

NOAA IOOS Data Integration Framework: Draft Architecture and Recommended Services

Jeff de La Beaujardière, PhD
NOAA IOOS Program
DIF Sr Systems Architect

Outline

- DIF overview
- Draft architecture diagrams (*partial set*)
- Recommended web services for data access
- Data provider status
- Next steps

NOAA IOOS Goals

- Modernize the way NOAA collects, shares, and uses ocean information
- Increase data interoperability and efficiency of operations across NOAA and the eleven IOOS regions
- Expedite access to data for improved decision making

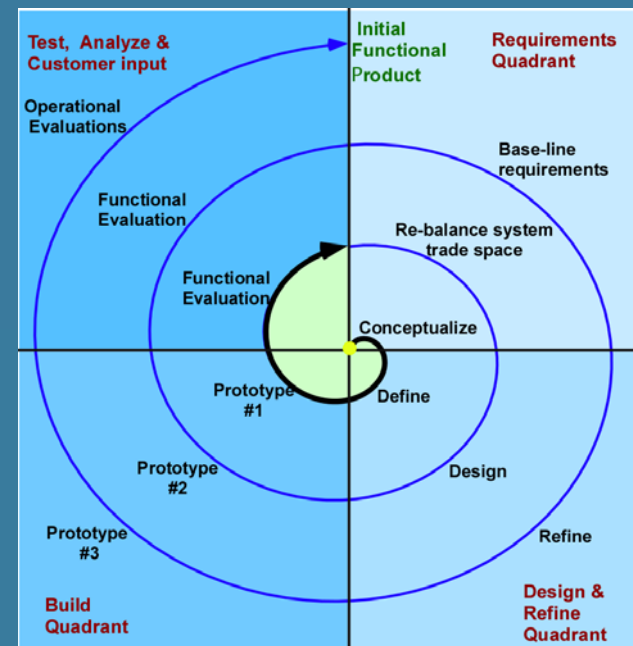


NOAA IOOS Program Components

- Standards
 - Develop and maintain a process to document, coordinate, evaluate and accept standards
- Regions
 - Invest in Regional Association efforts that contribute to the definition and implementation of IOOS
- Data Integration Framework (DIF)
 - Conduct a limited-scope implementation of IOOS as a proof of concept and to gather lessons to inform the larger IOOS effort

Data Integration Framework (DIF)

- First spiral of IOOS development
- Standardize on small number of services & encodings
- Implement at selected provider & customer sites
- Start with several core variables
 - Currents
 - Temperature
 - Salinity
 - Water Level
 - Winds
 - Waves
 - Ocean Color (chlorophyll)



(Graphic by i3 Aerospace Technologies Pty Ltd
– used with permission)

- Evaluate in FY 2010

Primary DIF Partners

- Data Providers
 - NWS NDBC (National Data Buoy Center)
 - NOS CO-OPS (Ctr for Operational Oceanographic Prod & Svcs)
 - NESDIS CoastWatch
- Customer Focus Areas
 - HAB (Harmful Algal Bloom Forecast System)
 - IEA (Integrated Ecosystem Assessments)
 - CI (Coastal Inundation)
 - HI (Hurricane Intensification)
- Regional associations
 - As represented in web services working group



Architectural Layers

DRAFT

ISO 3-Layer Model

IOOS "Subsystems"

