

Jan 2008 first version of pskreporter running in my basement.

Motivation

Few people would return my PSK31 CQ

Unsure about antenna (a long wire)

How far does my signal get?

Is this a common problem?

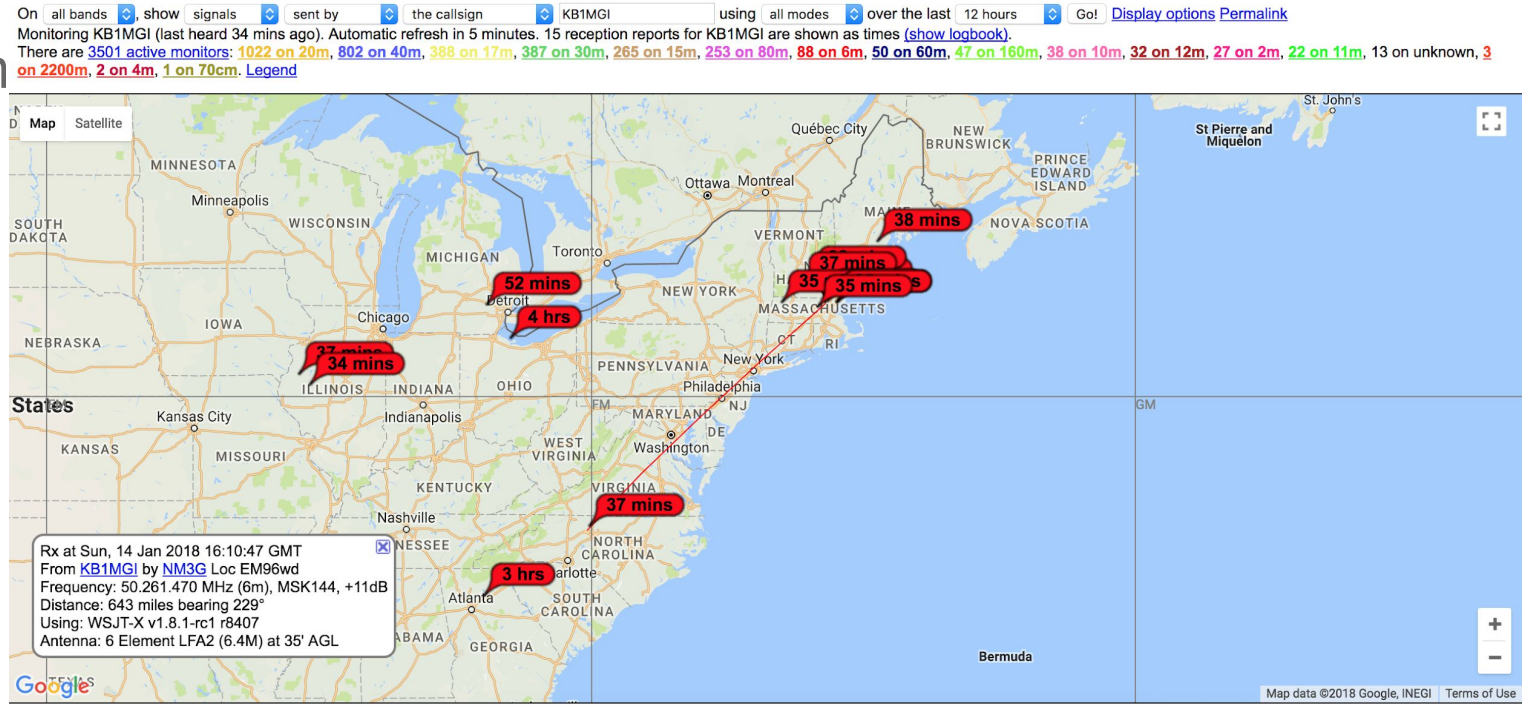
Can I build some software?

What protocol should I use?

What is pskreporter?

A way to see where your transmissions are being heard.

An



Evolution

Picked IPFIX (RFC5101 -- now RFC7011). Netflow version 10.

FIrst version intercepted windows messages sent internal to DM780. A few people ran it.

I produced a Windows DLL to handle everything.

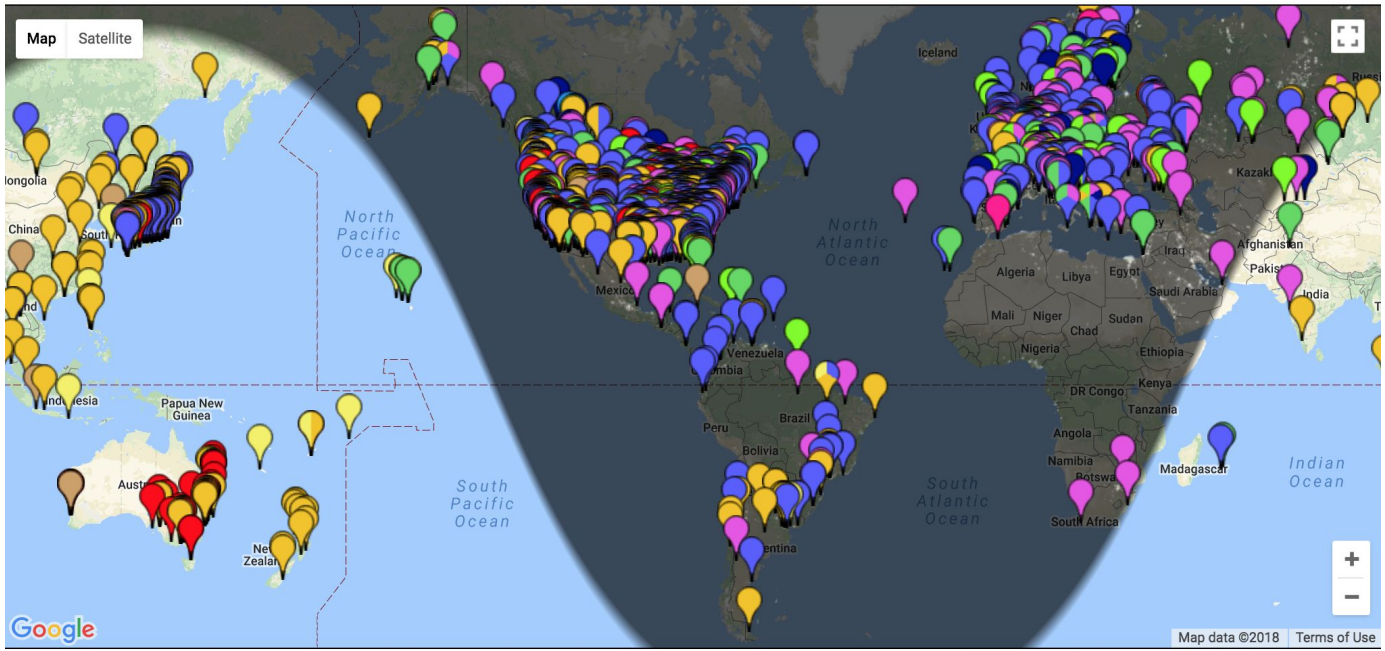
HB9DRV (Simon Brown – DM780 author) integrated it

Traffic started to grow and it became useful.

FIdigi implemented the protocol

A quiet evening in the early days

On all bands, show signals sent/rcvd by the callsign using all modes over the last 12 hours Go! Display options
Automatic refresh in 3 minutes. Large markers are monitors.
There are 2203 active monitors: 843 on 40m, 423 on 20m, 332 on 80m, 149 on 30m, 146 on 160m, 106 on 6m, 78 on 17m, 35 on 60m, 23 on 600m, 18 on 15m, 10 on 10m, 7 on 2m, 4 on unknown, 4 on 2200m, 3 on 12m. Legend



System statistics. Comments, problems etc to Philip Gladstone. Online discussion of problems/issues. Reception records: 2,3 2,075 0:

PSKREPORTER.INFO

Why do people contribute?

To get a good position on the leaderboard

They turned it on once, and forgot about it

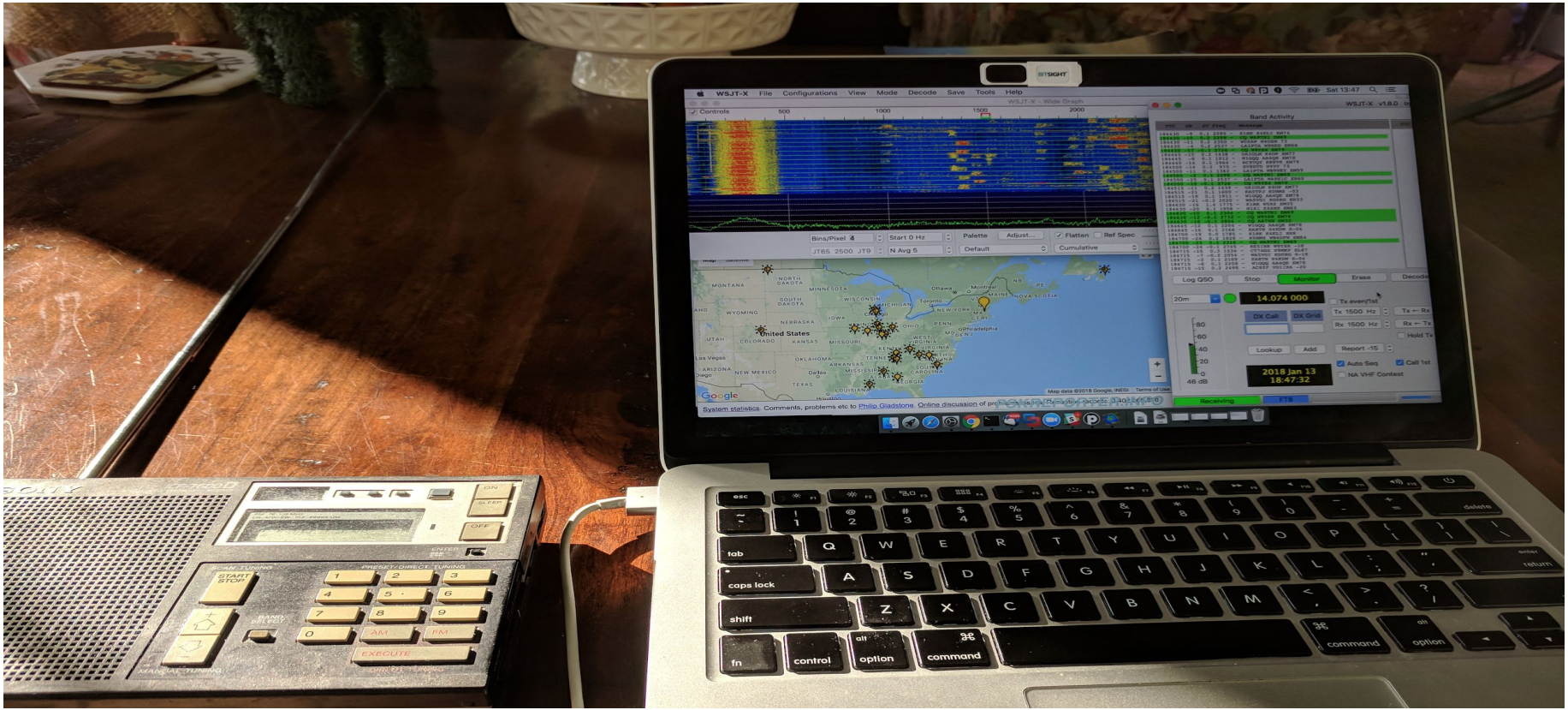
To be a good citizen

????

