A Semantic SOA Approach to NextGen Information Sharing

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Agenda

- Mission
- NextGen Information Sharing Challenges
- Information Sharing Approach
  - Process
  - Technical Capabilities
  - Infrastructure
- Demonstrations
- Putting It Together
- Way Ahead
Net-Centric Operations Division (NCOD) leads the Joint Planning and Development Office (JPDO), agency partners, and industry to realize information sharing capabilities to improve situational awareness, enhance decision making, and facilitate collaboration.
Net-Centric Operations Division (NCOD) promotes policies and strategies for information sharing and coordinate investment and development of network-enhancing capabilities

- Work to make the information **understandable** by:
  - Defining an ontology (or shared vocabulary)
  - Documenting required information exchanges
  - Provisioning services to improve discoverability, re-use, understandability

- Work to make the information **discoverable** and **accessible** through
  - Service registry, Semantic Metadata Catalog and Portal

- Help to identify **accurate** and **timely** data
  - Identifying Authoritative Data Sources, which provide accurate and timely data
  - Incorporating metadata about the accuracy and timeliness of data
Information Sharing Challenges

- Weather Community
- Integrated Surveillance Community
- UAS Community
- Flight and Flow Community
- Safety Community
- Airport Operations Community
- Airline Operations Community
- Other Communities

Standards:
- AXIM
- WXXM
- FIXM
- WCS
- WFS
- WMS
- KML
- GML
- ebXML
- UDDI
- Other Standards

Services:
- Weather
- Flight Track
- SAR
- Time
- Other Services

Data:
- Classification
- Live
- Geospatial Coverage
- Recorded
- Temporal Coverage
- Simulated

Conform

Net-Centric Operations Division

State/Local Government
Commercial Entities
International Partners

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Inter-Agency Information Sharing Challenges

Source: FAA Information Exchange Conference 9/2011

**Information Sharing Approach**

- **Repeatable process** for developing shared understanding through definition of information elements across domains.

- **Technology capabilities stack** that enables the information sharing vision of NextGen.
  - Services Oriented Architecture
  - Semantic Web Technology
  - Federated Ontology

- **Interagency infrastructure** that employs the technology stack and information sharing approaches and validates them in a near-realistic environment.
  - Enables shared R&D
  - Addresses real-world info sharing obstacles
  - Identifies pathways to near-term operational improvements
Shared Understanding
• Key Deliverables
  – COI Ontology
  – Business Context (DoDAF Artifacts)
  – Other Artifacts
• Current Engagements
  – Weather
  – Integrated Surveillance
  – Unmanned Aircraft System
• Consistent with DoD Net-Centric Data Strategy
Semantic Metadata Catalog and Portal Extended Capabilities

• Utilizes existing SOA Registry capabilities
• Addresses cross-agency information exchanges
• Facilitates collaboration
• Focuses on discoverability of defined information exchanges
• Takes full advantage of Semantic Relationships defined in ontologies

Bottom Line:
• Provides an intelligent search beyond simple keywords
• Utilizes semantic discovery capabilities
• Yields a more targeted result set

SOA Registry Scope
• Governed within an Agency
• Focused on discoverability of published services
• Supports only flat, non-semantic data
• Focused on governance
Inter-Agency Infrastructure
Net-Enabled Test Environment (NETE)

- **Concept**
  - Virtual test environment – no new facility
  - Government and industry participation
  - Experimental approach – test, measure, evaluate, adjust
  - Adopting existing projects; leveraging progress

- **Benefits**
  - Data sets made available will bring interested developers
  - Allows demonstration of concepts to flesh out requirements
  - Allows trade-off studies for architectural decisions – standards, processes, TTPs, tools, infrastructure design
  - Tests Governance model for efficiency
  - Accessible to all NextGen participants; can link to outside data sources/consumers
  - Leverages work already done by NextGen stakeholders
Technology in Action: NETE Demonstrations

AF Electronic Systems Center

Semantic Metadata Catalog and Portal

Service descriptions from registry will be imported for inter-agency discovery.

Web Services Layer

Semantic Metadata Catalog

Artifact Catalog

Semantic Process Layer

Integration Layer

NOAA NET

WCS
WFS
WMS

Data Source

ebXML

FAA

NOAA Registry

WCS Service Registry

R&D Domain

NNEW

Web Coverage Service RI

3-D Radar Mosaic

SWIM

DEX

ASDI

ASDE

HWDS

NASA LaRC

Timing

Other Services will be entered into the Semantic Metadata Catalog through User Interface.

Alion NETE Lab

NETE Dashboard

FAA/National Security Display

Demo Control

Mock Services

FAA Emergency OPS

EON Dashboard

SMDC

GIIEP

NOAA NET

Mock Services

Other Services will be entered into the Semantic Metadata Catalog through User Interface.

