

WSPR

and the

Raspberry Pi



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WSPR and the Raspberry Pi

It is pronounced “WHISPER”



And we do *monkey* around with cool hardware





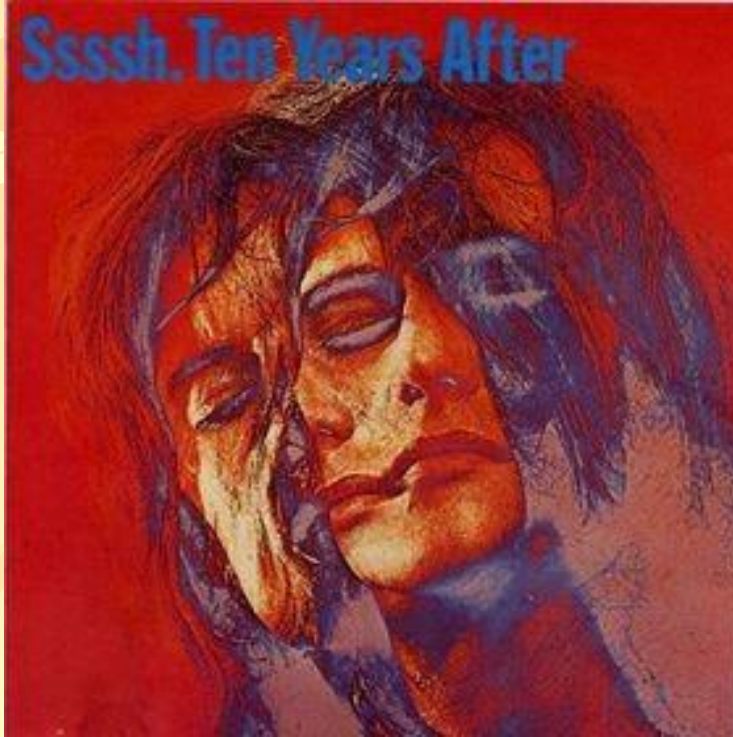
WSPR and the Raspberry Pi

But, you don't
have to talk
softly





WSPR and the Raspberry Pi



Or listen to
English
Blues

Unless you want to...





WSPR and the Raspberry Pi

So what is WSPR, then?

Weak **S**ignal **P**ropagation **R**eporter

- Uses MEPT-JT mode*
- Worldwide network of low-power beacons
 - Uses the Internet to expand connectivity
 - Reports SNR for each path
- Can also report bearing and distance for each path

* Manned Experimental Propagation Transmitter – Joe Taylor





WSPR and the Raspberry Pi

Why would we want to do this?

Weak **S**ignal **P**ropagation **R**eporter

- ❑ Real time propagation testing (measuring, not predicting)
- ❑ What bands are open *NOW* and to *WHERE*?
- ❑ Internet allows visibility of areas outside your location
 - ❑ In case you operate a remote SDR
- ❑ Real-life antenna pattern checking
 - ❑ Confirm Eznec simulation patterns





WSPR Technical Details

WSPR Beacon Transmission

- ❑ Takes 110.6 seconds per transmission
- ❑ Transmissions on even minutes + 1 second
- ❑ Contains Callsign, Maidenhead grid, TX power
- ❑ Compressed to 50 bits of data + FEC
- ❑ 1.4648 baud in a 6 Hz bandwidth
- ❑ Can be decoded down to -28dB S/N ratio





