Mount Hollowback 2.4GHz Investigations
August 2-4 2019

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Summary Observations

Several additional transmitters have been installed recently raising the RF noise floor, or in simple terms the background noise, leading to loss of signal by representative 2.4GHz receivers for periods upwards of several seconds.

There was no evidence of the presence of transmissions other than those from officially authorised transmitters.

We make no findings regarding the safe use of 36MHz equipment as this was not within our remit.

Background

Mount Hollowback is 14kM NNW of Ballarat and has been a popular slope soaring site since the mid 1960s. It has two distinct peaks the western one of which has a very large radio transmission complex comprising several towers.

Mount Hollowback from the North West

Western and Eastern Peaks from the South East

Several towers within the Mount Hollowback Complex

From late 2018 several aircraft have been lost or damaged following the loss of radio communications. To our knowledge all of aircraft were being controlled using 2.4GHz equipment at the time.

There has been significant speculation as to the cause of these losses and arising from this a request was made by VARMS that the matter be investigated.

Subsequently VARMS members Peter Cossins, Ray Cooper and Greg Egan spent the 2nd -4th of August at Mount Hollowback conducting an investigation.

It is important to realise that the 'Effective Radiated Power' levels from services at Mount Hollowback can be extremely high, some of which are close to the 2.4GHz ISM band we use.

With these power levels it is inevitable that the noise floor will be substantial even if the transmissions are not in the frequency band we share with others. This is particularly the case if we are very close to the transmitters.

https://maprad.io/au/search/advanced?filters=WyJpX3NpdGVfbmFtZTpjOmhvbGxvd2JhY2siXQ%253D%253D

https://www.acma.gov.au/Industry/Spectrum/Radiocomms-licensing/Class-licences/shortrange-spreadspectrum-devices-fact-sheet

Testing

The tests were conducted in two parts:

1) Measurement of noise floor and field strength on the western and eastern peaks and noise floor around the public road boundary at a distance of 1-2Km.

2) Inflight counts of 2.4GHz fail-safes over the most commonly used flying slopes.

Noise Measurement

The noise floors and field strength respectively were measured using a Protek 3290 RF Field Strength Analyser (100 Khz -2.9G) and a MIC METER 98195 3 Axis EMF Meter (50 MHz – 3.05GHz).

The noise floor was measured in power levels (dBm) and the electric field strength in volts/metre.

Aircraft

The test aircraft was a MultiPlex Xeno (flying wing) pusher prop, running on 3S 1300mAH battery.

Controlling Radio

JR 3810 Transmitter with JR RS77S Receiver (PCM). Frequency 36.17MHz. Failsafe set to neutral aileron, elevator, motor off and gear channel to high position. Gear channel monitored by Logger to record failsafe "Hits".

Inflight Logger

The inflight fail-safes were counted using a simple logger constructed for the purpose. The logger counted the number of distinct fail-safe occurrences and the maximum period for any fail-safe on both 2.4GHz and 36MHz. The aircraft carrying the logger was controlled using 36MHz equipment that it was believed

would provide greater noise immunity in the mix of frequencies being used on the site. The 2.4GHz equipment used was a Taranis X9D transmitter and a D4R II receiver with its designated failsafe channel monitored by the logger.

Ground Based Results

Field Strength

The electric field strength measured using the MIC 3 Axis Meter (360^0 Capture) on the western peak was generally high at around 3V/m about 30Ms from the fence but with off scale peaks of very high values above 20V/m. (The maximum allowable ARPANSA standard for the 'General Public' is 147 V/m). These large transitions are of concern.

Noise Floor

Measurement s were made using a Protek Field Strength Analyser with a small 2.4 G Yagi style antenna. As such it was terminated correctly and values are accurate to+/-3dB and with a scan repeatability of +/- 2dB.

Much of the equipment on the western peak supports packet based communication, and as a consequence the noise floor, gives the appearance of being random but is not. Barely discernable individual peaks occasionally occur but are short lived lasting only for a packet transmission burst. To the trained ear this makes a song! Also the Protek is scanning with a limited field of frequencies relative to the whole ISM band and activity occurring elsewhere could be missed. The instrument was left scanning for long periods of time to minimise this risk.

