FT8

A Powerful Mode for DX

Larry Banks, W1DYJ

First licensed: 1962 (KN1VFX)

W1DYJ since 1966 – Amateur Extra

10 Matthews Way   Harpswell   ME [FN43xs]

33 Blueberry Hill Road   Woburn   MA [FN42kl]

FT8

Agenda

- **Intro to WSJT-X / FT8**
- **HW Setup**
- **SW Setup**
- **JTAlert**
- **Reporting Sites**
- **Summary**

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I will not be discussing clones: JTDX, etc.

FT8 Agenda

- **Intro to WSJT-X / FT8**
- HW Setup
- SW Setup
- JTAlert
- Reporting Sites
- W1DYJ experience

INDEXA

FT8 is Controversial!

(Disruptive Technology)

FCC Part 97:

Advance the communication and technical skills of radio

FT8 →→ RTTY, PSK, etc.
is like
CW →→ Spark
or
SSB →→ AM

WSJT ~ Weak Signal Joe Taylor

Joe Taylor, K1JT, is a retired Princeton professor and a _Nobel Prize_ in Physics : *(discovered a new type of pulsar)*

The original version was introduced ~ 2001

WSJT is a computer program for amateur **VHF/UHF communication** using state-of-the-art digital techniques. It can help you to make contacts using fraction-of-a-second signals reflected from meteor trails, as well as steady signals more than 10 dB below the threshold of audibility. Distinct protocols or "modes" are provided for different types of propagation:

JTMS	For meteor scatter.
FSK441	For meteor scatter.
FSK315	For meteor scatter.
ISCAT	Optimized for meteor and ionospheric scatter on 6 meters.
JT6M	Optimized for meteor and ionospheric scatter on 6 meters. [2002]
JT65	For Earth-Moon-Earth (EME, "moonbounce") and weak troposcatter. [2003]
JT4	Designed for EME on microwave bands.
CW	For EME using timed, computer-generated transmissions.
Echo	For testing echoes of your own signal from the Moon.

WSJT–X *"experimental"* Aug 2017 2.0.0

Adds

JT9 — Optimized for the LF, MF, and HF bands

QRA64 — EME

MSK144 — Meteor Scatter on the VHF bands

WSPR — **W**eak **S**ignal **P**ropagation **R**eporter: probing potential propagation paths

FT8 — Targeted **multi-hop sporadic E propagation on 6m and possibly higher VHF bands**…shorter T/R period than JT65 or JT9 due to the sometimes very short openings.

The popularity of FT8 on HF is largely a happy accident in that it fulfilled a latent frustration of many potential users of WSJT-X with the slow rate of QSOs using 1 minute T/R periods.

Email, 1/10/19, Bill Somerville, G4WJS

What is FT8's Sensitivity

Typical S/N (BW = 2500 Hz.):

SSB	+10 dB
CW	+/- 0 → - 10 dB
	- 15 (good radio/ears)
FT8	- 21 dB
WSPR	- 31 dB

More sensitive than CW!

From Joe Taylor, K1JT

What is FT8?   Technically

Named for:

Steven *F*ranke: K9AN & Joe *T*aylor: K1JT

An 8 tone -frequency shift keying format [FSK] *[1 baud = 3 bits]*

15 Second T/R timing

Tone spacing: 6.25 Hz

50 Hz bandwidth

77 bit word + 14 bit CRC

→ 2^{77} = 151,115,727,451,828,646,838,272
(about 1.5×10^{23}) possible messages.

What is FT8? Operationally

- *Designed for WEAK SIGNAL Qs*
- *Absolute minimum info to be "legal" QSO*
- *Very structured syntax*
- *Maximum of 13 free form characters (TX5)*
- *Both ends must use the same syntax*

NOT QRP!
Not for Ragchewing

What is FT8?   Operationally

- *Designed for WEAK SIGNAL Qs*

- *Absolute minimum QSO info*

- *Maximum of 13 free form characters (TX5)*

- *Very structured syntax*

• *Both ends use same syntax* [automated]

CQ W1DYJ FN42	*TX6*
W1DYJ W1XXX FN43	*TX1*
W1XXX W1DYJ SN [s/n ratio]	*TX2*
W1DYJ W1XXX R-SN	*TX3*
W1XXX W1DYJ RRR *[or RR73]*	*TX4*
W1DYJ W1XXX 73	*TX5 can be customized*
	[13 characters]

[Use if you expect a "73"]

[Use if you don't expect a "73"]

Versions of FTxxx

WSJT-X 2.0　　　　　**Aug 2017**　　**FT8**

WSJT-X 2.1　　　　　**Jul 2019**　　**FT4**
- Aimed at CONTESTING: twice as fast, half the sensitivity
- Better FT8 transmitted signal characteristics

WSJT-X 2.2　　　　　**Jun 2020**
- Decoder Improvements
- New EU Contesting format

WSJT-X 2.3　　　　　**Feb 2021**　　**FST4   FST4W**
- FST4/4W designed for use on the LF and MF bands
- Additional improvements for other modes

WSJT-X 2.4.0-rc1　　**Feb 2021**　　**Q65**
- EME / very weak signal VHF/UHF

FT8 Growth ~ [from ClubLog: 2017-2019]

% Share of Modes Stored in Club Log from 2017 to 2019

Legend: FT8 — CW — Phone — RTTY — Other — PSK
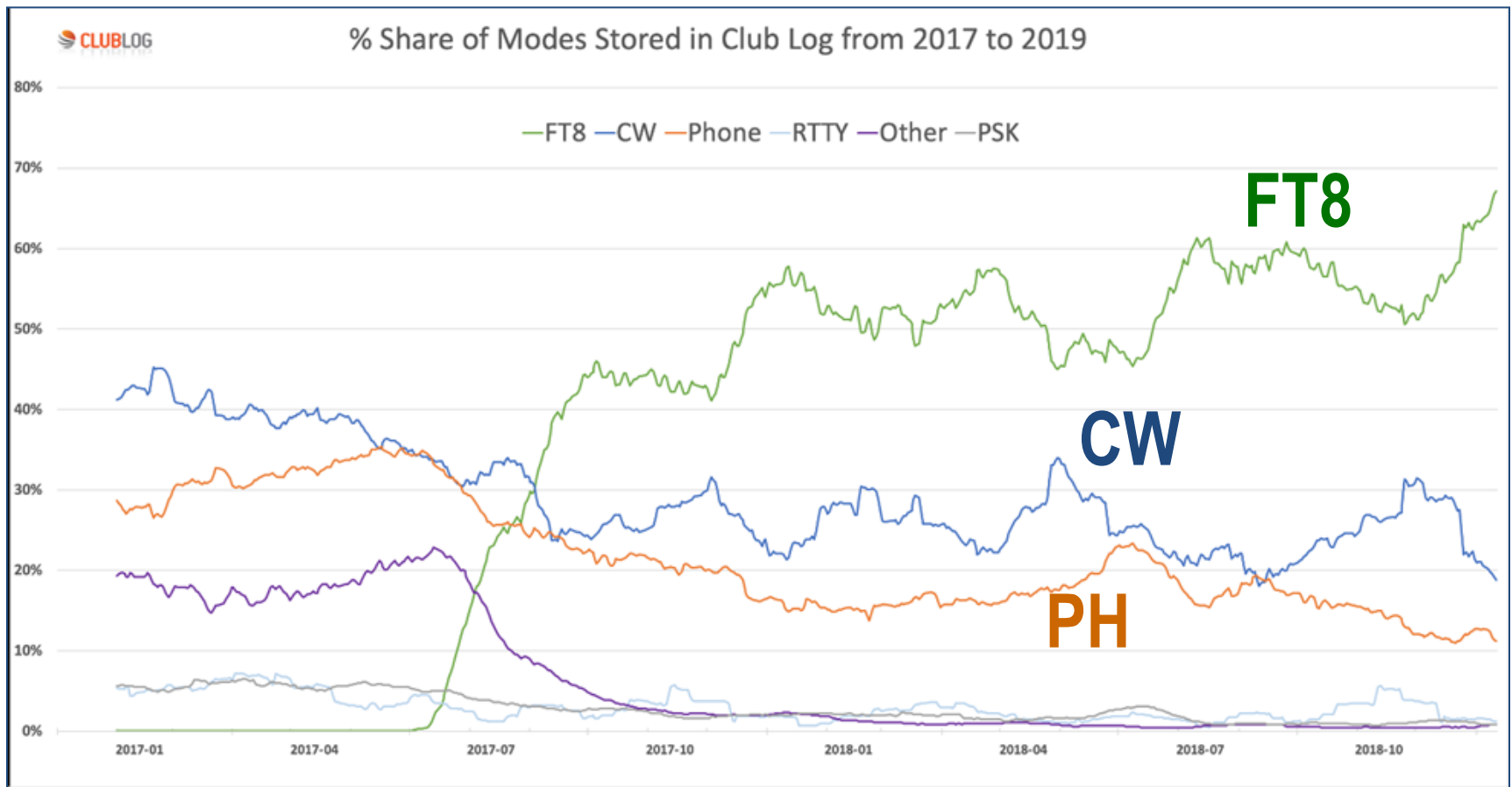
Why FT8?   *[for W1DYJ]*

- *Gave up on PSK years ago*

- *Tried JT65 – slow!*

- *FT8 is More Sensitive than CW*

  - *Important for someone (like me) with MEAGER CW skills*

- *Makes running barefoot with homebrew antennas viable for DX!*

FT8 Agenda

- Intro to WSJT-X / FT8
- **HW Setup**
- SW Setup
- JTAlert
- Reporting Sites
- Summary

