Senior Design Team 302:

Design/Prototype a Multi-Platform Broadband Communication Payload for a Search and Rescue Operation

Sponsor – Northrop Grumman

Introductions

Theodore Houck ~
Financial Advisor

Nicholas Crenshaw ~
Lead CPE

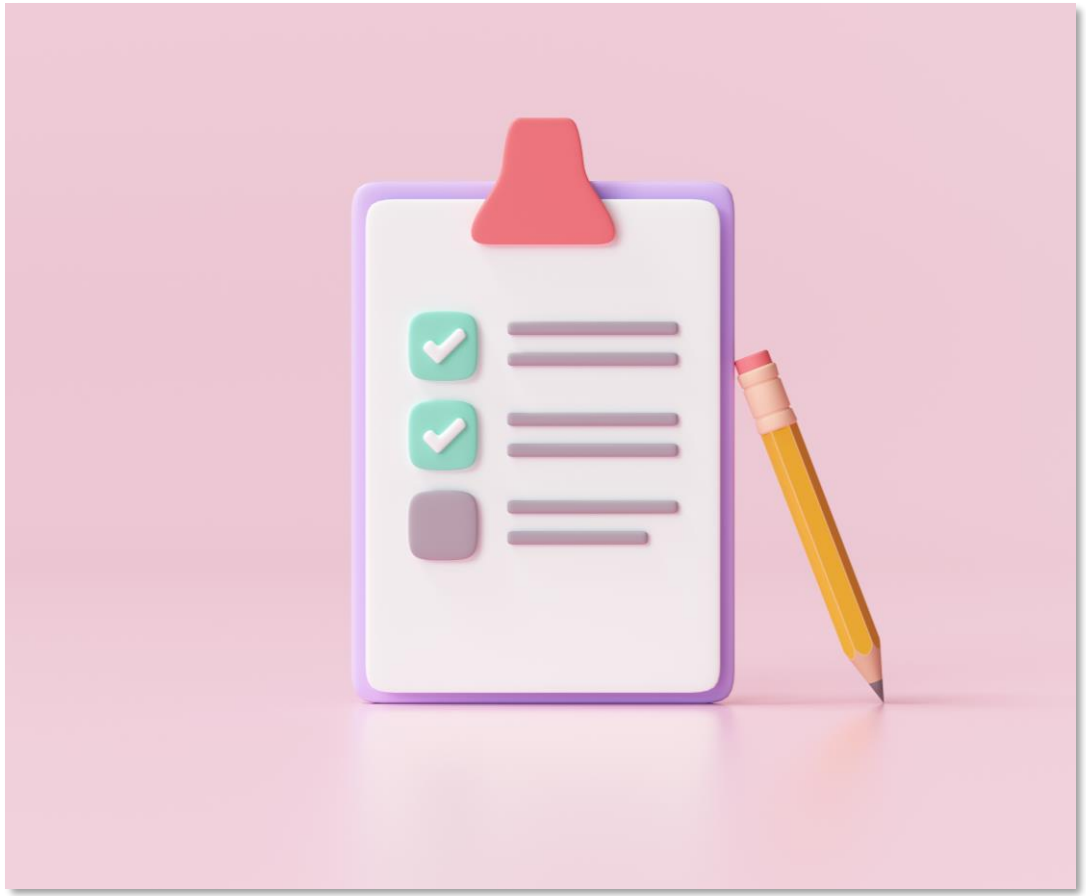
Jarrod Love ~
Lead EE

Matthew Brown ~
Team Leader

Sponsor Contact – Lin, Anny
Advisor – Dr. Arora

Outline

- Project Recap
- Preliminary Design
- Preliminary Results
- Where we are now

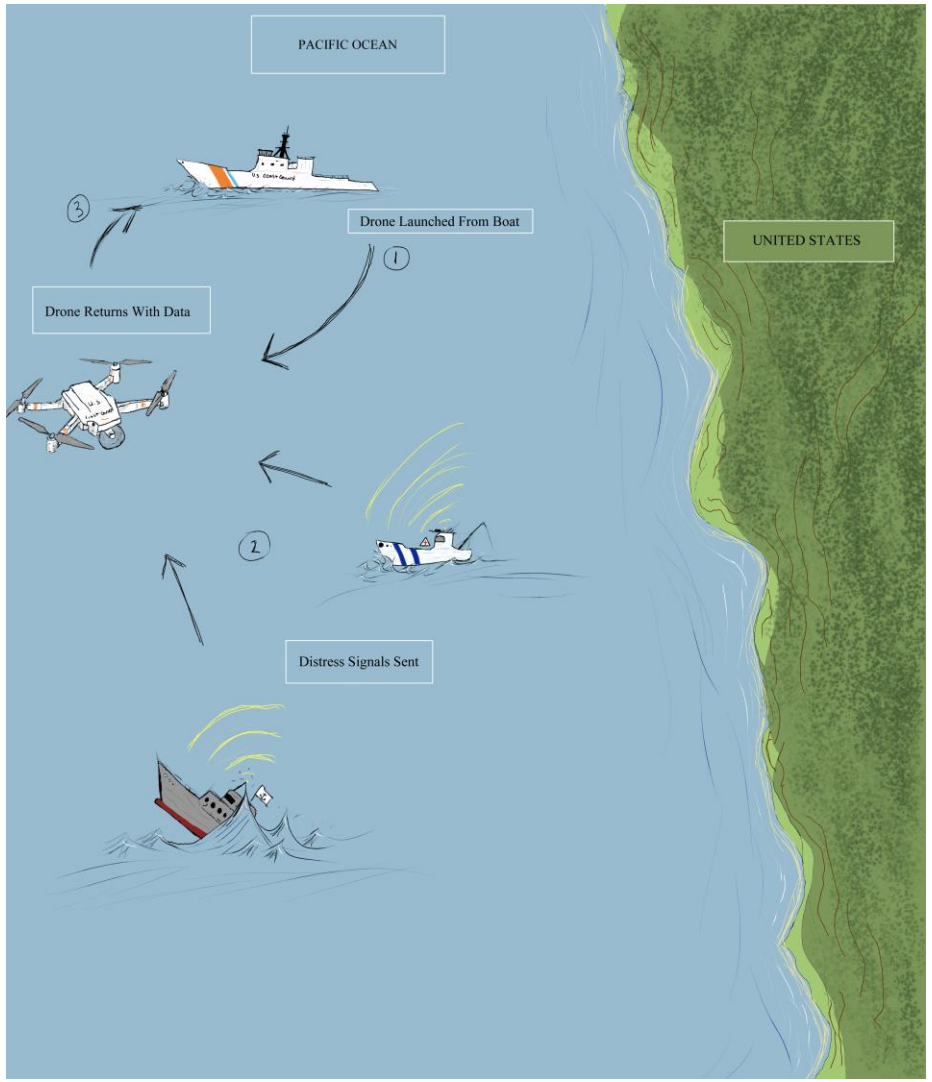


Presenter: Jarrod Love

Background of Project

- A natural disaster has occurred off the coast. Several ships have been severely damaged in such a way that they are unable to return to shore.

- These ships and yachts must be located so that search and rescue (SAR) operations such as emergency helicopters and lifeboats can be deployed to support stranded people and vessels.



