

# **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?

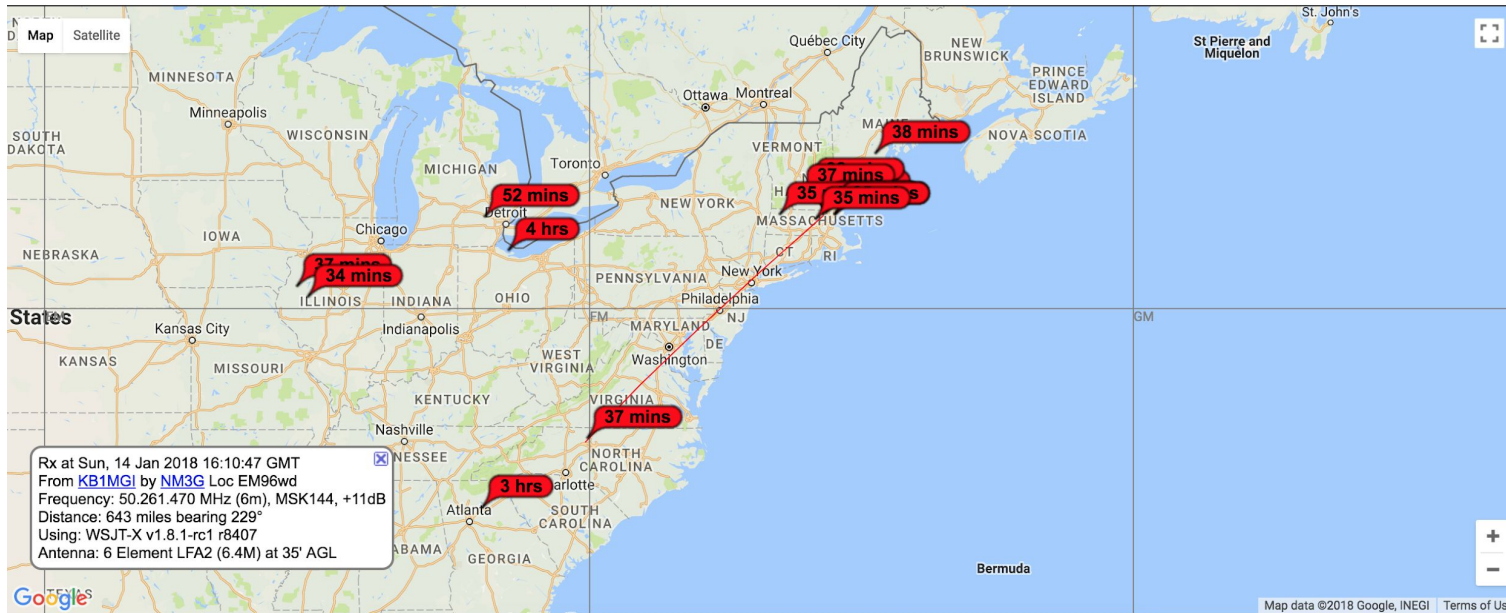
A way to see where your transmissions are being heard.

On  show  sent by  KB1MGI using  over the last  Go! [Display options](#) [Permalink](#)

Monitoring KB1MGI (last heard 34 mins ago). Automatic refresh in 5 minutes. 15 reception reports for KB1MGI are shown as times ([show logbook](#)).

There are **3501 active monitors**: **1022 on 20m**, **802 on 40m**, **388 on 17m**, **387 on 30m**, **265 on 15m**, **253 on 80m**, **88 on 6m**, **50 on 60m**, **47 on 160m**, **38 on 10m**, **32 on 12m**, **27 on 2m**, **22 on 11m**, 13 on unknown, **3 on 2200m**, **2 on 4m**, **1 on 70cm**. [Legend](#)

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.

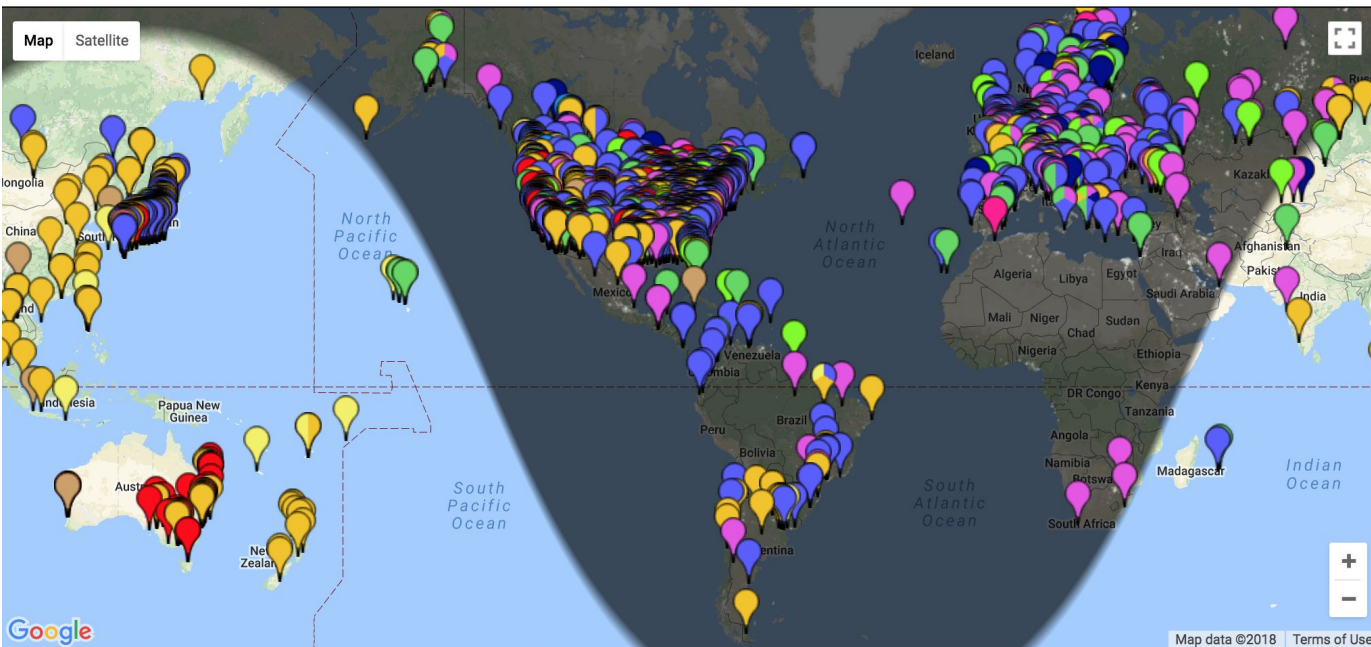
Fldigi implemented the protocol

# A quiet evening in the early days

On  show  sent/rcvd by  using  over the last  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:

