Defense Acquisition in Transition

6TH ANNUAL ACQUISITION RESEARCH SYMPOSIUM

Ontology-Based Solutions for Software Reuse

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Goal – Improve Current Software Repository Capabilities

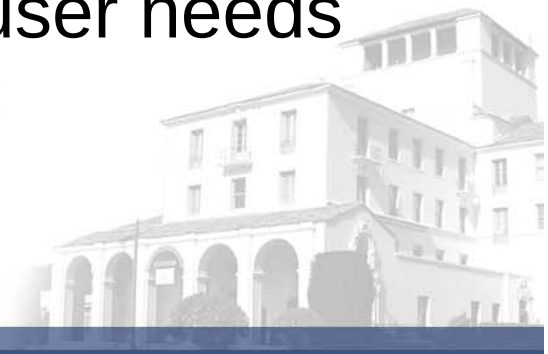
- Types of searches typically supported by repositories
  - Keyword search over metadata – dependent upon semantic assumptions
  - Browsable categories – becomes ineffective as size grows
- The goal of this research is to improve repository utility by expanding capabilities
- Initial research conducted in support of PEO IWS for the SHARE repository

Repository Framework

- Developed enriched metadata and semantic descriptions for improved search and reuse
- Goal of proposed framework is to enable multiple search and discovery options:
  - Semantic Search (e.g., relationships)
  - Model-Based Search (e.g., structures)
  - Maintain traditional search options (e.g., keyword)
- Approach: Repository Framework
  - Component Specification
  - Ontology

Component Specification and Ontology

- Component Specification - a description or model of the items in the repository
  - "Typical" Metadata - information about an asset/artifact
  - Software Behavior Description – a searchable representation of the software asset's behavior
- Ontology – a contextual model of the repository items describing their relationships to aid in associating artifacts with user needs