Presenter: Jarrod Love

Scope of Project

Key Goals

1. Payload can detect emergency signals found in typical emergency radar beacon signal
2. Once detected a timestamp of the detection and current GPS location will be stored
3. The payload should be able to attach to a drone without majorly hindering the function of the drone

Assumptions

- Team will be given a data sheet/information about the drone
- Detection algorithm needed for payload is provided by sponsor and is feasible

Markets

- Primary Market - U.S. Coast Guard
- Secondary Market - Various emergency responders or U.S. Military

Stakeholders

- Northrop Grumman
- United States Coast Guard
- United States Military

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Parts

FPGA
Xilinx Zynq UltraScale+ MPSoC ZCU102

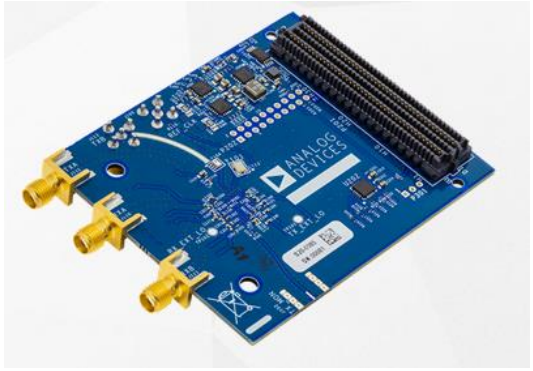
SD CARD
SanDisk 32GB Ultra SDHC UHS-I Memory Card - 120MB/s

