3. Project Plan

3.1 Project Management/Tracking Procedures

The Heimdall project utilizes a hybrid approach, taking advantage of both the Waterfall and the Agile structures for management. This hybrid style fits the Heimdall project best in reaching the goals set by the project team and the faculty advisor and client for the project, Professor Matthew Nelson. Progress is tracked through presentation of materials and an hour-tracking system used within the M.2.I. (Make To Innovate) organization called YouTrack, an online system that is used to assign tasks, track hours logged to a particular task, and track documentation throughout a project. Github is also used as a resource for more of the coding files and others of similar content, though YouTrack is the major focus system.

3.1.1. Waterfall-Agile Management Style

The Hybrid style used in the scope of Heimdall as a tool of collaboration with the H.A.B.E.T. project.While a structure of accomplishing goals subsequently and checking in with H.A.B.E.T. as well as some of the internal processes. Due to the nature of both projects, however, a large amount of flexibility is required to meet the deliverables of Heimdall. The Agile management style is utilized in these situations. The figure below shows how the hybrid management style works within Heimdall, giving clear guidelines for how this project is approached.

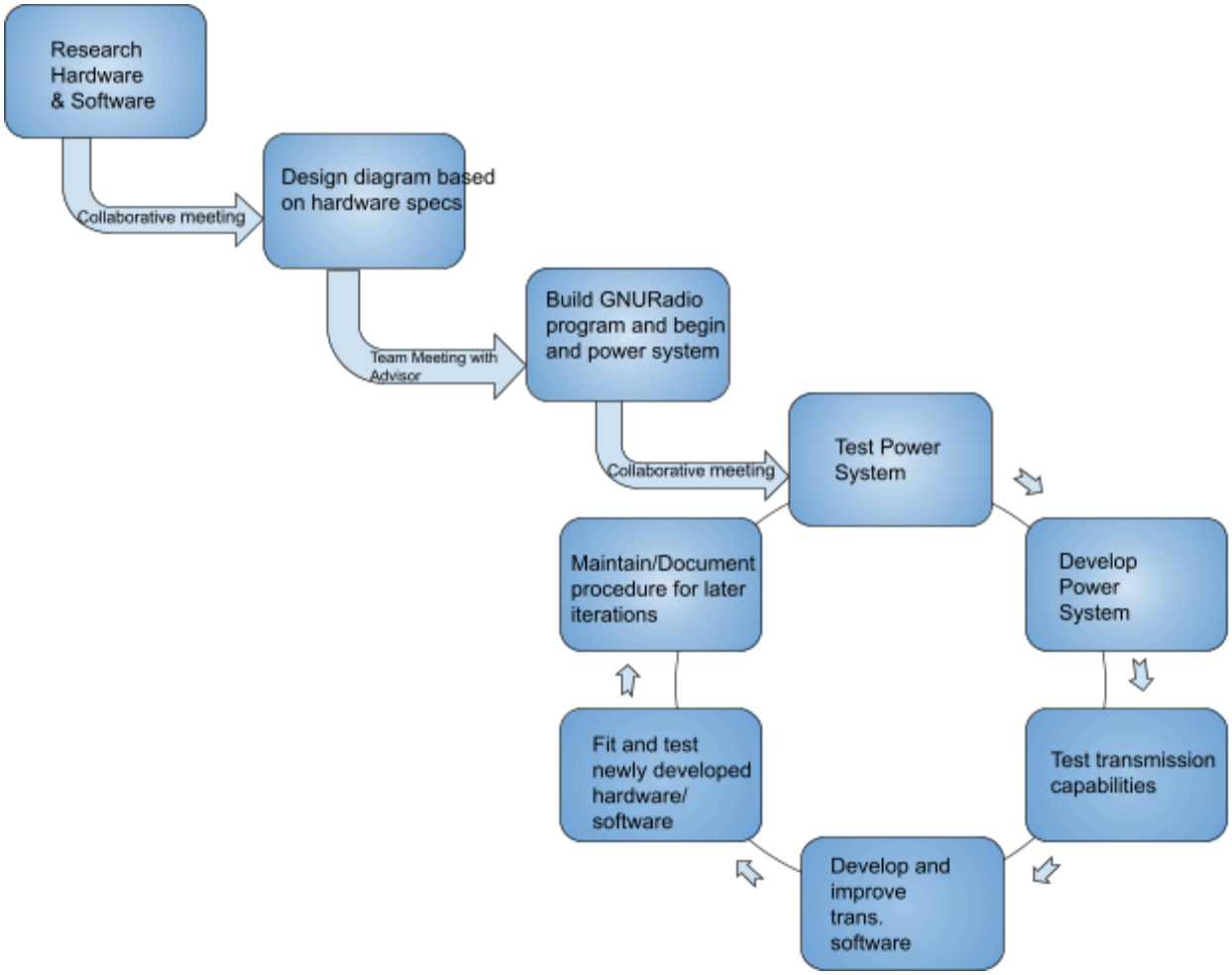


Figure 1: Hybrid Waterfall-Agile Flowchart describing Heimdall's project goals over the course of two semesters.

As described in *Figure 1*, the project begins in a research phase which consists of delving into the realm of H.A.M. (Hymam-Almy-Murray) radio and its direct relation to Digital Video Broadcasting Satellite (DVB-S), to be utilized here. This is followed by the design phase, where the GNURadio system is drawn up in block diagram format to represent the goals of the transmission, which is then developed in the GNURadio program during the build phase. The build phase involves building a power budget to account for the power usage of each component in the prototype hardware and sourcing a system to supply the energy needs of the system and components. This is then tested, observed and improved upon. The transmission system will then also be tested and improved upon, etc., until the project is ready for implementation. Once implemented, continuous improvement of the system is predicted and accounted for as seen above.

3.1.2. Data Storage and Tracking

Recording information, tasks performed, time, and logistical data will all be logged via YouTrack, previously defined. As a project affiliated with H.A.B.E.T., the YouTrack page is shared with H.A.B.E.T. members. Each project is given a code extension to show relation to which team and individual it is assigned.