WSPR Technical Details

WSPR Beacon Reception

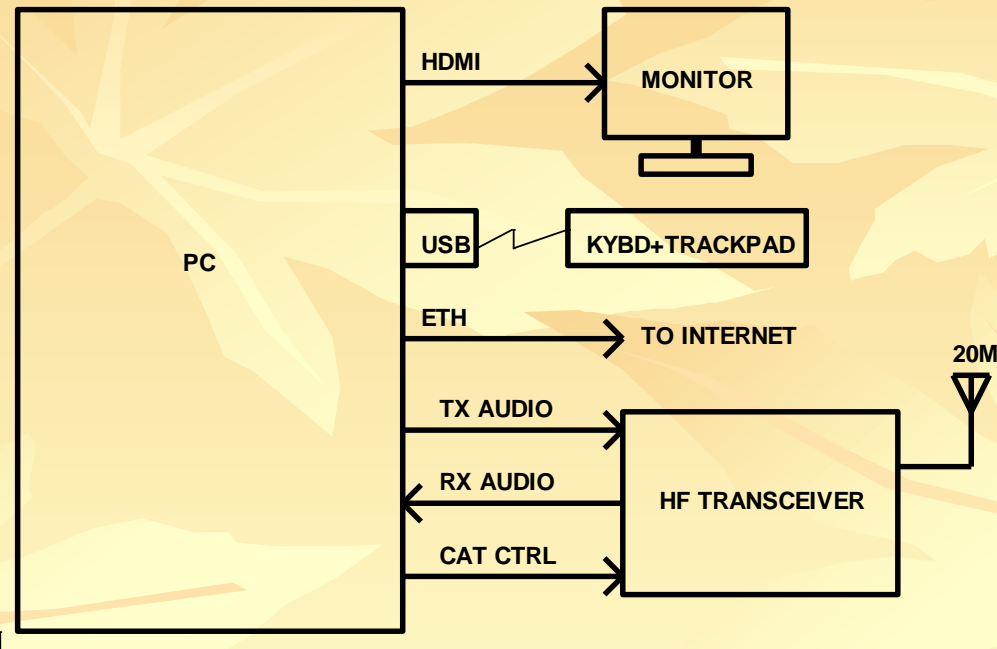
- ❑ Measures S/N in 2500Hz bandwidth
- ❑ Measures frequency
- ❑ Measures time offset error
- ❑ Measures frequency drift over transmission

Can calculate bearing and distance using received grid





WSPR Station Setup



WSPR Transceive Setup

- ❑ Send beacons
- ❑ Receive beacons
- ❑ Gate received data to Internet





WSPR Software

WSPR by K1JT

WSPR by K1JT

File Setup View Save Help

300
250
200
150
100

246 VE1VDM
241 KS7S
225 VE1RG
211 W6SZ
201 VE3CDX
198 N2JR
195 KOOG

Upload spots 78 Hz Band Map

Frequencies (MHz)
Dial freq: 10.1387 Tx freq: 10.140207

T/R cycle
 Idle Rx 20% 25% 33% Tx

| DATE | UTC | dB | DT | Freq | Drift | |
|--------|------|-----|-----|-----------|-------|----------------|
| 080406 | 1312 | -5 | 1.9 | 10.140225 | -2 | VE1RG FN76 30 |
| 080406 | 1312 | 1 | 0.8 | 10.140246 | -1 | VE1VDM FN85 25 |
| 080406 | 1318 | 8 | 2.0 | 10.140225 | -1 | VE1RG FN76 30 |
| 080406 | 1318 | -3 | 0.9 | 10.140246 | -1 | VE1VDM FN85 25 |
| 080406 | 1320 | -26 | 1.2 | 10.140198 | 1 | N2JR FM18 37 |
| 080406 | 1320 | -3 | 0.7 | 10.140246 | -1 | VE1VDM FN85 25 |
| 080406 | 1322 | -7 | 0.7 | 10.140246 | 0 | VE1VDM FN85 25 |
| 080406 | 1326 | 5 | 0.6 | 10.140246 | 0 | VE1VDM FN85 25 |
| 080406 | 1328 | -16 | 2.0 | 10.140201 | 1 | VE3CDX DM26 30 |
| 080406 | 1336 | 2 | 4.3 | 10.140195 | 1 | KOOG EM47 30 |