Power Source
BatteryGuy 12V 220 mAh Alkaline Door Lock Battery

Antenna
VHF stout and long antenna SMA connector 147-160MHz

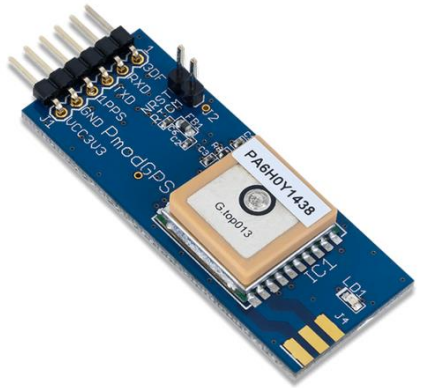
Presenter: Nicholas Crenshaw

Components



Transceiver
AD-FMCOMMS4-EBZ
Wideband Software Defined Radio Board

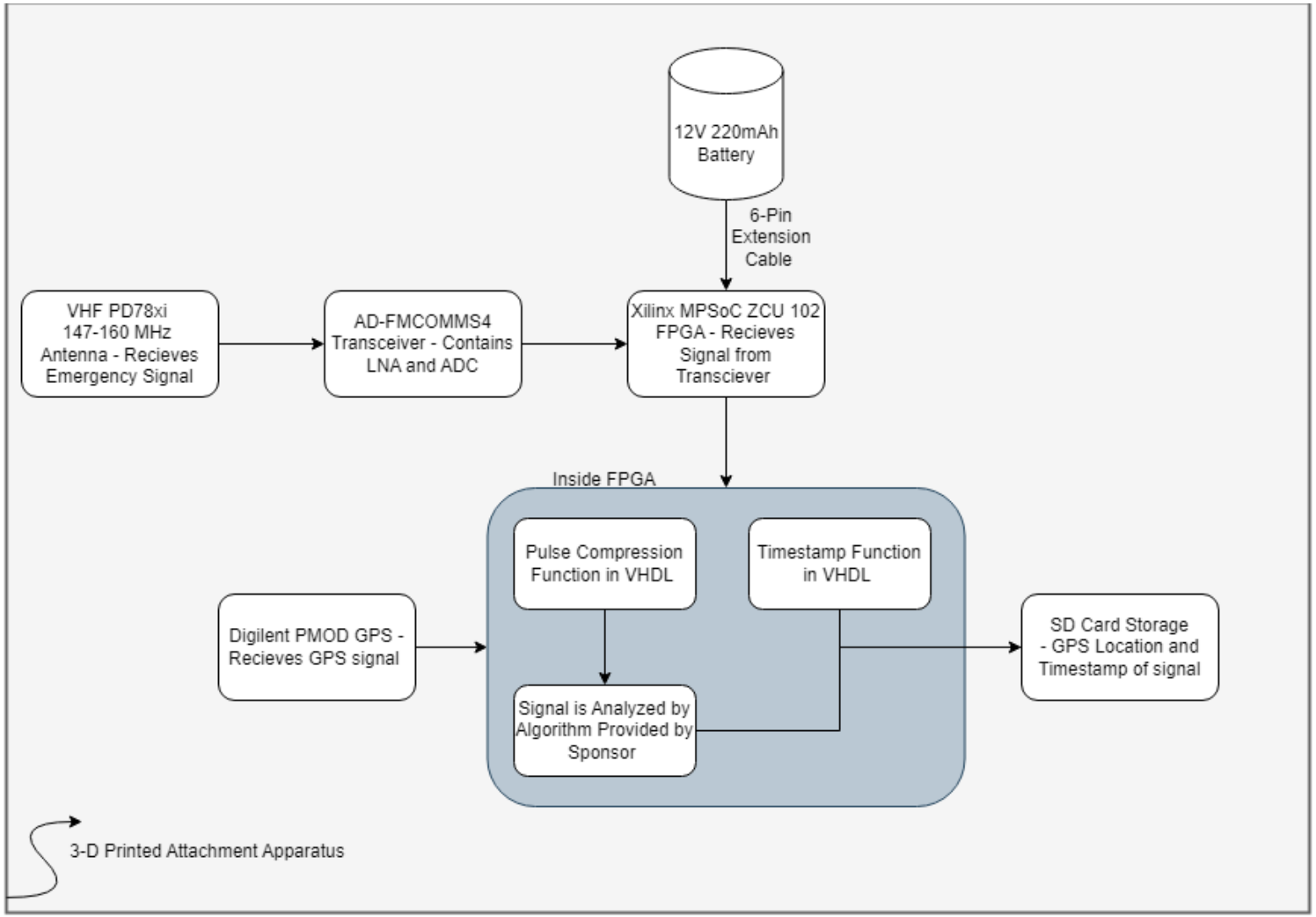
Battery Connectors
Cable Matters 2-Pack 6 Pin PCIe Extension Cable 10 Inches



