Proceedings from ODISSEE 2011

held April 12 -13, 2011

REPORT DOCUMENTATION PAGE	*Form Approved* *OMB No. 0704-0188*

1. REPORT DATE *(DD-MM-YYYY)*	**2. REPORT TYPE**	**3. DATES COVERED** *(From - To)*
31-05-2011	Proceedings	12-13 April 2011

4. TITLE AND SUBTITLE	**5a. CONTRACT NUMBER**
Proceedings from ODISSEE 2011	N61339-03-D-0300
	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	**5d. PROJECT NUMBER**
Hughes, LaRon	**5e. TASK NUMBER**
	DO #244
	5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)	**8. PERFORMING ORGANIZATION REPORT NUMBER**
Alion Science and Technology Corporation 1701 N. Beauregard Street Suite 600 Alexandria, VA 22311	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	**10. SPONSOR/MONITOR'S ACRONYM(S)**
SAF/XC/NXTGN 1500 K. ST NW, #500 Washington, DC 20005	SAF/XC/NXTGN
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT

13. SUPPLEMENTARY NOTES

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			**17. LIMITATION OF ABSTRACT**	**18. NUMBER OF PAGES**	**19a. NAME OF RESPONSIBLE PERSON**
a. REPORT	**b. ABSTRACT**	**c. THIS PAGE**			Ms. Carlynn Thompson
u	u	u	SAR	412	**19b. TELEPHONE NUMBER** *(Include area code)* 202-624-3236

Reset

Standard Form 298 (Rev. 8/98)
Prescribed by ANSI Std. Z39.18

Proceedings from ODISSEE 2011

held April 12 -13, 2011

Table of Contents

15) Barry Smith – *Coordinated Development of Ontologies across Diverse Communities of Interest*

INTRODUCTION

The National Center for Ontological Research (State University of New York at Buffalo) and Alion Science and Technology, will hosted a two-day "Ontology Driven Implementation of Semantic Services for the Enterprise Environment (ODISSEE) Workshop." ODISSEE aims to foster awareness of and collaboration between disparate information-sharing efforts across the US Government. The workshop featured individual presentations on information-sharing development, as well as panel sessions on ontology and data vocabulary. The workshop supports the Joint Planning and Development Office (JPDO) information-sharing initiatives. Information sharing is at the heart of the transformation, from the current state of the National Airspace System (NAS) to NextGen capabilities in 2025, in areas such as unmanned aircraft systems (UAS), integrated surveillance, and weather. This document includes the titles, abstracts, and presentations from the meeting.

McComb, Dave

A Case Study in Applying Ontologies to Service Oriented Architecure, Dave McComb, Semantic Arts

Sallie Mae is the leading issuer and servicer of Student Loans in the US. This case study describes a project we did with Sallie Mae to build an Enterprise Ontology and then use that ontology to automate the production of their SOA messages. The project was made more urgent when they decided to outsource one of their lines of business but wanted to have a single set of shared SOA messages that operated between their newly outsourced systems and their existing front and back end systems. The presentation will describe how we automated the production of the messages and the role the ontology played in that.

Dave McComb is President of Semantic Arts. Semantic Arts has been providing consulting on applying semantic technology to large enterprises for ten years. Dave has be designing, building and integrating enterprise systems for over 30 years. He is the author of Semantics in Business Systems and the co-founder of the Semantic Technology Confernece.

Case Studies in Applying Semantics to Enterprise Systems

Dave McComb, Semantic Arts
May 2011

Semantic Arts

- Small Consulting Firm, specializing in helping large organizations apply semantic technology to their enterprise architectures

Semantic Arts Clients

Key Differentiator

- We believe that simplicity may be ultimate competitive advantage

The iPod wasn't the first mp3 player

..But it was the simplest

But not just any simplicity will do

- "I would not give a fig for the simplicity this side of complexity...
  - ...but I would give my life for the simplicity on the other side of complexity."

Oliver Wendell Holmes, Sr.

So, that's one of the themes of these three case studies

- Sallie Mae – How we automated the creation of their SOA messages from an enterprise ontology
- Procter and Gamble – using a shared R&D ontology to organize knowledge from many disparate disciplines
- LexisNexis – an Enterprise Ontology as the basis for their next generation business

SallieMae®

Sallie Mae

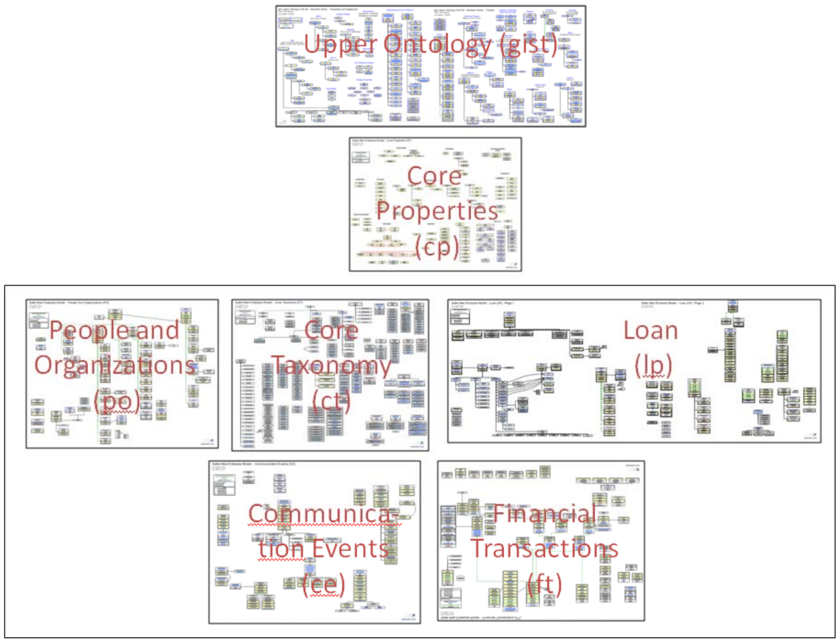
- Leading provider of Student Loans
- We built an Enterprise Ontology for them in early 2009
- In late 2009 they had an opportunity to apply it…

Getting a handle on complexity

	tables	attributes
Class	582	10,230
LoanCons	133	15,295
Eagle I	356	13,538
Eagle II	464	12,502
	1,535	51,565

These are the number of distinctions being made in the current systems

Sallie Mae Enterprise Model – May 2009



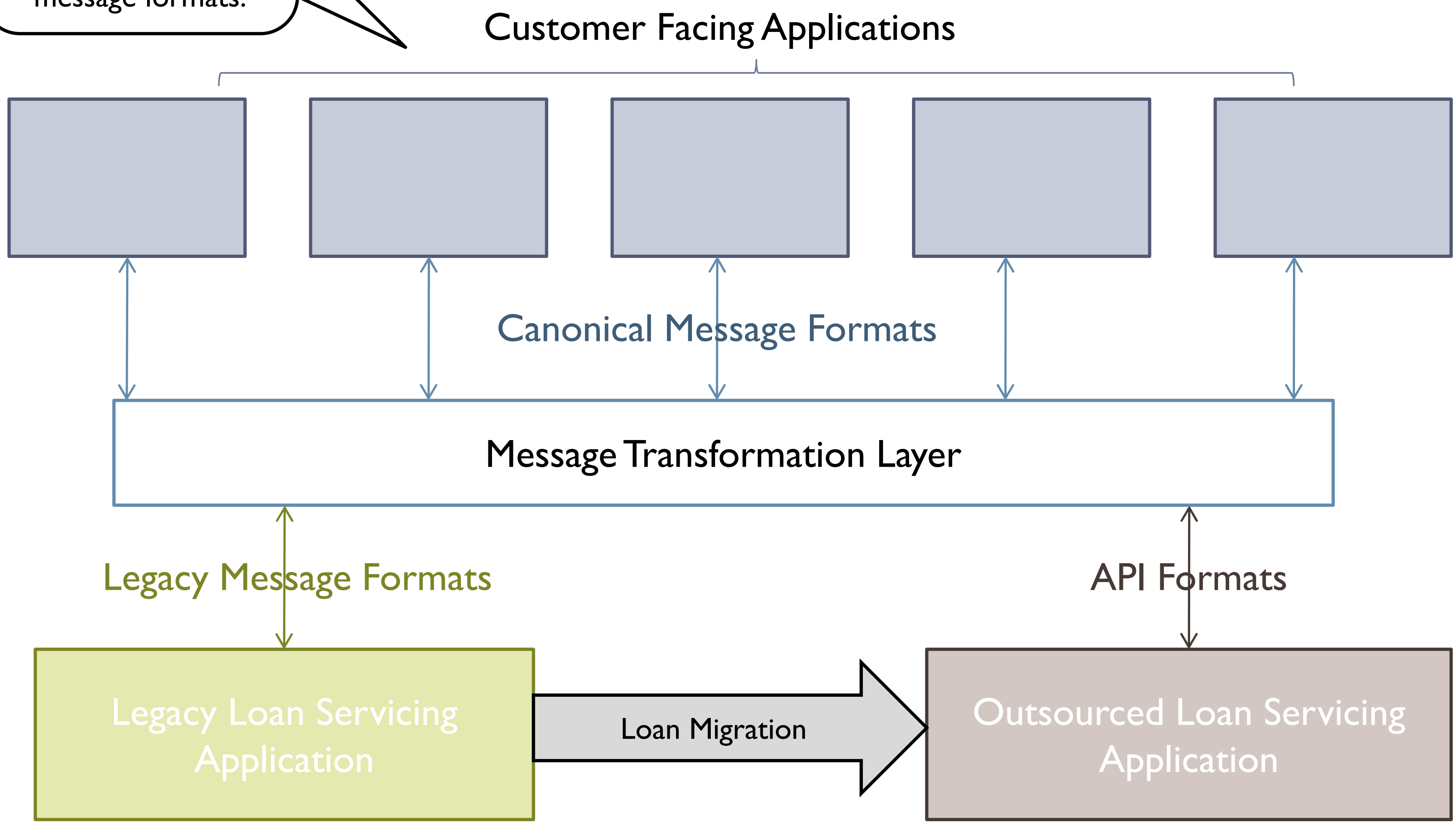
Classes	574
Object Properties	250
Data Type Properties	38
Total T-Box Axioms	**1470**

The original goals of the Sallie Mae Enterprise Semantic Model were to:

- Create formal business definitions of the principal concepts in use across the organization.
- Validate the model against existing data bases and interfaces, and start the process of formally describing the existing data using those enterprise definitions.
- Provide a basis for integrating structure and unstructured data.

rcing Initiative

Customer facing applications would be rewritten to use the canonical message formats.



Class Comparison

Sub Ontology	May 2009	March 2010
Loans	180	340
Communication	96	123
Social Beings	119	146
Finance	117	209
Core Properties	3	4
Core Taxonomy	99	284
Identifiers	21	56
Gist	130	129
GistComp		65
Message Model		134
CLASS specific (FinTran Codes)		130
All	610	1284

Mostly in the loan subject area as more detail on loan servicing events was added.

Instance taxonomies were converted to classes

Many new classes were specific to the Message Model class

Total doubled

Properties (Object/Datatype)

SubOntology	May 2009	March 2010
Loans	43/1	61/0
Communication	31/0	32/10
Social Beings	46/8	49/7
Finance	35/0	31/1
Core Properties	148/32	186/15
Core Taxonomy	4/0	2/0
Identifiers	2/1	2/2
	75/11	119/20
GistComp		42/0
Message Model		26/2
CLASS specific (FinTran		15/0
	225/44	317/36

A lot of the net increase was in gist.

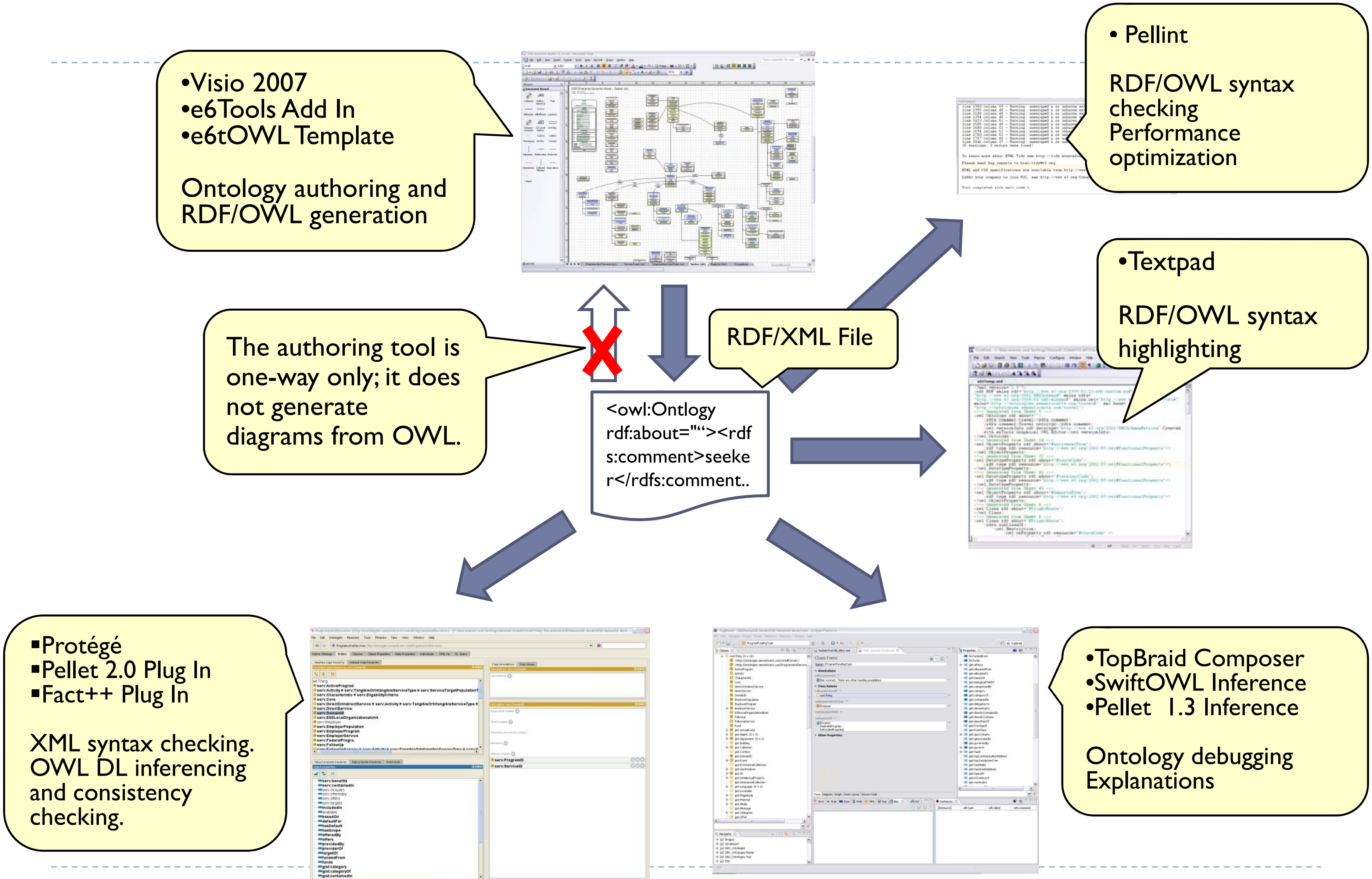
Surprisingly the total number of properties went up far less.

Tbox Axioms (sum of subclass, equivalent, disjoint and GCI)

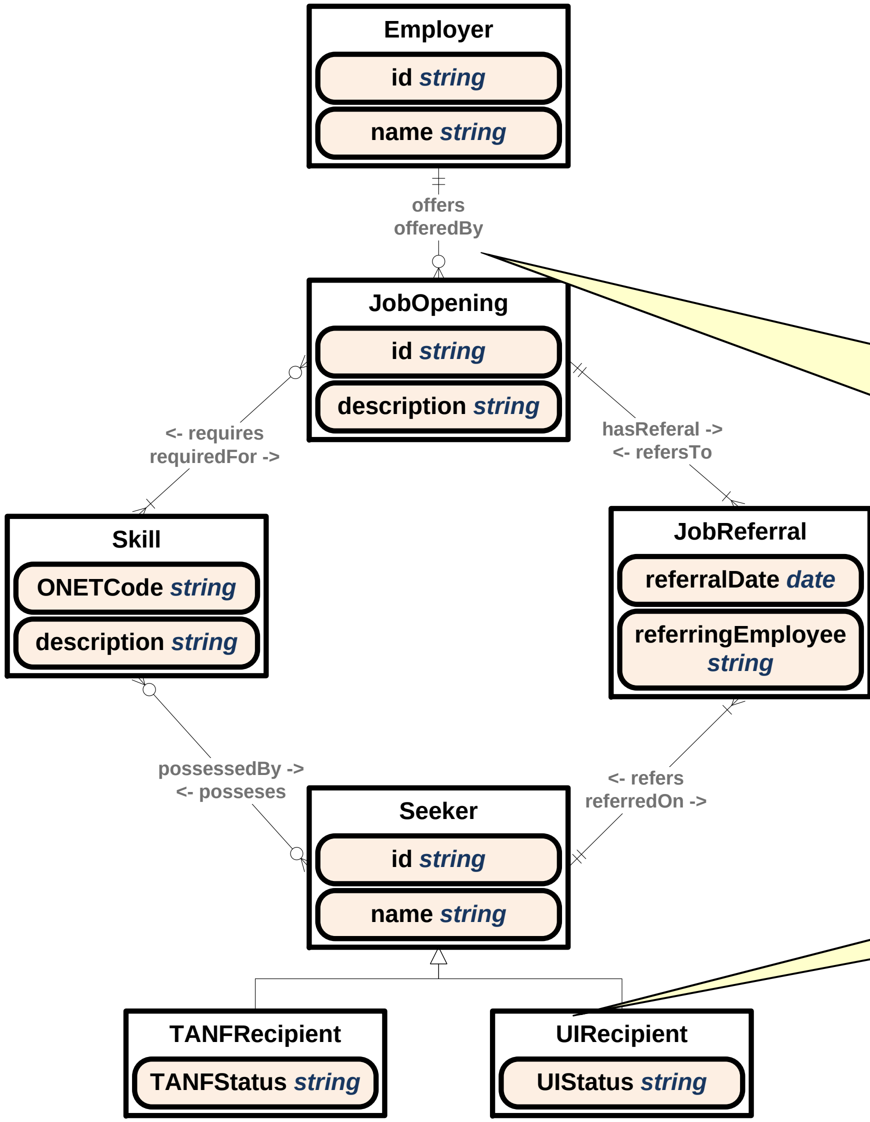
SubOntology	May 2009	March 2010
Loans	194	303
Communication	115	75
Social Beings	98	111
Finance	91	148
Core Properties	0	0
Core Taxonomy	327	160
Identifiers	27	116
Gist	246	160
GistComp		47
		86
		97
	1101	1257

The total number of axioms also went up slowly. We suspect that while we were adding a lot of restrictions we were also taking away redundant subclass assertions.

Toolset


•Visio 2007
•e6Tools Add In
•e6tOWL Template
Ontology authoring and RDF/OWL generation
• Pellint
RDF/OWL syntax checking
Performance optimization
•Textpad
RDF/OWL syntax highlighting
The authoring tool is one-way only; it does not generate diagrams from OWL.
RDF/XML File
<owl:Ontlogy rdf:about=""><rdfs:comment>seeker</rdfs:comment..
▪Protégé
▪Pellet 2.0 Plug In
▪Fact++ Plug In
XML syntax checking. OWL DL inferencing and consistency checking.
•TopBraid Composer
•SwiftOWL Inference
•Pellet 1.3 Inference
Ontology debugging Explanations

A Semantic Model Example

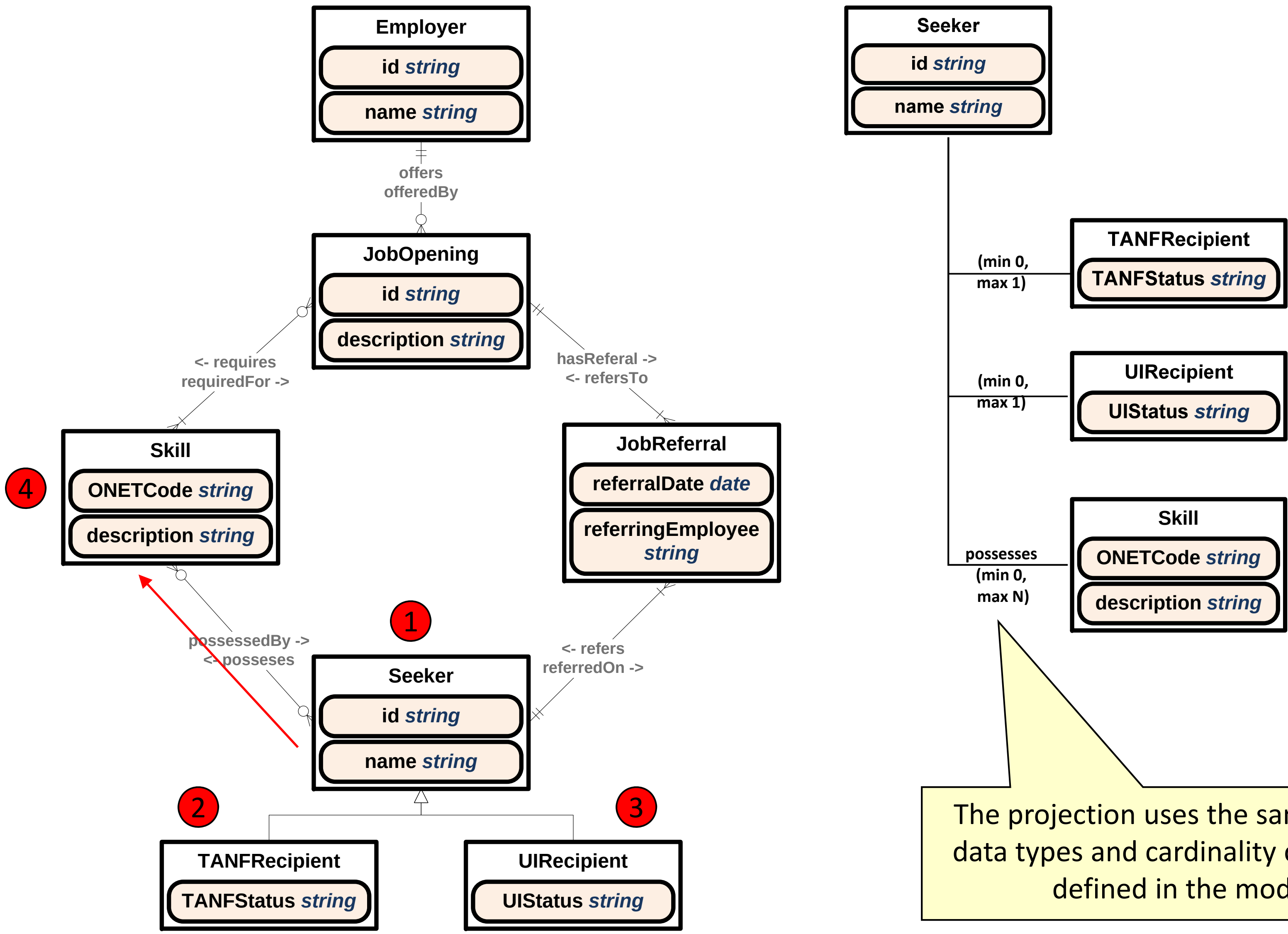


Let's take a simplified fragment of a logical message model.

The model defines relationships and cardinality.
"An Employer Offers zero or many Job Openings"
"A JobOpening is offeredBy one and only one Employer"

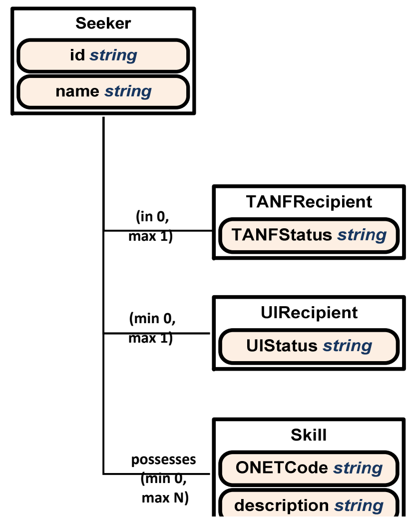
The model defines subsumption.
"A UIRecipient is a Seeker"

A Seeker Subject Projection



The projection uses the same names, data types and cardinality constraints defined in the model.

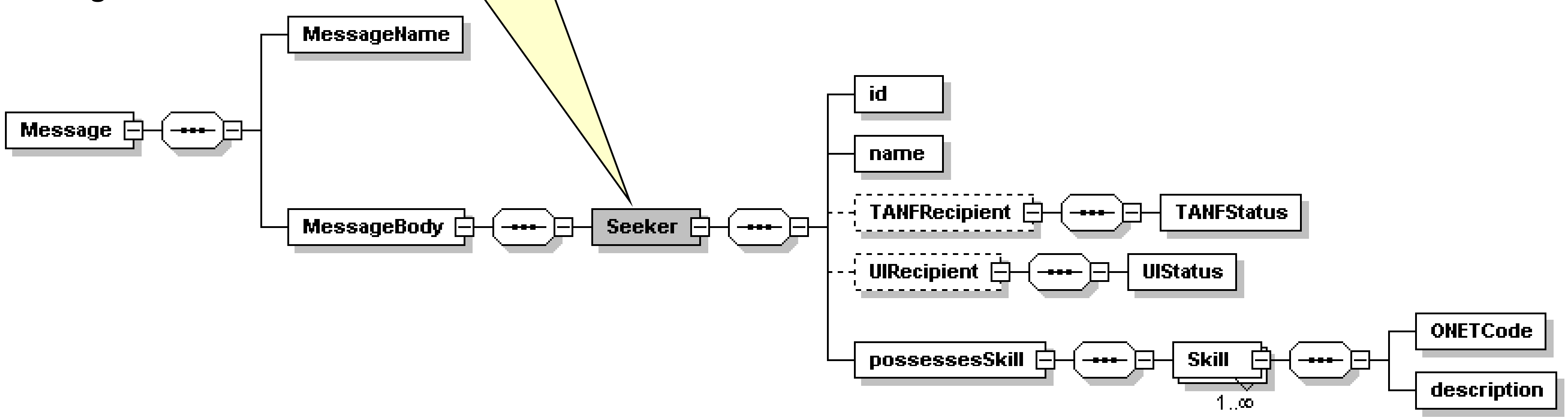
The Projection becomes the XSD Message Definition



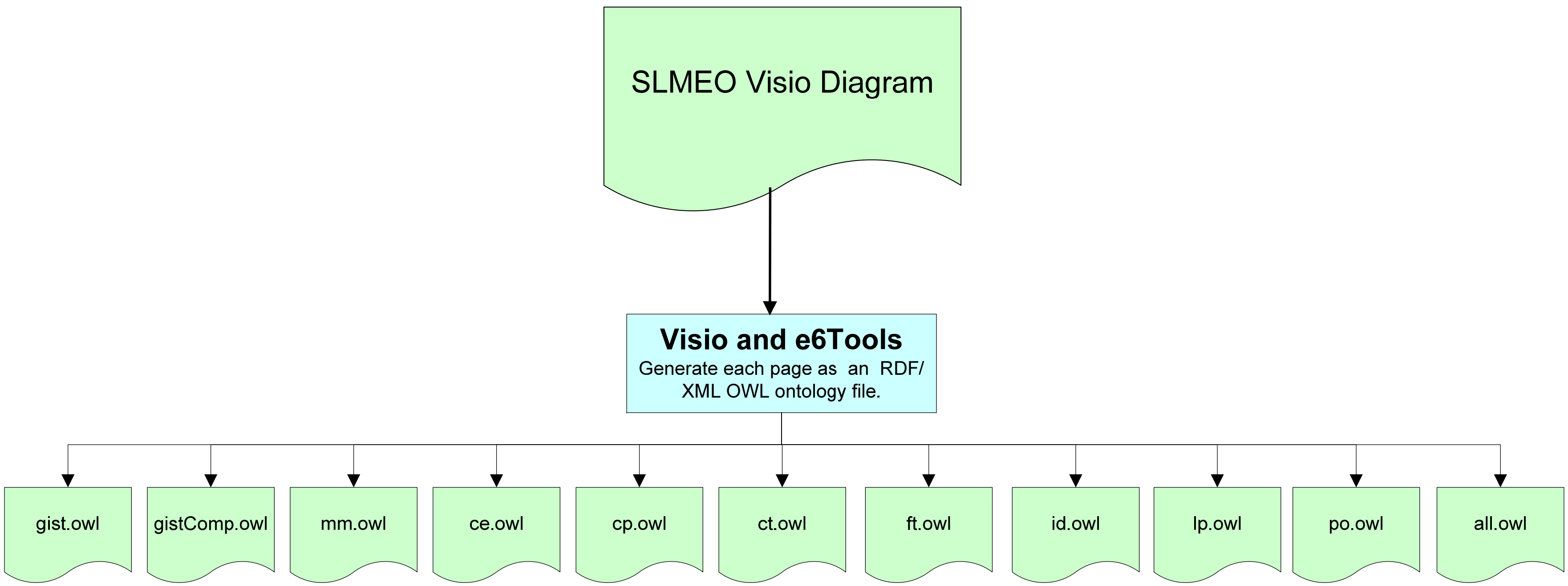
The message body for the "BasicSeeker" message type is defined in XSD based on the projection.

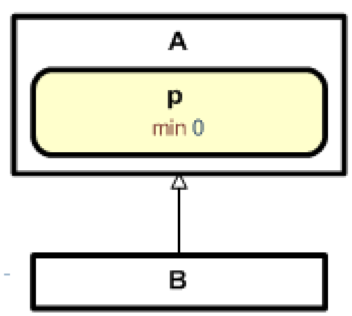
XMLSPY

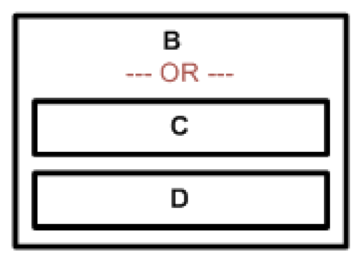
XSD Design View



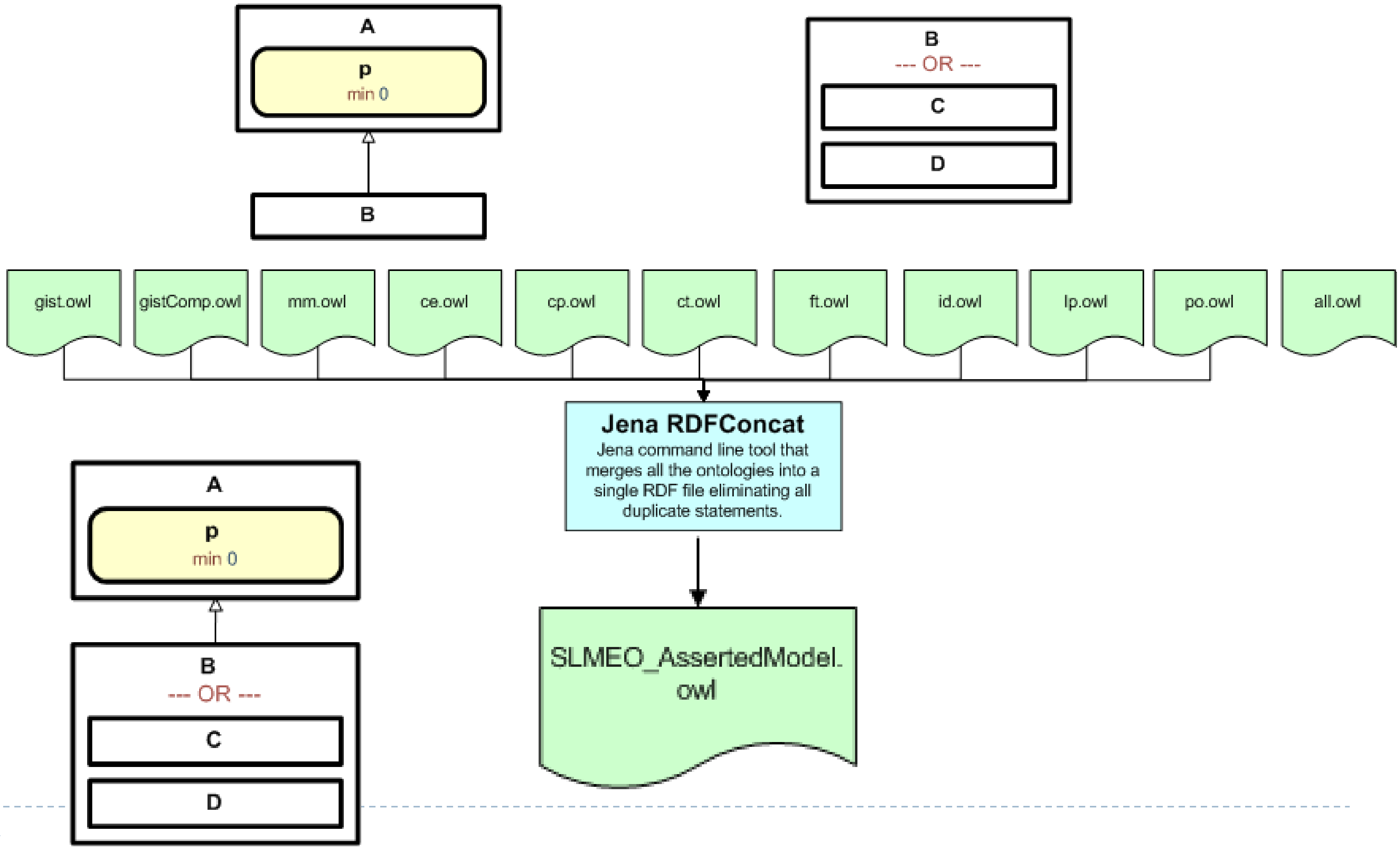
Step 1 – Generate the SLMEO OWL files using the e6Tools Visio add-in



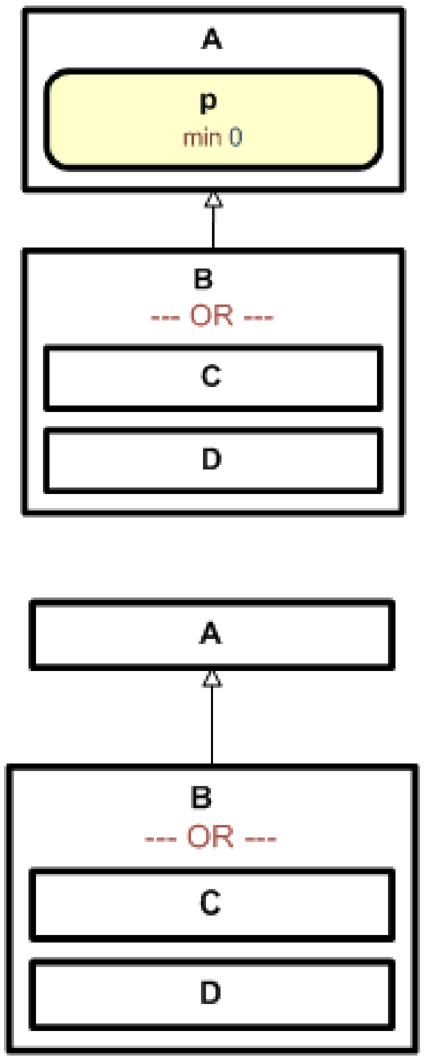


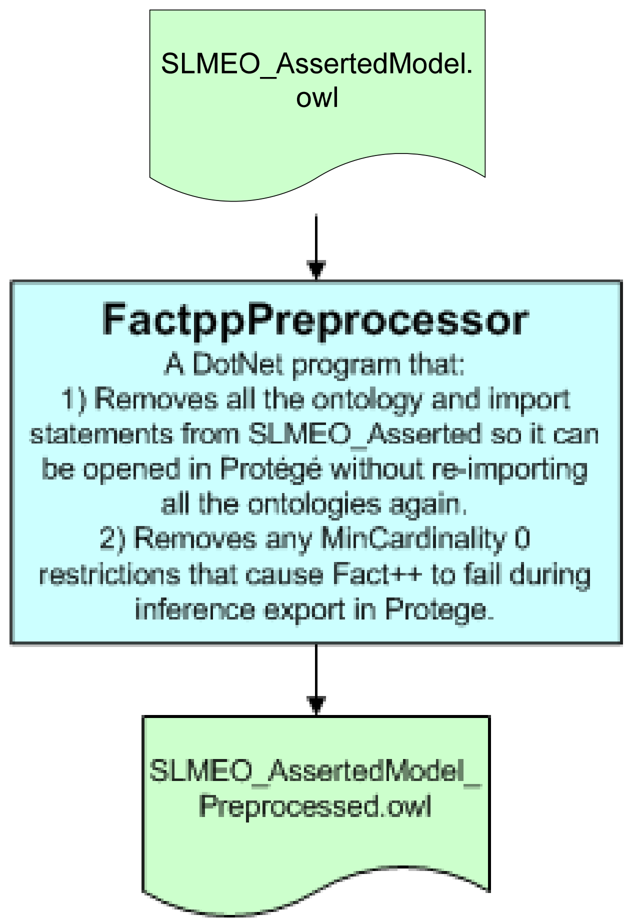


Step 2 – Combine all the ontologies into one using RDFConcat

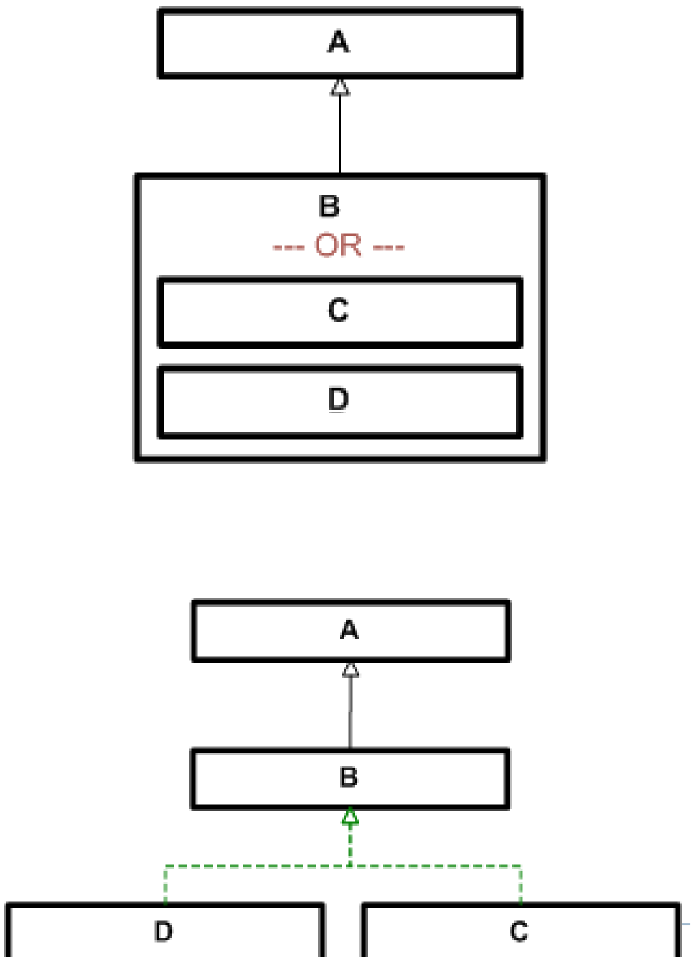


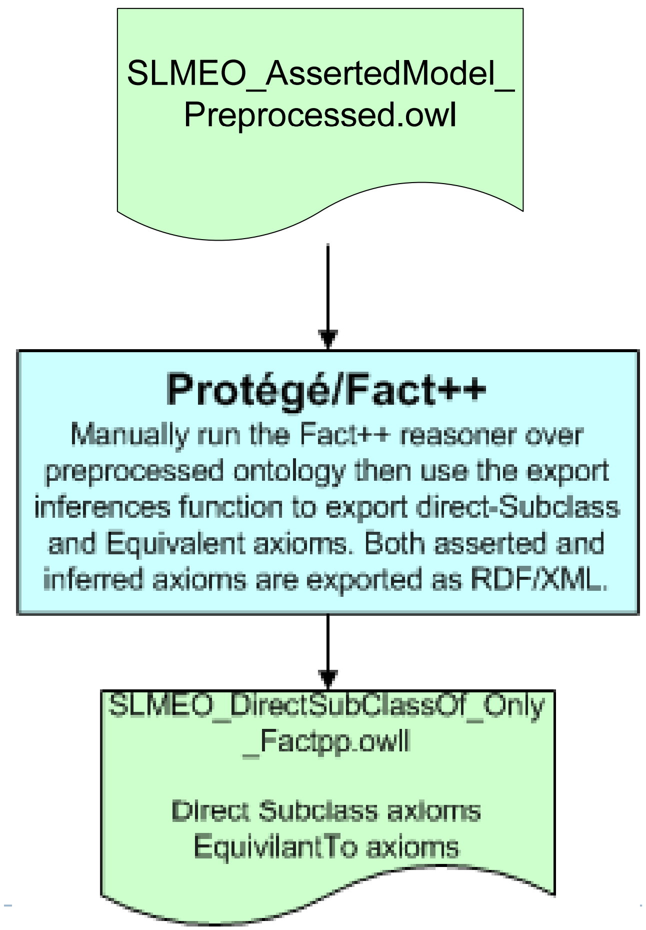
Step 3 – Preprocess the combined model for Protégé/Fact++ Inference



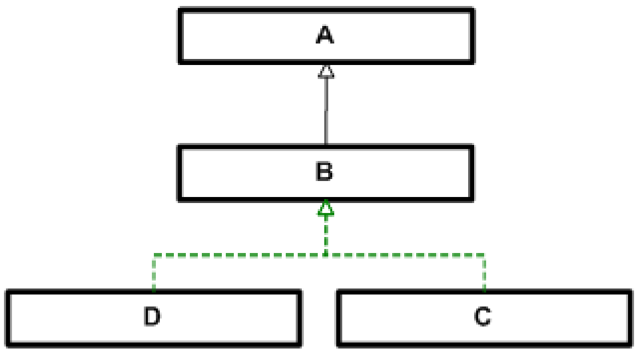


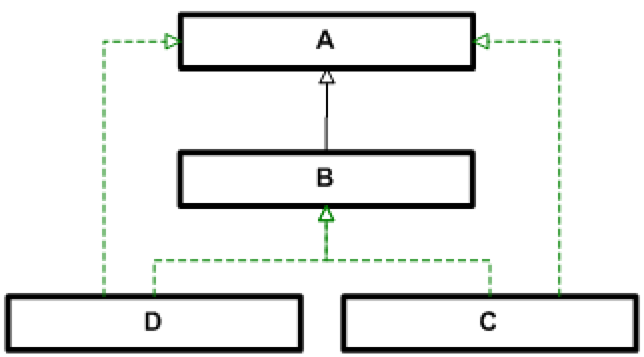
Step 4 – Infer in Protégé/FACT++ and export Direct Subclasses and Equivalent inferences.

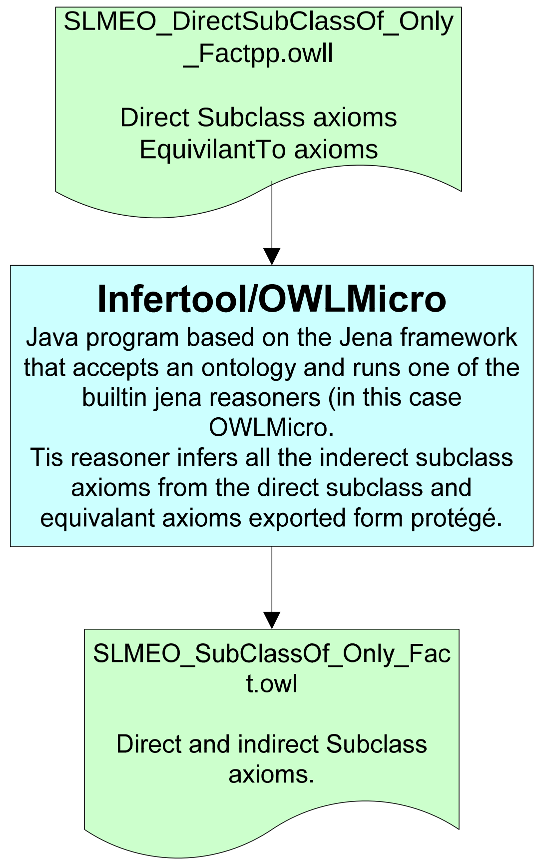




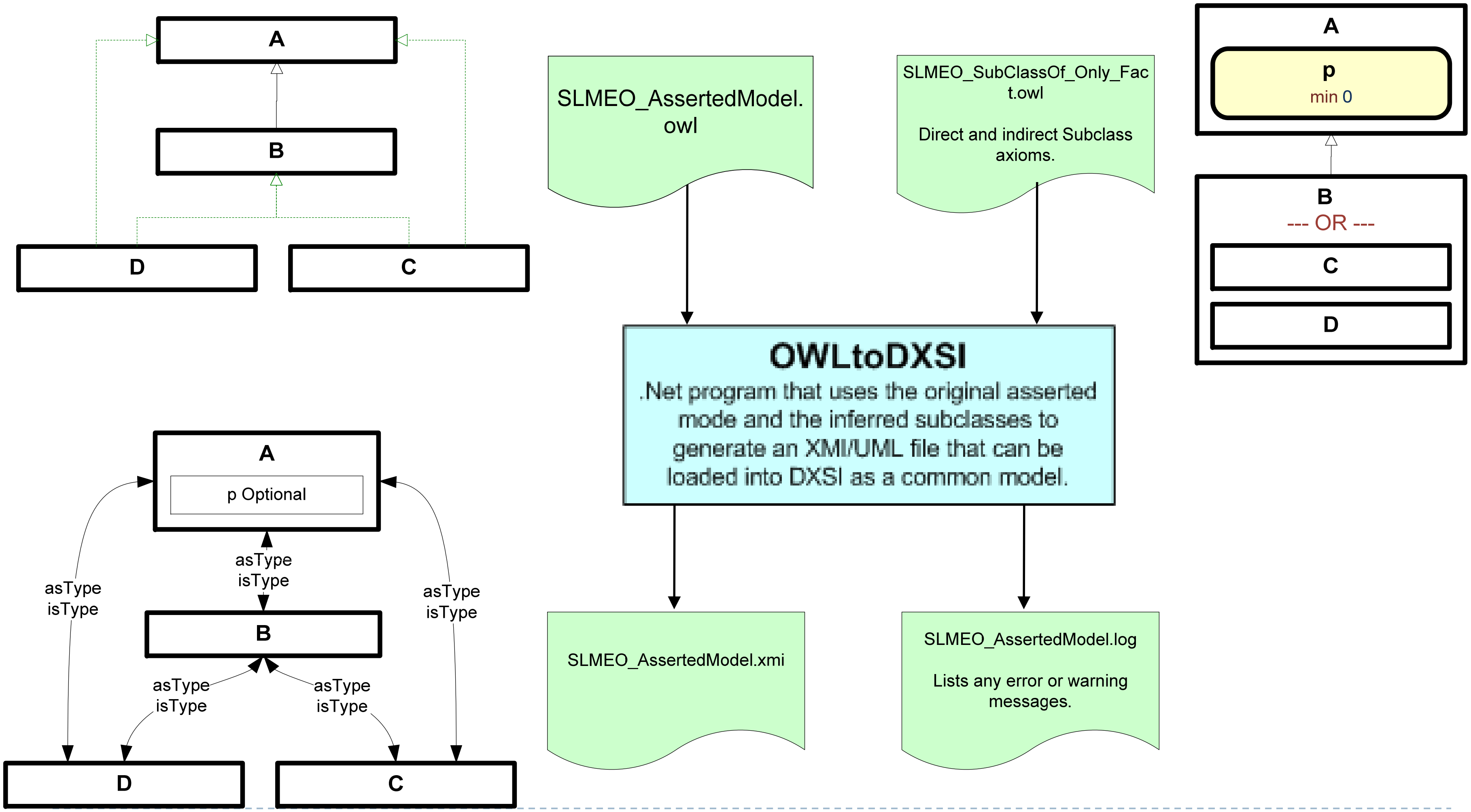
Step 5 – Infer Indirect Subclasses using the Jena reasoners OWLMicro



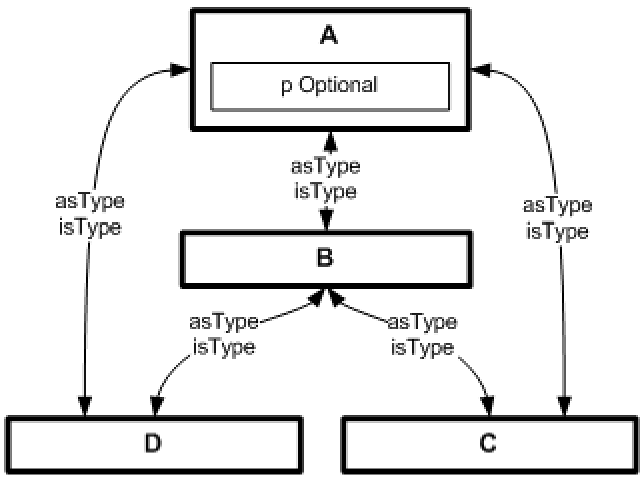


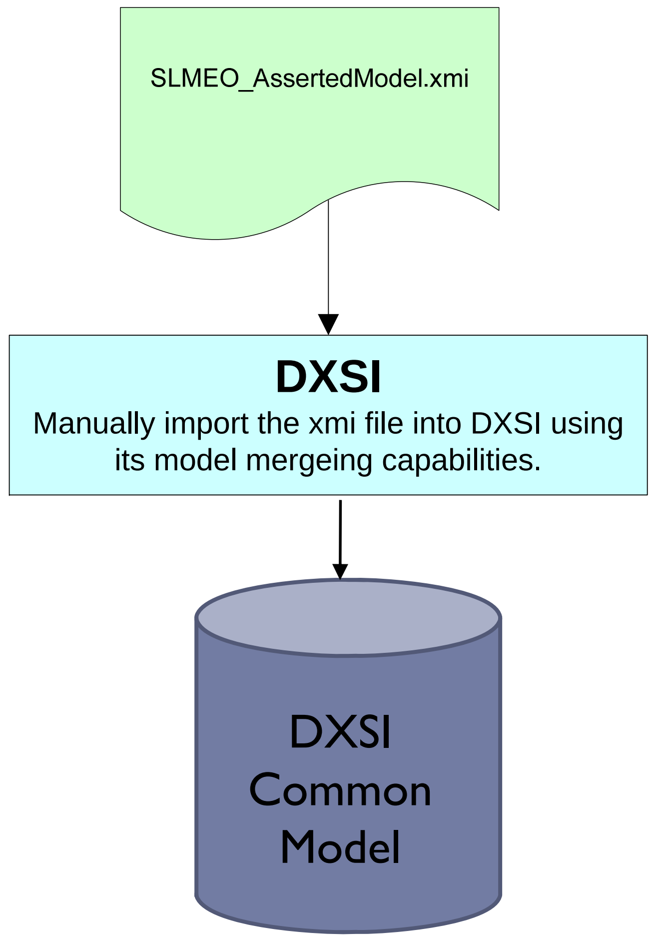


Step 6 – Transform the ontology into a UML based model in XMI

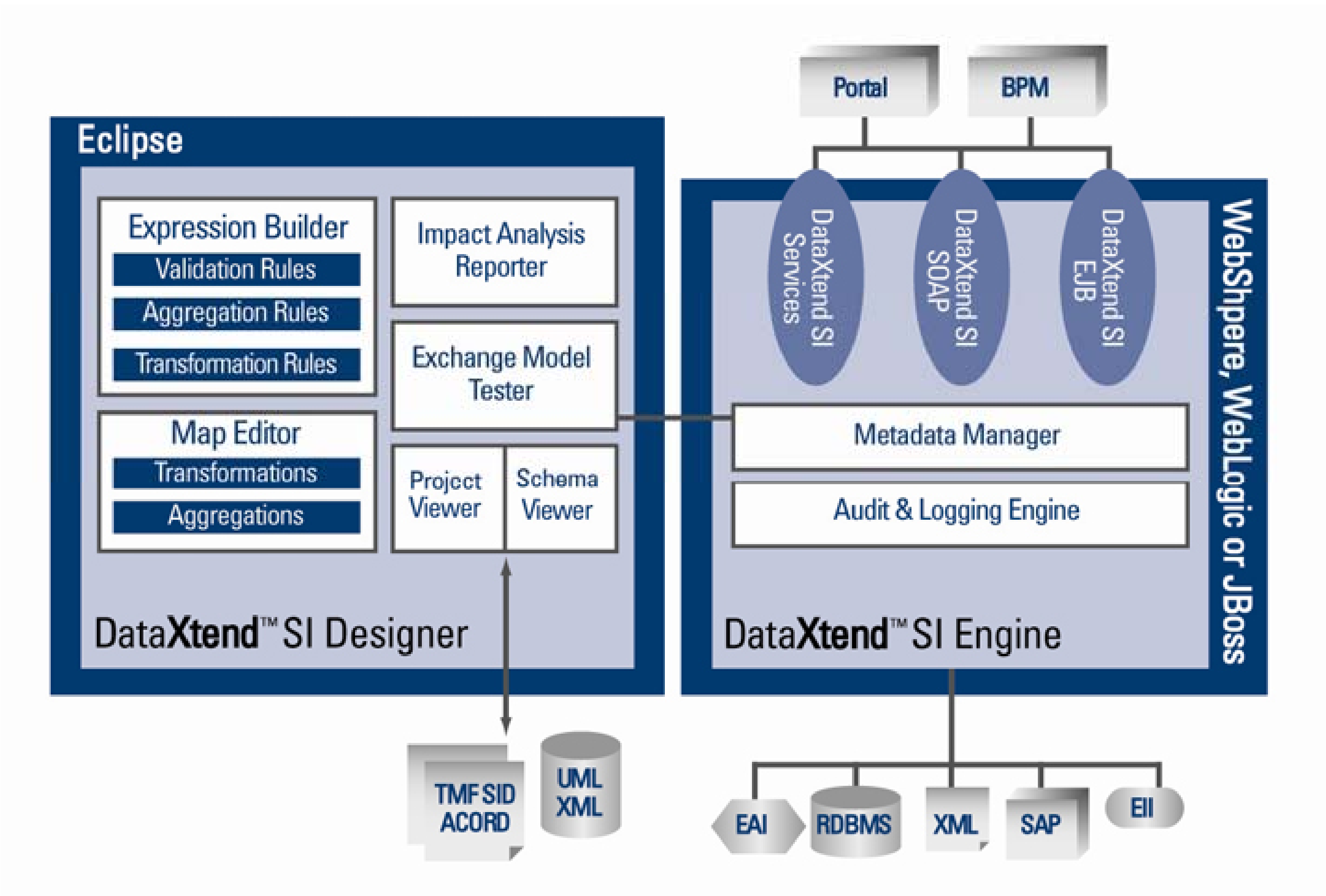


Step 7 – Import the MSI to the DXSI Common Model



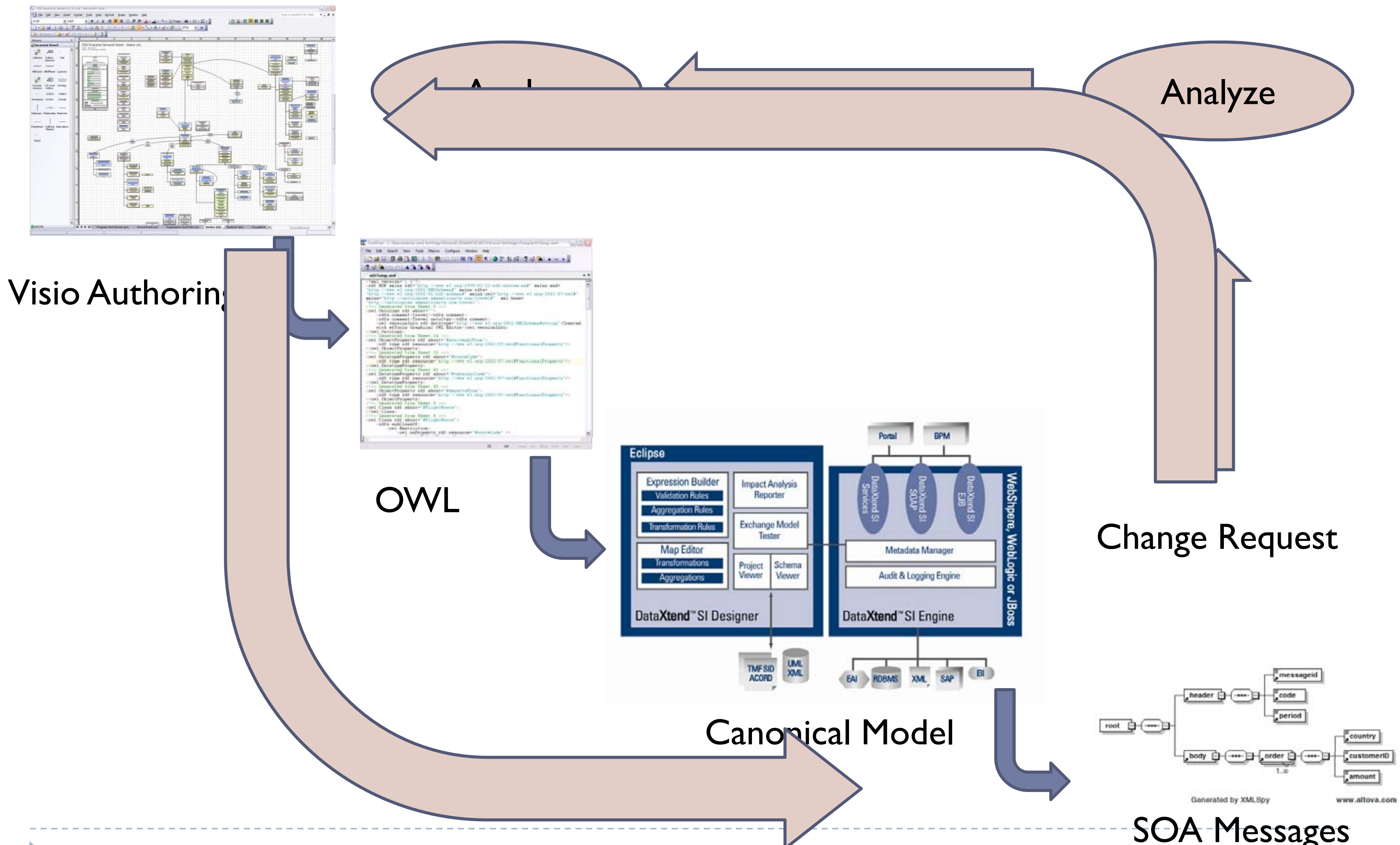


Progress/ Data Extend (DXSI)



Toolset

Full loop about 1-3 hours



Net Result

- New outsourced servicing system was integrated into Sallie Mae environment
- There is one set of SOA messages that handle both servicing systems
- The rationalization of the messages was made possible by the enterprise ontology
- Changes could be rapidly incorporated into the ontology and their impact reflected in messages within hours

Schema Complexity

- Most of the schema complexity in traditional systems is a product of the inflexibility of relational technology and procedural programming.
- Our work has demonstrated that complexity can be reduced by at least an order of magnitude and perhaps two orders of magnitude.

Summary

- Ontologically driven systems are moving into the early adopter mainstream for large scale systems
- Basing them on a rigorous, minimal upper ontology promotes design elegance.

Forbes, Germaine

Net-Enabled Test Environment (NETE)

Net- Centric Operations Division

Joint Planning and Development Office (JPDO)

Net- Enabled Test Environment (NETE)

Germaine Forbes T&E Manager
NCOD, JPDO
13 April 2011

Agenda

- Net- Enabled Test Environment (NETE) Overview
- NETE Partnership Participation and Benefits
- NETE Demos Descriptions
  - Telcordia Modeling Task
  - Demo 0
  - Demo 1
- Ongoing Activities

Net- Enabled Test Environment (NETE)

- Concept
  - Virtual Test environment – no new facility
  - Industry and Government 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 efficacy
  - Accessible to all NextGen participants; can link to outside data sources/consumers
  - Leverages work already done by NextGen Stakeholders

NETE Areas of Interest

- Address access control in Inter-Agency Environment
  - Authentication, identity verification
  - Interference by Firewall and automated security tools
  - Access the registry to define the service/data
- Measure Quality of Service and Throughput
  - Operator monitoring of quality of service and service delivery problems
  - Bandwidth and latency; network performance
- Evaluate Alternative approaches (i.e. AOA)
  - Enterprise Service Buses (ESB) interoperability, ESB Solutions
  - Scalability of service delivery
  - SOA Test Tools
- Demonstrate near-term benefits of information sharing with key communities
  - Weather, Integrated Surveillance, Flight and Flow

Goals

- Establish and Document Initial NETE Capabilities
  - Baseline connectivity and the ability to share information through web services, plan for R&D Domain (FAA)
  - Demonstrate a set of well-understood basic services that are relevant to the aviation community (Core)
  - Establish Charter and NETE participation framework (Baseline)

- Prepare NETE as a Platform for Inter-agency Demonstrations
  - Enable capability to test communications and services prior to future demonstrations
  - Work out issues related to coordinating a distributed demonstration
  - Provide and/or establish use of collaboration tools

Near Term Objectives

- Demonstrate the NCOD's approach to secure and effective information sharing by leveraging Semantic Web Service Architecture (SWSA)
  - Exercise information exchanges developed in collaboration with Integrated Surveillance community
  - Demonstrate ontology-driven approach to enhance service discoverability and interoperability
  - Elaborate key infrastructure components (e.g. Semantic Service Registry) of SWSA
- Demonstrate NETE as a platform for inter-agency demonstrations
  - Showcase the ability to execute distributed demonstration involving multiple agencies
  - Refine process to facilitate future NETE demonstrations
- Serve as a risk reduction environment for JPDO summer demonstrations
  - Improve confidence on the Lost Cargo Jet business scenario

Opportunities

- Build on the Foundation of Interagency Collaborations
  - NETE Working Group as a forum for addressing governance issues
  - On-going NETE infrastructure modeling initiative to provide a snapshot of the interagency network and SOA infrastructures
  - Participating from agencies critical to success of NETE

- Support Effective Information Sharing and Engagements of Community of Interests (COI)
  - JPDO is engaging with NextGen weather and Integrated Surveillance community to identify information exchanges
  - NETE supports information sharing goals by providing a platform for exploration, experimentation, and socialization of information exchange services

- Facilitate 1 Year Challenge Demonstration
  - Incremental approach progressing w participation with select demos
  - Serve as a risk reduction environment for summer demonstrations

Opportunities Cont

- Participation with FAA Program Priorities
  - FAA Tech Center/ R&D Domain
  - DEX Rel 6 (FTI/Harris)
  - SWIM
  - NEO
- Federal and Industry Participation
  - Northrup Grumman NNEW
  - JPL
  - NASA LaRC (Services, Registry)
- DoD Participation
  - Hanscom AFB, ESC
    - CoT
    - UAVs
  - Coalition Warrior Interoperability Demonstration (CWID)

Partner Benefits

- A multi-agency platform for exploration, experimentation, testing, and socialization of web service applications
- Access to NCOD's Semantic Web Services Registry
- Opportunity to perform risk reduction testing on a broad scale
- Established connectivity relationships with outside agencies
- Insight into other agency Information Assurance best practices at the working level
- Opportunity to participate and benefit from exercise best practices at minimal cost

NETE Participation

- Goal is to coordinate and facilitate 2-3 demos yearly (FY)
- Encourage maximum participation from government sponsorship and private industry
  - FUNDS for NETE are limited!!!
- Participation will be based upon an approved project review and selection process preferably independent stakeholder (Institute)
  - JPDO will submit participation packages requesting information
- Goal is to ensure the testing requirements are alignment with JPDO and NCOD priorities and objectives
  - For example during a particular demo phase (ND1FY11) focus area may be Integrated Surveillance, Target Based Operations, UAS (or an overlap)

NETE Event Planning

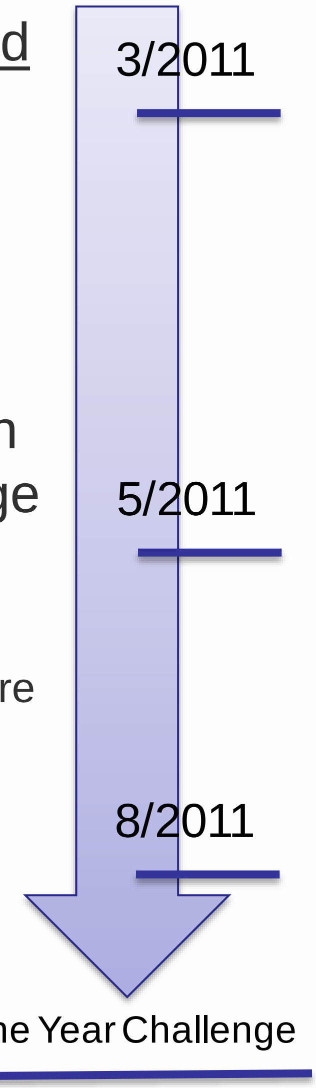
- Schedule out NETE events based upon JPDO mission and objectives
- Establish criteria for NETE projects
- Obtain an approved timeline for project submittals, due dates, review, selection, demo, reporting
- Develop requirements for test submittal package. Examples are:
  - Description of project/Sponsor
  - Architecture
  - Description and pedigree of the data exchanged/demonstrated
  - Communication requirements
  - Agreements (MOA, PLA, CRADA)
  - Any relevant historical data ie previous test reports
  - Security documentation if applicable
- Publicize events via a datacall, working group, fedbizopps, etc

Project Selection

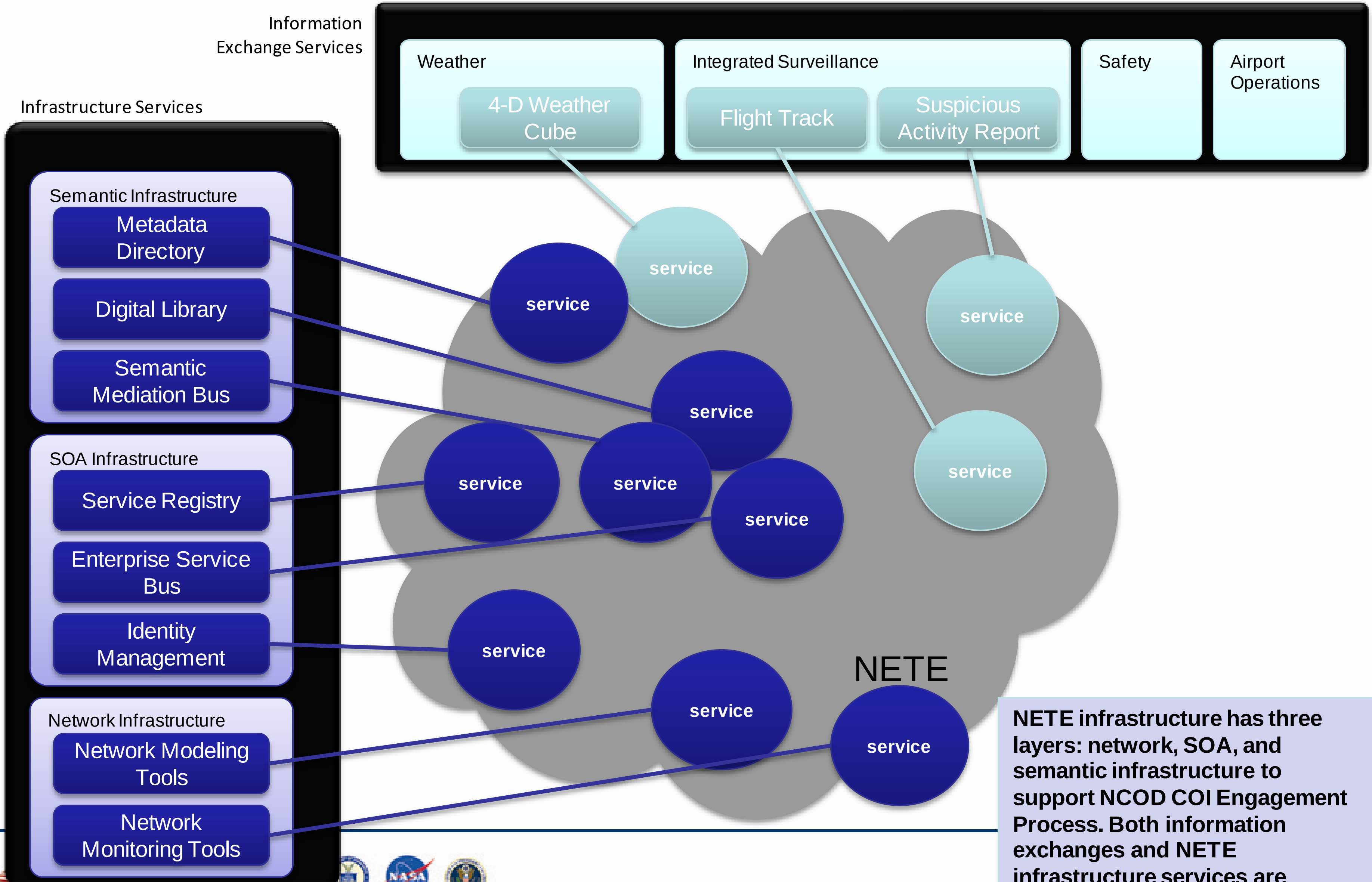
- Goal is to establish a tracking mechanism for participants
  - Working on a Collaboration tool and registry
- Eval and selection criteria based upon
  - Alignment with *published* JPDO mission areas and priorities
  - Benefit to the Sponsor (PoR) in support of milestones
  - Alignment with other exercises
  - Various partners
  - Government industry partnership
  - Amount of government industry in-kind Services provided as part of demo

Planned Demonstrations

- Communication Validation Demonstration (Demo 0) prepared NETE as the platform for Information Exchange Demonstrations
  - Establish connectivity among initial NETE nodes
  - Verify ability to share information through web services
  - Initiate discussions on security and business relationships
- Information Exchange Demonstration (Demo 1) will establish the software and service framework for Information Exchange Demonstrations
  - Exercise information exchanges related to integrated surveillance
  - Demonstrate key components of the semantic web service infrastructure (e.g. Semantic Service Registry)
- Information Exchange Demonstration (Demo 2) focuses on reducing risks for JPDO 1 Year challenge demonstration
  - Exercise information exchanges related to integrated surveillance



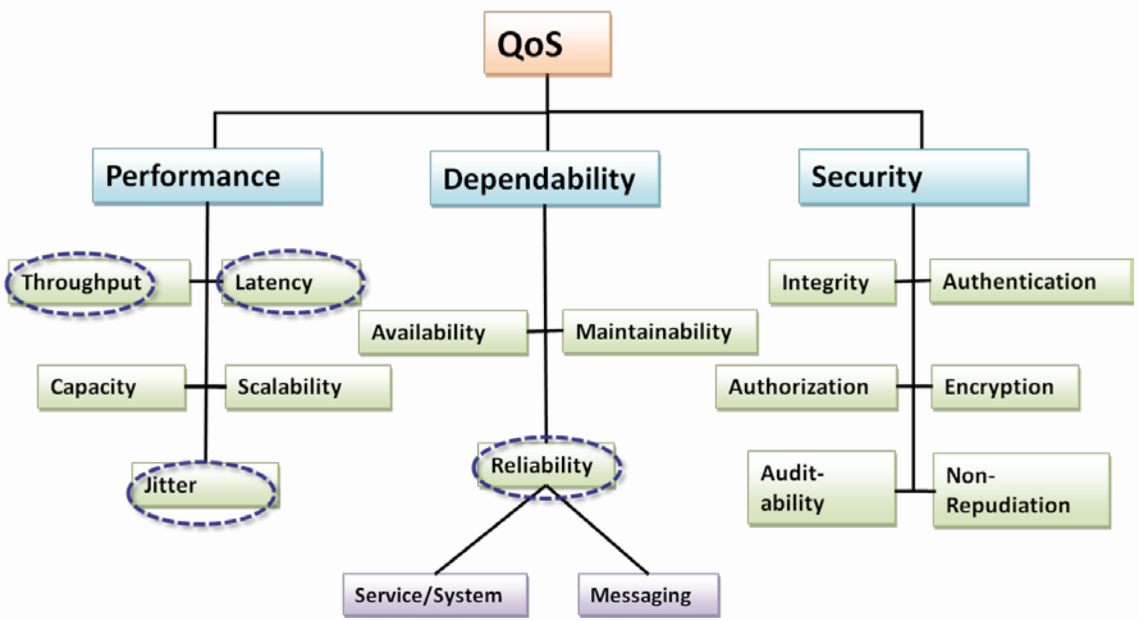
NETE as a Federated Infrastructure



NETE infrastructure has three layers: network, SOA, and semantic infrastructure to support NCOD COI Engagement Process. Both information exchanges and NETE infrastructure services are provided by participants.

NETE Modeling Overview and Objectives

- Provide Ability to Evaluate As-is Scenario and Alternative Architectures
- Provide Insights Into Inter-agency Applications and Information Services
- Uncover Issues Resulting from Interactions between the Application, SOA and Network Layers



NETE Infrastructure Modeling Approach

- Focused on Information Exchange Applications
  - Model the characteristics of interagency network and SOA infrastructures
  - Understanding how application requirements are supported by infrastructure capabilities
- Involving NETE Community
  - Require an application scenario that generates interests from NETE participants
  - Contribute to participants' existing initiatives
- Aligned with Information Exchange Development
  - Leverage ongoing collaborations with FAA and NASA
  - Support NextGen information sharing goals

NETE Modeling Approach (1 of 3)

- Application layer Characteristics:
  - Tunable characteristics such as data collection latency, information generation rate, information distribution model (unicast, multicast), frequency of information updates, processing latency, and the application service level requirements

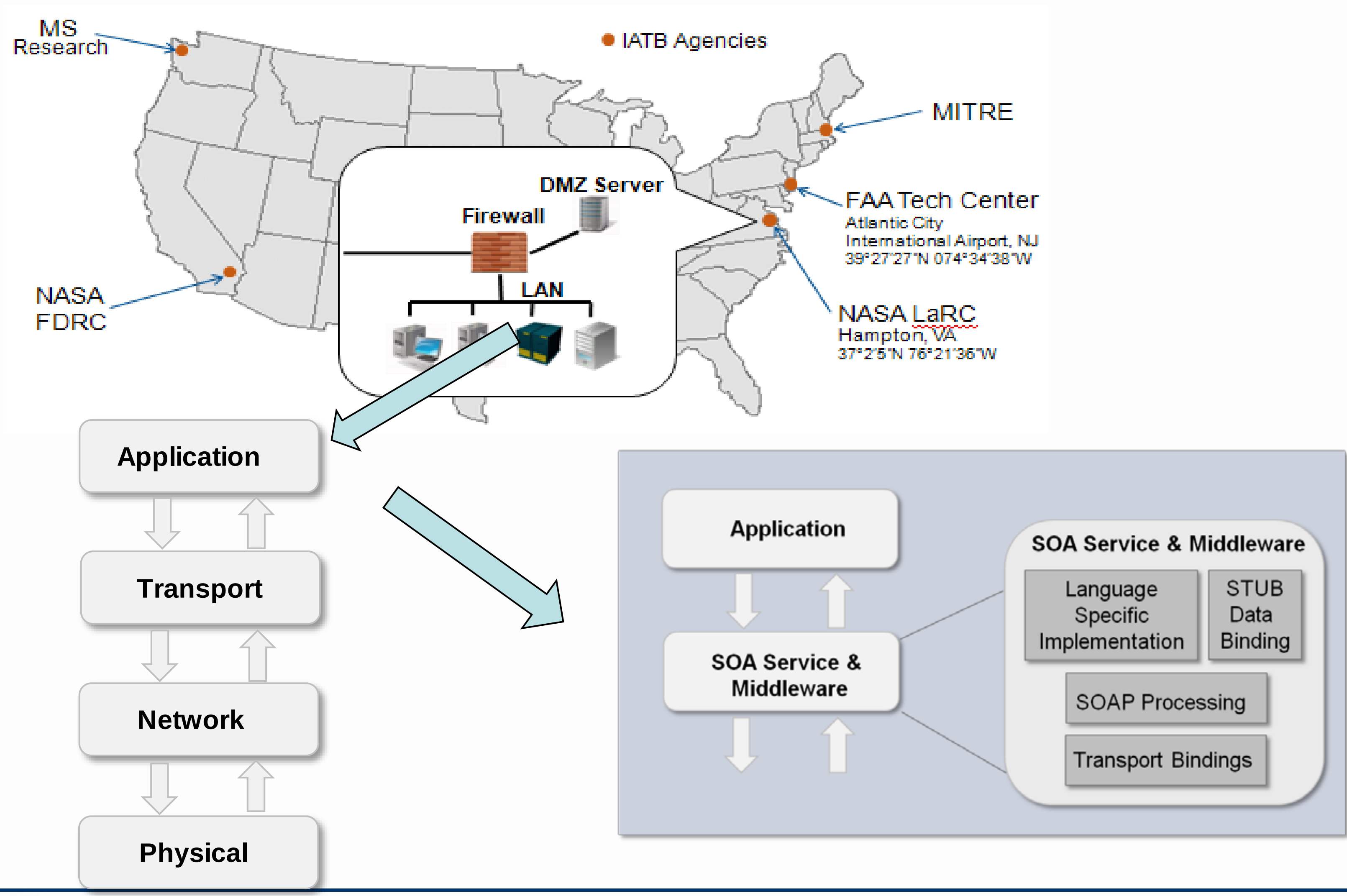
- SOA Layer Modeling:
  - SOA communication styles such as request/response, publish/subscribe and bulk transfer
  - Differing QoS characteristics, e.g. response time for request/response interaction or reliable delivery of notifications in a pub/sub interaction
  - SOA message communication model including message size, message payload type (e.g., XML, compressed XML, binary) and information overhead.
  - SOA transport protocol characteristics (e.g. http transport for Web Services) & middleware characteristics

NETE Modeling Approach (2 of 3)

- Characteristics of agency interconnections to the Internet or other private closed IP networks
  – Internet or private line based connectivity
    - Access link and choke-point based modeling
    - Network latency, jitter (i.e. the variation of network latency), bottleneck bandwidth, number of routing/forwarding hops

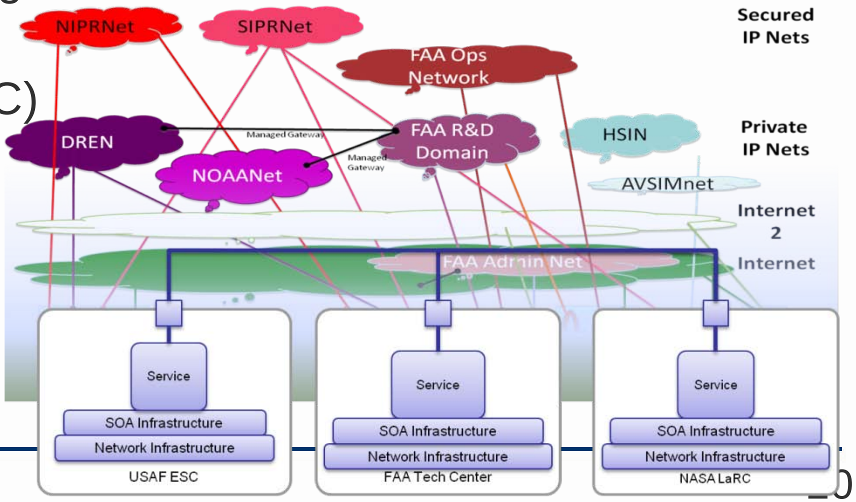
  – Capture statistical variances in instantaneous network characteristics with appropriate probabilistic models for variations in network delay, background load, queuing etc.

NETE Modeling Approach (3 of 3)



Comms Validation(Demo 0): Overview

- Establish and document initial NETE capabilities
  - Verified network connectivity
  - Verified the ability to share information through web services
  - Demonstrated a set of well-understood basic services
  - Control workstation in place with software installed
  - Demonstration script completed, deployed, and tested
  - Validated service endpoint availability
- Preparing NETE as a platform for inter-agency demonstrations
  - Working out issues related to coordinating a distributed demonstration
  - Establishing a baseline of available facilities and services
  - Initiated discussions regarding business relationships among the partners
  - Initiated discussions on security arrangements for distribute demonstrations
- Initial Partners
  - USAF Electronic Systems Center (ESC)
  - FAA Technical Center
  - NASA Langley Research Center
  - Alion NETE Lab
- Original Goal:
  - 2 NETE nodes active



Information Exchange Demonstration 1

- Demonstration Scenario
  - Lost Cargo Jet
- Information Exchanges
  - Focus on Integrated Surveillance, for example:
    - Suspicious Activity Report (SAR)
    - Flight Info
    - Track Info
    - Threat Info
    - Weather Data
  - Ongoing Collaboration with the Community
- Roles
  - Airport Personnel
  - Federal Aviation Administration (FAA)
  - Department of Defense (DOD)
  - Department of Homeland Security (DHS)
  - Local and State Law Enforcement
- Participating Locations
  - TBD

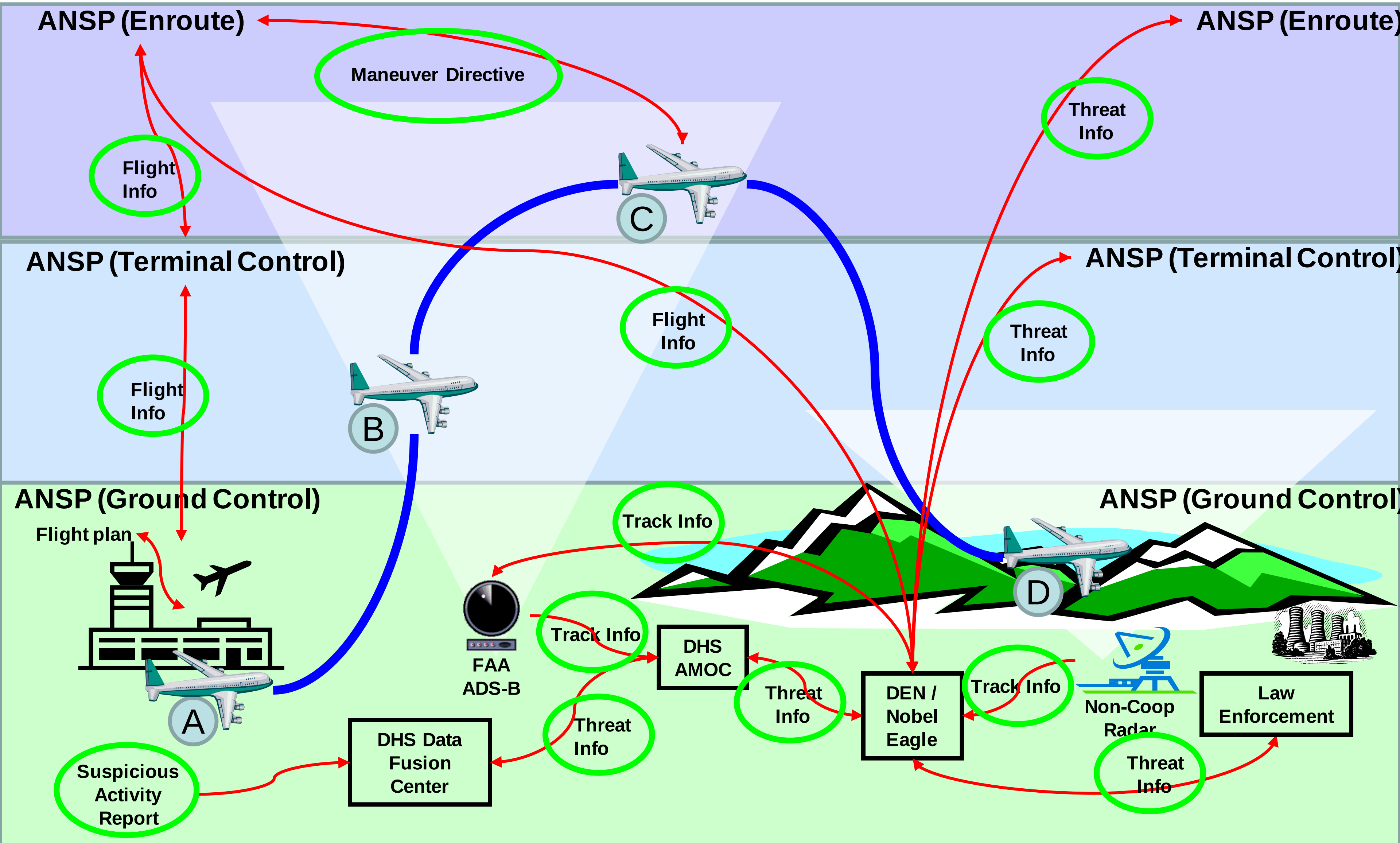
Ongoing Activities

- NCOD conducts monthly status meetings with JPDO Director, FAA Pillar Program Managers
- Collaborate with Industry efforts related to NEXTGEN
- Participation with IPT, Outreach Forums and Working Groups, such as NCOIC, ADA Working Group
- Interagency collaboration for information exchange lessons learned and discuss approaches for exchange
- Document processes, agreements, and infrastructure configurations
- Configuration Management
- Bi-monthly NETE WG meetings w/ Industry and Government
- BiWeekly NETE Engineering meetings with core partners
- Consistent alignment back to architecture
- Monitor tasks to ensure consistent alignment with JPDO and One Year Challenge objectives

Questions?

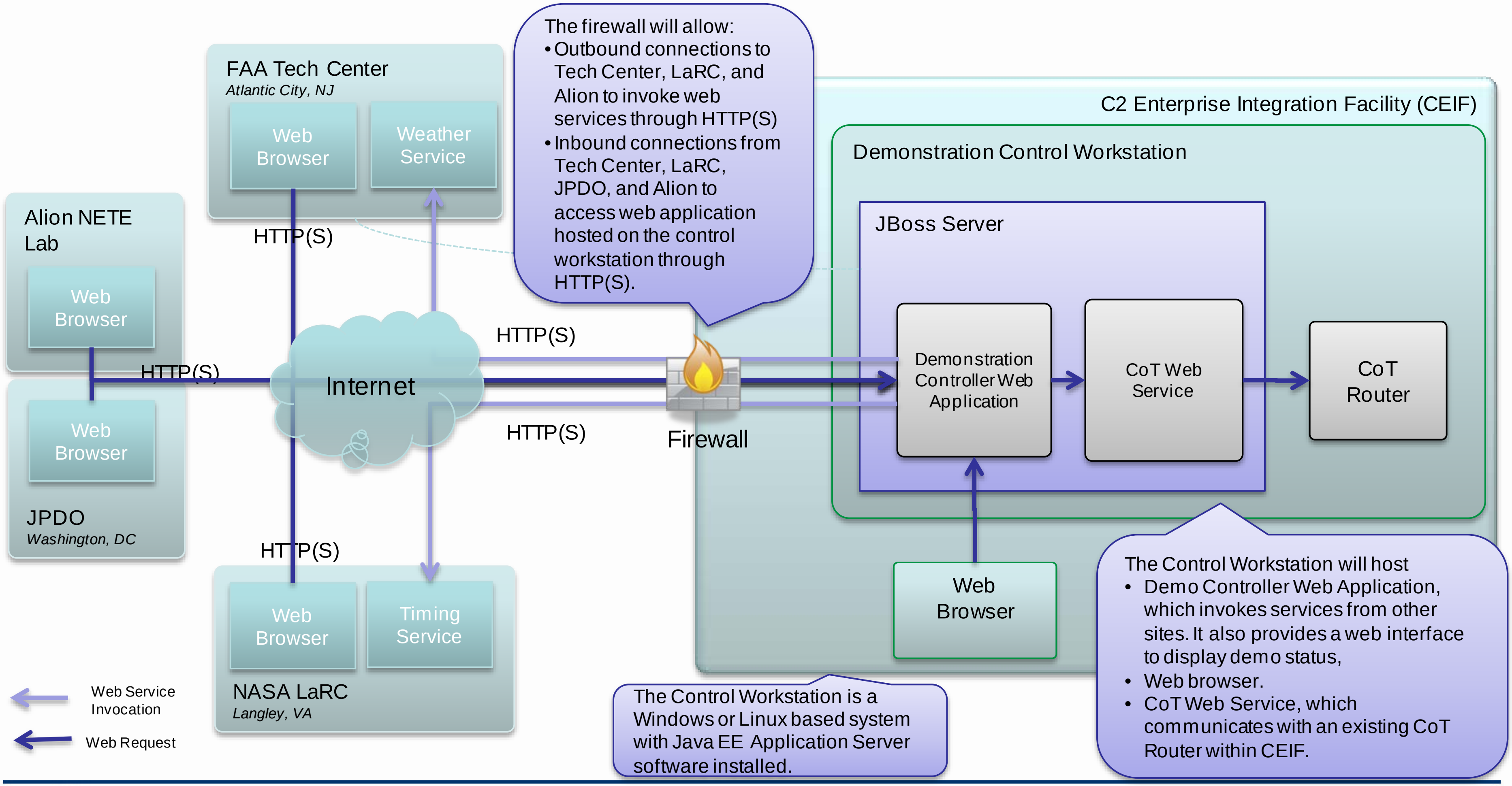

NETE
Net-Enabled Test Environment
interoperability • governance • security

Lost Cargo Jet Operational Scenario

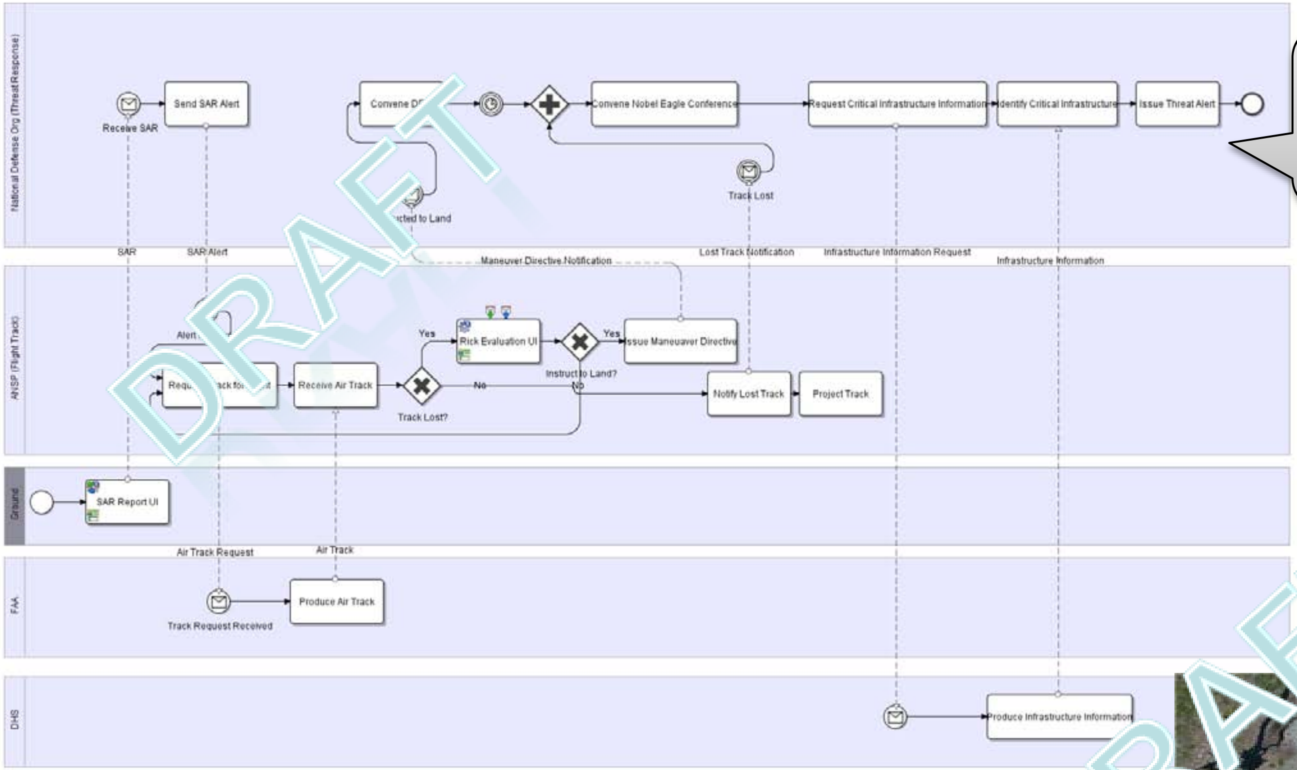


Backup Slides

Engineering Design for Demo Control Site (ESC)



Look Ahead: Information Exchange Demonstrations



Demonstration control script implemented as a BPMN process.