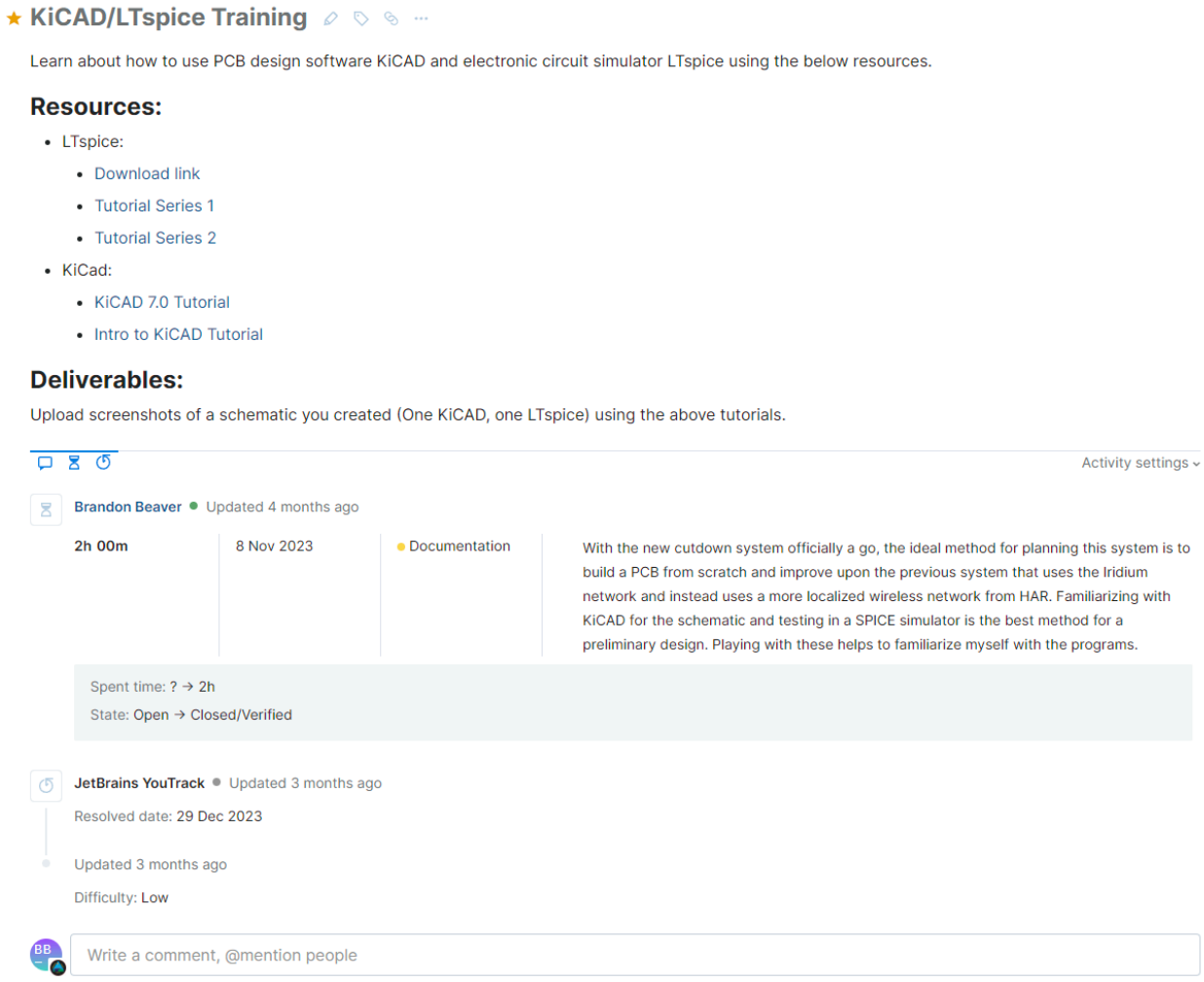


Figure 2: YouTrack task setup example, showing how time, task type, descriptions, etc. are documented.

Each task, as previously mentioned, has several components; Title, Deliverables, Priority, Category, File Uploads, Time Tracking, and Notes. Each portion will track progress through each Team Lead assigning tasks, making notes, and adding time to each weekly report for the following week.

Data such as large files, scripts and code, visual data such as graphs, and so on will be stored within the H.A.B.E.T. repository library in a branch labeled “*M2I-HABET/Heimdall”* for future reference as well. This repository will be used to add files during development as well as data collected during each flight equipped with the Heimdall DVB-S system.

