Transmission Protocol — iCRAB

Noah Strong

December 20, 2017 – v1.0-wip

1 Introduction

The Crab Tracker project aims to provide a simple, efficient, reliable, and cost-effective method for tracking crabs underwater. There are no accepted standards that we're aware of for achieving the results we hope to achieve, and to base our work too heavily off the work of existing products would violate the clauses in the licenses of those products that protect against reverse engineering. For these reasons and more, we must define our own technologies and protocols. Central to the project is the protocol that will be used to relay information from transmitters (attached to crabs) to the central receiver (affixed to a water-going vessel, such as a kayak). Documented herein is that protocol, as well as the motivations and requirements for many of the decisions behind it. As of this writing, **the protocol is still subject to change.** We may find shortcomings or other problems with the protocol during the prototyping stage of the product, at which point adjustments will be made. This document will be updated as needed to reflect these changes, and should always be treated as the official documentation for the protocol.

One of the major requirements of this project is the ability for each individual transmitter to be uniquely identifiable. Therefore, we must encode the device's unique identifier (herein referred to as the ID or UID) in each signal that the device broadcasts. We will discuss this in section $< \ldots >$.

Additionally, because all transmitters transmit at the same audio frequency (baseband signaling), it is possible for multiple transmitters to transmit simultaneously. We want such collisions to be detectable by the receiver so that invalid data is never presented to the user. Simple implementations of an encoding protocol can lead to situations in which collisions are not detectable, but the protocol proposed in this document aims to prevent the possibility of undetectable collisions. For a further discussion on how collisions may arise, proposed solutions, and other background information, please see RFC 1.

2 Background

For a thorough background on some of the challenges faced in designing this protocol, please refer to the RFC-1 "Collision Detection" document.

To satisfy the requirements of this project, we are designing a new protocol. This protocol will encode the UID of each transmitter in such a way that collisions (multiple simultaneous transmissions by different transmitters) can be detected by a receiving station and discarded. The protocol is a simple series of HIGH and LOW audio signals operating at a predefined frequency. (The specific frequency to be used will be documented elsewhere on the hardware engineering side of things.) The series of "pings" and the separation between them will be organized in a specific pattern based on the UID of the given transmitter, known as the Unique Transmission Pattern (or UTP for short).

Additionally, we may want to have the ability to detect when a transmitter has stopped moving, possibly because the crab molted its shell or died. In this case, we want each broadcast to not only encode the UID of the transmitter, but also some boolean value (such as $isInert$). To this end, we introduce a potential second encoding for each signal that will be used only if this boolean value is true. While the boolean value could theoretically represent any piece of data about the transmitter, we will assume herein that it refers to the $isInert$ variable.

We label this protocol the id-correlated rhythmic audio broadcast protocol, or iCRAB for short.

3 iCRAB Protocol Definition

3.1 Overview

At the core of this protocol is a single bust of information which is transmitted repeatedly on some randomly-varying interval. This burst of data, transmitted via acoustic waves, will encode the unique identifier of the given transmitter. The burst, hereafter referred to as a unique transmission pattern (UTP), will consist of two pings (short, continuous transmissions of the carrier frequency), separated by some delay time d. The duration of the pings and the delay time d will be functions of the transmitter's UID. The interval between UTPs will be random, and each transmitter will recalculate the interval time after each UTP according to a shared formula. See Figure 1 for an example of a UTP.

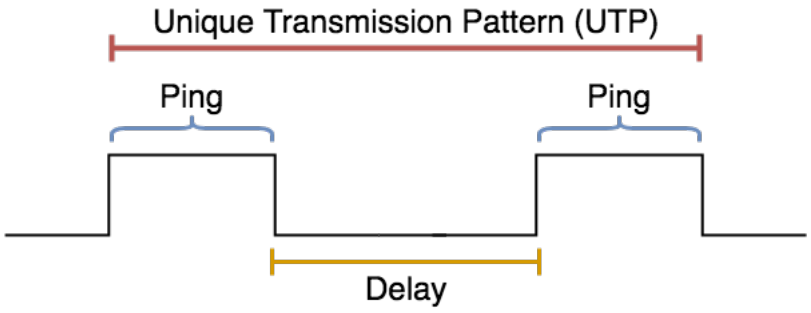

Figure 1: A Unique Transmission Pattern

In the general case, he duration of the two pings will be identical. In the case that the crab is inert, the lengths of the two pings in a given UTP will differ or one may omitted entirely. This

part of the protocol is still under development.

A Glossary of Terms

Delay: in the context of ID encoding, the space between the falling edge of one **ping** and the rising of the next within a single **UTP**.

Delay Time (*d*): the duration (generally in milliseconds) of a given **delay**.

iCRAB (id-correlated rhythmic audio broadcast) protocol: the protocol designed by the members of the Crab Tracker project and described in detail in this document.

Inert: A transmitter will be marked as **inert** if it is determined that the transmitter has not moved "enough" in a given period of time. This definition is subject to changes and hardware constraints, and refers to an experimental addition to the project's requirements that has yet to be implemented or fully defined in writing.

Interval: the time between two consecutive broadcasts of **UTP**. Measured by the distance between the final falling edge of one ping and the first rising edge of the next.

Ping: a single, continuous transmission of signal.

Ping Duration: the length of time between the rising and falling edges of a continuous transmission (a **ping**).

Unique Transmission Pattern, UTP: a sequence of two **ping**s separated by some **delay** used to encode the unique identifier of a transmitter.