Monitoring Displays available

O'Day, Shawn Lt Col

Delivery of Information within the SDDP Model

IT acquisition within DoD faces a number of challenges, including high costs, long turnaround times, non-interoperable solutions and frequent failures to meet actual warfighter needs. Accordingly, the FY10 National Defense Authorization Act mandated a number of changes to this acquisition process. These include: rapid, incremental development; user involvement throughout the process; and modular, open-system approaches. The Air Force has also developed an overarching solution set for many of these issues, called the Services Development and Delivery Process (SDDP).

This presentation briefly outlines the six top-level steps of the SDDP, with particular emphasis on its Community of Interest (COI), and ontology development activities. It describes how the SDDP provides detailed guidelines for the full business capability lifecycle, including (i) identification of capability requirements and performance measures; (ii) definition and streamlining of underlying mission and business processes; (iii) definition of executable actions; (iv) definition of a materiel solution and implementation plan; (v) implementation of the developmental components of the materiel solution; and (vi) deployment and sustainment activities.

One type of material solution governed by the SDDP is delivery of information assets needed to support mission and business processes via web services. As this presentation will explain, the SDDP provides detailed guidance for this process, beginning with the specification of information assets which are aligned to business activities and ultimately delivered as service messages. Information delivery within the SDDP also meets the DoD Net-Centricity goals and objectives, such as visibility and trust by employing COIs to identify authoritative data sources (ADS) and access rules, and by developing ontologies to support service discovery and interpretation. The COI standard process develops a series of products to ensure final COI ontology models support the needs of services-based information delivery and vets this model through SME and enterprise technical validation. Finally, ontology-inspired XML messages and the Metadata Environment (MDE) tool for service discovery will also be explained within the intent of this brief.

Headquarters U.S. Air Force

Integrity - Service - Excellence

USAF Delivery of Information within the SDDP Model

U.S. AIR FORCE

Lt Col Shawn H. O'Day
Dr Alan Belasco
SAF/US(M)X
13 April 11

IT Acquisition Challenges

U.S. AIR FORCE

- **66% of IT projects prove unsuccessful***
  - **Exceed budget**
  - **Overrun schedules**
  - **Under-delivered features & functions (performance)**
- **Lengthy requirements, budget, acquisition processes**
- **Struggle to fielding IT in 5 years – Goal <18 months (Moore's Law)**
  - **Current average = 81 months**
- **Duplication of Infrastructure**
- **Shortage of IT Expertise**
- **Ample, Conflicting Oversight**

* Gartner Inc, ID# G00151721, 26 Sep 07
**Standish Group surveys, 1994, 1998, 2000 & 2002

IT Acquisition Reform

- Defense Science Board Report – Mar 09
  - Deliberate acquisition process does not match speed for IT
  - Need New Acquisition Process for IT
  - Strong DOD CIO responsibilities for policy and architecture;
  - Move NII, BTA acquisition authority to AT&L
- FY10 NDAA – Section 804
  - Develop a new IT acquisition process based on DSB Report
    - Early and continual involvement of the user
    - Multiple, rapidly executed capability increments/releases
    - Early, successive prototyping for evolutionary approach
    - A modular, open-systems approach
  - Report to Congress by Jul 2010

U.S. AIR FORCE

DOD IT Acquisition Task Force

- IT Acquisition Task Force
  - DEPSECDEF (Chair), DCMO, AT&L, NII, SAEs & Service DCMOs
- Process Improvement and Efficiencies in:
  - Governance
  - Portfolio Management
  - Acquisition
  - Contracting
  - Funding
  - Requirements

USAF has developed solution set for many of these issues – Services Development and Delivery Process (SDDP)

- Modular / Incremental development, test & deployment of capability
- Delivered within 12-36 months – Focus on speed and open standards
- Stakeholder/User Engagement

U.S. AIR FORCE

SDDP (1) Identify DOTMLPF Capability Requirements

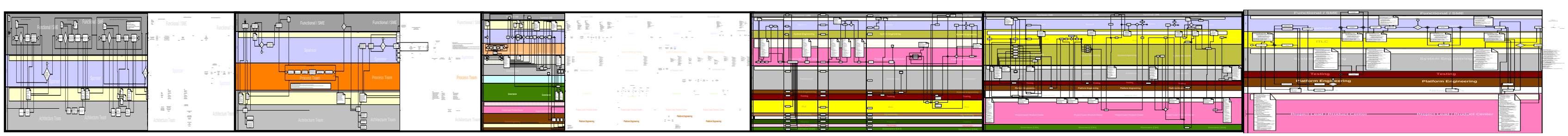
OUTCOMES
- **Clear, concise statement of the user's problem and/or needs**
- **Delineation of a proposed set of capabilities that will solve the user's problem or meet the user's needs**
- **Documentation of relevant Legislation, Regulation and Policy (LRP)**
- **Generation of a set of performance measures that will indicate whether the capabilities, once implemented, actually solve the user's problem or meet the user's need**

CAPTURED IN AND INFORMED BY ENTERPRISE ARCHITECTURE

PRM BRM

SRM DRM

TRM



Step 1	Step 2	Step 3	Step 4	Step 5	Step 6
Identify DOTMLPF Capability Requirements	Define DOTMLPF executable actions	**Define Material Solution and Implementation Plan**	Plan / implement developmental components of the Material Solution	Sustain Application Lifecycle	Deploy/Operate the Material Solution

The Service Development and Delivery Process

SDDP (2) Define DOTMLPF executable actions

U.S. AIR FORCE

OUTCOMES

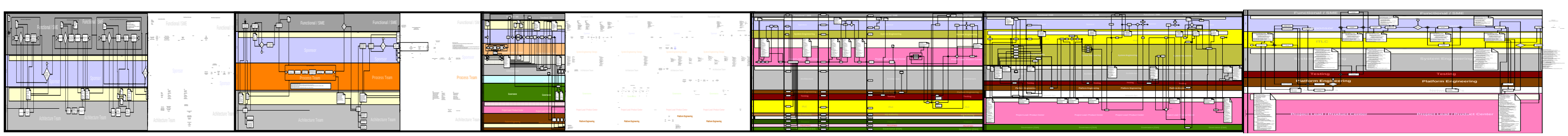
- Re-engineered Air Force processes to improve efficiency and effectiveness to deliver the capabilities
- Definition of the DOTMLPF executable actions and the implementation plan
- Sponsor approval to pursue the investigation of the Materiel Solution

CAPTURED IN AND INFORMED BY ENTERPRISE ARCHITECTURE

PRM BRM

SRM DRM

TRM



Step 1	Step 2	Step 3	Step 4	Step 5	Step 6
Identify DOTMLPF Capability Requirements	Define DOTMLPF executable actions	**Define Material Solution and Implementation Plan**	Plan / implement developmental components of the Material Solution	Sustain Application Lifecycle	Deploy/Operate the Material Solution

The Service Development and Delivery Process

U.S. AIR FORCE

SDDP (3) Define Material Solution / Implementation Plan

OUTCOMES

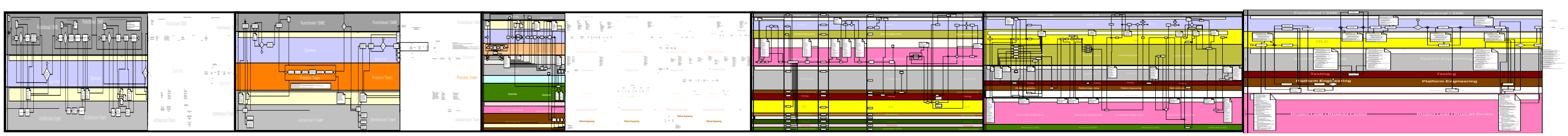
- **The bounded user requirement that includes definition of the materiel solution, information and data sources, and implementation plan**
  - **That considers implementation methods, e.g., Web services code, systems, and COTS/GOTS**
  - **That optimizes reuse**
- **Approval by Air Force corporate structure to fund / execute the implementation of Materiel Solution**

CAPTURED IN AND INFORMED BY ENTERPRISE ARCHITECTURE

PRM BRM

SRM DRM

TRM



Step 1	Step 2	Step 3	Step 4	Step 5	Step 6
Identify DOTMLPF Capability Requirements	Define DOTMLPF executable actions	**Define Material Solution and Implementation Plan**	Plan / implement developmental components of the Material Solution	Sustain Application Lifecycle	Deploy/Operate the Material Solution

The Service Development and Delivery Process

SDDP (3) Define Material Solution / Implementation Plan

A need for information within a process is identified.

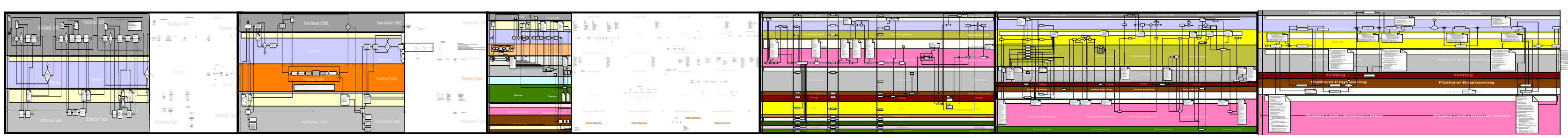
COI is chartered; clearly scoped to support need and processes.

Information assets are further refined.

Vocabulary is developed.

ADS are nominated.

Roles and permissions are defined.



Step 1	Step 2	Step 3	Step 4	Step 5	Step 6
Identify DOTMLPF Capability Requirements	Define DOTMLPF executable actions	**Define Material Solution and Implementation Plan**	Plan / implement developmental components of the Material Solution	Sustain Application Lifecycle	Deploy/Operate the Material Solution

The Service Development and Delivery Process

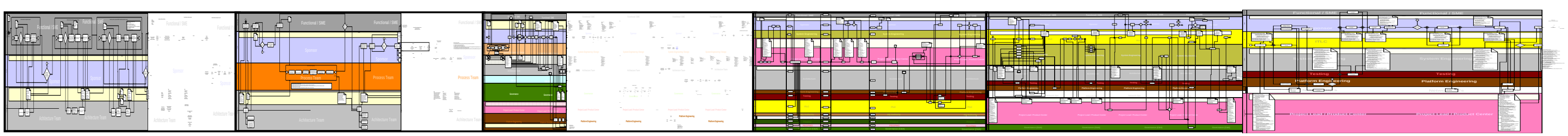
U.S. AIR FORCE

SDDP (4) Plan/implement Dev Components of Material Solution

OUTCOMES
- **Team from diverse organizations with a wide range of skillsets**
- **Integrated master schedule that delivers the deployed Materiel Solution**
- **Developed components of the Materiel Solution in TRM defined environment**

DEVELOPED AGAINST CONFIGURATION MANAGED TECHNICAL STANDARDS

PRM | BRM
SRM | DRM
TRM



Step 1	Step 2	Step 3	Step 4	Step 5	Step 6
Identify DOTMLPF Capability Requirements	Define DOTMLPF executable actions	**Define Material Solution and Implementation Plan**	Plan / implement developmental components of the Material Solution	Sustain Application Lifecycle	Deploy/Operate the Material Solution

The Service Development and Delivery Process

U.S. AIR FORCE

SDDP (5) Sustain Application Lifecycle

OUTCOMES

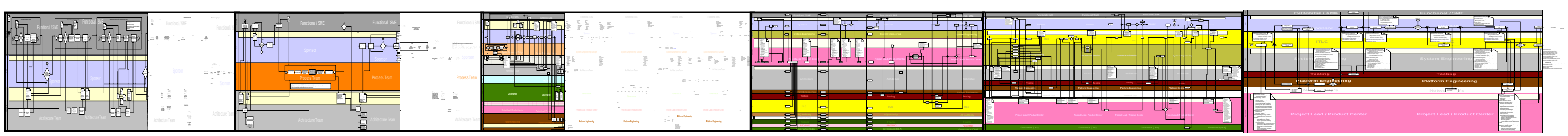
• **Test and sustain the Code in the implementation baseline**

TESTED / ACCREDITED TO CONFIGURATION MANAGED TECHNICAL STANDARDS

PRM BRM

SRM DRM

TRM



Step 1	Step 2	Step 3	Step 4	Step 5	Step 6
Identify DOTMLPF Capability Requirements	Define DOTMLPF executable actions	**Define Material Solution and Implementation Plan**	Plan / implement developmental components of the Material Solution	Sustain Application Lifecycle	Deploy/Operate the Material Solution

The Service Development and Delivery Process

SDDP (6) Deploy/Operate the Material Solution

U.S. AIR FORCE

OUTCOMES

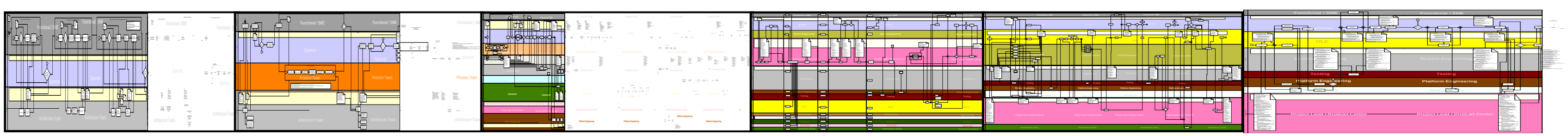
- **Deliver end user experience for the material solution**
  - Prototype >>> Operational Test
  - Full Scale Deployment Delivery

DEPLOYED TO PLATFORM CONFIGURED TO TECHNICAL STANDARDS

PRM BRM

SRM DRM

TRM



Step 1	Step 2	Step 3	Step 4	Step 5	Step 6
Identify DOTMLPF Capability Requirements	Define DOTMLPF executable actions	**Define Material Solution and Implementation Plan**	Plan / implement developmental components of the Material Solution	Sustain Application Lifecycle	Deploy/Operate the Material Solution

The Service Development and Delivery Process

U.S. AIR FORCE

AF COIs within the SDDP

- COIs are focused on delivery of actual capability
- COIs are chartered to define relevant small packages of information needed to support incremental delivery of capability and stand-down when complete
- COIs define information needs to support process-based capability in context of supported processes
- COI-defined information assets can be reused as needed to support the broader AF enterprise needs

- COIs support the broader IT Acquisition process by defining information needs for a bounded user requirement

COI Coordination Panel

Panel Responsibilities

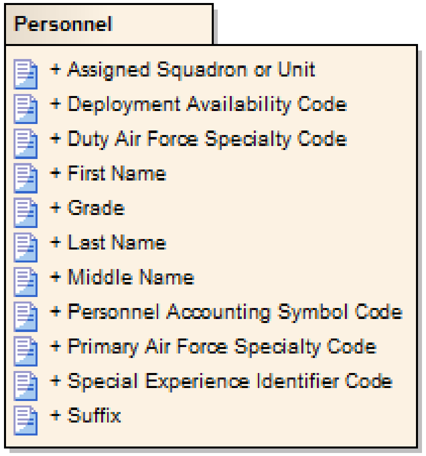
- Recommend stand up of new AF COIs, review COI charters
- Ensure AF COIs follow standard processes defined by Panel
- Conduct alignment and enterprise configuration management of AF COI vocabulary products
- Work with individual AF COIs to resolve conflicts or discrepancies between vocabularies
- Assist with the review of information requirements and recommend the reuse of all or part of existing AF COI vocabularies where applicable
- Review Vocabulary Packages and recommend approval
- Direct the Enterprise Vocabulary Team (EVT) to provide technical support directly to individual AF COIs

Information Delivery and the COI Standard Process

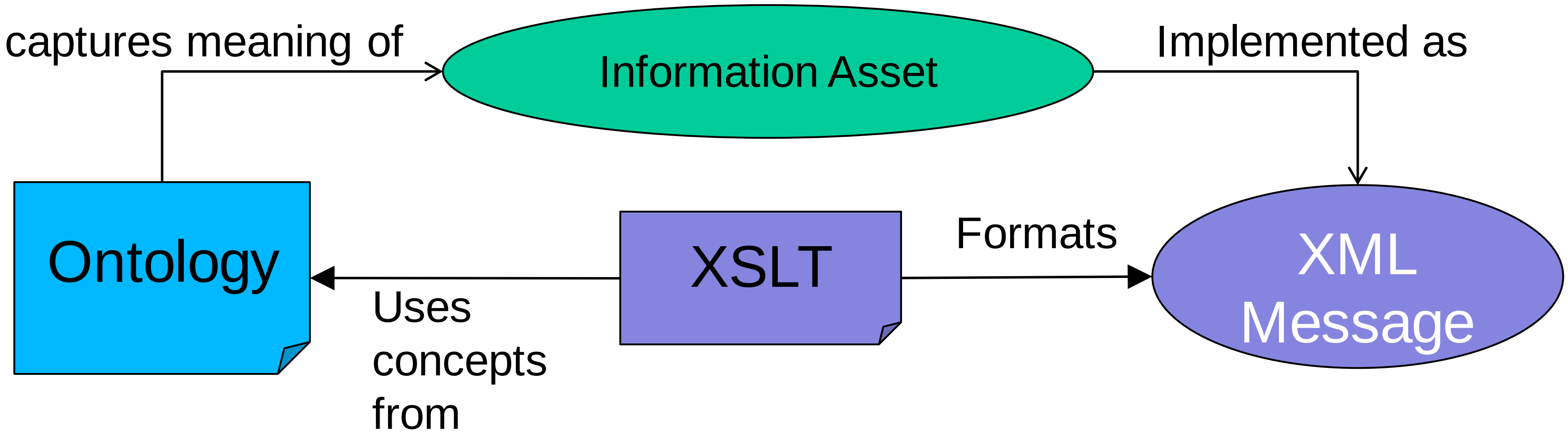
U.S. AIR FORCE

Information Assets

- An essential aspect of a business process is its information flow
- Information flow is defined partly by *information assets*: sets of information aligned to business processes
- SDDP Steps 2 and 3 identify information assets needed for desired capability
  - Business Reference Model
  - Service Architecture
- Web services deliver information assets
  - Establishes traceability between business processes and IT architecture



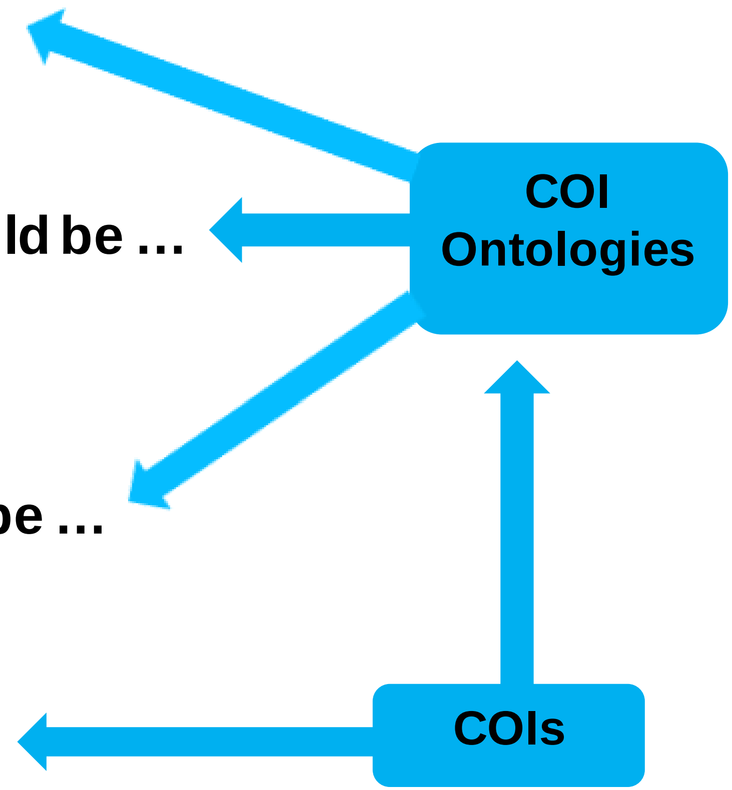
Information Assets, Ontologies and Messages



- Service messages align to Information Assets
- COI ontologies capture meaning of information contained in Information Assets
- XSL Transformation (XSLT) translates standard XML message into one containing ontology concepts

Net-Centric Data Strategy Goals

- *Visible:* Information should be …
  - Easy to find
  - Relevant
- *Understandable:* Information should be …
  - Delivered in a usable form
  - Delivered in context
  - Expressed in a known “vocabulary”
- *Interoperable:* Information should be …
  - Easily combined
  - Easily compared
- *Trusted:* Information should be …
  - Current
  - Complete
  - Authoritative



COI Standard Process

Milestones

- COI Stood Up
  - Charter Drafted
  - Charter Finalized
- Ontology Modeled
- Ontology Validated
  - SME Validation
  - Enterprise Alignment & Technical Validation
  - EVT Technical Review Presentation
- XML and XSLT Generated
- Vocabulary Package Completed
  - Submitted to Coord Panel
  - Approved for submittal to E-SWG by Coord Panel
  - Submitted to E-SWG
  - Approved by E-SWG

COI Products*

1. COI Charter
2. Charter Presentation
3. ADS Designation
4. Example Data Record (EDR)
5. Ontology Model
6. Ontologized Authoritative Data (OAD)
7. Identified and Recommended Roles and Permissions (Business Rules)
8. Completed and Approved Vocabulary Package

*There are additional, technical products that are produced by the ontologist member (DVT) or EVT they include: XSLTs, XML Prototypes and HTML Visualizations,.

U.S. AIR FORCE

ADS Designation

Entity	Example	Data Source	Table	Field
Status	Current	Financial Management Data Dictionary	tbl_budget_activity	status
BasicSymbol	740	Financial Management Data Dictionary	tbl_basic_symbol	basic_symbol_code
BudgetActivity	New Construction	Financial Management Data Dictionary	tbl_budget_activity	title
BudgetActivity	provides for: (1) erecting, installing,	Financial Management Data Dictionary	tbl_budget_activity	description
Dept	57	Financial Management Data Dictionary	tbl_department	dept
CalendarDateTime	2010-06-01T22:30:27.14	Financial Management Data Dictionary	tbl_budget_activity	LAST_UPDATED
CalendarDay	2100-09-00	Financial Management Data Dictionary	tbl_budget_activity	end_date
CalendarDay	10/1/1984	Financial Management Data Dictionary	tbl_budget_activity	begin_date
BA	1	Financial Management Data Dictionary	tbl_budget_activity	ba_code

U.S. AIR FORCE

Example Data Record

DRS_exampleDataSpreadsheet - Microsoft Excel

	B	C	D	E
1	**Data Element Name**	**Definition**	**Data Description**	**Example Value**
2	SSAN	Social security number		123-45-6789
3	IMM_STATUS	G means the member is current for all required immunizations. Y or R means the member is eligible to receive a required immunization and should report to the MTF immunization clinic if the vaccination is available.	G = Green (current), Y = yellow (Due), R = Red (Overdue)	R
4	IMM_AVAIL	Column will be blank if the IMM_Status is G. Y means immunizations are available and member is eligible to receive the vaccine; N means the required immunizations are not available to be given at this time and the member should not report to the MTF for the shot.	Blank if IMM_STATUS = G; if IMM_STATUS = Y or R, then Y (immunization available); N = Immunization not available.	N
5	DENTAL_STATUS	G= Dental Class 1 or 2; R = Dental Class 3,4, unknown, G = Green (current), R = Red(Overdue Exam or Class 3 Dental Problem).	G = Green (current), R = Red (Overdue Exam or Class 3 Dental problem)	R
6	DENTAL_CLASS	Dental Class 4 : dental exam is overdue and member should contact dental clinic to obtain an appointment. Members in Class 3 are under management for some dental or periodental issue and should not be directed to the MTF for dental classification exams. Class 1 or 2 are current and require no action.	Dental Class = 1,2,3,4, U, where U = Unknown	4
7	IMR_LABL_STATUS	means that one or more of the IMR lab components needs some action to correct. There are 6 specific lab values tracked by this section of the IMR - Blood Type, RH, G6PD values (These are one time updates usually handled at accession or first assignment), Periodic HIV testing, and DNA sample being on file at the AFIP repository. Only HIV testing drives report periodic blood draws	G = Green (current), Y = yellow(due), R = Red (Overdue / Incomplete).	G
		G means the members has no Deployment Limiting Condition		

MedicalReadiness_EDR | SFMIS Exposed Data | Sheet1

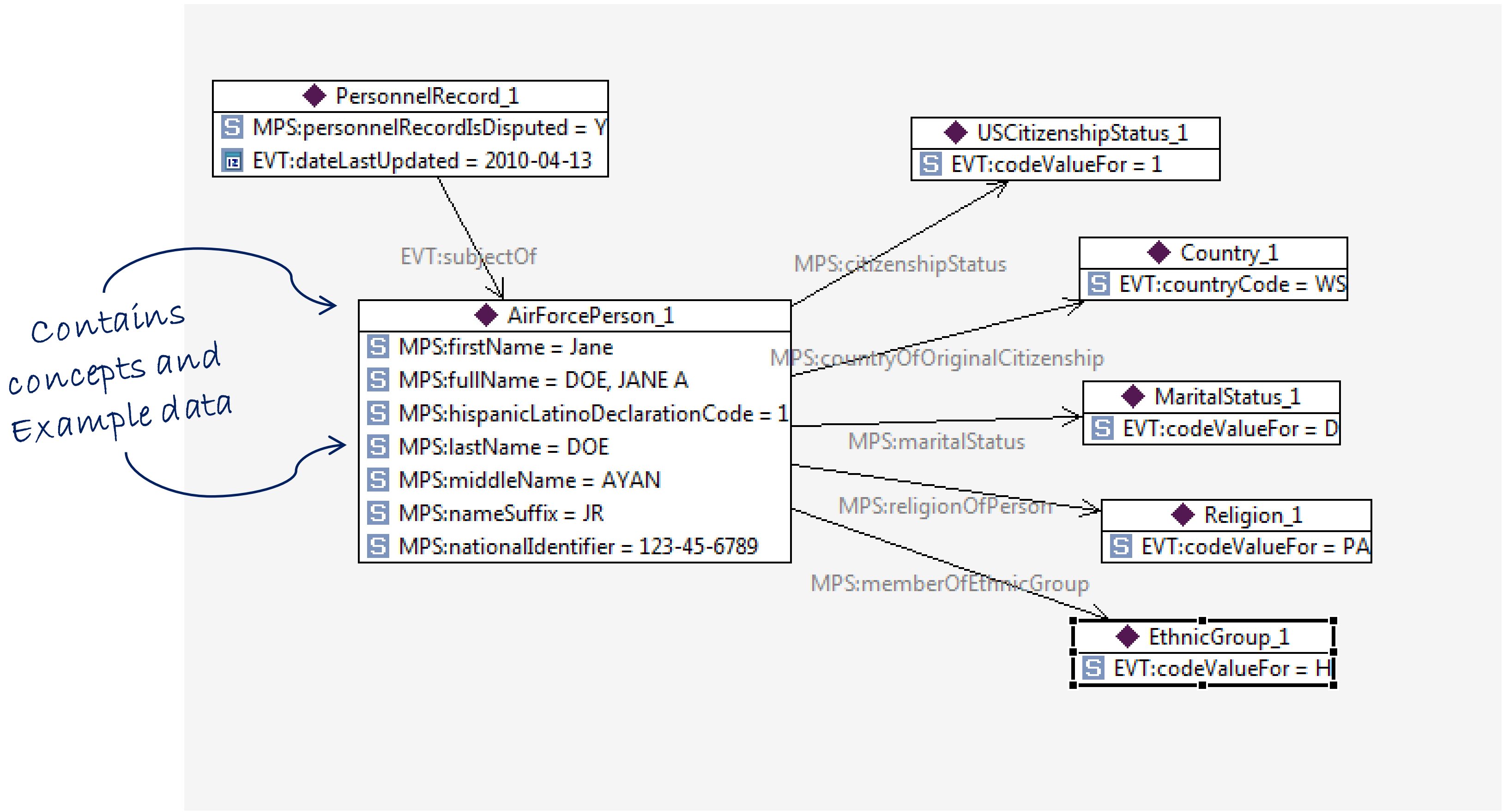
COI Ontologies

- Support Web Services
  - Clarify meaning and context of data values in message
  - Enable metadata-based discovery
- Provide Semantic Features
  - Classes and properties (less need for individuals)
  - Search on lexical assertions, class & property subsumption
- Developed Collaboratively
  - Basic development by Domain Vocabulary Teams (DVTs)
  - Coordination & evaluation by Enterprise Vocabulary Team (EVT)
- Standards and Tools
  - OWL
  - TopBraid Composer

Enterprise Vocabulary Team

- COI Ontology Alignment
  - Maintain EVT Common Ontology
  - Develop Ontology Design Patterns
- Configuration Management
  - Manage version-controlled repository of ontology products
    - softwareforge.mil
  - Ensure correct format for MDE registration (base URI, etc.)
- Ontology Validation
  - Create tools for HTML visualizations for SME validation
  - Conduct Formal Evaluation
    - Evaluation Criteria, Automated and Manual Assessment
  - Create XSLTs

Ontologized Authoritative Data (OAD)

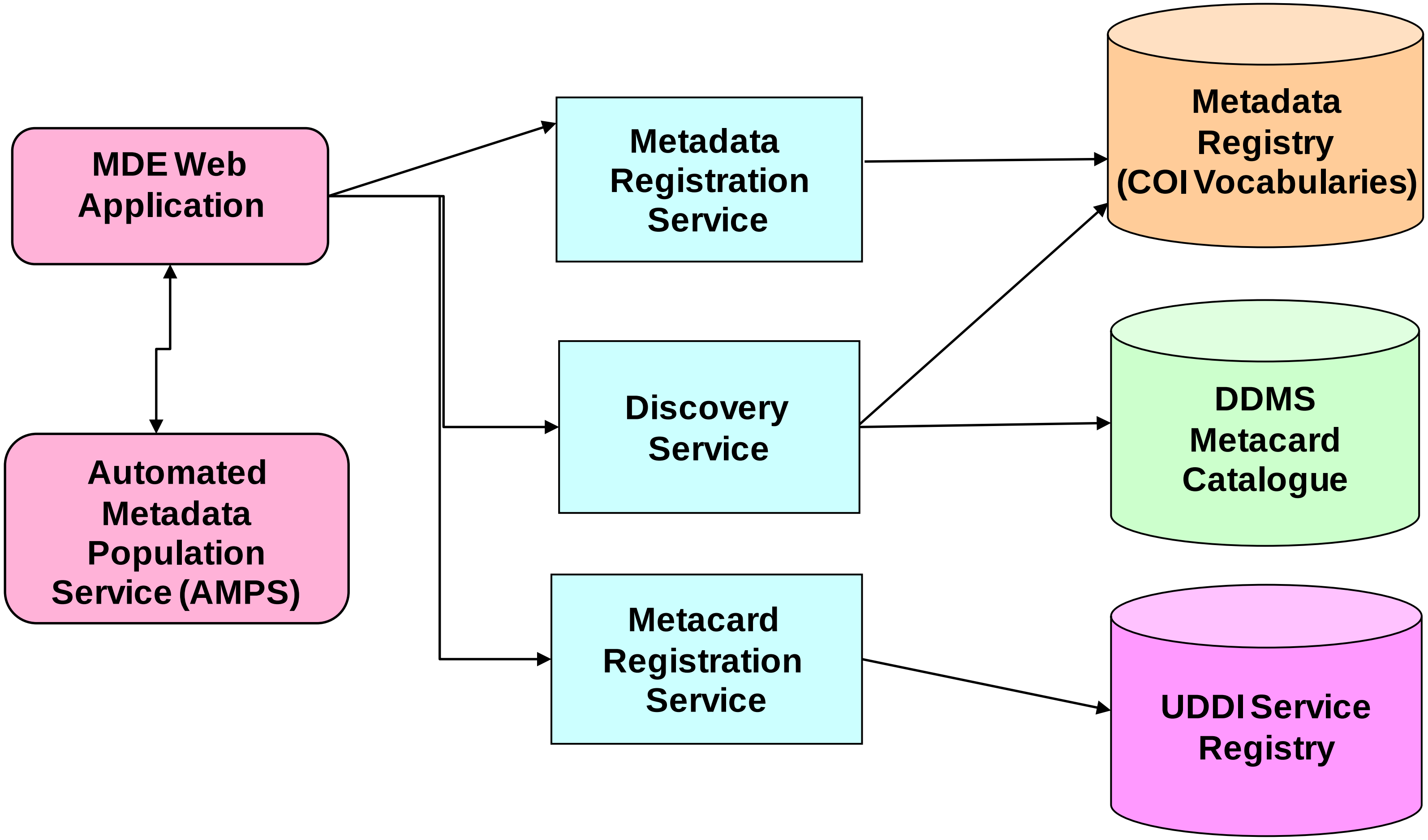


U.S. AIR FORCE

XML Message with Ontology Markup


```xml
<EVT:informationAbout xmlns:EVT="urn:USAF:SAF-USM:EVT:1#">
        <MPS:AirForceServiceMember MPS:firstName="JOHN"
                MPS:lastName="DOE" MPS:middleName="HENRY" MPS:nameSuffix="SR"
                MPS:socialSecurityNumber="987-65-4321">
                <MPS:memberRank>
                        <MPS:Rank EVT:abbreviationString="MAJ" />
                </MPS:memberRank>
                <MPS:memberServiceComponent>
                        <MPS:ServiceComponent EVT:codeValueFor="R" />
                        </MPS:memberServiceComponent>
                <MPS:dutyAssignmentWith>
                        <MPS:AirForceOrganization
                                MPS:orgFunctionNomenclature="COMMUNICATIONS"
                                MPS:personnelAccountingSymbolCode="ML0DFD6C"
                                MPS:unitNumberIdentifier="422">
                                <MPS:organizationType>
                                        <MPS:AirForceHierarchicalLevel
                                                        EVT:abbreviationString="SQ" />
                                </MPS:organizationType>
                                <EVT:directParentOrganization>
                                        <MPS:AirForceOrganization
                                                MPS:personnelAccountingSymbolCode="FHC3" />
                                </EVT:directParentOrganization>
                        </MPS:AirForceOrganization>
```

Metadata Environment (MDE)



SAF/US(M) Contacts

SHAWN H. O'DAY, Lt Col, USAF
Chief, Data Transparency Branch &
USAF COI Panel Chair
Enterprise Transformation
SAF/US(M)X
703-588-2698 (DSN: 425)
shawn.oday@pentagon.af.mil

Dr Alan Belasco
Enterprise Vocabulary Team
SAF/US(M)
703-588-7833
alan.belasco.ctr@pentagon.af.mil

Wisnosky, Dennis E.

Semantic Technology in the Department of Defense

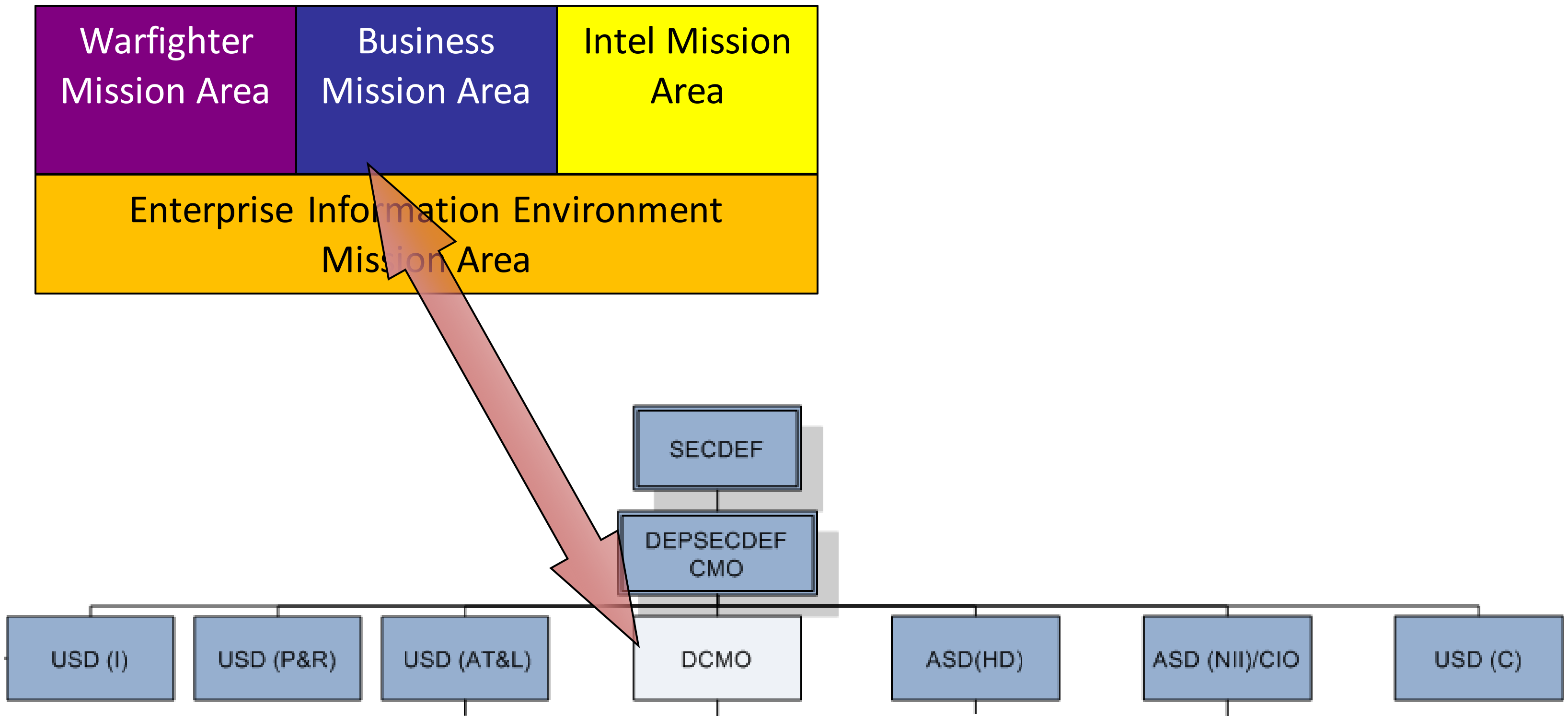
Semantic Technology in the Department of Defense

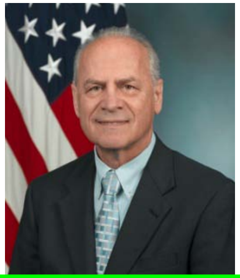
April 12, 2011

Dennis E. Wisnosky, DoD
BMA CTO &
Chief Architect in the
Office of the Deputy Chief
Management Officer

DCMO CTO/CA

Missions of the DoD





Dennis E. Wisnosky, DoD BMA CTO & Chief Architect in the Office of the Deputy Chief Management Officer (DCMO)

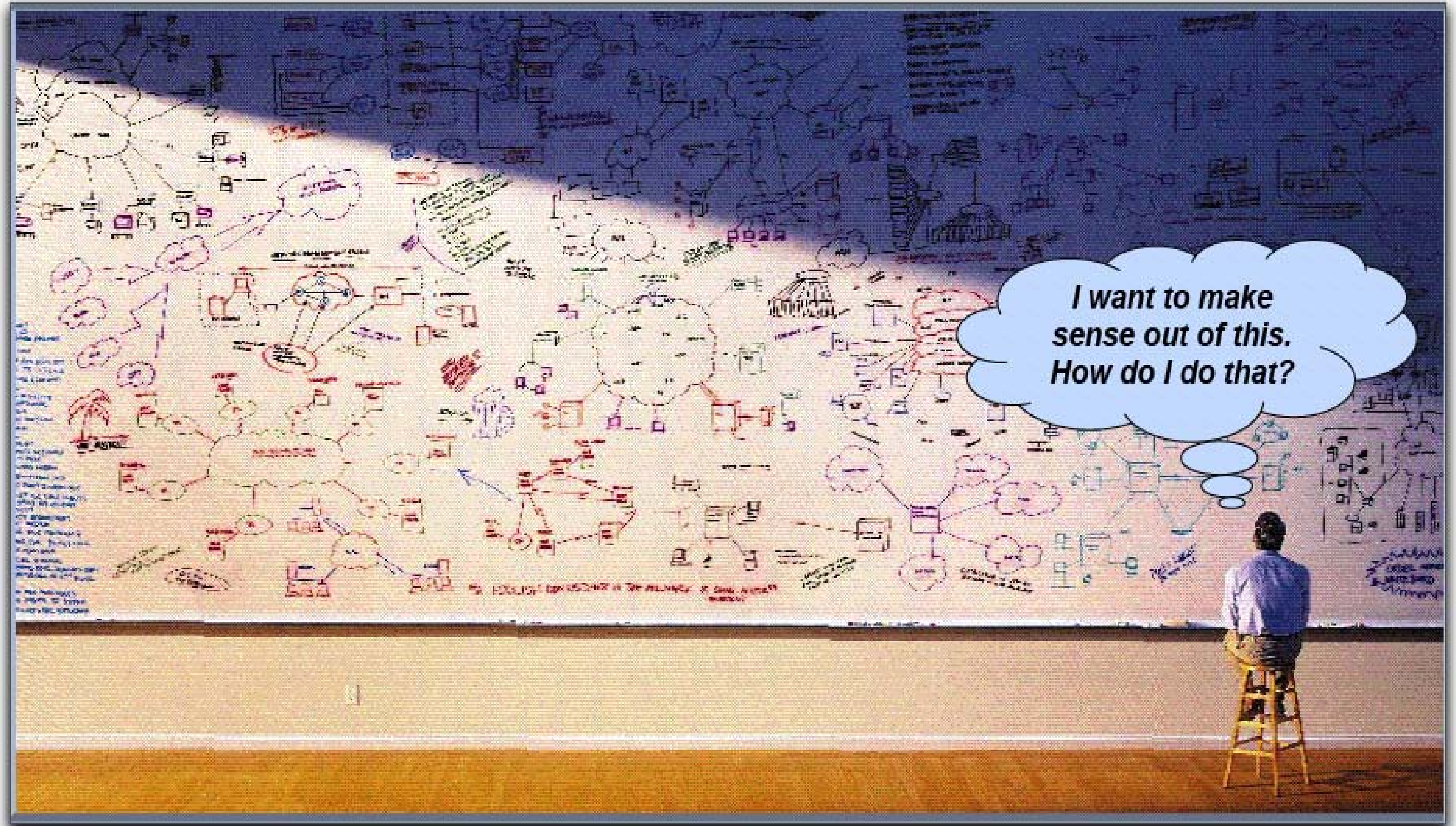
Flight Deck Management Challenges

Flight Deck Management Challenges

http://www.youtube.com/watch?v=qh42k3Kvxck

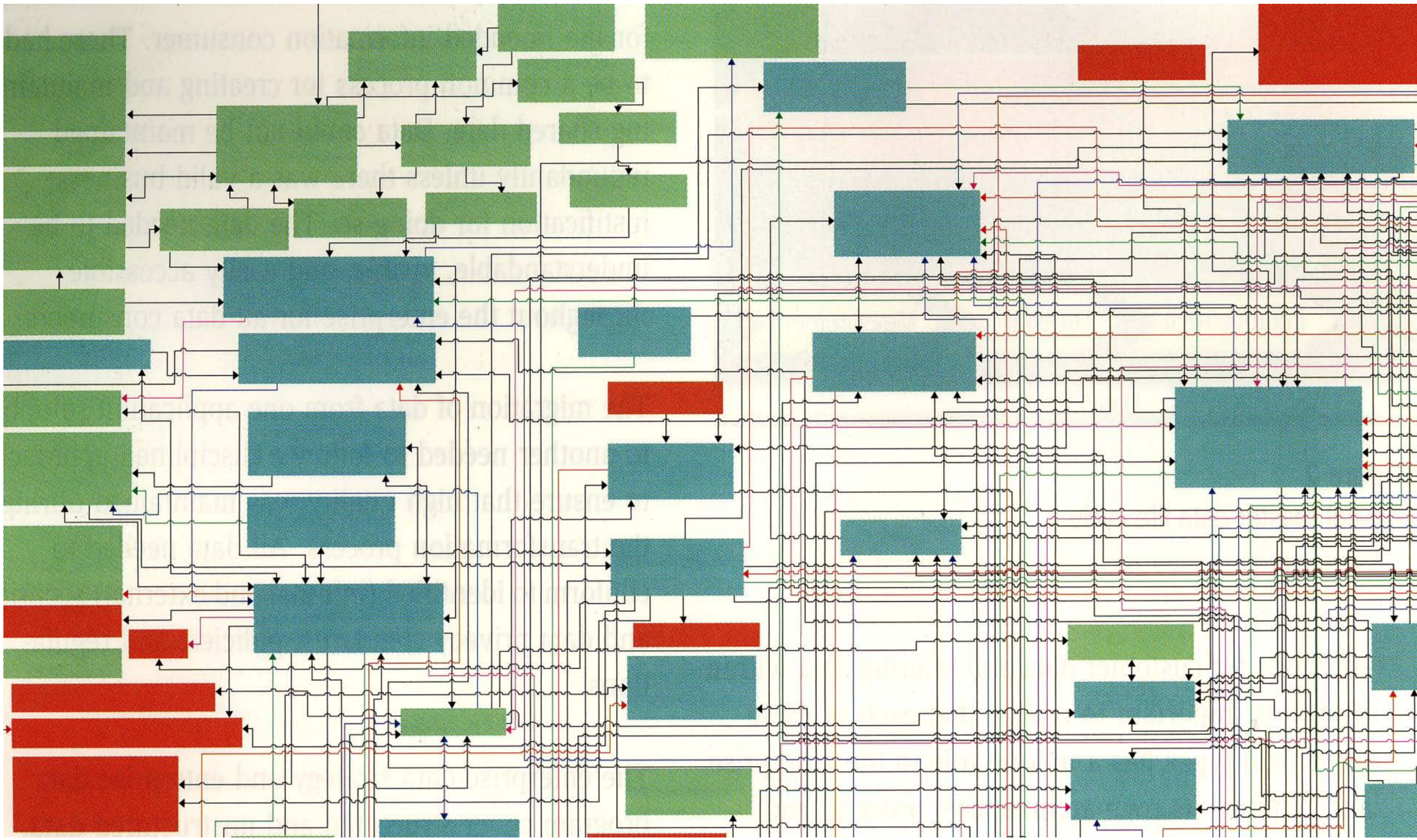
DoD Management Challenges

My Introduction to the DoD



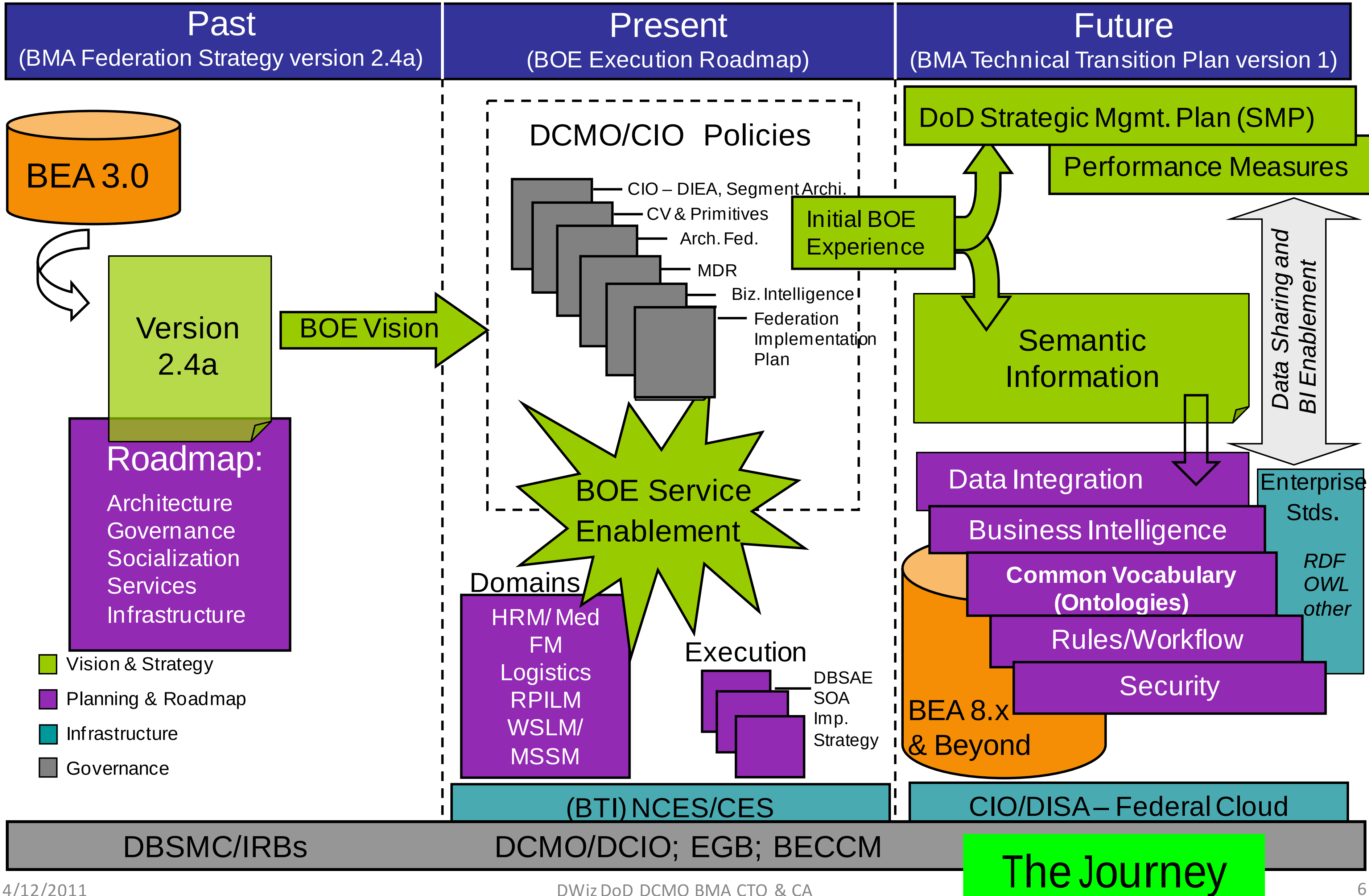
An Earlier Architecture

Another View



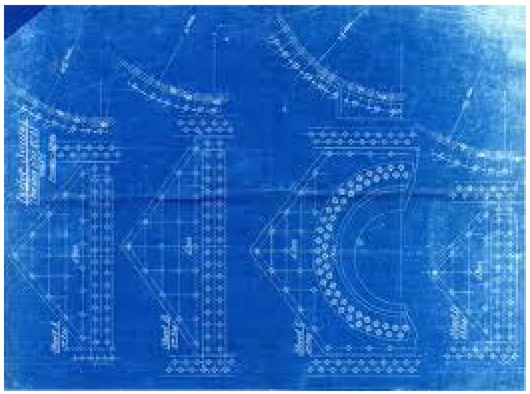
A More Reasoned Approach

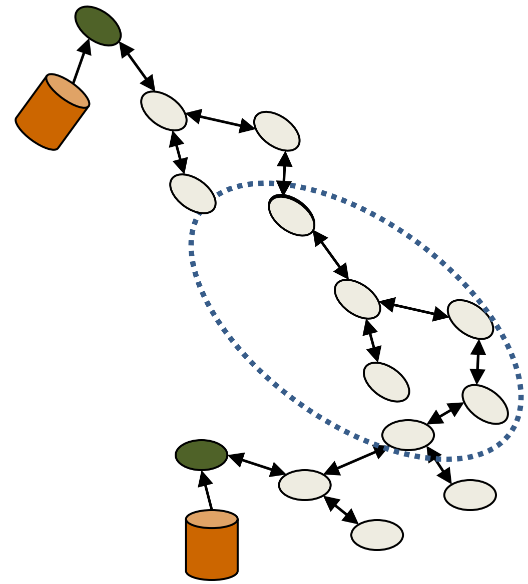
Strategy and Roadmap for DoD Business Operations Transformation



DoD Architecture Progression

Blueprinting → BEA - Stovepiped → BEA - Semantic





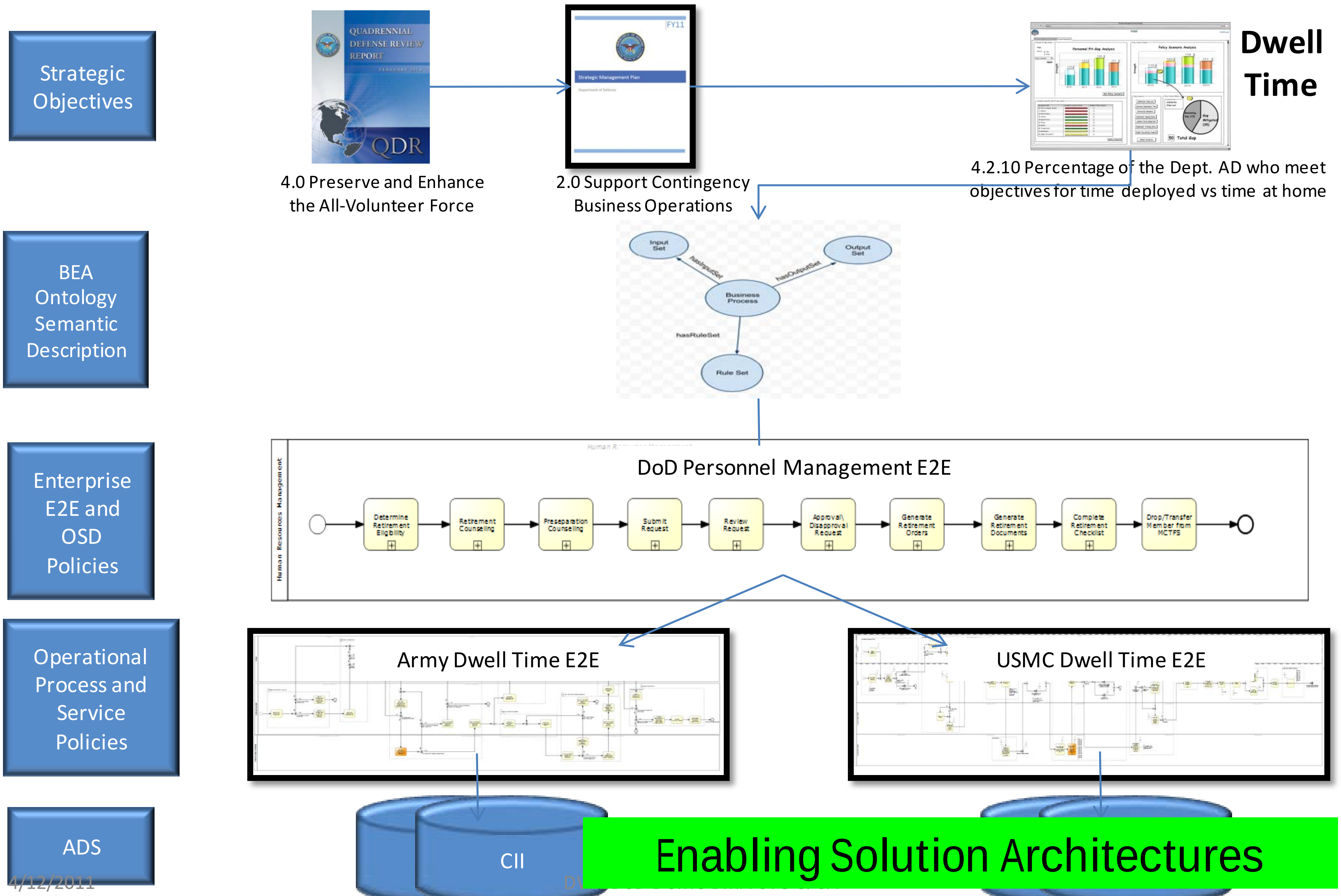
Branch office-based; readable but not analyzable; stovepiped

Business Mission-based; readable within a Business Mission; not analyzable; not integrated with solution

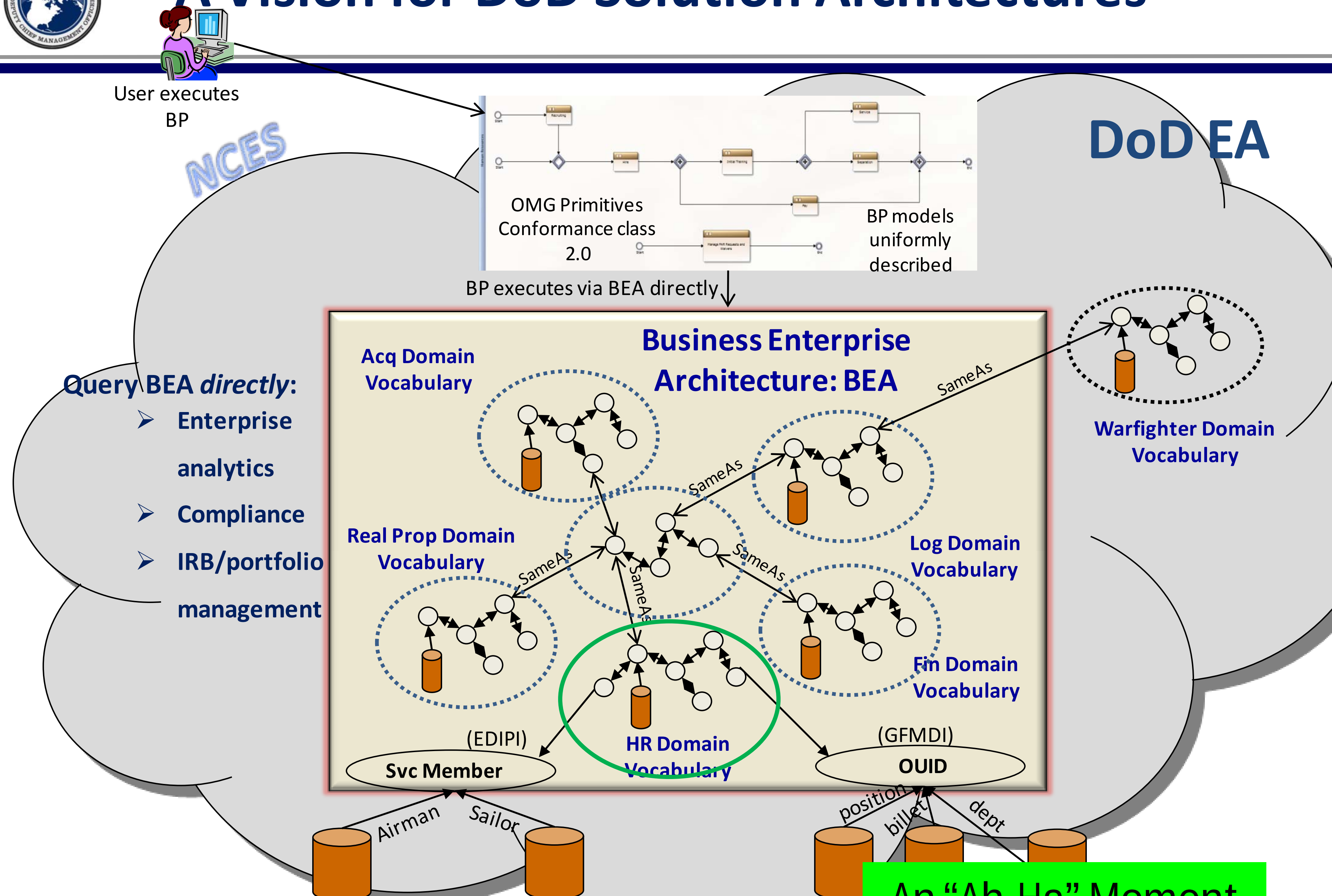
End-to-End based; analyzable; executable; integrated with & consumable by solution architectures

Enabling Strategic Management

Enabling Strategic Management

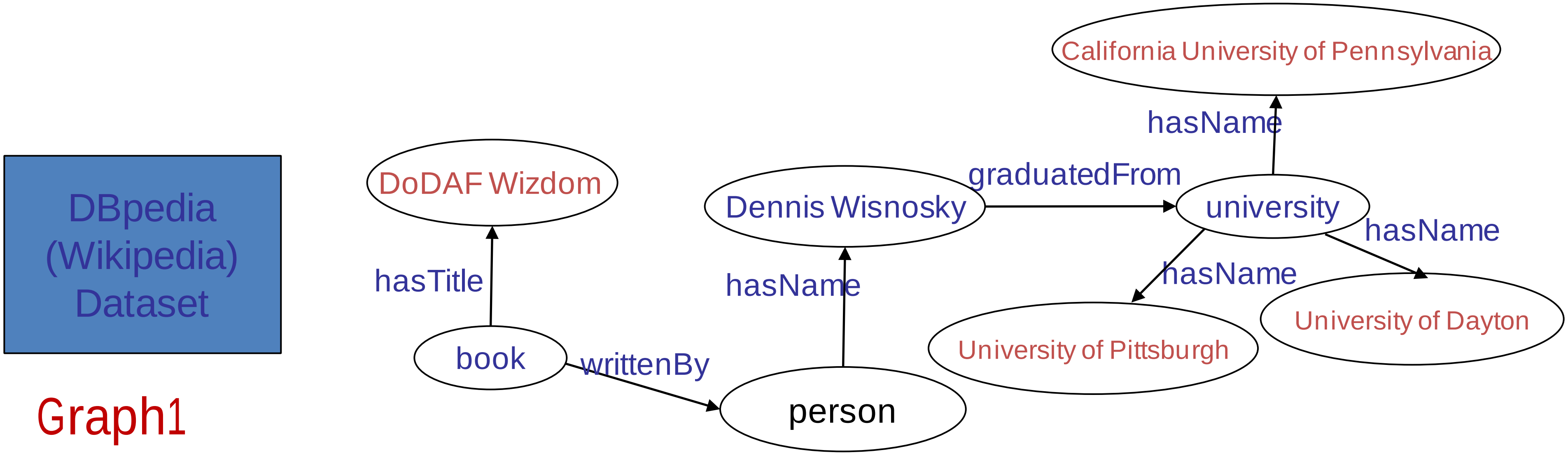


A Vision for DoD Solution Architectures



W3C Open Standards Legend: Data described in RDF ⟷ Relationship describ... rce

Ontology-Based Information Integration & Analytics

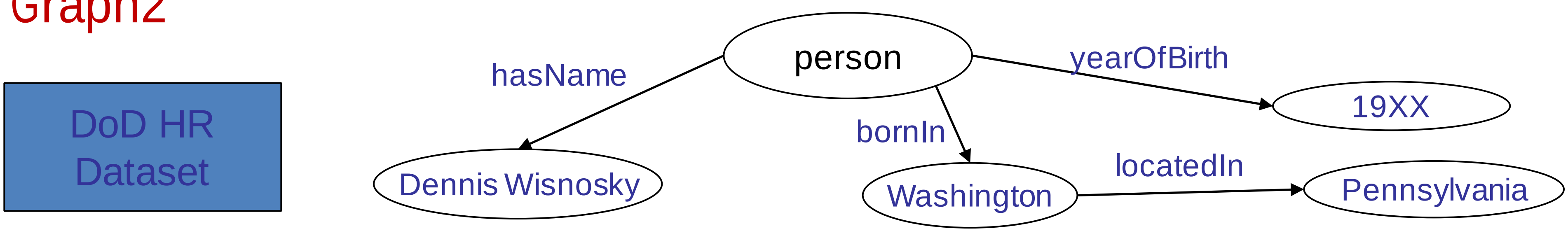


Who wrote "DoDAF Wizdom"?

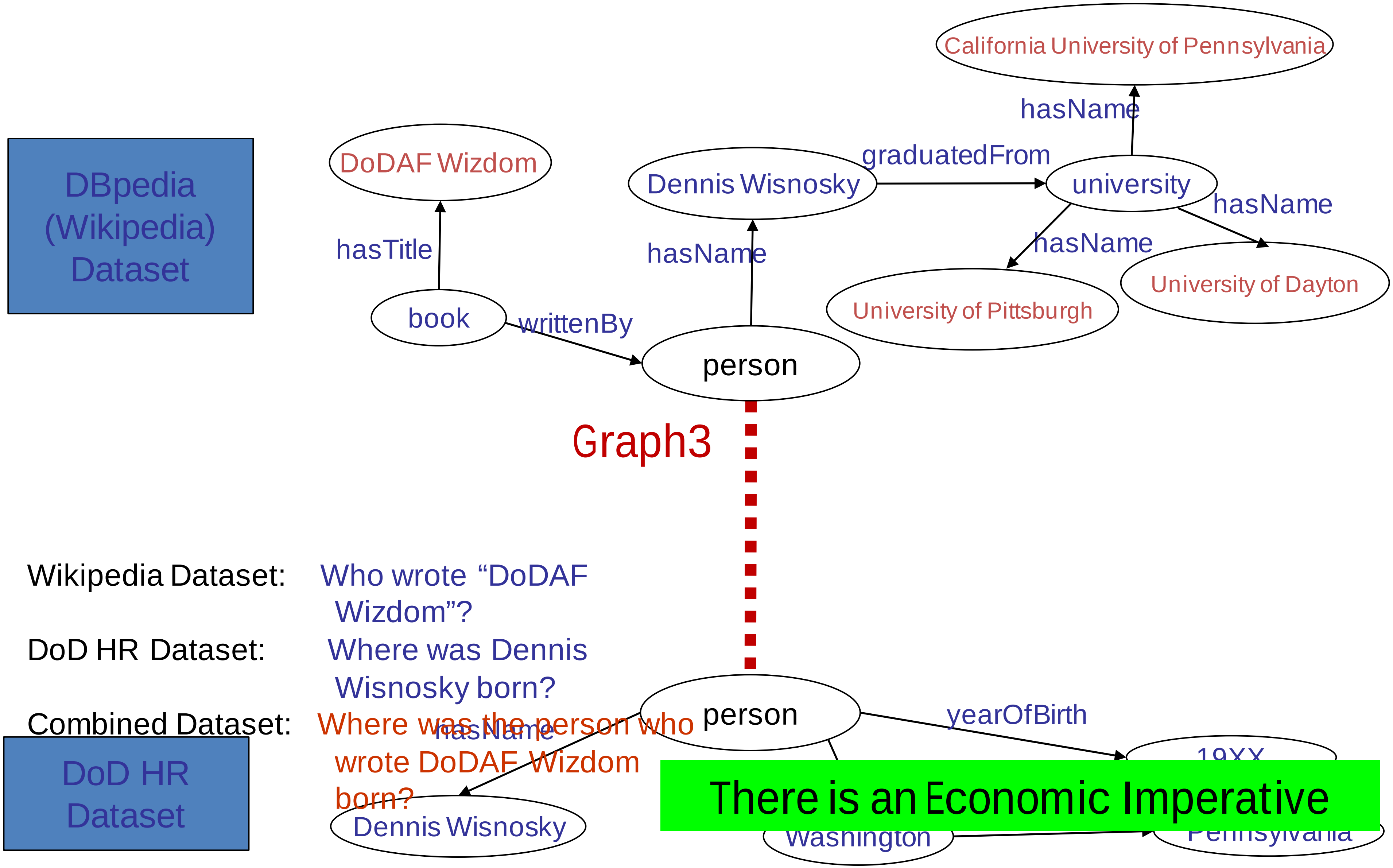
Ontology-Based Information Integration & Analytics

Where was Dennis Wisnosky born?

Graph2



Ontology-Based Information Integration & Analytics



Wikipedia Dataset: Who wrote “DoDAF Wizdom”?

DoD HR Dataset: Where was Dennis Wisnosky born?

Combined Dataset: Where was the person who wrote DoDAF Wizdom born?

57% of DoD I.T. Costs are in Infrastructure

OMB Budget Grouping	Number of Programs	FY2010 IT Spending - $ Billions
Communications and Computing Infrastructure	1,547	$16.3
Information Assurance Activities	353	$3.2
Functional Area Applications	3,244	$13.2
Related Technical Activities	156	$1.0
Total DoD IT Spending	5,300	$33.7

SOURCE: http://www.whitehouse.gov/omb/e-gov/

Issue: Infrastructure

DoD Contractors Build Separate Infrastructures & Dictionaries

Issue: Redundancy

DoD Projects Have Own Data

Projects	07 Budget $ Millions	Number of Projects	% of Total Budget $	% of Projects
Project - > $100 Million	$10,301	43	33.9%	1.3%
Projects - > $10 Million	$15,013	525	49.4%	15.4%
Projects - < $10 Million	$5,066	2,832	16.7%	83.3%
Total	$30,380	3,400	100.0%	100.0%

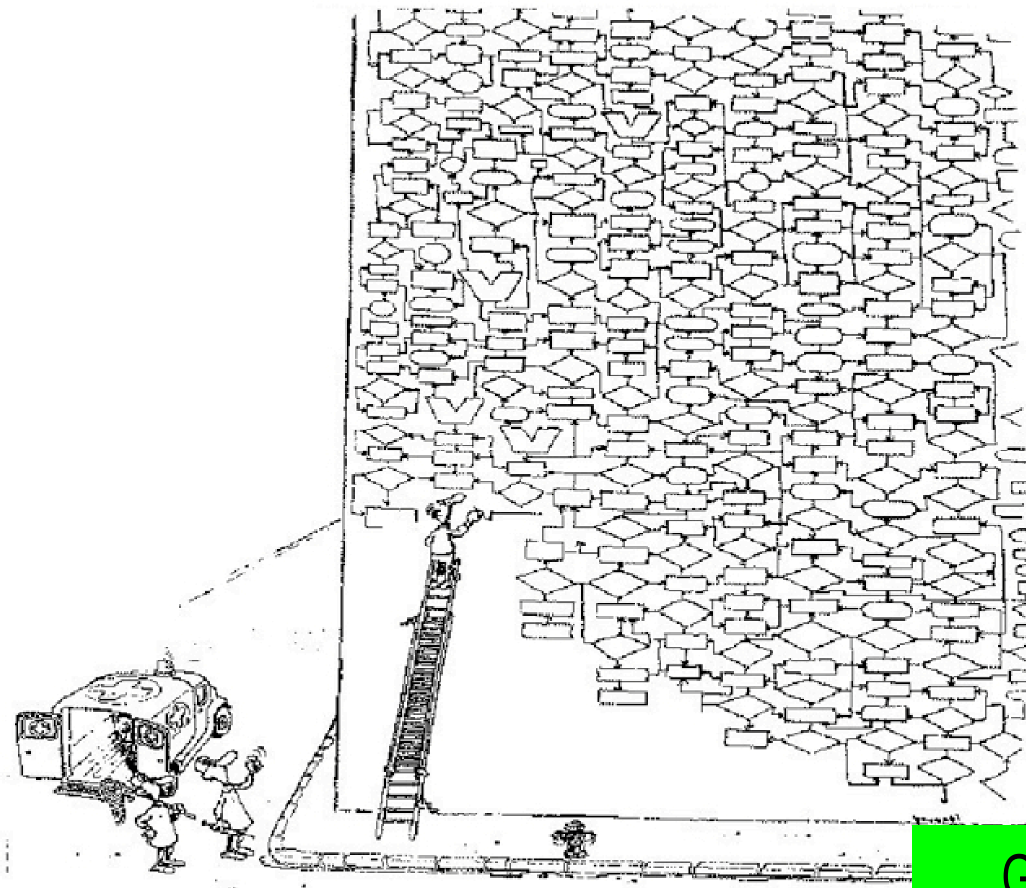
$ Billions	FY05	FY06	FY07
Total DoD I.T. Spending	$28.7	$29.9	$30.4
DoD Spending on Contractors	$21.1	$22.6	$24.1
% of I.T. Spending Contracted Out	73.5%	75.6%	79.3%

Issue: Data

New Way of Thinking Required

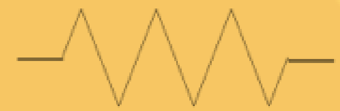
Other Disciplines Can Do It

Not This

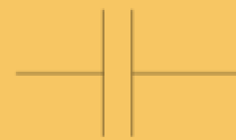


But This:

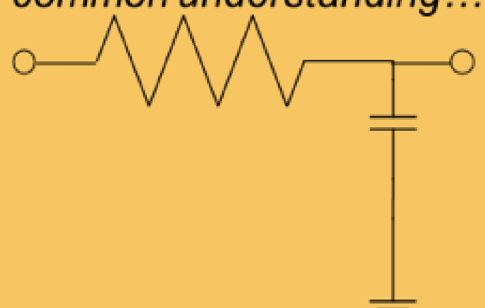
Resistor symbol



Capacitor symbol



This agreed upon representation of electrical engineering allows a common understanding…



Game Changing Innovations!

Standards-based Architecture - Primitives

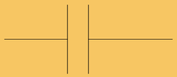
Style Guide

Standard Symbols

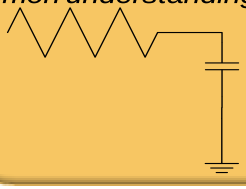
Engineering Language and Symbols:

Resistor symbol

Capacitor symbol



This agreed upon representation of electrical engineering allows a common understanding…



•DoDAF 2.0 serves as the foundation for architecture primitives

•Use Cases being developed and used to drive pilots

Architecture Primitives

Standards
Best Practices

informed by

influences

PriMo
Modeling Guide

foundation for

PrOnto
Ontology (Lexicon)

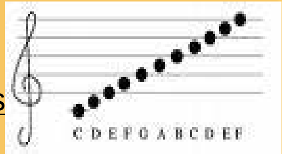
input for

Different
Frame

Architecture Primitives

Music Language and Symbols:

Music Scale symbols



Notes symbols

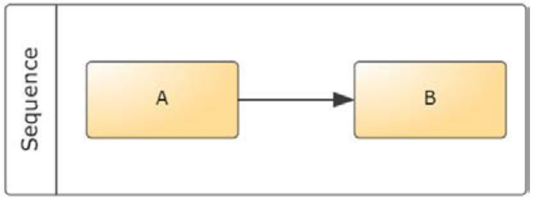
This agreed upon representation of music allows a common understanding…

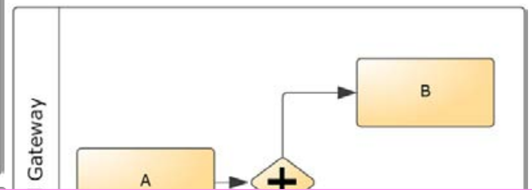
Standard Language

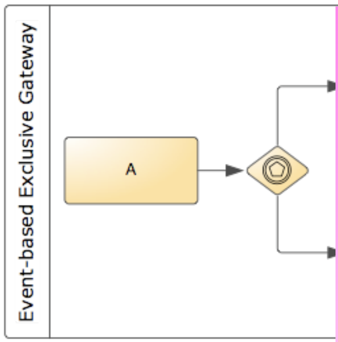
Dictionary

Primitives to Patterns!

Primitives to Patterns

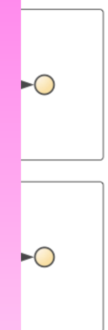






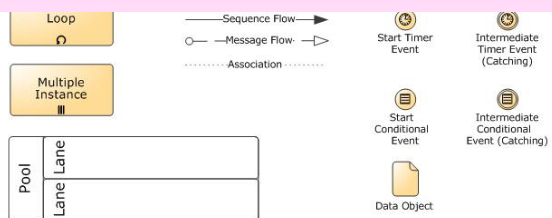
NEWS FLASH!

OMG Selects DoD Primitives as a BPMN 2.0 Conformance Class!



PriMo

- Provides basic definitions the architecture model semantics
- Provides elementary rule the connectivity of primi constructs
- Provides foundation buil blocks for constructing architecture products
- Caveat: A common vocabulary by itself does not guarantee high quality products



- tyle guide provides jective advice that will ure the design of high lity products
- tyle guide advises on
  - Choice of words
    - Which constructs are appropriate in a given situation
  - Choice of grammar
    - combine ts to m effect

Will Industry Care?

We Are Underway!

Common Vocabularies

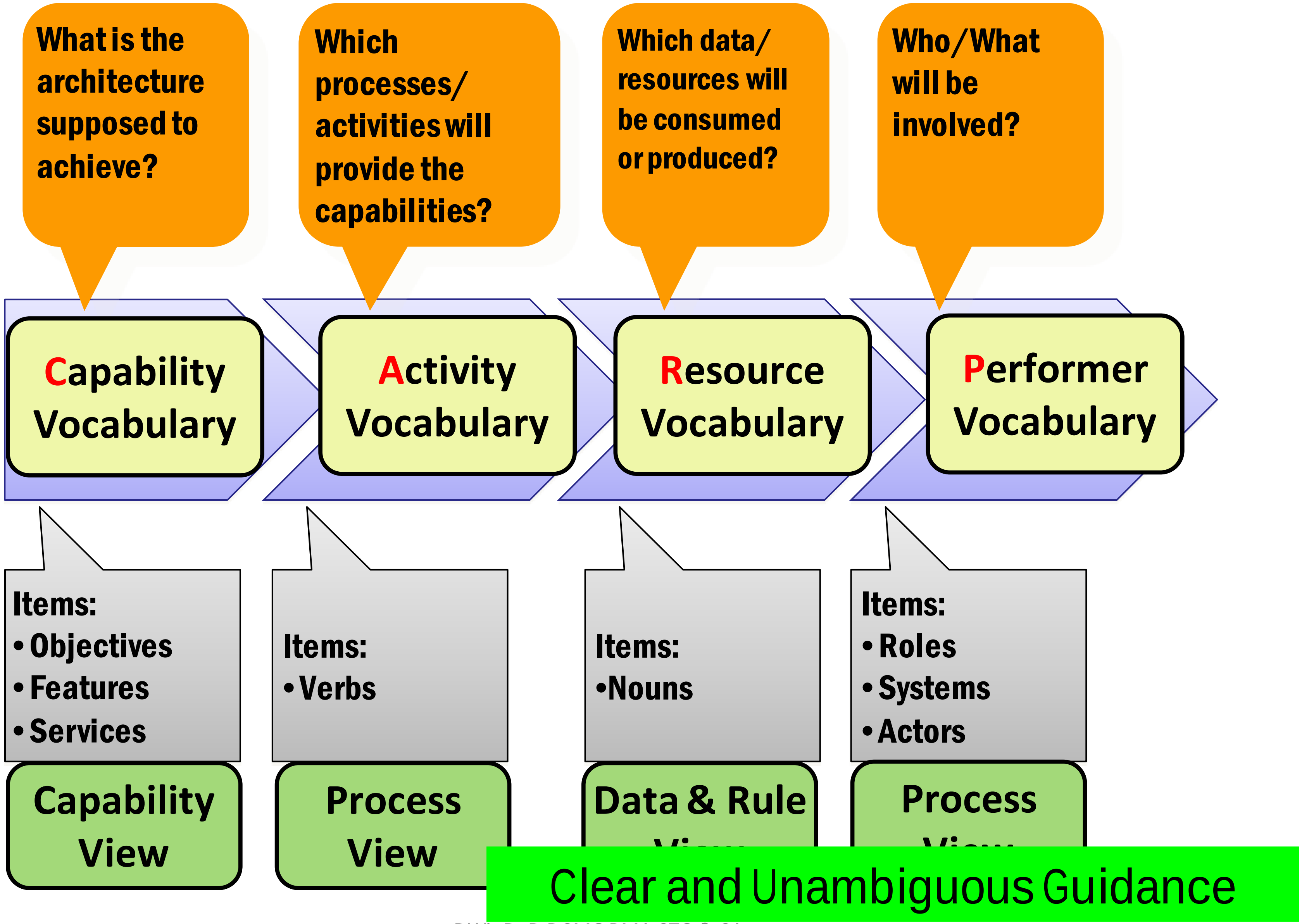
Common Vocabulary Development

- Identify information to communicate
- Agree on terms and contextual use
- Communicate

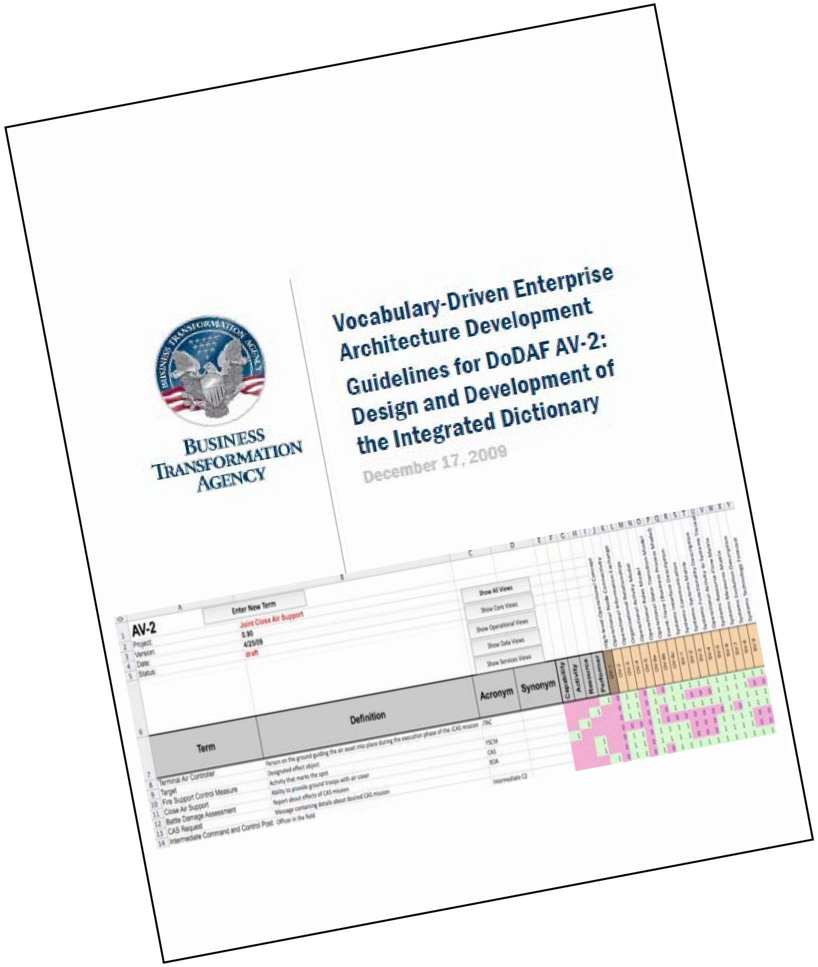
"Now! *That* should clear up a few things around here!"

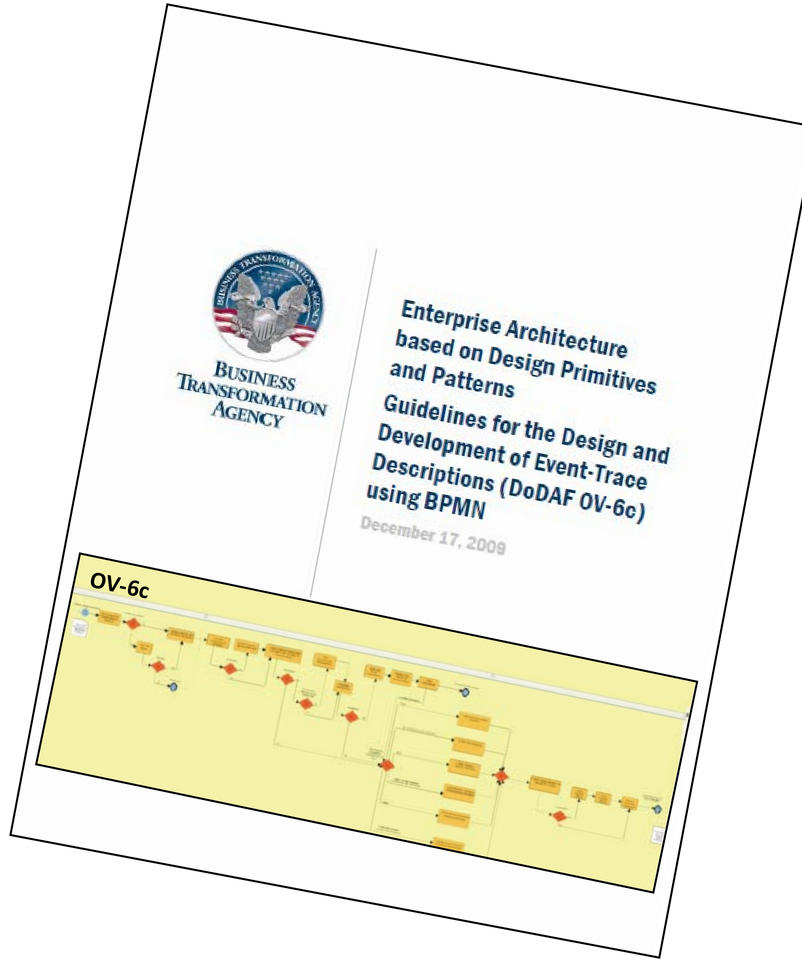
Common Ways to Build Architecture

Building Common Vocabularies



Architecture Primitives Series





DoD Architecture Framework Processes Best-Practice

http://cio-nii.defense.gov/sites/dodaf20/journal_exp3.html

Leading by Example

Department of Defense Enterprise Information Web (EIW)

BLUF

Bottom Line Up-Front (BLUF)

- The Enterprise Information Web (EIW) is pioneering the adoption of Semantic Technology and approaches that can be the way forward for enterprise business intelligence and solution architectures in the DoD.

