

# Application of Wireless Technology to at sea Mooring Management

FY 2003 Proposal to the NOAA HPCC Program

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Proposal Theme: **Next Generation Internet with aspects of Disaster Planning, Mitigation, Response and Recovery**

Funding Summary: FY 2003 \$ 54,000

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# **Application of Wireless Technology to at-sea Mooring Management**

Proposal for FY 2003 HPCC Funding

Prepared by: Phyllis Stabeno

## **Executive Summary:**

Pacific Marine Environmental Laboratory (PMEL) carries out several large scale ocean monitoring programs that include fixed mooring arrays that consists of hundreds of instruments. These mooring programs rely on paper and pen tracking systems for the staging, deployment and retrieval of each array. This system costs the projects hundreds of person hours and ship time in the time it takes to check each serial number, write down values and station information. Using wireless technology and barcoding advancements, we can automate some of the data archiving, retrieval and tasks that field operation specialists routinely do during the shipboard mooring operations. The use of wireless barcode readers connecting to hand held computing devices will allow field operations to proceed more smoothly. By creating a wireless connection to the shipboard scientific computing system, marine operations can be logged directly into the marine operations logs and the mooring deployment software system and a proposed mooring management software system under development at PMEL.

## **Problem Statement:**

The Pacific Marine Environmental Laboratory (PMEL) is the home of several large scale ocean monitoring programs including FOCI's North Pacific/Bering Sea Circulation studies, TAO's El Nino Monitoring Program and the Tsunami DART program. These long term mooring operations are crucial to NOAA's strategic goals of *implementing seasonal to interannual climate forecasts, assessing and predicting decadal to centennial change and building sustainable fisheries*. The mooring activities of these programs rely on collaboration between PMEL engineers, scientists, field operations specialists and OMAO shipboard and landside personnel to develop, build, successfully deploy and retrieve moored instruments. Tracking and managing the many instruments on a mooring is a major task. The actual deployment of a mooring requires logging and recordkeeping for aspects such as when and where each instrument enters the water, meteorological conditions during the deployment and associated operations such as CTD casts and ADCP tracklines to calibrate the mooring's measurements. Currently, mooring operations onboard NOAA vessels use pencils, paper and clipboards for recording and managing mooring deployment. Tasks include checking serial numbers, marking the time that the instruments go in and out of the water and recording all the other information pertinent to each deployment. After each deployment, field scientists must retrieve ancillary data from the ship's log and enter all the data from the paper forms into a spreadsheet or management database. Mooring retrievals have similar record keeping needs. With thousands of instruments in use, the process is tedious, error prone and time consuming.

## **Proposed Solution:**

To improve record keeping for deployments and to speed operations, we plan to investigate and implement a system of barcoding instruments that are deployed on moorings. These include current meters, ADCP current profilers, miniature temperature recorders (MTR), and SeaCATs. We will use barcode readers to track the instruments as the mooring is deployed or retrieved. To support faster and more accurate recordkeeping, we will implement wireless connectivity and handheld systems that will allow us to integrate the equipment information gathering with a MooringManager administrative system that will be developed with ESDIM funding. To this end, we will implement wireless connectivity from the fantail - where equipment is being deployed - to the Shipboard Computer System (SCS) to allow the rapid collection of ancillary data. This will allow us to automatically generate the various mooring deployment log forms needed by the projects. We will also integrate the mooring data collection with the cruise data collection made by SCS to provide an integrated comprehensive final product that includes deployment information and all the scientific data collected on the cruise.

The integration of barcoding technology and wireless networks has made the use and reading of barcodes a boon to organizations that house large inventories of equipment. The barcode can be used to identify equipment and track its history and behavior throughout its life cycle, making identification, maintenance and tracking of its activity less cumbersome. The same technologies and strategies can be applied to NOAA's mooring programs. By creating a barcoding system that tracks each piece of the moored array and wireless connectivity of barcode readers and handheld computer based logging devices to the SCS system, the field operations will run more smoothly and efficiently and with fewer errors. The time saved will translate into more efficient use of shiptime and decreased shipboard costs. The application of fixed asset (i.e. mooring instrument) management technologies on a sea-going vessel is an innovative use for this well developed technology.

By using a wireless connection to the SCS – the actual time of deployment and the geographical location can be also transmitted to the wireless device and vice versa. This would help by not repeating the steps of getting this info from the bridge and link right into the data tracking database. We will use the event logging capabilities of SCS to create a “mooring event.” This can be used to store ancillary and log times and locations of various activities.

## **Project Activities:**

1. Devise specifications for barcode labels and labelling and tracking protocol
2. Investigate the best combination of barcode reader and handheld device for at sea use
3. Investigate the best software for asset tracking, attempt to find COTS that can be modified for our needs
4. Meet with OMAO and mooring engineers to determine best wireless network connection to SCS
5. Integrate asset tracking software with FOCI mooring management software under development
6. Build a SCS software module that will log mooring operations, test wireless connection of SCS to mooring deployment handheld
7. Test bar code readers, handhelds and software in sea trials and debug if necessary

8. Provide software and documentation to FOCI and interested parties in NOAA

**Analysis:**

This proposal addresses the HPCC theme of NGL- advancing wireless technology within NOAA. The project will combine wireless data connectivity with user mobility to help NOAA support their scientific mission both in the laboratory and in field conditions. This proposal also addresses aspects of disaster planning, mitigation, response and recovery. By creating wireless applications for mooring management, rapid deployment and retrieval and management of instruments will allow scientists faster data access when responding to a natural disaster. The research conducted during this project on wireless use on ships will be applicable to other ship users in the future- for example, logging of fish catch, general oceanographic operations and other types of equipment deployment.

