

Ocean-TUNE: A Community Ocean Testbed for Underwater Wireless NETWORKS

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Motivations

- Simulations have limitations
 - No commonly accepted acoustic channel model
 - Unique features of the practical systems
- No common platform to validate research work in real world scenarios
- No real experiment data repository and advanced configurable acoustic modems

Objectives

- Explore practical issues such as communication/network dynamics and cross-layer optimization
- Encourage a rapid growth of the UWN community
- Facilitate the research of the community
- Move the whole field to the next milestone

Broader Impacts

- Societal Impacts
 - Enable a wide range of research within the community:
 - Communication
 - Networking
 - Engineering
 - Marine science
 - Promoting unprecedented progress towards practical solutions in diverse aquatic applications
- Educational Impacts
 - Afford a unique hands-on learning environment for undergraduate and graduate students
 - Serve as a powerful means for engaging K-12 students and teachers

Broader Impacts (Cont.)

- Industrial Impacts
 - Demonstrate the capacity of underwater wireless networks
 - Encourage commercial applications:
 - Surveillance
 - Health
 - Climatology
 - Meteorology
 - Oceanography
 - etc.

Ocean-TUNE Overview (1)

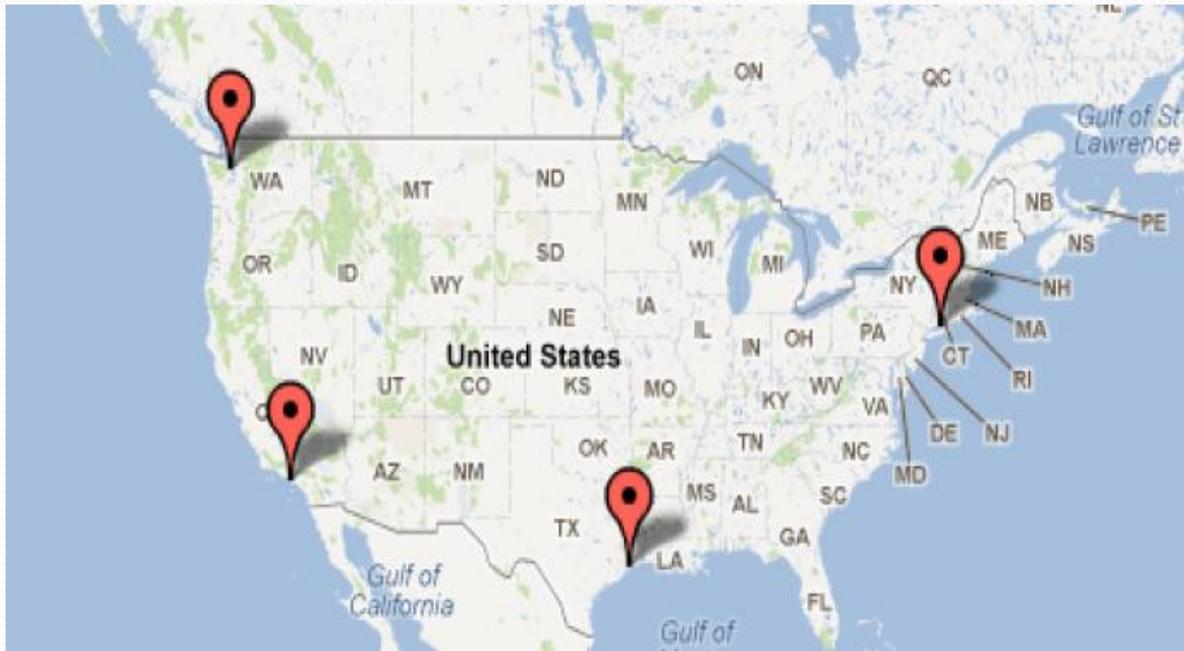
- **Ocean Testbed for Underwater Networks**
- An open testbed “suite” accessible to the public
- Collective efforts from four universities
 - University of Connecticut (UConn)
 - University of Washington (UW)
 - University of California Los Angeles (UCLA)
 - Texas A&M University (TAMU)
- Diverse Coverage of the US coast