History

EIW History

Problem: Personnel visibility (PV), accurate and timely pay
Alternative: Build an enterprise ERP for HR functionality across DoD

Measure	Outcome
Agility	10 year program, system did not pass Integration Testing and Acceptance Testing
Interoperability	100+ planned point-to-point interfaces to legacy systems; 1/3 successfully built and tested
Savings	>$$$$$$$$ spent, system not fielded

Post-DIMHRS Personnel Visibility Problem Persists	
Personnel Visibility	**Interoperability/Federation**
DoD currently lacks the enterprise level capability to quickly and accurately account for personnel, manage troop strength, and plan	• **Standards & transactional systems in constant state of change** • **Relationally-based architectures**

COAs

Alternatives Considered

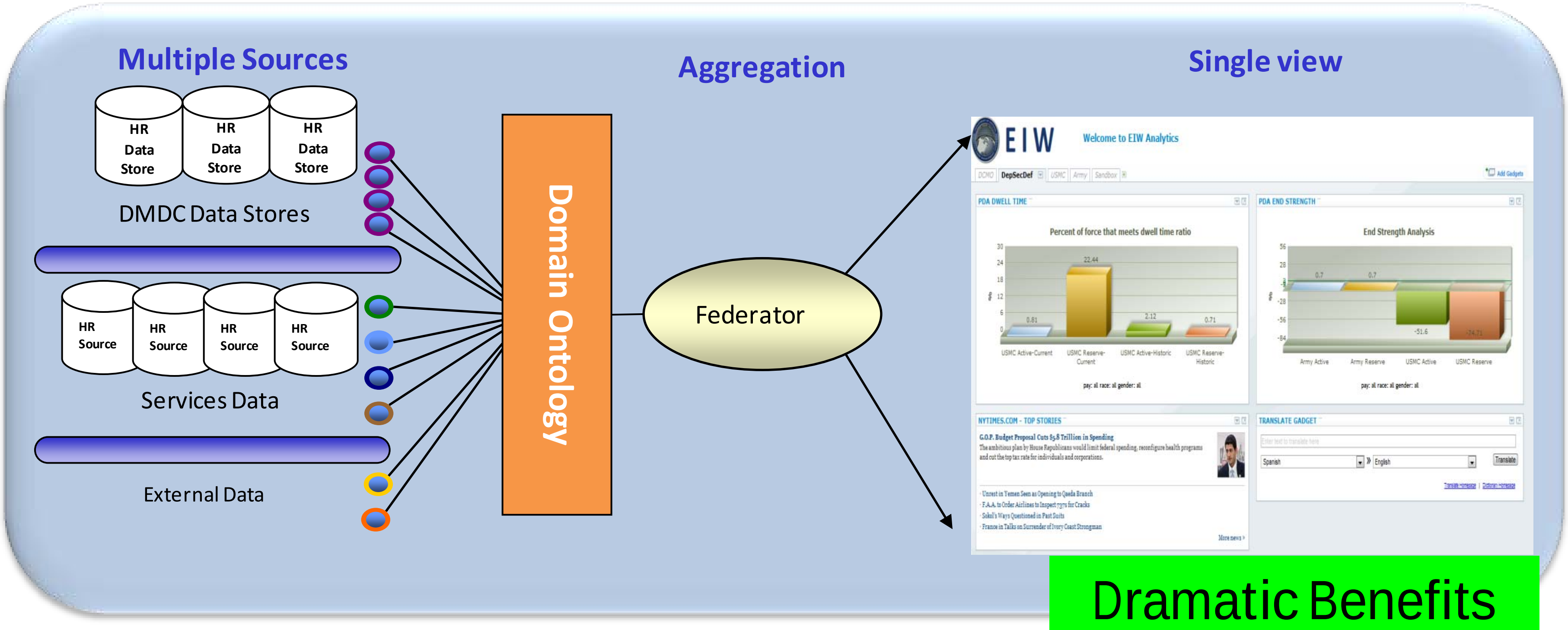
COA	Description	Pro	Con
Status quo	Manual aggregation and gathering of information in disparate systems	Process known	Labor intensive (eg: daily JPERSTAT report consumes 70 person-hrs); uncertain data lineage
DIMHRS	Single military personnel and pay system	Efficient; accurate	DIMHRS not fielded; Political change curve substantial
Traditional Warehouse	Set up a traditional network of data stores to pull and store personnel and pay related information	Known model and technology stack	Duplicates data; costly to develop & to maintain; very costly to modify
Semantic Approach	Semantically describe personnel and pay information assets, pull, aggregate and display (vice store)	Federated data = data lineage; powerful analytics; virtual data (no duplication); easier to modify and maintain; highly extensible	Maturing technology; Technology change curve exists

All In

New Approach to Personnel Visibility (PV)

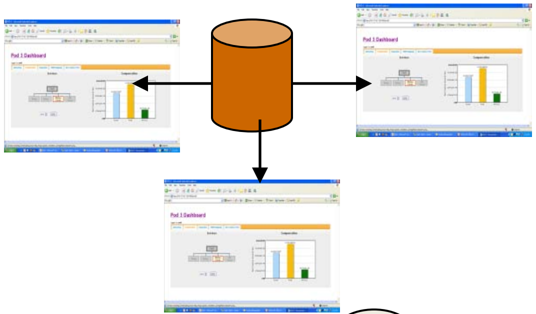
The HR Enterprise Information Web (EIW) is a mechanism for reaching into Authoritative Data Sources (ADS) to satisfy enterprise information needs. It accomplishes three things:

1. **Reports near real-time, authoritative information on-demand**
2. **Supports enterprise information standards (Open; HRM ES)**
3. **Supports IT flexibility/agility**

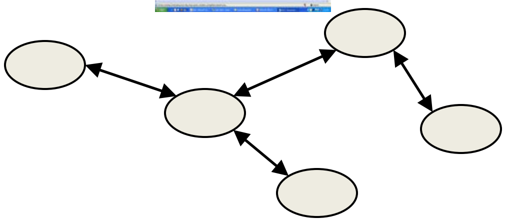


EIW Benefits

- **Visibility**: pull & display (vice store!) enterprise information directly from the authoritative data sources

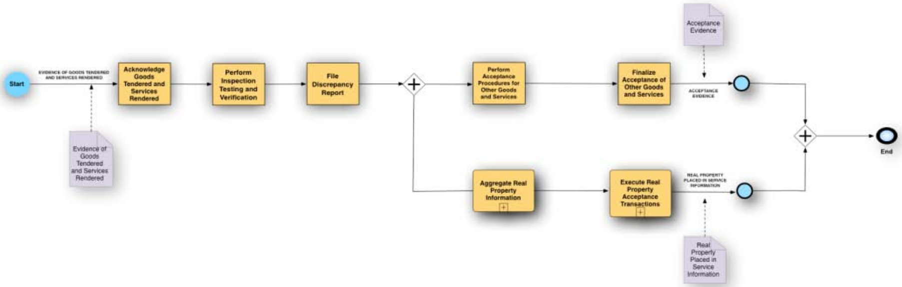


- **Agility**: plug-and-play federated environment so new systems or analytical needs can come online and go offline without disrupting the overall environment



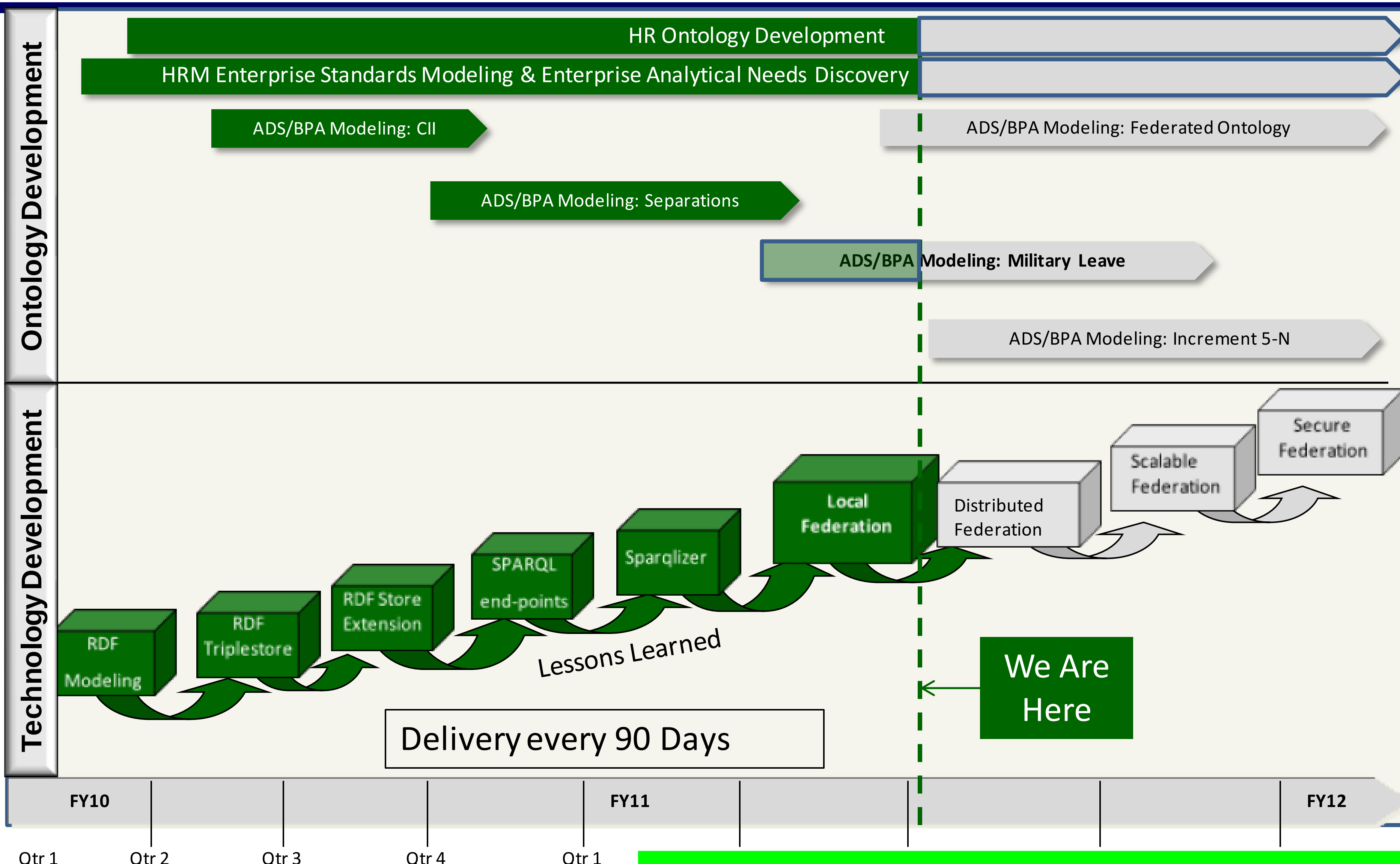
- **Access**: build <u>federation</u> into the solution
- **Standards**: leverage BPM and Semantic Web technology standards (RDF/OWL) developed by DARPA and approved by W3C and OMG

- **Savings**: People readable Architecture, Machine readable Architecture, Executable Architecture, Long-term re-use of authoritative data



Crawl, Walk, Run

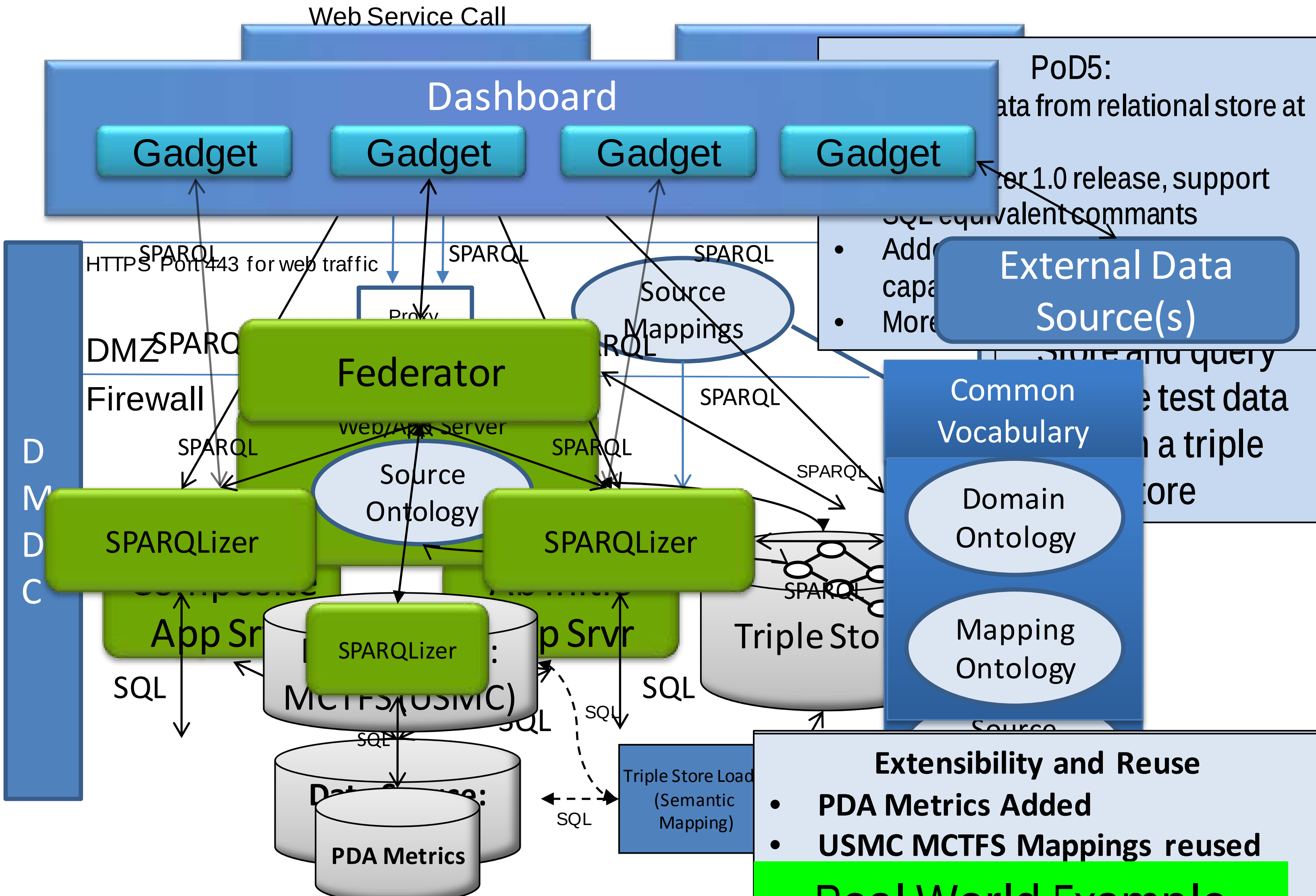
EIW Roadmap: Phased Approach



90 Day "Proof of Deliveries (PoDs)

Legend: ADS/BPA = Authoritative Data Source/Business Process Are

PoD Progression

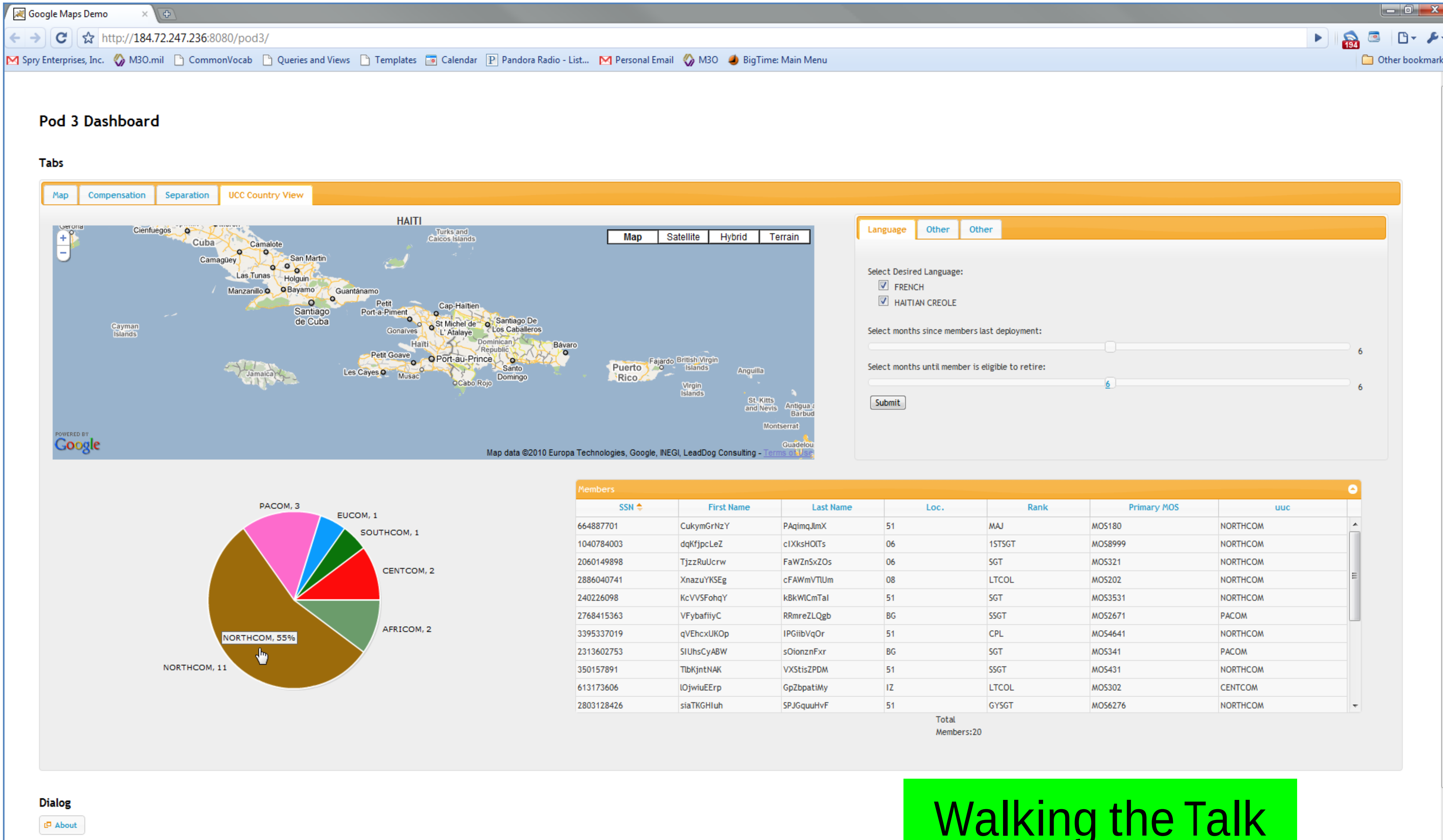


Extensibility and Reuse

- **PDA Metrics Added**
- **USMC MCTFS Mappings reused**

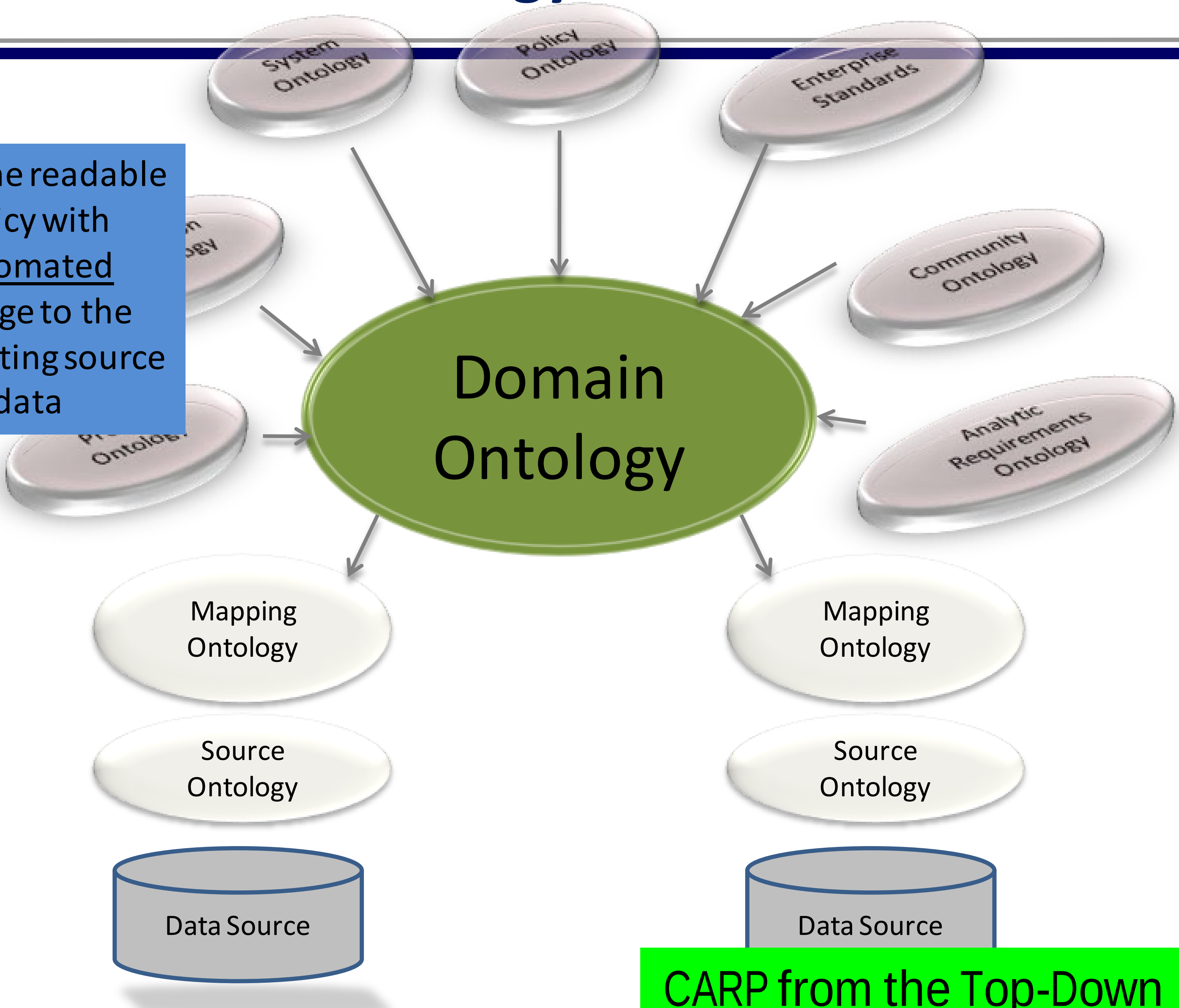
Real World Example

Operations – Country View: User Defined Query



Walking the Talk

EIW Ontology Architecture



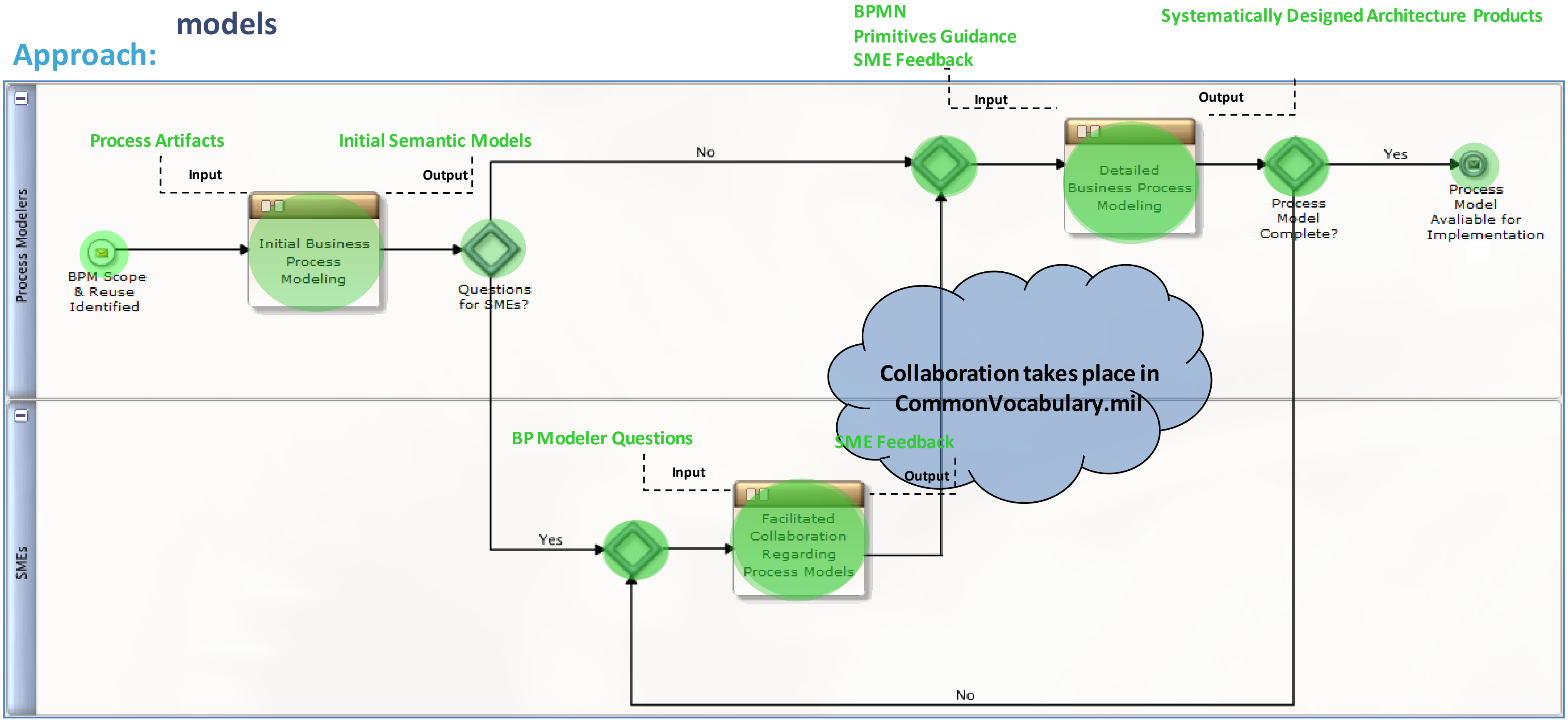
Machine readable policy with automated lineage to the supporting source data

CARP from the Top-Down

BPM Methodology

Goal: Develop correct, consistent, human and machine readable, high quality business process models

Approach:



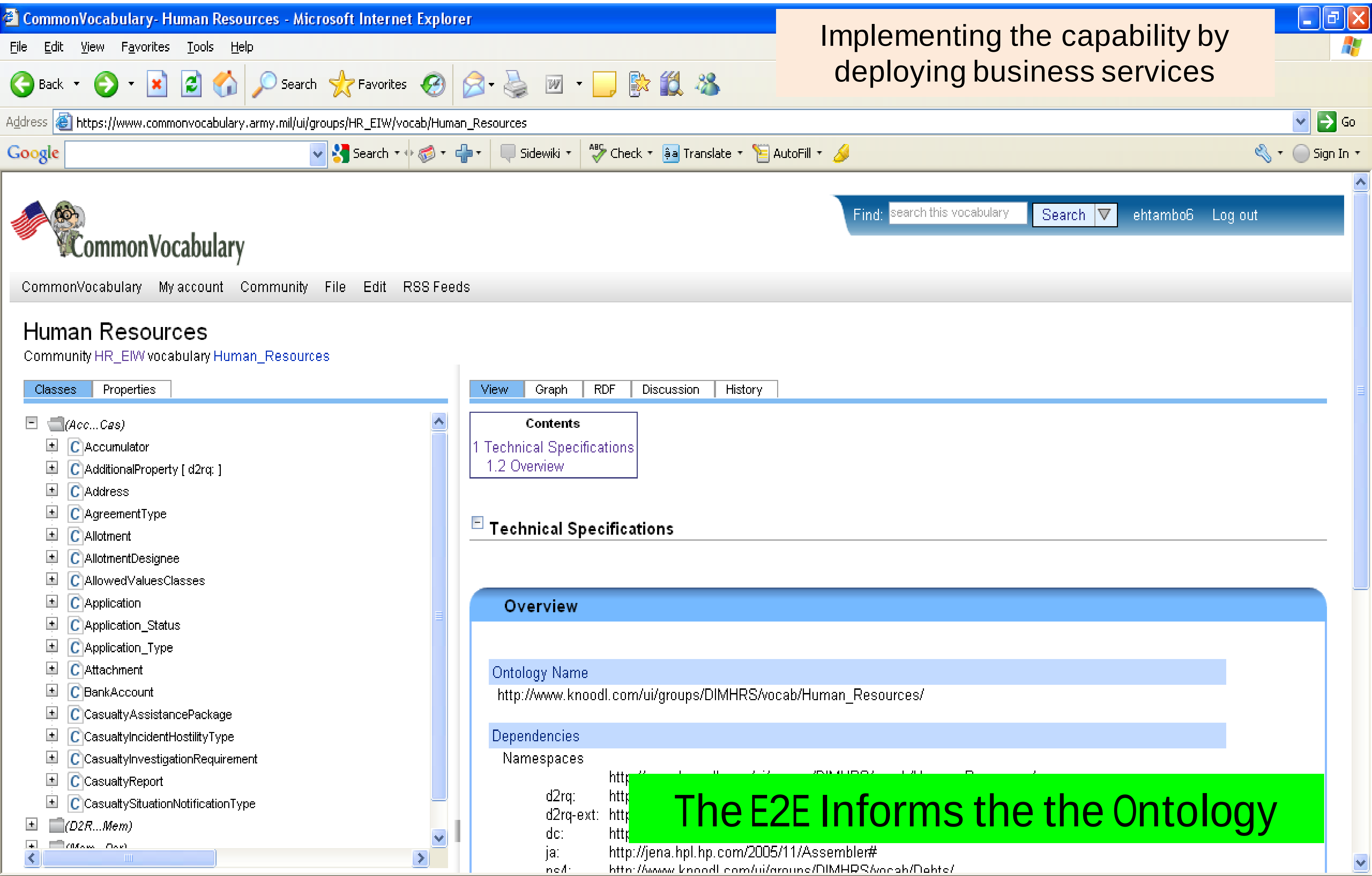
Benefits:

- Consistent, semantically aligned (end- to-end HR) business processes
  - Communicate effectively with the Services
- Machine readable (queryable) business processes
  - Perform gap analysis
- Standards based models result in fewer errors during implementation

Collaboration

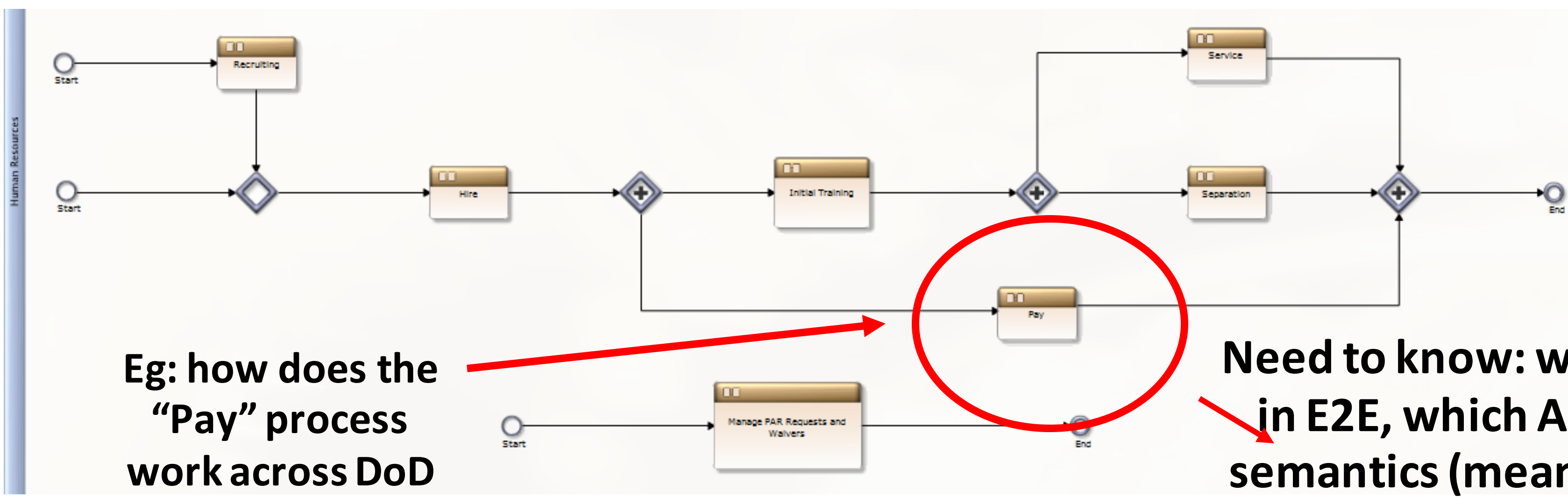
Community Workspace: www.Common Vocabulary.army.mil

https://www.commonvocabulary.army.mil/ui/groups/HR_EIW



HR EIW and H2R E2E

Personnel Visibility not possible if DoD doesn't understand the Enterprise H2R E2E processes, information flows, data sources, integration points, standards and exceptions

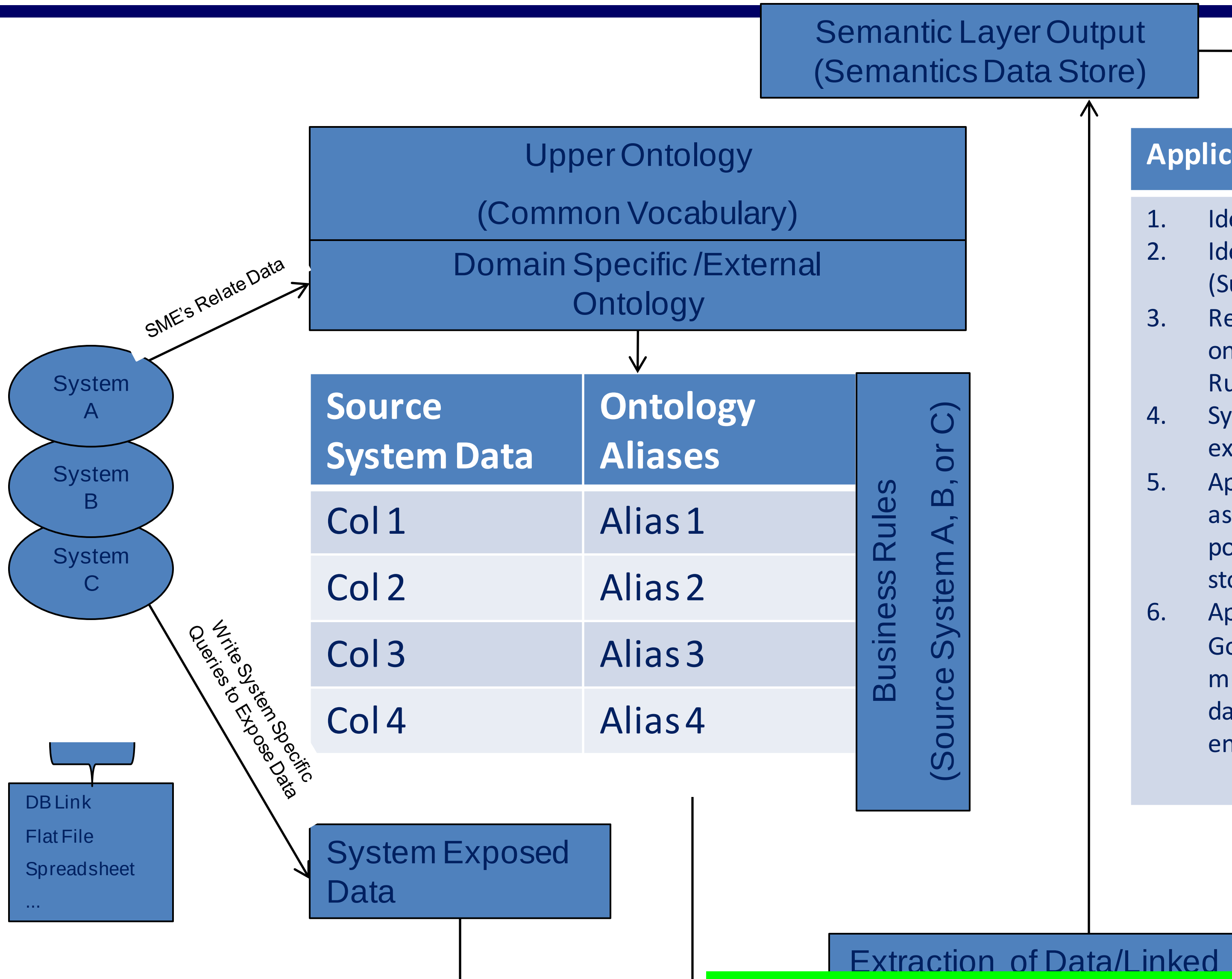


Eg: how does the "Pay" process work across DoD in the E2E?

Need to know: where in E2E, which ADS, semantics (meaning) of data, and access

CARP from the Bottom-Up

Semantic Development Approach



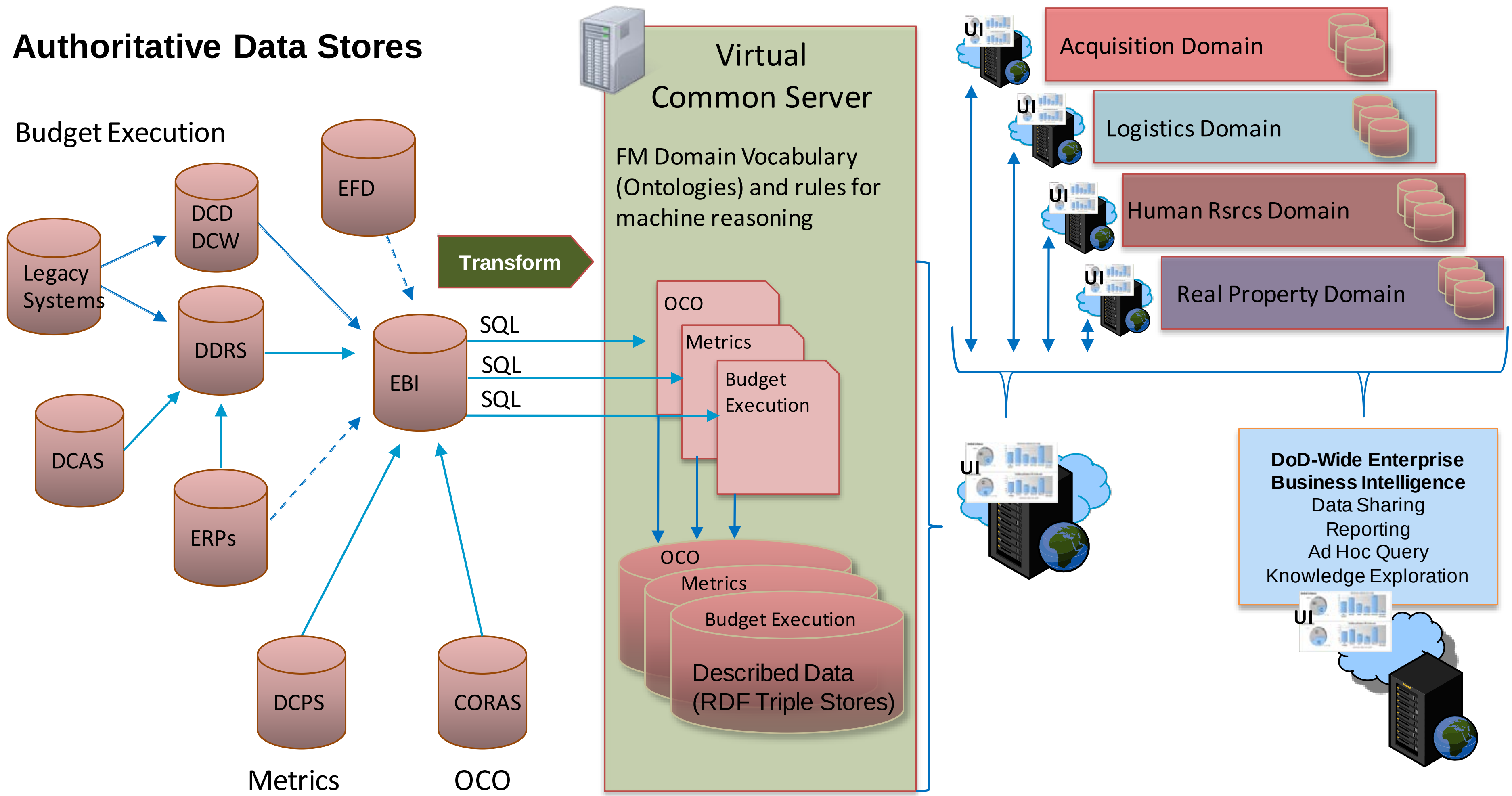
Source System Data	Ontology Aliases
Col 1	Alias 1
Col 2	Alias 2
Col 3	Alias 3
Col 4	Alias 4

Application Dev. Steps:

1. Identify Data to be exposed
2. Identify sources and SME's (Subject Matter Experts)
3. Relate system data to ontology/SFIS Business & Rules
4. Systems provide query to expose their data
5. Apply business rules and assign domain aliases, and populate the semantic store.
6. Apply User Interface (i.e. Google Gadgets) to access multiple federated source data into comprehensive enterprise views.

EIW from the FM Perspective

Financial Management Domain



Model-Data-Implement

Agile, Architecture-Driven, DoD Business Capability Delivery

Governance

Policy , Processes, Tiered Accountability

Model

Common Architecture Methodology
Common Vocabulary

Standard Representation and Composition
Primitives and Design Patterns

Data

Authoritative Data Sources
Semantic Technologies

Implement

Phased Implementations
Agile Business Services Delivery

Model to Guide Transformation
Data to Improve Performance
Implement to Deliver Capabilities

For the Rest of the Story

End-to-End (E2E) Business Models in the DoD Business Architecture

DEPUTY CHIEF MANAGEMENT OFFICER
9010 DEFENSE PENTAGON
WASHINGTON, DC 20301-9010

APR 4 2011

MEMORANDUM FOR SECRETARIES OF THE MILITARY DEPARTMENTS
CHAIRMAN OF THE JOINT CHIEFS OF STAFF
UNDERSECRETARIES OF DEFENSE
COMMANDER, UNITED STATES TRANSPORTATION COMMAND
ASSISTANT SECRETARY OF DEFENSE FOR NETWORKS AND INFORMATION INTEGRATION/DOD CHIEF INFORMATION OFFICER
DIRECTOR, COST ASSESSMENT AND PROGRAM EVALUATION
DIRECTOR, ADMINISTRATION AND MANAGEMENT
DIRECTOR, NET ASSESSMENT
DIRECTORS OF THE DEFENSE AGENCIES
DIRECTORS OF THE DOD FIELD ACTIVITIES

SUBJECT: Use of End-to End (E2E) Business Models and Ontology in DoD Business Architectures

DoD historically spends more than $6.0B annually developing and maintaining a portfolio of more than 2,000 business systems and Web services. Many of these systems, and the underlying processes they support, are poorly integrated. They often deliver redundant capabilities that optimize a single business process with little consideration to the overall business enterprise. It is imperative, especially in today's limited budget environment, to optimize our business processes and the systems that support them to reduce our annual business systems spending.

The Defense Business System Management Committee (DBSMC) embraced the E2E business lifecycle model as a viewpoint to frame and understand our business environment. Further, the DBSMC endorsed using and extending the E2E framework to evolve the Business Enterprise Architecture (BEA) within the context of the DoD Enterprise Architecture. This essential framework will be used by the DBSMC and the supporting Investment Review Board (IRB) process to guide and constrain business system investments and conduct business process reengineering determinations as required by statue.

This memorandum outlines a new approach to leverage the E2Es defined within the BEA and provides the illumination necessary to achieve the management and interoperability required by statute. The Assistant Deputy Chief Management Officer will issue additional guidance to ensure these approaches are clearly applied to these management efforts. Additional guidance will identify future "time boxed" BEA development activities in consultation with the E2E Governance Council.

The BEA is the Enterprise's blueprint for defining the Department's business environment. It captures required Enterprise capabilities; metrics aligned to the Department's Strategic Management Plan; processes, data standards and rules to permit system and Web service

...business process
...s 15 E2E business lifecycle

...ork (DoDAF), currently
...siness architecture within
...ing a common language
...ription Framework
...ness Process Modeling
...se open standards shall be
...ed or asserting compliance

...drive and organize BEA
...the BEA will be
...ization efforts related to
...ecycle models. Initial

...ng the new approach

...oD Chief Information

...nterprise Architecture and

...logies within the BEA.

...omponent and Agency
...via participation and conformance with procedures and processes described herein. The DBSMC will receive quarterly BEA updates via the E2E Governance Council.

My point of contact for this matter is Robert Jennings, robert.jennings@osd.mil or 703-614-0214.

Elizabeth A. McGrath

DCMO Memo signed 4 April 2011
Subject: End-to-End (E2E) Business Models in the DoD Business Architecture

- DBSMC endorsed using and extending the E2E framework to evolve the BEA
- BEA captures the following:
  - Enterprise capabilities
  - Performance metrics aligned to the DoD Strategic Management Plan (SMP)
  - Processes, data standards and rules for interoperability
- BEA will be a tool to drive portfolio management and *Business Process Reengineering*
- BEA 8.0 Release captured the and defined the Department's 15 E2E Business Lifecycle models
- BEA 8.0 further provided a detailed level business process models for the Procure to Pay E2E to include information exchanges

End-to-End (E2E) Business Models in the DoD Business Architecture

DEPUTY CHIEF MANAGEMENT OFFICER
9010 DEFENSE PENTAGON
WASHINGTON, DC 20301-9010

APR 4 2011

MEMORANDUM FOR SECRETARIES OF THE MILITARY DEPARTMENTS
CHAIRMAN OF THE JOINT CHIEFS OF STAFF
UNDERSECRETARIES OF DEFENSE
COMMANDER, UNITED STATES TRANSPORTATION COMMAND
ASSISTANT SECRETARY OF DEFENSE FOR NETWORKS AND INFORMATION INTEGRATION/DOD CHIEF INFORMATION OFFICER
DIRECTOR, COST ASSESSMENT AND PROGRAM EVALUATION
DIRECTOR, ADMINISTRATION AND MANAGEMENT
DIRECTOR, NET ASSESSMENT
DIRECTORS OF THE DEFENSE AGENCIES
DIRECTORS OF THE DOD FIELD ACTIVITIES

SUBJECT: Use of End-to End (E2E) Business Models and Ontology in DoD Business Architectures

DoD historically spends more than $6.0B annually developing and maintaining a portfolio of more than 2,000 business systems and Web services. Many of these systems, and the underlying processes they support, are poorly integrated. They often deliver redundant capabilities that optimize a single business process with little consideration to the overall business enterprise. It is imperative, especially in today's limited budget environment, to optimize our business processes and the systems that support them to reduce our annual business systems spending.

The Defense Business System Management Committee (DBSMC) embraced the E2E business lifecycle model as a viewpoint to frame and understand our business environment. Further, the DBSMC endorsed using and extending the E2E framework to evolve the Business Enterprise Architecture (BEA) within the context of the DoD Enterprise Architecture. This essential framework will be used by the DBSMC and the supporting Investment Review Board (IRB) process to guide and constrain business system investments and conduct business process reengineering determinations as required by statue.

This memorandum outlines a new approach to leverage the E2Es defined within the BEA and provides the illumination necessary to achieve the management and interoperability required by statute. The Assistant Deputy Chief Management Officer will issue additional guidance to ensure these approaches are clearly applied to these management efforts. Additional guidance will identify future "time boxed" BEA development activities in consultation with the E2E Governance Council.

The BEA is the Enterprise's blueprint for defining the Department's business environment. It captures required Enterprise capabilities; metrics aligned to the Department's Strategic Management Plan; processes, data standards and rules to permit system and Web service

conformance with procedures and processes described herein. The DBSMC will receive quarterly BEA updates via the E2E Governance Council.

My point of contact for this matter is Robert Jennings, robert.jennings@osd.mil or 703-614-0214.

Elizabeth A. McGrath

DCMO Memo signed 4 April 2011

Subject: End-to-End (E2E) Business Models in the DoD Business Architecture

- In order to facilitate integration of the systems and business architecture within the E2E lifecycle models, the BEA will be described in an ontology using a common language – {World-Wide Web Consortium (W3C) open standards Resource Description Framework (RDF)/Web Ontology Language (OWL) and modeling notation (Business Process Modeling Notation (BPNM) 2.0 Analytic Conformance Class (Primitives)}
- The E2E Framework shall be used to drive BEA content within the federated BEA ontology
- Future releases of the BEA will be synchronized with our highest priority system acquisition and modernization efforts related to critical activities within the Hire-to-Retire (H2R) and Procure-to-Pay (P2P) lifecycle models

For the rest of the story!

Spring 2011

Common Defense Quarterly Spring Issue Index

Engineering Enterprise Architecture: Call to Action

By Dennis Wisnosky

There are a plethora of Enterprise Architecture (EA) frameworks, methodologies, tools, views, languages, approaches and 'standards'. There are over thirty years of accumulated detritus with respect to how to build an EA, yet there are no accepted best practices. There is no underlying engineering discipline or mathematics. Instead, an EA is viscerally good or bad, useful or not. When two Architects cannot agree on a framework or a methodology, often a third one is born. When a community does reach agreement, the result is a stovepipe that itself is isolated from other communities.

Figure 1.1: Just a few of the Enterprise Architecture frameworks utilized today

An EA is, or should be - a blueprint, a model, a schematic diagram, a recipe, or even a formula that will lead to a specific predetermined result. Sadly, sometimes even tragically, based upon the amount of time and money expended, many or perhaps most EA's, have no practical value. They are built and shelved.

It is time to change this paradigm. It is time to approach the building and use of EA within the context of an engineering, or at least a business discipline. The experience of the U.S. Department of Defense (DoD) over the last 2 years demonstrates that this can be done.

Why would we not want every Enterprise Architect be able to read and understand the meaning of any Enterprise Architecture? Why would we not want computers to be able to execute the End to End Business Process Models that EA can represent?

Background: The DoD Business Enterprise Architecture (BEA) provides a blueprint for DoD business operations prescribed by the Department of Defense Architecture Framework (DoDAF). The purpose of the BEA is to provide defense business system owners and program managers with the information they need to make informed decisions in support of the Department; which in turn supports our Warfighter by ensuring that the right capabilities, resources and material are delivered to them when they need it, where they need it, anywhere in the world.

More specifically, the BEA guides and constrains implementation of interoperable defense business system solutions and guides information technology investment management to align with strategic business capabilities. The BEA outlines and defines the Department's business transformation priorities, the business capabilities required to support those priorities, and the combinations of enterprise systems and initiatives that enable those capabilities.

Point: The BEA is a big deal! It is significant in purpose, cost, man power and maintenance. It is also one of many architectures within the Department. The components, Army, Navy, Air Force, Marine Corps etc… have their own architectures, and these architectures must comply and federate with the BEA.

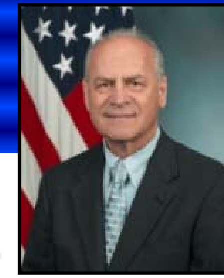
Issue: While the DoDAF provides the framework or views from which to build architecture, it does not prescribe a standard methodology of how to model the architecture within the views. This lack of a common standard means that the same work is being done over and over again. Certified Enterprise Architects cannot understand one another's work; and if enterprise architectures (EA's) cannot be read by anyone but the people and programs that created them, imagine the waste and cost associated with trying to integrate and/or federate. The cost in time and money within the DoD is substantial. But, it should not and does not need to be this way.

Figure 1.2: A standard EA representation that all can understand is a necessity!

Figure 1.3: Cost in time and money within the DoD is substantial

http://www.commondefensequart

See You in July



Save the Dates: July 13-14, 2011

3rd Annual SOA & Semantic Technology Symposium

SOA 3.0
Is a Team Sport

Interoperable Business Operations Through Shared Understanding

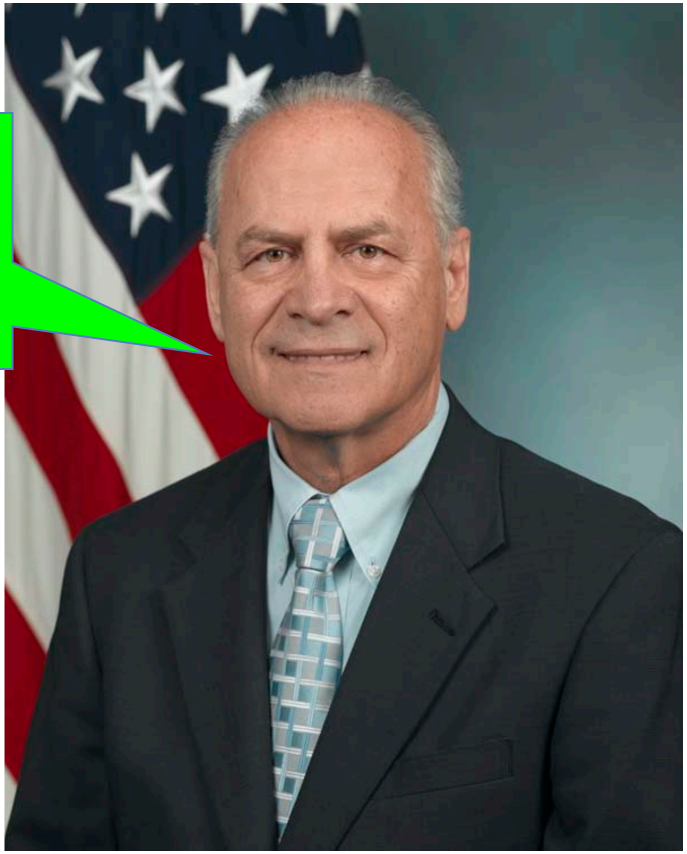
More information to come. To be added to the mailing list please contact: Jessica.Zucal.ctr@bta.mil

Waterford at Springfield
6715 Commerce Street
Springfield, VA 22150

Thank you!

Questions?

Dennis.Wisnosky@osd.mil



Huffer, Beth

Ontology-Driven Implementation of Semantic Services for the Enterprise Environment

ODISSEE*

a quest to share information about information sharing

*Ontology-Driven Implementation of Semantic Services for the Enterprise Environment

Net-Centric Operations in the NAS

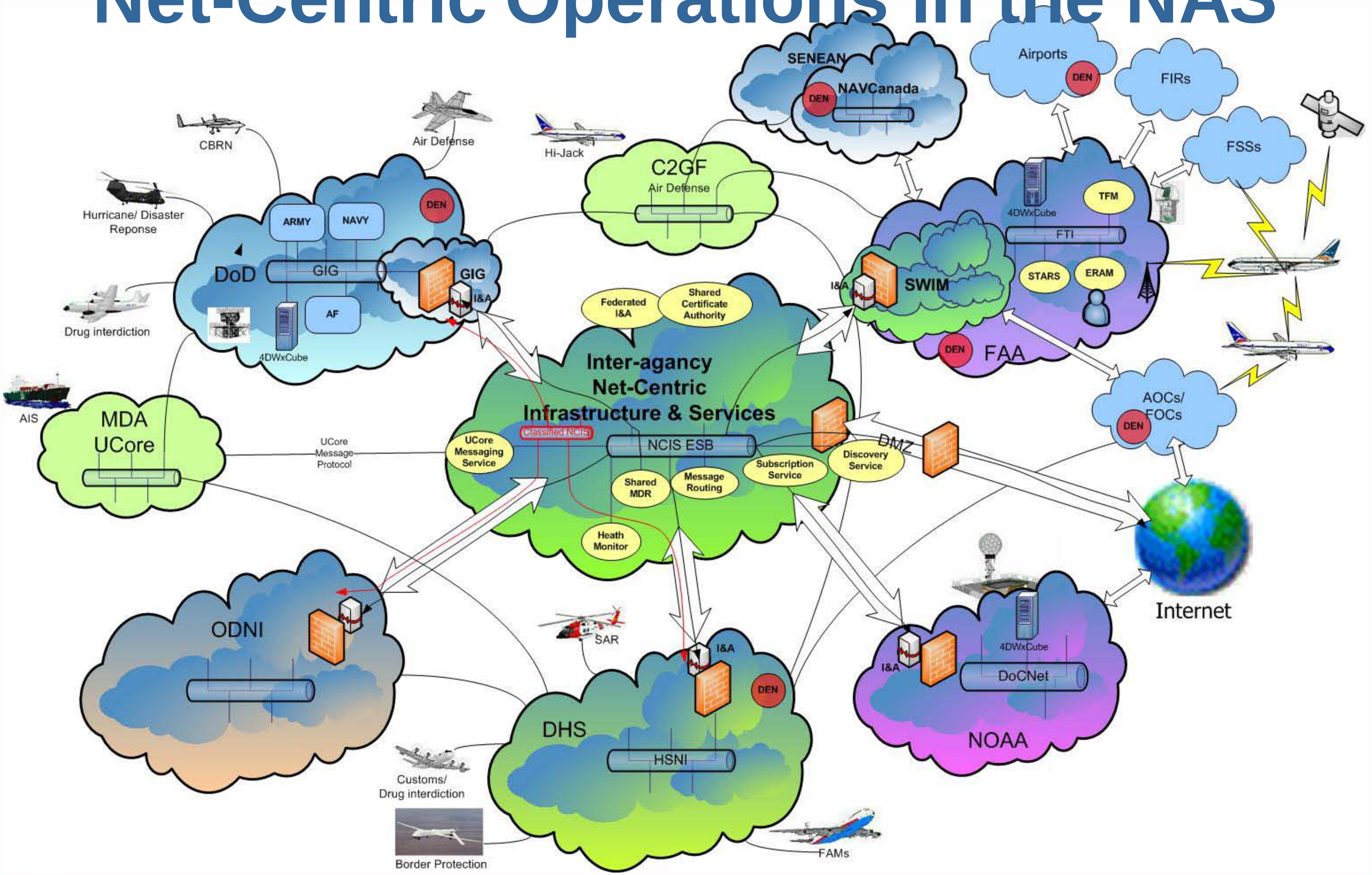
VISION 100—Century Of Aviation Reauthorization Act

SEC. 709. Air Transportation System Joint Planning and Development Office

(c) GOALS.—The Next Generation Air Transportation System shall—

(3) integrate data streams from multiple agencies and sources to enable situational awareness and seamless global operations for all appropriate users of the system, including users responsible for civil aviation, homeland security, and national security

Net-Centric Operations in the NAS

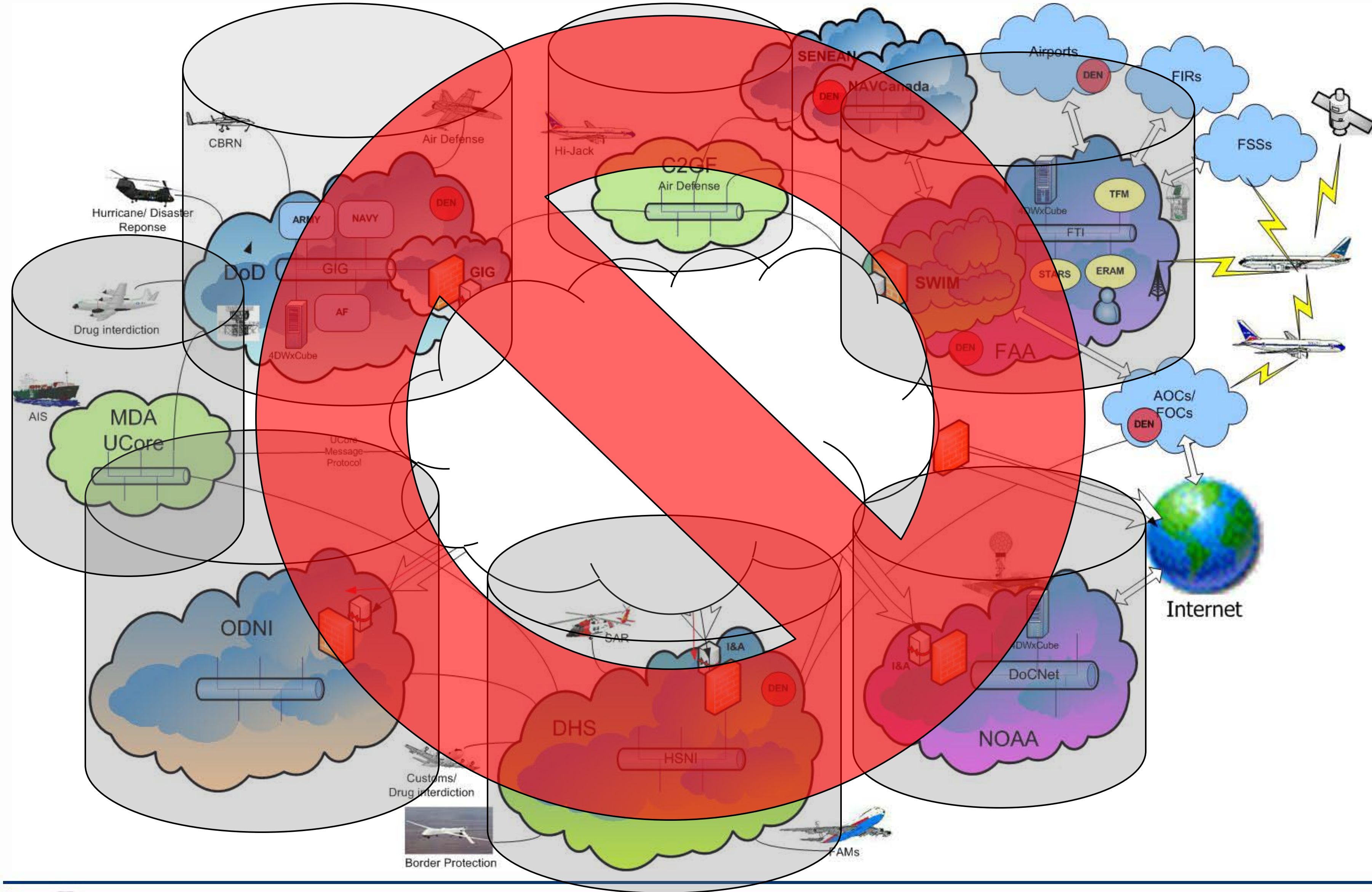


Net-Centric Operations in the NAS

DOD NET-CENTRIC DATA STRATEGY

- Ensuring data are visible, available, and usable when needed and where needed to accelerate decision-making
- "Taggng" of all data (intelligence, non-intelligence, raw, and processed) with metadata to enable discovery of data by users
- Posting of all data to shared spaces to provide access to all users except when limited by security, policy or regulations

No Stovepipes



ODISSEE 2011

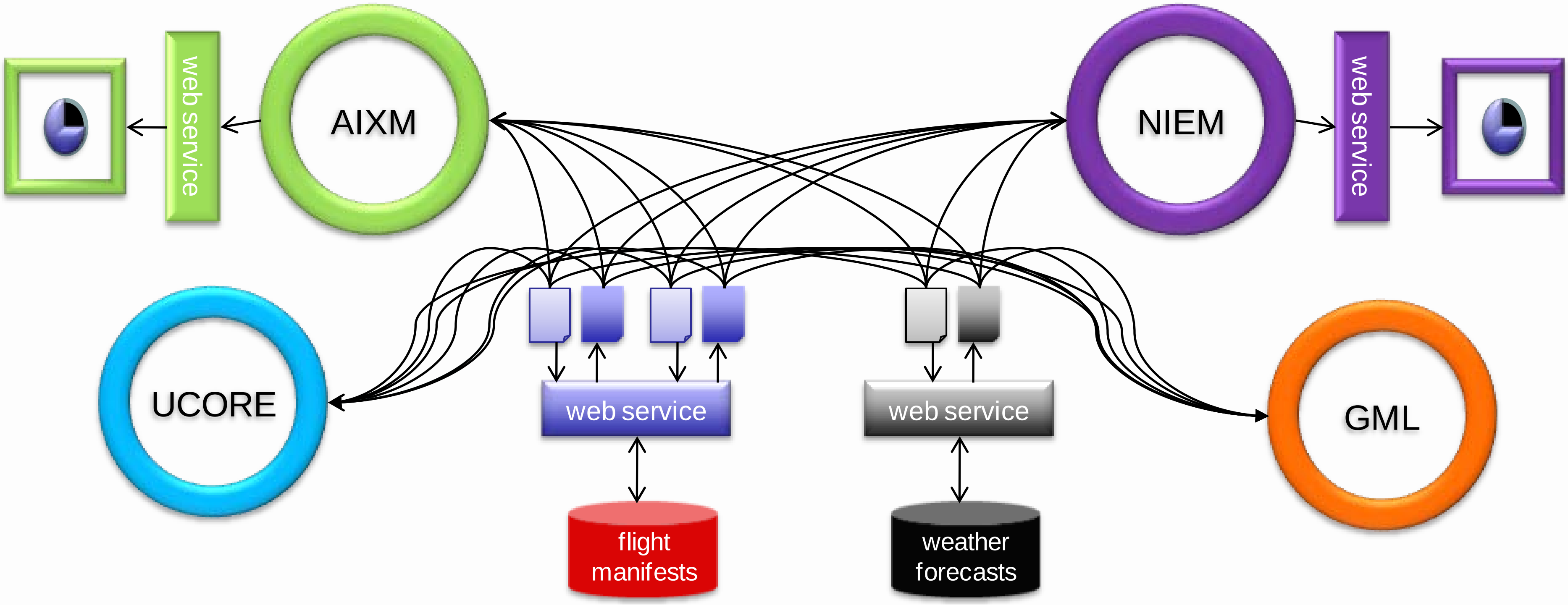
Identify and catalogue semantic technology efforts across the federal government

Got standards?

GEOSS
TADIL-J
ISO 11963:1995
ASTM F2595-07
W3C
ISO 11341:2004v
ArcGIS Resource Cen
ISO 11963:1995
ASTM F2595-07
ANSI 11507:2007
BSR
ASR-9
FGDC-STD-009.5-2006
NCSCI-STD-012.5-2007
NCSCI-013-2007
FGDC-STD-012.5-2007
IEC 62297-2
GEOTIFF
HZ INTERNATIONAL
ANSI 015-2009
IEC 62297-2
HRXML
Google earth
FGDC-STD-015-2009
1303:1994
ISO 105-1303:1994
4-2006
ANSI 013-2007
NIEM
ging Information Syste
ISO 11507:2007
IEC 61969-1
FGDC-STD-024-2006
NCSCI 010-2009
IEC 61969-2
GML
KML
NCSCI-009.5-2006
008
FGDC-STD-010-2009

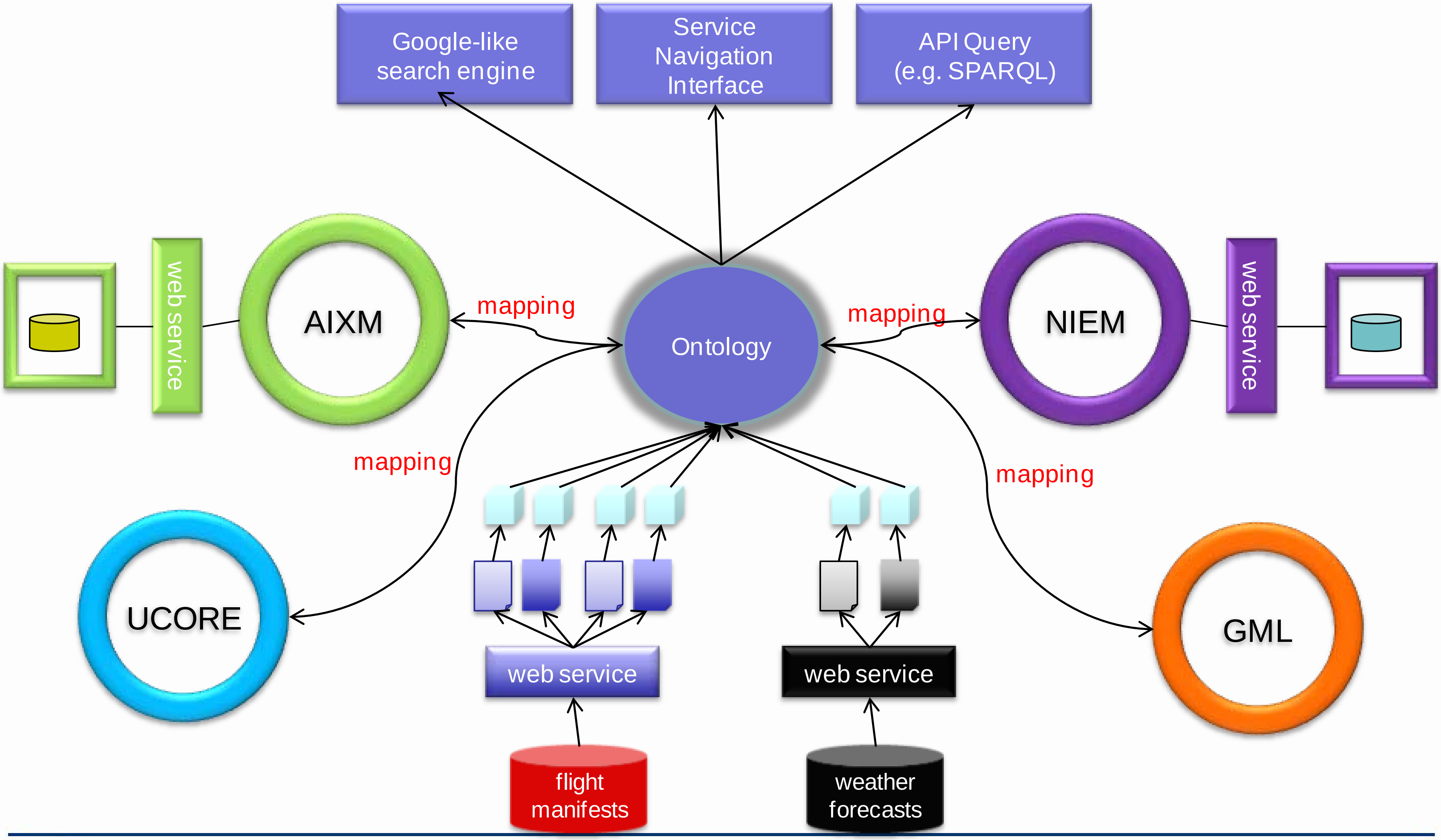
ODISSEE 2011

Identify, evaluate and catalogue standard information exchange models such as UCore and NIEM and semantic models of common domains such as time, geography, and events


web service
AIXM
NIEM
web service
UCORE
web service
web service
GML
flight manifests
weather forecasts

ODISSEE 2011

Explore the use of ontologies to enable service-oriented information exchanges, improve discoverability of services, and align disparate data standards and message models


Google-like search engine
Service Navigation Interface
API Query (e.g. SPARQL)
web service
AIXM
mapping
Ontology
mapping
NIEM
web service
mapping
mapping
UCORE
GML
web service
web service
flight manifests
weather forecasts

ODISSEE 2011

Coordinate ontology development across diverse Communities of Interest to ensure extensibility, interoperability and reusability

ODISSEE 2011

Form a Community of Interest for ontologists, data vocabulary specialists, service developers, information architects, and other information technology practitioners

THANK YOU

Beth Huffer
Concept Solutions
Contract Support for the
Joint Planning and Development Office
202-220-3418
elisabeth.ctr.huffer@faa.gov

Maybury, Mark T.

Metadata Matters: Ontology and Autonomy

U.S. AIR FORCE

Headquarters U.S. Air Force

Metadata Matters:
Ontology and Autonomy

Ontology Driven Implementation of Semantic Services for the Enterprise Environment (ODISSEE) Workshop Keynote

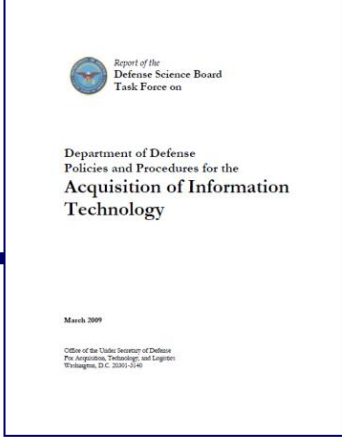
Dr. Mark T. Maybury

Chief Scientist of the U.S. Air Force

Air Force Pentagon (4E130)
Washington, D.C.

13 April 2011

2010 National Defense Authorization Act: Section 804

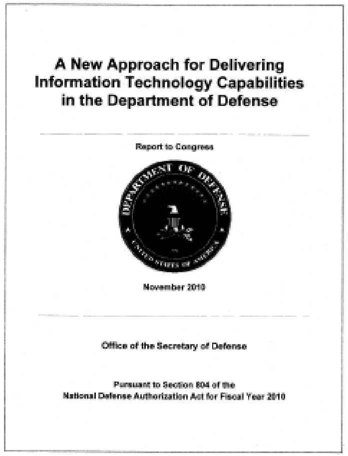

Report of the
Defense Science Board
Task Force on

Department of Defense
Policies and Procedures for the
Acquisition of Information
Technology

March 2009

Office of the Under Secretary of Defense
For Acquisition, Technology, and Logistics
Washington, D.C. 20301-3140

- DSB TF on Acquisition of Information Technology
- Section 804 of 2010 NDAA:
  - Early and continual involvement of the user
  - Multiple, rapidly executed increments or releases of capability
  - Early, successive prototyping to support an evolutionary
  - A modular, open-systems approach.
- DepSecDef Dec 9 Report to Congress– Guiding Principles:
  - Deliver early and often
  - Incremental and iterative development
  - Rationalized requirements
  - Flexible/tailored processes
  - Knowledge and experienced IT Workforce
- Industry: "Institute continuous, iterative, development, test, and certification processes that drive the commercial IT state-of-the-art to deliver more trusted, standard, off-the-shelf building blocks ... "bundle" trusted components."


A New Approach for Delivering
Information Technology Capabilities
in the Department of Defense

Report to Congress

November 2010

Office of the Secretary of Defense

Pursuant to Section 804 of the
National Defense Authorization Act for Fiscal Year 2010

DoD Net-Centric Data Strategy

The *DoD Net-Centric Data Strategy* (DoD CIO May 9, 2003) plans to make the Department's information resources:

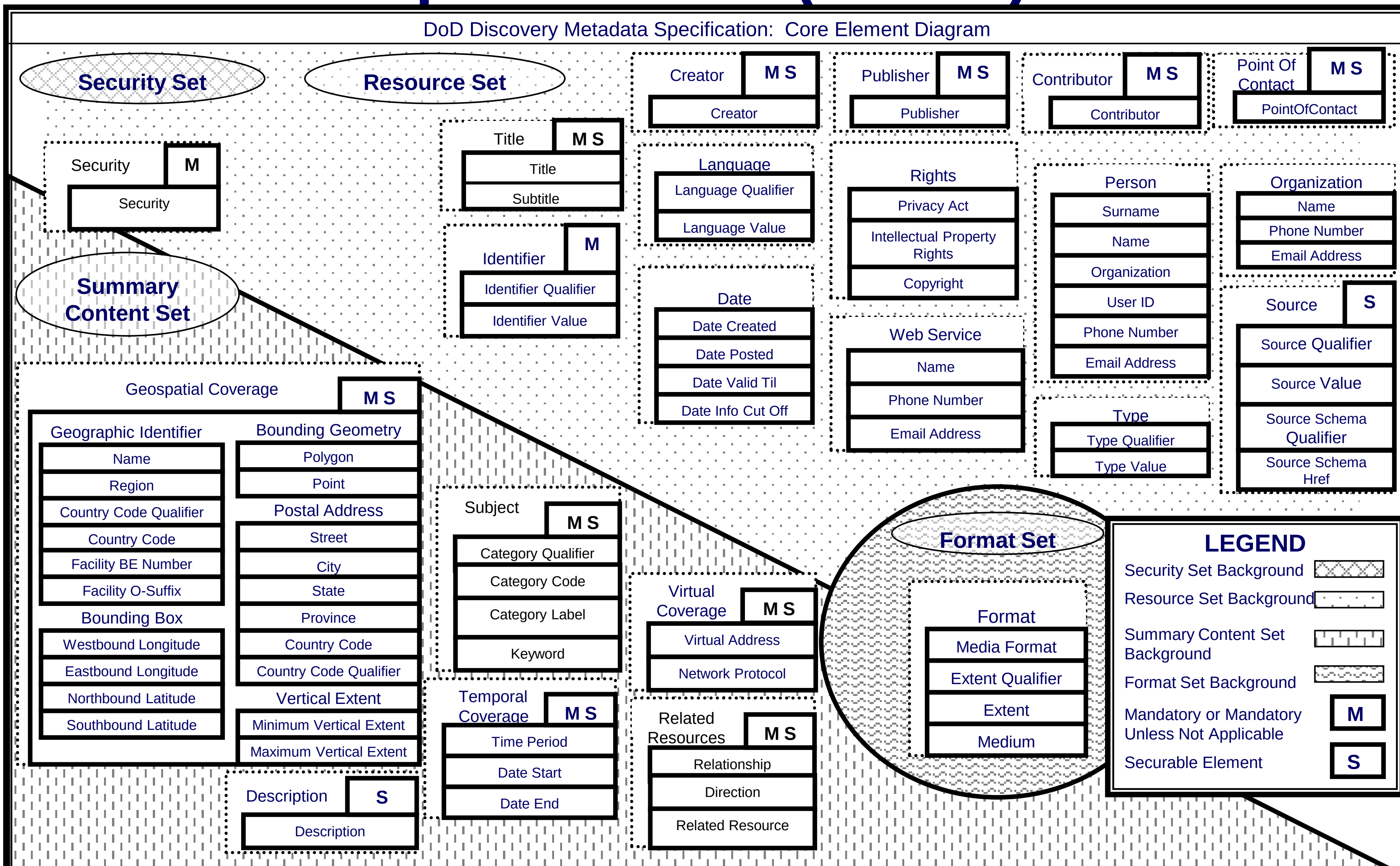
Visible	**Is an information resource discoverable by most users?**
Accessible	**Is it available on the network, and are tools readily available to use it?**
Understandable	**Can it be intelligibly used? Are the semantics well documented?**
Trusted	**Are the source, security level and access controls of the data available to users?**
Interoperable	**Can it be combined or compared with other information? Can it be mediated?**
Responsive	**Is the data what users need? Are robust user feedback mechanisms in place to improve it?**

CC/S/As must institutionalize processes to accomplish these goals

DoD Policy

- **DoD Net-Centric Data Strategy (May 2003)**
  - **“To facilitate discovery of data assets, users and applications will provide discovery metadata, in accordance with the DoD Discovery Metadata Standard (DDMS).”**
- **DoD Directive 8320.02 (Dec 2004, Apr 2007)**
  - **“Discovery metadata shall conform to the Department of Defense Discovery Metadata Specification”**
- **CJCSI 6212 (Dec 2008)**
  - **“Data assets shall be made visible by creating and associating metadata (“tagging”), including discovery metadata, for each asset using DOD Discovery Metadata Specification (DDMS) compliant metadata and posting it in the NCES Enterprise Catalog or another compatible/federated enterprise catalog.”**

DoD Discovery Metadata Specification (DDMS)



Approved for public release, Distribution unlimited

DoD Discovery Metadata Specification (DDMS)

Configuration managed by DoD Metadata WG

Data Catalog
(historical)

DDMS Attributes		
Security	*	IC: ISM
Title	*	ISO: Dublin Core
Identifier	*	ISO: Dublin Core
Creator	*	ISO: Dublin Core
Publisher		ISO: Dublin Core
Contributor		ISO: Dublin Core
Date		W3C: Date & Time
Rights		ISO: Dublin Core
Language		ISO: Dublin Core
Type		ISO: Dublin Core
Source		ISO: Dublin Core
Subject	*	W3C: OWL
Geospatial Coverage	**	OGC: GML
Temporal Coverage	**	W3C: Date & Time
Virtual Coverage		ISO: Dublin Core
Description		ISO: Dublin Core
Format		ISO: Dublin Core

DDMS endorsed by
Executive Order 13388

"Further Strengthening The Sharing Of Terrorism Information To Protect Americans"

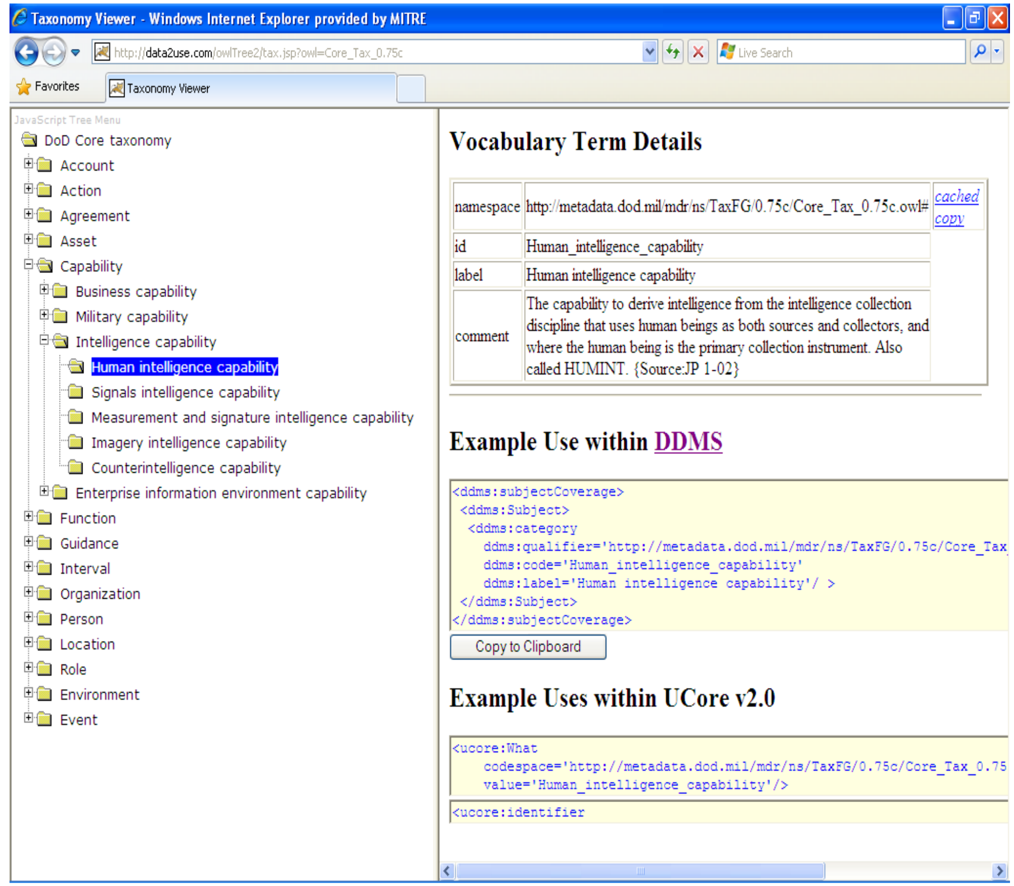
* Mandatory

** Mandatory if applicable

DDMS: Leverages Industry Standards

DoD Enterprise Taxonomy Effort

- **Purpose**
  - **References for ddms:Subject Coverage**
- **Approach**
  - **High-level taxonomy**
  - **Accommodate future COI taxonomies**
  - **Common syntax**
  - **3-level depth max**
  - **Definitions & sources**
  - **SMEs from DoD & IC**
- **Products**
  - **Syntax: OWL**
  - **Registration: DoD MDR**
  - **DoD Core Taxonomy v0.75c**



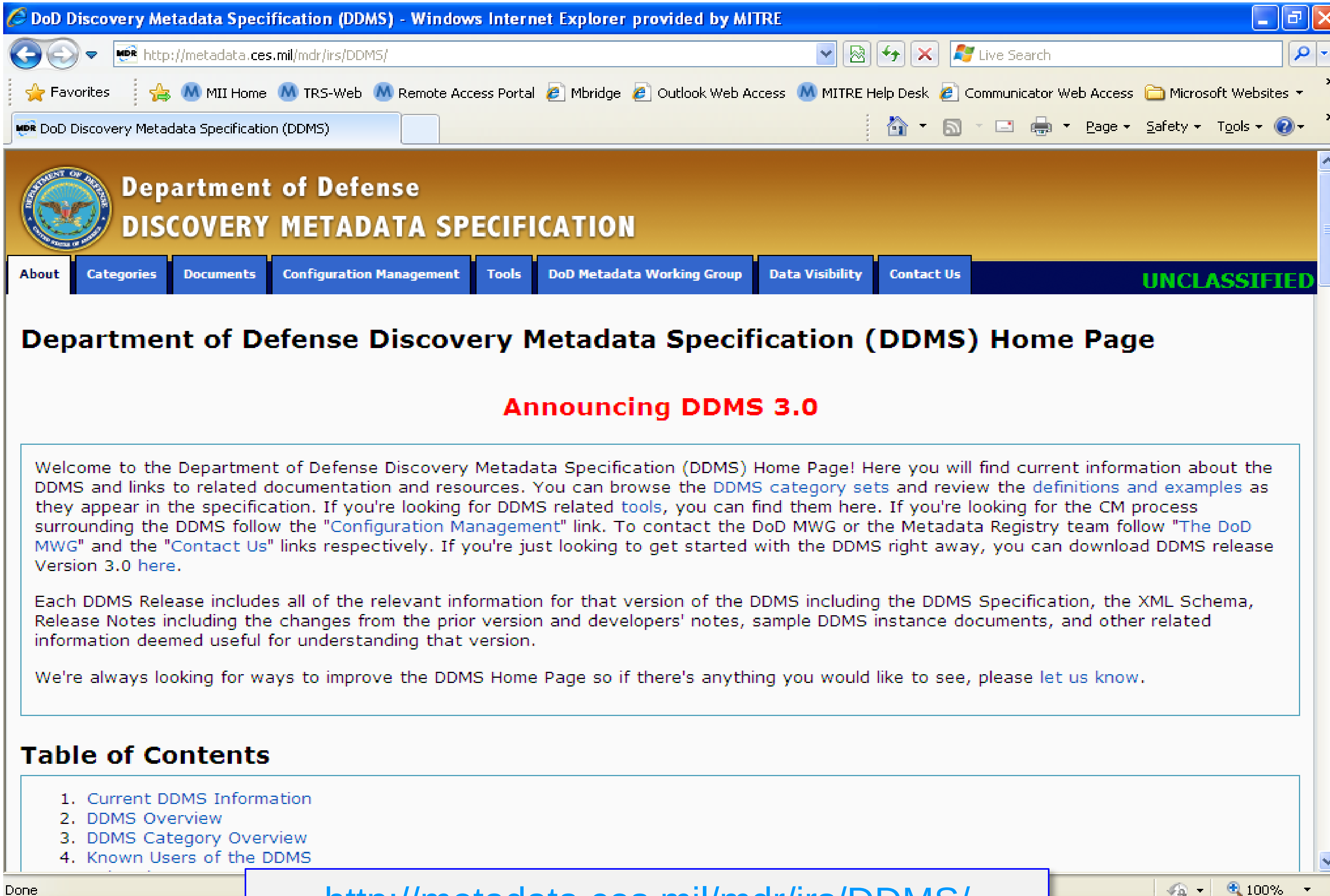
http://metadata.dod.mil/mdr/ns/TaxFG/0.75c/Core_Tax_0.75c.owl

IC Policy

- ICD 501 (Jan 2009)
  - “standards to allow information to be discoverable”
  - “Make information collected and analysis produced available for discovery in accordance with this Directive”

- ICS 2007-500-3 Resource Metadata
  - “This Implementation Profile for Information Resource Metadata (XML Encoding), also known as IRM-XML, is a statement of the Intelligence Community’s formal adoption of the Extensible Markup Language (XML) encoding from the Department of Defense Discovery Metadata Specification (DDMS)”

DDMS is Publicly Available



http://metadata.ces.mil/mdr/irs/DDMS/

Outline

- Why is ontology hard?
- Why is ontology important?
- Can automation help?
- Future?
- Lessons Learned

Why is Ontology hard?