User Interface Tier

Client Components

Modeling & Analysis

Business Process Tier

Utility Services

Data Access Tier

Data Access Services

*Data Management
and Communications
(DMAC)*

Data Providers

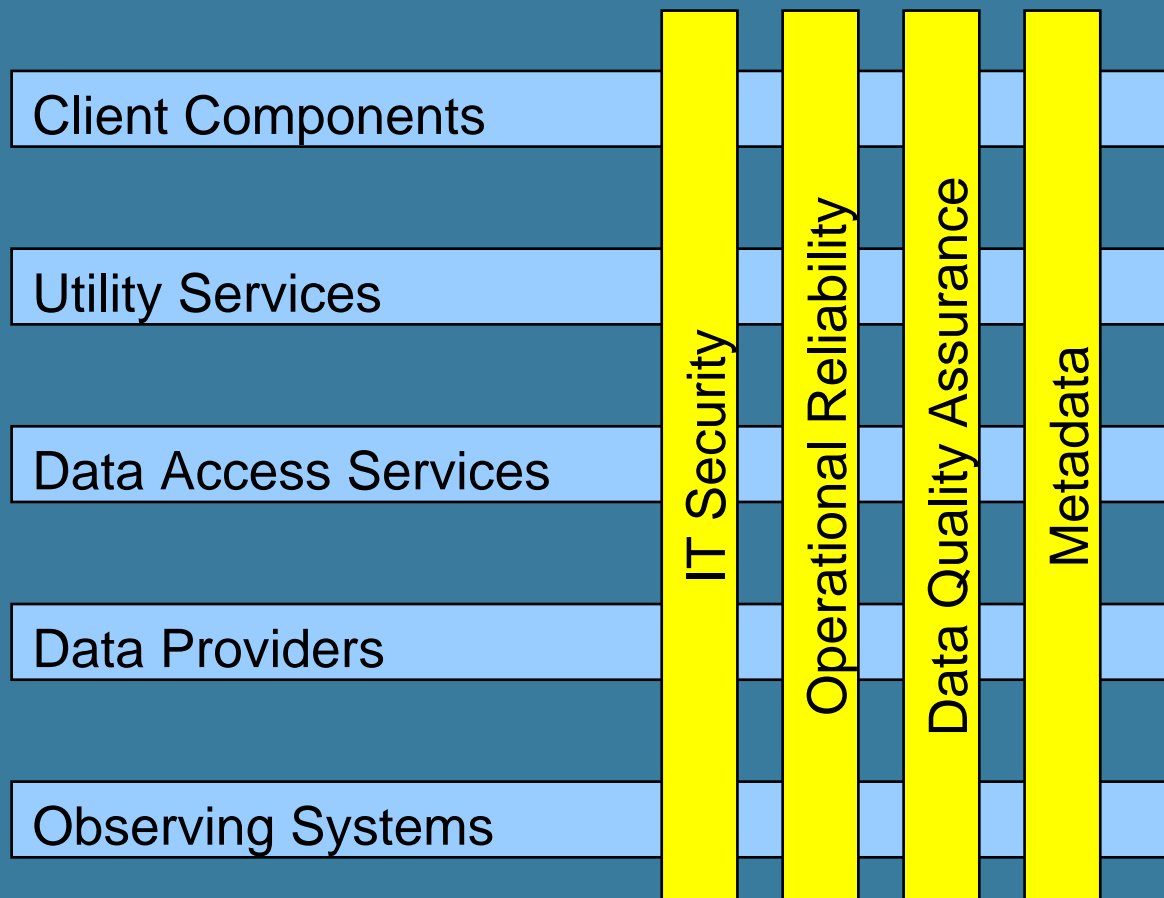
Observing Systems