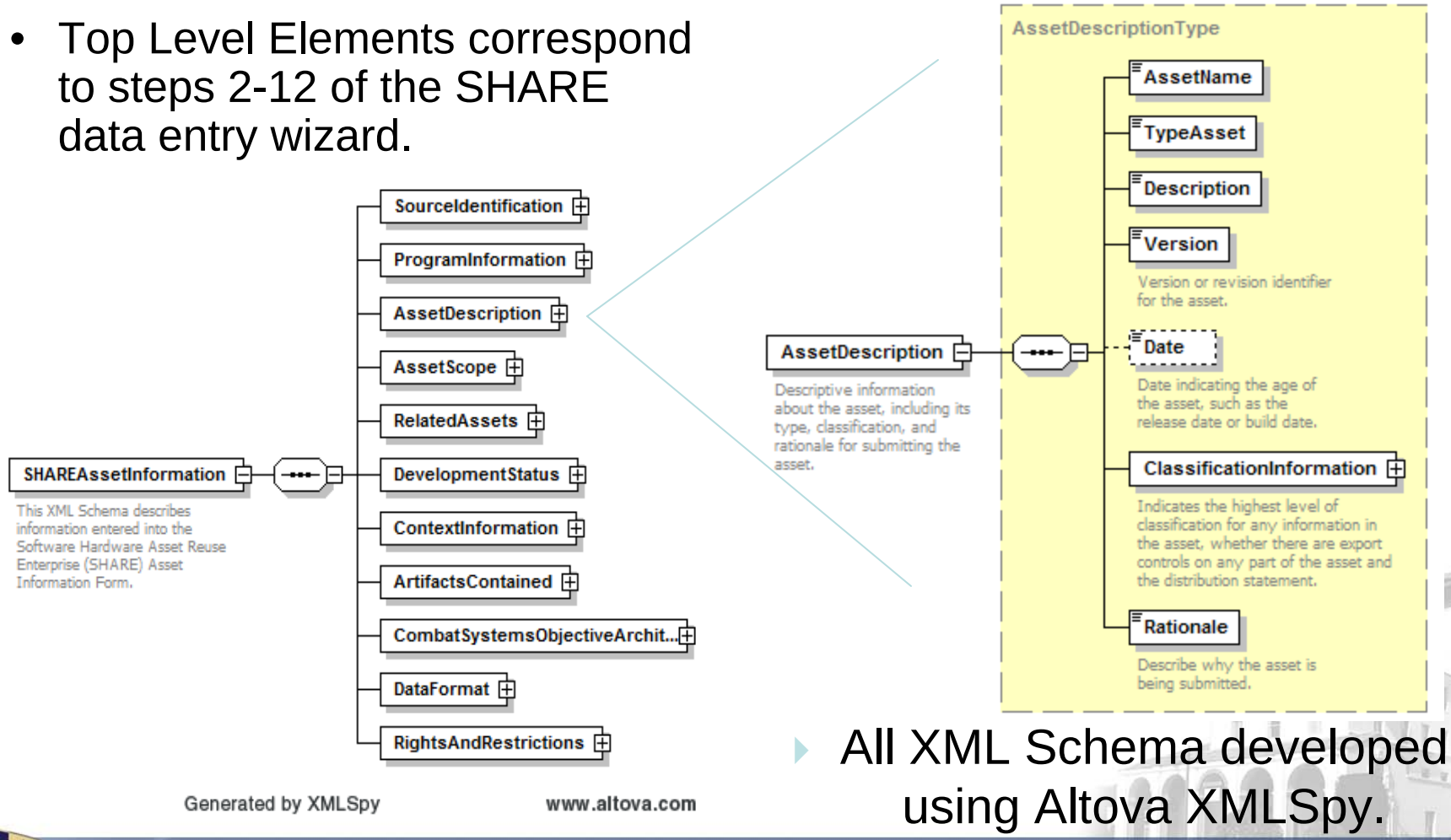


Metadata

- "As-is" Schema
  - Reflects current metadata schema in SHARE
  - Align with data entry steps in SHARE's Asset Information Form wizard
- Recommended "To-be" Schema
  - XML Schema designed using Artifacts as the basis
