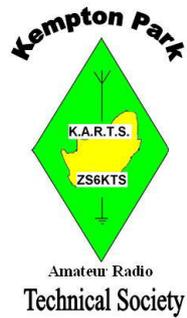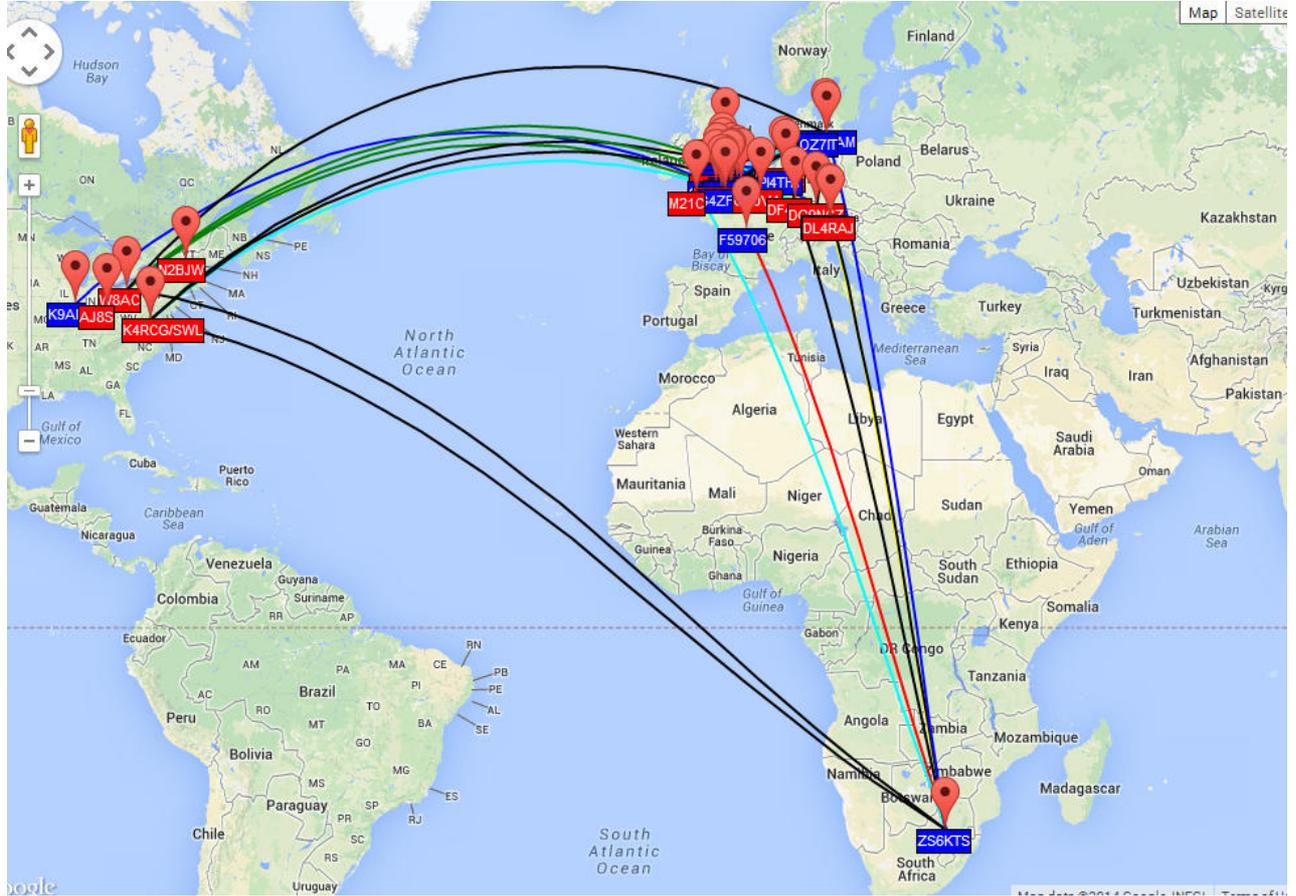# QUICK TUTORIAL TO START USING WSPR

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Version 1.0

Introduction

If you are interested in the mysteries of propagation then WSPR is the tool at your disposal.
To experience this fascinating tool, all you need is an SSB transceiver, simple antenna, a sound card interface to connect the transceiver to your computer and internet access.

