Ocean Observing System Instrument Network Infrastructure (SENSORS)
Observatory Middleware Framework (OMF)
Ocean Observing Initiative: Network for Ocean Research, Network and Interaction (NORIA)

Duane R Edgington

MBARI (Monterey Bay Aquarium Research Institute)
Moss Landing, California, USA

Agenda today

Briefly describe three USA activities defining and prototyping environmental (ocean) instrument interface and data management systems:

- Ocean Observing System Instrument Network Infrastructure (SENSORS)
- Observatory Middleware Framework (OMF)
- Ocean Observing Initiative Network for Ocean Research, Network and Interaction (NORIA)

Prototype funded by NSF 0330428: Ocean Observing System Instrument Network Interface

Common Themes

- Start with experiences and systems developed for single isolated Moored or cabled to shore observatories.
- Designing for:
  - Collaborative, web access
  - Utilizing Service Oriented Architecture
  - Incorporating Enterprise Service Bus technology
  - Grid enabled
- Requirements:
  - Multiple, diverse platforms (cabled to shore, moored surface expressions, solar powered, diesel powered, associated autonomous mobile platforms
  - Wide geographic distribution
  - Thousands of instruments
  - Distributed data
  - Interactive control
  - (near) real-time data acquisition
  - Event response

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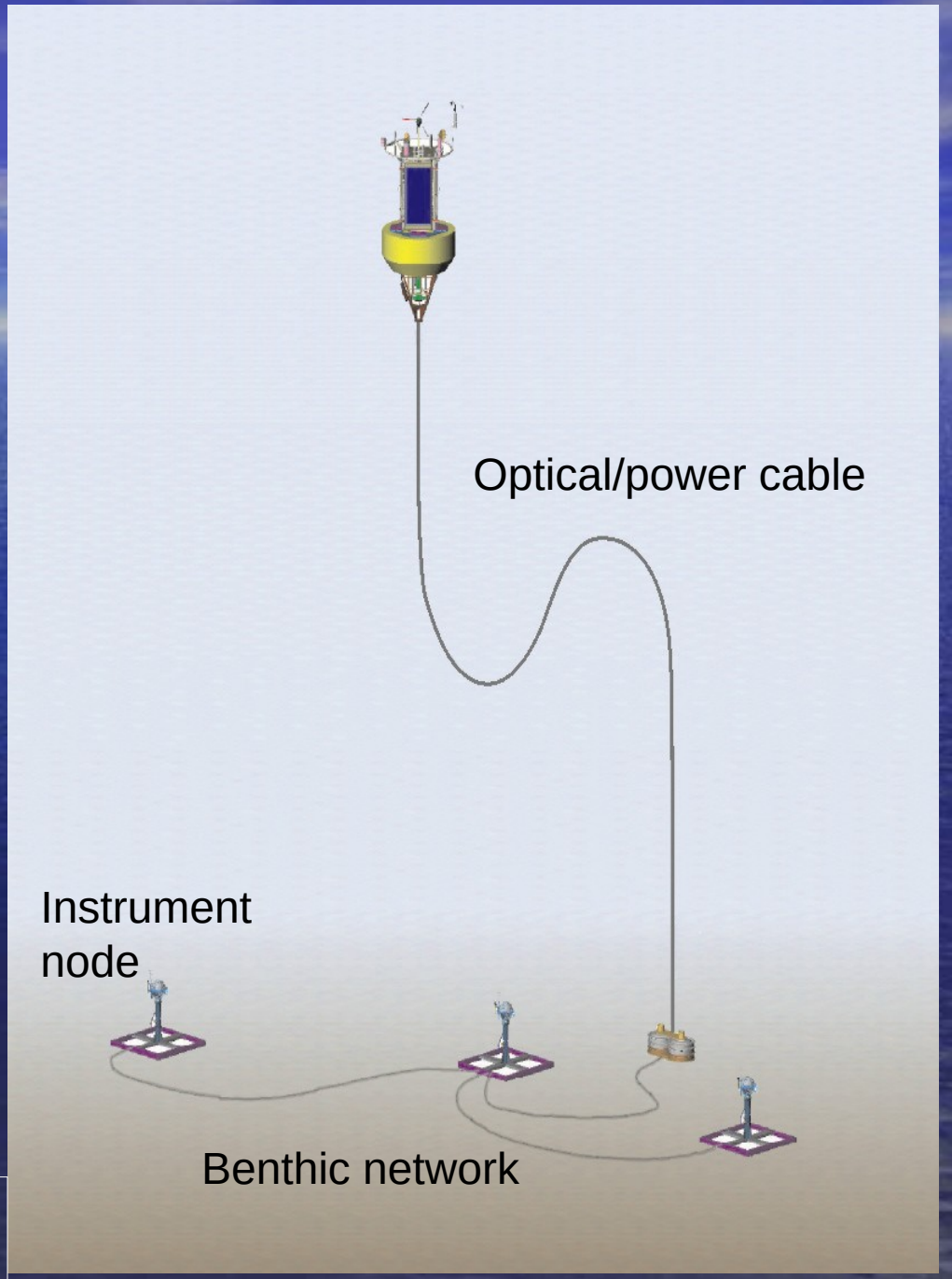
NSF 0330428. SENSORS: Ocean Observing System Instrument Network Interface. 2004-2007.