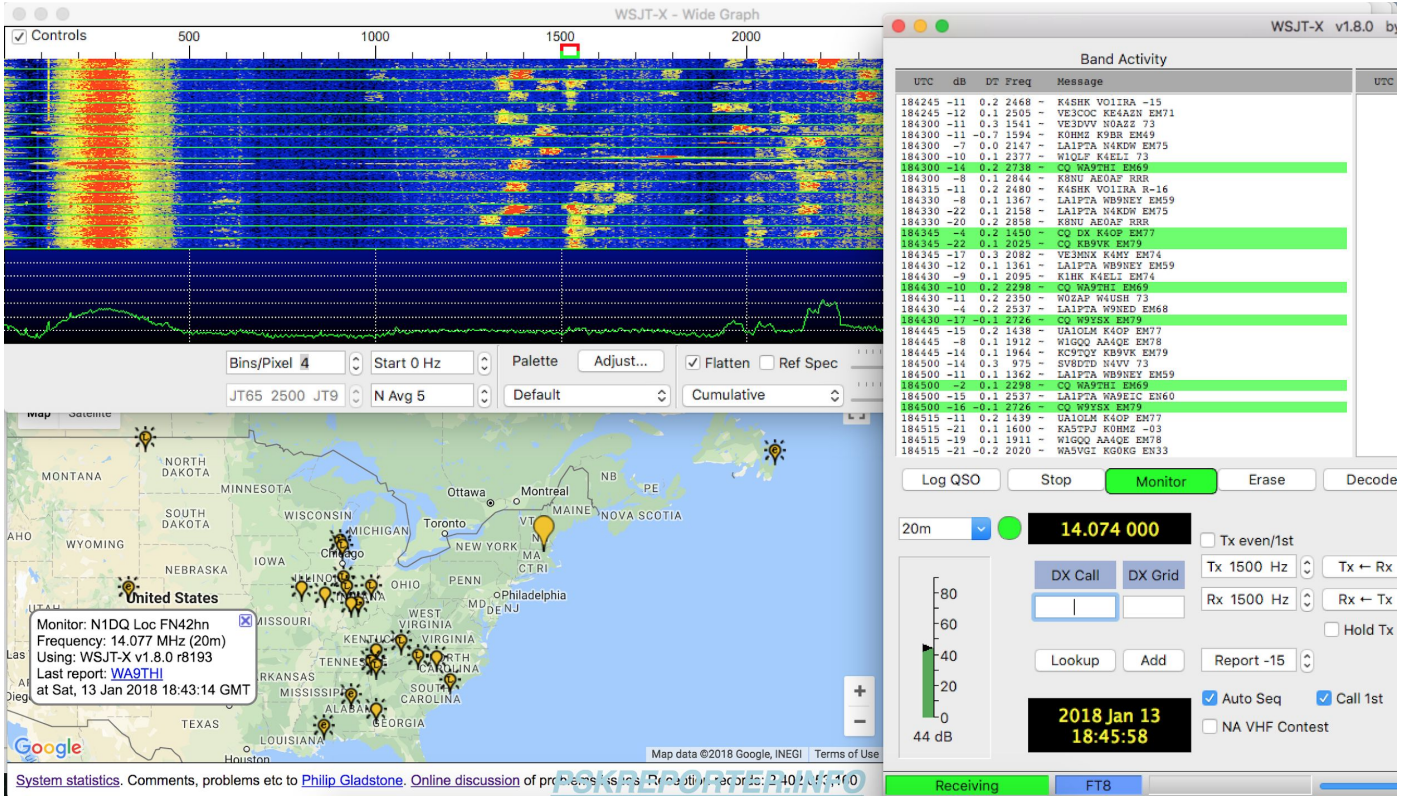
How to get started?

- Do you want to monitor only or exchange messages as well?
- Do you want to try for a leaderboard position?
- How much do you want to spend?
- What do you have already?

Simplest setup - no wires!

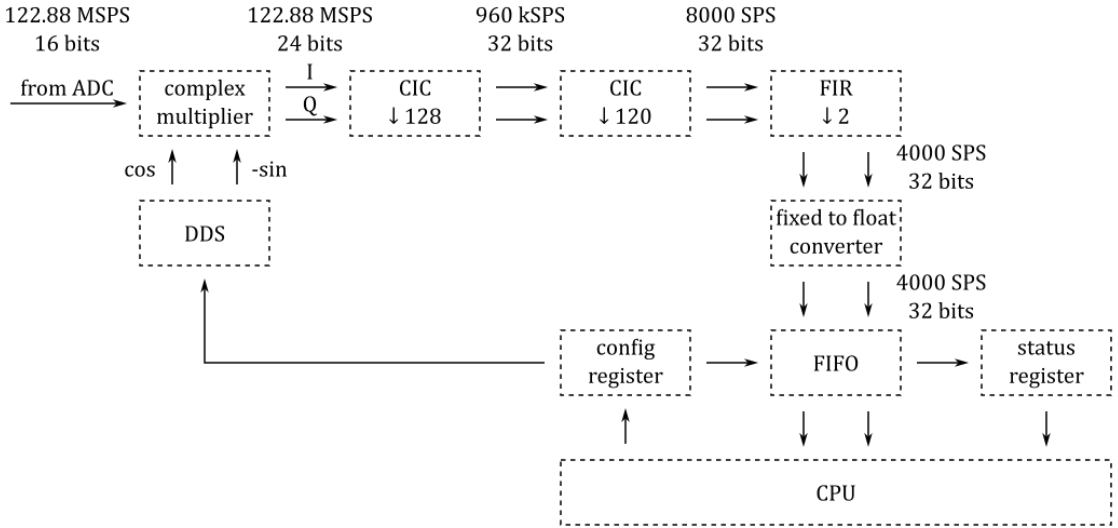


Laptop closeup



Using Red Pitaya STEMLab/SDRLab

- Red Pitaya SDRLab 122-16 is a 122Msps 16bit sampling receiver
- Red Pitaya STEMLab 125-14 is a 125Msps 14bit sampling receiver
- Have large FPGAs with dual core embedded processor
- https://pavel-demin.github.io/red-pitaya-notes/sdr-transceiver-ft8-122-88/
- 16 copies of



My Red Pitaya Setup

Using Rx888 MkII + KA9Q-Radio

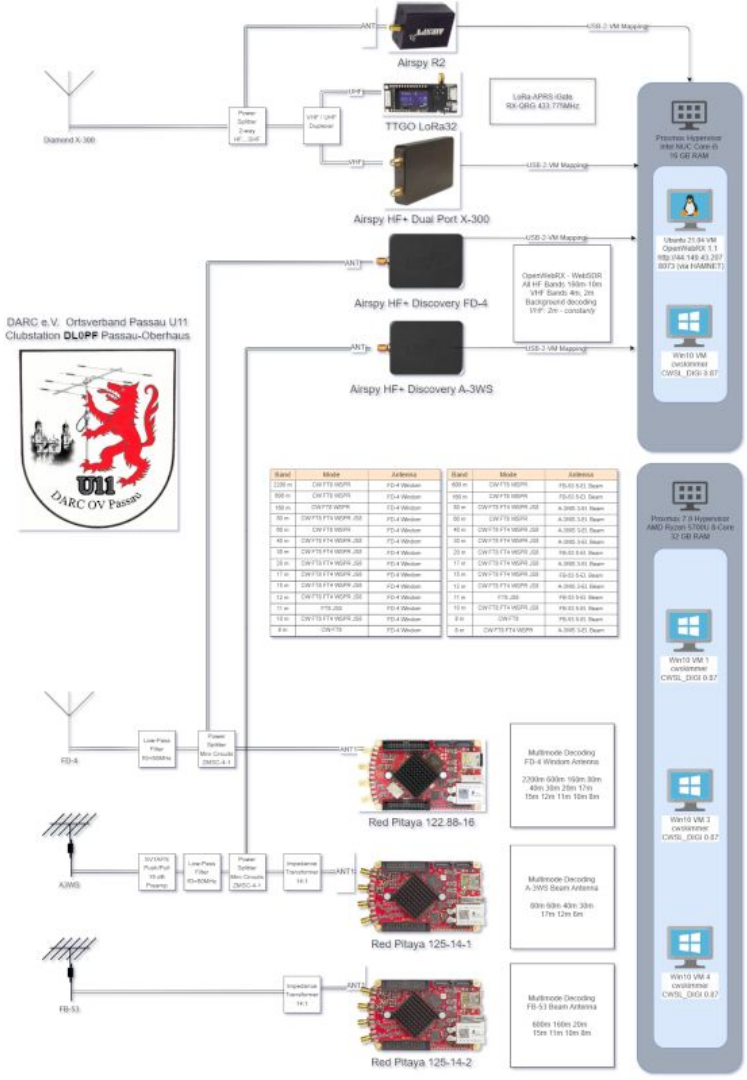
- Rx888 MkII is a 16 bit 128Msps direct sampling receiver (at HF). USB3 connected. Typically run at 64Msps (thermal issues)
  - Some mods recommended to improve thermal performance
- X86 box (e.g. Beelink mini PC)
- Can install KA9Q-Radio on PC
- Can install wsprdaemon by Rob Robinett (AI6VN)
  - Reports FT4 and FT8 on all bands to PSKReporter
  - Reports WSPR on all bands to WSPRNet
  - Runs on top of KA9Q-Radio