Erase

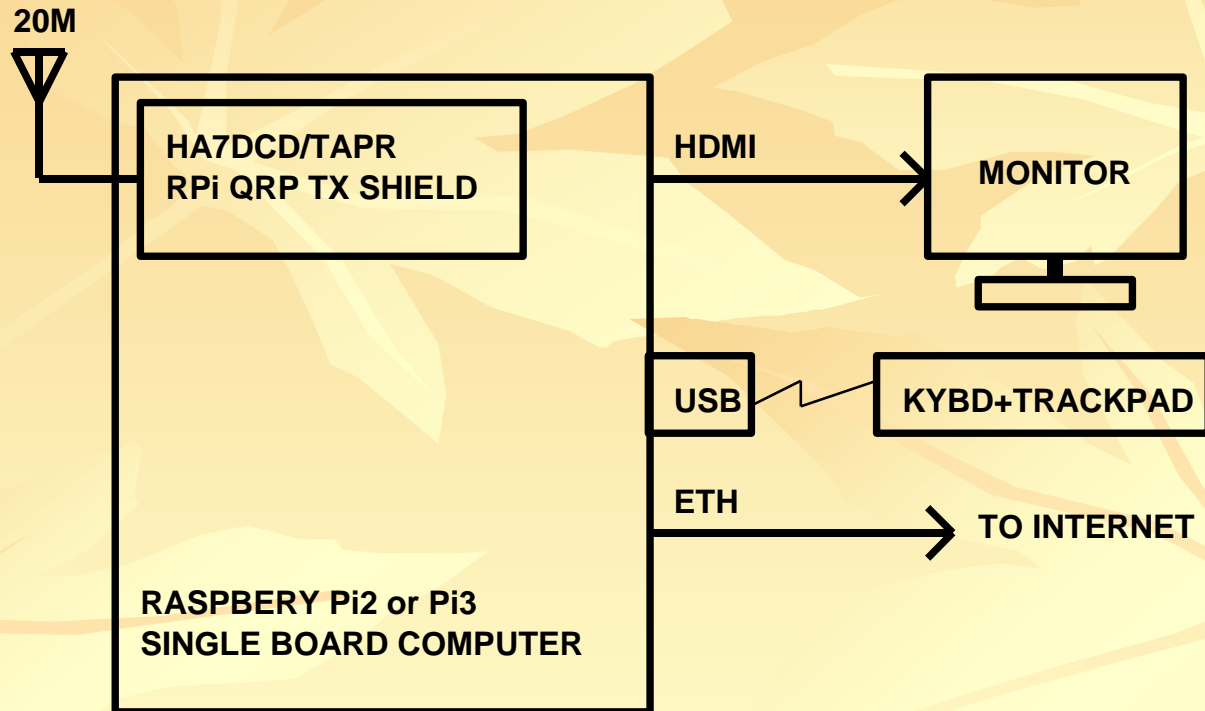
2008 Apr 14
19:34:14

Dsec 0.0





WSPR Station Setup



WSPR Beacon Only Setup

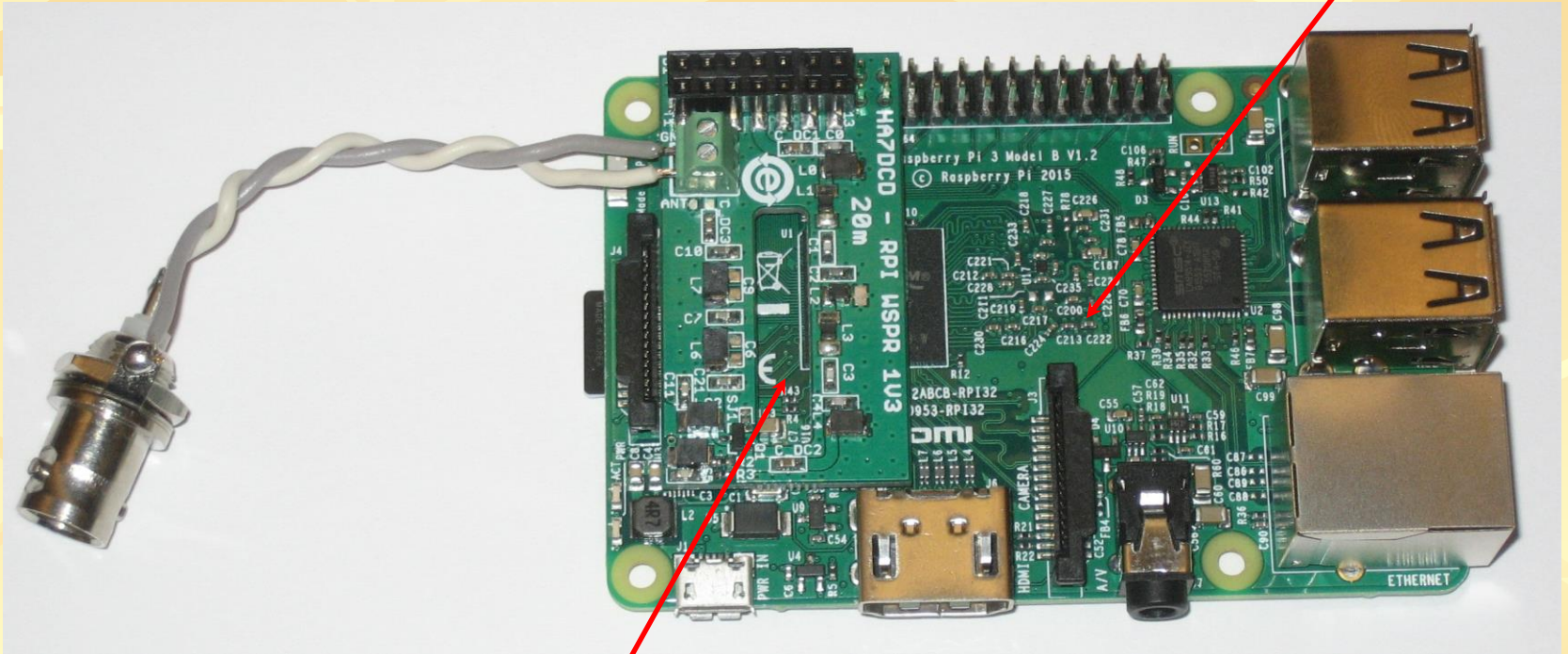
- ❑ Send beacons
- ❑ Manually observe Internet data





WSPR Station Hardware

Raspberry Pi



HA7DCD QRP TX Shield from TAPR





WSPR Station Hardware

What else do I need?

- ❑ 5V 1A micro-USB power supply
- ❑ USB keyboard and mouse
 - ❑ or Logitech K400 wireless keyboard+trackpad
- ❑ 4GB or larger micro-SD card
- ❑ HDMI monitor
- ❑ 20M antenna
- ❑ Optional: case for RPi+WSPR TX

Most of this is already available in a well-equipped ham shack!





WSPR Station Hardware

You can buy this tomorrow at Hamvention!

- ❑ MCM Electronics (booths SA0307-SA0311) will have:
 - ❑ RPi 3
 - ❑ microSD cards
 - ❑ Cases and power supplies
- ❑ TAPR (booths BA0451-BA454) will have:
 - ❑ HA7DCD 20M QRP WSPR TX Shield
- ❑ Vibroplex (booths NH0250-NH0252) will have:
 - ❑ Spiderbeam tri-band Yagi
- ❑ Luso (booth EH5000) will have:
 - ❑ 200 foot crank-up tower