- "SENSORS" Goal: identify and analyze software 'middleware' requirements for ocean observatories
- First step in standardizing instrument middleware interfaces to system and shore
- Requirements workshop held in 2004
- Application of MOOS (*Monterey Ocean Observing System*) software
  - SIAM (*Software and Applications for MOOS*) Data Acquisition system
  - SSDS (Shore Side Data System) Meta-data driven catalog and archive
  - PUCK (*plug and work technology*) instrument interface/metadata mgmt
- Prototype on Monterey Accelerated Research System (MARS) cabled to shore testbed

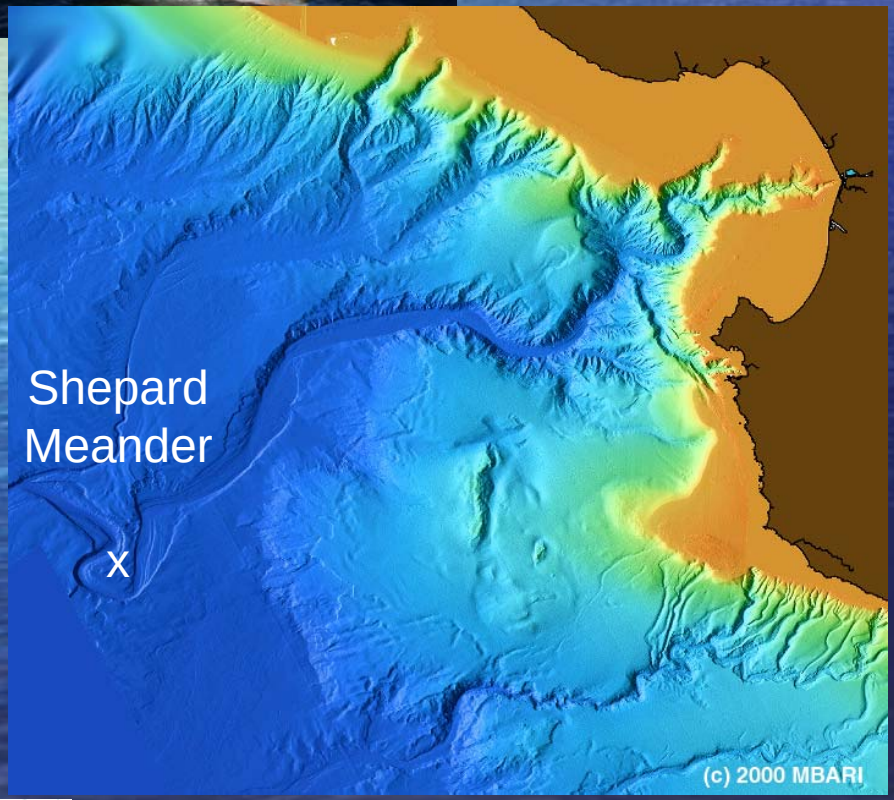
Some SIAM design goals

- Self-configuring system
  - *Minimize manual configuration, improve efficiency and reliability*
  - *Scalable to many instruments*
- Interoperability
  - Instruments and associated software components can be used in multiple observatories



MOOS Science Experiment

Deployed in Monterey Canyon July, 2006



Benthic node, 3200 meters

SIAM Instrument Services

Intermittent RF

Standard network interface to access diverse serial instruments

Get data/metadata, configure instrument, manage power, etc – same Application Programming Interface for any instrument!

Scalable to large-scale systems containing many instruments, *many kinds of* instruments

Shore Side Data System

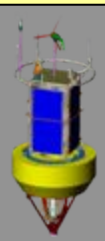
Telemetry retriever

SSDS Interface

Instrument services

Instrument services

Instrument services



Surface

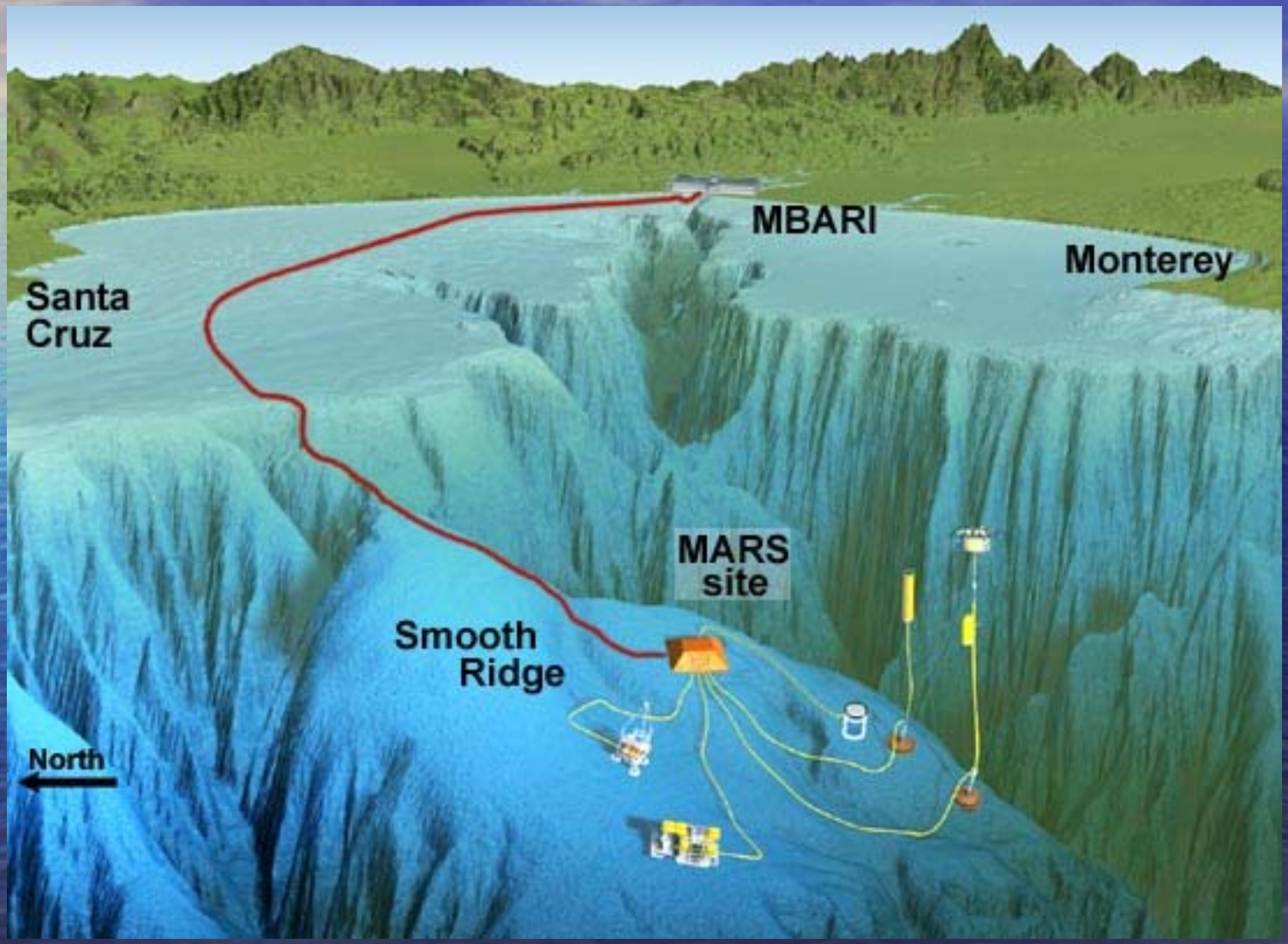
Seafloor 1

Seafloor 2

Shore Network

At-sea Moored Network

Monterey Accelerated Research System (MARS)