My Rx888 Setup

Big Monitors

DL0PF

Write up at http://wireless-access.de/

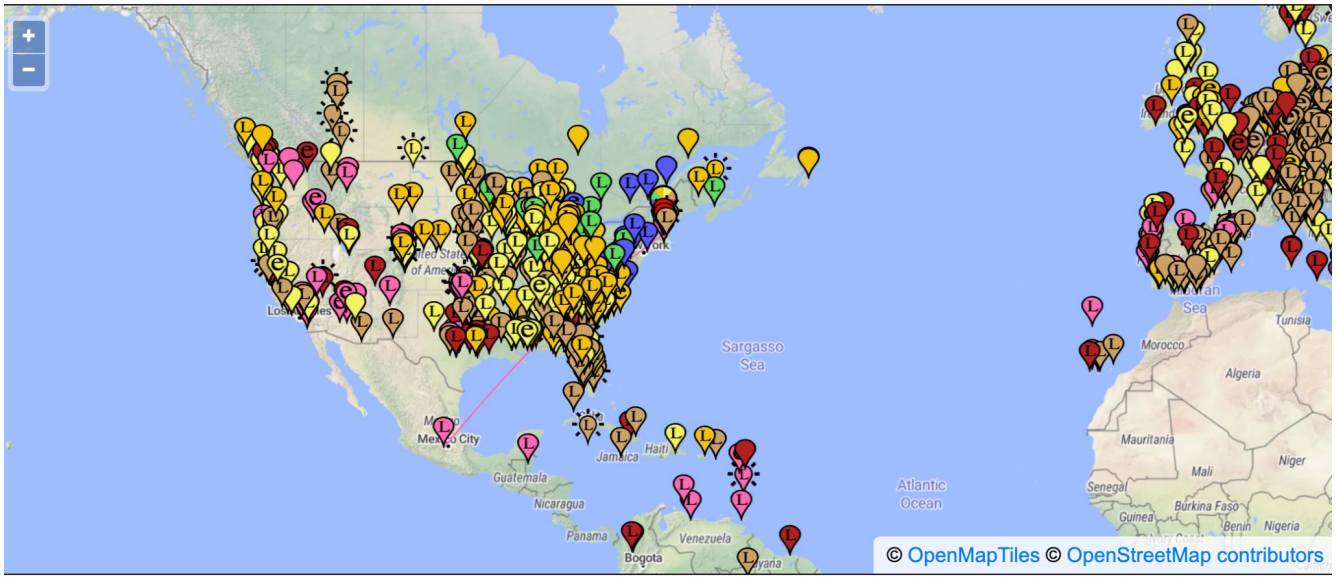


Web Interface

On all bands, show signals sent/rcvd by the callsign n1dq using all modes over the last 3 hours Go! Display options Permalink

Monitoring N1DQ (last report 4 mins ago). Automatic refresh in 5 minutes. Small markers are the 943 transmitters (show logbook) heard (distance chart) at N1DQ (21774 reports, 129 countries last 24 hours; 134466 reports, 140 countries last week).

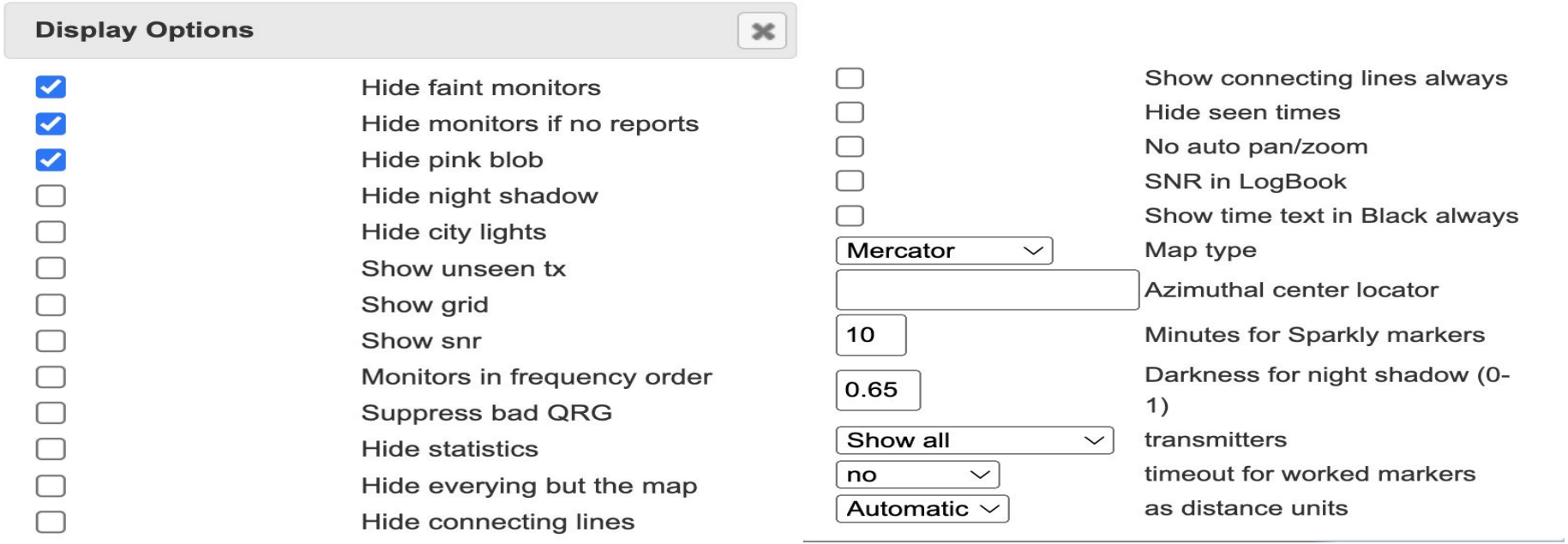
There are 7111 active monitors: 2051 on 20m, 1359 on 10m, 1339 on 15m, 879 on 17m, 800 on 12m, 686 on 30m, 584 on 40m, 476 on 6m, 457 on 2m, 70 on 80m, 50 on 11m, 39 on unknown, 26 on 60m, 23 on 2.4Ghz, 23 on 160m, 20 on 70cm, 11 on 10Ghz, 9 on invalid, 7 on 2200m, 4 on 4m, 3 on 8m, 1 on 600m. Legend



Statistics — Comments to Philip Gladstone — Online discussions — Reception records: 48,9[illegible] — Hosting by Fast Serv Networks, LLC

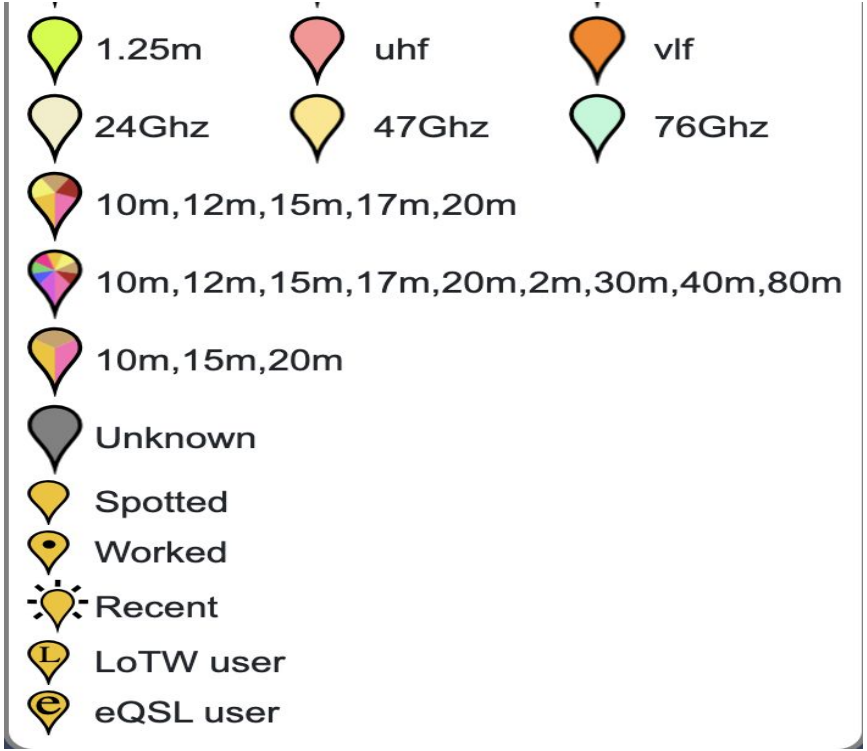
Display Options

Your selected options are saved in the browser

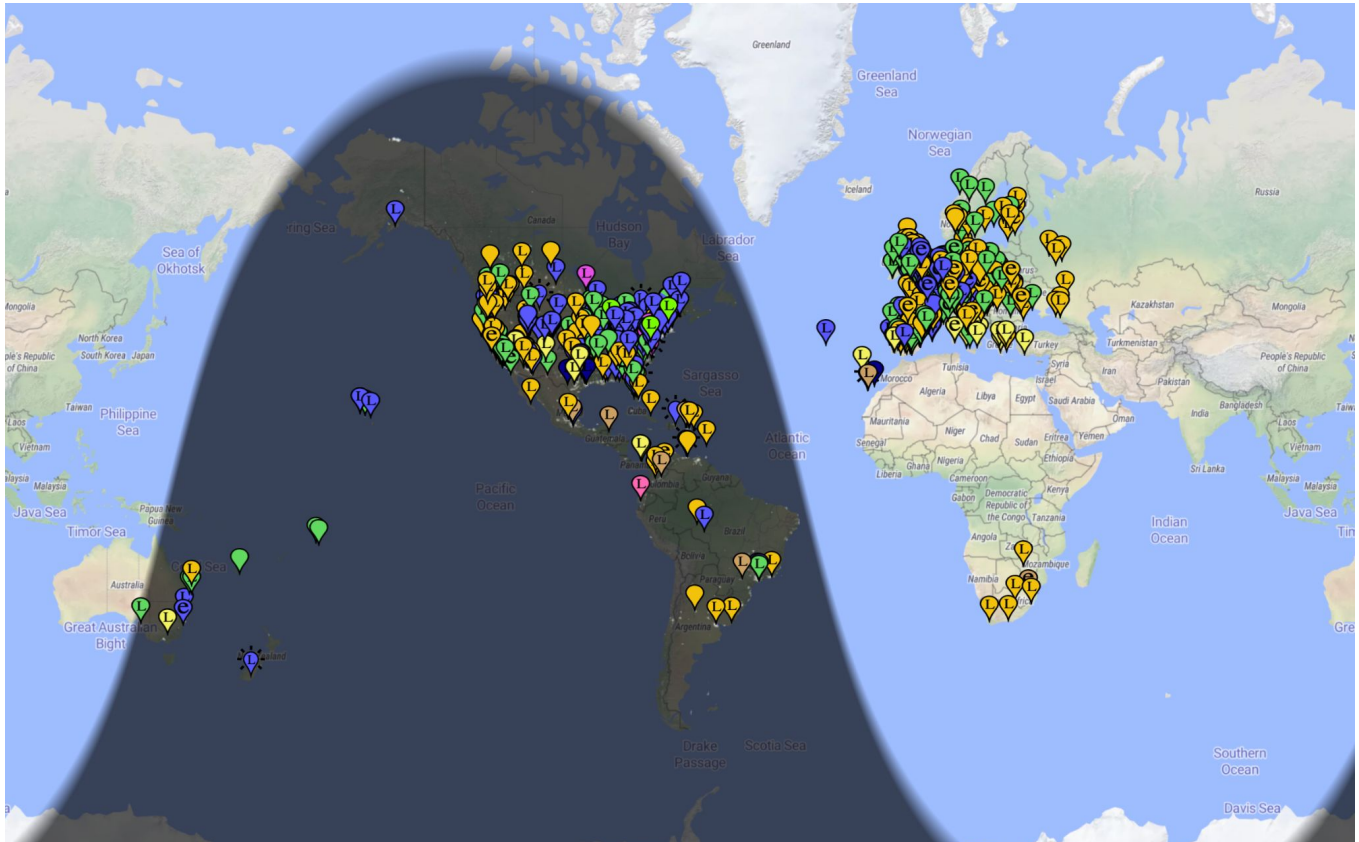


Band Colors


Click icon to change color (Reset)
15m
10m
17m
20m
2m
30m
12m
6m
40m
11m
4m
80m
70cm
2.4Ghz
160m
10Ghz
23cm
invalid
600m
60m
2200m
4000m
8m
5m

