Preserving and Sharing Knowledge – Extending the UAF Security Views with Libraries, Patterns and Profiles

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Mitchell Brooks (System Strategy Inc.)

13 March 2024

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Abstract

- **Knowledge and experience are gained during the execution of every project. This knowledge remains in the heads of the engineers, but often is not distributed more widely. In Model-Based Systems Engineering (MBSE) projects, this knowledge can include problem solving techniques, algorithms, libraries of types, patterns, interfaces, components, etc. One of the ways to preserve this knowledge is by creating libraries of these reusable assets. For example, the newest version of Unified Architecture Framework (UAF) included a library developed by Mitre of 1200 different security controls defined in National Institute of Standards and Technology (NIST) standard 800-53r5. These controls can be referenced on projects to mitigate many common security risks. Each defined control can be integrated with the corresponding risks, security metrics, mitigating elements, solutions, and so forth. All these elements could then be used to construct Security Patterns showing risks that the security controls can mitigate as well as abstract solutions that can satisfy these controls. Patterns publicly provided as a curated, searchable, solution set library could be leveraged by projects and augmented over time, preserving their Intellectual Property (IP) and knowledge assets. This paper discusses these concepts and methods and demonstrates how they can be applied.**

Introduction: Knowledge and Skills in Animals

- Knowledge and skills transfer is essential for survival for all animals
  - Hunting for food
  - Evading predators
  - Recognizing poisonous plants
- Complex Social Skills
  - Dominant male behavior
  - Social bonding
  - Acceptable play
- Transfer Methods
  - Copying behavior (monkey see, monkey do)
  - Positive and negative reinforcement
  - Natural Instinct/DNA
- In person, in the moment, and synchronous
  - Lost knowledge is costly to reaquire




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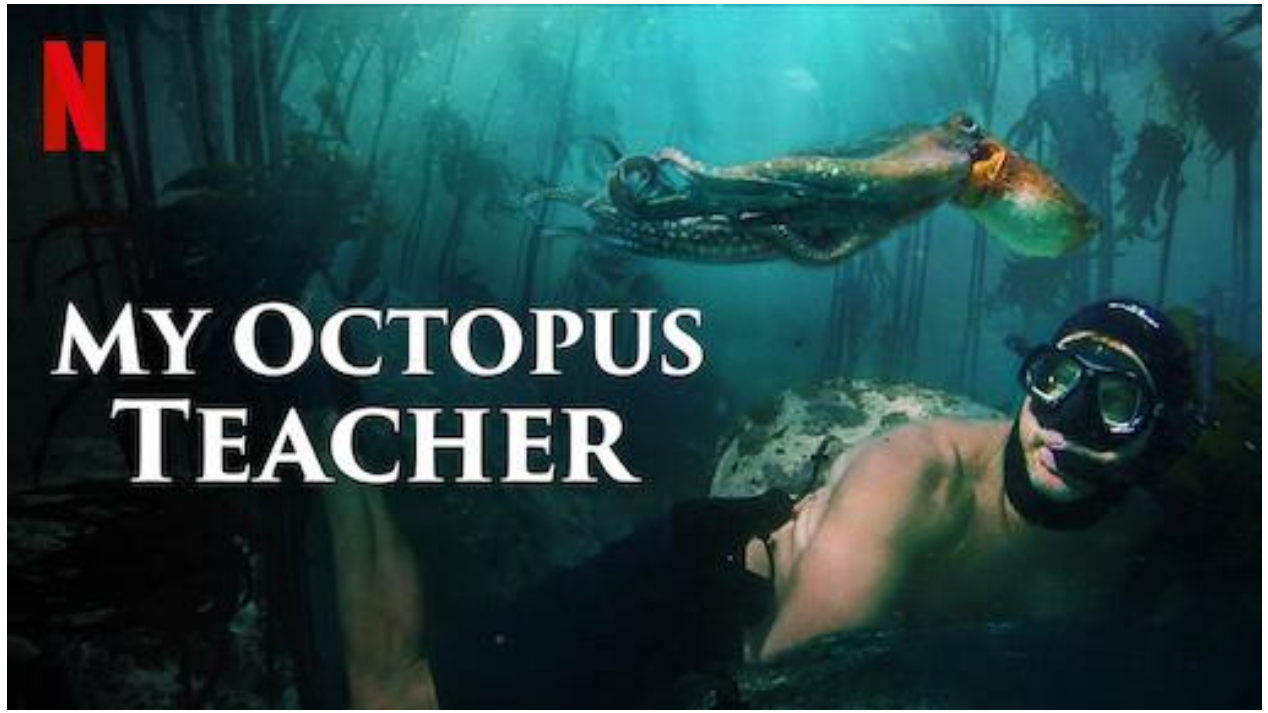
Example: The Octopus

- Intelligent, excellent at problem solving, uses tools, etc.
- Solitary, with no means of knowledge transfer
- Information skills acquired by one octopus is lost when it dies



Introduction: Knowledge and Skills in Humans

- **Synchronous Methods**
  - Animal methods previously listed
  - Spoken Language (Epic poems, Conversations, etc.)
  - Apprenticeships
  - Song and social events
  - Schools and education
- **Asynchronous Methods**
  - Written language (Scrolls, Books, Letters, Notes, etc.)
  - Libraries – general, technical, philosophy, architecture, science, etc.
  - The internet – All human knowledge and information both true and false
  - Preserves knowledge across generations.

Building on Past Knowledge

- **"If I have seen further [than others], it is by standing on the shoulders of giants." (Newton, 1675)**
- **Science and Engineering**
  - CAD Models
  - Complex computer simulations
  - Technical journals and presentations
  - Ontologies
  - Systems Engineering models
  - SysML profiles and domain specific languages
  - UAF NIST Security Controls Library
  - SysML libraries and patterns (QUVD for instance)
    - SysML V2 emphasizes libraries over profiles

https://www.prime1studio.com/mini-minions-in-laboratory-pcfmini-03.html

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UAF SECURITY LIBRARIES

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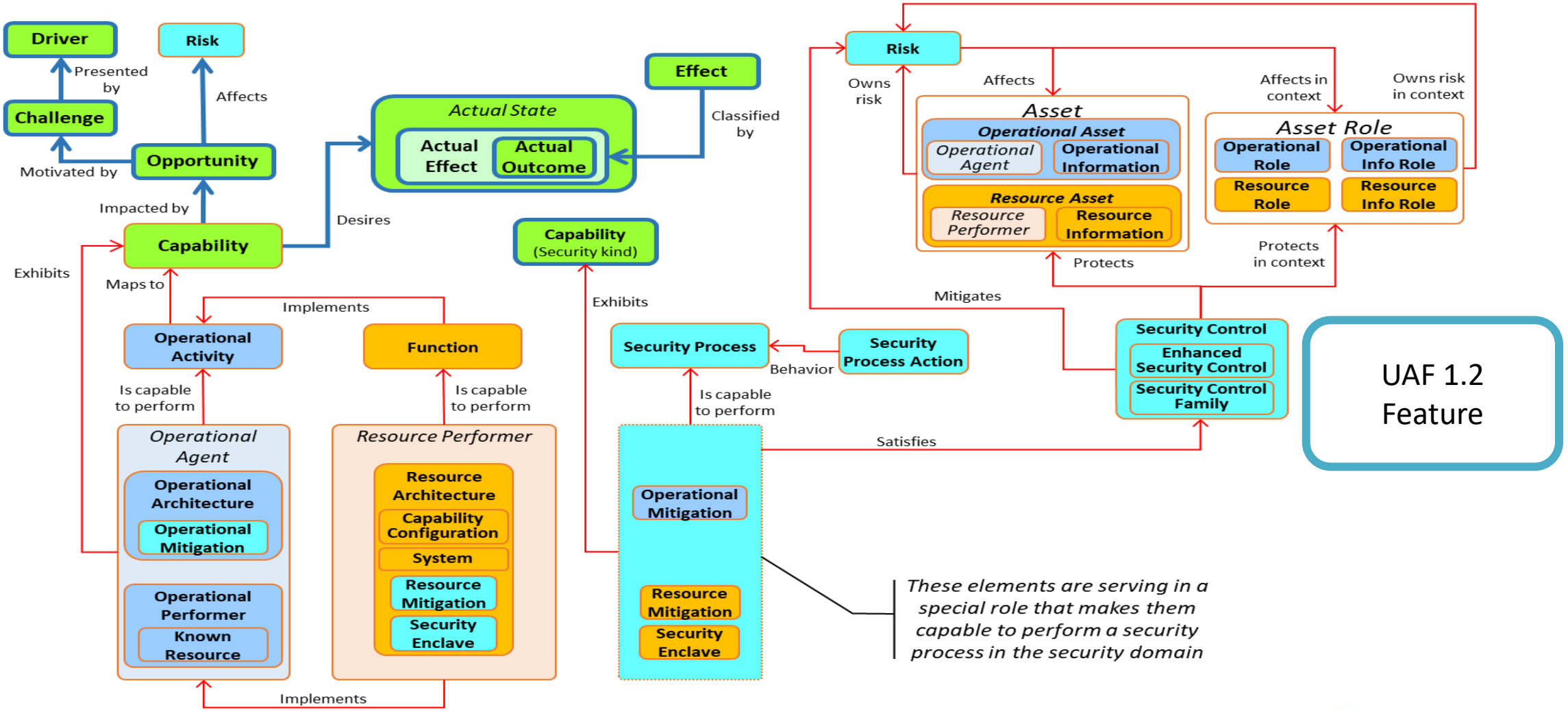
UAF Security Views Conceptual Meta-Model