WSPR is short for Weak Signal Propagation Reporter and is pronounced "Whisper".

It is important to note right away that WSPR is not a QSO mode. It is used to broadcast a position, call sign and power level and see who hears and decodes it. The receiving station can work out how far the signal travelled and how strong it is on the receiving end.

The mode that WSPR uses is called MEPT-JT. MEPT means Manned Experimental Propagation Transmitter. The JT part is Joe Taylor's initials.

Joe Taylor K1JT also developed the mode WSJT which is used for "moon-bounce" communication. In 1993 Joe Taylor shared a Nobel Prize in Physics with Russell Hulse, for some work they did in their field of Astrophysics. He obtained his license as an Amateur Radio operator as a teenager and as a result became interested in radio-astronomy.

This tutorial covers the reception and decoding of WSPR only. TX will be covered in later tutorial.
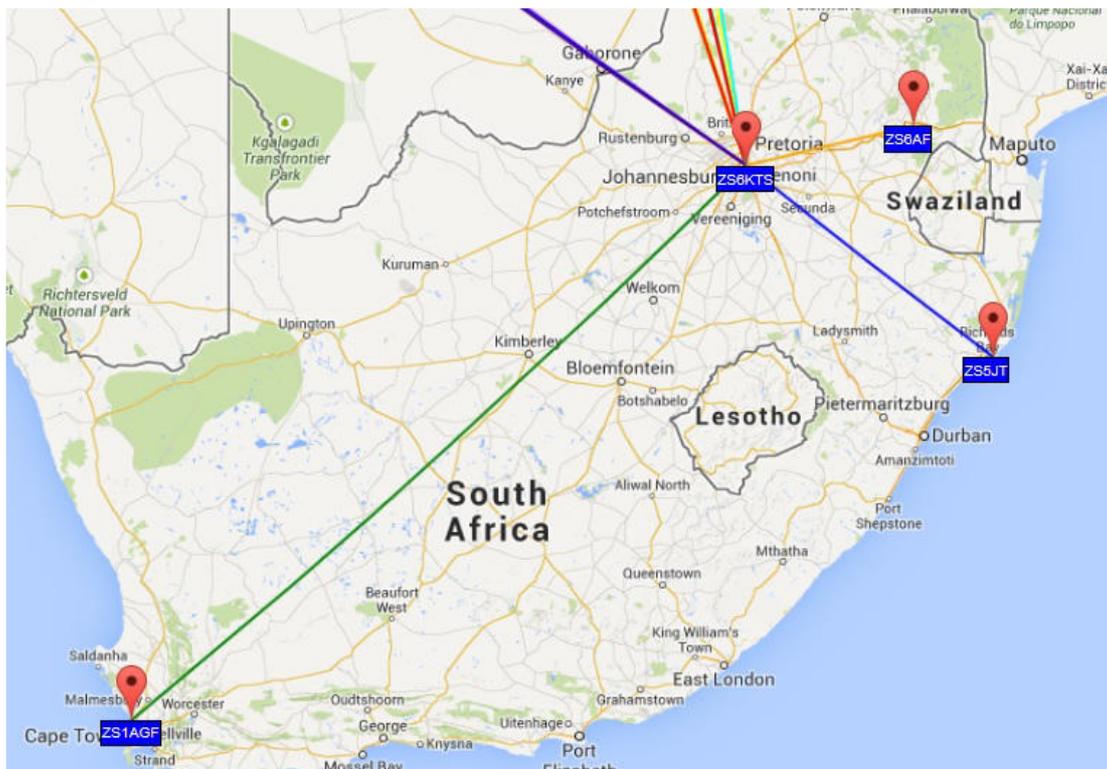
Decide what you want to do

This is important. Do you want to TX only, RX only or TX and RX?

