ECHO Services –
Foundational middleware for a Science Cyberinfrastructure

WGISS – March 2005
Goals of the presentation

- View of the future
- ECHO Overview
- Approach to Registries
- Interoperability
- Current status & activities
Supporting a comprehensive, and coordinated environment

- For science, education, governments, industry
- For system development and contribution
- Organic resource utilization
  - Resource capacity is established throughout the partner community
  - Partners offer what they wish
  - Enabling Science that is...
    - Comprehensive
    - Coordinated
    - Sustained
New paradigm

- Service-oriented enterprise
- Net-centric computing
- Enable with infrastructure of service middleware
- GEOSS momentum
ECHO Vision

- Goals
  - Support a Marketplace ...
  - Enabling ...

- Approach
  - Interoperable Registries
  - Not "the" solution/system
    - But integrated into a dynamic enterprise
    - Building systems, interoperating with systems
  - Net-centric
    - Power to the partners
**ECHO Is...**

- **Interoperability middleware solution** -
  - Open, XML-based APIs
  - Supporting net-centric architectures and solutions
  - Set of interoperable registries for both data (metadata) and services
  - Provides user accounts and common infrastructure for the registries
  - Built upon a layered architecture with extensible infrastructure for supporting community unique protocols
  - Operational since November 2002
  - Available as open source

---

**Data Registry**
*Representing data resources through metadata*

- **Publish Capability**
  - Supports Collection, Granules and Browse publication
  - Product Specific Attributes extending the standard data model

- **Discovery Capability**
  - Collection/DataSet
  - Granule/Inventory
  - Based on Z39.50 Standard
  - Full results Management

- **Access Capability**
  - Online Access
  - Legacy Order Mechanisms
  - Access Controls
    - Visibility of data resources
    - Access to data resources

---

**Service Registry**
*Service offerings leveraging Web Service Standards*

- **Publish Capability**
  - Advertisements
  - Service Interfaces
  - Service Implementations
  - Service GUIs
  - Linkage to Data Registry

- **Discovery Capability**
  - UDDI Standard Based
  - Data Registry View (*What services are appropriate for this collection/granules?*)

- **Future**
  - Service Brokering
  - Access Controls

---

**Metadata Subscriptions**
Power in the hands of the community

• **Data and Service Partners**
  - Use ECHO’s Partner Interface tools to manage how their resources are represented in the registries
  - 2-level access control in Data Registry (metadata visibility, ordering)
  - In defining each dataset, partners can establish which spatial search mechanism (Cartesian, geodetic, orbital) is best suited for searching that dataset
  - Special data modules supported as needed. (ie. Orbital search module)
  - Extending the standard data model through product specific metadata

• **Client Partners**
  - Provide discipline specific, application specific or individual preferred views of the contents of the clearinghouse
  - Use ECHOs APIs to access the clearinghouse to convey a seamless, efficient view of data holdings

• **Service Partners**
  - Advertise their service offerings
    - General Advertisements, Service Interfaces (API specifications), Service Instances (web services) or GUIs
  - Classification of services through taxonomies
  - Service offerings describe in WSDL
  - Access to services through SOAP

© 2004 Blueprint Technologies, Inc. All Rights Reserved
Registries in the Enterprise

**enterprise network solutions**
- point solutions
- open system solutions
- closed system solutions

Service Resource Registry

Data Resource Registry

Brokerage Service

Interoperability
Data Model
Taxonomies/Categorization

Client Partner (point solution)
Scientist

closed system solution

open system solution

Publish
Consume
Publish
Consume
Publish

Service Partner

Data Partner
ECHO Service Registry

- **Supporting SOA**
  - Publish
  - Find
  - Bind

- **Using Web Service Strategy**
  - Service Description
    - WSDL (Interface & Implementation)
    - Parameter language (ECHO/ISO 19115 subset)
  - Service Binding
    - SOAP
    - WxS Issues
  - Registry
    - UDDI
Fundamental Use Cases

- Publishing
- Discovering
- Understanding
- Accessing
Publish
Resource Partners “advertise” their offerings to publicly available registries

**Data Registry**
- Public Interface: “IngestService”
  - Register, Ingest services
- Standards
  - Data Dictionary ISO 11179 based
  - Data Model based on EOS
  - ISO 19115 Compliant
  - GCMD mapping
  - FGDC mapping
- Technology - Oracle database