- Metadata: data about data
- Polysemy
- Ambiguity
- Hidden Meaning
- Author Intention

Outline

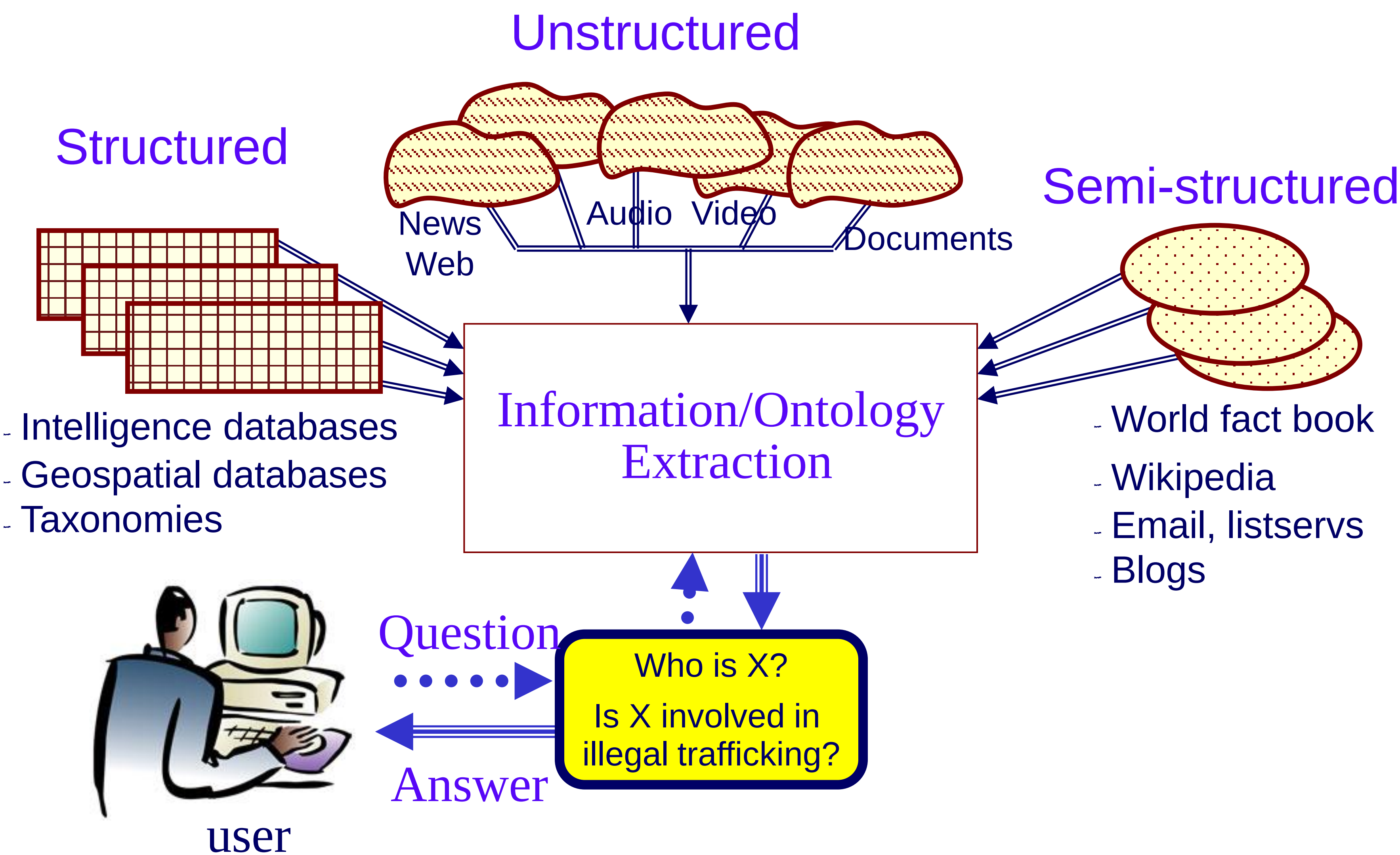
- Why is ontology hard?
- Why is ontology important?
- Can automation help?
- Future?
- Lessons Learned

Some AF Ontology Challenges

- Massive ISR collection
- Heterogeneous data integration
- Discovery of new and emerging “patterns of life”
- Real time information access
- Joint, Interagency, and Coalition information sharing

- Ontology essential for interoperability/integration:
  - entities (people, places, things)
  - properties (time, location)
  - relations (part-of, married-to)
  - states
  - events

Example Application Context: Ontology as Information Mediator



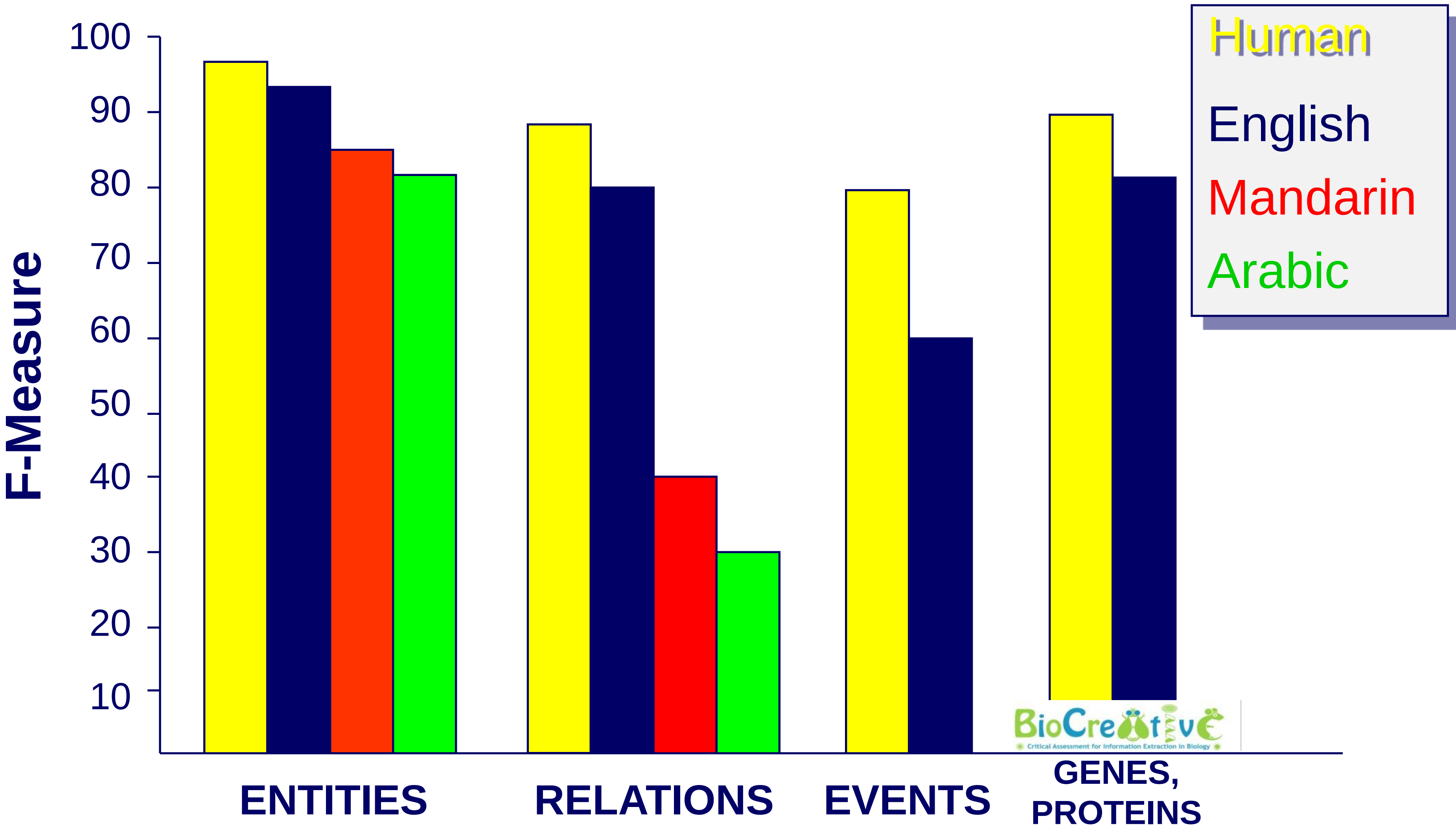
Outline

- Why is ontology hard?
- Why is ontology important?
- Can automation help?
- Future?
- Lessons Learned

Information Access Automation

- **Automated systems exist that can:**
  - **Return documents relevant to a particular subject with around 80% precision but low recall**
  - **Identify entities in news with over 90% accuracy and relations among entities at 70-80% accuracy**
  - **Provide gist quality machine translation in multiple languages**
  - **Respond to a simple factual question by returning answers from relevant documents at 75%+ accuracy**

Entity Extraction



Sources: Message Understanding Conference,
Automated Content Extraction Program, Event99, and BioCreative

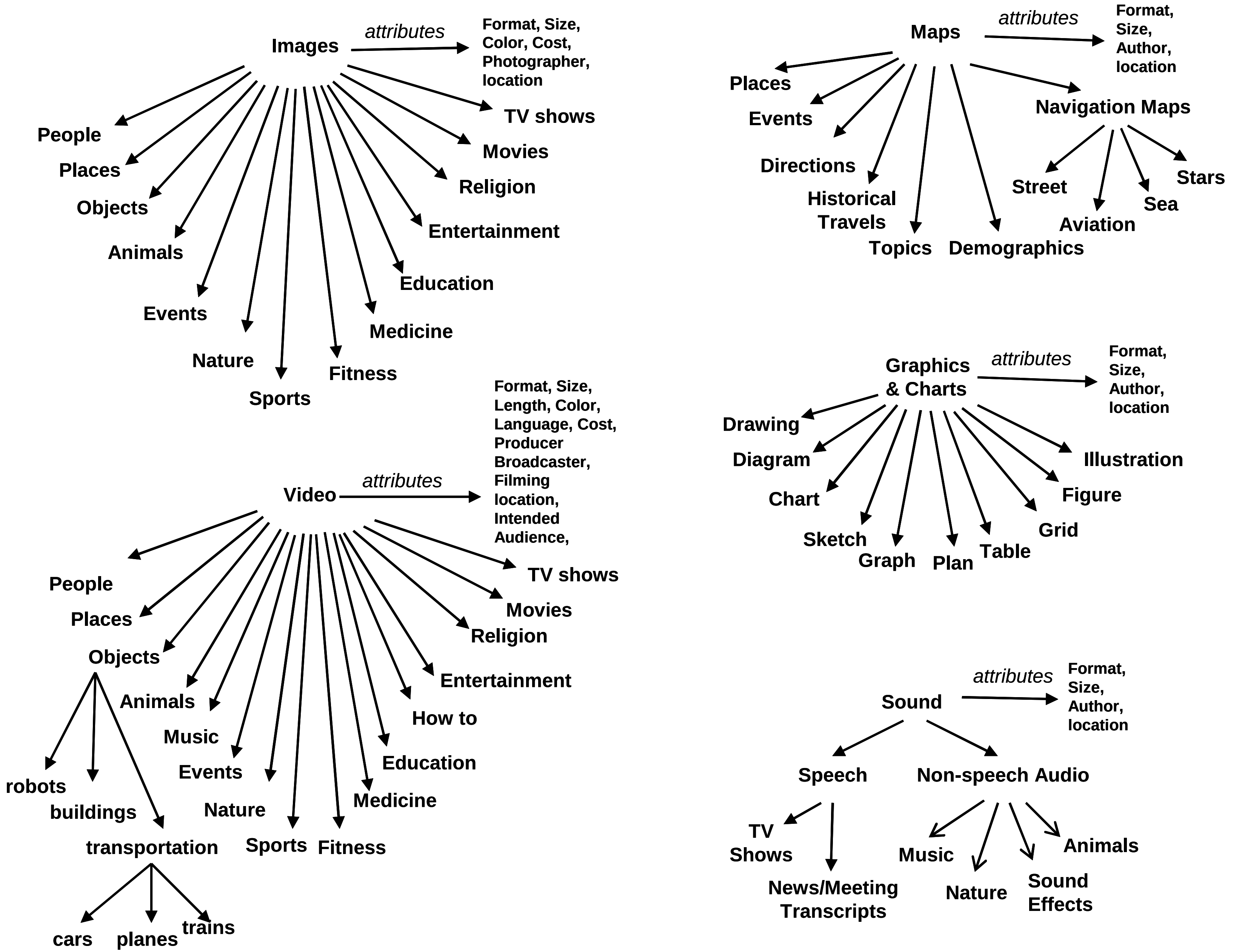
Outline

- Why is ontology hard?
- Why is ontology important?
- Can automation help?
- Future?
- Lessons Learned

Example: Video Queries on the Internet

- 1 Million search engine queries -> 209,496 well formed Qs
- Broad range of media including
  - photographs (of people, places, objects, animals, events)
  - video (of objects, events, shows, music, sports, dance, robots, famous people)
  - maps (of places, topics, events, directions, travels, demographics), special maps (for street navigation, aviation, sea navigation, stars)
- Limited by user expectations
  - e.g., they did not ask questions about broadcast news, surveillance video, UAV, meeting video

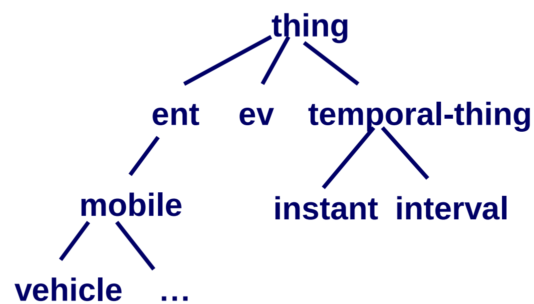
Taxonomy of Multimedia Queries



VEML (Video Event Markup Language) and VERL (Video Event Representation Language)

- VERL includes
  - Entities and events
  - Functions and predicates (e.g., change, cause, enable)
  - Logical operators (and, or, not, imply, equiv)
  - Control structures (sequence, alternation, conditional, repeat-until, do-while)
  - Temporal relations (before, during ,after, meets, overlaps, begins, inside, ends)
  - Subtype
  - Process (single, multi-thread)
- Examples
  - A causes B to change location from C to D:
    - cause(A, change(located-at(B, C), located-at(B, D))
  - X is moved from location from Y to Z:
    - process(move(thing x, ent y, ent z),

      change(located-at(x,y), located-at(x,z)))

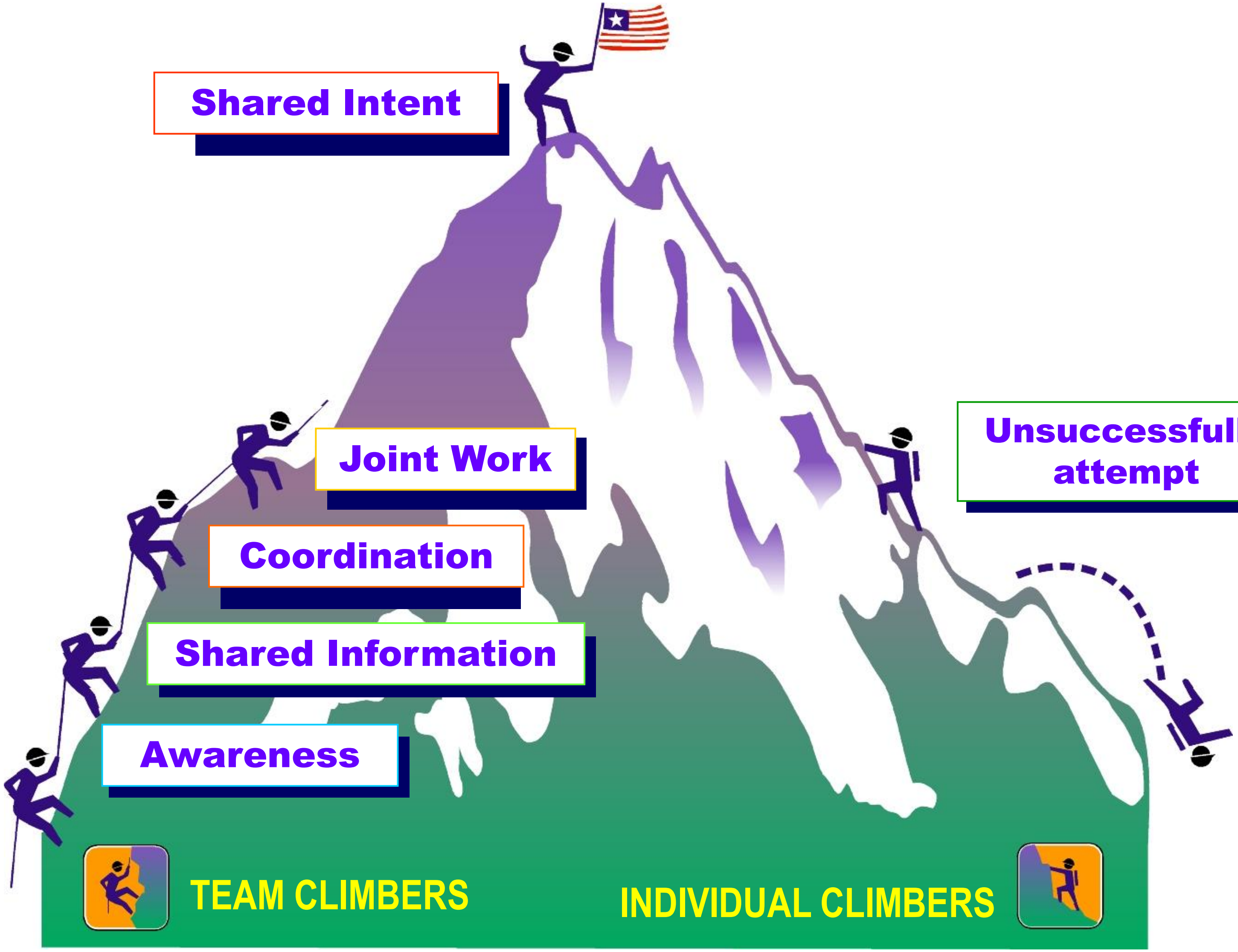


VERL: an ontology framework for representing and annotating video events. Francois, A.R.J.; Nevatia, R.; Hobbs, J.; Bolles, R.C.; Smith, J.R.; Univ of Southern California, Multimedia, IEEE. Oct.-Dec. 2005 12(4): 76 – 86. http://iris.usc.edu/Outlines/papers/2004/nevatia-Ontology_paper.pdf

Some Lessons Learned

- Focus on simple, usable, useful, open solutions
- Employ multidisciplinary teams, iterative staged process, scientific method
- Expect lack of documentation/expertise in legacy applications
- Loose couplers can facilitate integration
- Automation can ease burden of manual data population
- Need to enable incorporation of new data forms (e.g., audio, video) and genre/media (e.g., social media)
- Ontology merging challenging – differing cultures, conceptualizations, purposes, authorities
- Focus on analytic/operational impact

Multiple Levels of Collaboration



References

- DoD Discovery Metadata Standard (DDMS), http://metadata.ces.mil/mdr/irs/DDMS/
- International Association for Ontology and its Applications (IAOA): http://iaoa.org
- Ontology Summit 2011 NIST in Gaithersburg, MD, Apr. 18-19): ontolog.cim3.net/cgi-bin/wiki.pl?OntologySummit2011.

I keep six honest serving-men
(They taught me all I knew);
Their names are What and Why and When
And How and Where and Who.
I send them over land and sea,
I send them east and west;
But after they have worked for me,
I give them all a rest.

Rudyard Kipling
1865-1936

Questions?

Kolas, Dave

GeoSPARQL: Using the SPARQL Query Language for Geospatial Information

The GeoSPARQL Standards Working Group within the Open Geospatial Consortium is currently working to produce a common standard for geospatial query in an RDF/SPARQL context. The goal of the standard is to provide a common language that can be used for Semantic Web knowledge base systems such that spatial reasoning and indexing can be performed.

This talk will first discuss potential uses and applications for GeoSPARQL. Next the technical details of the implementation will be discussed, including the representation of features, geometries, and the spatial relationships between them; functions for spatial calcuations; support for DL-based spatial reasoning; and query rewriting for abstract spatial relationships. Finally the talk will include information about the current status of the working group.

GeoSPARQL: Using the SPARQL Query Language for Geospatial Information

Dave Kolas
Matt Perry & John Herring

ODISSEE Workshop

April 2011

The OGC: Making Location Count

Outline

- Purpose of the Specification
- Scope of Specification
- GeoSPARQL Vocabulary
- GeoSPARQL FILTER Functions
- GeoSPARQL Query Rewrite Rules
- Current Status

OGC®

Purpose of GeoSPARQL

- Many problems for which semantic solutions are relevant have an inherent geospatial context
  - Which hospitals within 20 miles have appropriate treatment centers for my patient?
  - What airports within 50 miles of a mission objective can support a C5?
- In order to efficiently perform geospatial reasoning, special indexing is required
  - We cannot take away the ability to do semantic reasoning though

OGC®

Scope

- GeoSPARQL is a minimal RDF/OWL/SPARQL vocabulary for storage and query of geospatial information
  - Should be able to be easily attached to ontologies with a need for spatial information
  - Represents *only* geometries and the concept of a Feature (a thing with a geometry) and the geospatial relationships between them
- Result: triple store implementations can spatially index information in the vocabulary, and perform spatial reasoning
- GeoSPARQL intends to be:
  - Robust enough to be used for 'serious' geospatial data
  - Simple enough for Linked Open Data

OGC®

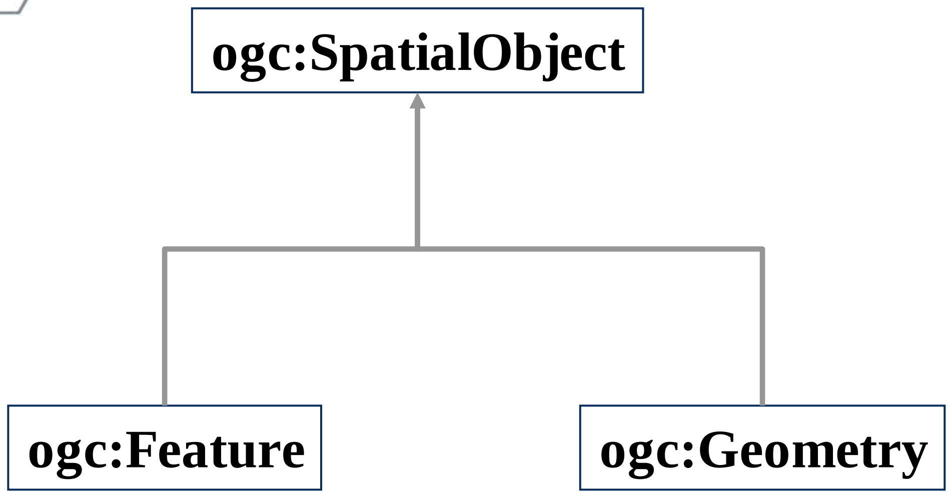
GeoSPARQL

- Uses W3C's SPARQL's extensibility framework
- Contains a shared vocabulary
  - Feature Model and Geometry Model
  - Minimal set of classes and properties supporting triple patterns
- Contains datatypes based on text-based geometry serializations : WKT (augmented for CRS); GML
  - ogc:WKTLiteral, ogc:GMLLiteral, …
  - Different conformance class for each serialization
- Contains shared set of FILTER functions
  - For each Simple Features function
- Contains Query Rewrite Rules for spatial relations between Features — both explicit (triples) and implicit (geometry)

OGC®

GeoSPARQL Vocabulary

Basic Classes



Explicitly typed as OWL classes and RDFS classes to accommodate both types of systems

```
<rdf:Description rdf:about="http://www.opengis.net/rdf#Geometry">
  <rdf:type rdf:resource=
    "http://www.w3.org/2000/01/rdf-schema#Class"/>
  <rdf:type rdf:resource=
    "http://www.w3.org/2002/07/owl#Class"/>
  <rdfs:subClassOf rdf:resource=
    "http://www.opengis.net/rdf#SpatialObject"/>
</rdf:Description>
```

OGC®

Datatype for Geometry Serialization

- Serialization defines the conformance class
- Initially conformance classes for WKT and GML
  - GML is used as-is for ogc:GMLLiteral
  - SRID URI is added for ogc:WKTLiteral

```
<rdfs:Datatype rdf:about=
  "http://www.opengis.net/rdf#WKTLiteral">
  <rdfs:isDefinedBy rdf:resource="http://www.opengis.net/rdf"/>
  <rdfs:label>Well-known Text Literal</rdfs:label>
  <rdfs:comment>
    A Well-known Text serialization of a geometry object.
  </rdfs:comment>
  </rdfs:Class>
```

```
“<http://www.opengis.net/def/crs/EPSG/0/4326>
                           Point(-83.38 33.95)”^^ogc:WKTLiteral
```

OGC®

Why Encode Geometry Data as a Literal?

Advantage: single self-contained unit

Consistent way to select geometry information

Find all water bodies that are within 1 km of Route 3

```
SELECT  ?water ?wWKT
WHERE { ?water      rdf:type             :WaterBody .
        ?water      :hasExactGeometry    ?wGeo .
        ?wGeo       ogc:asWKT            ?wWKT .
        :Route_3    :hasExactGeometry    ?r3Geo .
        :r3Geo      ogc:asWKT            ?r3WKT .
        FILTER(ogcf:distance(?r3WKT, ?wWKT,…) <= 1000)
}
```

Consistent way to pass geometry information around

OGC®

Datatype Properties for ogc:Geometry

- Explicitly typed as owl:DatatypeProperty and rdf:Property
  - ogc:dimension
  - ogc:coordinateDimension
  - ogc:spatialDimension
  - ogc:isEmpty
  - ogc:isSimple
  - ogc:is3D

  - ogc:asWKT
  - ogc:asGML

Only one of these -- based on the conformance class

- Implementations may do both.

OGC®

Object Properties

- Explicitly typed as owl:ObjectProperty and rdf:Property
- Object Properties (domain ogc:Geometry)
  - ogc:srid
- Object Properties (domain ogc:Feature)
  - ogc:hasGeometry (range ogc:Geometry)
  - ogc:defaultGeometry (range ogc:Geometry, subPropertyOf ogc:hasGeoemtry)

OGC®

Object Properties for Spatial Relations

- Domain / Range: ogc:SpatialObject
  - ogc:equals
  - ogc:disjoint
  - ogc:intersects
  - ogc:touches
  - ogc:within
  - ogc:contains
  - ogc:overlaps

Can be explicitly stated or inferred through qualitative spatial reasoning or query expansion/transformation

OGC®

Accommodating Qualitative Spatial Reasoning and Quantitative Geometry-based Computations

Find all water bodies within New Hampshire

```
SELECT ?water
WHERE { ?water  rdf:type     :WaterBody .
        ?water  ogc:within   :NH }
```

Same Query Specification

Qualitative

RCC8 Backward Chaining

Quantitative

```
SELECT ?water
WHERE { ?water  rdf:type     :WaterBody .
        ?water  ogc:defaultGeometry  ?wGeo .
        ?wGeo   ogc:asWKT            ?wWKT .
        :NH     ogc:defaultGeometry  ?nGeo .
        ?nGeo   ogc:asWKT            ?nWKT .
        FILTER(ogcf:relate(?wWKT, ?nWKT,
               ogc:within, :wgs84) }
```

Query Rewrite

Specified with a RIF rule

OGC®

Example Data

Meta Information

```
:Park             rdfs:subClassOf      ogc:Feature .
:Polygon          rdfs:subClassOf      ogc:Geometry .
:exactGeometry    rdfs:subPropertyOf   ogc:hasGeometry .
```

Non-spatial Properties

```
:MinesFallsPark   rdf:type    :Park .
:MinesFallsPark   :opened     "1950-03-01"^^xsd:dateTime .
```

Spatial Properties

```
:MinesFallsPark   :exactGeometry   :geo1 .
:geo1   rdf:type      :Polygon .
:geo1   :srid         <http://www.opengis.net/def/crs/EPSG/0/4326> .
:geo1   ogc:asWKT     "<http://.../4326> Polygon((...))"^^ogc:WKTLiteral .
```

OGC®

GeoSPARQL FILTER Functions

GeoSPARQL FILTER Functions

- **ogcf:relate (geom1: ogc:WKTLiteral, geom2: ogc:WKTLiteral, relation: xsd:anyURI, srid: xsd:anyURI): xsd:boolean**

- **ogcf:distance (geom1: ogc:WKTLiteral, geom2: ogc:WKTLiteral, srid: xsd:anyURI, units: xsd:anyURI): xsd:double**

- **ogcf:buffer (geom: ogc:WKTLiteral, radius: xsd:real, srid: xsd:anyURI, units: xsd:anyURI): ogc:WKTLiteral**

- **ogcf:convexHull (geom1: ogc:WKTLiteral, srid: xsd:anyURI): ogc:WKTLiteral**

- **ogcf:intersection (geom1: ogc:WKTLiteral, geom2: ogc:WKTLiteral, srid: xsd:anyURI): ogc:WKTLiteral**

OGC®

GeoSPARQL FILTER Functions

- `ogcf:union (geom1: ogc:WKTLiteral, geom2: ogc:WKTLiteral, srid: xsd:anyURI): ogc:WKTLiteral`
- `ogcf:difference (geom1: ogc:WKTLiteral, geom2: ogc:WKTLiteral, srid: xsd:anyURI): ogc:WKTLiteral`
- `ogcf:symDifference (geom1: ogc:WKTLiteral, geom2: ogc:WKTLiteral, srid: xsd:anyURI): ogc:WKTLiteral`
- `ogcf:envelope (geom1: ogc:WKTLiteral, srid: xsd:anyURI): ogc:WKTLiteral`
- `ogcf:boundary (geom1: ogc:WKTLiteral, srid: xsd:anyURI): ogc:WKTLiteral`

OGC®

Example Queries

Find all water bodies that are within 1 km of Route 3

```
PREFIX : <http://my.com/appSchema#>
PREFIX ogc: <http://www.opengis.net/rdf#>
PREFIX ogcf: <http://www.opengis.net/rdf/functions#>
PREFIX epsg: <http://www.opengis.net/def/crs/EPSG/0/>

SELECT  ?water ?wWKT
WHERE { ?water      rdf:type             :WaterBody .
        ?water      :exactGeometry       ?wGeo .
        ?wGeo       ogc:asWKT            ?wWKT .
        :Route_3    :exactGeometry       ?r3Geo .
        :r3Geo      ogc:asWKT            ?r3WKT .
        FILTER(ogcf:distance(?r3WKT, ?wWKT,
                             epsg:4326, :km) <= 1000)
}
```

OGC®

Example Queries

Find all land parcels for sale within a constant search polygon

```
PREFIX : <http://my.com/appSchema#>
PREFIX ogc: <http://www.opengis.net/rdf#>
PREFIX ogcf: <http://www.opengis.net/rdf/functions#>
PREFIX epsg: <http://www.opengis.net/def/crs/EPSG/0/>

SELECT  ?parcel
WHERE { ?parcel  rdf:type          :Residential .
        ?parcel  :for_sale         “true”^^xsd:boolean .
        ?parcel  :exactGeometry    ?pGeo .
        ?pGeo    ogc:asWKT         ?pWKT
        FILTER(ogcf:relate(?pWKT,
               “<http://.../EPSG/4326>
                          Polygon((…))”^^ogc:WKTLiteral,
               ogc:within, epsg:4326)) }
```

OGC®

Example Queries

Find all land parcels that are within the intersection of :City1 and :District1

```
PREFIX : <http://my.com/appSchema#>
PREFIX ogc: <http://www.opengis.net/rdf#>
PREFIX ogcf: <http://www.opengis.net/rdf/functions#>
PREFIX epsg: <http://www.opengis.net/def/crs/EPSG/0/>

SELECT  ?parcel
WHERE { ?parcel      rdf:type          :Residential .
        ?parcel      :exactGeometry    ?pGeo .
        ?pGeo        ogc:asWKT         ?pWKT .
        :District1   :exactGeometry    ?dGeo .
        ?dGeo        ogc:asWKT         ?dWKT .
        :City1       :extent           ?cGeo .
        ?cGeo        ogc:asWKT         ?cWKT .
        FILTER(ogcf:relate(?pWKT,
                  ogc:intersection(?dWKT,?cWKT),
                  ogc:within, epsg:4326))}
```

OGC®

GeoSPARQL Query Rewrite Rules

OGC®

Reminder: Motivation for Query Rewrite Rules

Find all water bodies within New Hampshire

```
SELECT ?water
WHERE { ?water   rdf:type       :WaterBody .
        ?water   ogc:within     :NH }
```

Same Query Specification

Qualitative → **RCC8 Backward Chaining**

Quantitative ↓

```
SELECT ?water
WHERE { ?water   rdf:type       :WaterBody .
        ?water   ogc:defaultGeometry      ?wGeo .
        ?wGeo    ogc:asWKT                ?wWKT .
        :NH      ogc:defaultGeometry      ?nGeo .
        ?nGeo    ogc:asWKT                ?nWKT .
        FILTER(ogcf:relate(?wWKT, ?nWKT,
                  ogc:within, :wgs84) }
```

Query Rewrite

Specified with a RIF rule

OGC®

Query Rewrite Rules

- Used to compute Feature-Feature spatial relations based on default geometries
- Specified as a collection of RIF rules
- Example: ogc:equals

```
(Forall ?f1 ?f2 ?g1 ?g2 ?g1Serial ?g2Serial ?gSRID
  (f1[ogc:equals->?f2] :-
    And
      (?f1[ogc:defaultGeometry->?g1]
       ?f2[ogc:defaultGeometry->?g2]
       ?g1[ogc:asWKT->?g1Serial]
       ?g2[ogc:asWKT->?g2Serial]
       ?g1[ogc:srid->?gSRID]
       External(ogcf:equals(?g1Serial,?g2Serial,?gSRID)))
  )
)
```

Conclusions & Future Work

- GeoSPARQL summary
  - Based heavily on Simple Features
  - Small RDF/OWL vocabulary
  - Datatypes for geometry literals
  - Set of FILTER functions
  - Set of query transformation rules
- Future work beyond GeoSPARQL spec
  - Define new conformance classes based on serializations
    - KML, GeoJSON
  - Define OWL axioms for qualitative spatial reasoning
    - ogc:within rdf:type owl:TransitiveProperty
  - Define standard methodology for (virtually) converting legacy feature data represented using the general feature model to RDF

OGC®

Current Working Group Status

- Currently putting the final touches on the documents and conformance classes
- The GeoSPARQL SWG plans to release a candidate standard for public comment mid 2011 (May or June)

Questions?

Craighill, Patricia

Next Generation Air Transporation System (NextGen) NetCentric Operations

Headquarters U.S. Air Force

Integrity - Service - Excellence

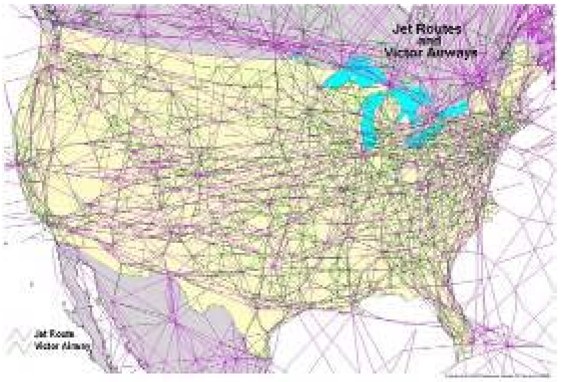
Next Generation Air Transportation System (NextGen) NetCentric Operations Draft April 5, 2011

Patricia Craighill
SAF/A6A

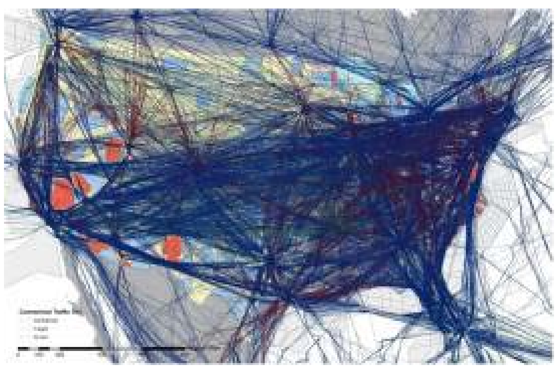
U.S. AIR FORCE

U.S. AIR FORCE

What is NEXTGEN?



1950 Design



2003 Congestion

Transforms the US National Aviation System to ensure the 2025 system meets national safety, security, mobility, efficiency, and capacity needs

Takes advantage of new technology for Communication, Navigation and Positioning

Allows for negotiated flightpaths/trajectories, dynamic re-planning, incorporation of weather and other considerations in flight planning and execution, and flexible ground operations

Makes information available to public and private sector stakeholders for improved air domain awareness and enhanced decision-making for homeland security and commercial application.

U.S. AIR FORCE

NEXTGEN Mandates

NEXTGEN enjoys Congressional, White House and Interagency commitment and support

- **VISION 100** – Century of Aviation Reauthorization Act” (P.L. 108-176) (2003)
  - Chartered JPDO, JPDO Board, Senior Policy Committee
- **28 Dec 07 DEPSECDEF Memo**
  - Designated AF as Lead Service for NEXTGEN
- **June 08 Interagency MOU - align plans/programs**
- **July 08 Senior Policy Committee**
  - SECAF pledged Net Centric Support-NCO Division
- **18 Nov 08 Exec Order:** Transformation of National Air Transportation System
  - SECDEF shall assist SECTRANS so that NEXTGEN meets defense needs

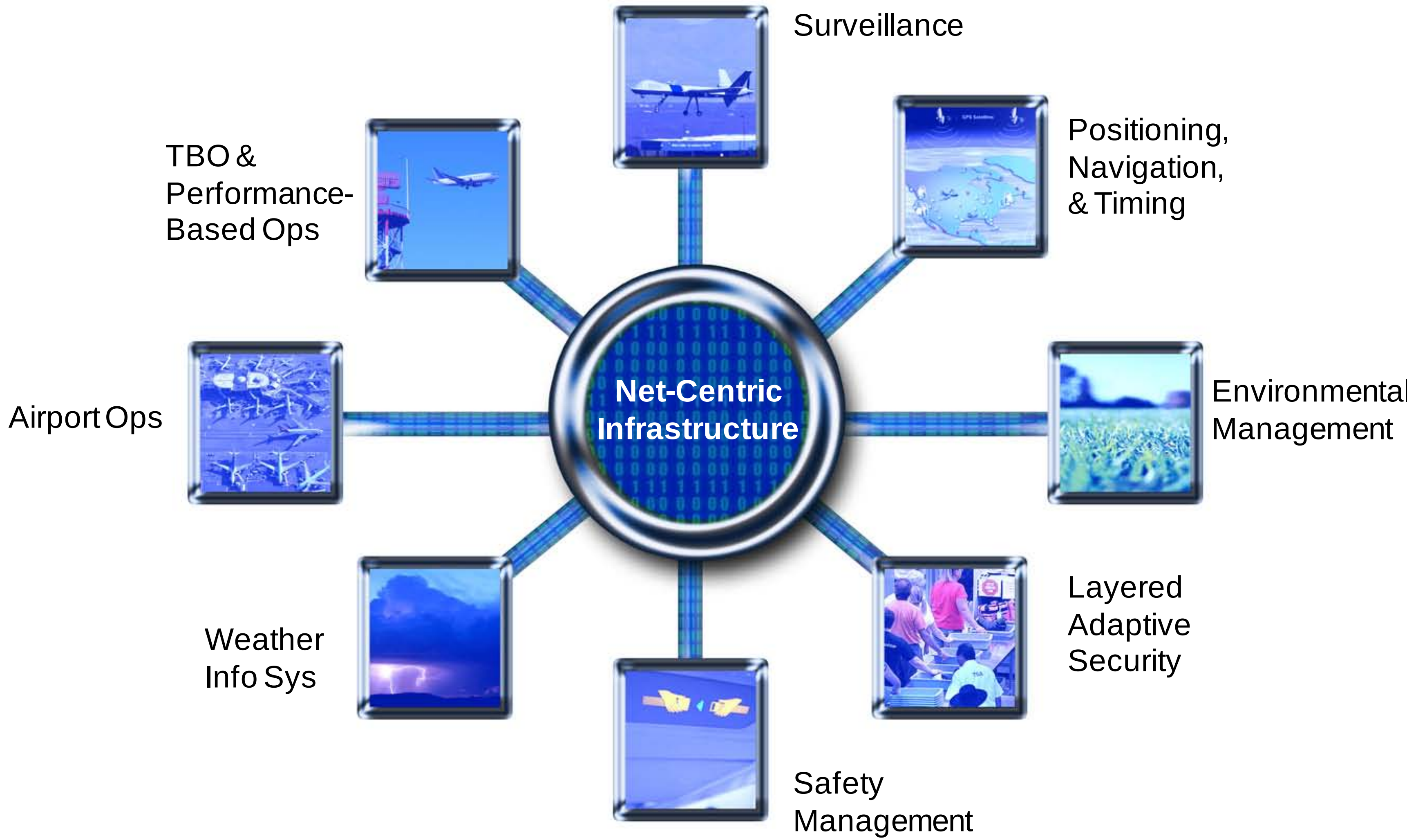
3

U.S. AIR FORCE

NextGen Transforms…

From…	To…
Ground-based Navigation and Surveillance	Aircraft Centric and Performance Based Navigation and Surveillance
Voice Radio Control	Digital Data Exchange
Disconnected Information Systems	Net Centric Information Access
Human-centric Air Traffic Control	Automation Assisted Air Traffic Management
Fragmented Weather Forecasting	Probabilistic Weather Decision Tools
Visibility Limited Airfield Operations	Equivalent Visual Operations
Forensic Safety System	Prognostic Safety System
Inefficient Security Screening	Integrated Security Risk Management
Current Aircraft Environmental Footprint	Reduced Aircraft Environmental Footprint

NextGen Architecture



NCO Division Mission

Facilitate the implementation of net-centric capabilities for NextGen among the partner agencies and serving the community at large.

Implementation

We do this by coordinating investment and development in network-enabled technologies, supporting proofs-of-concept, establishing a collaborative environment for test and experimentation, promoting the use of net-centric principles, coordinating the establishment of policy and standards, and assisting in transition of developmental efforts to operational capabilities.

Information Exchange Architecture, Process, Ontology	Network Infrastructure	Demonstration Capability	Experimentation and Measurement
Outreach			

Solving Shared Challenges

- Cross-domain info sharing
  - Security Domains and Community Domains (Intel, Law Enforcement, DOD, Privacy)
  - Dynamic roles/authorities
- Sensor fusion/intel sharing/integrated C2
- Interagency ID management/trust model/C&A management
- SOA Maturity
  - Federated Registry—for data and services
  - Management and sustainment of COIs
  - Configuration Mgmt
  - Acquisition changes
- Collaborative workspace usage for research and development
  - Social Networking tools for operational use
  - Taking advantage of industry R&D, shared vetting of vendor solutions
- Aerial Networking and other communications issues

U.S. AIR FORCE

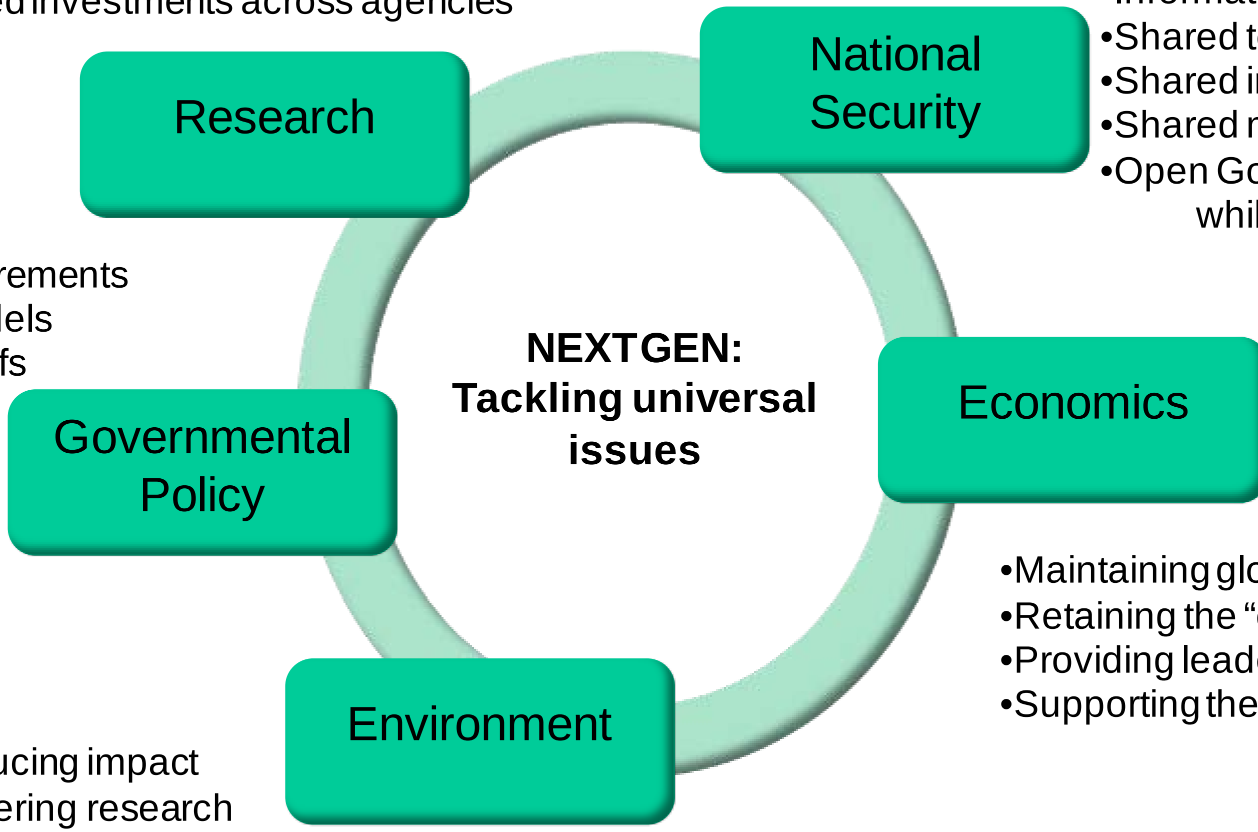
On the National Agenda

Challenges solved here will benefit sectors across the nation

- Technology transfer
- Coordinated investments across agencies

- Information sharing policy
- Shared technical issues
- Shared investment
- Shared mission
- Open Government Policy while protecting data

- Governance
- Multi-agency requirements
- New business models
- Investment tradeoffs
- Acquisition reform
- Open Government



- Maintaining global stature
- Retaining the "edge"
- Providing leadership
- Supporting the whole economy

- Reducing impact
- Fostering research
- Setting global example

Vizenor, Lowell

UCore-SL: An Overview and Some Suggested Improvements

The Universal Core (UCore) is a central element of the National Information Sharing Strategy that is supported by multiple U.S. Federal Government Departments, by the intelligence community, and by a number of other national and international institutions. The goal of the UCore initiative is to foster information sharing by means of an XML schema providing consensus representations for four groups of universally understood terms under the headings who, what, when, and where. UCore Semantic Layer (UCore SL) is a project to create an ontology-based supporting layer for UCore, entitled 'Universal Core Semantic Layer' (UCore SL), and describe how UCore SL can be applied to further UCore's information sharing goals. This presentation will provide an overview of UCore SL and recommend a number of structural improvements to UCore SL.

ALION
SCIENCE AND TECHNOLOGY
Aligned with your needs.

Universal Core Semantic Layer: An Overview and Suggested Improvements

Lowell Vizenor, PhD
Ontology and Semantic Technology Practice Lead
Alion Science and Technology

ODISSEE 2011 | Washington, DC | April 13, 2011

Overview

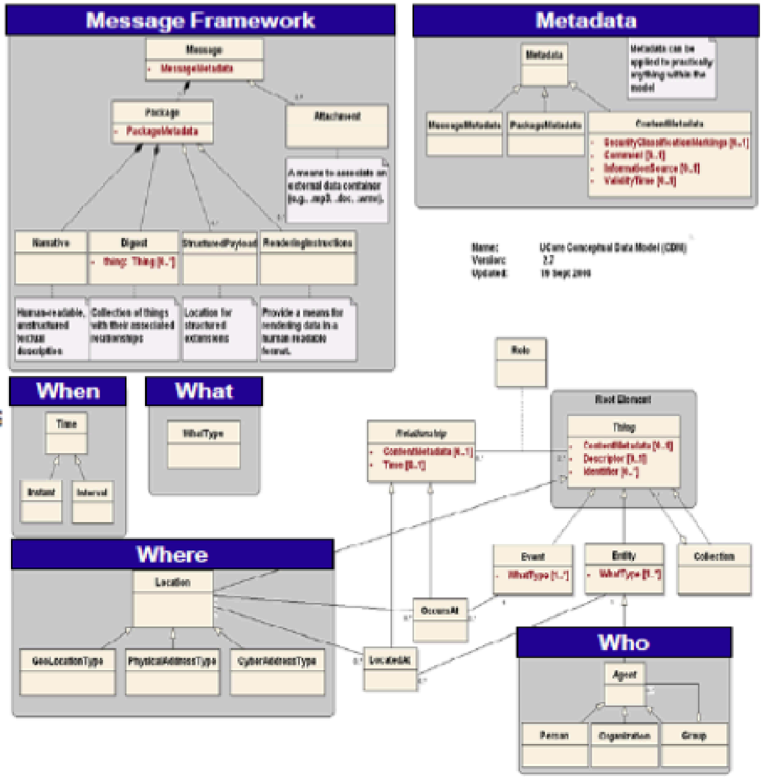
- UCore 2.0
- Overview of UCore 2.0 Taxonomy
- Overview of UCore SL
- UCore SL 1.1

What is the Universal Core (UCore)?

An information exchange specification and Implementation profile

- Vocabulary
  - Of most commonly exchanged concepts: Who, What, When, Where
- XML representation of the concepts
- Guidance for extension to permit tailoring to specific mission areas
- Security markings to permit controlled access electronic tear lines
- Messaging framework to package and unpackage the content consistently

UCore V2.0 Conceptual Data Model



UCore is Common Point of Departure

UCore 2.0

- UCore enables information sharing by defining an implementable specification (XML Schema) containing agreed upon representations for the most commonly shared and universally understood concepts of who, what, when, and where
- UCore artifacts will transition to the Defense Information Systems Agency's (DISA) Software.Forge.mil website on 15 March 2011. (*Common Access Card (CAC) will be required.*)

UCore 2.0 Taxonomy

- uc:Entity
  - uc:Cargo
  - uc:CollectionOfThings
  - uc:CyberAgent
  - uc:Document
  - uc:Environment
  - uc:Equipment
  - uc:Facility
  - uc:FinancialInstrument
  - uc:GeographicFeature
  - uc:GroupOfOrganizations
  - uc:GroupOfPersons
  - uc:InformationSource
  - uc:Infrastructure
  - uc:LivingThing
    - uc:Animal
      - uc:Person
    - uc:MicroOrganism
    - uc:Plant
  - uc:Organization
  - uc:PoliticalEntity
  - uc:Sensor
  - uc:Vehicle
    - uc:Aircraft
    - uc:GroundVehicle
    - uc:Spacecraft
    - uc:Watercraft

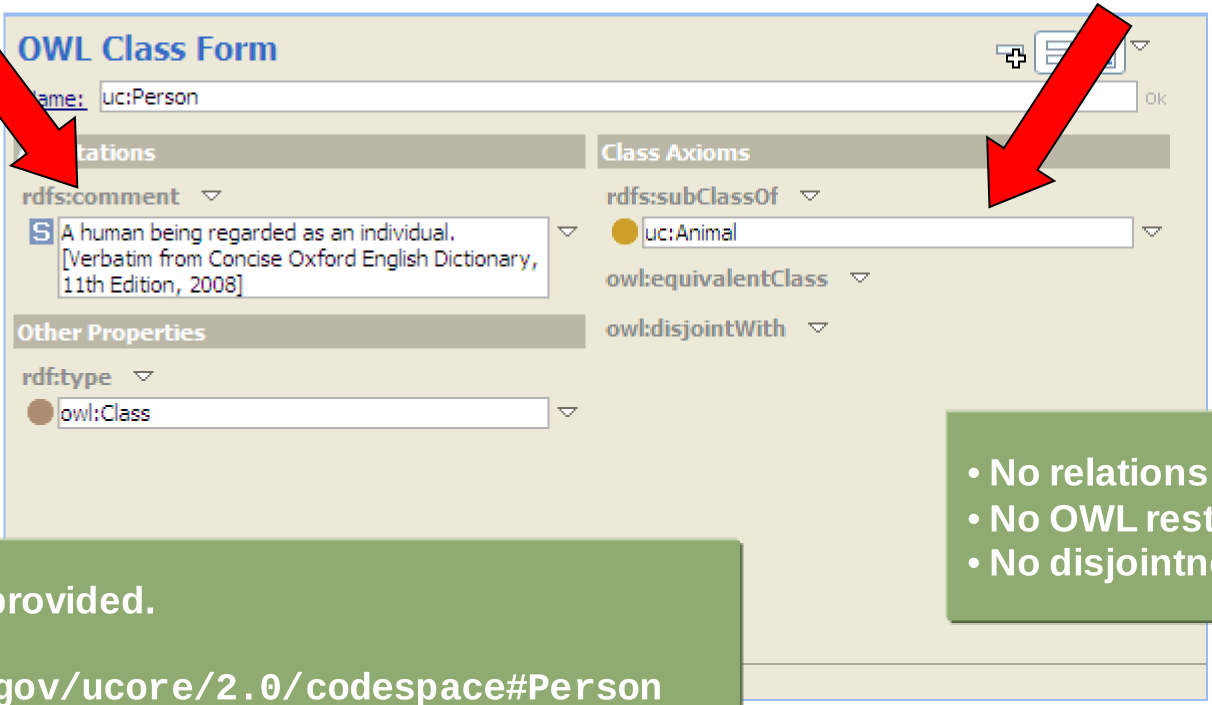
- uc:Event
  - uc:AlertEvent
  - uc:CommunicationEvent
  - uc:CriminalEvent
  - uc:CyberSpaceEvent
  - uc:DisasterEvent
  - uc:EconomicEvent
  - uc:EmergencyEvent
  - uc:EnvironmentalEvent
  - uc:EvacuationEvent
  - uc:ExerciseEvent
  - uc:FinancialEvent
  - uc:HazardousEvent
  - uc:HumanitarianAssistanceEvent
  - uc:InfrastructureEvent
  - uc:LawEnforcementEvent
  - uc:MigrationEvent
  - uc:MilitaryEvent
  - uc:NaturalEvent
  - uc:ObservationEvent
  - uc:PlannedEvent
  - uc:PoliticalEvent
  - uc:PublicHealthEvent
  - uc:SecurityEvent
  - uc:SocialEvent
  - uc:TerroristEvent
  - uc:TransportationEvent
  - uc:WeatherEvent

- 55 classes (no relations)
- Flat taxonomy
- Intentionally weak semantics
- Answers the “What” and the “Who” of UCore Messages
- Does not address the “When” and “Where” directly
- Adequate for message routing, indexing and metadata purpose

UCore 2.0 Taxonomy

Definition derived from the Oxford English Dictionary

Specifies where the term fits into the taxonomy



- **No relations**
- **No OWL restrictions**
- **No disjointness axioms**

NOTE: No label provided.

`http://ucore.gov/ucore/2.0/codespace#Person`

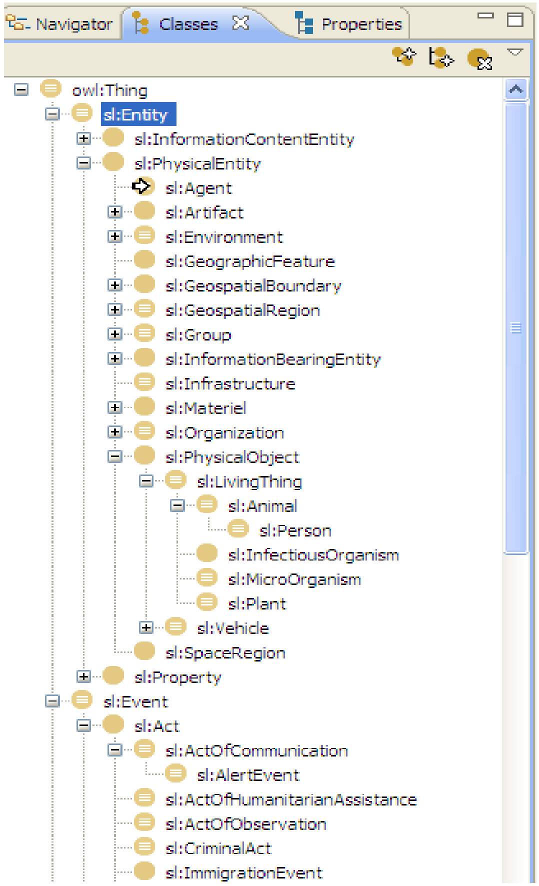
UCore SL

- An incremental strategy for achieving semantic interoperability
- Leaves UCore 2.0 as is, but provides a logical definition for each term in UCore 2.0 taxonomy and for each UCore 2.0 relation
- UCore SL is designed to work behind the scenes in UCore 2.0 application environments as a logical supplement to the UCore messaging standard

UCore SL History / Team / Acknowledgements

- Taxonomy Tiger Team prior to release of UCore 2.0
- U.S. Army Net-Centric Data Strategy Center of Excellence / Army CIO/G-6 (Lead and sponsor)
- National Center for Ontological Research (NCOR) (Developer)

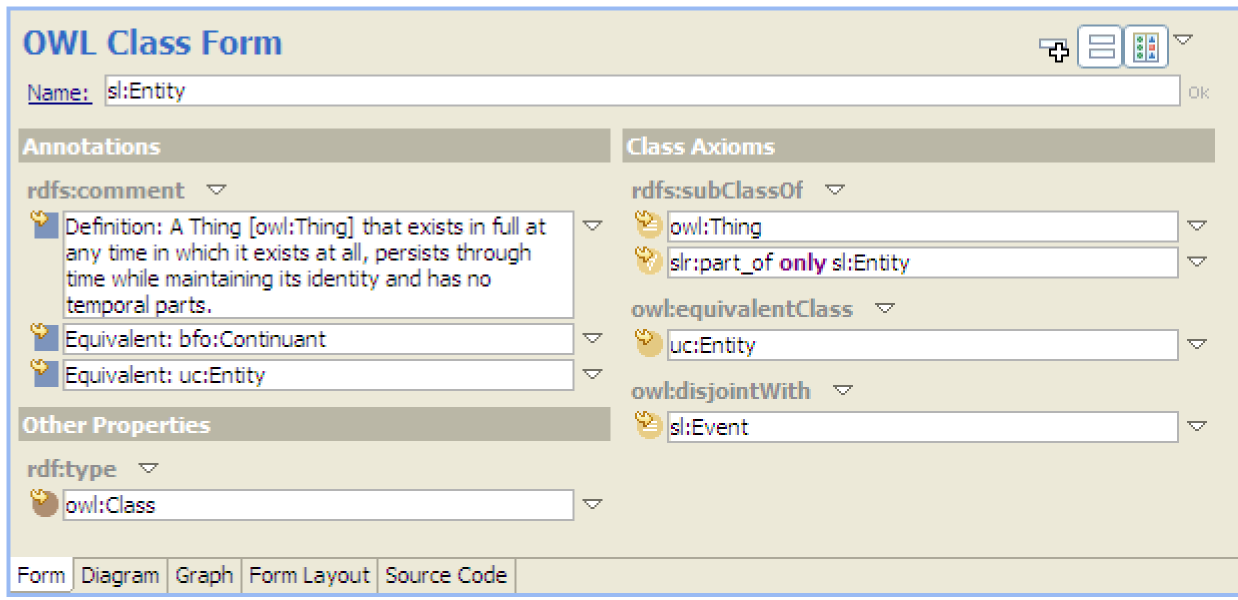
UCore SL

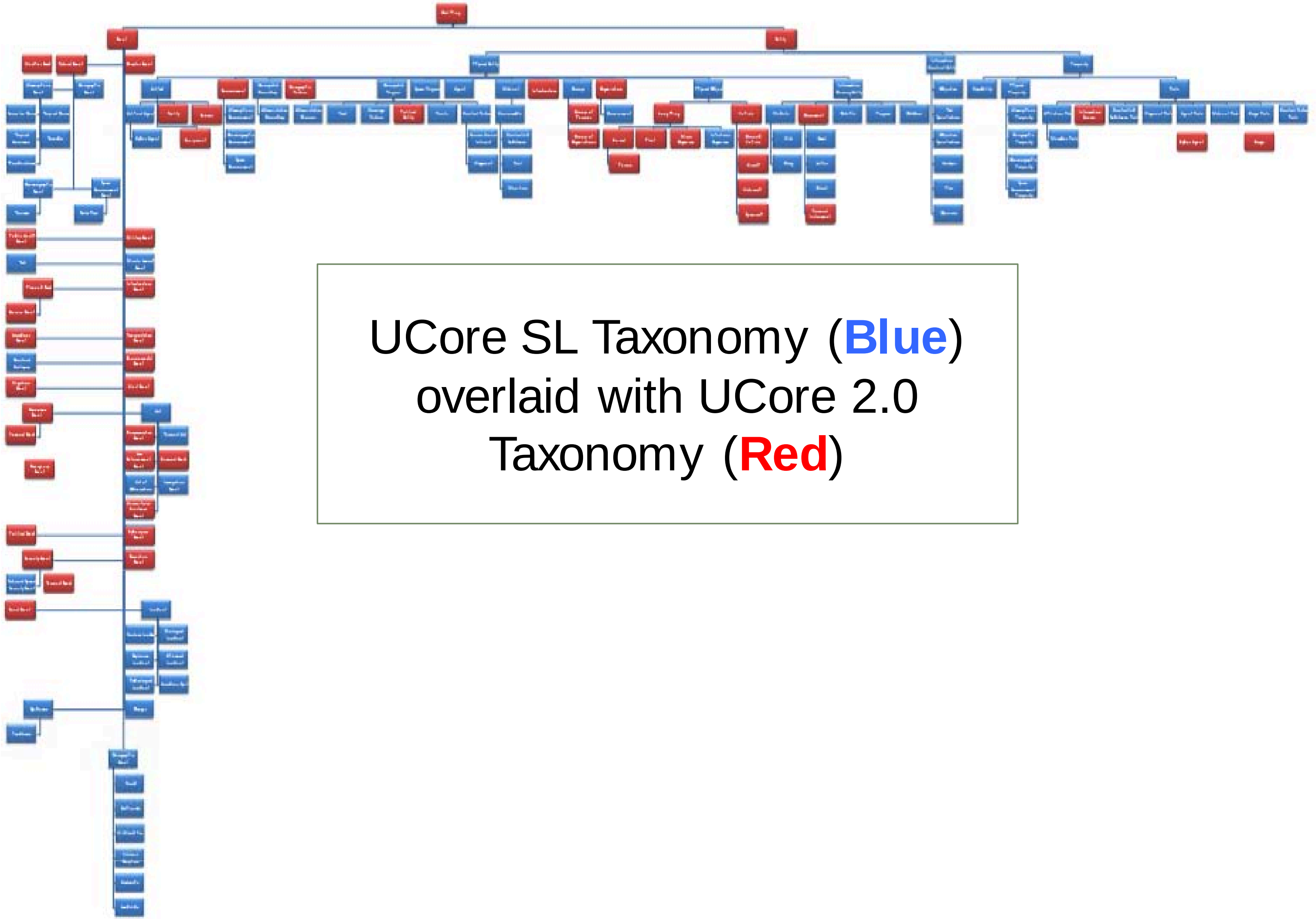


155 Classes
16 Relations
Logical Definitions

Class Axioms
- **Equivalence**
- **Restrictions**
- **Disjointness**

Hybrid between an upper level ontology and a universal core vocabulary





UCore SL Taxonomy (**Blue**) overlaid with UCore 2.0 Taxonomy (**Red**)

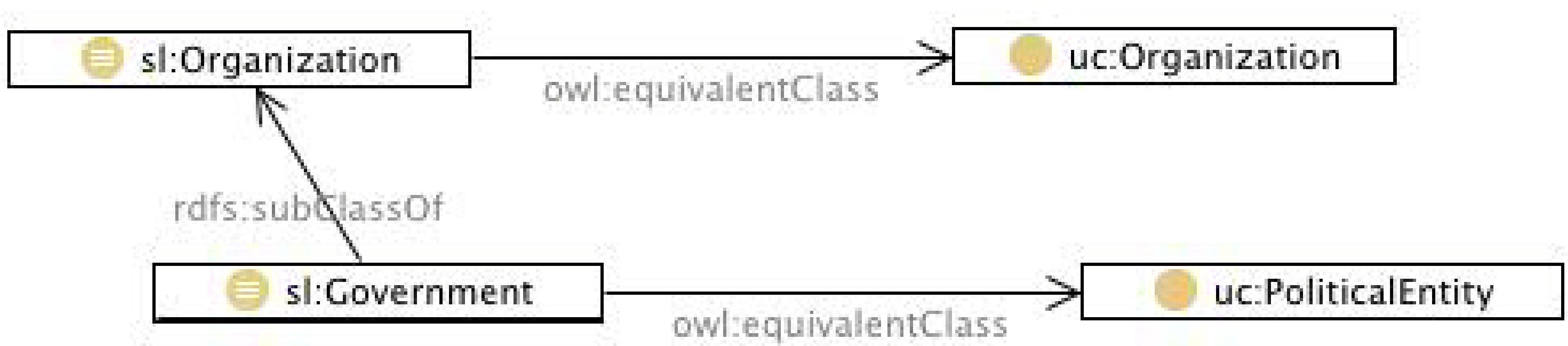
Logical Definitions

sl:Government: An Organization with political responsibility for governing in a specified GeospatialRegion

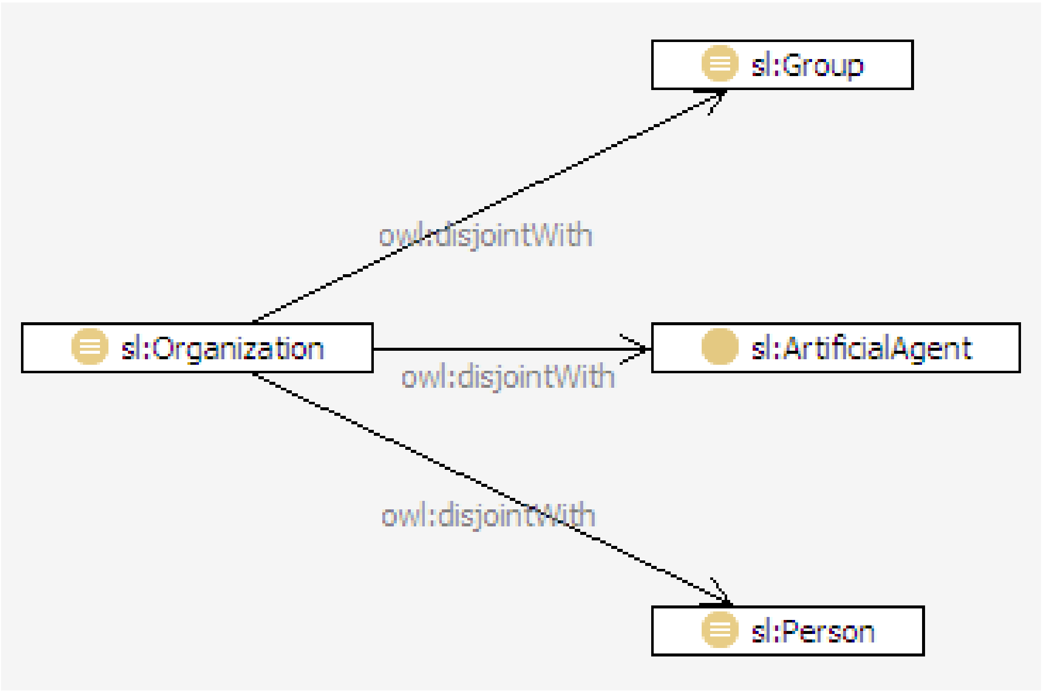
Logical Definition

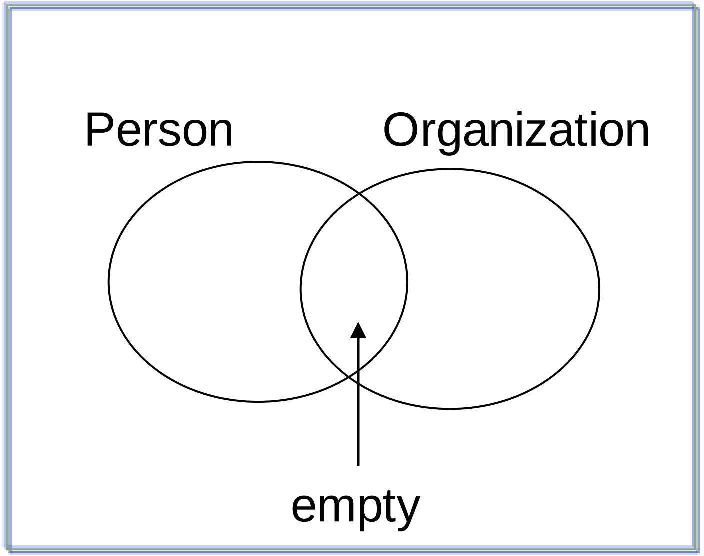
uc:PoliticalEntity: An organized governing body with political responsibility in a given geographic region. [Derived from Concise Oxford English Dictionary, 11th Edition, 2008]

Dictionary Definition



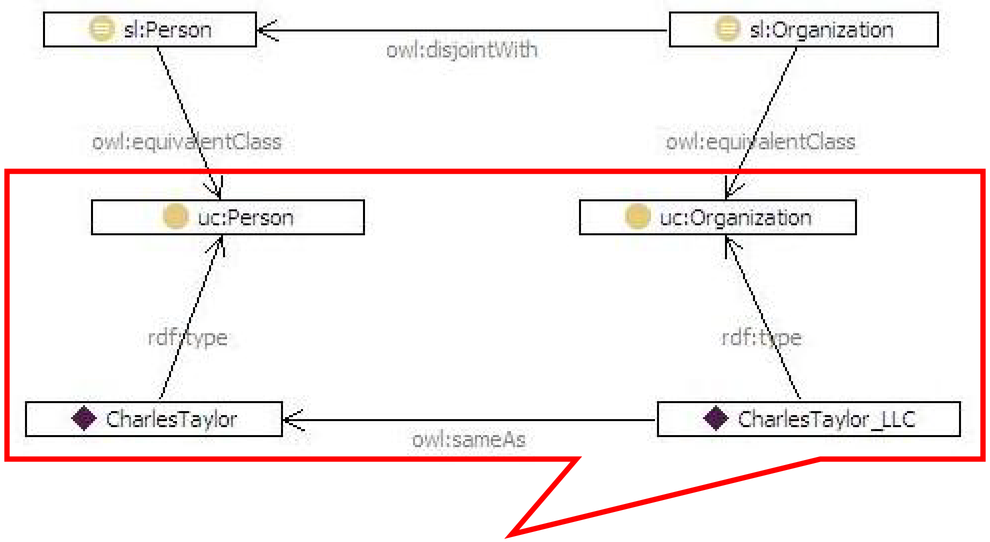
Disjointness Axioms





Provides Additional Logical Resources

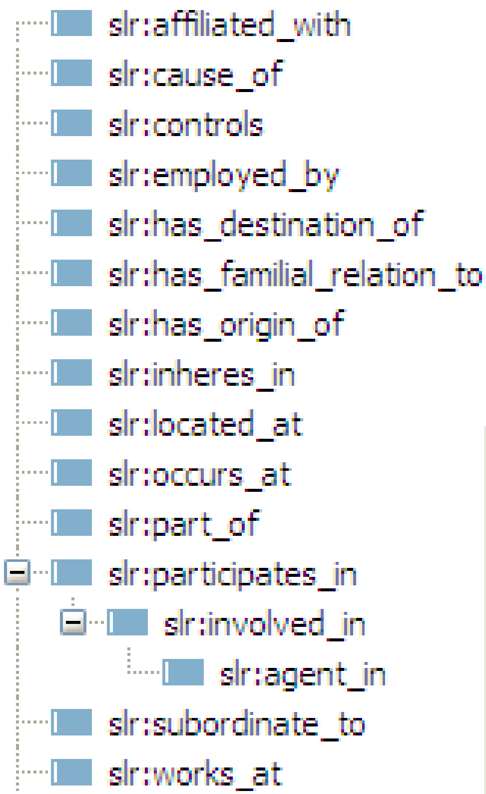
Using UCore SL as a supporting layer makes it possible to identify that something cannot be both a Person and an Organization



Logically speaking, UCore 2.0 is too weak to detect simple inconsistencies.

Chart by Barry Smith, Director, National Center for Ontological Research, phismith@buffalo.edu.

UCore SL Relations



- 16 Relations
- Derived from UCore XML schema
- ?x agent_in ?y => ?x involved_in ?y

UCore SL Relations

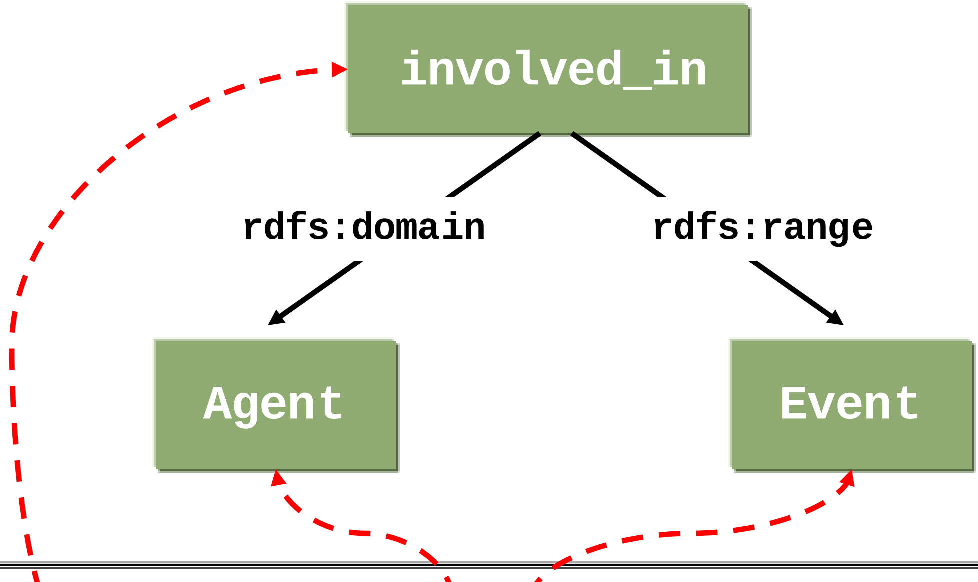
```
<!--:::RELATIONSHIP ELEMENTS-->
<xs:element name="AffiliatedWith" type="ucore:ThingThingRelationshipType" substitutionGroup="ucore:RelationshipAbstract">
    <xs:annotation>
        <xs:documentation>Oxford (derived): attached or connected with. closely associated with.</xs:documentation>
    </xs:annotation>
</xs:element>
<xs:element name="CauseOf" type="ucore:CauseOfRelationshipType" substitutionGroup="ucore:Rel
    <xs:annotation>
        <xs:documentation>Oxford: be the cause of; make happen.</xs:documentation>
    </xs:annotation>
</xs:element>
<xs:element name="Controls" type="ucore:AgentEntityRelationshipType" substitutionGroup="ucor
    <xs:annotation>
        <xs:documentation>Oxford: have control or command of.</xs:documentation>
    </xs:annotation>
</xs:element>
<xs:element name="DistinctFrom" type="ucore:ThingThingRelationshipType" substitutionGroup="uc
    <xs:annotation>
        <xs:documentation>Oxford: recognizably different or individual.</xs:documentation>
    </xs:annotation>
</xs:element>
<xs:element name="EmployedBy" type="ucore:PersonAgentRelationshipType" substitutionGroup="uc
    <xs:annotation>
        <xs:documentation>Oxford: give work to (someone) and pay them for it.</xs:documentat
    </xs:annotation>
</xs:element>
<xs:element name="HasDestinationOf" type="ucore:EntityLocationRelationshipType" substitutio
    <xs:annotation>
        <xs:documentation>Oxford (derived): the location to which an entity is going or bei
    </xs:annotation>
</xs:element>
<xs:element name="HasFamilialRelationTo" type="ucore:PersonPersonRelationshipType" substitutio
    <xs:annotation>
        <xs:documentation>Oxford (derived): a person who is related to another by birth or by marriage.</xs:documentation>
    </xs:annotation>
</xs:element>
<xs:element name="HasOriginOf" type="ucore:EntityLocationRelationshipType" substitutionGroup="ucore:RelationshipAbstract">
    <xs:annotation>
        <xs:documentation>Oxford (derived): the location where an entity begins or arises.</xs:documentation>
    </xs:annotation>
</xs:element>
<xs:element name="InvolvedIn" type="ucore:AgentEventRelationshipType" substitutionGroup="ucore:RelationshipAbstract">
    <xs:annotation>
        <xs:documentation>Oxford (derived): to experience or participate in an activity or situation.</xs:documentation>
    </xs:annotation>
</xs:element>
```

Most UCore SL Relations derived from the UCore XML Schema

The Relation Ontology

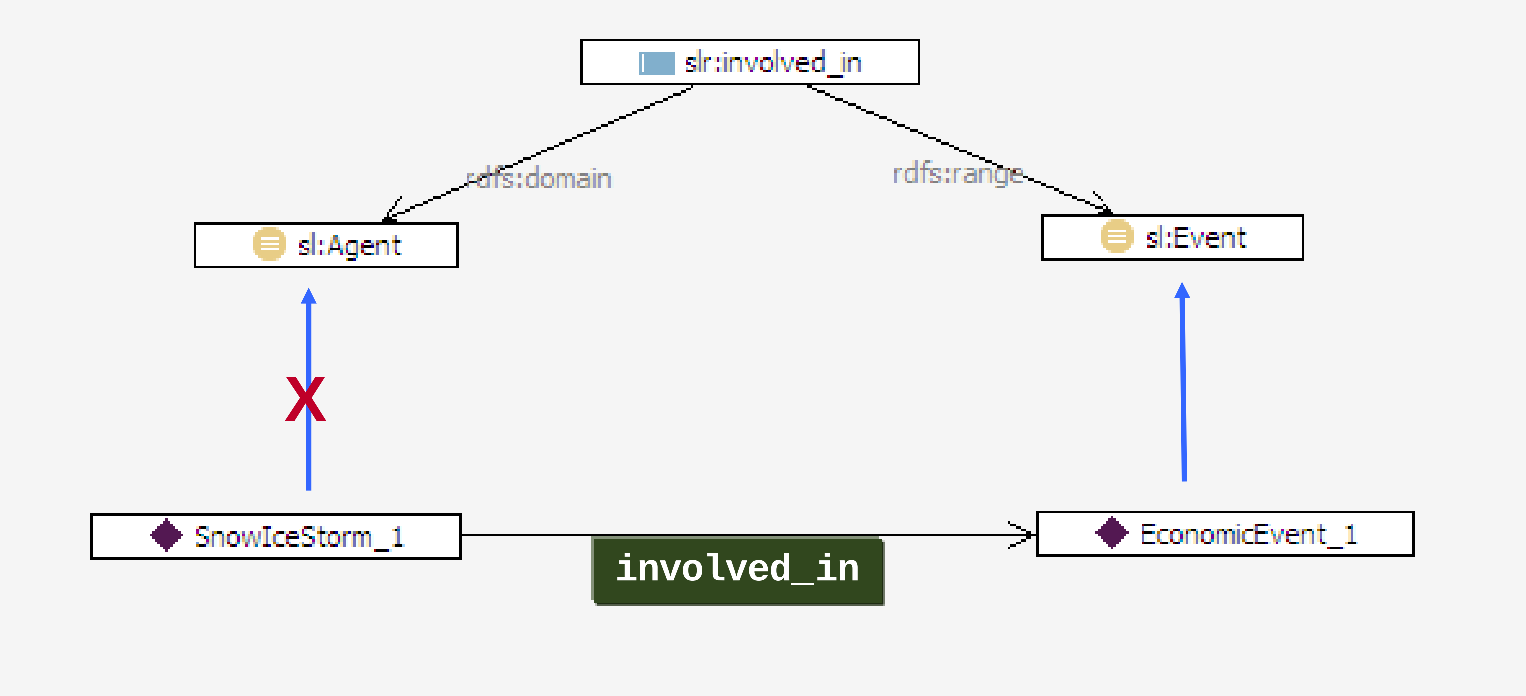
OBO Relation Ontology

UCore SL Relations

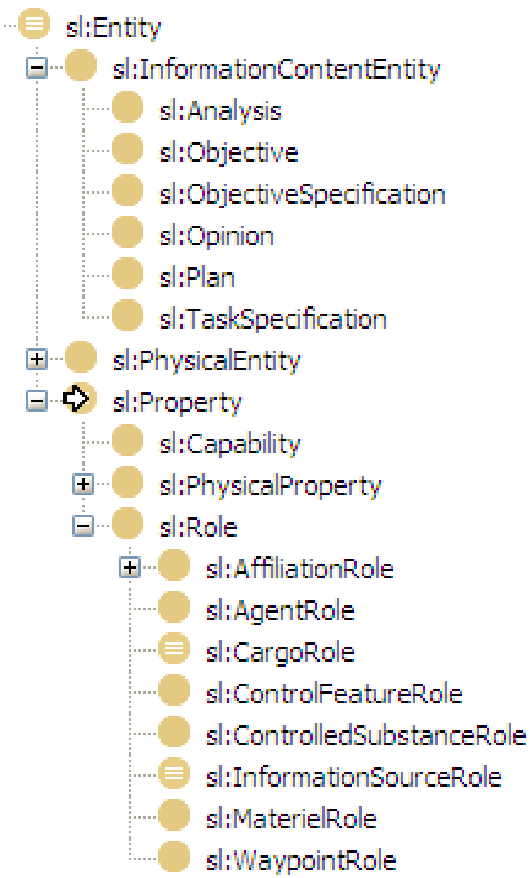


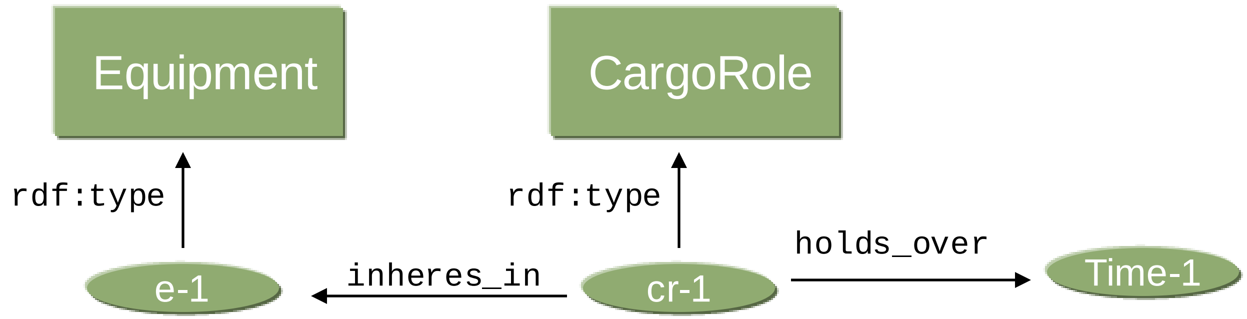

```
<xs:element name="InvolvedIn" type="ucore:AgentEventRelationshipType" substitutionGroup="ucore:RelationshipAbstract">
    <xs:annotation>
        <xs:documentation>Oxford (derived): to experience or participate in an activity or situation.</xs:documentation>
    </xs:annotation>
</xs:element>
```

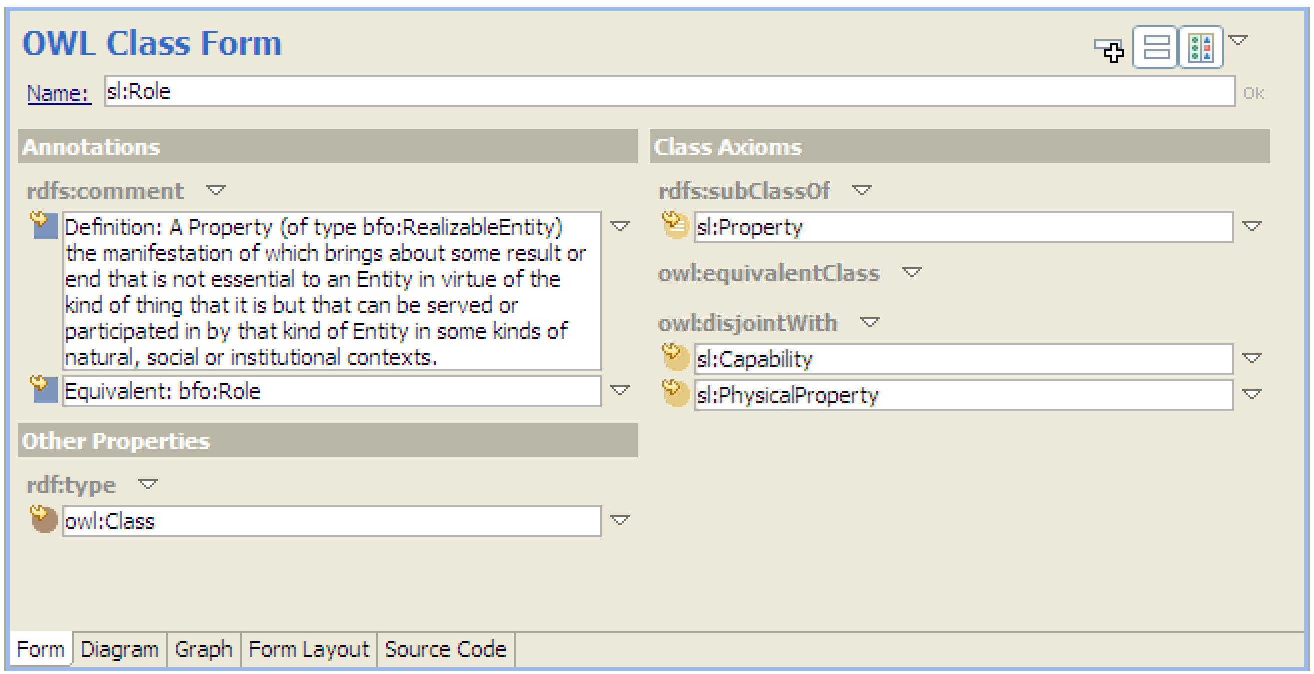
Note on Reasoning with Domain and Ranges



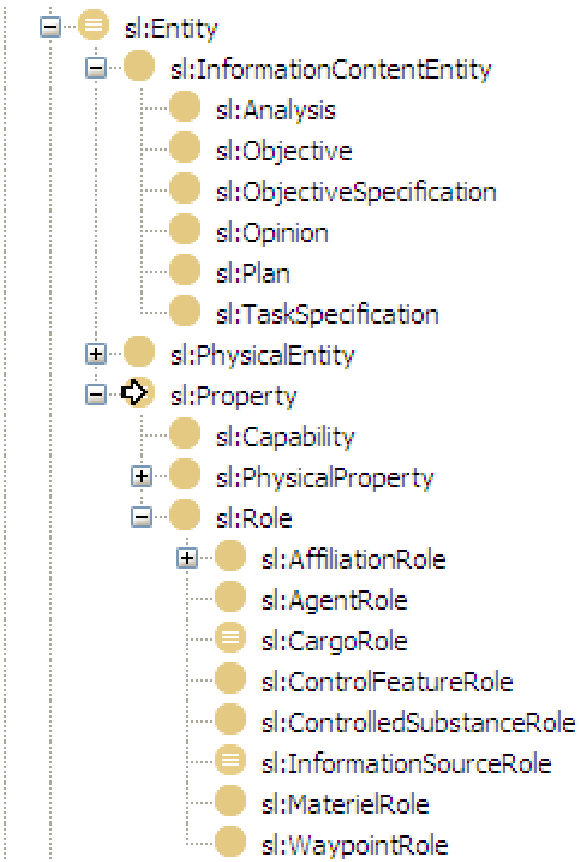
Roles


sl:Entity
sl:InformationContentEntity
sl:Analysis
sl:Objective
sl:ObjectiveSpecification
sl:Opinion
sl:Plan
sl:TaskSpecification
sl:PhysicalEntity
sl:Property
sl:Capability
sl:PhysicalProperty
sl:Role
sl:AffiliationRole
sl:AgentRole
sl:CargoRole
sl:ControlFeatureRole
sl:ControlledSubstanceRole
sl:InformationSourceRole
sl:MaterielRole
sl:WaypointRole


Equipment
CargoRole
rdf:type
rdf:type
holds_over
inheres_in
e-1
cr-1
Time-1

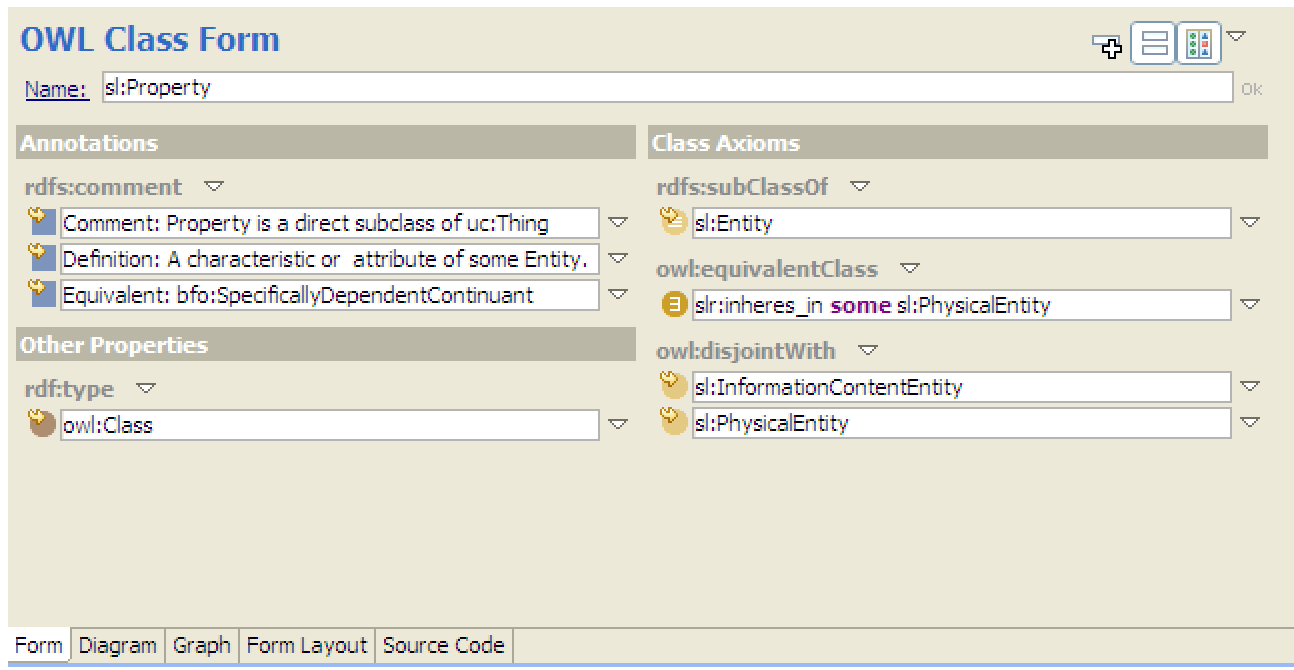

OWL Class Form
Name: sl:Role
OK
Annotations
rdfs:comment
Definition: A Property (of type bfo:RealizableEntity) the manifestation of which brings about some result or end that is not essential to an Entity in virtue of the kind of thing that it is but that can be served or participated in by that kind of Entity in some kinds of natural, social or institutional contexts.
Equivalent: bfo:Role
Other Properties
rdf:type
owl:Class
Class Axioms
rdfs:subClassOf
sl:Property
owl:equivalentClass
owl:disjointWith
sl:Capability
sl:PhysicalProperty
Form
Diagram
Graph
Form Layout
Source Code

Properties (or attributes)

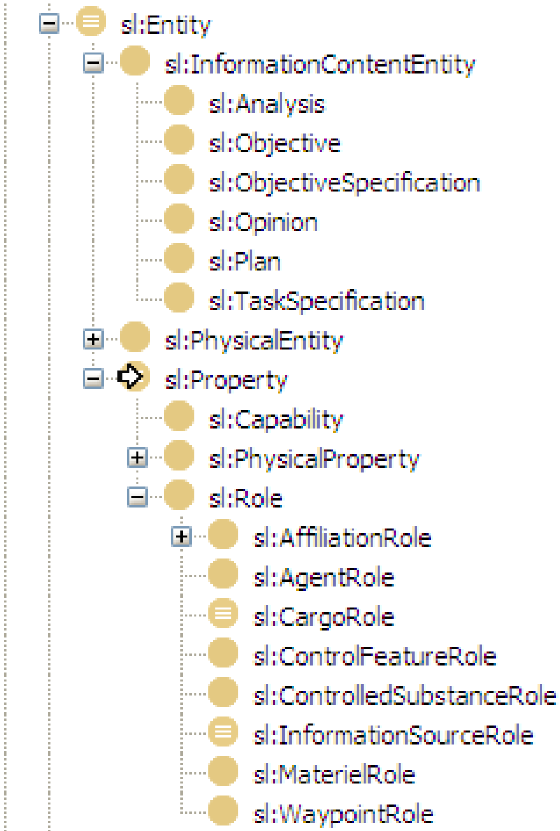


Sex, Age, Height, Weight, etc.

Diseases and Symptoms (biosurveillance)

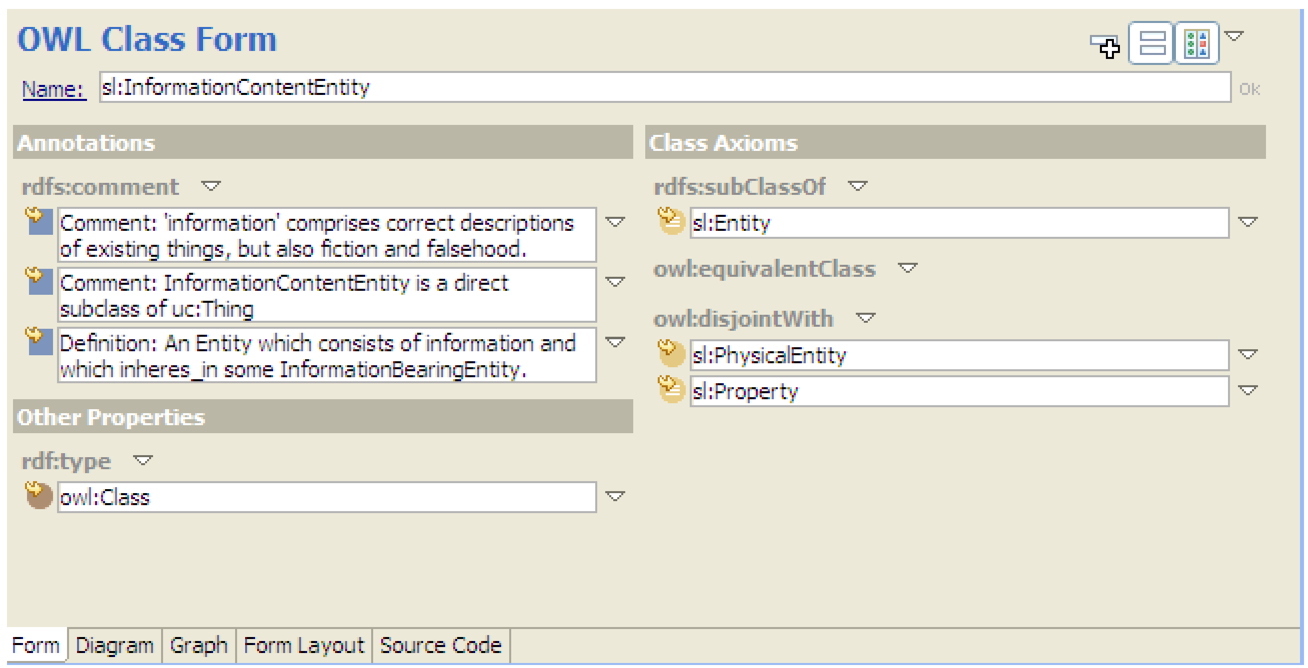


Information Content Entity



Classify Identifiers, Codes, Names, etc.