One of the joys of WSPR is being able to receive, decode and report WSPR signals on amateur frequencies you might not be able to transmit on. WSPR can decode really faint signals; the author of WSPR (**K1JT**) developed the protocols used in "Moon Bounce", so who know what you hear. The ZS6KTS beacon has been decoded on 5 MHz using 20W with an inverted V antenna at more than 13000kms.

Requirements

The following is needed for the WSPR software to work correctly.

1. <u>Time:</u> Accurate and synchronized time. (Normally by GPS or Internet but it is possible to get right by hand). In the next section there is a recommendation for software to use. The transmitting and receiving station need to be no more than 2 seconds apart. WSPR starts transmitting on exactly the start of a randomly chosen even minute and will transmit for basically 2 minutes. The transmission ends at the start of the next even minute. The website http://time.is will allow you to check your computer time using a web browser.

2. <u>Computer:</u> A computer with a speaker and a microphone at the very least. Computer should have an internet connection running some time synchronization software. The receiving computer should be a reasonable spec and not an "old clunker" more than 5 years old. The TX computer can be an old clunker or even a cheap microprocessor with a GPS clock. Most of the computing power is in decoding the signal.

3. <u>Radio Station and antenna:</u> If you are RX only you can get really good results using a wide band "active loop" antenna hanging in a tree with a cheap Software Defined Radio dongle or usb box. ZS6KTS beacon is decoded in a number of locations in Europe on this configuration. For local RX a long wire lying on the floor does fine. TX requires the full setup including a "radio interface board" to supply audio to the computer and trigger PTT.

4. <u>Location:</u> You need your current location as a grid locator. E.G. ZS6KTS beacon is KG43cw. WSPR transmits only 4 digits of the locator but does report 6 digits via the internet.

5. <u>Callsign:</u> As a convention, if the station is a listening station not an amateur radio station, they should still use an appropriate and identifiable call sign. Callsign out of your license region should have a suffix in the following format ZS6KTS/ZS1 for ZS6KTS operating at ZS1.

What does it sounds like

It sounds like a continuous tone for 2 minutes. The tone starts on exactly the even minute and will continue for 1 min 54 sec.

Bandwidth

The WSPR signals are 6 Hz wide. The software will decode 100 Hz either side of the TX Frequency (see settings below), which gives a total receive bandwidth of only 200 Hz. However this is plenty of space to play around in, even during narrow band QRM.

Let's get started!

Firstly you need to download the WSPR software. At the time of writing the latest version was WSPR v2.21, but it was not easy to find.

You download the WSPR software from http://www.physics.princeton.edu/pulsar/K1JT/wspr.html Please run version 2.12 or higher (2.11 on Linux).

You need to be able to synchronize your time with the internet. A really good program to use is Meinberg. It is a collection of open source programs which automatically keeps your computer time in sync. **Install** the **Meinberg** software and select the **Africa** region when prompted.

The recommended location to download Meinberg is as follows, but a Google search will also turn up the correct location.

http://www.meinbergglobal.com/english/sw/ntp.htm

The name of the correct download at the time of writing this tutorial is:
ntp-4.2.6p5@london-o-lpv-win32-setup.exe (2.80 MB)

Connect to the internet and you are ready to go!

Let's Find Someone to Decode!

Open the WSPR **website** …. http://www.wsprnet.org

The "**Activity**" tab on the website will show all the reporting TX and RX stations. It will be grouped by band. The ZS6KTS beacon runs on 60m, exact frequency of 5.250040 MHz. It is 40Hz up to move away from local and DX QRM.

Most frequencies are commonly used by multiple stations and it is good practice, if given the choice, to use the same frequency as everyone else. WSPR will randomly transmit so you won't always be transmitting on top of each other.

If you are registered (which is not compulsory) then you can use the "**Chat**" functionality on the website. This will allow you to get help or to co-ordinate easily especially when signals are weak.

You can keep track of your spots (both TX and RX) using the "**Database**" functionality on the website. There is also a useful "**Map**" on the website.