UAF 1.2 Feature

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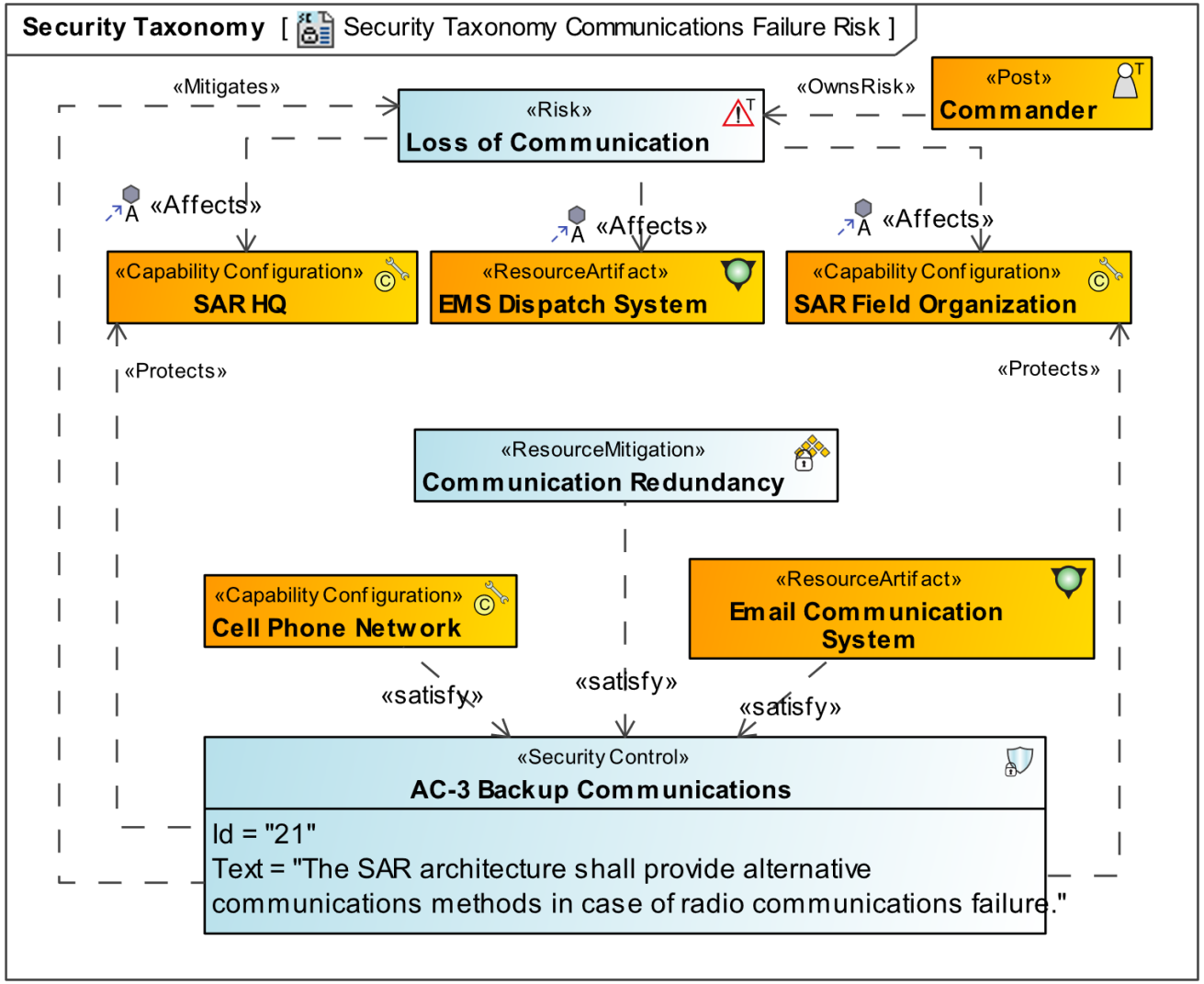
Sc-Tx Security Taxonomy

- **This figure shows the taxonomy for some of the security elements**
- **Risks are the possibility of an adverse effect and its likelihood of occurrence**
  - Risks affect resource artifacts, capability configurations, etc.
- **Security Controls are a management, operational, or technical control (e.g., safeguard or countermeasure) which Protects an asset.**
  - They mitigate risks and protect assets
- **Resource Mitigations are a set of performers established to manage operational or resource Risks.**
  - They are represented as an overall strategy or through techniques (mitigation configurations) and procedures (Security Processes)and other assets to satisfy security controls



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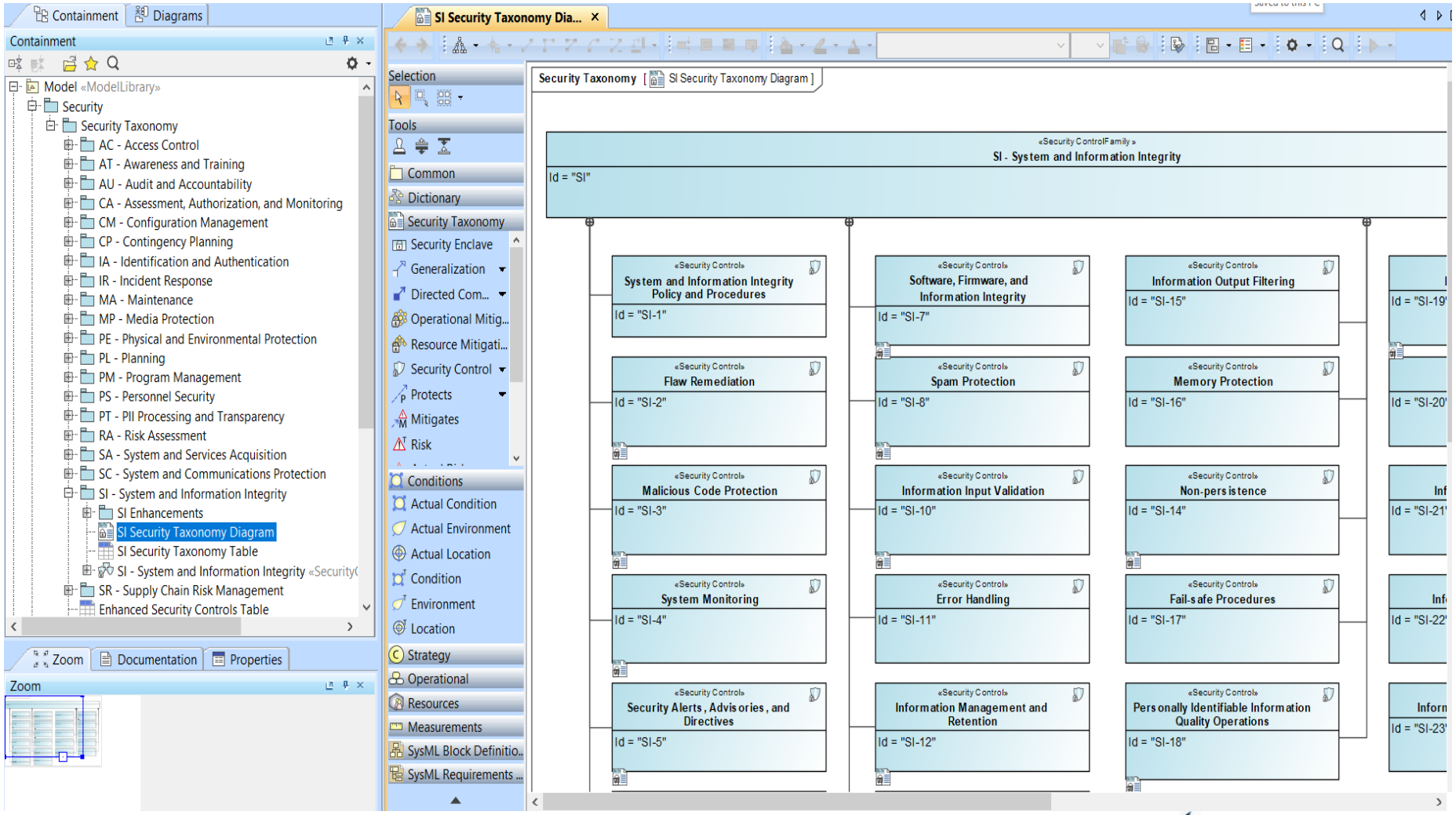
NIST SP 800-53 Security Controls Library

- UAF Reference Library
- Captures Security Controls, Families, Enhanced, Etc.
- No risks, mitigations, solutions – How can we add these?



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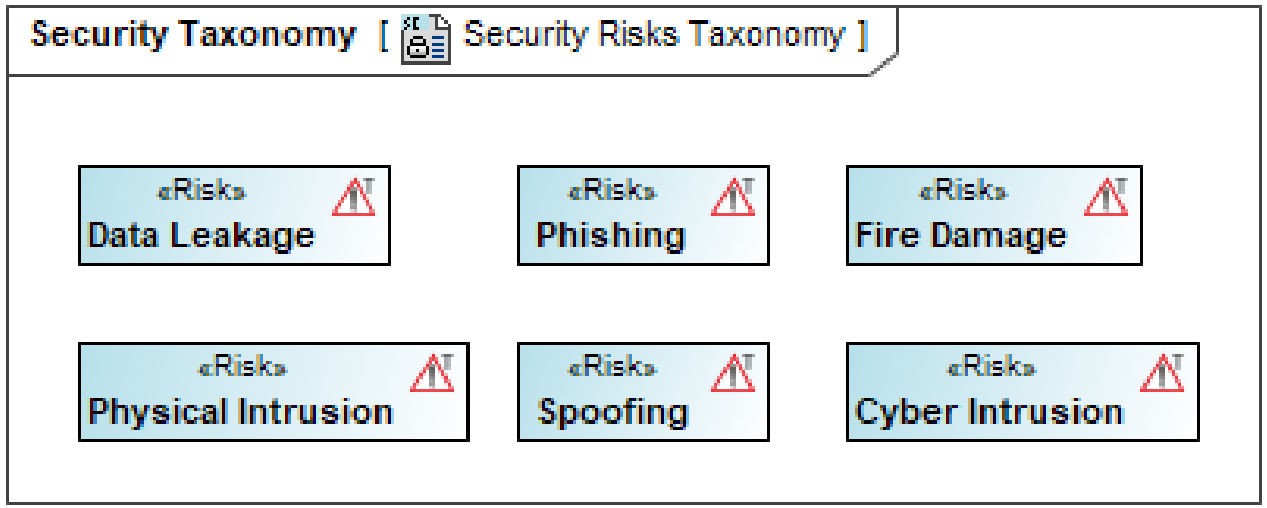
Security Risks Taxonomy

- Sample of risks used in the sample model
- Can be built up over time with complete descriptions
- Links added to mitigations
- Examples of affected elements



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Security Measurements

Measures Type	Definition	Measure	Category
Implementation	measure execution of security policy	System and Communications Protection System and Information Integrity Awareness and Training Configuration Management	situational awareness
Effectiveness/efficiency	metrics used to monitor results of security control implementation for a single control or across multiple controls	Vulnerability Management System and Information Integrity Access Control Audit and Accountability Certification, Accreditation, and Security Assessments Identification and Authentication Incident Response) Maintenance Media Protection Physical and Environmental Risk assessment	Incident response system vulnerabilities, Mitigation attack or threat severity situational awareness
Impact	metrics used to convey the impact of the information security program on the institution's mission, often through quantifying cost avoidance or risk reduction produced by the overall security program	Security Budget	situational awareness

