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LoRa – low cost long distance telemetry

Following the success of $50SAT, which is still operating over a year after it was launched, one of its co-designers, **Stuart Robinson, GW7HPW**, has turned his attention towards Pico High Altitude balloon trackers.

Theses are trackers normally weighing less than 20g and launched using 36" foil party balloons filled with Helium.

In order to test the long distance telemetry capability of the new ISM band radio modules using Semtechs SX1278 transceiver, the HABAXE2 Pico tracker was designed using a PICAXE 28X2, Hope RFM98 transceiver and Ublox MAX8 GPS. The entire payload and a 10g battery for around 24 hours operation weighed 16g.

HABAXE2 was launched around 09:30 on the 4th January 2015, from Caerphilly Common, 51.5621N 3.2228W. It was last heard of at Latitude 44.1618N, Longitude 4.3205E, just short of the Mediterranean coast at an altitude of 8032M having travelled just over 1000km.

UK amateur licensing conditions do not permit the use of transmitters in 'airborne' devices so licence exempt transmitters operating in the 434Mhz ISM band are used with the power limited to 10mW only. In the UK the balloon tracker payload is normally sent as FSK RTTY as this can be picked up at hundreds of kilometres range even at 10mW. The objective of HABAXE2 was to see if the LoRa data telemetry was viable as an alternative and if it could be used at long distances for remote control of the tracker.

Tests had shown that at 1042bps the LoRa devices needed only 2mW to cover 40km line of sight, so it did look feasible to use the LoRa for long distance tracking. The telemetry from the RFM22B used for $50SAT had needed 100mW to cover the same distance.

This is an example of the main tracker payload that was being sent out as LoRa at the 1042bps rate;

$$HABAXE2,479,23:04:10,44.1618,4.3205,8026,61,169,223,42,42,6,3080,-164,Y,0*EC36

Using only a vertical omni antenna at the base station (Diamond X50N) and 10mW output with a ¼ wave wire and radials on the balloon tracker the following results were obtained;

The last time the main tracker payload was received error free was at a distance of 269km, no base station LNA was used or needed.

At 242km an a command was sent to HABAXE2 for it to send a series of 98bps packets at varying powers which were received error free down to 2dBm\3mW. Extrapolating the 2dBm upwards to 10mw (UK limit) would represent a UK legal range @ 10mW of 611km LOS, which is the radio horizon at an altitude of circa 22km.

For another test, I used a higher data rate of 13.7kbits, this high rate was received at down to 7dBm at 105km.

Clearly the LoRa devices are a very significant improvement over the RFM22B telemetry that $50SAT and T-Logoqube satellites relied on and offers the possibility of a cheap to build hand held device that could receive telemetry direct from a low Earth orbiting satellite. A portable LoRa receiver can be built for around £20.

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