FT8 / MSK144

PRESENTED TO 285 TECHCONNECT RADIO CLUB

AUGUST 2018

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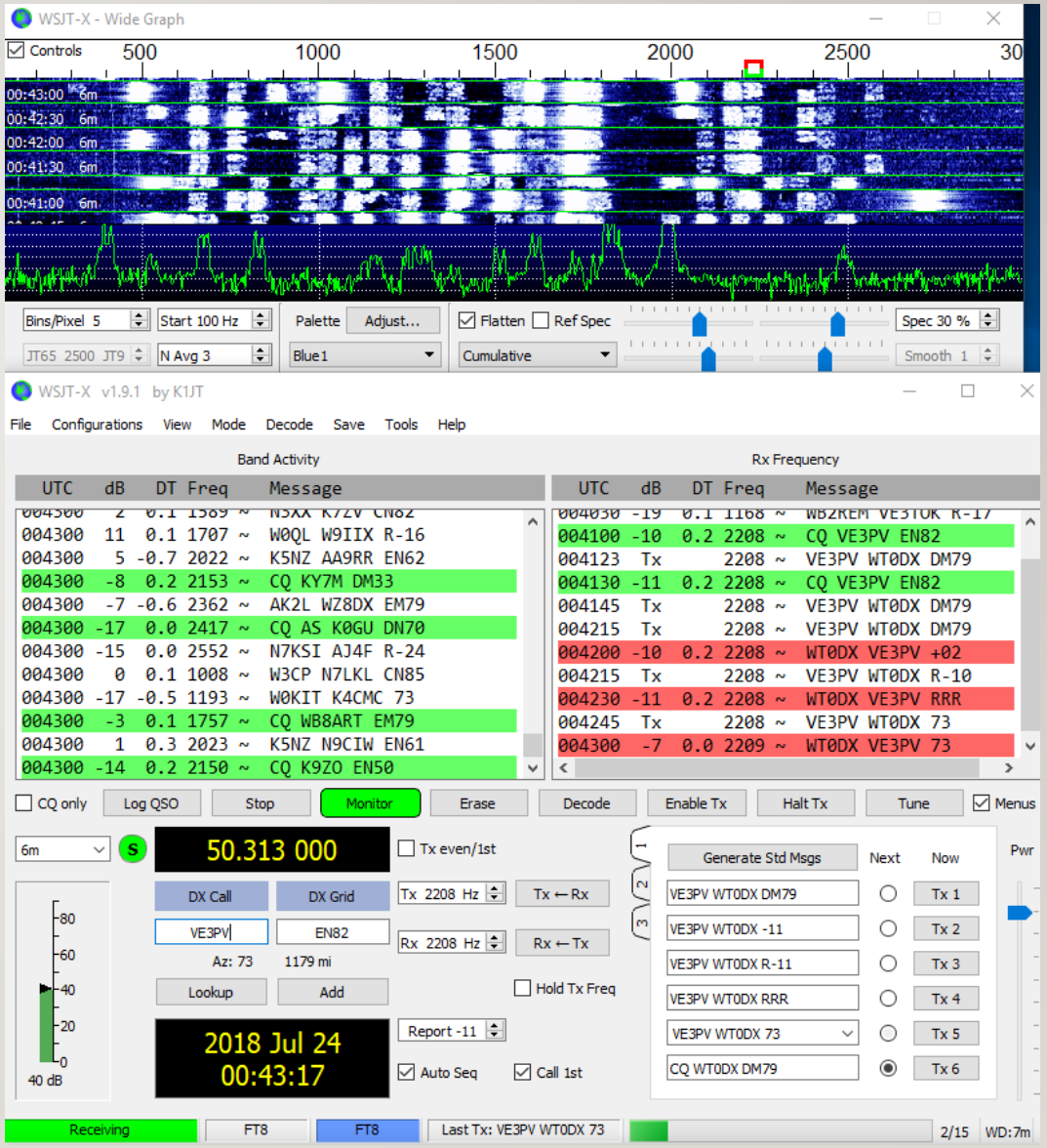
8/3/18 V1.0

2 FT8 / MSK144 OVERVIEW

- Who is WT0DX
- What is FT8
- What is MSK144
- Equipment Setup
- Software
- Getting Started
- Operating Tricks
- FT8 in the field
- Demo / Q&A / Appendix

