

Application Exploration of 5G-and-Beyond Wireless Systems and Rural Broadband PROJECT PLAN

Introduction

- ▶ Utilizing 5G, we set out to create a low latency solution for the rural population, with a particular focus on farmers.
- ▶ Not so much a problem being focused on, but exploration into new possibilities as 5G is now available to rural communities
 - ▶ Automation
 - ▶ Ways to increase productivity
 - ▶ Quality of life improvements

Management and Tracking Procedures

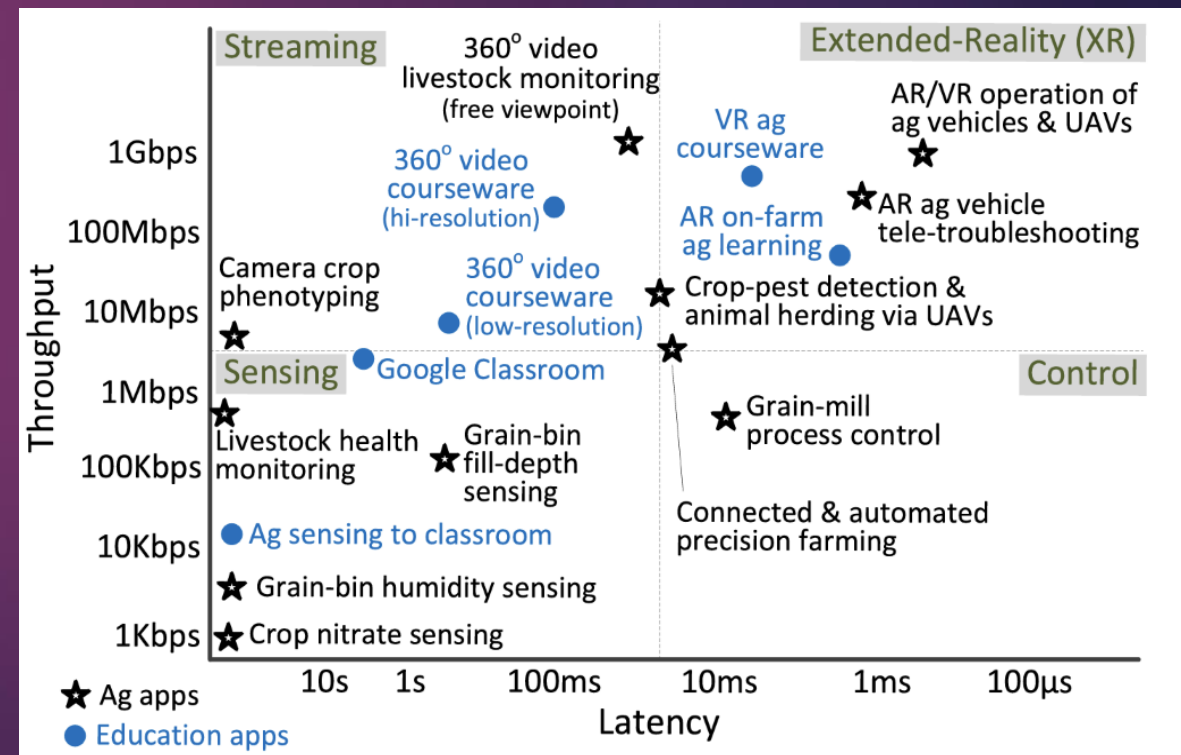
- ▶ Agile
 - ▶ The iterative development will allow us to avoid time and resource pitfalls
- ▶ Github
 - ▶ Issues – allow us to create and track issues
 - ▶ Branches - separate out code from source to mitigate potential issues

Task Decomposition

- ▶ 5G Applications in Agricultural Environments
 - ▶ Basic Internet of Things Applications (IOT)
 - ▶ 4G Capability
 - ▶ Data Sensing and Transmission
 - ▶ Low Latency and High Data Rate Operations (Our focus is here)
 - ▶ Automation, AR/VR capabilities in vehicles
 - ▶ Data streaming (sensing, analysis, and transmission done in real time) via sensors and cameras.
 - ▶ Control of automated and precision farming
 - ▶ Hardware
 - ▶ Specific application specific hardware
 - ▶ Network connectivity devices, Sensors, Cameras, etc.
 - ▶ Used for implementing software
 - ▶ Devices made to be power efficient to optimize usage
 - ▶ Conditions devices exposed to need to be taken into consideration
 - ▶ Software
 - ▶ Basic open-source 5G code adjusted for application specific uses
 - ▶ Optimization is necessary for different applications
 - ▶ UI design

Project Proposed milestones, Metrics, and Evaluation Criteria

- ▶ Connect a User Equipment (UE) to a Base Station (BS)
 - ▶ In-lab BS
 - ▶ Deployed field BS for ARA network
- ▶ Successful tested throughput
 - ▶ 10 Mbps
 - ▶ 100 Mbps
 - ▶ 1 Gbps
- ▶ Successful tested latency
 - ▶ 10 ms
 - ▶ 1 ms
 - ▶ 10 μ s



Project Timeline/Scheule

- ▶ Phase 1: Background Research and Project Familiarization
 - ▶ Meet with our advisor and ARA wireless team
 - ▶ Conduct background research
 - ▶ Find use-case scenarios
- ▶ Phase 2: Finalize Project Focus and Initial Testing
 - ▶ Finalize project focus
 - ▶ Begin using open-source code and prototyping
 - ▶ Developing test requirements
- ▶ Phase 3: Iterate and Refine the Application
 - ▶ Summarize current successes and failures
 - ▶ Define new goals and improve current applications
- ▶ Phase 4: Real-World User Review and Final Benchmarking
 - ▶ Conducting final testing and real-world uses review
 - ▶ Develop report and present project successes and findings

GANTT CHART

Application Exploration of 5G and Beyond Wireless Systems and Rural Broadband Project Schedule

TASK	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE/JULY
PHASE 1	█					
PHASE 2			█			
	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER	
PHASE 3	█					
PHASE 4			█			

Risks and Risk Mitigation

- ▶ 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.
Will mitigate time loss by performing research in advance and writing our code such that it can be adapted easily.
- ▶ 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 is being performed that would prevent us from performing tests.

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