

## 2. Design Constraints

The competitive market of portable audio players requires that all newcomers meet a certain level of quality and usability, even if a product addresses a specific niche in the market. Because of the newness of this market, it is especially important that WiRAD effectively meet the requirements of consumers in order to preemptively combat potential competition. The WiRAD design focuses on the following ten socio-economical and technical constraints.

### 2.1 Technical Design Constraints

The technical design constraints of this design are listed in Table I.

**Table I: Technical Design Constraints**

Name	Description
<b>Decoding Quality</b>	WiRAD is capable of decoding streaming audio encoded at bitrates of up to 128kbit/s.
<b>Transmission Rate</b>	The 802.11b wireless link is capable of sustaining 1Mbit/s transfer at an operating frequency of 2.4GHz and range of 30m from a base-station.
<b>Battery Life</b>	The battery provides at least 3 hours continued usage before recharge.
<b>Portability</b>	WiRAD is less than 10cm (W) x 15cm (H) x 5cm (D).
<b>Audio Quality</b>	WiRAD provides 24-bit stereo audio at 96KHz.

#### 2.1.1 Decoding Quality

MP3 format audio encoded at bitrates of 128kbit/s is regarded as near CD quality. It is at this bitrate that nearly all SHOUTcast Internet radio stations are broadcasted. Supporting bitrates of 128kbit/s allows WiRAD to decode most MPEG-1 Layer 3 (MP3) format audio while placing only modest constraints on the wireless transmission quality.

#### 2.1.2 Transmission Rate

A sustained wireless transmission throughput of 1Mbit/s is used to deliver streaming audio at the supported maximum bitrate of 128kbit/s. Such a transmission rate allows a 100% data inflation due to Hyper-Text Transport Protocol (HTTP) headers, which are utilized in the SHOUTcast protocol, and a 300% safety margin. This rate is well within the specifications of the 802.11b wireless standard, which allow a maximum throughput of 11Mbit/s [1].

#### 2.1.3 Battery Life

WiRAD's battery provides 3 hours of continued usage. After depletion, WiRAD is recharged using a 110 VAC to 5V wall transformer.

#### 2.1.4 Portability

Dimensions of 10cm (W) x 15cm (H) x 5cm (D) place WiRAD in the same size class as Apple's iPod while still allowing for a 2.4GHz antenna and rechargeable battery [2]. At this size, WiRAD may be carried or worn comfortably.

#### 2.1.5 Audio Quality

WiRAD's audio quality of 24-bit stereo at 96KHz allows for playback of CD-quality sound. This capability ensures that decoding artifacts such as "clicks" and "pops" are not introduced due to low-frequency digital to analog conversion. This also places the audio-quality bottleneck on decoding technology, which might be improved in future firmware upgrades.

## 2.2 Practical Design Constraints

The practical design constraints of this design are listed in Table II.

**Table II: Practical Design Constraints**

Type	Name	Description
Health and Safety	Volume Restrictions	Maximum volume is limited to a safe volume for the user.
Political	Streaming MP3 Licensing	In order to cover licensing issues, a microprocessor manufacturer that covers the licensing fees is used.
Compatibility	Software and Hardware Compatibility	WiRAD uses a USB interface. It is compatible with Windows XP and 2000. WiRAD can work on any existing 802.11b/g network.
Manufacturability	Mass Production	WiRAD can easily be mass produced by being outsourced to any country with lower labor costs.
Economic	Pricing	WiRAD is marketed to the consumer for under \$100.

### 2.2.1 Volume Restrictions

WiRAD is designed to ensure consumer safety. By restricting the noise level to under 90dB per watt meter, WiRAD eliminates the possibility of hearing loss due to long term exposure [3]. This limited maximum output minimizes consumer health risks and allows prolonged use of WiRAD as might be encountered during industrial or military use.

### 2.2.2 Streaming MP3 Licensing

Any profit-producing corporation wishing to provide tools for decoding MP3 content, whether it be in hardware or software, must pay appropriate licensing fees to Thompson Corporation [4]. By utilizing a hardware MP3 decoder for which licensing fees have already been paid by the developer, WiRAD is able to avoid legal and political fallback from the sale of an unlicensed MP3 product.

### 2.2.3 Software and Hardware Compatibility

WiRAD incorporates a connection conforming to the Universal Serial Bus (USB) standard. This allows WiRAD to be configured from any computer with a USB interface and makes the device software compatible with Microsoft Windows Vista/XP/2000. WiRAD is additionally hardware compatible with the 802.11b standard.

### 2.2.4 Mass Production

WiRAD has many properties that contribute to its potential for mass production, such as a lack of moving parts and utilization of low pin-count devices. Additionally, WiRAD components are available in large quantities. All of these characteristics enhance WiRAD's manufacturability and speed deployment.

### 2.2.5 Pricing

WiRAD's list price is less than \$100 dollars. This relatively low price keeps WiRAD below the price range of high-end iPod music players. When compared to Apple's products, WiRAD offers increased

capabilities at a lower price. With this competitive edge, WiRAD is poised to seize much of the market for portable music devices.

### 2.3 References

[1] Institute for Electrical and Electronic Engineers. (2006, September 13). "Popular Wireless Local Area Networks Gain Large Boost in Speed," *IEEE Standards Organization*. [Online]. Available: <http://standards.ieee.org/announcements/80211gfinal.html>

[2] Apple Inc. (2006, September 13). "Apple - iPod - Technical Specifications," *Apple iPod Technical Specifications*. [Online]. Available: <http://www.apple.com/ipod/specs.html>

[3] R. Russell. (2006, September 13). "Listening and Hearing," *www.roger-russell.com*. [Online]. Available: <http://www.roger-russell.com/hearing/hearing.htm>

[4] Thomson Technology. (2006, September 13). "mp3licensing.com - Home," *www.mp3licensing.com*. [Online]. Available: <http://www.mp3licensing.com/>