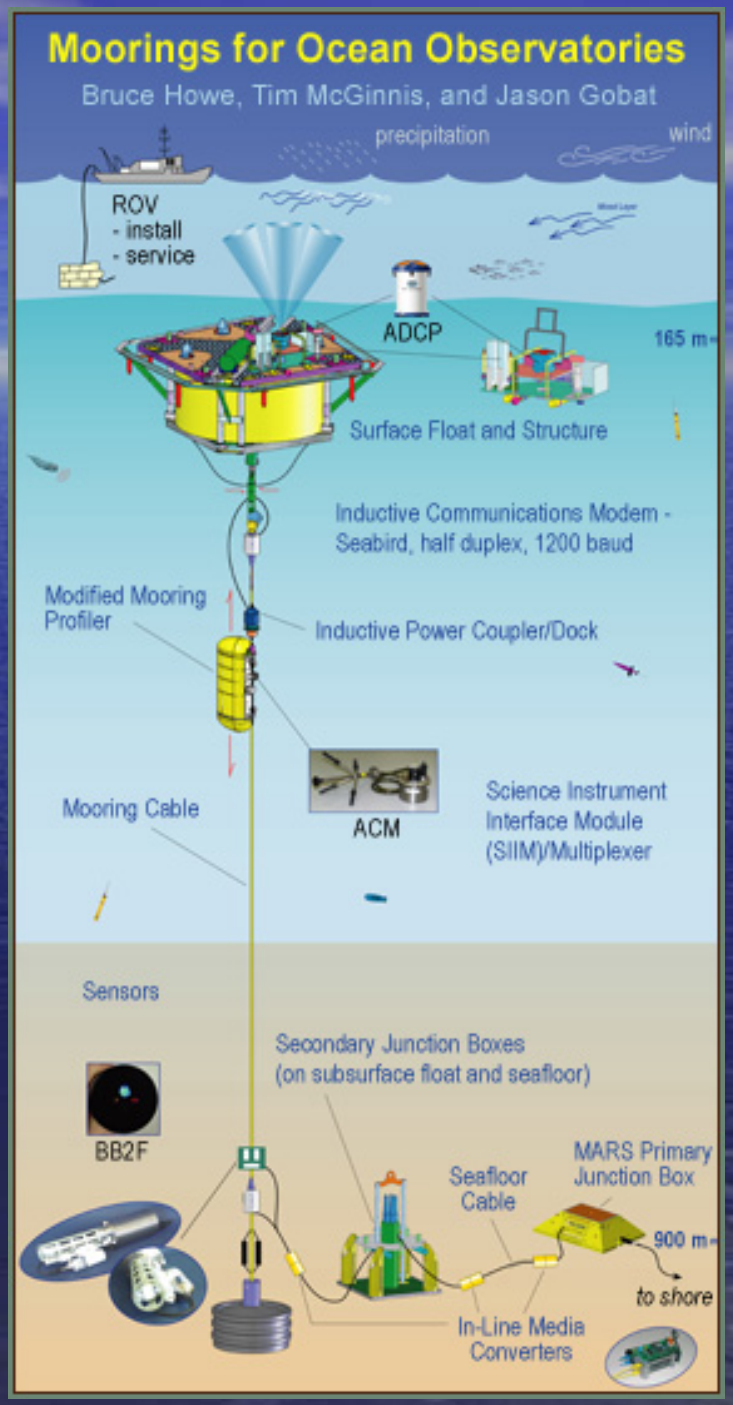


ALOHA/MARS

- **The ALOHA/MARS mooring sensor network** combines adaptive sampling methods with a moored deep-ocean sensor network.
- MBARI supplied SIAM services and SSDS interfaces for two instruments:
  - **CTD: SeaBird SBE-52MP**
  - **Scattering/Fluorometer: Wetlabs ECO-BB**
- Working on ADCP: RDI Workhorse Sentinel

