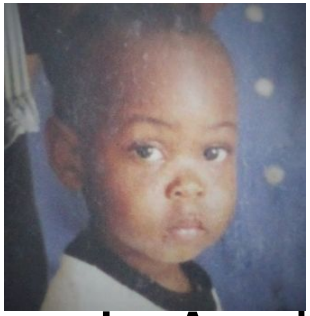
Preliminary Design Review

Sync-In
October 23, 2015

Sync-In

Ajwad Alam
EE

Joseph Bellve
EE



Levis Agaba
CSE

Carl Senecal
CSE

Problem

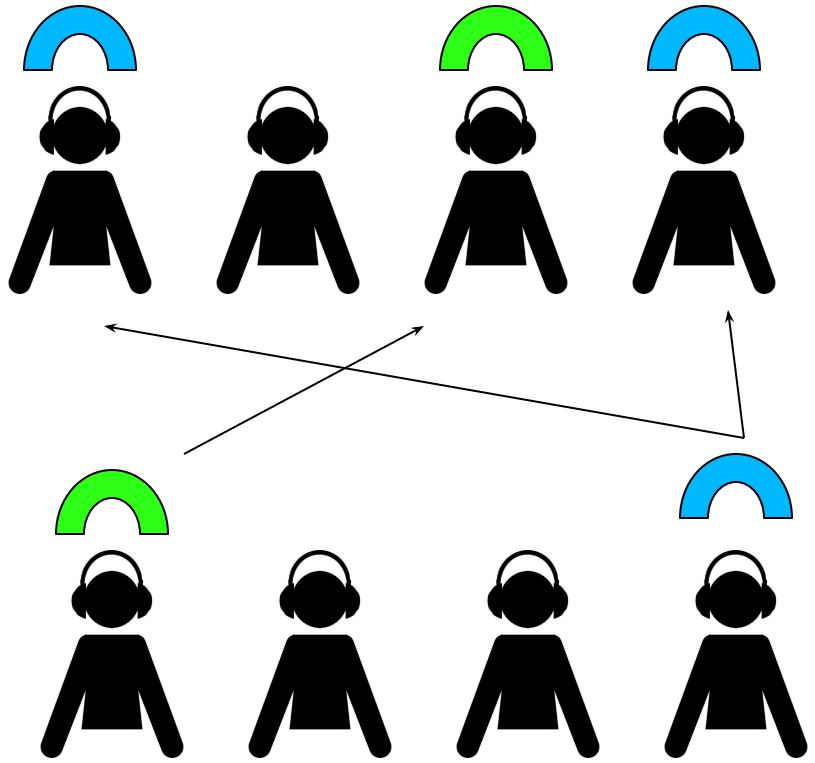
- Prevalence of isolation in public spaces
- "Social Disengagement on the Greyhound Bus" study: Uncertainty about strangers encourages nonsocial behavior[1]
- Research demonstrates link between perceived social isolation and mortality risk[2]

Our Solution

- Bring people together through music
- Allow headphone users to broadcast music to one another
- Indicators on the device help users identify one another and encourage face-to-face interaction
- Additional features to block out background noise and maximize connectedness and quality of experience

Our Solution

- Standard audio jack accepts any input source
- Broadcast button to allow others to listen
- Scan button to find other broadcasters
- Volume control
- Colored lights on unit identify users on the same channel