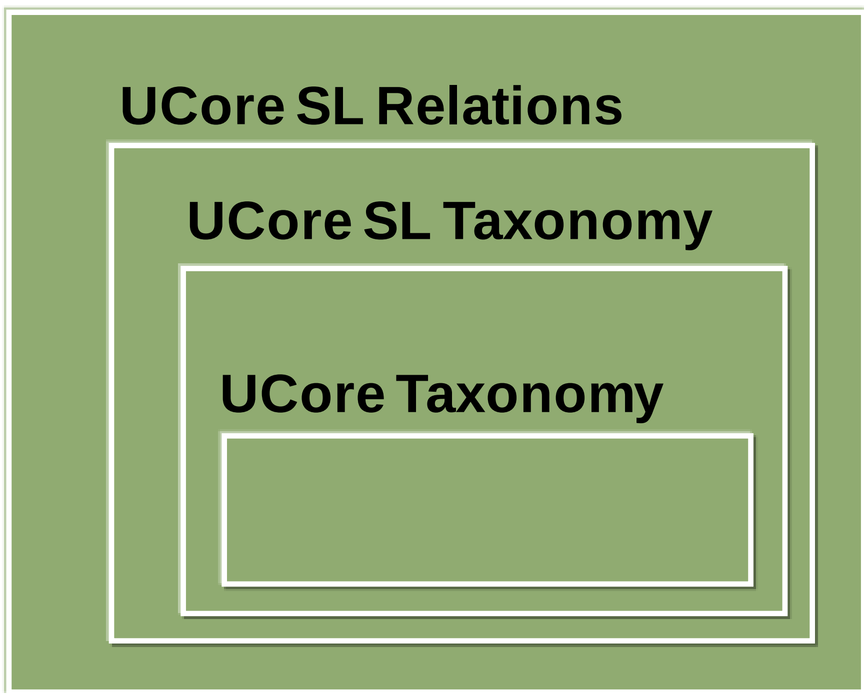
Classify Information



UCore SL 1.1

UCore SL 1.0

UCore SL Imports

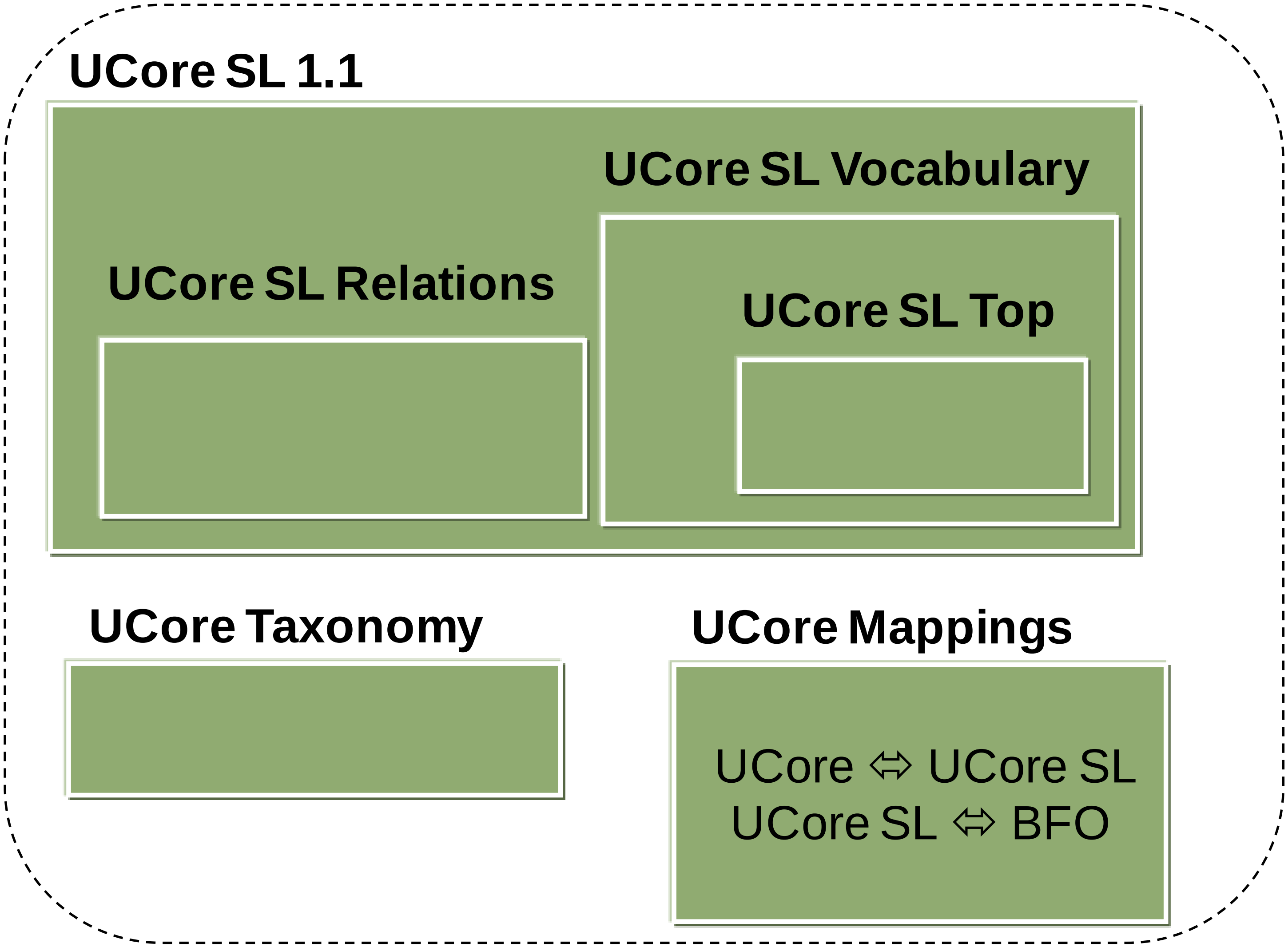


- UCore SL namespaces
  - http://UCore-SL-Taxonomy-OWL-DL#
- Typographical errors
- Change sl:Property to sl:Attribute
- Explicit mappings
- UCore SL Import Structure
  - Dependent on UCore Taxonomy

UCore SL Top

- Entity
  - InformationContentEntity
  - PhysicalEntity
  - Attribute
- Event
  - Act

UCore SL 1.1.


UCore SL 1.1
UCore SL Vocabulary
UCore SL Relations
UCore SL Top
UCore Taxonomy
UCore Mappings
UCore ⇔ UCore SL
UCore SL ⇔ BFO

Conclusion

- UCore SL Users Group
  - https://www.kc.army.mil/book/groups/ucore-sl-user-group
  - Looking to move UCore SL User Group to the NextGen Ontology Portal
- Barry Smith, Lowell Vizenor and James Schoening. *Universal Core Semantic Layer*. Proceedings of Ontology for the Intelligence Community 2009, CEUR Workshop Proceedings, vol. 555.

Guiton, Mark

Large-scale data analysis – 'The Missing Gap': The exponential growth of large-scale data sets and the proliferation of data silos is presenting a growing data analysis challenge to organizations around the world. Recently, semantic technologies have made significant strides toward making large-scale data integration, integrated query solutions and other complex data analytics more tractable. However, this new capability is pushing the limits of current hardware technology to such an extent that many analytics problems cannot perform on today's architectures at scale. For many large-scale semantic knowledgebase applications, particularly ones that involve complex queries and/or complex inferencing, the lack of performance becomes a critical issue. This presentation will describe an alternative hardware architecture designed for these classes of problems – the Cray XMT. The Cray XMT is a highly scalable large shared memory system with characteristics that also include: massive multithreading, fine grained word level synchronization and memory latency hiding mechanisms.

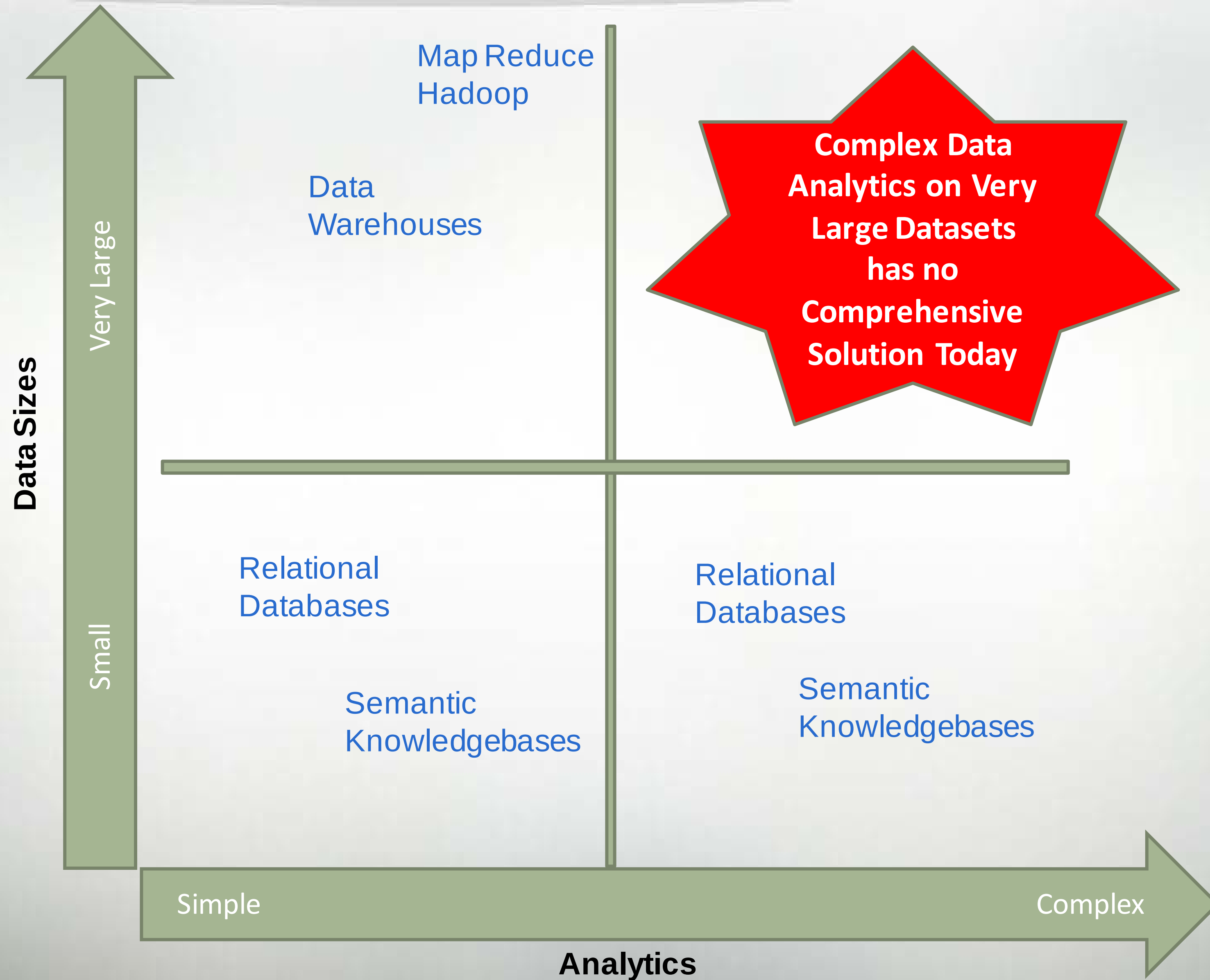
Large-Scale Data Analysis – "The Missing Gap"

12 April 2011

Mark Guiton
Director, Government Programs
mguiton@cray.com

CRAY
THE SUPERCOMPUTER COMPANY

Current Missing Data Analytics Gap



Current Challenges

- ***Average Fortune 100 company has thousands of databases (silos)***
- ***~20% have data stores in the 1-10 Terabyte range***
- ***Data stores are growing 2x every 12-18 months***

Data Integration/Access Challenge

- ✓ *How can I get access to all the data that I really need?*

Knowledge Discovery/Data Analytics Challenge

- ✓ *How can I get better insight from information?*

Ease of Use/Cost Challenge

- ✓ *How can I get better access and analytics that I really need?*
  - Faster
  - Cheaper
  - Easier

Example Query (HIGHFLEET)

- "Are there any Iranian Bahai doing business in opium sometime in February 2003 with other Iranians (their names) whose relatives have spent time in Afghanistan and those relatives are supporters of the Taliban?"

  - This query does a LOT of deductive inference, temporal reasoning, qualitative geography, and event reasoning. All in one query.

Benefits of Semantic Technology

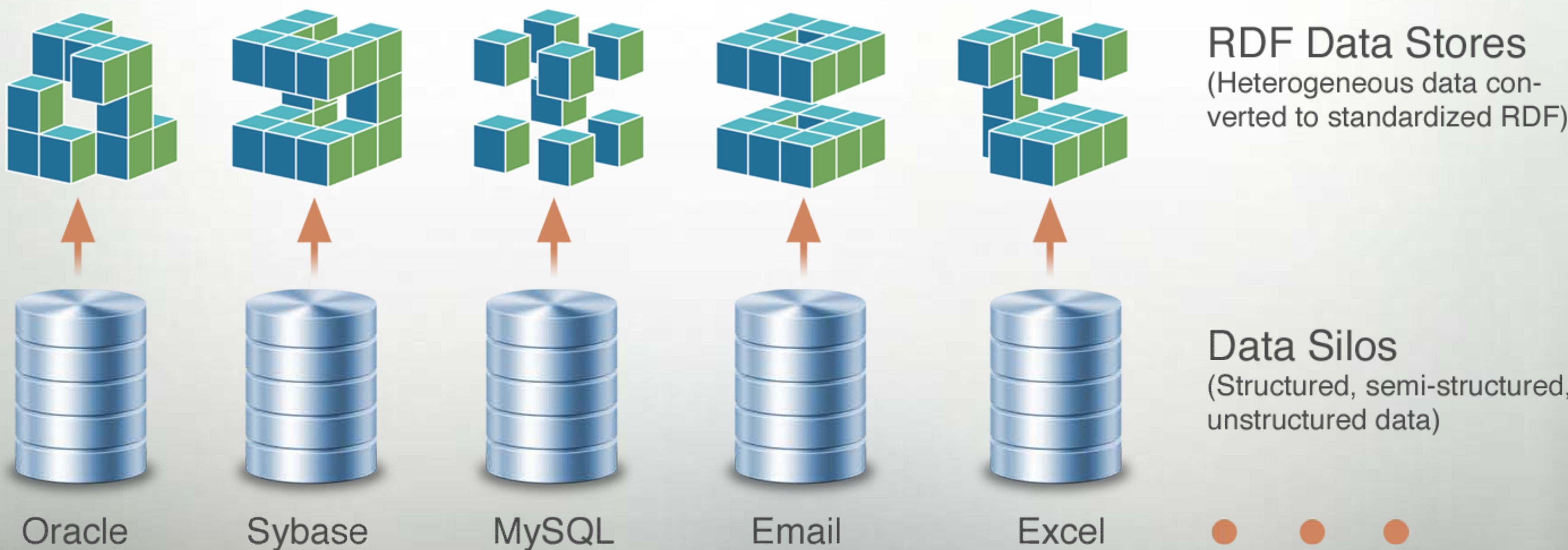
- ***1) Data Integration***
  - Comprehensive (virtual) view of your data
  - Easy interoperability with internal and external data sources
  - Standardized technologies
  - Meaning and relationships

- ***2) Knowledge Discovery/Data Analytics***
  - Richer, more intelligent analysis
  - Interactive analytics
  - Automates Reasoning

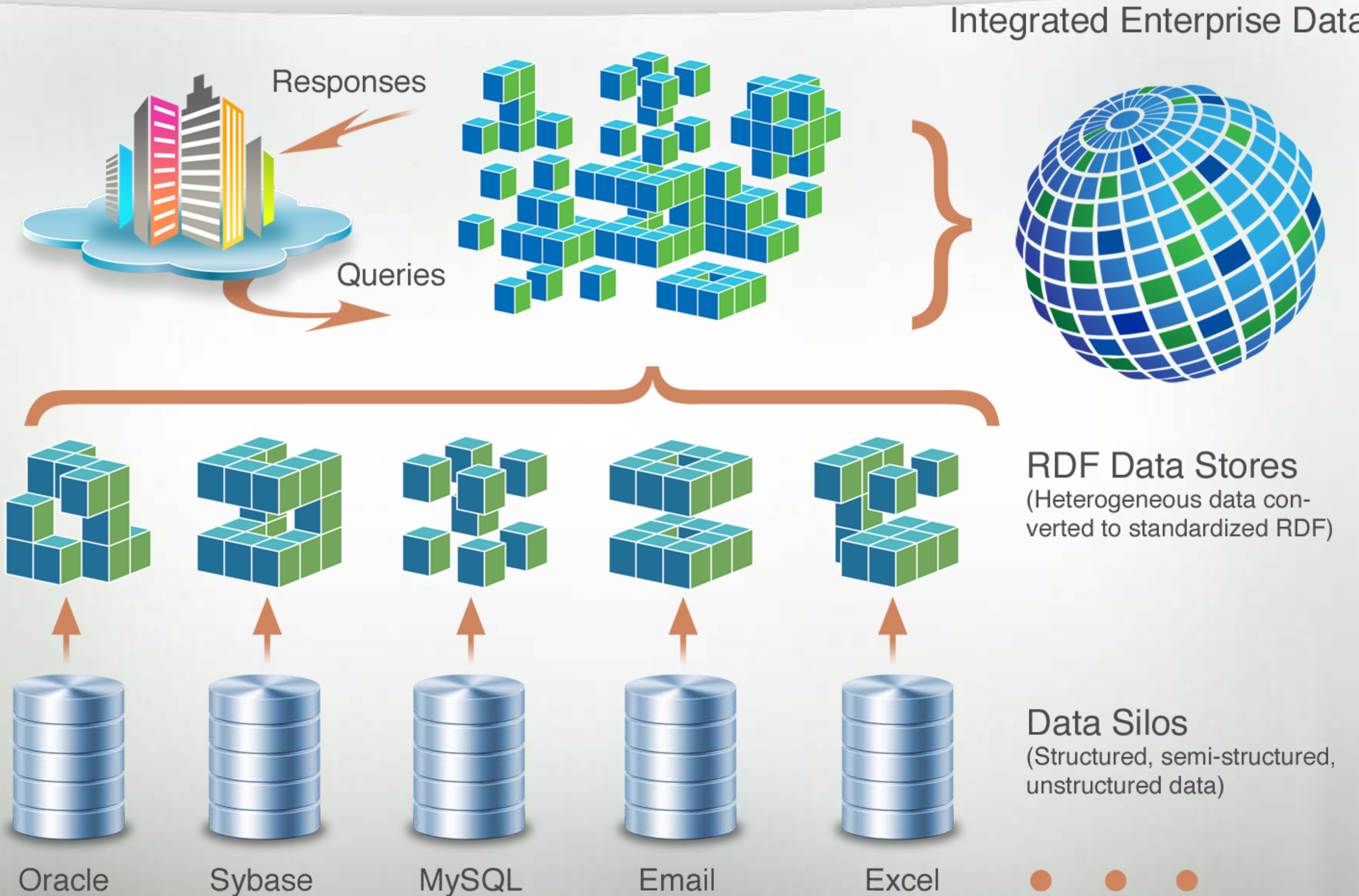
- ***3) Productivity/Fexibility***
  - Complements existing IT
  - Fosters collaboration
  - Highly Adaptable to Change
  - Dramatically Faster Time to Solution
  - More robust, flexible and understandable applications

Proposed General Purpose Solution

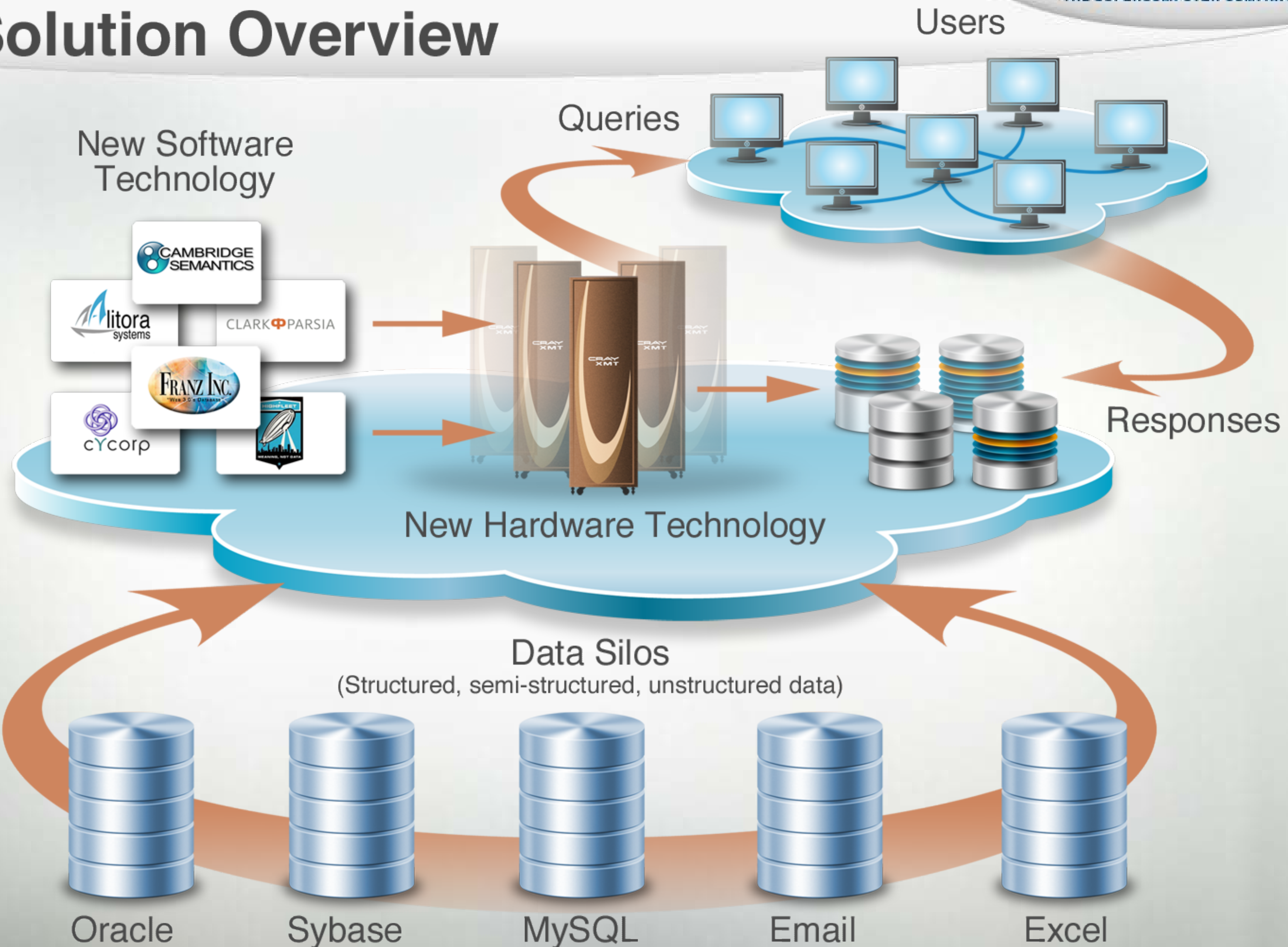
Proposed General Purpose Solution



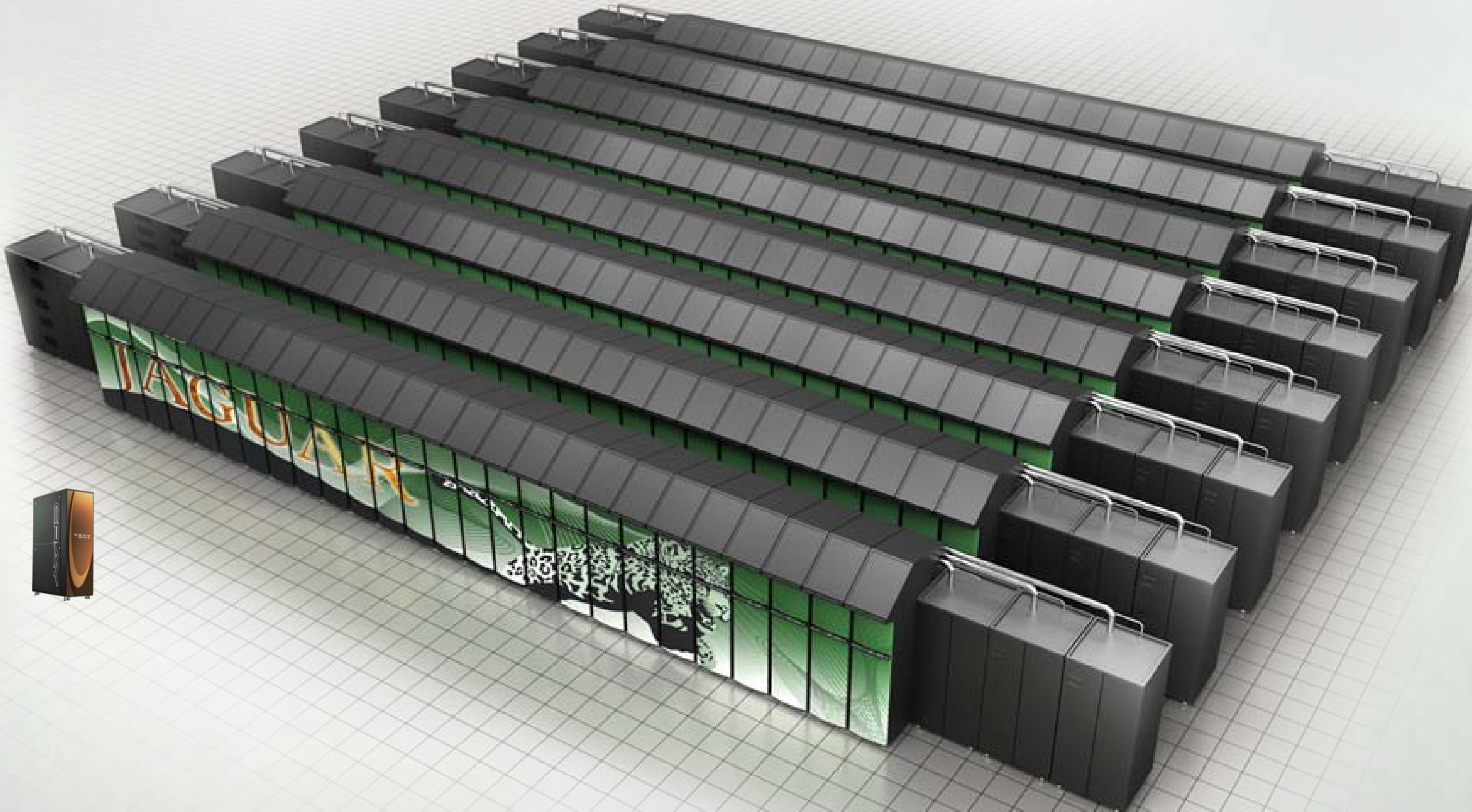
Typical Enterprise



Solution Overview



Dispelling Preconceptions



Enabling Next Generation Data Analytics

New Hardware Technology

❖ Cray XMT

- Excels at Data Intensive Computing

❖ Characteristics

- Very large shared memory
  - 128TB
- Extreme multithreading
  - 128 hardware threads per processor
  - Practically unlimited virtual threads
- Fine Grained Synchronization
- Very low power
  - 30 watt processors
- Ease of use
- Superior price/performance
- Semantic Database
  - Software Product Integration Layer
  - 10s to 100s of times better average performance on analytics

Cray XMT Processing Efficiency

- **Today's HPC systems support one reference**
  - Every 3 ticks (L1 cache)
  - Every 30 ticks (L2 cache)
  - Every 150 ticks (local memory)
  - Every few thousand ticks (non-local memory, solid state storage)
  - Every few million ticks (Disk)

- **Cray XMT**
  - 1 tick to every remote memory reference with enough thread parallelism

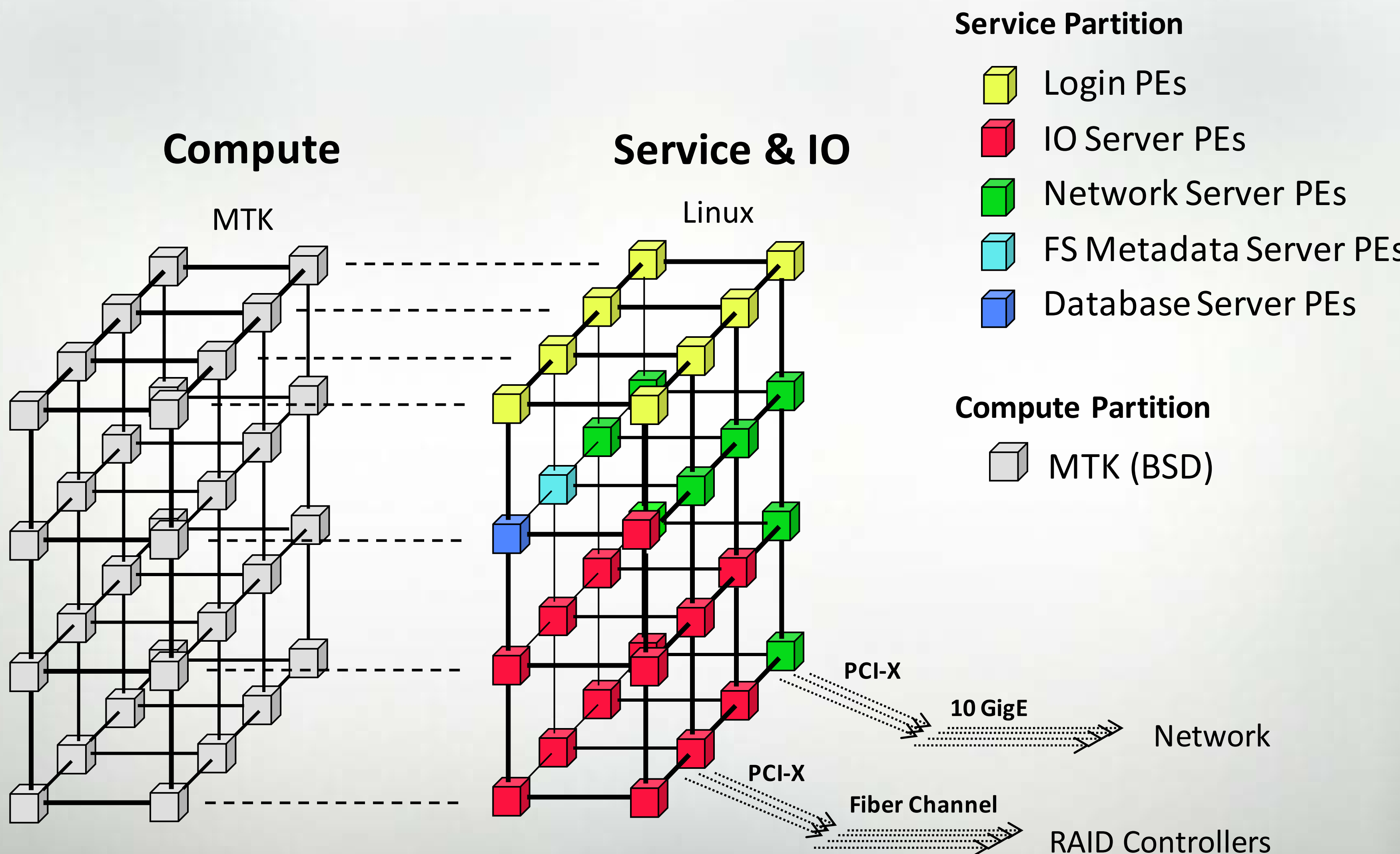
CRAY THE SUPERCOMPUTER COMPANY

Enabling Next Generation Data Analytics

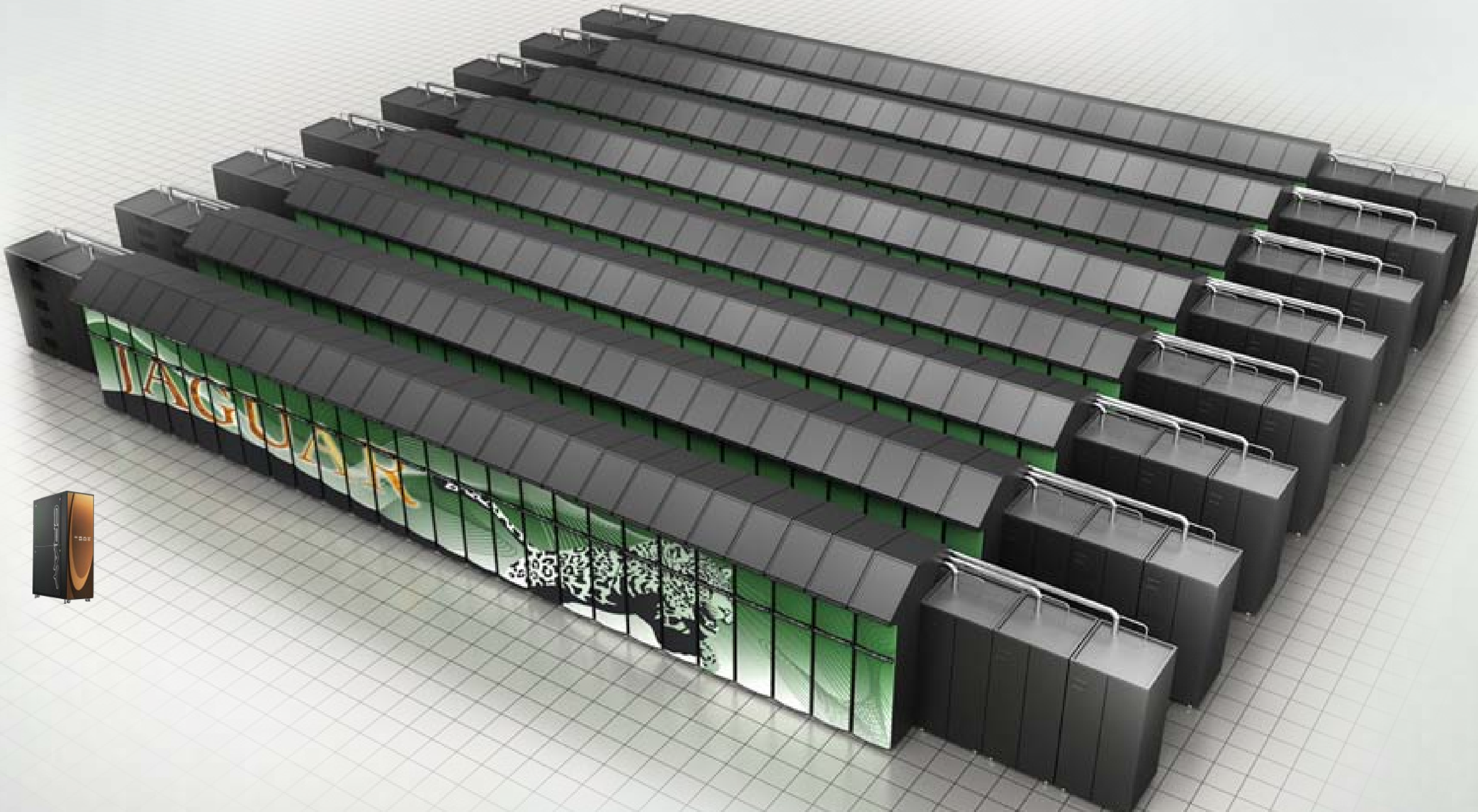
New Hardware Technology

- **Cray XMT**
  - Excels at Data Intensive Computing
- **Characteristics**
  - Very large shared memory
    - 128TB
  - Extreme multithreading
    - 128 hardware threads per processor
    - Practically unlimited virtual threads
  - Fine Grained Synchronization
  - Very low power
    - 30 watt processors
  - Ease of use
  - Superior price/performance
  - Semantic Database
    - Software Product Integration Layer
    - 10s to 100s of times better average performance on analytics

Cray XMT Architecture



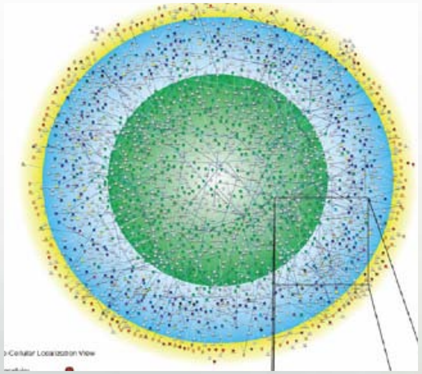
Equivalent Capability on Graph Data Structures

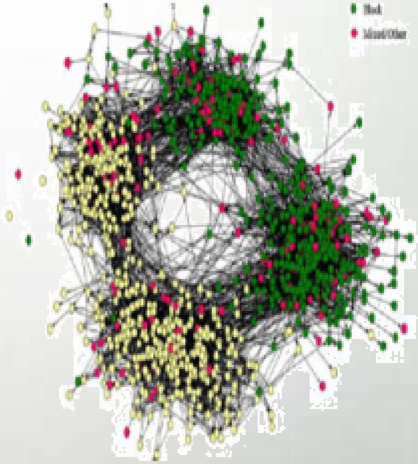


Cray XMT Excels

- On applications involving ...
  - Random or indirect memory accesses
  - Dynamic or unbalanced subcomputations
  - Unstructured, dynamic, and/or sparse data structures
  - Linked data structures (lists, graphs, trees)

- Applications that need to access large amounts of memory (terabytes) and in an unpredictable manner.
  - Graph Analysis (intelligence, protein folding, bioinformatics)
  - Optimization problems (branch-and-bound, linear programming)
  - Computational geometry (graphics, scene recognition and tracking)
  - Data mining
  - Semantic Database/Web
  - Parallel Discrete Event Simulation
  - Cyber Security
  - Social Network Analysis
  - Dynamic Network Analysis
  - Video Analytics
  - Etc.





Thank You!

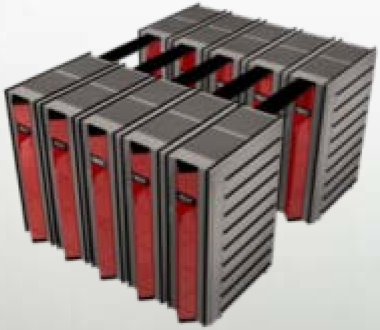
Questions?

Erdos-Renyi Random Graph Algorithm

- **Application Significance:**
  - ✓ Sandia National Laboratory case study
  - ✓ Used to generate random graphs

- **XMT vs. IBM BlueGene/L Comparison:**
  - ✓ 4 Billion vertices, 20 Billion Edges
    - IBM BlueGene/L 32,000 processors
    - Cray XMT 16 processors

- **XMT performed 2000 times better than IBM BlueGene/L per processor**



Vs.

Breadth-First Search (BFS)

- **Application Significance:**
  - ✓ an important graph algorithm for systematically visiting each node in a graph
  - ✓ easily adaptable to other important graph algorithms, e.g. connected components, spanning trees, shortest path

- **XMT vs. IBM BlueGene/L Comparison:**
  - ✓ 3.2 Billion vertices, 32 Billion Edges
    - IBM BlueGene/L 4.9 seconds on 32,000 processors
    - Cray XMT 17.3 seconds on 128 processors

- **XMT performed 882 times better than IBM BlueGene/L per processor**

Vs.

Alameh, Nadine

Update on Semantic Activities within the Open Geospatial Consortium (OGC)

OGC®
Open Geospatial Consortium

Update on Semantic Activities

Within the Open Geospatial Consortium (OGC)

Nadine Alameh, Ph.D.
OGC, Director of Interoperability Programs

nalameh@opengeospatial.org
(240) 669-8788

OGC at a Glance (1)

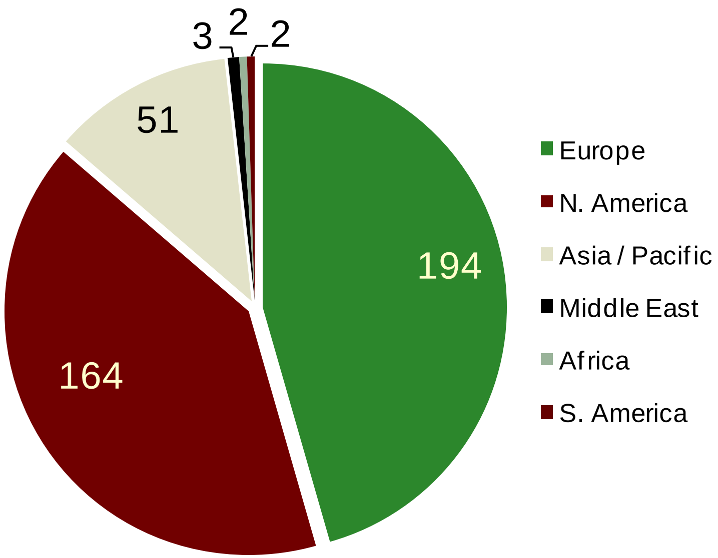
The Open Geospatial Consortium (OGC) is a non-profit, international voluntary consensus standards organization that is leading the development, promotion and harmonization of standards for geospatial and location based services.

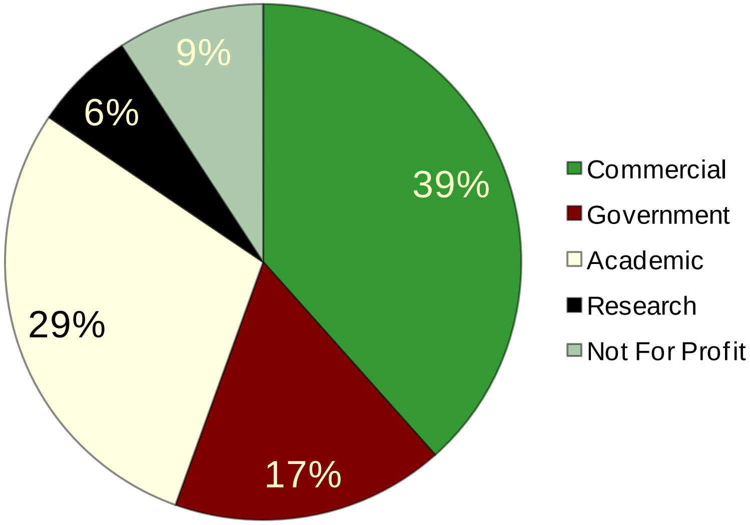
- Founded in 1994, not for profit, consensus based and voluntary
- Over 416 member organizations (industry, government, academia) (January 2011) http://www.opengeospatial.org/ogc/members
- 30+ adopted OGC Standards (some are ISO Standards) http://www.opengeospatial.org/standards
- Several hundred software products, implementing OGC Standards http://www.opengeospatial.org/resource/products
- Broad user community worldwide, many policy positions for NSDI based on OGC standards
- Cooperation with other standards organizations and foundations, e.g. ISO, W3C, OMG, etc http://www.opengeospatial.org/ogc/alliancepartners

OGC®

OGC at a Glance (2)

OGC Vision: to achieve the full societal, economic and scientific benefits of integrating location resources into commercial and institutional processes worldwide





OGC Alliance Partners

A Critical Resource for Advancing Useful Standards

… and others

www.opengeospatial.org/ogc/alliancepartners

OGC Semantics Work

- The OGC has not generally focused on geosemantics and interoperability other than a few targeted projects
  - Geosemantics Interoperability Experiment
  - Geosemantics Domain Working Group

Welcome to the Geosemantics Domain Working Group web

This is a collaboration space for initiatives and activities of the Geosemantics Domain Working Group. The charter of this group is located here. The scope of the Geosemantics DWG is any aspect of conceptual modeling and formal representation of geospatial knowledge which advances the geospatial interoperability mission of OGC. A particular focus will be the adoption or development of tools and methods in support of these activities. The mission of the Geosemantics DWG to establish an interoperable and actionable semantic framework for both representing the geospatial knowledge domains of information communities and mediating between them.

Initiatives

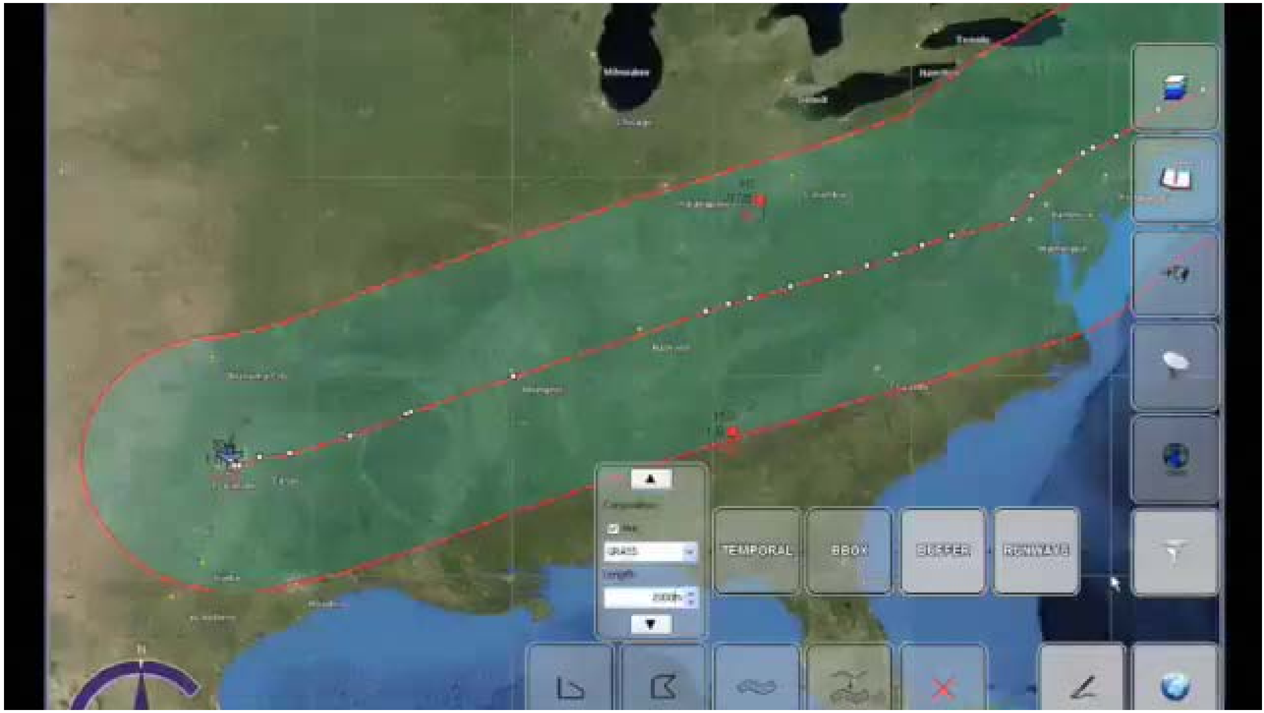
- Semantic Annotations
- Geospatial Ontologies in OWL
- Geospatial SPARQL
- Spatial Ontology Management

Links to other work and resources

- https://portal.opengeospatial.org/twiki/bin/view/GSWie/WebHome?

Aviation in OGC Web Services Testbed 6

- Testing SOA Architecture
  - AIXM over WFS
  - 4D trajectory filtering
  - Event Architecture
  - Digital NOTAMs



- Outcomes
  - Aviation Clients
  - Event Service
  - Change Requests to AIXM and Web Services

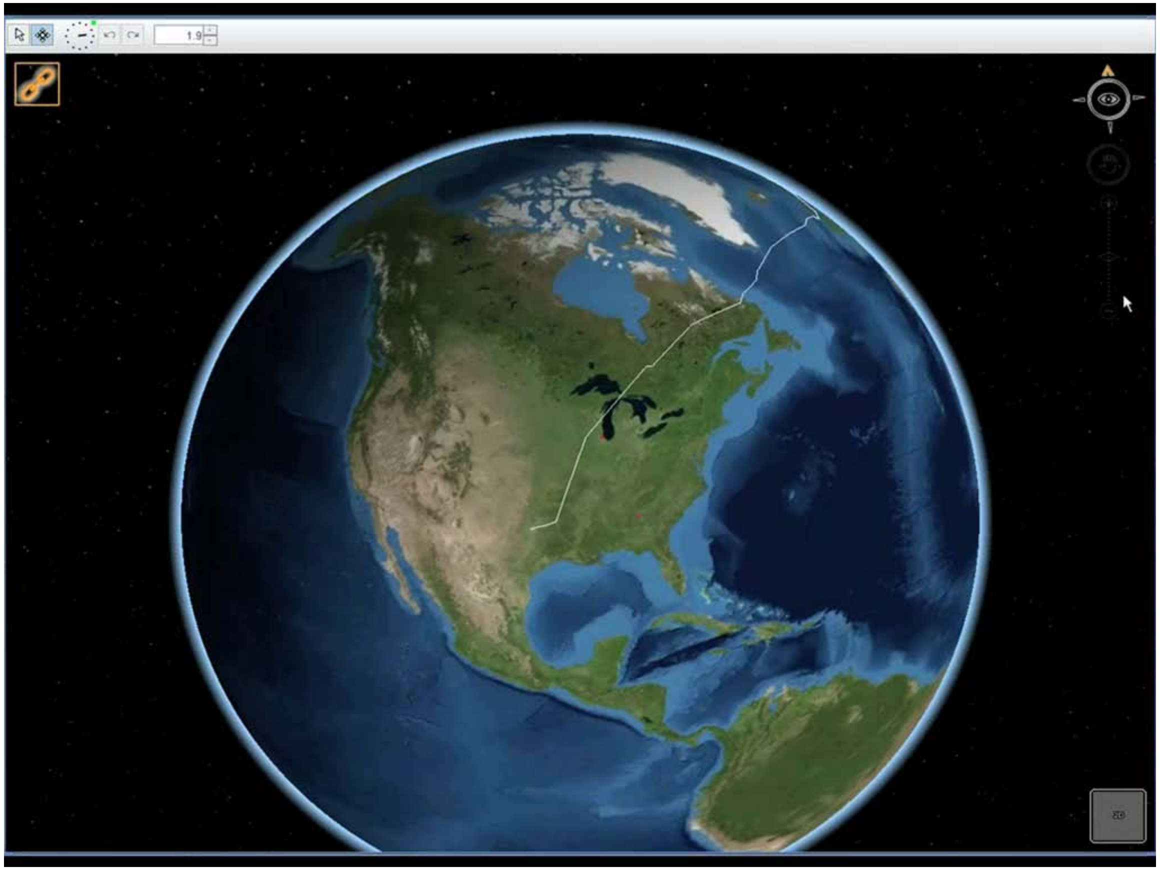
OGC®

http://www.opengeospatial.org/pub/www/ows6/index.html

Aviation in OGC Web Services Testbed 7

- Enhancing the architecture
  - AIXM 5.1 over WFS
  - Modeling & validation tools
  - Portrayal
  - Weather and WXXM

- Outcomes
  - Standards-compliant Commercial Off-The-Shelf products (COTS)
  - Open source validator
  - Portrayal
  - More Change Requests



OGC®

http://www.opengeospatial.org/pub/www/ows7/index.html

Global Participation by Industry and Academia

- Participants from Europe, USA, Australia and Canada

Aviation in OGC Web Services Testbed 8

- OGC Web Services Phase 8 Testbed (OWS-8)
  - Focusing on information management and automation
    - Advancement of AIXM including metadata
    - Validation of Digital NOTAM Event Specification
  - Supporting end-users
    - Access, filtering & notification of information
    - Styling using ICAO symbology
- Supporting current developments undertaken by the EAD (implementation of the Digital NOTAM) and the implementation of the ADQ Regulation (AIXM).

Aviation / Weather

Aviation: Architecture

AIXM 5.1: Metadata, GML Profile, Performance

Aviation: Portrayal

FPS, SLD: ICAO symbol libraries for AIXM, WXXM

Aviation: Events

Digital NOTAM: Events spec, AIXM event schema, validation

Aviation: Security

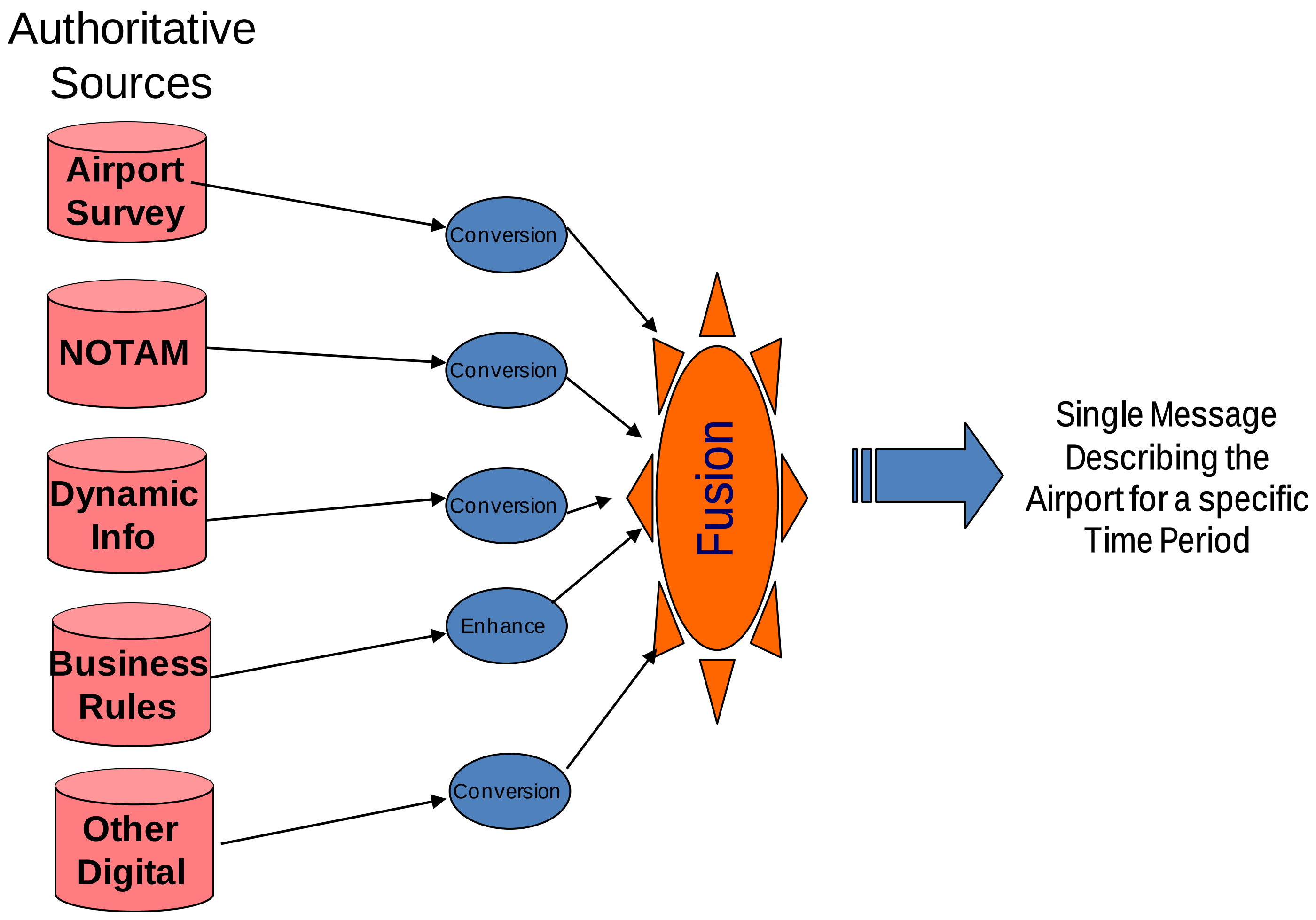
$\boxed{\textbf{Authoritative AIXM Services:}}$
Authentication (PDP), Authorization (PIP), Gatekeeper (PEP)

Aviation: Weather

WXXM 1.1: WCS conversion, probabilistic TAF, distributed UoM


Aeronautical Information Management (AIM)
ENSURING THE RIGHT DATA AT THE RIGHT TIME AT THE RIGHT PLACE...
FEDERAL AVIATION ADMINISTRATION
Airport
Airspace
Inputs
Equipment
Procedures
Aeronautical Common Service
Data Management
Accurate
Complete
Data Release
Authoritative
Consistent
Configuration-Managed
Transformable
Commonly Represented
Secured
Flight & Flow
Working with Other FAA Information Domains...
...to Provide a COMMON OPERATIONAL PICTURE OF THE NATIONAL AIRSPACE SYSTEM
Surveillance
Outputs
Weather
Integrated Products for Pilots, Air Traffic and Airport Managers, IM Personnel, and External Stakeholders

Example: Fused data for an Airport



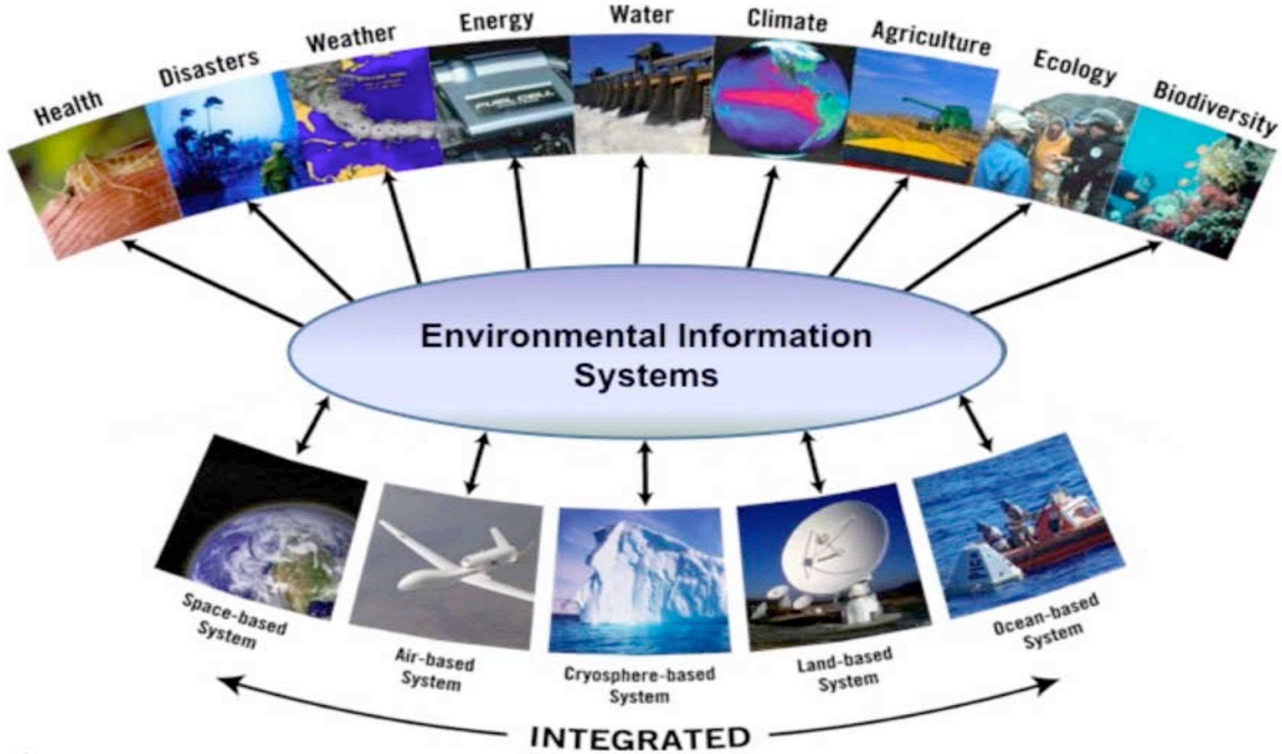
Relevant Activities

- Interest in exploring how semantic mediation between the concepts and vocabularies from different communities/domains/information sources can be performed to enable successful discovery, exploitation and integration of geodata resources

- Activity 1: Global Earth Observing System of Systems (GEOSS)
  - Architecture Implementation Pilot (AIP-3)
  - First exploratory use of semantics within GEOSS focusing on the use of semantic repositories for linking concepts from different scientific domains and the value of a brokering approach to mediate multidisciplinary resources

- Activity 2: OGC Web Services Testbed 8 (OWS-8)
  - Cross-Community Interoperability (CCI) thread
  - Investigate, evaluate and demonstrate the benefits of semantic mediation approaches (e.g. ontologies, mappings, SPARQL) to query and use data, based on different data models, available via OGC Web Feature Services (WFS)

GEOSS AIP and Semantic Activity



Architecture Implementation Pilot (AIP) Phase 3

- Aimed at developing process and infrastructure components for the GEOSS Common Infrastructure (GCI) and the broader GEOSS architecture as a means of coordinating cross-disciplinary interoperability deployment of earth observation resources.

VATIONS

AIP-3 Home

GEOSS Architecture Implementation Pilot Phase 3

https://sites.google.com/a/aip3.ogcnetwork.net/home/home/semantics

Scenario Areas	Functional Areas
Water Quality & Drought	End2Engineering
Disaster Management	Semantics
Air Quality & Health	Data Harmonization
Energy	Data Sharing
Biodiversity & Climate Change	*Engineering Use Cases*

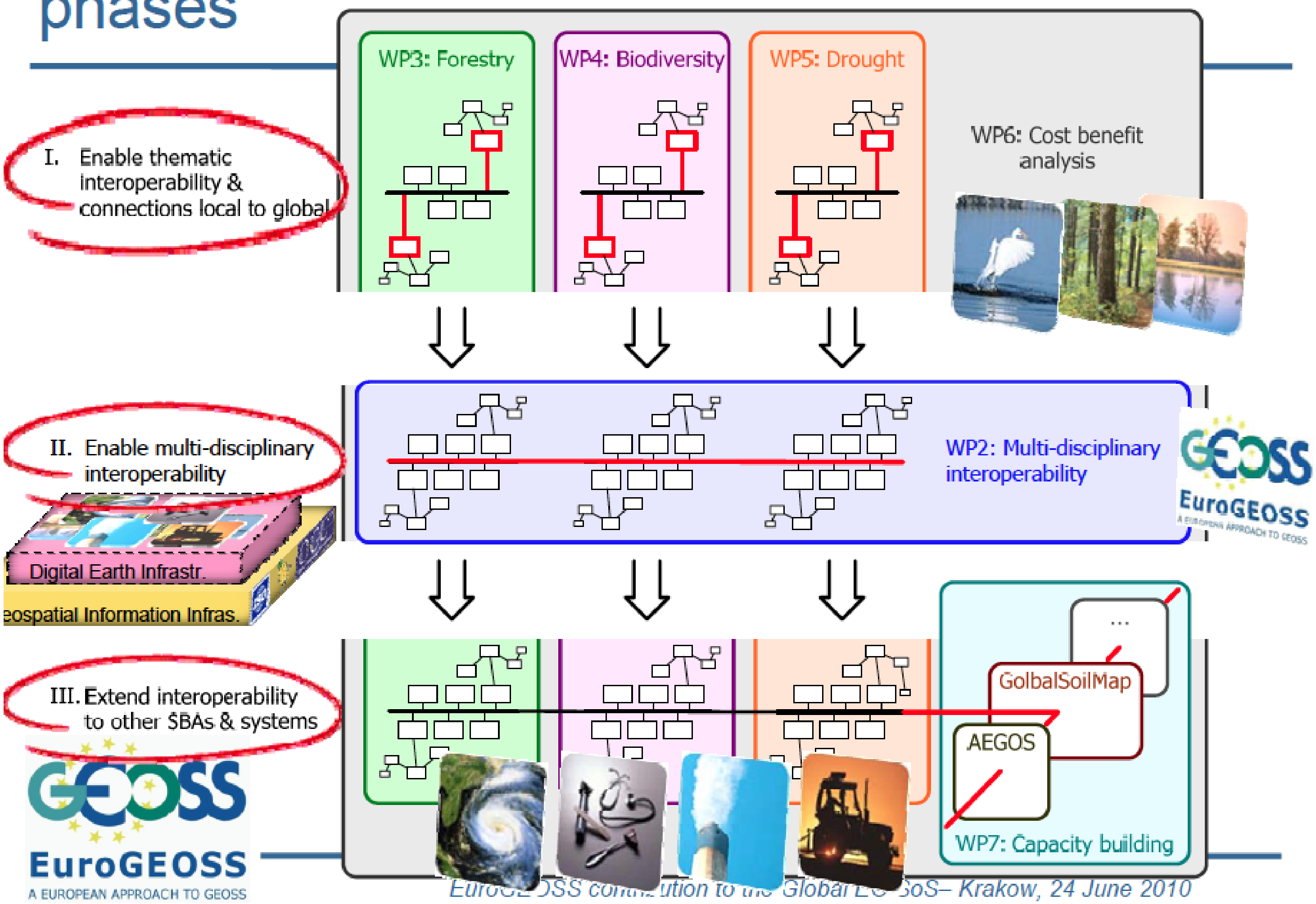
GEOSS AIP-3 Semantics Activity

- Problem
  - GEOSS as a multi-national endeavor including members with hundreds of different languages, geographic place names in multiple languages for the same place
  - GEOSS as a global system involving scientific variables collected from multiple disciplines
  - How do you automate the process of finding the exact information that the user is looking for?

- Approach
  - Semantic enrichment of a Discovery Augmentation Component of the EuroGEOSS discovery broker

EuroGEOSS

Operating Capacity: three Interoperability phases



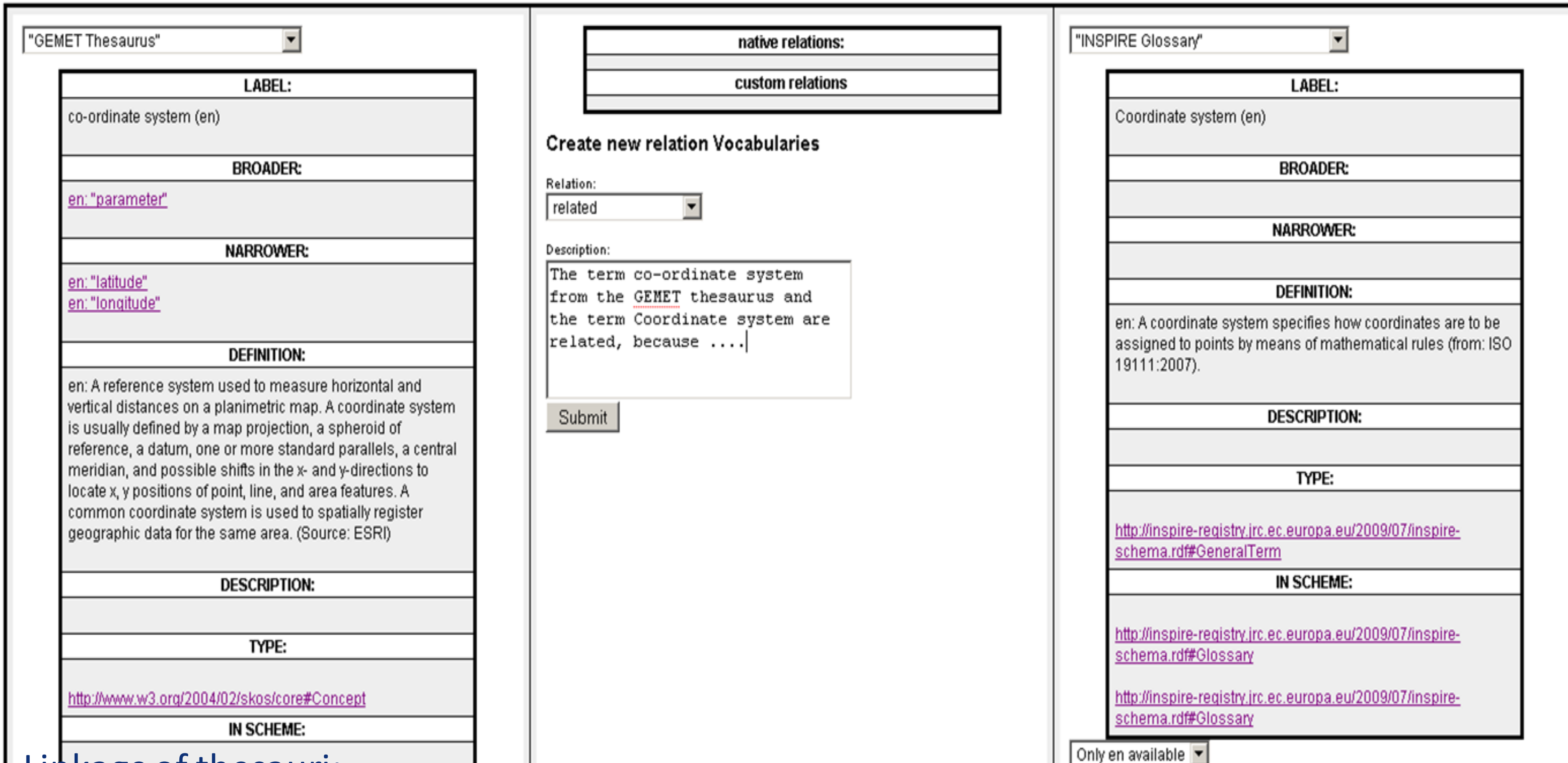
The mission:

- ✓ Organizing the vocabulary for spatial data annotation and retrieval
- ✓ Creation of thesauri for thematic areas by domain experts
- ✓ Linking individual thesauri to each other and to general purpose ones
- ✓ Publishing thesauri in a standard-compliant, easily accessible way

Thesauri creation:

- ✓ Based on SKOS, the Semantic Web standard for developing taxonomies
- ✓ Leveraging wiki tools to ease thesauri creation by domain experts
- ✓ Exported as RDF for usage by other applications

Linking SKOS vocabularies

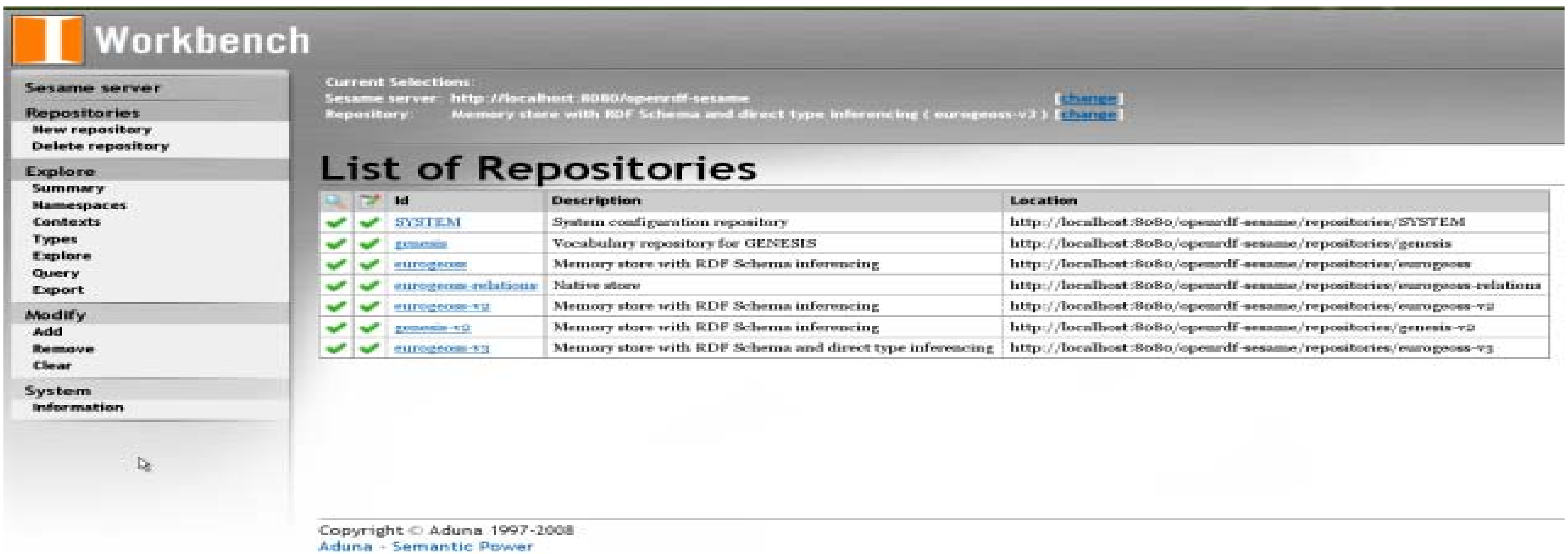


Linkage of thesauri:

- ✓ Essential for creating consistent data structures from heterogeneous sources
- ✓ Important for grounding resource retrieval in cross-domain settings
- ✓ Requires user-friendly tools that abstract from the technicalities of the SKOS format

Publishing thesauri:

- ✓ Applications require standard means to leverage thesauri
- ✓ SPARQL endpoints allow for HTTP-based querying of RDF data sources
- ✓ RDF triple stores allow for creating data bases of SKOS data



Application scenarios (1):

- ✓ Annotation of spatial data and services

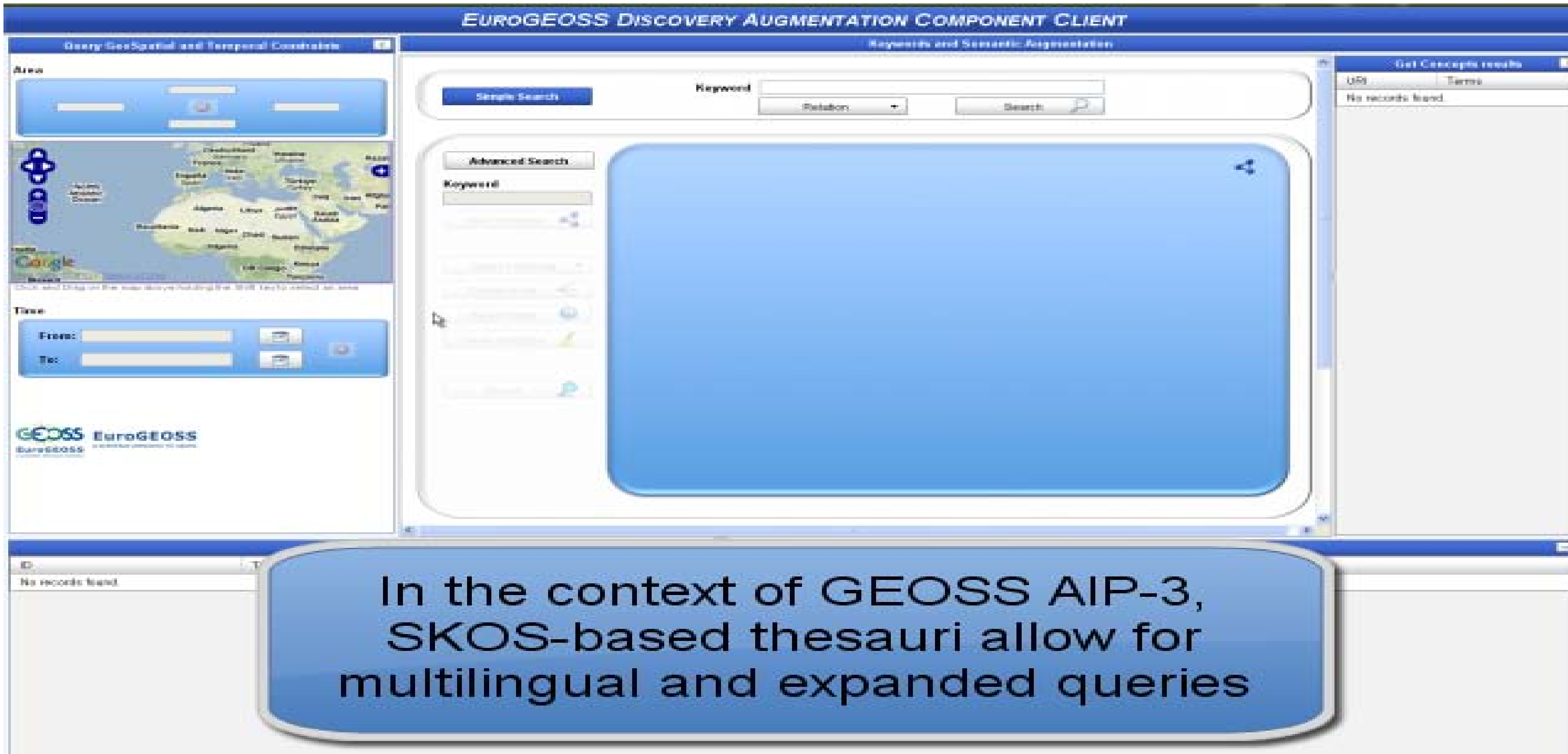
INSPIRE Metadata editor

Spatial Data Infrastructures Unit - JRC-IES

http://ies.jrc.ec.europa.eu/spatial-data-infrastructures-unit

Application scenarios (2):

- ✓ Semantics-aware retrieval of resources

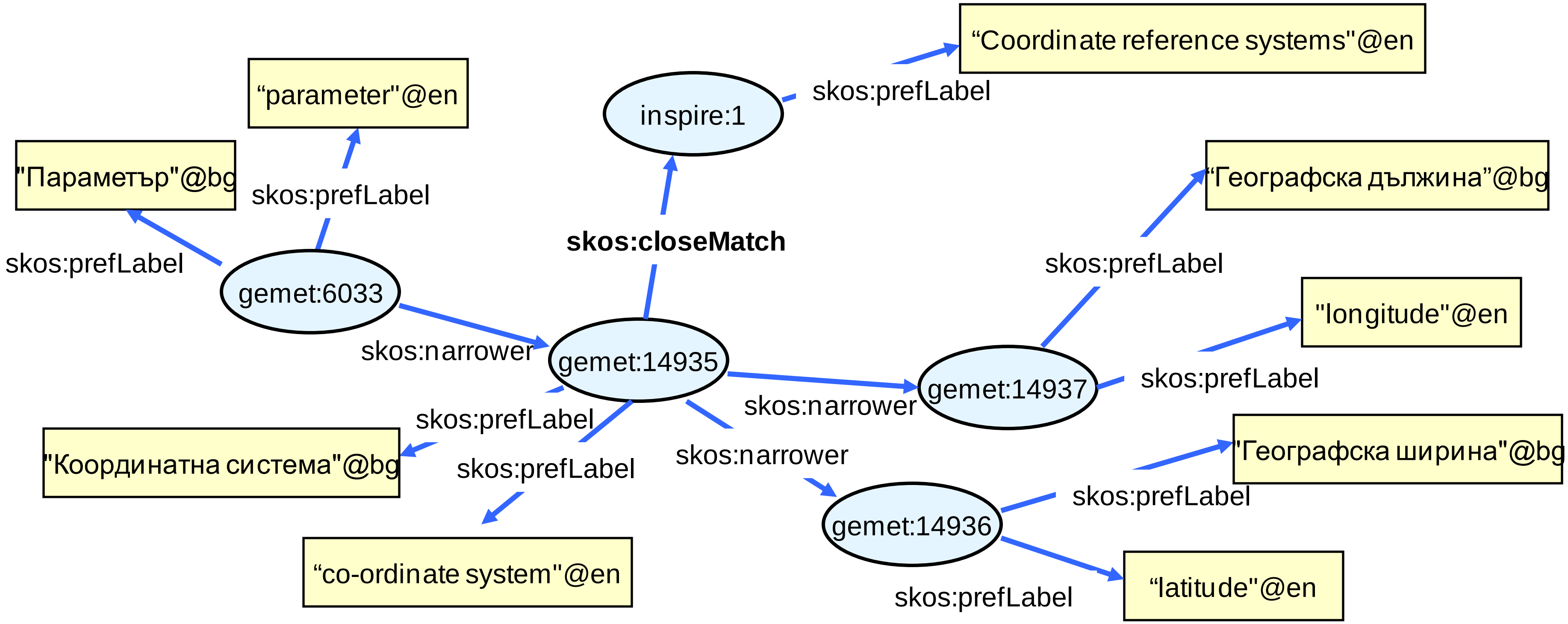


In the context of GEOSS AIP-3, SKOS-based thesauri allow for multilingual and expanded queries

EuroGEOSS semantics-aware search
ESSI Lab group – CNR

Grounding the query expansion

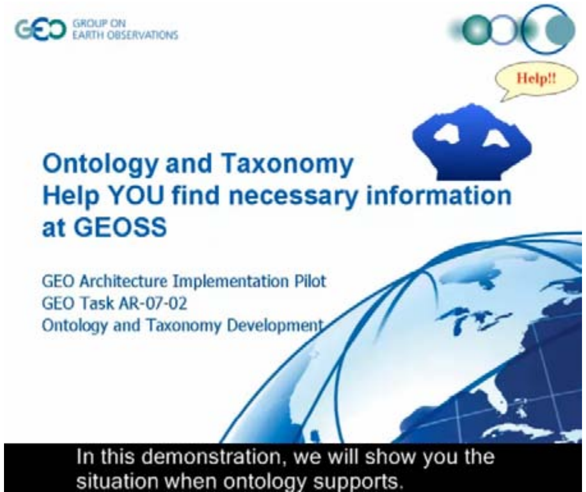
- Vocabularies are **stored** into an instance of the Sesame RDF repository and **linked** to each other by means of a custom application.
- A **text-based** query is applied for deriving terms containing the search keyword in **labels**, **definitions**, and **descriptions**.
- The set of terms matching the keyword is extended with terms **narrower**/**broader**/**related** to them.



For More Information

- AIP-3 Vocabularies and Semantics Engineering Report
  - http://www.ogcnetwork.net/pub/ogcnetwork/GEOSS/AIP3/pages/AIP-3_ER.html#aipsemantics
    - Scope: The AIP-3 Vocabularies and Semantics ER summarizes the outcomes of the first exploratory use of semantics (the new integrative technologies being deployed over the world wide web) to provide more user-friendly, seamless integration across cross-cutting activities within the GEO SBAs.
    - The AIP-3 Vocabularies and Semantics scenario aimed at leveraging and further developing the RDF repository developed in the context of the GENESIS FP7 project and implementing the semantics-aware extension to the GI-CAT EuroGEOSS discovery broker. This new capability was tested in supporting of the AIP-3 Water/Drought and e-Habitat scenarios.
    - Point of Contact Editor: Cristiano Fugazza EC, JRC-IES
    - Contributing Editors: Masahiko Nagai, Stefano Nativi, Mattia Santoro, Will Pozzi

- AIP-3 Vocabularies and Semantics Demo Video
  - http://www.ogcnetwork.net/pub/ogcnetwork/GEOSS/AIP3/pages/Demo.html



Relevant Activities

- Interest in exploring how semantic mediation between the concepts and vocabularies from different communities/domains/information sources can be performed to enable successful discovery, exploitation and integration of geodata resources

- Activity 1: Global Earth Observing System of Systems (GEOSS)
  - Architecture Implementation Pilot (AIP-3)
  - First exploratory use of semantics within GEOSS focusing on the use of semantic repositories for linking concepts from different scientific domains and the value of a brokering approach to mediate multidisciplinary resources

- Activity 2: OGC Web Services Testbed 8 (OWS-8)
  - Cross-Community Interoperability (CCI) thread
  - Investigate, evaluate and demonstrate the benefits of semantic mediation approaches (e.g. ontologies, mappings, SPARQL) to query and use data, based on different data models, available via OGC Web Feature Services (WFS)

OWS-8 Testbed Milestones

Kickoff Meeting	9-11 March 2011
Key Initial Designs/Components/Services Due	22 April 2011
Interim Milestone (first draft of components, services, and reports)	24 June 2011
Demonstration Milestone (screen captures; final services and testing due)	26 August 2011
Interoperability Day at OGC TC (live & screen capture demonstrations)	22 September 2011
Final Delivery (all final reports are due)	30 September 2011

OWS-8 Activity Threads & Subthreads

Sensor / Observation Fusion

Observation Fusion: Coverages

Web Coverage Service 2.0: EO App Profile, WPS/WCPS, Compliance Tests

Observation Fusion: Motion

Moving Objects in Motion Imagery: Detecting & tracking objects, and setting bookmarks

Feature Fusion / Portrayal

Gsync

Geodata Bulk Transfer with Synchronization: Content management across SDI

CCI: Mediation

Cross-Community Interoperability: Semantic mediation across heterogeneous data models

CCI: Schema

Schema Automation: UML-GML enhancements, Schematron support for SWE (O&M) schema

CCI: Portrayal

Portrayal Enhancements: Registries for symbols and rules (incl. DGIWG), FPS with SE + KML

Aviation / Weather

Aviation: Architecture

AIXM 5.1: Metadata, GML Profile, Performance

Aviation: Portrayal

FPS, SLD: ICAO symbol libraries for AIXM, WXXM

Aviation: Events

Digital NOTAM: Events spec, AIXM event schema, validation

Aviation: Security

Authoritative AIXM Services: Authentication (PDP), Authorization (PIP), Gatekeeper (PEP)

Aviation: Weather

WXXM 1.1: WCS conversion, probabilistic TAF, distributed UoM

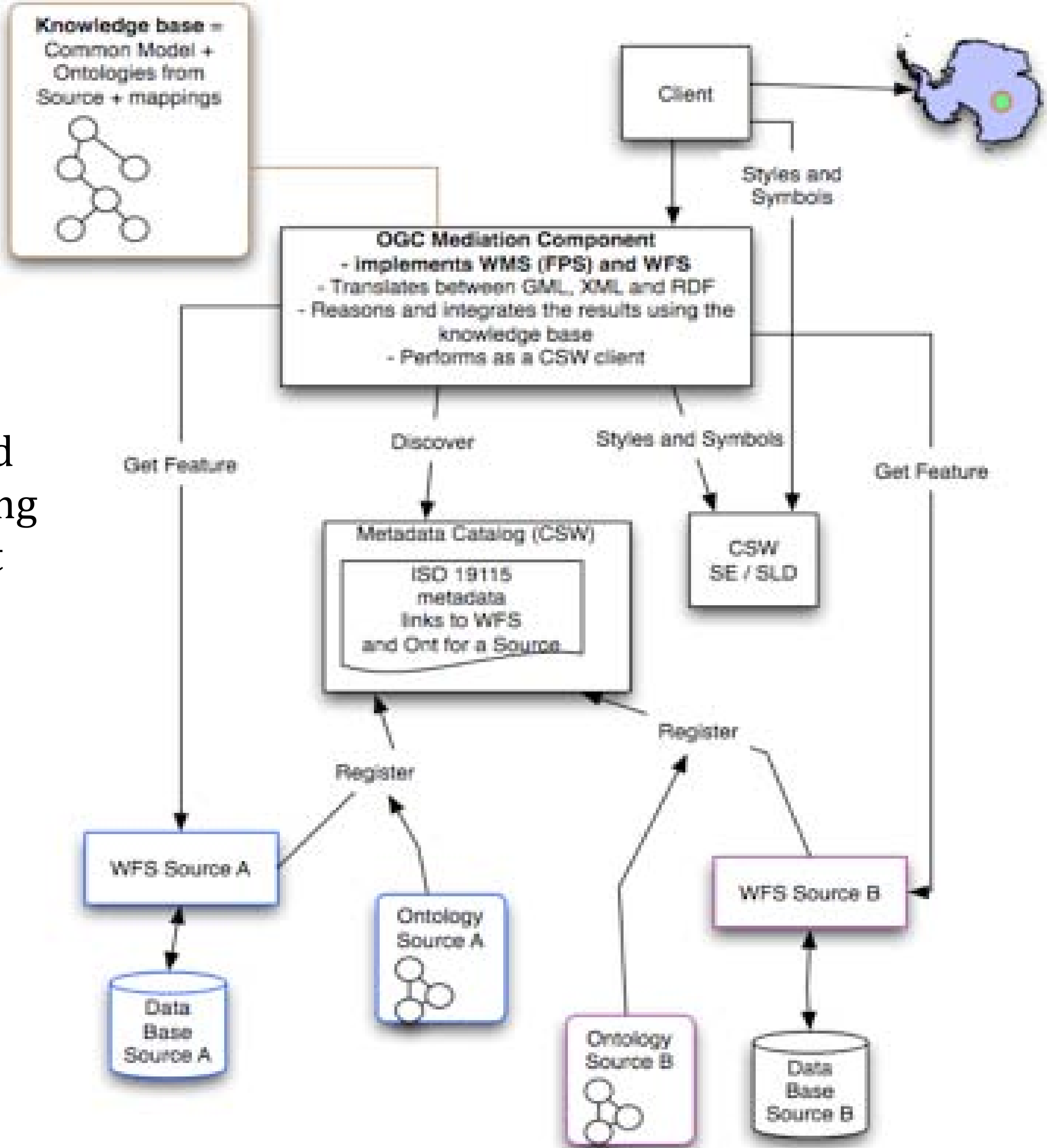
Cross-Community Interoperability (CCI)

- Semantic mediation is a function provided by service brokers and clients to overcome mistmatches in community concept vocabularies between service providers and consumers.
  - Topographic Data Store (TDS) data model from NGA
  - National Map Data Model from USGS

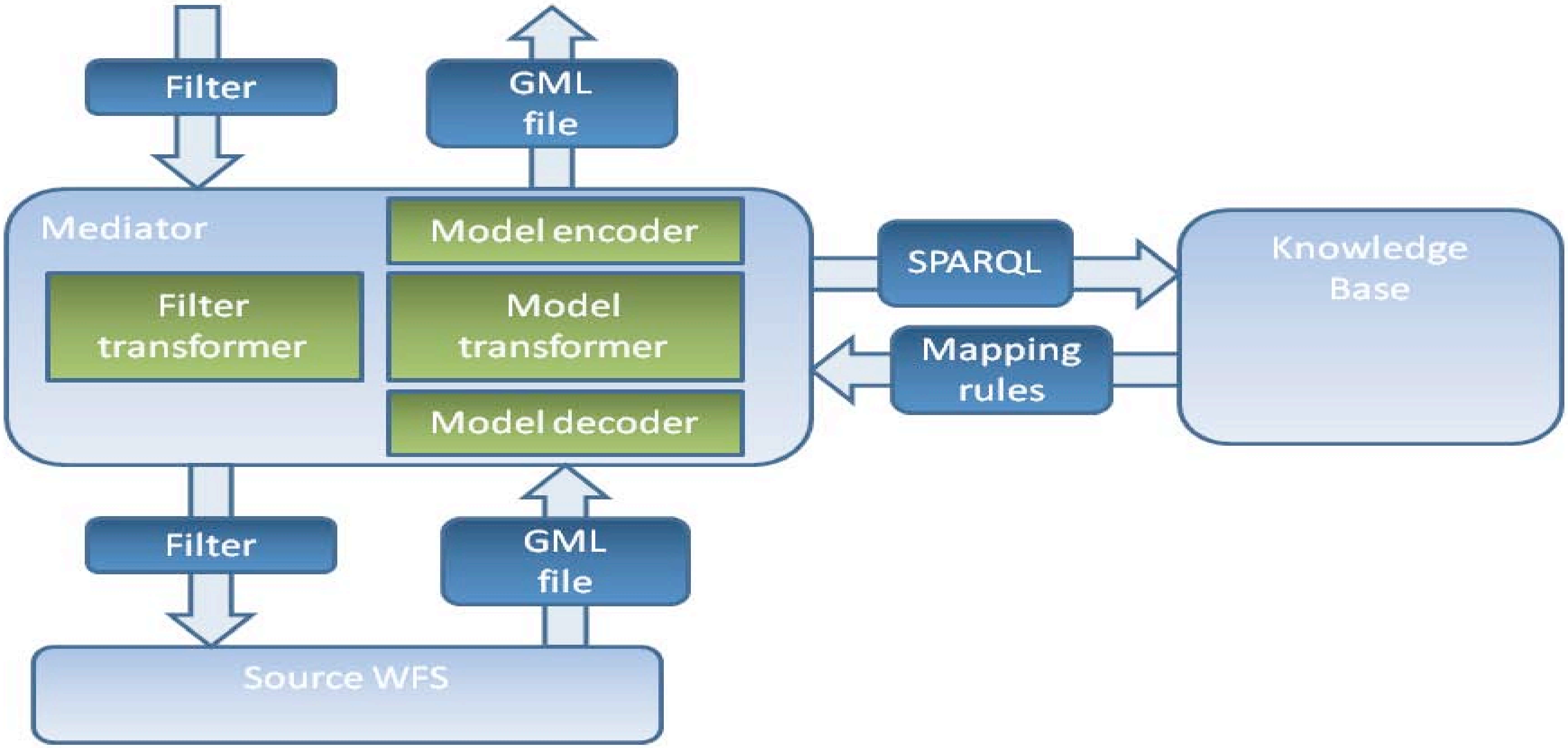
- Problem
  - NGA user is used to working with (and styling/portraying) NGA data and NGA data model but wants to be able to query other sources of data based on other models

- Approach
  - Develop common data model (Rosetta Mediation Model)
    - NGA model as basis augmented as needed by USGS model
    - Develop mapping rules between NGA/USGS data models and the Rosetta Mediation Model
  - Introduce mediation component
    - Allow clients to query multiple data sources in real time regardless of the different source data models

CCI Thread Engineering Viewpoint



Semantic Approach



Current Issues

- Adequacy/inadequacy of OWL and SKOS for specifying semantic mappings
  – Compiling list of semantic relationships that are needed for the NGA-USGS models and not supported by either OWL or SKOS

- Using generic mapping transfer language such as RIF (Rule Interchange Format – W3C recommendation)

- Implementation of the mapping engine (transforming not just the data but also the filter)

For More Information

- OWS-8 RFQ (Annex B – Architecture)
  - http://www.opengeospatial.org/standards/requests/74
- OWS-8 CCI Twiki (requires OGC portal username/password)
  - https://portal.opengeospatial.org/twiki/bin/view/OWS8/CciHome
- Stay tuned for Demonstration and final results at OGC Technical Committee Meeting on September 22 in Boulder, Colorado

Conclusion

- Increased need for semantic mediation activities across communities and domains to achieve full interoperability

- Need for a consistent standards-based approach for successful mediation to occur
  - Current approaches based on model mapping and brokering/mediation components
  - Use of semantic repositories to link concepts from different domains
  - Value of brokering/mediation approach to mediate multidisciplinary resources

– Many examples exist out there in different domains
  - GEOSS
  - NGA/USGS

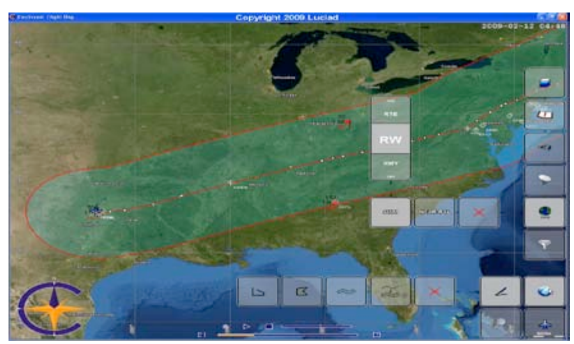
For More Information

Open Geospatial Consortium, Inc
www.opengeospatial.org

OGC Aviation Domain Working Group
http://www.opengeospatial.org/projects/groups/aviationdwg

OGC Geosemantics Domain Working Group
http://www.opengeospatial.org/projects/groups/semantics

Nadine Alameh, Ph.D.
nalameh@opengeospatial.org

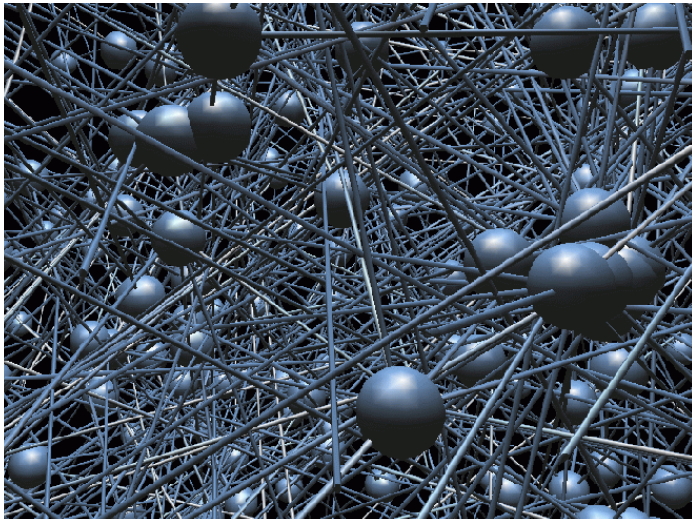


OGC®

Hodgson, Ralph - Valuing the Role of Semantic Web Technologies - A Ten Year Personal Reflection

Since 2001, in government projects, I have faced the questions: "What does the use of semantic technology mean to the users of data?", "Can semantic web technologies really 'connect the dots' and break down data silos?", "What does it mean to link data?", “How do Ontologies help data interoperability?”, "How can RDF and OWL co-exist with XML?", "What has to happen in an organization for semantic web technologies to be put to work effectively?". Using examples from government organizations, I will look back and reflect on how these questions where addressed. In 2003, at GSA, we created the FEA ontologies. My experiences have also been in situations where data has mission criticality, with challenges to data aggregation and interoperability. Since 2002, at NASA, we have worked on the use of semantic technology in data architecture, systems engineering, simulation and Modeling, and Telemetry and Commanding for Space Systems Interoperability in support of Manned Space Missions. At the Netherlands Ministry of Justice, our work was to use semantic technology of a model-based approach to generating component XML Schemas compliant with UN/CEFACT Core Component Technical Specifications (CCTS). The oeGOV.us project was a personal effort to ontologize the structure of the US Government. All these efforts provide lessons on "how to put ontologies to work". At this workshop I look forward to sharing predictions and plans for the next ten years.