Choose a frequency where there are stations you want to decode (you can ignore the 10Hz and 1Hz values; this is within the 100 Hz each side receiving limitation).

Plug in your interface board if you are using one, or get the computer's microphone as close as possible to the radio speaker. WSPR likes to use low power and low gains. Rather turn everything way down (to 1%) and you can turn it up as you test.

The radio should be on USB. USB dial frequency is 1.5 KHz lower than the actual transmitted frequency. So you need to take the frequency you want to decode and subtract 1.5 KHz. For example ZS6KTS is transmitting on 5.250 MHz and the USB dial frequency is 5.2485 MHz (1.5 KHz down).

Tune your radio to the calculated dial frequency.
PLEASE NOTE: Turn off AGC and ALC on the radio. You can use a noise blanker.
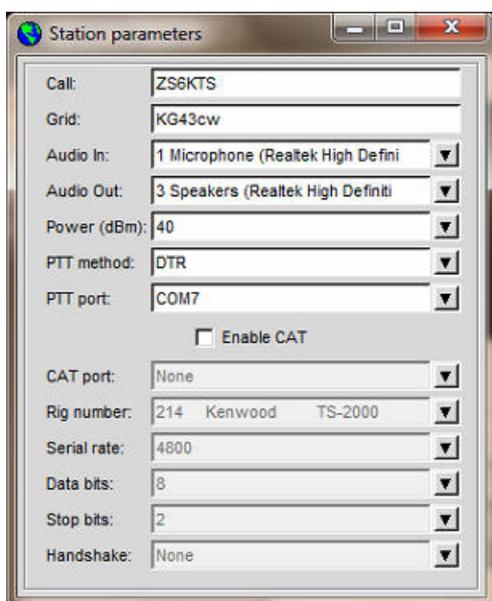
Running the WSPR software

You can now open the WSPR software. Enable the Idle check box immediately to prevent TXing.

We need to configure everything correctly.

Below is an example of how the ZS6KTS beacon was configured at one stage.
Choose *Setup* from the menu and choose "*Station Parameters*"

Enter your Callsign and Grid location.
If you are using an interface board, choose the PTT port, and the PTT method. (RTS or DTR is normally standard).

The Audio IN port and Audio Out port should be chosen automatically but if it is not then chose any setting that makes sense. This is where your sound card supplies the audio, either via microphone or Audio In port. The output audio can come from headphone or speaker port.

