Comprehensive Design Review

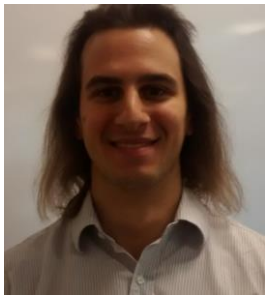
Sync-In
March 4, 2015

Sync-In

Ajwad Alam, EE
Amplifier/Power

Joseph Bellve, EE
ADC

Levis Agaba, CSE
DAC



Carl Senecal, CSE
Networking/Integration

Agenda

- Review of Project
- CDR Deliverables
- Demo
- FDR Deliverables

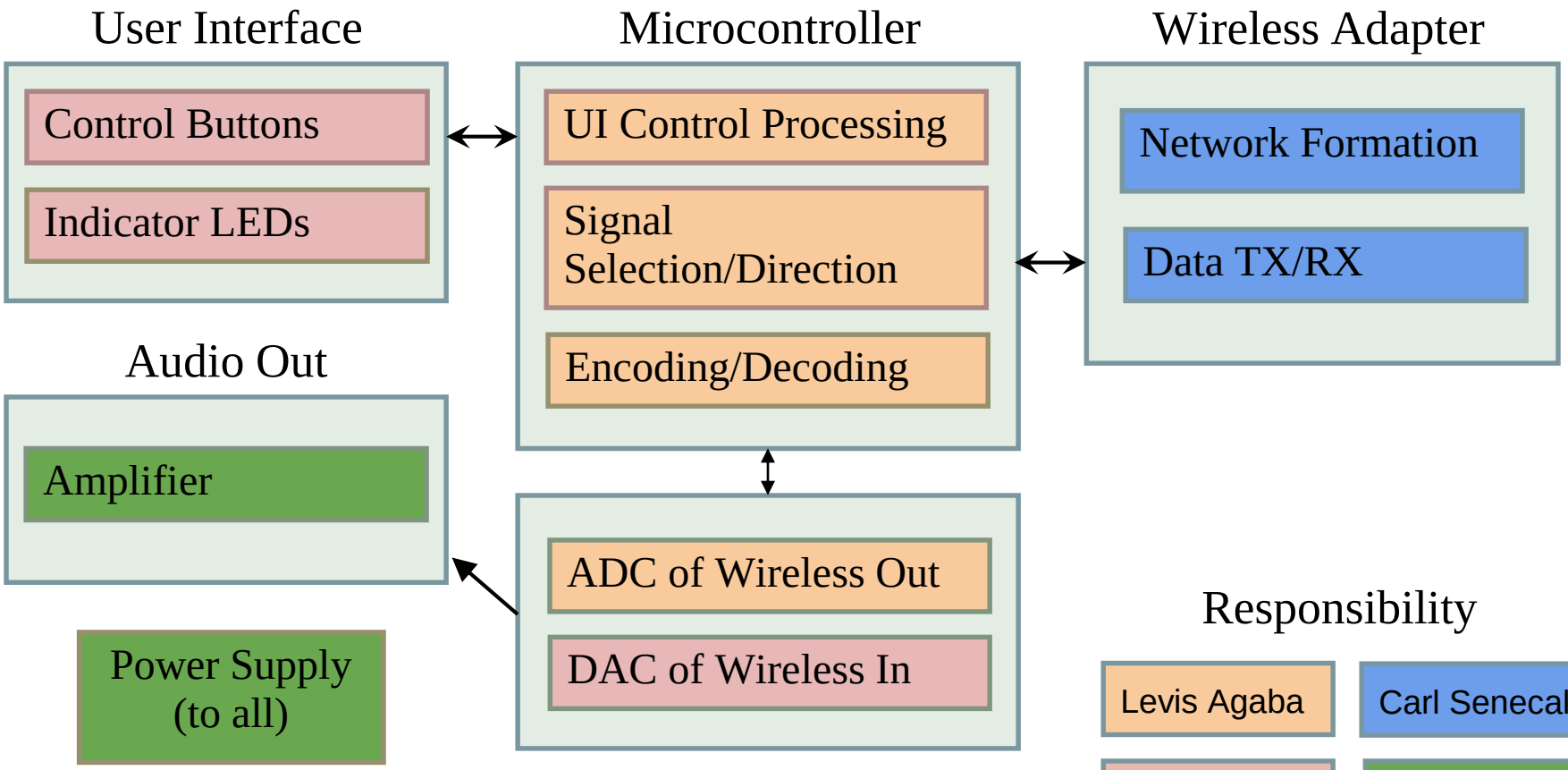
Sync-In Overview

- Broadcast audio from one set of headphones to many in a local area via WiFi
- Independent of Internet connection or phone data plan
- Various applications
- Social – Bring together strangers in unfamiliar situations through music
- Conferences/Events – Broadcast translations in multiple languages