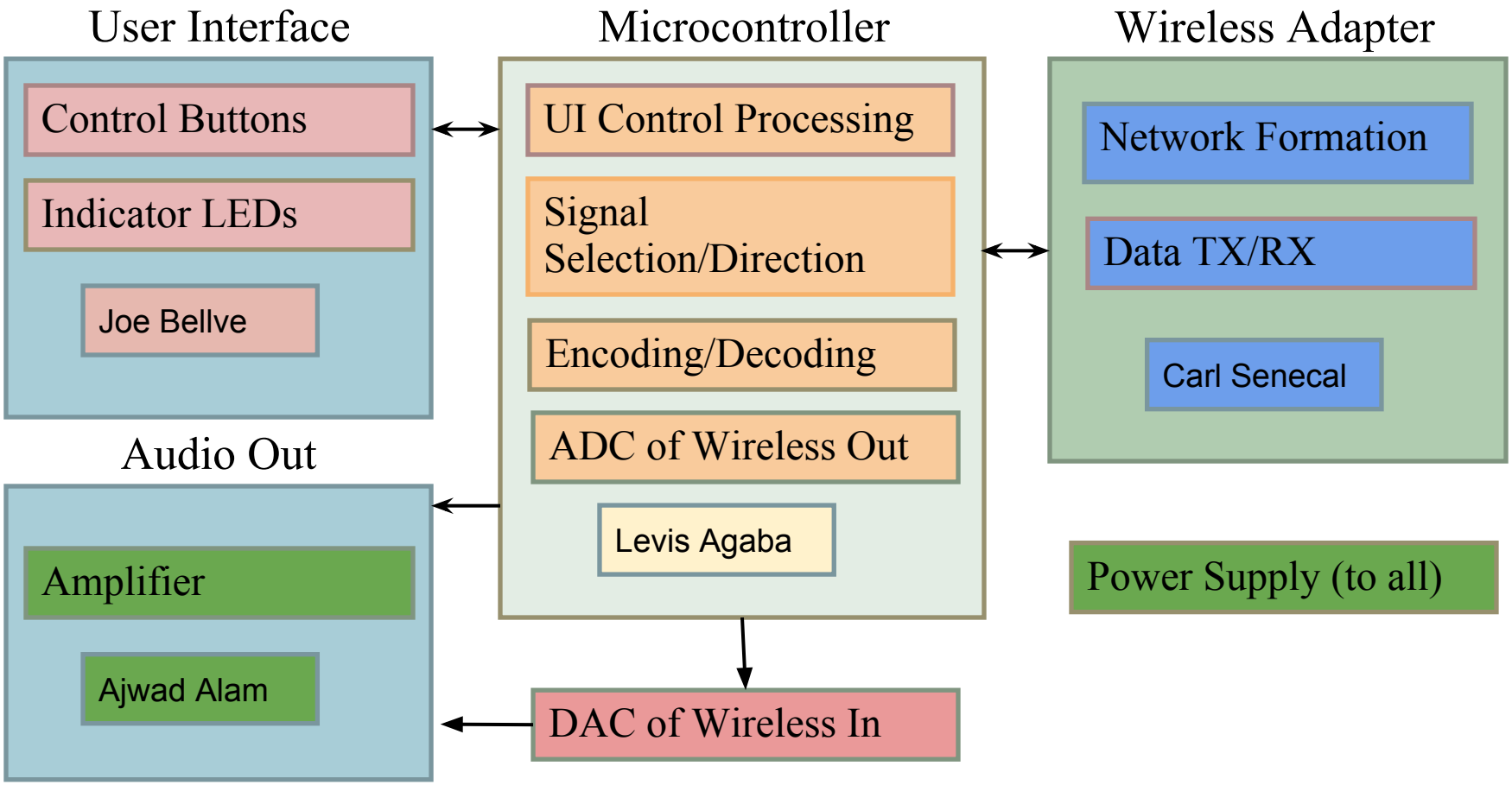
Requirements

Portability	▪ Everything including control and transmission units and battery must be contained inside a normal over-the-ear style headset
Ease of Use	▪ Clear controls ▪ Clear indicators
Battery	▪ At least 4 hours of charge ▪ Rechargeable via a standard connector (micro USB)
Noise cancellation	▪ Filter out background noise ▪ <500 Hz and >4 kHz selects for human voice