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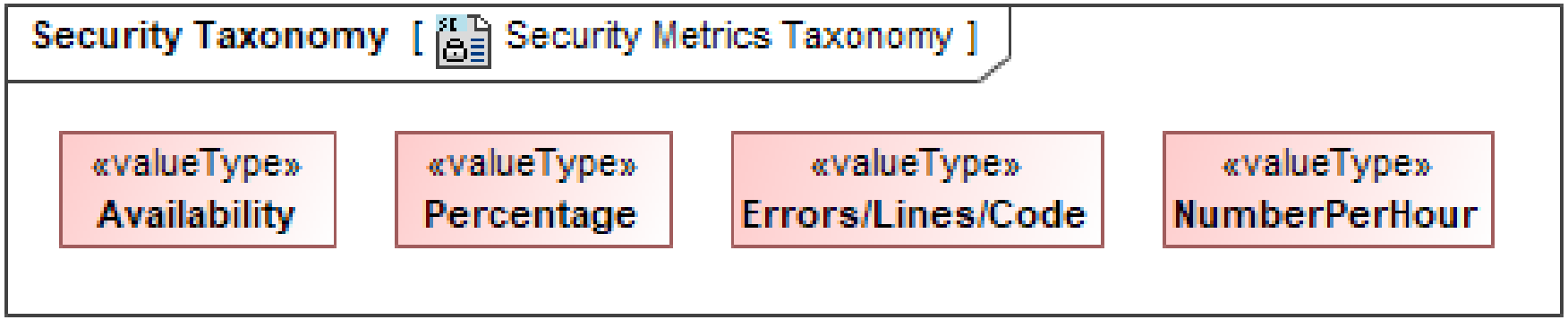
Value Types Library

- **Having defined the measurements, it is necessary to define types.**
- **Many will be in the SysML libraries**
- **These can be reused throughout the model**



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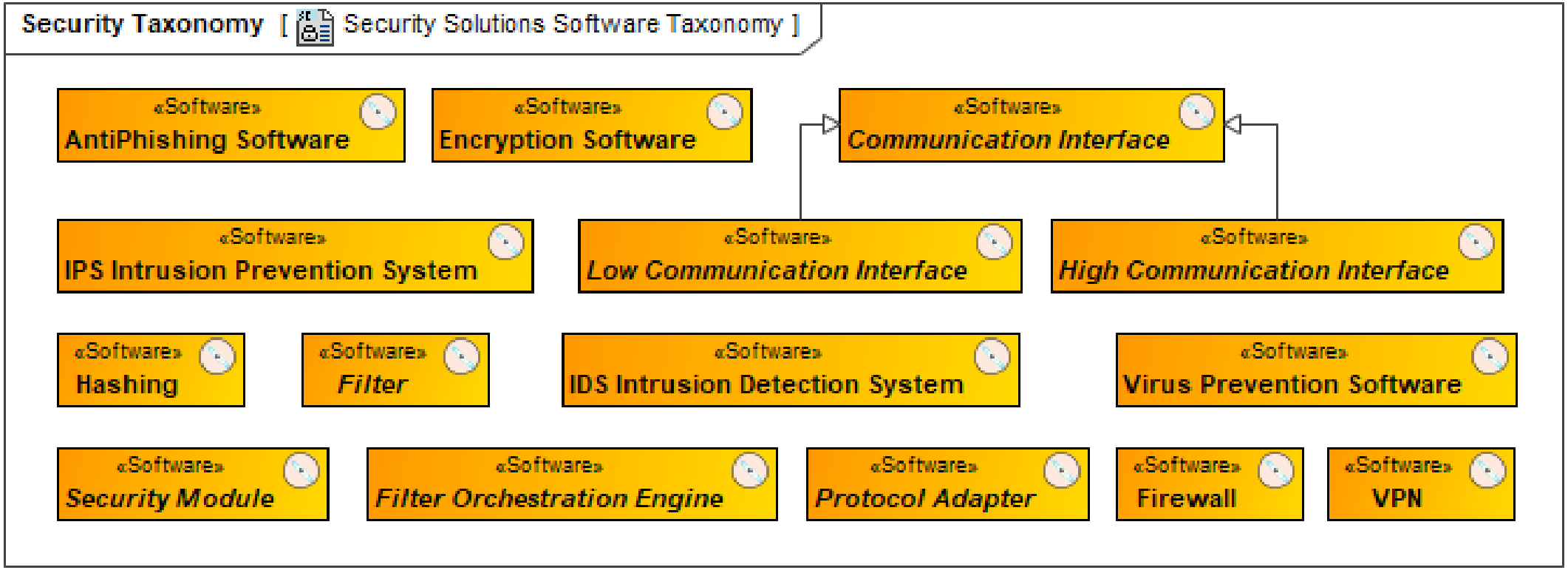
Security Solutions Library

- Library of elements that can mitigate risks
- Can be both abstract (solution independent) or concrete



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SECURITY PATTERNS

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Introduction to Patterns

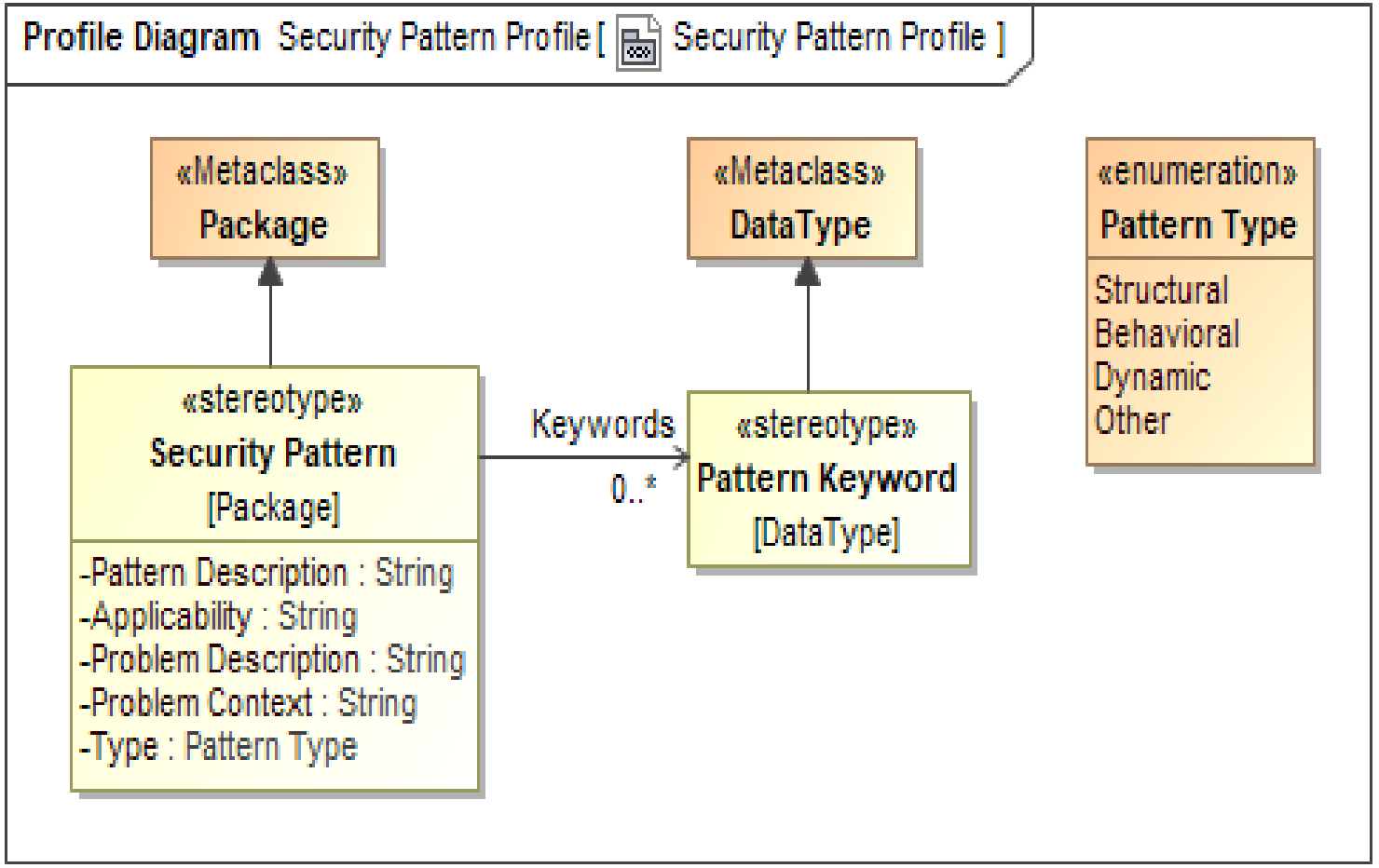
- Pattern recognition describes a cognitive process that matches information from a stimulus with information retrieved from memory. (Eysenck at al, 2003)
- Information from the environment is received and entered into short-term memory, causing automatic activation of a specific content of long-term memory.
- Semantic memory, which is used implicitly and subconsciously is the main type of memory involved with recognition. (Snyder, 2000)
- In engineering, pattern recognition is the automated recognition of patterns and regularities in data.
- Modern approaches include the use of machine learning, due to the increased availability of big data and a new abundance of processing power. (Mattson, 2014)

Model-Based Design Patterns

- **Enables a solution to a specific problem that commonly occurs in the programming process (Alexander, 1979).**
- **The Gang of Four (GOF) defined Design Patterns in software engineering. Provides specific and effective solutions for software design and architecture scenarios. (Gamma, Helm , et al. 1994)**
- **Design patterns are classified according to their applicability and purposes.**
  - Creational Design patterns,
  - Structural Design patterns and
  - Behavioral Design patterns (Gamma et al, 1994).
- **Douglas (2002) further extended the design patterns into real-time software and systems engineering using UML.**

Security Pattern Profile

- **Patterns are contained within a package**
- **Attributes include:**
  - Description
  - Applicability
  - Problem Description
  - Problem Context
  - Pattern Type
  - Keywords
- **Patterns are reusable and shareable**



