

FT8 DXpedition Mode

User Guide

Joe Taylor, K1JT — May 16, 2018

WSJT-X Version 1.9 introduces special operating features that enable DXpeditions to make FT8 QSOs at very high rates. The following instructions explain how to use these new features. The instructions are intended for users already familiar with program *WSJT-X* and the FT8 protocol. If necessary, refer also to the [WSJT-X User Guide](#), accessible from the *WSJT-X* Help menu.

Basic Operation and Frequency Conventions

In FT8 DXpedition mode, QSOs between the DXpedition (“Fox”) and calling stations (“Hounds”) can be completed with as little as one Fox transmission per QSO. Moreover, authorized Foxes can transmit up to five signals simultaneously, thereby allowing QSO rates up to about 500 per hour in ideal conditions.

Please note these restrictions and prerequisites:

- FT8 DXpedition mode is intended for use by rare-entity DXpeditions and other unusual circumstances in which sustained QSO rates well above 100/hour are expected. Do not use the multi-signal capability if you do not satisfy this requirement.
- DXpedition Mode must not be used in the conventional FT8 sub-bands. If you are contemplating operation as Fox in DXpedition Mode, find a suitable dial frequency consistent with regional band plans and publicize it for the operators you hope to work. Remember that on-the-air signal frequencies will be higher than the dial frequency by up to 4 kHz.
- Everyone, including Fox and all Hounds trying to work Fox, must use *WSJT-X* Version 1.9.0 or later.
- Everyone should use CAT control with **Split Operation**, either **Rig** or **Fake It** on the *WSJT-X* **Settings | Radio** tab:



- Everyone should check **Monitor returns to last used frequency** on the **Settings | General** tab.

Fox transmits at audio frequencies between 300 and 900 Hz. When transmitting multiple simultaneous signals, the signals are spaced at 60 Hz intervals.

Hounds make initial calls anywhere in the range 1000 – 4000 Hz. Fox will not respond to Hounds initially calling below 1000 Hz. Hounds acknowledge having been called and send their “R+rpt” messages at the same frequency at which they were called by Fox, nominally

in the range 300 – 540 Hz. If a Hound needs to send “R+rpt” more than once, subsequent transmissions will be moved 300 Hz higher or lower. These frequency conventions are enforced and orchestrated semi-automatically by *WSJT-X*.

When Fox is running a pileup the standard messages look something like the following, where Fox is signing KH1/KH7Z:

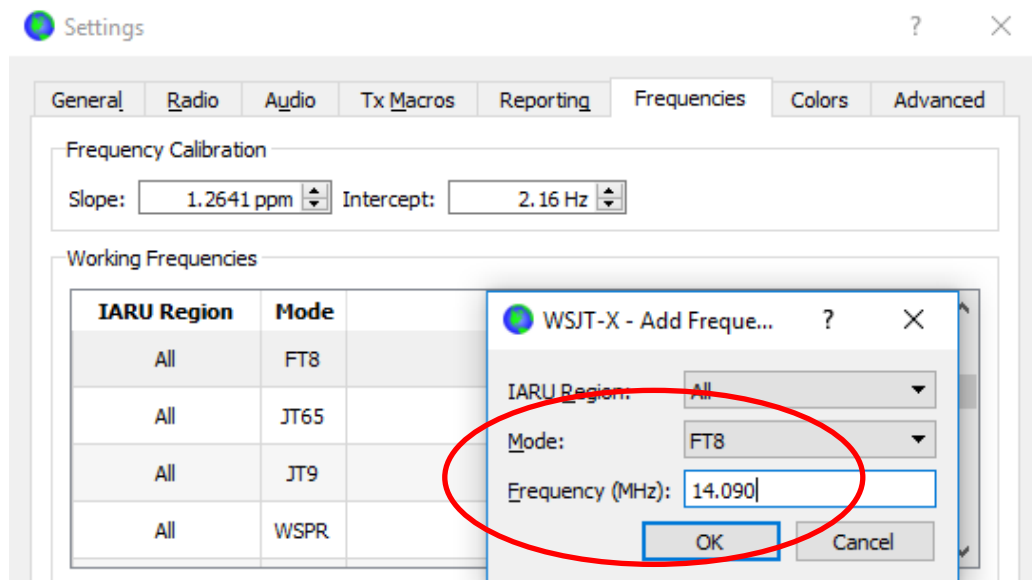
Fox	Hounds
1. CQ KH1/KH7Z	
2.	KH7Z K1ABC FN42, KH7Z W9XYZ EN37, ...
3. K1ABC KH7Z -13	
4.	KH7Z K1ABC R-11
5. K1ABC RR73; W9XYZ <KH1/KH7Z> -17	
6.	KH7Z W9XYZ R-16
7. W9XYZ RR73; G4AAA <KH1/KH7Z> -09	
8. ...	