  - Incorporates software behavior and ontology references
- Evaluated both schema approaches against other metadata schemes

As-is Metadata Schema

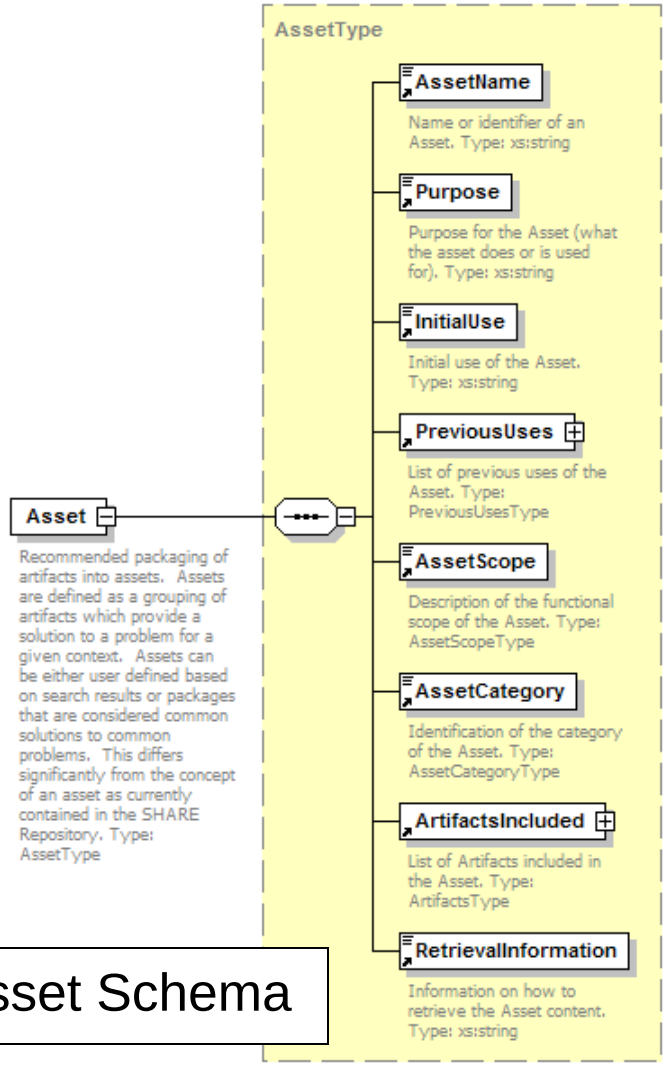
- Top Level Elements correspond to steps 2-12 of the SHARE data entry wizard.