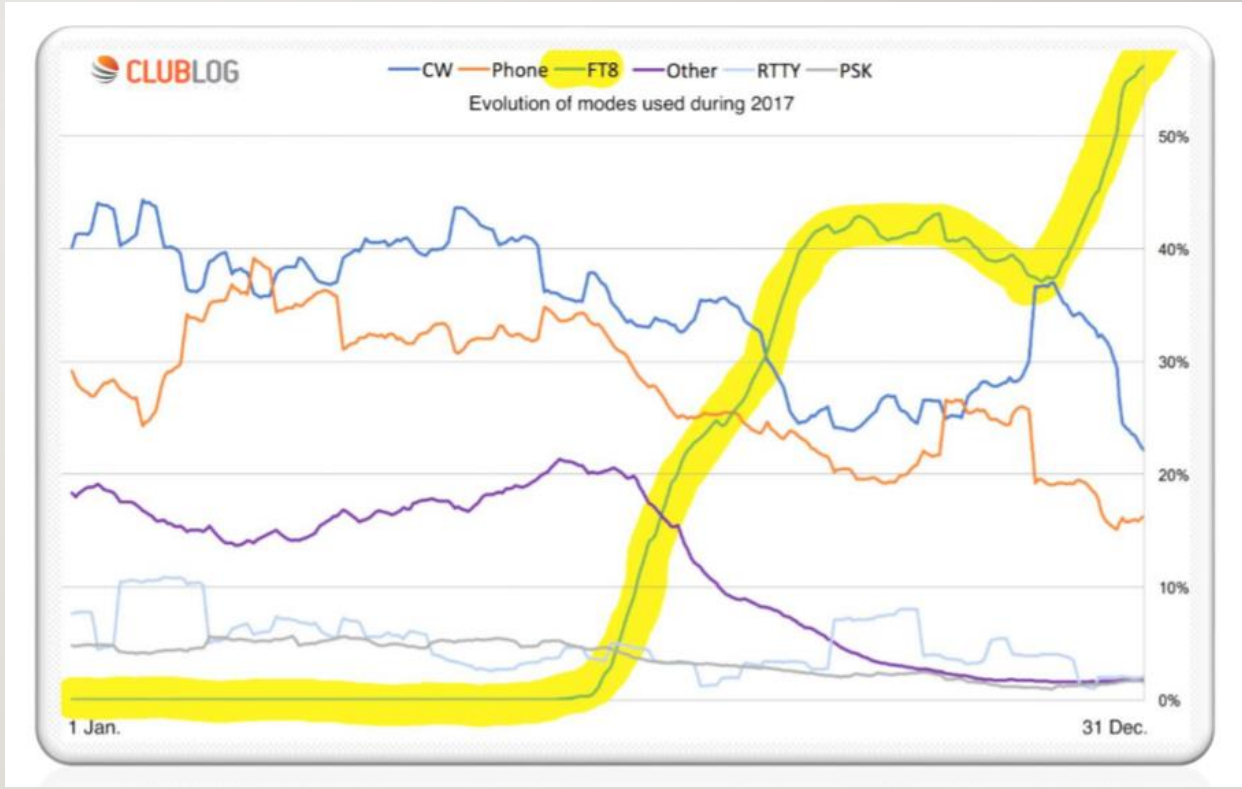


3 WHO IS WT0DX

- Licensed since 1968 - Extra class
- WN8AVH, WB8AVH, WB6FGR, WB9KPT
- Operated from many states…
- Author of 1976 QST article
  "Meet the Microprocessor"
- While in PA was in HOA community
- Now located in Evergreen, CO (no HOA)
- Recently retired from TiVo (130+ patents)
- **4000 JT65 / FT8 / MSK144 contacts**

4

FT8 IMPACT


CLUBLOG
CW
Phone
FT8
Other
RTTY
PSK
Evolution of modes used during 2017
50%
40%
30%
20%
10%
0%
1 Jan.
31 Dec.

5 WHAT IS FT8

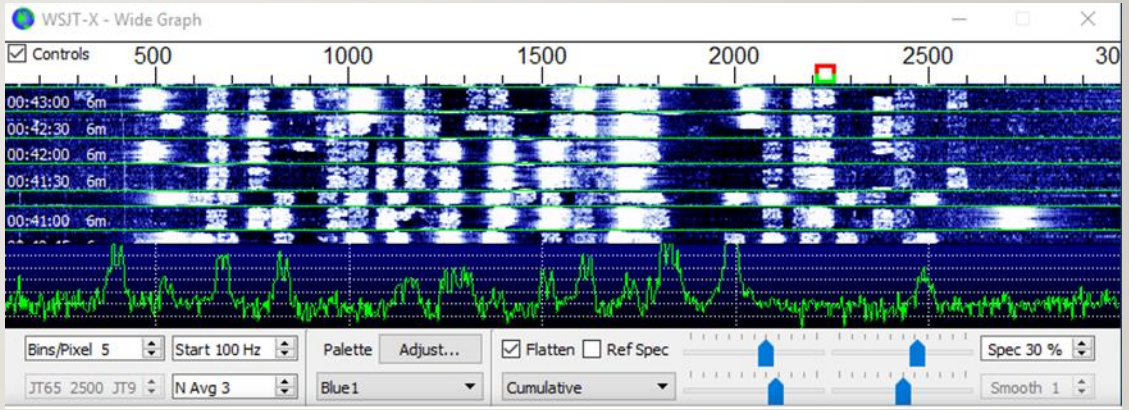
- A form of digital communications developed by Joe Taylor K1JT and his team for applications where signals are very weak
- Uses sophisticated digital signal processing
- 75 information bits per message
  - Two 28-bit fields normally used for callsigns
  - A 15-bit field for a grid locator, report, acknowledgment, or 73
  - A bit for flagging an arbitrary 13 character message
  - A bit to indicate DX-pedition mode
  - Two unused bits