**Service Registry**
- Public Interface: “ExtendedServicesManagement”
  - Register service
- Standards
  - Service Description – WSDL
  - Registry – UDDI
  - OGC Service Taxonomy (ISO 19119)
- Technology – Systinet WASP UDDI Server

**Issues**
Data Model inconsistency
- Ingest adapters for data model translation and validation

Data Fidelity
- Update and delete interfaces available
- Time delays between registry and source
Discovery
Consumers participate in the marketplace by looking for resources of interest

**Data Registry**
- Public Interface: “CatalogService”
  - Query
- Inventory and Dataset level
- Standards
  - Z30.50 based queries and results management
- Technology – XML-based API
  - Oracle augmented with additional spatial query engine

**Service Registry**
- Public Interface:
  - UDDI: Inquiry
  - Registry (domain)
- Standards
  - UDDI
- Technology – Systinet WASP UDDI Server

**Issues**
- Interoperability
  - Data represented in a consistent data model
  - Service – Data interoperability through Taxonomies
  - Common Data Language for data definition and parameter specification

© 2004 Blueprint Technologies, Inc. All Rights Reserved
**Brokering Service**

- Public Interface: "BrokerService"
  - Validate, Submit
- Optimize data access pattern, bind to service on behalf of consumer, manage status and results delivery
- Standards
  - TCP/IP based data access and delivery
- Technology – XML-based API

**Issues**

Interoperability – Matching services to data
- Common Data Language for data definition and parameter specification
- Validation operation (optional)
- Co-location
  - Moving data, not services (so far)
  - Temporary resources provided for facilitating data movement

Resource Efficiency
- Validation operation (optional)
- Security
  - Registered Users only
  - Moving data, not services
Basic Brokering Pattern

*Multiple paths for data movement in support of brokering or orchestrating services*

Brokering Service optimizes data movement from path based on:
- Data partner access options
- Service Partner access and delivery options
- Consumer requests

© 2004 Blueprint Technologies, Inc. All Rights Reserved
Orchestration
Customers orchestrate the active integration of multiple resources in a sequence

Orchestration Service

- Public Interface: "Orchestrate"
  - Validate, Submit
- Ensure service invocation sequence is valid
- Translucent and Aggregate/Opaque capabilities
- Standards
  - OCG efforts (OWS 2.0) ISO 19119
- Technology – XML-based API

Issues

Interoperability –
- Data represented in a consistent data model
- Service – data interoperability through taxonomies
- Common data language for data definition and service parameter specification

© 2004 Blueprint Technologies, Inc. All Rights Reserved
Interoperability

- Between registries
  - Service Registry through Taxonomies
  - Data Registry through Catalog Service
    - <details>

- External Interoperability
  - Adaptors
    - Protocol interoperability with Partners for order and ingest
    - Data model interoperability through Ingest Adapters and data set registration
    - Can establish "Views" of results

- API's enable external other interoperability through adaptors
  - Ostensibly, ECHO clients
Classification

- **Taxonomies (so far)**
  - Data Set
    - Data Partner → Dataset → Version
  - Data Format
    - Similar to mime-type
  - Service Type
    - OCG/OSE model
    - Looking for others

- **Other Classification schemes possible**

- **Potential for user defined taxonomies**
  - Dynamically defined and leveraged
  - Profile entities
  - Semantic web integration
Service Semantic understanding

- **Ensure that services can work together**
  - Enabling binding is easy for a registry
  - Flexibility always has its price
    - Understanding relevance of context and parameters in an open, dynamic and loosely coupled network enterprise is the challenge
  - Developing a Common Data Language for parameter specification

- **Service Metadata**
  - Common way of describing
    - Partner
    - Service Type
    - Interface
    - Source
    - Capability
    - Understanding
    - Applicability
UDDI v3

Upcoming Technology evolution

Key Features

- Multi-registry environments
- Allows for federation of service registries
- Publisher specified keys
- Beyond UUIDs
- Flexible and powerful namespace management
- Security enhancements
- Adds digital signing to core data types
Rules of Engagement for Service Partners

