FT8

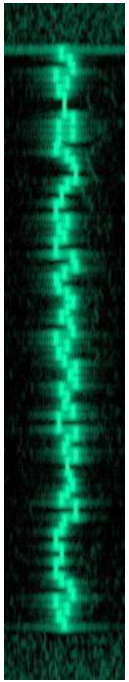
And other digital modes

Agenda

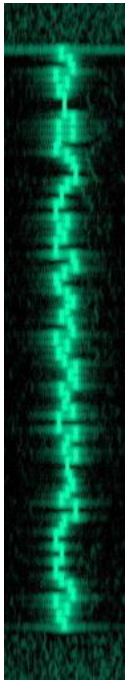
- Some of the modes we have
- FT8
- What is it?
- Characteristics
- How to use it?

Various Digital Modes

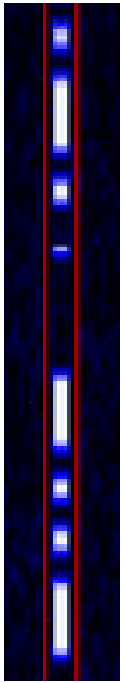
FT8



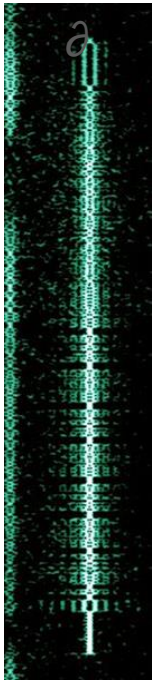
JS8



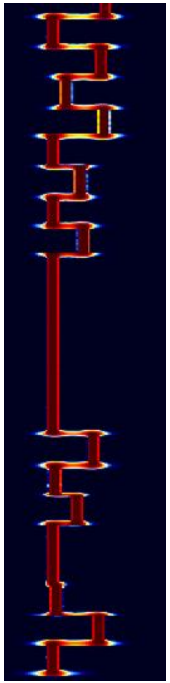
CW



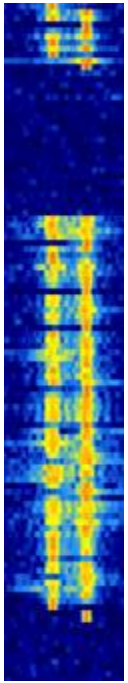
PSK31



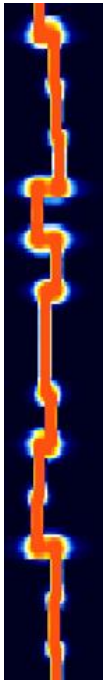
JT65



RTTY



JT9



Sun 4/21 ~1-3p CDT

Mode	Count
FT8	1,540,317
CW	9,921
JS8	3,666
PSK31	1,264
PSK63	754
JT65	515
RTTY	136
MSK144	97
ROS	79
JT9	51
OPERA	40

Sun 5/26 4-6p CDT

Mode	Count
FT8	1,030,053
CW	27,962
JS8	2,701
FT4	420
PSK31	384
OPERA	115
ROS	54
JT65	49
	35

Thu 6/20 7-9p CDT

Mode	Count
FT8	824,432
JS8	3,945
CW	1,820
PSK31	149
JT9	59
OPERA	33
JT65	24

Mon 7/22 1-3p CDT

Mode	Count
FT8	1,017,376
FT4	33,041
CW	3,777
JS8	1466
PSK31	676
RTTY	132
PSK63	128
OPERA	69
MSK144	48

Fri 8/16 2-4p CDT

Mode	Count
FT8	1,441,168
FT4	117,732
CW	7,281
JS8	2,089
PSK31	939
MSK144	378
JT65	123
RTTY	90
OPERA	68
ROS	36
SIM31	31
PSK63	30
FSK441	28

7/15 2.1.0 General Release with FT4

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Removed modes below 20

Weak-Signal S/N Limits

Mode	(B = 2500 Hz)
SSB	~ +10 dB
RTTY	-5
MSK144	-8
CW, “ear-and-brain”	~ -10
FT4	-17
FT8	-21
JT4	-23
JT65	-25
JT9	-27
QRA64	-27
WSPR	-31

} Sweet Spot ?

Slide reused from K1JT presentation

What is FT8?

- Invented by Steve(K9AN) and Joe(K1JT) - July 2017
- Designed for multi-hop Es where
  - Signals may be weak and fading
  - Openings may be short
  - Want fast completion of reliable, confirmable QSOs
- Comparison with slow modes JT9, JT65, QRA64:
  - FT8 is a few dB less sensitive
  - Allows completion of QSOs four times faster
  - Bandwidth
    - Greater than JT9
    - About 1/4 of JT65A
    - Less than 1/2 QRA64.
- Comparison with fast modes JT9E-H:
  - FT8 is significantly more sensitive
  - Much smaller bandwidth
  - Uses the vertical waterfall
  - Offers multi-decoding over the full displayed passband

- Modes:
  - FT8: 8-GFSK BW: 50Hz
  - FT4: 4-GFSK BW 83Hz
  - RTTY: 2 tone, 250hz
  - JT9: 9-FSK BW: 20Hz Tone stops smaller then JT65
  - JT65A: BW: 180Hz

Derived from Joe Taylor (K1JT) comments

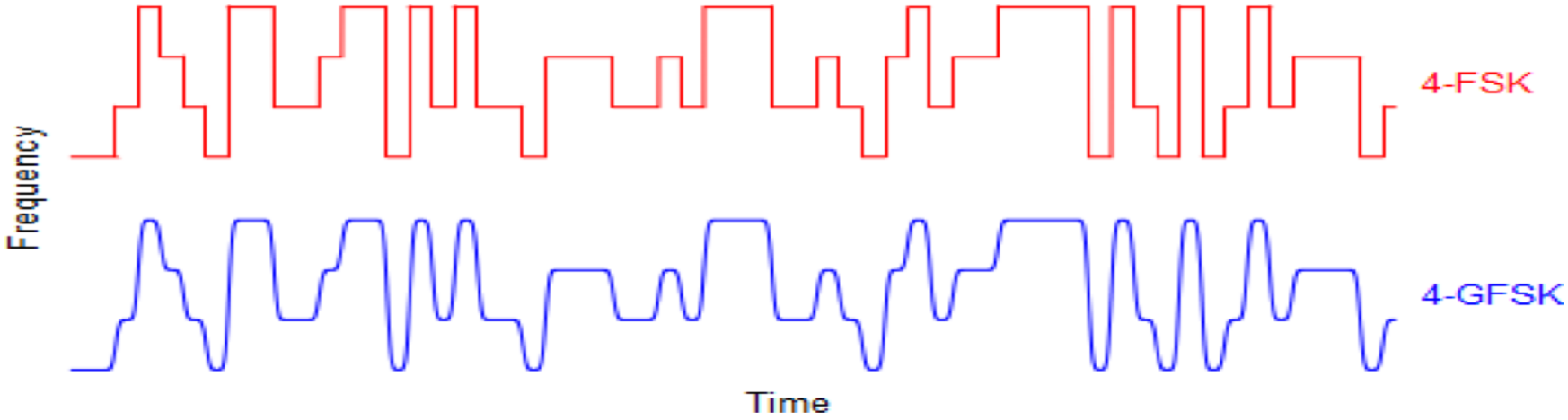
Characteristics of FT8

- T/R sequence length: 15 s
- Message length: 77 bits (updated from 75 bits)
- FEC code: LDPC(174,91)
- Modulation: 8-GFSK, keying rate = tone spacing = 5.86 Hz
- Waveform: Continuous phase, constant envelope
- Occupied bandwidth: 47 Hz
- Decoding threshold: -20 dB (perhaps -24 dB with AP decoding, TBD)
  - I had a -25 db decode QSO during Mentorfest ‘18
- Operational behavior: similar to HF usage of JT9, JT65
- Multi-decoder: finds and decodes all FT8 signals in passband
- WSJT supports auto-sequencing after manual start of QSO

