

Further investigations into the “SNR top-up” issue

Gwyn Griffiths, G3ZIL gwyn@autonomousanalytics.com

A previous report with N6GN and AI6VN showed that the after .wav files from the KiwiSDR were decoded using AI6VN's kiwiwsp.sh script there were occasions when the SNR of the weaker of two closely adjacent signals was “Topped-up” leading to an SNR discrepancy compared with N6GN's Apache receiver. Here we look at this issue in more detail using a KiwiSDR (v1.245, reporting as G3ZIL/K) and a direct conversion analogue receiver (G3ZIL) and show that these “Top-up” errors are due to the use of an inadvisable combination of options in release 1.1g of kiwiwsp.sh.

G3ZIL used WSJT-X v2.0 rc3 on a Raspberry Pi with the “Decode” pull-down list set to “Deep” thereby enabling the new -o option that makes use of the hashtable. Steve Franke, K9AN, has confirmed that WSJT-X v2.0 rc3 “Deep” decode setting uses “-C 5000 -o 4” and does not use “-d” the “Deep” setting used in v1.9 and earlier versions¹.

G3ZIL/K used WSJT-X v1.9 and the kiwiwsp.sh script from AI6VN that invoked wsprd -d -C 10000.

On 22 November 2018 at 0900 an example of this SNR “top-up” was observed for DK9MS, with uploads to wsprnet.org being -11dB for G3ZIL and -3dB for G3ZIL/K; DK9MS being 2.3Hz above DK2CH (SNR -2dB). Figure 1 shows the spectrum between 1400–1600Hz computed from a 65536-point FFT with Hanning window and a 5-point moving average filter (i.e. over 0.916Hz) for the two .wav files. Only very minor differences exist in the spectra from G3ZIL (blue dots) and G3ZIL/K (red dots). At the top of Figure 1 are markers at the observed frequencies for callsigns spotted. DK9MS is highlighted, red diamonds are callsigns only decoded by the KiwiSDR (G3ZIL/K).

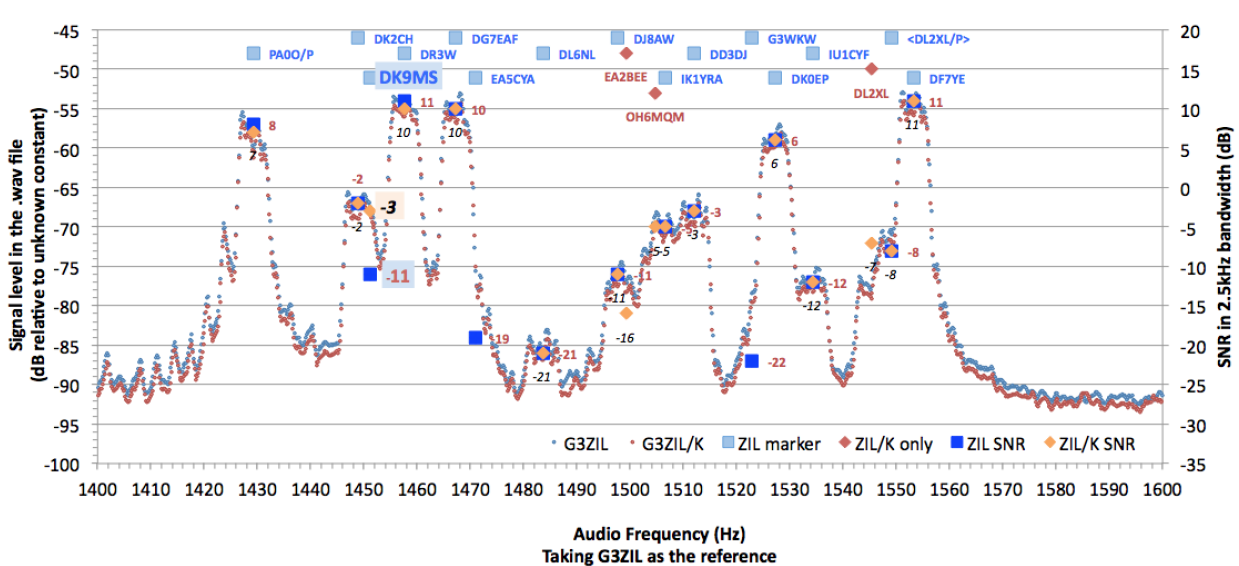


Figure 1. Spectra for the .wav files for G3ZIL and G3ZIL/K at a resolution of about 1Hz with callsigns spotted and SNR against each spot. The spots from DK9MS are highlighted, others are discussed below.

