
EE/CprE/SE 491 WEEK 4 REPORT

Feb 21 – Feb 27

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:**
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- 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.
 - *link budget stuff* here.....
 - **Testing**
 - *Branden, George, Lex - GNURadio was installed, but physical testing was delayed due to installation issues*
 - *Cullen & Alec - No testing yet*
- o **Pending issues**
 - Installing GNURadio locally took longer than expected due to an issue with conflicting homebrew installations. This was caused by an incorrect path variable that controlled where homebrew looks for dependency kegs and taps. GNURadio required python version 3.12 to run, which was not in the Cellar of the homebrew installation GNURadio was looking in. Removing the duplicate homebrew installation and correcting the path variable to look in the correct homebrew directory fixed the issue.
 - 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.

- 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	<ol style="list-style-type: none"> 1) finished reading leandvb documentation 2) created a spreadsheet to organize link budget information 3) researched about different losses that will be relevant in link budget calculations 	4.5	15.5
Cullen White	<ol style="list-style-type: none"> 1) Working with Lex on building the website. 2) Working with our client with hardware ideas and possibilities for our project 	4	14
George Cleaver	<ol style="list-style-type: none"> 1) Studied a method of generating C/C++ code from a Simulink model and compared it to GNURadio code generation 2) looked into Iowa State's MATLAB licensing history and made an executive decision to cut MATLAB development for the longevity of the project. 	3	17
Lex Somers	<ol style="list-style-type: none"> 1) Started reading DVB-S documentations 2) Installed GNURadio locally and began watching tutorials on how to implement basic sdr functionalities 3) Began setting up team website; uploading reports and adding team members 	5	19.5
Branden Buhler	<ol style="list-style-type: none"> 1) Identified that the language for GNURadio computing is C++ and the writing for applications is either C++ or Python. 2) Analyzed the configurations for transmitting DVB-S2 with GNU Radio. 	3	16.5
Brandon Beaver	<ol style="list-style-type: none"> 1) Watched DVB-S videos on the previously acquired resources. (1hr) 2) Not much was done due to a family emergency. 	1	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**
 - continue adding to link budget spreadsheet
 - add continue adding losses to spreadsheet
 - find out specs on the existing radio receiver
 - Continue reading DVB-S documentation
 - F5OEO

- Cullen White:
 - Link budget calculations
 - **Website building**
 - Acquire professional Headshots from each project member
 - Add project description
 - 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**
 - Install GNURadio drivers on a personal computer to begin local development and understanding of the program. – talk with Lex about this
 - Attempt to use PLUTO SDR with GNURadio.
- Lex Somers:
 - **Experiment with GNURadio locally and consult George and Branden on basic needs for our SDR's functionality**
 - **Research DVB-S/2 further using the client provided documentation watch videos.**
 - Finish uploading reports and team member info to website
 - Read the chapter provided by Branden about modulation.
- Branden Buhler:
 - **Use the Linux machine in Howe to start running tests with GNURadio using the documentation that has been provided for us.**
 - 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

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