# 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

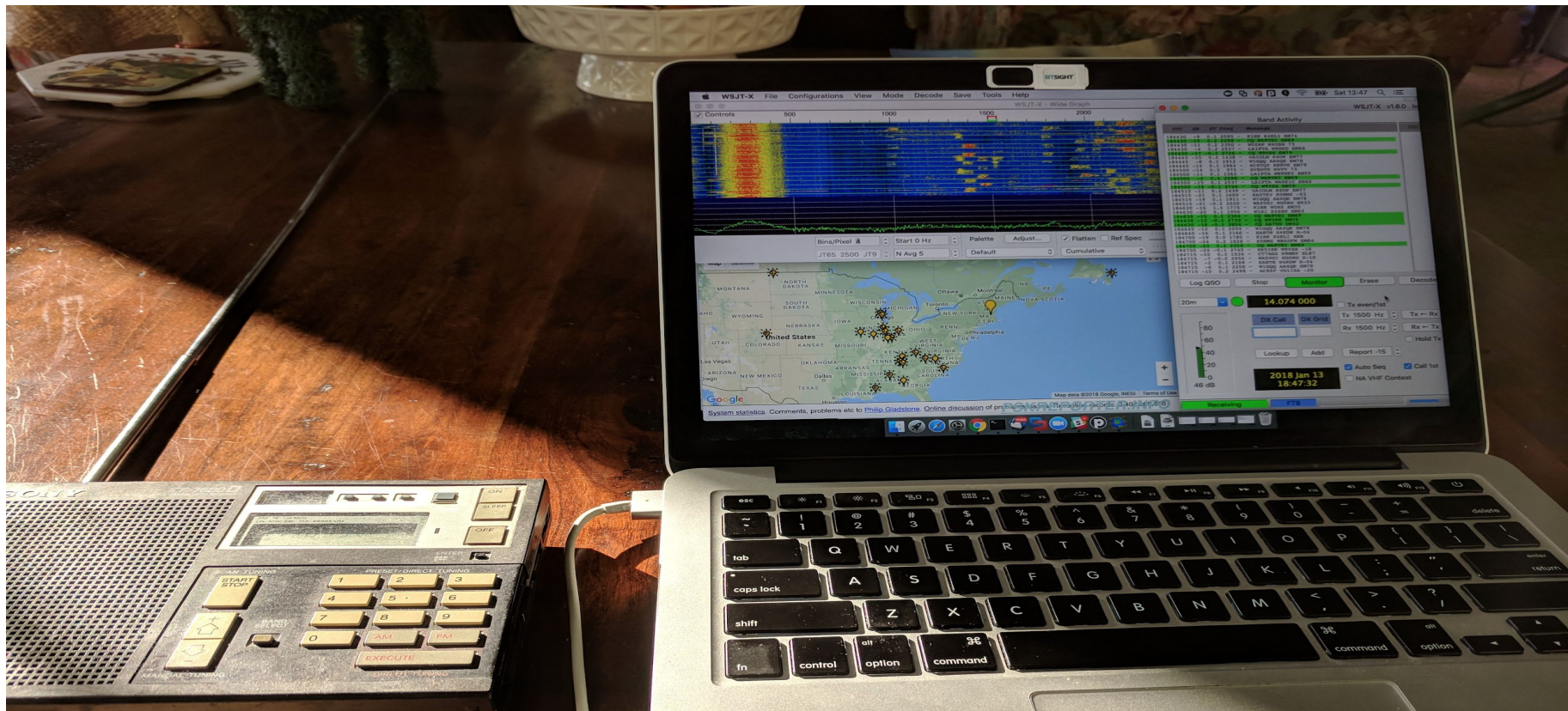
????

# 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

The screenshot displays the WSJT-X software interface. The top window, titled "WSJT-X - Wide Graph", shows a waterfall plot with a frequency range from 500 to 2000 kHz. The plot shows a strong signal at approximately 14.074 MHz. Below the plot are controls for "Bins/Pixel" (set to 4), "Start 0 Hz", "Palette", "Adjust...", "Flatten", "Ref Spec", "JT65 2500 JT9", "N Avg 5", "Default", and "Cumulative".

The bottom-left window shows a map of the United States with a pop-up for "Monitor: N1DQ Loc FN42hn". The pop-up text reads: "Frequency: 14.077 MHz (20m)", "Using: WSJT-X v1.8.0 r6193", "Last report: [W9THI](#) at Sat, 13 Jan 2018 18:43:14 GMT".

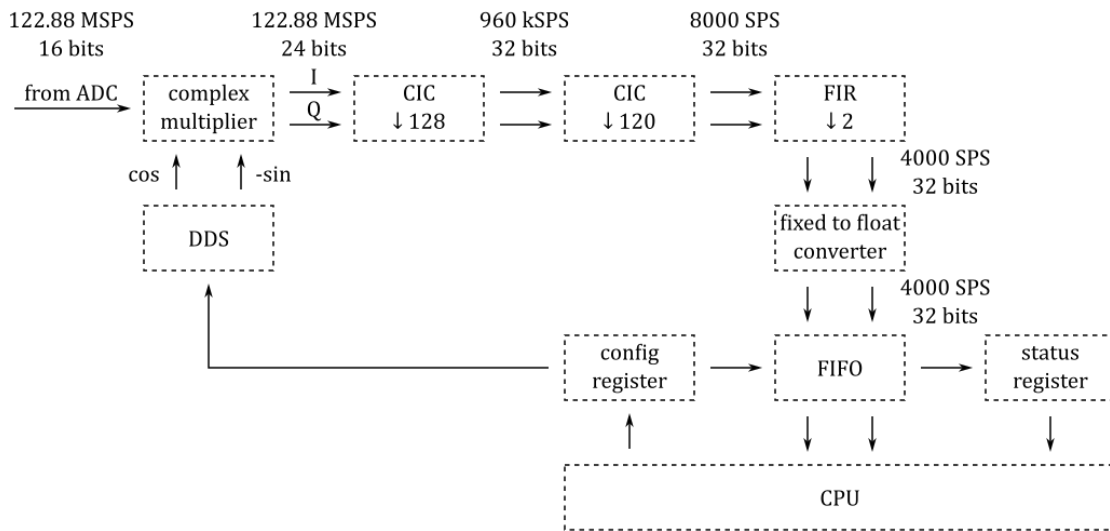
The bottom-right window, titled "WSJT-X v1.8.0", shows the "Band Activity" log. The log contains the following entries:

UTC	dB	Dz	Freq	Message	UTC
184245	-11	0.2	2468	K4SHK VO1RA -15	
184245	-12	0.1	2505	VE3COC KE4RN EM71	
184300	-11	0.3	1541	VE3DVV NOA2Z 73	
184300	-11	-0.7	1594	K0HMZ K9BR EM49	
184300	-7	0.0	2147	LA1PTA W4KDW EM75	
184300	-10	0.1	2377	W1QLF K4ELL 73	
184300	-14	0.2	2738	CQ W9THI EM69	
184300	-8	0.1	2844	K8NU A0AP RRR	
184315	-11	0.2	2480	K4SHK VO1RA R-16	
184330	-8	0.1	1367	LA1PTA W9NEY EM59	
184330	-22	0.1	2158	LA1PTA W4KDW EM75	
184330	-20	0.2	2858	K8NU A0AP RRR	
184345	-4	0.2	1450	CQ DX K4OP EM77	
184345	-22	0.1	2025	CQ K8VRK EM79	
184345	-17	0.3	2082	VE3MKX K4M EM74	
184430	-12	0.1	1361	LA1PTA W9NEY EM59	
184430	-9	0.1	2095	K1IKR K4ELI EM74	
184430	-10	0.2	2298	CQ W9THI EM69	
184430	-11	0.2	2350	W0ZAP W4USH 73	
184430	-4	0.2	2537	LA1PTA W9NED EM68	
184430	-17	-0.1	2726	CQ W9YXK EM79	
184445	-15	0.2	1438	UA1OLM K4OP EM77	
184445	-8	0.1	1912	W1GQQ A4AQE EM78	
184445	-14	0.1	1964	KC3CQF K8VRK EM79	
184500	-14	0.3	975	SV8DDZ N4VV 73	
184500	-11	0.1	1362	LA1PTA W9NEY EM59	
184500	-2	0.1	2298	CQ W9THI EM69	
184500	-15	0.1	2537	LA1PTA W9AEC EN60	
184500	-16	-0.1	2726	CQ W9YXK EM79	
184515	-11	0.2	1439	UA1OLM K4OP EM77	
184515	-21	0.1	1600	K8STP K0HKG -03	
184515	-19	0.1	1911	W1GQQ A4AQE EM78	
184515	-21	-0.2	2020	W4SWG1 G0KRG EN33	

The bottom-right window also features a "Log QSO" button, a "Stop" button, a "Monitor" button (highlighted in green), an "Erase" button, and a "Decode" button. Below these buttons is a frequency display showing "20m" and "14.074 000". There are also controls for "Tx even/1st", "Tx 1500 Hz", "Tx ← Rx", "Rx 1500 Hz", "Rx ← Tx", "Hold Tx", "Lookup", "Add", "Report -15", "Auto Seq", "Call 1st", and "NA VHF Contest". At the bottom, there is a status bar showing "Receiving" and "FT8".