- All XML Schema developed using Altova XMLSpy.

To-be Metadata Schema

- Two schemas to capture data at appropriate level of granularity
- Artifact Schema describes individual artifacts (smallest useful package of items)
- Asset Schema defines package of artifacts to meet a particular need
- Allows user-defined assets as well as submitter-defined



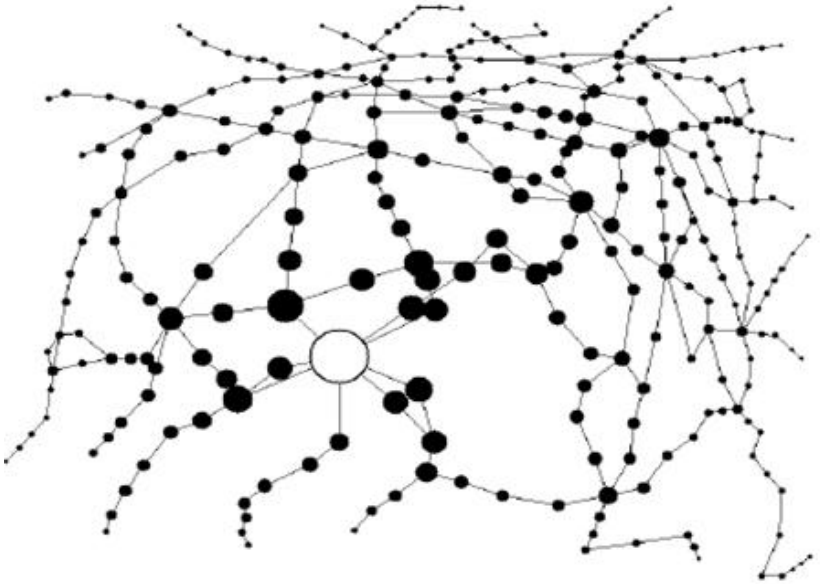
Asset Schema

Software Behavior Representation

- Informal Approach
  - Common System Function List, Web Service Description Language
- Behavioral description elements are included in the metadata for each artifact

Relationships (Ontology)

- Multiple sources of context for repository artifacts
  - Artifact's place in the Software Engineering Lifecycle
  - Original System Architecture (Aegis, SSDS, etc.)
  - Surface Navy Open Architecture reference architecture
  - Semantic relationships (ReSEARCH work)
- Ontologies represented in OWL-DL (Description Logic)