HW Setup ~ Essentially the same as PSK31 or AFSK RTTY

Harpswell ME

USB

USB

Rig Control

Audio Control

14.282.40

TS-590S

Rig with USB

HW Setup ~ Essentially the same as PSK31 or AFSK RTTY

Woburn, MA

USB

USB

Keyspan
USB >> Serial

Audio

RS232

RS232

Rig Control

RTSystems
USB >> Serial

RIGBlaster
NoMic

Audio Control

TS-2000
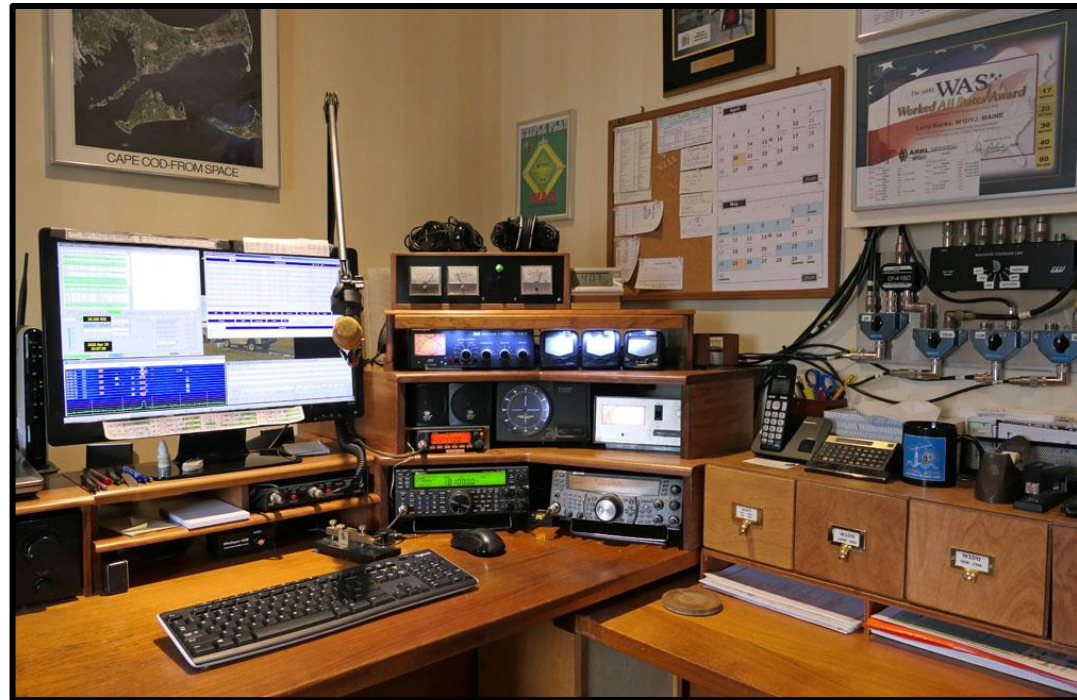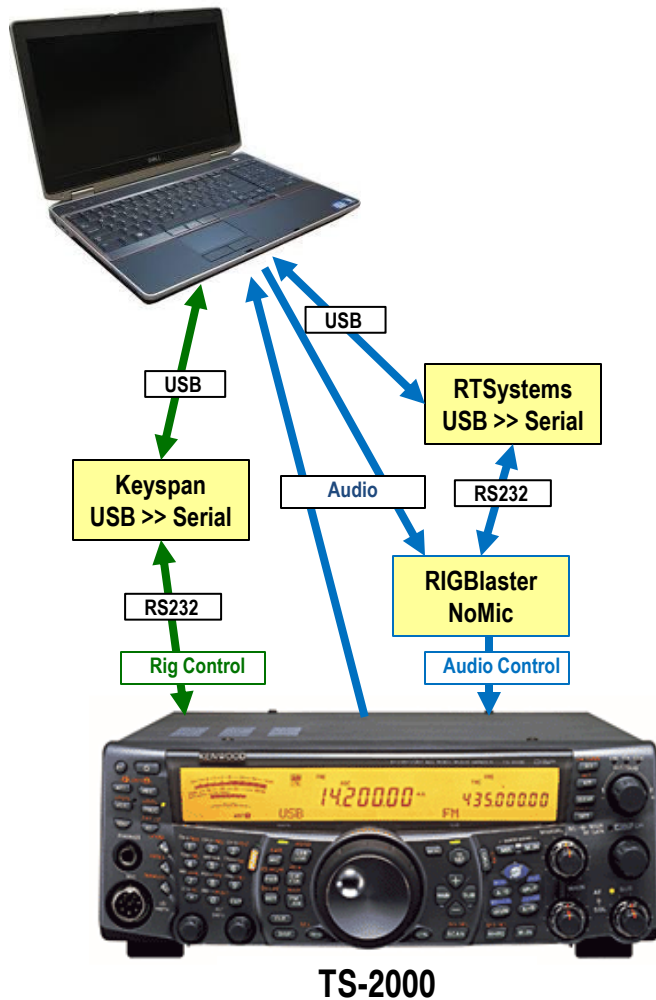
Rig without USB

FT8 HW Setup

Essentially the same as PSK31 or AFSK RTTY

Rig Setup

Rig Dependent

Transmitting

→NO processing, ALC ~0, FLAT equalization

Receiving

→ NO noise reduction, FLAT response, full SSB BW

→*Let the WSJT-X software do it's thing*

FT8 Agenda

- Intro to WSJT-X / FT8
- HW Setup
- **SW Setup**   *[Windows, Linux, macOS]*
- JTAlert
- Reporting Sites
- Summary

Email groups:
General: *wsjtx*
"RCs":   *wsjt-devel*

FT8 SW Setup

Read the Fine Manual

RTFM!

You WILL NOT operate FT8 effectively if you don't.
I'm only covering a small portion of the application.

Windows Clock → **Meinberg NTP**
[or GPS Dongle if no Internet]

Check your computer with: *"time.is"*

FT8 GUI

Graphical User interface
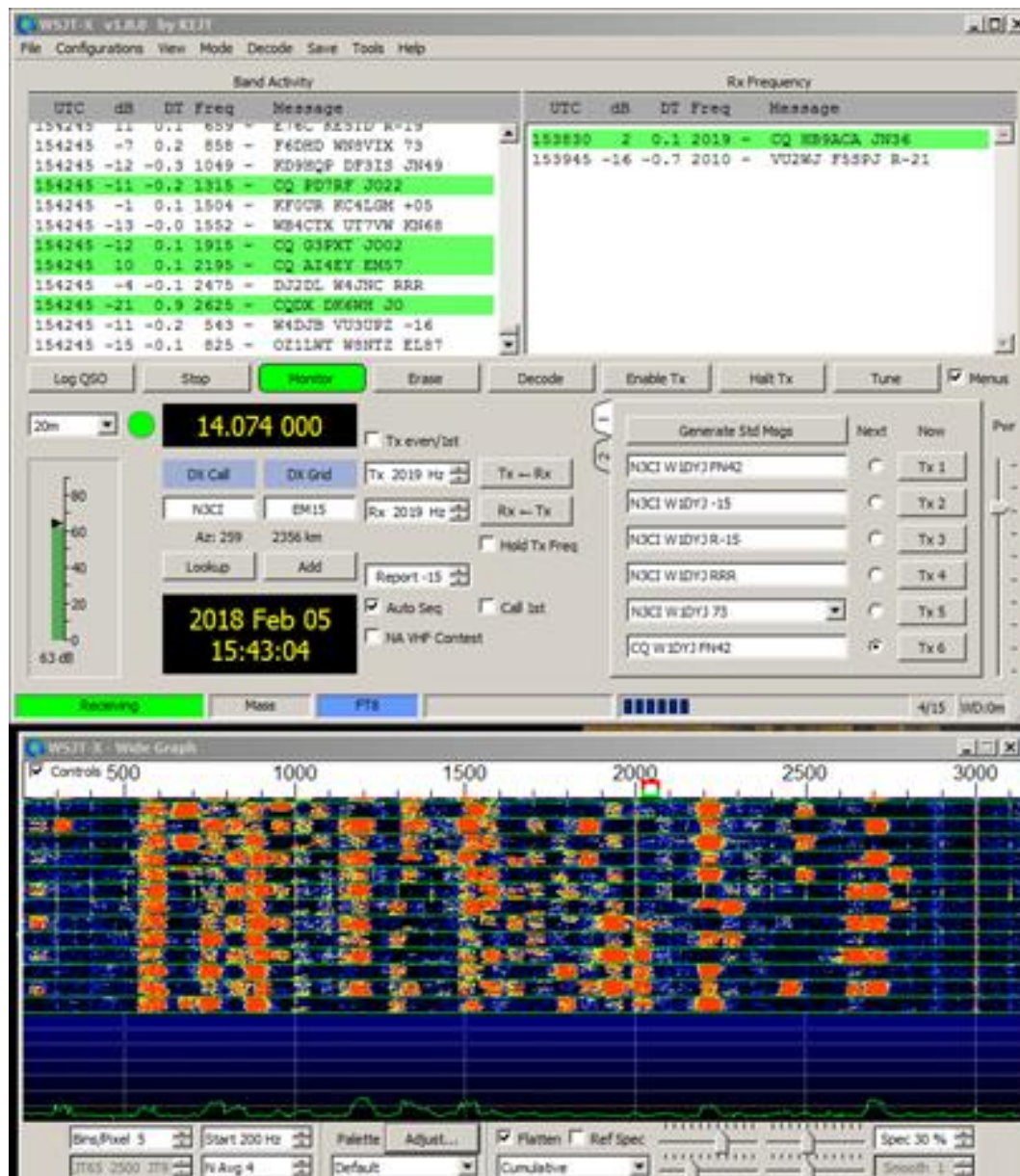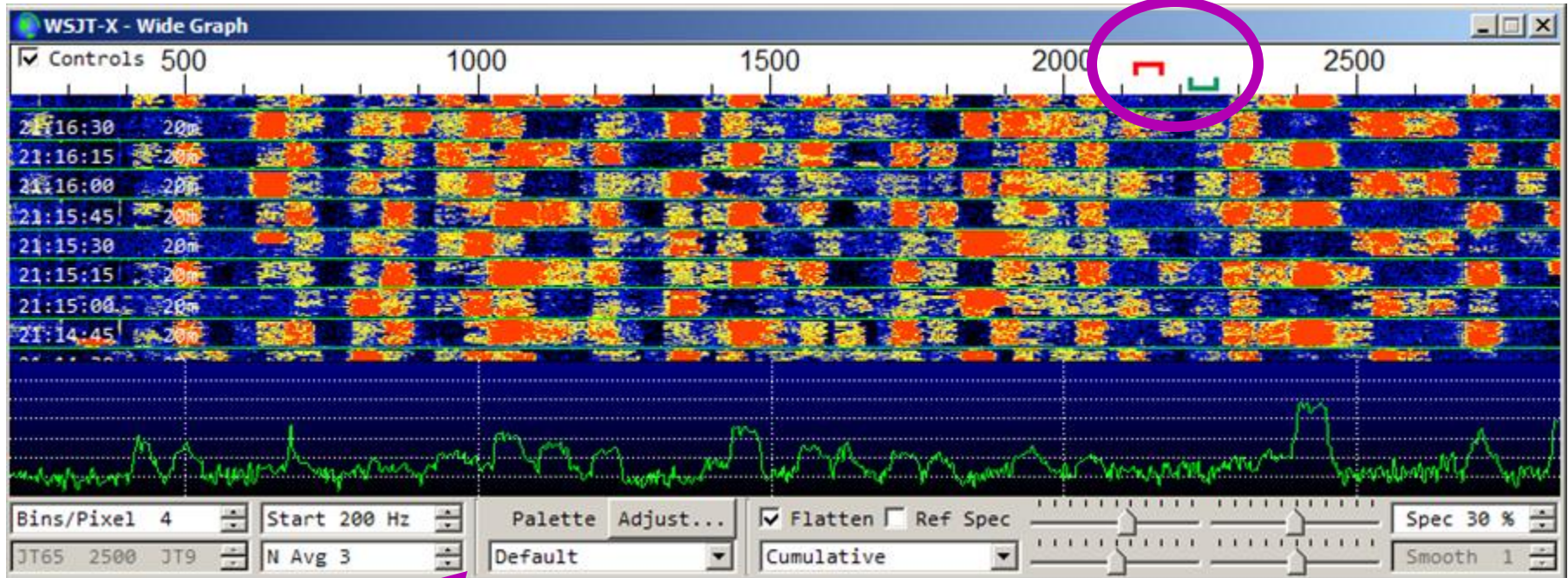
FT8 GUI ~ Waterfall

