Adaptively Sampled Underwater Node

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MOTIVATION

• When deploying underwater sensors, marine scientists must select a sampling rate that they think will be fast enough to sample their phenomenon of interest (eddies, harmful algal blooms, turbulence, etc.), but slow enough to allow for a long deployment.

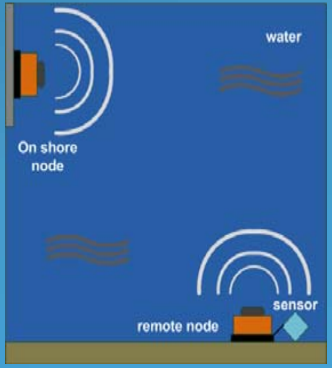
• It is difficult to determine the 'ideal' sampling rate and therefore the sensor may fail to capture the event of interest.

•Scientists recognize that the solution to this sampling rate problem would be to 'talk' to their instruments from shore and dynamically adjust the sampling rate according to weather conditions and/or what is seen in the already collected data

GOAL

Our goal is to design and build a two-node wireless system to allow scientists to remotely 'talk' to their deployed instrument and adjust its sampling rate.

Fig.1. deployment setup for the on shore node and remote node



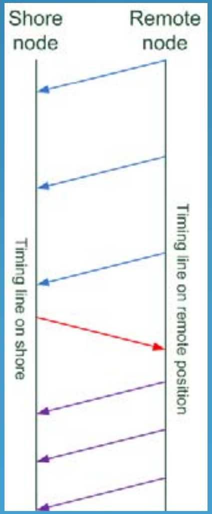


Fig.2. Example of adaptive sampling. The remote node is sending data at a 'slow' rate until it receives a command from the shore node to send data at a faster rate.

SYSTEM DESIGN

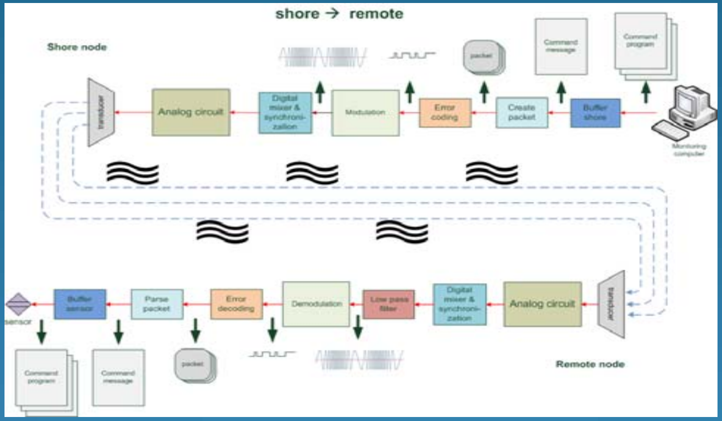


Fig. 3. High Level Block Diagram of Shore->Remote Operations

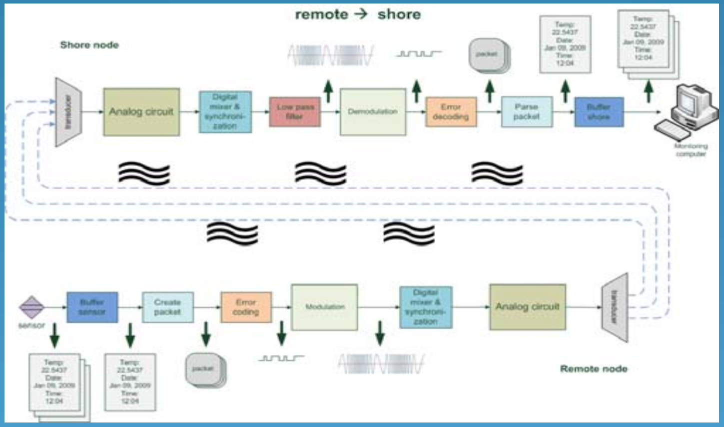


Fig. 4. High Level Block Diagram of Remote->Shore Operations

•Figures 3 and 4 show the high level block diagrams of the shore->remote operations and the remote->shore node operations

•The nodes communicate wirelessly underwater using acoustics

•The two-nodes communicate to the sensor or computer via RS-232 protocol

•The nodes talk using packet based communication

•The link is half-duplex (can only send OR receive at one time)

•The nodes are intended for short-range, low data rate communication

SYSTEM REQUIREMENTS

Range	Bit Error Rate	Power supply	Modulation scheme	Modulation frequencies
< 500 m	< 1e-2	+/- 15 V	FSK	1 kHz, 2 kHz
Carrier Frequency	**Baseband Sampling Frequency**	**Bit Rate**	**Power Consumption**	**Packet Size**
40 kHz	96 kHz	80 - 500 bps	< 10 W	26 bytes

Table 1. Modem Parameters

Training Sequence	Source Address	Destination Address	Sequence Number	Data Length	Error Coding	Future Use	Data
16	8	8	12	4	16	16	128

Table 2. Proposed Packet Structure

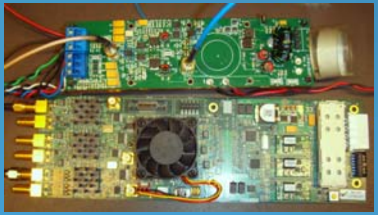
RESEARCH CHALLENGES

• Designing a two way communication system to work in an underwater environment subject to long propagation delays and multipath
• Building hardware that is low-cost and low-energy
• Analyzing the potential energy benefits realized by adaptive sampling

PROGRESS

• Creation of inexpensive transducers and initial pool tests to insure functionality
• Design and current testing of analog circuit (tx/rx switch + amp)
• Initial testing of sending 'Hello World' with FSK algorithm in water bucket
• Hardware design of FSK modulator and demodulator
• Simulations of packet synchronization schemes
• Initial Simulink simulation of overall design

Fig. 5. Prototype hardware for one node. The hardware includes the transducer (ring in upper right corner), the analog circuit (upper board) and an DINI group's DNMEG_ADDA evaluation board. The two boards are connected via SMA cables.



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