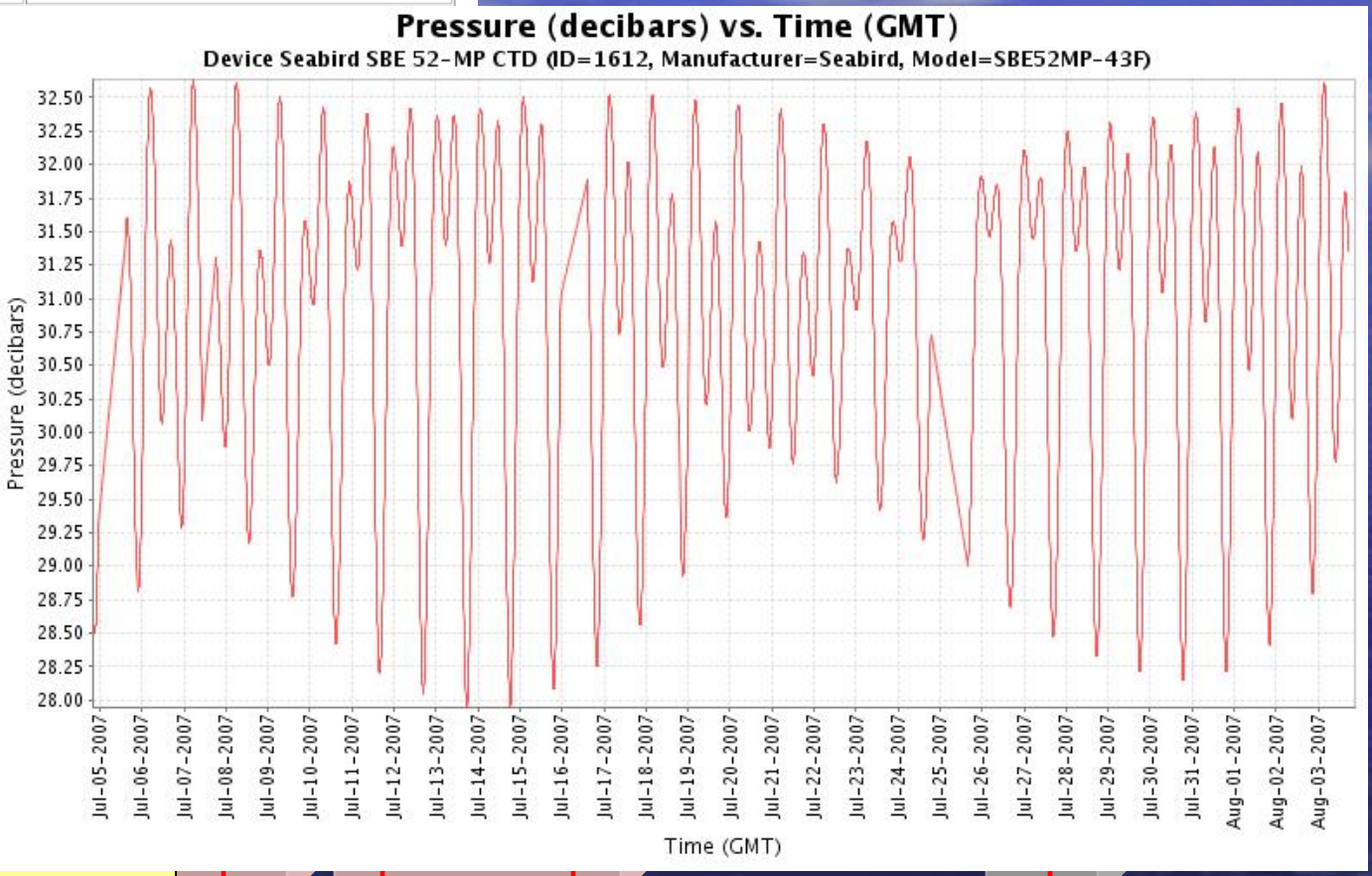
SIAM: Software Infrastructure and applications for MOOS

SSDS: Shore Side Data System



SENSORS and ALOHA

SIAM Timestamp converted to time/date (GMT)	String Representation of Data Buffer
2007-08-03 14:01:45 +0(	
2007-08-03 14:11:45 +0(	
2007-08-03 14:21:45 +0(	
2007-08-03 14:31:45 +0(	
2007-08-03 14:41:45 +0(	
2007-08-03 14:51:46 +0(	
2007-08-03 15:01:46 +0(	



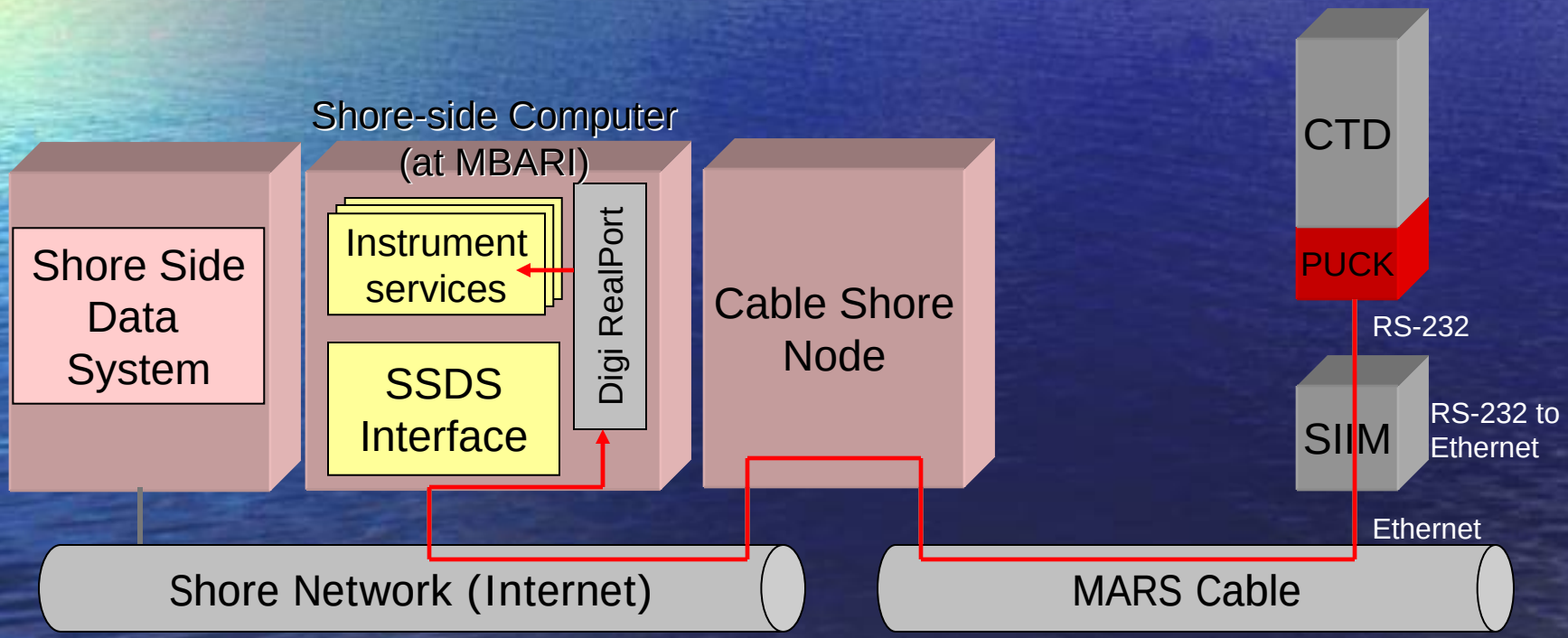
Shore Side Data System

Ethernet

Shore Network (Internet)