This is a screen shot of the software after it has been running a while.
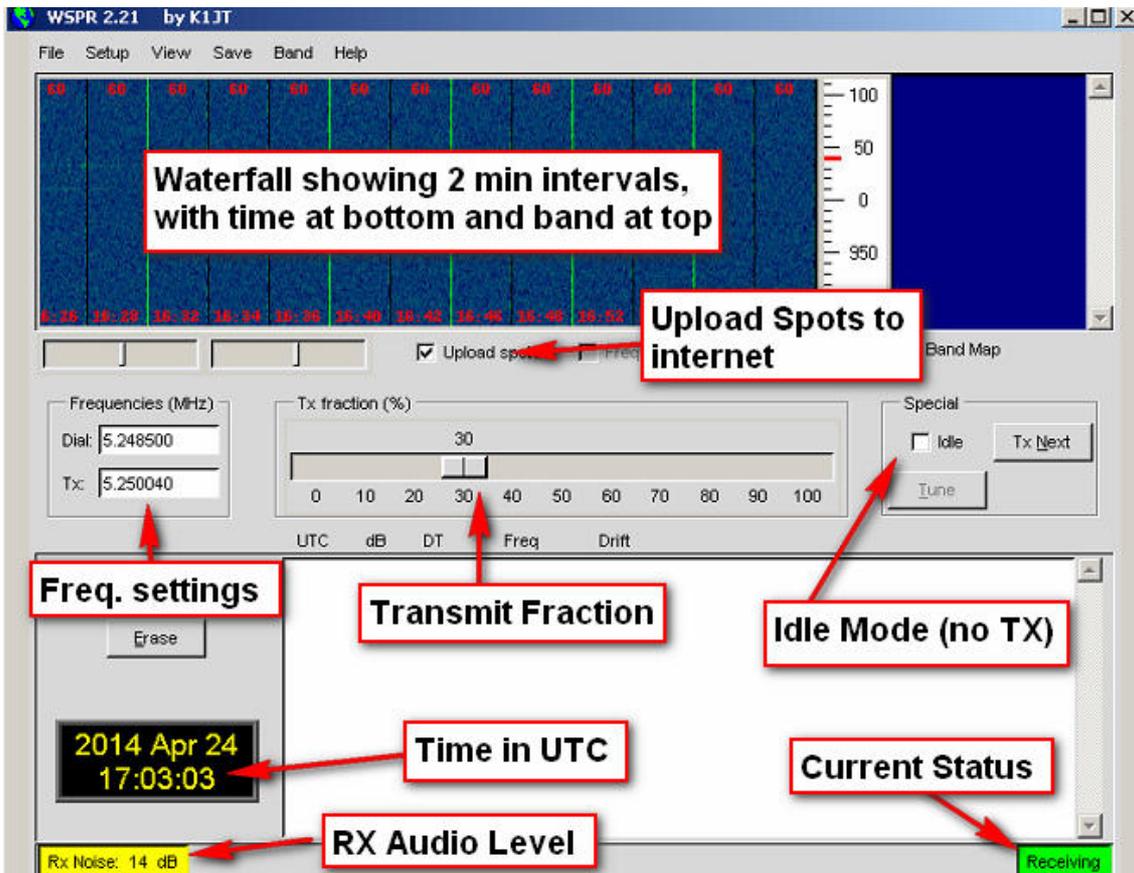
When the software is first started the waterfall is black. The waterfall is only updated every two minutes

The Waterfall runs from right to left. The fuzzy dots are the signals. Each segment on the waterfall represents a full two minutes. The time of the start of each segment is at the bottom of the display. Each segment is either divided by a black line or a yellow line. The black line represents the end of a two minute window; the yellow line represents the end of a two minute window and a two minute transmission (if TX is enabled).

Time is displayed in UTC.

The ZS6KTS beacon runs on 60m, exact frequency of 5.250040 MHz. It is 40Hz up to move away from local and DX QRM. This also makes room for other stations that might transmit on the default

Receiving and Decoding Only

To start listening set the TX fraction to 0%. Check the Idle Box. If you are connected to the internet choose "Upload Spots". You can upload all your spots later on if you need to or you find it did not upload a few.
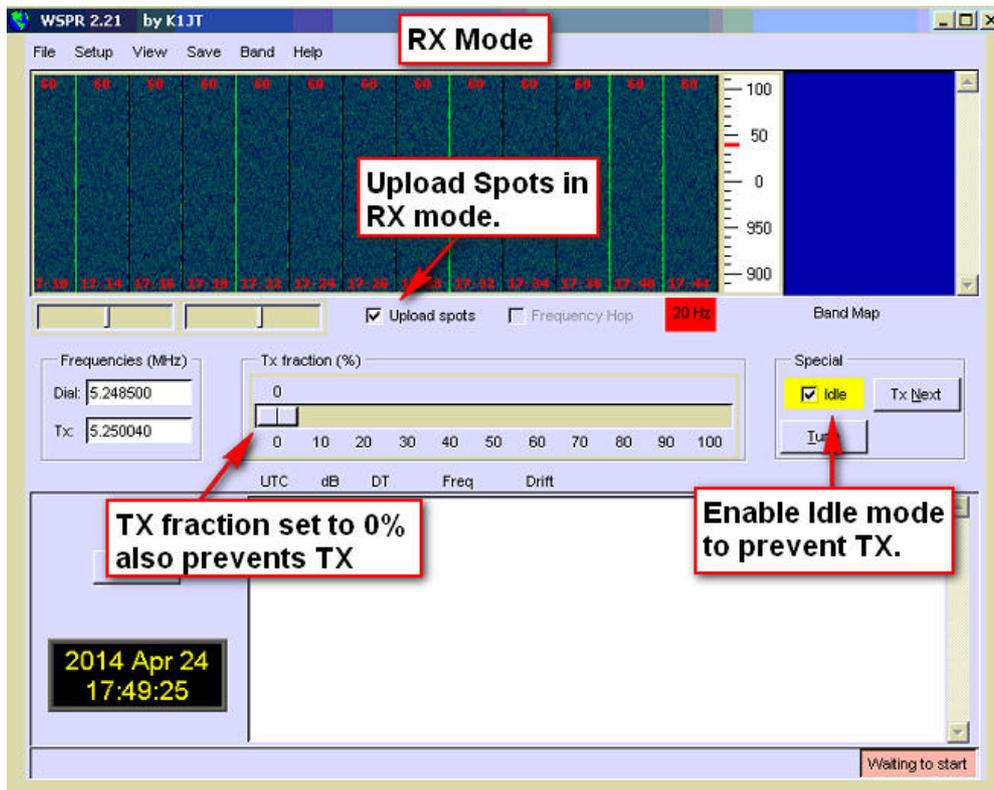
On the left hand side are two **very important settings**.
These are the **Dial Frequency** and the **TX Frequency**.