Note that Hounds use Fox’s base call, not his full compound callsign.

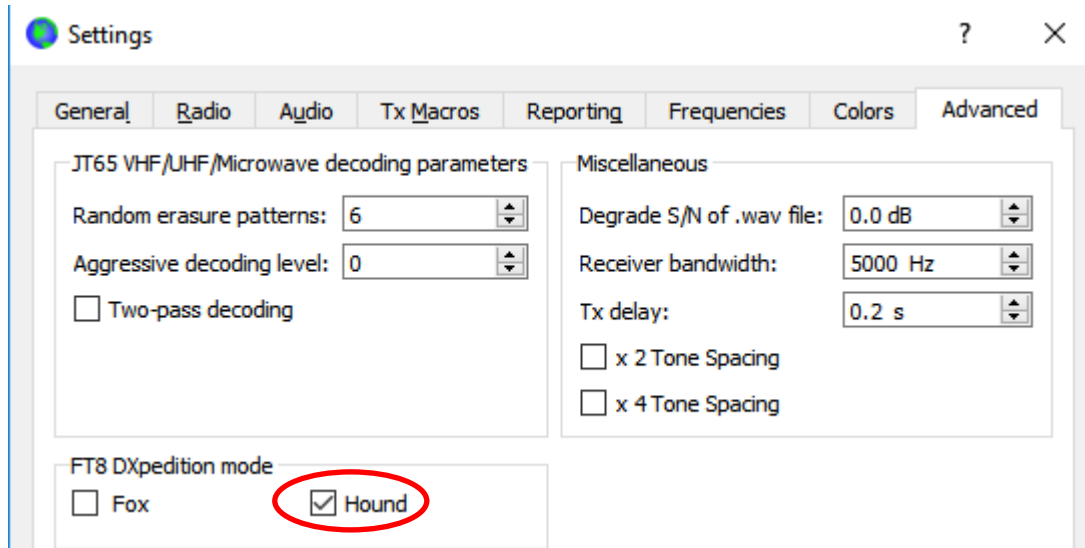
Hounds that must use a compound callsign should enter their compound callsign in the usual place, in the **My Call** box on the **Settings | General** tab. *WSJT-X* will detect the compound callsign and will call Fox by omitting the locator and sending DE followed by the compound call: for example DE W2/G4XYZ or DE K1ABC/7. We recommend using the option **Full call in Tx5 only**.

