

OOI: An overview (1)

- A NSF-funded project to build a cyber-infrastructure for observing oceans in US and beyond through a network of observatories, with usage span of more than 30 years.
- Integrate real-time data acquisition, processing, storage and sharing for ocean research: sensor data constantly coming from both off-shore and on-shore (e.g. sensor arrays, submarines, high-res under-water cameras, ...), processed by distributed compute nodes.
- Provide access to numerous data and equipments in ocean and on earth for a wide ranging user community under different administrative domains.



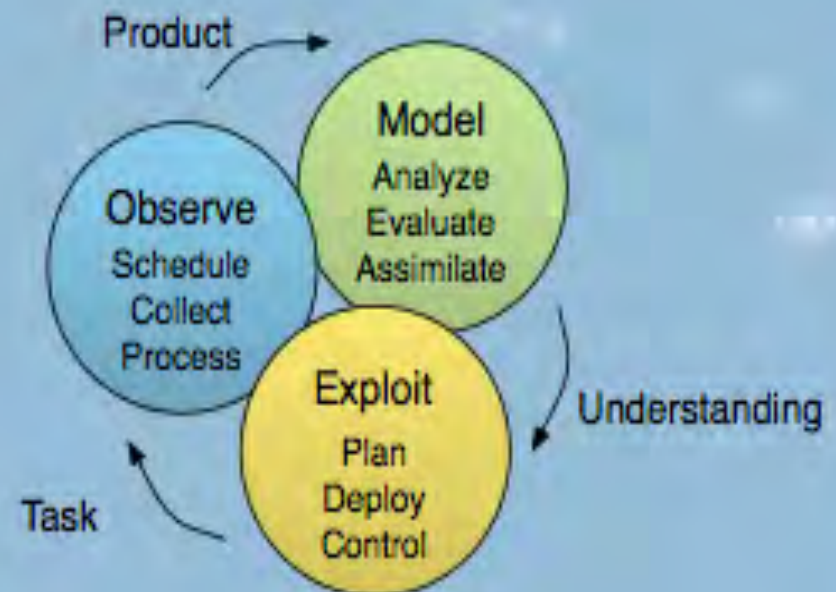


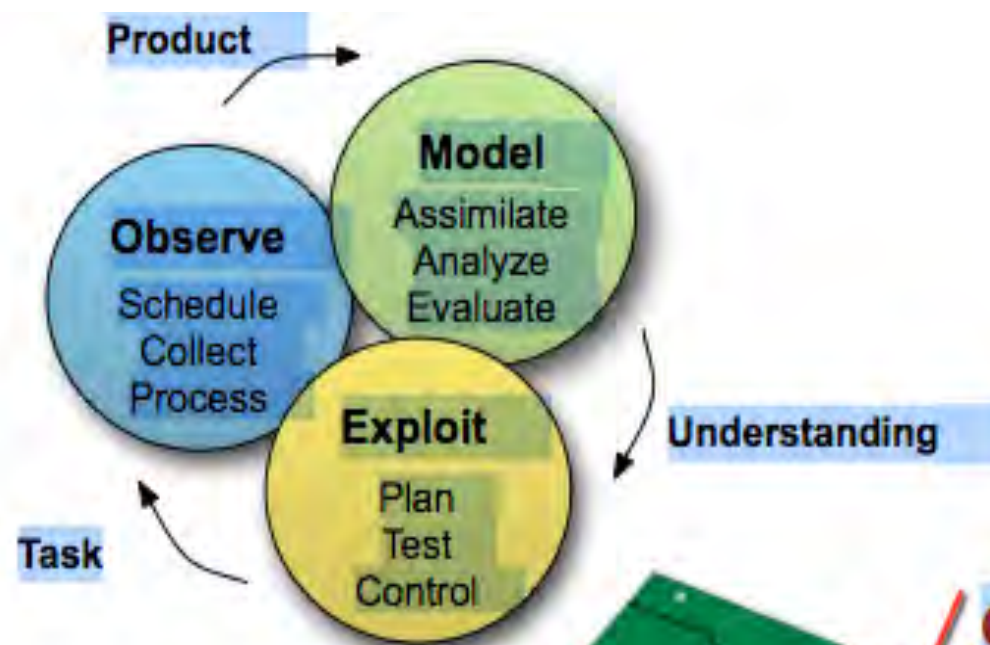
Science & Education Operations



- Interactive Ocean Observing
- Interactive Ocean Modeling & Data Assimilation
- Automated Data Product Generation
- Discipline-Driven Semantic Organization of Data
- Interactive Instrument Network
- Integrated Observatory Management
- User-Driven Integration of Resource

