CARME NEARSPACE BALLOON SYSTEM

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Design Alternatives

James Howard
jh@jameshoward.us

https://jameshoward.us/resources/carme

Carme Nearspace Balloon System

DESIGN ALTERNATIVES

1. INTRODUCTION

1.1. Purpose

The purpose of this document is to propose design alternatives for the Carme Nearspace Balloon System (CNBS). These alternatives will be evaluated and a design strategy selected.

1.2. Project

Our goal is to build two Carme payloads, CNBS-1 and CNBS-2, both of which will be launched from weather balloons with parachute recovery. The system should provide, minimally, a human-receivable radio signal as well as a machine-receivable APRS digital signal. Both signals should provide the location and altitude of the payload to provide tracking and recovery.

1.3. Features

The Carme system shall provide the following features:

- The system shall on a regular time interval not exceeding 2 minutes, broadcast its callsign and location via Morse code on the 70cm amateur radio band.
- The system shall on a regular time interval not exceeding 2 minutes, broadcast telemetry to the existing APRS telemetry network.

Via the APRS broadcast, interested parties shall be able to view the telemetry data through the HabHub Tracker website. To facilitate operations, the payload shall be waterproof and include a return system.

1.4. References

- HabHub Tracker – http://tracker.habhub.org
- Carme Requirements Specification – https://jameshoward.us/projects/carme/

2. ARCHITECTURE

The overall architecture of the CNBS includes three core components. There is a GPS receiver, a main logic board, and a radio transmitter. These conduct the overall operations of the system. Additional facilities, such as power and chassis are also required for proper operation.

The architecture is shown in Appendix B.

3. DESIGN ALTERNATIVES

3.1. Option 1

This option uses off the shelf hardware for the transmitter and an Arduino-based architecture.

3.1.1. Parts List

- 1 Arduino Uno
- 1 SparkFun GPS Shield Kit
- 1 Habduino Kit

3.1.2. Architectural Notes

The overall architecture for Option 1 is to collect the location via the GPS shield from the shield kit and broadcasts the location information and identity via the Habduino kit. The Habduino kit is designed to communicate via radio with the HabHub Tracker platform. The Habduino does not support other communications modes.

3.2. Option 2

This option uses off the shelf hardware for the transmitter and a Raspberry Pi-based architecture.

3.2.1. Parts List

- 1 Raspberry Pi
- 1 Adafruit Ultimate GPS
- 1 Pi In the Sky Kit

3.2.2. Architectural Notes

The overall architecture for Option 2 is to collect the location via the GPS shield from the GPS kit and broadcasts the location information and identity via the Pi In the Sky kit. The Pi in the Sky kit is designed to communicate via radio with the HabHub Tracker platform.

While using a different logic board than Option 1, this option is substantially the same.

3.3. Option 3

3.3.1. Parts List

- 1 Arduino Uno
- 1 SparkFun GPS Shield Kit
- 1 SparkFun RFM22 Shield

3.3.2. Architectural Notes

The overall architecture for Option 3 is to collect the location via the GPS shield from the shield kit and broadcasts the location information and identity via the RFM22 Shield. Unlike Options 1 and 2, the RFM22 Shield does not support the HabHub Tracker platform directly, but custom software can transmit the HabHub requirements. In addition, the RFM22 Shield also supports a test mode that can be used to send a Morse Code signal.

4. EVALUATION AND RECOMMENDATION

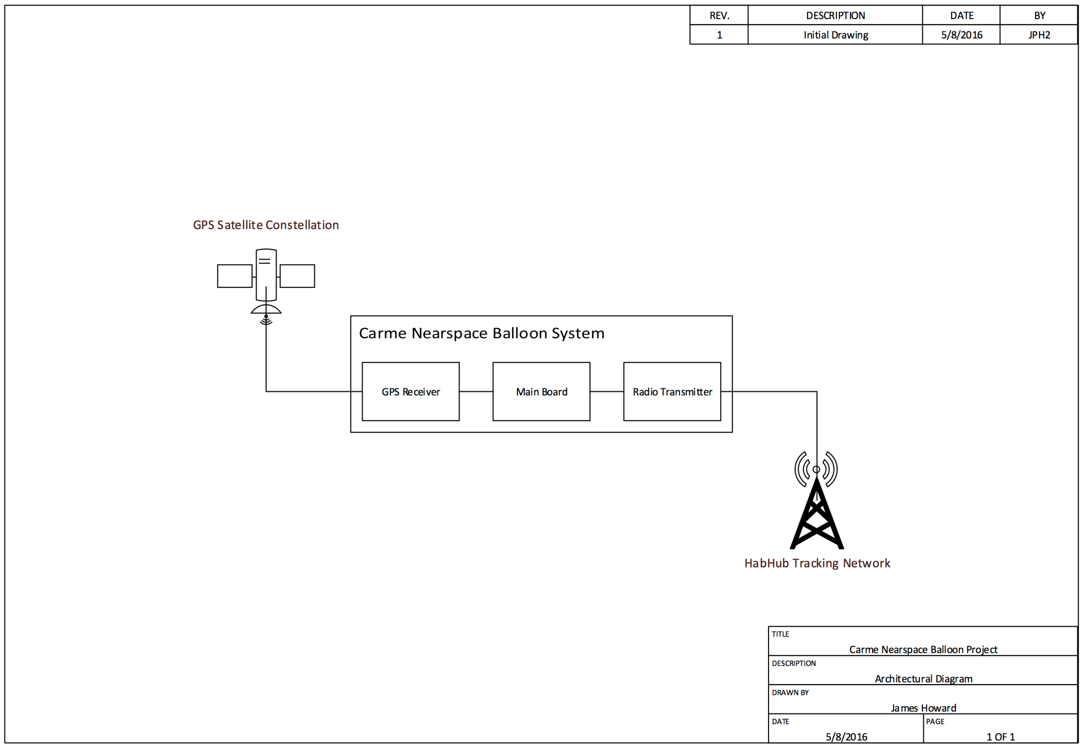
Based on the potential options and the associated architectural notes, we recommend option 3. Option 3 is the only described option that supports the Morse Code signal requirement. This is an especially viable option, given there is little cost difference among the three options.

However, there is an increased risk of failure due to the requirement to write custom software to generate a HabHub Tracker compatible signal. This risk can be mitigated through ground-based and tethered flight testing.

APPENDIX A: REVISION HISTORY

Version	Date	Author	Comment
1.0	May 8, 2016	James Howard	Initial design

APPENDIX B: FUNCTIONAL ARCHITECTURE DIAGRAM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GPS Receiver
Main Board
Radio Transmitter
HabHub Tracking Network
TITLE
Carme Nearspace Balloon Project
DESCRIPTION
Architectural Diagram
DRAWN BY
James Howard
DATE
5/8/2016
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