WSPR Introduction

WSJT (Weak Signal Propagation Reporter)
Developed by Joe Taylor K1JT

John DeGood NU3E
David Sarnoff Radio Club
Tue 17 Jun 2008

What is WSPR?

WSPR (pronounced "whisper") stands for "Weak Signal Propagation Reporter". This program implements transmitting and receiving functions for a digital soundcard mode called "MEPT_JT", or simply "the WSPR mode".

WSPR generates and receives signals using structured messages, strong forward error correction, and narrow-band 4-FSK modulation. Its principal design goal is reliable copy at very low signal levels. In practice it works well at signal-to-noise ratios down to about -27 dB in a reference bandwidth of 2500 Hz.

WSPR Operation

- In normal operation WSPR displays information every two minutes and is silent otherwise.

- In receive mode the program looks for all detectable MEPT_JT signals in a 200 Hz passband, decodes them, and displays the results. If nothing is decoded, nothing will be printed.

- In T/R mode the program alternates in a randomized way between transmit and receive sequences.

Basic Specifications of MEPT_JT

1. Transmitted message: callsign + 4-character-locator + dBm. Example: "K1JT FN20 30"

2. Message length after lossless compression: 28 bits for callsign, 15 for locator, 7 for power level ==> 50 bits total.

3. Forward error correction (FEC): long-constraint convolutional code, K=32, r=1/2.

4. Number of channel symbols: nsym = (50+K-1)*2 = 162.

5. Keying rate: 12000/8192 = 1.46 baud.

6. Modulation: continuous phase 4-FSK. Tone separation 1.46 Hz.

7. Synchronization: 162-bit pseudo-random sync vector.

8. Data structure: each channel symbol conveys one sync bit and one data bit.

9. Duration of transmission: 162*8192/12000 = 110.6 s.

10. Transmissions start two seconds into an even UTC minute: i.e., at hh:00:02, hh:02:02, ...

10. Occupied bandwidth: about 6 Hz

11. Minimum S/N for reception: around -27 dB on the WSJT scale (2500 Hz reference bandwidth).

WSPR Performance

How will WSPR compare in sensitivity with other weak signal communication modes? Under the assumption of additive white gaussian noise, no QSB, and negligible Doppler spreading, the following table applies:

Mode	Threshold S/N	Comments
CW	-18 dB	Best human operators
JT65B	-24	Koetter-Vardy (KV) decoder
JT65B	-27	Avg of 3 transmissions, KV decoder
JT65B	-28	Deep Search
WSPR	-29	
WSPR	-32	Avg of 3 transmissions

It should be noted that JT65 uses 1-minute T/R sequences while WSPR uses 2-minute sequences. The occupied bandwidth of a WSPR signal is about 6 Hz, about 60 times smaller than the JT65B bandwidth.

WSPR QRGs (USB dial frequency)

- 1.8366
- 3.5926
- 7.0746
- 10.1387
- 14.0956

- 18.1046
- 21.0946
- 24.9246
- 28.1246
- 50.293

WSPR Configuration

- Press F2, enter:
  - Callsign
  - 6-character grid locator
  - COM port for PTT (0 for VOX)
  - Audio in and audio out device
  - Transmitter power in dBm (1 W = 30 dBm)
- On main screen enter:
  - SSB transceiver dial frequency (in MHz, USB)
  - Desired Tx frequency (Rx freq + 1500 +/- 100 Hz)

WSPRnet.org

- Internet database of WSPR spots

- WSPR application can automatically upload spots

- Also includes propagation map, forums, and user blogs

Coming Soon: WSPR QSO Mode

QSO mode will be added to a future <u>WSJT</u> release.

A minimal QSO using WSPR might look like the following sequence of messages:

1. CQ K1JT FN20
2.   <K1JT> W6CQZ
3. W6CQZ <K1JT> S4
4.   K1JT <W6CQZ> R S3
5. <W6CQZ> K1JT RRR
6.   TNX JOE 73 GL

Web Resources

- http://physics.princeton.edu/pulsar/K1JT/

  - WSPR application download

  - Quick Start guide

- http://WSPRnet.org/

  - Spot database

  - Propagation map

  - Forum

  - User blogs