Observing Systems



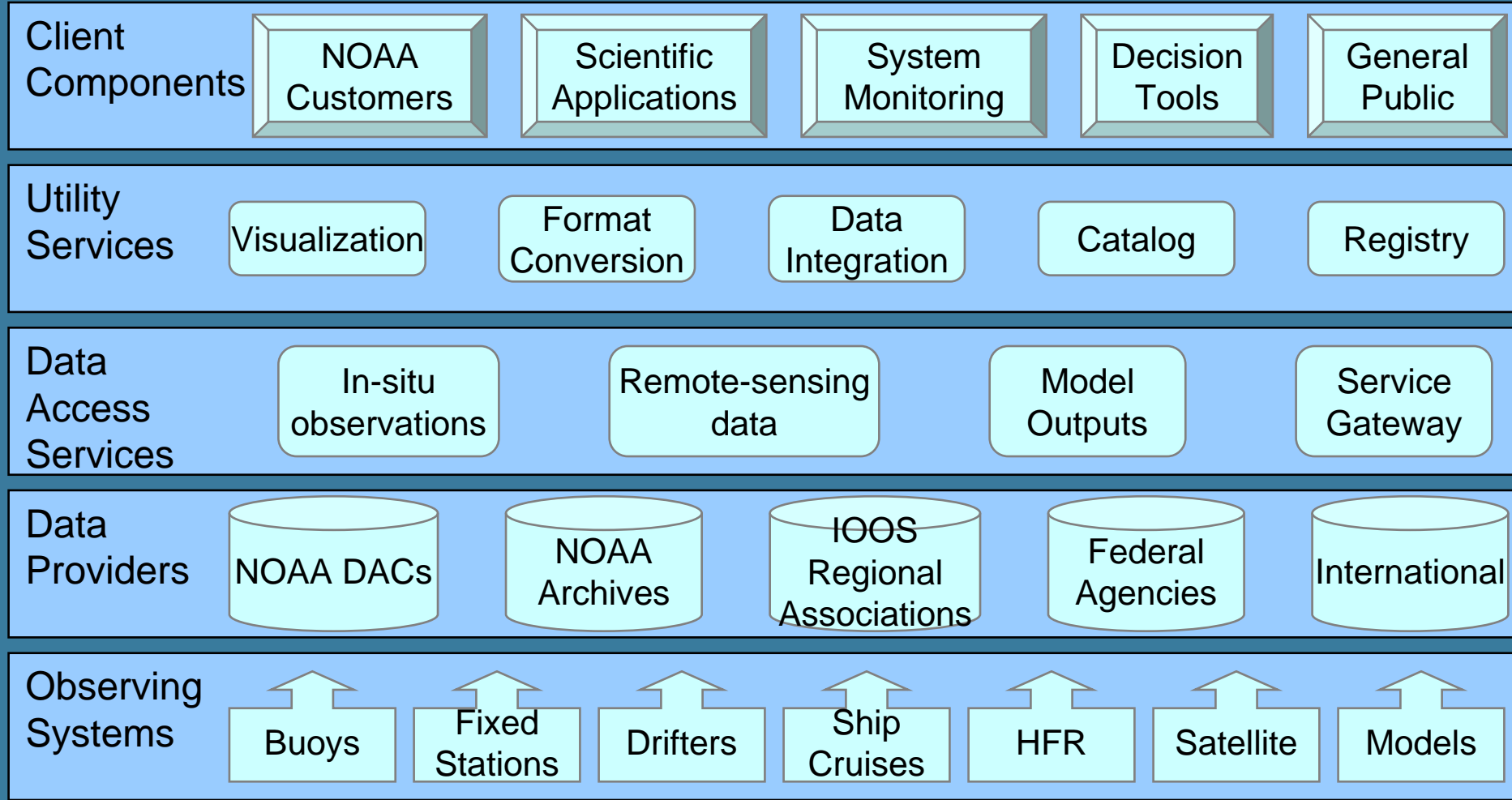
Crosscutting Layers

DRAFT



Component Types Needed for IOOS

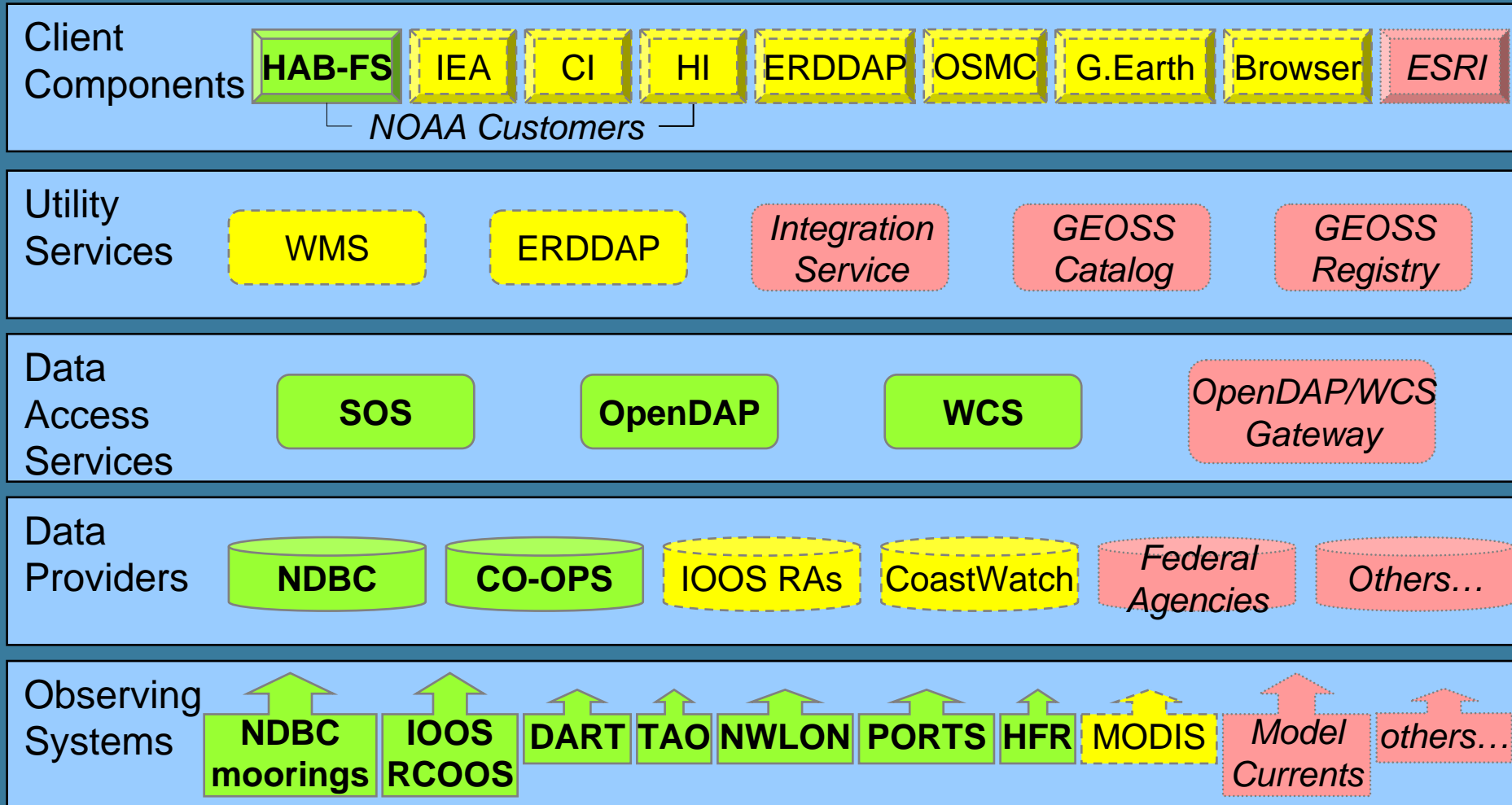
Engineering Viewpoint from Reference Model for Open Distributed Processing (RM-ODP)