6 WHAT IS FT8

- Forward error correction (FEC) in FT8 uses a low-density parity check (LDPC) code with 75 information bits, a 12-bit cyclic redundancy check (CRC), and 87 parity bits making a 174-bit codeword. It is thus called an LDPC (174,87) code.
  - Synchronization uses 7×7 Costas arrays at the beginning, middle, and end of each transmission
  - Modulation is 8-tone frequency-shift keying (8-FSK) at 12000/1920 = 6.25 baud
  - Each transmitted symbol carries three bits, so the total number of channel symbols is 174/3 + 21 = 79
  - The total occupied bandwidth is 8 × 6.25 = 50 Hz
- Stations take turns transmitting
  - Stations transmit on even or odd 15 second intervals, and then listen on the following interval
  - Station clocks must agree within about 1-2 seconds

7 WHAT IS FT8

- A FT8 contact is designed to exchange the bare minimum information needed to qualify as a "QSO"
  - Call Signs
  - Signal Reports
  - Grid Squares
  - Optional: 13 character "message"



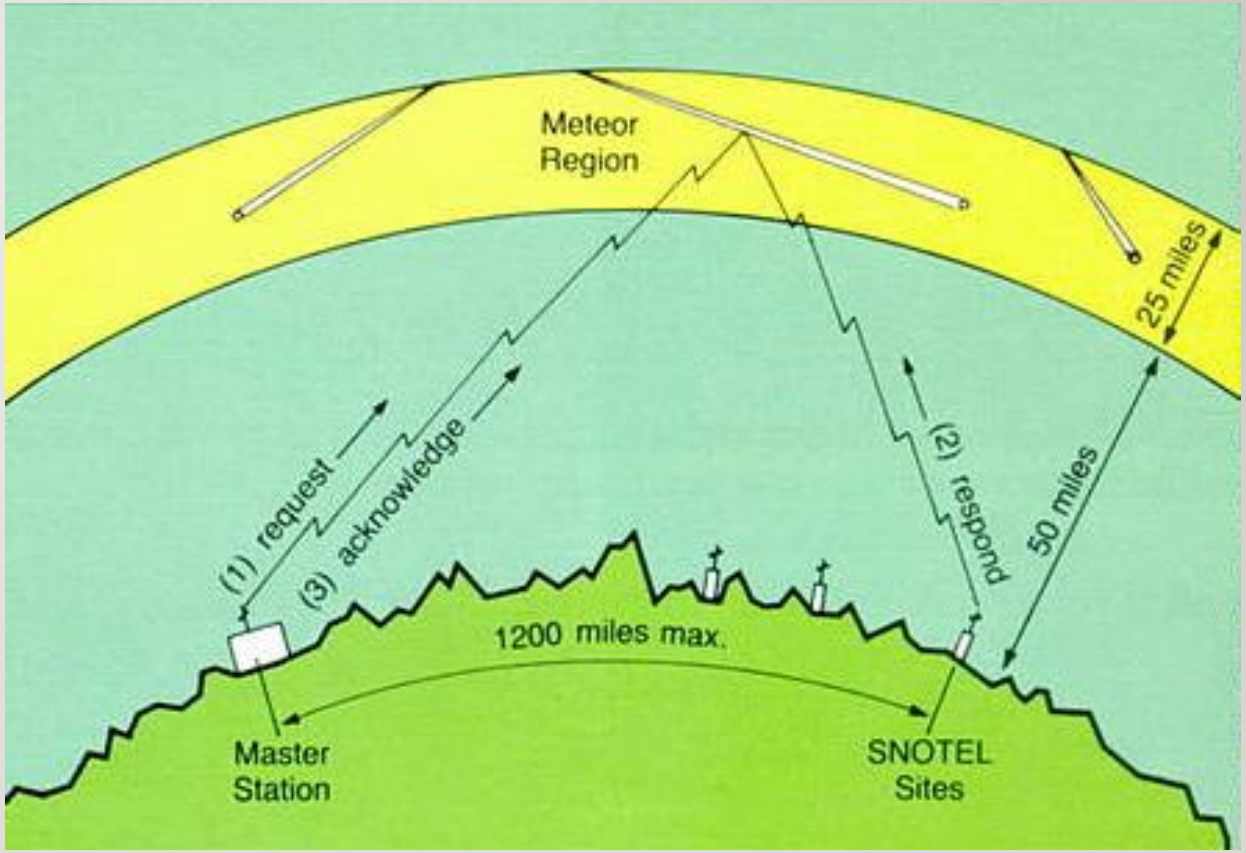
- Auto Sequencing is typically used to complete the QSO
- A special Dxpedition mode has been developed that allows 100s of contacts an hour, and was recently used on the KH1/KH7Z Baker Island activity

8 WHAT IS FT8

- FT8 contacts are valid for most awards
  - DXCC
  - Worked all States
  - Worked all Continents
- Also supported by Logging programs, LOTW, eQSL
- There are 1000's of stations on the air every day
- FT8 has replaced JT65 HF as the predominate digital mode, and some operators have also noticed a reduction in daily SSB and CW activity… "has FT8 killed ham radio?"