PMOD GPS
Digilent GPS Receiver

Presenter: Nicholas Crenshaw

Preliminary Design Block Diagram



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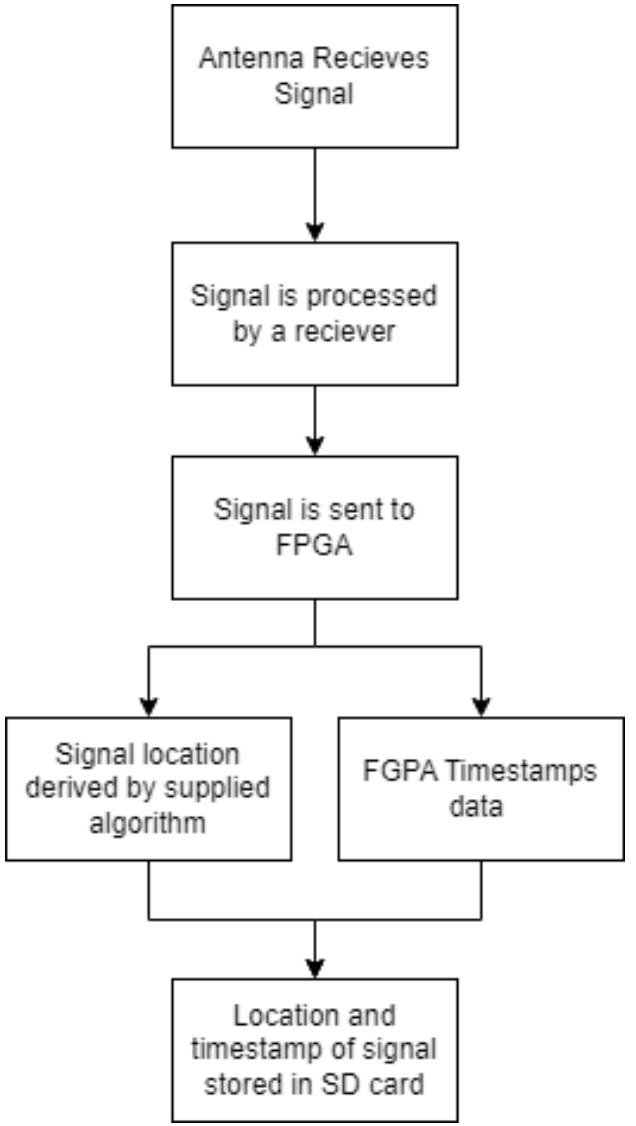
Planned Solution

