2 Project Plan

2.1 Project Management/Tracking Procedures

For our project, we will utilize the agile project management style. Our project will likely be a combination of two parts: software and hardware. Thus, by utilizing the agile management style we will be able to create, test, and re-evaluate parts of our project as necessary.

One large tool that we will be using to track progress is GitHub/GitLab. Our project is open source, with a necessary requirement of making it more efficient for our specific utilization. Thus, GitHub will allow us to create and separate tasks regarding software. Similarly, we will be able to create Issues regarding other timeline specific items and simply not assign someone to complete it as necessary for other parts of the project.

2.2 Task Decomposition

In order to solve the problem at hand, it helps to decompose it into multiple tasks and subtasks and to understand interdependence among tasks. This step might be useful even if you adopt agile methodology. If you are agile, you can also provide a linear progression of completed requirements aligned with your sprints for the entire project.

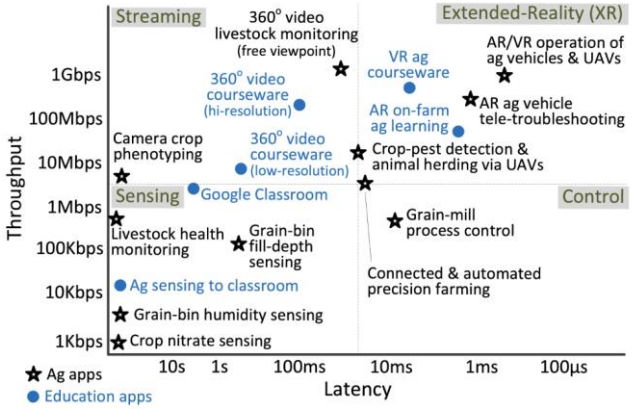
We are looking into 5G applications for agriculture applications.

5G Consists of:

- Standard IOT operations
    - Data sensing
    - Data transmission
- Low Latency High Data Rate operations
    - Automation via AR/VR operated vehicles
    - Data streaming (real time data collection and transmission) via sensors and cameras
    - FOCUS IS IN THIS AREA OVER STANDARD IOT OPERATIONS for 5G solutions
- Hardware
    - Specific application-based hardware (360 Cameras, sensors, network connectivity devices)
        - Applications must be able to connect to 5G ARA network
        - Hardware must be able to implement needed software
        - Power efficiency is important
        - Conditions device will be exposed to will be important as devices will be important as device will be used in agricultural setting
- Software
    - 5G stack (srsRan openAirInterface5g open-source code)
        - Adjusting basic code outline to optimize operation for each different application (Operation of applications is heavily reliant on this)
        - Implementing code on hardware systems

- User interface must be designed to be accessible

2.3 Project Proposed Milestones, Metrics, and Evaluation Criteria



Our main goal is to be able to utilize the ARA network with a high throughput and low latency application. Whether this be AR/VR/XR, automation, or imaging via drones and robots, we will hold ourselves to the ranges that make up that Extended-Reality (XR) and Streaming. In thinking about this process alone here are a few key miles stones we have in mind:

1) Connect a User Equipment (UE) to a Base Station (BS)
    a) In-lab BS
    b) Deployed field BS for ARA network
2) Successful tested throughput
    a) 10 Mbps
    b) 100 Mbps
    c) 1 Gbps
3) Successful tested latency
    a) 10 ms
    b) 1 ms
    c) 10 us

As we progress in the project and as it becomes more defined, we hope to be able to define more milestones to track our progress and successes.

2.4 Project Timeline/Schedule

To best optimize our task schedule, we have developed four main phases to our project that each has specified tasks and milestones that we are striving to achieve along the way. By having this outline, we then know when we are beginning to reach a point to transition to the next phase. We want to maintain an organized project and hopefully gain success through this project schedule.

Phase 1: Background Research and Project Familiarization

To best understand our project, we want to learn more about how 5G networking has improved upon current technology and how our application will utilize this to meet the needs of our customer. During this phase we have the following tasks:

- Meet with Dr. Hongwei and ARA wireless team
- Find readings and information on 5G networking
- Researching agricultural communities to better understand their needs for certain applications
- Begin looking at Use-Case scenarios to start developing an application focus

Phase 2: Finalize Project Focus and Initial Testing

Once we have the necessary information we need, our team plans to finalize the application focus of the project and begin developing prototypes with our ARA partners. We can also begin testing with the ARA 5G network. Our tasks for this phase are as follows:

- Finalize project focus
- Begin using open-source code to interact with the ARA network and configure our application
- Develop testing requirements and goals
- Creating a resource list