9 WHAT IS MSK144

- MSK144 is a mode designed for Meteor Scatter communications
- 1000's of "meteors" burn up in the atmosphere each day
- We can send short messages using the ionization trails of these meteors
- Typically on the 6 Meter band, but other bands also



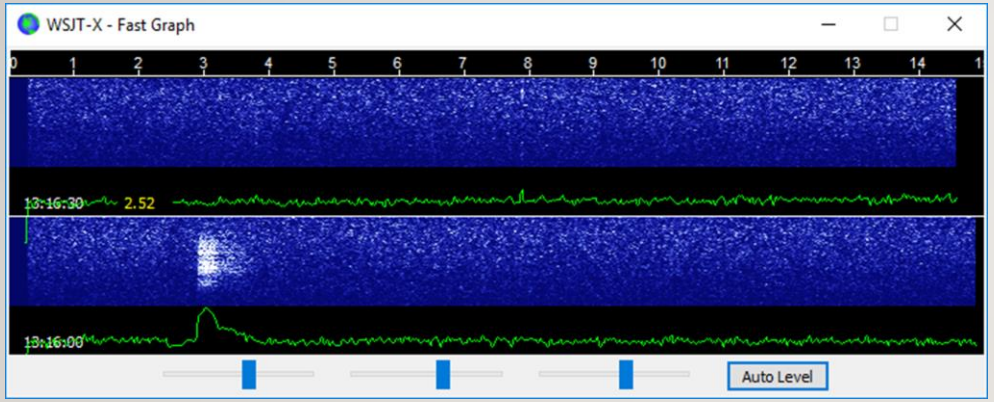
WHAT IS MSK144

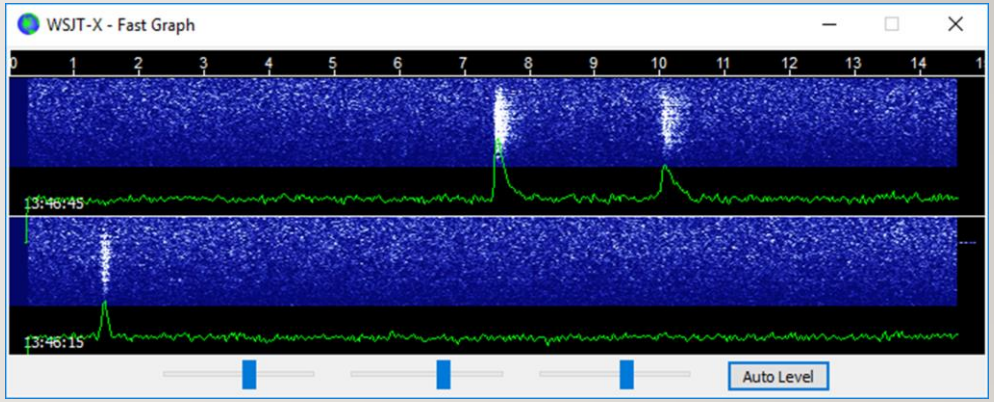
- MSK144 messages are structured in the same way as FT8, with 72 bits of information.
  - Forward error correction is implemented by first augmenting the 72 message bits with an 8-bit cyclic redundancy check (CRC) calculated from the message bits
  - The resulting 80-bit augmented message is mapped to a 128-bit codeword using a (128,80) binary low-density-parity-check (LDPC) code
  - Two 8-bit synchronizing sequences are added to make a message frame 144 bits long.
  - Modulation is Offset Quadrature Phase-Shift Keying (OQPSK) at 2000 baud
  - Frame duration is 72 ms, so the effective transmission rate is up to 250 cps
  - The frames of MSK144 messages are repeated without gaps for the full duration of a transmission cycle

