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Low-Power Localized Wireless Data Communication Options

Introduction

In this technical review paper, methods of wireless data delivery will be explored and compared. Since this project will rely on maintaining a continuous data stream to the base-stations on shore, the choice of radio will be critical in ensuring the reliability of the system.

For interconnected devices, there are a few major ways of delivering information wirelessly from a remote device to a base-station or processing computer, three of which will be explored. Traits such as power draw, reliability, and cost will be analyzed.

These radios do not have the ability to be programed, and as such, all solutions listed here will require a microcontroller to operate the radio functions.

IoT Service

IoT (Internet-of-Things) refers to devices that communicate somehow with the internet, and whose data eventually makes it to a main computer or server via an internet connection [6]. There are quite a few of these services protocols available. In the US, the two largest including TheThingsNetwork and SigFox [7]. Since this project will be tested at Lake Lanier, the available coverage for these services must be examined. Immediately, it can be realized that TheThingsNetwork will not be applicable for this project since their coverage map shows now coverage at Lake Lanier [10]. SigFox, however, may be able to provide acceptable service [9].

SigFox receivers operate at 902MHz in the US, and operates using binary phase-shift keying (BPSK), which favors peer-to-basestation communication but is very robust even at long ranges [1, 9]. Radio IC's for SigFox are low-power, and can be bought for about $3, not including a PCB and antenna [1]. The primary disadvantage to SigFox in this project's case is that service may be spotty at best since Lake Lanier is not an urban area. Furthermore, SigFox requires a paid service subscription, similar to cell phones (costing about $20 per device per year for continuous connectivity) [9].

Cellular Connection

Cellular networks exist almost everywhere in the US, and therefore would be a reliable connection method to send data from remote devices to a base-station / server setup. Using devices like Adafruit's Fona (based on the SIM808 module), it would be possible to send data reliably via services such as Ting, much the same as our smart phones [2]. This technology comes at a price, however. Adafruit's Fona costs about $50 each, and the raw cellular module costs about $20 with no support circuitry [2]. Since each module requires an independent sim card, the price of this solution could be considered too high for detailed exploration.

Independent Radio Networks

Since this project only needs to transfer data from remote devices to a base station that is near-by, an independent radio network can be used. This network consists of many independent radio nodes, all of which can send data to each other. No overall service is required, and as such, there are no associated service costs or reliance on a preexisting infrastructure. One of the most common IC for this type of network is based around the RFM69HCW, a 915MHz data radio that has a 500m range and costs about $5 each [3, 5]. If a longer range is required, the RFM95W can be used, which is very similar to the RFM69HCW except it has a range of about 2km and a slower data transfer rate by using the LoRa protocol [1, 8]. These radios are very well supported, easy to configure, low power, and relatively inexpensive, making them a great choice for nebulas networks of devices [3, 5].

Since this project heavily focuses on distance-measurement devices (a topic of another group member's paper), those devices can be taken into consideration for data transfer as well. The Decawave 1000, for example, facilitates distance measurements, but can also send raw data to other Decawave modules, like the RFM series discussed earlier [4]. Using this one device for both purposes would reduce cost. However, it should be noted that the Decawave 1000's general data communication range is about 300m [4]. For this reason, it might be possible for a cluster of boats to be cut off from the base station, even though they can still calculate relative distances between themselves. Such a problem would not be the case for the RFM radios. From a cost prospective, using the Decawave (or another chip with distance and data transfer capabilities) makes the most sense, as the included data radio yields less chips and radio hardware, resulting in a cheaper overall product. This solution would also use little power, as the distance-measurement radio will have to be active whether it sends data or not.

Sources

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