Semantic Web Technologies



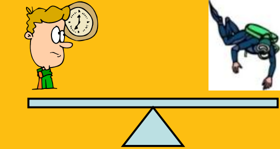
"Valuing the Role of Semantic Web Technologies - A Ten Year Personal Reflection and a Vision For The Next Ten Years"

A Personal Appreciation

Ralph Hodgson
TopQuadrant CTO

April 12, 2011

Introductions

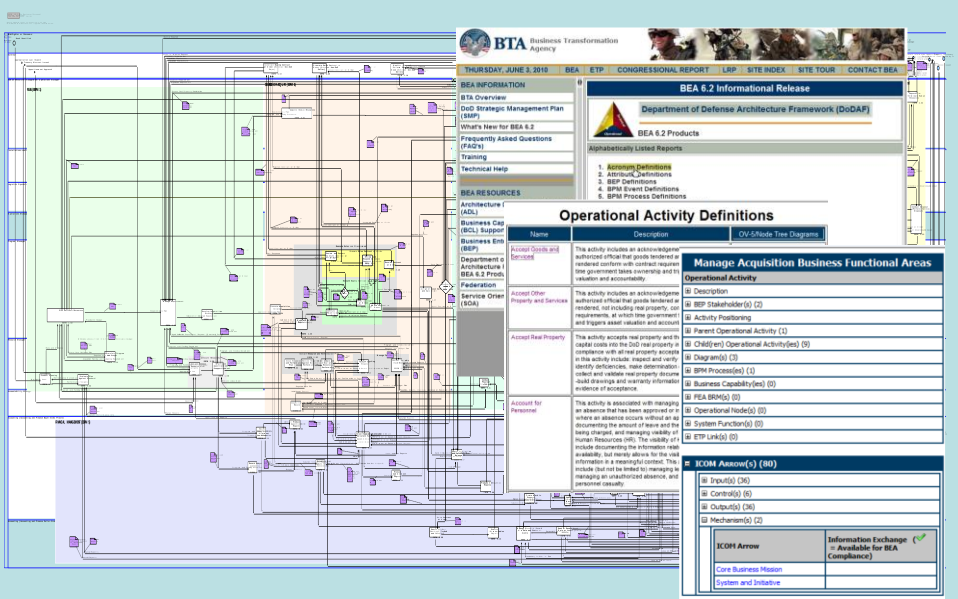


Ralph Hodgson

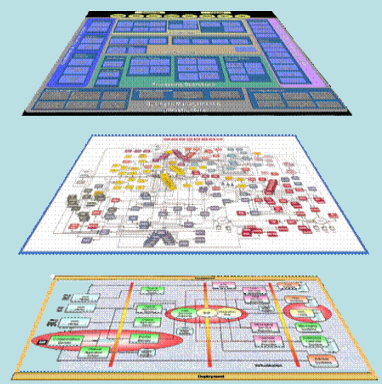
– *co-founder and CTO of TopQuadrant, Inc., a US-headquartered company that specializes in semantic technology consulting, training, tools and platforms;*
– *Lead Ontologist for the NASA NExIOM Ontologies.*
– *Prior to starting TopQuadrant in 2001, Executive Consultant at IBM Global Services and founding member of the Portal and Object Technology Practices;*
– *Co-authored \Adaptive Information, published by John Wiley in 2004, and Capability Cases: A Solution Envisioning Approach, published by Addison-Wesley in July 2005.*
– *Member of INCOSE, and participates in the Model-Based Systems Engineering Initiative.*

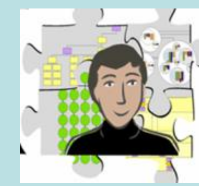
What I care about:

From Complex information Spaces



to





Layered Information Spaces with “Fitness for Purpose” and “Filtered to Context”

A Self-Confessed Methodologist

What the other Ralph Hodgson said

"Some things have to be believed to be seen"

➔ There has to be an "openness" to possibility before a value proposition can be appreciated.

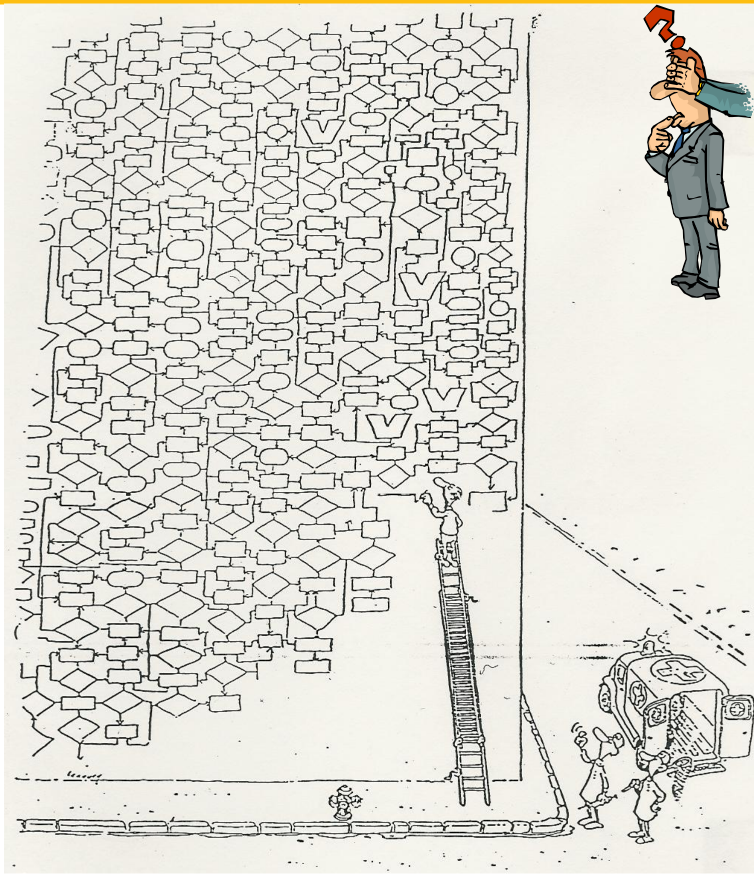
Image source: http://www.brynmawr.edu/library/mirabile/mirabile2/hodgson.html

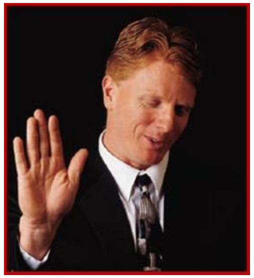
How Semantic Web Technologies Deliver Value

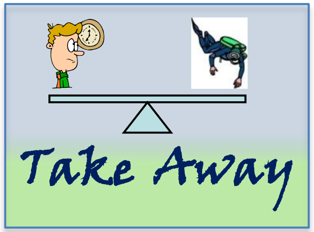
1. Canonical data → Subject-Predicate-Object Triples
2. Identifiers → Composition Construct for Aggregations
3. Schemas are also expressed in Triples and can be queried using same query language – SPARQL
4. Evolvability – schemas, vocabs and datasets can readily evolve

Some of the Questions that are asked

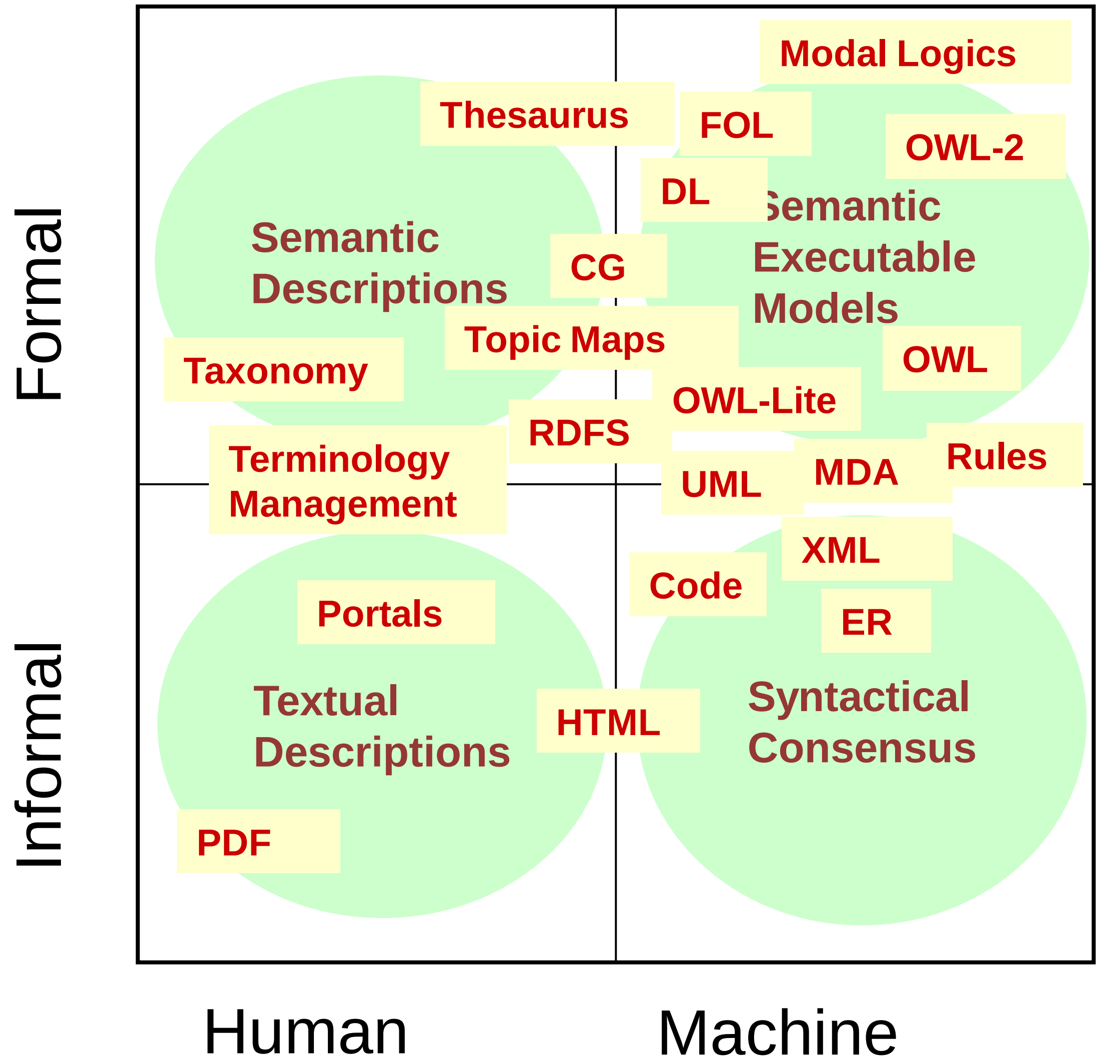
- "What does the use of semantic technology mean to users of data?"
- "Can semantic web technologies really 'connect the dots' and break down data silos?"
- "What does it mean to link data?"
- "How can data access and visualization be improved?”
- "How can RDF and OWL co-exist with XML?"
- "What has to happen in an organization for semantic web technologies to be put to work effectively?"
- “What are the criteria for choosing technologies for implementing solutions?“
- “When to know when to stop modeling?”

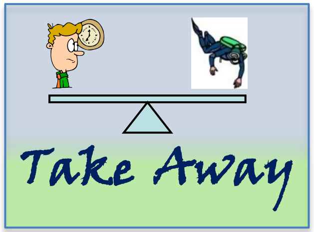




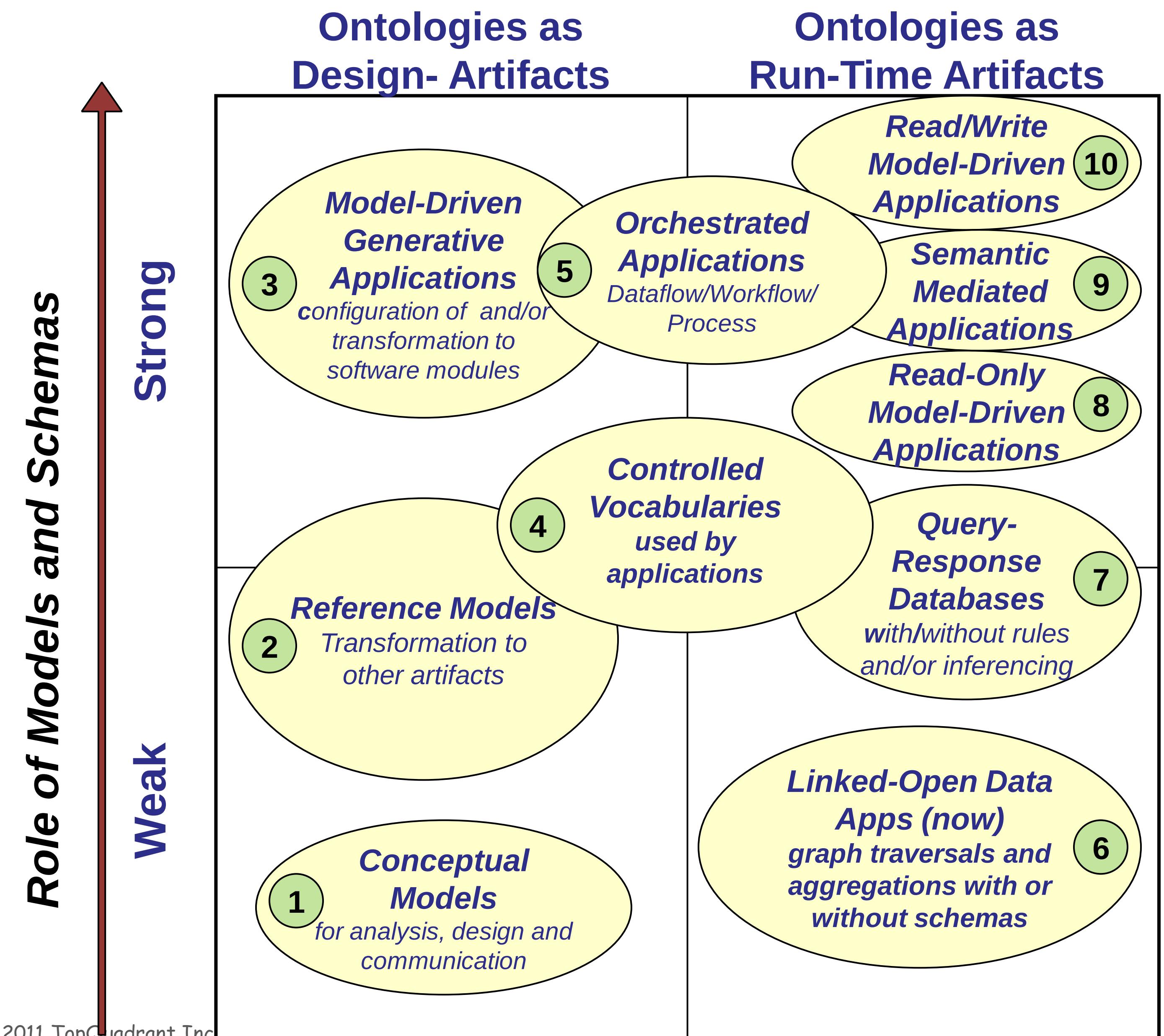


"Quadrants of Meaning"

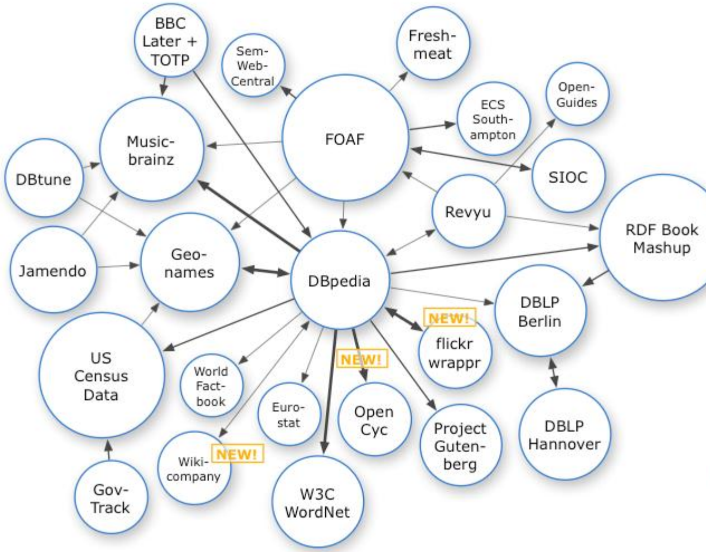




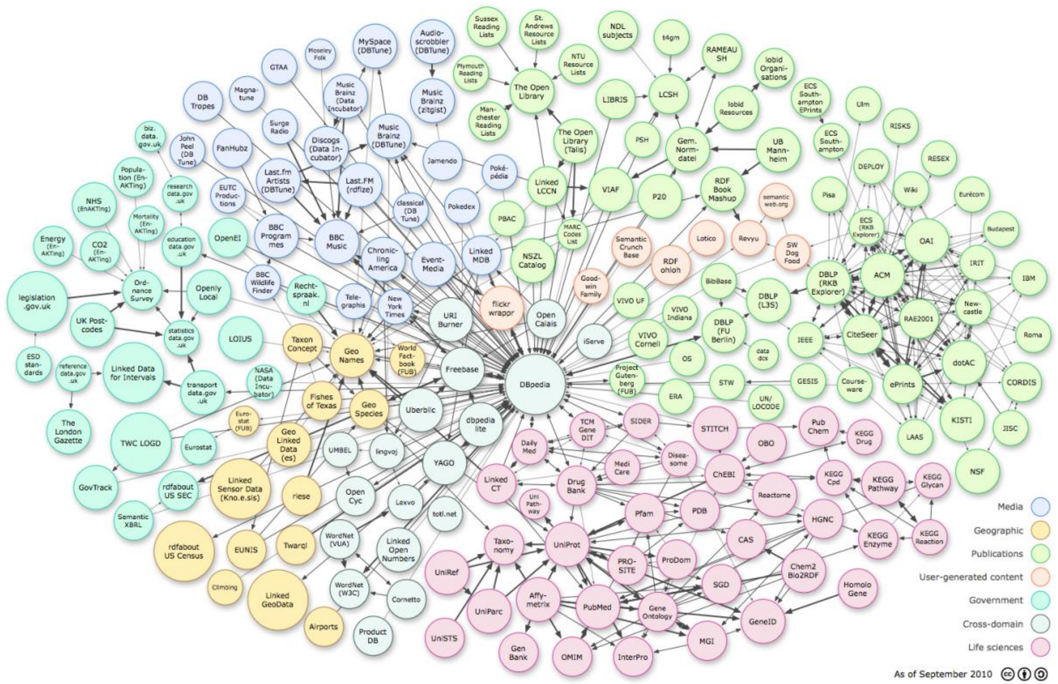
Putting Ontologies to Work



Linked Open Data



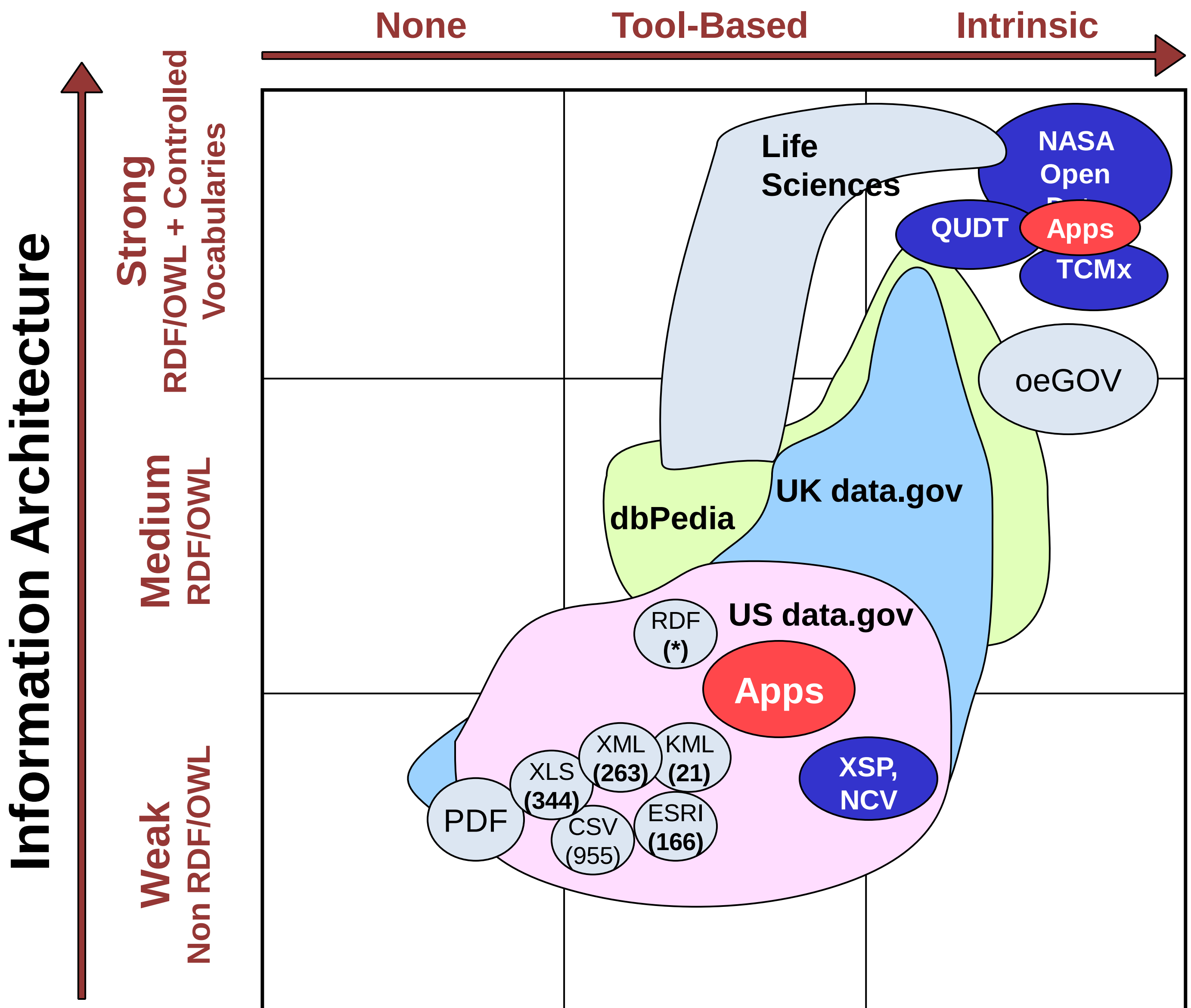
2007



2011

ref1: http://www.readwriteweb.com/cloud/2011/01/the-concept-of-linked-data.php
ref2: http://richard.cyganiak.de/2007/10/lod/

The Linked Open Data World

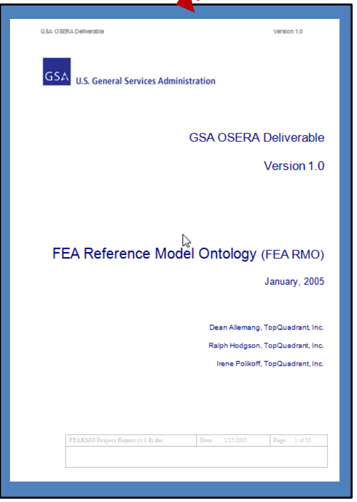


"Link-ability"

F (#) Based on data.gov June 2009

Some Key Moments in the Evolution of Open Semantic Web Technology in U.S. eGovernment

2003 2005 2007 2009 2011


GSA OSERA Deliverable Version 1.0

U.S. General Services Administration

GSA OSERA Deliverable

Version 1.0

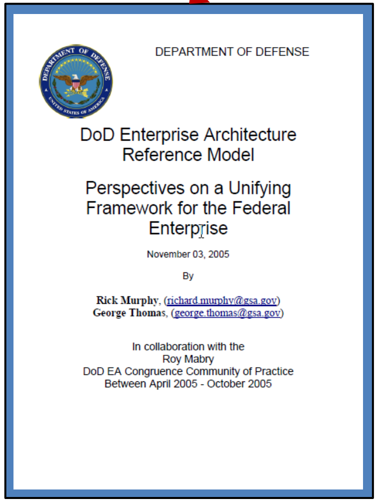
FEA Reference Model Ontology (FEA RMO)

January, 2005

Dean Allemang, TopQuadrant, Inc.

Ralph Hodgson, TopQuadrant, Inc.

Irene Polikoff, TopQuadrant, Inc.


DEPARTMENT OF DEFENSE

DoD Enterprise Architecture Reference Model

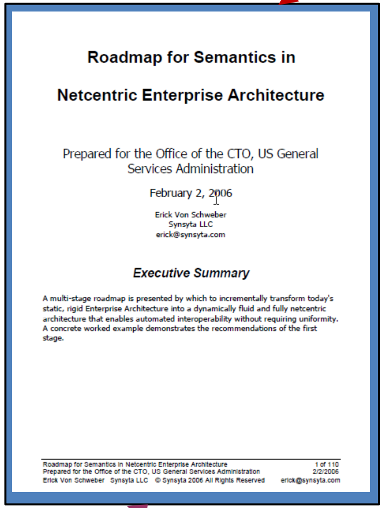
Perspectives on a Unifying Framework for the Federal Enterprise

November 03, 2005

By

Rick Murphy, (richard.murphy@gsa.gov)
George Thomas, (george.thomas@gsa.gov)

In collaboration with the
Roy Mabry
DoD EA Congruence Community of Practice
Between April 2005 - October 2005


Roadmap for Semantics in

Netcentric Enterprise Architecture

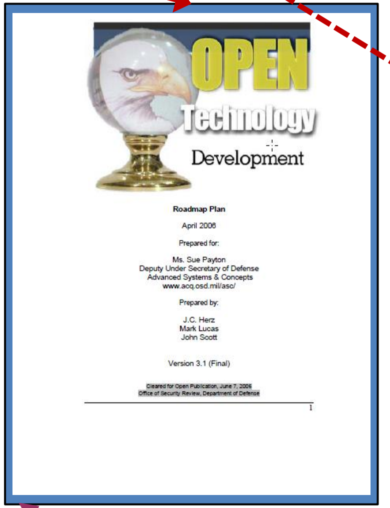
Prepared for the Office of the CTO, US General Services Administration

February 2, 2006

Erick Von Schweber
Synsyta LLC
erick@synsyta.com

Executive Summary

A multi-stage roadmap is presented by which to incrementally transform today's static, rigid Enterprise Architecture into a dynamically fluid and fully netcentric architecture that enables automated interoperability without requiring uniformity. A concrete worked example demonstrates the recommendations of the first stage.



Roadmap Plan

April 2006

Prepared for:

Ms. Sue Payton
Deputy Under Secretary of Defense
Advanced Systems & Concepts
www.acq.osd.mil/asc/

Prepared by:

J.C. Herz
Mark Lucas
John Scott

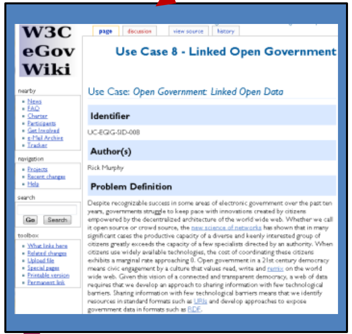
Version 3.1 (Final)


OE-GOV

Ontologies for e-Government

What is oeGOV?

Why build ontologies for eGovernment?


W3C eGov Wiki

Use Case 8 - Linked Open Government

Use Case: Open Government: Linked Open Data

Identifier

Author(s)

Problem Definition

http://www.oegov.org

http://www.acq.osd.mil/jctd/articles/OTDRoadmapFinal.pdf

http://www.w3.org/egov/wiki/Use_Case_8_-_Linked_Open_Government apFinal.pdf

http://colab.cim3.net/file/work/SOACoP/Roadmap%20for%20Semantics%20in%20Netcentric%20Enterprise%20Architecture.pdf

http://cio-nii.defense.gov/docs/20051102-GSA_DoD_Ontology_final.pdf

2001 – Birth of TopQuadrant

Formed in 2001, TopQuadrant is a well-established tools, products, solutions, training, ontology development and consulting company with more than 100 person years experience in Semantic Web Technologies.

Training

TopQuadrant has trained many people in Semantic Web Technologies perhaps more than any other company in the world.

Tools

TopQuadrant has the leading RDF, OWL and SPARQL tool suite that integrates with a number of triple stores and databases, including ORACLE-11G.

Platforms and Solutions

TopQuadrant has a semantic platform, a rapid application builder, and solutions for vocabulary and metadata management

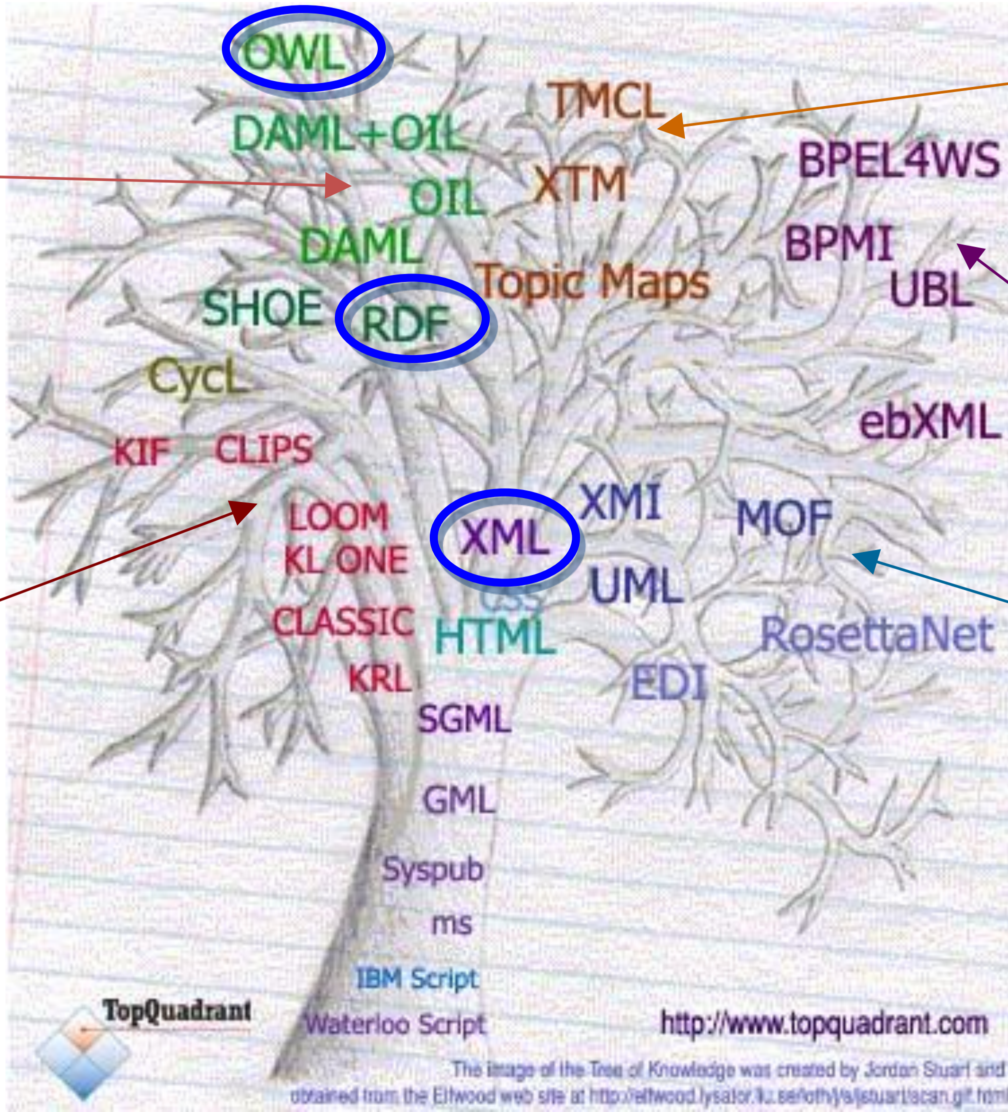
Consulting

TopQuadrant has consultants that have worked, both in TQ and in previous companies (notably IBM), on many consulting projects. At TQ we do: Jumpstarts, Competency Development, Solution Envisioning Workshops, Ontology Modeling, Semantic Application Development

2001 – Helping People Make Sense of Semantic Web Technologies

Semantic Technology Languages

AI Knowledge Representation

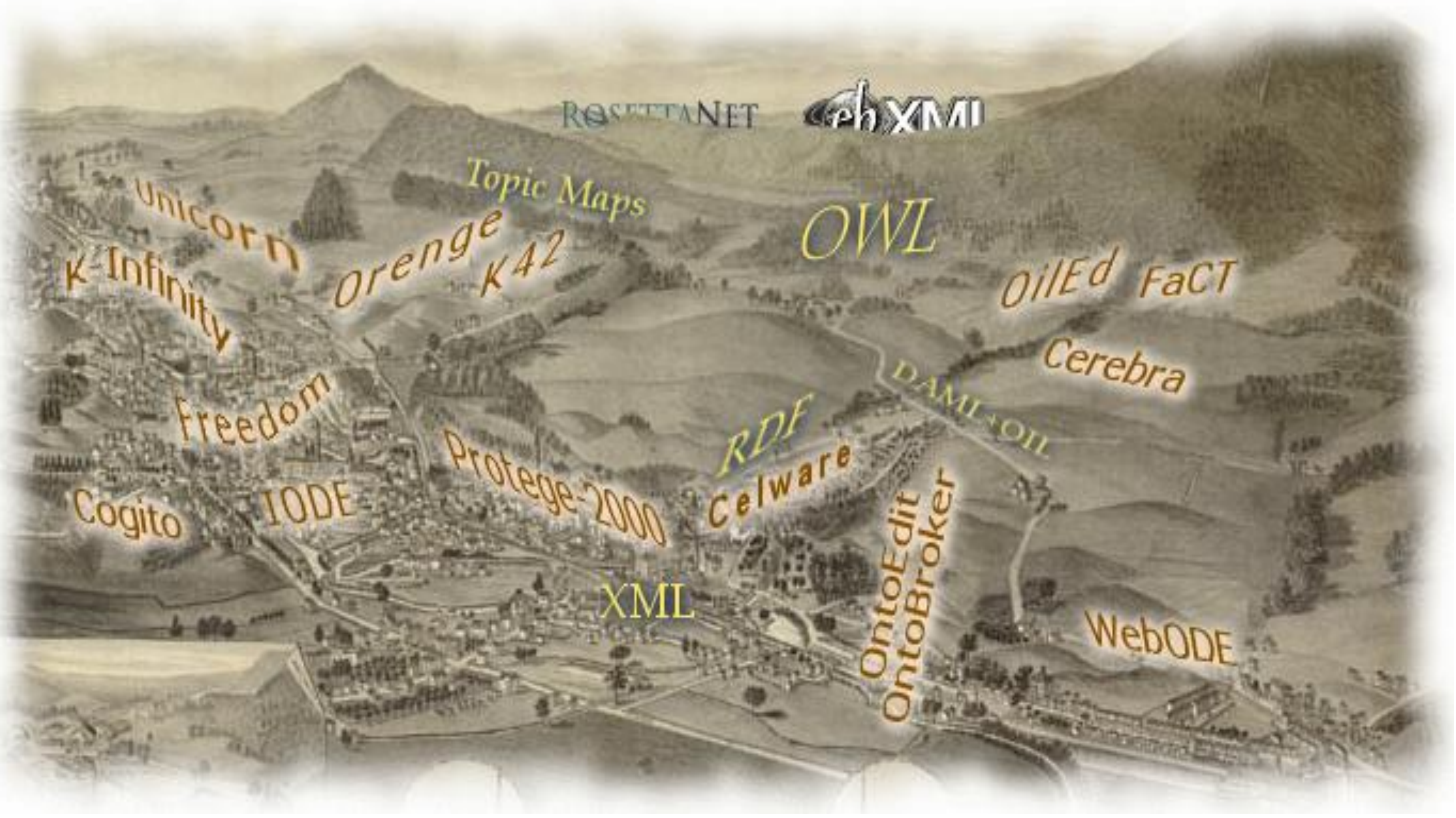


Content Management Languages

Process Knowledge Languages

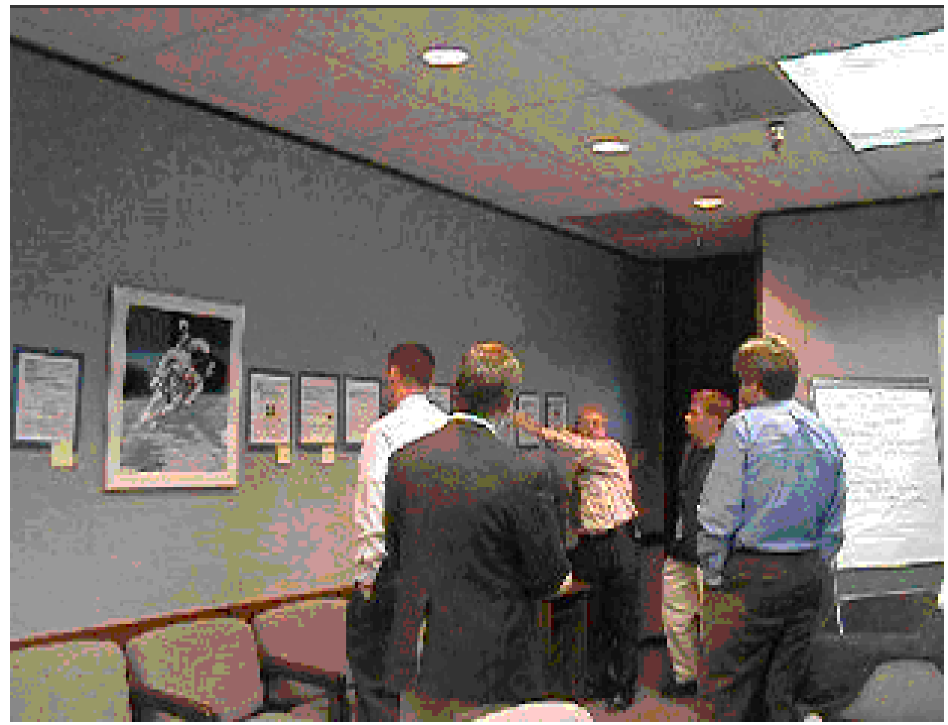
Software Modeling Languages

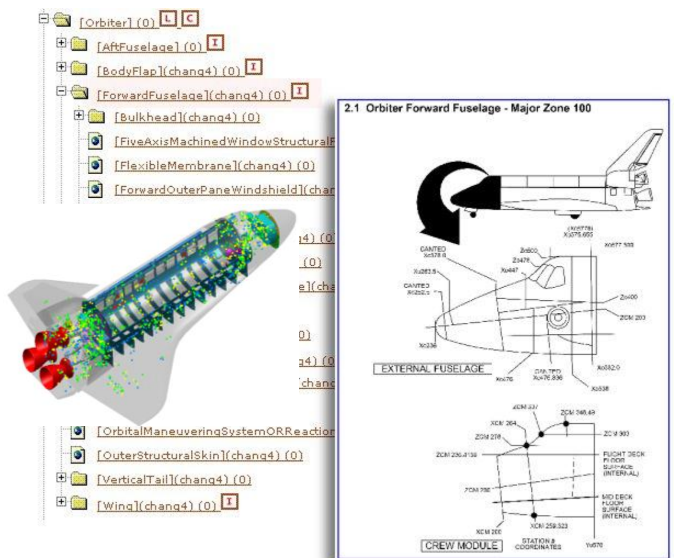
2002 - Terrain



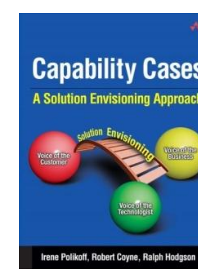
2002 – Digital Shuttle Project

“We never know exactly what we want …

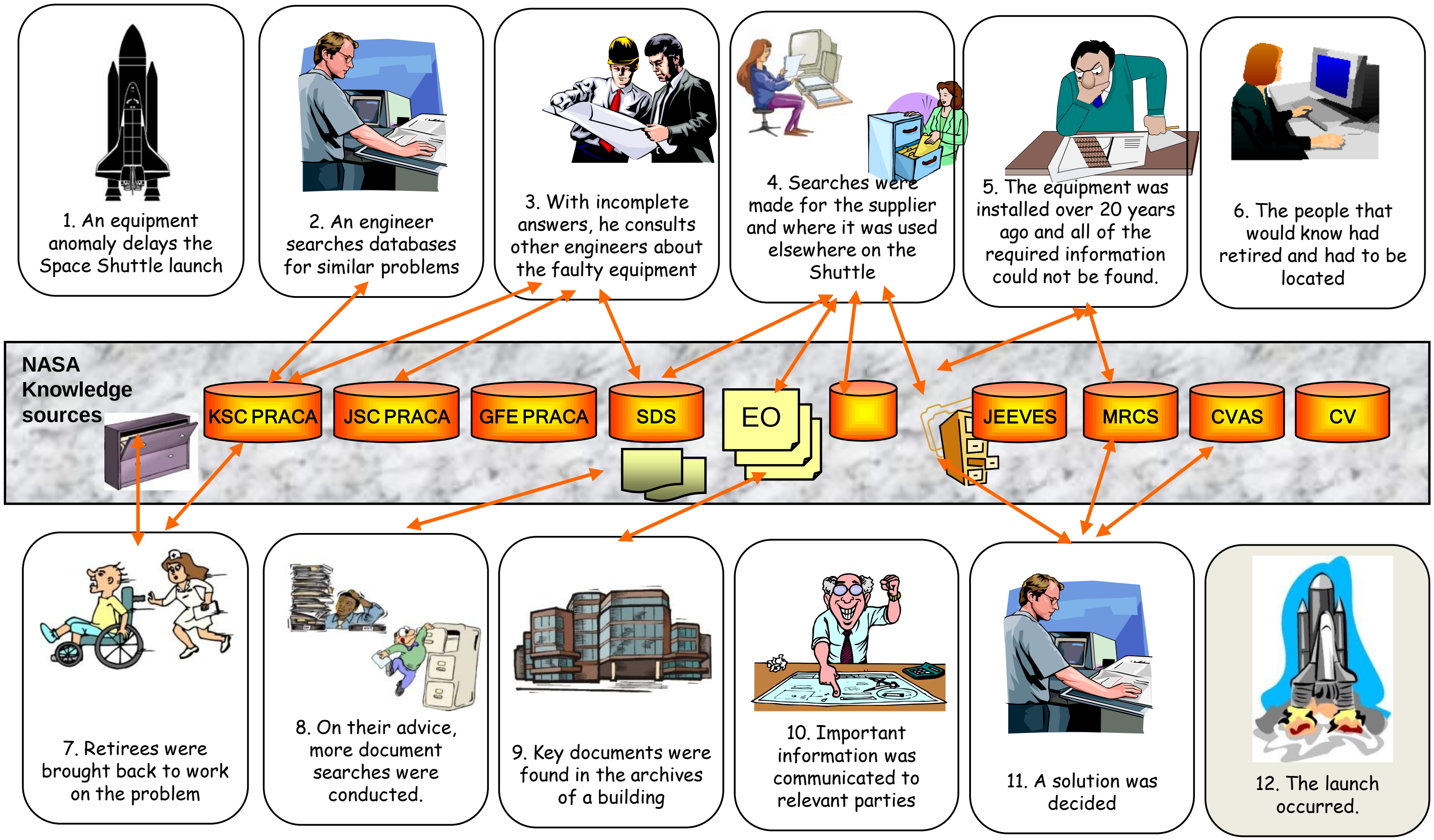




… until we see what is possible.”



2002 Illustrative Scenario – Leaking Valve

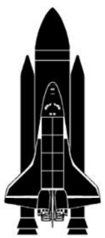


Disclaimer

This scenario is fictitious and is not based on any actual occurrences on the Space Shuttle. It is inspired by the movie entitled "The Space Cowboys".

2002

Future Scenario – Leaking valve is discovered on STS-nnn



1. Leaking valve delays Shuttle launch

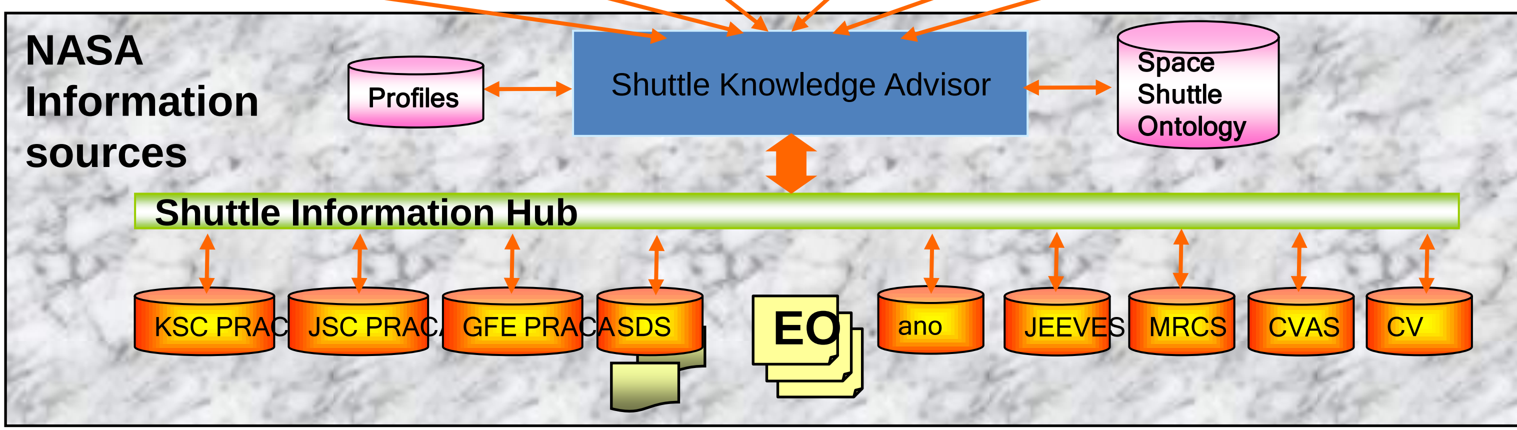
2. Engineer asks the Knowledge Advisor about the valve that is leaking – has it happened before? System reports previous incidents.

3. Engineer asks who supplied the valve, relevant Engineering Orders (EOs) and Drawing numbers also where the valves are used

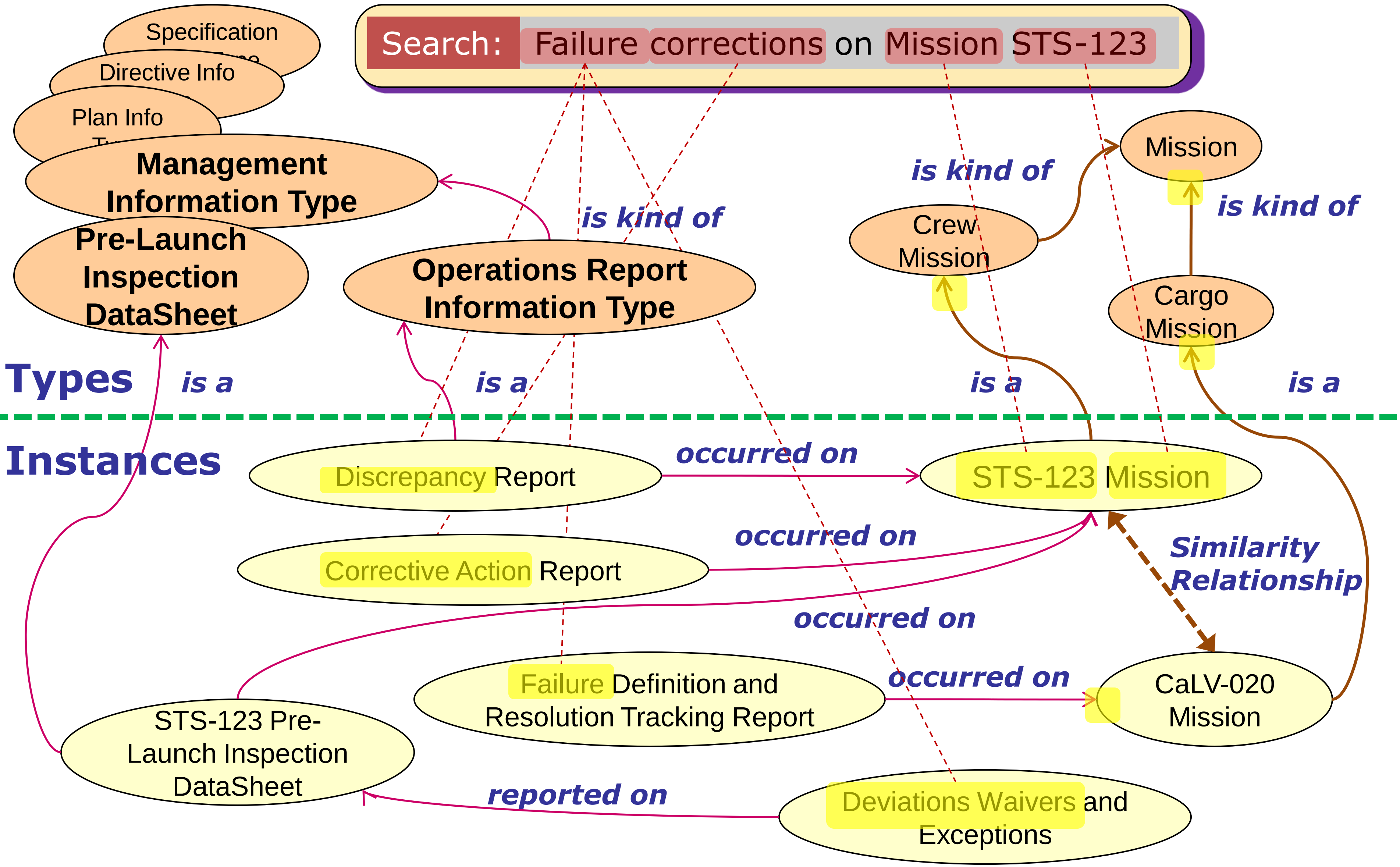
4. Engineer determines what needs to be done to replace the valves

5. New EOs are raised and the problem is fixed

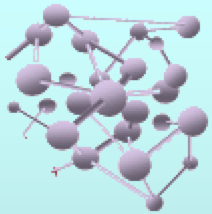
6. Shuttle mission is ready for launch



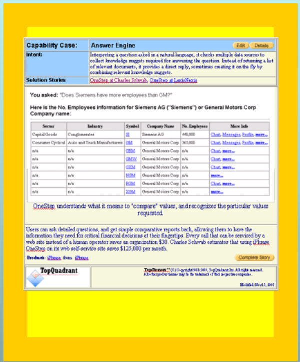
Context/Concept-Based Search finds information based on similarity measures

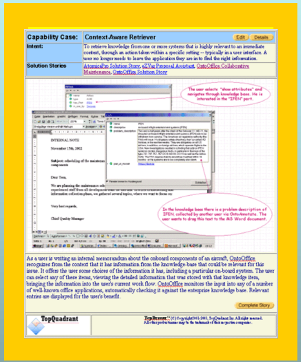


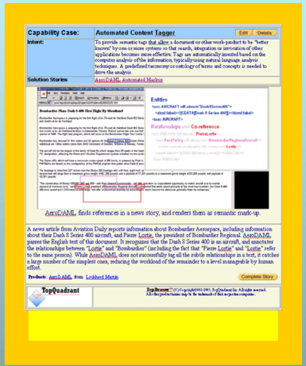
2003

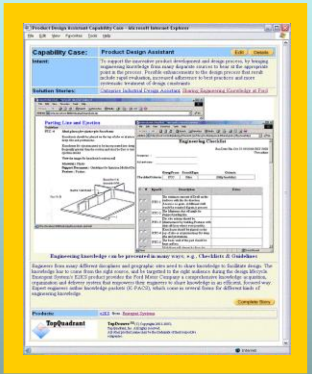


"Semantic Technologies for e-Government"
White House Conference Center,
Washington D.C., September 8th, 2003

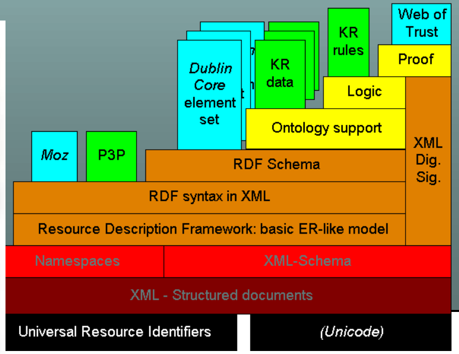








Keynotes
Capability Cases Gallery
Panel Sessions



Brief History of TQ's in RDF/OWL for Semantic-Enabled Enterprise Architecture

2002 2004 2006 2008 2010

Capability Cases

FAA

FEA-RMO

OSERA

NASA NExIOM

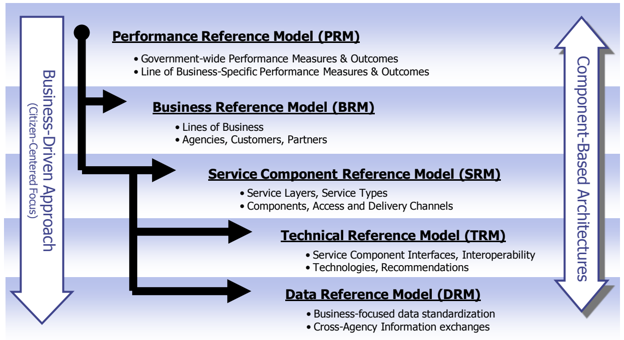
NATO

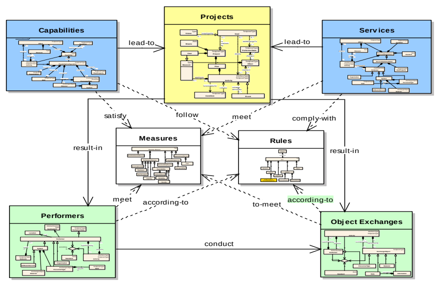
DoDAF

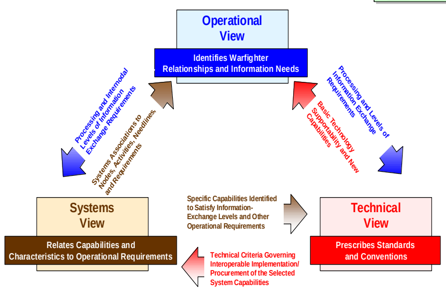
BEA

CCTS

oeGOV

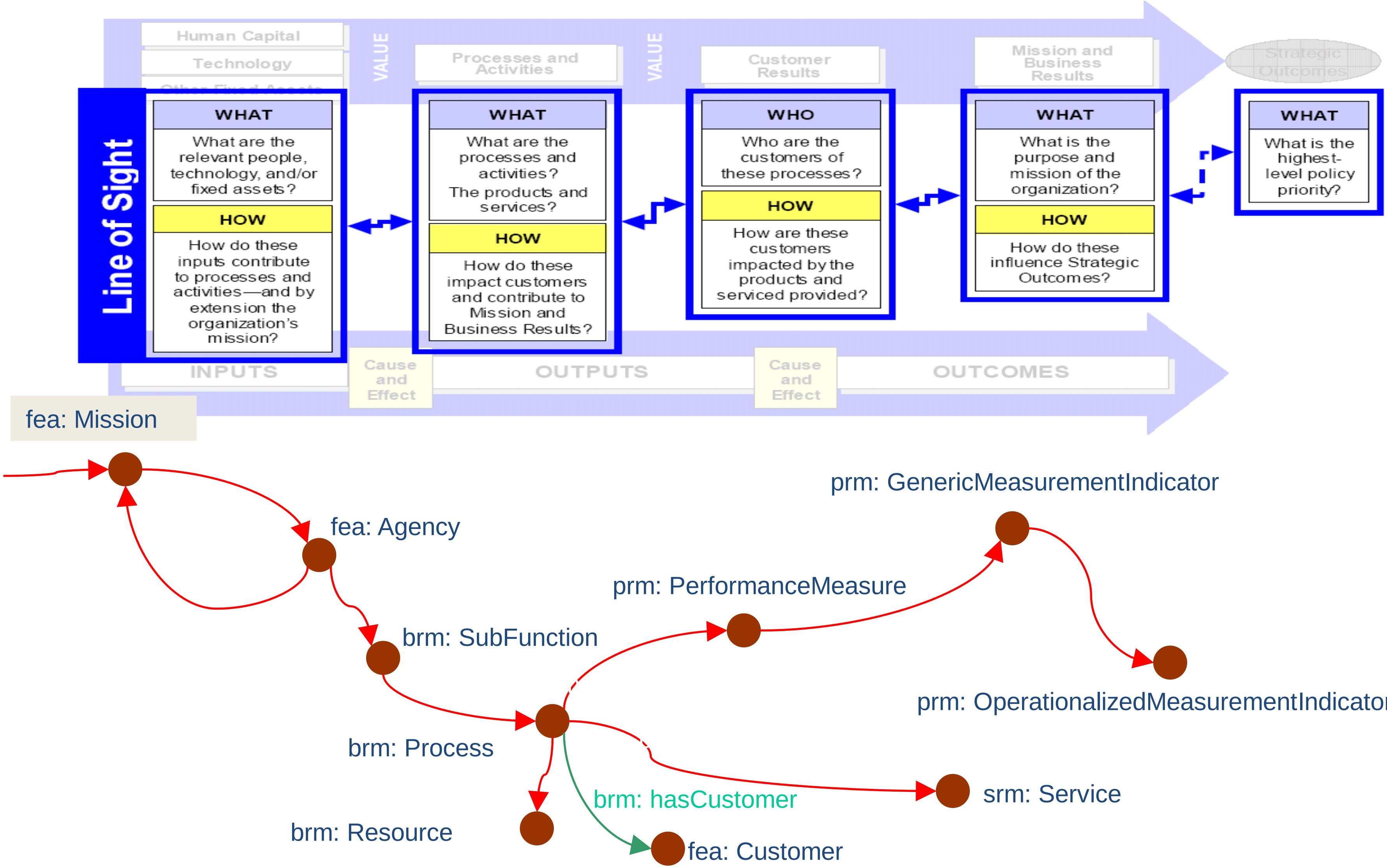






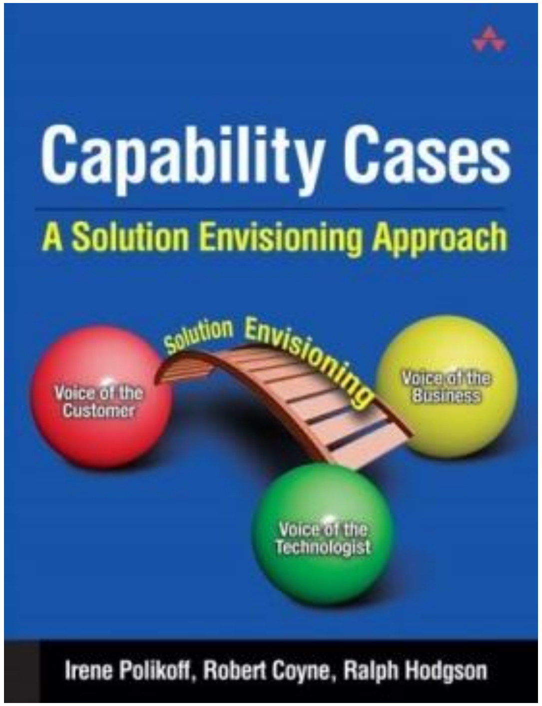
References: (1) SKOS-based FEA-RMO Ontologies are at http://www.oegov.us/blog/?page_id=102
(2) oeGOV ontologies are at http://www.oegov.us

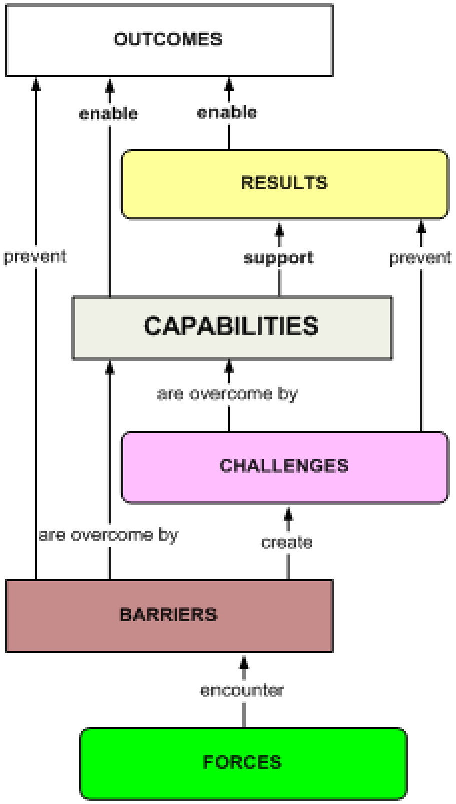
2004 - FEARMO



Human Capital
Technology
Other Fixed Assets
VALUE
Processes and Activities
VALUE
Customer Results
Mission and Business Results
Strategic Outcomes
Line of Sight
WHAT
What are the relevant people, technology, and/or fixed assets?
HOW
How do these inputs contribute to processes and activities—and by extension the organization's mission?
WHAT
What are the processes and activities?
The products and services?
HOW
How do these impact customers and contribute to Mission and Business Results?
WHO
Who are the customers of these processes?
HOW
How are these customers impacted by the products and serviced provided?
WHAT
What is the purpose and mission of the organization?
HOW
How do these influence Strategic Outcomes?
WHAT
What is the highest-level policy priority?
INPUTS
Cause and Effect
OUTPUTS
Cause and Effect
OUTCOMES
fea: Mission
fea: Agency
brm: SubFunction
brm: Process
brm: Resource
brm: hasCustomer
fea: Customer
prm: PerformanceMeasure
prm: GenericMeasurementIndicator
prm: OperationalizedMeasurementIndicator
srm: Service

2004





Need Strategy

Solution Outcome

www.capabilitycases.org

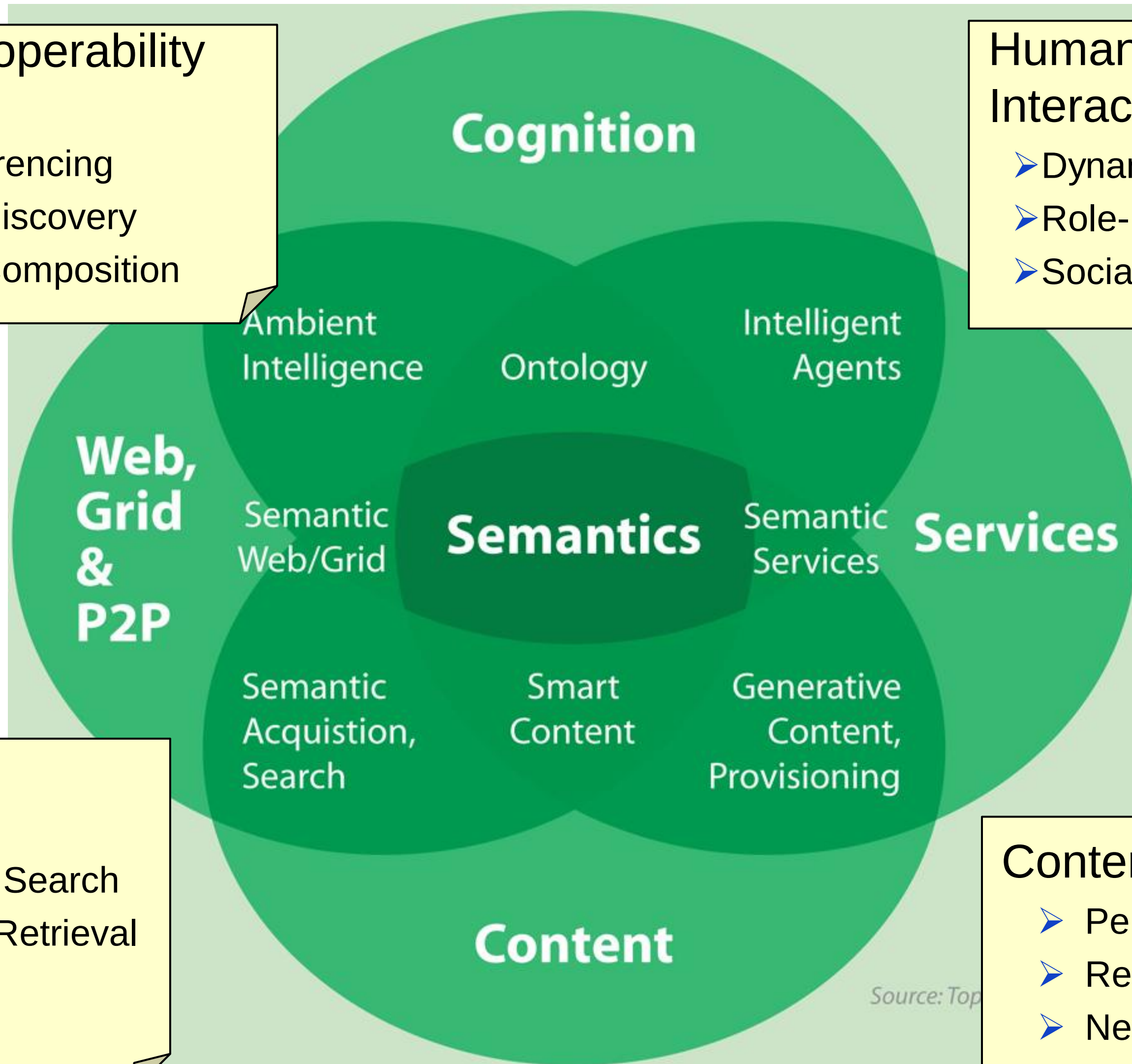
2005

Semantic Interoperability

- Data Integration
- Information Inferencing
- Web Services Discovery
- Web Services Composition

Human-Computer Interaction

- Dynamic User Interfaces
- Role-Based Portals
- Social Networks



Advisors

- Design Assistants
- Matchmakers
- Recommenders
- Mediators

Knowledge Management

- Concept-Based Search
- Context-Aware Retrieval
- Expert Locators
- Collaboration

Content Management

- Personalized Information
- Repurposing
- News feeds
- Markup

2005 – Connecting FEA and DoD Models

Agency-specific extensions shown "green"

FEA Registry

DOD
FEA
DOD

Performa[nce RM]

Measurement Area (4)
Measurement Category (49)
Measure Of Effectiveness (188)

Business RM

Business Area (4)
Line of Business (39)
Subfunction (156)

Service Component RM

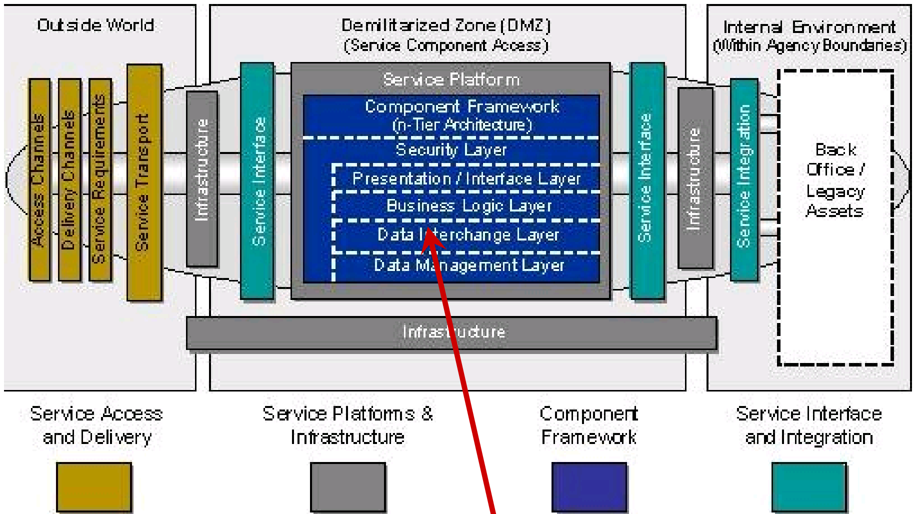
Service Domain (7)
Service Type (29)
Service Component (168)

Technology RM

Service Area (4)
Service Category (18)
Service Standard (54)
Service Specification (214)

include descriptions in search

Search



Identification Friend or Foe (IFF)

The primary function of Identification Friend or Foe (IFF) is to establish the identity of all friendly systems within the surveillance volume of surface-to-air, air-to-air, and some air-to-ground Weapon System platforms. The need for friend identification is to permit tactical action against all foe (non-friendly) systems and to avoid tactical action against friendly systems. This need is a key element in modern combat, as an object detected by a sensor, even beyond visual range, has to be identified and classified as early as possible so that, if necessary, either an appropriate defense can be prepared against the foe or that steps can be taken to prevent the friend from being engaged/ attacked by friendly forces.

Data Interchange Service Standard

* = agency specific

Data Exchange

Computer Graphics *
Digital Audio and Video *
Digital Media *
Electronic Business using XML
Identification Friend or Foe *
Internationalization *
Resource Description Framework
Simple Object Access Protocol
Spatial Imagery *
Tactical Information Exchange *
Voice Encoder *
Web Services User Interface
XMI
XML Digital Signature *
XML Forms *
XML Path Language *
XQuery

Hot links to TRM areas

2005 – Searching FEA and DoD Model Differences

2005 – OARS and SAPPHIRE

TopQuadrant

SAPPHIRE Project

Situation-**A**ware **P**revention of **P**ublic **H**eath **I**ncidents using **R**easoning **E**ngines

Systematic and Continuous Collection, Analysis, Interpretation, and Dissemination of Diagnostic and Pre-Diagnostic Data for use in Timely and Sensitive Detection of Public health Incidents (Bioterrorism or Natural) to Reduce Morbidity and Mortality by Better Response Planning and Coordination.

The Center for Biosecurity and Public Health Informatics Research

University of Texas, Houston

Navigate *Sapphire_OA*

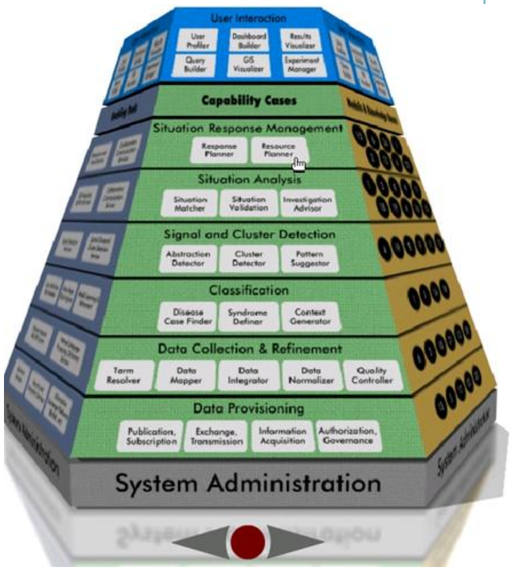
- [CompetencyQuestion] (34)
- [OntologyAccessRight] (3)
- [OntologyArchite
- [OntologyQuality]
- [OntologyVintage
- [Representation]
- [Scenario] (1)
- [Stakeholder] (11
- [SubjectArea] (7)
- [WebEntity] (53)
  - [Ontology] (47)
  - [Organization] (6
  - [Project] (0)
  - [Resource] (4)

Browse CompetencyQuestion (34 total)

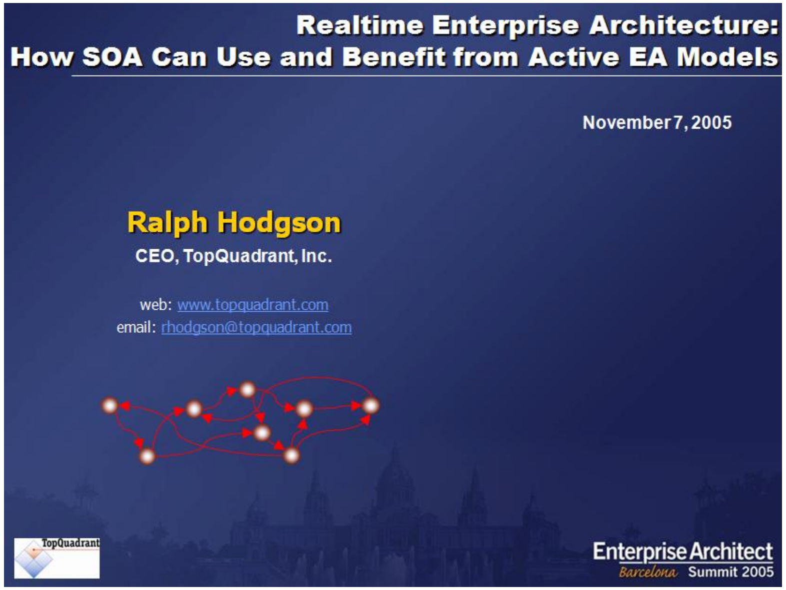
- [Case Finding Syndrome Definition]
- [Contextualized Access to PHP services and Information]
- [Contextualized selection of statistical and mathematical functions]
- [Contextualized System Behavior]
- [Controlled Smart User interaction]
- [Cross Domains Investigation]
- [Customizable Communication Plan]
- [Dynamic composition and orchestration of services for novel tasks]
- [Dynamic Mapping Across Taxonomy Systems]
- [How System Events are Associated with Authorities]
- [How to deal with contradictory data]
- [How to deal with erroneous incidents]
- [How to distinguish bioterrorism from natural event]
- [How to Distinguish Disorders]
- [Identify Appropriate Response]
- [Impact Analysis]
- [Is this a potential act of Terrorism]
- [Is this incident explained by historic or cultural or social events]
- [Local determinants of PH]
- [Natural Language Processing]

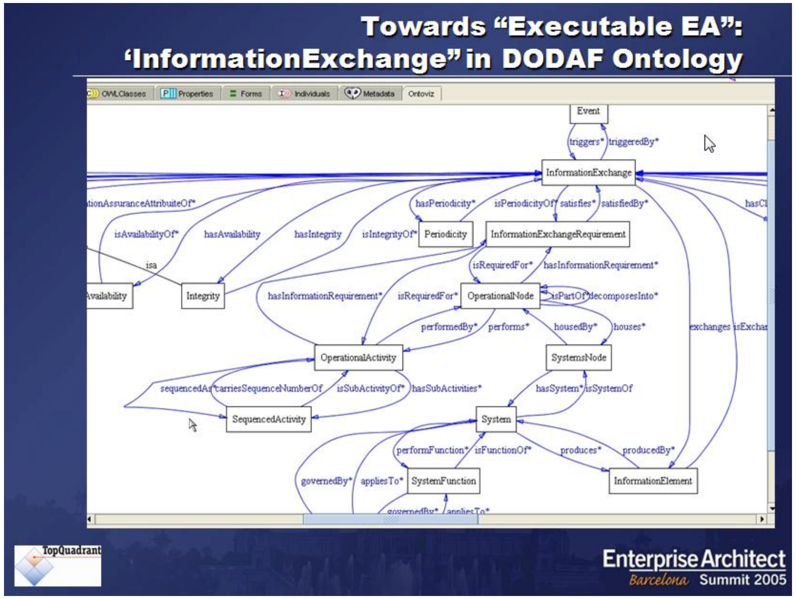
Browse Stakeholder (11 total)

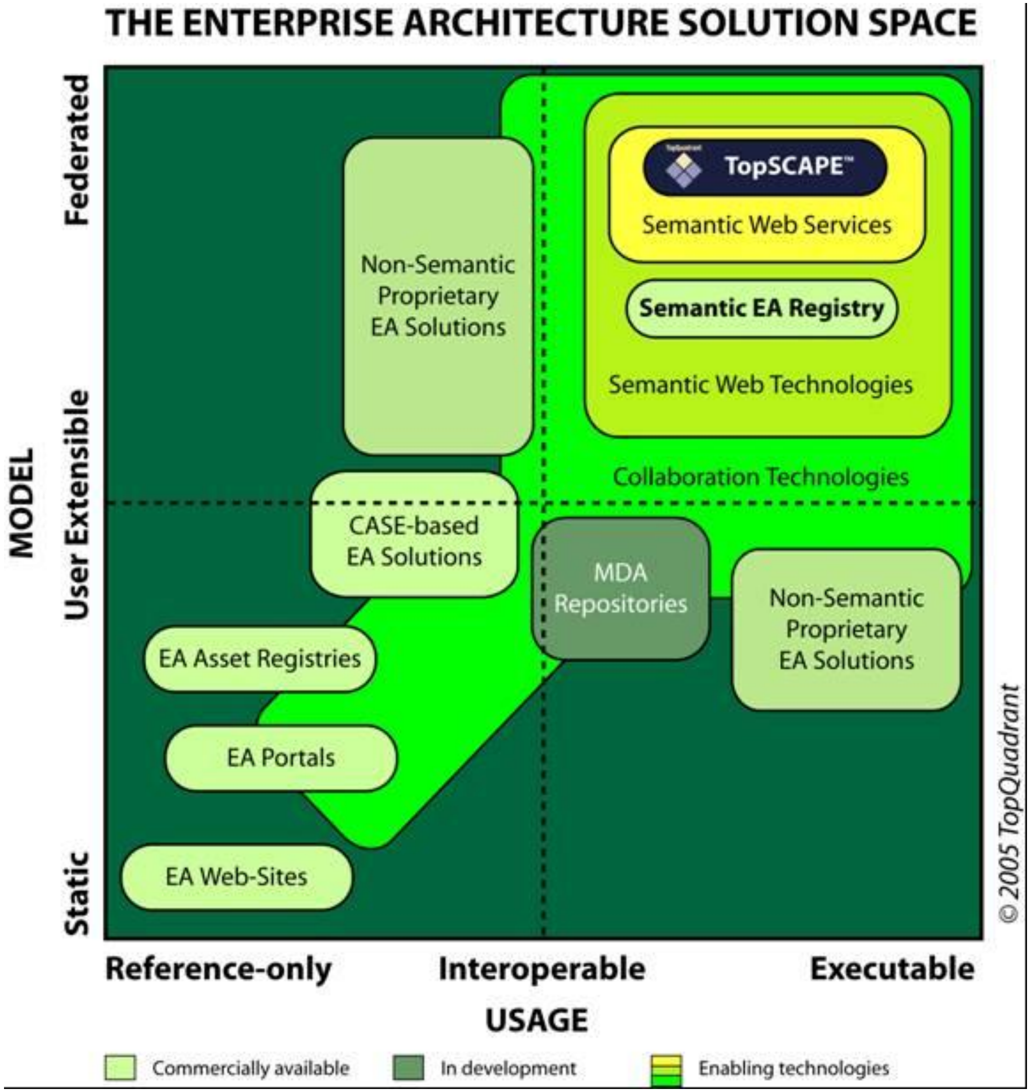
- [CDC]
- [DoD]
- [EPA]
- [FEMA]
- [HCP Hospitals]
- [Houston Dept of Health]
- [Memorial Herman Health Care System]
- [NASA JSC]
- [TATRC]
- [UT Office of Biotechnology]
- [UT School of Health Information Sciences]



2005 – SOA, EA, DoDAF and Semantic Technology





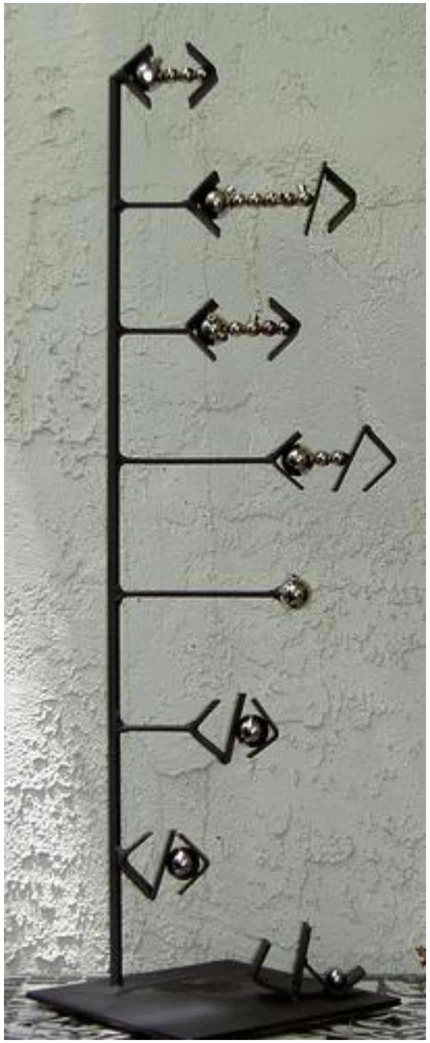


2006

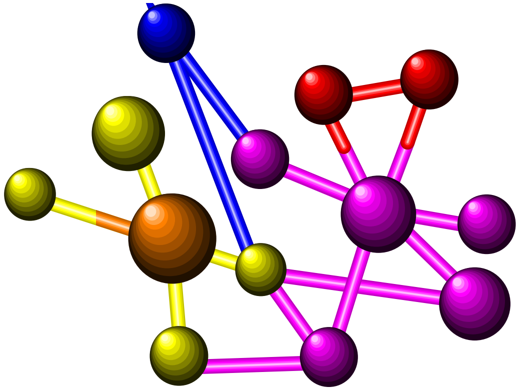
source: “Time Flies” image - http://positivecoachmaryellen.wordpress.com/2011/01/

2007

from hierarchies



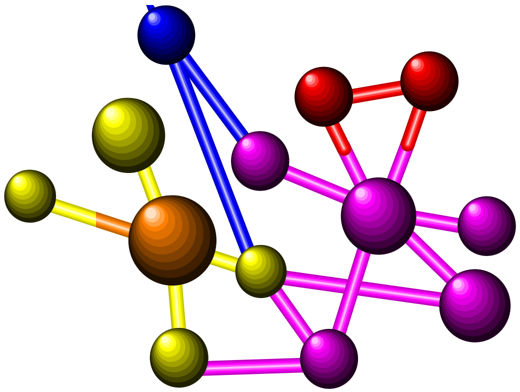
to Graphs



from Graphs

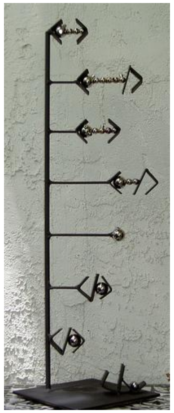
to hierarchies

2008



from Graphs

to Documents



to XML

The National Aeronautics and Space Administration

Presents the

Group Achievement Award

to

Computing Systems and Interoperability SIG

For the extraordinary contributions and achievements which led to the Constellation Program's successful System Requirements Reviews and Program Baseline Sync-point.

Ralph Hodgson

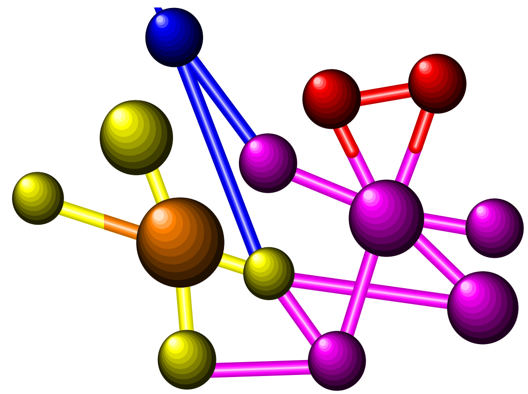
Signed and Sealed at Washington, DC this eighth day of May Two Thousand Eight

Administrator, NASA

TopQuadrant™

2009

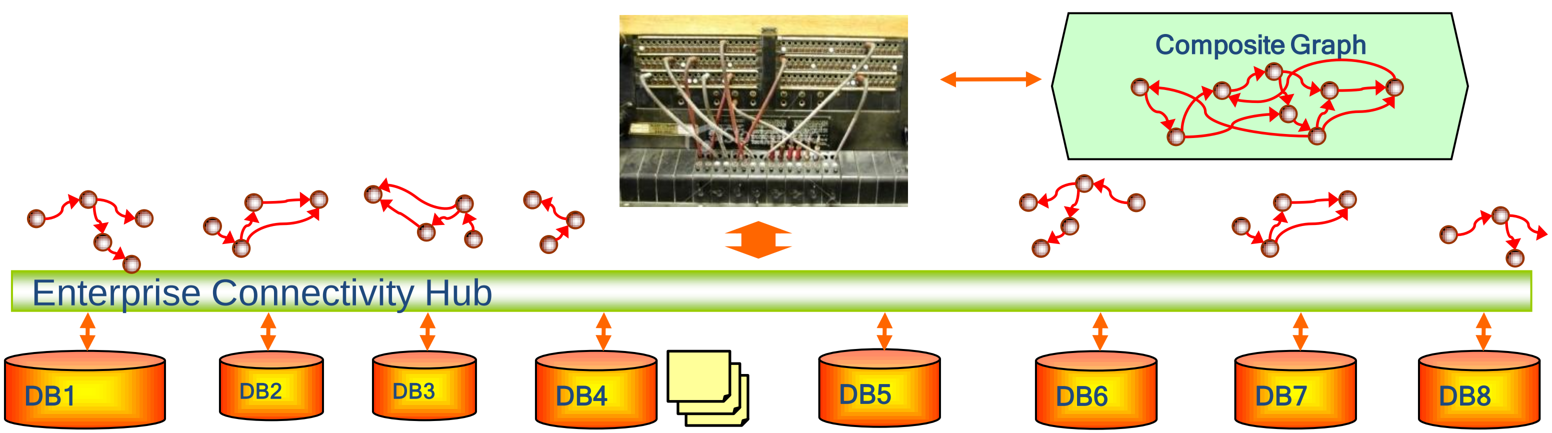
from databases and spreadsheets



to Graphs

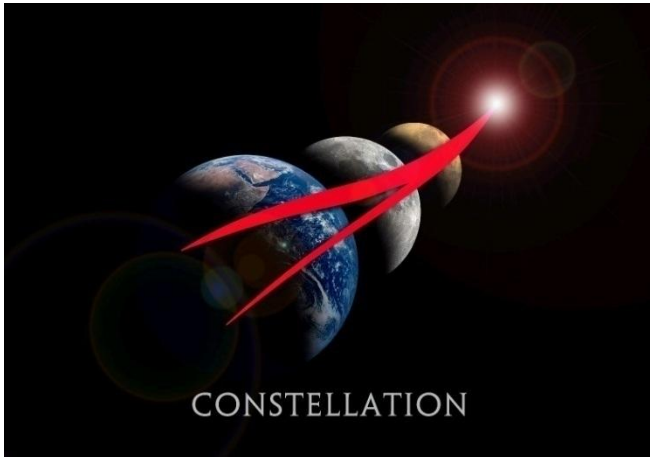
Query Brokering through an Ontology-Driven "Switchboard"

Different Data in Different Places

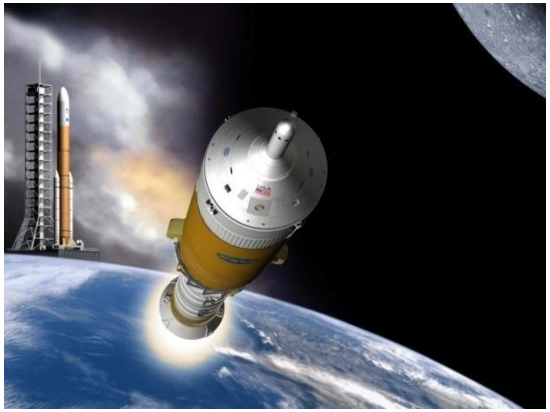


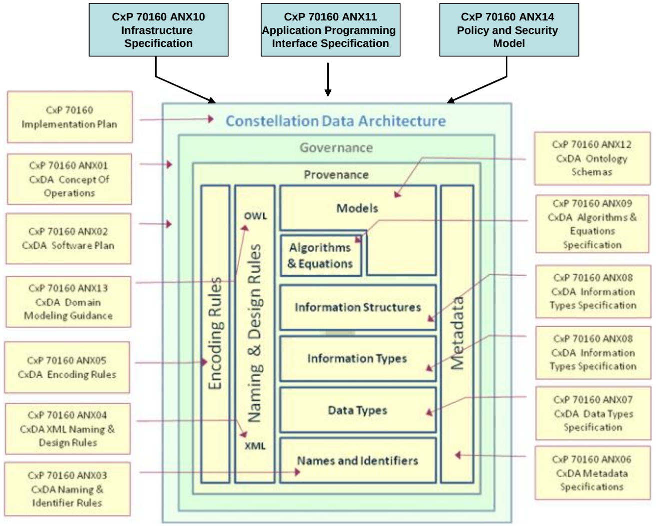
NASA NExIOM, QUDT, TCMX and Information Architecture Ontologies

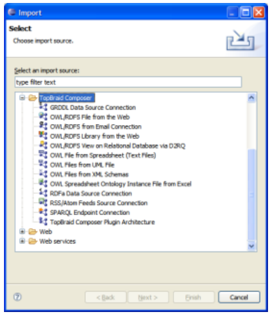
NASA Constellation Program

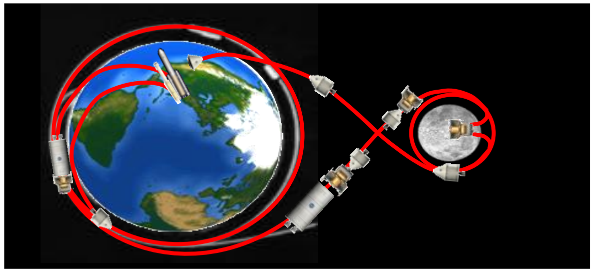


Constellation Program Data Architecture and Interoperability through the use of OWL Ontologies with strategies for co-existence with XML and other data formats.

