Software Defined Radio for the Wright State University High Altitude Balloon
Midpoint Progress Report
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1. INTRODUCTION

1.1 Purpose
This report documents the progress our team has made in developing a software defined radio (SDR) to install on the Wright State University high altitude balloon.

1.2 Background
The software defined radio system for the WSU high altitude balloon was proposed and accepted on January 14, 2011. This project aims to enhance balloon-to-ground communication and will allow for new endeavors such as balloon-to-balloon communication. The primary benefit of SDR is that the parameters of the radio, such as frequency range or modulation scheme, can be easily modified. This gives the balloon more versatility for future communication needs.

At the time of this project's proposal, the balloon was using a hardware-based amateur radio communication system which cannot be configured to take advantage of multiple communication protocols. Any significant modifications to this system would require major hardware upgrades which are costly and time consuming. A software defined radio is easily configurable and allows users to change communication protocols through simple programming techniques. Future research teams will be able build off this design and experiment with related communication systems and antenna power amplifiers. This project will enable future teams to quickly and efficiently customize the radio with lower (or no) additional costs. With hardware-defined radio, this versatility in design is available only though acquiring new hardware.

1.3 Scope
This report provides the status of all tasks described in the project abstract project schedule, which includes the following:

- Acquiring the necessary equipment.
- Installing computer software: operating systems, development toolkits.
- Generating signal processing code for digital video broadcast (DVB).
- Acquiring an FPGA board and implementing the tested DVB signal processing algorithm using an in-house firmware design.
- Programing the FPGA to process balloon telemetry data.
• Installing the system on the balloon payload and testing the radio in flight.

2. STATUS

2.1 Tasks completed

Task 1: Acquiring the necessary equipment
• It was arranged for two university USRP1 boards and one desktop computer to be allocated to this project on January 17, 2011. These units are being housed in room 482 of the Joshi Center.

Task 2: Installing computer operating system and development toolkits
• Ubuntu Linux version 10.10 was installed on the desktop computer and all team member's personal laptops. The installation of the operating system was generally pain free, but did require multiple time consuming hard disk partitions. Initially, the desktop install was unsuccessful due to the absence of an on-board DVD drive. A standard CD drive was insufficient in this case, because Ubuntu 10.10 requires more space than is available on the format. Therefore, another computer with a DVD drive was chosen to be allocated to the project. The software install on the new machine was successful.
• The GNU Radio Toolkit was downloaded and installed on all machines. For our chosen operating system, the toolkit was not available for download as a prepackaged installation file, so the software had to be compiled from source code. This task, completed across several different machine platforms, proved to be somewhat problematic and time consuming, but ultimately the installs were successful.

Task 3: Generating signal processing code for a Digital Video Broadcast
• The team researched various digital video broadcast methods and implemented a scheme using the gnu radio companion. The gnu radio companion is a visual flow graph editor bundled with the gnu radio toolkit that will quickly and efficiently generate python code. Specifics of the design can be found in the design review document submitted on February 11, 2011.

2.2 Tasks remaining

Task 4: Acquiring an FPGA board and implementing the DVB signal processing algorithm through firmware design.
• We have just begun this task and are in the process of acquiring an FPGA for design and testing
purposes. Once the necessary equipment is allocated to the project, the team will begin generating the VHDL code that will emulate the DVB signal processing algorithm executed by the gnu radio toolkit.

Task 5: Programming the FPGA to process balloon telemetry data.

- Once the video system has been thoroughly tested and debugged, the FPGA must be properly interfaced with various telemetry equipment such as altimeters, accelerometers, and gps which will be on the balloon payload.

Task 6: Installing the system on the balloon payload and testing the radio in flight.

- After all coding and interfacing is complete, the system will be mounted onto a balloon payload to be launched into a near-space environment. The launch will test the capabilities of the design and expose any problems that need resolved.

3. Conclusion

The team is pleased with the progress made to date. The project is on schedule and the remaining tasks will be completed by June 10, 2011. Tasks one through three were completed within limits and it is expected that tasks four through six will require a proportional amount of time. If further information is needed, group contact information is included below.

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