
EE/CprE/SE 491 WEEK 8 REPORT

April 10 – April 16

Group 01

Project title: Heimdall

Client &/Advisor: Matthew Nelson

Team Members/Role:

Alec Sutton – Design and Power Team Lead

Cullen White – Power Systems and Logistics Manager

George Cleaver – Communications and Controls Advisor

Lex Somers – Programming and Software Advisor

Branden Buhler – Communications and Program Team Lead

Brandon Beaver – Project Manager

o **Weekly Summary:**

- The end of the semester is approaching and, while the semester deliverable has been met, there is still a lot of setup work to be done for next semester. This week primarily focused on finding the Link Budget, building the project website, and planning the approach towards new hardware and software for ease of use. Sourcing a proper helical antenna is also an addition to the final push for the semester. The project will be spending the final weeks organizing documents for future use.

o **Past week accomplishments**

- Design
 - Using tools suggested by Professor Nelson, the team is designing a helical antenna with a wide-angle focus of attenuation. These tools include a MATLAB toolbox (if available to the student license), online design tools, etc. The major goals of the antenna design are high gain and wide focus area (~30-40°), with a priority to reception angle. Evaluation will be done in a CST tool.
 - New Hardware has been ordered and should arrive in the following week. Current hardware is unavailable due to the recovery of the H.A.B.E.T. craft taking longer than expected. The craft should be recovered by the end of the week, and a new hardware setup with the second iteration of the antenna should be ready to test just before finals.
 - Website design is to be completed this week per the course, and the inclusion

of the other organizations involved in the April eclipse launch with H.A.B.E.T. , who are considered benefactors of the Heimdall project are to be honored on the page as well. Inclusion of documents, reports, and all other information has been added as well.

- Preliminary Research (All Members)

- Due to the change in hardware, new link budget calculations must be performed with the new data sheets in mind, though the requirements are the same as before; 30km altitude, 200km linear distance
- Next semester planning began this week, so documentation is to be established more strongly as a preparation for the summer between semesters. This is to avoid any major information loss during the time.

- Testing

- *Branden, George, Lex - Transmission and reception testing continues and is making progress. More research into blocks and libraries to be used in the flowgraph needs to be done, especially with the upcoming switch from PLUTO to HackRF*
- *Cullen & Alec - No testing yet*
- *Brandon - Finalizing the secondary antenna design for a helical antenna with the previous requirements and checking transmission with the Pluto Board until HackRF arrives. PowerPoint presentations have been established as a new method of informing the advisor of any news, issues, and updates as a method of practicing with information relevant to the project, also as a method of confidence when asking questions.*

- o Pending issues

- **Scheduling: It is very tough for all group members to attend the same lab session, so we have to split into sub-groups that can meet to work on GNURadio. This can cause slowed production from the team.**
- In order to determine what the hardware capabilities will be, the Link Budget will need to be calculated. This includes what our distance is, what the output power, bandwidth, gains, and losses will be for the system. This will determine what hardware needs to be ordered.
- A solder workshop will be held the week before spring break to help prepare both projects (Heimdall and H.A.B.E.T.) for assembling the new hardware as necessary. This will use hardware that the M2I lab has available, preventing unnecessary costs, and display critical soldering skills, such as temperature, practical uses for solder paste, flux, etc., type of appropriate solder for different applications, and surface-mount solder techniques.