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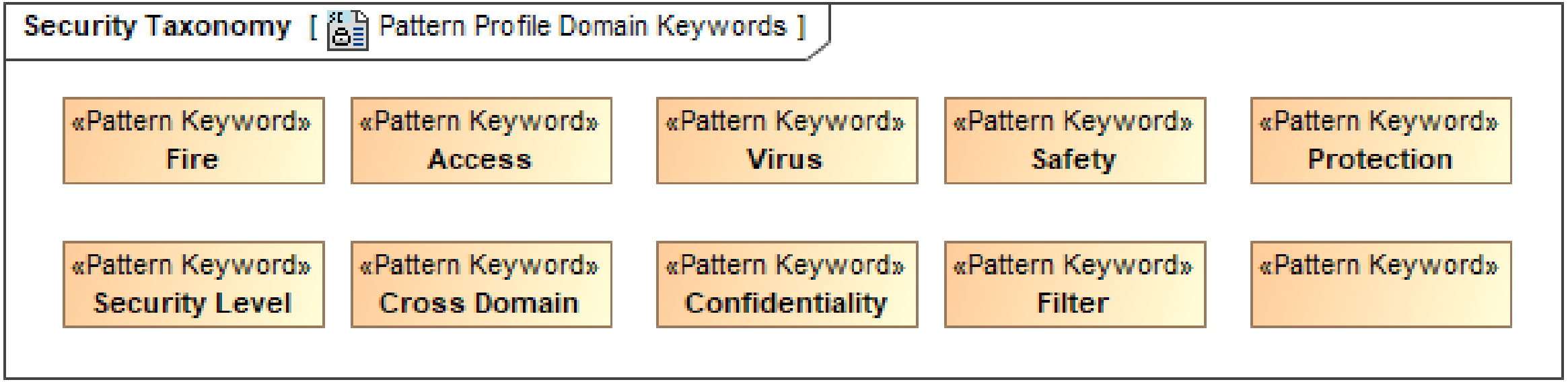
Security Pattern Keywords

- Keywords allow for searching for patterns
- Applicable keyword library will expand over time



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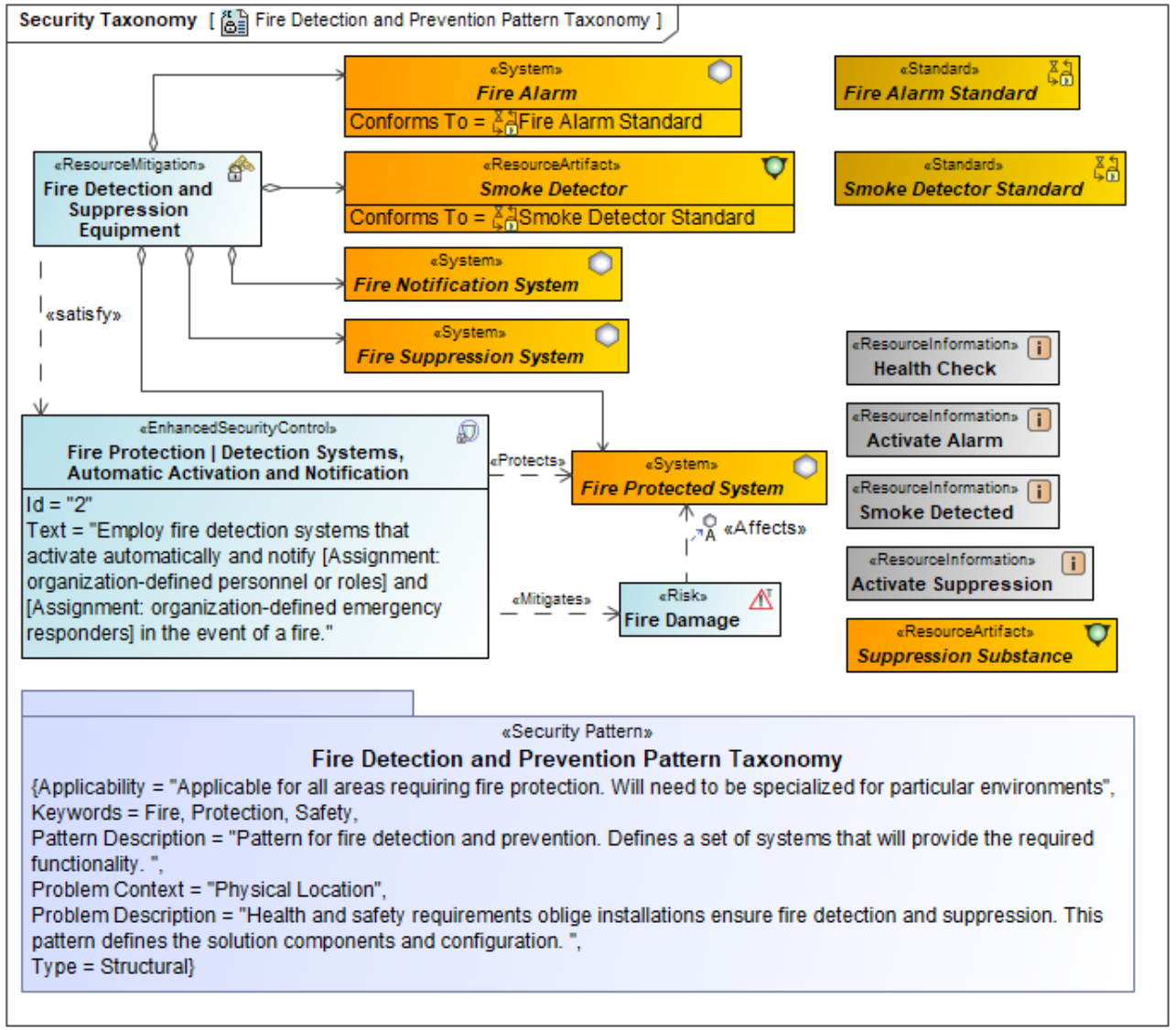
Fire Detection and Prevention Pattern



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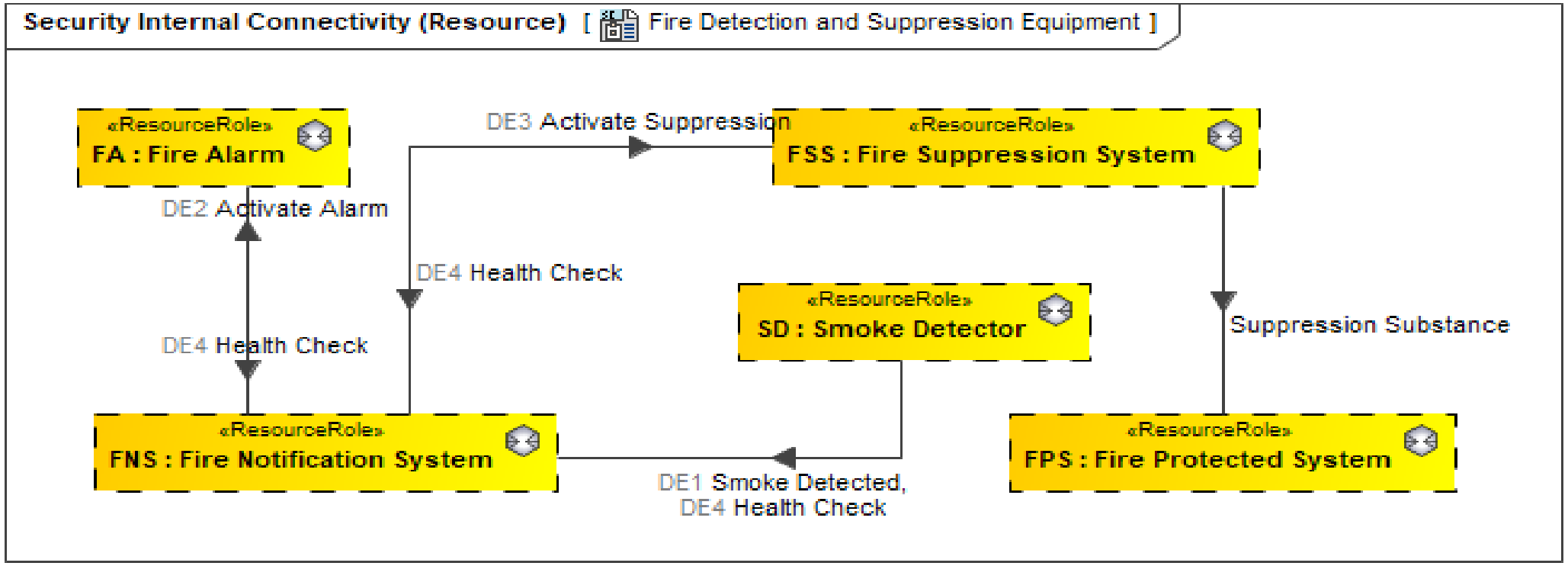
Fire Detection and Suppression Resource Mitigation Abstract Definition