Important Specifications

Ease of Use	▪ Clear controls and indicators
Size	▪ Small enough to fit in headphone enclosure
Power	▪ Use as little power as possible; ideally 4-8 hours of battery life
Network	▪ Free WiFi network (no need for ISP or data plan)
Concurrent users	▪ Minimum 3 users (one broadcaster, two listeners)
Streaming Quality	▪ Minimum 192 kbps audio quality ▪ No noticeable drops/stuttering in playback ▪ Near-synchronous listening
Range	▪ 100 foot radius

Block Diagram



MDR Review

- Demonstration of audio amplifier
  - LM2662 switch capacitor voltage converter
  - Single channel only
- Demonstration of communication between two boards
  - Ability to switch between transmit and receive modes of operation
  - Sending of empty packets only
  - No audio playback or transmission

CDR Deliverables

Deliverable	Responsible	Achieved	Remaining
Audio Tx/Rx	Carl	Yes	Improve playback quality
Base Station Scanning and Switching	Carl	Yes	Nothing
Multi-person Groups	Carl	No	Find alternate solution in software or hardware
Convert analog input to digital	Joe	Yes	Improve audio quality
Convert digital input to analog	Levis	Yes	None
Power supply to all subsystems	AJ	Incomplete	Determine correct cc3200 battery power configuration

Subsystem 1: User Interface

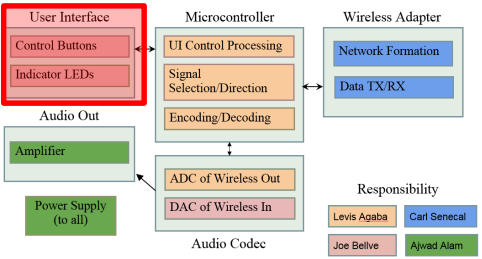
- Currently reduced to two buttons

  - Scan to switch between available channels

  - Broadcast/Idle to switch between broadcasting audio and solely listening to one's own audio

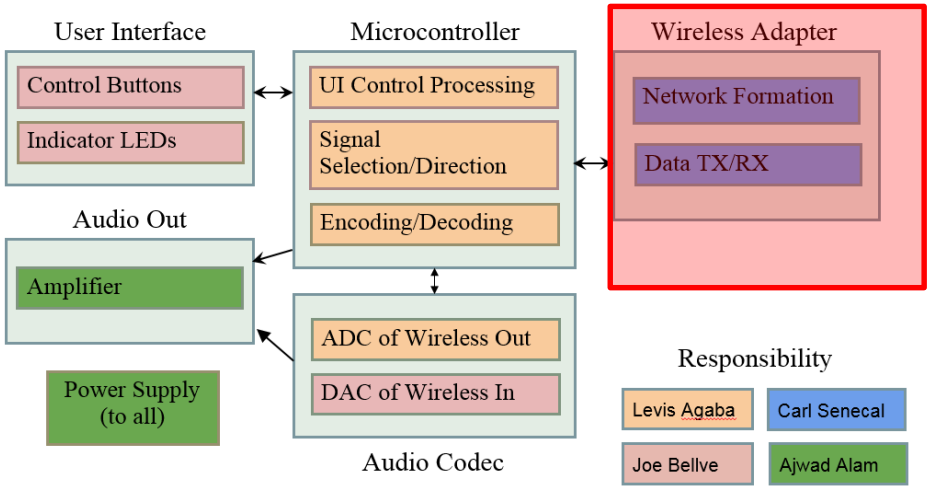
- LEDs to indicate status

- Interaction with the main control code through interrupts and interrupt handlers



Subsystem 2: Networking

- Boards can now transmit, receive, and play back audio data
- Boards can cycle through listening to all actively broadcasting boards that are within range