Phase 3: Iterate and Refine the Advanced Wireless Application

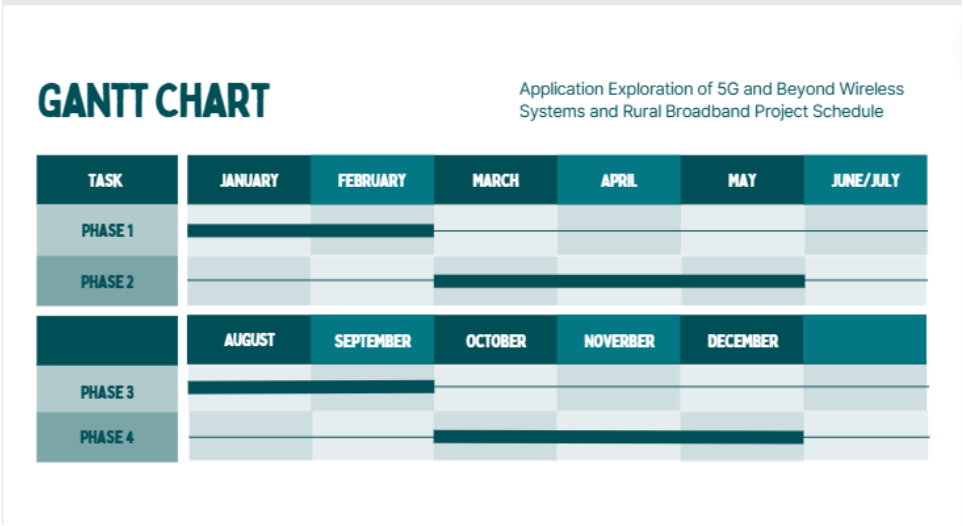
Once we begin prototyping our application, we will most likely see improvements that can be made. To tackle these issues, we will refine our project scope and re-evaluate our goals during this time. To do this we will:

- Summarize current successes and failures
- Define new goals
- Improve upon current applications

Phase 4: Real-World User Review and Final Benchmarking

After our project reaches its final stages, we want to conduct a final assessment of its usability. We will run our final tests and conduct user interviews to evaluate if it is reaching the needs of our customer. During this time, we will:

- Conduct final testing
- Develop a report of our successes of our project
- Assess real-world uses of our applications
- Present our project



2.5 Risks And Risk Management/Mitigation

Consider for each task what risks exist (certain performance target may not be met; certain tool may not work as expected) and assign an educated guess of probability for that risk. For any risk factor with a probability exceeding 0.5, develop a risk mitigation plan. Can you eliminate that task and add another task or set of tasks that might cost more? Can you buy something off-the-shelf from the market to achieve that functionality? Can you try an alternative tool, technology, algorithm, or board?

Risk 1 – 10% - Our device won't be able to connect to the ARA network.

Risk 2 – 75% - During transmission through the ARA network our data will become hard to use based off differences in encoding schemes.

Risk 3 – 10% - We'll face complications when trying to increase our data rate and decrease our latency.

Risk 4 – 5% - Updates are made to the ARA network that would break our application or maintenance procedures that prevent us from performing tests on the network.

Agile project can associate risks and risk mitigation with each sprint.

2.6 Personnel Effort Requirements

Task	Person-hours Required to Complete	Reference/Explanation

Meet with Dr. Hongwei and ARA project team	Dependent on bi-weekly meetings, as well as when required otherwise	Hour biweekly meetings to touch base, check progress and direction of our project.
Readings and research information on 5G networking for background knowledge	20 hrs / person	Using a book as well as other resources provided, learn more about 5G and how it works.
Researching agricultural communities to better understand their needs for certain applications	5 hrs / person	Figure out what problems primarily concern farmers, what solutions exist, and what 5G could possibly do to create a better solution.
Researching Use-Case scenarios to start developing an application focus	10 hrs / person	Draw inspiration from current issues in ag and what applications are enabled from 5G to help define our direction.
Finalize Project focus	5 hrs / person	What we will specifically be utilizing the ARA network for and how it can impact ag communities.
Open-source code utilization	TBD	Network test with the ARA wireless network.
Testing goals / requirements	40 hrs / person	Create testing procedures for software to maintain quality. Phase 2/3: 3 Months.
Resource list	Less than 1 hr	Keeping track of our resources as the project progresses is important so that we know who we can go to for specific information or specific aspects of wireless communication. (UE, BS, RAN, Software vs hardware)
Re-evaluate successes/failures	2 hours in group discussion	Find out what we did well, as well as what we can improve upon.
New goals	1 hour	Adjust to unexpected challenges that we need to meet and add additional features to our design.
Improve current applications	TBD on what we need to revise	Improve our current implementation of the project.
Final testing	TBD	Create and run final tests to confirm our projects status,

		and what to do next semester.
Create and develop Report	5 hrs / person	Develop final report with all our findings, success as well as things we can improve upon.
Real World applications	15 hrs / person	Conduct tests in real-world test cases and user experience.
Present project	1 hr / person	Gather all the results to present to our advisors and customers. Summarize the project successes and failures

2.7 Other Resource Requirements

We have plenty of resources that can supplement our research and development in this project. First and foremost, we will have access to Dr. Hongwei's expertise in the 5G field. Dr Hongwei is a professor in the Department of Electrical and Computer Engineering as well as the Department of Computer Science. He has been able to provide a list of helpful resources to supplement our understanding of 5G as well. We can also reach out to any of his graduate students who work on the ARA project, all of which have their own specialty. We have met with Joshua Boateng, who is a graduate student currently amid his own project which utilizes the ARA Network and 5G to create a self-driving tractor. He specializes in more hardware aspects. We have also met with Sharath who works on more of the software-defined aspects of the RAN.

Dr. Hongwei has also introduced us to two other professors that we could also reach out to. Dr. Marie-Jose Montpetit is a research affiliate with MIT who has interests in wireless internet and network coding applications. Dr. Myra B. Cohen is a professor and chair of software engineering in the Department of Computer Science at ISU.

Finally, we have access to everything that the previous 5G project members have done, as well as the members themselves upon request. This allows us to have a vast array of contacts that we may be able to utilize as necessary.