Observatory Activity Model





OOI Mid Atlantic Bight Coastal Array Deployment

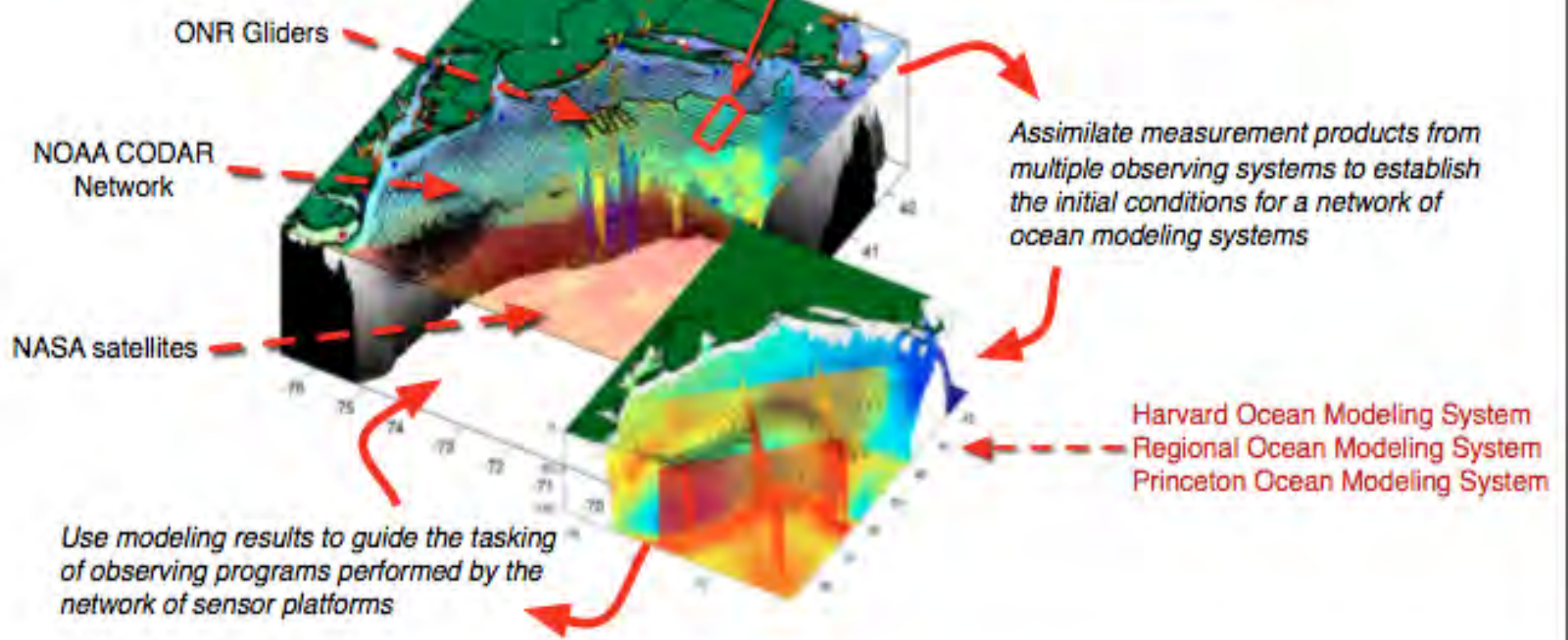




Figure 5: A coordinated set of autonomous underwater vehicles

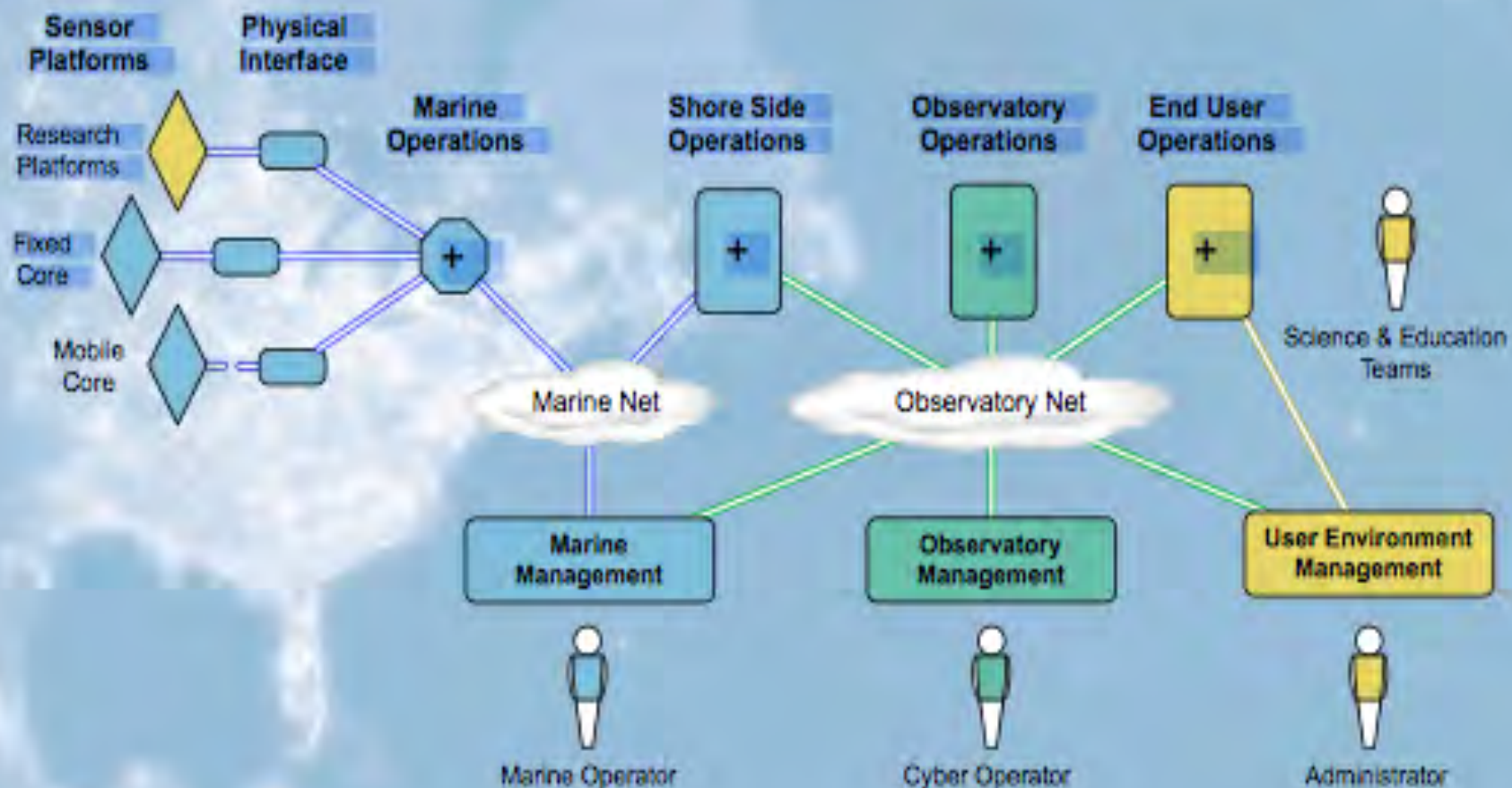


Figure 3: Observatory comprised of ships, aircraft and autonomous vehicles linked to assimilation modeling capabilities on shore

