

Bluetooth Music Streaming

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Outline

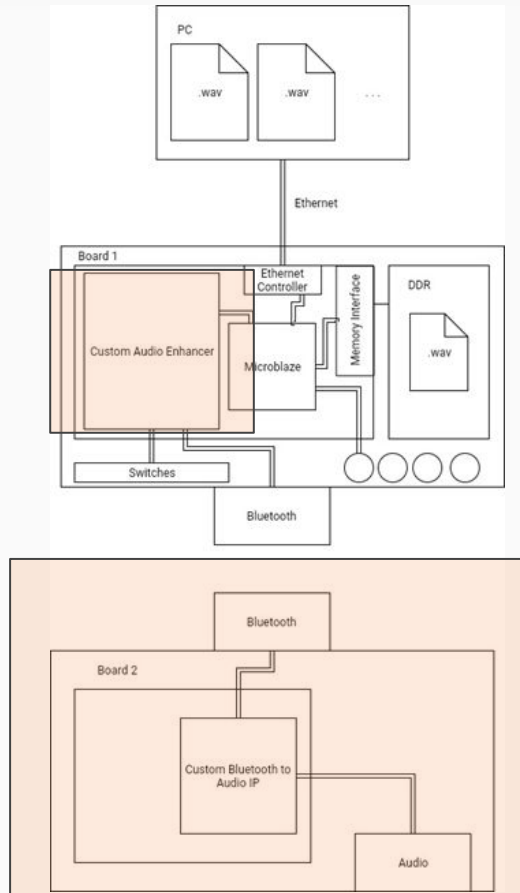
- Goals
- Overview
- Final Results
- Team members:
 - Farhad: IP Blocks
 - Ruben: Network
 - Pranali: Bluetooth
- Design Process
- Lessons Learned

Goals

- **Motivation:** Spotify, Apple AirPods, SONOS
- Interconnected music streaming system
 - Ethernet
 - Bluetooth
- Novel audio enhancers



System Overview



Iteration 1

Iteration 2



System Overview: Iterations

- **Iteration 1:** Use two FPGAs, play out music on second
- **Iteration 2:** Use phone instead of second FPGA
- **Iteration 3:** Use computer in place of second phone

Final Results

- System consists of single FPGA, computer to represent server and a computer to represent speakers
- Streaming music through Bluetooth proved to be too slow
 - Bluetooth ultimately used to control pause/play

Final Results

- End to end system works
- Bluetooth controls pause/play functionality
- DDR used as cache
- Unable to integrate custom audio enhancer into system
- Tested and verified the enhancer separately
- Validated with Matlab implementation

Team Member: Pranali

Role:

- Bluetooth Module
- Android App with Interrupts
- Integration

Challenges:

- Integrating Android app with the interrupts of the other system.

Design Methodology:

- Basic test cases
- Building off of example modules

Team Member: Ruben

Role:

- Ethernet
- DDR2
- Bluetooth Integration

Challenges:

- Unreliable Bluetooth

Design Methodology:

- Python tests
- lwIP Raw API

Team Member: Farhad

Role:

- Echo Filter
- Chorus Filter
- Integration

Design Methodology:

- Verify basic behaviour using testbenches
- Compare against MATLAB

Challenges:

- Integration proved to be more complicated than expected
- Tried multicore system and DMA
- Created proof of concept of multicore
 - Unable to integrate into the larger system

Design Process (Team Management)

- Regular Meetings
- Design Planning
 - Status updates
 - Discuss next steps
- Modular tasks
 - Each person was an “expert” on a specific topic
 - Helped prevent road blocks

Design Process (Design Planning)

- **First:**
 - Designed the over-all architecture
 - Discussed required resources
- **Second:**
 - Delegate tasks/fields of research
 - Complete modular tasks
- **Third:**
 - Integrate modular tasks into one system

Lessons Learned

- Continuous integration is easier than one large integration
- More knowledge share between teammates
 - Especially when connecting different parts