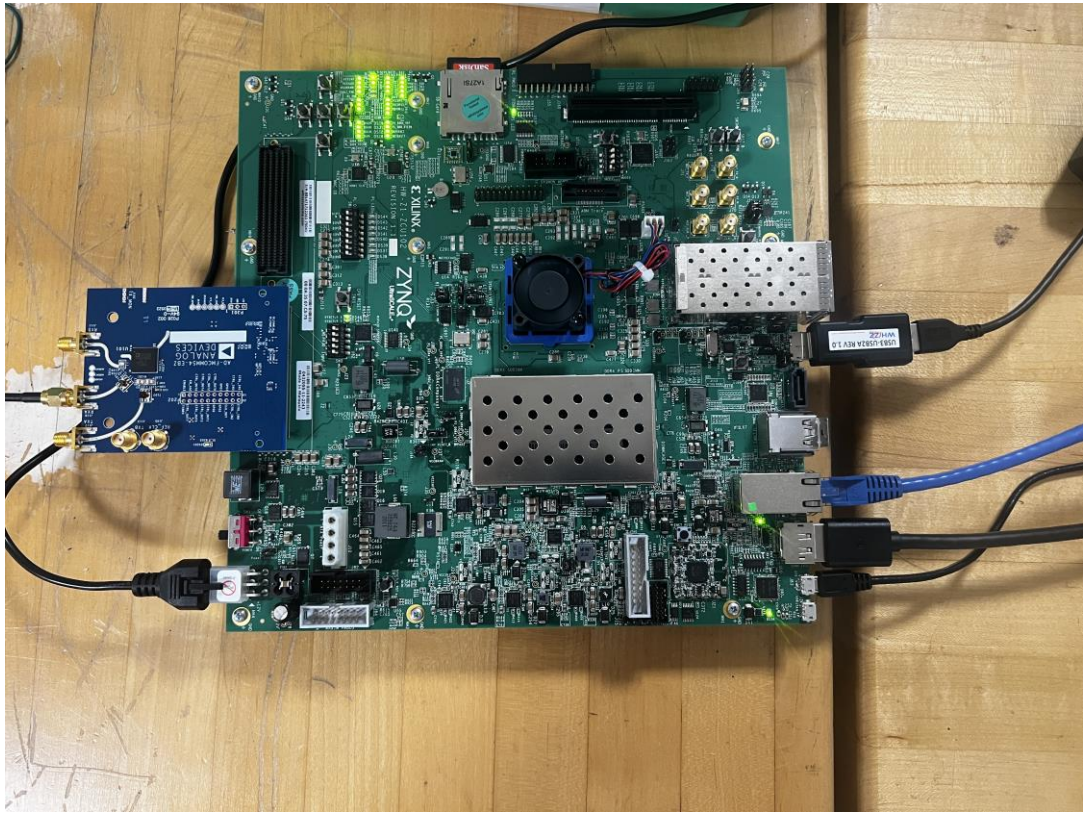
- This diagram follows the path of the signal
- Additional parts of the planned design solution are the following
  - Independent battery source
  - Payload container shall be water resistant



Presenter: Nicholas Crenshaw

Transceiver Module Progress

- Original idea was to plug into FPGA and code to it
- Documentation for the receiver do not say what pins are needed to program/read data to/from transceiver
  - FMC Connection (68 single-ended, 34 differential user-defined pair pins)
- The suggested method from the dealer is to setup up their local Linux environment on the FPGA



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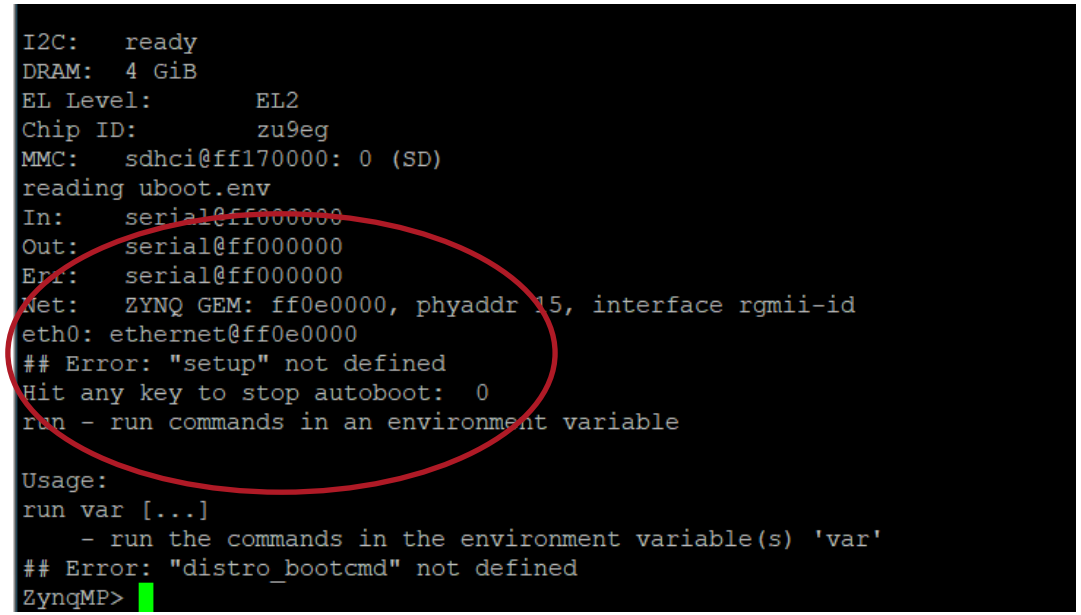
Transceiver Module Progress