Requirements

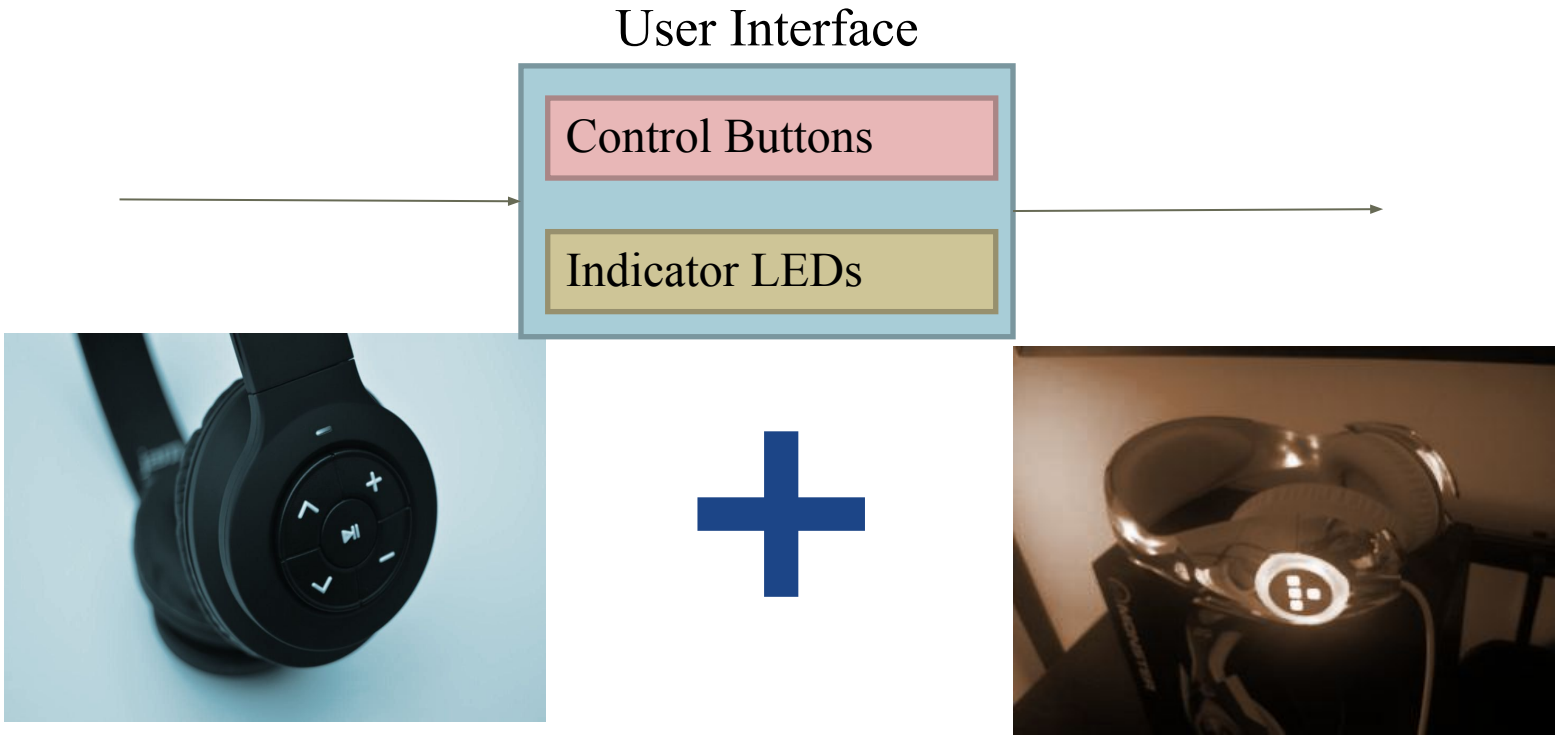
Streaming Quality	▪ Minimum 128 kbps audio quality ▪ No noticeable drops/stuttering in playback ▪ Near-synchronous listening
Concurrent Use	▪ Minimum 3 users ▪ Ideally 10-30 users for larger public spaces
Range	▪ 100 foot radius for use on public transit
Network Operation	▪ No need for Internet connection ▪ Standard legal frequency
Cost	▪ Must be affordable to reach widest audience ▪ ~$100 per unit