Detailed Instructions for Hounds

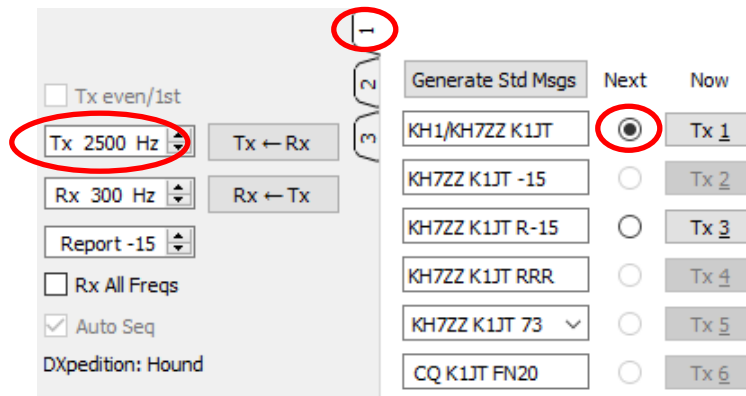
1. Start *WSJT-X* in FT8 mode and select the desired band and pre-arranged dial frequency. If this frequency is not already present in the **Working Frequencies** table on the **Settings | Frequencies** tab, you should add it there. Right click on the **Working Frequencies** table, choose **Insert**, then select **Mode** = FT8 and enter the frequency in MHz. You can do this for any number of bands and frequencies.



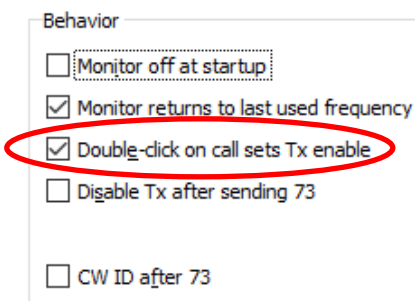
2. Select **Hound** under **FT8 DXpedition mode** on the **Settings | Advanced** tab. Do not try to work the Fox in normal FT8 mode.



3. Select **Tab 1** on the main window for transmitted messages, and set **Tx nnnn Hz** to a Tx frequency between 1000 and 4000 Hz. You can also select a Tx frequency by using **Shift+Click** on the waterfall display. You may find frequencies above 3000 Hz are desirable because they have less QRM. Select the "Tx1" message under Next.



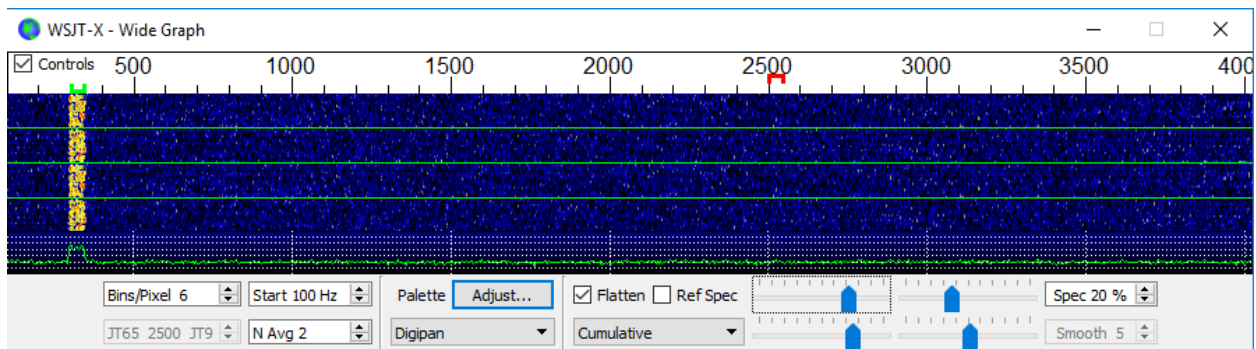
4. On the **Settings | General** tab, check **Double-click on call sets Tx enable**.



- Enter Fox's callsign as **DX Call**. If Fox is using a compound callsign, be sure to enter all of it. The grid locator is optional but provides the advantage of displaying the short-path azimuth and distance from your location.

DX Call	DX Grid
KH1/KH7Z	AJ10
Az: 279 11018 km	

- Configure Wide Graph (the waterfall window) suitably for your system. It should look something like the screen shot below. Signals from Fox are expected at audio frequencies between 300 and 900 Hz, so be sure that the low-frequency end of your displayed spectrum goes down to 200 Hz or lower. You may want to set the high frequency end of the waterfall to 4000 Hz, to make it easy to set your Tx frequency with **Shift+Click** on the waterfall. Doing so also makes it easy to see the frequencies of other Hound signals as you monitor the band.