Derived from Joe Taylor (K1JT) comments

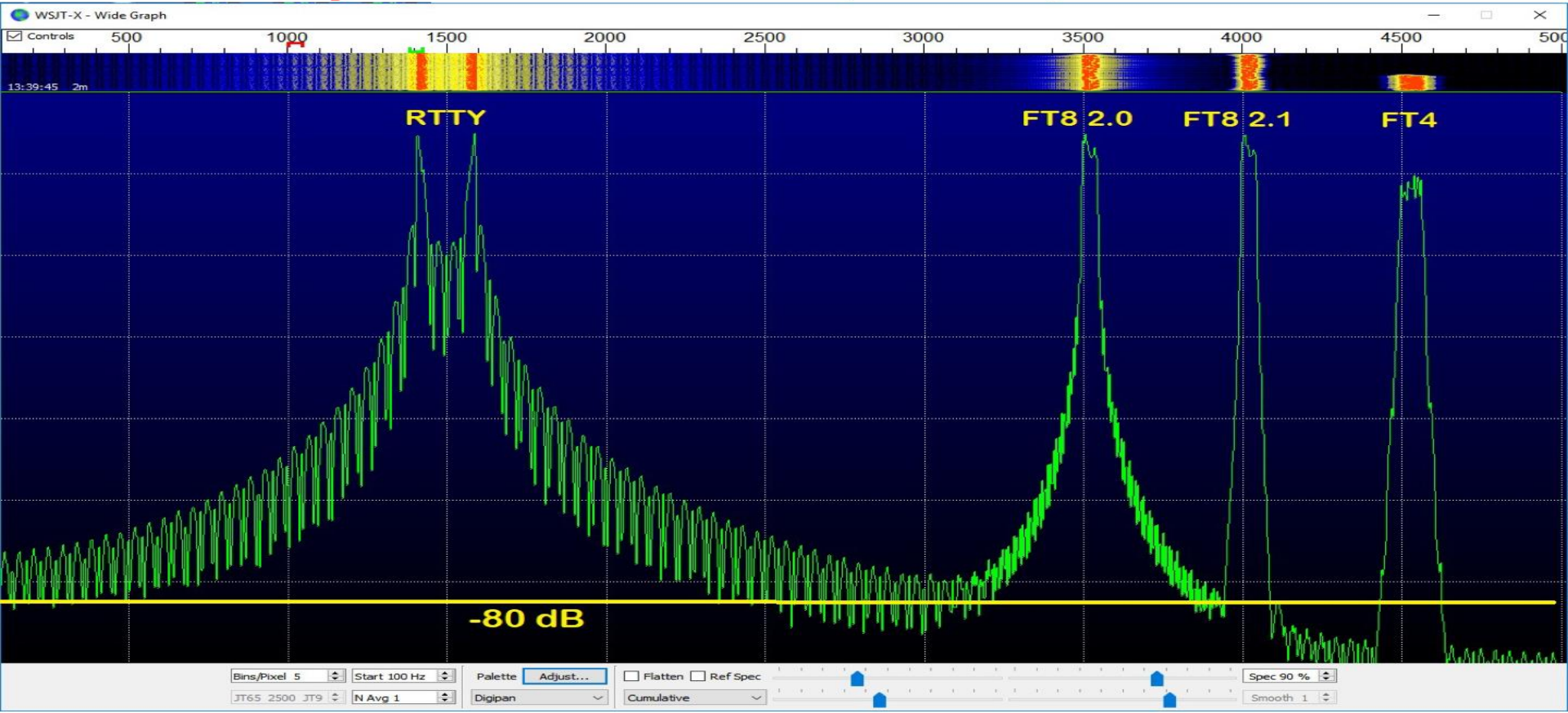
GFSK

Smoothed frequency transitions



Slide reused from K1JT presentation

Spectra: RTTY, FT8, FT4



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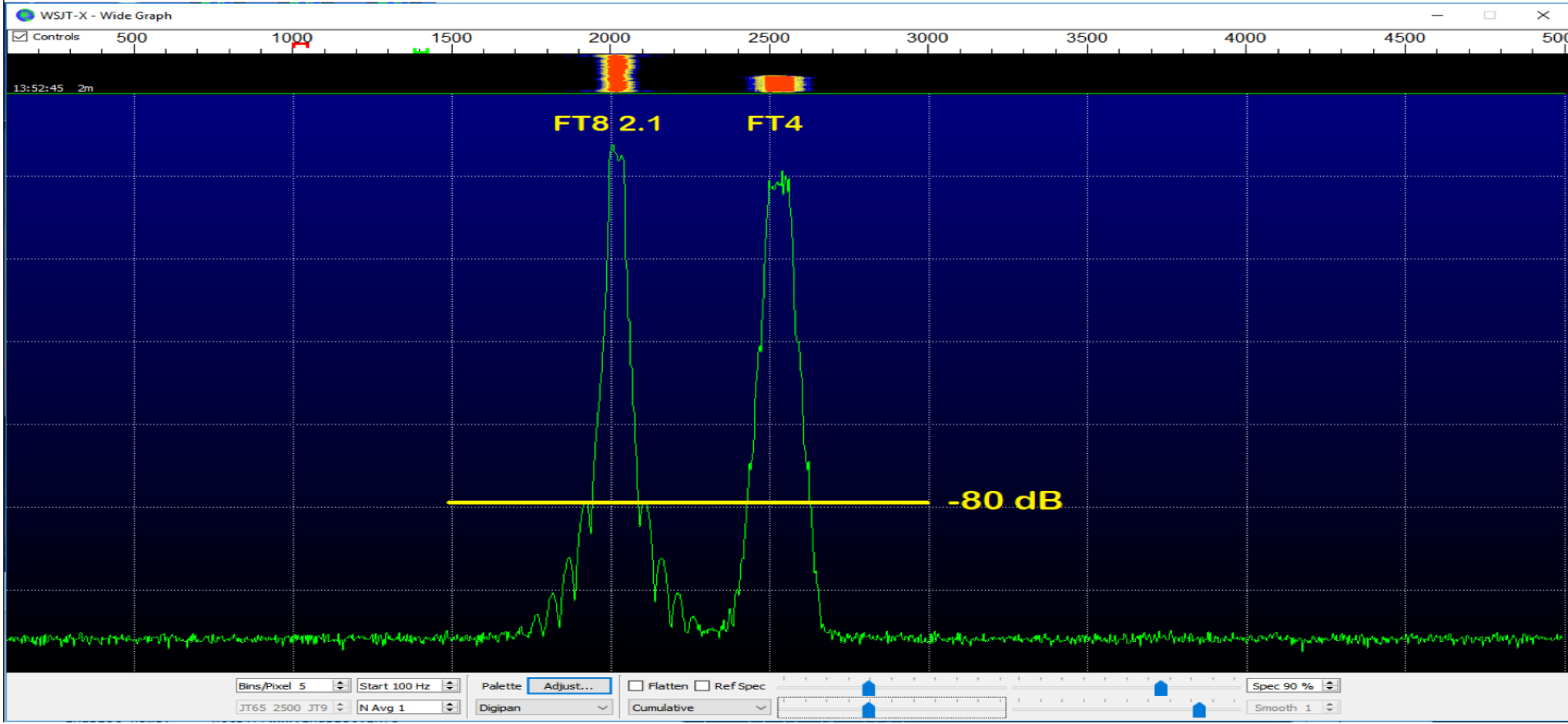
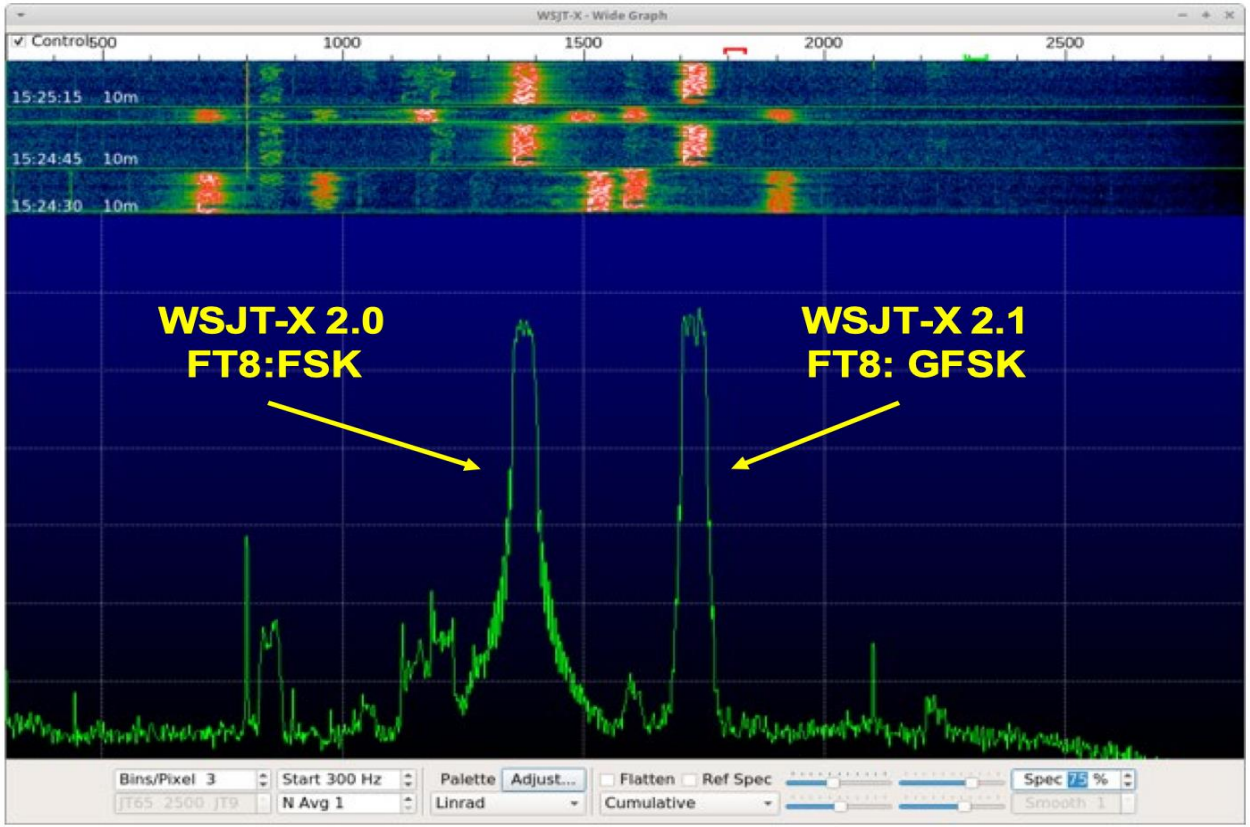
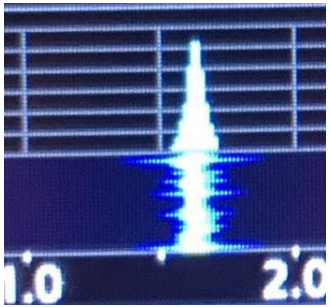
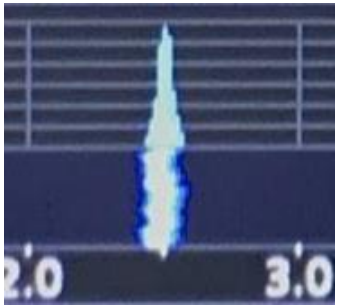
Spectra: FT8, FT4



Slide reused from K1JT presentation







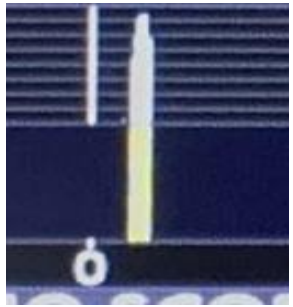


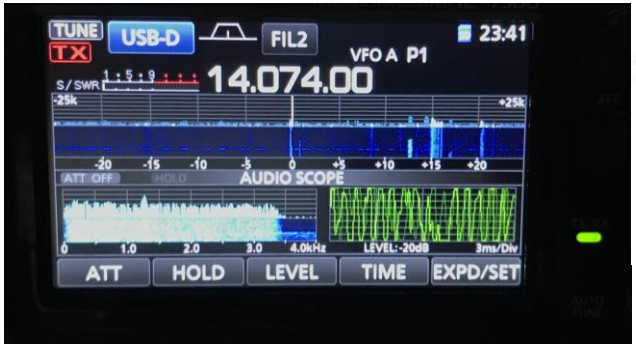
Image reused from K1JT presentation

Uses/Details of FT8

- Intended: Multi-hop E skip on VHF
- Actual: DX contact during poor propagation
- High noise tolerant
- Low power
  - QRP is common
  - 40w is loud
- Time slot based (Even 0:15,0:45/ Odd 0:00,0:30)
- Accurate time sync is critical
- Payload per message is small (13 characters)
- Free text is possible but not common
- No long QSOs

	UTC	dB	DT	Freq	Message
Odd	010845	4	-0.2	1515 ~	CQ K5GCC EM13
Even (Dropped in late)	010905	Tx		601 ~	K5GCC WE5TR EM12
Odd (still decoded)	010915	5	-0.2	1515 ~	WE5TR K5GCC +00
Even	010930	Tx		601 ~	K5GCC WE5TR R+05
Odd	010945	5	-0.2	1515 ~	WE5TR K5GCC RRR
Even	011000	Tx		601 ~	K5GCC WE5TR 73
Odd	011015	6	-0.2	1515 ~	WE5TR K5GCC 73

Basic Setup



Normal rig setup with Antenna, tuner, etc

Modern(ish) PC, Mac, RPI, Linux

USB cable (modern rig)
SignalLinnk or similar (audio into PC)

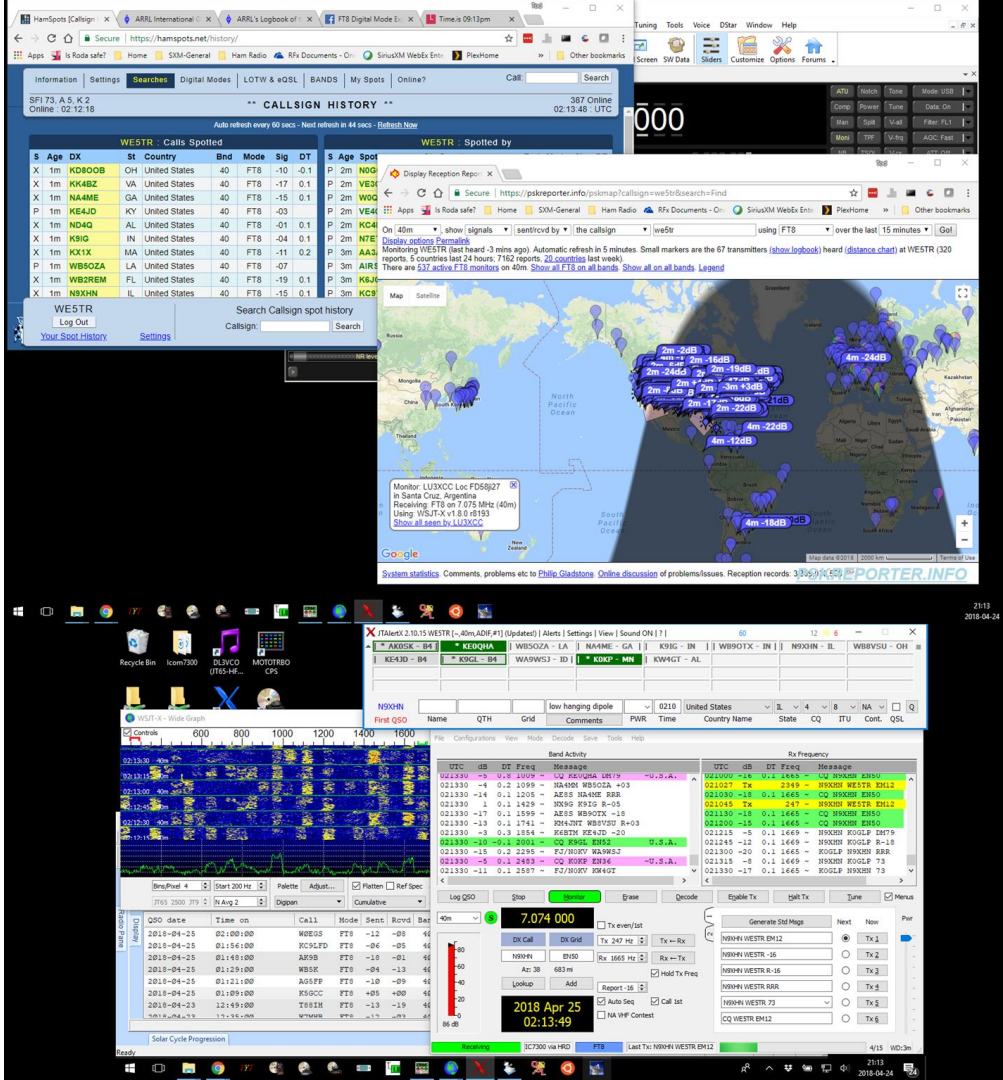
How to use it?

- Required:
  - WSJT-X / Operating Guide
  - Time sync software
    - BktTimeSync
    - Dimension4
    - Meinberg NTP
    - (or similar)
  - Rig to PC interface
    - Soundcard for audio - older radios
    - USB or Ethernet - newer radios
  - Carefully set your PC audio levels
  - Confirm speaker / mic settings
- Optional:
  - JTAlertX - Call sign, grid square and prior QSO
  - QSO Logging software - Give the QSO credit
  - HamSpots.net (web)
  - PSKReporter.info (web)
  - Logging software
  - Time.is (web)
  - FT8 group on FaceBook (web)
  - Other FT8 software such as JTDX

URLs are provided later in this deck.
Email me for the deck: WE5TRcq@gmail.com

A Typical Operating Setup

- Windows 10 Desktop
  - FT8 is not VM friendly
- Icom 7300
- Tuner
- Vertical antenna
  - HOA Friendly
  - Hidden near tree in backyard
  - 60m-6m
- 80m bent-dipole
  - HOA Friendly
  - Cause its too low (3m from ground)



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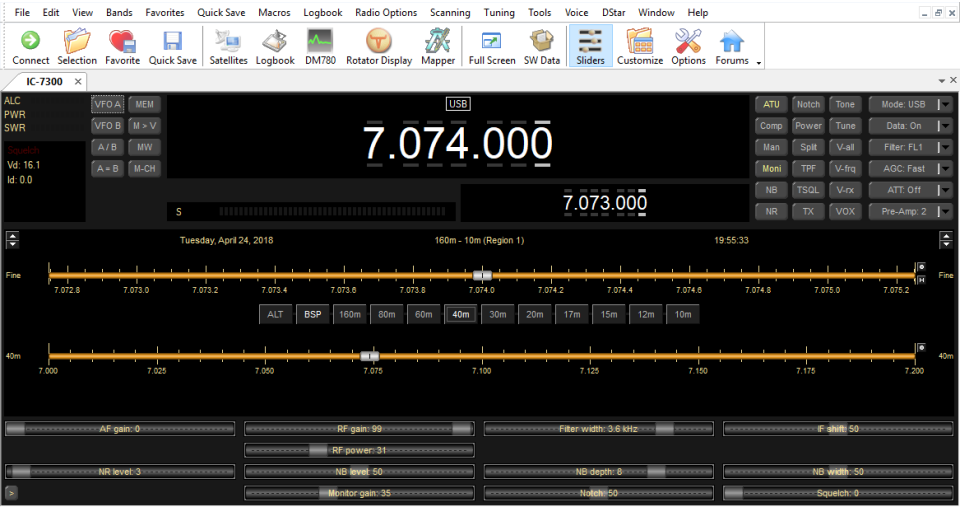
IC-7300 FT8 Transmit