Our Solution: Block Diagram

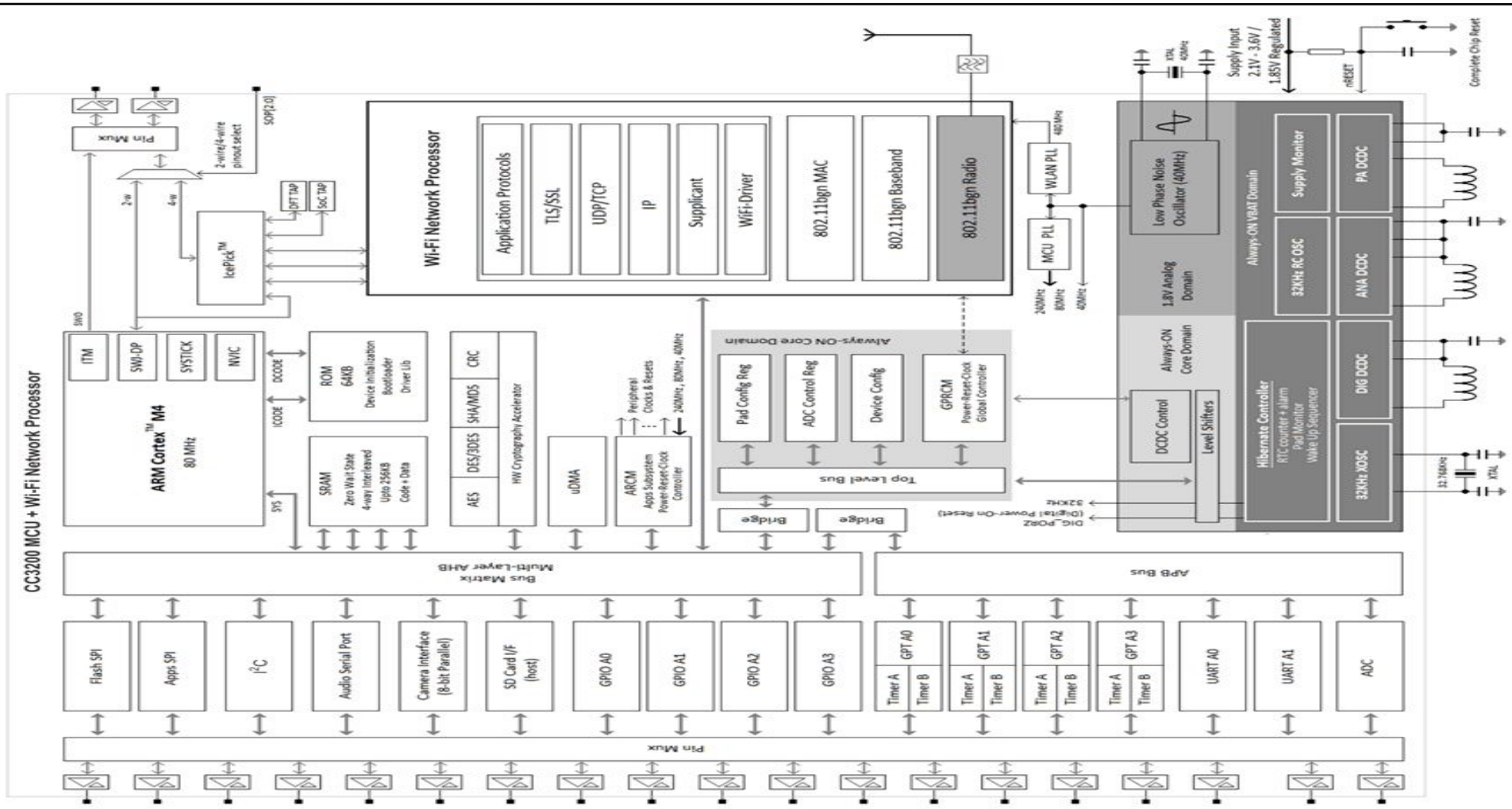


User Interface

- The user Interface allows the listener to have a great deal customization of their listening experience.