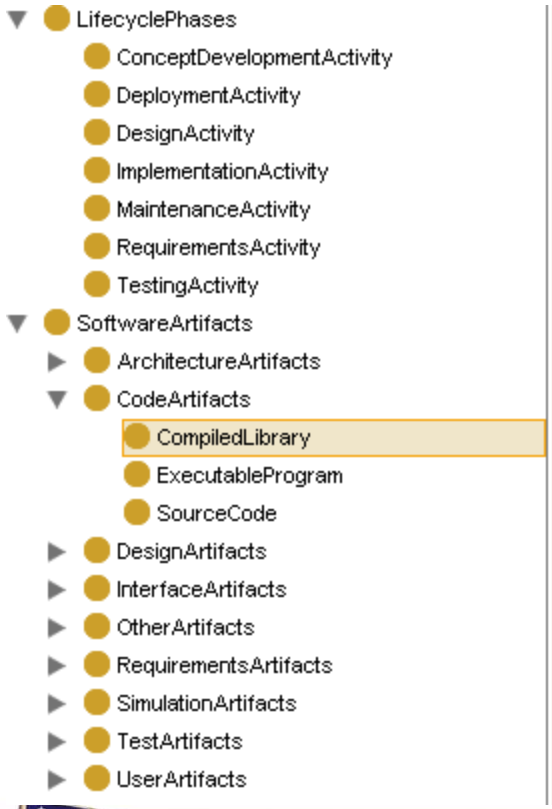


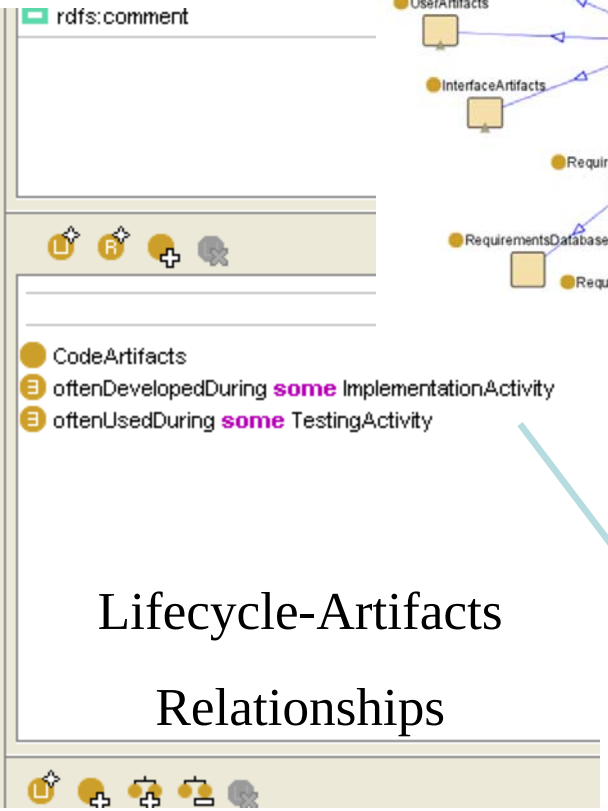
Fish Eye Graph

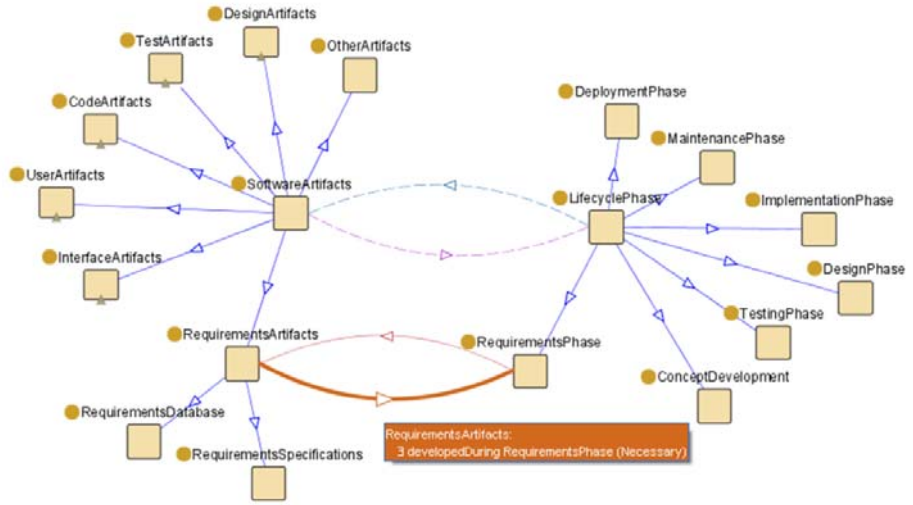
(Sarkar and Brown,1993)

Lifecycle-Artifact Ontology

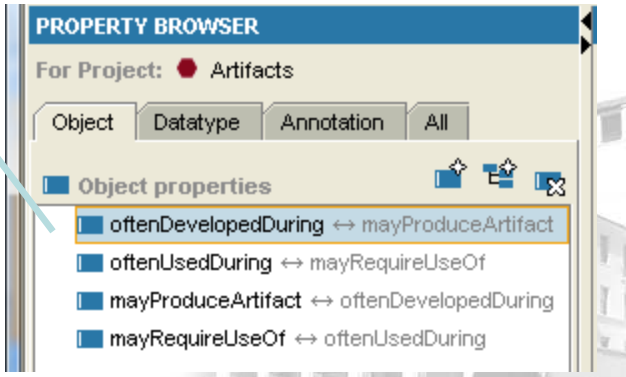
- Links artifact types to development activities





