Extending SOA Infrastructure for Semantic Interoperability

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Agenda

- Background
- Semantic Mediation Bus™
- Semantic Mediation and System of Systems
Service Oriented Architecture (SOA)

- **Key Benefits:**
  - Provides standards based mechanism to access Services at the transport and protocol level
  - Promotes re-use of existing services
  - Enables fast adaptation to business needs
  - Aligns information resources to business goals
SOA Limitations

• Current Web Service standards provide the syntactic description of the service interface, but do not describe the meaning or the semantics of the data or behavior. Hence the consumer of the service; whether another service or a human, needs to have intimate knowledge and awareness about the data and its elements.

• Current Enterprise Service Buses (ESBs) don’t have an out of the box ability to perform Semantic Mediation, that is the transformation and co-relation of data elements and services based on a pre-defined vocabulary.

• Manual intervention and deep domain knowledge is required to develop custom mappings to correctly use data exposed by these related but different Web Services.

Source: Elements of a deployed, modern net-centric system
http://www.mil-embedded.com/articles/id/74597
Case In Point: Information Sharing in NextGen

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

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

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

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

Conform:
- Other Services

Publish:
- Live
- Recorded
- Simulated

State/Local Government
- Commercial Entities
- International Partners
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”
**Semantics + SOA**

**SOA**
Foundation for Service Interoperability

**Semantics**
Common Understanding of Business Concepts

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**Semantic Mediation Bus™**

Runtime infrastructure enables semantic interoperability through common ontologies, even if the services are implemented using different data models and message standards.

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**Problems**

- How can I improve Interoperability between different services and reduce system integration costs?
- I have already invested a lot in my SOA infrastructure, how do I leverage it for Semantic Interoperability?
- **How can I effectively test the same SOA message in multiple formats between the systems?**
Excess time is spent interpreting data from different sources despite the usage of advanced IT techniques like Web Services.
Alion Semantic Mediation Bus™

- An ontology-based web services mediation component (Semantic Mediator) that enables services with different message formats to interoperate.
- Embedding the Semantic Mediator in an Enterprise Service Bus (ESB) enables runtime semantic mediation within traditional SOA infrastructure, creating a Semantic Mediation Bus™.
Semantic Mediation Bus™: Key Characteristics

• Cooperation through federation, instead of standardization
  • The ontology driven approach avoids imposing a standard that has to be agreed by everybody, thus allowing the agencies to select the formats best suited for their business needs, while still being able to use services offered by other agencies.

• Increased ability to adapt to the ever changing business needs in a timely and cost effective manner
  • The semantic mediation approach encourages transformation logic to be declaratively defined in the ontology, instead of buried in the code, often in multiple places.

• No need for rigid conformance
  • Through loose coupling, the SMB allows transformation between message formats which might not be a complete match.

• Building on SOA infrastructure, instead of replacing it
  • By extending ESB infrastructure, organization can leverage their SOA investment and the existing expertise of their personnel.
Validating business requirements and determining service compatibilities.

1. Test Script
2. Business Requirements
3. Technical Requirements

- Semantic Mediation Bus™
  - Semantic Lookup
  - Message Transformation
  - Web Service Endpoint

- FAA Web Service
- Air Force Web Service
- 3rd Party Web Service

- Airline Code Lookup Table
  - Data: UA
  - Flight of Interest
    - Data: UA211
  - FlightID
    - Data: United 211

Delegate to infrastructure to collect measurements for non-functional requirements.
Ontologies reflecting shared understanding of business concepts is developed by engaging the established Communities of Interest (COI) and Subject Matter Experts (SME).

Secure and effective IT infrastructure is the foundation for Net-Centric information sharing.

SMB is part of the technology capability that extends traditional SOA to enable semantic service discoverability and interoperability.

SMB as Part of a Semantic Enterprise

SHARED UNDERSTANDING

SEMANTIC TECHNOLOGY CAPABILITIES

SERVICE ORIENTED INFRASTRUCTURE

EFFECTIVE INFORMATION SHARING

COORDINATION THROUGH FEDERATION

INCREASED REUSE AND AGILITY
Summary

• Put Ontologies to Work
  • Enhance service understandability at design time
  • Facilitate service interoperability at runtime

• Leverage Existing SOA Investment
  • Increase service discoverability and interoperability through semantic annotation
  • Build on existing services
  • Use in-house expertise
  • Ready to deploy now

• Streamline Service Integration and Testing
  • Shorten lifecycle by eliminating the need for custom message mapping
  • Reduce maintenance cost by leveraging existing infrastructure