# 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



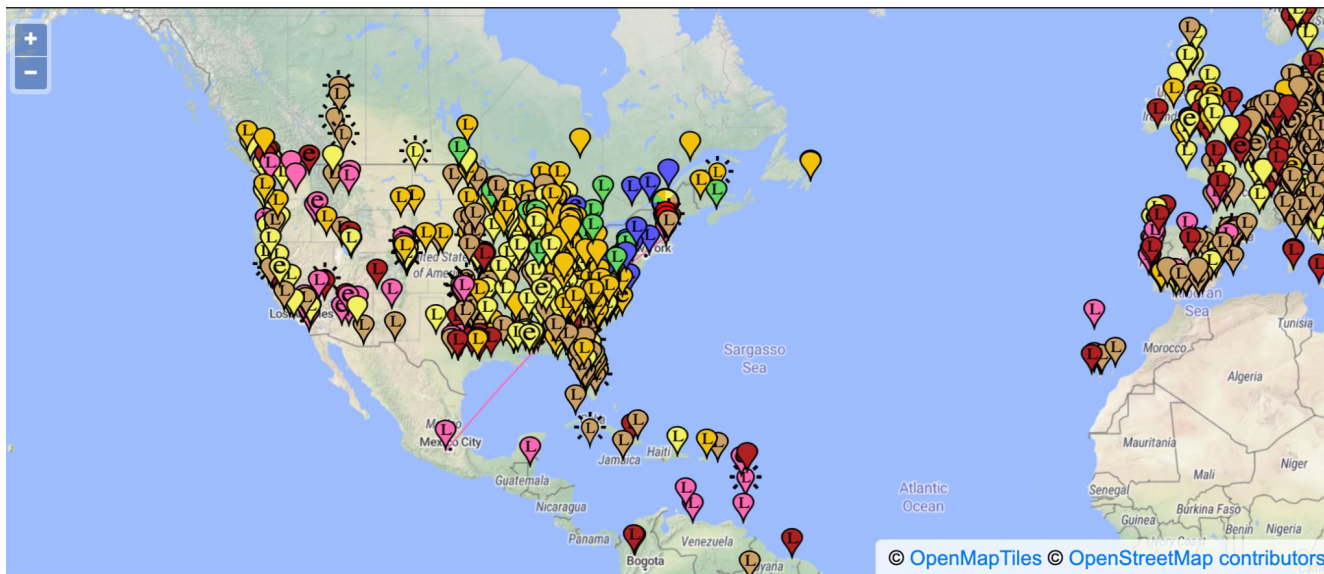


# Web Interface

On  , show  sent/rcvd by   using  over the last   [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](#)





# Display Options

Your selected options are saved in the browser

**Display Options** ✕

<input checked="" type="checkbox"/>	Hide faint monitors	<input type="checkbox"/>	Show connecting lines always
<input checked="" type="checkbox"/>	Hide monitors if no reports	<input type="checkbox"/>	Hide seen times
<input checked="" type="checkbox"/>	Hide pink blob	<input type="checkbox"/>	No auto pan/zoom
<input type="checkbox"/>	Hide night shadow	<input type="checkbox"/>	SNR in LogBook
<input type="checkbox"/>	Hide city lights	<input type="checkbox"/>	Show time text in Black always
<input type="checkbox"/>	Show unseen tx	<input type="checkbox"/>	Map type
<input type="checkbox"/>	Show grid	<input type="text" value="Mercator"/>	Azimuthal center locator
<input type="checkbox"/>	Show snr	<input type="text" value="10"/>	Minutes for Sparkly markers
<input type="checkbox"/>	Monitors in frequency order	<input type="text" value="0.65"/>	Darkness for night shadow (0-1)
<input type="checkbox"/>	Suppress bad QRG	<input type="text" value="Show all"/>	transmitters
<input type="checkbox"/>	Hide statistics	<input type="text" value="no"/>	timeout for worked markers
<input type="checkbox"/>	Hide everything but the map	<input type="text" value="Automatic"/>	as distance units
<input type="checkbox"/>	Hide connecting lines		

---

# Band Colors

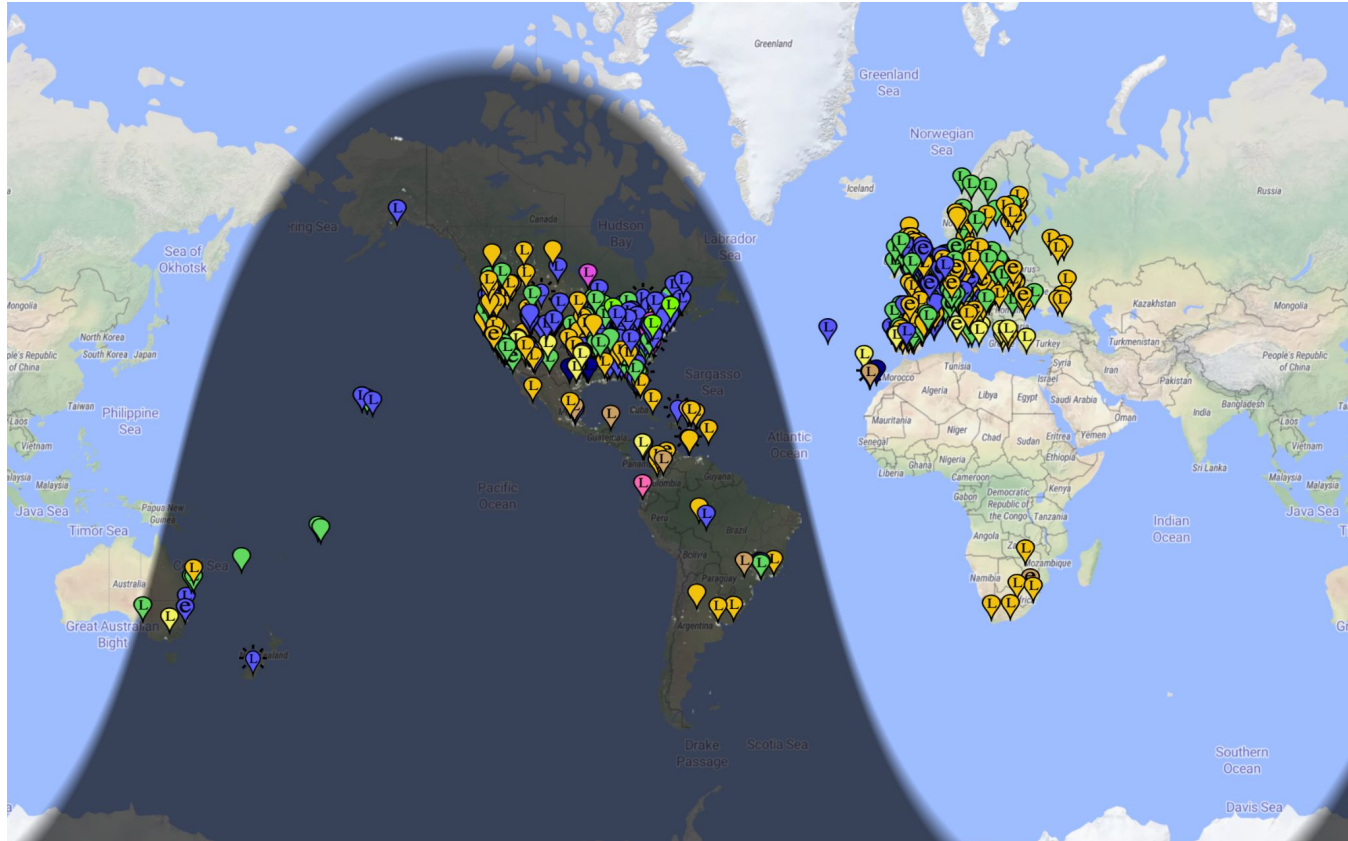
Click icon to change color ([Reset](#))