Ocean-TUNE Overview (2)

- Key features
 - Ubiquity
 - Economy
 - Flexibility
 - Openness
 - Configurability
 - User-friendliness
- Supported by NSF CRI
 - UConn (lead), UW, UCLA, TAMU
 - \$2,635,000 for 3 years
- URL: <http://www.oceantune.org/>

Ocean-TUNE Overview (3)

- Sea Testbed with 4 sites:
 - Long Island Sound
 - Santa Monica Bay
 - Galveston Bay
 - Hood Canal



Site	Location	Surface Nodes	Bottom Nodes	Mobile Nodes	Reconf. Modems
UConn	Long Island Sound	3	5	2 Slocum Gliders	2
UW	Hood Canal	2	2	1 Seaglider	2
UCLA	Santa Monica Bay	1	2	1 Drogue	-
TAMU	Galveston Bay	2	1	-	2

Research Activities

- Tempo-Spatial Multi-level Dynamics (UConn)
 - Robust Channel Solutions
 - Reliable Link Solutions
 - Resilient Network Solutions
- Adaptive Physical and MAC Layers (UW)
 - Adaptive physical layer modulation and modem signal processing based on OFDM modulation
 - Adaptive cognizant MAC protocols that effectively support broadcast functionalities
- Efficient Localization Schemes (UCLA)
 - Dive'N'Rise (DNR) Positioning
 - Network-based Localization
- Software-Defined Acoustic MIMO-OFDM (TAMU)
 - Space, time, frequency, power, and code

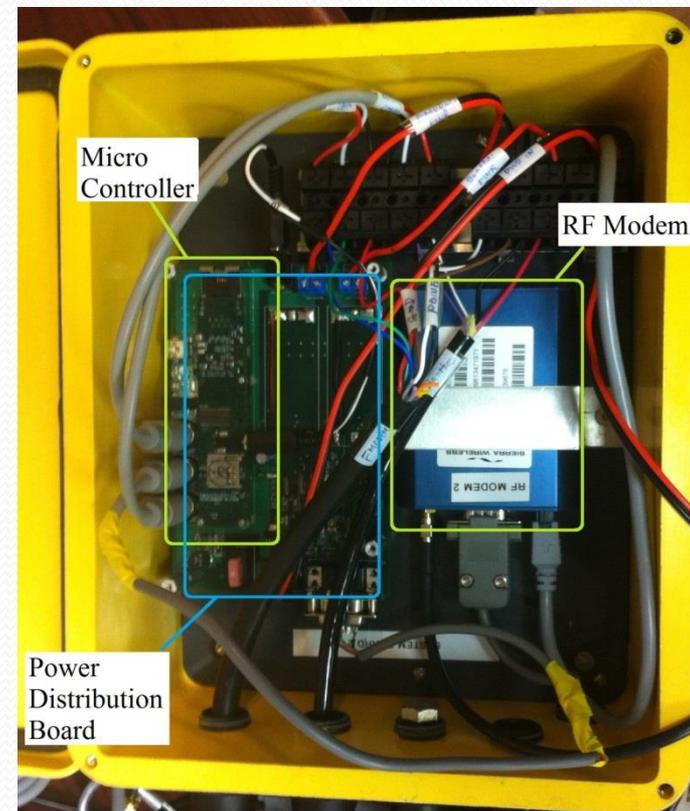
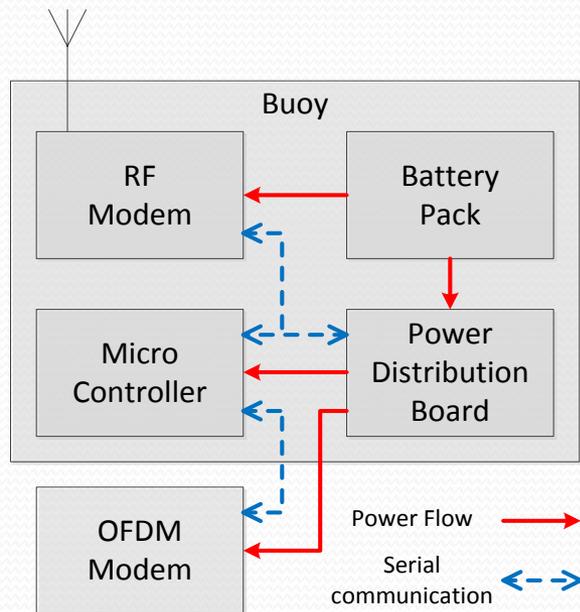
Ocean-TUNE Hardware (1)

