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Over-The-Horizon Global High Altitude Balloon Communications System

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Abstract. For the last two years Taylor University Research has been working on a global satellite communications network for the TSAT and ELEOSAT satellites. This unit has FCC approval for production and flight. The Module has been flown on multiple balloon flights to test for ruggedness, reliability and tested in the RF anechoic chamber for FCC compliancy. It is now being implemented into the High Altitude Research Platform (HARP). This capability will allow Over-The-Horizon (OTH) communication to the payload allowing extended flight time and long duration without loss of data or tracking. We have designed and built an efficient communication system to extend the battery life from days to months and an extremely reliable flight approved system for long duration flights with global coverage of live Data and Tracking. The HawkEyeII ground support software handles the mapping, Data storage, and status screens switching automatically from a direct RF connection to the satellite network provider over the web. The scope of this paper is to introduce a reliable global communications solution for high altitude balloons.

1. History of HARP

For over Fifteen years Taylor University has operated a High Altitude Research Platform (HARP). This program includes building instruments and control systems to be flown in the near-space environment. We have launched over 300 flights with payloads ranging from one pound to twelve pounds. There have been single balloon to multiple balloons in the air at one time with fast turn around between flights.

2. Down Range Communication

The typical systems available today rely on a balloon-to-ground communication system that includes fixed and mobile units to collect data. If the balloon travels beyond the range of the system, data and possibly the payloads could be lost. Extending the range of the system would require the use of multiple hubs to repeat the data back to the control point. This would require maintaining a network of hubs across a large geographical area. If the balloon's flight path is in a remote area or over a large body of water, this type of system would not be feasible or possible.

3. Over-The-Horizon Communications System

The Over-The-Horizon satellite based system removes the need for multi ground stations and allows flights to be operated in any environment (from short to long duration). All that is required is to have access to the website to monitor the data and location of the balloon. The chase team can use a smartphone to track the location of the balloon or have the position relayed to them by phone, if Internet service is not available.

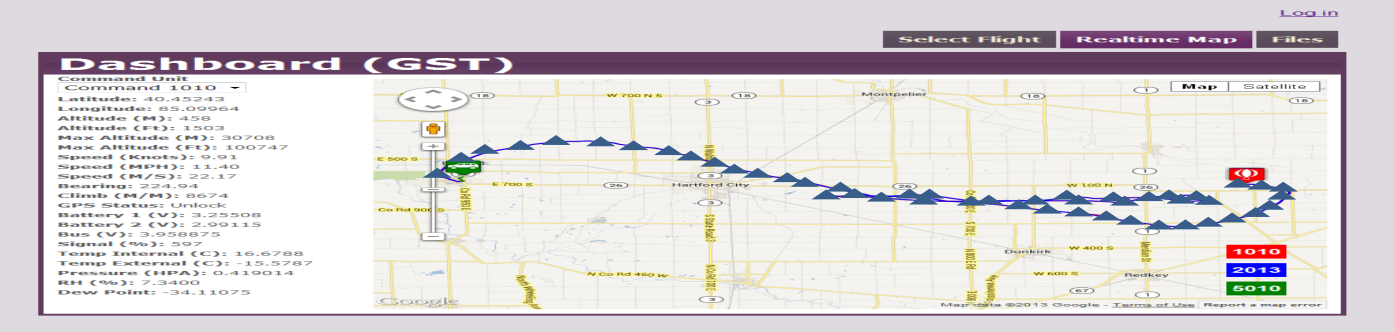

Figure 3.1 Flight 299 blue triangles are the satellite linked flight path overlaid on the direct linked data.

Position and instrument data is transmitted to the GlobalStar's network of satellites and relayed to their ground stations around the world. The ground station server transfers the data via the web to the NearSpace Launch server. The data is parsed to the database and made available to the end user for download. Figure 3.2 shows the flow of data from balloon to user.

Error!

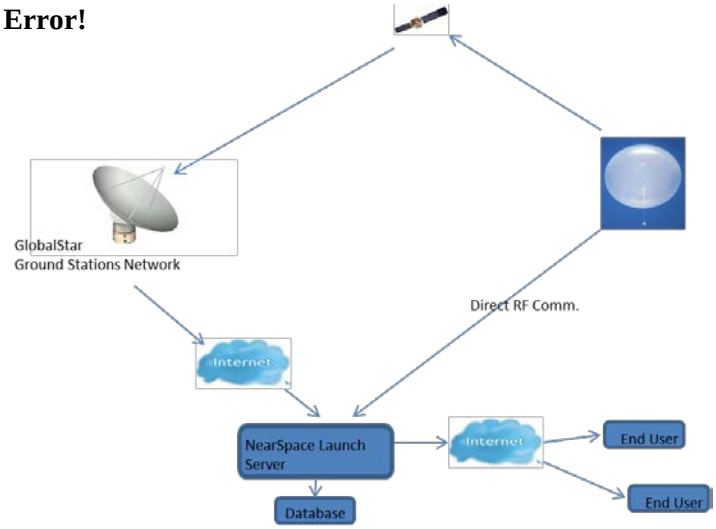

Figure 3.2 System overview

4. Specifications

Data Link
Data Packet: Programmable from 3/sec. to 1/10sec.
GPS Packet: Programmable from 1/sec. to 1/30sec.
Packet Format: HawkEyeII Flex Protocol
User Port: 38.4Kb 36 Byte Format

RF Module
RF Frequency: 1616.25 Mhz (No interference to Radio Astronomy Observations)
Bandwidth: +/- 1.25Mhz
RF Power: 18dBm RMS
Approval: GlobalStar, FCC

I/O Ports
Analog Inputs: Ten (0-5V 10bit)
Digital Inputs: Four (5V TTL)

GPS: 20Hz

Data Logging: 2Gb SD Card

Options
RF Interface: ZigBee 2.4Ghz network

Compatibility:
HawkEyeII System: Command, Beacon, Swarm, Astro POD, MET, Flight Termination, Data Logger, Buoyancy Control.

Product Availability:
The HawkEyeII System Modules, and flight services are available from:
NearSpace Launch 8702E 825S, Upland IN. 46989 (260) 241-0409

References
Hank D. Voss and Jeff Dailey: Express Launch Capabilities for High-Altitude Ballooning, Academic High Altitude Balloon Conference 2013

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