Subsystem 2: Networking

- Challenges: API Limitations and Transmission Rates
- Broadcasting

  - API does not allow for more than one client to connect to soft AP at a time

  - Possibility of circumventing limitations with IP address trickery

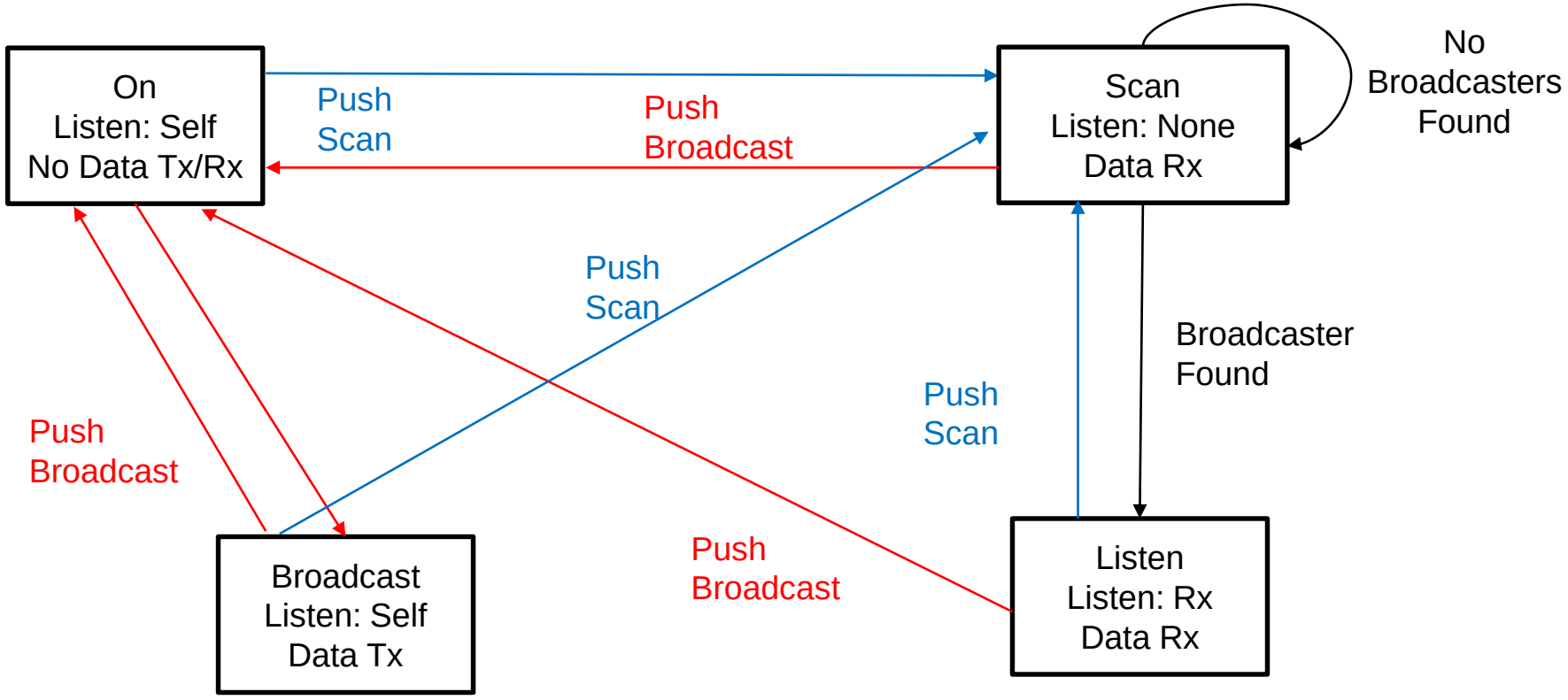
  - New hardware may be used to avoid this problem if time allows

- Transmission Rates

  - Multiple threads on single core processor leads to blocked processes

  - Playback thread receives insufficient running time when also broadcasting

State Diagram



Code

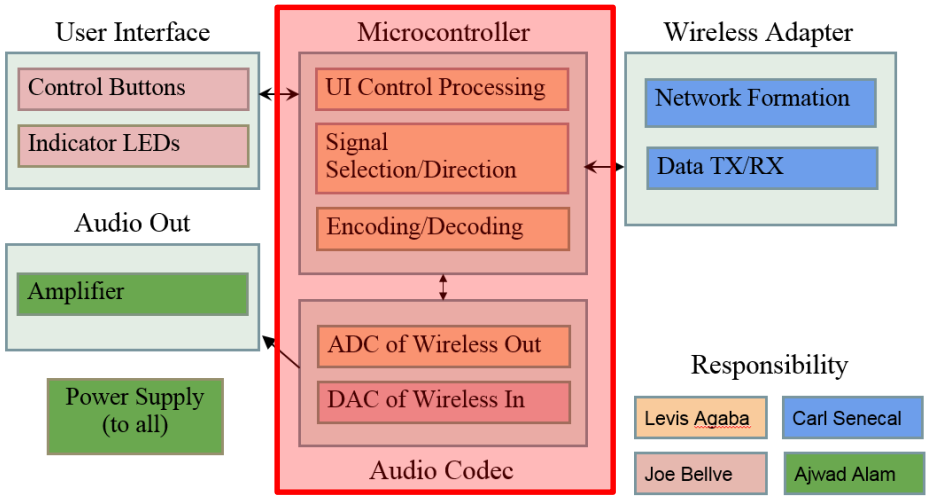
- System Thread — Monitors for network events
- I/O Event Thread — Watches for and processes button presses
- Audio In Thread — Depending on state, forwards line in to a socket, places line in in the play buffer, or does nothing
- Audio Out Thread — Depending on state, listens for audio data on a socket and places that data in the playback buffer or does nothing
- Networking Thread — Configures board in Access Point or Station mode and handles network connection events