HRD Rig Control - [IC-7300]



Rig Items:

- Transmit power down
  - I'm typically 30w or less
- Generally:
  - Turn off signal conditioners
  - Widen filters

Remote Operate:

- RF Power Control
- Other rig features

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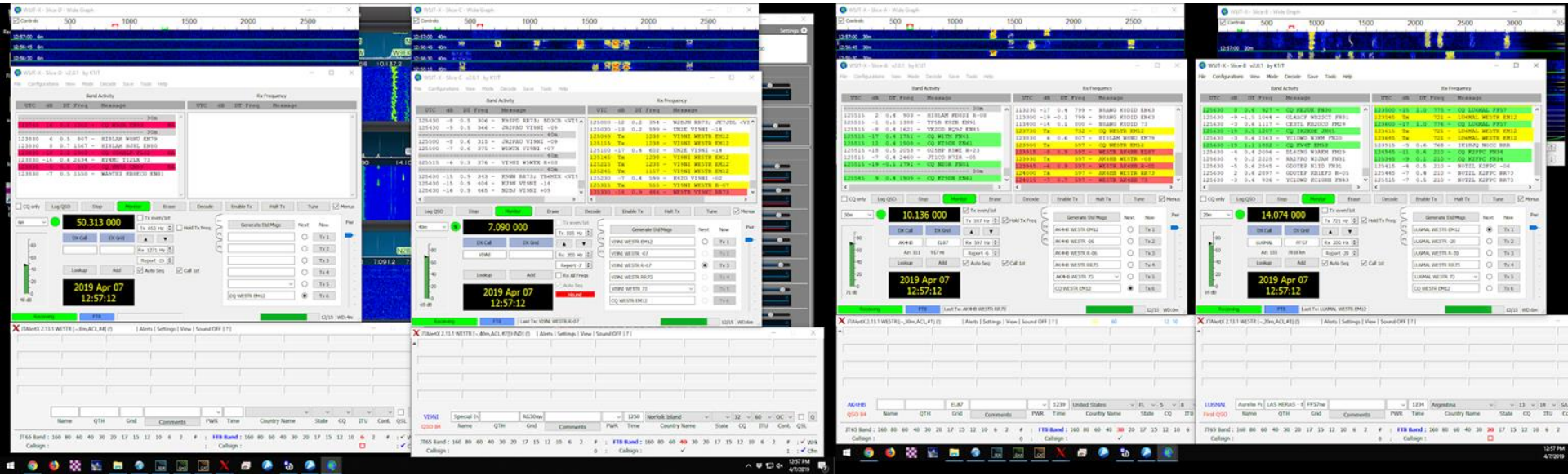
IC-7300 FT8 Receive

Multiple Simultaneous Decodes Flex 6000 series

Only one transmit

The coupon code is LARA19
Free FlexControl with rig purchase



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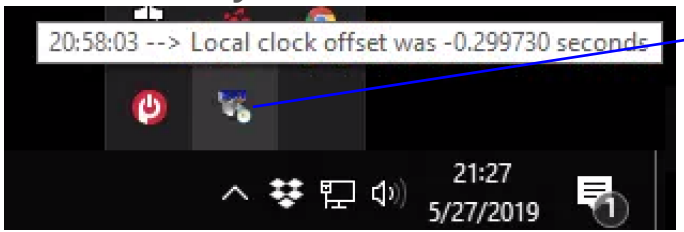
Time Sync

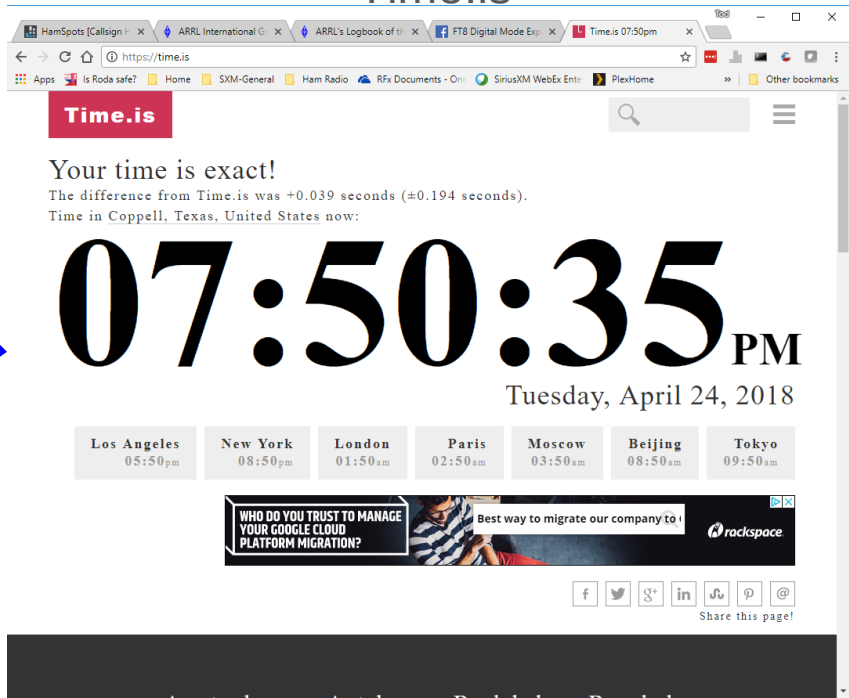
If you see signals but fail to decode → Check your time sync

Dimension 4

BktTimeSync

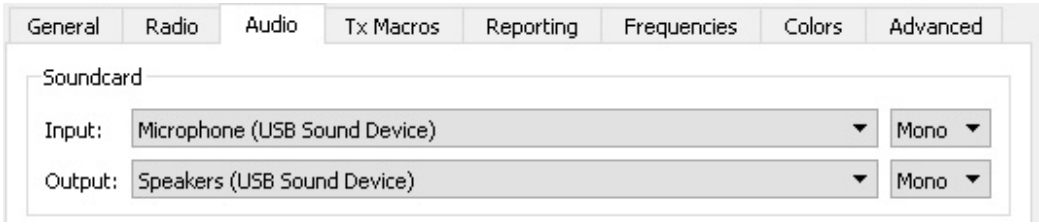


Time.is

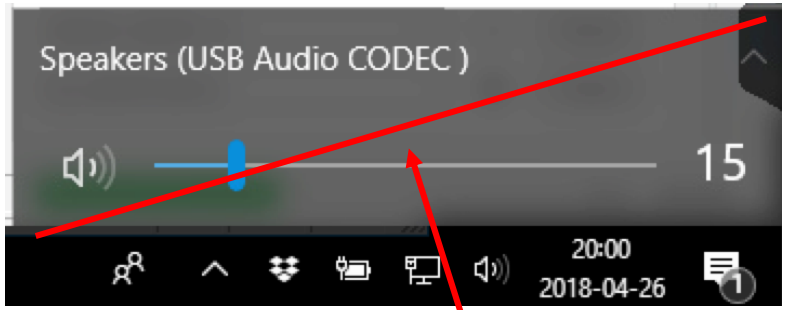


WSJT-X Setup (IC7300)

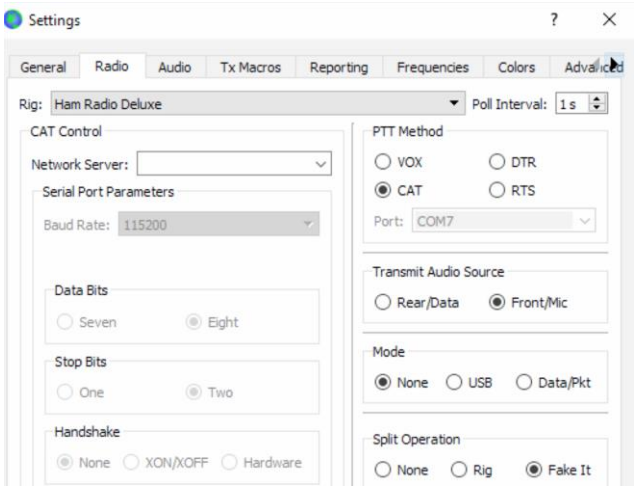
File...Settings



- Be sure to have audio settings match your setup
- Be sure the PC audio remains in the PC
  - Common problem to have PC sounds transmit out
- Set rig control
  - Radio
  - Ham Radio Deluxe
  - (or your rig control)



Confirm that windows main sound isn't set to radio's TX input



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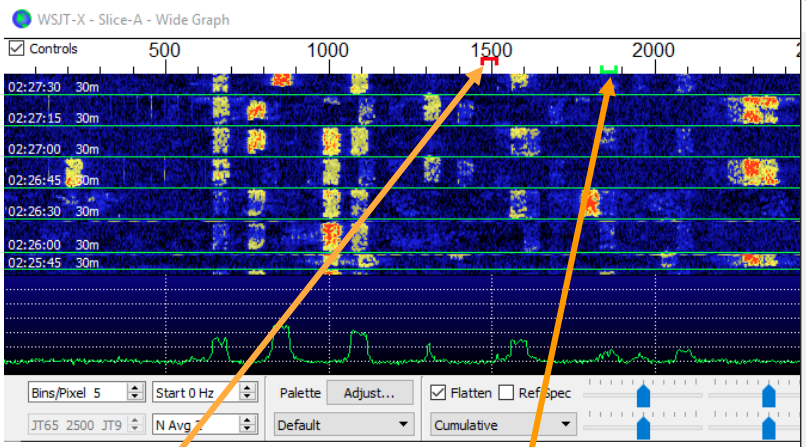
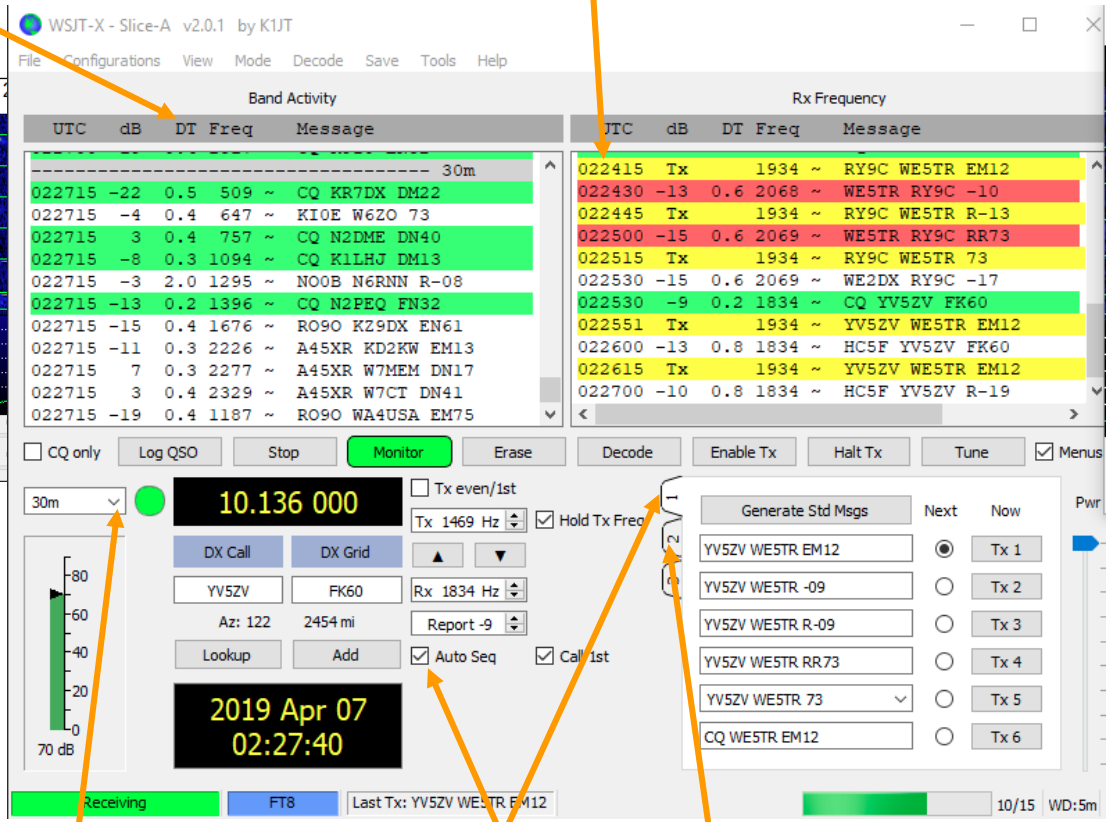
WSJT-X with QSO

Delta Time
FT8 can handle up to about 2.5s





1. Shift-click to set TX freq
2. QSO with CQ double click sets RX

-or-

2. JTAlert double click
3. Auto Seq can help or you can manually run
4. I typically work split
   a. “Hold Tx Freq”
   b. Avoid QRMing

