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**EE/CprE/SE 4920 Status Report 3**

**09/20/2024 – 10/03/2024**

**Group number: 1**

**Project title: Heimdall**

**Client &/Advisor: Matthew Nelson**

**Team Members/Role:**

**Brandon Beaver – Project Manager**

**Alec Sutton – Design and Power Team Lead**

**Branden Buhler – Communications and Program Team Lead**

**Cullen White – Power Systems and Logistics Manager**

**George Cleaver – Communications and Controls Advisor**

**Lex Somers – Programming and Software Advisor**

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- **Status Summary** *Since the last report saw the proper resumption of the physical work in the Make to Innovate lab. The process towards completing Phase III.a finally back in motion with a fresh install of Ubuntu and GNURadio onto the desktop provided by the faculty advisor. This was a critical step as last semester's work was lost due to an unknown error that prevented the machine from booting to the desktop, causing the booting sequence to infinite loop at the file verification step. Critical equipment was also acquired over the last two weeks, allowing for the Heimdall project to begin machine-to-machine test via direct connection later this week, possibly by completing this report, in which case the information will be attached below. Antenna design, though showing promising results in simulation, has also been put on a short hold pending this test.*
  
  - **Past week accomplishments**
    - **Brandon Beaver:**
      - Wiped the desktop of the previous version of Ubuntu on the desktop, unfortunately losing the data that was on the desktop from last semester. However, the Raspberry Pi 4 that was used last semester during the HABET Eclipse launch at SIU Carbondale, which fortunately retained the previous iteration of the GNURadio plot. with the fresh install, there was some reprieve from malfunctioning equipment

before the same issue arose once again. The hardware in the desktop may be the issue, which requires further investigation.

- Worked with **George Cleaver** and **Branden Buhler** on identifying issues with the previous GNURadio plot based on a resource from an international student (linked in George's accomplishments section.)
- Confirmed functionality of the sourced HackRF received from the CySat team this past week with a sample plot within the GNURadio examples—documentation for the next report.
- **Lex Somers:**
  - Researched how to boot Ubuntu from USB and attempted to install it onto the M2I lab desktop computer.
  - Installed SDRAngel on the M2I lab desktop computer that Heimdall will use to receive transmissions. Checked the GNURadio installation and dependencies.
  - Read through introductory documentation and use case examples for SDRAngel to become familiar with the UI and prepare for testing.
  - Installed SDRAngel on personal laptop and downloaded use case examples to run a simple GNURadio integration test, passing input files through a GNURadio flowgraph to the SDRAngel receiving end.
- **Branden Buhler:**
  - Researched GNURadio block diagrams and sampling rates for a sufficient line-to-line connection.
  - Found products and a way to create the loop antenna when the time comes.
  - <https://www.menards.com/main/electrical/electrical-wire-cable/copper-electrical-grounding-wire/copper-electrical-grounding-wire/3691201/p-1473854610627-c-1525874617507.htm>
  - <https://we-supply.com/products/s-bnc58-6>
- **Alec Sutton:**
  - Acquired a coax cable for testing a wired connection for a proof of the flowgraph
  - Worked on revising goals for this semester.
- **George Cleaver:**
  - Obtained a coax cable for wired transmission test for flowgraph verification
  - Located and studied two separate examples online of other users implementing similar hardware to heimdall's.
    - <https://eva.fing.edu.uy/mod/url/view.php?id=133559>  
Online example with video "proof"
    - [https://kb.ettus.com/Transmitting\\_DVB-S2\\_with\\_GNU\\_Radio\\_and\\_an\\_USRP\\_B21\\_Q](https://kb.ettus.com/Transmitting_DVB-S2_with_GNU_Radio_and_an_USRP_B21_Q)  
Example using gnuradio with USRP
  - Reorganized GNURadio tx-flowgraph for readability
  - uploaded a copy of heimdall files from raspberry pi to USB drive, that will eventually be used to duplicate on two separate linux machines.
- **Cullen White:**
  - **out of town**

