Executive Summary

Corporate-owned radio stations use fixed-format play lists designed to attract the most listeners. While this maximizes advertising revenue, it does not cater to the varying and specialized music interests of all consumers. Although independent stations have, in the past, helped alleviate this problem, substantial startup costs keep new independent stations from entering the market. The Internet provides a unique opportunity for such broadcasters. By broadcasting online, independent stations avoid the infrastructure costs inherent in building radio towers and laying cable. This advantage has lead to a current community of over 15,000 Internet radio stations with an average of 150,000 listeners at a given time. Nonetheless, the growth of the medium is limited by the lack of portable listening devices. Consequently, a need exists for an inexpensive and portable wireless device for accessing Internet radio stations via an already developed and widely available wireless infrastructure. By utilizing widely available 802.11b wireless networks, WiRAD answers this need.

The key technical challenge of the WiRAD is ensuring adequate streaming audio quality over an unreliable wireless connection. This imposes a number of constraints on product design. The first is that a wireless transmission throughput of 1 Mbit/s be sustained. This allows consistent delivery of majority of Internet radio streams, which are encoded at 128 kbit/s. The second quality constraint is that MP3 decoding proceed at a rate of 128 kbit/s. The third quality constraint is that WiRAD present decoded audio in 20-bit stereo at frequencies up to 48 KHz. In addition to these quality constraints, WiRAD must be portable and manufacturable. Portability constraints include a maximum size of 10cm x 15cm x 5cm and a minimum battery life of 3 hours. Manufacturability constraints include low production cost and a retail price of less than $100.

The outlined constraints are satisfied by a modular design incorporating inexpensive and widely available components. The two main system components are a microcontroller (MCU) and an 802.11b WiFi module. While several MCU options were examined, the Atmel AT89C51SND1C was selected due to its on-chip MP3 hardware decoder and USB controller. For the WiFi module, the Airborne WLNB-AN-DP100 was chosen. This module includes an application processor that implements a communication stack in a real-time operating system. Other various peripheral devices include an Electrically Erasable Programmable Read Only Memory (EEPROM) for nonvolatile storage, a digital-to-analog converter (DAC) for audio, and an antenna. While the EEPROM and DAC are generic devices with numerous near-identical models available from a variety of manufacturers, the chosen antenna was custom-designed for WiRAD. This was necessary due to the lack of commercial antennas the met WiRAD's size and power constraints. Despite this custom-design, the antenna's microstrip design is inexpensive and easily fabricated. With these components, WiRAD's total manufacturing cost is approximately $70.

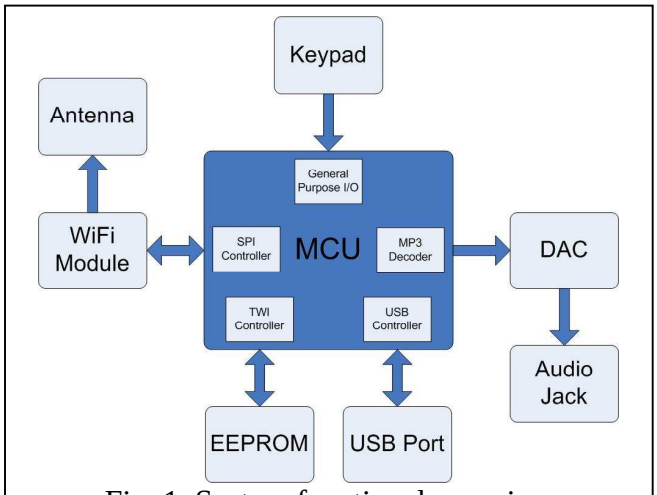

Fig. 1. System functional overview

Many portable technologies, such as traditional radio and satellite radio, provide access to corporate streaming media. Likewise, personal media players, such as iPod, provide access to non-streaming independent content. However, WiRAD is unique in that it provides portable access to independent streaming media. This suggests a variety of real-time applications outside of the music domain, such as listening to Internet-broadcasted sporting events, personalized news feeds, and financial data.