OOI: An overview (2)

- To achieve seamless systems integration, resource sharing and advanced governance, the OOI architecture is built on **communication abstraction** from the ground-up.
- Basis: AMQP offers a uniform abstraction throughout OOI, supported by a high-speed private US-wide backbone network (1Gb/sec), capable of real-time streaming from a high-def. camera without compression, with direct high speed links into Amazon EC2 and MS Azure clouds.
- Governance: distributed governance architecture centring on communication monitoring by local governance agents, covering a wide range of concerns including interactive usage of equipments (see the next slide).

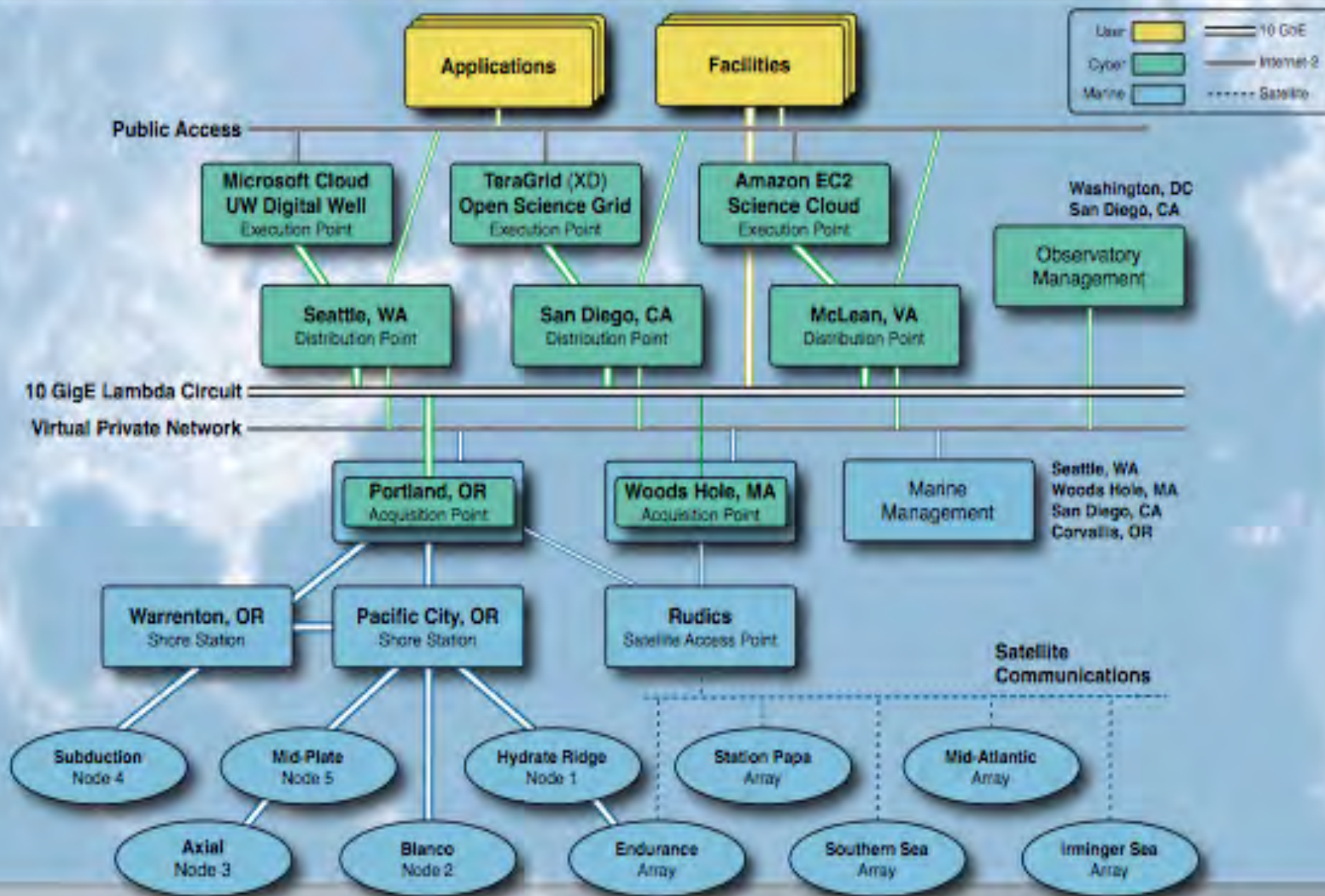
Integrate Observatory Network

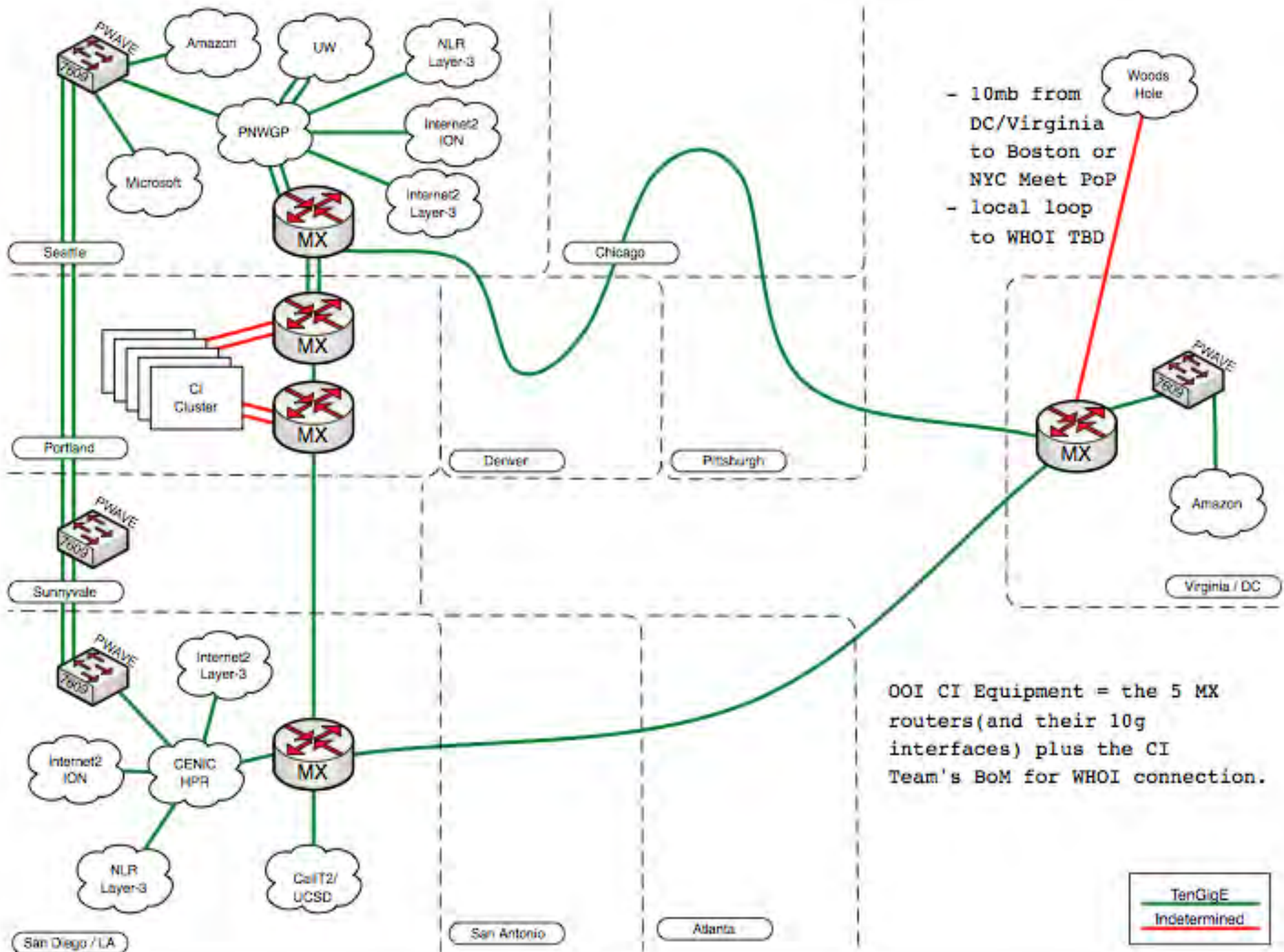




Implementation

DOI





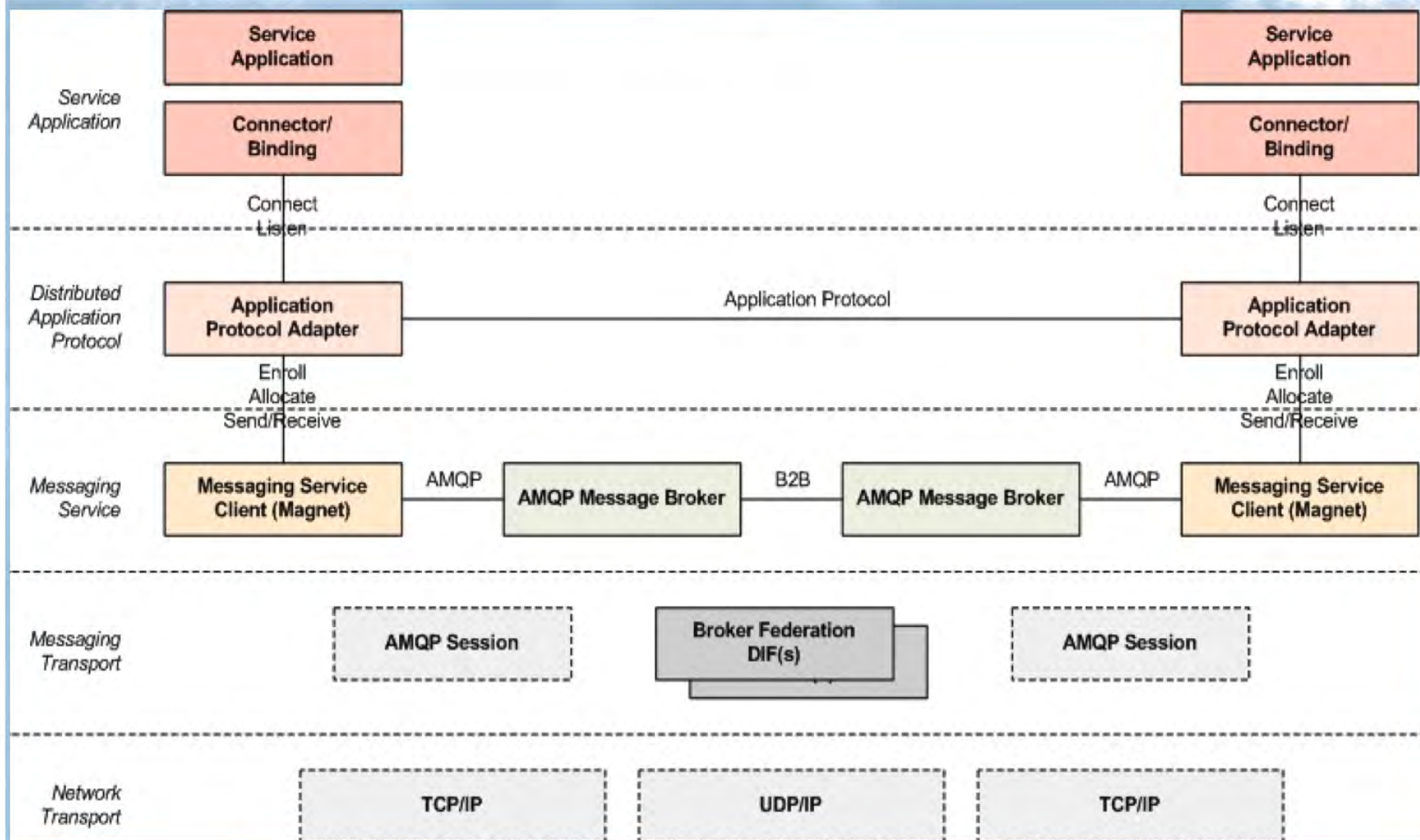
- 10mb from DC/Virginia to Boston or NYC Meet PoP
- local loop to WHOI TBD