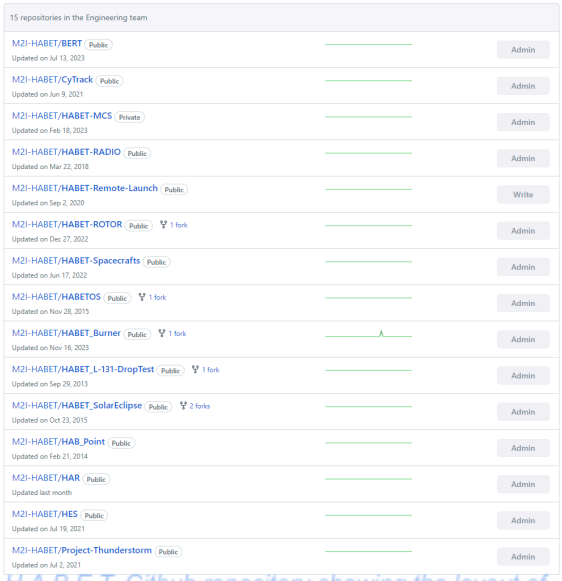


Figure 3: H.A.B.E.T. Github repository showing the layout of the repositories available, exemplifying future structure.

3.2 Task Decomposition

Phase 1: Background Research

- Objectives & Requirements Overview
    - All Heimdall team members meet with the client & discuss the scope of the project, its objectives, and requirements.
- SDR & DVB-S2 Standards Research
    - All team members read through client’s SDR thesis paper & other client provided documentation SDR/DVB-S2.
- GNURadio & Raspberry Pi Research
    - Communications & Program team research GNURadio use cases relating to SDR, Raspberry Pi specifications, and how to integrate the two.
- Link Budget & Battery Research
    - Design & Power Team research the power needed to drive Heimdall’s transmission signal.