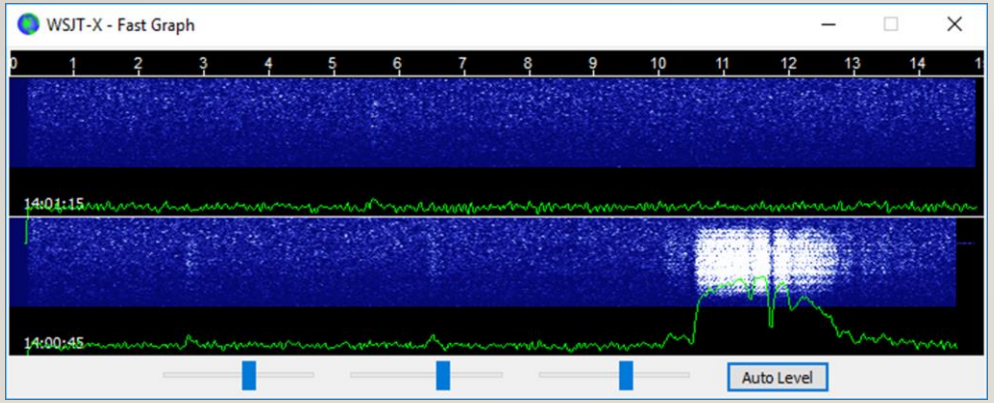
WHAT IS MSK144

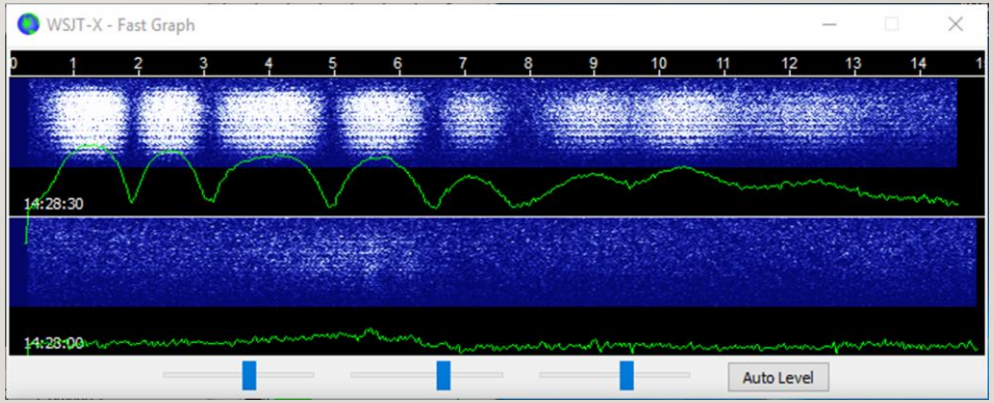
- For most purposes, a cycle duration of 15 s is suitable and recommended for MSK144
- The modulated MSK144 signal occupies the full bandwidth of a SSB transmitter, so transmissions are always centered at audio frequency 1500 Hz.
  - For best results, transmitter and receiver filters should be adjusted to provide the flattest possible response over the range 300Hz to 2700Hz.
  - The maximum permissible frequency offset between you and your QSO partner ± 200 Hz.

12 MSK144 EXAMPLE TRACES









13 EQUIPMENT SETUP

- A rig interface is required between Radio and PC
  - Audio in / out
  - PTT / CAT for transmit / receive
- If you already do PSK31 or AFSK via the PC you are ready
- Various options for the rig interface
  - Direct USB on more recent transceivers
  - Commercial interfaces
  - Homebrew interfaces
    - Google “Homebrew rig to pc interfaces” or “homebrew sound card interface”
    - eBay search for: "EASY DIGI" Sound Card Interface

14 EQUIPMENT SETUP

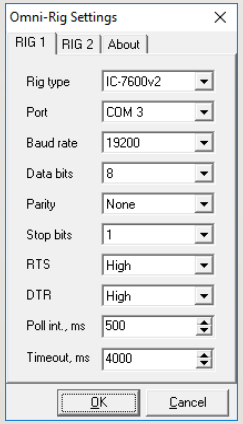
- Tigertronics SignaLink-USB
  - Built-in Low-noise Sound Card
  - Complete Radio Isolation
  - USB Port Powered
  - Uses Mic, Data, or Accy Port
  - Cables available for all radio manufacturers
  - Google "signalink mods"
- MFJ-1204 USB to rig interface
- RigExpert TI-5000
- West Mountain Radio RIGblaster
- microHAM USB Interface II, III
- Timewave Navigator

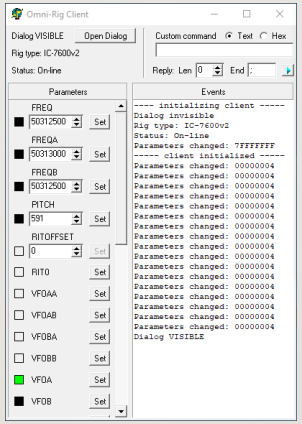
15 SOFTWARE

- There are several FT8 software applications available
  - All run on Windows, but there are some Mac and Linux applications available too
- Support is available via online forums and reflectors
- You must also run a time sync application
- To monitor your success there are several real time reporting websites
  - PSK Reporter
  - Hamspots
  - DX Spots