Code Flow

- Initialization: Board Setup, Pin Setup, UART Setup, Thread Creation (System, I/O Event, Audio In, Audio Out), Thread Launch
- Board loops back audio until a button is pressed
- Button Handler starts AP or STATION thread and sets flags for use by the Audio In and Audio Out threads according to a state machine
- AP/STATION thread configures soft AP with SSID, key, operating channel, transmission strength, connection policy, handles connection to AP, assigns IP addresses, creates socket for Audio Tx/RX, handles all network events like device connection and disconnection

Subsystem 3: MCU/Signal Processing

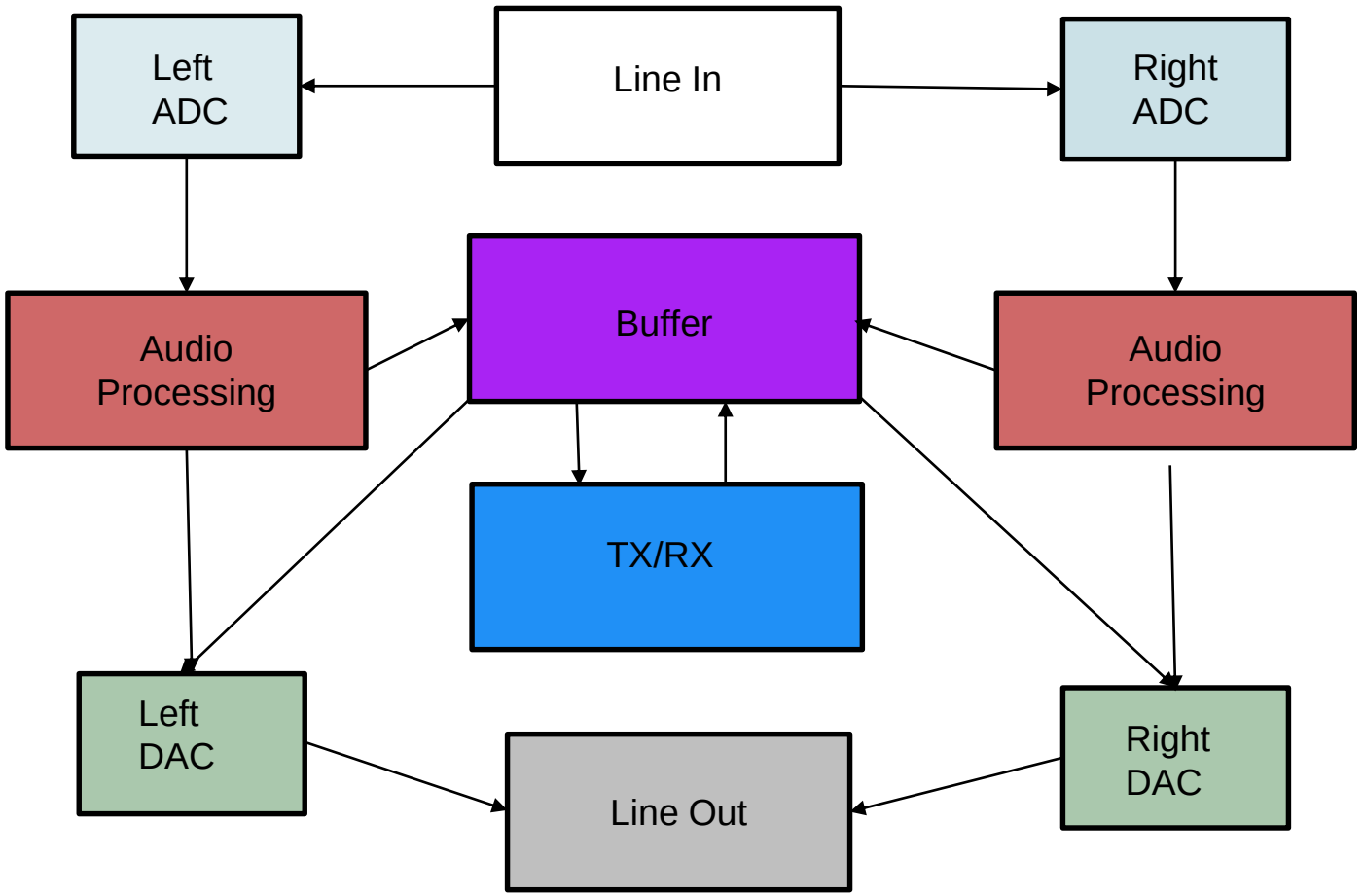
- To do the audio Processing we are using CC3200AUDBOOST
- It includes many features but the main feature that we are using is the Audio Codec.