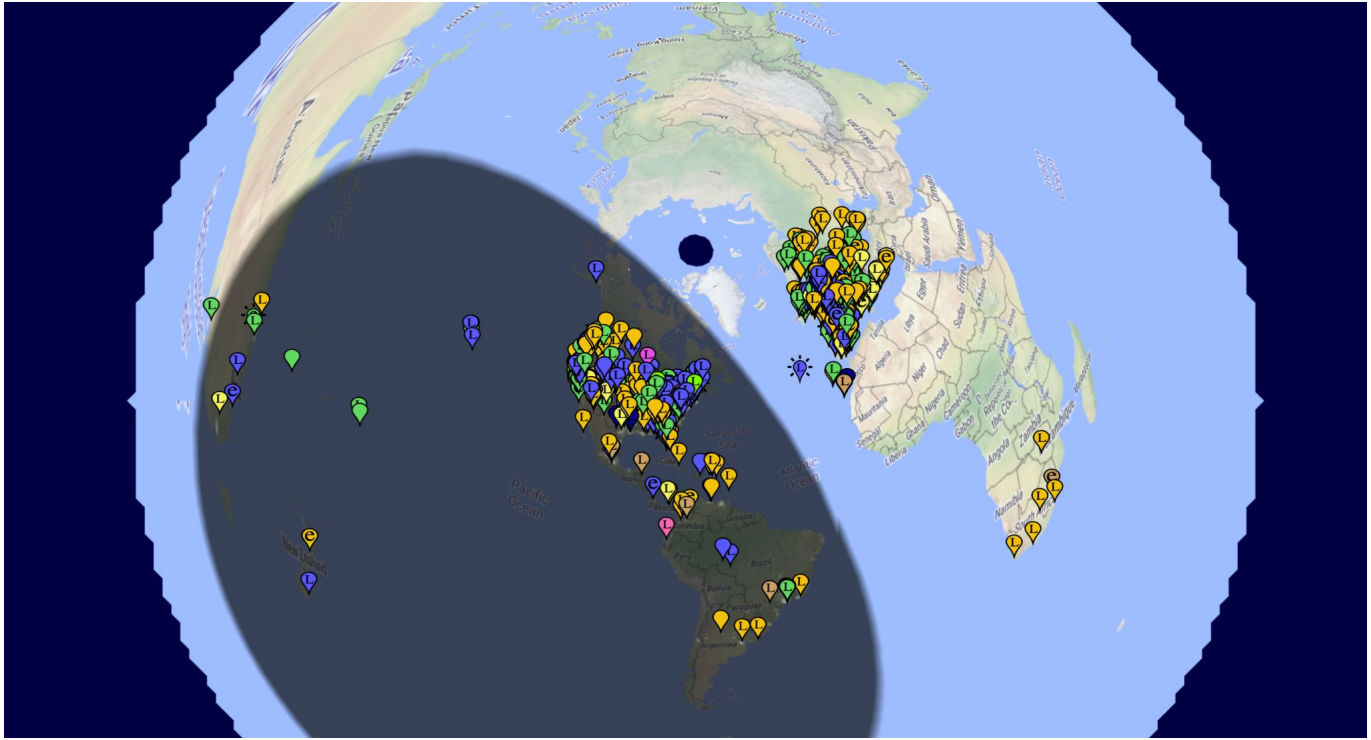

1.25m
uhf
vlf
24Ghz
47Ghz
76Ghz
10m,12m,15m,17m,20m
10m,12m,15m,17m,20m,2m,30m,40m,80m
10m,15m,20m
Unknown
Spotted
Worked
Recent
LoTW user
eQSL user

Map Projection – Mercator

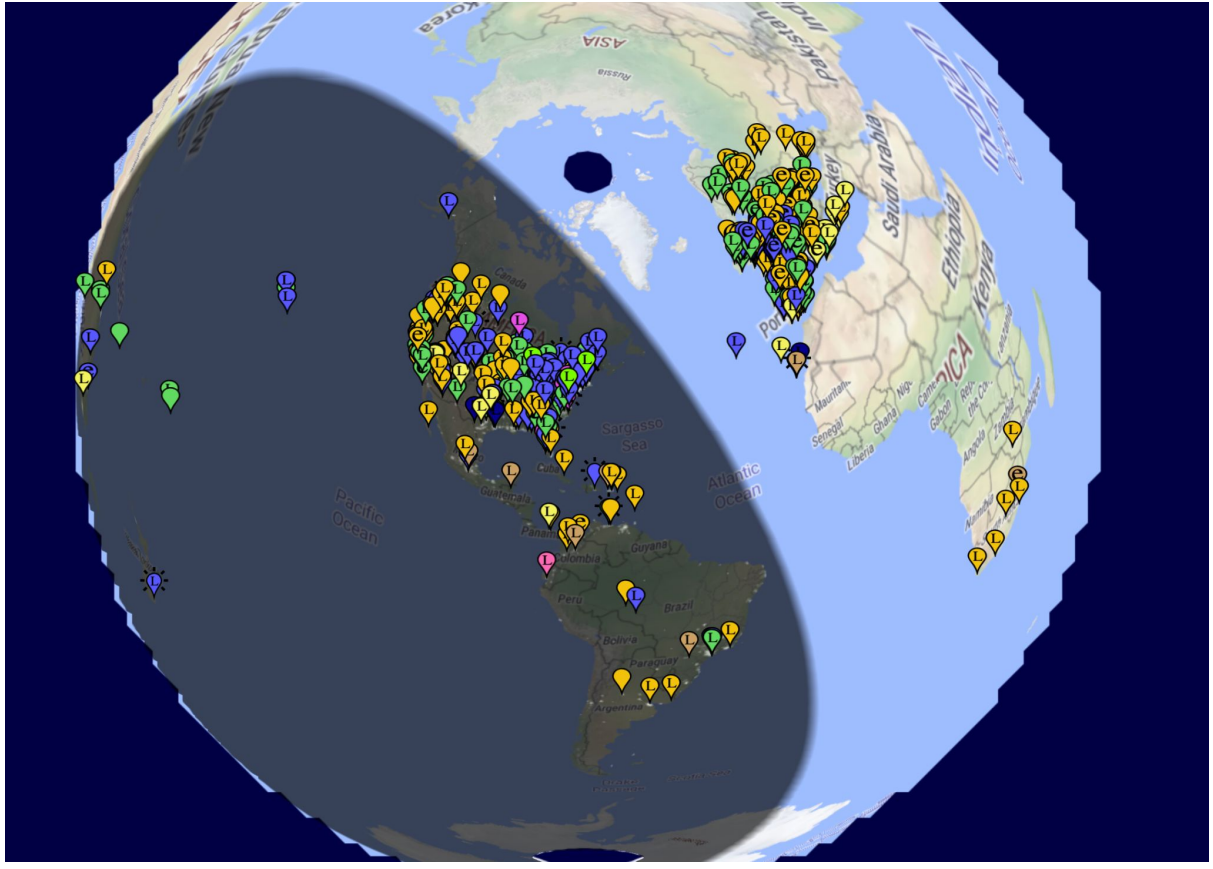


Map Projection - Azimuthal Equidistant

Put yourself at the center – all paths to/from you are straight lines!