- **Pending issues**
  - **Brandon Beaver:**
    - Find the issue or replace the desktop for testing the transmission, likely in hardware.
    - Move current GNURadio plot to new or fixed desktop to begin testing
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    - Begin GNURadio transmission tests
  - **Branden Buhler:**
    - Designing the antenna is on hold until after the line to line connection is satisfied.
- **Individual contributions**

<b><u>NAME</u></b>	<b><u>Individual Contributions</u></b> <i>(Quick list of contributions. This should be short.)</i>	<b><u>Hours this period</u></b>	<b><u>HOURS cumulative</u></b>
Brandon Beaver	<ul style="list-style-type: none"> <li>• GNURadio plot investigation</li> <li>• HackRF module testing</li> <li>• ATTEMPTED to boot Ubuntu onto the desktop encountered an unknown boot issue again.</li> </ul>	12	19
Branden Buhler	<ul style="list-style-type: none"> <li>• Made a shopping list for the antenna and discussed with George what will need to be done to create it once that step is reached.</li> <li>• Researched DVB-S2 more in depth and trying to find a sufficient sampling rate.</li> </ul>	3	8
George Cleaver	<ul style="list-style-type: none"> <li>• Obtained a coax cable for wired transmission test for flowgraph verification</li> <li>• Located and studied two separate examples online of other users implementing similar hardware to heimdall's.</li> <li>• Reorganized GNURadio tx-flowgraph for readability</li> <li>• uploaded a copy of heimdall files from raspberry pi to USB drive, that will eventually be used to duplicate on two separate linux machines.</li> </ul>	4	7
Alec Sutton	<ul style="list-style-type: none"> <li>• Searched for a suitable coax cable for wired connection testing of the plot. <ul style="list-style-type: none"> <li>○ Found something that will work for testing but will need something better for actual transmission</li> </ul> </li> <li>• Revised goals with the faculty advisor to better solidify goals for the semester.</li> </ul>	2	5
Cullen White	<ul style="list-style-type: none"> <li>• Out of town</li> </ul>	0	5
Lex Somers	<ul style="list-style-type: none"> <li>• Installed SDRAngel onto personal laptop &amp; lab desktop.</li> <li>• Read usage documentation &amp; use case examples for SDRAngel</li> </ul>	3	6

	<ul style="list-style-type: none"> <li>• Experimented with basic GNURadio &amp; SDRAngel integration</li> </ul>		
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○ **Plans for the upcoming week**

- Brandon Beaver
  - Introduce MATLAB DVB-S toolbox to team to simulate different bandwidths, possible noise, and gain options.
  - Book time with HABET's new members and begin filling out requests/forms for future flight and design accommodations.
  - Fill order forms and submit to ETG for Griddy RF antenna, equipment needed for loop antenna build,
- Branden Buhler
  - Keep working on GNURadio line to line connection and find how much gain can be achieved.
- Lex Somers
  - Fix the desktop computer Ubuntu boot issue
    - Likely requires resetting the BIOS to factory defaults and wiping the desktop.
  - Test GNURadio flowgraph on Pi and lab desktop and make adjustments if needed for the HackRF instead of PLUTO.
  - Start SDRAngel receiving end flowgraph.
- Alec Sutton
  - Work on updating documentation and citations to match IEEE formatting
  - Work on GNURadio flowgraph with team
    - get re acquainted with the software
- George Cleaver
  - Continue to revise flowgraph and work toward a wired transmission test.

○ **Summary of weekly advisor meeting**

The team met with Matt Nelson to discuss the review of the previous semester and get more face to face input on what can be improved upon this semester and what the goals should be moving forward. Additionally, the "Phase" structure was revisited for the project workflow to ensure all work is working **towards** a goal, providing insight for order of testing flow. The intense timeline HABET and CySat, the Make to Innovate teams Professor Nelson advises as well, have kept him busy, preventing any solid meetings until now with the Professor. This should change in the future, allowing for more communication between Heimdall's group, Professor Nelson, and the HABET team.