- Register
- Provide Reference Web Page
- Active Services
  - Provide WSDL
  - SOAP binding point
- Optionally:
  - Categorize resource
- Brokered
  - Declare Input access support
  - Declare Output support
# Current Data Partner Status

### 5 Operational:

<table>
<thead>
<tr>
<th>Data Partner</th>
<th>Collections</th>
<th>Granules</th>
<th>Browse</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oak Ridge National Laboratory (ORNL)</td>
<td>679</td>
<td>105,706</td>
<td>0</td>
</tr>
<tr>
<td>Distributed Active Archive Center (DAAC)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Land Processes EOS Core System (ECS) DAAC</td>
<td>87</td>
<td>11,587,961</td>
<td>2,349,125</td>
</tr>
<tr>
<td>Goddard ECS DAAC</td>
<td>357</td>
<td>18,071,296</td>
<td>1,890,246</td>
</tr>
<tr>
<td>Socioeconomic Data and Applications Center (SEDAC)</td>
<td>50</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Alaska SAR Facility</td>
<td>14</td>
<td>1,872,361</td>
<td>0</td>
</tr>
</tbody>
</table>

### 3 Development/Test:

<table>
<thead>
<tr>
<th>Data Partner</th>
<th>Collections</th>
<th>Granules</th>
<th>Browse</th>
</tr>
</thead>
<tbody>
<tr>
<td>National Snow and Ice Data Center (NSIDC) DAAC</td>
<td>35</td>
<td>62,066</td>
<td>0</td>
</tr>
<tr>
<td>Atmospheric Sciences Data Center (ASDC) DAAC</td>
<td>93</td>
<td>2,954,549</td>
<td>1,507,711</td>
</tr>
<tr>
<td>Stennis Space Center Data Purchase Project</td>
<td>22</td>
<td>17,766</td>
<td>15,892</td>
</tr>
</tbody>
</table>

**Total data items in ECHO = 34,671,705**
## Current Client Partner Status

### 2 Operational:

<table>
<thead>
<tr>
<th>Application</th>
<th>Organization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mercury EOS</td>
<td>Oak Ridge National Laboratory (ORNL) DAAC, Department of Energy, ORNL, Oak</td>
</tr>
<tr>
<td></td>
<td>Ridge, Tennessee</td>
</tr>
<tr>
<td>Power User Interface (script based)</td>
<td>Earth Science Data and Information System (ESDIS) Project, NASA/GSFC,</td>
</tr>
<tr>
<td></td>
<td>Greenbelt, MD</td>
</tr>
</tbody>
</table>

### 9 Development/Test:

<table>
<thead>
<tr>
<th>Application</th>
<th>Organization</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASF ECHO Client</td>
<td>University of Alaska, Fairbanks, AK</td>
</tr>
<tr>
<td>Data Validation User Interface (DVUI)</td>
<td>ESDIS Project, NASA/GSFC, Greenbelt, MD</td>
</tr>
<tr>
<td>MODIS Website</td>
<td>MODIS Project, NASA/GSFC, Greenbelt MD</td>
</tr>
<tr>
<td>SNOWI-E</td>
<td>NSIDC, University of Colorado, Boulder, CO</td>
</tr>
<tr>
<td>WISRD</td>
<td>NSIDC, University of Colorado, Boulder, CO</td>
</tr>
<tr>
<td>WIST (Warehouse Inventory Search Tool)</td>
<td>ESDIS Project, NASA/GSFC, Greenbelt, MD</td>
</tr>
<tr>
<td>New Earth Observer (NEO)</td>
<td>Earth Science Directorate, NASA/GSFC, Greenbelt MD</td>
</tr>
<tr>
<td>Simple MODIS ECHO Client (SIMECC)</td>
<td>MODIS Rapidfire Project, NASA/GSFC, Greenbelt MD</td>
</tr>
<tr>
<td>Invasive Species</td>
<td>NASA and USGS</td>
</tr>
</tbody>
</table>
Current Activities

- Brokering Services
- Service Orchestration – exploration within the ESIP community
ESIP Participation

• **Strategic Direction**
  - Promote Services that can participate in SOA systems
  - Descriptions in WSDL
  - SOAP access/interface

• **Establish a testbed of a service registry**
  - Using ECHO
  - Semi-public

• **Explore techniques and technologies of orchestration**