FT8 Control

All Signals in Waterfall

What you are listening to

UTC dB DT Freq Message

```
WSJT-X  v2.2.2  by K1JT, G4WJS, and K9AN
File  Configurations  View  Mode  Decode  Save  Tools  H

                    Band Activity
  UTC   dB   DT Freq   Message              UTC   dB   DT Freq   Message
211930  -1  0.3 2532 ~  W6JH EB3JT RR73      211330 -19  0.1 2219 ~  <LU2ICA> SX200HXX 73
211930 -10 -1.1 2444 ~  CQ N3ITT FN20        211430 -19  0.1 2219 ~  <YV5OIE> SX200HXX
211930 -14  0.1  431 ~  ND4X EA3GBY RRR      211800 -19  0.1 2219 ~  <XE1KIM> SX200HXX
211930  -6  0.3 1576 ~  HP2NG AC0DH EN34     211815   8 -0.0 2394 ~  CQ KI5GIG EM53
211930   2 -0.0 1731 ~  VE3KPD EA8ACW R-15   211833  Tx       2122 ~  KI5GIG W1DYJ FN42
211930   0  0.1 2643 ~  WB9SDD EA5WO IM99    211845   8 -0.0 2394 ~  CQ KI5GIG EM53
211930  -5  0.1 2533 ~  CQ USA IW2ILQ JN45   211900 -14  0.1 2389 ~  KR7LD N6TN +02
211930  -2 -0.0 1893 ~  EA5GTU K5JNT -10     211900 -20  0.1 2403 ~  AE4S IW4APB JN45
211930 -10  0.1 1590 ~  LU2ICA VA3LX FN14    211915   3  0.0 2394 ~  CQ KI5GIG EM53
211930   1  0.2  822 ~  GM4UBJ PT2GMA RR73   211930 -18  0.1 2388 ~  KR7LD N6TN RR73
211930 -19  0.0 1432 ~  N8CQD K5DGC RR73
211930   1  0.2 1331 ~  9J2MM WD4CNO R-15
211930 -21  0.1  219 ~  CQ LU3EMB GF05
211930 -16  0.6 1499 ~  KC2DUX EA5ITJ -12
211930 -21  0.2 2780 ~  YV4GLF DJ6MN R-11
211930 -18  0.2  631 ~  HP2NG WA0YMH EM13
211930  -7  0.2 2579 ~  N1UL EA3C -15
211930 -12  1.9 2405 ~  AE4S EA3ENB JN11
211930  -6  0.1 1987 ~  KB3AAY AK6A +08
211930 -10 -0.5  879 ~  CQ DX K7PAX CN88
211930  -9  0.1  845 ~  W4FXI EC3A -13
```

Clicking on CQ call → starts xmit

```
☐ CQ only   Log QSO    Stop    Monitor   Erase    Decode   Enable Tx  Halt Tx   Tune   ☑ Menus

20m ▼   (S)  14.074 000      ☑ Tx even/1st        Generate Std Msgs  Next  Now
                           Tx  2122 Hz ☑ Hold Tx Freq
                                                    KI5GIG W1DYJ FN42   ⦿   Tx 1
        DX Call    DX Grid     ▲       ▼
         KI5GIG    EM53      Rx  2394 Hz ☐          KI5GIG W1DYJ +08    ○   Tx 2
 -80
        Az: 243    1849 km    Report 8 ☐            KI5GIG W1DYJ R+08   ○   Tx 3
 -60    Lookup     Add      ☑ Auto Seq  ☑ Call 1st
 -40                                                KI5GIG W1DYJ RR73   ○   Tx 4
 -20    2021 Feb 16                                 KI5GIG W1DYJ 73 ▼   ○   Tx 5
  0     21:19:54
 56 dB                                              CQ W1DYJ FN42       ○   Tx 6

    Receiving    MA590SG    FT8   Last Tx: KI5GIG W1DYJ FN42  40   ▮▮▮▮▮▮▮   9/15  WD:3m
```

Predefined Messages

TX5

INDEXA

FT8 Control ~ Hold Tx Freq
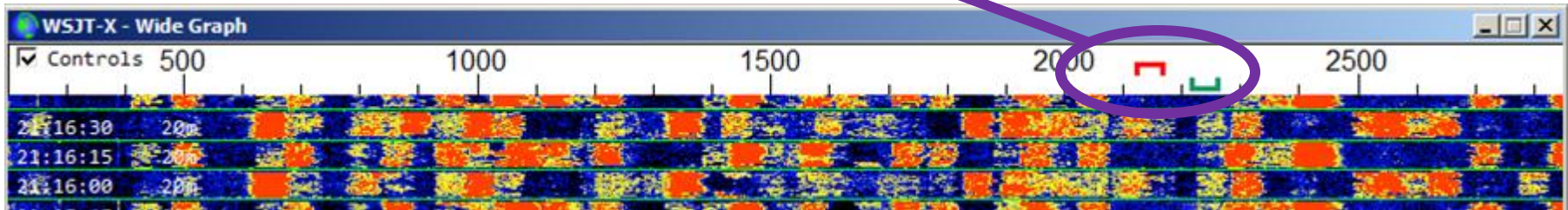
To avoid QRM from competing callers, it is usually best to answer a CQ on a different frequency from that of the CQing station. The same is true when you tail-end another QSO. Choose a Tx frequency that appears to be not in use. **From the WSJT-X online manual**

FT8 Setup Screens ~ *General*

"F2"

From main menu:

FILE >> Settings

FT8 Setup Screens ~ *Radio*

"F2"

Cat Control

FT8 Setup Screens ~ *Fake It*
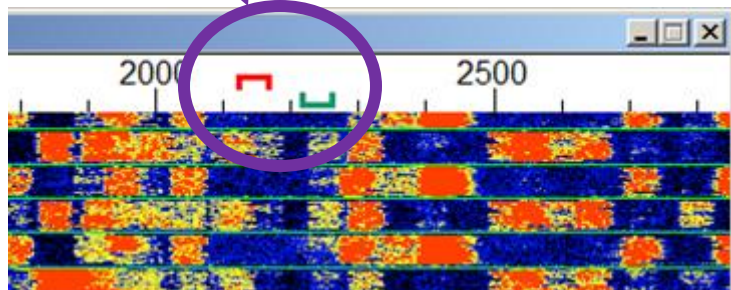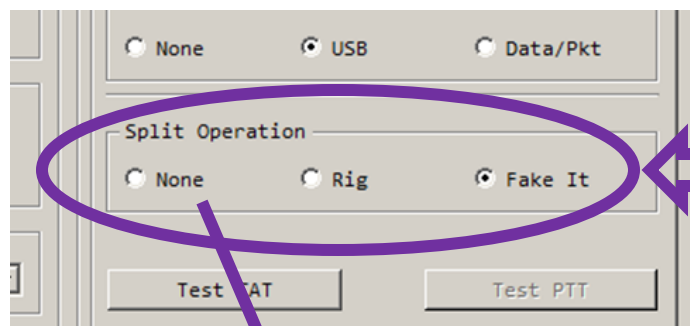
Moves the RF and Audio frequencies in opposite directions, resulting in a cleaner transmitted signal. It keeps the Tx audio always in the range 1500 to 2000 Hz, where the audio pass band is flat, and puts audio harmonics above the audio pass band.