Set band

“Auto” QSO

“Manual” QSO

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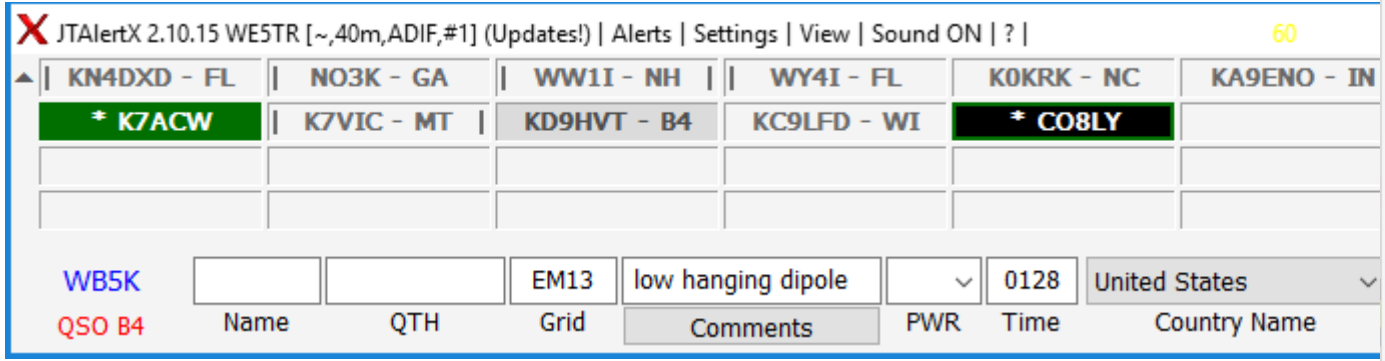
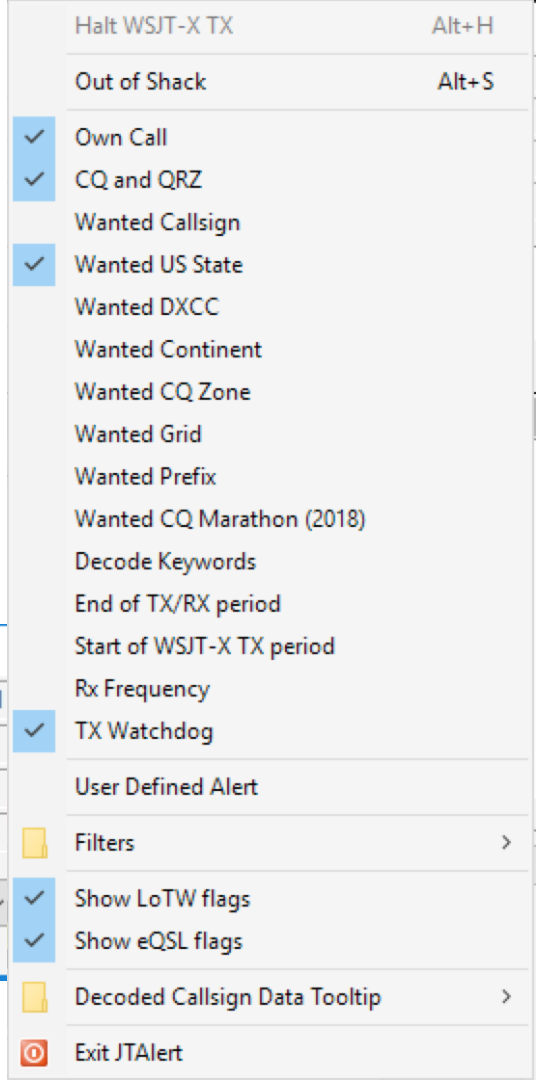
JTAlertX

- Helper app
- Shows worked before (gray)
- Allows blocked call signs (black)
- Alerts for various reasons (yellow)
- CQs (green)
- Shows LOTW/eQSL users
- Launch after WSJT





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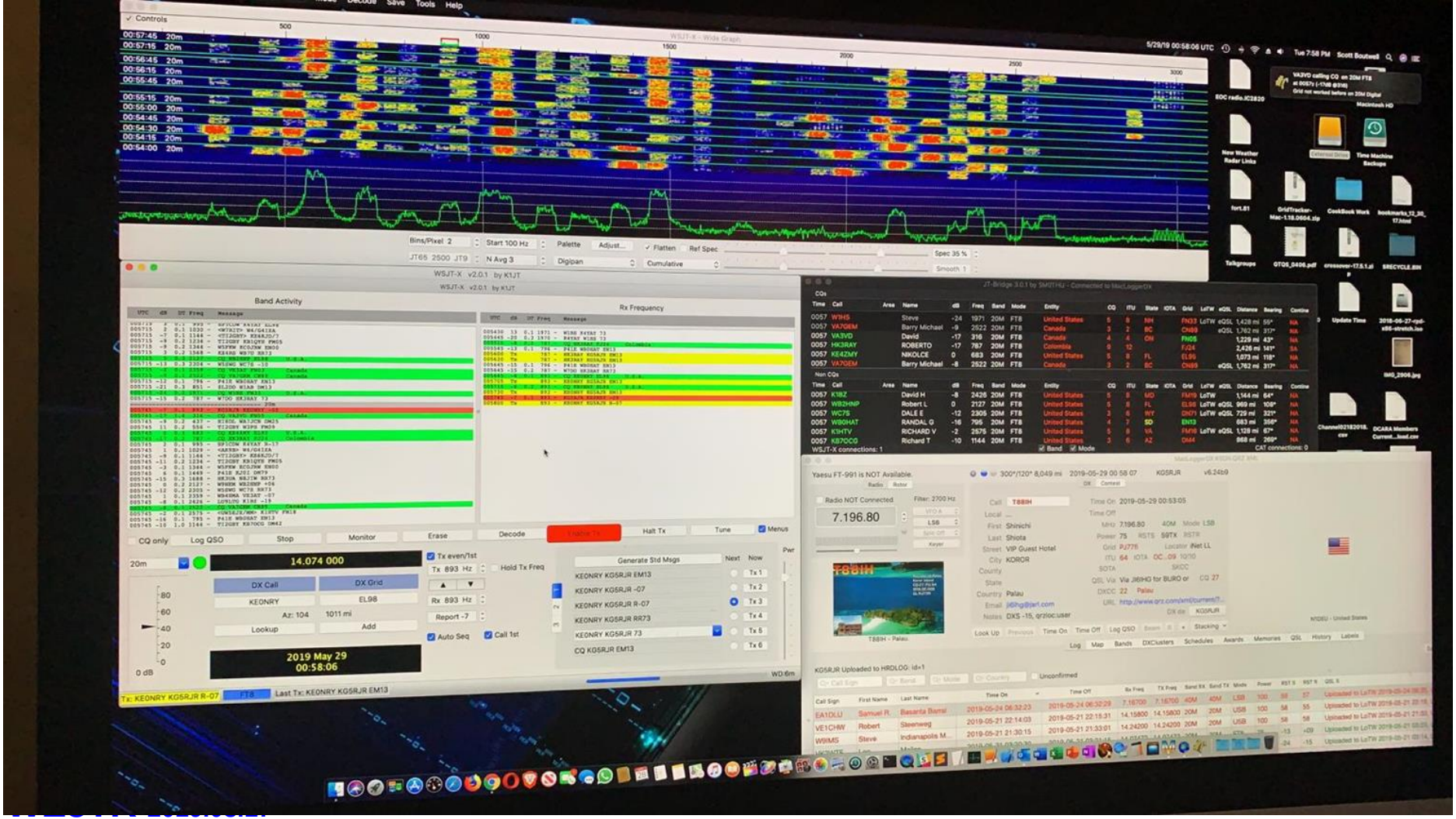
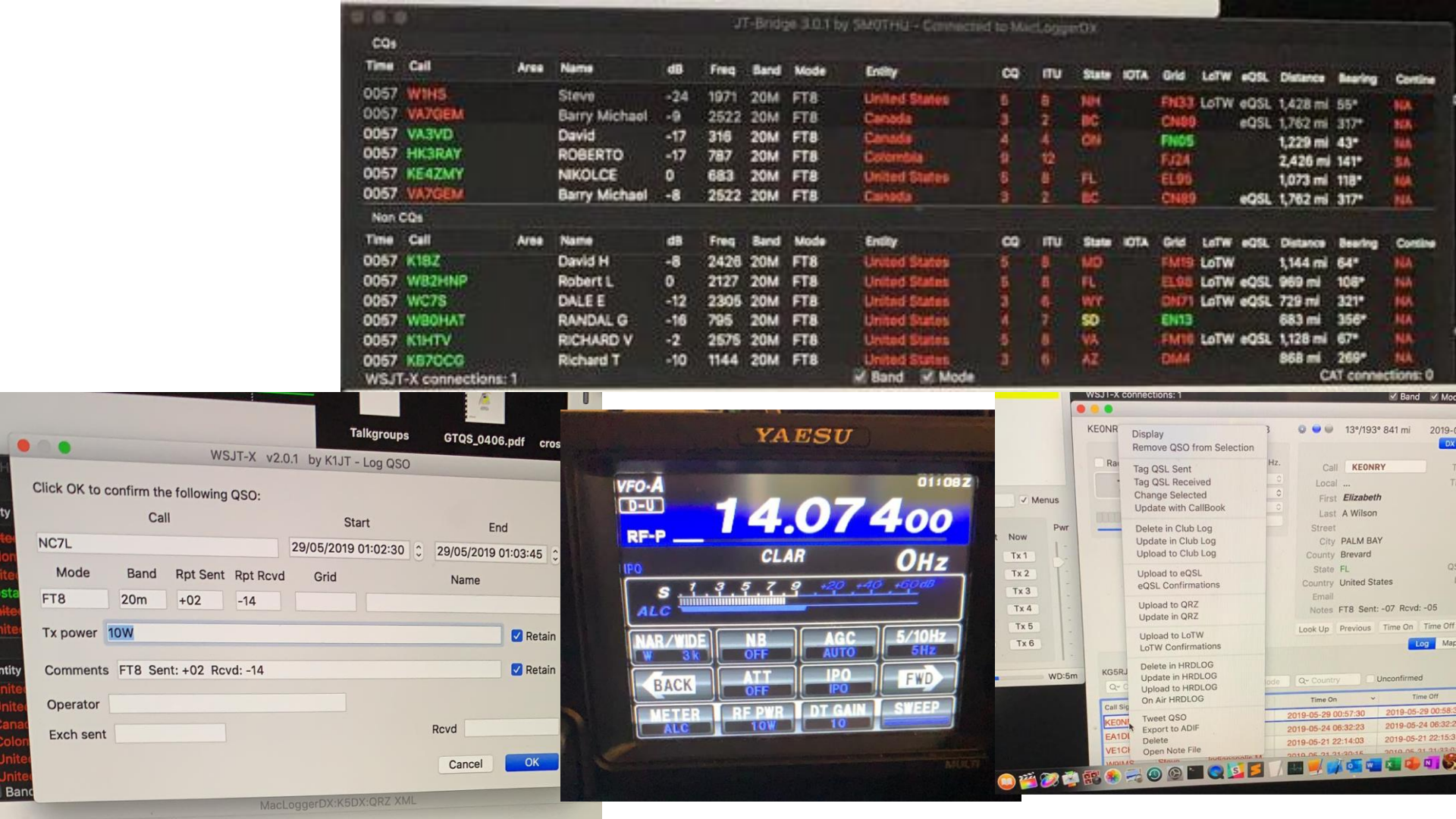
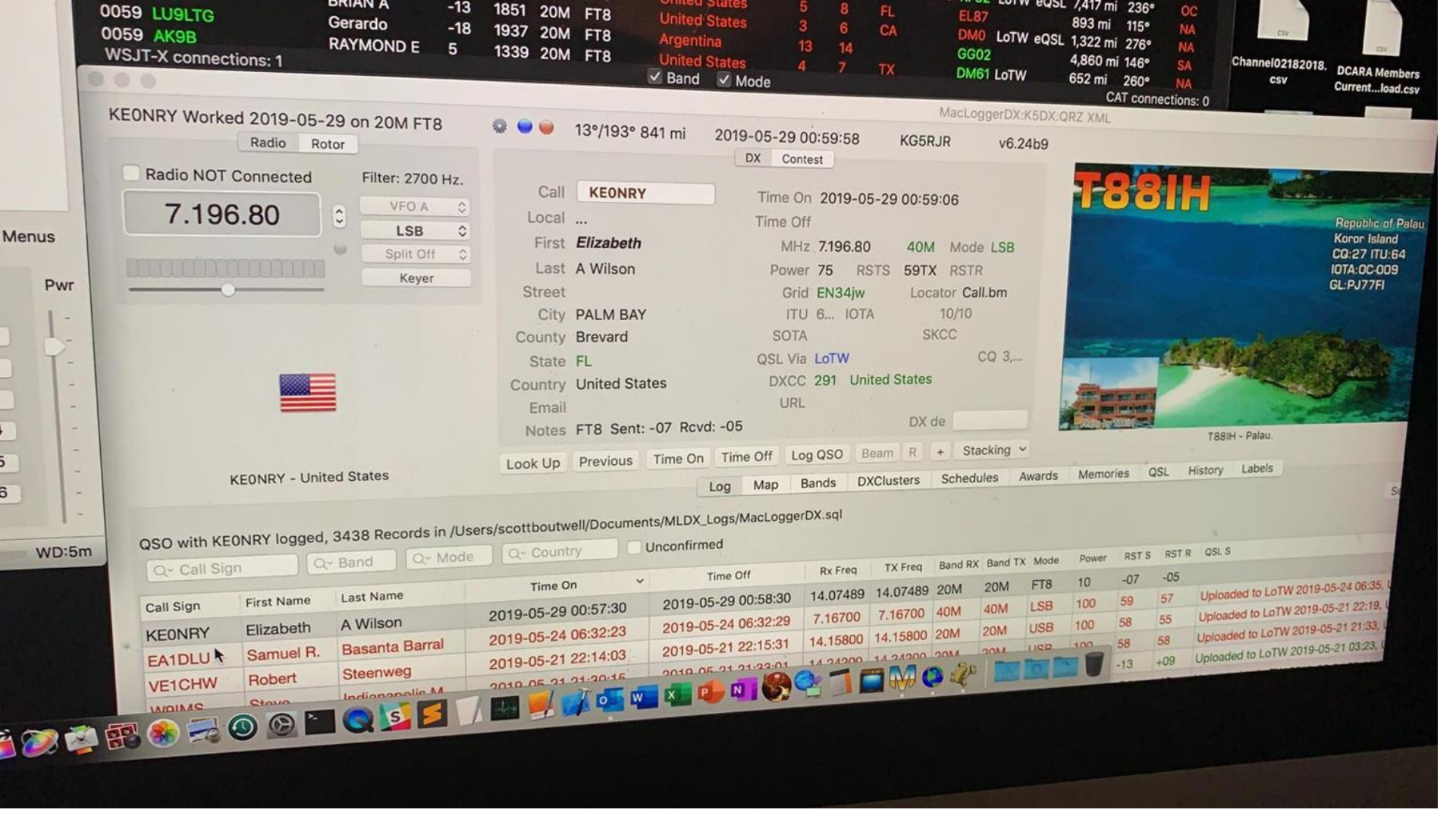
Mac WSJT-X Operating