ALOHA Cable

SENSORS and MARS



Observatory Middleware Framework (OMF) Project

- Evaluate Enterprise Service Bus (ESB) technology for the federation of instruments deployed within different observatories
- Design and develop crosscutting observatory functions including:
  - Governance
  - Policy enforcement
- Team:
  - University of Illinois Urbana Champagne, National Center for Supercomputing Applications (NCSA)
  - Monterey Bay Aquarium Research Institute (MBARI)
  - Scripps Institution of Oceanography (SIO)
- $500K (US), 3 year, starting fall 2007

OMF Conceptual Architecture

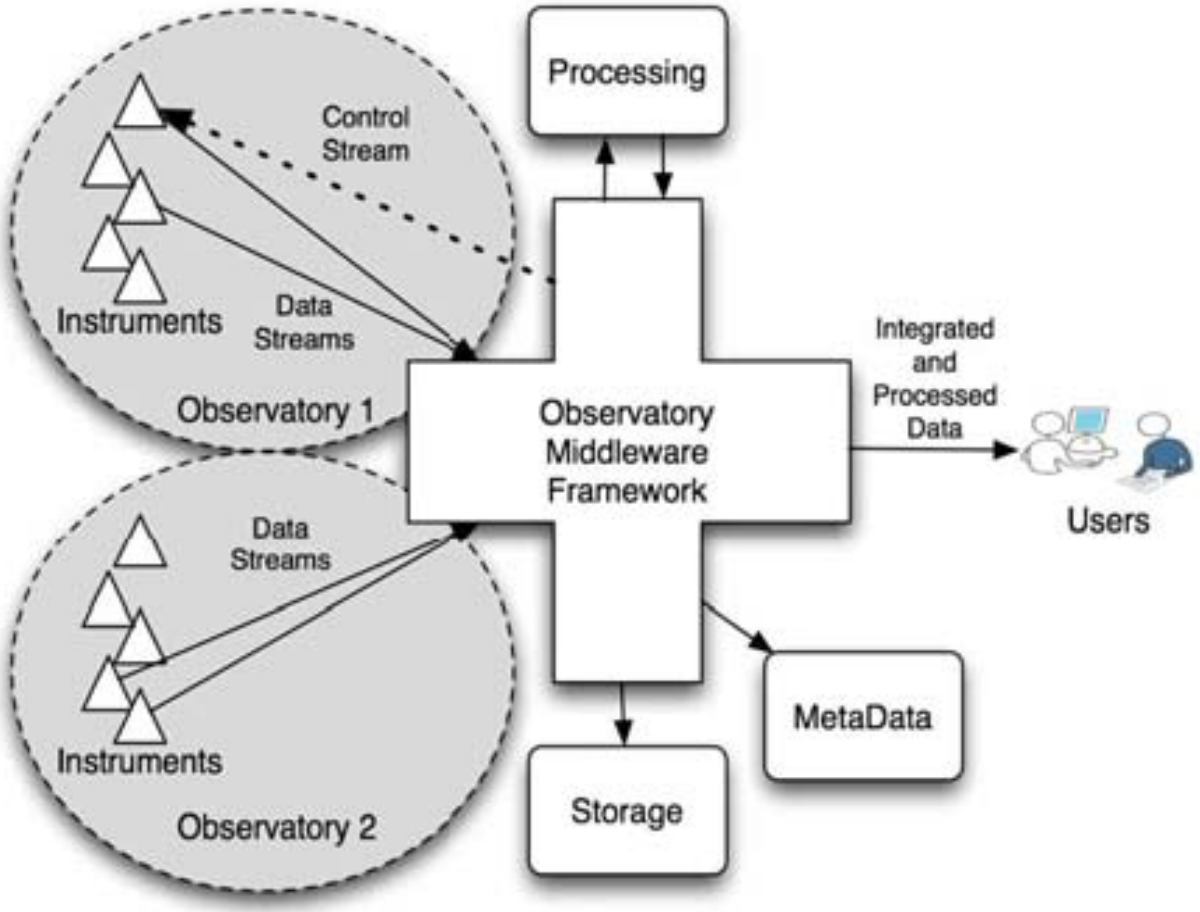


Figure 1: Conceptual architecture of our Observatory Middleware Framework, showing integration of sensor data streams from multiple observatories, processing of streams, and delivering of processed data. Provenence information is collected as metadata. Governance functionality (not show) provides access control.

