*Wireless* Audio Effects Processor

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April 30th, 2007
6.111 Project Presentation
Our Model: AirTunes®

- Audio input from source
- Compressed
- Wirelessly transmitted
- Decompressed
- Equalizer & Audio Effects
Top Level Block Diagram

AC97 Codec

AC97 Controller

Transmission

Reception

Compression

MDCT

SRAM

FSM

Decompression

IMDCT

SRAM

FSM

IFFT

Equalizer

FFT

Equalization
Compression of Audio

- **MP3, MPEG-4, AAC**
  - *Modified* Discrete Cosine Transform
    - *Lapped*: Map $2N$ discrete points into $N$ discrete points

![Waveform Diagram](image)
Wireless CC2420DBK RF Transceiver

- CC2420 radio
- 2.4 GHz frequency band
- Atmel Atmega128L AVR microcontroller
- 2x32 kBytes external RAM
- PCB antenna
- Joystick, buttons, LEDs (visual user application interface)
Wireless Transmission Algorithm

- Error Correction Algorithm
  - Forward Error Correction (FEC)
    • sender adds redundant data to its messages
    • allows receiver to detect errors
- Reed Solomon Code
  - Key idea:
    • data is encoded as a polynomial
    • any \( k \) distinct points uniquely determine a polynomial of degree at most \( k-1 \)
  - Polynomial is then “encoded” by its evaluation at various points, and these values are what is actually sent
  - Transmission: some of these values may become corrupted
  - More than \( k \) points are actually sent
  - Receiver decodes the original data
  - Total number of m-bit symbols in the encoded block is \( n = 2^m - 1 \)
- Example: \( m = 8 \), Code Rate 223/255
  - (In each block 223 symbols are formed from the encoder input and 32 parity symbols are added.)
  - Capable of correcting up to 16 symbols per block
Equalization

- Use FFT to convert audio signal into frequency spectrum
- Add desired effects as required by the user
- Take IFFT of resulting signal
- Transmit processed audio to AC-97 output line
Audio Effects: The BIG Picture
Questions?