- New software tests using SDRAngel must take place as soon as possible.
- New hardware will be tested soon, so researching HackRF SDR is top priority.

o **Individual contributions**

<u>NAME</u>	<u>Individual Contributions</u> <i>(Quick list of contributions. This should be short.)</i>	<u>Hours this week</u>	<u>HOURS cumulative</u>
Alec Sutton	<ol style="list-style-type: none"> 1) Took pictures for website and wrote bio for website 2) Read documentation and some datasheets for SDR Angel and HackRF 	5.5	45
Cullen White	<ol style="list-style-type: none"> 1) implementing our data into the website as well as including our sponsors and partners that are helping and funding this project. 2) Took headshots of team members to include into our website 3) Finalized the website to get it ready for the presentation 4) Working on Lightning talks and Design Documents 	5	44
George Cleaver	<ol style="list-style-type: none"> 1) Introductory research with SDRAngel: no physical testing has been done yet 2) Team member headshots for website and professionalism. 	3	51
Lex Somers	<ol style="list-style-type: none"> 1) Started initial research on HackRF & its integration with GNURadio. 2) H.A.B.E.T. and Team meeting 3) Team member photos 	3	58
Branden Buhler	<ol style="list-style-type: none"> 1) Did the math and designed the helical antenna in CST. 5 turn antenna with roughly 9 dB gain. 	4	55
Brandon Beaver	<ol style="list-style-type: none"> 1) Built and organized pre-meeting presentation over eclipse launch (1hr) 2) Met with Matthew to discuss retrieval of the craft and what the process from that point would be with HackRF(2hr) 3) Planned new antenna design process with Program and Design team lead (1hr) 	4	63.5

o **Comments and extended discussion**

- **Documentation is the most important portion of the next few weeks as the semester wraps up. Losing any sources for the next semester will cause a hefty slowdown in progress and avoiding losing any of the data will prevent this. A reference document will need to be established with proper sources and a final major report with the findings of the project should be started early next semester as well.**

o **Plans for the upcoming week**

- **As a Team:**
 - Meet with H.A.B.E.T. to plan adding an SDR board to a future flight for testing.

- Explore use with HackRF board on the GNURadio on the transmitting end
- Explore SDRAngel to receive transmissions. This already seems more promising than previous software used.
- Meet and discuss eclipse launch; What went right? What can be improved? How?
- Individual (bolded tasks are the tasks to be focused on):
 - Alec Sutton:
 - **Link budget calculations**
 - Read SDRAngel and HackRF documentation
 - Work with communications team to finish getting gains
 - **Work on evaluating power needs of communications module**
 - Cullen White:
 - **Website building**
 - Prepare for presentation
 - George Cleaver:
 - Research GNURadio application with Raspberry Pi for physical testing with an SDR transmission/reception
 - Use HackRF and SDRAngel and make a baseline transmission to test the receiver functionality while simultaneously verifying the ability to transmit *something*.
 - Design and build a sustainable antenna by the end of the semester.
 - Lex Somers:
 - **Continue research and implement HackRF and AngelSDR into GNURadio.**
 - Research and test file sink/source blocks in GNURadio and think of method for maintaining a continuous stream of video using files rather than UDP.
 - Test UDP Sink and Source blocks in GNURadio & ensure compatibility Pi cams and output media players.
 - Branden Buhler:
 - Finish the helical antenna design in CST and optimize with a 50 Ohm match and a S11 of -20 dB at 1.2 GHz. Will be able to work on Thursday at earliest because that is when I have EE 517 lab and can talk with the TA on design.
 - Download and setup SDRAngel and receive a spectrum or video feed from our GNURadio transmission.
 - Brandon Beaver:
 - **Run SDRAngel tests with the current hardware, troubleshoot any issues with the GUI as needed.**
 - Find proper bandwidth parameters for transmission to have a cleaner receiving end hardware.
 - Use CST tools with Coms. And Program team to design and build helical antenna
 - prepare team for upcoming final presentation.

o **Summary of weekly advisor meeting**

- The eclipse launch didn't provide the type of data sought for the deliverables, though the team did learn much from the experience leading up to the launch. The major takeaway was noted above; documentation is king. Instructional documents on how the system can be started, setup practices, and troubleshooting errors needs to be drawn up before too long. Secondly, major testing of the system in flight needs to happen as soon as possible, though with the upcoming changes, first flight may take place over the summer with H.A.B.E.T., as Heimdall's Project Manager will be involved in the project over that period.