Communication Project

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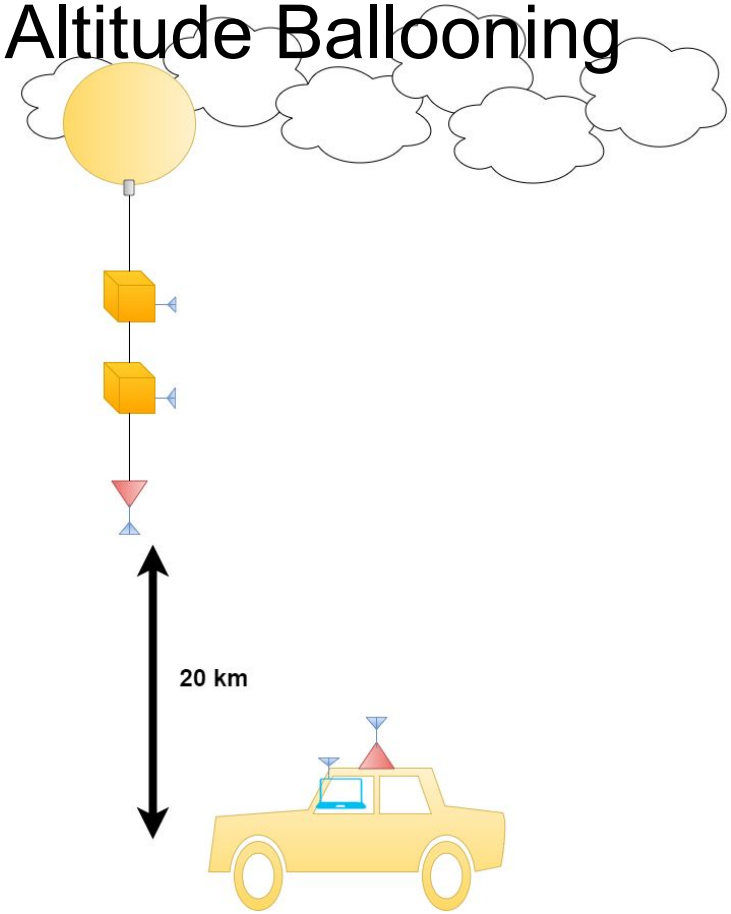
Overview of Presentation

- Background
- Goals
- System Block Diagram
- Implementation
- Testing
- Design Challenges
- Demonstration
- Questions

Background: Application in High Altitude Ballooning

- Long range to short range router concept
  - Xbee Series 2 Pro range: 300 ft
    - Package to package comm.
  - Xtend range: 50 km
    - Ground to balloon comm.
- Data transfer between balloon payload avionics and ground
- Develop project for later use in application consistent with MXL tech.
  - End application influenced part selection
  - Verify new design
- EECS 330 application: Walkie-Talkies



Background: Physical Principles

Sampling Theorem:

- Typical adult human voice range is roughly 300 Hz to 3400 Hz
- Peaks and jitters in voice can cause variation in frequency
- Ideally sample at 20 kHz to catch finer elements of voice

Digital Communications: UART

- Send/Receive single samples (1 byte)
- Goal was half duplex form (taking turns transmitting and receiving)

Using Friis Transmission Equation:

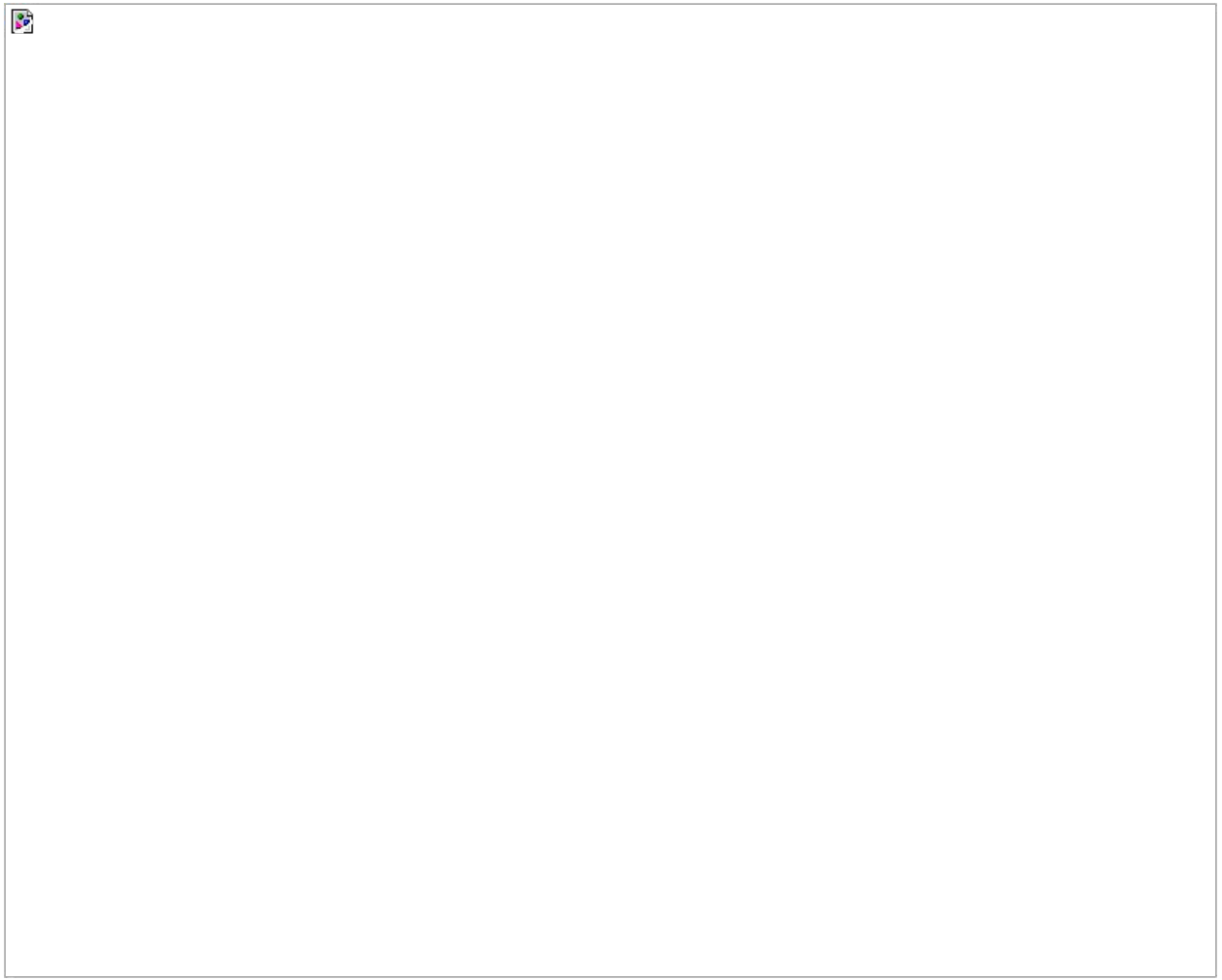
$$P_{rec}/P_t = G_{rec}G_t(\lambda/(4\pi R))^2$$

- P_t= 63 mW (From XBee Spec)
- P_{rec} (min) = 0.0794 pW (Xbee Spec)
- ¼ Wave Monopole (ξ=0.998)
- P_{rec} = 806 nW
- R_{max} = 1.27 km (Theoretical)
- No issues for use inside a room