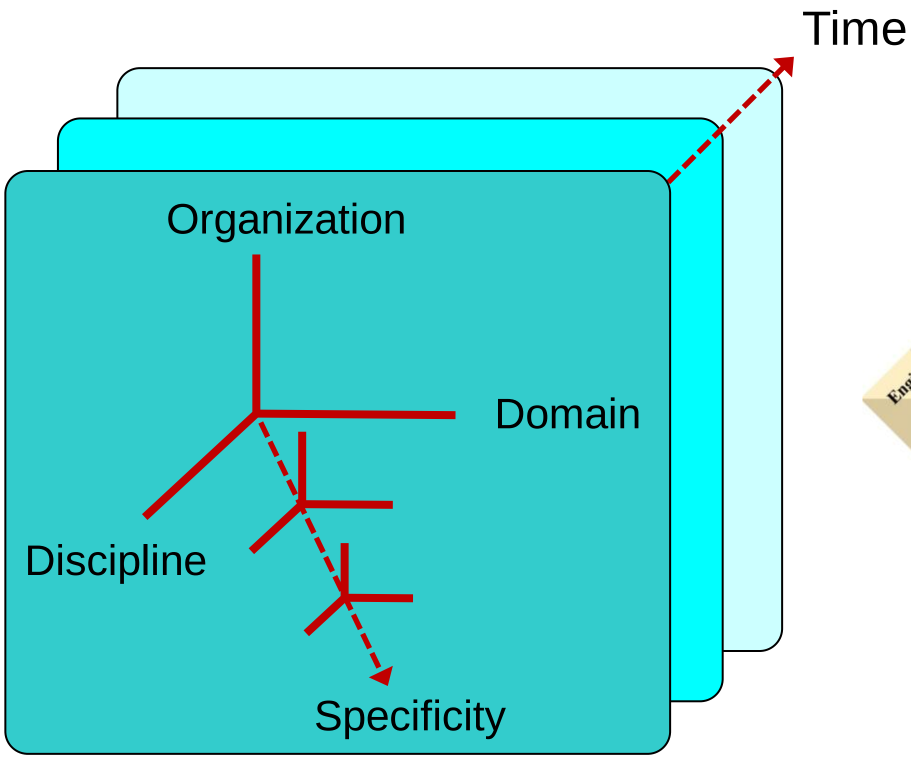


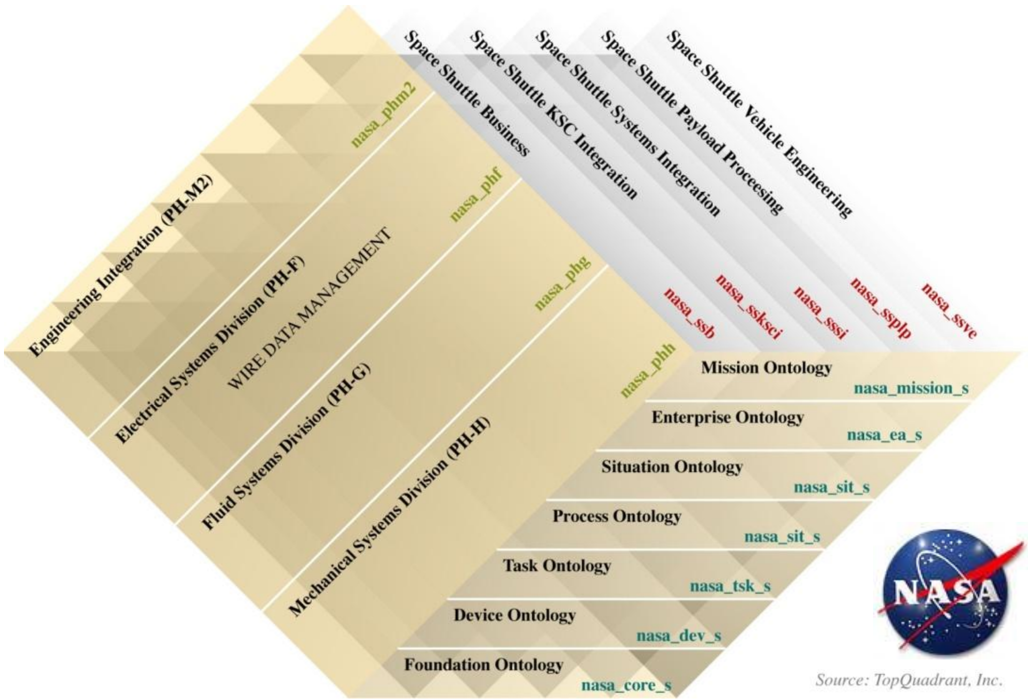






Key to Success is an Ontology Architecture – Five Dimensions turned out to be important

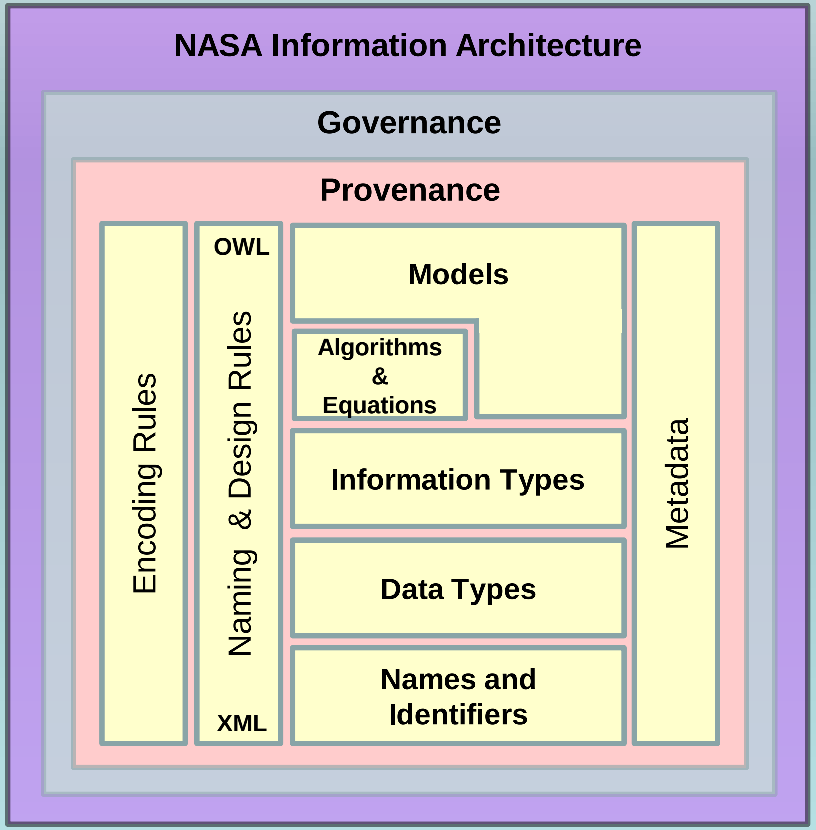




- Ontologies partitioned by domains, disciplines, organizations, specificity and time;
- Named graphs aggregated using configuration ontologies according to need;
- Three other dimensions also important: aspect, viewpoint and perspective.

Information Architecture

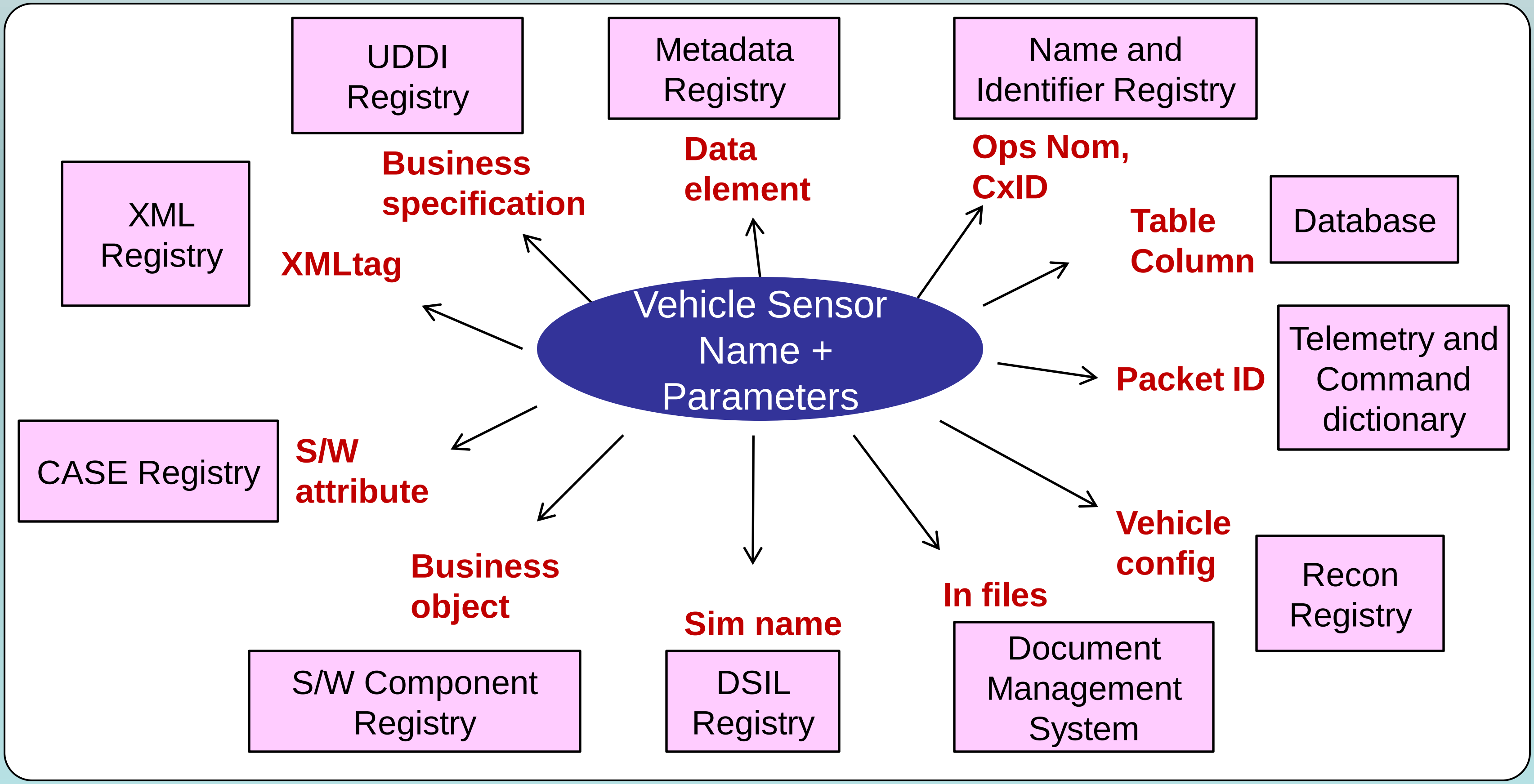
Information architecture (IA) defines a model, processes and services for how information is represented, governed and used in systems, applications, databases, documents and activities in order to ensure compliance to naming and identifier rules, standard data and information types, controlled vocabularies and coding schemes.



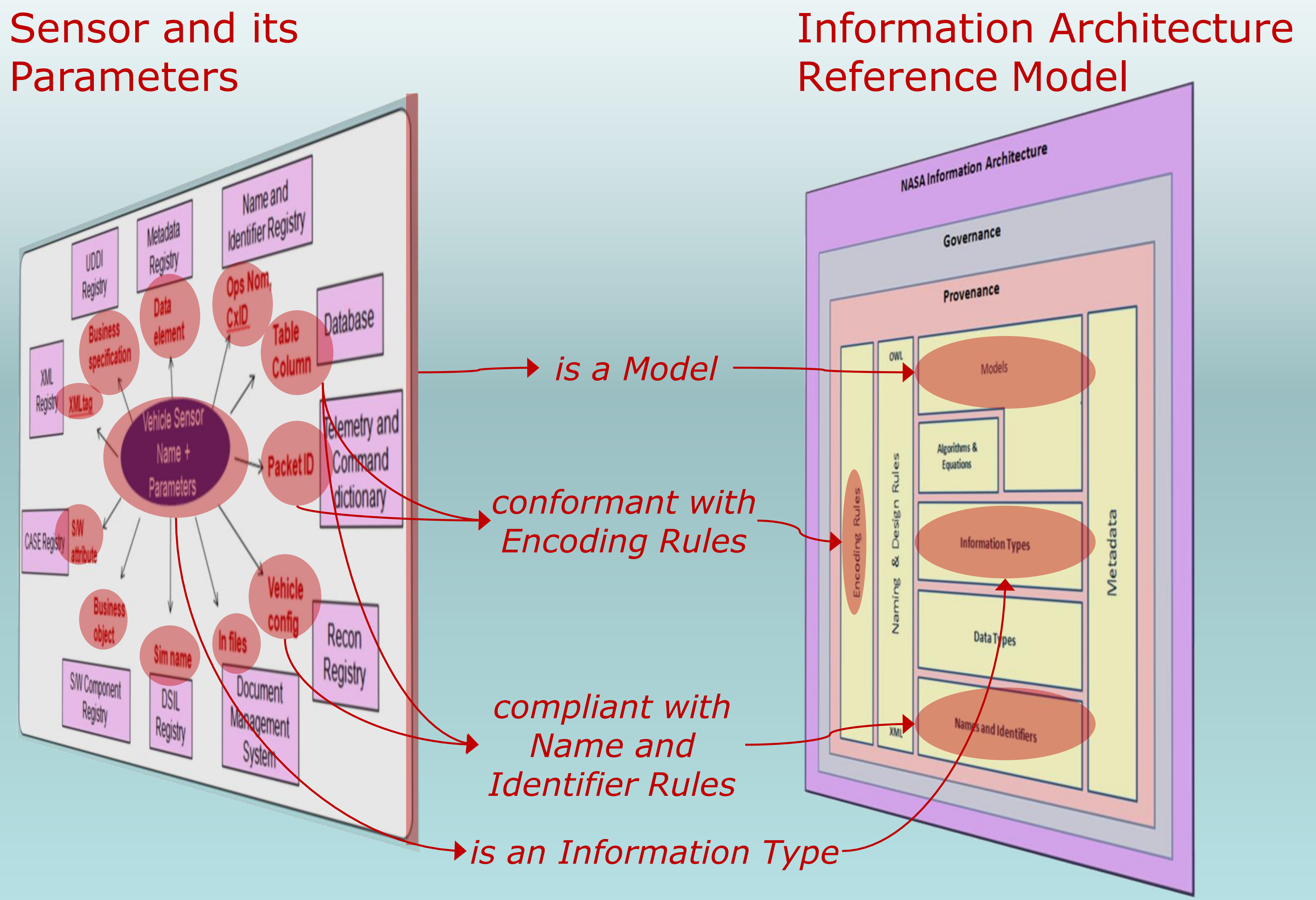
> "Among these activities are library systems, Content Management Systems, web development, user interactions, database development, programming, technical writing, enterprise architecture, and critical system software design. Information architecture has somewhat different meanings in these different branches of IS or IT architecture. Most definitions have common qualities: a structural design of shared environments, methods of organizing and labeling websites, intranets, and online communities, and ways of bringing the principles of design and architecture to the digital landscape.

Operational Roles of an Information Architecture

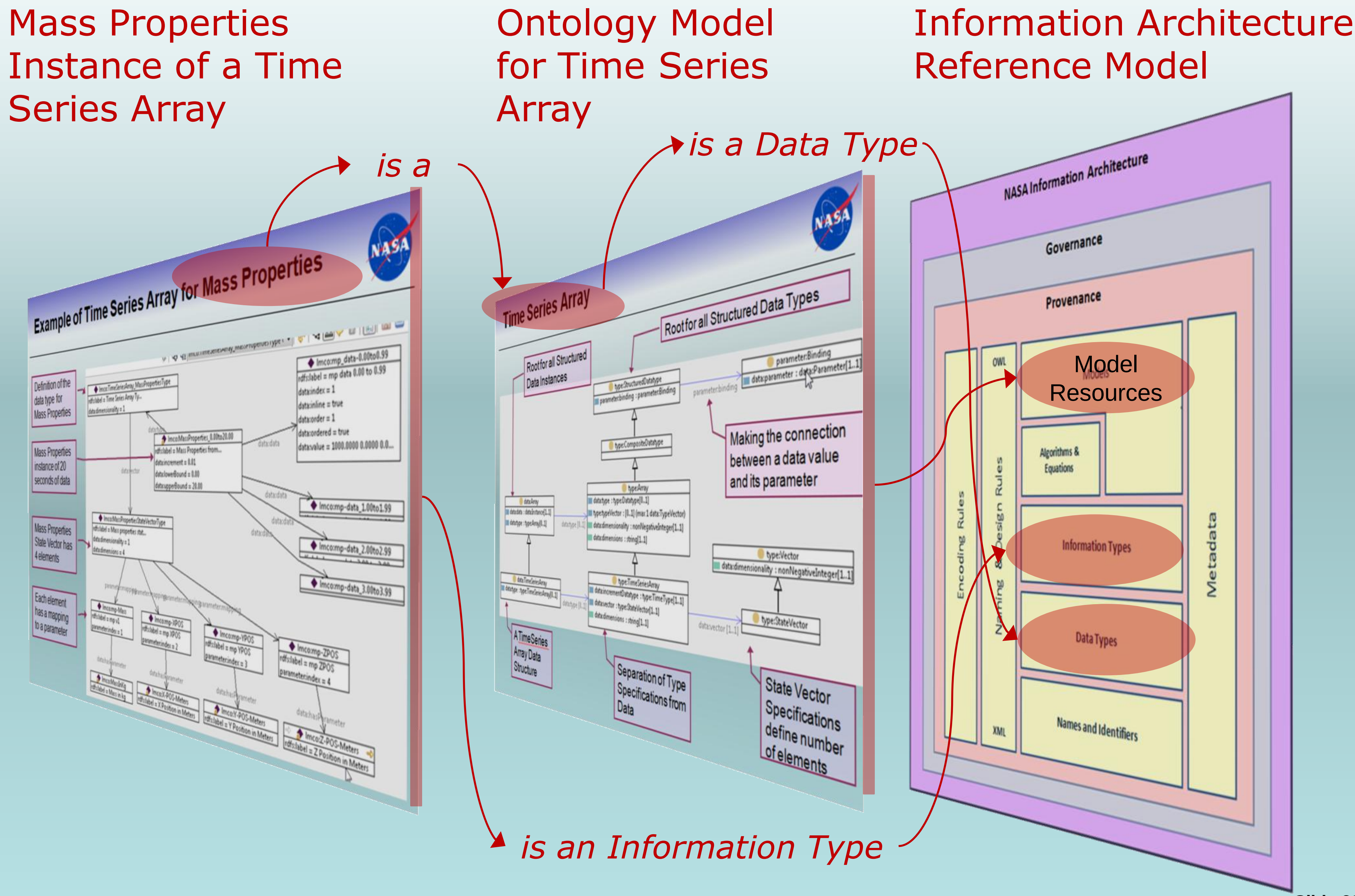
IA serves as a “Rosetta Stone” for finding authoritative information. Instead of reading documents, specifications of models and schemas can be queried by both software and people. For example, a Sensor and its parameters is named and encoded differently across systems and applications.



IA resolves the meanings of all Sensor information objects irrespective of their locality.



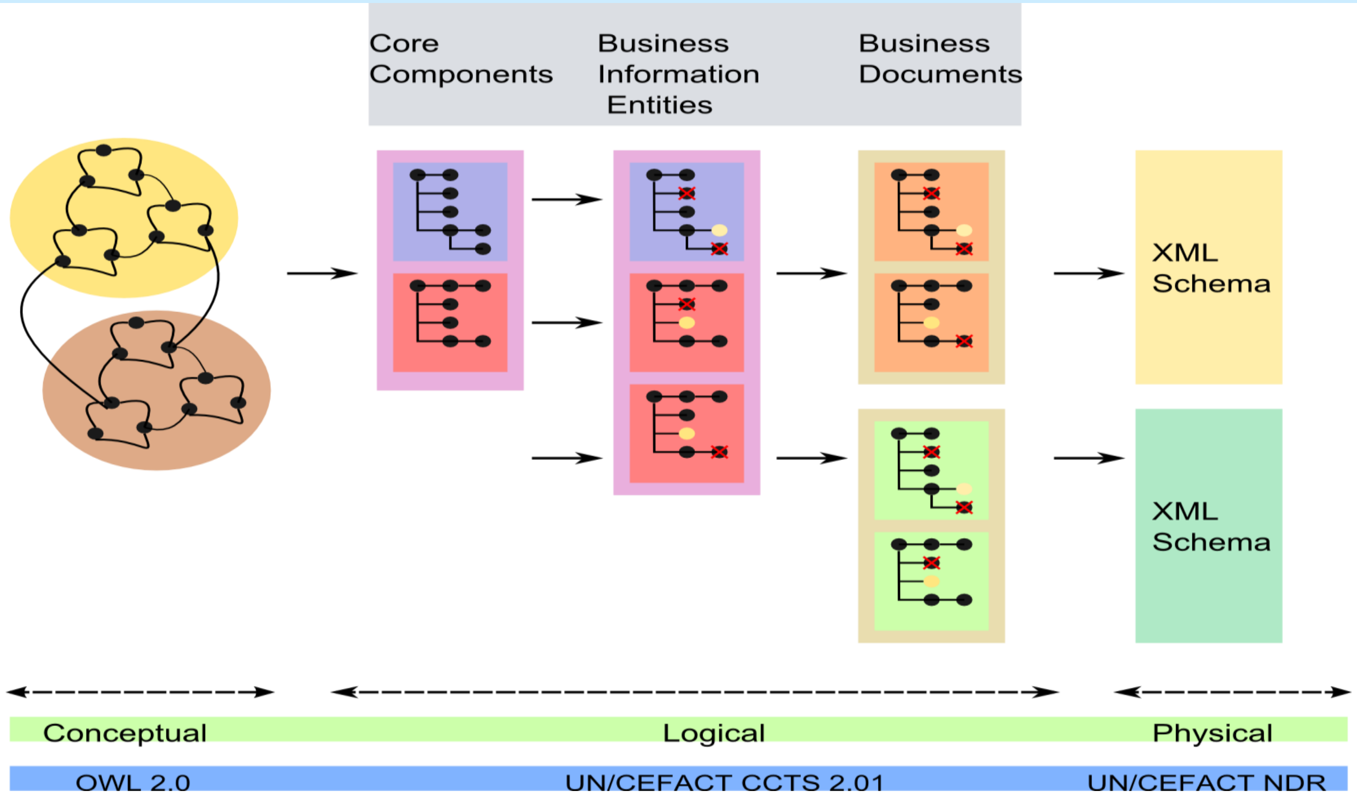
IA and Ontologies, Time Series Array Example: Mass Properties



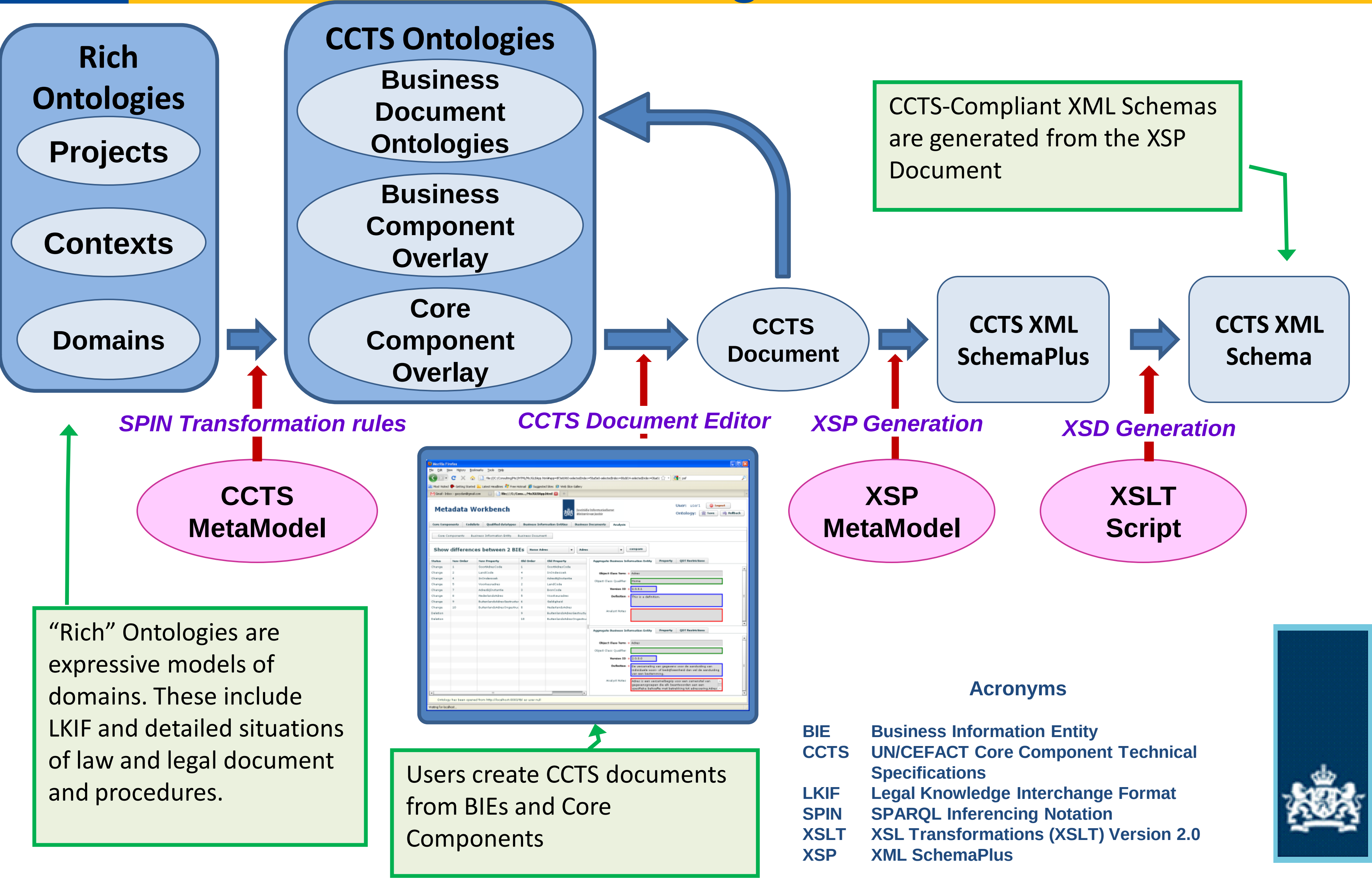
Netherlands MoJ Approach to Message Design for Interoperability

Problem: Seamless information sharing is challenging:
Data resides in many diverse systems supporting unique operation requirements of courts, police, hospitals, border control, motor vehicle, local and federal offices.

Solution: Ontology-Based Metadata Workbench:
Transform "Rich" Ontologies into CCTS Ontologies and allow Business Analysts to assemble business documents for electronic messages from Component Parts.



Netherlands MoJ – Creation of XML Message Schemas



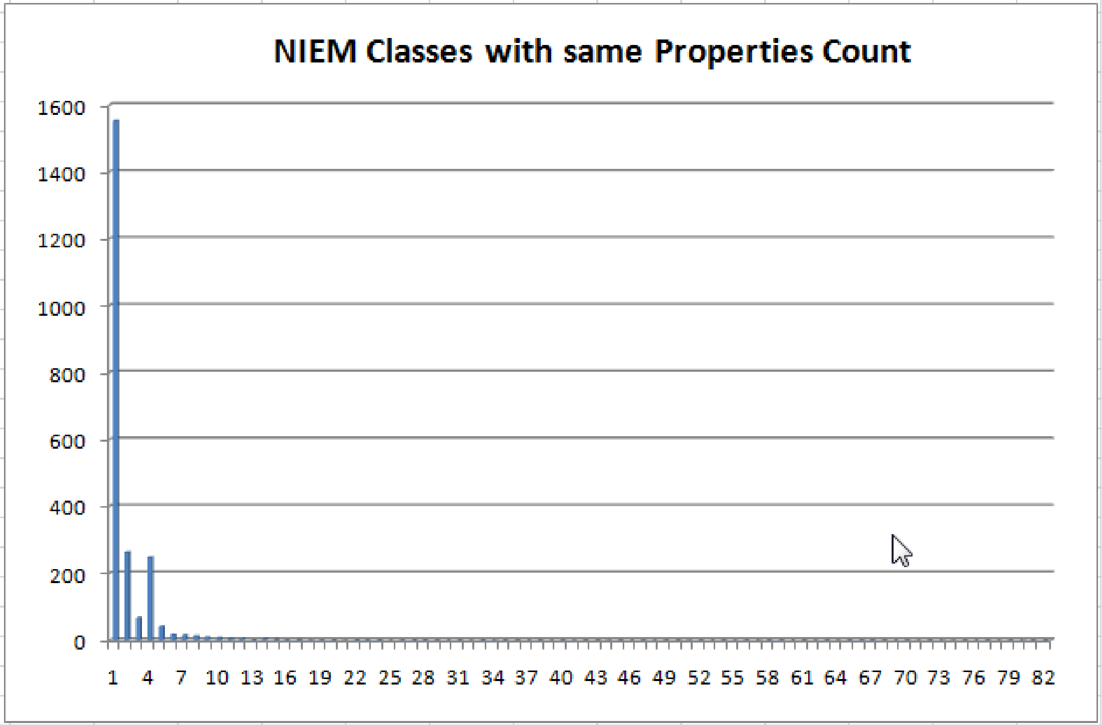
Acronyms

BIE	Business Information Entity
CCTS	UN/CEFACT Core Component Technical Specifications
LKIF	Legal Knowledge Interchange Format
SPIN	SPARQL Inferencing Notation
XSLT	XSL Transformations (XSLT) Version 2.0
XSP	XML SchemaPlus

NIEM JXDM to OWL Transformation

Metrics on the NIEM OWL Model

Class	Properties
Person	81
Document	66
Vehicle	32
Metadata	27
Organization	26
Item	23
nist:Transaction	22
Location	21
Biometric	19
Locale	17
ItemTitle	16
TangibleItem	16
Obligation	15
TelecommunicationDevice	14
PersonEmploymentAssociation	14
nist:NISTImage	14
DriverLicenseWithdrawal	13
Program	13
ItemRegistration	13
nist:ImageCapture	13
Binary	12
PersonEncounter	11
Insurance	11
Injury	11




```
SELECT ?class ?restrictionCount
WHERE {
 ?class a owl:Class .
   LET ( ?restrictionCount := smf:countResults( "SELECT
DISTINCT ?property WHERE { ?class rdfs:subClassOf
?restriction . ?restriction a owl:Restriction . ?restriction
owl:onProperty ?property }" ))
}
```

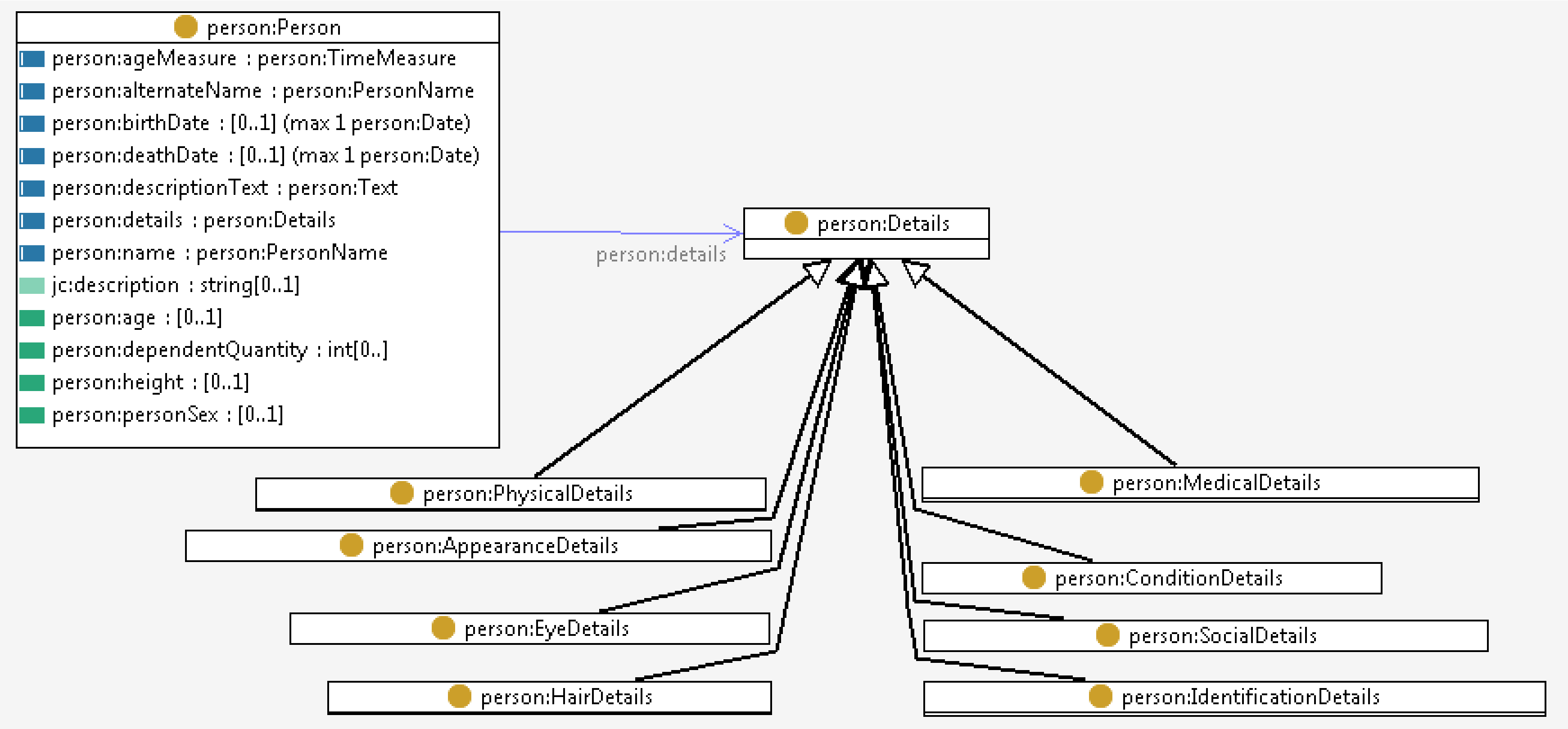
NIEM Person (Proto) OWL Model

Person

- hasPersonAccentText : Text
- hasPersonAgeDescriptionText : Text
- hasPersonAgeMeasure : TimeMeasure
- hasPersonAlternateName : PersonName
- hasPersonBirthDate : Date
- hasPersonBirthLocation : Location
- hasPersonBloodType : PersonBloodType
- hasPersonBodyXRaysAvailable : PersonBodyXRaysAvailable
- hasPersonBuildText : Text
- hasPersonCapability : Capability
- hasPersonCircumcisionIndicator : xsd1:Boolean
- hasPersonCitizenship : PersonCitizenship
- hasPersonClothing : Clothing
- hasPersonComplexionText : Text
- hasPersonDNA : DNA
- hasPersonDeathDate : Date
- hasPersonDependentQuantity : Quantity
- hasPersonDescriptionText : Text
- hasPersonDigitalImage : Image
- hasPersonDigitizedSignatureImage : Image
- hasPersonDisguiseDescriptionText : Text
- hasPersonDonorOrgan : PersonDonorOrgan
- hasPersonEducationLevelText : Text
- hasPersonEthnicity : PersonEthnicity
- hasPersonEyeColor : PersonEyeColor
- hasPersonEyewearDescriptionText : Text
- hasPersonFacialHairText : Text
- hasPersonFingerprintSet : FingerprintSet
- hasPersonGeneralAppearanceDescriptionText : Text
- hasPersonHairAppearanceText : Text
- hasPersonHairCategoryText : Text
- hasPersonHairColor : PersonHairColor
- hasPersonHairLengthText : Text
- hasPersonHairStyleText : Text
- hasPersonHandednessText : Text
- hasPersonHeightDescriptionText : Text
- hasPersonHeightMeasure : LengthMeasure
- hasPersonHumanResourceIdentification : Identification
- hasPersonInjury : Injury
- hasPersonIntoxication : Intoxication
- hasPersonJewelryDescriptionText : Text
- hasPersonLanguageEnglishIndicator : xsd1:Boolean
- hasPersonLearningDisabilityText : Text
- hasPersonLicenseIdentification : Identification
- hasPersonLivingIndicator : xsd1:Boolean
- hasPersonMaritalStatusText : Text
- hasPersonMedicalCondition : MedicalCondition
- hasPersonMedicalDescriptionText : Text
- hasPersonMedicalFileIndicator : xsd1:Boolean
- hasPersonMedicationRequiredText : Text
- hasPersonMentalStateText : Text
- hasPersonMilitarySummary : MilitarySummary
- hasPersonMoodDescriptionText : Text
- hasPersonName : PersonName
- hasPersonNationalIdentification : Identification
- hasPersonNationality : PersonNationality
- hasPersonNationalityText : Text
- hasPersonOrganDonatorIndicator : xsd1:Boolean
- hasPersonOtherIdentification : Identification
- hasPersonPassportIdentification : Identification
- hasPersonPhysicalDisabilityText : Text
- hasPersonPhysicalFeature : PhysicalFeature
- hasPersonPrimaryLanguage : PersonLanguage
- hasPersonRace : PersonRace
- hasPersonReligionText : Text
- hasPersonResident : PersonResident
- hasPersonSSNIdentification : Identification
- hasPersonSecondaryLanguage : PersonLanguage
- hasPersonSecurityClearance : PersonSecurityClearance
- hasPersonSex : PersonSex
- hasPersonSexualOrientationText : Text
- hasPersonSkinTone : PersonSkinTone
- hasPersonSpeechDescriptionText : Text
- hasPersonStateIdentification : Identification
- hasPersonTaxIdentification : Identification
- hasPersonTooth : Tooth
- hasPersonUSCitizenIndicator : xsd1:Boolean
- hasPersonVisionPrescriptionText : Text
- hasPersonWeightDescriptionText : Text
- hasPersonWeightMeasure : WeightMeasure
- hasPersonXRayImage : Image

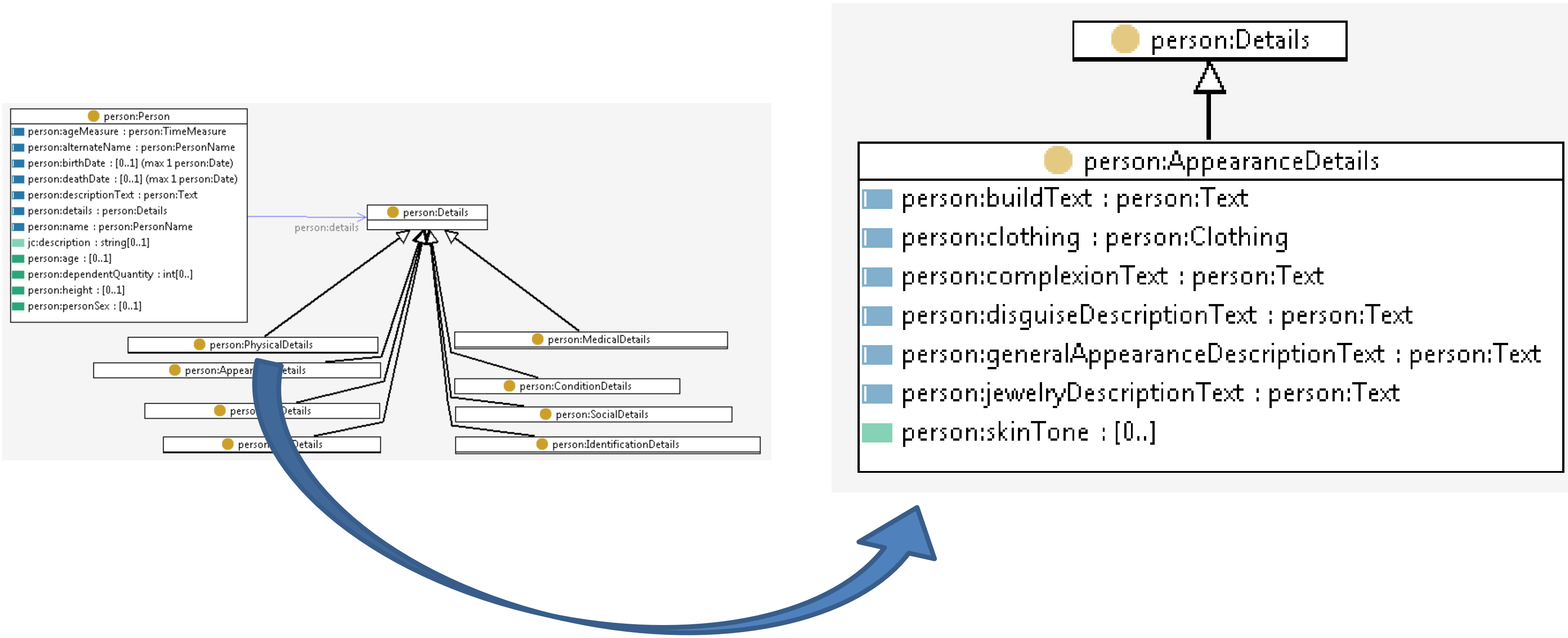
To address the reusability required in the MoJ work, the NIEM Person was re-factored into individual 'Details' classes.

Refactoring of NIEM Person into an OWL Model with reusable Concepts (person:Details)



Depending on the context of use, concepts describing different details about a person can be selected for the UBL Business Documents and Messages.

Refactoring of the NIEM Person into an OWL Model with reusable Concepts (person:AppearanceDetails)

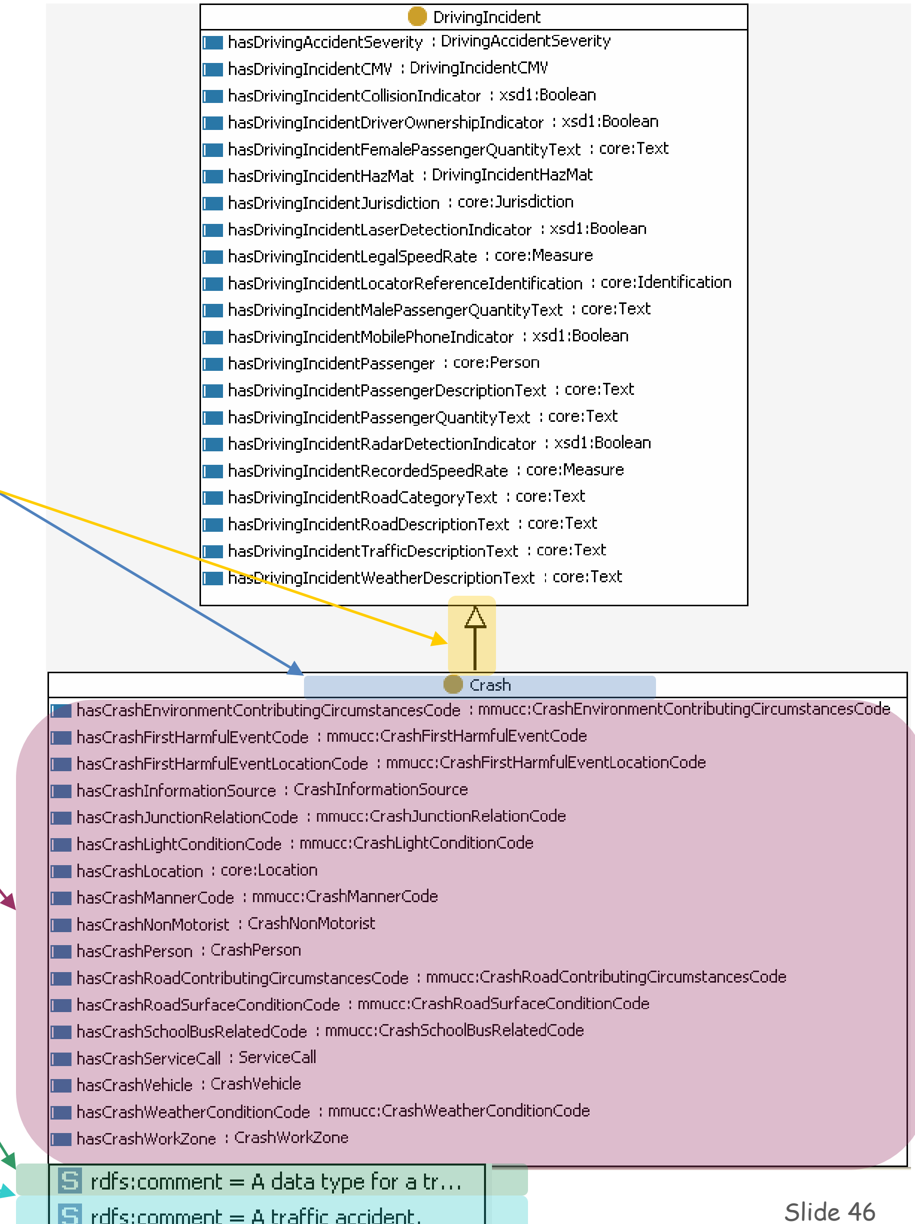


A Person’s ‘Appearance Details’ will be needed for criminal investigations.

NIEM JXDM Complex Type Example

```
<xsd:complexType name="CrashType">
 <xsd:annotation>
  <xsd:documentation>A data type for a traffic accident.</xsd:documentation>
  <xsd:appinfo>
   <i:Base i:name="DrivingIncidentType"/>
  </xsd:appinfo>
 </xsd:annotation>
 <xsd:complexContent>
  <xsd:extension base="j:DrivingIncidentType">
   <xsd:sequence>
    <xsd:element ref="j:CrashServiceCall" minOccurs="0" maxOccurs="unbounded"/>
    <xsd:element ref="j:CrashFirstHarmfulEventCode" minOccurs="0" maxOccurs="unbounded"/>
    <xsd:element ref="j:CrashFirstHarmfulEventLocationCode" minOccurs="0" maxOccurs="unbounded"/>
    <xsd:element ref="j:CrashMannerCode" minOccurs="0" maxOccurs="unbounded"/>
    <xsd:element ref="j:CrashInformationSource" minOccurs="0" maxOccurs="unbounded"/>
    <xsd:element ref="j:CrashWeatherConditionCode" minOccurs="0" maxOccurs="unbounded"/>
    <xsd:element ref="j:CrashLightConditionCode" minOccurs="0" maxOccurs="unbounded"/>
    <xsd:element ref="j:CrashRoadSurfaceConditionCode" minOccurs="0" maxOccurs="unbounded"/>
    <xsd:element ref="j:CrashEnvironmentContributingCircumstancesCode" minOccurs="0" maxOccurs="unbounded"/>
    <xsd:element ref="j:CrashRoadContributingCircumstancesCode" minOccurs="0" maxOccurs="unbounded"/>
    <xsd:element ref="j:CrashJunctionRelationCode" minOccurs="0" maxOccurs="unbounded"/>
    <xsd:element ref="j:CrashSchoolBusRelatedCode" minOccurs="0" maxOccurs="unbounded"/>
    <xsd:element ref="j:CrashWorkZone" minOccurs="0" maxOccurs="unbounded"/>
    <xsd:element ref="j:CrashVehicle" minOccurs="0" maxOccurs="unbounded"/>
    <xsd:element ref="j:CrashNonMotorist" minOccurs="0" maxOccurs="unbounded"/>
    <xsd:element ref="j:CrashPerson" minOccurs="0" maxOccurs="unbounded"/>
    <xsd:element ref="j:CrashLocation" minOccurs="0" maxOccurs="unbounded"/>
   </xsd:sequence>
  </xsd:extension>
 </xsd:complexContent>
</xsd:complexType>

<xsd:element name="Crash" type="j:CrashType" nillable="true">
 <xsd:annotation>
  <xsd:documentation>A traffic accident.</xsd:documentation>
 </xsd:annotation>
</xsd:element>
```



August 1, 2009 – "Data Independence Day"

OE-GOV

Ontologies for e-Government

What is oeGOV?

oeGOV is making and publishing W3C OWL ontologies for eGovernment. This initiative is born out of the idea: *"Use small OWL ontologies to model recovery and deploy across all government"* posted at *TheNationalDialogue.org* and Tim Berners-Lee's vision of "Linked Open Data".

The blog for oeGOV is www.oegov.us/blog

Why build ontologies for eGovernment?

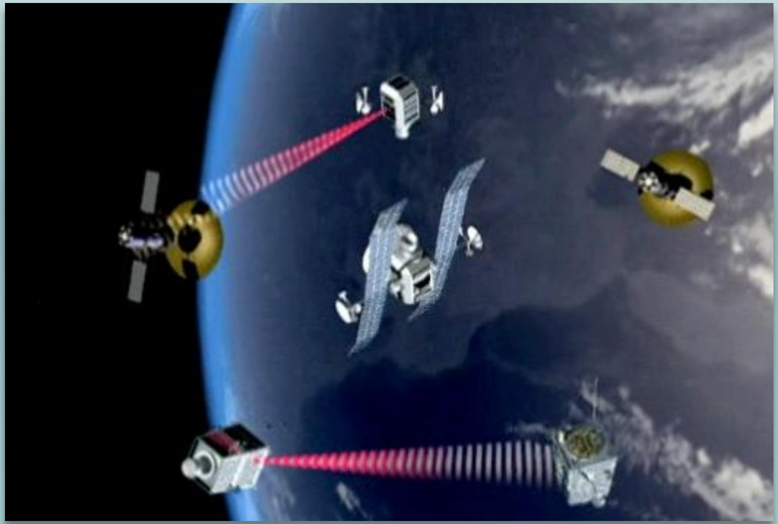
By having ontologies for eGovernment we enable:

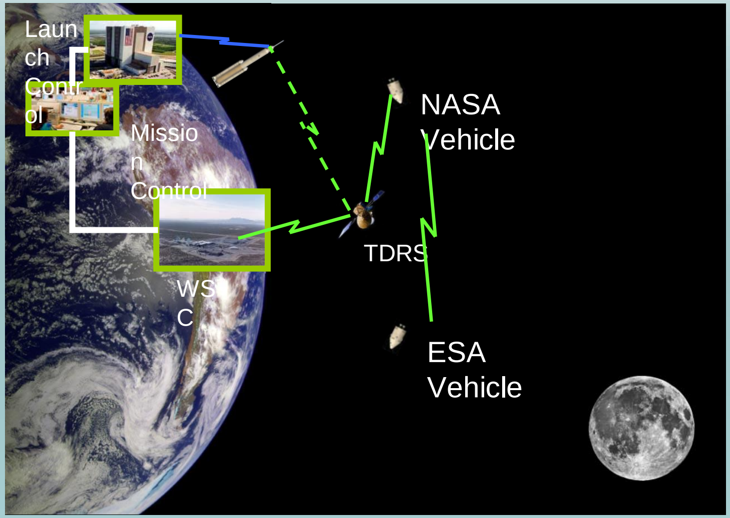
1. distributed creation and maintenance of information on data, about where it is used, and the government data itself;
2. standardization of neutral models for data exchange and transformation;
3. aggregation of data through the use of RDF/OWL formats;
4. interpretation of data through precise semantics and controlled vocabularies, including geospatial and temporal aspects;
5. navigation over who is publishing what in what format;
6. provenance and trust in the sources of data;
7. correlations and comparisons of data;
8. accountability of the political process with policy making;
9. transparency of government efficiencies and effectiveness;
10. citizen awareness and appreciation of government initiatives.

www.oegov.org

2010

NASA Work on Telemetry, Messaging and Commanding (TMC) of Space Vehicles and Systems for Space Interoperability

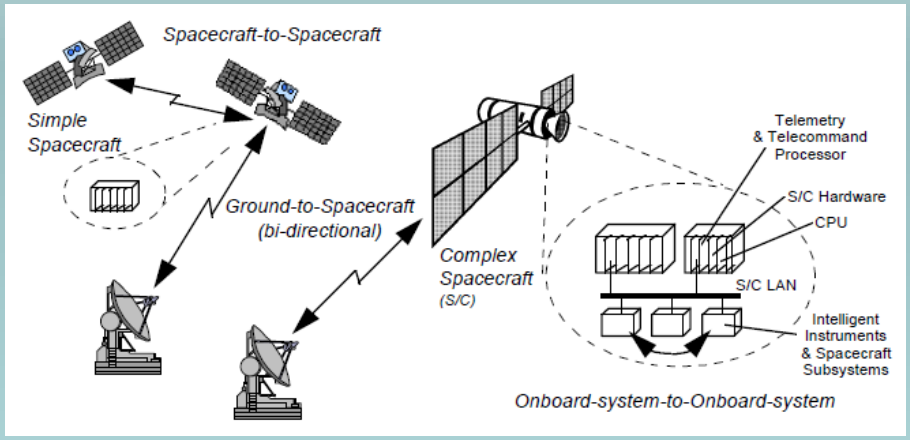


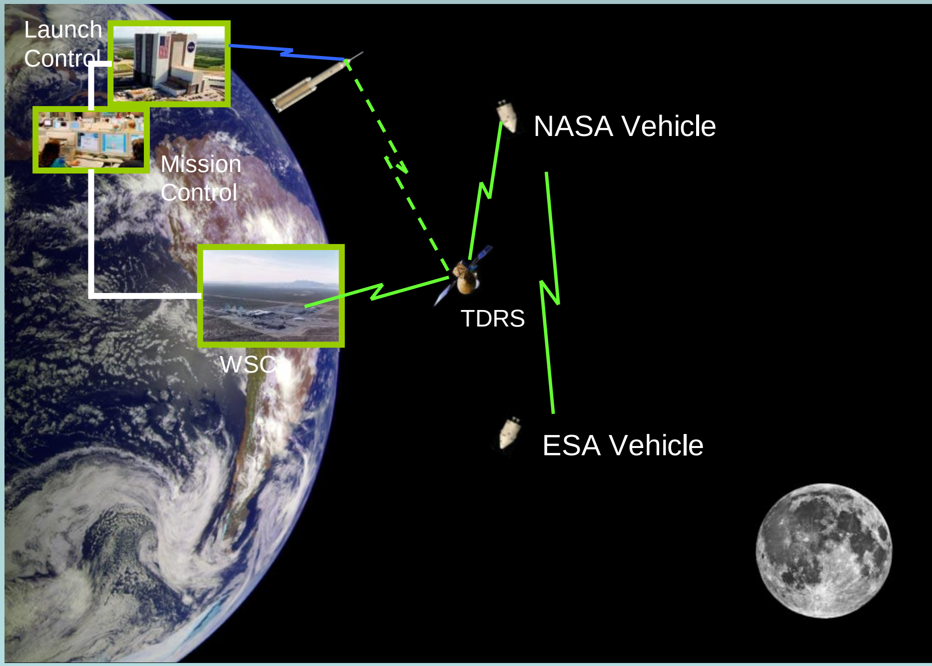


TMC - Paradigms

Manned — **Unmanned**

Fixed — **Re-configurable** — **Dynamic** — **Programmable** — **Autonomous**





TMC - a Choice of Paradigms

Fixed — T&C is static with all measurements, messages and commands pre-configured at design time

Re-configurable — T&C can be changed for each mission and/or flight before launch

Dynamic — T&C can be changed during each flight by uploading commands and telemetry packet definitions

Programmable — T&C systems are smart and can be instructed to do event monitoring, tasks, journaling and other jobs on-demand.

Autonomous — Space systems are capable of making their own decisions using agent-based technologies

Manned … **Unmanned**

APOLLO

SHUTTLE

ISS

ARES, ORION

MARS Rovers

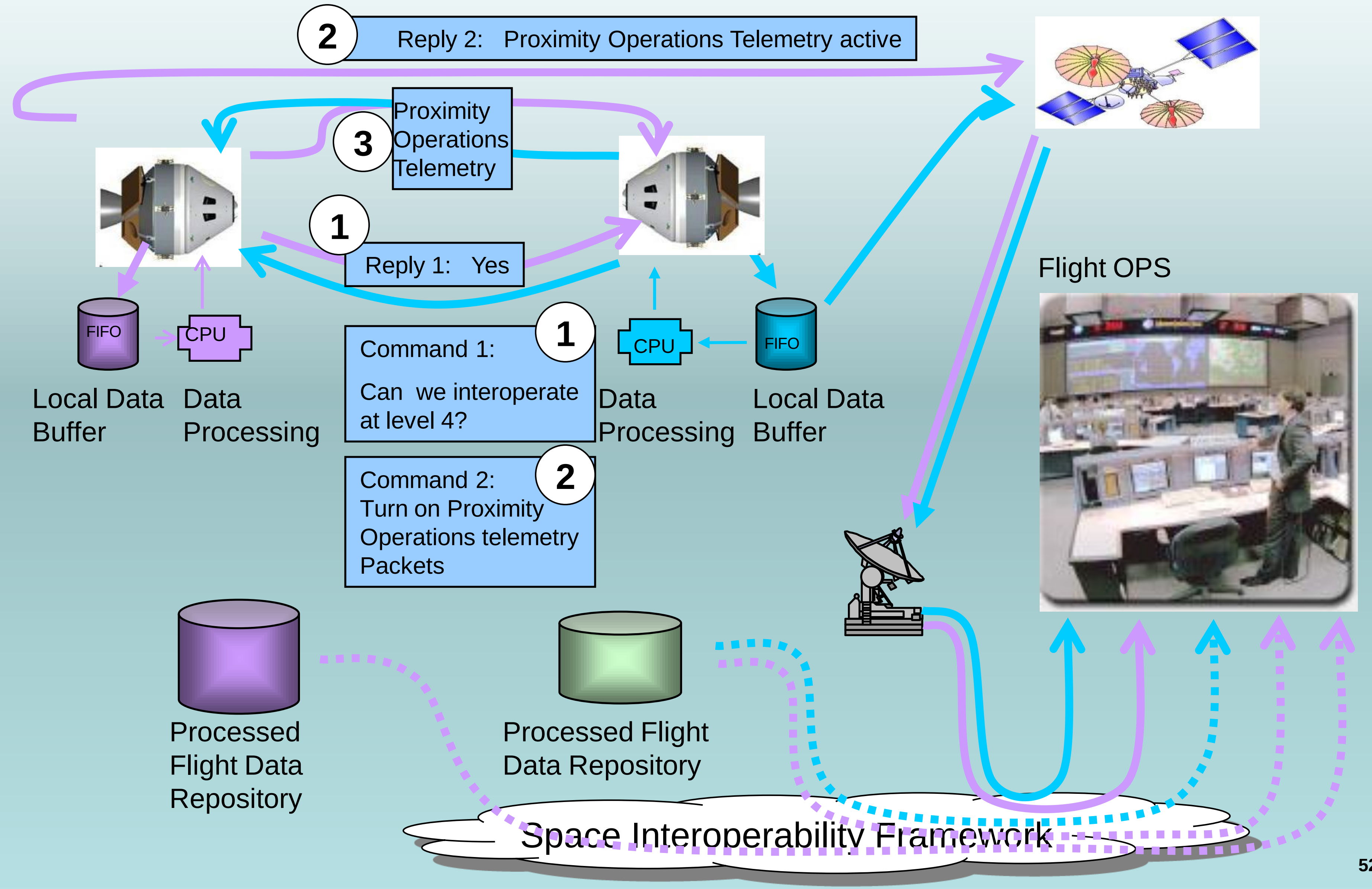
MSL

MEX, VEX, Rosetta

Proba-2, Aeolus

Future Space Systems

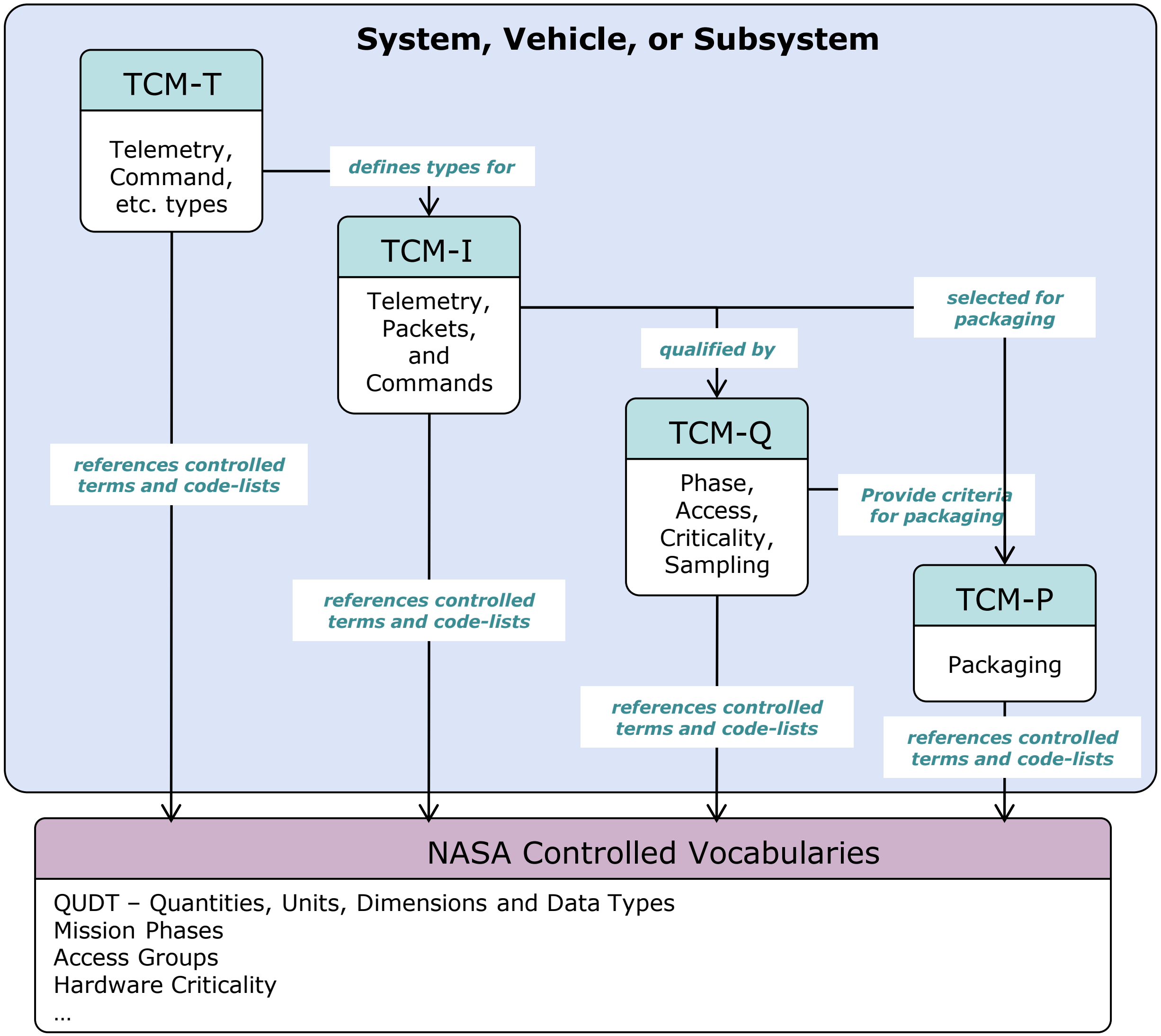
Space Interoperability Scenario 1: Proximity Operations Between 2 Space Vehicles



NASA TCMX: Ontology-Based Telemetry, Commands and Messaging

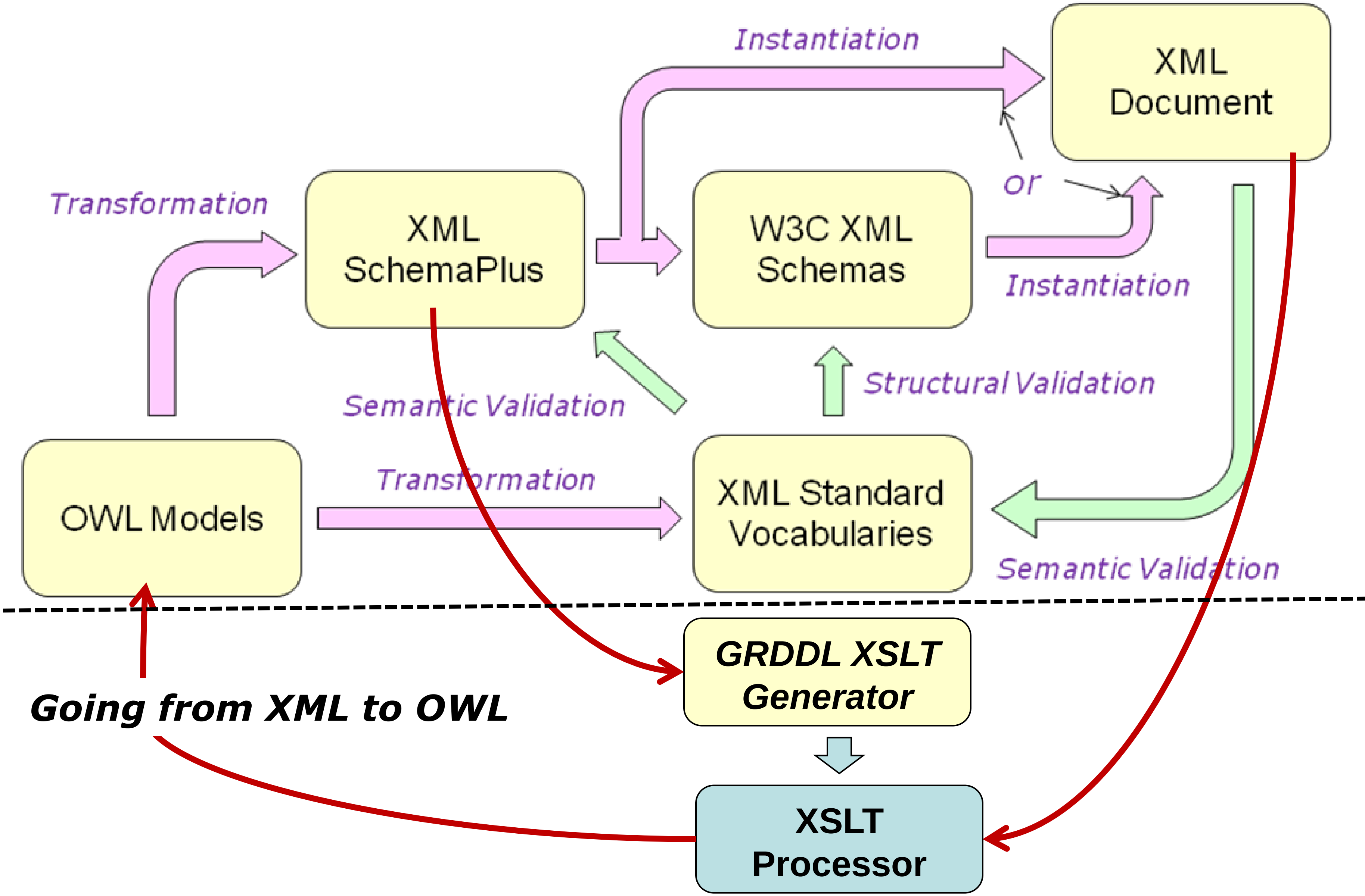
Types › Instances › Qualification › Packaging

Workflow



Ontology and Schema Components

Generating XML Schemas and Controlled Vocabularies



Ref: XML SchemaPlus – http://www.xspl.us

TCMX – Generating XML Schemas and Vocabularies from OWL Models for Space Systems Interoperability

Modular OWL Specification Models → XML SchemaPlus (XSP) → XML Schema

XSLT

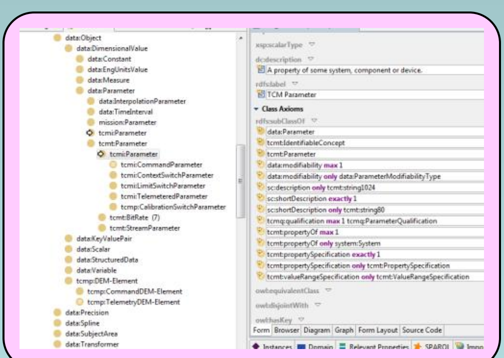
Modular OWL Specification Models → XML Vocabularies

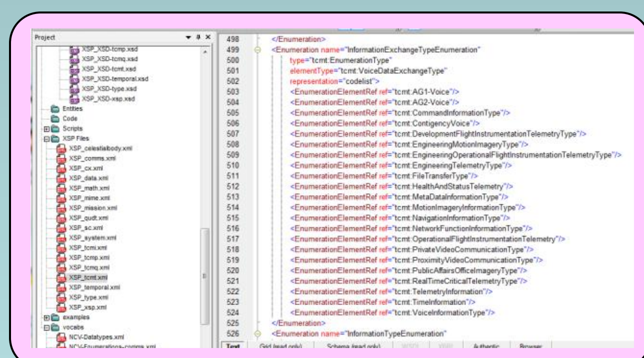
SPARQL Rules

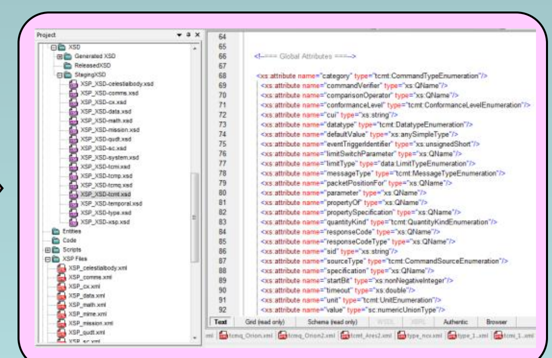
Modular TCMx, QUDT and System Ontologies are transformed through annotations to an intermediate language XSP for controlling the XML Schema Generation

XMLSchemaPlus (XSP) is an XML Dialect for specifying how an XML Schema should look. An XSLT script ensures compliance with XML Naming and Design Rules

XML Schemas use controlled vocabularies to ensure semantic consistency of referenced concepts such as units of measure, quantities and codelists.





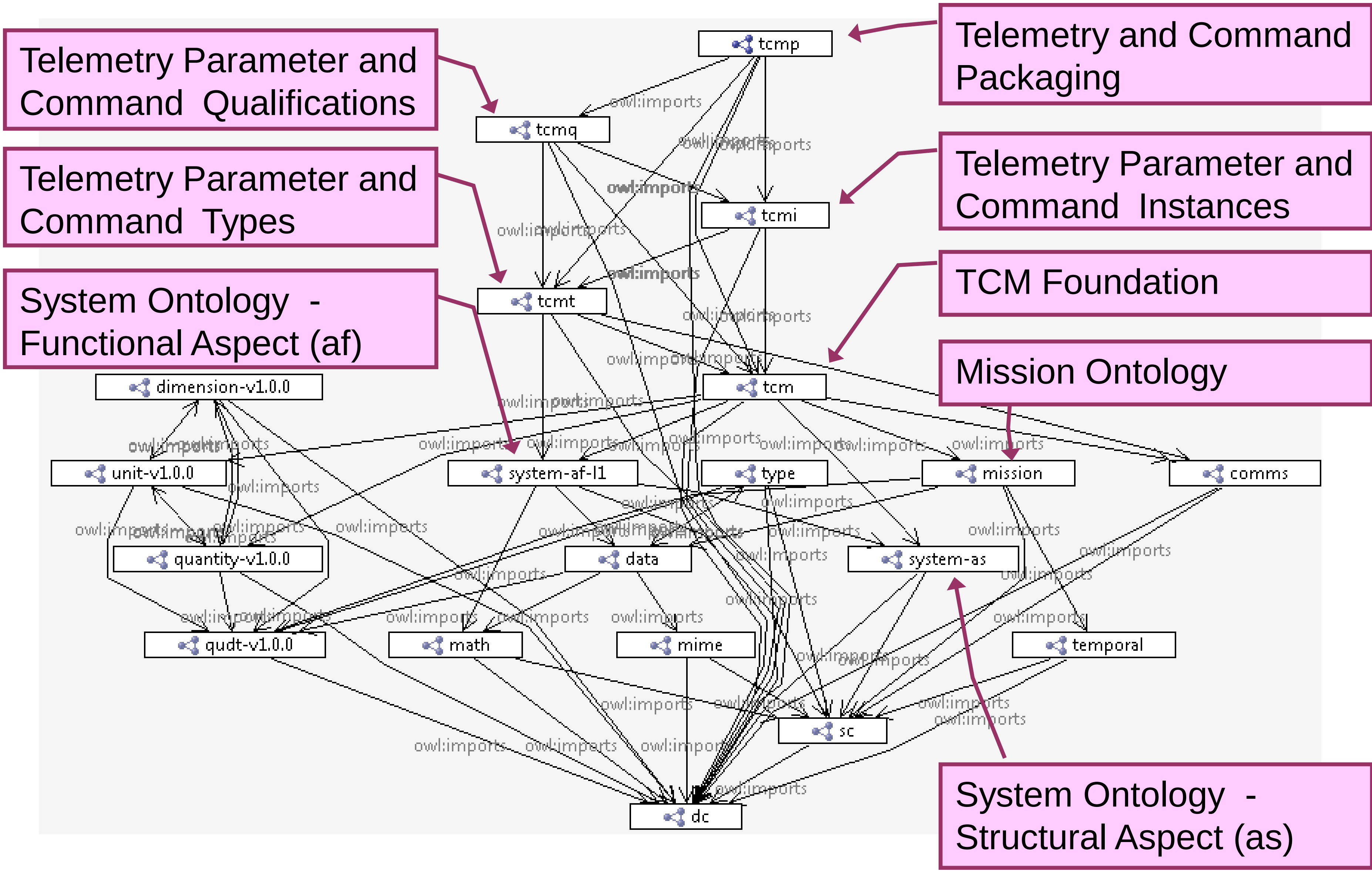


TopBraid Composer

Altova XMLSpy

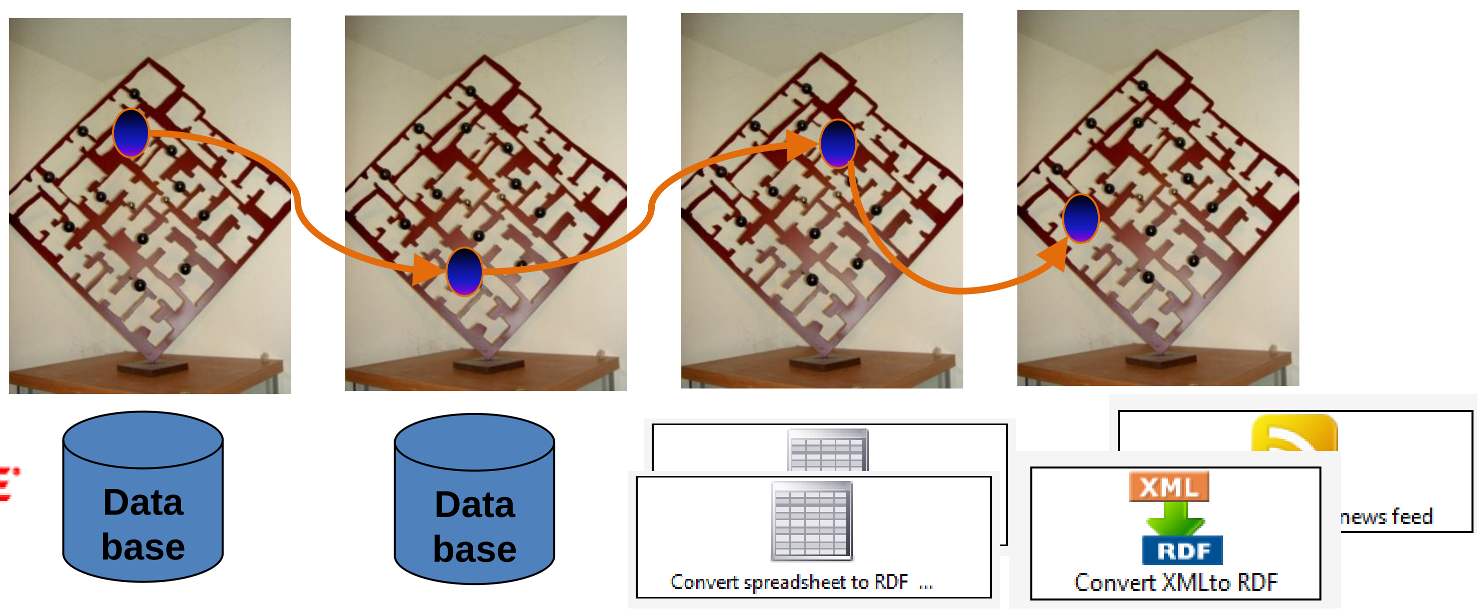
References: QUDT – http://www.qudt.org , XSP – http://www.xspl.us

TCMX Ontology Architecture builds of System SBFI and QUDT Ontologies

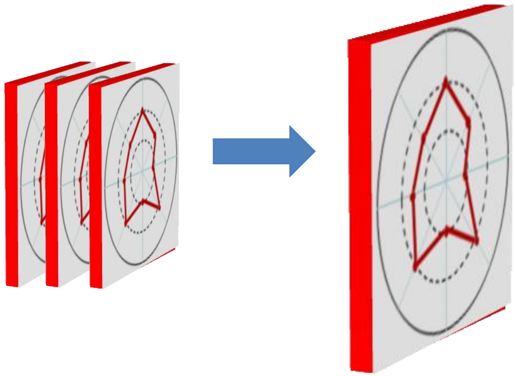


How Semantic Web Technologies help "Connect the Dots"

- They capture, align and resolve the data semantics of different data sources through:
  - Flexibility of the RDF data model and
  - Rich modeling formalisms of OWL and
  - A standards-based approach

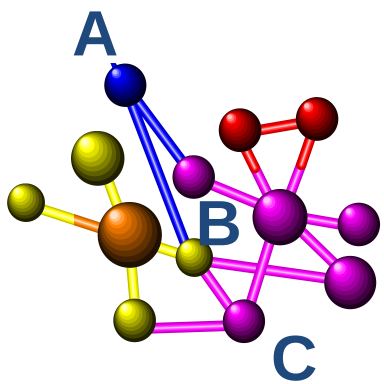


Different Reasons to "Connect the Dots"



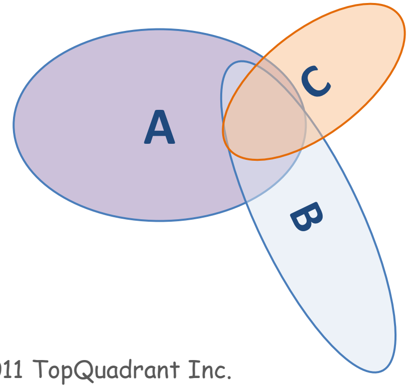
1) 360 Degrees View

More about the same thing



2) Transitive Connections

What is linked to a thing of interest

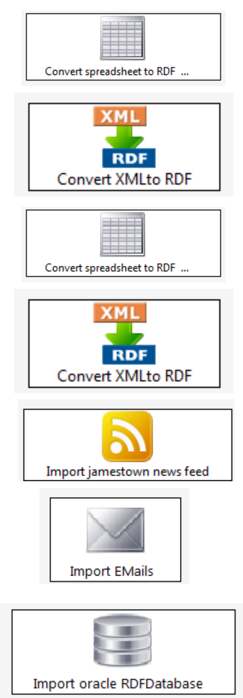


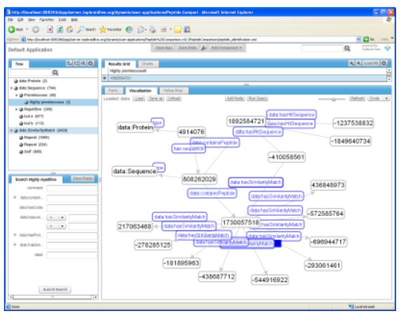
3) Information Discovery

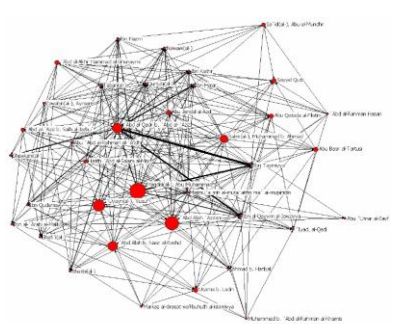
Find things that share common attributes or relationships

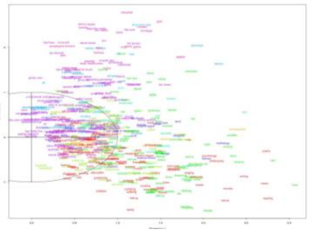
Ingest→ Normalize→ Explicate→ Decide → Act
I.N.E.D.A.