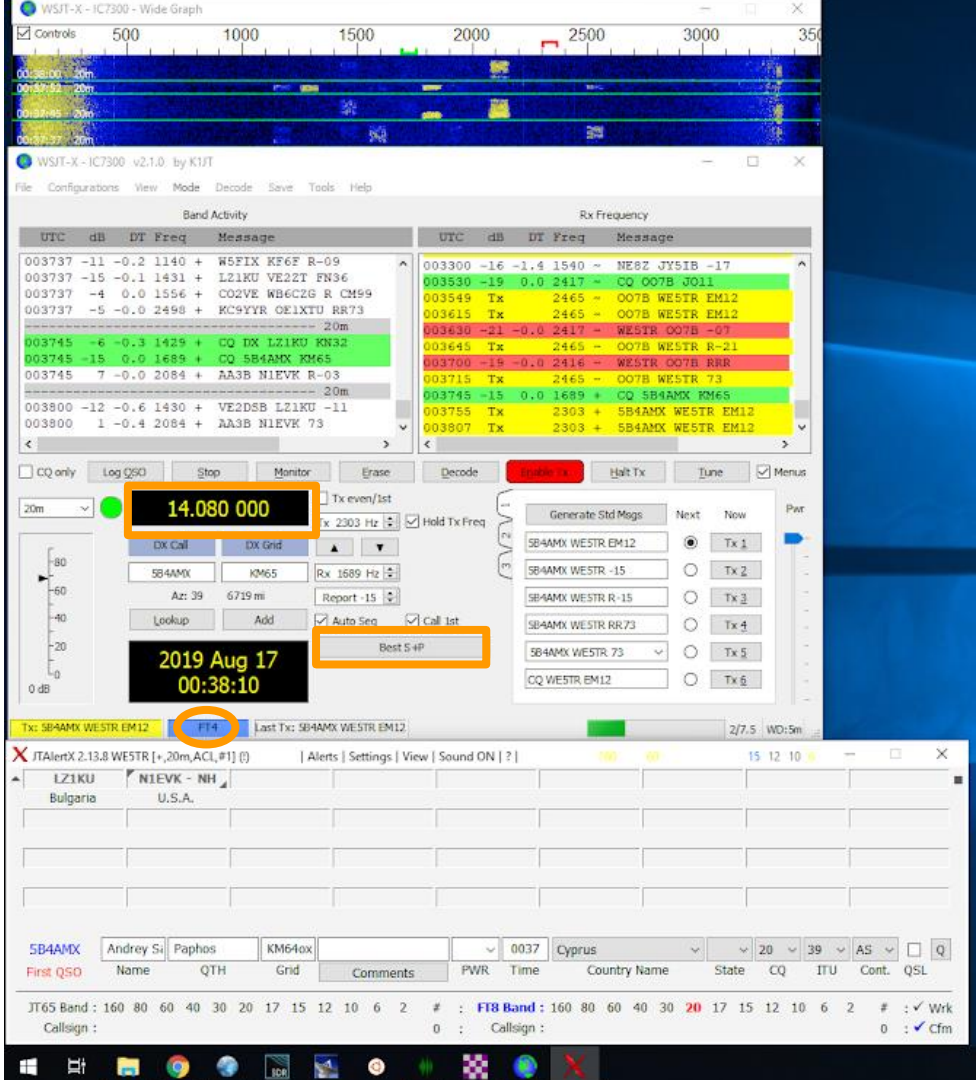
(Mac screenshots courtesy of KG5RJR)



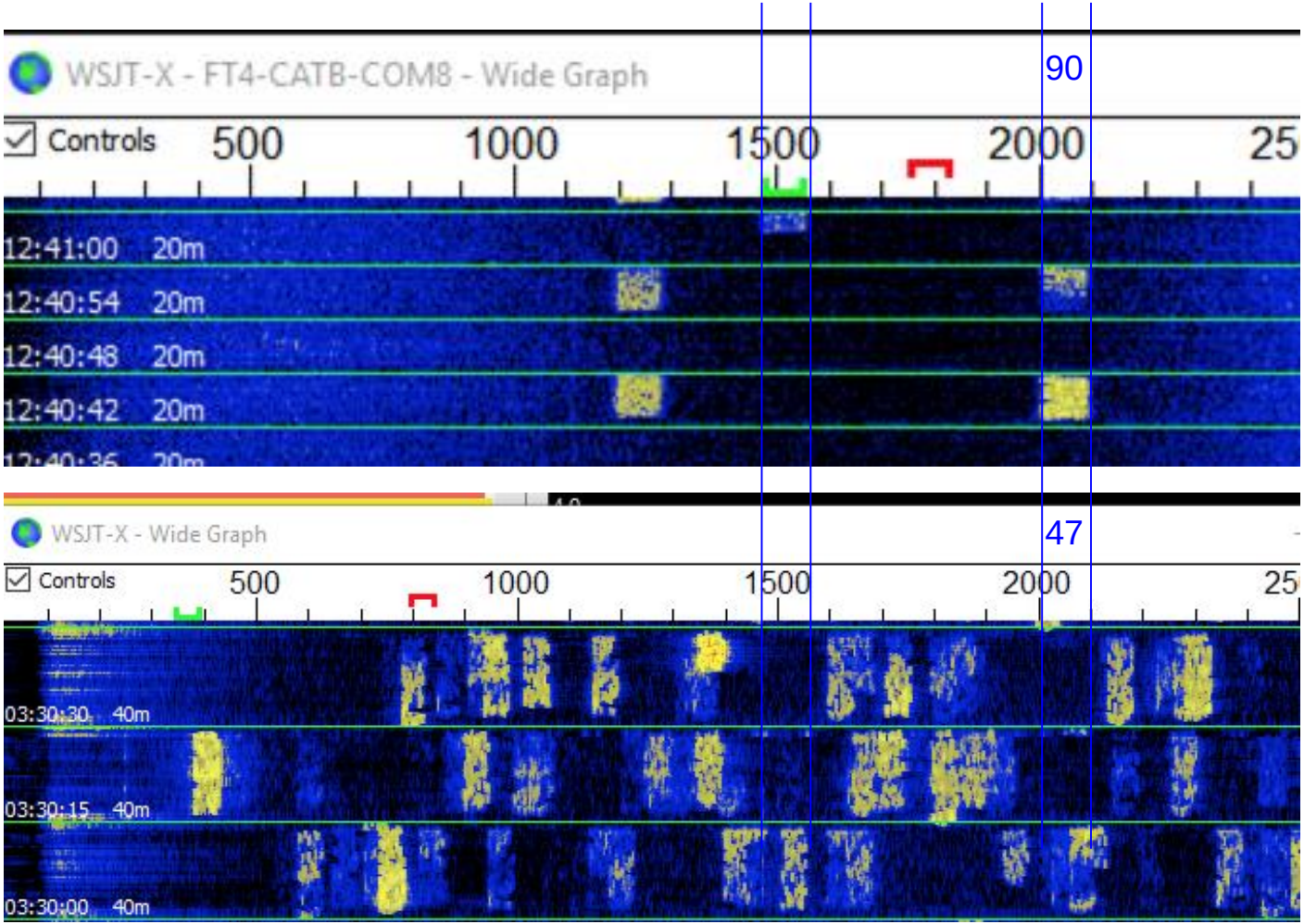

JT-Bridge 3.0.1 by 9M0THU - Connected to MacLoggerDX
CQs
Time Call Area Name dB Freq Band Mode Entity CQ ITU State IOTA Grid LoTW eQSL Distance Bearing Contine
0057 W1HS Steve -24 1971 20M FT8 United States 5 8 NH FN33 LoTW eQSL 1,428 mi 55° NA
0057 VA7GEM Barry Michael -9 2522 20M FT8 Canada 3 2 BC CN89 eQSL 1,762 mi 317° NA
0057 VA3VD David -17 316 20M FT8 Canada 4 4 ON FN05 1,229 mi 43° NA
0057 HK3RAY ROBERTO -17 787 20M FT8 Colombia 9 12 FJ24 2,426 mi 141° SA
0057 KE4ZMY NIKOLCE 0 683 20M FT8 United States 5 8 FL EL96 1,073 mi 118° NA
0057 VA7GEM Barry Michael -8 2522 20M FT8 Canada 3 2 BC CN89 eQSL 1,762 mi 317° NA
Non CQs
Time Call Area Name dB Freq Band Mode Entity CQ ITU State IOTA Grid LoTW eQSL Distance Bearing Contine
0057 K1BZ David H -8 2426 20M FT8 United States 5 8 MD FM19 LoTW 1,144 mi 64° NA
0057 WB2HNP Robert L 0 2127 20M FT8 United States 5 8 FL EL98 LoTW eQSL 969 mi 106° NA
0057 WC7S DALE E -12 2305 20M FT8 United States 3 6 WY DN71 LoTW eQSL 729 mi 321° NA
0057 WB0HAT RANDAL G -16 795 20M FT8 United States 4 7 SD EN13 683 mi 356° NA
0057 K1HTV RICHARD V -2 2575 20M FT8 United States 5 8 VA FM18 LoTW eQSL 1,128 mi 67° NA
0057 KB7OCG Richard T -10 1144 20M FT8 United States 3 6 AZ DM4 868 mi 269° NA
WSJT-X connections: 1
Band Mode
CAT connections: 0
Talkgroups
GTQS_0406.pdf
WSJT-X v2.0.1 by K1JT - Log QSO
Click OK to confirm the following QSO:
Call Start End
NC7L 29/05/2019 01:02:30 29/05/2019 01:03:45
Mode Band Rpt Sent Rpt Rcvd Grid Name
FT8 20m +02 -14
Tx power 10W Retain
Comments FT8 Sent: +02 Rcvd: -14 Retain
Operator
Exch sent Rcvd
Cancel OK
MacLoggerDX:K5DX:QRZ XML
YAESU
VFO-A
01:08Z
D-U
14.074oo
RF-P
CLAR
0Hz
IPO
S 1 3 5 7 9 +20 +40 +60dB
ALC
NAR/WIDE W 3k
NB OFF
AGC AUTO
5/10Hz 5Hz
BACK
ATT OFF
IPO IPO
FWD
METER ALC
RF PWR 10W
DT GAIN 10
SWEEP
WSJT-X connections: 1
Band
Menus
Pwr
Now
Tx 1
Tx 2
Tx 3
Tx 4
Tx 5
Tx 6
WD:5m
KEONR
13°/193° 841 mi
Display
Remove QSO from Selection
Tag QSL Sent
Tag QSL Received
Change Selected
Update with CallBook
Delete in Club Log
Update in Club Log
Upload to Club Log
Upload to eQSL
eQSL Confirmations
Upload to QRZ
Update in QRZ
Upload to LoTW
LoTW Confirmations
Delete in HRDLOG
Update in HRDLOG
Upload to HRDLOG
On Air HRDLOG
Tweet QSO
Export to ADIF
Delete
Open Note File
Call KEONRY
Local ...
First Elizabeth
Last A Wilson
Street
City PALM BAY
County Brevard
State FL
Country United States
Email
Notes FT8 Sent: -07 Rcvd: -05
Look Up Previous Time On Time Off
Log
Unconfirmed
Time On Time Off
2019-05-29 00:57:30
2019-05-24 06:32:23
2019-05-21 22:14:03


0059 LU9LTG
0059 AK9B
WSJT-X connections: 1
BRIAN A -13 1851 20M FT8
Gerardo -18 1937 20M FT8
RAYMOND E 5 1339 20M FT8
United States 5 8 FL
United States 3 6 CA
Argentina 13 14
United States 4 7 TX
EL87 7,417 mi 236° OC
893 mi 115° NA
DM0 LoTW eQSL 1,322 mi 276° NA
GG02 4,860 mi 146° SA
DM61 LoTW 652 mi 260° NA
Band Mode
CAT connections: 0
Channel02182018.csv
DCARA Members Current...load.csv
KE0NRY Worked 2019-05-29 on 20M FT8
MacLoggerDX:K5DX:QRZ XML
13°/193° 841 mi
2019-05-29 00:59:58
KG5RJR
v6.24b9
Radio Rotor
Radio NOT Connected
Filter: 2700 Hz.
7.196.80
VFO A
LSB
Split Off
Keyer
DX Contest
Call KE0NRY
Local ...
First Elizabeth
Last A Wilson
Street
City PALM BAY
County Brevard
State FL
Country United States
Email
Notes FT8 Sent: -07 Rcvd: -05
Time On 2019-05-29 00:59:06
Time Off
MHz 7.196.80 40M Mode LSB
Power 75 RSTS 59TX RSTR
Grid EN34jw Locator Call.bm
ITU 6... IOTA 10/10
SOTA SKCC
QSL Via LoTW CQ 3,...
DXCC 291 United States
URL
DX de
T88IH
Republic of Palau
Koror Island
CQ:27 ITU:64
IOTA:OC-009
GL:PJ77FI
T88IH - Palau.
KE0NRY - United States
Look Up Previous Time On Time Off Log QSO Beam R + Stacking
Log Map Bands DXClusters Schedules Awards Memories QSL History Labels
QSO with KE0NRY logged, 3438 Records in /Users/scottboutwell/Documents/MLDX_Logs/MacLoggerDX.sql
Unconfirmed
Call Sign Band Mode Country
Call Sign First Name Last Name Time On Time Off Rx Freq TX Freq Band RX Band TX Mode Power RST S RST R QSL S
KE0NRY Elizabeth A Wilson 2019-05-29 00:57:30 2019-05-29 00:58:30 14.07489 14.07489 20M 20M FT8 10 -07 -05
EA1DLU Samuel R. Basanta Barral 2019-05-24 06:32:23 2019-05-24 06:32:29 7.16700 7.16700 40M 40M LSB 100 59 57 Uploaded to LoTW 2019-05-24 06:35,
VE1CHW Robert Steenweg 2019-05-21 22:14:03 2019-05-21 22:15:31 14.15800 14.15800 20M 20M USB 100 58 55 Uploaded to LoTW 2019-05-21 22:19,
58 58 Uploaded to LoTW 2019-05-21 21:33,
-13 +09 Uploaded to LoTW 2019-05-21 03:23,
Menus
Pwr
WD:5m