The noise floor at the southern end of the western peak was -70dBm with occasional peaks 10-15dBm higher. The floor on the northern end of the peak was generally 10dBm higher or -60dBm. The noise floor on the eastern peak was -70dBm. The noise decreased slightly across the band.

Perhaps surprisingly the noise floor on the road boundaries in measurements conducted on the 3rd of August are still relatively high at around -80dBm when there was clear line of site and rising across the band but falling to below -103dBm when the towers were not visible.

In the NW direction parallel to the transmission lines the noise floor was peaking at -50dBm at around 2.433GHz and 2.45GHz.

Consistent with the measurements of electric field strength closer to the tower structures, occasional 20 - 25 dB relatively short increases in the noise floor was observed.

For reference, the noise floor in Creswick township was -107dBm with various WiFi Services visible. (-107dBm is the lowest signal that can be measured by the Protek 3290).

Current spread spectrum RC radios are not sensitive to signal peaks at specific frequencies particularly if they are intermittent. Older radios that used two frequencies only may be more susceptible.

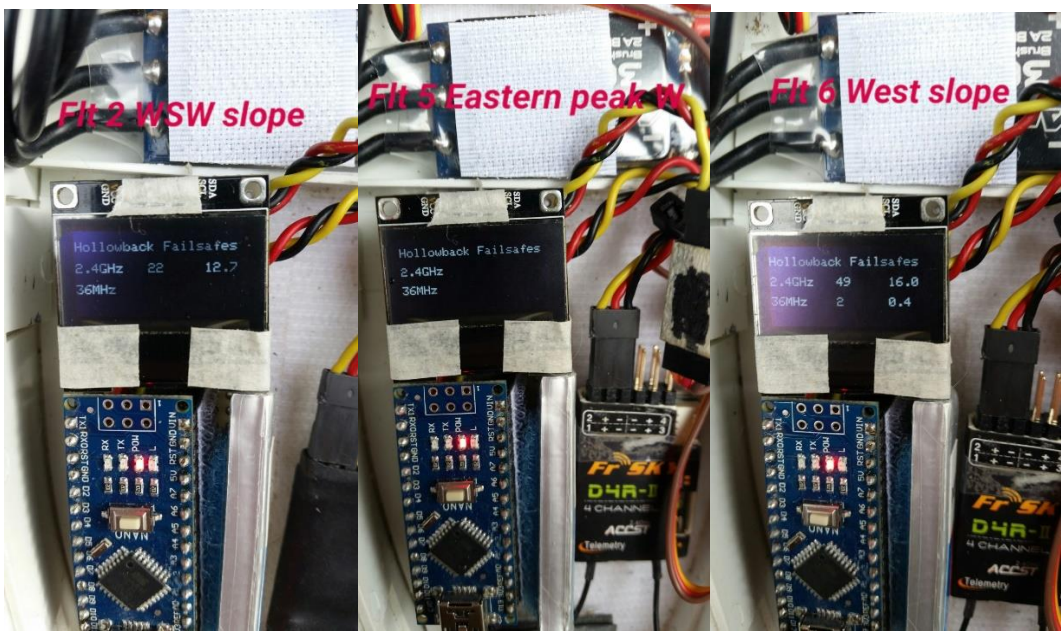
Inflight Results

Several flights were conducted on the 2nd of August mainly on the western peak. These were repeated on the 4th including flights on the eastern peak, a distance of some 600M from the main peak.

Failsafe triggering was observed when flying on the Western peak from SW to NW, and NNE to E. The most prolonged failsafe events were from the SW to NW. Failsafe events were more apparent when flying at approximately half the average tower height.

Use of the electric motor, which was required for flights over downwind areas and when wind was insufficient for slope lift, may have resulted in slightly increased failsafe triggering.

Areas covered by Test Flights



Flight logger displays showing the number of hits and maximum duration

VARMS Field

For completeness a 10 minute reference flight was conduced at VARMS Field, High Street Road, Wantirna, 3pm on the 5th August 2019. The flight extended from the SW corner to the NW corner and generally over the field.

This flight was all motor assist, apart for about 2 Min in a thermal. Various altitudes were flown to approx. 300' above ground.