**Appropriateness:**

By providing a novel approach to integrating wireless communication in a field environment, this proposal addresses more than one HPCC networking goal as well some of the larger goals of the HPCC program. The proposal integrates wireless barcoding to field mooring management and creates wireless connections between the management software and the on-board shipboard computing system for position and operations logging.

**Technology:**

This proposal will utilize current barcoding and wireless technologies in a new and innovative way in a previously unexplored environment. The proposal calls for testing different types of handheld and barcoding devices to determine which will work the best under at-sea conditions. Optimal wireless frequencies for marine use will be determined by OMAO. OMAO will also test the feasibility of connections between wireless devices and the shipboard computing system.

**Scope:**

The outcome of this proposal can be applied to other field programs within other NOAA line offices. Currently, PMEL hosts several large-scale buoy monitoring programs that could benefit from this technology. By creating a barcoding system to track mooring equipment from shipping to retrieval using handheld system and wireless connections, field operation specialists and engineers will be able to reduce the amount of time tracking, logging and inventorying the equipment both on land and in field conditions. This project uses the FOCI North Pacific Mooring program as its pilot project. However, the TAO engineers have expressed interest in using the same system for buoy and equipment management. The technology and applications developed in this project could easily be ported to other line offices such as NWS or NOS attempting to simplify their asset managements for field operations. The operations logging capabilities could be used by a variety of programs and the wireless connectivity could be used by NOAA Fisheries projects on NOAA and charter vessels.

**Leverage:**

This project leverages off of already completed HPCC proposals. Handheld devices have been tested in field conditions in DIS/SE/06 "Geographic Data Servers for Wireless Clients" in FY01. Wireless protocols have been tested by OMAO in FY01 for data transfer. Development of a wireless-based Fisheries SCS (FSCS) has been started with support by ESDIM. The co-investigators have a highly rated ESDIM proposal for FY03 to develop a mooring management database and web-enabled planning application for mooring development This proposal serves to

implement the hardware and technology component that will link to the mooring management software being developed at PMEL. Salaries of full time NOAA personnel to serve in a supervisory capacity will be at no cost to the HPCC program. This proposal will piggyback on existing ship time, at no cost to the program.

### **Cost/Benefit:**

This proposal has a high benefit to cost ratio. If this project is successfully implemented, it could revolutionize the mooring operations. In the planning stages, by successfully tracking equipment from shipment to deployment and retrieval to post-deployment calibration at PMEL. At sea, the efficiency with which a barcoding system could allow field personnel to check in and out equipment, log changes and communicate with the SCS would reduce the amount of time these operations now take. With ship time at a premium, making deployment and retrieval and turnaround of instruments more efficient would allow for better use of ship's resources. FOCI is a good test bed for this project, its new mooring management schema and field season timing makes for an excellent candidate for a one year project.

### **Compare the selected plan with other alternatives**

The alternative proposal would be to continue using paper logging method of mooring management. This requires that a field specialist to remain out on deck during operations to log the deployment and retrieval times of each instrument and manually check each instrument's serial number. Once the equipment has been logged and the specialist has written in each value, then he or she receives the time and geographic location from the ship's log. This data is then typed in by personnel and placed into a spread sheet for later use. This method is reliable, but is time consuming and does not allow for any quick changes to the mooring configuration.

The next best alternative would be to use a bar coding method that is not wireless, but uses an scanning device attached to a handheld or laptop computer. Though the outcome is the same, it does not provide the user much mobility, which could be crucial depending on how the mooring operation is proceeding.

The proposed solution has the benefit of applying a widely used technology in a new way to a project and equipment management issue. Successful implementation would greatly shorten the amount of paper-based processing and greatly improve error checking in mooring staging, deployment and retrieval operations.

### **Performance Measures:**

Finding the appropriate wireless technology that does not interfere with shipboard electronics, will leverage off of work done by OMAO in FY01

Testing various barcoding labels for durability in field conditions

Testing various handheld devices (will leverage off of DIS/SE/06 "Geographic Data Servers for Wireless Clients" from FY2001) to see what will work the best in marine field conditions

Successful implementation of the appropriate type of asset management system software to use for the mooring equipment tracking

Successful integration of asset management software with existing FOCI mooring management software

Successful connectivity between the handheld device and the SCS system for operations logging

Field season implementation of wireless application – deployment and retrieval if during the same funding cycle

### **Milestones**

- Month 01 – meet with mooring engineers and field operations specialists to determine specifications for barcode labels, devise labelling protocol
  - review results of previous HPCC projects to investigate ruggedized handhelds and laptop computers
  - research barcode readers and software for asset tracking
  - have meeting with OMAO regarding wireless network connection to SCS system and how to build the operations logging module
  - deploy example barcode media and scanner to test durability in marine conditions
- Month 02- design barcodes and order printer, labels and barcode scanner
- Month 02- purchase handhelds, scanner and laptop, configure software for asset tracking
- Month 03- purchase equipment for wireless connectivity, test on land, install on ship
- Month 04- begin wireless network connection testing with ship and SCS logging
  - test software and hardware configurations for mooring management
- Month 05 –write interface to mooring management database
- Month 07- test barcode reader and mooring equipment tracking in lab
- Month 08- trial with barcode reader at sea
- Month 09- revise system based on results of sea trials
- Month 10- complete work on SCS to mooring management link
- Month 12- write user’s guide to mooring asset management

### **Deliverables**

- Deployment and retrieval tracking system using barcoding and wireless technology
- Successful integration of SCS module to send data to a wireless application for integration with deployment and retrieval of mooring instruments
- Integration of barcoded information with FOCI’s Mooring Management system
- Documentation on barcoding system and any PMEL written software to be packaged as requested