FT4



WE5TR 2019.08.17



6 s cycle - FT4

15 s cycle - FT8

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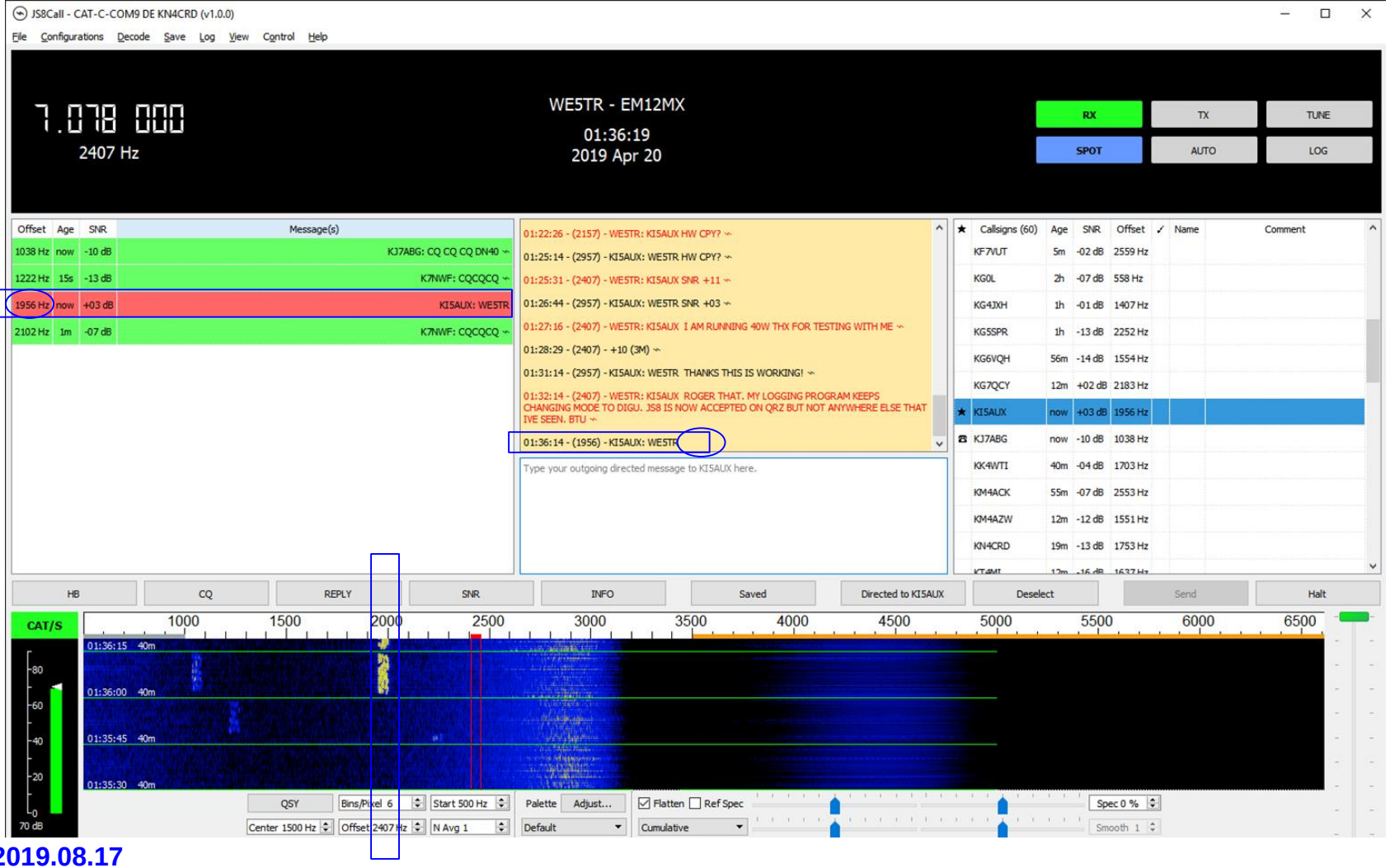
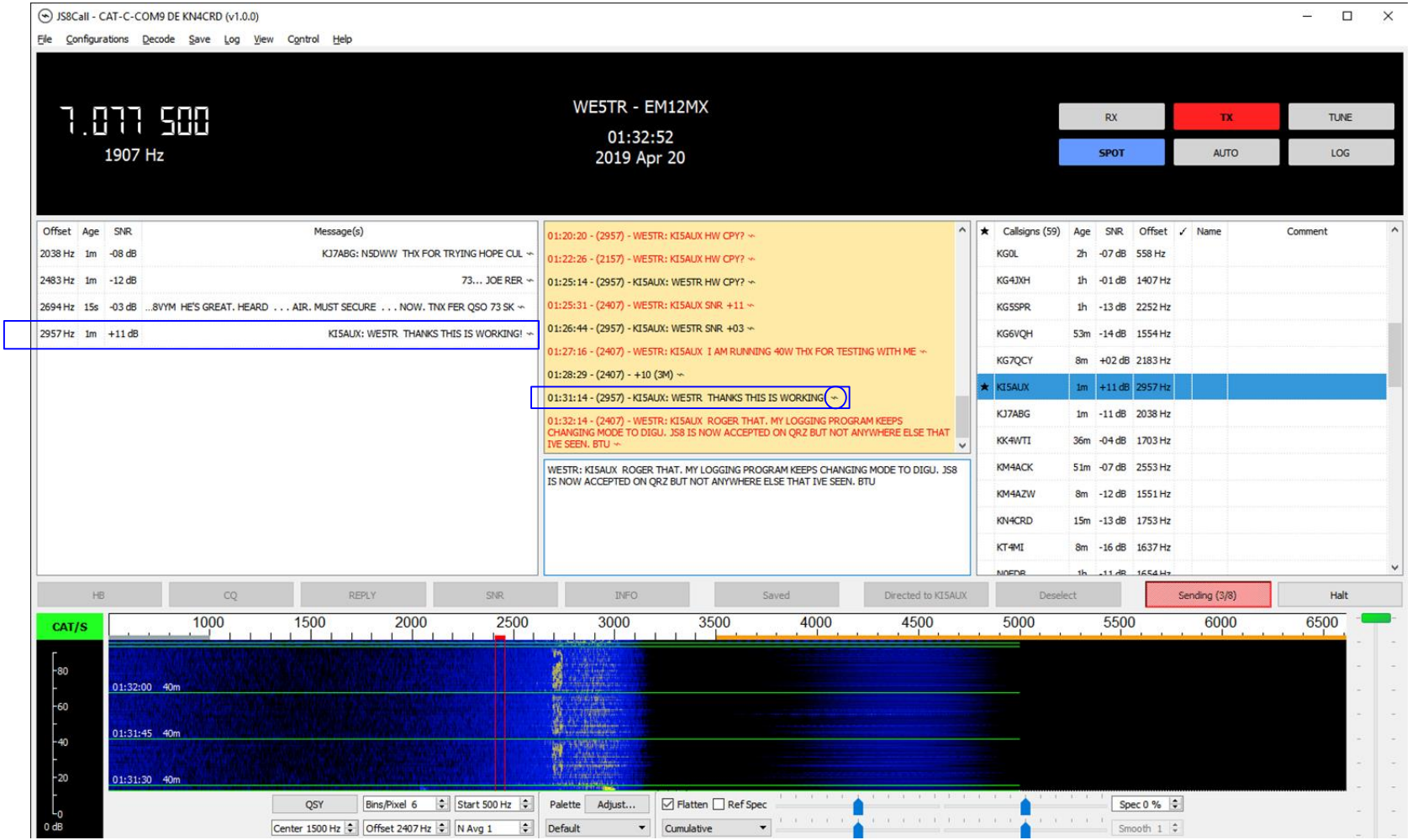
JS8Call



WE5TR 2019.08.17



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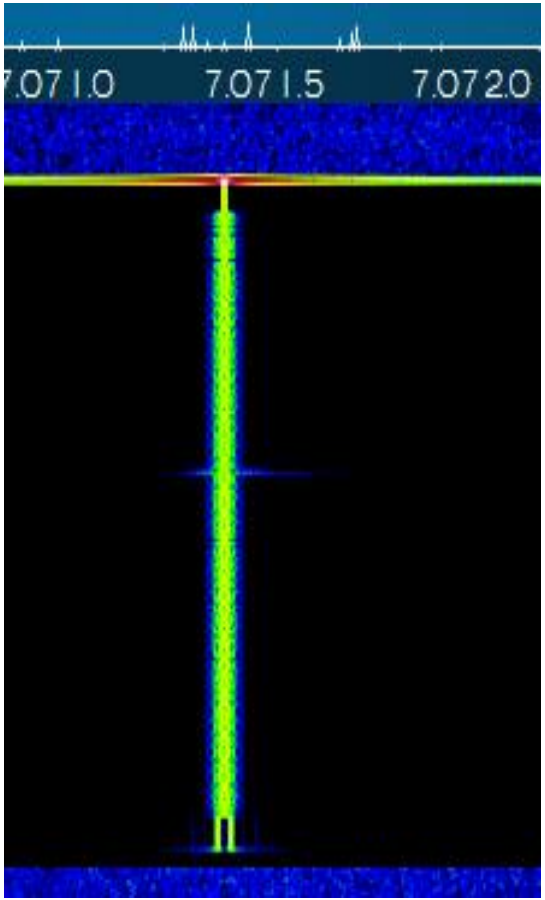
PSK31



sliceA ver4.1.01 / SmartSDR:FLEX-6000 [Slice A] (serial) - WE5TR

File Op Mode Configure View Logbook Help

Spot RxID TxID TUNE

7070.000

Freq 7071.724 On Off 0004 In 599 Out 599 Cnty/Cntry Notes

Call Op Az

DIGU Filter 2x3 Qth St Pr L

7071.72 ro.yo qth Valencia Valencies.. fkAF BS.. WA2C

==========
Read macros from: C:\Program Files (x86)\Fldigi-4.1.01\sliceA\macros\macros.mdf
==========
chal urnel1htB 1X p ea `O h A2CCN de YV4DHS
Re
or : 599 599
Name : Homero.a. Homero qth Valencia Valencie... fkAF
BTU.. WA2C