- Acoustic Modems
 - Benthos ATM-885
 - Handle multipath up to 25ms at 600bps
 - High speed mode up to 15,360 bps
 - AquaSeNT modem
 - Handle multipath up to 150ms at 6,300bps
 - High speed mode up to 9,000 bps



Ocean-TUNE Hardware (2)

- System Board (UConn Version)
 - RF modem
 - Power Distribution Board
 - Micro-controller
 - Battery Pack



Ocean-TUNE Hardware (3)

- Surface Nodes (UConn Version)
 - Solar panels
 - A radar reflector and flasher
 - A surface wireless communication system
 - A splash-proof compartment
 - Acoustic modems
 - A GPS unit
 - An anchor



Ocean-TUNE Hardware (4)

- Bottom Nodes (UConn Version)

- A bottom A-frame
- A waterproof compartment
- An acoustic releases
- An Acoustic modem
- A small floatation device



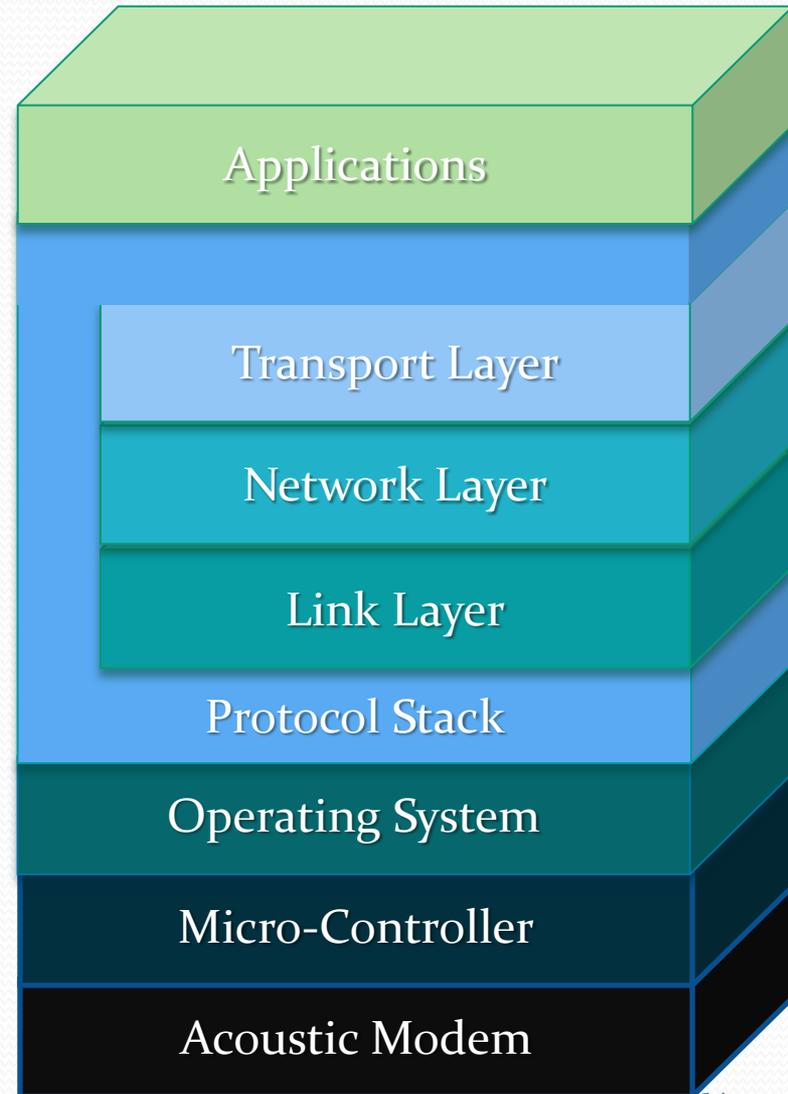
- Underwater Glider

- Slocum Gliders (from Webb Research)