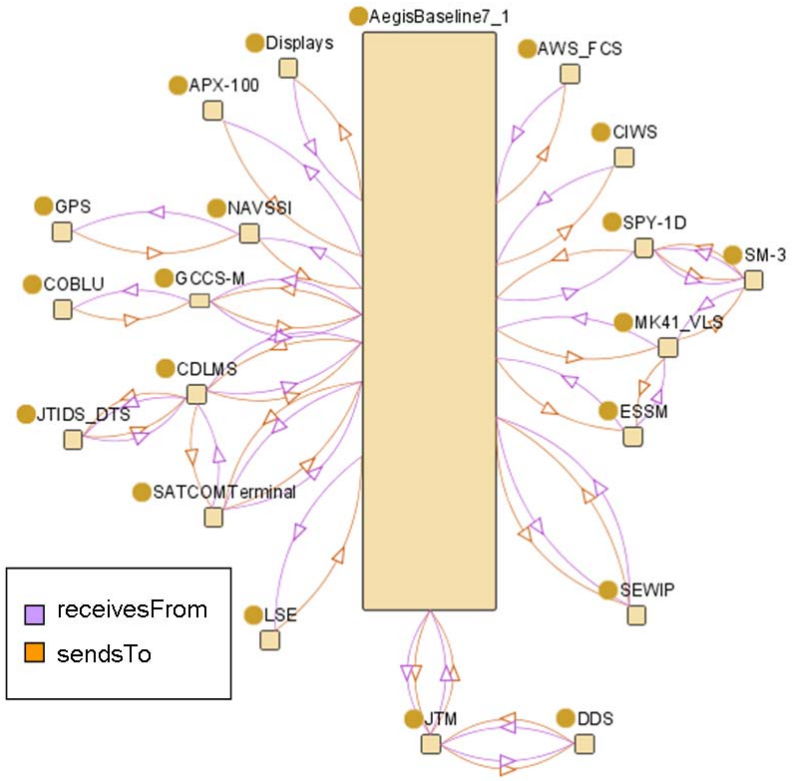


Lifecycle-Artifacts Relationships



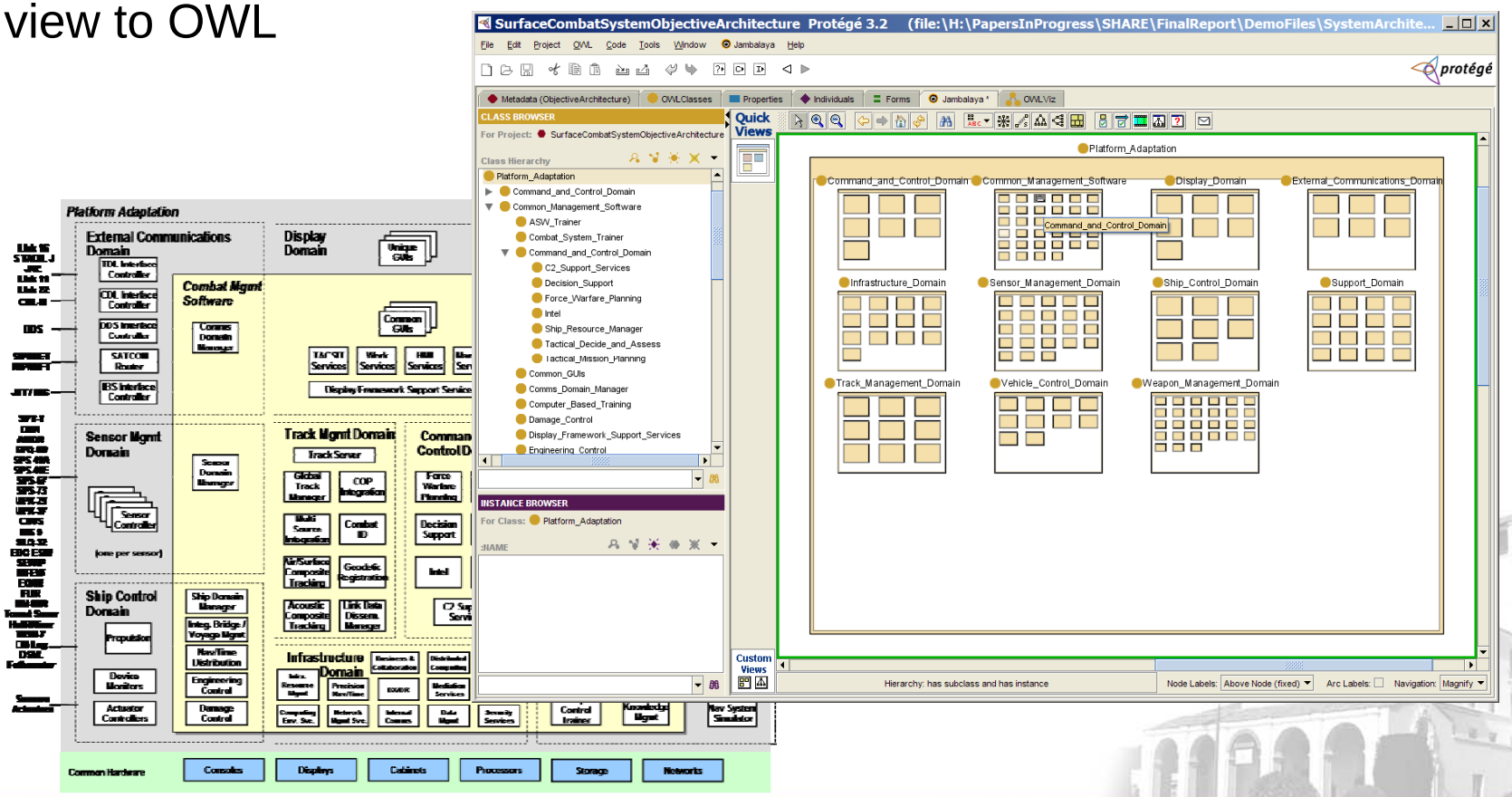
Original System Architecture

- Captures
  - System-subsystem relationships
  - Interfaces
  - Any other desired architectural relationships
- Report includes **example** to show possibilities
- From Aegis SV-1 available in RDA CHENG Naval Architecture Repository System (NARS)