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

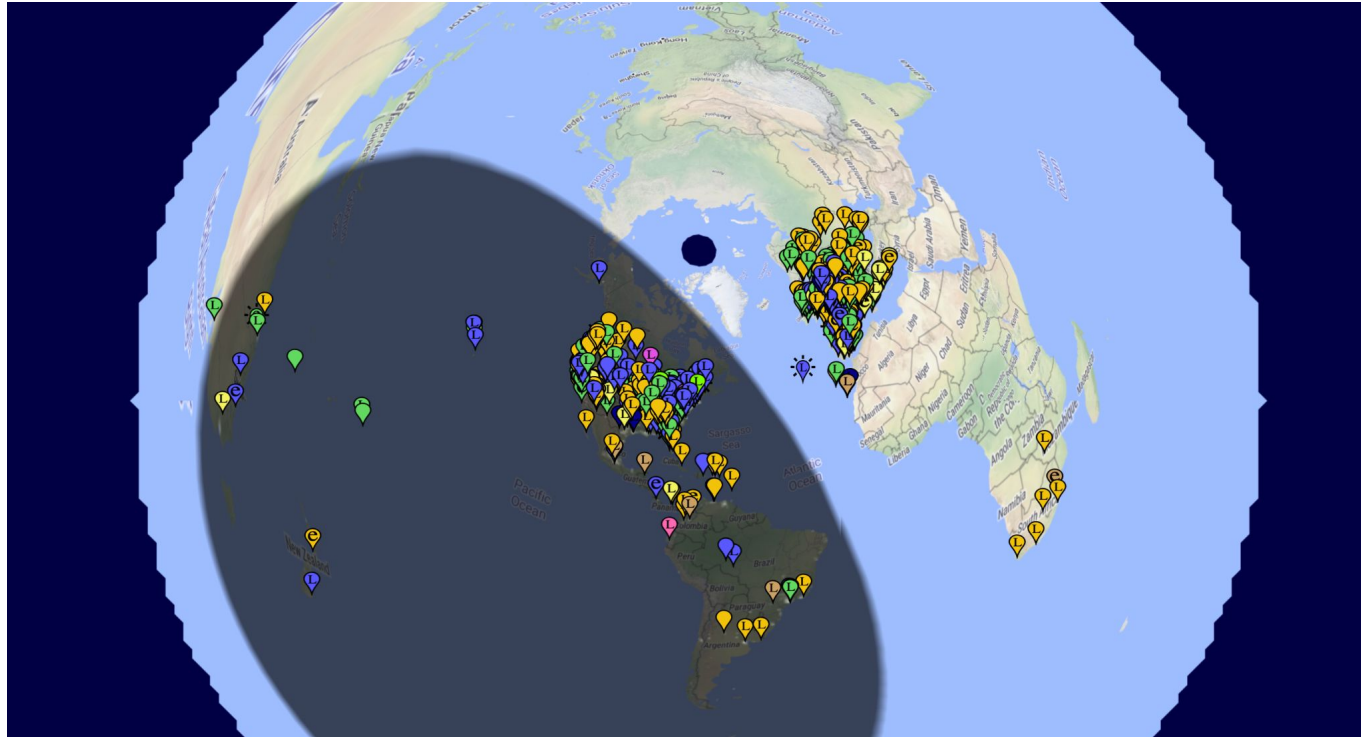
1.25m	uhf	vlf
24Ghz	47Ghz	76Ghz
10m,12m,15m,17m,20m		
10m,12m,15m,17m,20m,2m,30m,40m,80m		
10m,15m,20m		
Unknown		
Spotted		
Worked		
Recent		
LoTW user		
eQSL user		

# Map Projection – Mercator

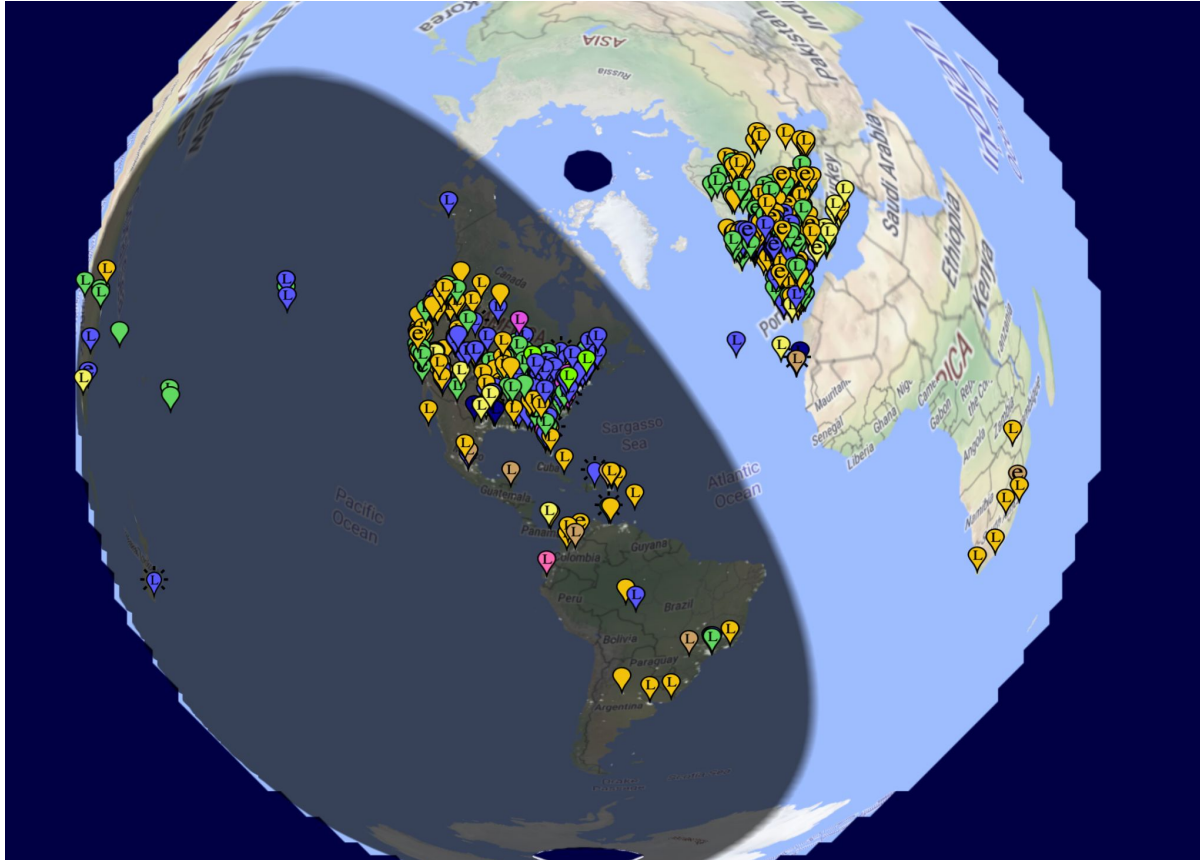


# Map Projection - Azimuthal Equidistant

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



# Map Projection – Azimuthal Equal Area



# Eclipse

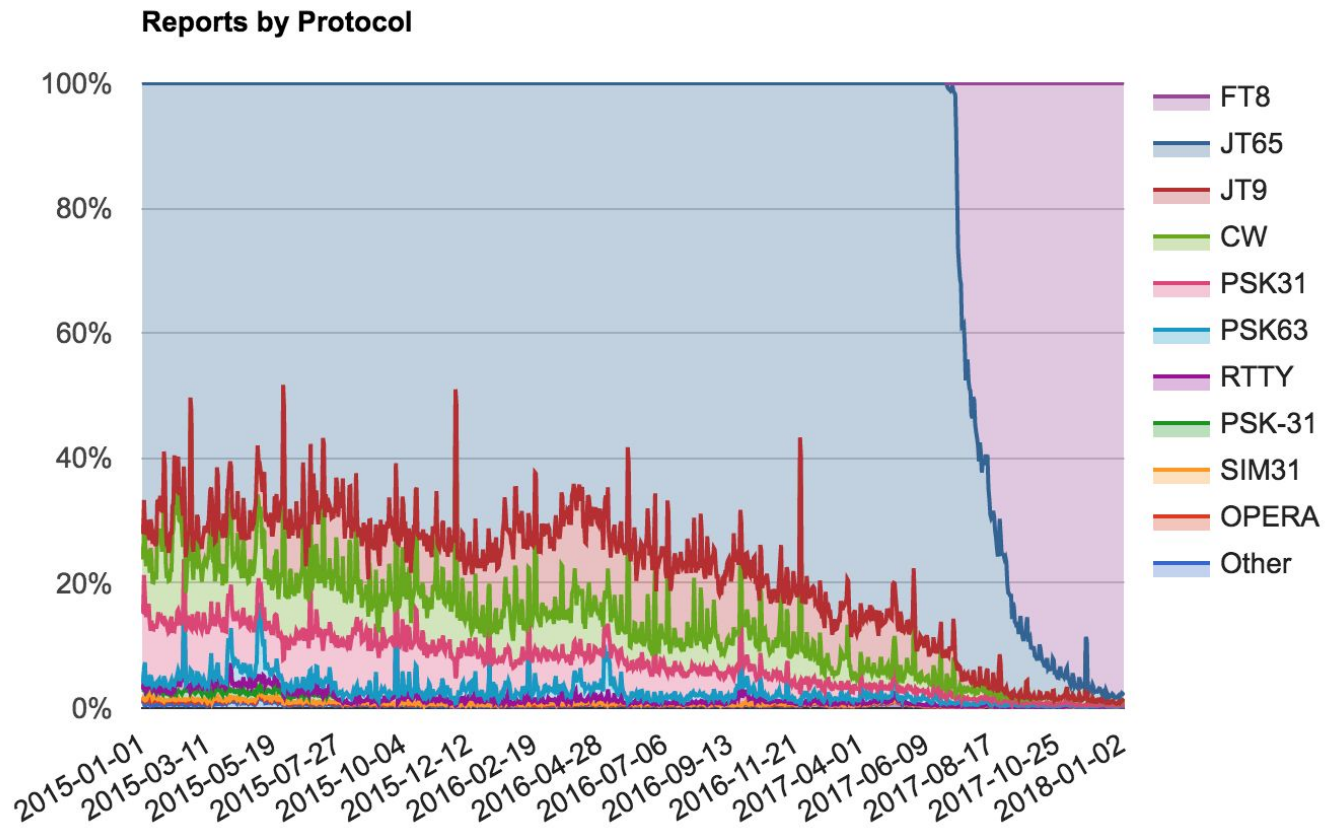
JF3GFH\_K6QJ @JF3GFH\_K6QJ · 21 Aug 2017