Map Projection – Azimuthal Equal Area

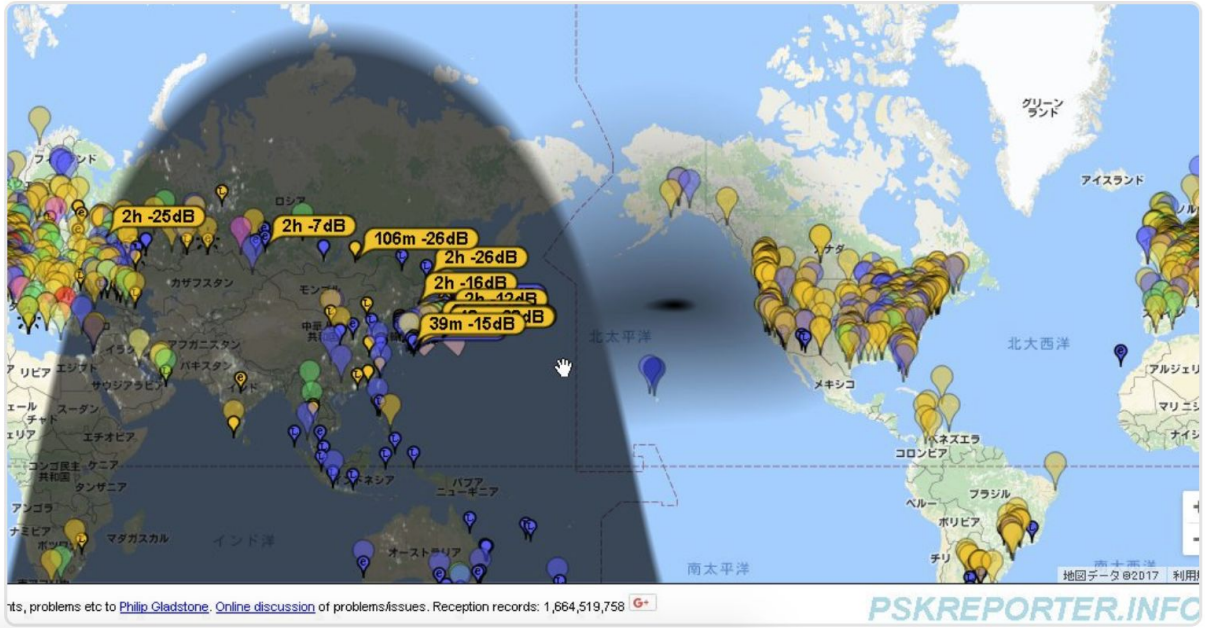


Eclipse

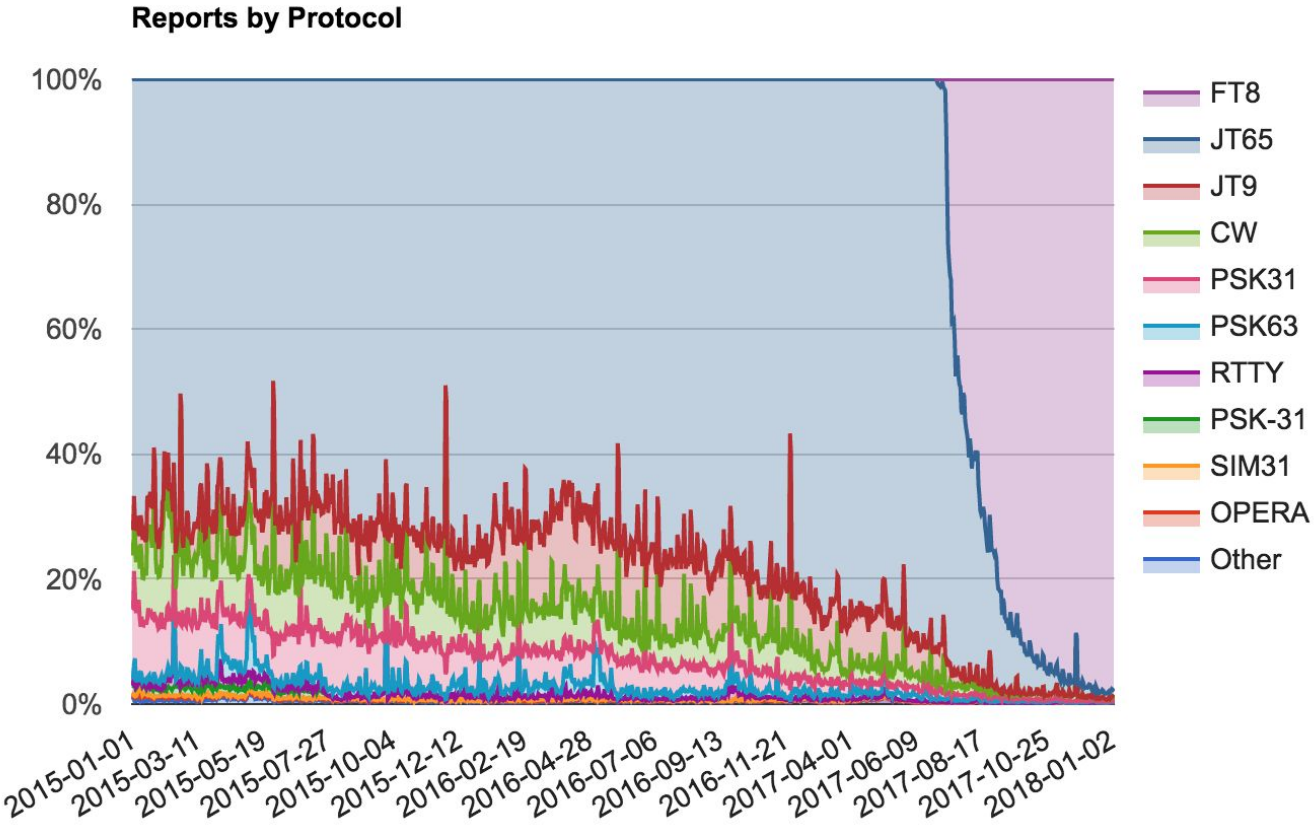
JF3GFH_K6QJ @JF3GFH_K6QJ · 21 Aug 2017

PSKREPORTER の太平洋の影ってひょっとして皆既日食を示している？！　　Solar eclipseis area is shown on the **pskreporter** map?!

Translate from Japanese

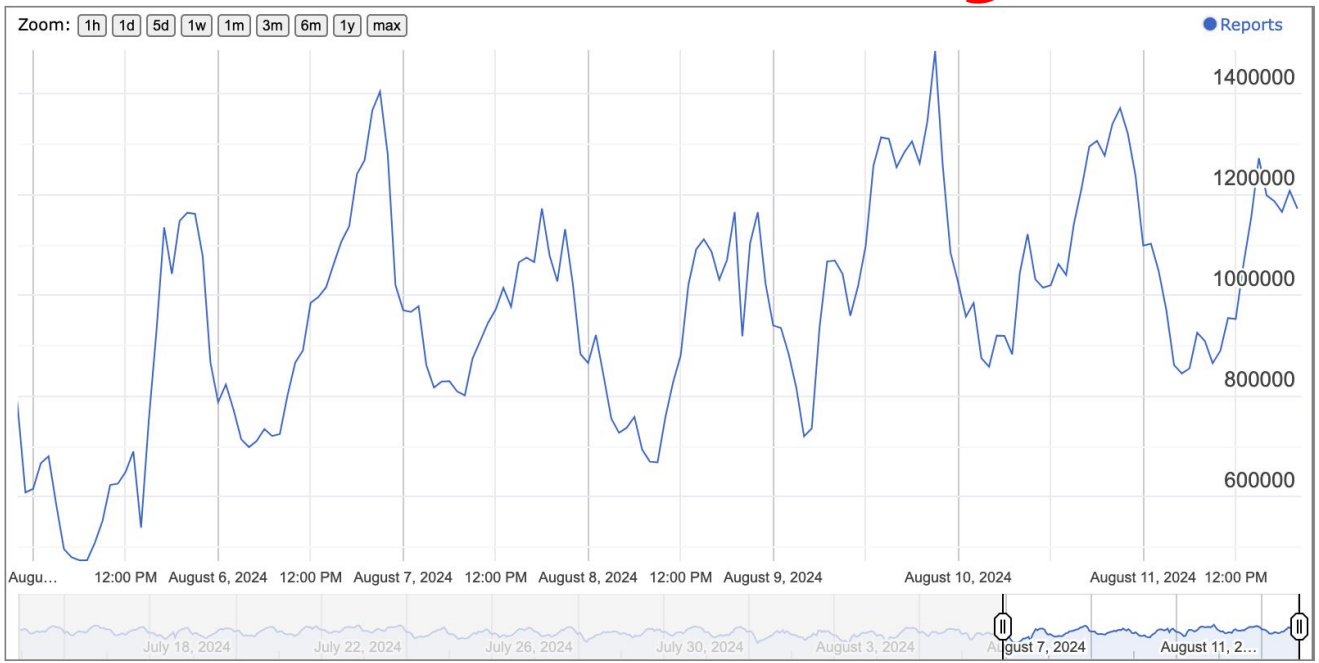


Impact of FT8



How much traffic?

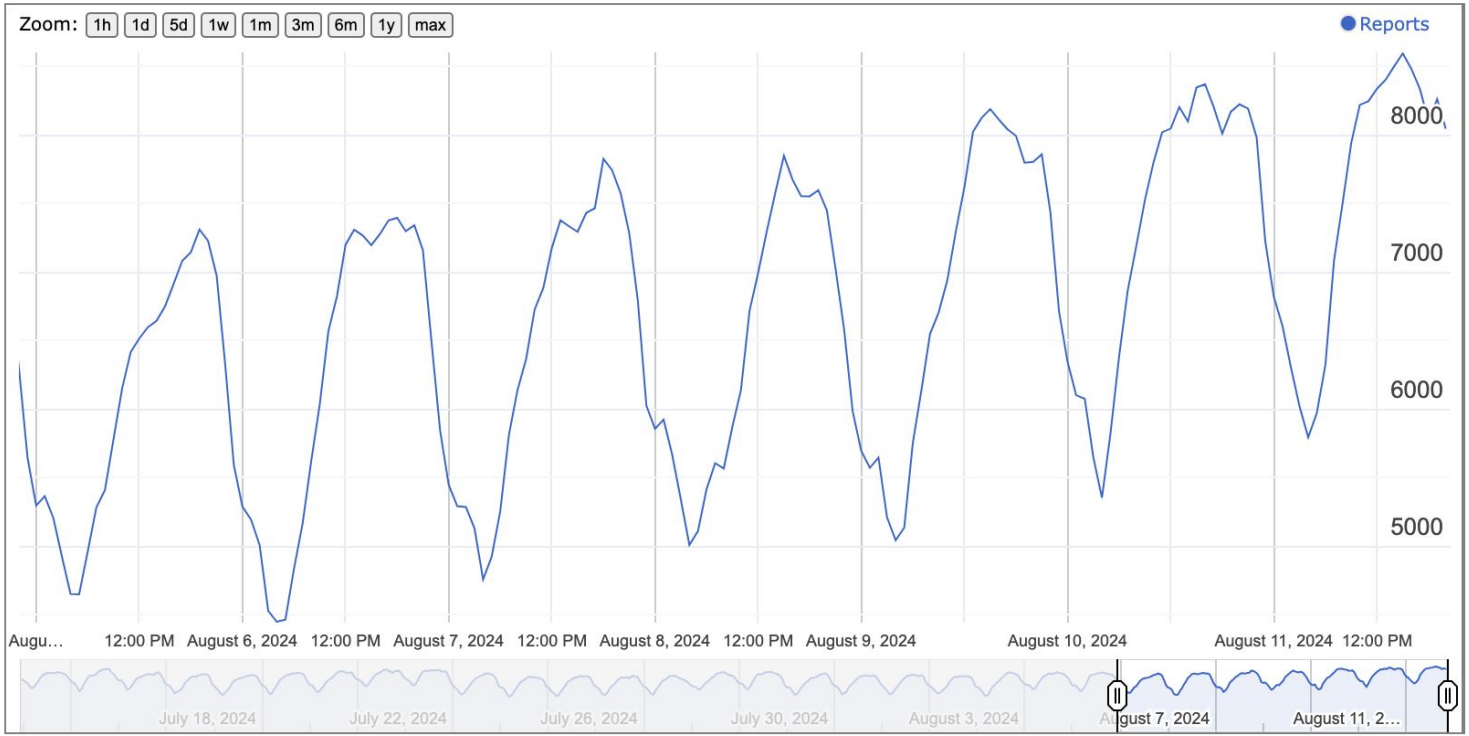
Number of reports per hour ~~received~~ saved



This is around 400 records per second at peak over a typical week.
System actually receives ~1500 records per second.