Phase 2: Design & Prototype

- Determine High-Level SDR Design & Flow
    - Create high level diagrams of projects implementation.
- Calculate Link Budget

- Design Rx & Tx GNURadio Flowgraphs
- Test Flowgraphs & PLUTO on H.A.B.E.T. Launch
    - Equip H.A.B.E.T. launch with Heimdall's Raspberry Pi & SDR along with any hardware components that have been prepared.
- Design Battery for Desired Transmission Time

Phase 3: Implementation & Optimization

- Revise High-Level Design with Optimizations
    - Revisit old design and add optimizations based on performance from H.A.B.E.T. test launches.
- Implement Battery & Analog Amplifiers/Filters
- Implement Ground Controlled Dynamically Adjustable Flowgraph
- Test Dynamic Flowgraphs on H.A.B.E.T. Launch

Phase 4: Documentation

- Presentation
- Documentation

3.3 Project Proposed Milestones, Metrics, And Evaluation Criteria

● Comparative analysis of SDR tools (Analyze MATLAB Simulink vs GNU Radio)

○ Completed already, it was determined Simulink would process faster, but would not be maintainable long-term due to licensing issues.

● Successfully transmit video broadcast on date of eclipse in April

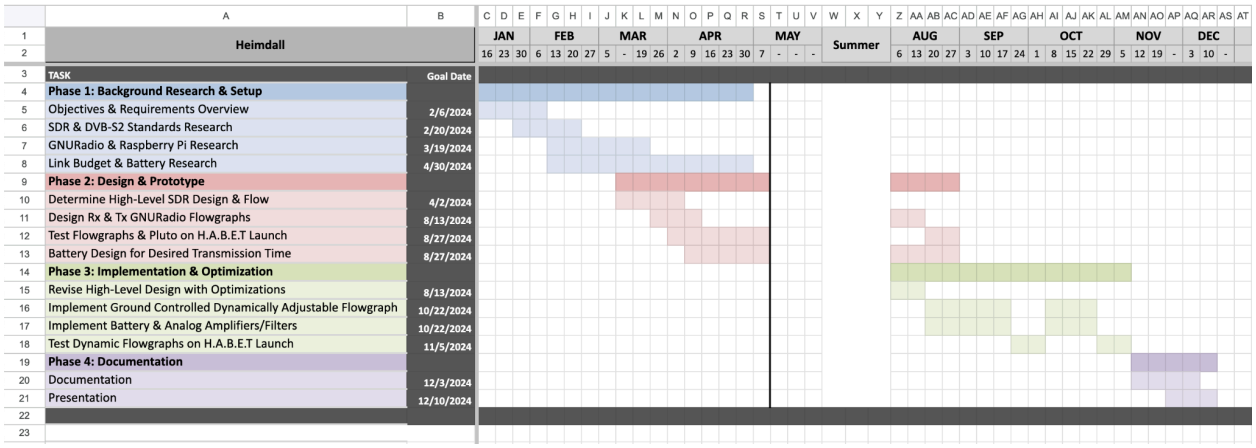
○ Aiming for a transmission quality of 720p, but will be satisfied with a successful transmission of any quality.something.

● Use a custom designed and implemented SDR modulation circuit for a launch.

○ Ideally, at the end of our project we will have designed our own modulation circuit to optimize the system's efficiency and quality of output.

3.4 Project Timeline/Schedule

The proposed project schedule is included in the figure below.



Heimdall	Goal Date
Phase 1: Background Research & Setup	
Objectives & Requirements Overview	2/6/2024
SDR & DVB-S2 Standards Research	2/20/2024
GNURadio & Raspberry Pi Research	3/19/2024
Link Budget & Battery Research	4/30/2024
Phase 2: Design & Prototype	
Determine High-Level SDR Design & Flow	4/2/2024
Design Rx & Tx GNURadio Flowgraphs	8/13/2024
Test Flowgraphs & Pluto on H.A.B.E.T Launch	8/27/2024
Battery Design for Desired Transmission Time	8/27/2024
Phase 3: Implementation & Optimization	
Revise High-Level Design with Optimizations	8/13/2024
Implement Ground Controlled Dynamically Adjustable Flowgraph	10/22/2024
Implement Battery & Analog Amplifiers/Filters	10/22/2024
Test Dynamic Flowgraphs on H.A.B.E.T Launch	11/5/2024
Phase 4: Documentation	
Documentation	12/3/2024
Presentation	12/10/2024

Figure 3: Project Heimdall will go through multiple phases consisting of tasks with respective deadlines.

