Eclipse Data, 8/21/17,
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Mequon, WI, approximate Lat/Long: 43.218, -87.951

Radio: Yaesu FT-857D with XRef-FT oscillator interface driven by a Trimble Thunderbolt GPSDO ("TBolt"). That is, "locked to GPS".
Calibration: Rigol DG1022Z signal generator locked to a second TBolt for reference signals.
Antenna: DX Engineering RF-PRO-1B aimed N-S with Mini-Circuits splitter feeding the Yaesu and also an SDRplay RSP2, the RSP2 locked to 24 MHz via the Rigol generator.
Software: Spectrum Lab (SL) and custom DSP software.

Using the Rigol with a 1000 Hz reference signal the audio path is determined to have an effective sample rate of 11024.8545 Hz when set to 11025 Hz. Using a 10 MHz signal from the Rigol the Yaesu radio is determined to have a DDS error of 0.0026 Hz. That is, audio being recorded is too high in frequency by 0.0133 + 0.0026 = 0.0159 Hz when very near 1000 Hz. Equivalent RF measurements near 10 MHz will have the identical 0.0159 Hz error. The error changed slightly (+0.0004 Hz) during the day as the room warmed up, but the 0.0159 number is a good representation.

Procedure:
The Yaesu radio was tuned to 9999.00 kHz USB (upper sideband) and locked to the GPSDO. WWV on 10 MHz was received and perceived as a nominal 1000 Hz tone. This was analyzed by SL, using a 512k-point FFT, overlapping data by 75%, giving a measurement every 12 seconds. Strictly speaking SL is logging the strongest signal in the range +/- 20 Hz around 10 MHz. Therefore, there is no guarantee that WWV is being logged. It could be WWVH, if WWV fades severely, for example.

Files:
WA9VNJ_10000kHz_20170821_1357UT.txt
The 8-hours of FFT results from Spectrum Lab as a text file, starting at 1357 UTC on 8/21/17.

WA9VNJ_10000kHz_20170821_1400UT.wav
The 8-hour WAV file from Spectrum Lab, starting at 1400 UTC on 8/21/17. The sample rate has been determined to be 11024.8545 Hz. The audio includes the sample rate error and DDS error, so that audio frequencies are high by 0.0159 Hz. It contains 317,497,651 samples over the time duration of 7.9995425 hours.

eclipse_compare.xlsx
A spreadsheet comparing the control day data from 8/20/17 to the eclipse day data from 8/21/17.

calibration.jpg
The experiments that were used to determine the sample rate and DDS errors.

resampled.wav
The original WAV file resampled from 11024.8545 to an exact rate of 11025 Hz. It contains 317,501,841 samples over 7.9995425 hours. Resampling was done with a GNU audio processing program called SoX with the .BAT file:

```
"C:\Program Files (x86)\sox-14-4-2\sox"  c:\users\steve\desktop\stevein.wav -
b 16 c:\users\steve\desktop\steveout.wav rate 11025.1455
```

I_7.txt and Q_7.txt and IQ_7.txt
The in-phase and quadrature portions of an analytic signal produced by first converting the resampled WAV file to analytic form: the real part was the resampled file and the imaginary part was the Hilbert transform of that file. Then it is multiplied by a complex carrier at 1000 Hz having a negative imaginary part. It is then filtered with a 1000-point moving average filter and decimated by 35 to a sample rate of 315 Hz. It is then filtered with a 199-point digital lowpass filter and decimated by 9 to a sample rate of 35 Hz. Finally it is filtered with another 199-point FIR lowpass filter and decimated by 5 to a sample rate of 7 Hz. Thus, it includes the variations that used to be around 1000 Hz, now around zero Hz. The relative phases of I and Q indicate whether the original error was above or below 1000 Hz. Furthermore, the sample rate is now a more convenient 7 Hz. The file IQ_7.txt contains both I and Q on each line separated by a tab character.

control_day.jpg
A plot of the received frequency on the control day: 8/20/17

eclipse_day.jpg
A plot of the received frequency on the eclipse day: 8/21/17

hilbert.txt, fir1.txt, fir2.txt
The digital filters used in creating I and Q.