Component Implementations for DIF (2008)

Technology Viewpoint from Reference Model for Open Distributed Processing (RM-ODP)

Legend: **Testing** Starting Planning



Recommended Web Services and Data Encodings

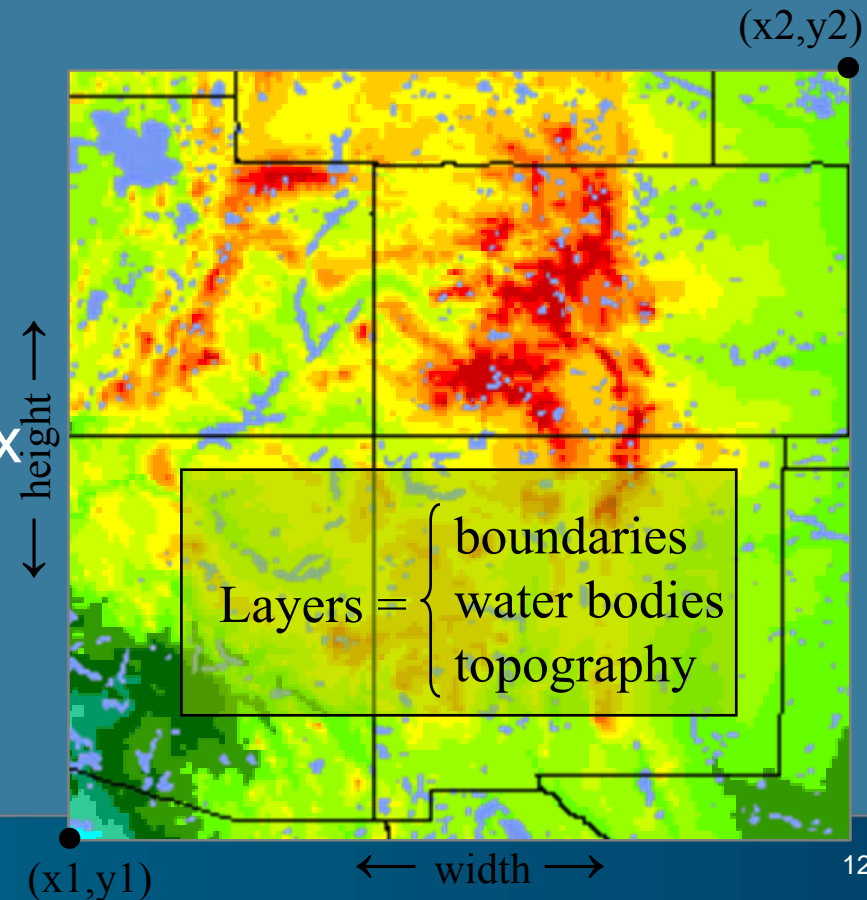
Data Type	Web Service	Encoding
In-situ data (buoys, piers, towed sensors)	OGC Sensor Observation Service (SOS)	XML based on OGC Observations and Measurements (O&M)
Gridded data (model outputs, satellite)	OpenDAP and/or OGC Web Coverage Service (WCS)	NetCDF using Climate and Forecast (CF) conventions
Images of data	OGC Web Map Service (WMS)	GeoTIFF, PNG etc. -possibly with standardized styles