OMF Prototype

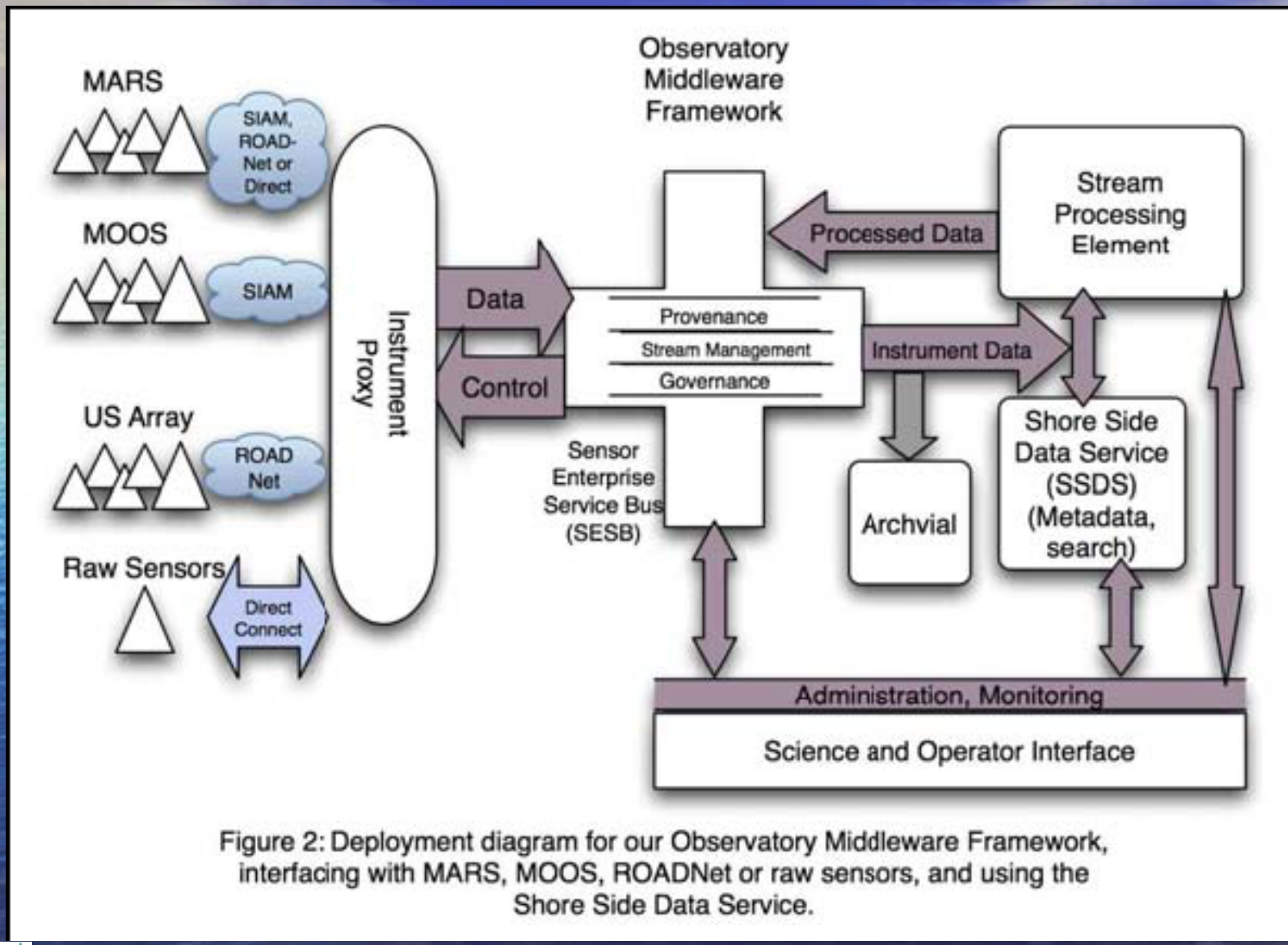
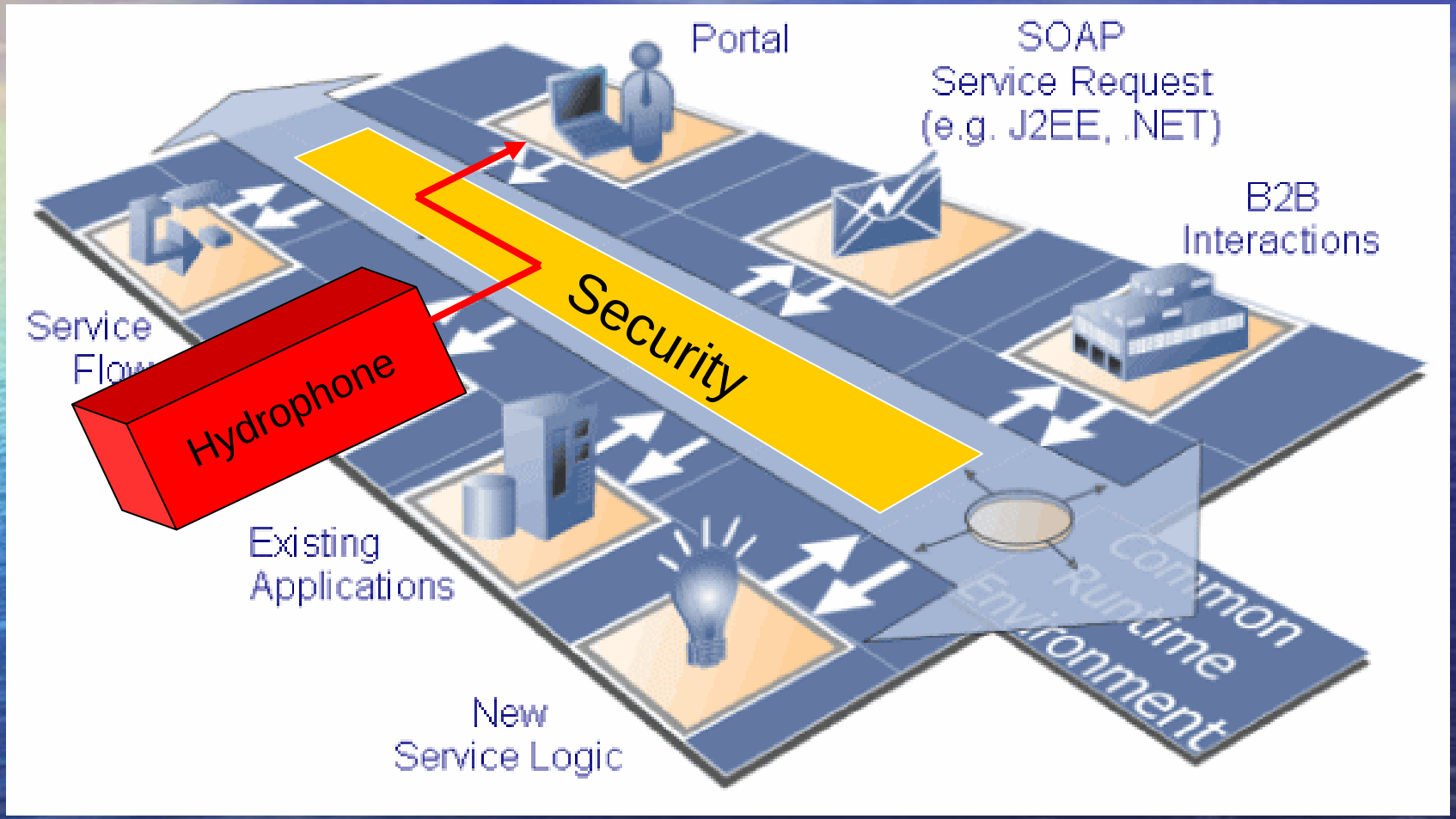


Figure 2: Deployment diagram for our Observatory Middleware Framework, interfacing with MARS, MOOS, ROADNet or raw sensors, and using the Shore Side Data Service.