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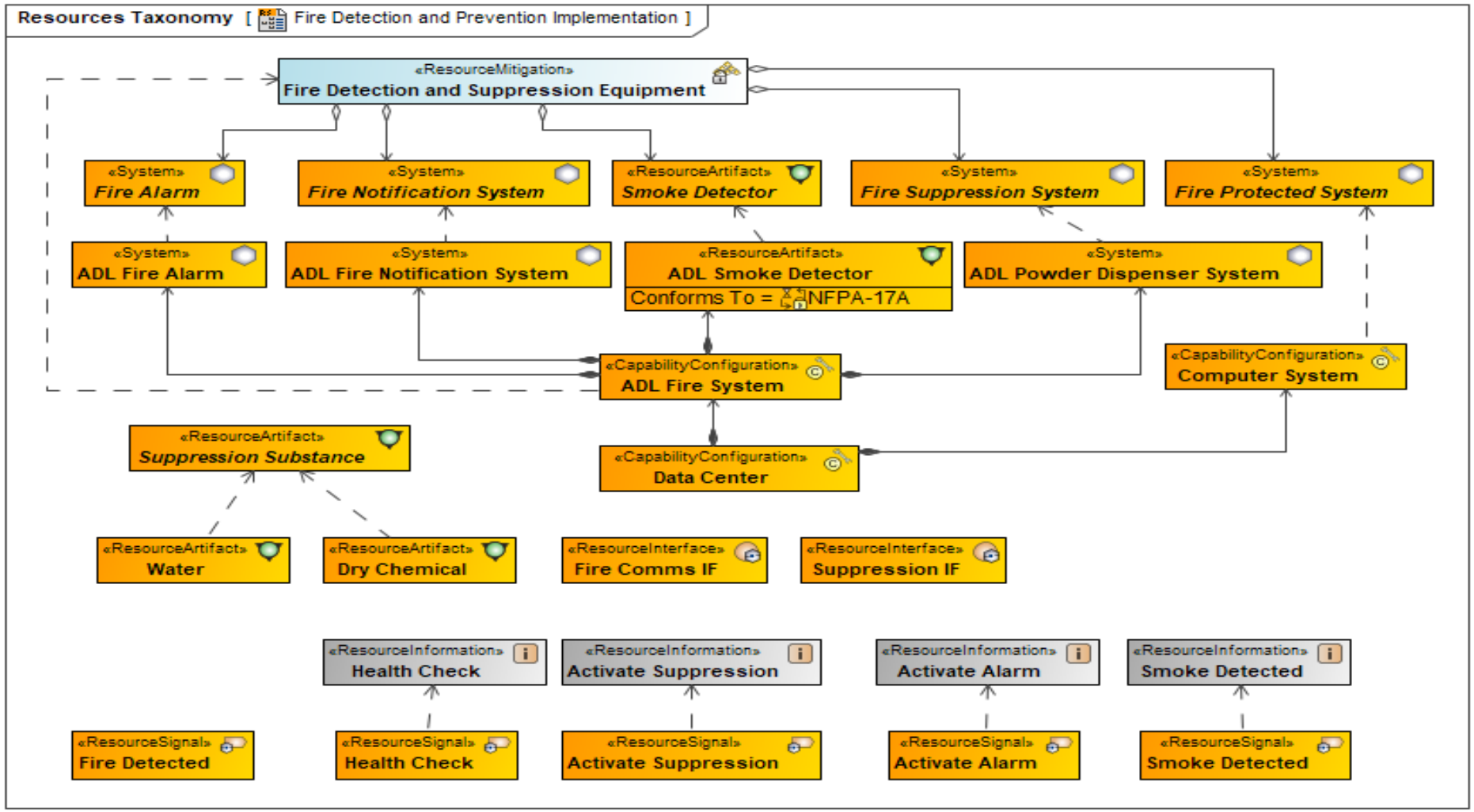
Fire Detection and Suppression Implementation Definition



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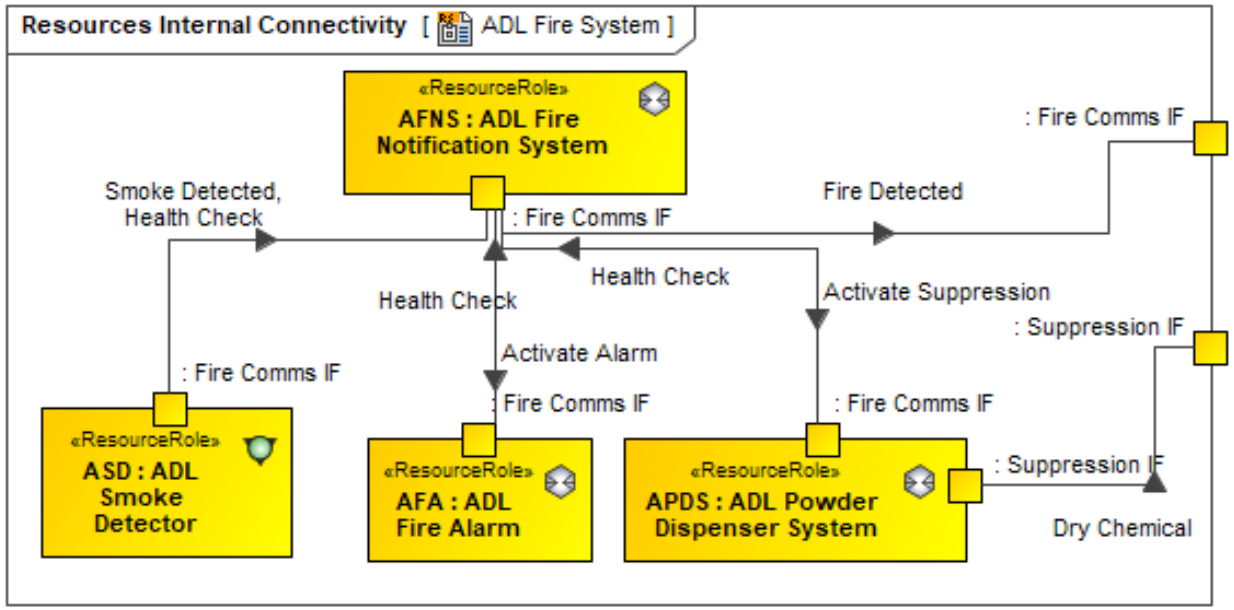
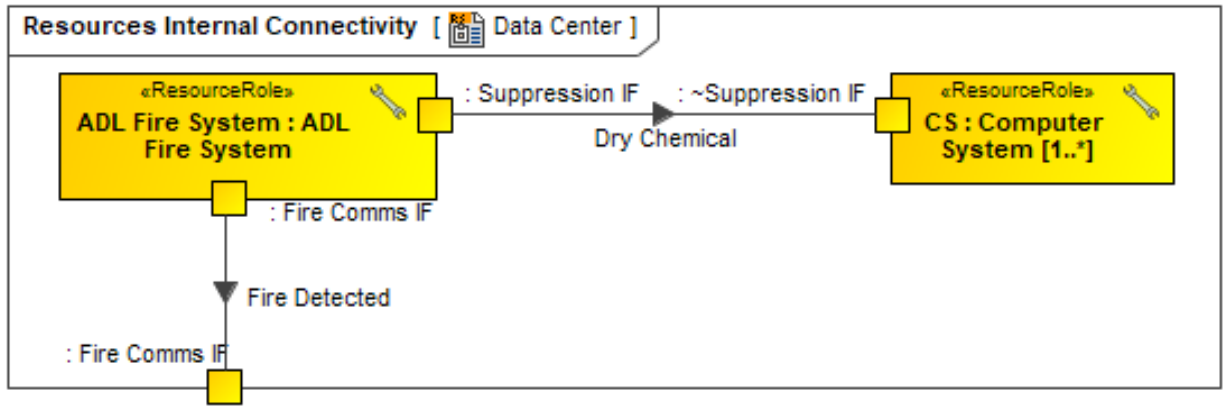
Fire Detection and Suppression Implementation





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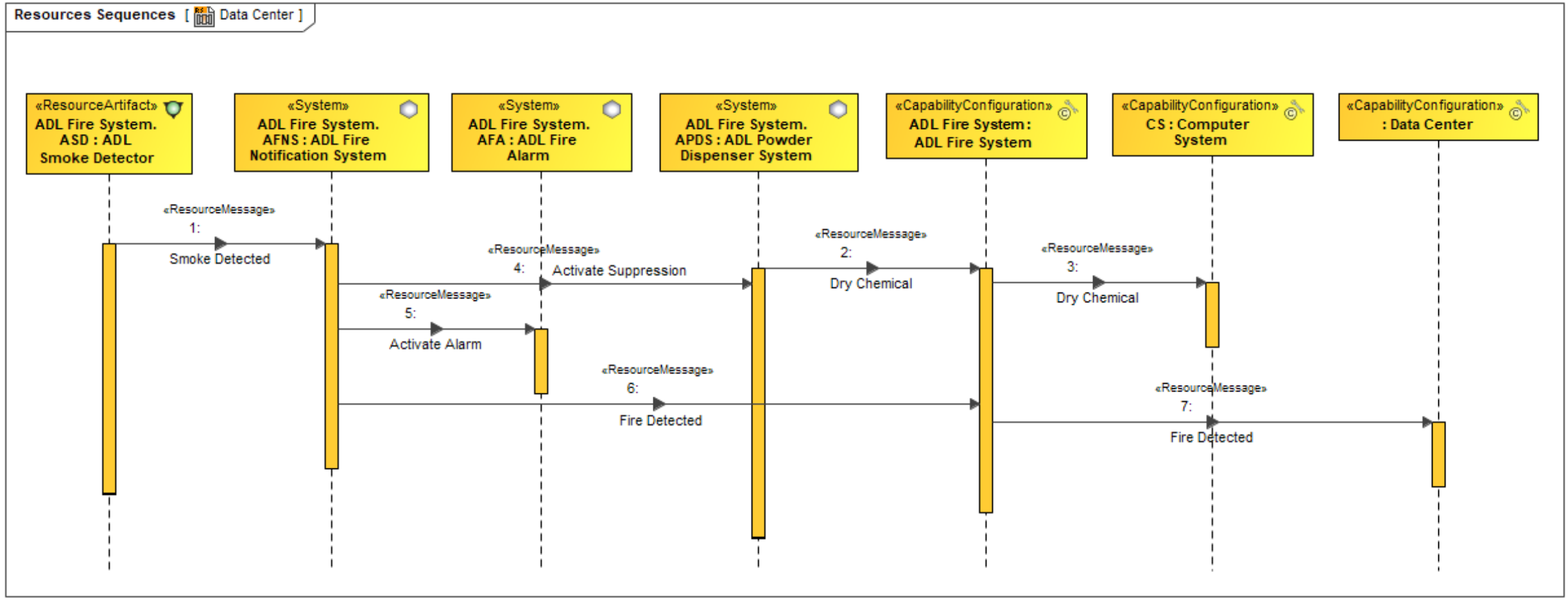
Fire Detection and Suppression Implementation



