DESIGNING A STANDARD COMMUNICATIONS PLATFORM FOR LOW-COST SPACE APPLICATIONS

BSc Computing Honours Project Proposal
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PROJECT AIM

Evaluate, design and implement and a low-cost platform for intra-payload and long-range radio communications for High-Altitude balloons

OBJECTIVES

- Evaluate existing platforms & protocols used for communications between payloads and over radio in high-altitude balloons and low-cost space applications (CubeSat class nano-satellites)

- Evaluate the feasibility of a generalised High-Altitude Balloon bus based on low-cost, open-source, off-the-shelf hardware

- Design the required protocols and build a prototype for an open-source high-altitude balloon flight computer and communication platform.

RESEARCH QUESTION

What are the issues in designing a generalised intra-payload communications and telemetry platform for High-Altitude Balloon scientific missions?

LITERATURE

Consultative Committee for Space Data Systems. 2003.
Space Packet Protocol. CCSDS Secretariat.

- Current industry standard for in-satellite networking and telemetry packets transmission

- Uses packets for each instruments' data, encapsulated in frames for long-range radio transmission

- Might be too heavy for simpler balloon applications, but can be used as a reference design

LITERATURE

Hinschelwood et al. 2015. A Raspberry Pi Weather Balloon. *Young Scientists Journal* (17), pp. 20–24.

- Raspberry Pi-based flight computer and basic radio communications

- Moderately modular computer/payload architecture.

LITERATURE

Volstad, M. 2011. *Internal Data Bus of a Small Student Satellite*. Norwegian University of Science and Technology.

- Describes a similar system as envisioned, for nano-satellites.

- Demonstrates usability of a standard protocol (I2C) for intra-payload communication

LITERATURE

Eatchel, A. L. et al. 2002. *Development of a Baseline Telemetry System for the Cubesat Program at the University of Arizona*. University of Arizona

- Demonstrates the feasibility of a custom packet format for telemetry

- Hardware/Software overview of custom radio telemetry system for a low-budget nano-satellite

METHODS

- Design & build a High-Altitude Balloon payload's data bus

- Implement modular flight computer and payload management software

- Design & implement digital radio communications with different Forward Error Correction algorithms

METHODS - EVALUATION

- Evaluate the performance of the radio link through physical testing (range tests of the integrated system)

- Compare and rate the data rate and the bit loss rate of the the implemented radio communications protocols

- Evaluate the performance of the internal bus through hardware-in-the-loop testing and power consumption, data throughput and timing measurements