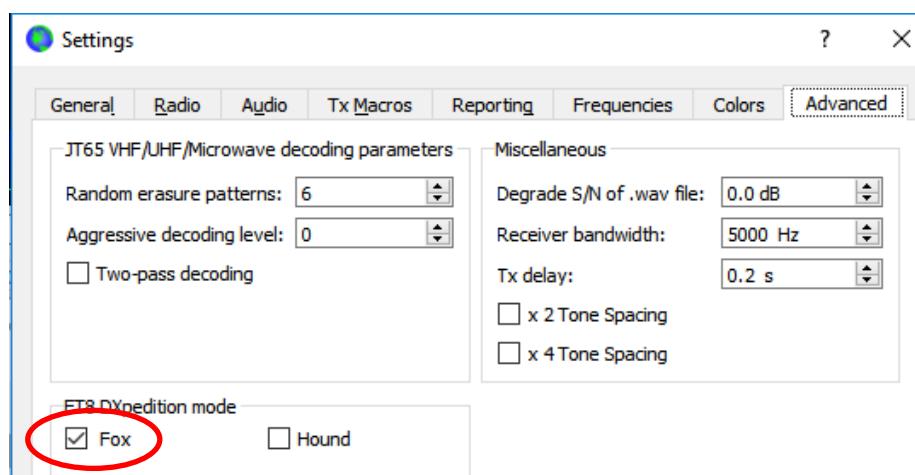
- Toggle the **Monitor** button on the main window to green, to start receiving.
- Note that in Hound mode, *WSJT-X* is normally configured to ignore signals above 1000 Hz. If you wish to decode signals over the full range of the waterfall, to keep closer track of the pileup, check the box **Rx All Freqs**.
- Please do not call Fox if you are not receiving his transmissions.** Do not call Fox if he issues a directed CQ ("CQ EU", "CQ 7", ...) and your continent or numerical call area does not match the requested one. Calling out of turn only creates QRM, and will certainly not get you a QSO.
- Remember that FT8 is a weak-signal mode. Contacts can be made reliably with signals well below the audible threshold. The Fox operator may explicitly decide to answer only calls with signal strength below some limit, for example $S/N = -10$ dB. In many cases you will not need and should not use an amplifier. It's more important to find a calling frequency free of QRM.
- After you have copied Fox calling CQ or working someone else, double-click on his decoded message to call him. You may keep calling until he answers, perhaps changing your Tx frequency in the hope of finding a frequency clear of interference. Use **Shift+Click** on the waterfall to change your Tx frequency — the red "goal

posts” marker on the waterfall scale. You will need to re-activate **Enable Tx** (or hit **Enter** on the keyboard) at least once every two minutes. (This restriction is to ensure that an operator is present and paying attention.)

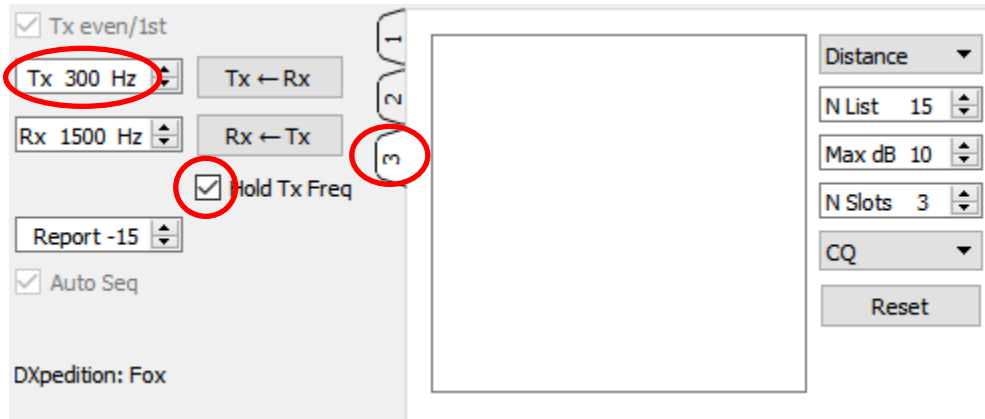
12. After you receive a signal report from Fox, *WSJT-X* will automatically send your next transmission as message **Tx 3** (“R+rpt”) at the same frequency at which Fox called you. If you need to send “R+rpt” more than once, subsequent transmissions will be moved 300 Hz higher or lower. Note that *WSJT-X* will send this message even if **Enable Tx** is disabled, and even if you have not called Fox for several Tx sequences. If you have stopped calling Fox because you will be leaving the rig unattended, you should quit *WSJT-X* or disable Hound mode in order to avoid the possibility of unwanted transmissions.
13. When Fox receives your “R+rpt” message he responds with “RR73”. At this point he considers your QSO complete and logs it. When you receive “RR73” you should log it, too !
14. If for some reason a Hound fails to copy an RR73 sent by Fox, that Hound will repeat his transmission of **Tx 3** (“R+rpt”). Fox will respond to such “R+rpt” messages by sending “RR73” up to three times.