Audio Codec Specs

- Stereo Audio DAC with 100db SNR
- 4.1 mW Stereo 48ksps DAC Playback
- Stereo Audio ADC with 93 dB SNR
- 6.1mW Stereo 48ksps ADC Record
- Support Sample ADC sample rate 8kHz to 192kHz
- DAC supports data rates form 8kHz to 192 kHz

Audio Codec Flow Diagram



TLV32AIC3

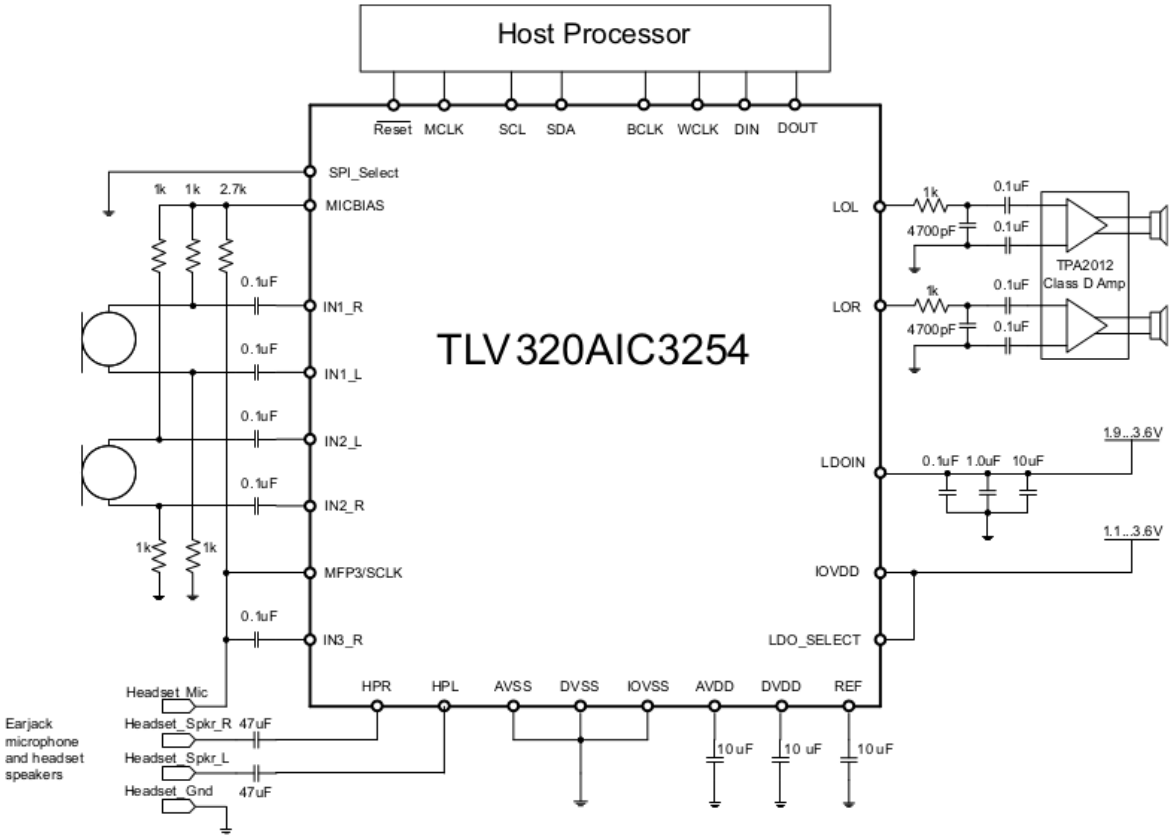
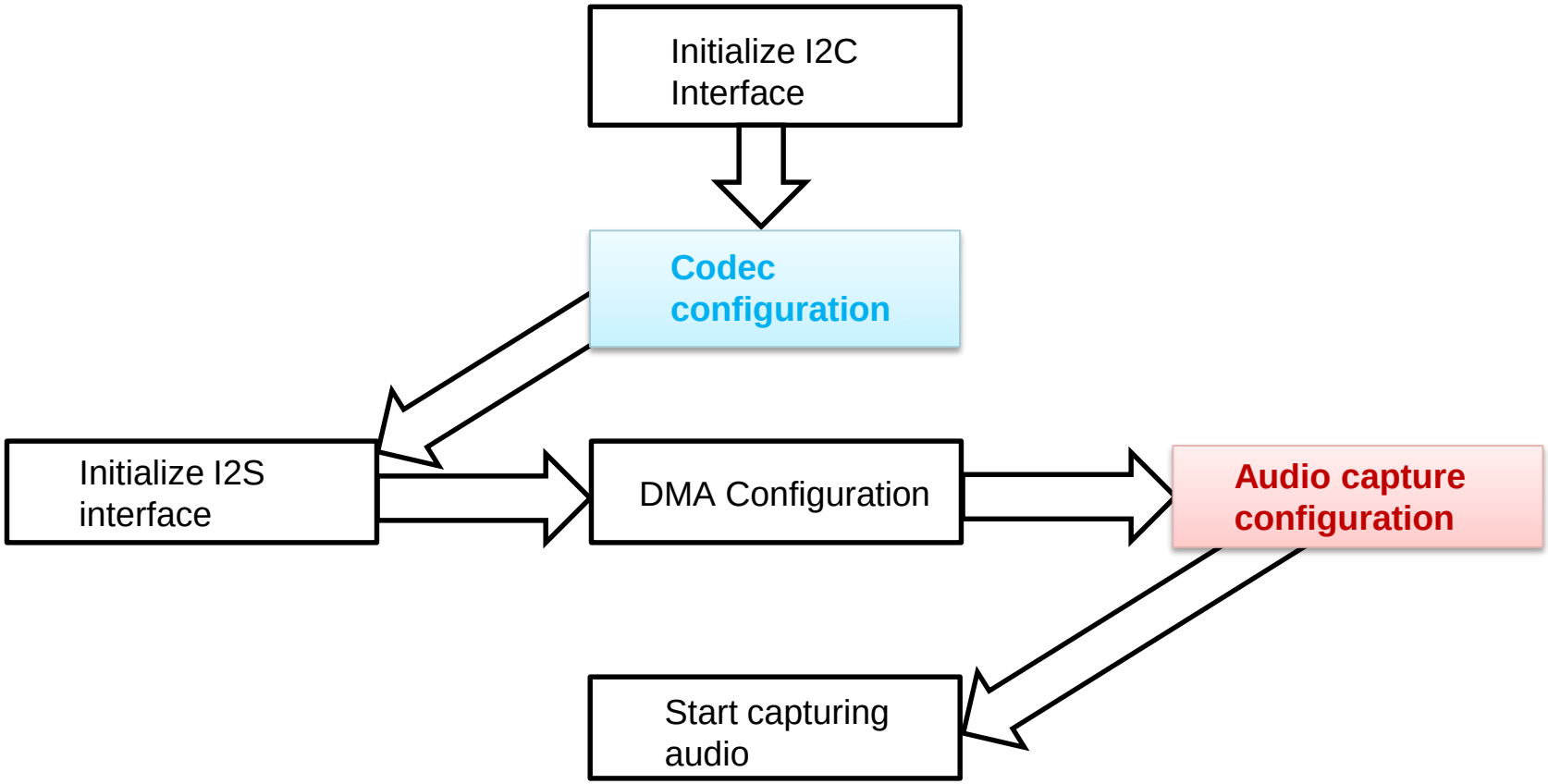
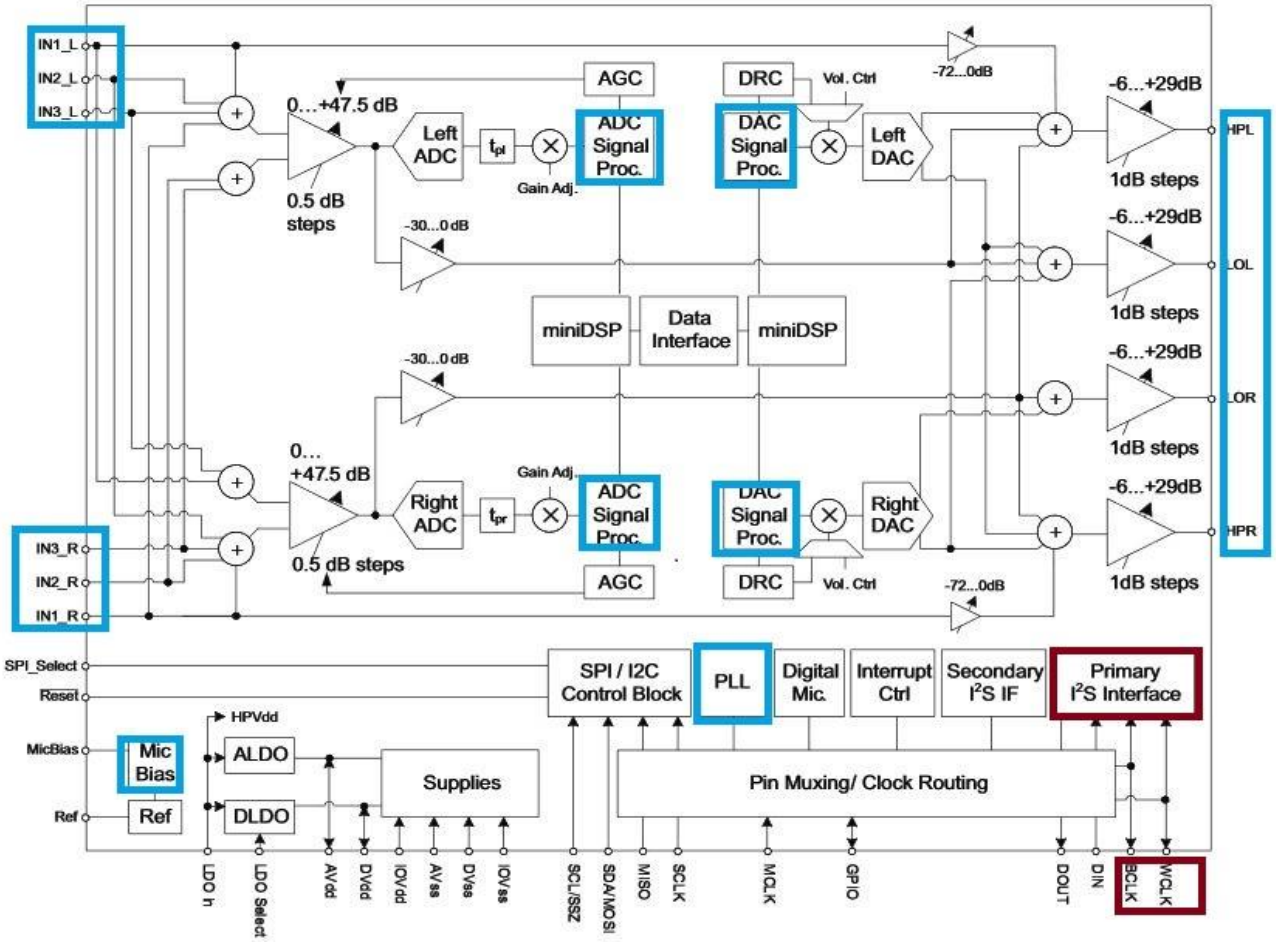