[*OGC = Open Geospatial Consortium] 11

WMS for Images of Data

OGC Web Map Service

- “Map” = georeferenced picture of data
- GetCapabilities operation: “table of contents” in standardized format
- GetMap operation: image of data customized according to:
 - Variable(s) of interest
 - User-specified bounding box
 - User-specified time
 - Image size
 - File format (e.g., PNG, GetTIFF, JPEG, GIF)



WCS for Gridded Data

OGC Web Coverage Service

- Coverage ~ array of gridded data values
 - (simplified viewpoint for this discussion – coverage can be more complex)
- GetCapabilities operation: “table of contents”
- GetCoverage operation: data file containing header and array(s) of numbers customized for:
 - Variable of interest
 - User-specified bounding box
 - User-specified time
 - File format (e.g, NetCDF, HDF, floating-point TIFF)
- DescribeCoverage operation: metadata about a specific dataset

(x2,y2)

```
27 1828 1828 4590 4523 5360 2874 7135 2662 4977
9676 2772 4076 6303 5354 7594 5713 8217 8525 1664
9218 1741 3596 6290 4357 2900 3342 9526 595 6307
2338 2988 753 1952 5101 9011 5738 3418 7930 7021
2447 6146 668 822 6480 168 4774 1185 3742 3454
695 5170 2761 8386 626 1331 3845 8300 752 449
2007 932 8709 1274 4374 7047 2306 9697 7209 3101
6574 6377 2111 2523 8978 4425 569 5369 6770 7854
9879 3163 6889 2300 9879 3127 7361 7821 5424 9992
1936 6803 3182 5288 6939 8496 4651 582 939 2398
1173 123 8197 684 1614 397 198 3767 9320 6832
3287 8250 9819 4558 1530 1756 7173 6133 2069 8112
3515 9888 8519 3458 727 3866 7385 8942 2879 2284
6104 8419 8444 3634 6324 4968 4875 6023 3624 8270
2353 436 9941 8491 4631 4093 4317 3814 3640 5462
167 6839 6424 3781 4059 2714 5635 4906 1303 1072
7041 7189 8610 6873 9696 5521 2671 5468 8957 350
3210 6817 121 56 2788 235 1930 3322 4745 158
5036 6041 6997 3297 2508 8687 6966 4035 5570 7162
7871 3419 5124 6652 103 592 1236 6771 9432 5278
```

(x1,y1)

SOS for In-Situ Data

OGC Sensor Observation Service

- Sampling feature = discrete location(s) of measurements
 - Point, Vertical or Horizontal Profile, Trajectory (e.g., ship track)
 - ...and Time Series or Collections thereof

- GetCapabilities operation: “table of contents”

- GetObservation operation: XML data file containing observation values for desired:

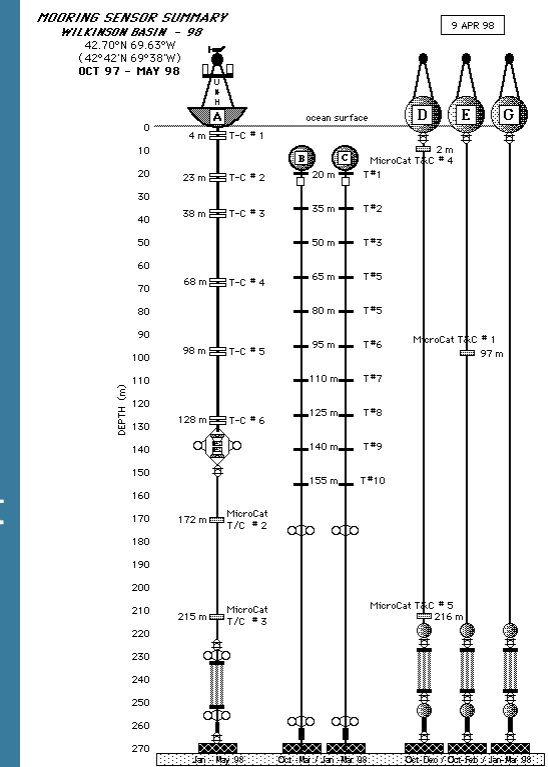
- Variable(s) of interest
- Bounding box
 - Or perhaps named geographic feature of interest
 - Or perhaps a single sensor