Though it would be ideal for Heimdall to advance strictly according to schedule, there will likely be unforeseen issues or advancements that will cause the need for this timeline to be adjusted. Additionally, following Heimdall's hybrid management style, there will be instances of revisiting the prior phases' tasks, especially those part of phase 2, the design and prototyping phase.

3.5 Risks and Risk Management/Mitigation

- Tracking connection loss with onboard system causing loss of whole balloon
  - Mitigation: A dynamically adjustable receiver that can be properly tuned to reduce the chances of a system connection failure.
- Power supply issues for data transmission on the balloon
  - Mitigation: Have some 'wiggle room' in the link budget to allow for increased power demand if necessary

3.6 Personnel Effort Requirements

Task Description	Estimated Effort (Person-Hours)
Research and Planning	40
Procurement of Equipment and Materials	20

Assembling Weather Balloon Kit	15
Testing Weather Balloon and Equipment	25
Designing and Implementing Data Collection	30
Launch Preparation	20
Launching the Weather Balloon	10
Monitoring and Tracking the Balloon's Trajectory	35
Data Analysis and Interpretation	40
Reporting and Documentation	25
Review and Post-Project Evaluation	15
Total Estimated Effort:	275 Person-Hours

- Research and Planning: This phase involves comprehensive research on weather balloon technology, regulations, and planning the project workflow. It also includes defining project objectives and requirements. Given the complexity of the project, this phase is estimated to take around 40 person-hours.
- Procurement of Equipment and Materials: This task involves sourcing all necessary equipment, including the weather balloon, payload instruments, tracking devices, etc. It also includes purchasing materials required for the project. This task is estimated to take around 20 person-hours.
- Assembling Weather Balloon Kit: Assembling the weather balloon kit involves carefully following instructions to put together the balloon, payload, and other necessary components. This task is estimated to take around 15 person-hours.

- Testing Weather Balloon and Equipment: Prior to launch, thorough testing of the weather balloon and all associated equipment is necessary to ensure functionality and reliability. This task is estimated to take around 25 person-hours.
- Designing and Implementing Data Collection: This task involves designing a system for collecting data during the balloon's flight and implementing it into the payload. It includes sensor calibration, programming, and testing. This task is estimated to take around 30 person-hours.
- Launch Preparation: This involves preparing for the launch, including selecting the launch site, obtaining necessary permissions, and conducting pre-launch checks. It also includes preparing the payload for attachment to the balloon. This task is estimated to take around 20 person-hours.
- Launching the Weather Balloon: This task involves the actual launch of the weather balloon, which includes inflating the balloon, attaching the payload, and releasing it into the atmosphere. This task is estimated to take around 10 person-hours.
- Monitoring and Tracking the Balloon's Trajectory: Throughout the flight, the balloon's trajectory needs to be monitored and tracked to ensure it follows the intended path. This task involves using tracking systems and software to monitor the balloon. It is estimated to take around 35 person-hours.
- Data Analysis and Interpretation: After the balloon has completed its flight and the data has been collected, it needs to be analyzed and interpreted to extract meaningful insights. This task involves statistical analysis, visualization, and interpretation of the collected data. It is estimated to take around 40 person-hours.
- Reporting and Documentation: This task involves preparing a comprehensive report documenting the project methodology, results, analysis, and conclusions. It also includes preparing any necessary presentations or documentation. This task is estimated to take around 25 person-hours.
- Review and Post-Project Evaluation: Finally, a review of the project's successes and areas for improvement is necessary to inform future projects. This task

involves gathering feedback, conducting a post-mortem analysis, and documenting lessons learned. It is estimated to take around 15 person-hours.

- This breakdown provides a detailed estimate of the effort required for each task involved in the weather balloon project, totaling to 275 person-hours. Adjustments may be necessary based on specific project requirements and team capabilities.

3.7 Other Resource Requirements

Aside from financial resources, the Heimdall project shall make use of the following:

- Hardware Tools & Resources:
  - Raspberry Pi
  - Video Cameras
  - ADALM-PLUTO Board
  - Cables & Connectors
- Software Tools & Resources
  - Linux
  - GNURadio
  - Git