



# Experimental Exploration of 5G-and-Beyond Wireless Systems and Rural Broadband

## Team SDMay24-23:

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## Client:

Dr. Hongwei Zhang

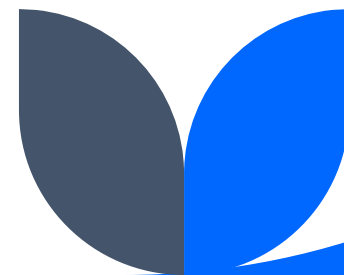
## Advisor:

Arsalan Ahmad



# Project Description (Brief)

- Constructed a learning platform using Sphinx and ReadTheDocs to teach future users about the fundamental concepts networking overall
- 6 Modules filled with wikipages covering specific topics, quizzes testing users, and step-by-step labs for an optimal learning experience.



# What is ARA?



- ARA – **A**griculture and **R**ural **C**ommunities
- At-Scale, Real—world experimental infrastructure for rural wireless and applications
- Part of NSF Platforms for Advanced Wireless Research(PAWR) program.
- Deployments scattered across Iowa State University campus, City of Ames, and surrounding research and producer farms as well as rural communities in central Iowa

# Project Showcase (Brief)

🏠 Experimental Exploration of 5G-and-Beyond Wireless Systems and Rural Broadband

Search docs

## MODULES

📖 Module 0: Introduction to 5G (© Copyright 2023, Zachary Miller, Adam Kruger, Danny Cao, Ethan Gabriel. Revision 23440036)

### 📖 Module 1: Modulation and Communication Techniques

📖 Understanding Modulation & Demodulation Techniques

Quiz 1: Modulation Techniques and Communication

📖 Lab 1: Modulation and Demodulation Techniques

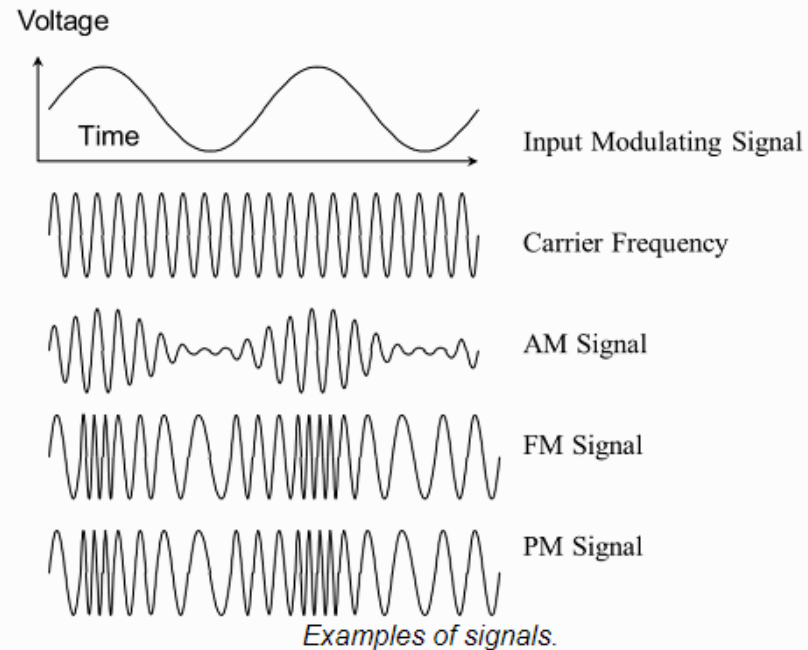
📖 OFDM: Principles and Implementation

📖 Frequency Hopping in Communication Systems

Quiz 2: OFDM: Principles and

## Analog Signal Limitations

In an analog communication system, repeaters can only amplify the signal and filter out noise components outside the expected frequency band. This process is similar to repeated recordings using analog media, where noise accumulates with each copy, degrading the quality over time.



# Testing

- Performed Unit Testing with SDR, USRP, OAI configurations, labs, and Github.
- Various Interface Testings performed such as Software-to-Hardware Interfaces, Software-to-Software Interface, and User Interface to Backend System Interface.
- Integration Testing with DR Software and USRP Hardware Integration, OAI integration with USRP, Lab Experiment Scripts with SDR/OAI Systems, Documentation Hosting on ReadTheDocs Integrated with GitHub
- System and Acceptance Testing by splitting our groups into 3, as we progressed we internally tested the quality of the materials
- Regression Testing by constantly checking there are no bugs or errors of previous materials when updating or making a change to a particular system.

# Conclusion

- First Semester we focused on researching 5G materials that was required for the ARA project.
- We constructed a prototype and continued to build off of this making various changes that were need using the Agile system during the second semester.
- Our team was able to take a complex request, conduct research, create a prototype, conduct testing, and build a final product that hit all requirements.