Statistics

Number of active monitors (in any hour)



Where is PSK31?

Mode	Count
FT8	2122360
FT4	56356
WSPR	24332
CW	19778
MSK144	13770
JS8	5671
VARAC	2566
FST4W	116
JT65	73
Q65B	48
Q65	24
FSK441	20
FSQ	19

How many DX entities can you spot?

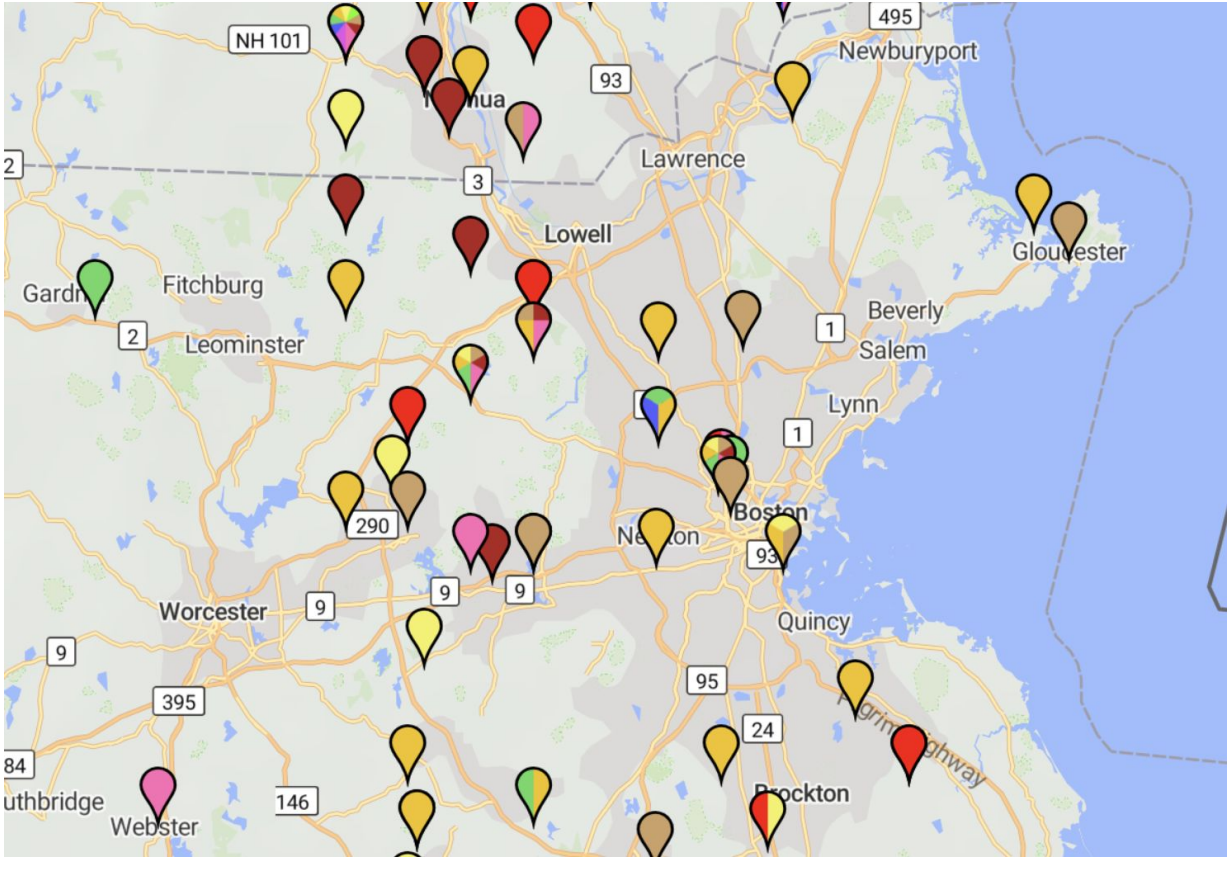
Monitor	Reports over 24 hours	Reports over 7 days
MM3NDH	193	230
DL0PF	182	225
YO2MAX	181	189
OH6BG	179	205
VE3EID	176	212
LZ4UX	173	202
2E0INH	172	204
DL9GTB	170	212
K9IMM	169	203
HA8TKS	168	201
PD2RPS	163	179
SM7IUN	162	197
KM3T-3	161	197
VK2LX	161	184
RN4WA	160	191
F5AHD	159	197
OH2BUA	159	186

How many reporters?

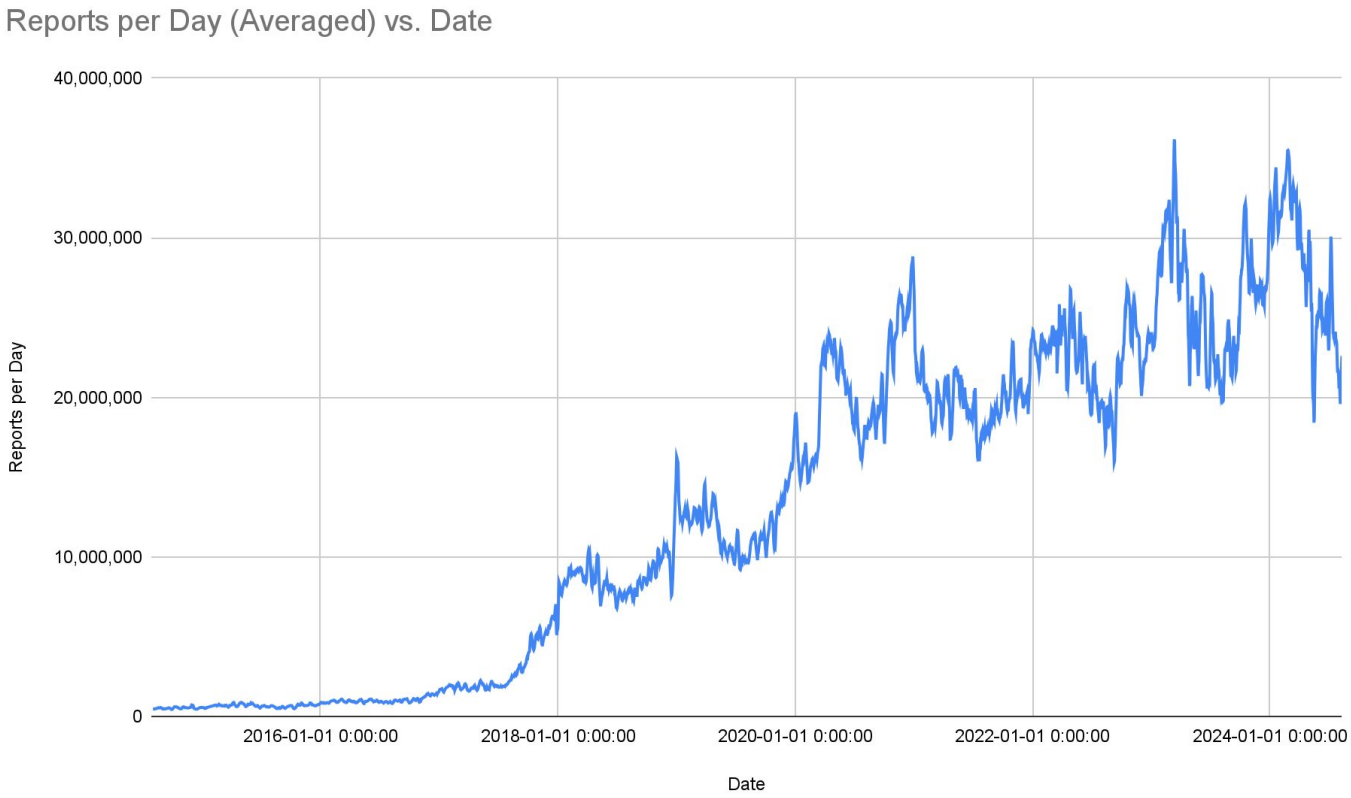
Over a week:

Software	Count
WSJT-X	29625
JTDX	10664
MSHV	2148
JS8Call	1561
VarAC V	969
OpenWebRX	645
KiwiSDR	438
ROS	158
SmartSDR	128
SDR-Control	126
fldigi	123
SDR Control for Icom	121
iFTx	104