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 eclipse area is shown on the **pskreporter** map?!

 Translate from Japanese



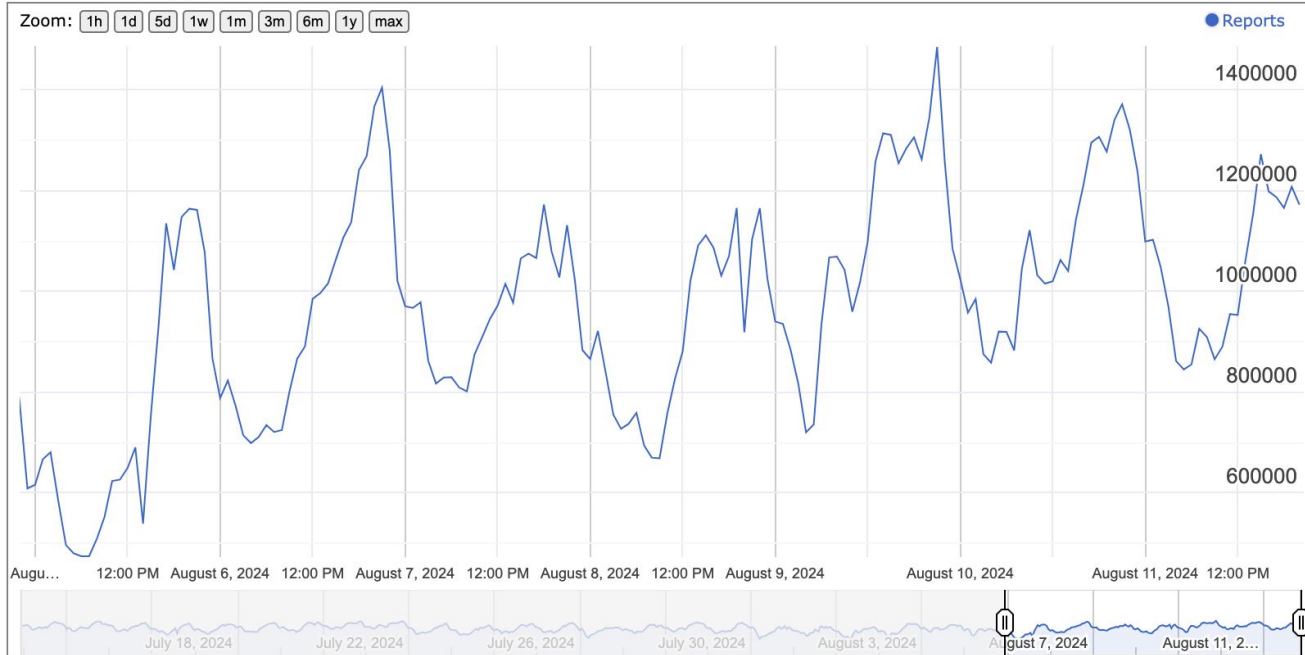
# Impact of FT8



# How much traffic?

Number of reports per hour ~~received~~

saved

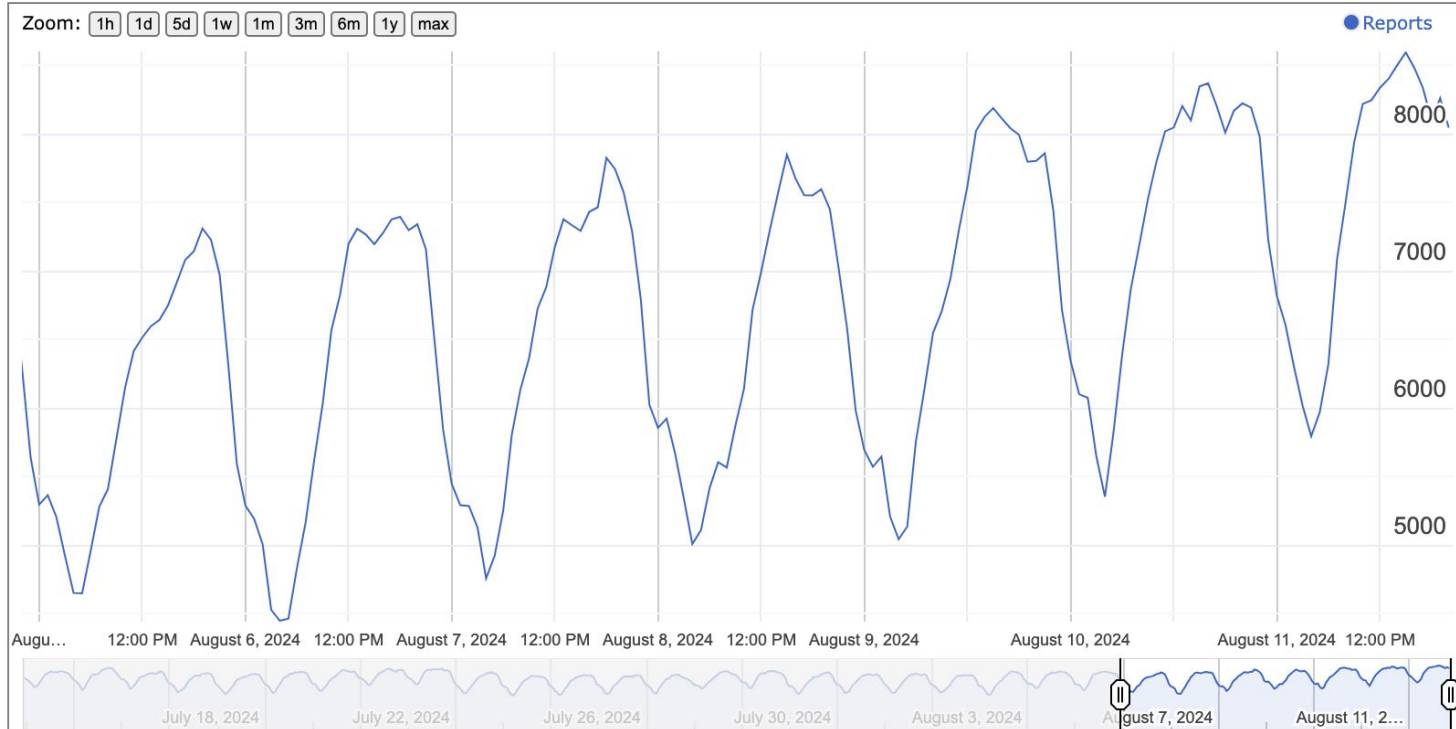


This is around 400 records per second at peak over a typical week.  
System actually receives ~1500 records per second.