In the case of the ZS6KTS beacon the dial frequency as we worked out before was 5.2485Mhz. We tune our radio to this frequency and enter the **actual** real live USB dial frequency in the Dial box. If you cannot do 500 Hz increments, then enter the real live USB dial frequency that you can get in the box.

The TX Frequency is the frequency the WSPR signal is being transmitted on. This is the frequency listed on the Activity page of WSPRnet.org. The TX Frequency will determine where WSPR will try to decode WSPR signals.
Please note: The software will decode 100 Hz either side of the TX Frequency

Decoded call signs appear as a list on in the box and in the band map. WSPR transmissions show up as bright yellow and orange lines in the waterfall.

Please note: You need to adjust your audio input levels to set the RX Audio level to a level above 11dB and below 20dB. This allows WSPR to decode into the noise.. The screenshot on page 6 shows the RX level is yellow when it is at the right level.

Troubleshooting RX decodes

Sometimes WSPR does not decode a signal even though a signal is showing up clearly in the waterfall.
Here are some hints to help you diagnose the problem.

1. Ensure your time is correct and the transmitting station is correct time. If you are sure your time is correct you can try adjust your time by 2 seconds either way to see if the transmitting station is out. Keep adjusting your time if you are sure this is the problem. The transmitting station might not have its time correctly synchronized.

   The website http://time.is will allow you to check your computer time using a web browser.

2. Ensure that your RX Audio level is above 10dB and below 20dB when nobody is transmitting. This will allow WSPR to "hear" into the noise and decode sub-noise signals. The RX Audio box (as shown in the screenshot on page 6) should be yellow when the audio level is good enough.
3. Ensure the transmitting station is not transmitting a 6 digit locator. This can sometimes cause problematic decodes. This is found under Advanced Settings
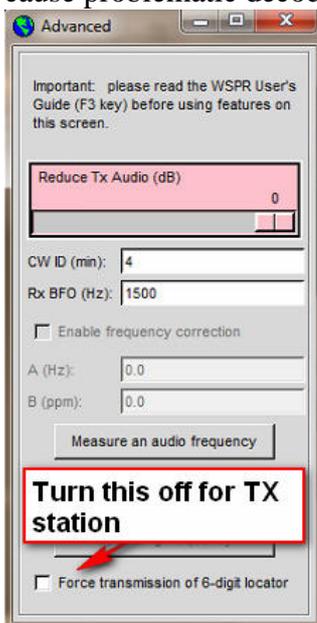
4. Ensure radio is on USB and that the dial frequency is correct according to the calculations you made.
5. In the WSPR software ensure the Dial Frequency and TX Frequency boxes have the correct details in them.
6. Connect to WSPR website and use the "**Chat**" functionality to ask for assistance.

Sometimes the trace is just too weak. Wait until the next transmission cycle to see if it is the band conditions.