OOI CI Equipment = the 5 MX routers (and their 10g interfaces) plus the CI Team's BoM for WHOI connection.

TenGigE
 Indetermined

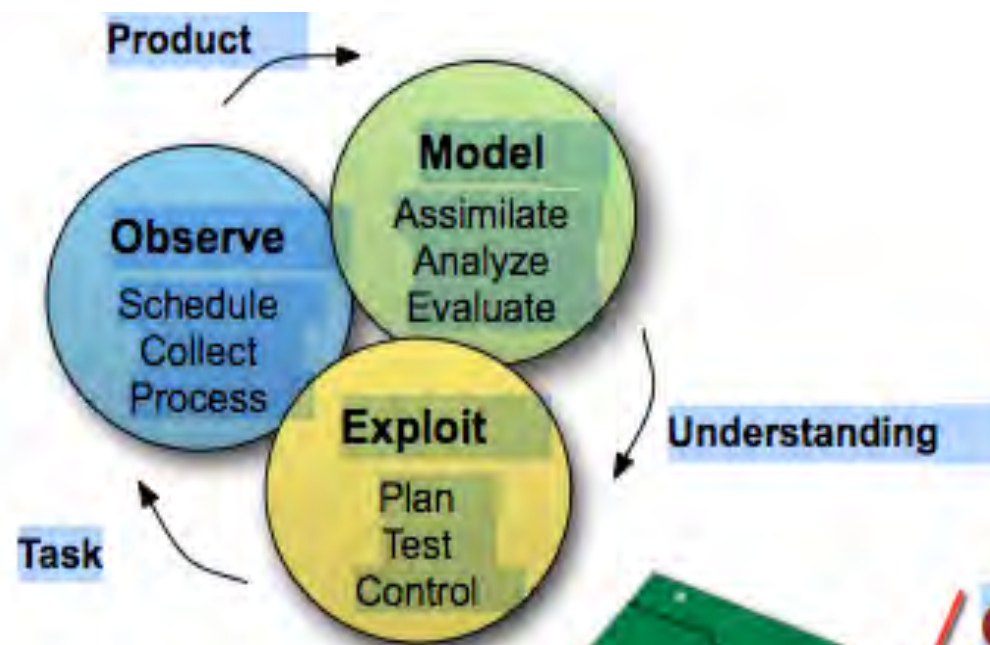


Messaging Service

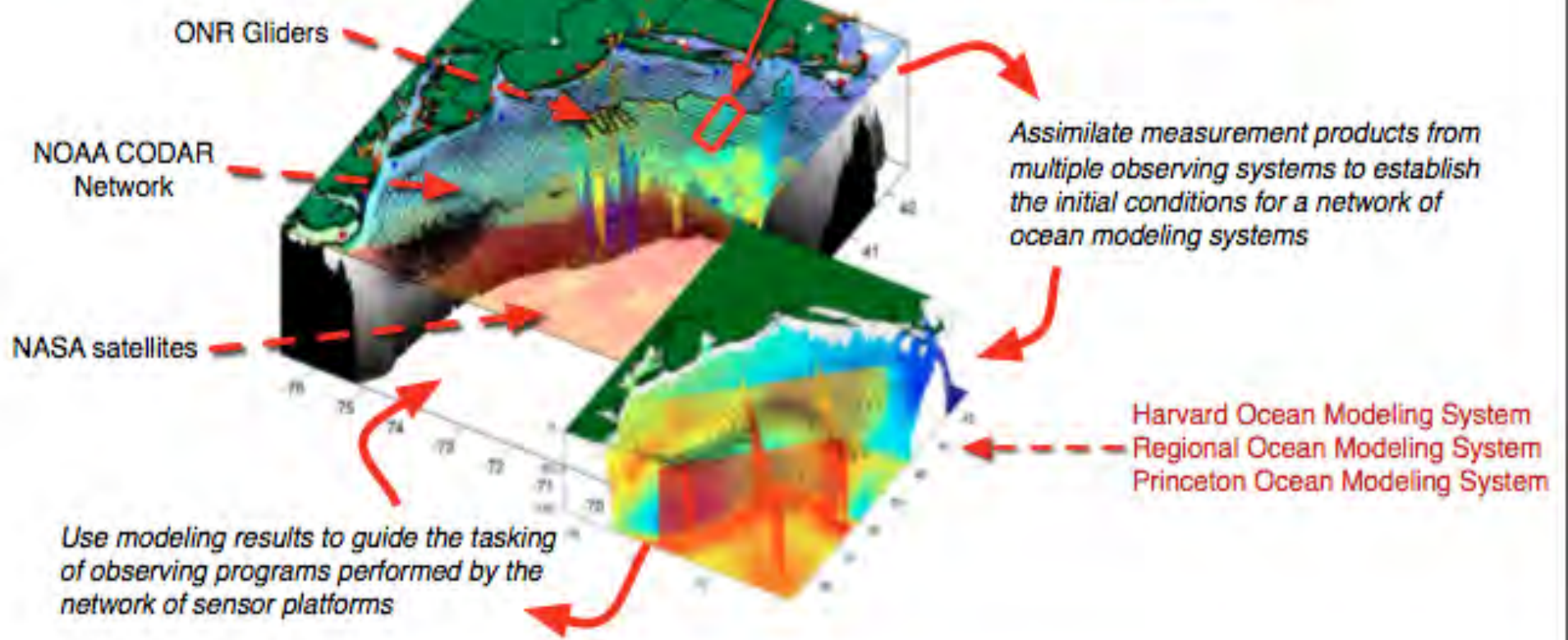


OOI: An Overview (3)

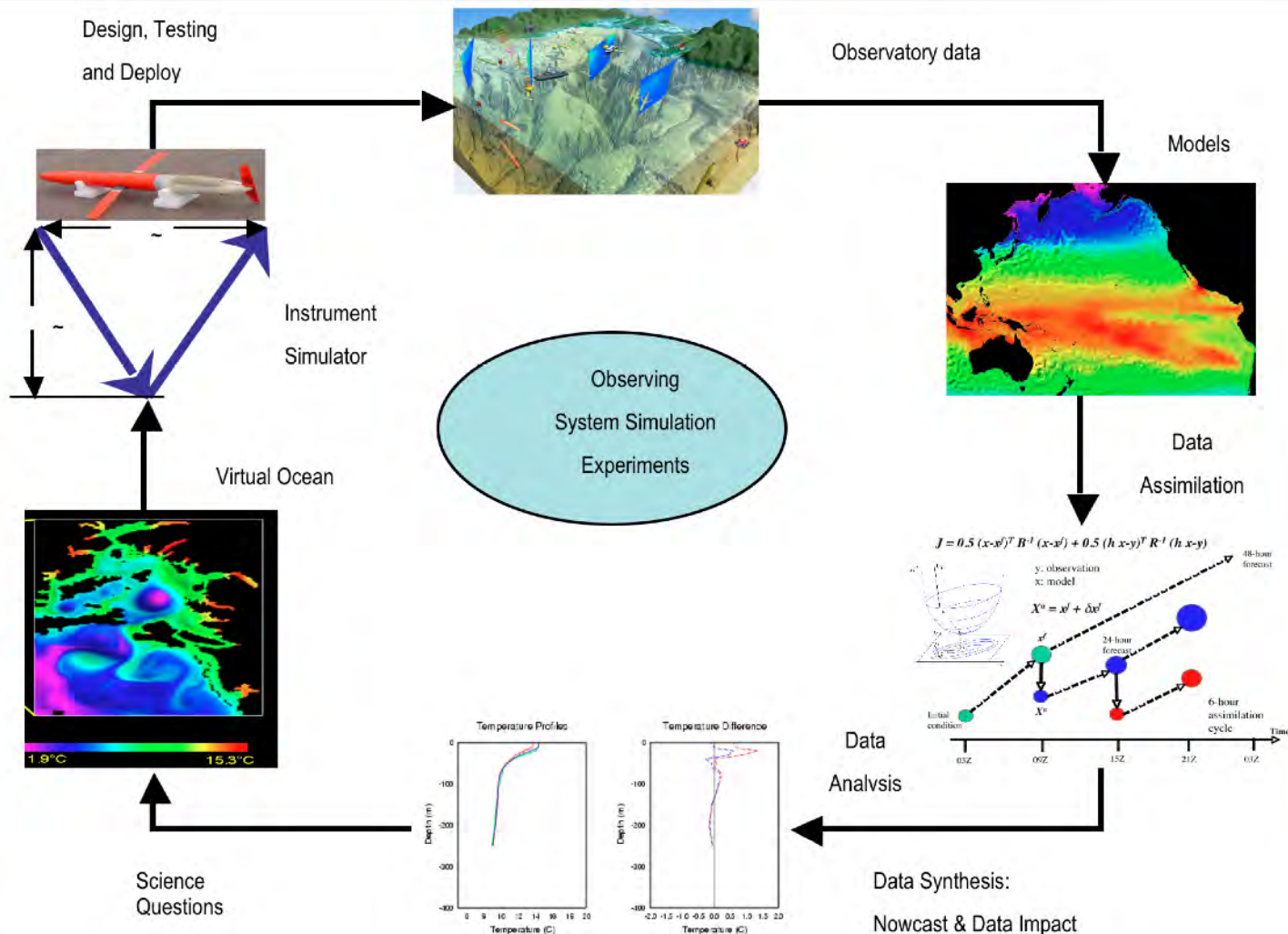
- OOI includes the development of scientific and educational applications that make use of OOI services, written in various programming languages.
- A basic application architecture centres on reactive, protocol-driven interactional components and their aggregations, where components often act as proxies for other agents.