Given that there is no substantial difference between these spectra, the .wav files were replayed through the wsprd decoder with various settings, Table 1. The left cluster of columns has the SNRs and SNR differences as uploaded to wsprnet.org. On the color coding: DK9MS SNR differences are highlighted in pink; EA5CYA in blue is a hashtable enabled decode only possible with G3ZIL; EA2BEE, OH6MQM and DL2XL in red were only decoded by G3ZIL/K; G3WKW in green was only decoded by G3ZIL, but was not hashtable enabled; DG7EAF in purple is a spur at +100Hz only decoded using the combined -d and -o options. We observe:

- Second cluster: wsprd -q (quick mode, does not dig deep for signals). This is NOT the option used

¹ See <https://sourceforge.net/p/wsjt/mailman/message/36476205/> accessed 25 November 2018

real-time by either G3ZIL or G3ZIL/K, but it does decode DK9MS (-s the single pass mode did not) and here the SNRs are identical at -11dB.

- Third cluster: wsprd -d (deeper search), this is the option used real-time in G3ZIL/K, and DK9MS SNR is -3dB. **Conclusion – whatever causes the SNR “top-up” with the KiwiSDR .wav file it only occurs when -d decoding is used, it is not present with -q decoding, or the -C 5000 -o 4 setting invoked by the pull-down “Decode” setting in WSJT-X v2.0.**
- Fourth cluster: wsprd -C 5000 -o 4 which produces exactly the same data as G3ZIL in real time.
- Fifth cluster: wsprd -d -C 5000 -o 4, which is the option set for kiwiwspr.sh running with WSJT-X V2.0 at the time of the experiment. While this provides the fullest set of decoded spots in this example, it also includes a spur at 100Hz for DG7EAF at 36dB below the wanted signal not present with the other wsprd options, and as in the previous -d example, it gives a wrong SNR for DK9MS. As using -d together with -C 5000 -o 4 in WSJT-X v2.0 is not advised by K9AN it will be removed in the next release of AI6VN's kiwiwspr.sh.

Callsign	SNR Uploaded to wsprnet (dB)			SNR wsprd -q			SNR wsprd -d			SNR wsprd -C 5000 -o 4			SNR wsprd -d -C 5000 -o 4		
	G3ZIL	G3ZIL/K	Difference	G3ZIL	G3ZIL/K	Difference	G3ZIL	G3ZIL/K	Difference	G3ZIL	G3ZIL/K	Difference	G3ZIL	G3ZIL/K	Difference
PA0O/P	8	7	1	8	7	1	8	7	1	8	7	1	8	7	1
DK2CH	-2	-2	0	-2	-2	0	-2	-2	0	-2	-2	0	-2	-2	0
DK9MS	-11	-3	-8	-11	-11	0	-11	-3	-8	-11	-11	0	-11	-3	-8
DR3W	11	10	1	11	10	1	10	10	0	11	10	1	10	10	0
DG7EAF	10	10	0	10	10	0	10	10	0	10	10	0	10	10	0
EA5CYA	-19	no decode		no decode	no decode		no decode	no decode		-19	-20	1	-19	-20	1
DL6NL	-21	-21	0	-21	-21	0	-21	-21	0	-21	-21	0	-21	-21	0
DJ8AW	-11	-11	0	-11	-11	0	-11	-11	0	-11	-11	0	-11	-11	0
EA2BEE	no decode	-16		no decode	no decode		-16	-16	0	no decode	no decode		-16	-16	0
OH6MQM	no decode	-5		no decode	no decode		-6	-5	-1	no decode	no decode		-6	-5	-1
IK1YRA	-5	-5	0	-5	-4	-1	-4	-5	1	-5	-4	-1	-4	-5	1
DD3DJ	-3	-3	0	-3	-3	0	-3	-3	0	-3	-3	0	-3	-3	0
G3WKW	-22	no decode		-22	no decode		-22	no decode		-22	no decode		-22	no decode	
DK0EP	6	6	0	6	6	0	6	6	0	6	6	0	6	6	0
IU1CYF	-12	-12	0	-12	-12	0	-10	-12	2	-12	-12	0	-10	-12	2
DL2XL	no decode	-7		no decode	no decode		-8	-7	-1	no decode	no decode		-8	-7	-1
<DL2XL/P>	-8	-8	0	-8	-7	-1	-8	-8	0	-8	-7	-1	-8	-8	0
DF7YE	11	11	0	11	11	0	11	11	0	11	11	0	11	11	0
DG7EAF	no decode	no decode		no decode	no decode		no decode	no decode		no decode	no decode		-26	-25	-1

Table 1. SNR for G3ZIL (analogue receiver) and G3ZIL/K (KiwiSDR and kiwiwspr.sh script by AI6VN) together with SNR difference for (left) the WSJT-X V2.0 RC3 for G3ZIL and wsprd within WSJT-X V1.9 for G3ZIL/K, both running on Raspberry Pi, then with the two .wav files replayed with different wsprd options, with wsprd from WSJT-X V2.0 RC4.