Microcontroller (signal processing)



Wireless (communication)

Device states:

- Not advertising, no listeners
- Advertising, no listeners
- Broadcasting to one or more listeners
- Searching for advertisers and broadcasters

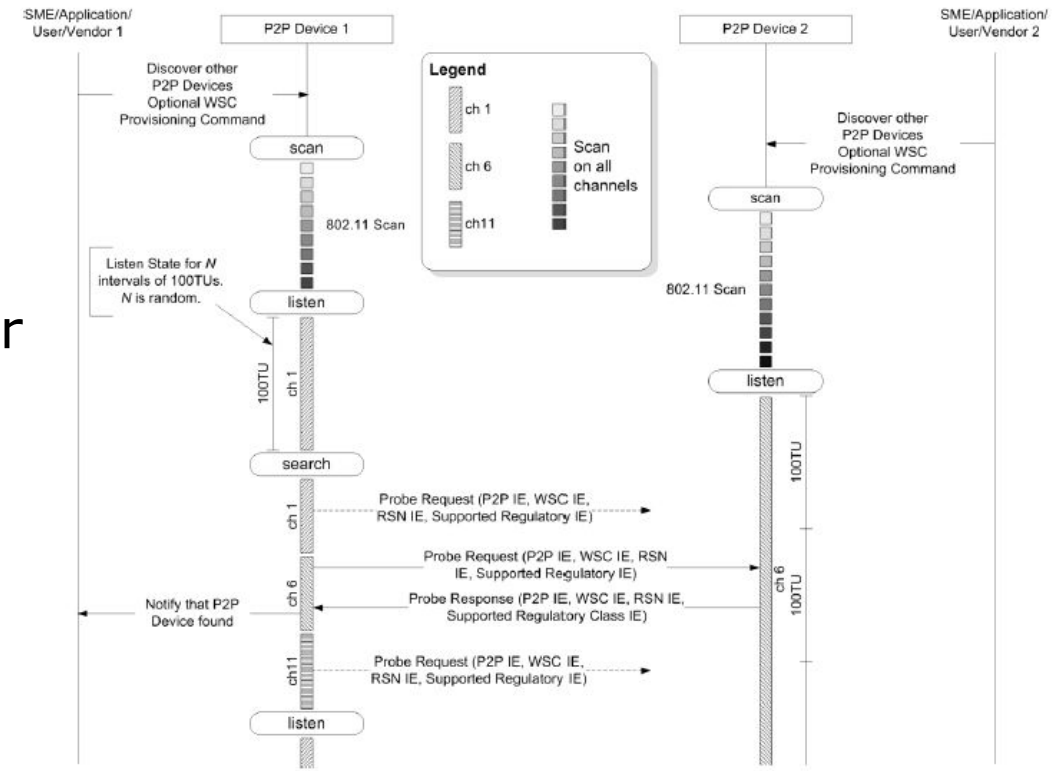
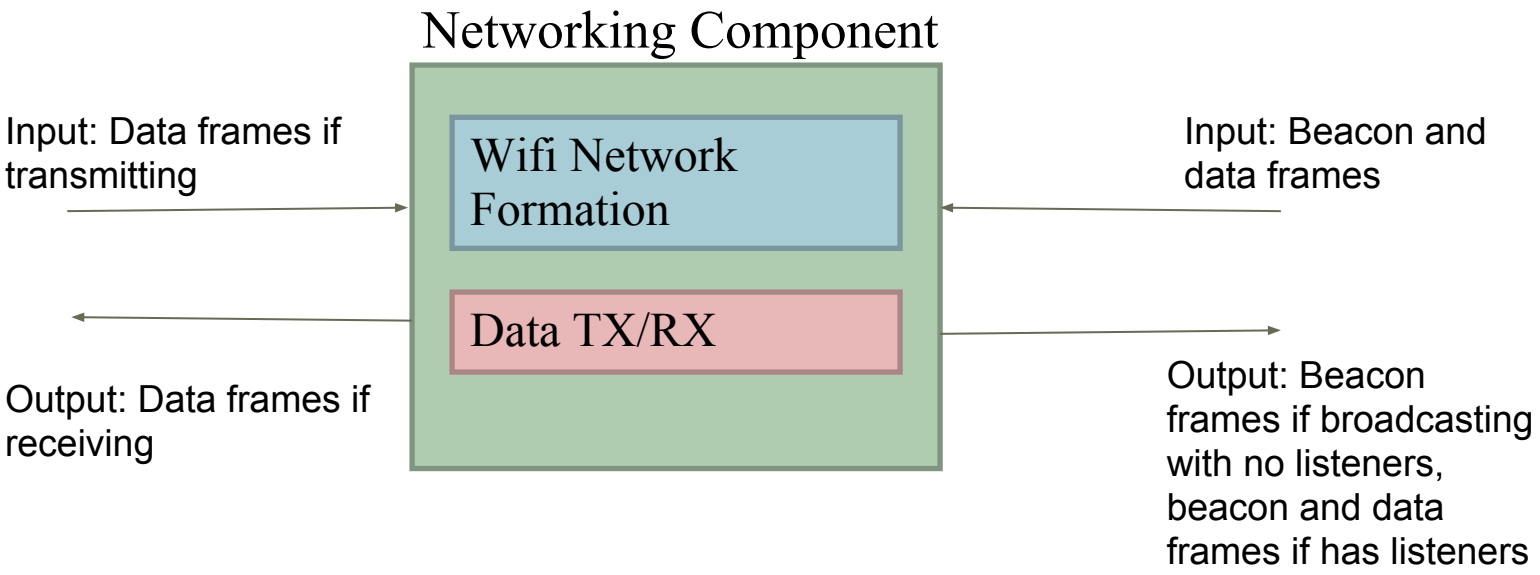