Detailed Instructions for Fox

1. Start *WSJT-X* in FT8 mode and select the desired band and pre-arranged dial frequency. If this frequency is not already present in the **Working Frequencies** table on the **Settings | Frequencies** tab, you should add it. Right click on the **Working Frequencies** table, choose **Insert**, select **Mode** = FT8, and enter the frequency in MHz. Check **Show DXCC entity and worked before status** on the **Settings | General** tab.
2. Select **Fox** on the **Settings | Advanced** tab. This choice will enforce that **Tx even/1st** and **Auto Seq** (on the main window, see next page) are checked.



- Configure the Wide Graph (waterfall window) as shown for Hounds on page 4. Hounds make their initial calls at audio frequencies 1000 – 4000 Hz; after being called they acknowledge and send their report at a frequency between 300 and 900 Hz. Be sure to configure the Wide Graph so that your waterfall extends at least from 200 to 4000 Hz.
- Select **Tab 3** for Tx messages. Set **Tx 300 Hz**, and check **Hold Tx Freq**.



- To evade QRM you can choose another Tx frequency in the range 300 – 600 Hz. Alternatively, you can uncheck **Hold Tx Freq** and *WSJT-X* will randomly choose a starting frequency in this range for each transmission.
- In Fox mode the left text panel on the main window is labeled “Stations calling DXpedition ...”. When Hounds are calling Fox, this window will be filled with a sorted list of callsigns and associated information, as shown below. By using the drop-down list at the top right of **Tab 3** you can choose to sort the list by **Call**, **Grid**, **S/N**, **Distance**, or **Random** order. The **Age** parameter tells how many Rx sequences ago each Hound was most recently decoded. Hound callsigns are dropped from the list if their **Age** exceeds 4 sequences. If your most recent CQ was directed to a particular continent, only calls from that continent will be displayed.

WSJT-X v1.8.2-devel by K1JT

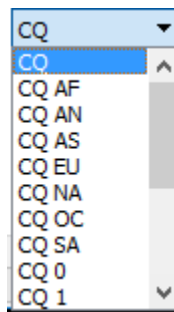
File Configurations View Mode Decode Save Tools Help

Stations calling DXpedition W2/K1JT

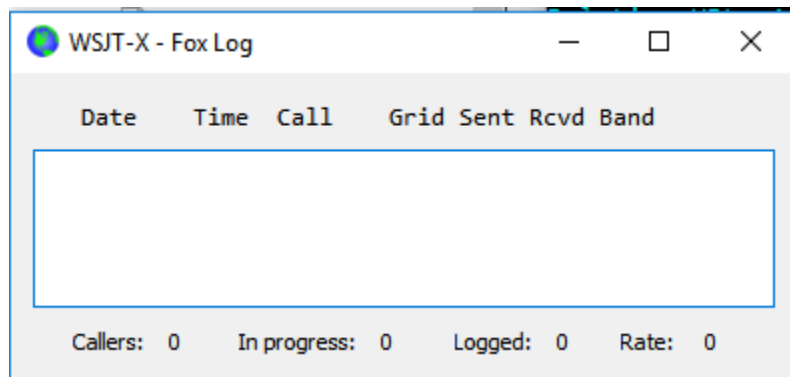
Call	Grid	dB	Freq	Dist	Age	Continent
AA7A	DM43	7	1143	3300	0	NA
K1HTV	FM18	-11	1311	286	0	NA
K9AN	EN50	-4	1653	1215	0	NA
WA1SXX	EM95	-13	1640	773	0	NA