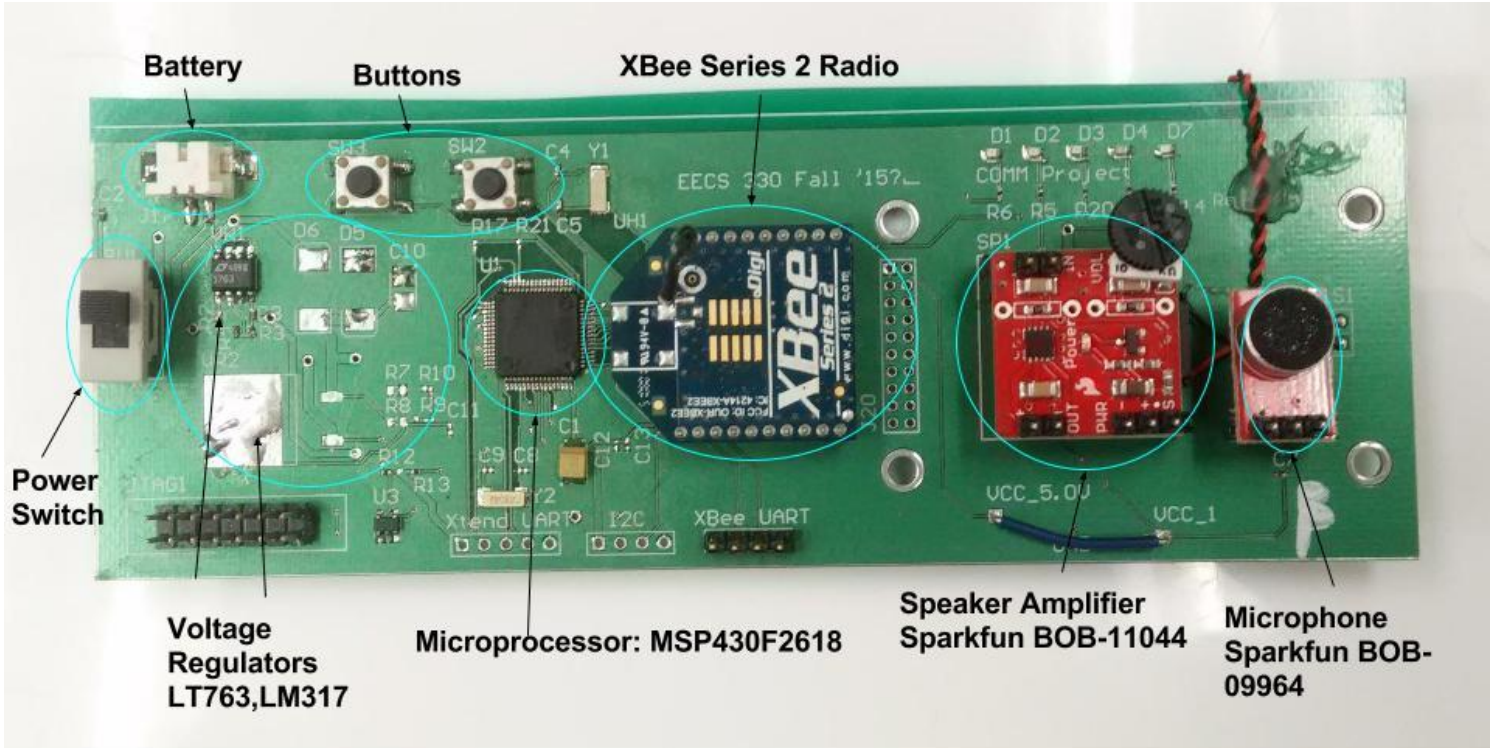
Goals: Functional Walkie Talkies

- Verify short-long range router prototype as walkie talkies
  - Conform to commonly used parts from MXL
- Sample and transmit voice with Xbee Radios
- Implement as an embedded system with PCB
  - Design a PCB for a contained system
- Low cost and reliable system

System Block Diagram



Implementation



Testing

- Hooked up input and output to an oscilloscope to determine if data was going through.
- Microphone worked well, input showed varying frequency when spoken into.
- When IO is connected on the same board, perfect signal matching of the DAC and microphone input.
- Packets of XBee data analyzed and verified to be sound.
- DAC of receiving XBee matches input microphone on other board.
- Full system test.

Design Challenges

- Design flaws in circuit board made fabrication difficult
  - Ground plane too close to other components, excess solder can cause short circuits.
  - Almost all footprints were incorrect size, 0402 not 0603
- Sampled components were not correct, causing fabrication issues
- Issues with two way communication
  - Data is good on receiving side, most likely problem with speaker amplifier.
- Debugging the code for the microprocessor took a substantial amount of time and effort.
- Able to distinguish different frequencies transmitted through the microphone, but voice isn’t great quality.
- If we had more time, some of these issues may be resolvable.

Demonstration

Questions?