OOI Mid Atlantic Bight Coastal Array Deployment

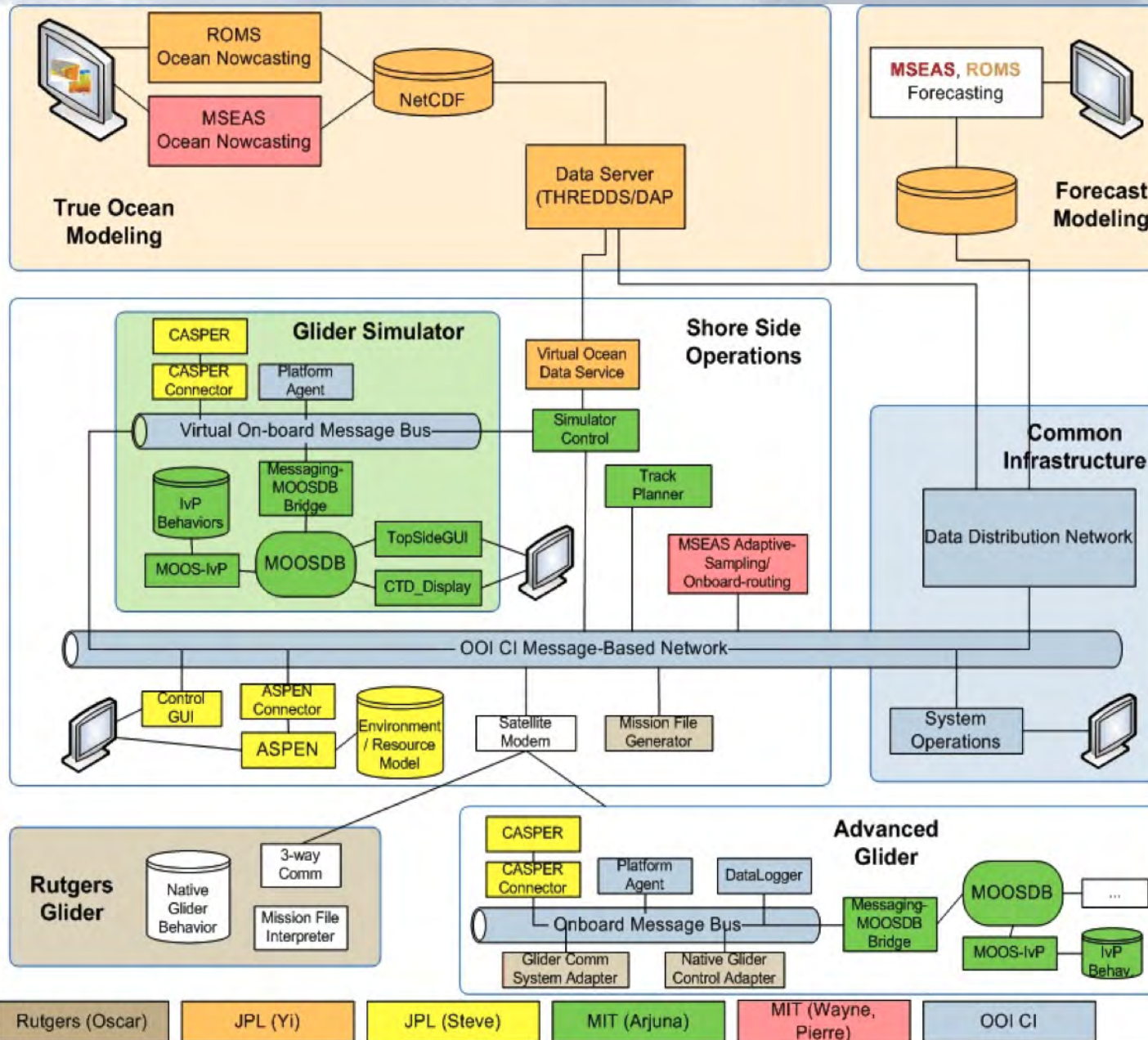


OOI-CI OSSE Workflow



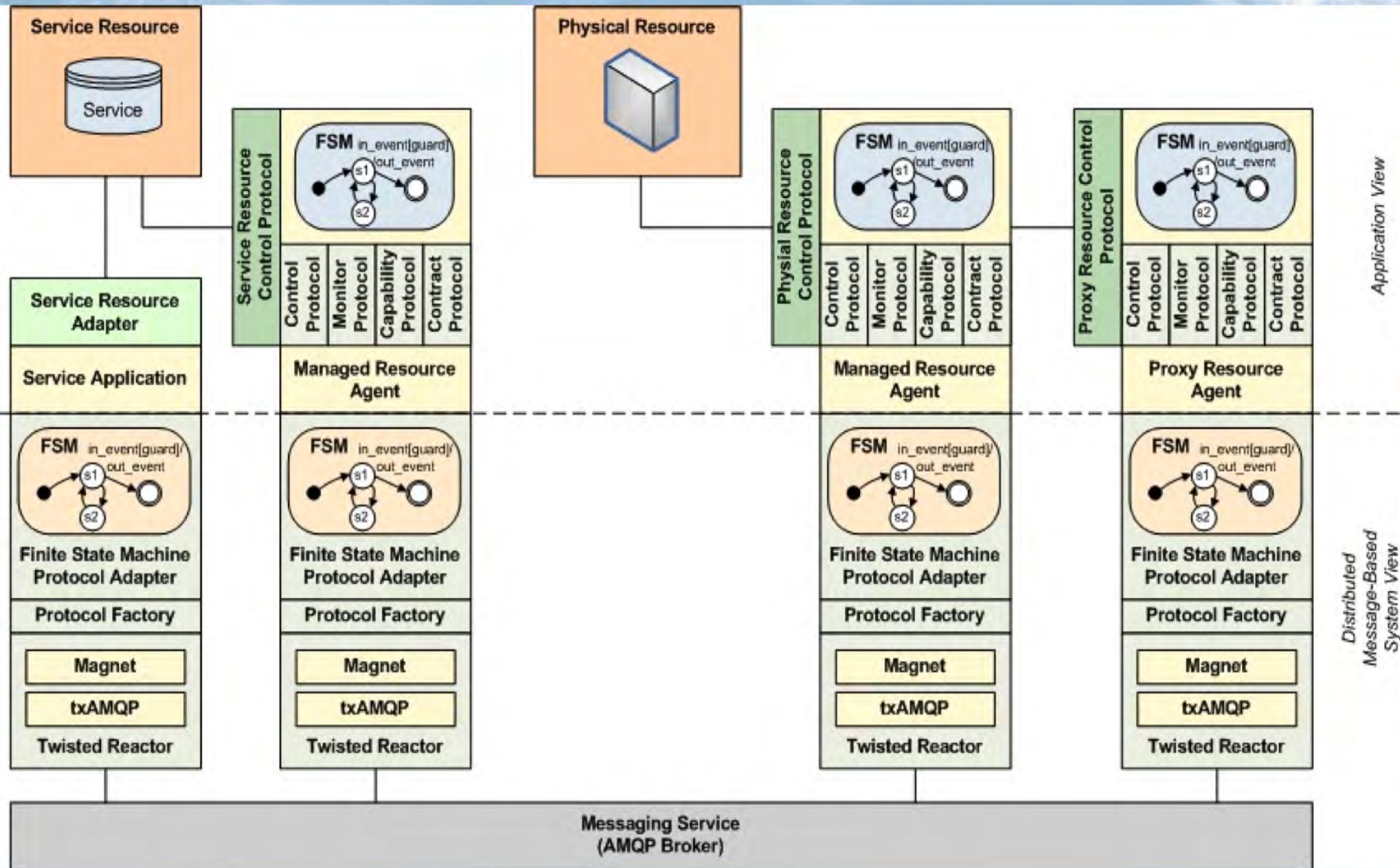


OSSE Prototype





Distribute Application Facility



OOI: Development Roadmap

- Yearly build cycle for four years starting from 2010, with the first half for prototyping, the second half for building production code. In 2010, the main prototype development occurring between March and July.
- System expected to be operational for 30 years.
- Core messaging infrastructure based on AMQP.
 - current preferred supplier is RabbitMQ
 - From the most recent conference call, RabbitMQ were doing work to 'cloud enable' their product - this was considered to be an important feature, to shield the OOI infrastructure from the cloud vendors

Governance in OOI (1)

- To participate in the OOI infrastructure, an application must register ('enrol') itself, identifying the protocols it wishes to use and which parts it wishes to play (e.g. User in a User-Equipment interaction).
- Based on previously agreed contracts, 'commitments' may be associated with the participant for their actions (e.g. use of resources in permitted domains), which are policed at runtime and/or sanctioned after the fact.
- Two levels of governance:
 - First level: based on protocols. If the application violates its protocol, their messages will be blocked.
 - Second level: based on state updates, including inter-protocol assertions & commitments (SLAs in SOA)

Governance in OOI (2)

- An OOI governance use case:
 - A researcher Alice wishes to use special equipments (e. g. high-res camera in seabed) for a specific period.
 - The equipment is owned by a different organisation with which Alice's organisation has an agreement for mutual usage under some conditions.
 - Alice identifies and enrolls herself in OOI, and reserves the equipment through her Org, which in turn interacts with another Org to check contract details.
 - Once acquired, Alice can control/query equipments remotely (e.g. manoeuvre a camera on the seabed), receiving streamed data.
 - Her research budget will be transacted based on the resource usage.

Governance in OOI (3)