20M:
14074.00 + 2.120 = 14076.12

With Fake It:
14074.50 + 1.620 = 14076.12

FT8 Setup Screens ~ *Fake It*
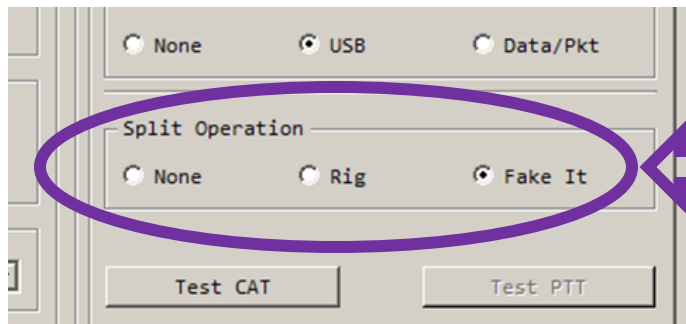
Audio = 400 Hz.

Moves the RF and Audio frequencies in opposite directions, resulting in a cleaner transmitted signal. It keeps the Tx audio always in the range 1500 to 2000 Hz, where the audio pass band is flat, and puts audio harmonics above the audio pass band.
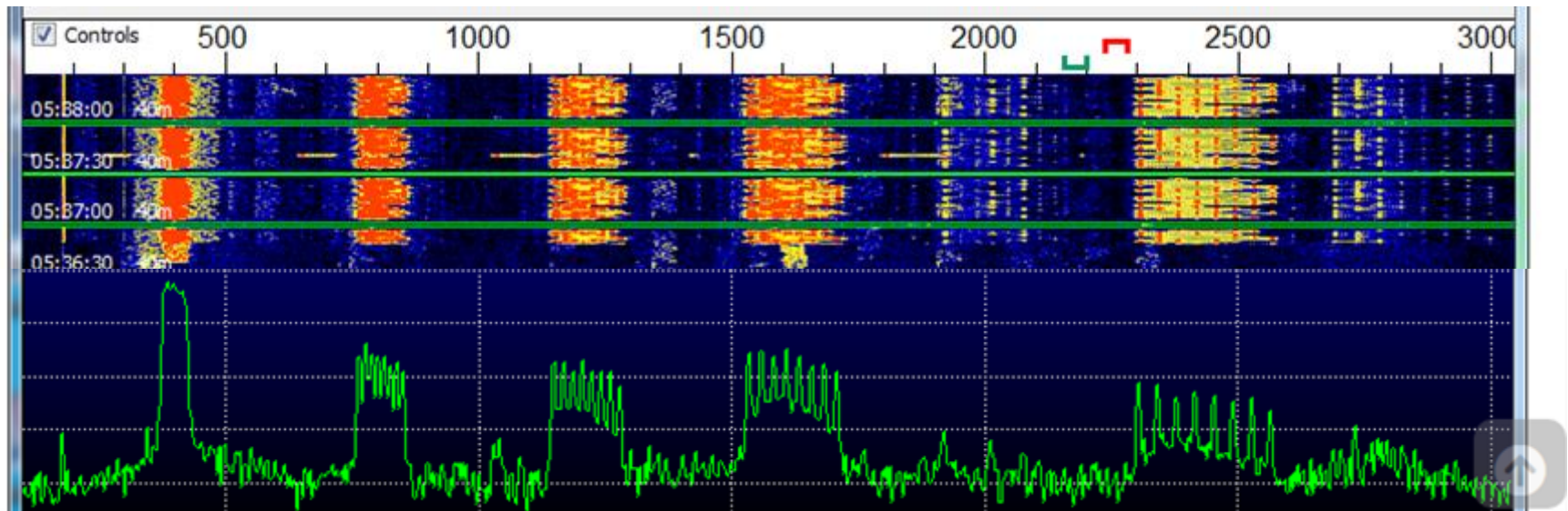
Vastly over modulated and bad harmonics

FT8 Setup Screens ~ *Audio*

"F2"

Configure audio device for 48000 Hz, 16 bits

DO NOT USE the windows default device

Audio I/O

Settings

| General | Radio | Audio | Tx Macros | Reporting | Frequencies | Colors | Advanced |

Soundcard

Input: Microphone (High Definition Aud ▼ Mono ▼

Output: Speakers (High Definition Audio ▼ Mono ▼

Save Directory

Location: C:/Users/Larry/AppData/Local/WSJT-X/save   Select

AzEl Directory

Location: C:/Users/Larry/AppData/Local/WSJT-X   Select

Remember power settings by band

☐ Transmit   ☐ Tune

Don't let extraneous audio into your FT8 audio chain!

OK   Cancel

INDEXA

FT8 Setup Screens ~ *Tx5 Macros*

"F2"

Settings

General | Radio | Audio | Tx Macros | Reporting | Frequencies | Colors | Advanced

[Add] [Delete]

TNX 73 GL
TU NEW ST 73
TU ATNO 73
FROM MAINE 73

For "TX5"

13 characters

[OK] [Cancel]
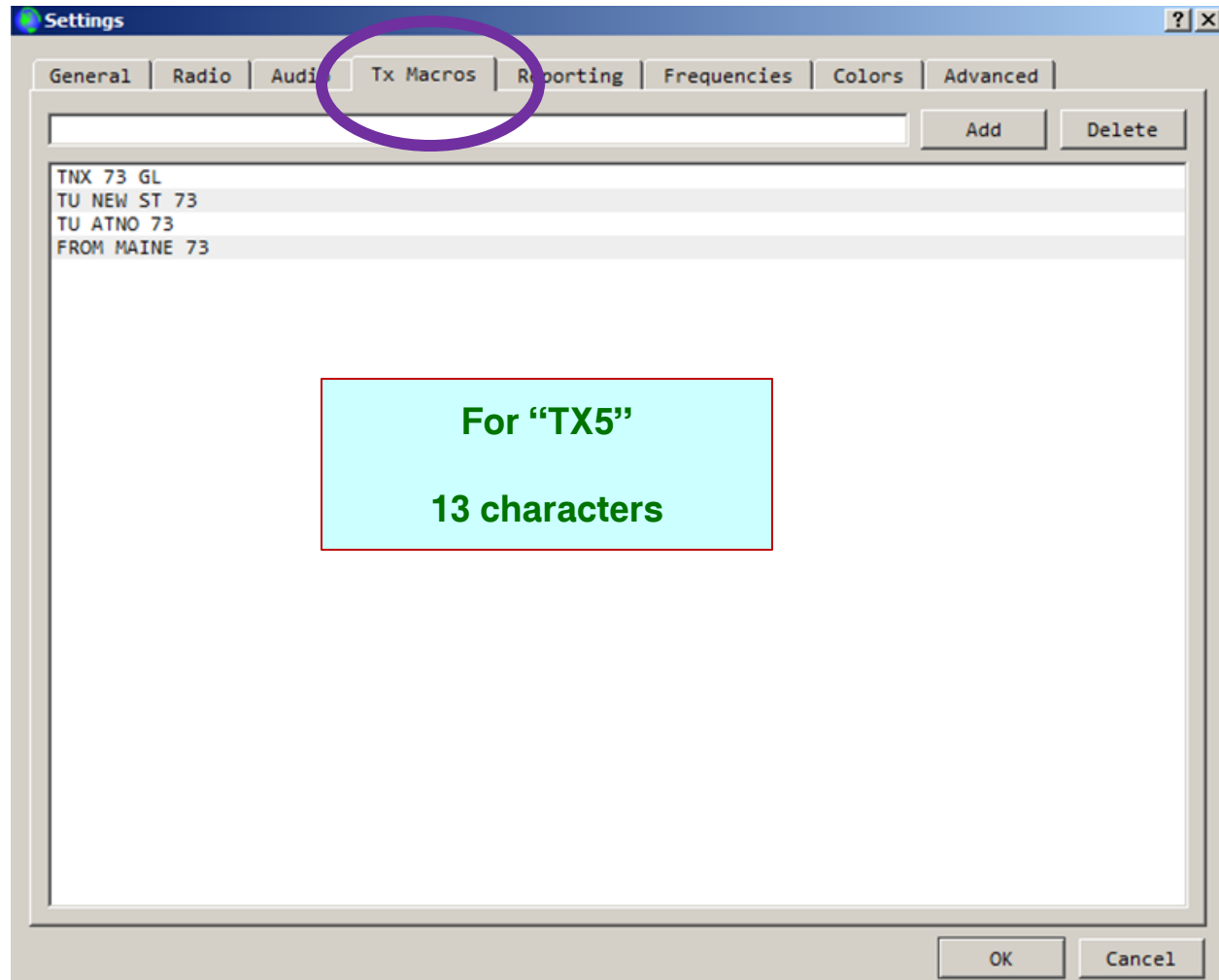
FT8 Setup Screens ~ *Reporting*