- N List** on **Tab 3** sets the maximum number of sorted callsigns that will be displayed in the left text panel.

8. You can limit displayed callsigns to those no stronger than **Max dB**. As Fox you can use this feature to work weaker stations, thereby discouraging Hounds from engaging in a high-power “arms race”. Remember that FT8 is designed as a weak-signal mode. It provides reliable decoding at signal-to-noise ratios down to about – 20 dB.
9. **N Slots** sets the maximum number of Fox signals transmitted simultaneously. Fox can conduct as many as **N Slots** QSOs in parallel.
10. The **CQ** drop-down list offers a selection of CQ messages directed to a particular continent or numerical call area. If you have selected one of these options, non-matching calls from Hounds will be ignored. You should probably call CQ for several sequences after changing this selection, to make sure everybody gets the message.



11. Click on **Fox Log** on the **View** menu to display an optional window showing QSOs logged in the current *WSJT-X* session. This window also displays the number of decodable Hounds found to be calling, the number of QSOs in progress, the number logged in the current session, and the hourly QSO rate.



12. To send logged QSOs directly to *N1MM Logger+*, go to **Settings | Reporting**, check **Enable logged contact ADIF broadcast**, and enter the IP address and port number used by *N1MM*.

N1MM Logger+ Broadcasts

Enable logged contact ADIF broadcast

N1MM Server name or IP address:

N1MM Server port number:

You must also configure *N1MM* to accept logging data from *WSJT-X*. Go to **Config | Configure Ports, ... | Broadcast Data ...** and check the box near the bottom that enables *WSJT* and *JTAlert* connections

13. The Fox operator's main task is to select Hounds to be called and worked. The rectangular text box on **Tab 3** holds the **QSO queue**: a list of Hound calls to be worked and the signal reports they will be sent. Hit **Enter** to select the top callsign from the sorted list and enter it in the **QSO queue**. Alternatively, you may double-click on any call in the list to move it to the **QSO queue**.
14. Double-click on a callsign in the **QSO queue** to delete it from this queue.
15. The **Reset** button clears all queues, thereby ensuring that Fox will call CQ at the next opportunity.
16. The right text window (labeled "Rx Frequency") displays decodes of signals below 1000 Hz (by default these are highlighted in red) and Fox's own transmissions (highlighted in yellow). The red messages will be those containing "R+rpt", signifying that a Hound is awaiting the concluding "RR73" from Fox.
17. To start a run, activate the **Enable Tx** button. If a Hound call is available in the **QSO queue**, that station will be called in Fox's next transmission. If the **QSO queue** is empty, Fox will call CQ. If **N Slots** is greater than 1 and more Hounds are available in the queue, Fox will call more than one Hound.
18. After receiving "R+rpt" from a Hound previously called, Fox will send "RR73" to that Hound and log the QSO.
19. *WSJT-X* maintains several queues in a manner that allows difficult QSOs to be completed while keeping the overall QSO rate high. We use a "3 strikes and you're out" rule. Fox will call a specific Hound up to 3 times, waiting for an "R+rpt" response. If a Hound repeatedly sends an "R+rpt" message, Fox will send RR73 up to 3 times. Finally, the total timespan of an attempted QSO is limited to 3 minutes. When any of these timeouts is exceeded, the QSO is aborted.
20. Fox is programmed to call CQ in a single slot (and thus at maximum signal power) at least once every 5 minutes.
21. You can transmit short messages to instruct the pileup by using one of the Tx message boxes (say **Tx 5**) on Tab 1, or the **Free msg** box on Tab 2. Examples might be "NOW 15 M" or "QSY 21.067".
22. If you have plenty of Hound callers and you're tending to work Hounds with S/N = -10 dB or higher, you can speed up the decoding by choosing **Normal** rather than

Deep on the **Decode** menu. Don't forget to return to **Deep** when working weaker signals.