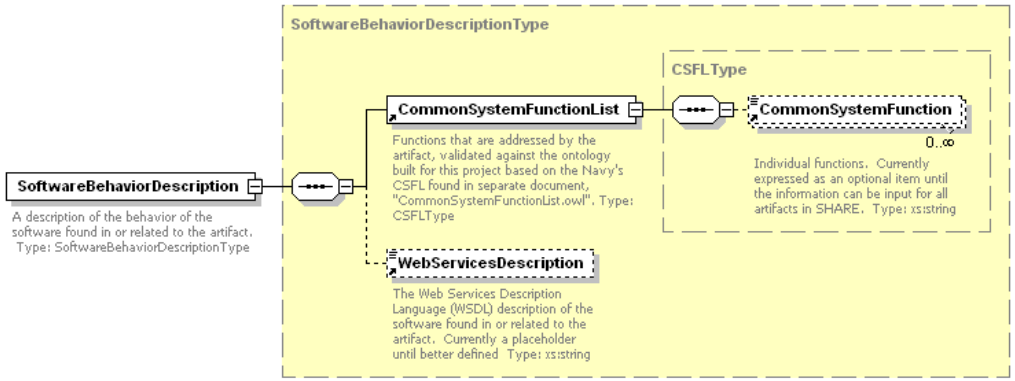


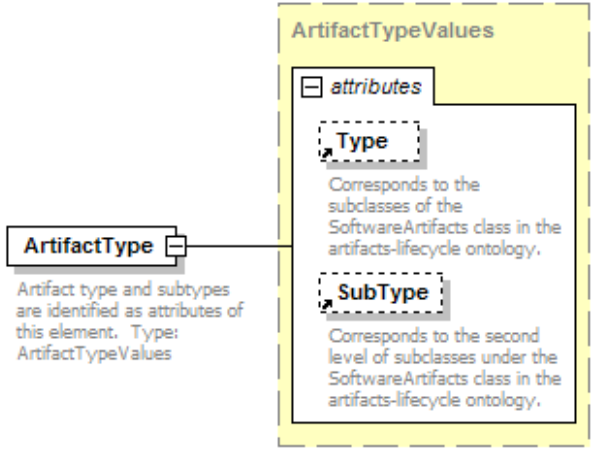
Surface Combat System Top Level Objective Architecture

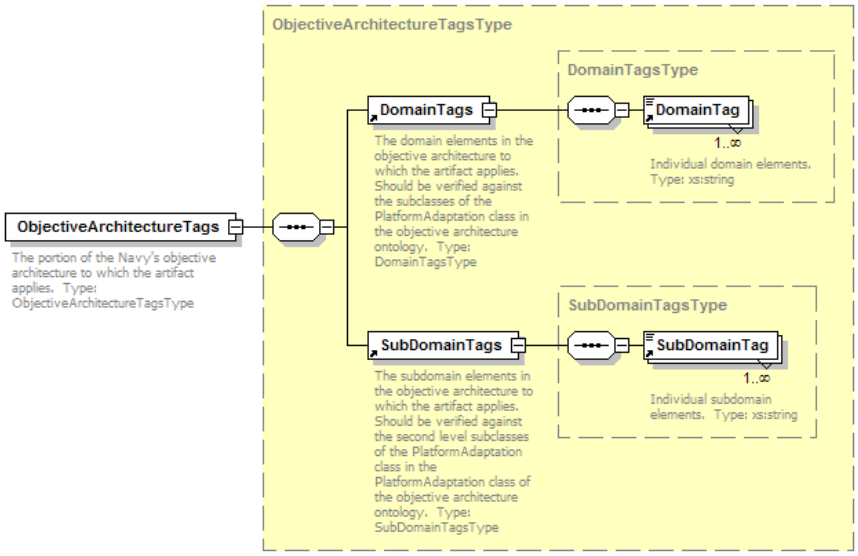
- Converted architecture view to OWL



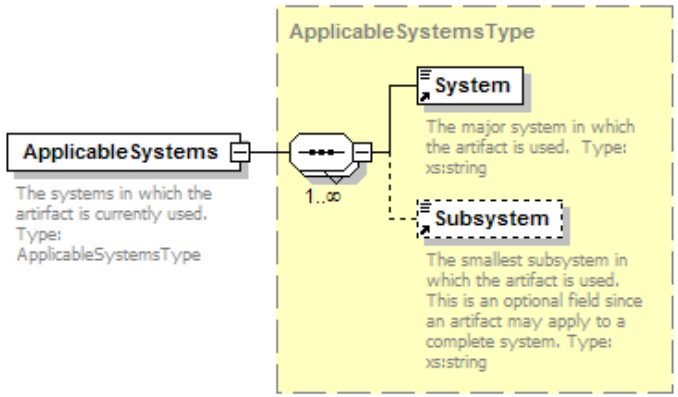
Schema References to Ontologies







Recommended metadata schemas tie artifacts to ontologies



User Scenarios

- Requirements Phase Scenario
  - Start with metadata to select a particular item of interest
  - Use behavior descriptions (CSFL) and ontologies to expand list of useful items
- Design Phase Scenario
  - Start with CSFL to identify group of items of interest
  - Use metadata to identify items that should be retrieved.
- User's context drives search and discovery process

Current Research Efforts

- Design of software repository tools that allow for guided navigation and insertion of artifacts in repositories
  - These tools will take advantage of the improved repository framework developed during the previous effort.
  - Demonstrate the value of these tools through use case demonstrations, sponsor evaluation, and a focus group study
- Detailed Specification
  - Search and Discovery Tool
  - Asset Submission Tool

Questions?

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