CQ

3.0 Clear

CQ ANS QSO KN SK Me/Qth Brag T/R Tx Rx TX 1

500 1000 1500 2000 2500 3000 3500

WF 0 60 x1 NORM 1724 QSY Store Lk Rv T/R

BPSK31 S/N 23 dB IMD -23 dB -3.0 AFC SQL

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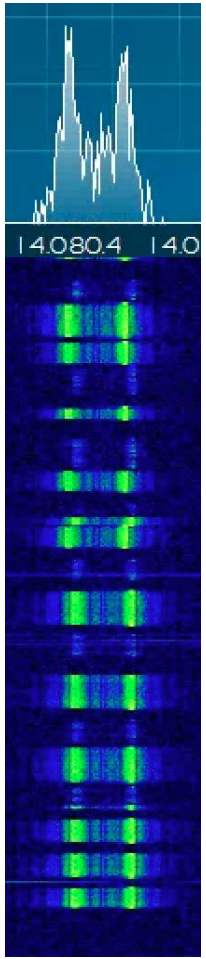
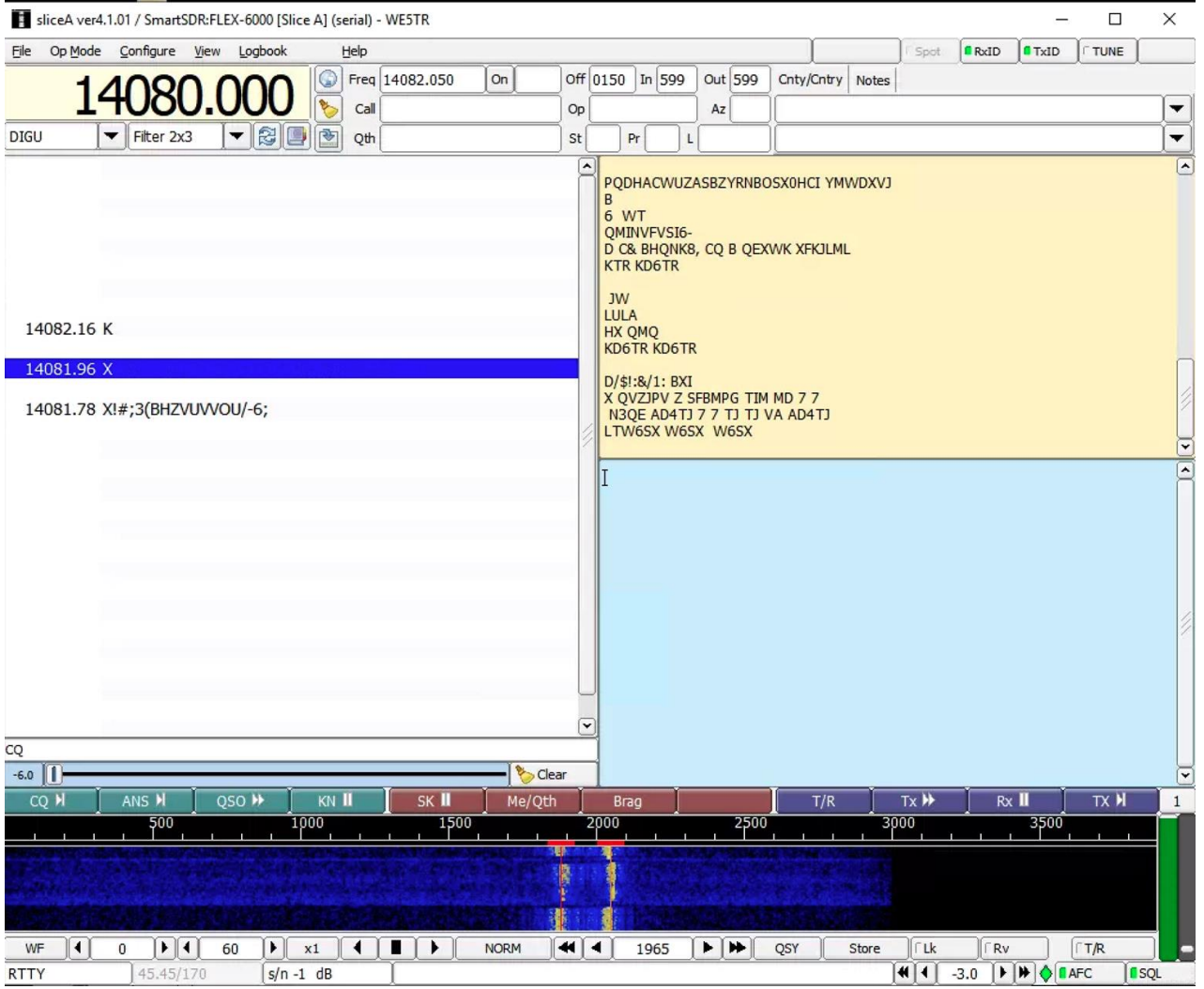
RTTY





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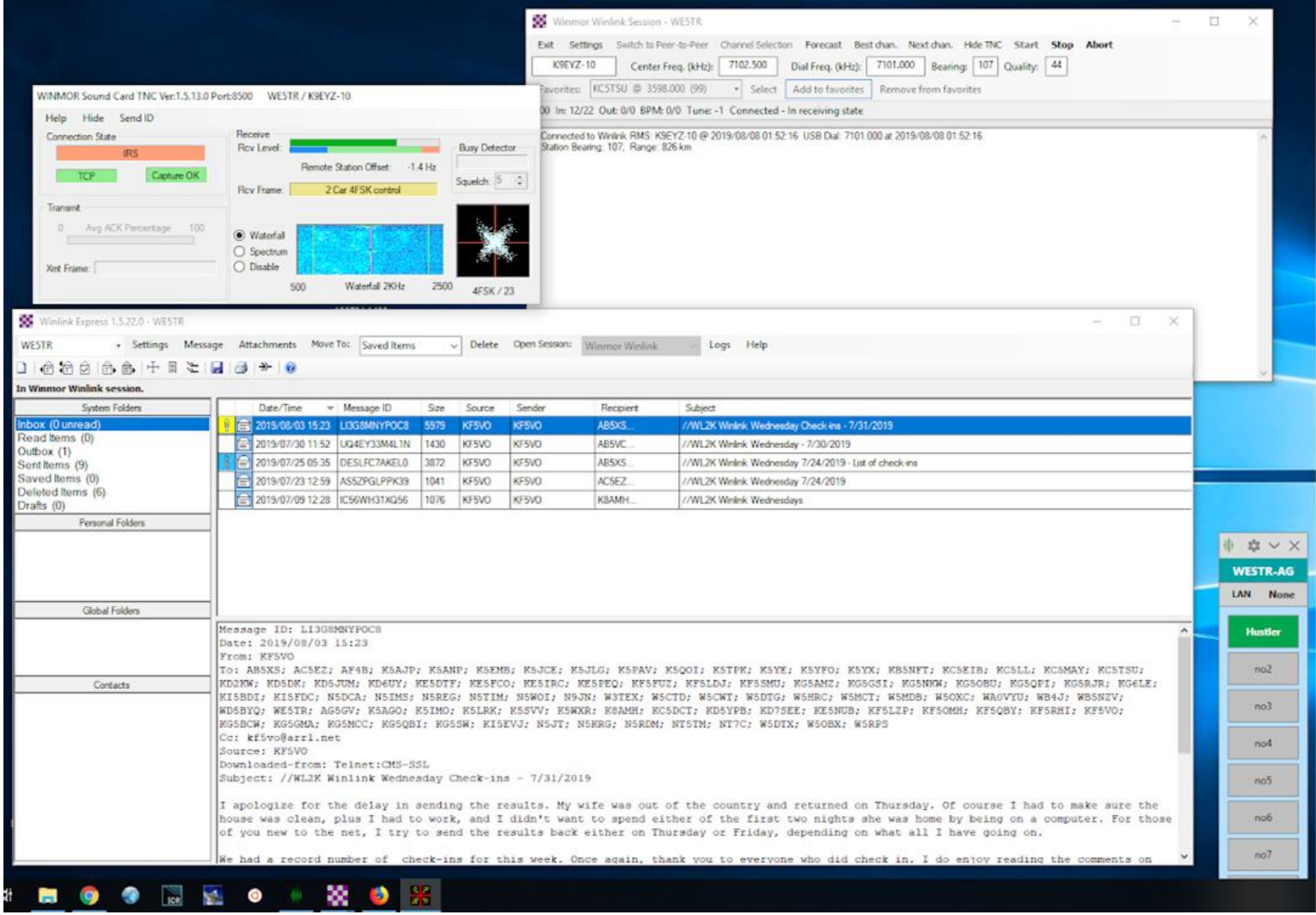
WinLink HF



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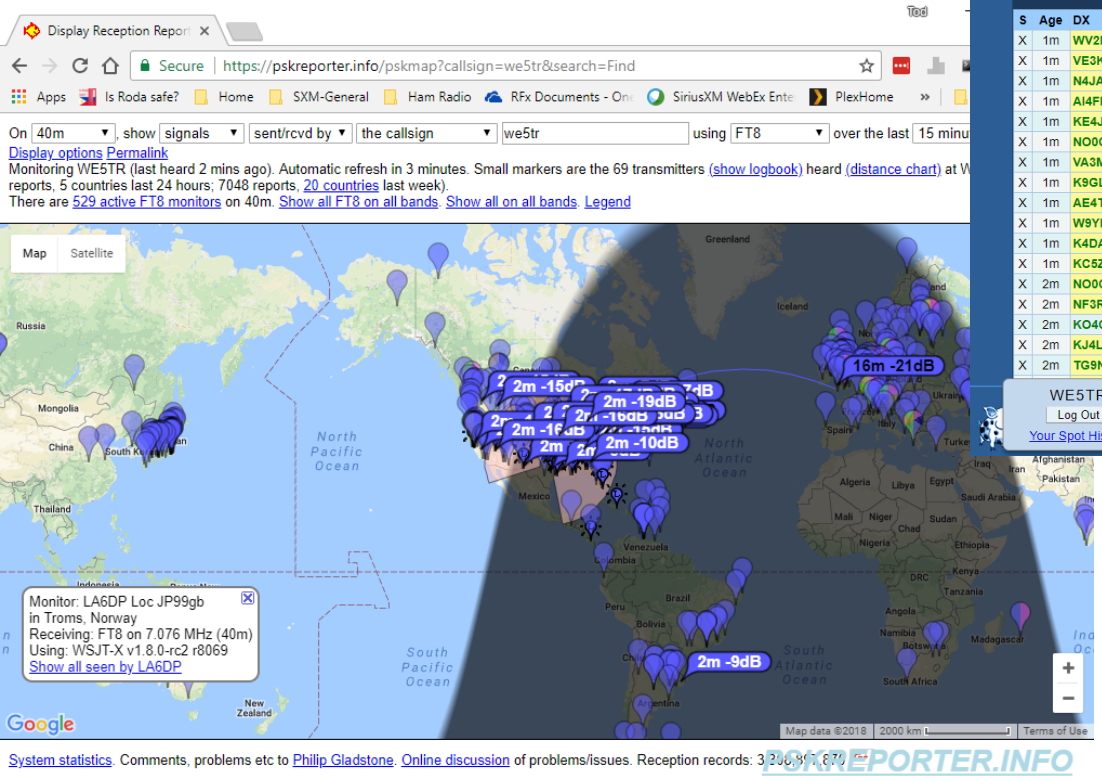
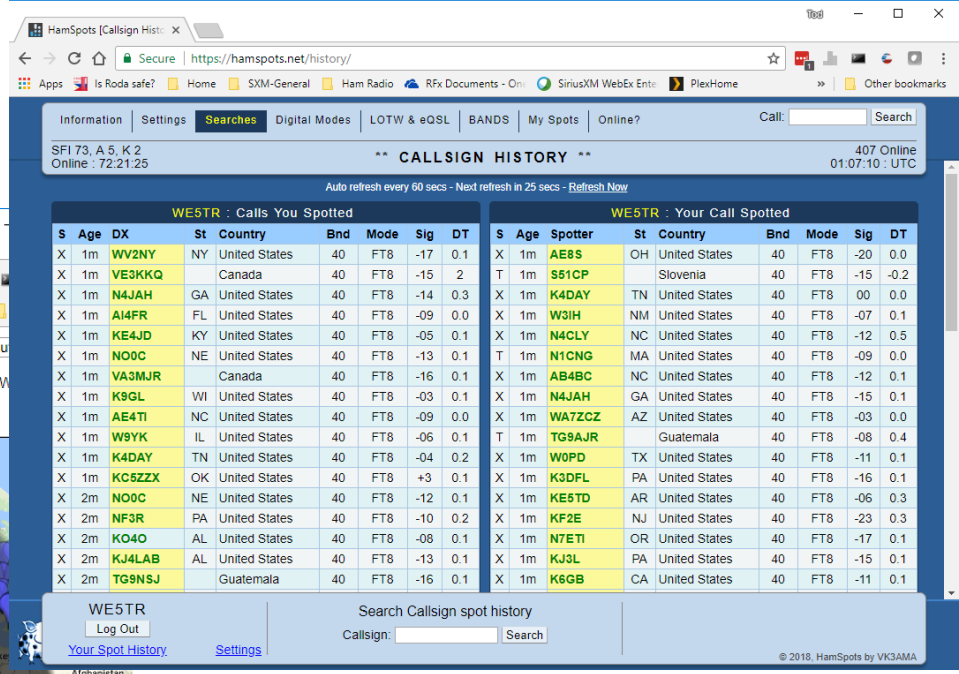
Check Your Propagation





- JTAlert updates HamSpots
- WSJT-X updates PSKReporter

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References

Operating:

- WSJT-X
  - Windows: https://physics.princeton.edu/pulsar/k1jt/wsjtx-2.1.0-win32.exe
  - Mac: https://physics.princeton.edu/pulsar/k1jt/wsjtx-2.1.0-Darwin.dmg
  - User Guide: https://physics.princeton.edu/pulsar/k1jt/wsjtx-doc/wsjtx-main-2.1.0.html
- BktTimeSync (Win)
  - Win: https://www.maniaradio.it/en/bkttimesync.html
- JTAlertX (Win)
  - Win: https://dnl.hamapps.com/JTAlert/HamApps_JTAlert_2.14.2_Setup.exe (be sure to download support packages too)
- JT-Bridge (Mac)
  - Mac: https://jt-bridge.eller.nu/download/JT-Bridge.app-3.0.1.zip

Logging:

- N3FJP ACLog (commercial) - 45 day trial
  - Win: http://n3fjp.com/programs/ACLOGINST.exe
- MacLoggerDX - 15 minute trial (unlimited runs of 15 min)
  - Mac: http://www.dogparksoftware.com/files/MacLoggerDX.dmg