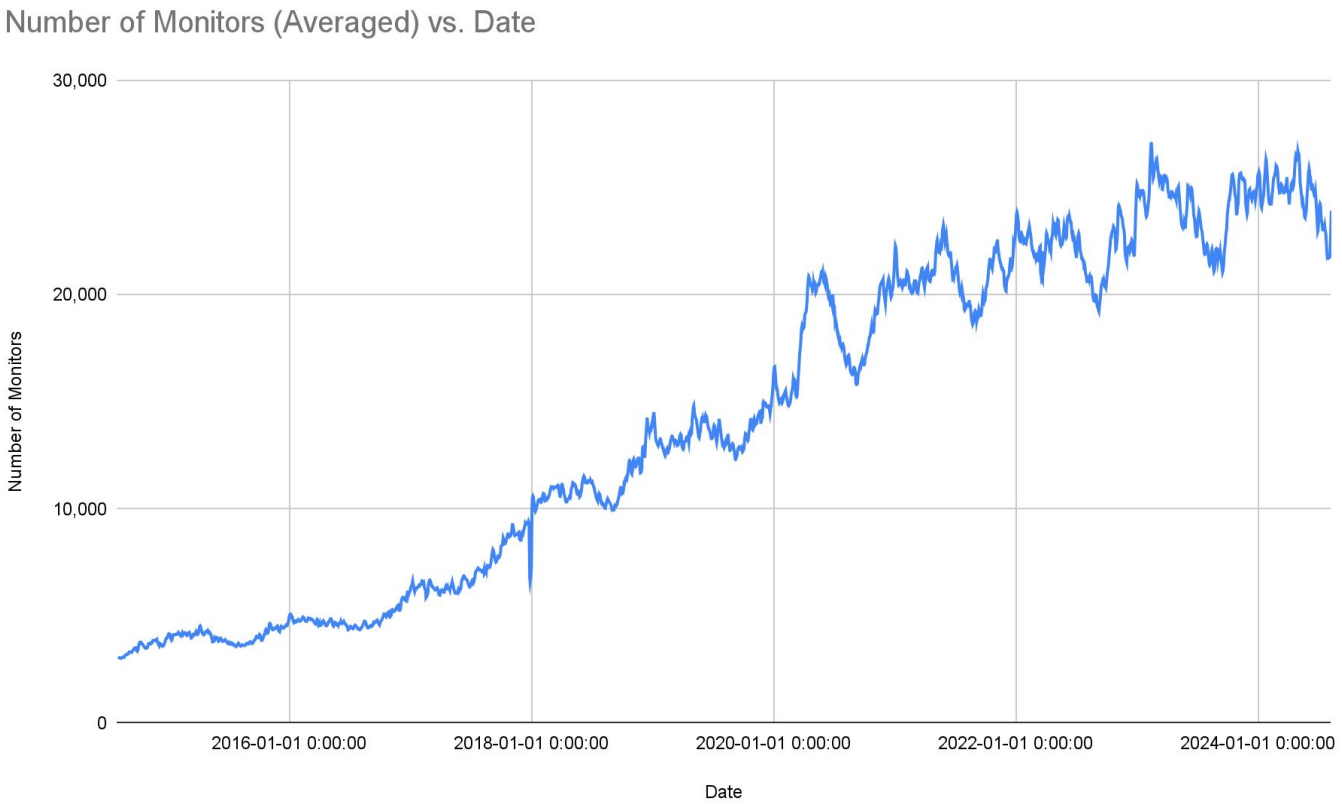
Reporters near QTH



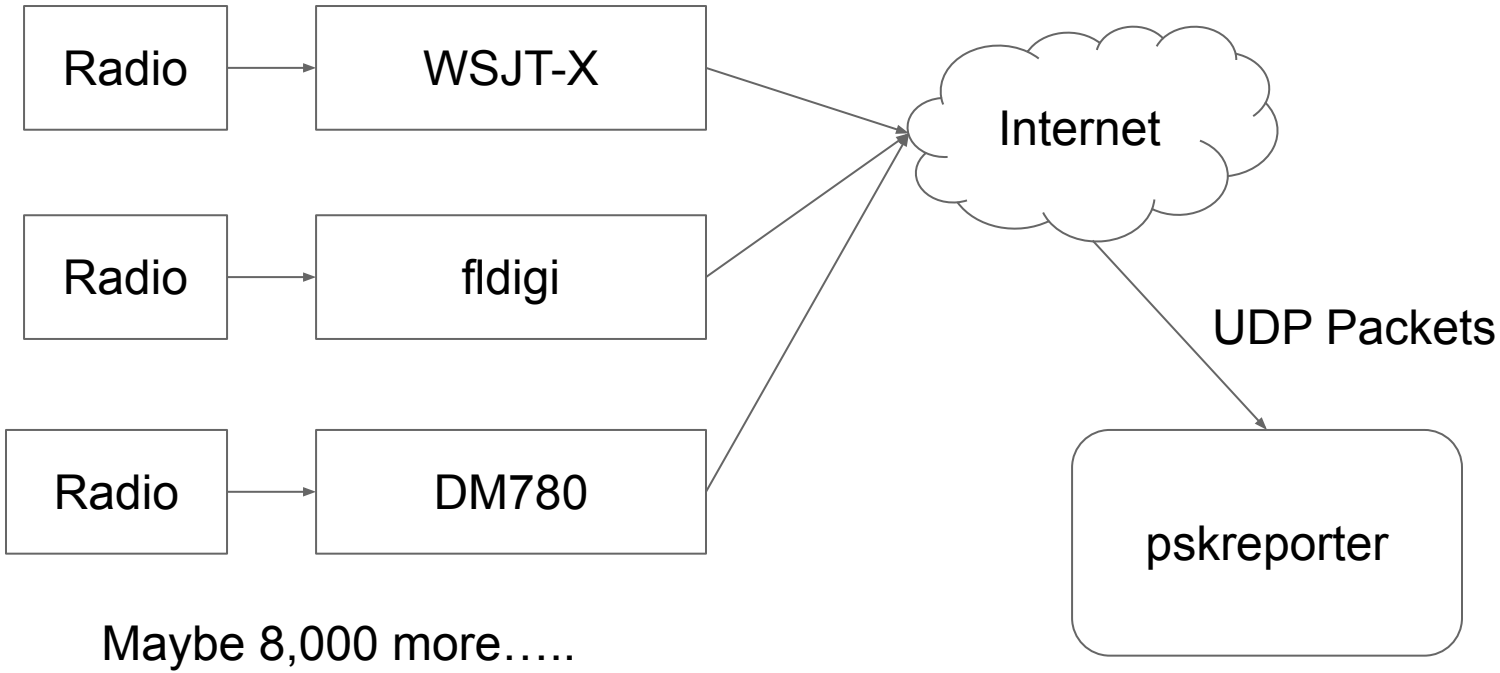
Growth of reports over 10 years



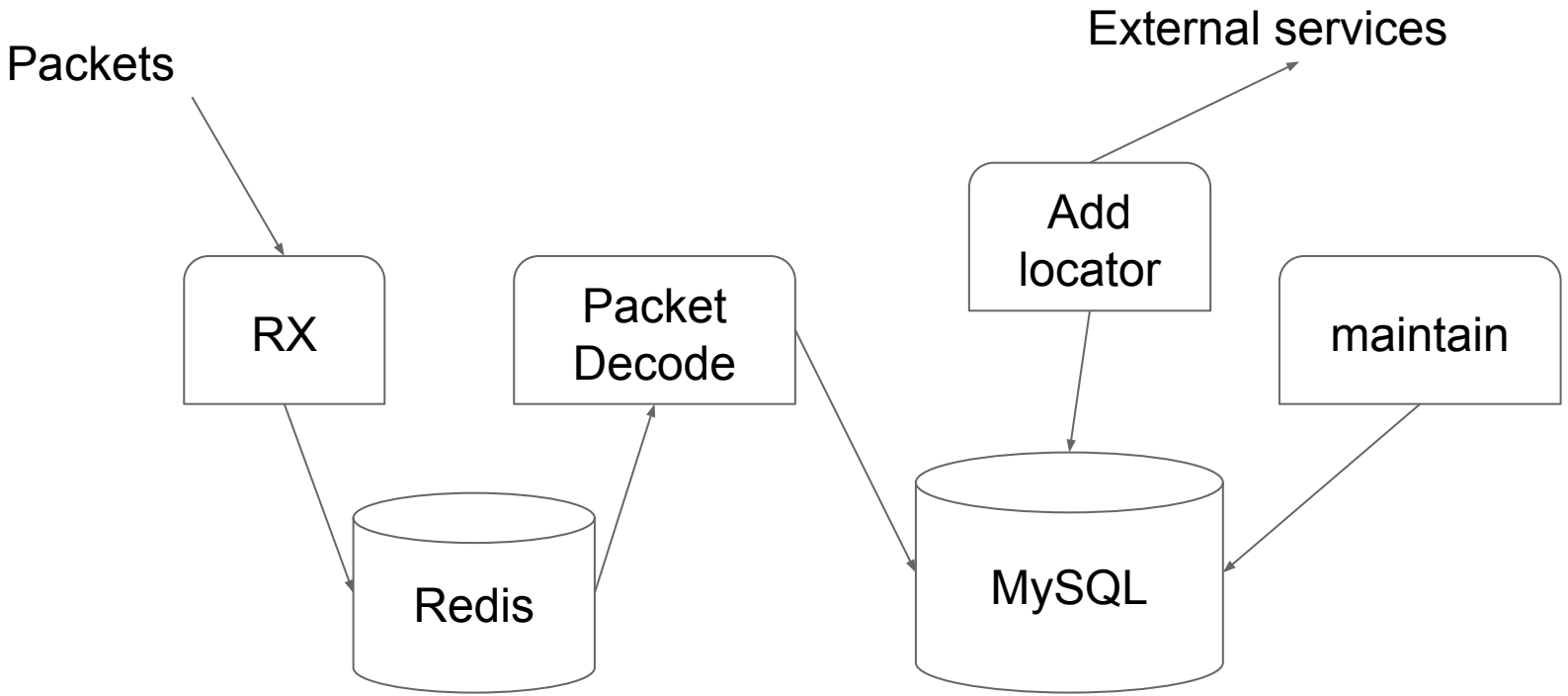
Growth of Monitors over 10 Years



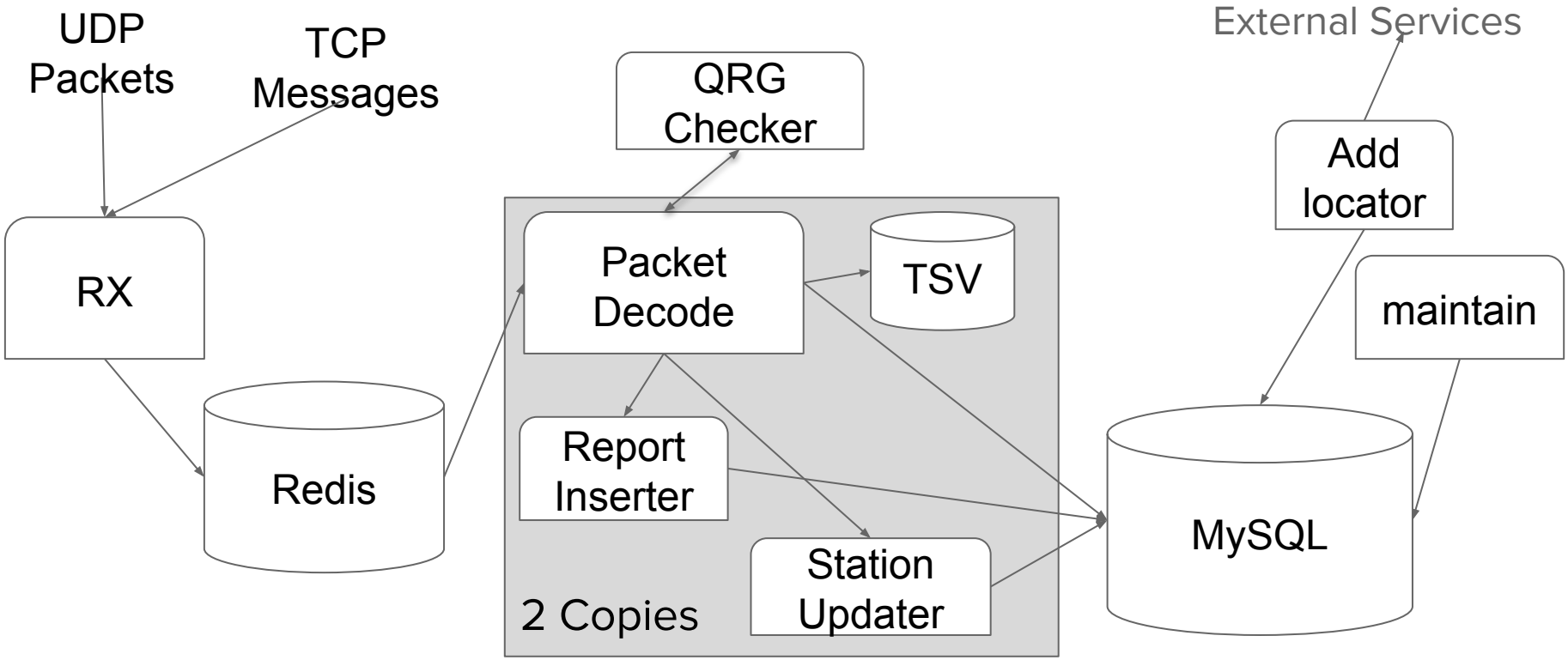
Architecture - Submission



Conceptual Architecture - Insert



Actual approach



Wrong reported Frequency (band)

Some reporters do not set the reporting frequency correctly. No CAT connection

People complain to me....