Steps to get On the Air

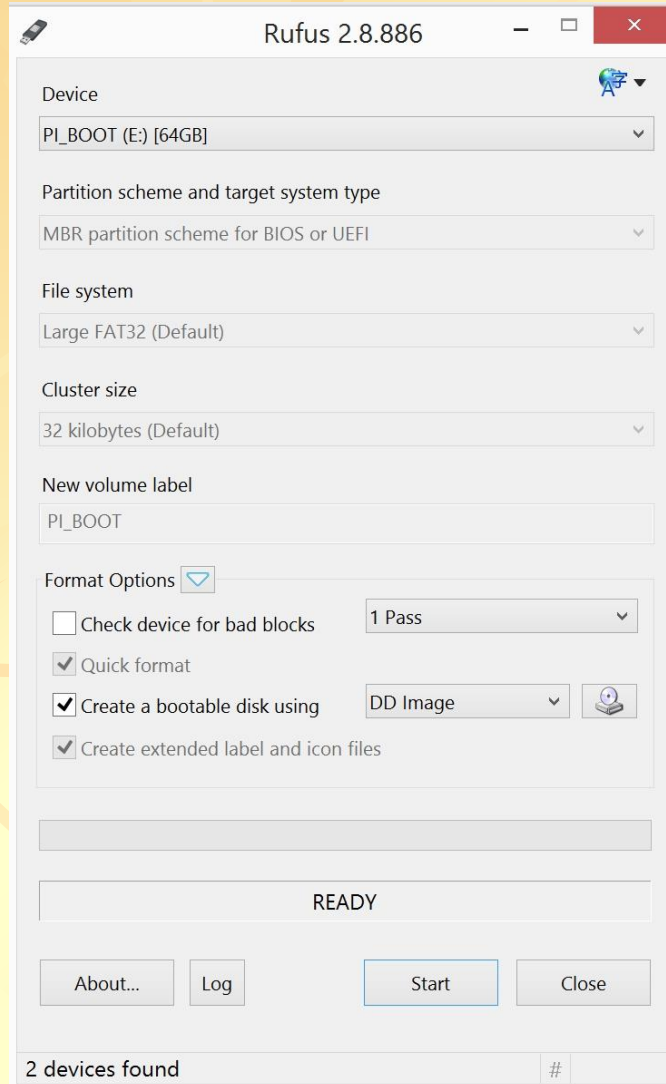
See my article in the proceedings for details

- ❑ Program micro-SD card with bootable image
 - ❑ download 7-zip, Rufus tools
 - ❑ download Ubuntu Mate
 - ❑ program image onto micro SD card
- ❑ Hook up all the hardware
 - ❑ PS, monitor, keyboard, mouse, antenna
- ❑ Boot Linux from the micro-SD card and set it up
- ❑ Download and compile WSPR application
- ❑ Run the WSPR application