# 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?

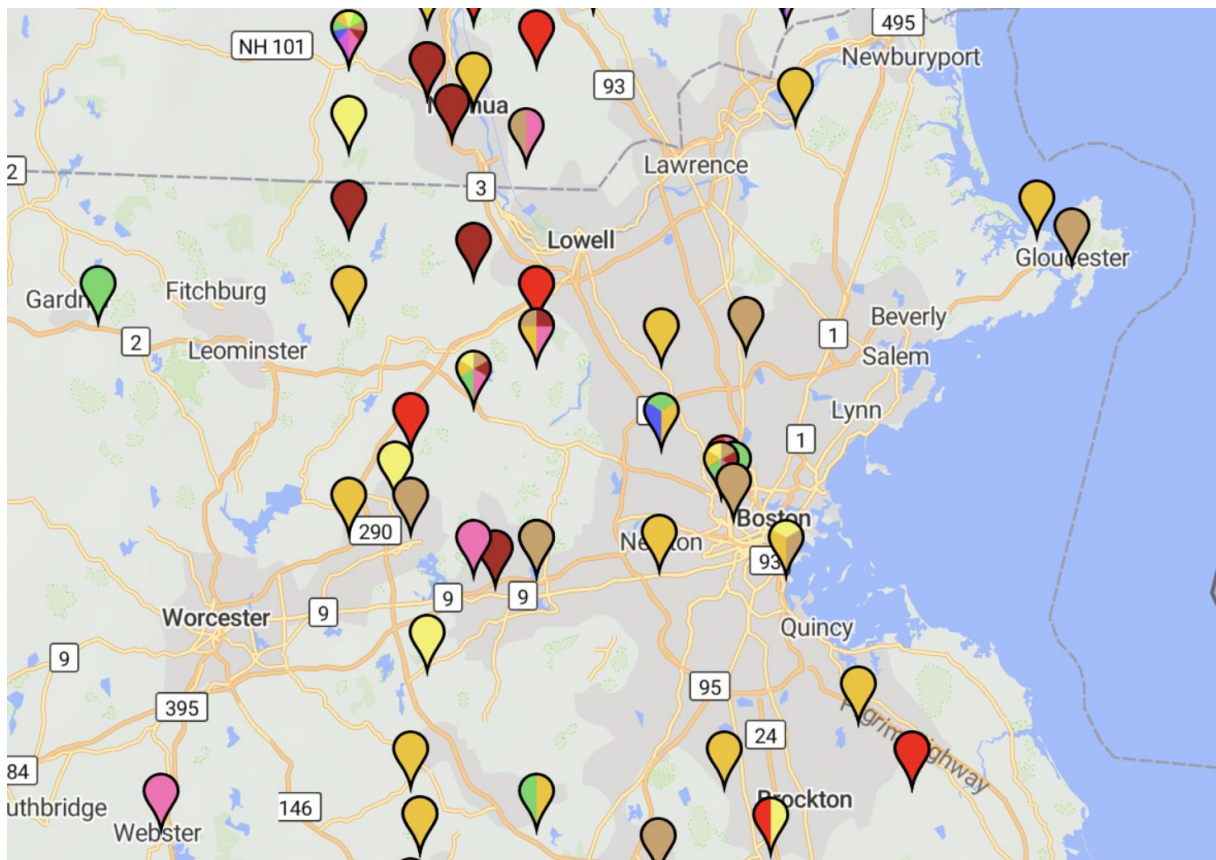
Monitor	Reports over 24 hours	Reports over 7 days
MM3NDH	193	230
DL0PF	182	225
YO2MAX	181	189
OH6BG	179	205
VE3EID	176	212
LZ4UX	173	202
2E0INH	172	204
DL9GTB	170	212
K9IMM	169	203
HA8TKS	168	201
PD2RPS	163	179
SM7IUN	162	197
KM3T-3	161	197
VK2LX	161	184
RN4WA	160	191
F5AHD	159	197
OH2BUA	159	186

# How many reporters?

Over a week:

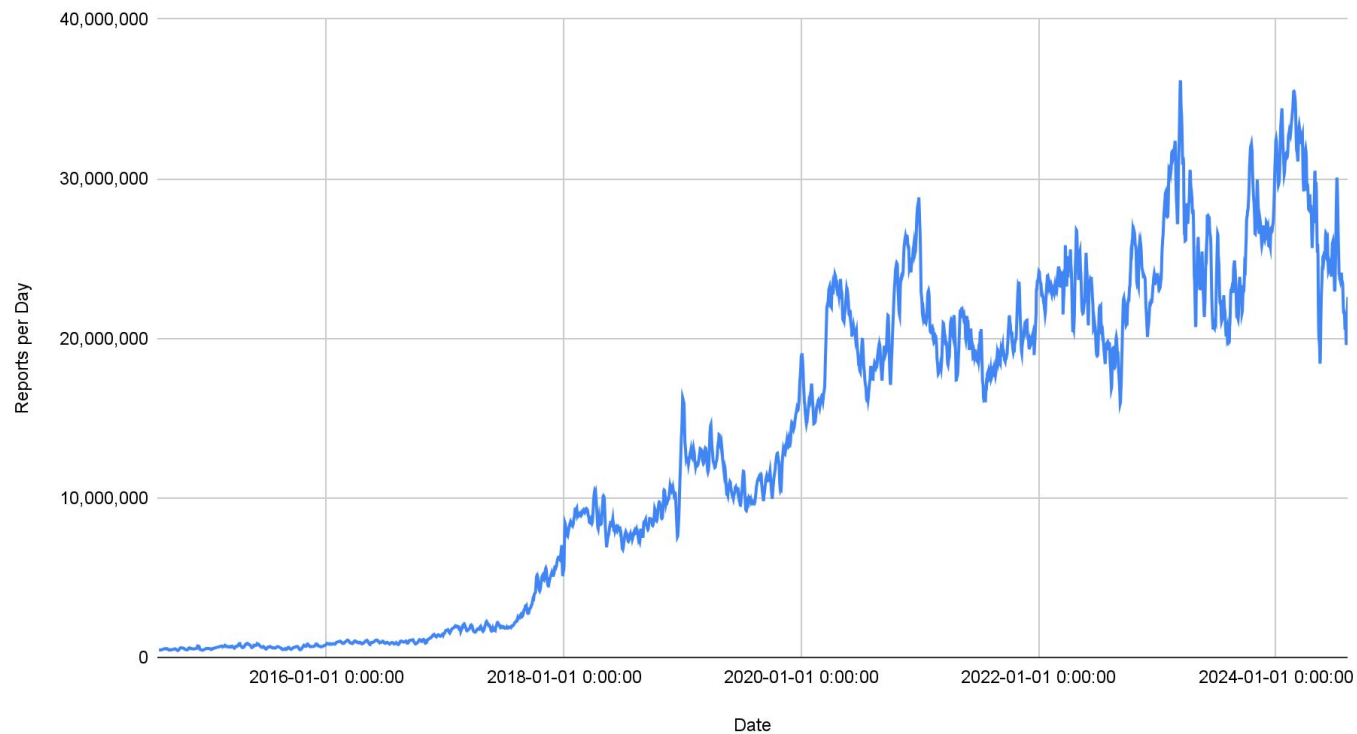
Software	Count
<a href="#"><u>WSJT-X</u></a>	29625
<a href="#"><u>JTDX</u></a>	10664
<a href="#"><u>MSHV</u></a>	2148
<a href="#"><u>JS8Call</u></a>	1561
<a href="#"><u>VarAC V</u></a>	969
<a href="#"><u>OpenWebRX</u></a>	645
<a href="#"><u>KiwiSDR</u></a>	438
<a href="#"><u>ROS</u></a>	158
<a href="#"><u>SmartSDR</u></a>	128
<a href="#"><u>SDR-Control</u></a>	126
<a href="#"><u>fldigi</u></a>	123
<a href="#"><u>SDR Control for Icom</u></a>	121
<a href="#"><u>iFTx</u></a>	104