"F2"

Check for JTAlert

FT8 Setup Screens ~ *Freq's*

"F2"

FT8 Setup Screens ~ *Colors*

"F2"
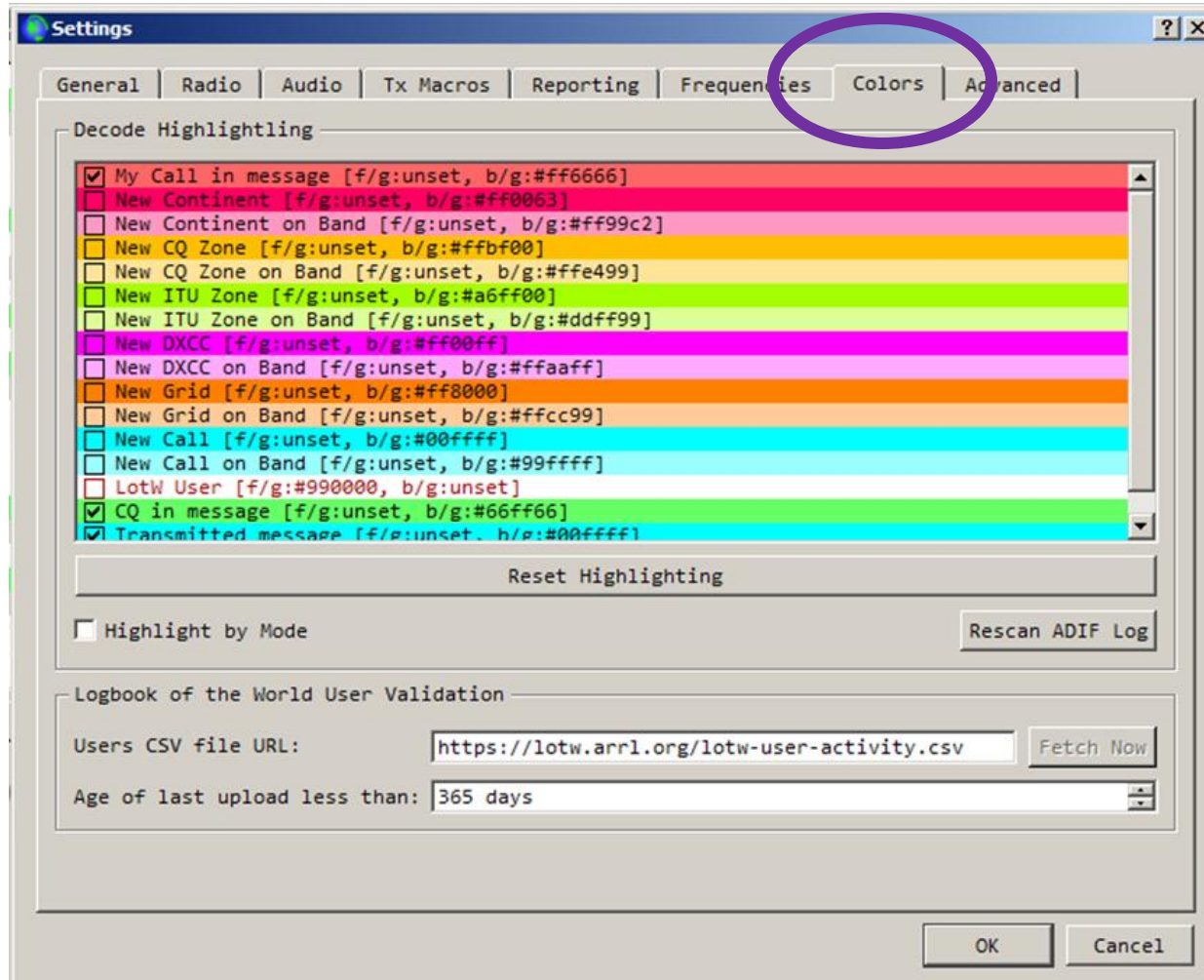
FT8 Setup Screens ~ *Advanced*

"F2"

Settings ? X

| General | Radio | Audio | Tx Macros | Reporting | Frequencies | Colors | Advanced |

JT65 VHF/UHF/Microwave decoding parameters

Random erasure patterns: `6`

Aggressive decoding level: `0`

☑ Two-pass decoding

Miscellaneous

Degrade S/N of .wav file: `0.0 dB`

Receiver bandwidth: `2500 Hz`

Tx delay: `0.5 s`

Tone spacing

☐ x 2   ☐ x 4

☑ **Special operating activity: Generation of FT8 and MSK144 messages**

○ Fox   ○ Hound

⦿ NA VHF Contest   ○ ARRL Field Day   FD Exch: [   ]

○ EU VHF Contest   ○ ARRL RTTY Roundup   RTTY RU Exch: [   ]

[OK]   [Cancel]

INDEXA

FT8 Control ~ the other stuff

RTFM

FT8 Agenda

- Intro to WSJT-X / FT8
- HW Setup
- SW Setup
- **JTAlert → Provides Audio & Visual Alerts.**
- Reporting Sites
- Summary

My 23" Monitor

A large screen is very helpful.

JTAlert

Laurie Cowcher, VK3AMA   *https://hamapps.com/jtalert*

WSJT - X

Logger

- DXLab DXKeeper
- ACLog
- Log4OM
- HRD Log
- Standard ADIF 2.2 file

CQ Border

New State

New DXCC

LoTW "flag"

Clicking on a call → Sets up WSJT-X

Some JTAlert Details
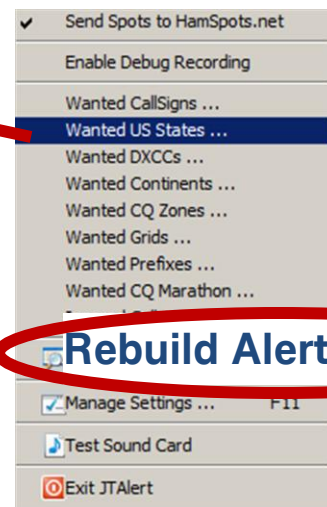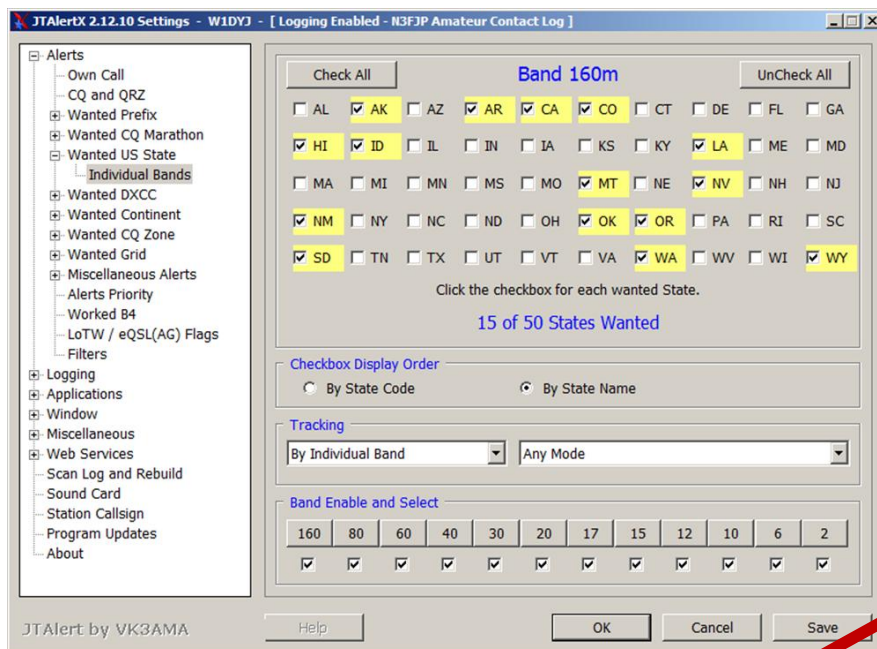
Manual setup