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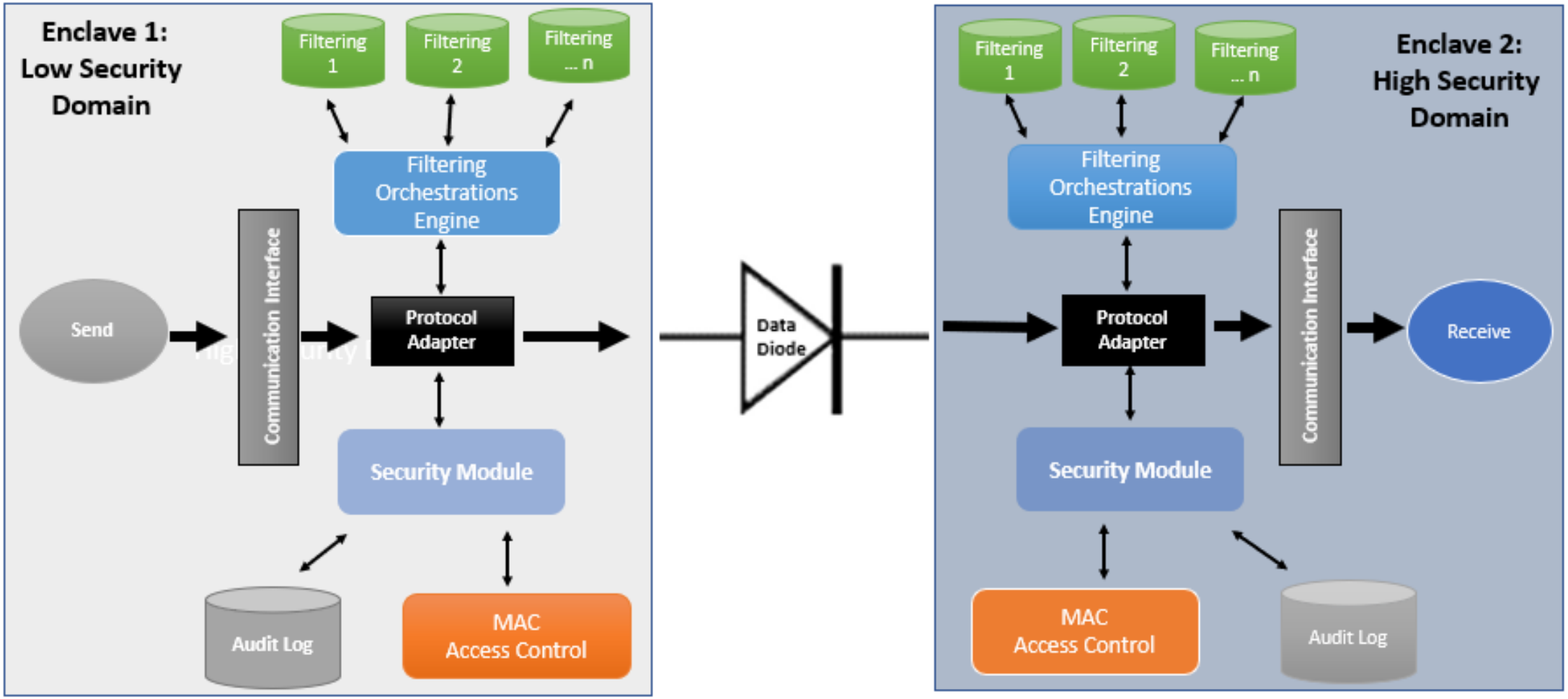
Cross Domain Solution



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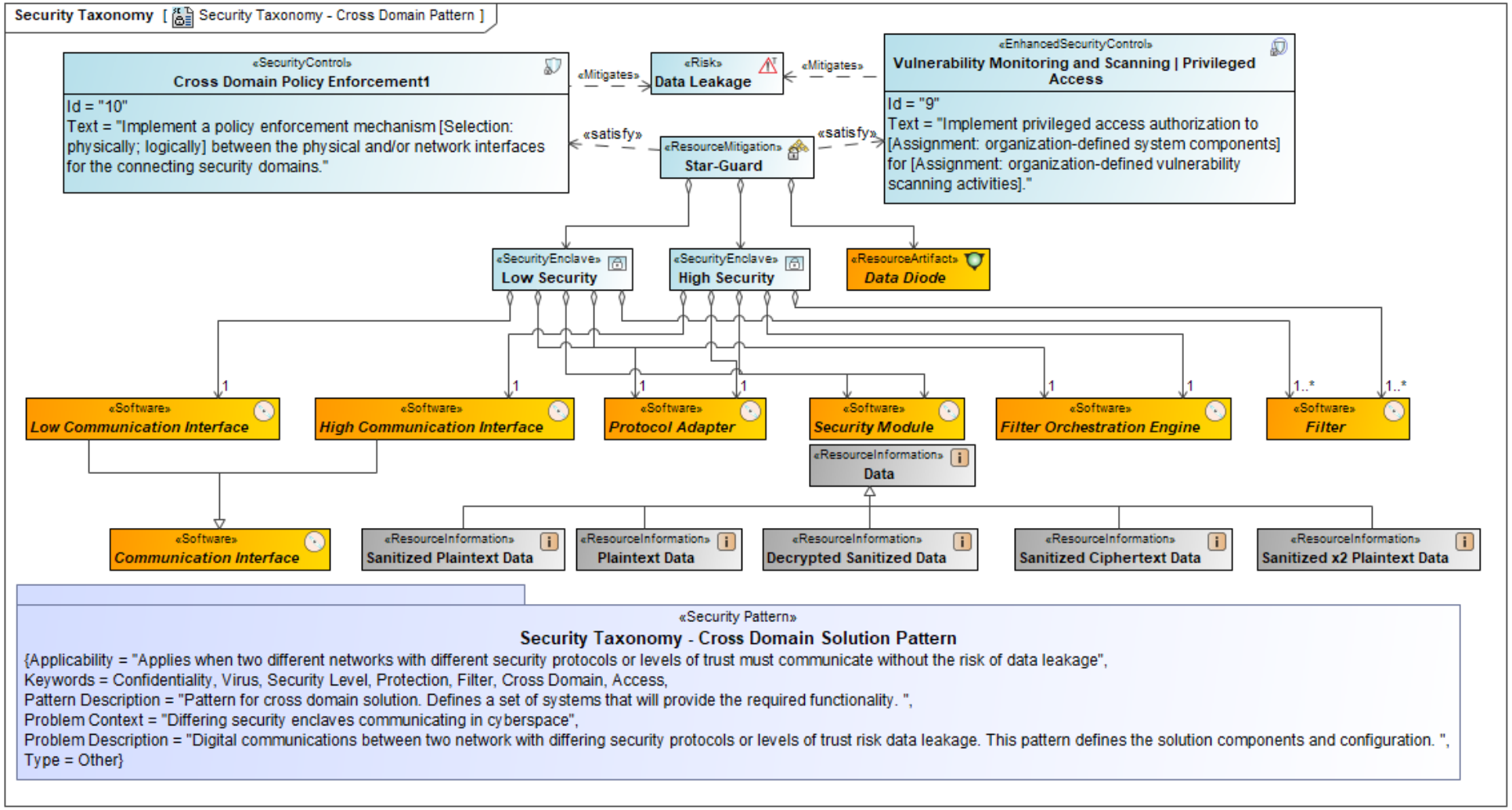
Cross Domain Solution Definition



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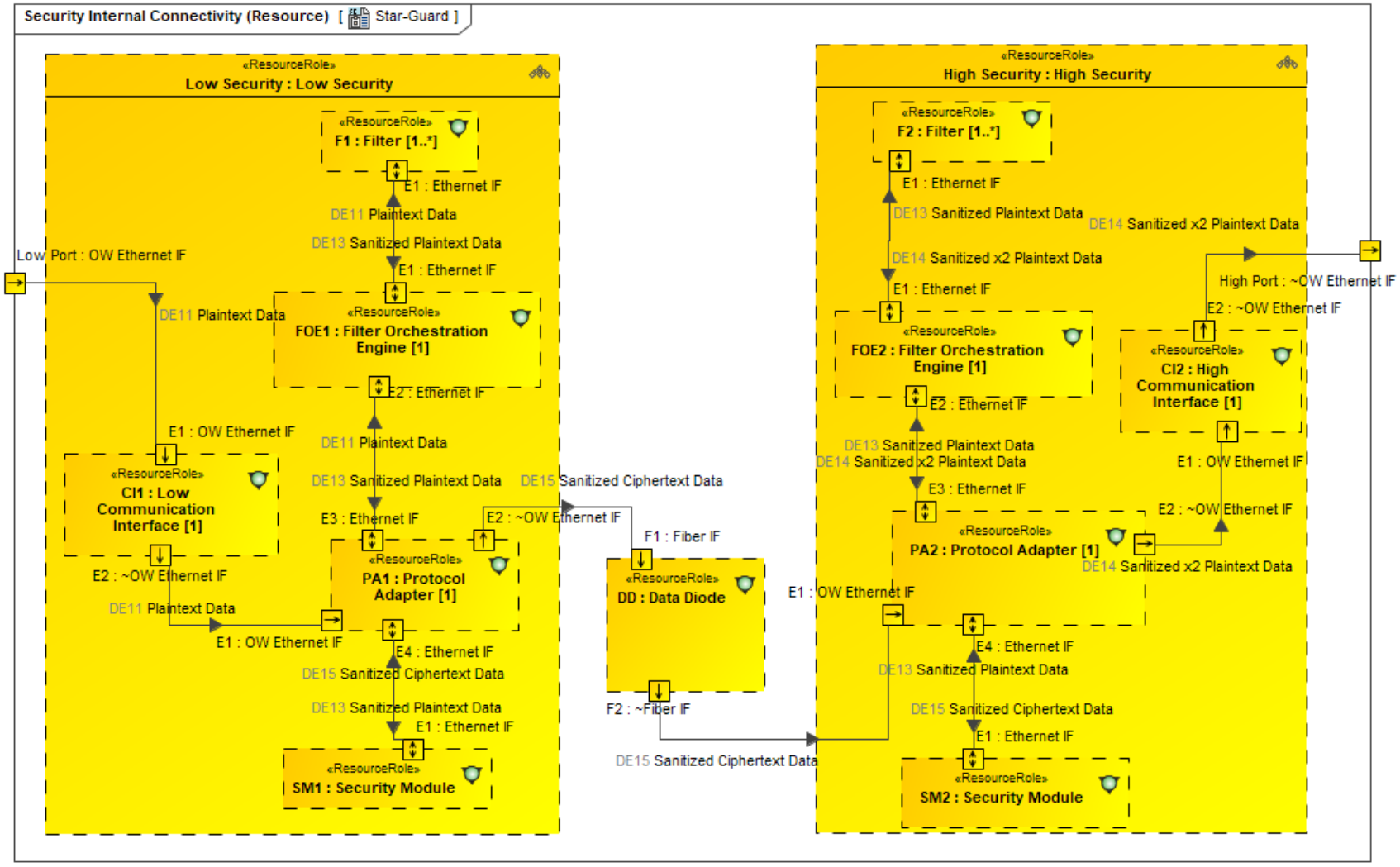
Cross Domain Solution Internal Connectivity



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OMG Model-based Acquisition (MBAcq) User Group:
A Government & Industry Collaboration Reference Architecture and Patterns

DAFMSC Brief 2/23/2024

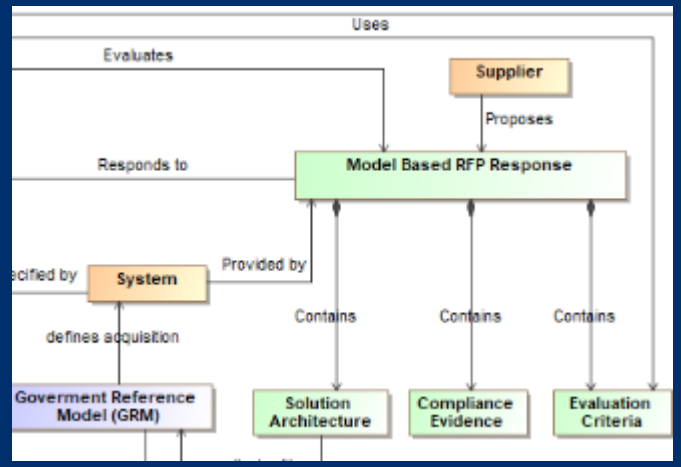
LAURA E HART LAURA.E.HART@LMCO.COM

MBACQ UG CO-CHAIR/OMG UAF CO-CHAIR

Model-Based Acquisition (MBAcq) User Group Introduction

About MBAcq

Model-based acquisition is the Technical approach to acquisition that uses models and other digital artifacts as the primary means of information exchange, rather than document-based information exchange.