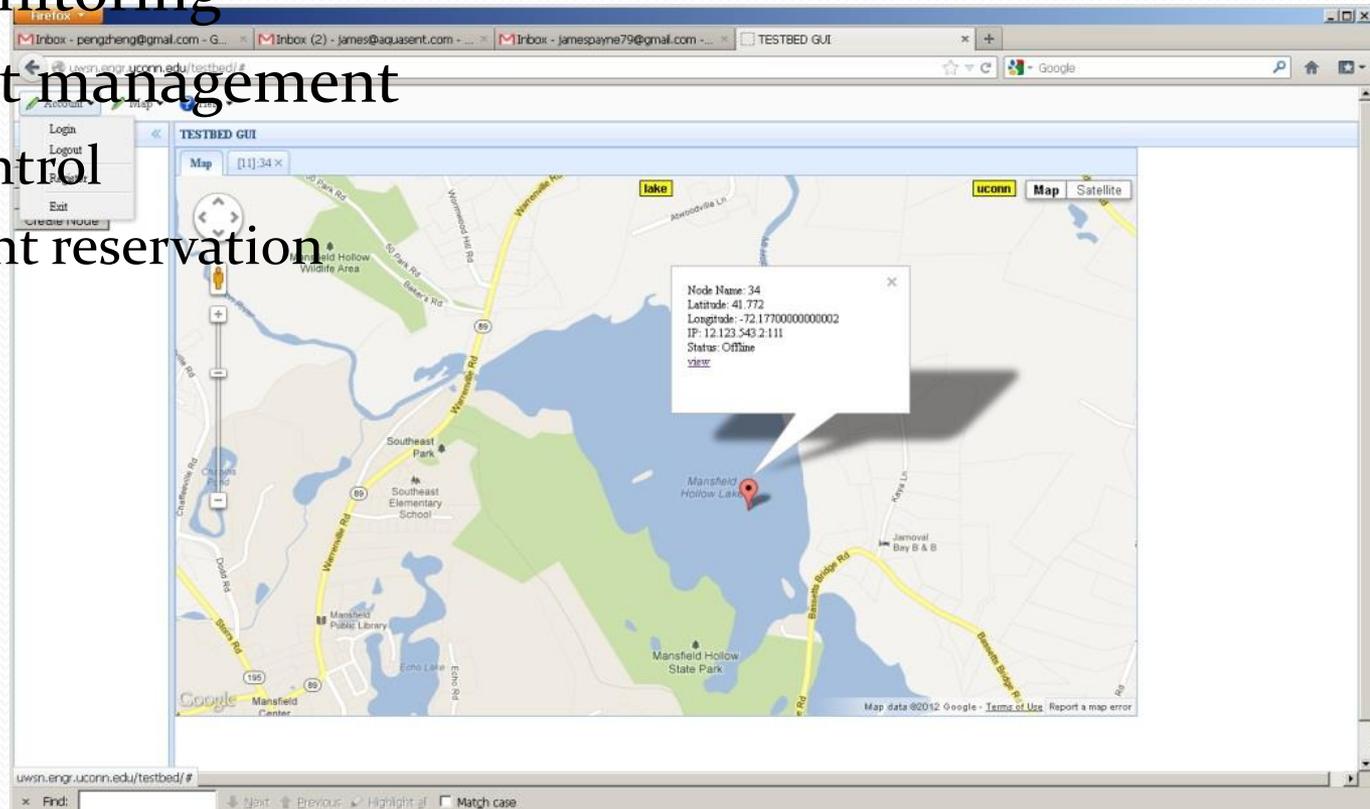
Ocean-TUNE Software (1)

- Networking Development Kit
 - A comprehensive, reliable, and configurable underwater acoustic network solution
 - Each kit includes:
 - A network development framework
 - Customized acoustic modem driver(s)
 - A set of sample networking protocols