Rebuild Alert Database

Pulls info from logger to JTAlert

Settings
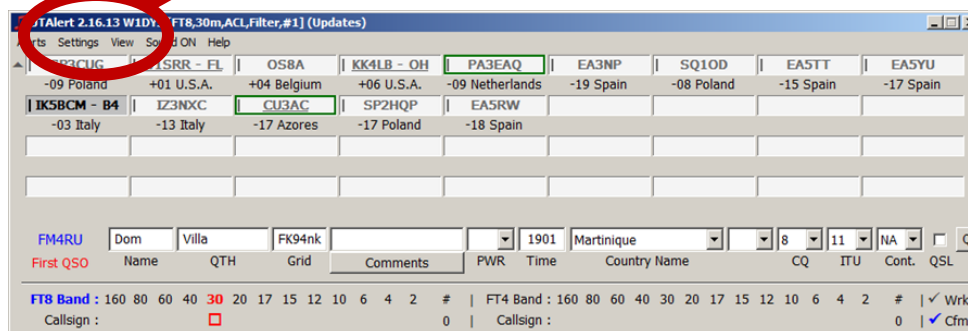
Some JTAlert Details

Cell Alerts and priority

Also has Voice Annunciations:
DX   *New State*   *Calling You*

Show LoTW Flags

Filters   **LoTW only**
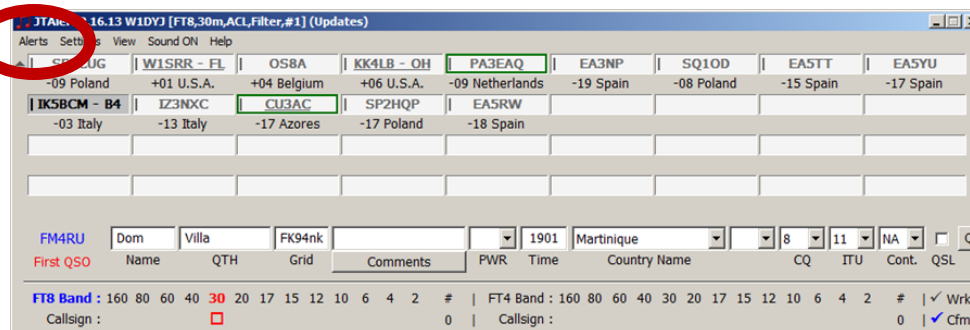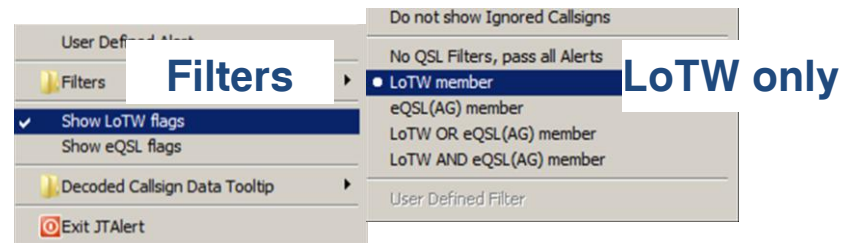
Alerts

Some JTAlert Details


```
Show QSOs History Popup

DXKeeper/DXView/PathFinder Lookups
DXKeeper Previous QSOs
DXView Lookup
Pathfinder Lookup

Open Browser to QRZ.com Callsign page

Add to Wanted CallSigns List
Delete from Wanted CallSigns List

Add to Ignored CallSigns List
Delete from Ignored CallSigns List

Copy Callsign to Clipboard
Send Text Message to Callsign
```

Current Station Transmission Details

	tx	rx	tx	rx	tx	rx		tx	rx	tx	rx	tx	rx
160m					80	40	17m					323	284
80m					235	123	15m					197	105
60m					36	34	12m					9	18
40m	1	1			364	423	10m					90	107
30m					239	278	6m					71	184
20m	6	10	1	3	647	864	ALL	7	11	1	3	+1K	+2K

Unique Callsigns TX/RX per Band
Solar : SFI 68 : A 14 : K 1

JT65   JT9   (Last Update : 21-Aug. 20:43 utc)   FT8

Right Click on Call

Hover

Hover

FT8 Agenda

- Intro to WSJT-X / FT8
- HW Setup
- SW Setup
- JTAlert
- **Reporting Sites**
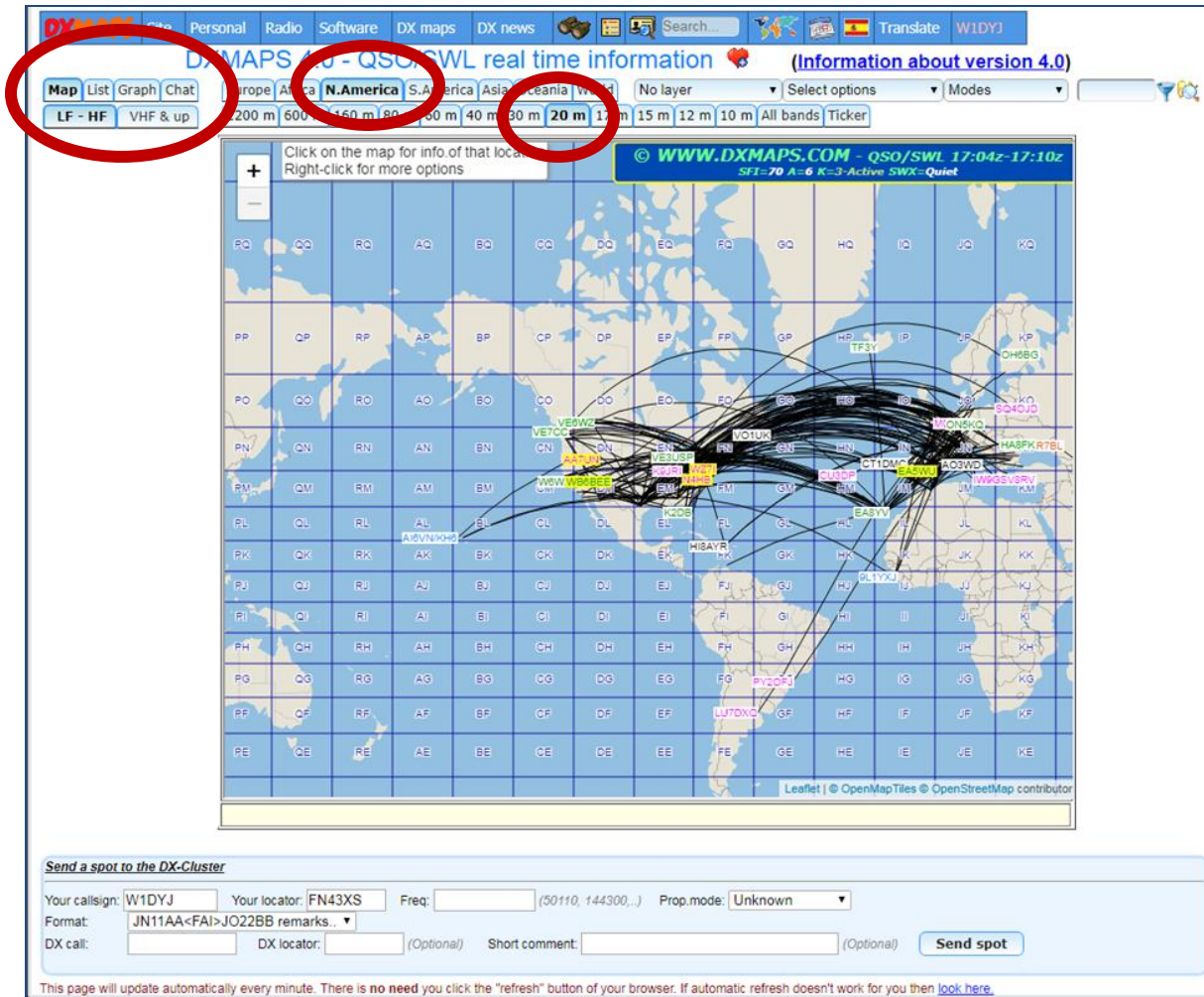- Summary

- *JTAlert*
- *DXMaps*
- *PSK Reporter*

These slides show just a small part of these sites.

Reporting Sites ~ JTAlert

https://hamspots.net/ft8/

Reporting Sites ~ JTAlert ~ *Searches*

https://hamspots.net/ft8/

FT8 Agenda

- Intro to WSJT-X / FT8
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- SW Setup
- JTAlert
- **Reporting Sites**
- Summary

> - *JTAlert*
> - ***DXMaps***
> - *PSK Reporter*
>
> ***These slides show just a small part of these sites.***

Reporting Sites ~ DXMaps ~ *Map mode*

http://www.dxmaps.com/spots/mapg.php

Map

Reporting Sites ~ **DXMaps** ~ *List mode*

http://www.dxmaps.com/spots/mapg.php

Reporting Sites ~ DXMaps ~ *Graph mode*

http://www.dxmaps.com/spots/mapg.php

Graph
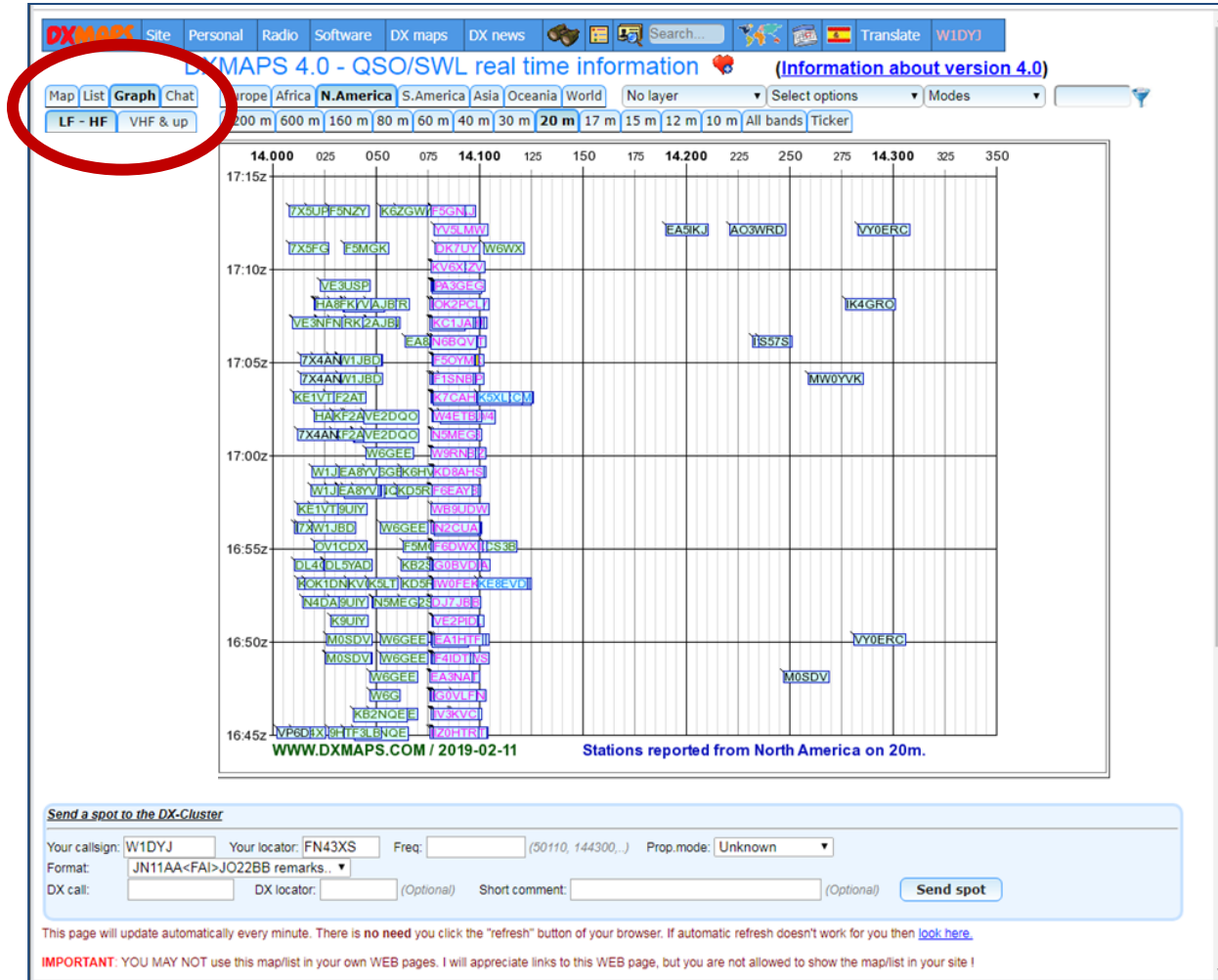
Reporting Sites ~ DXMaps ~ *options*