- Time

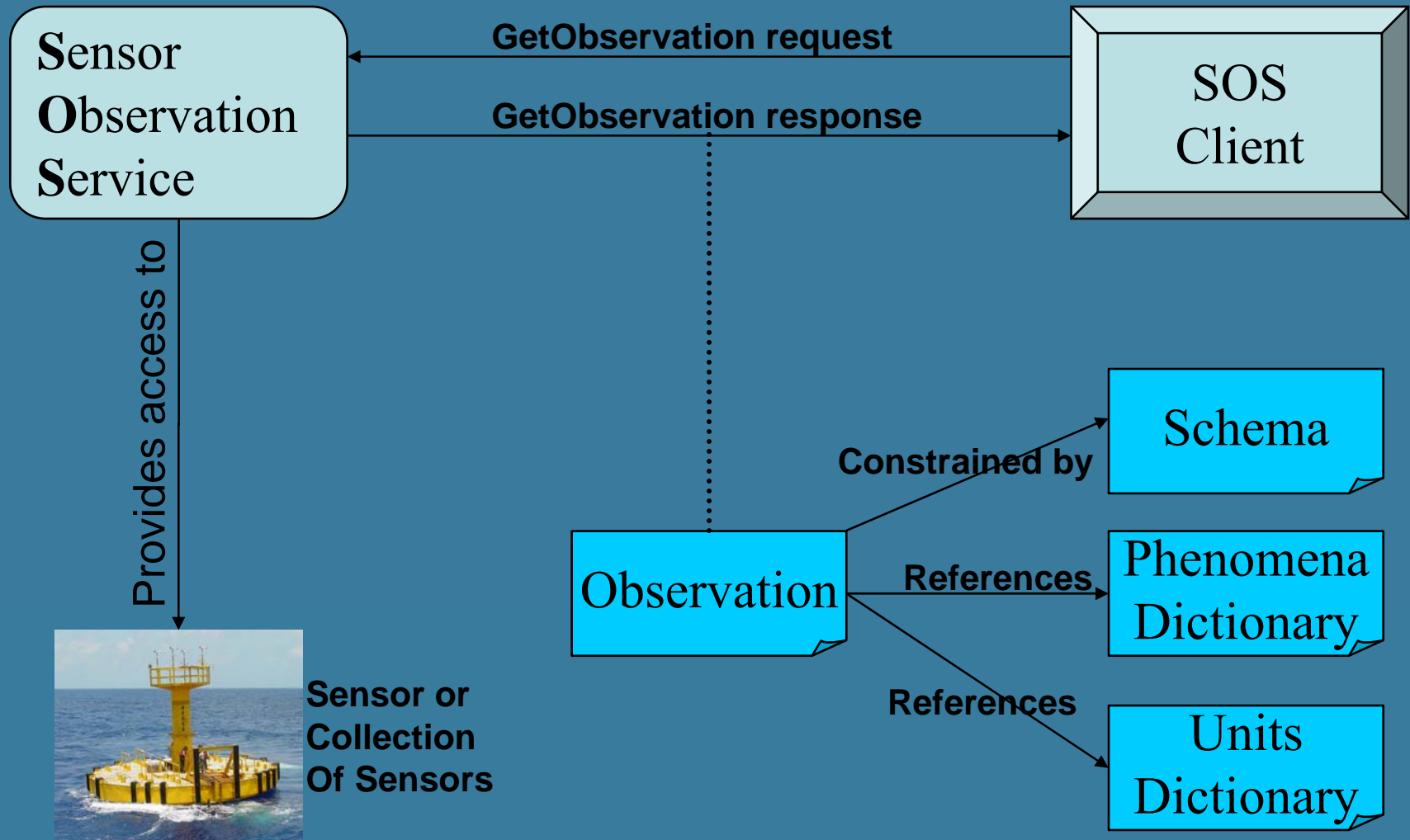
- DescribeSensor operation:

XML providing detailed information about a specific sensor

(or platform or group of sensors)

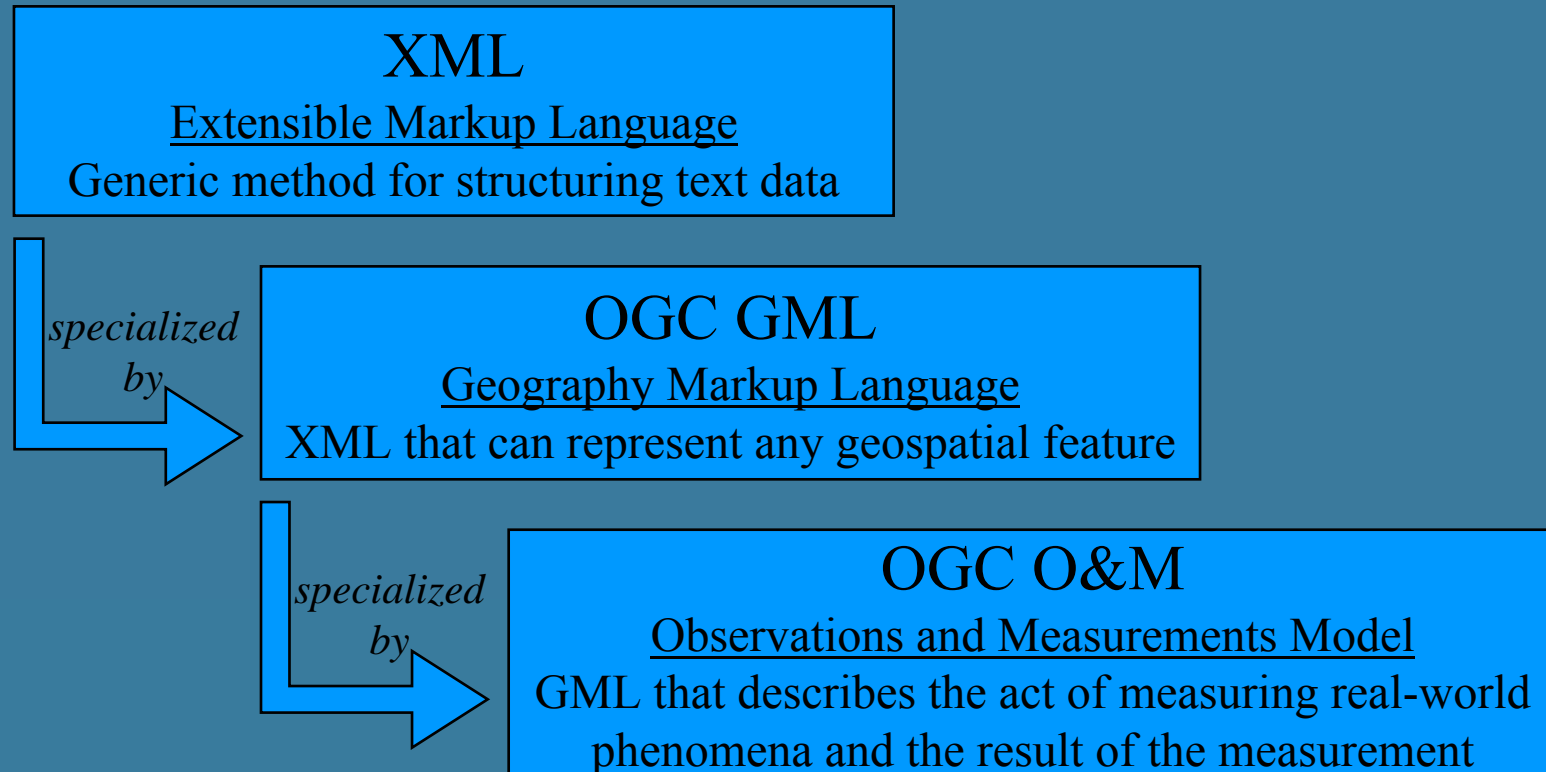


SOS Concept



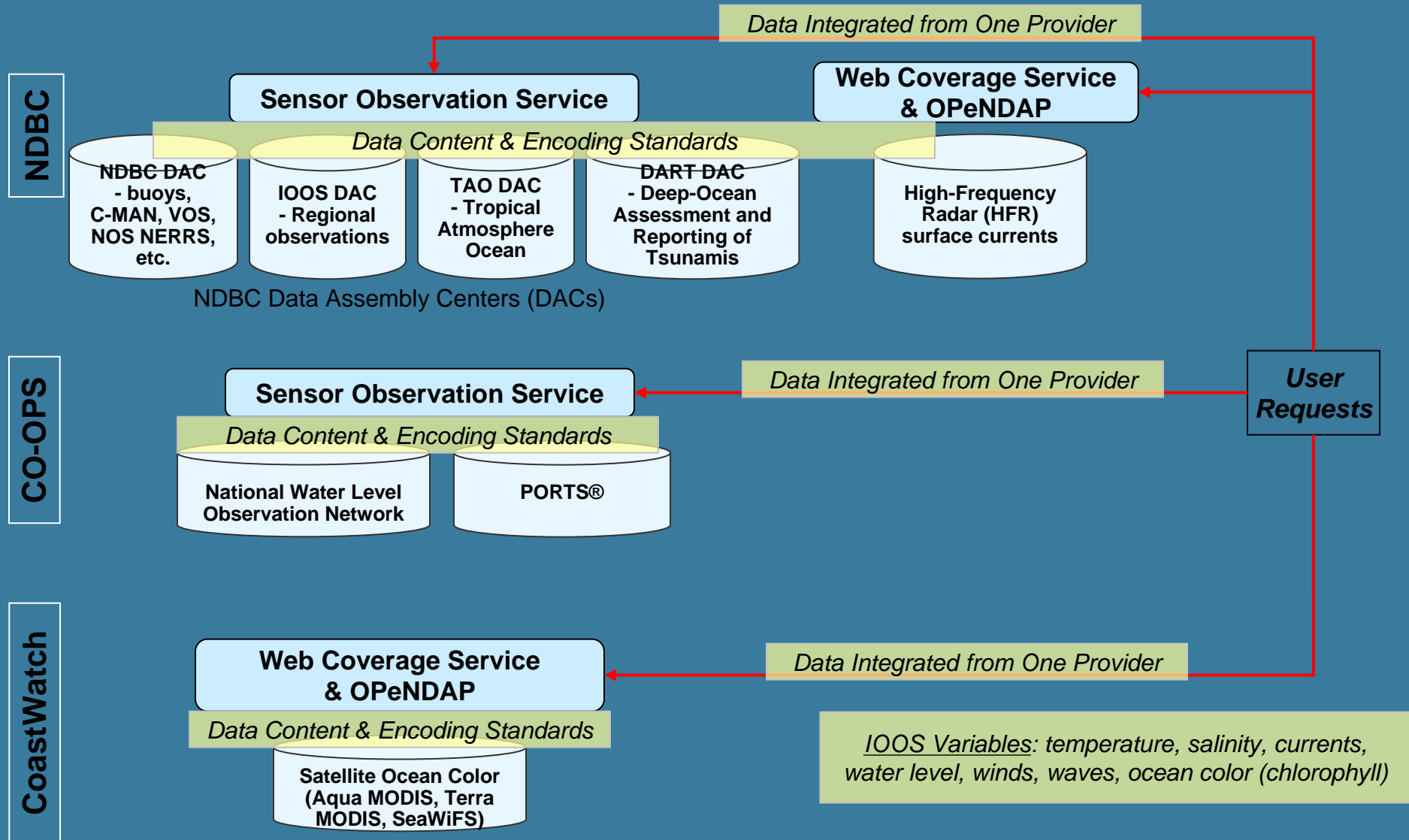
SOS GetObservation Response

XML Encoding of In-Situ Data



Data Provider Status

(expected by end of CY2008)



Possible Next Steps

Tentative, partial list; dependent on funding & requirements

- SOS DescribeSensor + SensorML implementation
- Testing/evaluation/refinement of existing work
- Software reference implementations
- Metadata for discovery and QA/QC
- Model Data Access
- Additional customers
- Additional variables & data providers
- Build or borrow needed components in the architecture
 - Catalog of available data
 - Registry of terms, relationships, sensors
 - Data translation service