Ocean-TUNE Software (2)

- Web-based Graphic User Interface (GUI)
 - Easy access
 - Remote control
 - Online monitoring
 - Experiment management
 - Access control
 - Experiment reservation

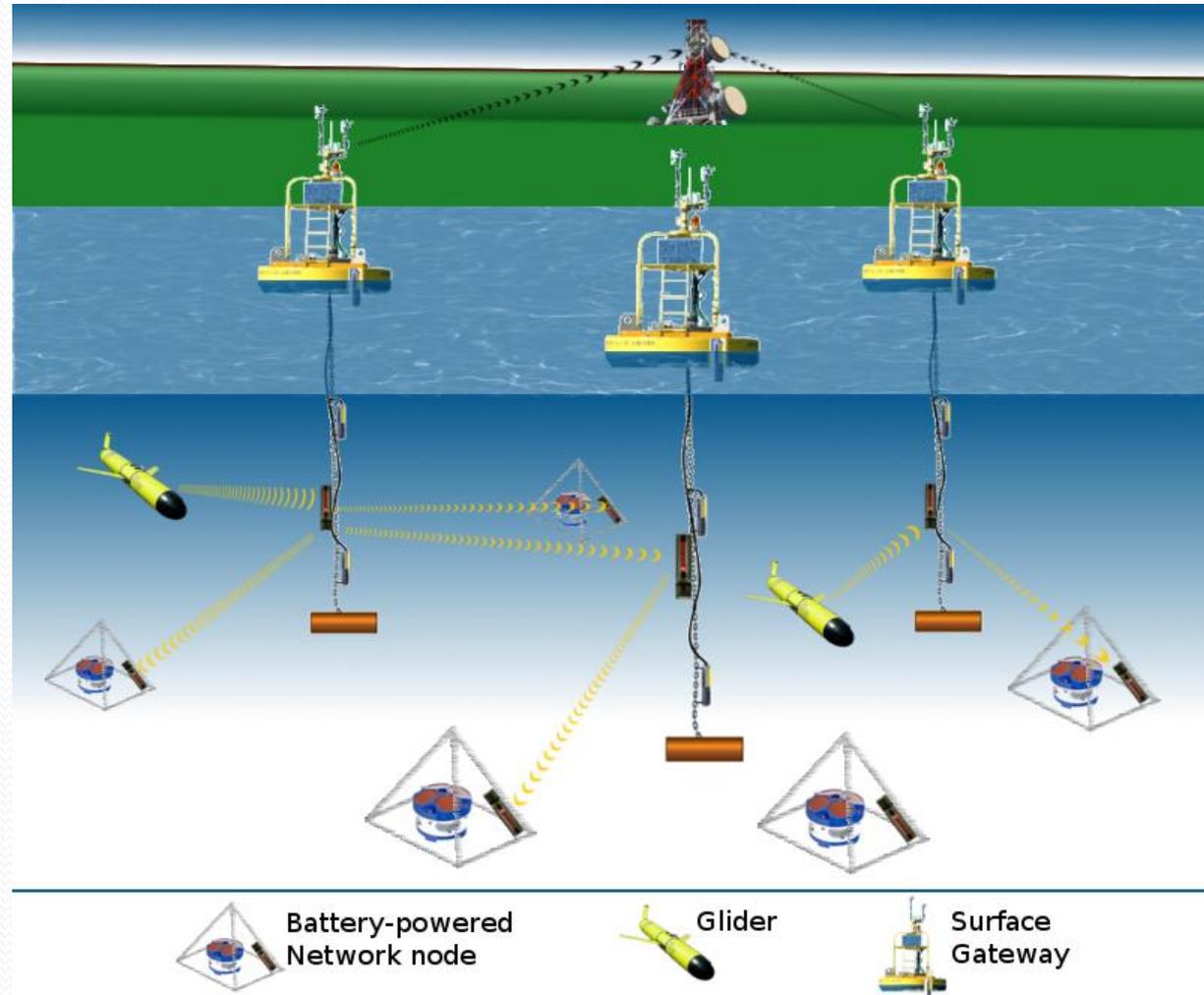


Ocean-TUNE Software (3)

- Acoustic Remote Control
 - Necessity
 - Enable remote control and monitoring for underwater nodes
 - Responsibilities
 - Remote control
 - Online monitoring
 - Node reprogramming
 - Real-time data collection
 - Practical Issues
 - Security
 - Reliability
 - Multi-hop networks
 - Overheads: bandwidth, energy, efficiency, etc.