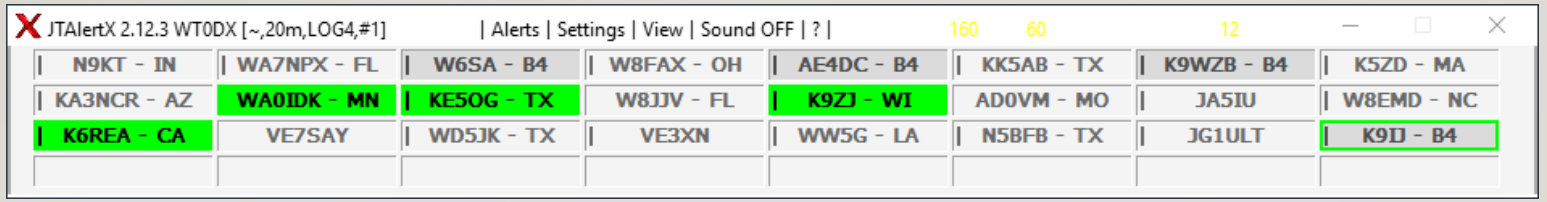
16 SOFTWARE

- Rig control software
  - Omni-Rig
  - Commander
  - Hamlib
  - HRD



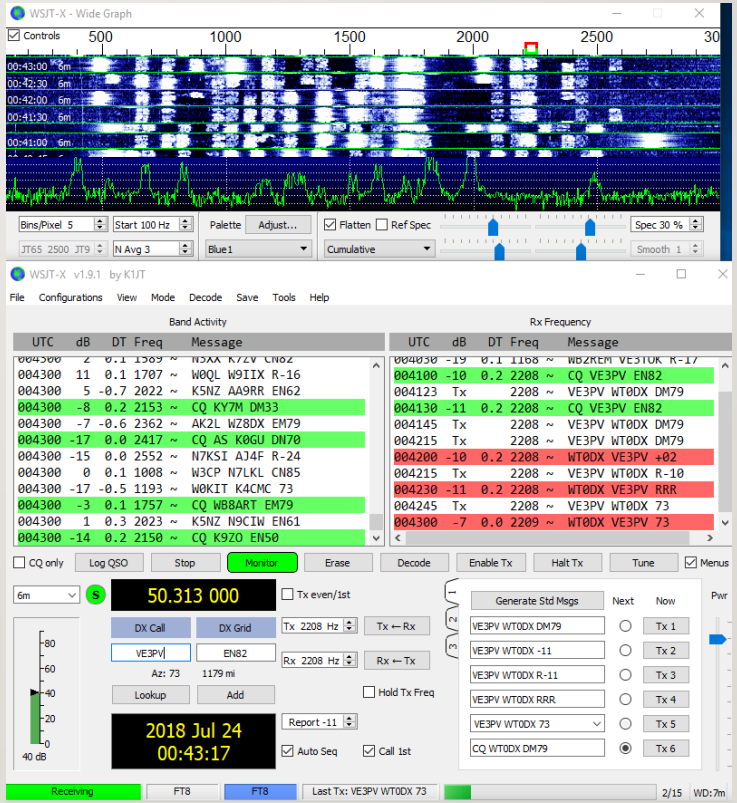


- For many users the other useful application is JTAlert
  - Provides alerts and info on decoded call signs



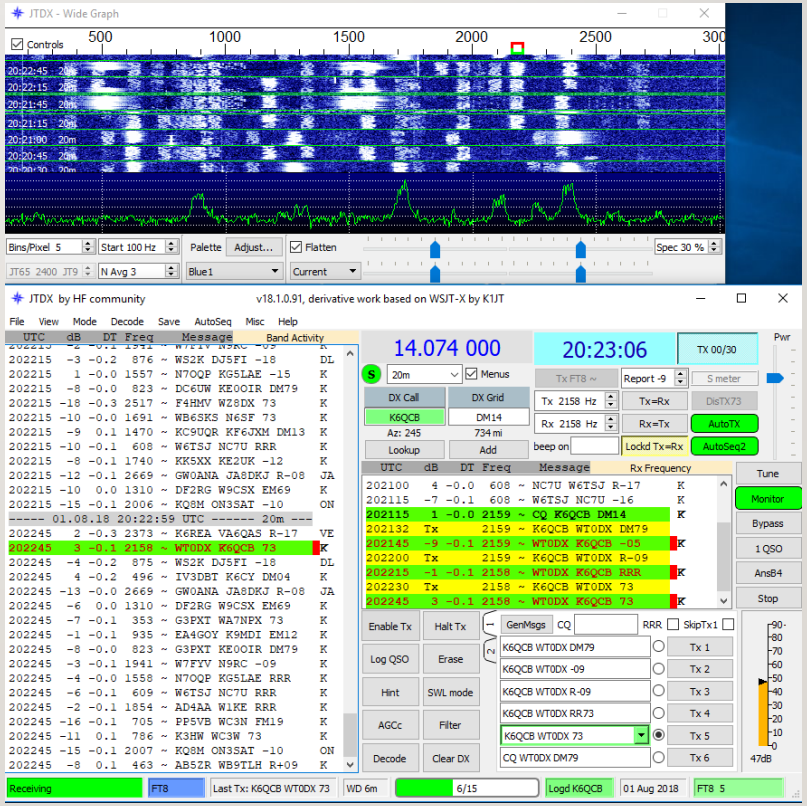
17 SOFTWARE

- WSJT-X FT8 / MSK144
- Written by K1JT and team
- Latest version 1.9.1
- Open source software
- Supports many modes
- Mac and Linux versions
- **This is what I use…**