- All important actions (such as enrolment) are done through a local governance agent, representing a real-world organisation inside OOI.
- Each governance agent has its own policies and acts as a custodian of contracts among agents in its administrative domain, realising distributed governance with minimal human intervention.
- The enforcement of policies/contracts is by monitoring and administering communication actions of OOI agents, demanding a rigorous, general and transparent description of communication actions and high-level policies.

Scribble and OOI (1)

- Currently the OOI dev team are describing protocols using MSCs (message sequence charts).
- Protocol enforcement in the first version will be through the use of hand-coded FSMs from MSCs. However:
 - MSCs are limited in their descriptive power when protocols become complex.
 - No notion of types in messages and protocols.
 - No precise correspondence between descriptions and programs' behaviour
- Scribble protocol notation is being evaluated as a means of describing protocols for OOI governance.

Scribble and OOI (2)

- This evaluation is proceeding through weekly discussions and parallel software development by G.B., assisted by K.H. and Aybek Mukhamedov (a research fellow at QM).
- The target Scribble language is restricted to the core part with enough expressive power, which will later be augmented with state and assertions (from the original 'conversation models').
- The exact correspondence between protocol descriptions and message exchanges to be observed, **monitorability**, is the key (potential) advantage of Scribble over other notations in the context of OOI governance.

Scribble and OOI (3)

- The initial prototype includes runtime monitoring against a specified protocol as a key component, thus providing an automated policing of communication actions, the first step in OOI governance.
- Addition of assertions to multiparty sessions by Bocchi (Leicester), Yoshida (Imperial) and others, already being incorporated into Scribble, is being examined for describing high-level governance concepts.
- On this basis, a further collaboration with Munindar Singh is expected to provide a basis of refined usage of Scribble for OOI governance, capturing such concepts as 'commitment'.