SENSORS and CI Prototyping



SENSORS and CI Prototyping

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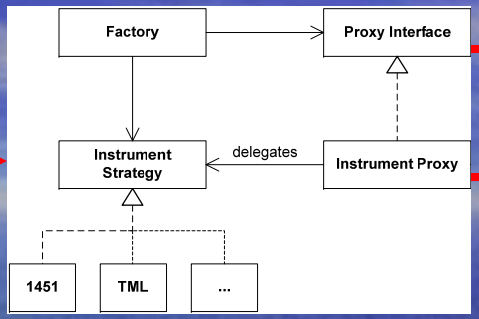
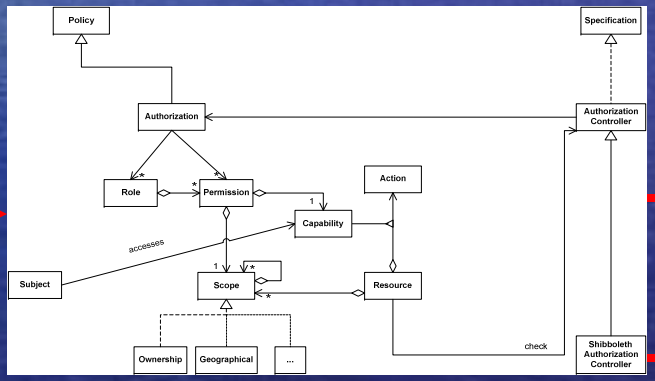


MBARI Enterprise Service Bus

Data Security

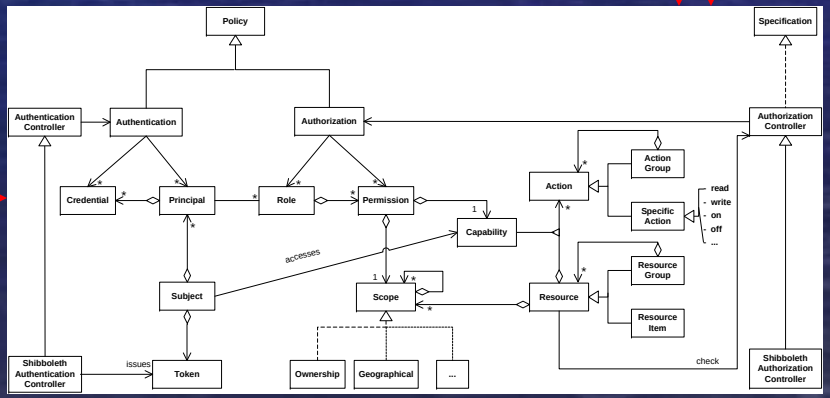
NCSA



NCSA Enterprise Service Bus

Data Security

Scripps/Calit2 (LOOKING)



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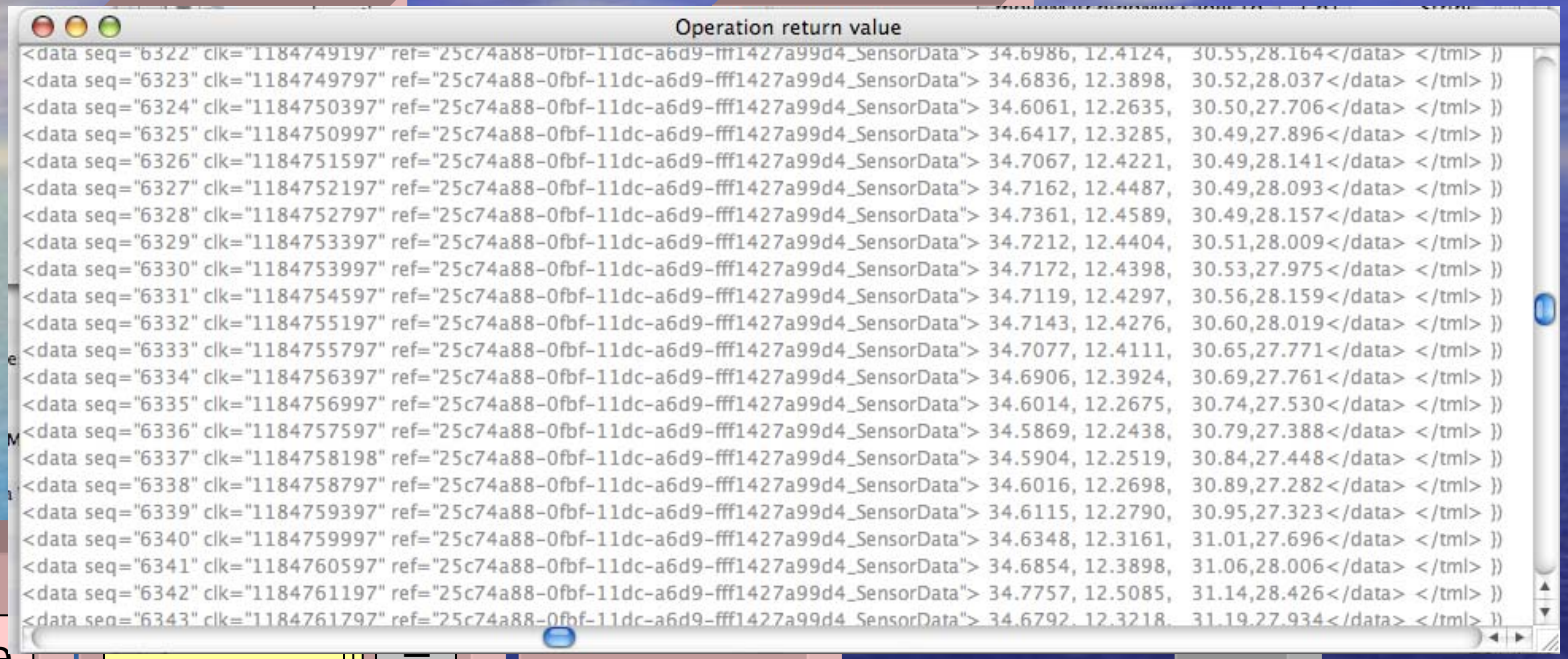
SENSORS and CI Prototyping