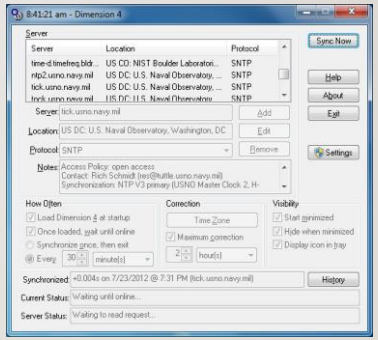
18 SOFTWARE

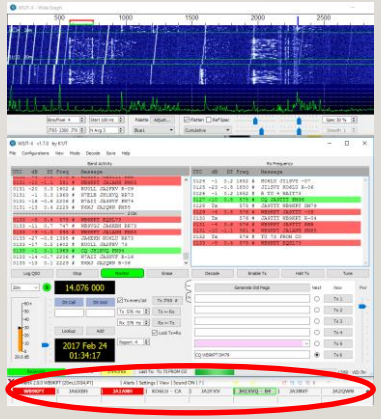
- JTDX FT8 (no MSK144)
- Written by Igor UA3DJY and team
- Latest version is 18.1.xxx
- Derivative of WSJT-X
- “Main focus on the sensitivity and decoding efficiency, both, in overcrowded and half empty HF band conditions.”
- Has a larger received signal window than WSJT-X



19 OTHER SOFTWARE

- Time sync application - required
  - You must use a time sync application on your computer
  - Do not rely on built in time sync function
  - Dimension 4 (probably the easiest and most popular)
  - Meinberg NTP, BktTimeSync, NetTime, others…
- JTAlert – optional, but almost "required"
  - Integrates with WSJT-X and JTDX
  - Provides info on each decoded callsign
  - Provides wanted alerts (many options)
  - Provides link to logbook
  - Also includes JTMacro





20 GETTING STARTED

- Determine how to interface your rig to the computer
- Select the software you want to use
- Install and configure your software
  - Station information including 4 letter Grid Square
  - Audio interface
  - Rig control
  - Logging / reporting
- Watch QSOs to see the flow of messages
- Answer a CQ on a strong station
- Operating frequencies USB: 1.840, 3.573, 7.074, 14.074, 10.1396, 18.100, 21.074, 24.915, 28.074, 50.313

21 QSO MESSAGES

- Standard sequence of messages

CQ WT0DX DM79	Calling CQ
WT0DX W0XX DM76	W0XX responding
W0XX WB9KPT -01	His signal report
WT0DX W0XX R-02	Confirm, plus my signal report
W0XX WT0DX RRR	Confirm
WT0DX W0XX 73	Bye
W0XX WT0DX 73	Bye