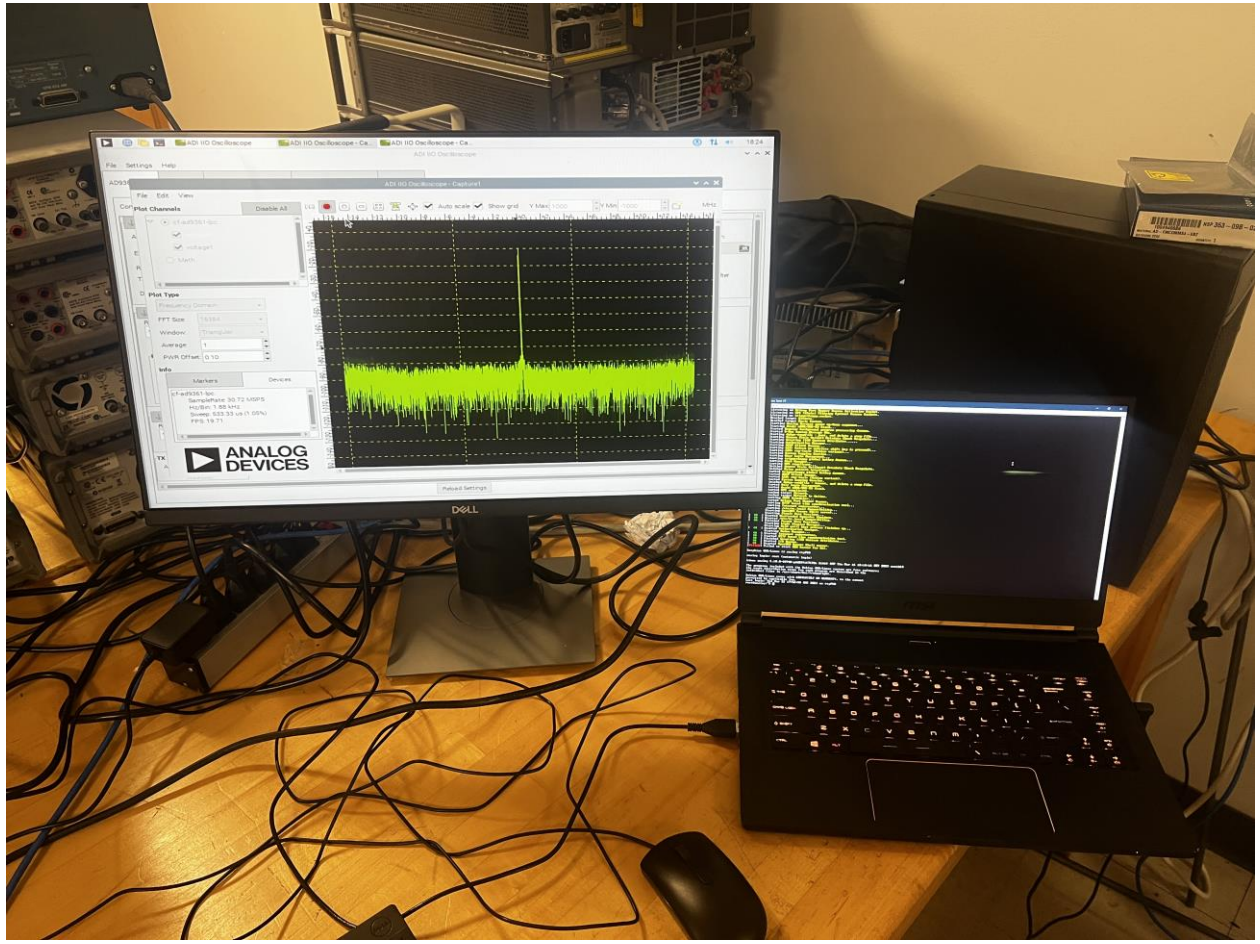
- Took approximately 1 month to setup the transceiver and this Linux environment
- Main issues:
  - Did not know how to connect to console UART on FPGA
  - Had no experience with setting up a Linux environment/image
  - Display was not working
  - Peripherals in device tree were setup incorrectly
  - Once environment was setup it was not detecting the transceiver