Ocean Observatories Initiative Cyberinfrastructure Project: *Network for Ocean Research, Network and Interaction* (NORIA)

- Funded by NSF. Administered by Joint Oceanographic Institutions (JOI)
- Initial award, $29 Million (US), 6 years, starting end 2007 (preliminary design review)
- Potential extension to $42M over 11 years

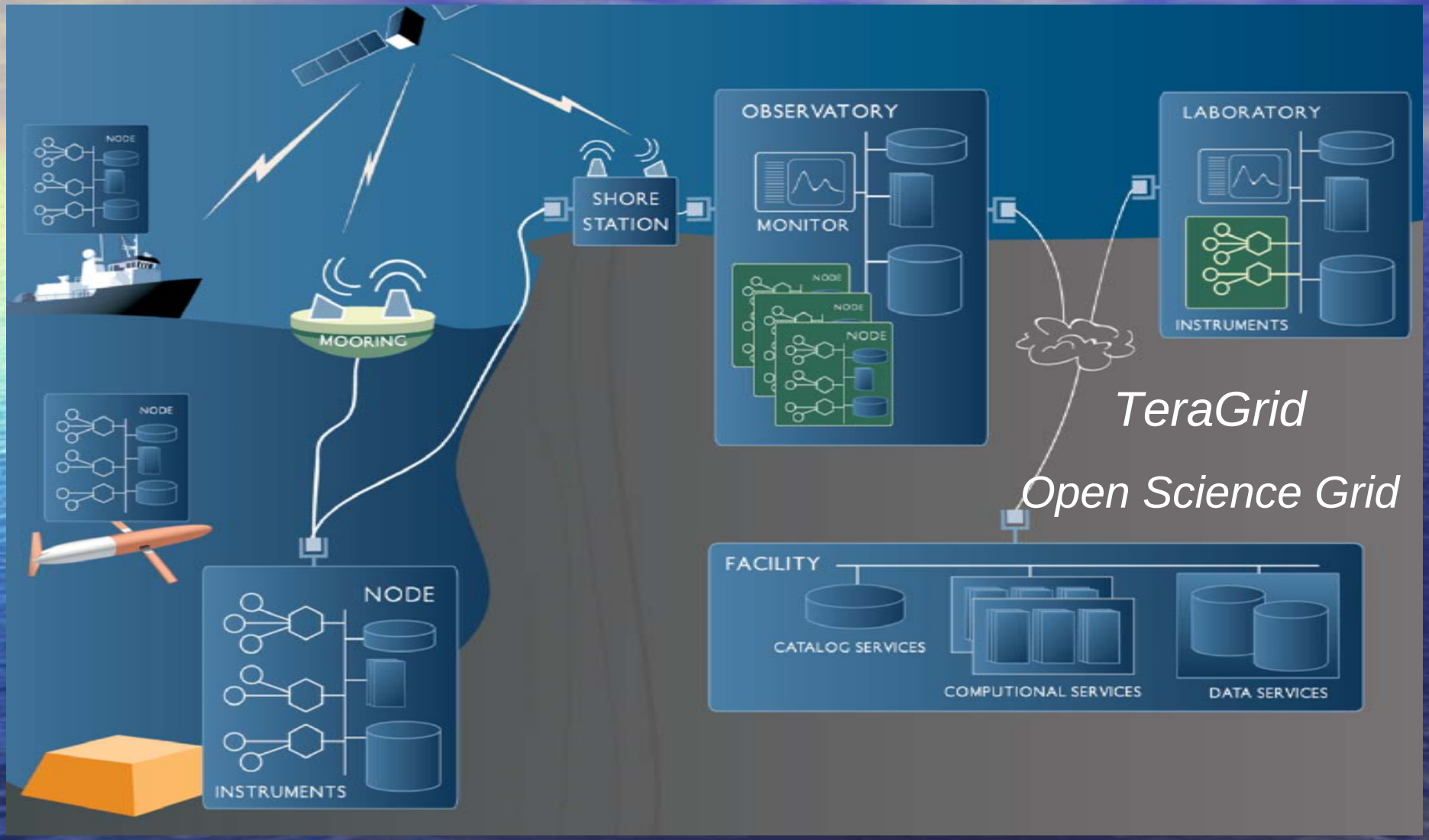
OOI CI Scenarios

- The project's architecture will be configured for certain basic scenarios, including:
  - Monitoring and control of a single observatory, or of multiple observatories;
  - Detecting and responding to an event;
  - Fusion of data from an observatory with a pre-existing ocean model;
  - Design of field experiments;
  - Creation of 'virtual' observatories by combining components distributed among multiple physical observatories.

NORIA Architecture Features

- Leverage the integrative principles of modern, service-oriented computer architecture
- Adopt Enterprise Service Bus, to integrating sensors, storage, scientific laboratories and computing
- Reuse the same software over many scales -- coastal, regional and global

Ocean Observatory Schematic



Partners in the OOI Cyberinfrastructure project include

- **Univ California San Diego**
  - o Scripps Institution of Oceanography
  - o Calif Inst for Telecommunications and Information Tech (CalIt2)
  - o San Diego Supercomputer Center
  - o National Center for Microscopy and Imaging Research

  Academic Partners
  - o NASA Jet Propulsion Laboratory
  - o Massachusetts Inst of Tech, Center for Ocean Engineering
  - o Monterey Bay Aquarium Research Institute
  - o North Carolina State University, Dept. Computer Science
  - o Rutgers University, Coastal Ocean Observatory Lab
  - o University of Chicago, Globus
  - o Univ Southen California, Information Sciences Institute
  - o Univ Illinois UC, National Center for Supercomputing Applications
  - o Woods Hole Oceanographic Institution

  Corporate Partners
  - o Raytheon
  - o Triad Project Management

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Questions?

Duane Edgington

duane@mbari.org

http://www.mbari.org/rd/sensors/sensors.htm