Figure 4—Example In-band Device Discovery procedures for a P2P Device

Wireless (communication)

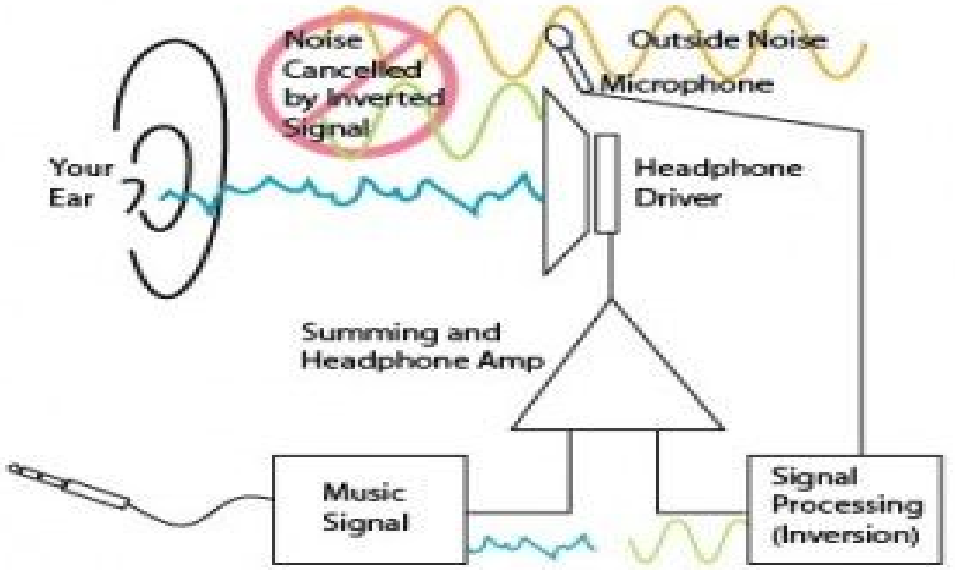


Noise cancellation (Active)

- Noise Cancellation is to specifically target low frequency noise that is common in public areas.
- To give the listeners a better listening experience
- To achieve this we take the noise signal and produce an equal magnitude and antiphase signal and play it through the speakers