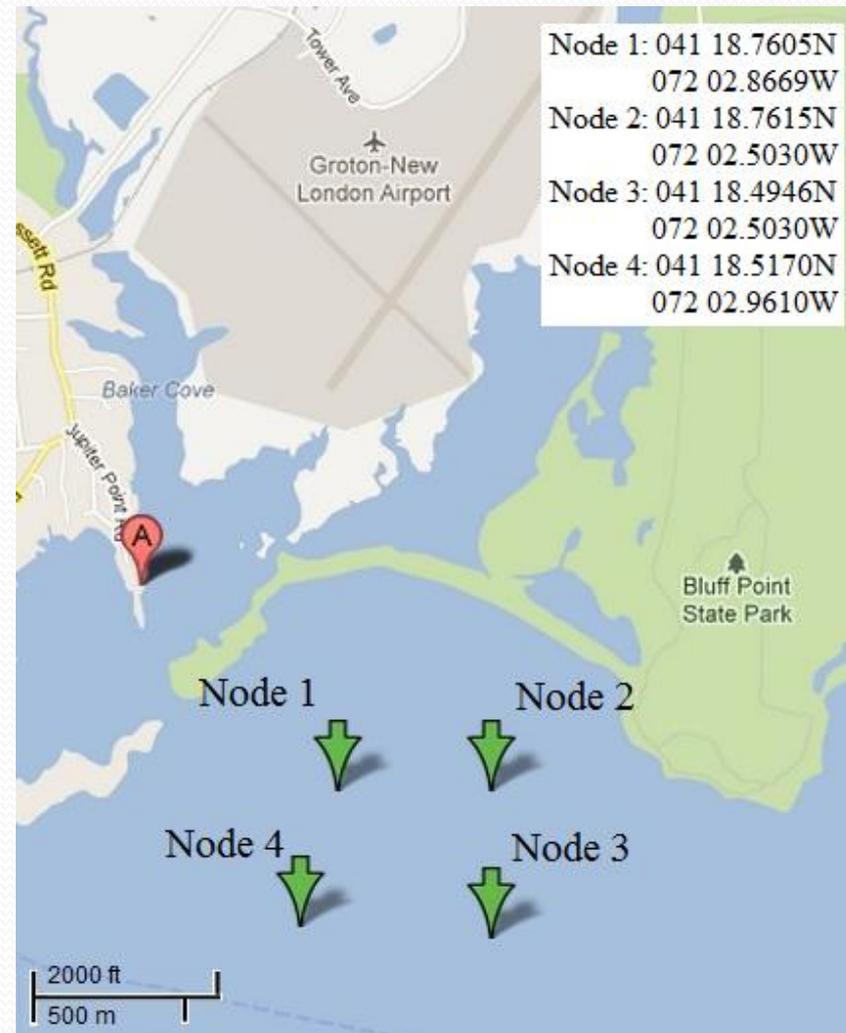
UConn Testbed Vista

- Location:
 - Long Island Sound
- Water depth:
 - 20~80 meters
- Facilities
 - 3 surface nodes
 - 5 underwater nodes
 - 3 underwater gliders



Long Island Sound Deployment

- Initial testbed deployment
- Location:
 - Near Avery Point Campus
- Experiment date:
 - Aug 14~27, 2012
- Number of nodes:
 - 4 surface buoys



Conclusions

- Ocean-TUNE is a community testbed that opens to public
- It consists of four test beds in the US
- Diverse coverage in terms of geography and weather
- Major properties
 - Ubiquity
 - Economy
 - Flexibility
 - Openness
 - Configurability
 - User-friendliness

THANKS!



Questions
&
Comments?