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Putting It All Together

**Design Time**
- Service Governance
- Service Discovery

**Run Time**
- Business Concept
- Service Relationships
- Data Sources

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**SWIM**

- NAS Service Registry and Repository (NSRR)
- SWIM NAS Enterprise Messaging Service (NEMS)

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**Shared Understanding**

**Communities of Interest**

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**Semantic Metadata Catalog and Portal**

**Semantic Mediation**

**COI Governance**
- Semantic Discovery
- Information Federation

**Semantic Interoperability**
- ESB Federation

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**State/Local Government**

**Commercial Entities**

**International Partners**
GOAL – Procurement-quality specifications that can be used to drive acquisition of interoperable services, systems, and networks in support of information sharing.
Way Ahead

- Provide operational transition plan for the technical concepts
- Continue to foster JPDO and Inter-Agency Partnership
Backup Slides
Semantic Web Technologies

- Semantic Web (aka Linked Data or Web 3.0) is a set of W3C standards and technologies designed to allow machines to understand the meaning of the information on the WWW
  - Standards-based
  - Open-source tools
  - Agent-based distributed computing paradigm
  - Web Oriented Architecture
  - Agile Development, improved interoperability
- Semantic Web in the Enterprise: A tool for knowledge discovery and management
  - Common Vocabulary
  - Open Linked Data
  - Intelligent Searches
- Semantic Web in the Industry
  - US government and leading social network companies have been implementing semantic-driven solutions

Source: Tim Berners-Lee: “Semantic Web and Linked Data”
Welcome to the NextGen Ontology Portal

NextGen is a collaboration of numerous Agencies and contributors. Its vision is to provide a next generation air traffic system that leverages enterprise semantic web services for seamless information sharing. A key component of that information sharing infrastructure is the NextGen collection of ontologies. This Portal can help you find all ontologies that are part of the NextGen Project.

Read more

### Ontologies

<table>
<thead>
<tr>
<th>Title</th>
<th>Description</th>
<th>Last Changed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Service Metadata</td>
<td>A dataset of registered services</td>
<td></td>
</tr>
<tr>
<td>ASDI</td>
<td>An ontology that defines the data elements which show the position and flight plans of all aircraft in U.S. and optionally, UK airspace.</td>
<td>2011/08/24</td>
</tr>
<tr>
<td>CMS Ontology</td>
<td>An ontology that defines exchange elements for Operational Flight Plans, Flight Management Actions, Track Positions, Departure Information, Security and Weather Impact Information</td>
<td>2011/08/24</td>
</tr>
<tr>
<td>Information Sharing Environment - Suspicious Activity Report</td>
<td>An ontology that provides a semantic specification of suspicious activity reports</td>
<td>2011/08/24</td>
</tr>
<tr>
<td>OWL Time</td>
<td>An ontology of temporal concepts for describing the temporal content of Web pages and the temporal properties of Web services</td>
<td>2011/08/24</td>
</tr>
<tr>
<td>Weather Ontology</td>
<td>An ontology created to support the semantic specification of high value weather information exchanges</td>
<td>2011/08/22</td>
</tr>
</tbody>
</table>
Semantic Metadata Catalog and Portal

NextGen Semantic Metadata Portal

admin
- My account
- Create content
- Administer
- Log out

Search
- Find Services

Register
- Register a Service
- Import Services

Home

Search for: 

GSD Web Feature Service (WFS)
This is the WFS Reference Implementation for accessing feature or point NWS Nextgen data sets.

MDL Web Feature Service (WFS)
This WSDL document defines the service-specific properties of a CDDS WFS-N (WFS with notification extension) implementation; it specifies available endpoints that conform to the SOAP interface binding.

MDL Web Coverage Service (WCS)
This is the WCS Reference Implementation for NDGD Wind Speed data set

Flight Tracking Service
Mock SOAP (WSDL 1.1, WSDL 2) service which provides general information on current flights. Aircraft GPS position, velocity, and heading are provided, among many other flight characteristics.

GSD Web Coverage Service (WCS)
This is the WCS Reference Implementation for accessing grid or coverage NWS Nextgen datasets.

GSD Web Mapping Service (WMS) server
This is an WMS implementation based on ncWMS. The intent of the server is to provide image access services for aviation weather, as part of the NWS Nextgen Program.
An ontology-based web services mediation component that enables services with different message formats to interoperate.

Embedding in an Enterprise Service Bus (e.g. SWIM Enterprise Messaging Service) enables runtime semantic mediation within traditional SOA infrastructure, creating a Semantic Mediation Bus™.
NETE Demonstration Scenario