Presenter: Matthew Brown

Transceiver Module Progress

- **Total implementation of transceiver ~90%**
- Currently able to detect signals coming from the signal generator via a direct SMA cable
- Need to test antennas
- The current FPGA local Linux environment/program setup allows to change numerous settings on FPGA



Presenter: Matthew Brown

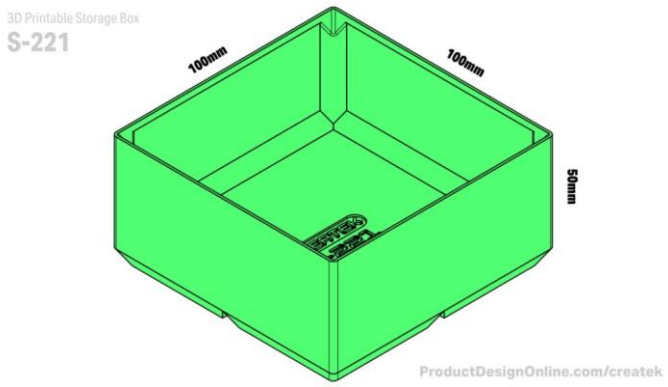
PMOD GPS Module Progress

- GPS Module was a recent addition
- Have not started implementing the PMOD GPS
- Focus was getting the transceiver to work the past couple of weeks

Presenter: Matthew Brown

Housing Progress

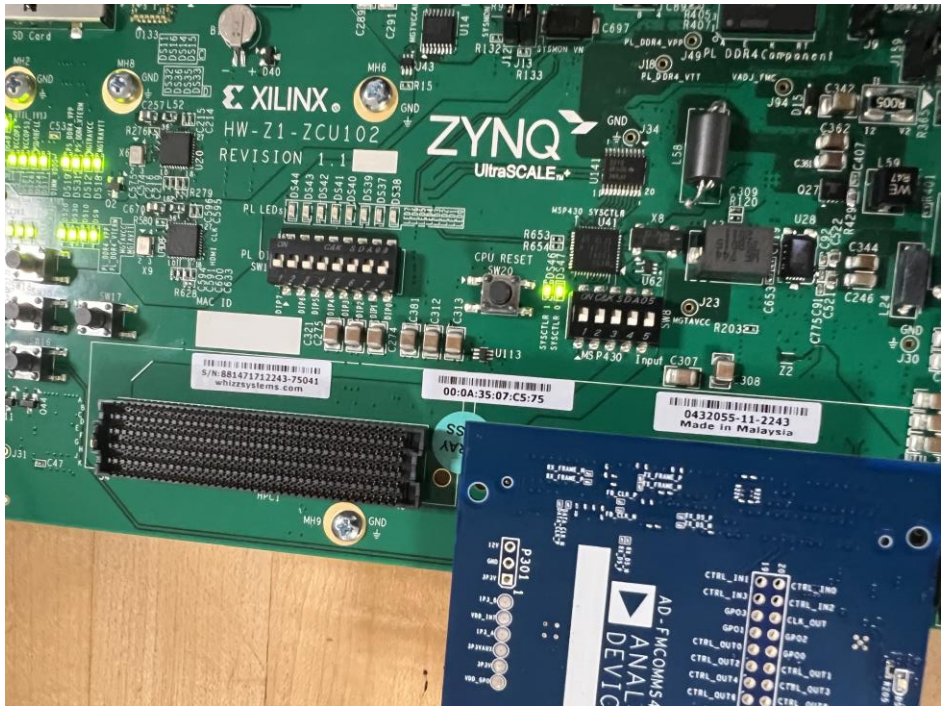
- The 3-D printed housing for the design is currently in production
- The design for said housing is completed
- Will be printed using FSU's provided 3D printers



Presenter: Theodore Houck

What's Next

- **Transceiver**
  - Setup grab data from DDR4 memory on FPGA using VHDL
  - Combine this with PMOD GPS time data for timestamping
- Test antennas attached to transceiver and a signal generator
- Test remote power source for FPGA
- Test housing design
- Calculate and test limits of design



Presenter: Theodore Houck

Summary

- The FPGA has been configured for operation with a working GUI interface.
- The transceiver has been configured to operate with the FPGA.
- Signals received by the payload can now be displayed and viewed. *However, this has only been achieved by direct connection, and signal detection from the antenna has yet to be established.
- The payload's housing is awaiting 3-D printing.

Presenter: Theodore Houck

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Thanks for Listening! Questions?