There were no hits on 2.4GHz or 36MHz. The noise floor was -80dBm.

Reference Flight at VARMS Field

Conclusion

With the current, and most likely increasing level of background noise, the use of 2.4GHz equipment is NOT recommended for use at Mount Hollowback.

APPENDIX

Flight records are presented below in full for completeness. Reference should be made to the figures in the body of the report.

Mount Hollowback

Flight 1 - 2 Aug 2019 between 1 – 4pm, wind WSW 10 to 12 knots
Zone flown - West
Pilot location – 20M to the South of the Western tower
Flight duration – 8 Minutes
Failsafe hits – 2.4GHz 17, Max duration **13.6 Sec**.
Failsafe hits – 36MHz 5, Max duration **1.1 Sec**.

This was the worst possible place to fly from. The flight was mostly slope soaring with some motor assist. Majority of hits occurred at roughly half tower height and close in. Even though 36MHz had hits no loss of control was noticed.

Flight 2 - 2 Aug 2019 between 1 – 4pm, wind WSW 10 to 12 knots
Zone flown – West to South West
Pilot location – 110M from Western tower on South side
Flight duration – 17 Minutes
Failsafe hits – 2.4GHz 22, Max duration **12.7 Sec**.
Failsafe hits – 36MHz 0

Again mostly slope soaring with some motor assist. Various altitudes to approx. 150' above launch height. A very repeatable hit zone was observed at roughly ½ tower height when traversing N to S on the west slope.

Flight 3 - 2 Aug 2019 between 1 – 4pm, wind WSW 10 to 12 knots
Zone flown – North
Pilot location – 60M to the North of the Western Tower
Flight duration – 7 Minutes
Failsafe hits – 2.4GHz 14, Max duration **6.3 Sec**.
Failsafe hits – 36MHz 0

This flight was all motor assist due to the wind direction. Most hits occurred at half tower height and within the N East landing zone. Some hits in the NW corner of the slope.

Flight 4 - 4 Aug 2019 between 11am – 2pm, wind W 0 to 5 knots
Zone flown – Eastern peak
Pilot location – Eastern peak
Flight duration – 10 Minutes
Failsafe hits – 2.4GHz 1, Max duration < 1 Sec.
Failsafe hits – 36MHz 0

This flight was all motor assist and circling the hill top. Various altitudes to approx. 150' above launch height.

Flight 5 - 4 Aug 2019 between 11am – 2pm, wind W 0 to 5 knots
Zone flown – Eastern peak West zone over saddle and out as far as possible towards the Western peak.
Pilot location – Eastern peak
Flight duration – 10 Minutes
Failsafe hits – 2.4GHz 0
Failsafe hits – 36MHz 0

This flight was all motor assist. Various altitudes to approx. 150' above launch height. Tried to get out towards the towers as far as possible, but the model gets hard to see!

Flight 6 - 4 Aug 2019 between 11am – 2pm, wind W 0 to 5 knots
Zone flown – West
Pilot location – 110M to the South of the Western tower
Flight duration – 10 Minutes
Failsafe hits – 2.4GHz 49, Max duration **16 Sec**.
Failsafe hits – 36MHz 2, Max duration **0.4 Sec.**

This flight was all motor assist. Various altitudes to approx. 150' above launch height. 36MHz hits were due to transmitter and receiver antennas pointing at each other, model was over power line at the time of hits (a bad position).

Flight 7 - 4 Aug 2019 between 11am – 2pm, wind West 0 to 5 knots
Zone flown – South
Pilot location – 110M South of the Western tower
Flight duration – 10 Minutes
Failsafe hits – 2.4GHz 3, Max duration **6.7 Sec**.
Failsafe hits – 36MHz 0

This flight was all motor assist. Various altitudes to approx. 150' above launch height. Less hits may have been due to greater distance to towers, but still enough to bring a model down.

Flight 8 - 4 Aug 2019 between 11am – 2pm, wind W 0 to 5 knots
Zone flown – North
Pilot location – 60M North of the Western tower
Flight duration – 10 Minutes
Failsafe hits – 2.4GHz 23, Max duration **11.3 Sec**.
Failsafe hits – 36MHz 0

This flight was all motor assist. Various altitudes to approx. 150' above launch height.