Noise Cancellation

- Microphone
- Low Pass Filters
- Antiphase Signal Generation



Amplifier

An internal amplifier is essential for the following reasons:

- Over-ear speakers instead of earbuds (larger drivers, higher impedance)

- Analog signal from DAC/headphone jack cannot drive speakers alone

⟶ Takes in analog signal from MCU as input
⟶ Output is fed to summer circuit

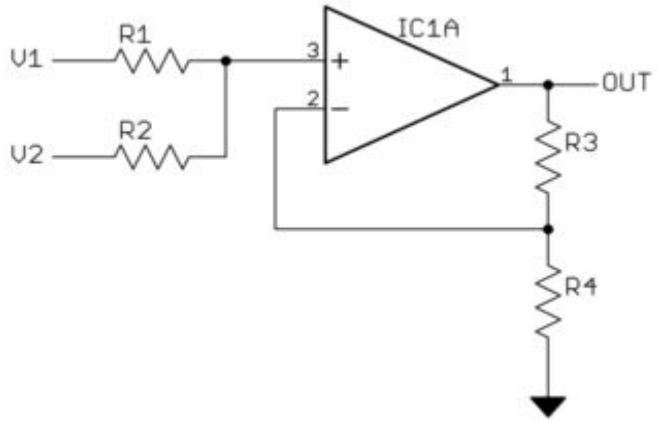
⟶ Gain will be set according to the speaker we pick for our headphones

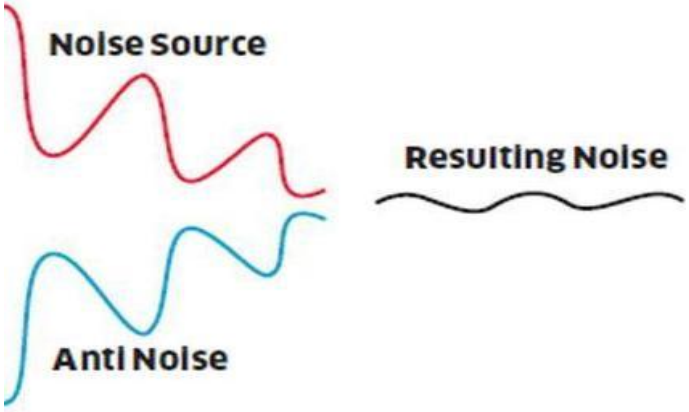
Non Inverting Summer circuit

- Takes two inputs:
  i) Output from NC circuit
  ii) Boosted signal from amplifier

- Output from non inverting summer circuit is used directly to drive headphone drivers

- Antiphase ambient noise present in output cancels ambient noise in the background





Cost Analysis

parts	quantity	shipping costs	price	price for 3
cc3200 wireless mcu	2	6.25	36	
rechargeable batteries	3	6.25	29.7	
monoprice headphones	3	6.25	53.94	
resistors	10	0	0	
capacitors	10	0	0	
potentiometers	3	0	0	
opamp	2	0	0	
12vdc omni direct microphones	4	6.25	4.356	
totals	37	25	123.966	

Design Alternatives

- Some design alternatives are bluetooth instead of Wifi
- The advantage of bluetooth is power but the drawbacks are in range and bandwidth
- Single Wifi network vs. multiple smaller networks
- External ADC
- App

MDR deliverables

- 2 “working” prototypes: One will broadcast while the other will receive.
- Working DAC, amplifier, and volume control knob.

Constraints/Goals:

- <5 second asynchronicity
- >80% uninterrupted playback

Timeline

Friday November 6th

- Working amplifier and volume control knob.

Friday November 13th

- Functioning DAC integration

Friday November 21st

- Be able to broadcast and receive small audio samples between two devices.

Some next date

research noise cancellation

January?

start noise cancellation?

Thank You

Questions?

Citations

Aarti Singh, NSIT, “Adaptive Noise Cancellation”
www.cs.cmu.edu/~aarti/pubs/ANC.pdf