Exploiting Semantic Web Services in an Integrated Satellite Control Network: An Open Standards Approach

L-3 Communications
CSW-Space and Satellite Control
March 30, 2004
Terminology

- Semantic Web Services are designed to support interoperable machine to machine interaction over a network
- Semantic Web technologies have been adopted as the way ahead by the DoD Chief Information Officer (CIO)
- Resource Description Framework (RDF) is a Joint Technical Architecture (JTA) standard for data interchange
- RDF defines a relationship between data or entities
- Ontologies define the semantic relationship between the RDF data
Overview

Evolving Mission Requirements

- National Security Space: Interoperable access to launch ranges and satellite control networks
- Homeland Security: Integration of information and collaboration at all levels down to first responders
- Network-Centric Warfare: Interoperability among disparate platforms
- Transformational Communications: Integration of information and collaboration for all TC segments

L-3 Research Objective

- Evaluate emerging technologies to support evolving mission requirements while recognizing investment in legacy systems
Integrated Satellite Control Network

ISCN Objective

• Seamless integration of DoD, NASA, Civil, National, and Commercial Users

• Improve efficiency of operations and reduce O&M costs through increased access to AFSCN, Navy, NASA, and civil entities stovepiped satellite/spacecraft control networks

Problem

• No semantic data integration between Air Force, Navy, NASA, commercial and other ISCN Users.

• This problem is representative of the issues facing DoD and other government entities (e.g. DHS)

L-3 Research Approach

• Evaluate the potential of Semantic Web Services to solve ISCN integration problem

• Extensible to Federal and DoD user base
Network Centric Enterprise Services

- Two Compliance Levels
  - DoD Chief Information Officer (CIO)
  - DISA Network Centric Enterprise Services (NCES)

**NCES Strategy**

- DoD CIO Compliant
- NCES Compliant

*Semantic Web Services are compliant and preferred*
Network-Centric Enterprise Services

Users

C2
Weapon Systems
Dynamically Created COIs
Personnel
Etc.

Comms
Backbone

Finance
Community-of-Interest (COI) Capabilities

ESM
Data Exchange
Messaging
Storage
App
User Asst

Core Enterprise Services (CES)

Service Identification
Security/IA
Collaboration
## Features and Benefits

<table>
<thead>
<tr>
<th>Features</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Automated machine to machine interaction</td>
<td>• Interoperability on the cheap</td>
</tr>
<tr>
<td></td>
<td>• Reduced O&amp;M</td>
</tr>
<tr>
<td></td>
<td>• Data stores may be distributed</td>
</tr>
<tr>
<td>Integrates disparate data sources</td>
<td>• Data aggregation</td>
</tr>
<tr>
<td>DII COE Level 7/8</td>
<td>• Semantic mapping to XML Registry data</td>
</tr>
<tr>
<td>Seamless integration with existing networks</td>
<td>• Does not disturb underlying architectures</td>
</tr>
</tbody>
</table>
L-3 Technical Approach

• Team surveyed available RDF-based products
  – Cost
  – Capability/Sustainability
  – Ease of Use

• ISCN integration problem identified as a candidate for evaluation of the technology

• Formulated a preliminary ISCN data interchange strategy

• Developed two rapid prototypes to evaluate technical feasibility in L-3 Software Development Lab
  – Microsoft based RDF tool
  – Java based RDF tool
Semantic Web Services

- RDF provides seamless integration of data and services
- Allows users to access disparate databases
- Provides aggregation to leverage information in custom clients

**Diagram:**

1. **publish**
   - Register Web Service (at development time)

2. **find**
   - look up web service

3. **Reply with URL**

4. **bind**

5. **call**
   - Call Web Service

6. **Reply with data**

Web service requestor - NASA

Web service provider - AFSCN

RDF Document
RDF-based AFSCN Integration

Ontology Server
- Inference Engine
- RDF Service Definitions
- RDF Parameter Mapping Definitions

IR&D Prototype
- Parameter Translation Mechanism

AFSCN Systems
- Web Services
- Web Services
- Web Services

External Network
- NASA
- Navy
- Commercial User

IR&D Prototype
- Workstations Eliminated

AFSCN SOC User
- Request
- XML Result

IR&D Prototype
- Invoke service
- XML Result

IR&D Prototype
- XML request for service
- XML containing service link

AFSCN Systems
- ASAP-NG
- ARTS RBC
- Application Servers
- Oracle
- MS Access

IR&D Prototype
- JDBC

4/26/2004
Summary

• Semantic Web Services allow:
  – Data integration to comply with DISA XML Registry
  – Load balancing to eliminate a single point of failure
  – Avoidance of JMS compatibility issues found in other solutions
  – External users to access network resources without imposing additional architectural components

• Demonstrates ability to integrate legacy applications, support evolving mission requirements, recognize investment in legacy systems, and is extensible to additional problem sets

• Recommendation: Include Semantic Web Services as part of the ISCN Integration solution

RDF supports transformation of AFSCN to ISCN