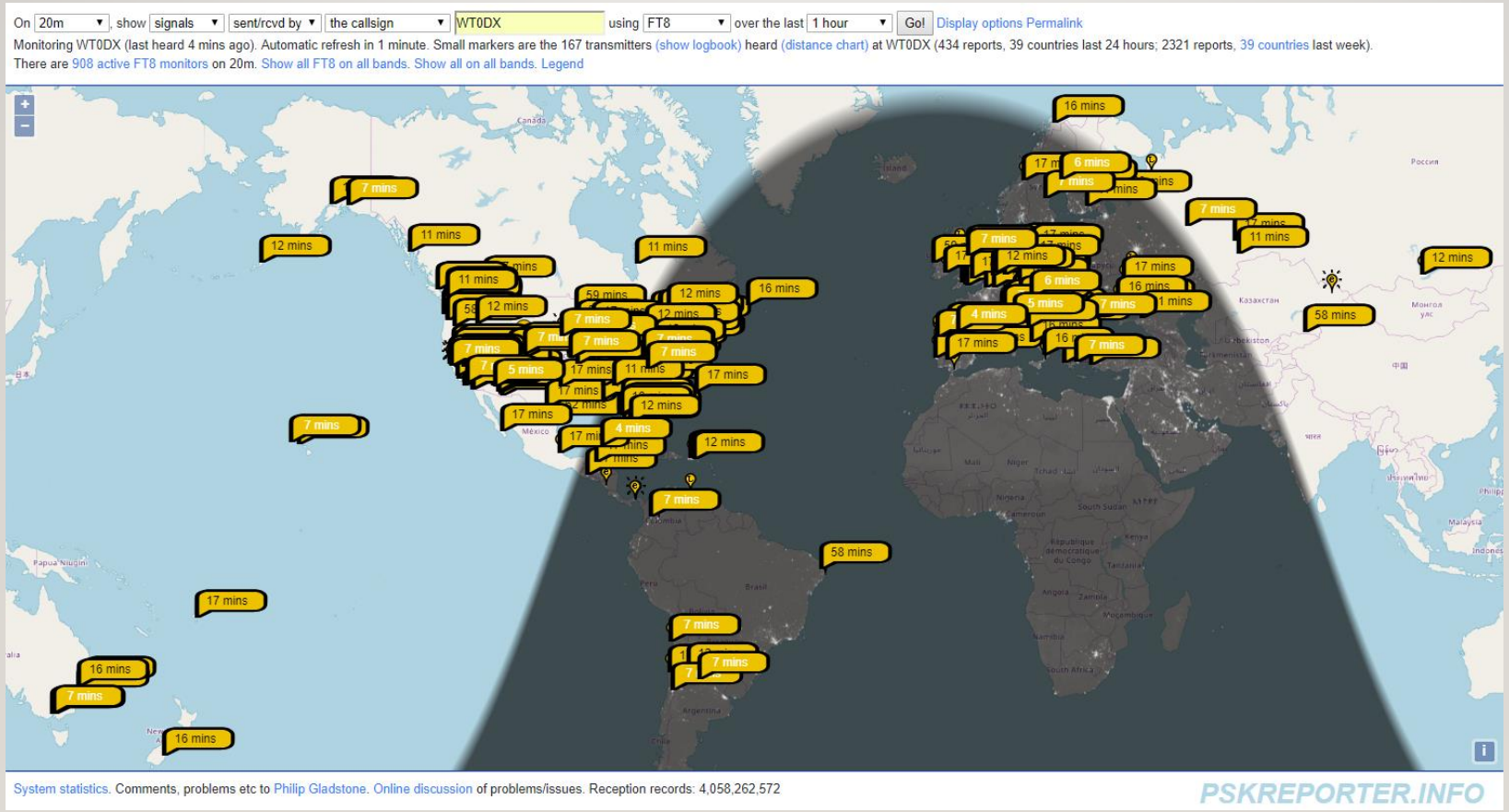
- Optional responses

WT0DX W0XX R-02	Confirm, plus my signal report
W0XX WT0DX RR73	Confirm & Bye
10W HEXBM 73	13 character custom

22 OPERATING TRICKS

- Read the excellent introduction to FT8 by ZL2IFB
- Read the WSJT-X and JTDX User Guides
- Don't use more power than you need to make a contact
- Try calling CQ on a "dead band", you might be surprised!
- Understand the "Split" modes
  - Rig control (to maintain transmit audio in the 1500-2000 Hz range)
  - Audio transmitting frequency different than receiving frequency (conventional split operation)

23 OPERATING TRICKS



FT8 IN THE FIELD: CRESTED BUTTE CO VACATION

- Operated from vacation rental home
  - From 6/20 - 7/20/2018
  - 20M / 6M dipole @ 30’
  - IC-7100 @ 75 Watts
  - S5-7 noise level on 20M
  - Worked all 50 states
  - Worked KH1/KH7Z
  - Over 300 contacts

25 DEMO / Q & A

- Recent FT8 QSO demo…
- You can email me at: wt0dx1@gmail.com
- Please contact me if you would like to share this presentation

APPENDIX

Links to software, websites and other useful stuff

27 FT8 / MSK144 SOFTWARE

- WSJT-X
  - http://physics.princeton.edu/pulsar/K1JT/wsjtx.html
- JTDX (no MSK144)
  - http://www.jtdx.tech/en/

28 HELPER SOFTWARE

- Time Sync
  - Dimension 4 http://www.thinkman.com/dimension4/
  - Meinberg NTP https://www.meinbergglobal.com/english/sw/ntp.htm
  - BktTimeSync http://www.maniaradio.it/en/bkttimesync.html
  - NetTime http://www.timesynctool.com/

29 HELPER SOFTWARE

- Helper Apps
  - JTAlert (PC) http://hamapps.com/
  - JT-Bridge (Mac) http://jt-bridge.eller.nu/
  - QSO Relay (PC) http://www.vk2byi.com.au/qsorelay/

30 HELPER SOFTWARE

- Rig Control
  - Omni-Rig http://www.dxatlas.com/omnirig/
  - Commander http://www.dxlabsuite.com/
  - Hamlib https://sourceforge.net/projects/hamlib/
  - HRD https://www.hamradiodeluxe.com/

31 WEBSITES

- Grid Square
  - LevineCentral http://www.levinecentral.com/ham/grid_square.php
- Support
  - Yahoo Groups, Groups.io and Facebook
- Real time reporting
  - PSK Reporter https://pskreporter.info/
  - DX Maps https://www.dxmaps.com/spots/mapg.php
  - Hamspots https://HamSpots.net

32 INTERFACES

- Tigertronics SignaLink-USB: http://www.tigertronics.com/
- MFJ-1204 USB to rig soundcard interface http://www.mfjenterprises.com/Product.php?productid=MFJ-1204D8
- RigExpert TI-5000 https://rigexpert.com/products/interfaces/ti-5000/
- West Mountain Radio RIGblaster: http://www.westmountainradio.com/rigblaster.php
- microHAM USB Interface II, III http://microham-usa.com/index.html
- Timewave Navigator https://timewave.com/product/navigator-sound-card-modem/

33 OTHER

- External Soundcard: ASUS Xonar U5 5.1-Channel USB Sound Card https://www.bhphotovideo.com/c/product/1086995-REG/asus_xonar_u5_sound_card.html
- ZL2IFB Guide http://www.g4ifb.com/FT8_Hinson_tips_for_HF_DXers.pdf
- ARRL Book http://www.arrl.org/shop/Get-on-the-Air-with-HF-Digital-2nd-Edition/
- Ask Dave #104: Everybody's Trying the New FT8! (KE0OG Dave Casler) https://www.youtube.com/watch?v=zHXScGrsw-A