Important Note for Fox Operators: When using **N Slots** > 1, your transmitted signal will not have a constant envelope. To avoid producing unwanted sidebands you must ensure good linearity throughout your Tx system. One way to get things about right is to use the **WSJT-X Tune** button to generate an unmodulated carrier. Configure your transmitter and PA as required for the desired peak output power, say P_0 . Then pull the **Pwr** slider (bottom right of the **WSJT-X** main window) down until your output power decreases by about 10%. Use this audio level setting for all your Fox transmissions. If you are using **N Slots** signals, your average transmitted power will be $P_0/(\mathbf{N\ Slots})$ and the power in each signal will be $P_0/(\mathbf{N\ Slots})^2$. Thus, for **N Slots** = 1, 2, 3, 4, and 5 the average power *per signal* will be down from P_0 by about 0, 6, 9.5, 12, and 14 dB, respectively.

Answers to Frequently Asked Questions

1. **Why should FT8 DXpedition Mode be used only by DXpedition stations and those trying to work them?**
 - a. In FT8 DXpedition mode, Tx frequencies of Fox and Hound stations are sometimes controlled by the program rather than by the operator. This behavior is undesirable for general use, and would be extremely anti-social if used in the conventional FT8 subbands.
 - b. Stations other than legitimate DXpeditions should not "hog the spectrum" by generating multiple simultaneous signals.
2. **Can FT8 DXpedition Mode be used for Field Day, QSO parties, and other contests?** No. This new mode is explicitly designed for the many-to-one situation of a pileup trying to work a rare DX station, exchanging reports. It is not suitable for events where everybody works everybody, exchanging other specified information.
3. **Can the new program version be used for normal FT8 operation?** Yes, and also for operation in all the other modes supported by **WSJT-X** v1.8.0.
4. **The Tx filter in my rig cuts off at 2700 Hz. How can I make use of the full frequency range 1000 – 4000 Hz allocated for Hounds?** You should be using **Split Operation**, so that your Tx audio always stays in the range 1500 to 2000 Hz. See [Section 4.2](#) in the **WSJT-X** User Guide.
5. **I can't use CAT control; can I still work the Fox?** With some extra effort and inconvenience, yes. Select your initial Tx frequency somewhere in the range 1000 – 4000 Hz where you know you can transmit. When Fox sends you a signal report, immediately change your audio Tx frequency to something below in the range 300 – 900 Hz, and send your Tx3 message there.

6. **My big antennas and legal limit amplifier make me loud, and I'm used to working DX before everyone else. Why can't I make a contact with Fox?** The DXpedition operator may have the **Max dB** filter set, and you're being ignored because your signal is too strong. FT8 is a weak-signal mode. Try reducing your power output.
7. **How does the new message format work?** Standard JT-style structured messages include two callsigns and a locator or report. Normally the two callsigns are those of the addressed and transmitting stations. The new message format used by Fox (e.g., lines 5 and 7 near the top of page 2) is flagged by setting one of the three extra bits in the 75-bit FT8 payload. Upon reception, the two callsigns are then interpreted as those of two different Hounds: one whose QSO is acknowledged as complete, and one now invited to send a report. The 16-bit field normally used for a locator or report is instead used for a 10-bit hash of Fox's callsign and a signal report.
8. **Are you trying to kill CW as a mode?** No. CW is a highly flexible general-purpose mode with good weak signal performance and good spectral efficiency. FT8 has even better weak signal performance and spectral efficiency, but it is a special-purpose mode designed specifically to optimize reliable, minimal QSO exchanges.