http://www.dxmaps.com/spots/mapg.php

Highlight a call

Options

DXMaps sends me email alerts for 6M openings

FT8 Agenda

- Intro to WSJT-X / FT8
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- **Reporting Sites**
- Summary

> - *JTAlert*
> - *DXMaps*
> - **PSK Reporter**
>
> *These slides show just a small part of these sites.*

Reporting Sites ~ PSKReporter

https://pskreporter.info/pskmap.html

When first
fired up.

Shows
all bands,
all signals,
all calls,
all modes.

Over a
certain
time
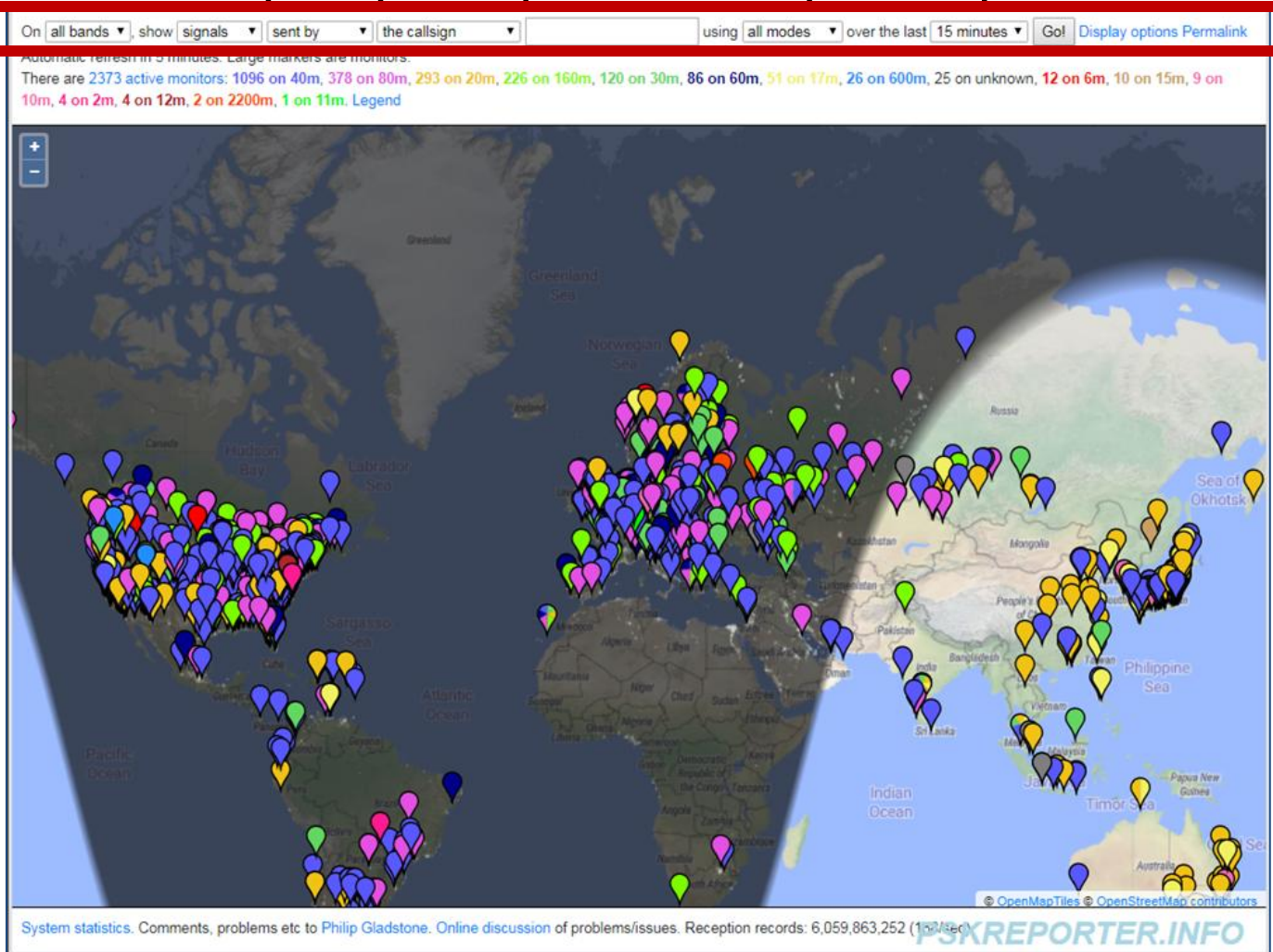
Reporting Sites ~ PSKReporter
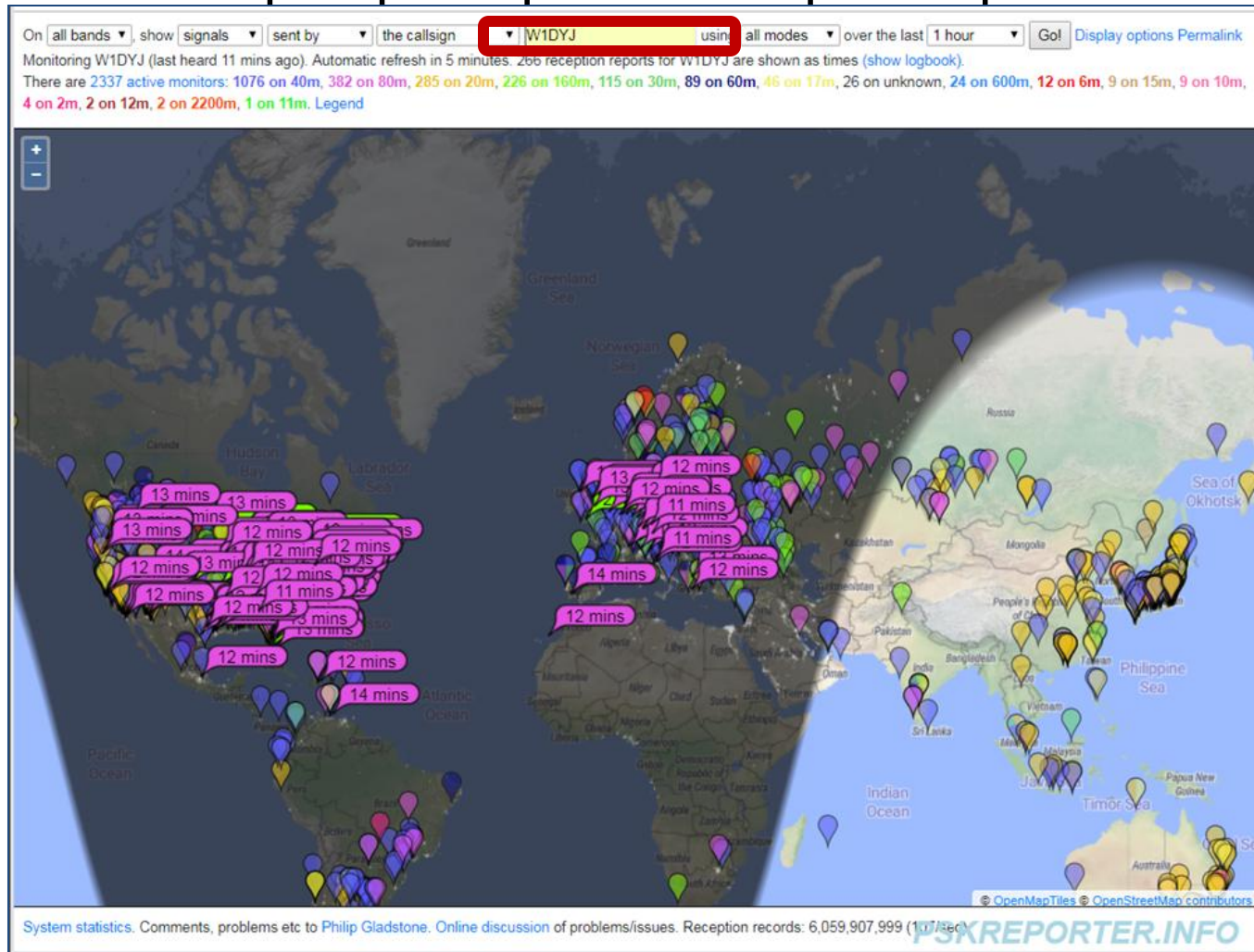
https://pskreporter.info/pskmap.html

