
EE/CprE/SE 491 WEEK 6 REPORT

March 12 – March 19

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 – Programing and Software Advisor

Branden Buhler – Communications and Program Team Lead

Brandon Beaver – Project Manager

o **Weekly Summary:**

- Overall, this past week was focused more on the logistical aspects of the project since this was an exam-heavy week for most group members. Additionally, our advisor/client is out of town currently, so hardware and software testing was paused due to limited access to resources.

o **Past week accomplishments**

- **Preliminary Research (All Members)**
 - Researching example use cases of GNURadio that others have posted about on various forums. This may not line up exactly with our project intentions, but it is still good to get exposure to GNURadio in action to have a better idea of what our project will look like.
- **Testing**
 - *Branden, George, Lex - GNURadio was installed, but physical testing was delayed due to issues. Some general experimentation and familiarization was done locally.*
 - *Cullen & Alec - No testing yet*

o **Pending issues**

- GNURadio works for MacOS, Windows, and Linux, but ideally, we will test on Linux. However, not all people in the communications and programming team are set up on a campus Linux machine, so meeting in the lab is required to test as a group.
- 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.
- A desktop in the M2I lab is capable of being used for testing the capabilities of the ARM Linux OS that the raspberry pi utilizes, but it needs to be installed. Matthew Nelson is required for this step, as IT will need to install it properly onto the desktop. This will likely take a few days to complete as IT is hard to plan for.

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	1) Worked on flow diagram 2) Read datasheet on current ground receiver 3) Read Ettus DVB-S documentation	3.5	20.5
Cullen White	1) Working with Lex on building the website. 2) Working on Lightning talks		17
George Cleaver	1) Introductory steps for Linux setup 2) Other progress is on hold.	2	20
Lex Somers	1) Assisted with website setup	1	22.5
Branden Buhler	1) Met with advisor the Friday before spring break to get an understanding of how GNU Radio will function and how to log in to the computer. 2) Due to interviews and spring break I was not able to go into the lab to use GNU Radio so I tested some modules in MATLAB Simulink with the PLUTO SDR.	3	20.5
Brandon Beaver	1) Watched DVB-S videos on the previously acquired resources. (1hr) 2) Not much was done due to a family emergency.		20

o **Comments and extended discussion**

- **Plans for the upcoming week**
- **As a Team:**
 - Begin testing GNURadio
- **Individual (bolded tasks are the tasks to be focused on):**
 - **Alec Sutton:**
 - **Link budget calculations**
 - Get help on coax losses and link-budget in general
 - Watch videos from DVB-S documentation
 - **Cullen White:**
 - **Website building**
 - Acquire professional Headshots from each project member
 - Add/gather team member bios
 - Add Weekly Reports & presentations
 - Add I.S.G.C.(Iowa Space Grant Consortium), H.A.B.E.T., and M2I logos to the website, accompanied by descriptions of each entity
 - **George Cleaver:**

- **Set up a user account and log into a campus Linux machine**
- **Research GNURadio application with Raspberry Pi to prepare for physical testing with an SDR**
- Attempt to use PLUTO SDR with GNURadio.
- Lex Somers:
 - **Assist with running GNURadio tests on linux machines in M2I lab. Continue local experimentation and testing as well.**
 - Read the chapter provided by Branden about modulation.
 - Research GNURadio flowgraph modules needed
- Branden Buhler:
 - **Use the Linux machine in Howe to start running tests with GNURadio using the documentation that has been provided for us.**
 - **Use the PLUTO SDR with GNURadio as that will be the main SDR that will be utilized.**
 - Look more into ground station work (polarization, gain, etc.) long term goal.
- Brandon Beaver:
 - Whenever possible with family obligations, reviewing more documents and observing the visual code programmed by the Communications and Program team.

o **Summary of weekly advisor meeting**

- **NOTE: These are the same notes as last week since there was no meeting this week!!**

Link Budget Specifications

- Coax losses
- Pointing losses
- Connector losses
- Free Space losses (function of relative distance between receiver and transmitter)

The GNURadio vs. Simulink battle:

- GNURadio has a lengthier process to go from a block diagram to exportable code than Simulink. This means that the more ambitious we get without transmission demands (e.g. upgrading 720p to 1080p or 4k resolution), the better Simulink will outperform GNURadio. Simulink block diagram components are a direct implementation of C/C++ code.
- Longevity à Even though it seems like all the signs point to using Simulink in lieu of GNURadio, there is a downside to consider. For the SDR application to work in Simulink, you must have the 'Simulink coder' and 'communications' toolboxes.

Currently, these toolboxes are included in the base student license, but relying on these toolboxes for the functionality of our delivered product puts a lot of project weight out of our control. For example, last year, the financial sector cut the communications toolbox to save on costs and re-added it due to complaints.

- Conclusion à SDR development will be done exclusively in GNURadio to ensure the longevity and security of our project. After talking to Matt today, it was decided this is the best course of action.