# Reporters near QTH



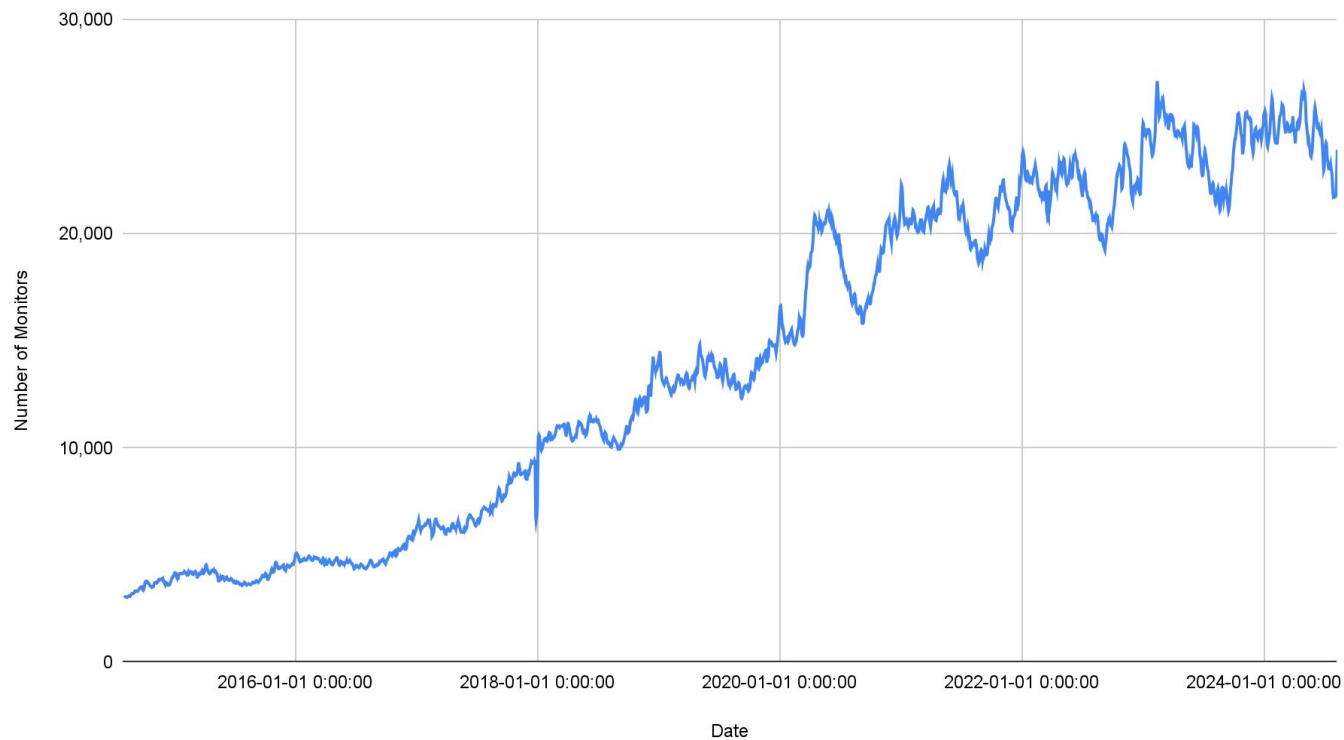
# Growth of reports over 10 years

Reports per Day (Averaged) vs. Date

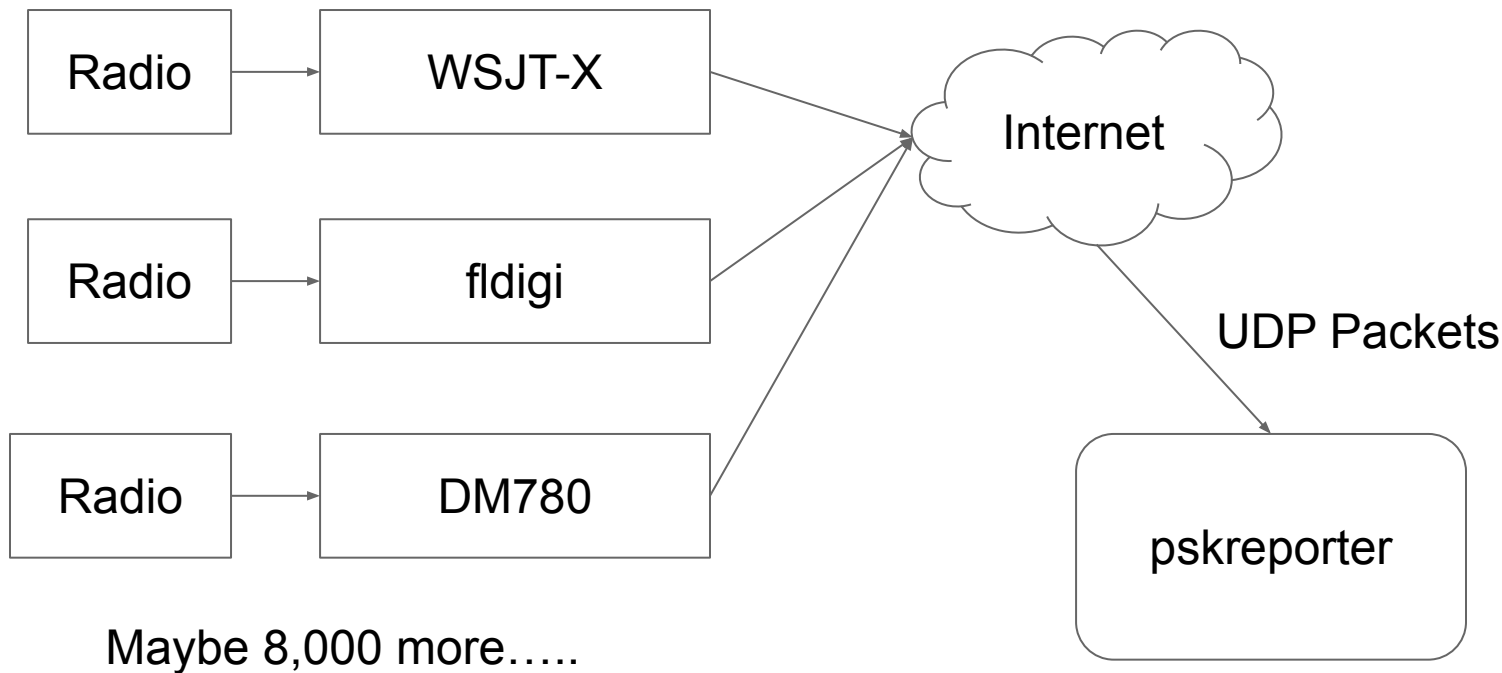


# Growth of Monitors over 10 Years

Number of Monitors (Averaged) vs. Date

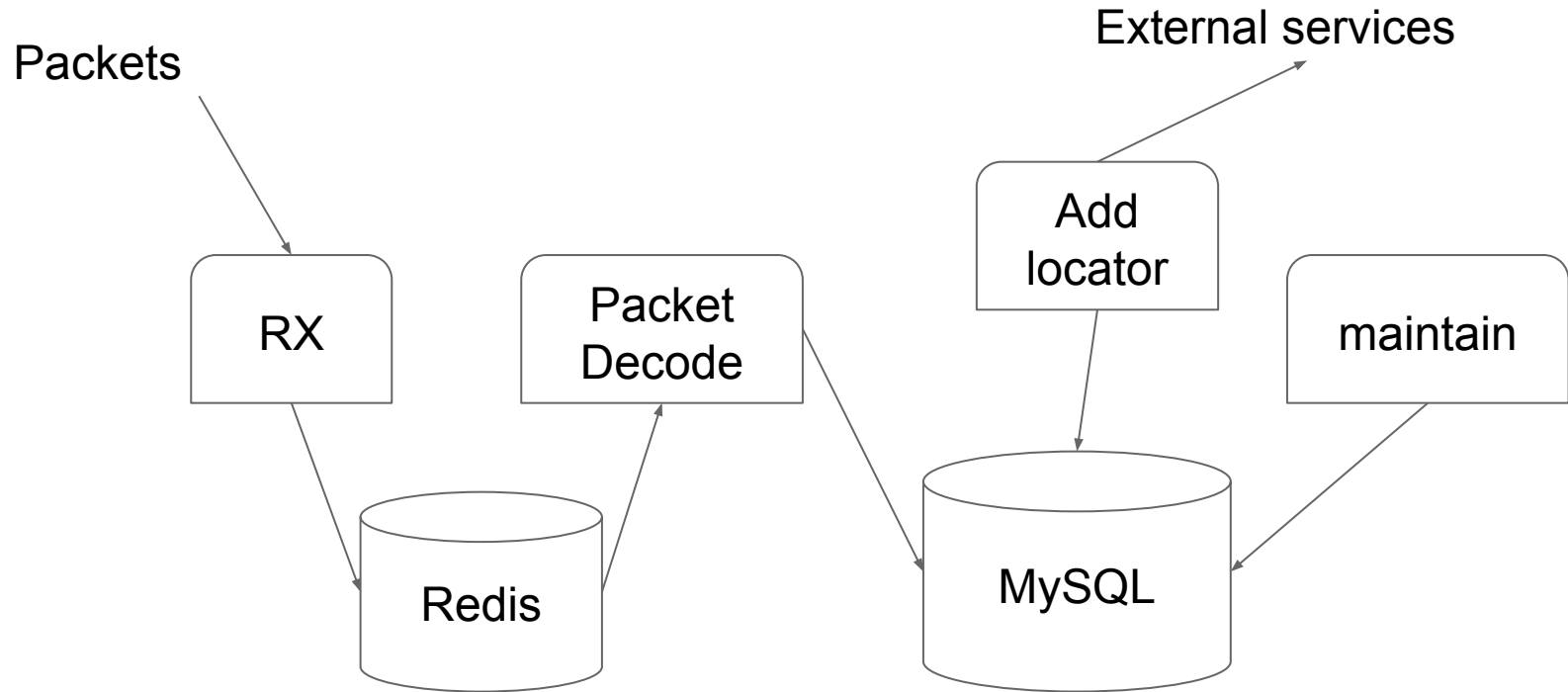


# Architecture - Submission

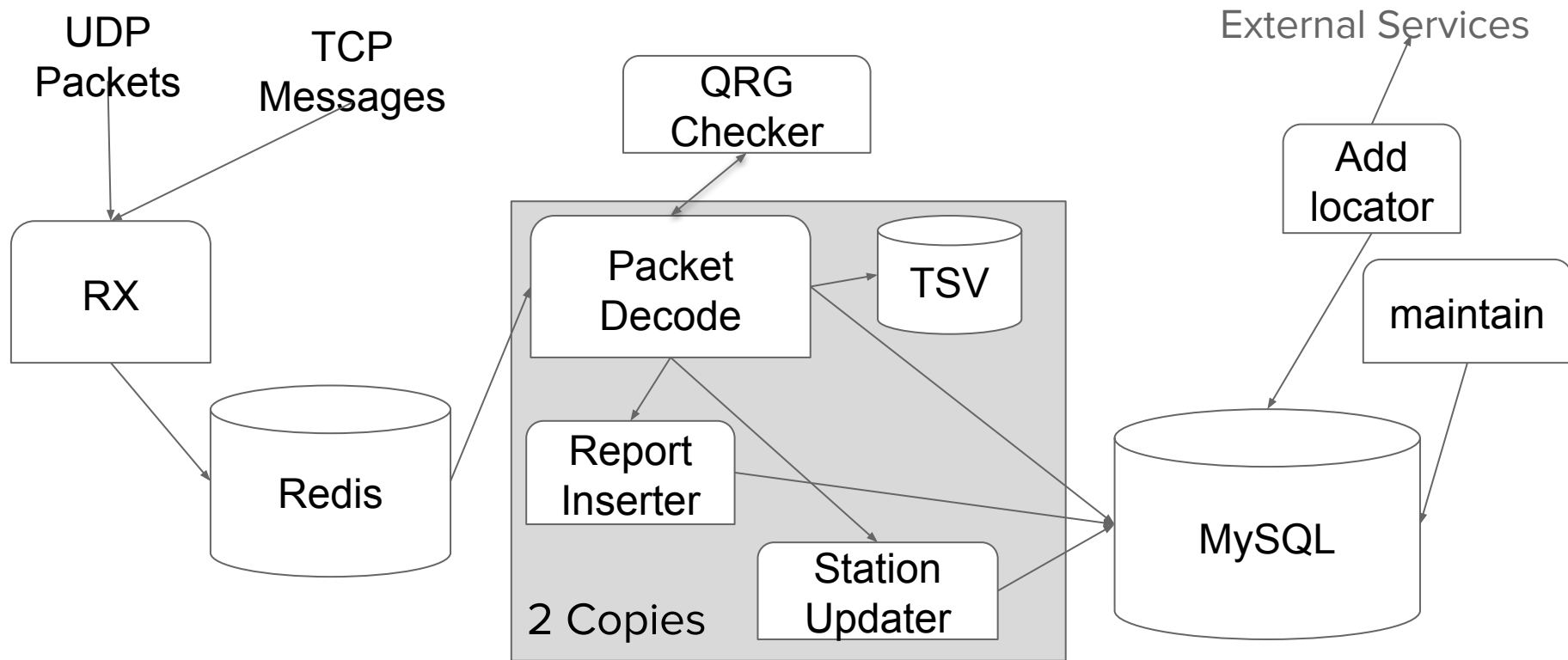