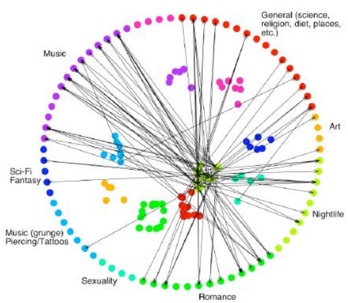
INGEST → NORMALIZE → EXPLICATE (Explore) → DECIDE (Disseminate) → ACT

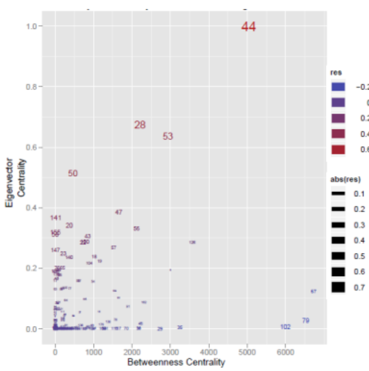


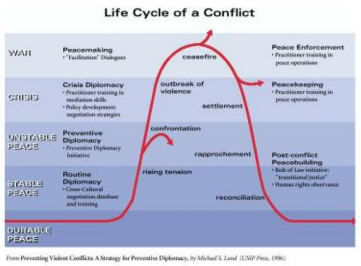




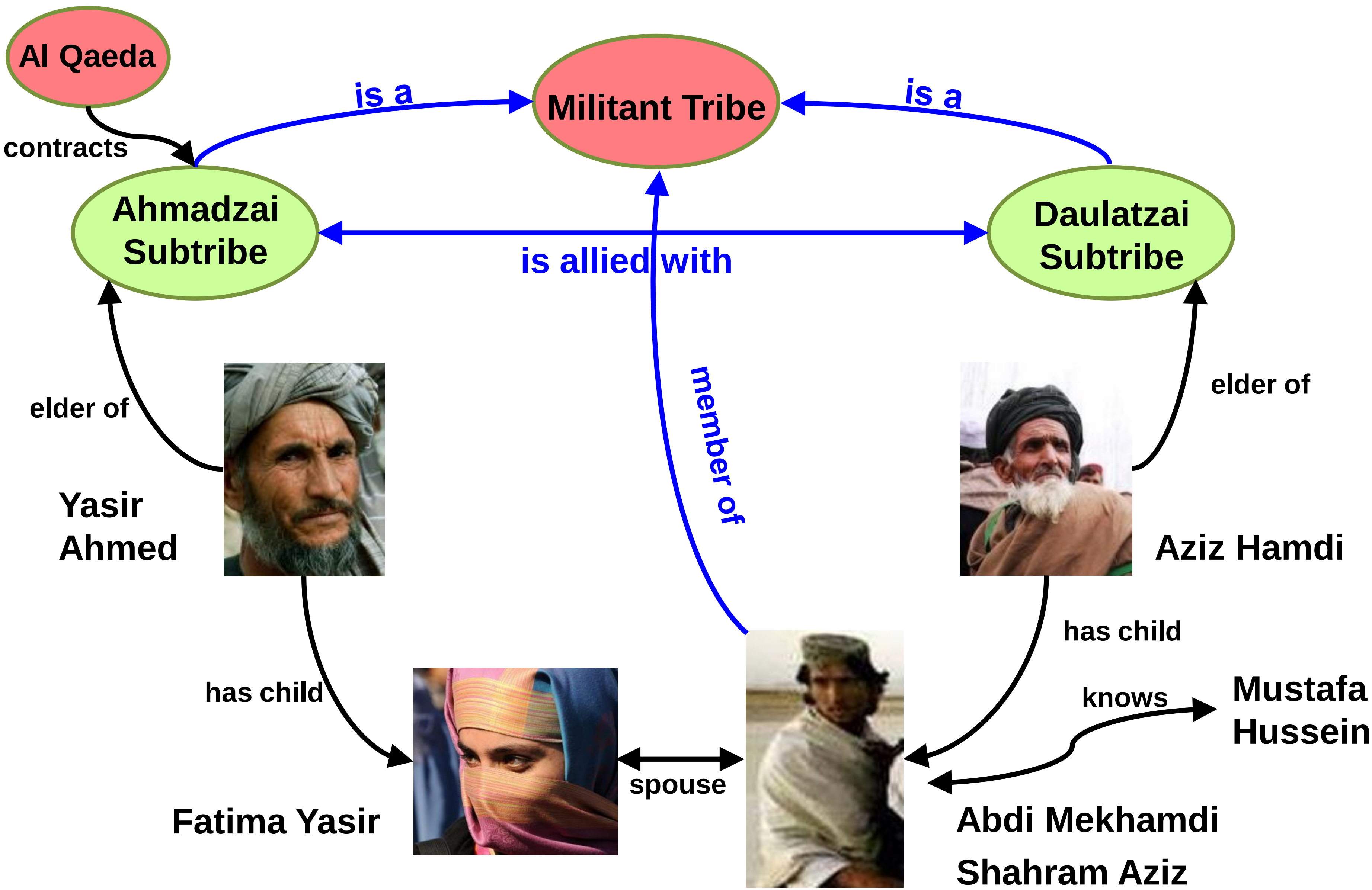








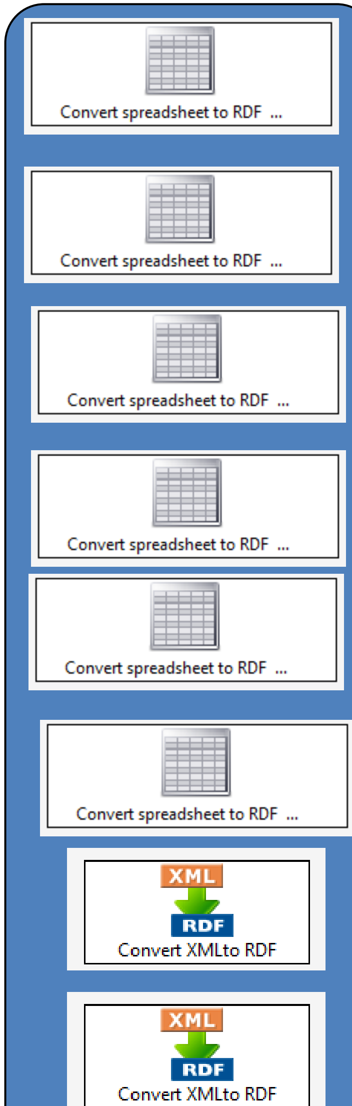
Terrorism Information Insight



Creating the DEMO Terrorist Database Content

1. Dept. of State Wanted List
2. South Asia Terrorist Portal
3. Tracking The Threat
4. Minorities at Risk
5. Wikipedia
6. Global Terrorist Database
7. United Nations (consolidated list)
8. Militant Ideology Atlas

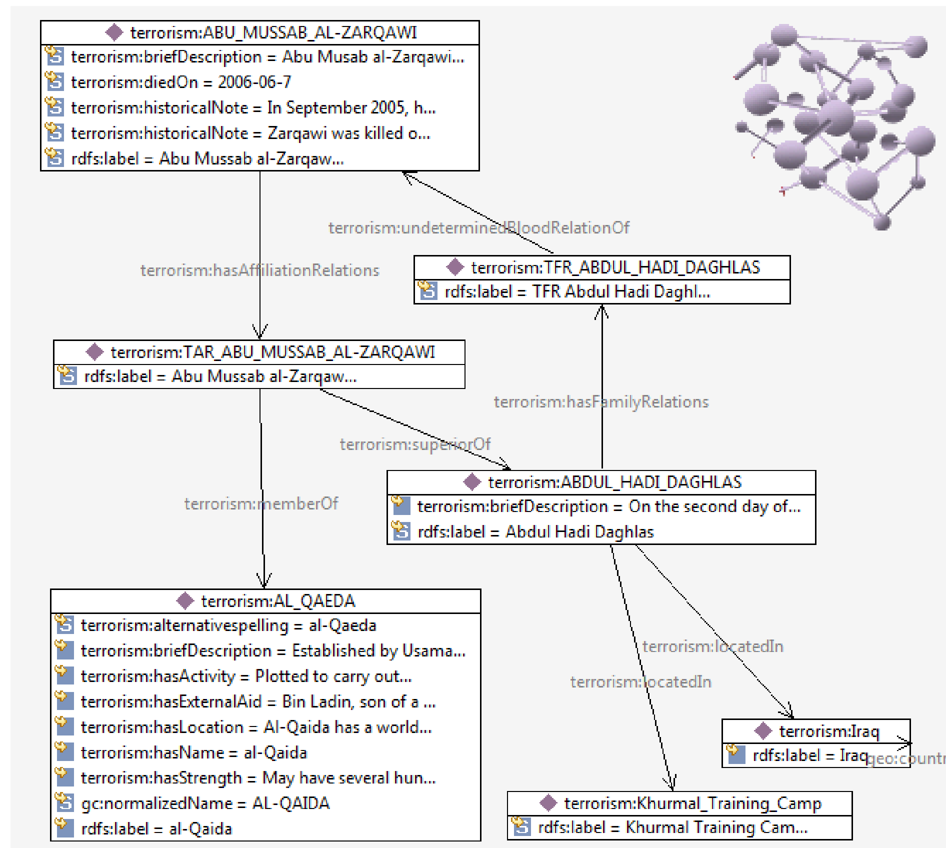
Demo "INEDA"



TopBraid Importers

SPARQL Rules Conversion to OWL Graphs

OWL provides the 360º view



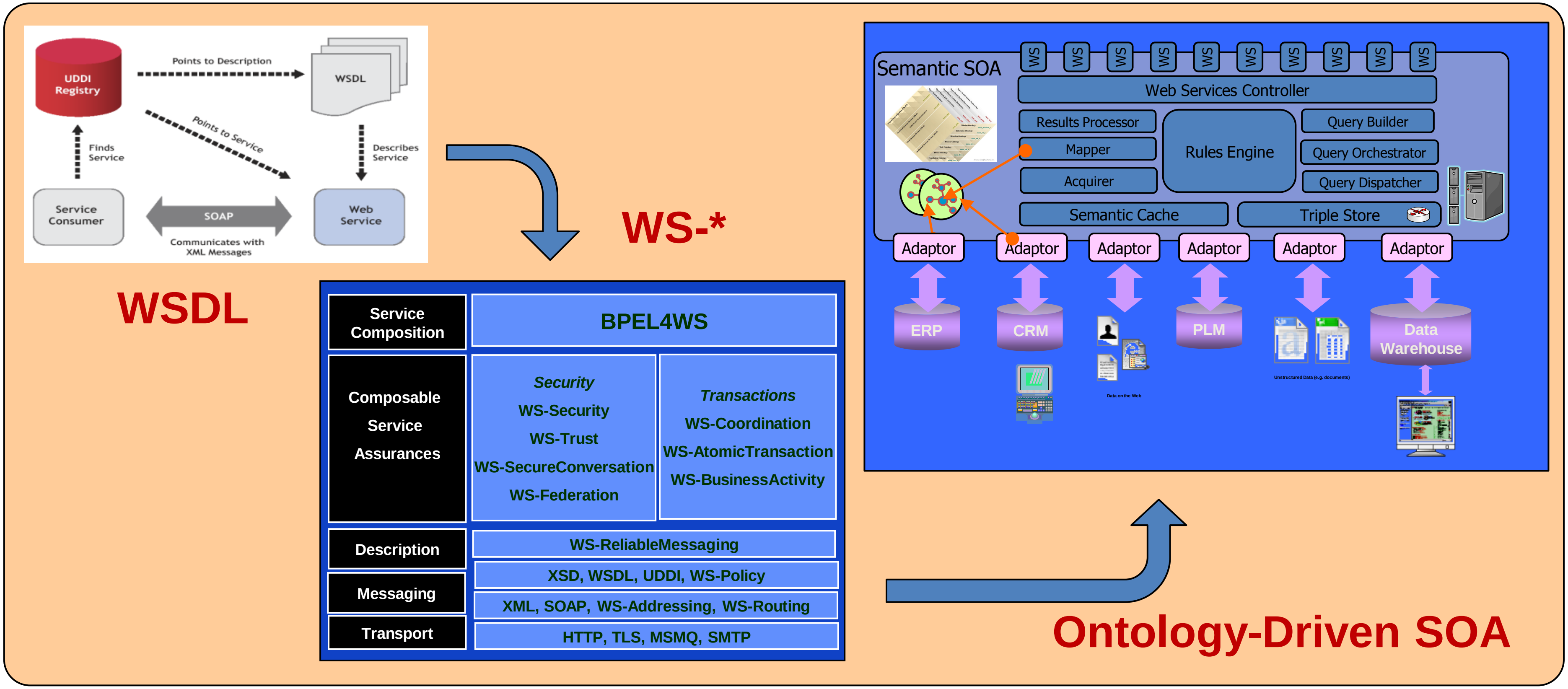
Ontology-Driven Service-Oriented Architecture

1995 1998 2001 2004 2007 2010

JINI

CORBA/COM SOAP WSDL WS-* REST The “CLOUD”

OWL-S Linked Open Data

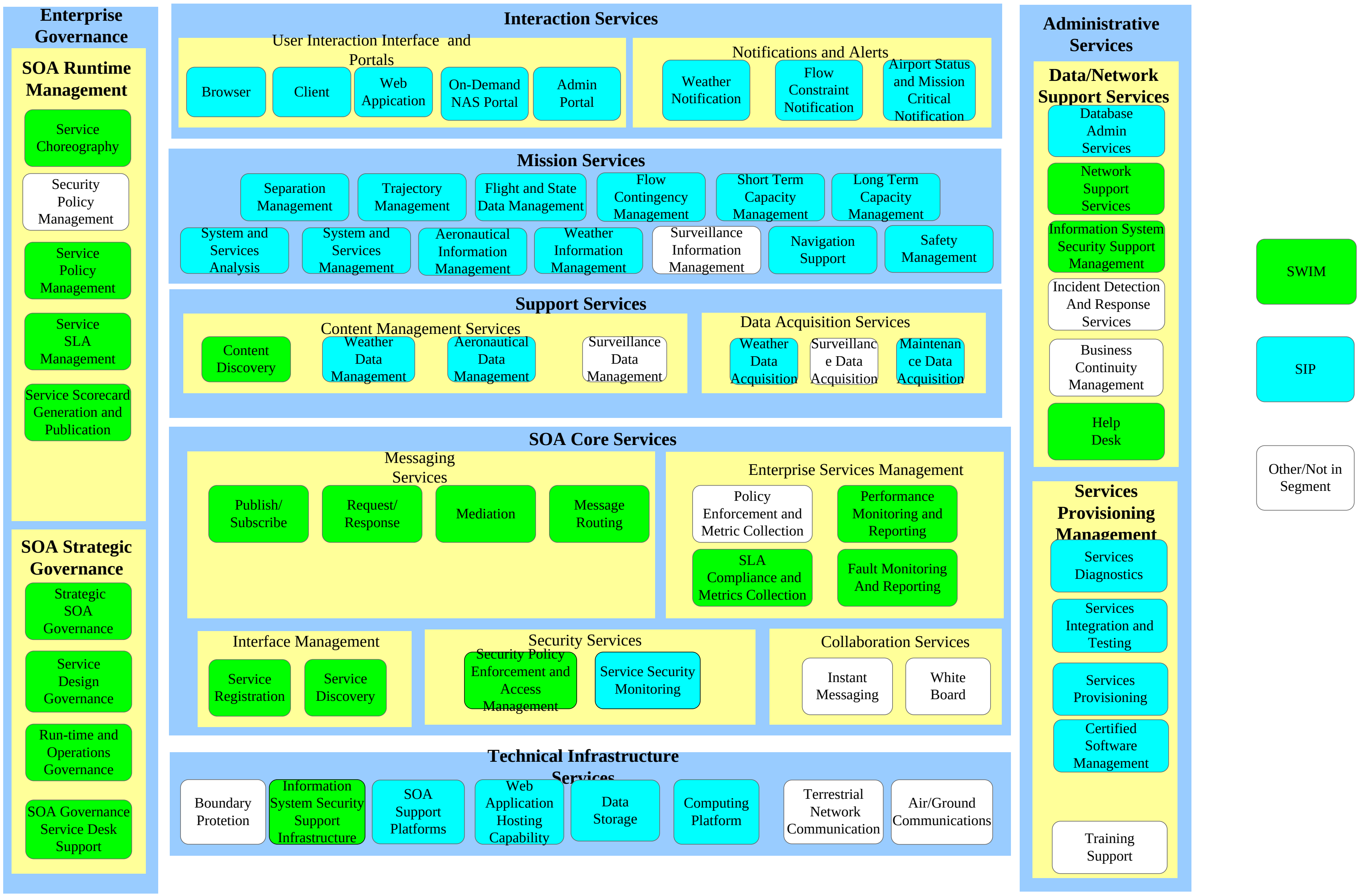


TopQuadrant™

Example of an SOA:

NASEAF SV4 NAS Enterprise Services (SWIM Segment 2)

Federal Aviation Administration



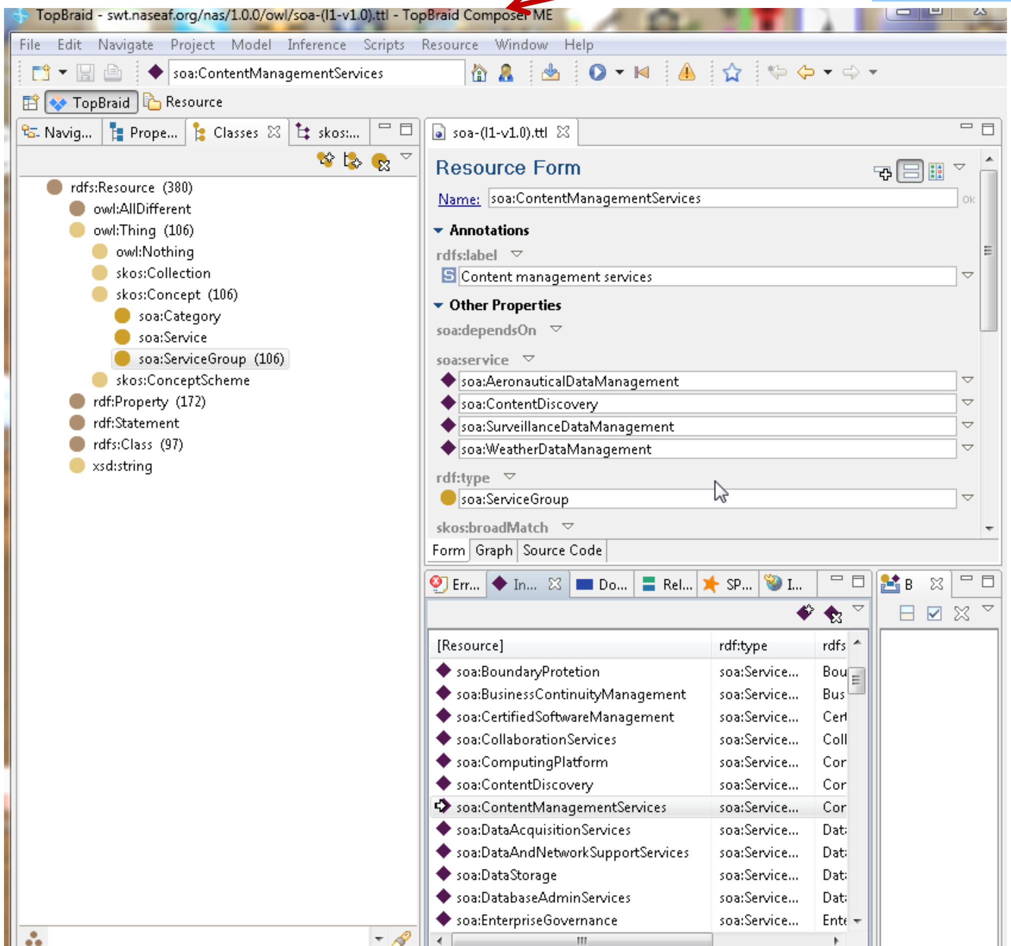
Source: System Wide Information Management", Eurocontrol AP4 Team, Ahmad Usmani, SWIM Program Manager December 2009

Ref: SWIM – http://www.swim.gov

Using SKOS to represent NASEAF SV4 NAS Enterprise Services

SKOS - Simple Knowledge Organization System

Ontology Editor



Triples

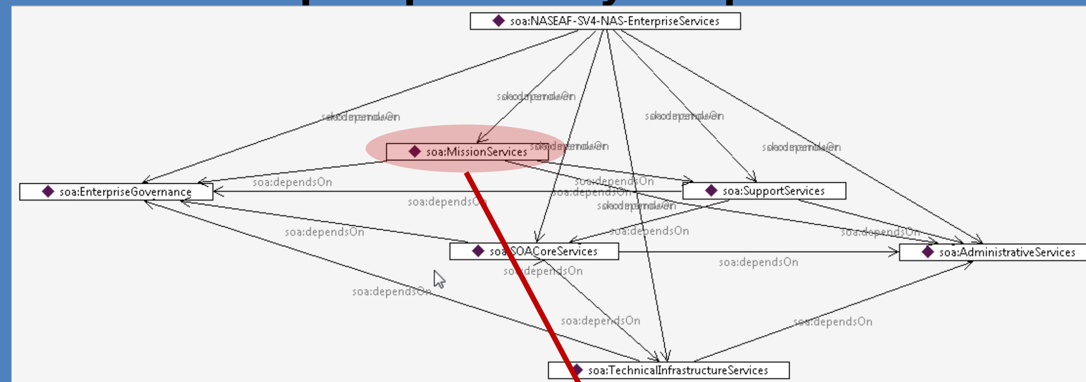
soa:MissionServices
a soa:ServiceGroup ;
rdfs:label "Mission services"^^xsd:string ;
soa:dependsOn
soa:EnterpriseGovernance ,
soa:AdministrativeServices ,
soa:SupportServices;
skos:narrower
soa:FlightandStateDataManagement ,
soa:WeatherInformationManagement ,
soa:SystemAndServicesManagement ,
soa:SeparationManagement ,
soa:LongTermCapacityManagement ,
soa:FlowContingencyManagement ,
soa:SafetyManagement ,
soa:ShortTermCapacityManagement ,
soa:AeronauticalInformationManagement ,
soa:NavigationSupport ,
soa:SystemAndServicesAnalysis ,
soa:SurveillanceInformationManagement ,
soa:TrajectoryManagement .

NASEAF SV4 NAS Enterprise Services Ontology Views

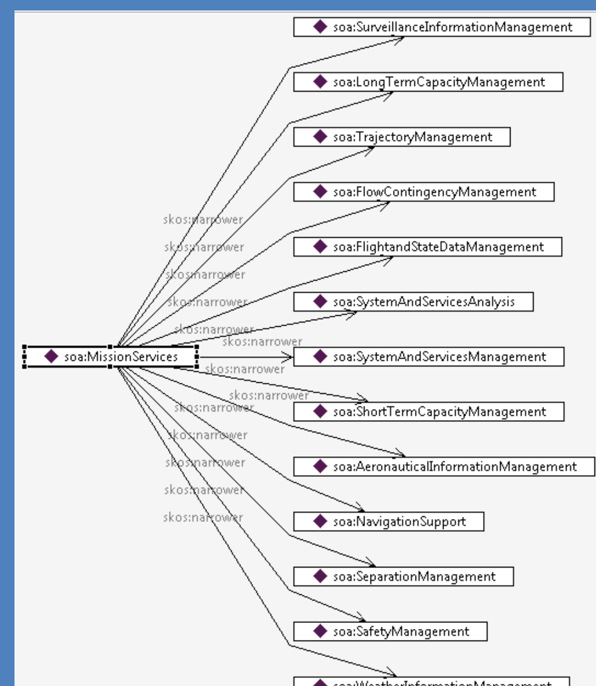
Service Taxonomy

- soa:NASEAF-SV4-NAS-EnterpriseServices
  - soa:AdministrativeServices
    - soa:DataAndNetworkSupportServices
    - soa:ServicesProvisioningManagement
  - soa:EnterpriseGovernance
    - soa:SOARuntimeManagement
    - soa:SOAStrategicGovernance
  - soa:MissionServices
    - soa:AeronauticalInformationManagement
    - soa:FlightandStateDataManagement
    - soa:FlowContingencyManagement
    - soa:LongTermCapacityManagement
    - soa:NavigationSupport
    - soa:SafetyManagement
    - soa:SeparationManagement
    - soa:ShortTermCapacityManagement
    - soa:SurveillanceInformationManagement
    - soa:SystemAndServicesAnalysis
    - soa:SystemAndServicesManagement
    - soa:TrajectoryManagement
    - soa:WeatherInformationManagement
  - soa:SOACoreServices
    - soa:CollaborationServices
    - soa:EnterpriseServicesManagement
    - soa:InterfaceManagement
    - soa:MessagingServices
    - soa:SecurityServices
  - soa:SupportServices
    - soa:ContentManagementServices
    - soa:DataAcquisitionServices
  - soa:TechnicalInfrastructureServices
    - soa:AirAndGroundCommunications
    - soa:BoundaryProtetion
    - soa:ComputingPlatform

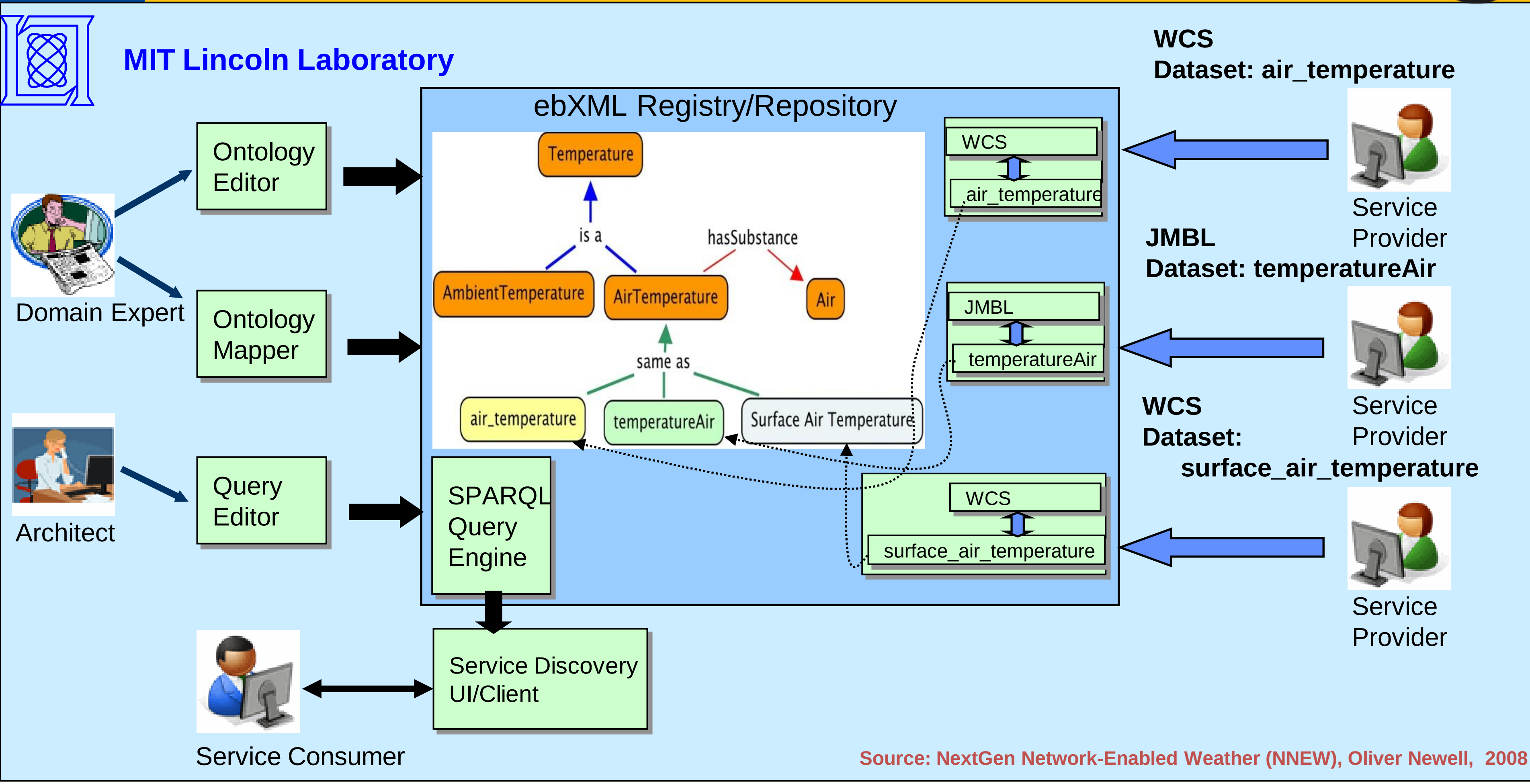
Service Group Dependency Graph



Mission Services Taxonomy

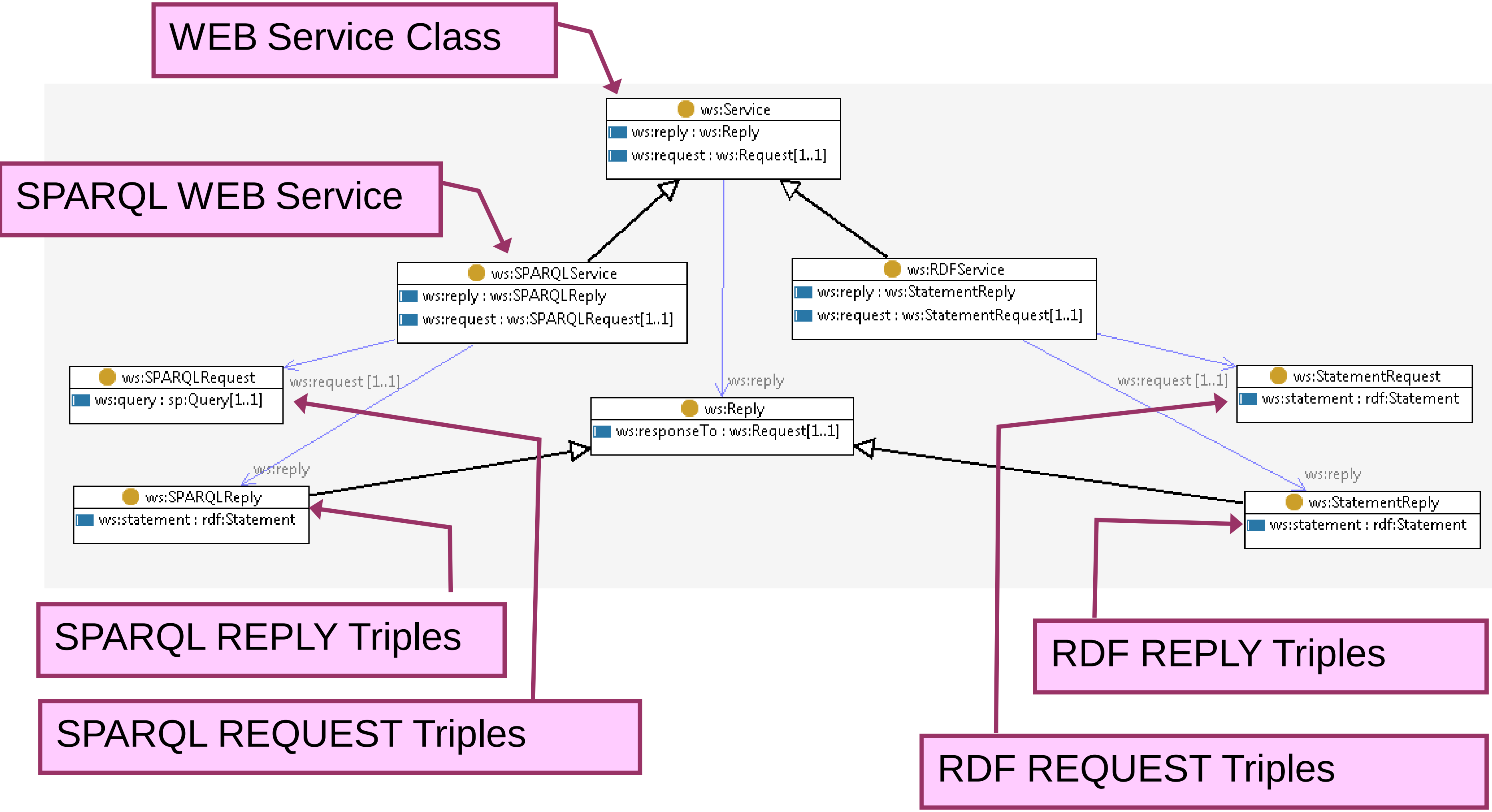


(3) Semantically Enhanced Discovery of Datasets from NextGen - NNEW[1]



[1]NNEW – NextGen Network Enabled Weather

RDF/OWL Based Web Services



Implementing Web Services in SPARQL

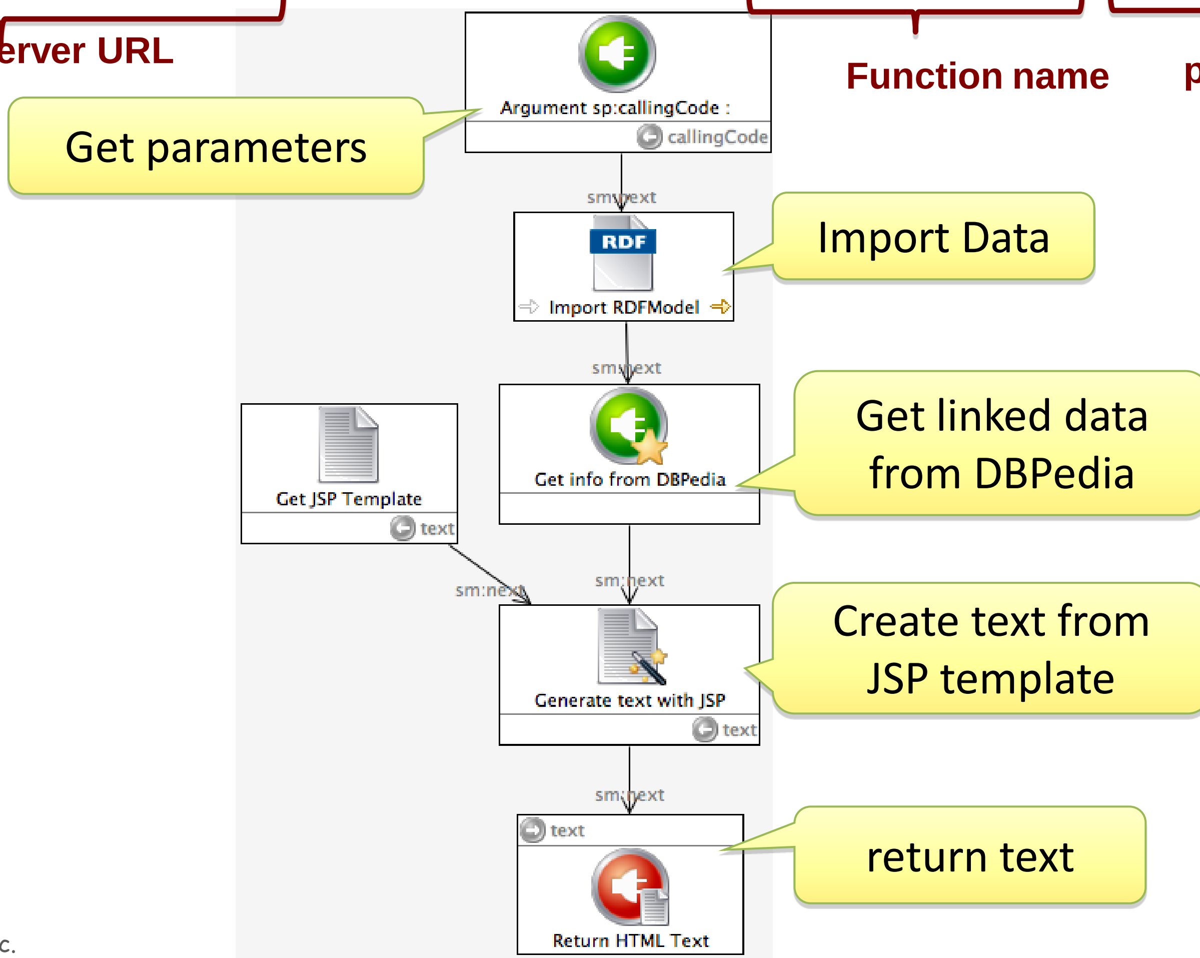
- Web service calls to SPARQL-Based scripts
  - URL embedded in any HTML or application

http://localhost:8083/tbl/actions?action=sparqlmotion&id=FindByCallingCode&callingCode=61

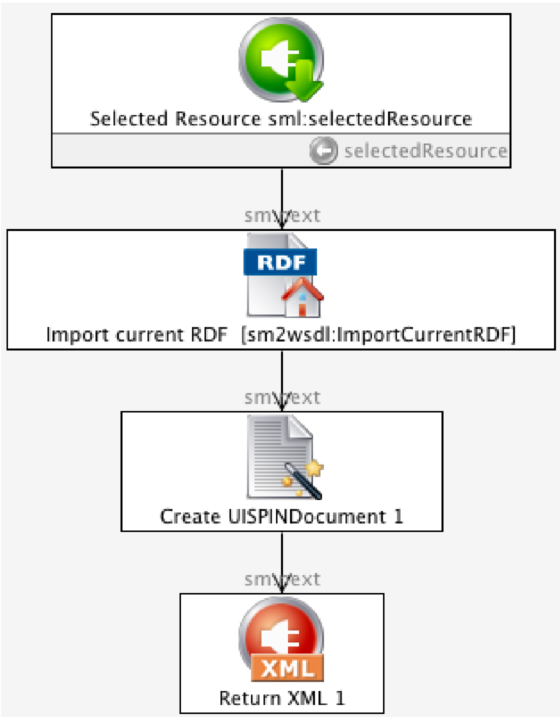
Live server URL

Function name

parameters



Converting a SPARQLMotion Script to WSDL (1 of 2)



ui:prototype

```
<description>
    <interface name="RESTfulInterface">
        <operation name="Get">
            <ui:forEach ui:resultSet="{#
                SELECT ?arg
                WHERE {
                    ?function spin:constraint ?arg .
                } }">
                <sm2wsdl:Input sm2wsdl:arg="{= ?arg }"/>
            </ui:forEach>
        </operation>
    </interface>
</description>
```

```
<description>
  <interface name="getWSDL-RESTfullInterface">
    <operation name="getWSDL" pattern="http://www.w3.org/2003/11/wsdl/in-out">
      <input messagelabel="selectedResource" type="xsd:anyURI"/>
      <output type="rdf:XMLLiteral"/>
    </operation>
  </interface>
  <binding interface="getWSDL-RESTfullInterface" name="getWSDL-HTTPBinding"
type="http://www.w3.org/ns/wsdl/http">
    <operation method="GET" ref="getWSDL"/>
  </binding>
  <service name="getWSDL-Service">
    <documentation>Takes a SM function as (selected) argument and generates a WSDL
(XML) document for it.</documentation>
    <endpoint address="http://localhost:8083/tbl/sparqlmotion?id=getWSDL"
binding="getWSDL-HTTPBinding" name="getWSDL-HTTPEndpoint"/>
  </service>
</description>
```

Converting a SPARQLMotion Script to WSDL – (2 of 2)

```
<wsdl:description xmlns:whttp="http://www.w3.org/ns/wsdl/http"  xmlns:wsdl="http://www.w3.org/ns/wsdl">
  <wsdl:interface wsdl:name="getWSDL-RESTfullInterface">
    <wsdl:operation wsdl:name="getWSDL" wsdl:pattern="http://www.w3.org/2003/11/wsdl/in-out">
      <wsdl:input wsdl:messageLabel="selectedResource" wsdl:type="xsd:anyURI"/>
      <wsdl:output wsdl:type="rdf:XMLLiteral"/>
    </wsdl:operation>
  </wsdl:interface>
  <wsdl:binding wsdl:interface="getWSDL-RESTfullInterface" wsdl:name="getWSDL-HTTPBinding"
wsdl:type="http://www.w3.org/ns/wsdl/http">
    <wsdl:operation whttp:method="GET" wsdl:ref="getWSDL"/>
  </wsdl:binding>
  <wsdl:service wsdl:name="getWSDL-Service">
    <wsdl:documentation>Takes a SM function as (selected) argument and generates a WSDL (XML)
document for it.</wsdl:documentation>
    <wsdl:endpoint wsdl:address="http://localhost:8083/tbl/sparqlmotion?id=getWSDL"
wsdl:binding="getWSDL-HTTPBinding" wsdl:name="getWSDL-HTTPEndpoint"/>
  </wsdl:service>
</wsdl:description>
```

2011 – Helping People Make Sense of Semantic Web Technologies

Human | Machine

Expressivity: Formal / Informal

Semantic-Enabled Competency Network

Ontology Driven Information Retriever

Context-Aware Retriever

Concept-Based Search

Semantic Multi-Faceted Search

Recommender

Semantic Workplace

Semantic-Enabled Communities

Generative Documentation

Connection and Pattern Explorer

Faceted Search

Answer Engine

Navigational Search

Semantic SOA

Semantic Mediation

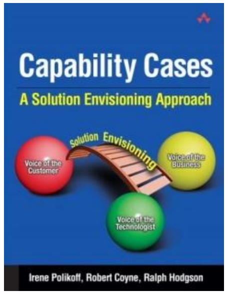
Semantic Data Integrator

Semantic Data Registry

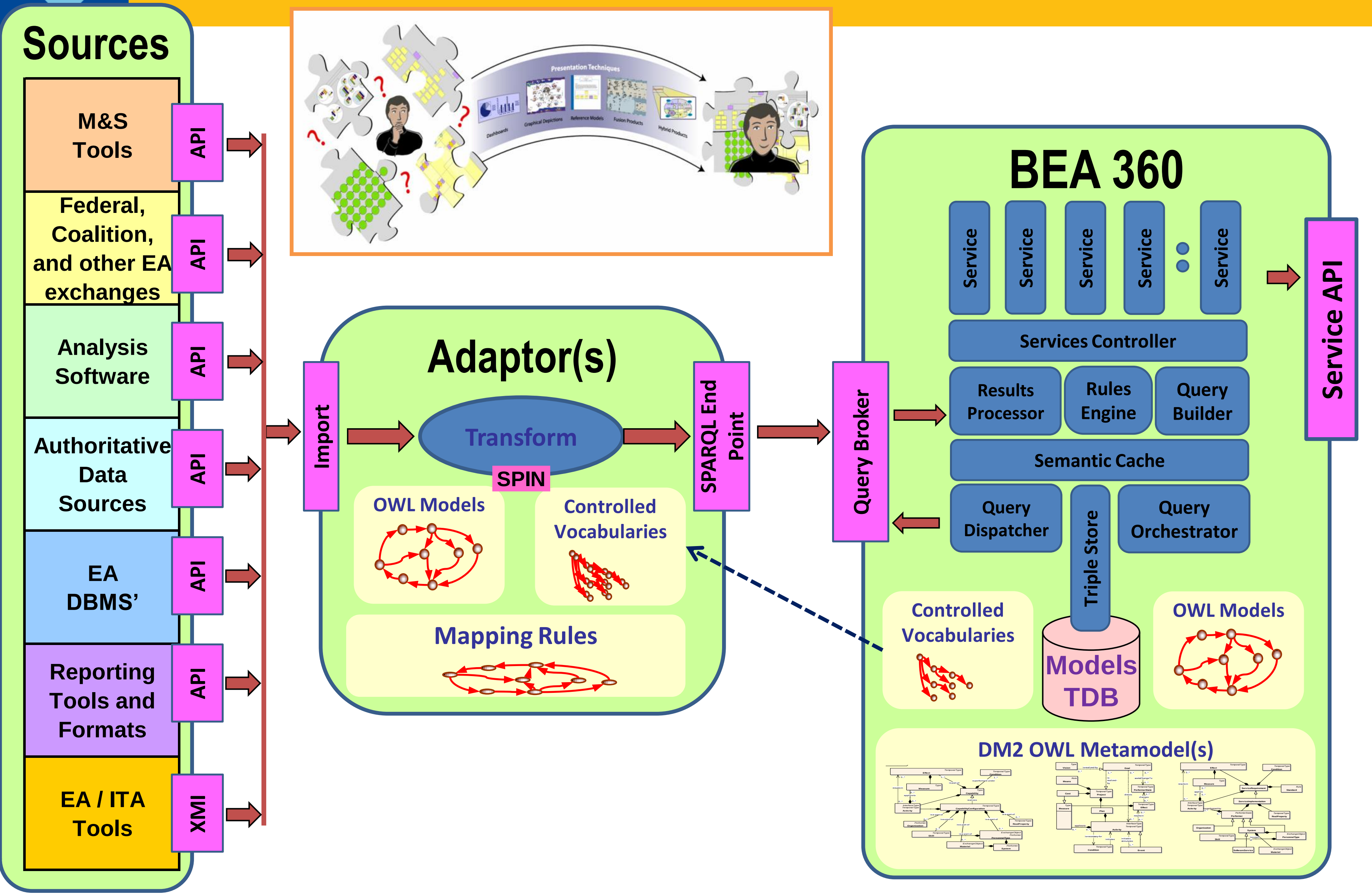
Information Aggregator

Application Integrator

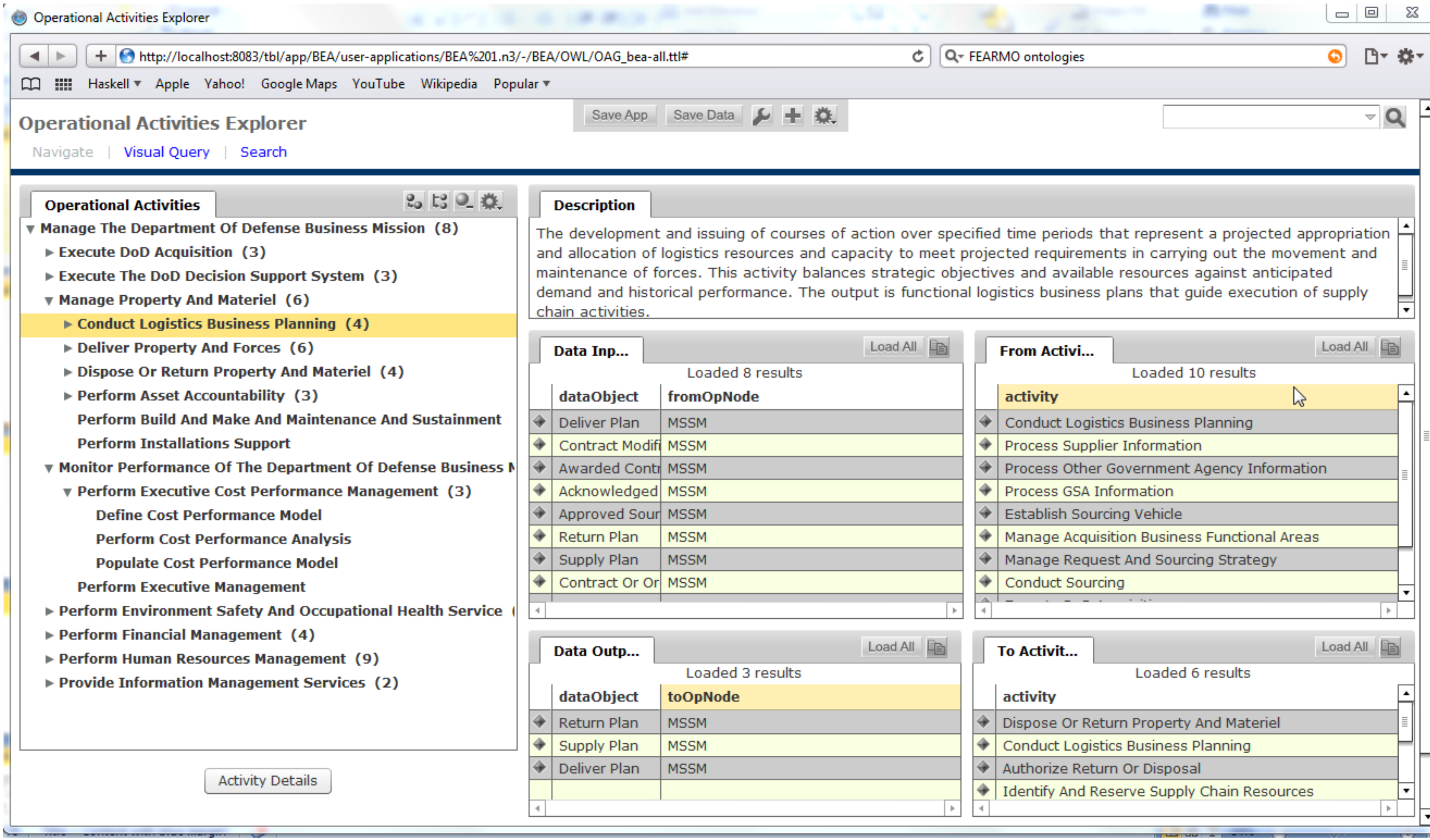
WEB 2.0 Mashups



DoD BEA 360 - Solution Concept



DoD BMA BEA Explorer – a TopBraid Ensemble Demonstrator



2011

2011

Linked Models

QUDT

Home Page

QUDT (Quantities, Units, Dimensions, and Types) Ontologies and vocabularies, and generated XSD schemas and XML Vocabularies, were developed for the NASA Exploration Initiatives Ontology Models (NExIOM) project as a foundational part of a comprehensive Information Architecture for NASA's Constellation Program. This effort was led by TopQuadrant working with NASA Ames Research Center (ARC). The goals of the QUDT ontologies are to provide a unified reusable model of measurable quantities, units for measuring different kinds of quantities, the numerical values of quantities in different units of measure, and the data structures and data types used to store and manipulate these objects in software.

QUDT is intended to provide a set of information models and vocabularies for standardizing units of measure, quantities and data types for the purpose of data interoperability and metadata management in linked data and semantic web infrastructures. Not all applications of QUDT will require a full dimensional treatment of units. For this reason, there is a vocabulary graph for a basic treatment of units, 'QUDT Unit' , and another graph, 'QUDT Dimensional Units' , for the full treatment.

QUDT Collection Metadata

The following metadata values are set on this collection:

2011

Subject	Quantities, Units, Dimensions and Types
Intent	QUDT is intended to provide a set of information models and vocabularies for standardizing units of measure, quantities and data types for the purpose of data interoperability and metadata management in linked data and semantic web infrastructures. Not all applications of QUDT will require a full dimensional treatment of units. For this reason, there is a vocabulary graph for a basic treatment of units, 'QUDT Unit' , and another graph, 'QUDT Dimensional Units' , for the full treatment.
Rights	The QUDT Ontologies are issued under a Creative Commons Attribution Share Alike 3.0 United States License. Attribution should be made to NASA Ames Research Center and TopQuadrant, Inc.
Created	2011-01-31T10:00:00
Last Changed	2011-04-09 21:19:57 -0700 (Sat, 09 Apr 2011)
Version	1.1
Owner	qudt.org
Collection Graph	http://www.qudt.org
Home Page	

2011

QUDT Content

The QUDT content is made up of schemas and vocabularies. In the table of contents, both schemas and vocabularies are listed. The table is ordered on the 'role' of the ontology. All vocabularies have a hyphenated name starting either with 'qudt' or a name that denotes the source. For example, the NIST constants vocabulary starts with 'nist'.

The following schemas and vocabularies make up this collection. In the first column of the table, for each ontology graph, there are links that take you to HTML documentation and a source file in N3/Turtle format.

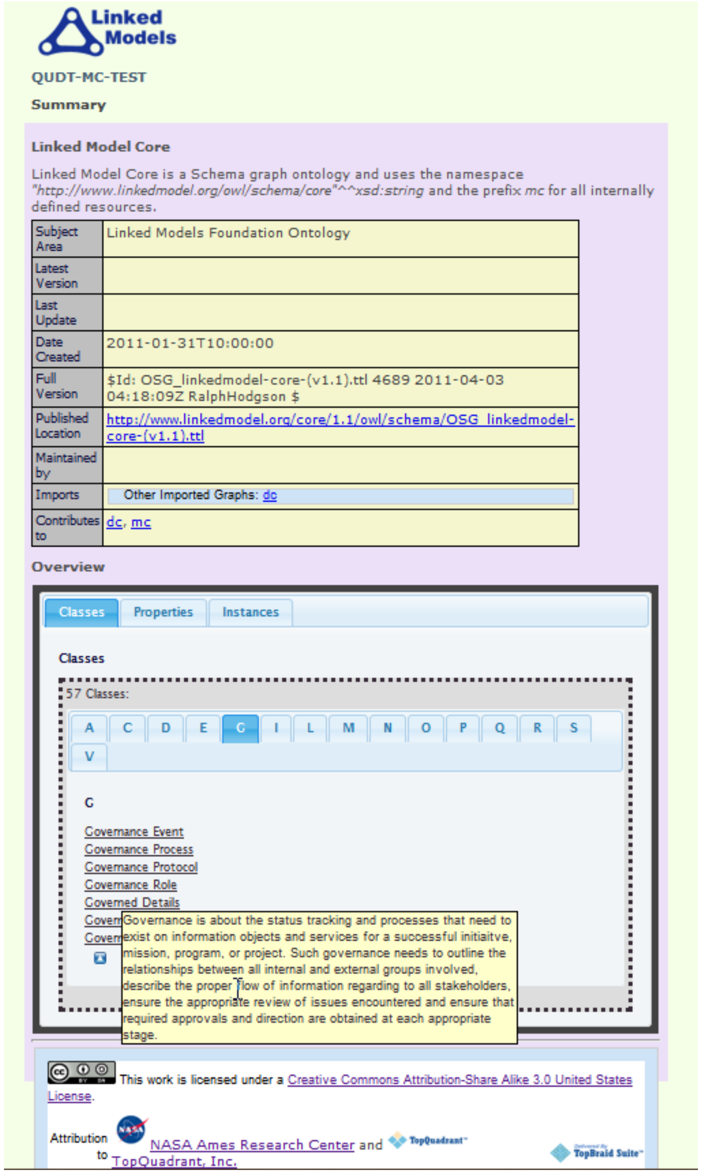
Ontology (Documentation)	Subject	Role	Namespace	Description
Linked Model Core Documentation: HTML Source: N3/Turtle	Linked Models Foundation Ontology	Schema graph	mc	The LinkedModel Core Ontology, prefix mc, provides a foundation ontology for commonly needed metadata on ontologies as well as concepts and properties that are of general applicability. The metadata provided includes support for licensing rights, accreditation and other provenance properties. The concepts that are commonly used in ontologies are 'mc:Category', 'mc:Entity', 'mc:EnumeratedValue' and 'mc:Enumeration'. LinkedModel Core makes use of the Creative Commons RDF model. Other Imported Graphs: dc Last Changed: 2011-04-10 03:07:58 -0700 (Sun, 10 Apr 2011)

2011

QUDT Dimension Ontology Documentation: HTML Source: N3/Turtle	Quantities, Units, and Dimensions	Schema graph	dimension	QUDT, or the 'Quantity, Unit, Dimension and Types' ontology defines the base classes properties, and restrictions used for modeling physical quantities, units of measure, and their dimensions in various measurement systems. In physics and science, dimensional analysis is a tool to find or check relations among physical quantities by using their dimensions. The dimension of a physical quantity is the combination of the basic physical dimensions (usually mass, length, time, electric charge, and temperature) which describe it; for example, speed has the dimension length / time, and may be measured in meters per second, miles per hour, or other units. Imported Schemas: mc, qudt Other Imported Graphs: dc Last Changed: 2011-04-02 21:17:50 -0700 (Sat, 02 Apr 2011)
QUDT Documentation: HTML Source: N3/Turtle	Quantities, Units, and Dimensions	Schema graph	qudt	The QUDT, or quantity-unit-dimension-type ontology defines the base classes properties, and restrictions used for modeling physical quantities, units of measure, and their dimensions in various measurement systems. Imported Schemas: mc Other Imported Graphs: dc, skos Last Changed: 2011-04-09 21:19:57 -0700 (Sat, 09 Apr 2011)

Attribution to NASA Ames Research Center and TopQuadrant, Inc.

2011



Linked Models

QUDT-MC-TEST

Summary

Linked Model Core

Linked Model Core is a Schema graph ontology and uses the namespace *"http://www.linkedmodel.org/owl/schema/core"^^xsd:string* and the prefix *mc* for all internally defined resources.

Subject Area	Linked Models Foundation Ontology
Latest Version	
Last Update	
Date Created	2011-01-31T10:00:00
Full Version	$Id: OSG_linkedmodel-core-(v1.1).ttl 4689 2011-04-03 04:18:09Z RalphHodgson $
Published Location	http://www.linkedmodel.org/core/1.1/owl/schema/OSG_linkedmodel-core-(v1.1).ttl
Maintained by	
Imports	Other Imported Graphs: dc
Contributes to	dc, mc

Overview

Classes Properties Instances

Classes

57 Classes:

A C D E G I L M N O P Q R S V

G

Governance Event
Governance Process
Governance Protocol
Governance Role
Governed Details
Govern
Govern

Governance is about the status tracking and processes that need to exist on information objects and services for a successful initiaitve, mission, program, or project. Such governance needs to outline the relationships between all internal and external groups involved, describe the proper flow of information regarding to all stakeholders, ensure the appropriate review of issues encountered and ensure that required approvals and direction are obtained at each appropriate stage.

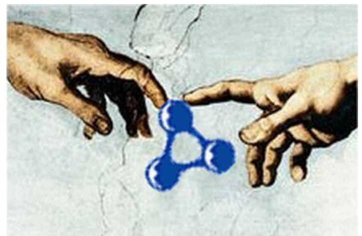
This work is licensed under a Creative Commons Attribution-Share Alike 3.0 United States License.

Attribution to NASA Ames Research Center and TopQuadrant, Inc.

1991-2021

1991 2001 2011 2021

Ethernet

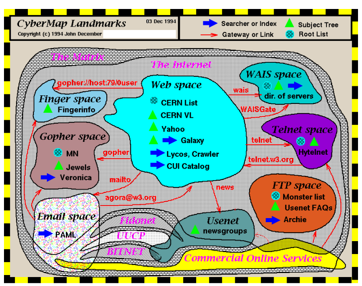


“The One”

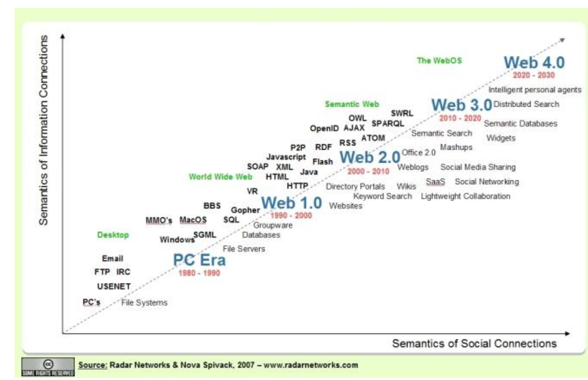
Web of Things

Timeshare The Web Web 3.0 The Cloud

DARPA Net



The Mesh



“WebOS”

References

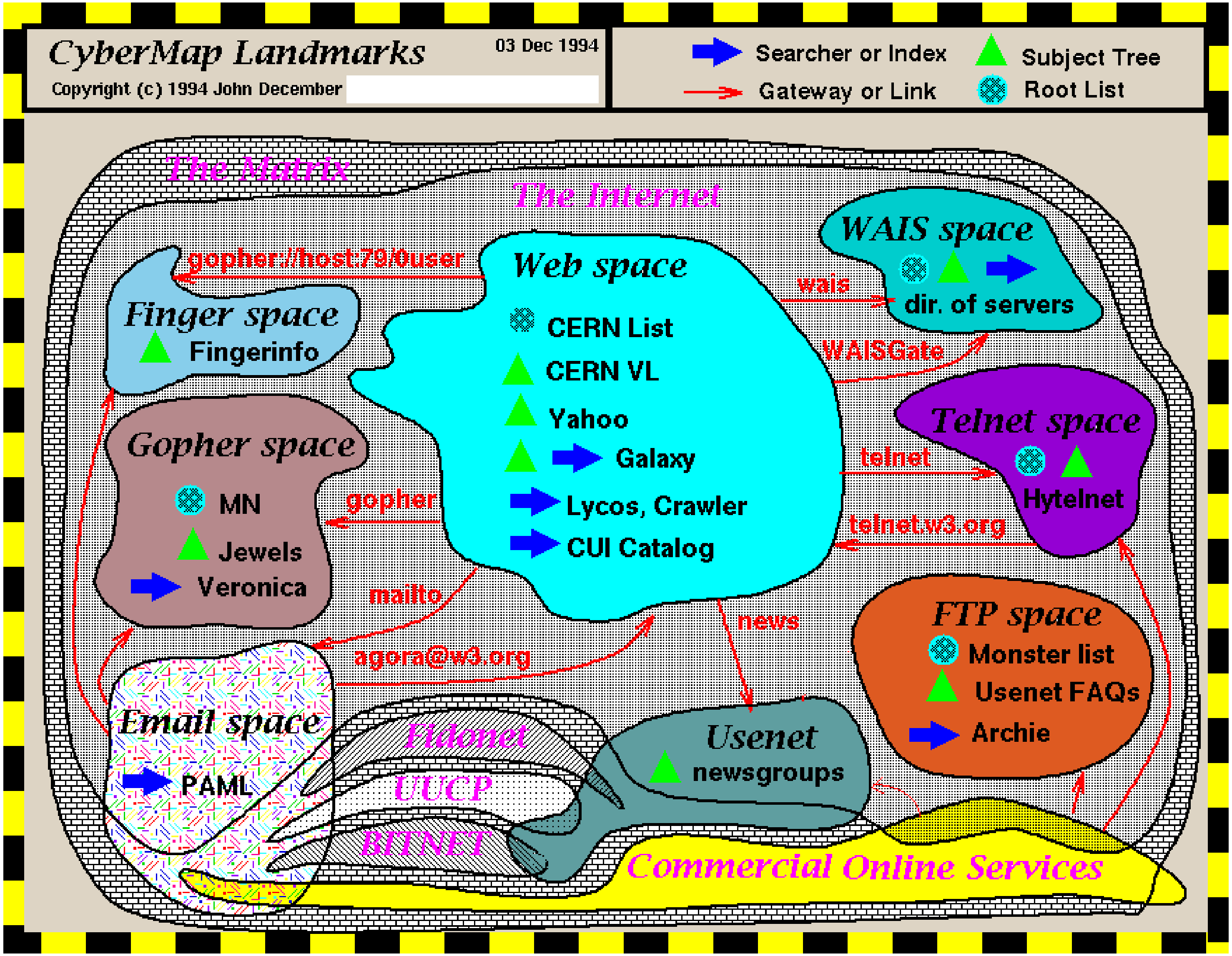
[The One] "Kevin Kelly on the next 5,000 days of the Web" - http://www.ted.com/talks/kevin_kelly_on_the_next_5000_days_of_the_web.html. at 11:23 - Semantic Web vision - from Linking Pages to Linking Data.

[Web Of Things] Web Architecture Fall 2009 — INFO 290 (CCN 42593), Erik Wilde, UC Berkeley School of Information, 2009-12-03 -- http://dret.net/lectures/web-fall09/trends#(1)

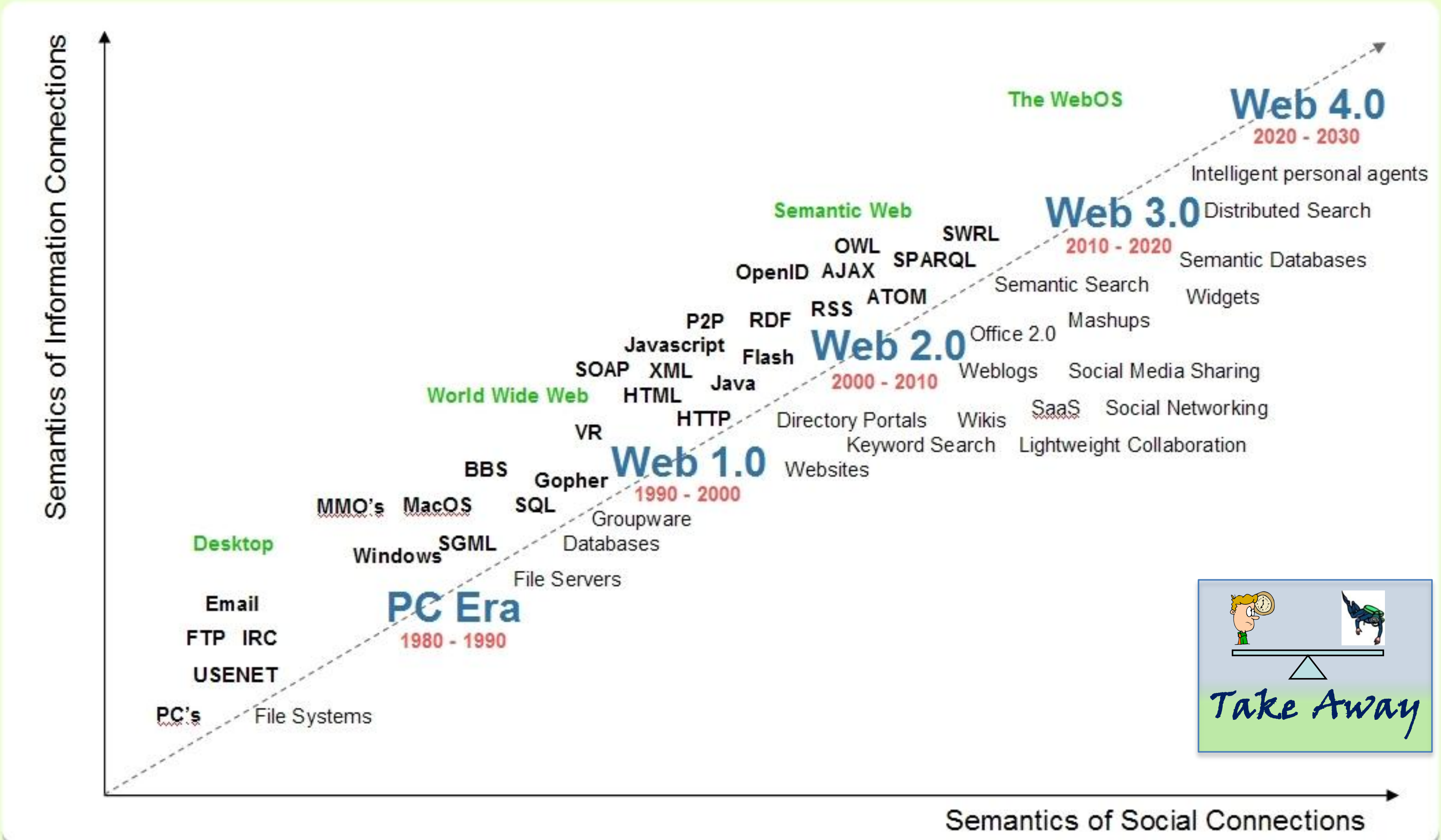
[Cybermaps] http://www.december.com/web/text/cyberatlas.html

[The Mesh] Lindsay Lush, gravityshack.com - http://www.gravityshack.com/blog/?cat=60

Early Web (1994) – According to CyberMap Landmarks



According to Nova Spivack …



Source: Radar Networks & Nova Spivack, 2007 – www.radarnetworks.com

TopQuadrant™

2021 – Helping People put SBFI Technologies to Work

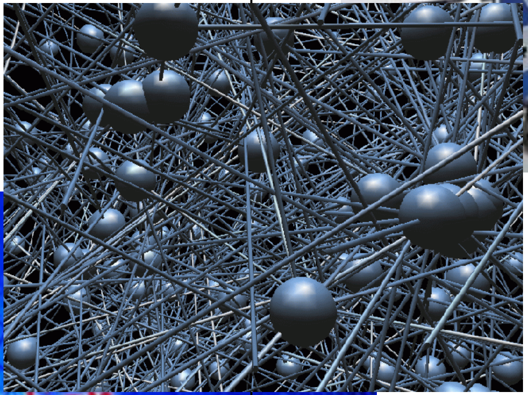
Human

Machine

Expressivity

Formal

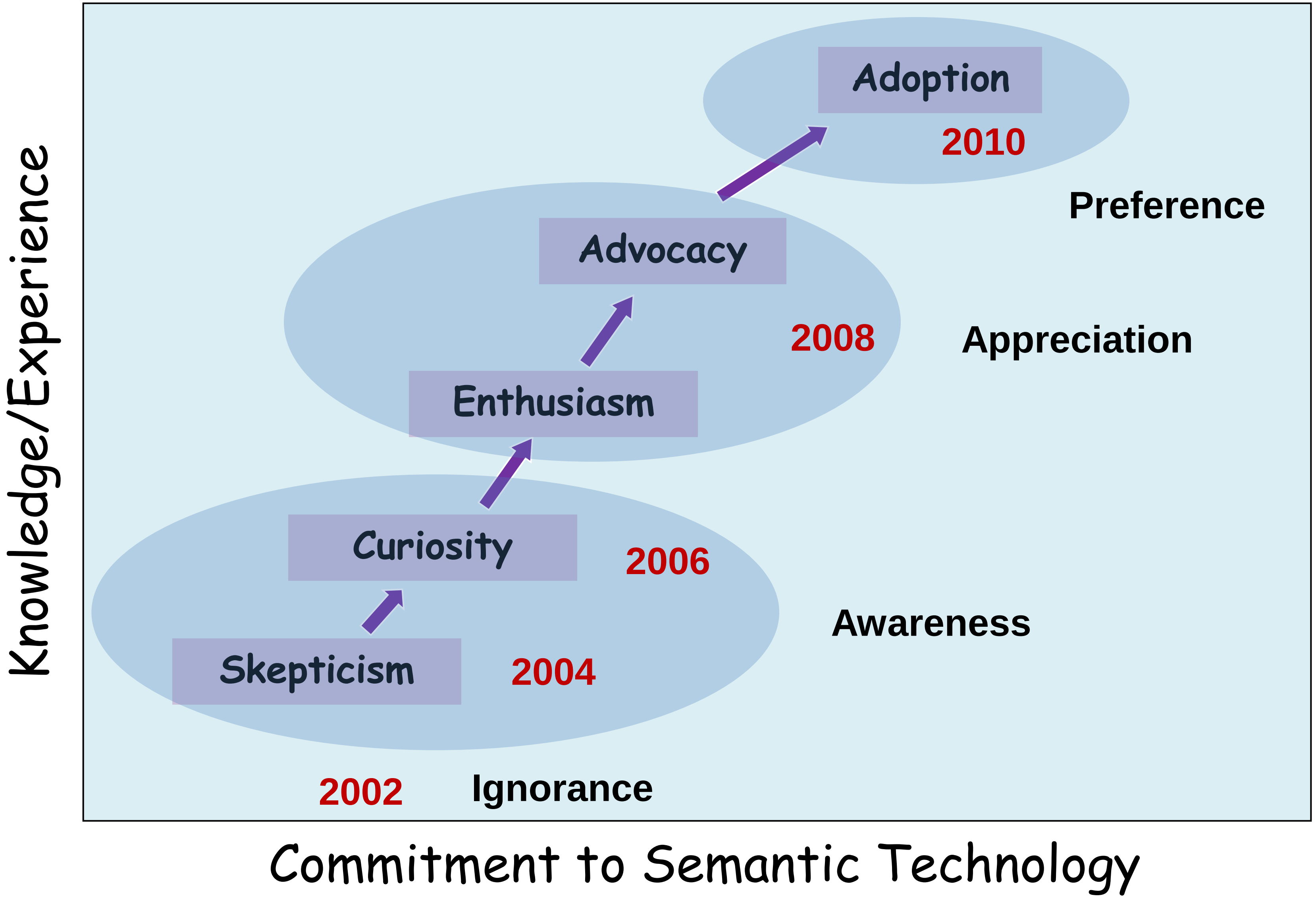
Informal



The Lattice

©2010 Gravity Creative. Illustration: Lindsay Lush

Semantic Technology Adoption



2011-2021 Trends and Needs

Immediate Trends

1. Data in RDF
2. Increase in RDFa use
3. Preference for OWL-lite
4. Rules shake-out
5. “Frictionless” Data
6. Ontology Explosion

Future Trends

7. From Data to Apps
8. Composite Apps
9. Internet of Things
10. SBFI on the Web

Needs

1. Linked Models
2. Registries
3. Governance
4. URI Standards
5. Ontology Design Profiles and Patterns
6. Ontology Architecture
7. Ontology Alignment Methods and Tools
8. Ontology Metrics and Reuse Assessment Methods and Tools
9. API Standards
10. Standards for Transforms

2011-2021 Outcomes and Challenges

- Outcomes
  1. Accurate Information Provisioning
  2. Frictionless Data Gathering
  3. Compliance Checking
  4. Rule Making

- Challenges
  1. Vendors
  2. System Integrators
  3. Govern ance
  4. Standards Confusion

TopQuadrant™

Thank You

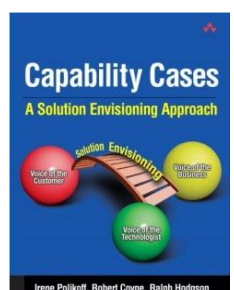
Ralph Hodgson

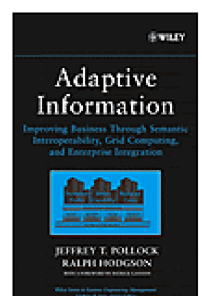
E-mail: rhodgson@topquadrant.com

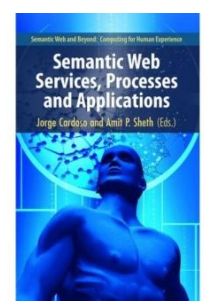
Presentations: http://www.scribd.com/ralphtq

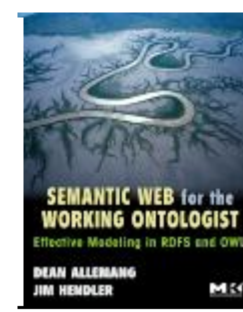
Twitter: @topquadrant, @ralphtq, @oegovnews

Some References









Vizenor, Lowell

Putting NextGen Ontologies to Work

The Net-Centric Operations Division (NCOD) of the Joint Planning and Development Office (JPDO) is using Ontology (the explicit formal specifications of the terms in a domain and the relations among them) and Semantic Web technology to enhance service discoverability, interoperability and understandability through the use of semantic, machine-interpretable service descriptions. The NextGen ontologies will be used to specify a precise and reusable terminology that facilitates information sharing across multiple agencies and communities through the precise description of the intended meaning of service. This presentation will discuss the overall approach to the development of NextGen Community of Interest (COI) ontologies, applications of these ontologies and, finally, strategies to coordinate and govern COI- driven, ontology development.

Putting NextGen Ontologies to Work

Lowell Vizenor, PhD
Alion Science and Technology

April 12, 2011

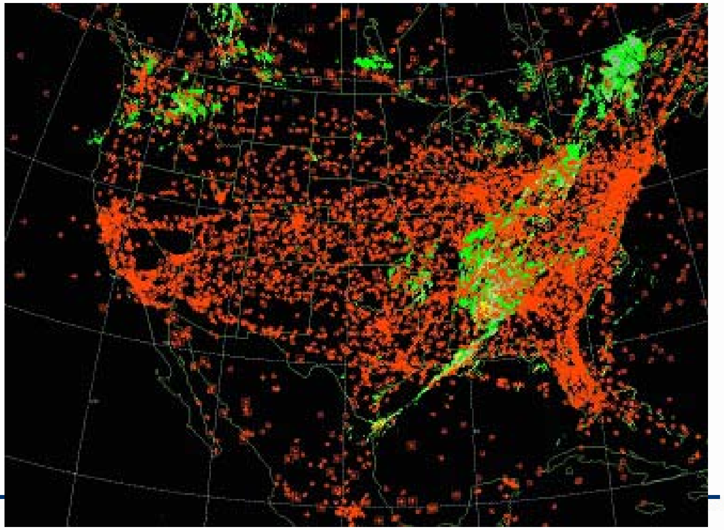
NextGen and Net-Centricity

As traffic in the National Airspace grows in volume, the associated information is expected to grow.

Much of this information comes from multiple sources, covers a broad range of topics, and requires manual treatment.

As a result, there is a clear need to modernize the information environment associated with the National Airspace.

Users require easy access to the information they need, as well as the ability to understand and use this information.



- NCDS Goals: Data should be:
  - *Visible* – Who has what data available?
  - *Accessible* – Can I gain access to this data?
  - *Understandable* – What does this data mean?
  - *Trusted* – Is this data accurate and authoritative for my purposes?
  - *Interoperable* – Can my application use the data?
  - *Responsive to users' needs* – Is the data applicable and timely?
  - *Institutionalized* – What and who governs the definition, lifecycle, and use of this data?
- DoD Strategies
  - Distributed: Communities of Interest (COI) develop vocabularies

DoD Net-Centric Data Strategy (cont…)

- Community of Interest (COI) Driven Ontology Development

Community of Interest: A collaborative groups of users who must exchange information in pursuit of their shared goals, interests, missions, or business processes and who therefore must have **shared vocabulary** for the information they exchange.

Figure 4. COI Characteristics

	Functional	Cross-Functional
Expedient	Tactically driven, Implied authority, Formal processes modified for need, Relatively many entities (e.g., New Imagery Analysis capability for Damage Assessment)	Tactically driven, Derived authority, Ad hoc processes, Many entities (e.g., Forward deployed JTF planning New Threat Response)
Institutional	Explicitly recognized, Longer term, More formalized processes based on span of control, Relatively few entities (e.g., PSAs such as Logistics)	Explicitly or implicitly recognized, Longer term but priority driven, Blended processes resulting from agreements (e.g., JS area such as Battlespace Awareness)

Big Picture

- Joint Planning and Development Organization (JPDO) Mission:

  Ensure the NextGen transformation is realized by identifying, facilitating and integrating the activities, commitments and contributions of partner agencies, industry, and other key stakeholders to achieve the goals and benefits of the Next Generation Air Transportation System.

- Net-Centric Operations Division (NCOD) Mission:

  Manage policies and strategies for information sharing and coordinate investment and development of network-enhancing capabilities.

- Key attributes for information re-use:
  - Understandable
  - Discoverable
  - Timely
  - Accessible (within security constraints)
  - Accurate
- Ontology and Business Process Analysis
  - Work to make the information understandable by:
    - Defining an ontology (and common message model)
    - Documenting information exchanges required
    - Describing services to increase the potential for re-use
  - Work to make the information discoverable and accessible through
    - Service registry, metadata directory, and digital library
  - 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

NextGen COIs/Working Groups

Phase 1
- Weather
- Integrated Surveillance

Phase 2
- Airport Business and Operations
- Unmanned Aircraft Systems
- Flight & Flow

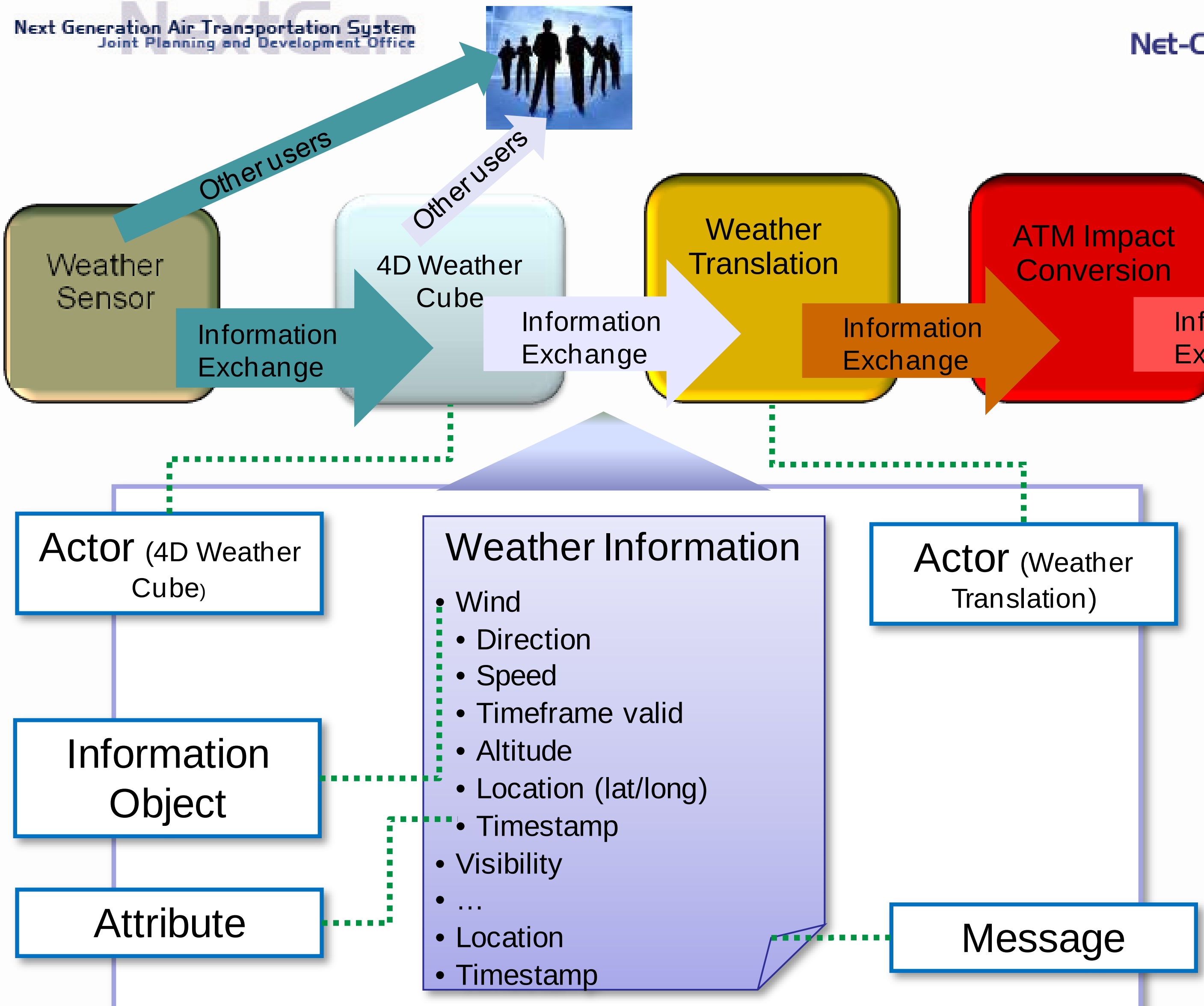
Phase 3
- Safety
- Trajectory and Performance-Based Operations
- Layered Adaptive Security
- Environmental Management
- Positioning, Navigation, and Timing
- Airline Business and Operations
- Special use Airspace

Challenges to Success

- Ontology Coordination
  - Defining the domain of each COI to avoid redundant development efforts and encourage reuse of each others ontologies
  - Leveraging work from communities outside of NextGen community (e.g. the geospatial community)
  - Creating effective incentives to avoid “semantic” stovepipes and encourage the use of a agreed upon set of best practices
- Ontology Scope
  - Prioritizing areas of ontology development (i.e. how do we identify what are our core terms)
- Training and Outreach
  - Identifying key participants
  - Expanding developer and user base

JPDO Engagement Model

Ontology Scope: Information Object Analysis

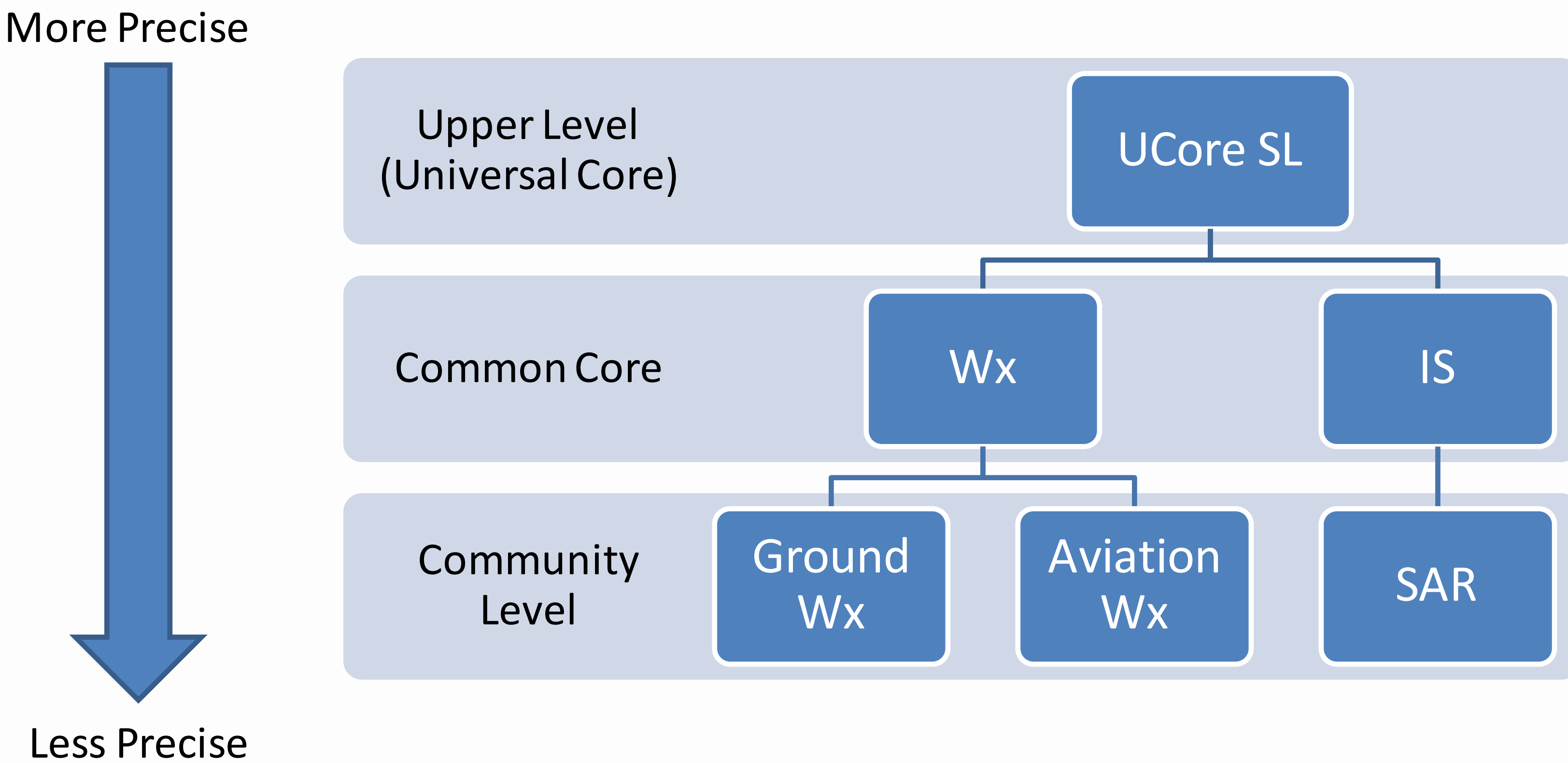


Note that this diagram is not intended to present a comprehensive picture. It depicts a type of weather information exchange, but there may also be additional types of weather information exchange that are not pictured here.

“Sprint and Drift” Strategy

- Sprint
  - First pass definition of COI information objects and exchanges
  - Approximately 3 months
  - Goal is to jump-start the process
  - Focus on 3-4 information objects and ontology
  - Products not expected to be complete or final
- Drift
  - COI reviews and discusses the first pass products
  - COI formulates opinions
  - Team works with other COIs and identifies areas of overlap
- Sprint again (2nd pass)
  - About 1 year after first pass
  - Refine the products from the first pass or re-work them

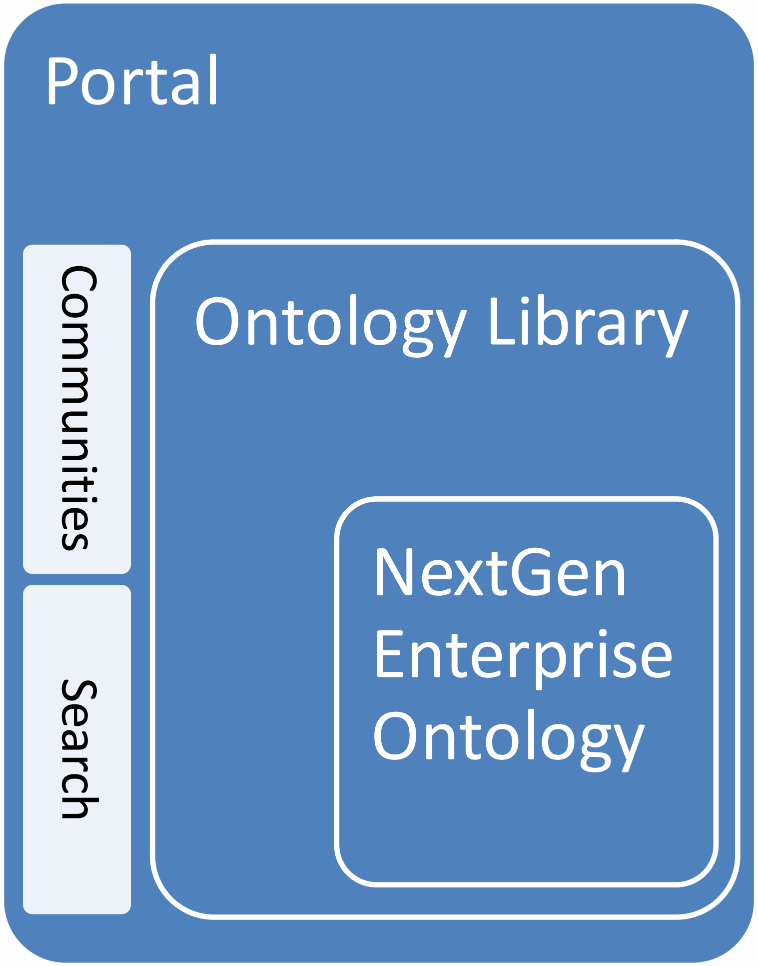
Ontology Coordination: Top Down/Bottom Up Methodology



NextGen Semantic Service Registry

- Purpose
  - Improve service discoverability and understandability
  - Support Semantic Service Provisioning
  - Provide Federated Search
- Technical
  - Provide Federated Search
  - Encode service metadata in RDF
  - Use ontology to annotate message content
  - Convert WSDL and XSD Schema files into RDF

NextGen Ontology Portal



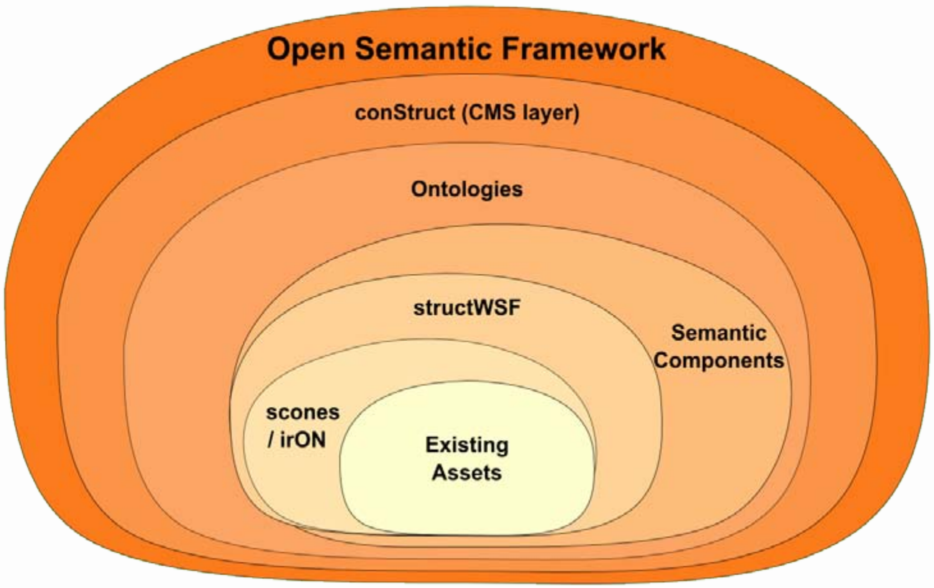
Ontology Portal

- Two-Tiered Registry
  - NextGen Ontology – consist of vetted ontologies
  - Ontology Library – open to the wider community
- Ontology Metadata
  - Ontology owner, domain, and location
- Ontology Search*
  - Support ontology discovery

Use of Open Source Software

Open Semantic Framework

Software Component	Description
Linux	Operating System
MySQL	Relational Database
Apache HTTPD	Web Server
Apache Solr	Enterprise search platform
Virtuoso	Multimodel data server / triplestore
OpenSSL	Secure Socket Layer Library
iODBC	Open DataBase Connectivity Library
PHP	Professional Home Pages
Java	Software development language and interpreter
Drupal	Web Content Management System
OpenStructs	Semantic Web Service Framework



Schoening, James

Strategies toward a Standard Upper Ontology

Data continues to be locked in semantic silos, unable to be understood by unanticipated users across or outside the enterprise. XML provides syntax and structure for data sharing, but relies on human senders and receivers to agree on the meaning of the data. Ontologies capture the semantics of data, but they too become semantic silos if developed in isolation. A potential solution for wide-scale Semantic Interoperability lies in standard ontologies. While there can never be a single comprehensive ontology for all concepts, there could be one standard 'upper' ontology, to provide the foundation for extension ontologies for domains and sub-domains, and to provide common conceptsfor sharing data between and across domains. Multiple upper ontologieshave been developed, but the ultimate value of an upper ontology will only be realized if one of them becomes the standard. It need not be a perfect ontology, just 'good enough' for enough stakeholders to utilize and to start building market adoption. Once this momentum gets started, early adopters and vendors will develop tools, best practices, conformance tests, and training to make it easier for others to adopt. This presentation will cover some past, current, and potential future strategies for getting to a Standard Upper Ontology, plus how interested stakeholders can get involved.

Strategies Toward a Standard Upper Ontology

April 13, 2011

ODISSEE Workshop

James R. Schoening
Phone: 732-996-0018; Email: Jim.S3@juno.com

Agenda

- Challenge of Semantic Interoperability
- Potential Solution: Standard Ontologies
- Benefits of a Standard Upper Ontology
- What do we mean by Upper?
- Upper Ontology Debate
- Library of Standard Ontology Components
- Elements of a Good Standard
- Ways to Develop the Specification
- Past, Current, and Potential Strategies
- Conclusions

Challenge: Semantic Interoperability

- Net-Centric Data Strategy calls this: ‘Understandability ‘
  - By unanticipated humans and computers
- Data continues to be locked in semantic silos
  - Unable to be understood by unanticipated users across or outside the enterprise
- XML helps with the structure of data sharing
  - But relies on human senders and receivers to agree on the ‘meaning’ of the data
- Ontologies can express the semantics of data
  - But they too become semantic silos unless based on a common model

Potential Solution: Standard Ontologies

- Could never be a single ontology
  - Too big to ever complete
  - Too big for developers to learn
- There could (in theory) be a single upper ontology
  - Would need to be small
  - Could be extended for domains and sub-domains
- Value of an upper ontology is realized when one of them becomes the standard

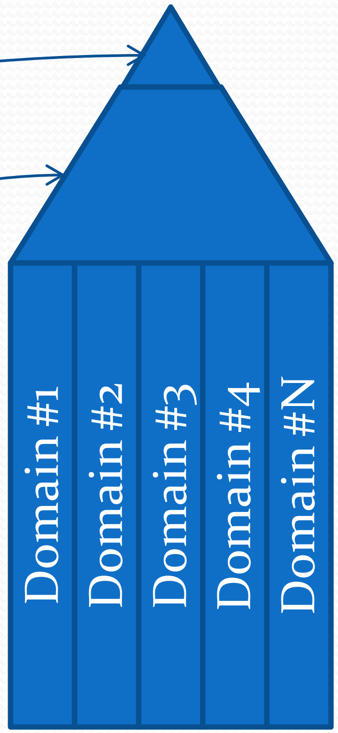
Key Question: How do we get to a standard?

Benefits of a Standard Upper Ontology

- Data sharing across domains, enterprises, and globally
  - Depends on how far the standard spreads
  - Not total semantic interoperability, but some useful level of it
  - Enables conformance testing to ensure interoperability
- Improves ontology development
  - Provides common base to extend from
  - Better tools
  - Simplifies training
- Other areas to benefit
  - Enables Services to be Semantically Interoperable
  - Enables Data Integration on a larger scale
  - Enables unstructured data to have tags with standard meaning
  - Enables Master Data to be semantically consistent and understandable across the enterprise and beyond
  - Provides Linked Open Data (LOD) with standard ontologies to link to
  - Allows Natural Language Processing (NLP) to express derived meaning in standard semantics
  - Enables development of logically consistent and scalable vocabularies

What do we mean by <u>Upper</u>?

- I suggest <u>two</u> levels:
  - Upper <u>foundational</u> ontology
    - Provides philosophical foundation for extension ontologies
    - Example: Basic Foundational Ontology (BFO)
  - Upper <u>practical</u> ontology
    - Includes <u>common concepts</u> used by multiple domains
    - Extended from (or includes) upper foundational ontology
    - Designed for further extensions
    - Examples: UCore-SL, Upper Cyc, SUMO, ISO-15926,



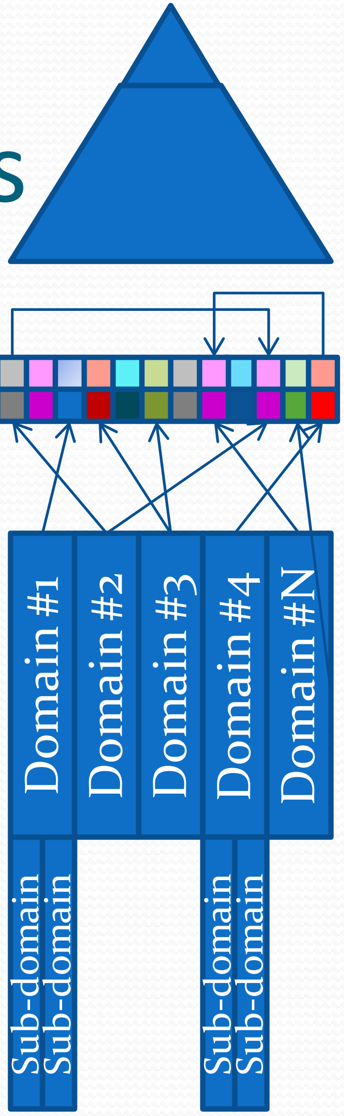
Upper Ontology Debate

- Arguments <u>against</u> feasibility
  - Been tried before
  - Differing valid perspectives, plus no purely objective perspective
  - Will never achieve consensus
- Arguments <u>for</u> feasibility
  - Doesn't need to be perfect or correct
    - Just good-enough for enough users to get started, then others will follow
  - Unique perspectives can be handled in extensions or non-standard ontologies
- More on these arguments at
  - ht tp://en.wikipedia.org/wiki/Upper_ontology
- Stalemate: This debate will not be settled through argument
  - Up to the proponents to show feasibility and value

Library of Standard Ontology Components

- Examples: Time, location, money, person, Units of Measure, etc.
- Used by many domains
- Each should have simple and complex versions
- Many components already being developed
  - But they are not interoperable
- Domains and sub-domains reference specific components
- Large numbers will be developed
  - With some becoming standards

- **May provide critical mass for ontology standards**



Notional Architecture

Elements of a Good Standard

- Good-enough specification
- Momentum of adoption (aka “de facto standard”)
- Stability, plus a process for revisions
- Formal standardization via a Standards Developing Organization (SDO)
- Conformance testing
- Tools, training, best-practices, etc.

Ways to Develop the Specification

- Start from scratch
- Select an existing specification and refine it
- Merge existing upper ontologies

- Ways to resolve differing input:
  - Open consensus process and voting
  - Consortium
  - Major player develops and releases

Past Strategies

- Technique of merging ontologies developed (late 1990's)
- National Cte for IT Standards (NCITS) explored developing a Reference Ontology (2000)
- Various Upper Ontologies developed
  - Examples: SUMO, BFO, DOLCE,
- IEEE Standard Upper Ontology Working Group (SUO WG)(early 2000's)
  - Matured draft specifications but didn't have 75% of votes to pass them.

Current Strategies

- Open Biomedical Ontologies (OBO) Foundry
- UCore-SL gaining adoption
- DoD Architecture Framework (DoDAF) Meta-Model
  - An ontology for architectures, based on IDEAS Ontology

Potential Strategies

- Merge the leading upper ontologies
  - Will build buy-in and improve the specification
  - 'Community sourcing' might provide the bulk of this work, but should have a paid editor.
- Government could lead
  - Develop, refine, or merge to create a broad-enough upper ontology
  - Encourage government piloting and adoption
  - Mandate internally only when fully proven and mature
  - Government vendors will adopt if required or beneficial, creating wider momentum toward global de factor standard
- Seek component developers to rally around one upper ontology
- Formally standardize
  - Only after clear momentum toward a given upper ontology
  - ISO might be better then IEEE
- Encourage stakeholders to develop tools, training, best-practices, conformance testing, etc.

Conclusions

- A Standard Upper Ontology holds great promise in enabling Semantic Interoperability
- Ingredients for momentum are coming together
  - With more in the works
- What's your stake? Champions needed.
- Questions?