Most FT8 signals reported multiple times -- can vote on **right** frequency

Assign goodness score to monitors based on percentage of frequency matches.

1.2% seem to report bad frequencies

Packet Format

Use UDP so easy to implement (both send and receive)

Standard binary protocol for efficiency.

Custom registered attributes for ham use. Easily extensible to carry new data fields.

```
▼ Set 4 [id=20707] (29 flows)
    FlowSet Id: (Data) (20707)
    FlowSet Length: 715
    [Template Frame: 7297]
  ▼ Flow 1
    ▶ Enterprise Private entry: (Philip Gladstone) Type 1: Value (hex bytes): 41 45 38 53
      Enterprise Private entry: (Philip Gladstone) Type 5: Value (hex bytes): 00 6b f5 01
      Enterprise Private entry: (Philip Gladstone) Type 6: Value (hex bytes): ff
    ▶ Enterprise Private entry: (Philip Gladstone) Type 10: Value (hex bytes): 46 54 38
    ▶ Enterprise Private entry: (Philip Gladstone) Type 3: Value (hex bytes): 45 4d 37 39
      Enterprise Private entry: (Philip Gladstone) Type 11: Value (hex bytes): 01
      StartTime: Jan 13, 2018 17:42:59.000000000 EST
  ▼ Flow 2
```

Architecture - Database

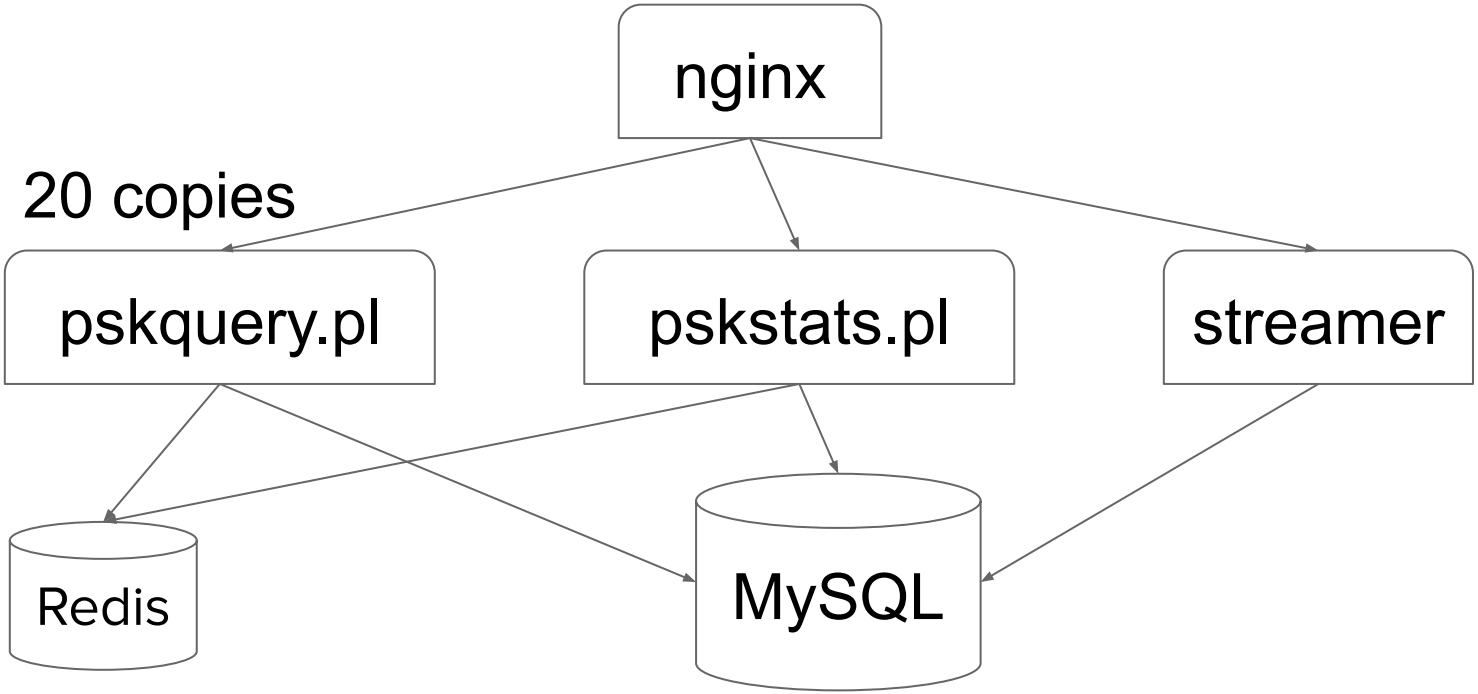
stationInfo - 78M records - callsign, locator, software, antenna, dxcc entity. Most of them are false decodes with one report.

report - 48G records - sender, receiver, mode, timestamp, frequency, etc. Most records kept offline.

callsignProgram - 500K records - callsign to LoTW and eQSL status

dxcc - 340 records - name, lat/lng of center, radius, match pattern

Architecture - Output



MQTT Interface

MQTT provides a clean subscription interface to a subset of the full data stream

- Service implemented by Tom, M0LTE
- Can be accessed directly or over websockets (from a browser)
- Documentation at http://mqtt.pskreporter.info/
- Subscribe to topics like:
  - `pskr/filter/v2/+/+/SV8DCW/#` all signals sent by SV8DCW
  - `pskr/filter/v2/10m/FT8/+/+/+/+/291/223` all 10M FT8 from US to UK
- Can subscribe to multiple topics on a single connection
- https://ft8.live/ is an example website built on this technology

Realtime Stream

Server built on node.js

URL to get almost real-time stream (possibly filtered)

Authenticated by API key

One report per line in JSON format


```
{"sequenceNumber":2400358267,"frequency":7074294,"mode":"FT8
","sNR":-3,"flowStartSeconds":1515857114,"senderCallsign":"J
K1OZS","senderLocator":"QM05GR","receiverCallsign":"JI1SZR",
"receiverLocator":"QM06an","receiverDecoderSoftware":"WSJT-X
v1.8.0 r8193"}
```

Received Data Archive

Contains compressed TSV files of all data received

No duplicate elimination.

No checks for frequency correctness.

No sanity checks.

Kept online for maybe 4-6 months

Used by HamSCI community for Ionospheric studies (especially the two recent North American eclipses)

Hiccups - 1

July 2014: On vacation. Power loss at home. UPS doesn't last long enough. System down for many days. Migrated out of basement to Rackspace (provided by KF5WAY)

Feb 2017: Have to find another provider. Thanks to VA3ISP.

Summer 2017: On vacation. FT8 explodes. Performance problems. Added processing delay message

August 2017: Eclipse webgl overlay -- rendering problems

Hiccups - 2

Fall 2017: FT8 popularity explodes. Database size issues

Nov 2017: Emergency maintenance

Dec 2018: Migrate to new faster server

2021: Ran out of disk space – MySQL lost main report table.

Today: Traffic growth requires changing bits of implementation.

Day / Night terminator

Calculated in the browser

Use WebGL if possible

- Calculates each pixel
- Uses the GPU
- Takes eclipses into account

Merges nighttime lights image tiles

Issue: Maybe should take gamma into account.

WebGL

Code runs on GPU Application draws shapes such as triangles

GPU processes vertexes

GPU runs shader for every pixel inside the shape and colors pixel (but GPUs are not all the same! FP16 vs FP32)

```
float fLatitude = v_latlng.x * 3.1415926 / 180.0;
float fLongitude = v_latlng.y * 3.1415926 / 180.0;
// Calculate difference (in minutes) from reference longitude.
float fDifference = (((fLongitude) * 180./3.1415926) * 4.) / 60.0;
// Caculate solar time.
float fSolarTime = u_fLocalTime + u_fEquation + fDifference;
// Calculate hour angle.
float fHourAngle = (15. * (fSolarTime - 12.)) * (3.1415926/180.0);
// Calculate current altitude.
float cc = cos(u_fDeclination) * cos(fLatitude);
float t = (sin(u_fDeclination) * sin(fLatitude)) + (cc * cos(fHourAngle));
```

Sample complaints

My tx-marker in the PSK-reporter does not contain L.

A W6 station is operating portable from VA and including the FM19 grid square in his data. PSK Reporter however shows him in California while he is fairly local to me in VA.

kb7qag should be in Tacoma not Purdy

My location is wrong please correct to DN06ah near Sunnyside Wa.

.@n1dq Hi OM Philip, CB radio spots are missing on #pskreporter when "11m" is selected.They are shown when "all bands" is selected. vy 73

Do you have a facility to donate for your services and great service?

From time to time, stations appear using /LH on PSKreporter, not sure what they try to indicate, but it is not that they are in Norway. LH is in general reserved for airplanes, hardly ever used for amateur radio. (today)

Path Forward

People want more capabilities

Want to keep more data online

Want to get a team to own/manage/operate the service

Need to find a funding source appropriate for OpEx.

Don’t want advertising

Merge with other similar services?

Be more aggressive in filling in sparse areas of the map?

Record more data?

Volunteers?

Underserved areas of the world

- Wsprdaemon now supports FT8 and FT4 and reports to PSKReporter
- 46 installations currently running recent code
- HamSCI is trying to install systems in the southern hemisphere
- Target to put at least 5 in Antarctica

Custom monitoring package

Rx888 MkII – wideband SDR

Cheap x86 linux box running KA9Q-Radio & Wsprdaemon

Simple to setup

- Set callsign (or other identifier) and locator
- Done!

Low cost package for underserved areas of world:

- Africa, Middle East, Western China, Eastern Russia

Questions?

https://pskreporter.info

Philip Gladstone - N1DQ

philip@gladstonefamily.net