# Conceptual Architecture - Insert



# 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

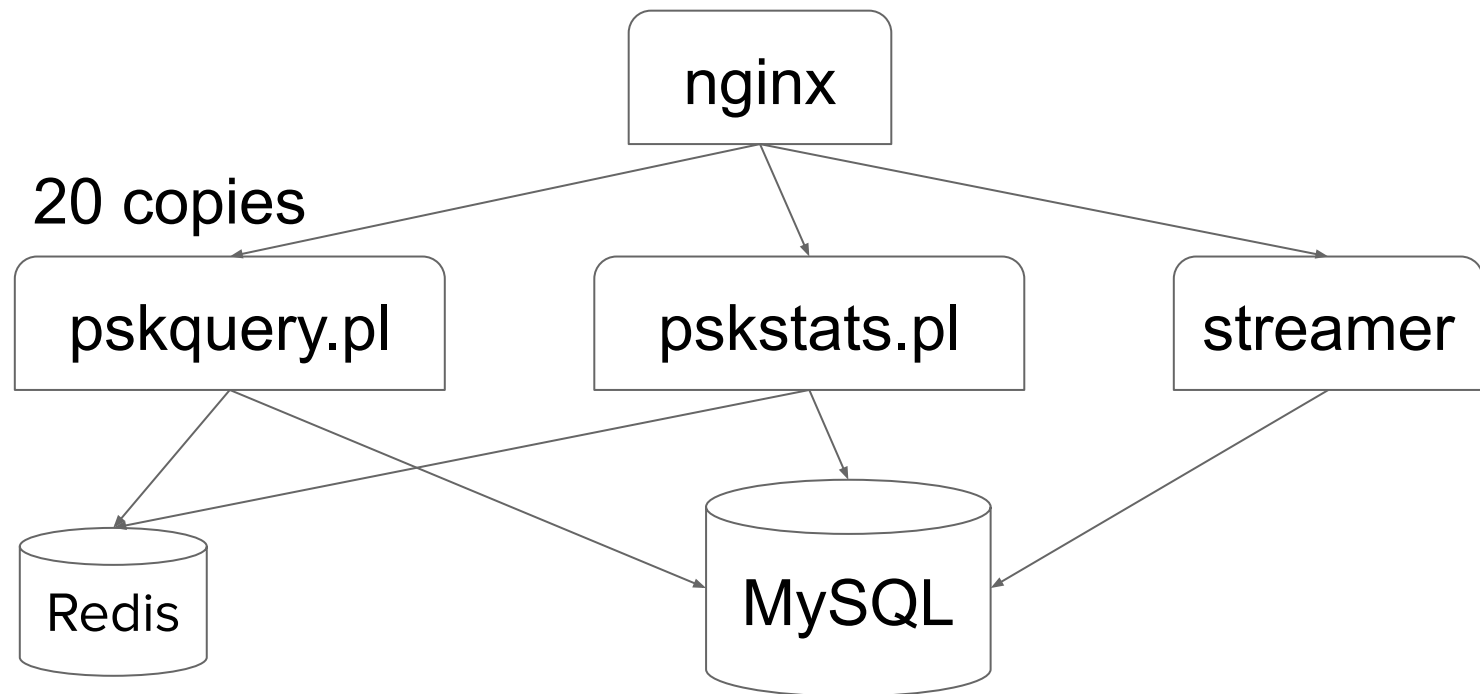
stationInfo - 78M records - callsign, locator, software, antenna, dxcc entity. Most of them are false decodes with one report.

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/Ing 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, MOLTE
- 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