Figure 1-2. Typical Circuit Configuration

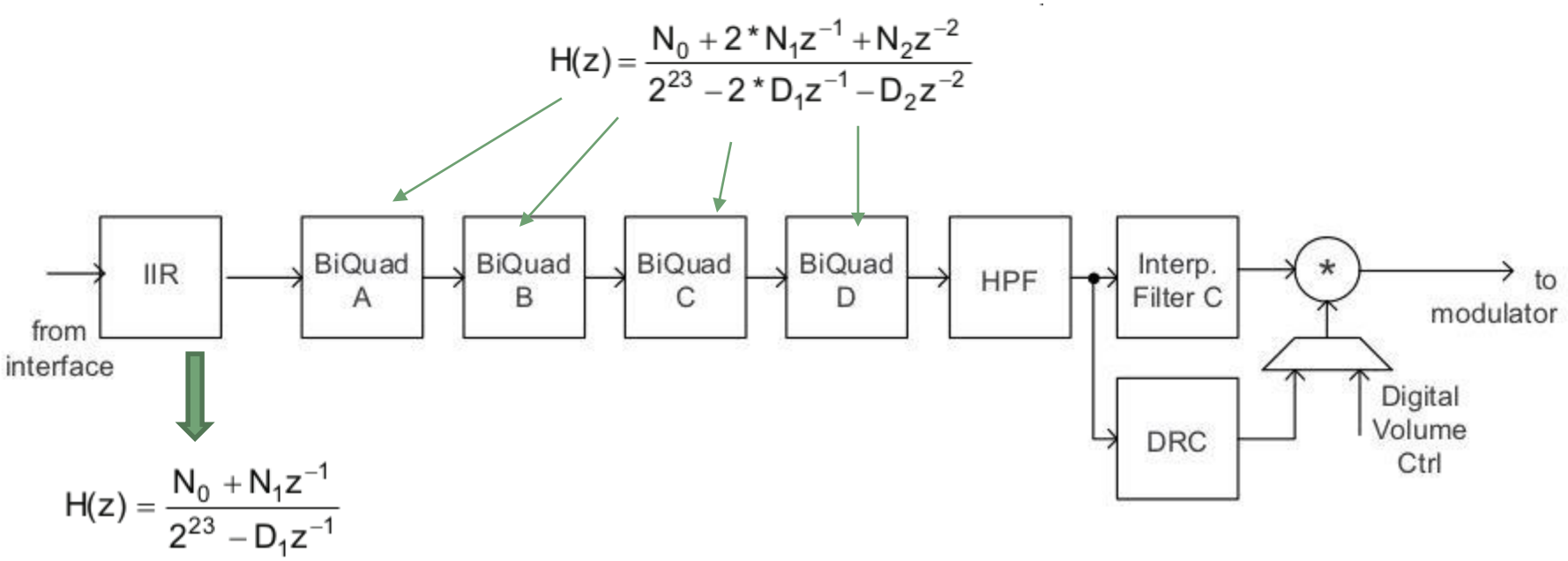
Program Flow



TLV32AIC4354 Block Diagram



Sig Proc. Block for Adaptive Filtering



Subsystem 4: Power Supply

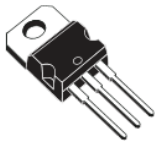
- Test Battery

  9.6V, 2000mAh

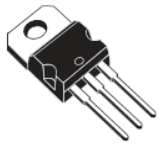
  Powers amplifier, MCU & codec

  Fed to voltage regulators
  -LT323A (5V)
  -LD1117 (3.3V)

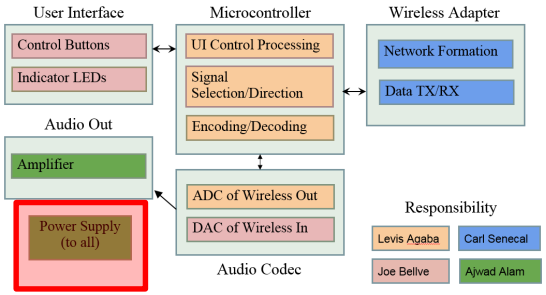
- For final prototype, a smaller battery will be used



LD1117



LT323A



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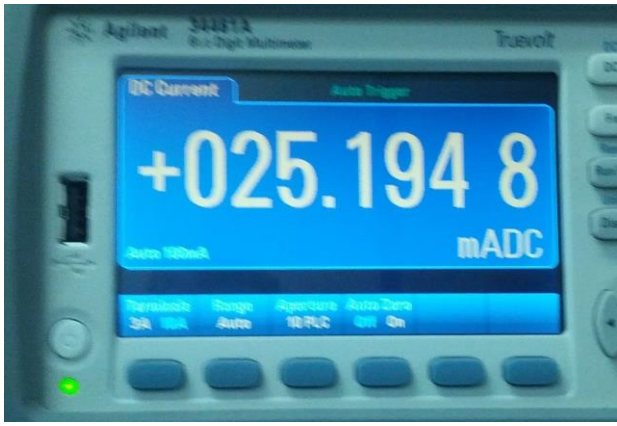

- Output from LT323A → 5.014V DC

  Amplifier: Worst case
  Max current draw = 25.2mA
  Power = 241.92mW

- Output from LD1117 → 3.293V DC

  MCU+Codec: Worst case
  Max current draw = 350mA
  Power = 1152mW

- Total power consumption = 1393.92mW
- Duration achievable = (2000mAh/375.2mA)
  = 5.33 hours

Demo

FDR

---FDR----------

- Alternate networking solutions/networking improvements - Carl
- PCB design - Joe
- Increasing audio quality - Levis
- Housing within headphones/Power supply integration - AJ

Thank You

Questions?