Making a Bootable SD Card

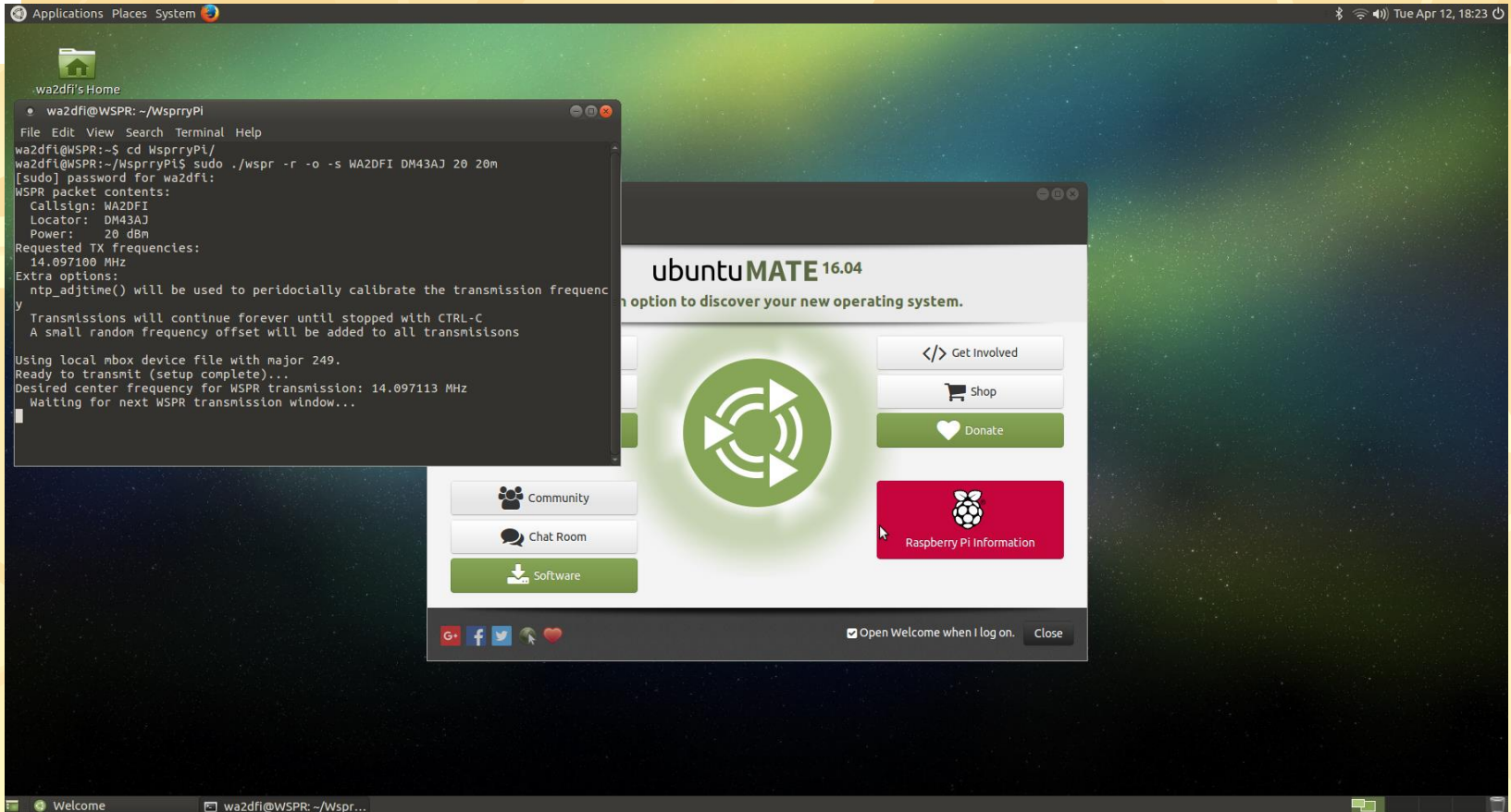


Rufus is one possible app





Running the WSPR App



Screen shot of Ubuntu Mate
running WSPR application





Running the WSPR App

```
wa2dfi@WSPR: ~/WsprryPi
File Edit View Search Terminal Help
wa2dfi@WSPR:~$ cd WsprryPi/
wa2dfi@WSPR:~/WsprryPi$ sudo ./wsprryPi -r -o -s WA2DFI DM43AJ 20 20m
[sudo] password for wa2dfi:
WSPR packet contents:
  Callsign: WA2DFI
  Locator:  DM43AJ
  Power:    20 dBm
Requested TX frequencies:
  14.097100 MHz
Extra options:
  ntp_adjtime() will be used to periodically calibrate the transmission frequency
  Transmissions will continue forever until stopped with CTRL-C
  A small random frequency offset will be added to all transmissions

Using local mbox device file with major 249.
Ready to transmit (setup complete)...
Desired center frequency for WSPR transmission: 14.097113 MHz
  Waiting for next WSPR transmission window...
█
```

Zoom-in on WSPR application window





TAPR's MISSION

Support digital radio development with:

R&D funding

- Breadboard prototypes
- Alpha PCBs

Early volume production

- Put leading edge technology into many hands





TAPR's MISSION

Result: An ever growing pool of contributors,
experimenters and subsequent advancement of
the radio art





Thank you!

WSPR Project information at:

Joe Taylor's WSPR page: physics.princeton.edu/pulsar/K1JT/wspr.html

Wiki: [en.wikipedia.org/wiki/WSPR_\(amateur_radio_software\)](http://en.wikipedia.org/wiki/WSPR_(amateur_radio_software))

WSPRnet website: wsprnet.org

Boards available at:

TAPR: tapr.org

MCM Electronics: mcmelectronics.com

See One in Operation in the Demonstration Room