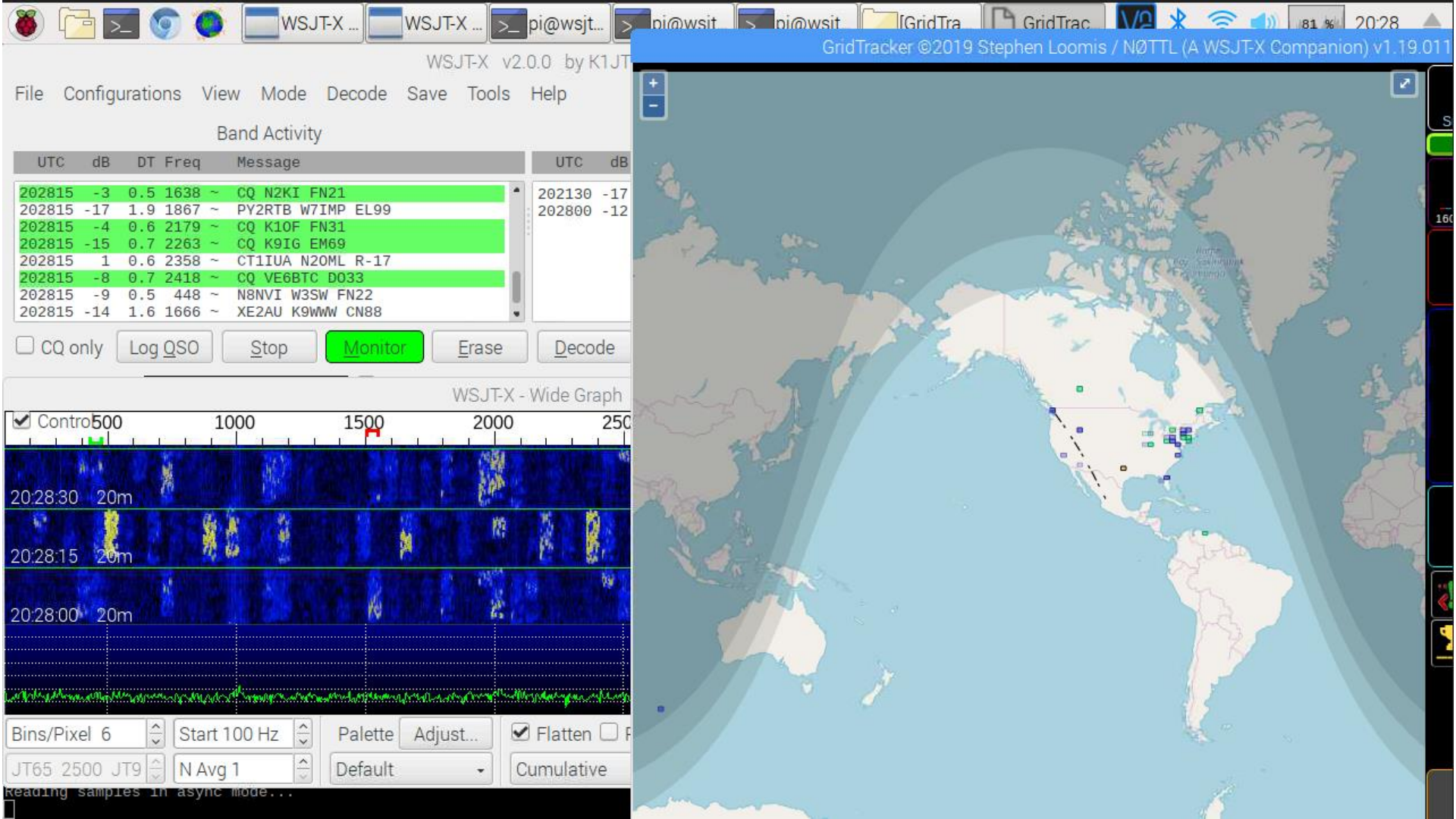
References:

- Facebook FT8/FT4/JT9: WSJT 2-Way Narrow Modes For Amateur Radio
  - https://www.facebook.com/groups/FT8.Digital.Mode/
- FT8 Manual
  - http://www.g4ifb.com/FT8_Hinson_tips_for_HF_DXers.pdf

Just Interesting

- I try to make sure other station has a clean end
- I'll try ~3 times then wait

173015	-12	0.2	1288	~	CQ AB5ZR DM77	~U.S.A.
173036	Tx		932	~	AB5ZR WE5TR EM12	
173100	Tx		932	~	AB5ZR WE5TR EM12	
173130	Tx		932	~	AB5ZR WE5TR EM12	
173345	-9	0.2	1151	~	WE5TR AB5ZR +06	
173407	Tx		932	~	AB5ZR WE5TR R-09	
173415	-10	0.2	1151	~	WE5TR AB5ZR +06	
173430	Tx		932	~	AB5ZR WE5TR R-10	
173500	Tx		932	~	AB5ZR WE5TR R-10	
173515	-10	0.2	1151	~	WE5TR AB5ZR RRR	
173536	Tx		932	~	AB5ZR WE5TR 73	
173545	-14	0.2	1151	~	WE5TR AB5ZR RRR	
173607	Tx		932	~	AB5ZR WE5TR 73	
173615	-7	0.2	1151	~	WE5TR AB5ZR RRR	
173630	Tx		932	~	AB5ZR WE5TR 73	
173645	-5	0.2	1151	~	WE5TR AB5ZR 73	
173745	-8	0.2	1151	~	CQ AB5ZR DM77	


WSJT-X ...
WSJT-X ...
pi@wsjt...
GridTrac
81 %
20:28
WSJT-X v2.0.0 by K1JT
File Configurations View Mode Decode Save Tools Help
Band Activity
UTC dB DT Freq Message
202815 -3 0.5 1638 ~ CQ N2KI FN21
202815 -17 1.9 1867 ~ PY2RTB W7IMP EL99
202815 -4 0.6 2179 ~ CQ K1OF FN31
202815 -15 0.7 2263 ~ CQ K9IG EM69
202815 1 0.6 2358 ~ CT1IUA N2OML R-17
202815 -8 0.7 2418 ~ CQ VE6BTC DO33
202815 -9 0.5 448 ~ N8NVI W3SW FN22
202815 -14 1.6 1666 ~ XE2AU K9WWW CN88
UTC dB
202130 -17
202800 -12
CQ only
Log QSO
Stop
Monitor
Erase
Decode
WSJT-X - Wide Graph
Contro
500
1000
1500
2000
20:28:30 20m
20:28:15 20m
20:28:00 20m
Bins/Pixel 6
Start 100 Hz
Palette
Adjust...
Flatten
JT65 2500 JT9
N Avg 1
Default
Cumulative
Reading samples in async mode...
GridTracker ©2019 Stephen Loomis / NØTTL (A WSJT-X Companion) v1.19.011

Dipole (80m)

Vertical (40-6m)

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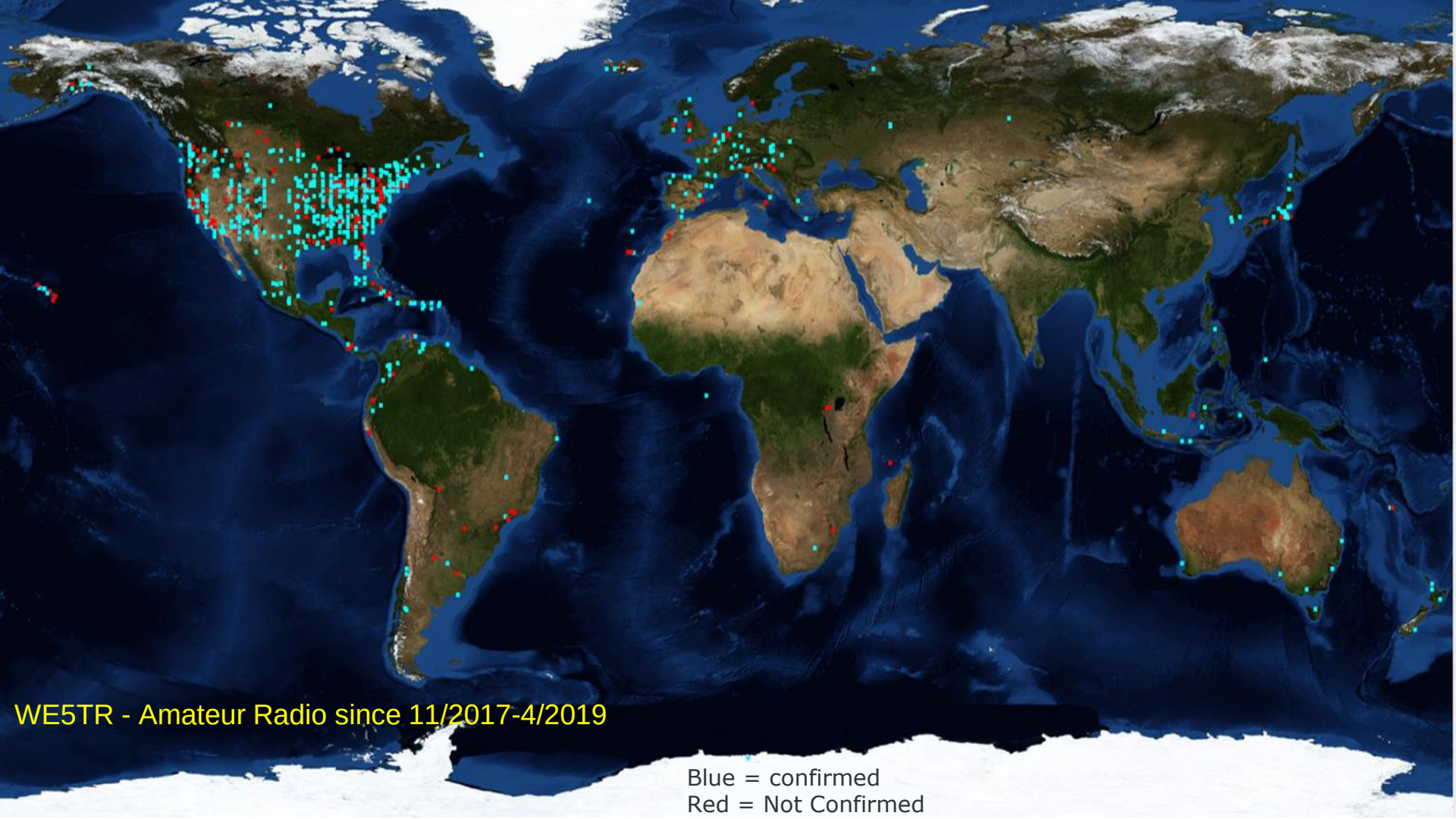
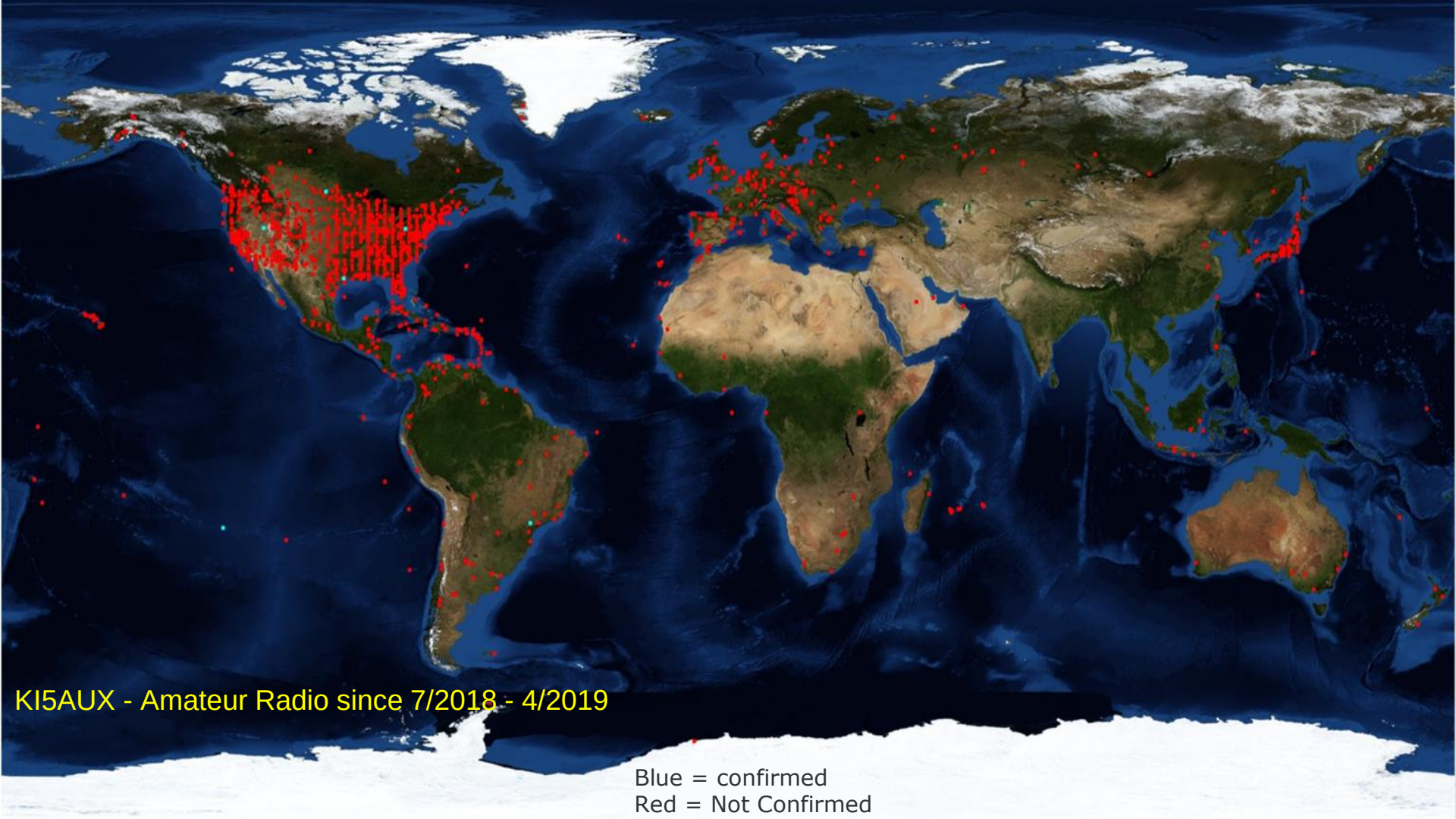
WE5TR@ARRL.net


WE5TR - Amateur Radio since 11/2017-4/2019
Blue = confirmed
Red = Not Confirmed


KI5AUX - Amateur Radio since 7/2018 - 4/2019
Blue = confirmed
Red = Not Confirmed