Reporting Sites ~ PSKReporter

https://pskreporter.info/pskmap.html
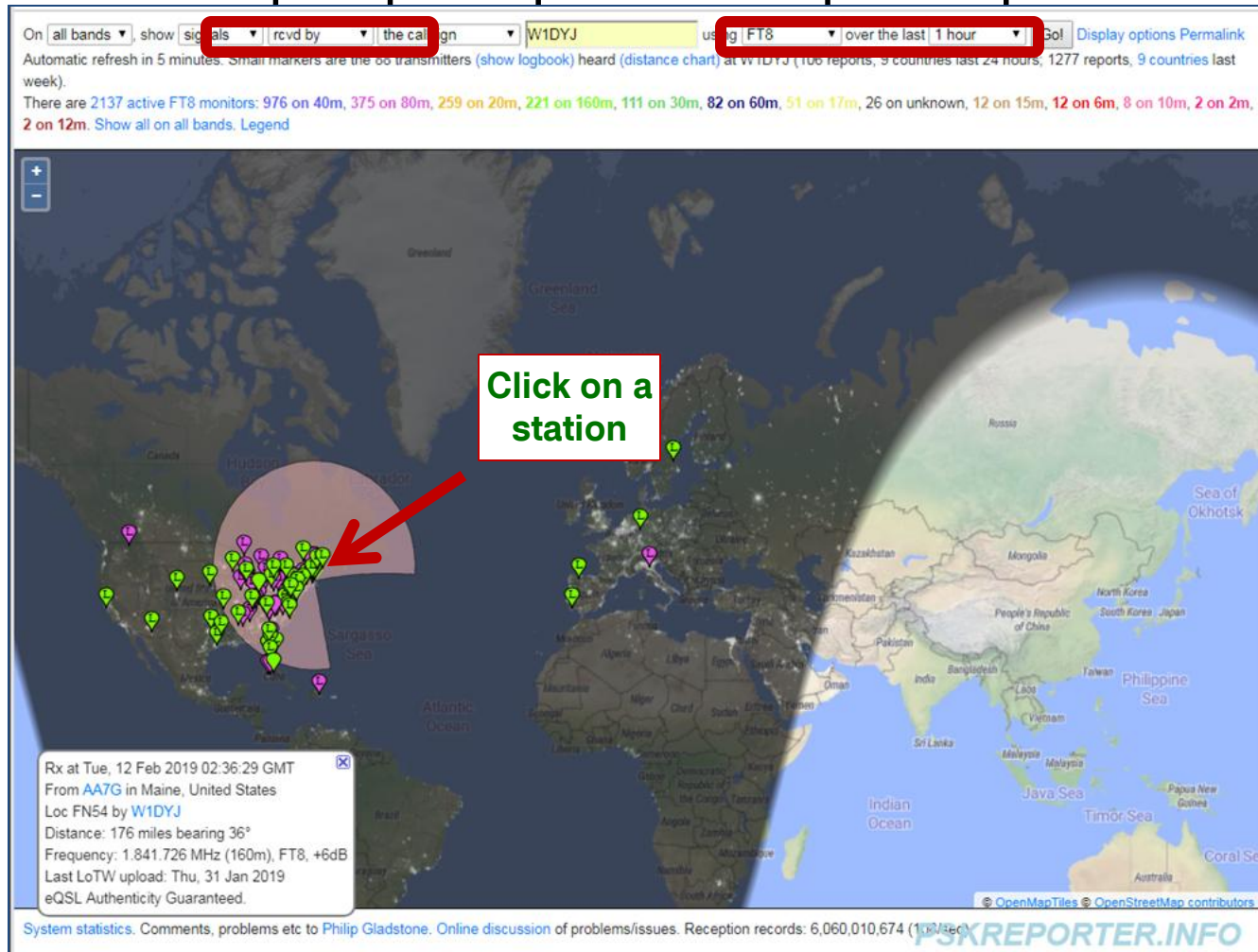
Changed to:

All stations received by W1DYJ over last hour on FT8

Reporting Sites ~ PSKReporter

https://pskreporter.info/pskmap.html

14 Feb '19

Heard by

V84SAA
Brunei

30M

FT8 Agenda

- Intro to WSJT-X / FT8
- HW Setup
- SW Setup
- JTAlert
- Reporting Sites
- **Summary**

Summary ~ W1DYJ DXCC Experience

April 2017

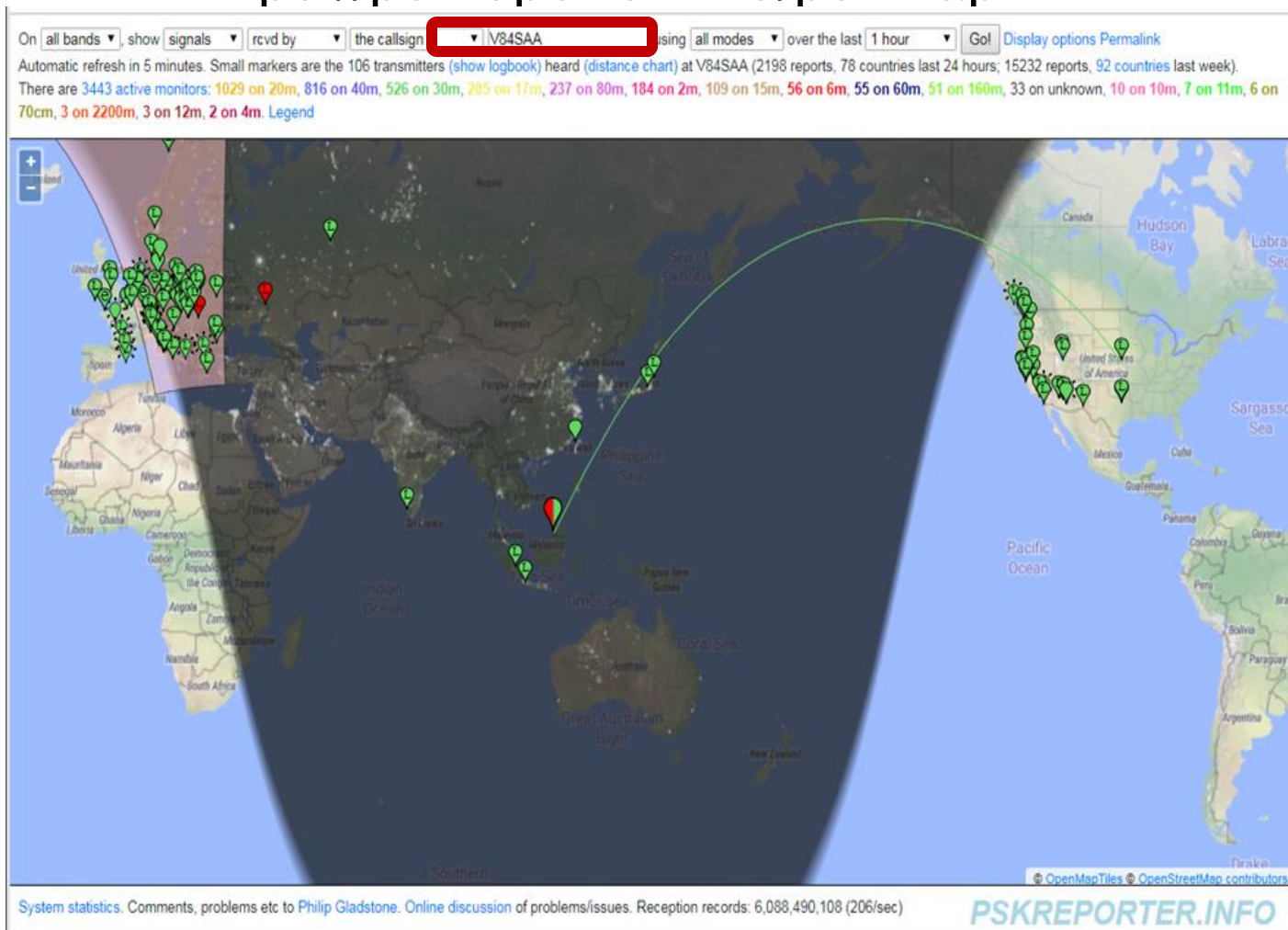| DXCC	Phone 223	CW 166	Digital 61	Mixed 235
160	1	7	0	7
80	60	71	7	86
60				
40			18	
30		48	2	50
20			18	
17	40	19	0	58
15			15	
12	18	6	0	24
10		91	1	
6	25	6	0	26

March 2021

DXCC	Phone 229	CW 201	Digital 180	Mixed 258
160	7	50	63	84
80	71	91	97	
60	0	0	45	45
40				
30		81		
20				
17	47	26		
15				
12	20	11	69	89
10		91	21	
6	26	7	41	52

Summary ~ Some Final Thoughts

- *Be sure your computer clock is accurate*
  - *WINDOWS clock is not!*

- *Be aware of different FT8 modes:*
  - *Contests, Fox/Hound, etc.*

- **SPLIT is good for DX** *[Fake It / Hold TX Freq]*

- *Don't allow extraneous audio in audio chain*

- *How much power???*
  - *"Keep received reports to ~ -5 dB" (Joe T.)*