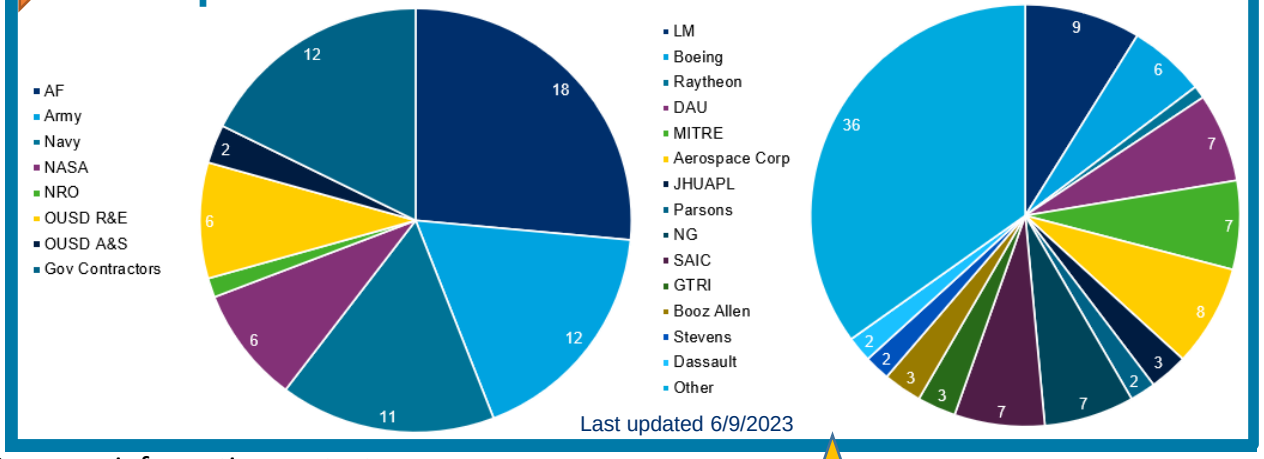


Why MBAcq Matters

Customers are increasingly specifying MBSE in RFPs
Customers are increasingly requiring models in proposals
Lack of standardization raises proposal learning curves & compliance risk

- **Model Based Acquisition will be disruptive**
- **Increased interest to organize around the MBAcq UG to define and standardize approach**
- **Broad government and industry participation**
- **Gov & Industry have an opportunity to shape future MB Acquisitions & Compliance together**

Participation



Expected Timeline

2022: Formed Team & Framework
2024: Q2 Govt Ref Arch
2024: Q4 Acquisition Users Guide
Q2/3 DAU Acquisition Training
Q4 Acquisition Model Example
Ongoing: Curate and Create Reusable Content (Reference Architectures, Domain Overlays, …)

For more information contact:
laura.e.hart@lmco.com
rahaselden@mitre.org
toni.m.nolder@aero.org

Full lifecycle should be addressed during Acquisition!

MBAcq User Group is an OMG Managed Community

OMG Managed Community Charter

1. Mission and Scope of the Community.

1.1. Purpose. The purpose of the Model Based Acquisition (MBAcq) User Group (the "Community") is to enable collaboration in support of various pre-competitive or open collaboration activities including:

- Provide a forum to addresses standardization in the use of Model-Based Engineering (MBSE) and subsequent models during the acquisition process thereby reducing the learning curve for every MB-RFP and OEM proposal response.
- Act as a bridge to the OMG Standard Development Organization (SDO) process, to assess and provide validated inputs to the SDO to update relevant specifications based on evolving user needs, including Systems Engineering (SE) and Architecture standards, such as SysML, UAF and Systems Modeling API & Services as it pertains to Acquistion.
- Provide a forum for cross-industry end users, gov services, FFRDCs, academia and tool vendors to share and develop practices that promote the adoption and advancement of Architecture and Model Based Systems Engineering (MBSE) including the definition and use of new Reference Architectures as patterns.
- Provide associated process guidance for both engineering and acquisition professionals to use the Reference Architectures for RFP creation, response, evaluation, and program execution thereby introducing MBSE principles earlier during the RFP phase.
- Provide support for building other modeling languages and domain-specific extensions based on KerML, SysML, UAF when required.

Approved by the OMG BOD 9/26/2023

- Approved by the OMG BOD 26 September 2023 as an enduring OMG Entity
- Founding Members
  - Lockheed Martin (Laura Hart)
  - The MITRE Corporation (Rae Anderson)
  - The Aerospace Corporation (Toni Nolder)

OMG Standards Development Organization.

Collaboration and Transparency in an Open Env

Transitioning Knowledge Repository to OMG MC

wiki.codev.mitre.org/display/UAF/T3%3A+High-Level+Domain+Model

Welcome to LMPeo... | External Outreach... | Service Central Ho... | CoDev Portal | SAP Budet Reports | Calendar Vacation... | Weekly Team M

Spaces | Forums | People | Questions | Polls | Ideation | Glossaries | Calen

- Websites
- Digital Acquisition WG
  - Membership and Attendance
  - Agenda/Meeting Minutes
  - Activities and Deliverables
    - T1/2: Landscape Assessment
    - **T3: High-Level Domain Mo**
      - Sustainment
    - T4: Use Case Development
    - T5: Digital Eng Env (DEE) ass
    - T6: Language Architecture
    - T7: Updates to the Example I
    - T8: (ARM) Acq Ref Model: Te
    - T9: Policy Review Group
    - T10: Identify Reference Reso
    - T11: Acquisition Guide Outli
    - T12: Modeling Environment
    - T13: MOSA Metrics
    - T14: Define (ARA & OAD): pr
    - T15: Define Model Based RFI
    - T16: Joint interface compone
- MBAcq Shared Files

Pages /... / Activities and Deliverables

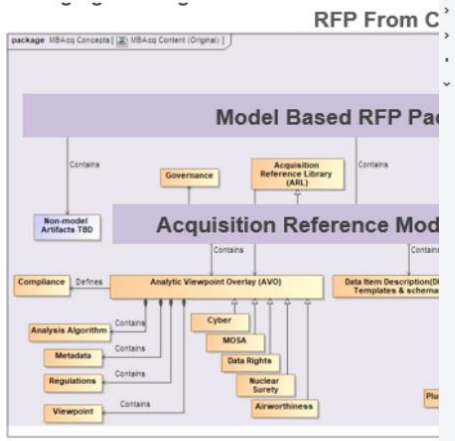
T3: High-Level Domain Mod

Created by Laura Hart, last modified about 22 hours ago

Special Task Description: Capture the core high-level con

Task Leader: @Laura Hart @Matthew Hause , Monty

Members: Yvette Rodriguez, Jeff Banks



OMG UAF Task Force

- Pages
- Calendars

SPACE SHORTCUTS
- Meeting Notes & Action Items
- UAF 1.2 Sample Model Document
- Glossaries

PAGE TREE
- Meeting Notes & Action Items
- UAF 1.2 Sample Model Document
- UAF 1.2 Layers
- Files list
- How-to Articles
- Websites
- Digital Acquisition WG
  - Membership and Attendance
  - Agenda/Meeting Minutes
    - 05/06/2022 Agenda/Minutes
    - 05/20/2022 Agenda/Minutes
    - 06/07/2022 Agenda/Minutes
    - 07/01/2022 Agenda/Minutes
    - 07/29/2022 Agenda/Minutes
    - 08/12/2022 Agenda/Minutes
    - **09/02/2022 Agenda/Minutes**
    - 09/09/2022 Agenda/Minutes
    - 10/14/2022 Agenda/Minutes
    - 10/28/2022 Agenda/Minutes
    - 11/18/2022 Agenda/Minutes
    - 12/6/2022 OMG Agenda/Minutes
    - Orientation Meeting Sept 1, 2023
  - Activities and Deliverables
  - MBAcq Shared Files
  - Files: Reference Documentation
  - MBAcq User Group Charter
  - New CoDev Request
  - Model & Data Catalog
  - Sub Committee Meeting Schedule
  - FAQs -- Frequently Asked Questions
- Glossaries

Pages /... / Agenda/Meeting Minutes 22 views

09/02/2022 Agenda/Minutes

Created by Laura Hart, last modified on Sep 02, 2022

All Attendees put your name/org/email in the chat window. That allows us to cap
and if you need access to the MITRE CoDev Collaboration Site (Confluence)

https://wiki.codev.mitre.org

General Request:

- If this was your first meeting, please send me your Chat Introduction
- To request an MBAcq collaboration site account, send email request to Rae Ande
  - Gaining access to the OMG UAF Task Force Confluence site is a THREE STE

1) follow the link and register either using a password or enrolling your Dc
2) You must log in to the MITRE CoDev network to create an account on t
3) Once you do, please email me (rahaselden@mitre.org), and I will invite

Agenda:

- Topics:
  - Report from the subgroups: What can we get done in the next 30, 60, 90 c
    - [x] Rae Anderson: T1/2: Landscape Assessment and Lessons Learned
      - [ ] Monte will provide rolled up Lessons Learned
    - [x] Hart/Hause: T3: High-Level Domain Model
    - [x] Rae/Tom: T4: Use Case Development
      - [ ] Review UC document and instructions
    - [ ] Hart: T7 Example Model Definition
    - [x] Tom M and Barry P: T9: Policy Review Group - The SERC has comple
    - [x] Yvette Rodriguez: T10: Identify Reference Resource Authoritative So
    - [x] Bob Scheurer/John Quintana: T11: Acquisition Guide Outline
      - [ ] This will be a distributed effort: all please review and provide
    - [x] T5: Digital Eng Env (DEE) associated with primary System
    - [x] Rae Anderson/Dave McDaniel: T14: Define (GRA & GRM): proposed
    - [ ] Daniel Brookshier: T12: Modeling Environment Tool Support
    - [ ] Gene Sherve: T6: Language Architecture
  - General conversation around the room:
    - Nadine: new OSD Architecture group is being formed lead by Lt Co
    - Ed Moshinski (OUSD R&E and NDIA Arch co-chair) stated that a MC
      these deliverables will be pivotal to the MOSA standardization appr
    - Frank Salvatore Asked, Are you planning to start with what was do
    - Keith provided new contract for ASDP ->"Frood" SCHNEIDER, MICH
    - Monte Porter - PEO MS : I'm interested in the govt reference model
    - Frank Salvatore : I will sign up to be a reviewer of the concept map.
    - Mike Guba to support GRA/GRM development
    - Frank Salvatore : There is a digital engineering measurement framework that was just released. You can find it here https://www.psmsc.com/DEMeas
    - Keith Siders, AFLCMC/EZSI, working to get AF legal/contract support from Jim Hague
  - Actions:
    - [ ] Frank, can you get us a copy of the Skyzer model?
    - [ ] Ed Moshinsky, provide MOSA Implementation Guide
    - [ ] Ed Moshinsky, provide NDIA Arch MOSA Metrics from Steve Henry
    - [ ] Get SATCOM RM
  - Acquire existing Arch models to build upon (NAVAIR, AF MBSE, AFC, SATCOM....) who can get these for us?

Next Week:

Spaces | Forums | People | Questions | Polls | Ideation | Glossaries | Calendars | Blogs | Create

- Meeting Notes & Action Items
- UAF 1.2 Sample Model Document
- UAF 1.2 Layers
- Files list
- How-to Articles
- Websites
- Digital Acquisition WG
  - Membership and Attendance
  - Agenda/Meeting Minutes
  - **Activities and Deliverables**
    - T1/2: Landscape Assessment and L
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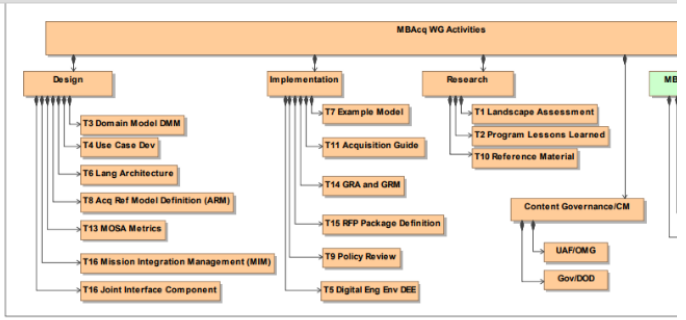
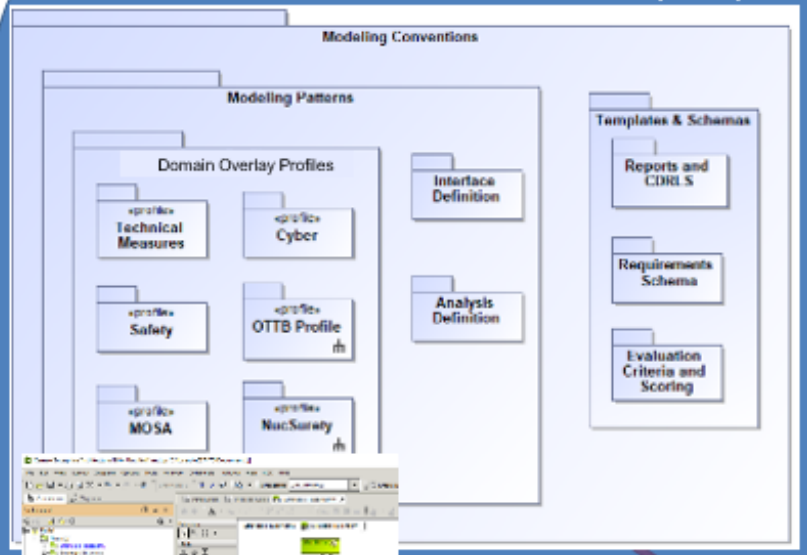
    - T16: Joint interface component arc
  - MBAcq Shared Files
  - Files: Reference Documentation
  - MBAcq User Group Charter

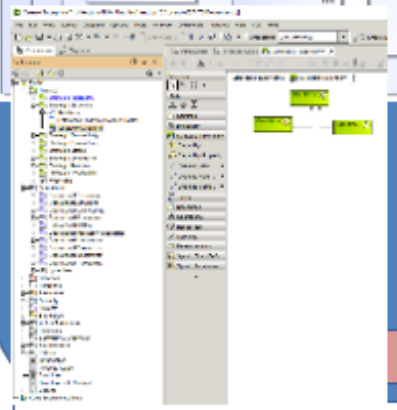


Topic ID#	WG Name	Leader(s)	Description
T1/2 Landscape Assessment & Lessons Learned	Research	@Rae Anderson	Identify Existing activities and organizations associated with D
T3 Domain Model	Design	Laura Hart Matthew Hause	Capture the core high-level concepts, definitions, relationshi Metamodel
T4 UC Development	Design	@Rae Anderson	Identify and define major MBAcq Use Case set
T5 Digital Eng Env	Implement		Examine the special considerations for addressing the **Digita** support the larger strategic goals expected from Digital Engi address DEE requirements/specificity in a MBAcq context. De the enabling system and a lighter version of requirements. D
T6 Lang Arch	Design	Gene Sherve	Define the implementation of the ACQ DMM for inclusion int

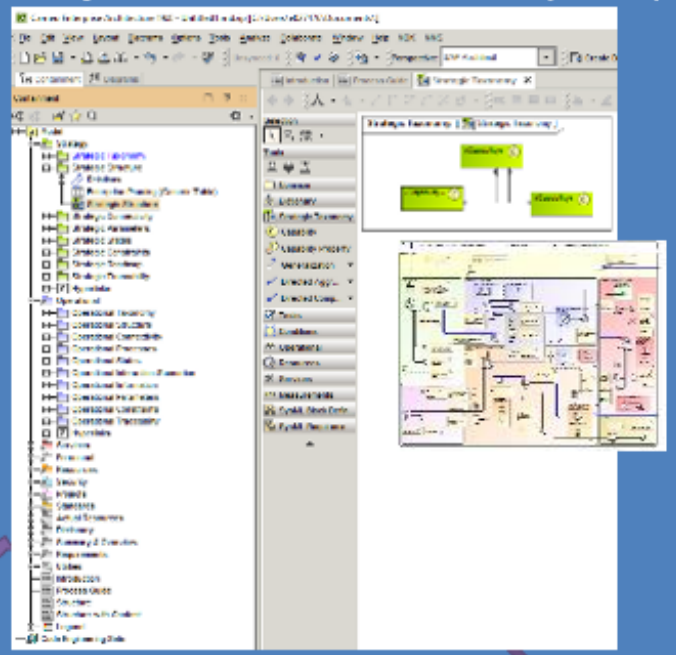
Model-Based Acquisition

1. Architecture Evaluation Criteria (AEC)

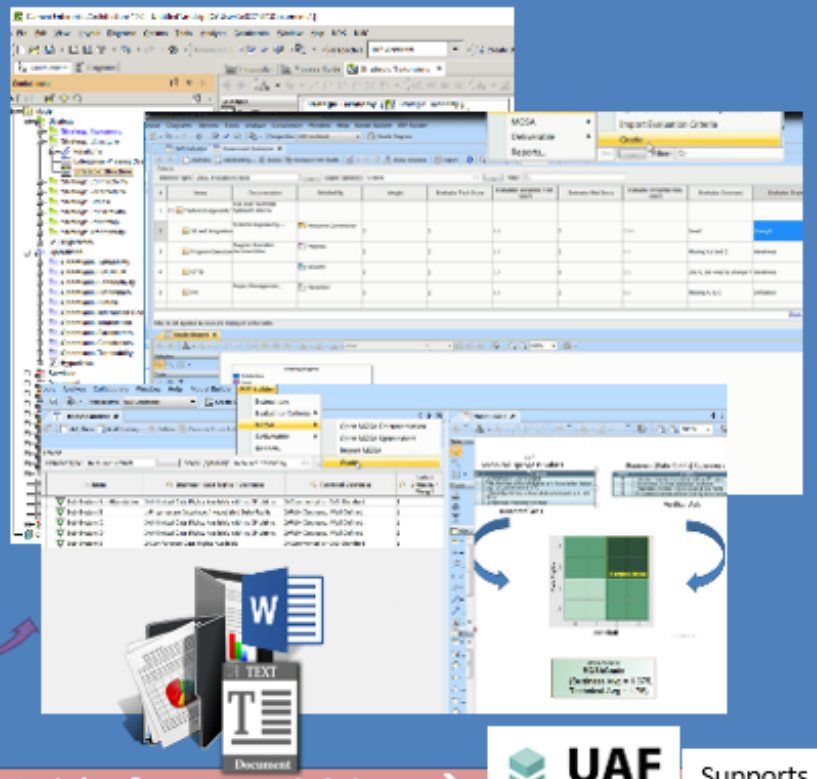




2. Objective Architecture Description (OAD)



3. Model-based RFP Package



AEC & (OAD)

Populated with Program & contract Data

← 4. Unified Architecture Framework (UAF) Process Guide for Acquisition →

UAF OMG UNIFIED ARCHITECTURE FRAMEWORK

Supports DoDAF

1. The AEC provides model structure for RFP content and evaluation tools:
- Modeling Patterns
  - DO Profiles (i.e. MOSA, Data Rights, certs)
  - Interface & Analysis Definitions
- Templates & Schemas
  - Evaluation Criteria & Scoring (Section K, L, M)
  - Reports & CDRLS

2. The OAD is a descriptive model containing the program requirements, constraints and context
- High-level Capabilities, mapped to Operational scenarios, traced to requirements (e.g. CDD, SRD, Conops)
- Technical performance measures (i.e. KPPs, KSAs, MOEs..)
- Any required architectural partitioning including structural and functional

(Based on UAF acquisition process guide and template)

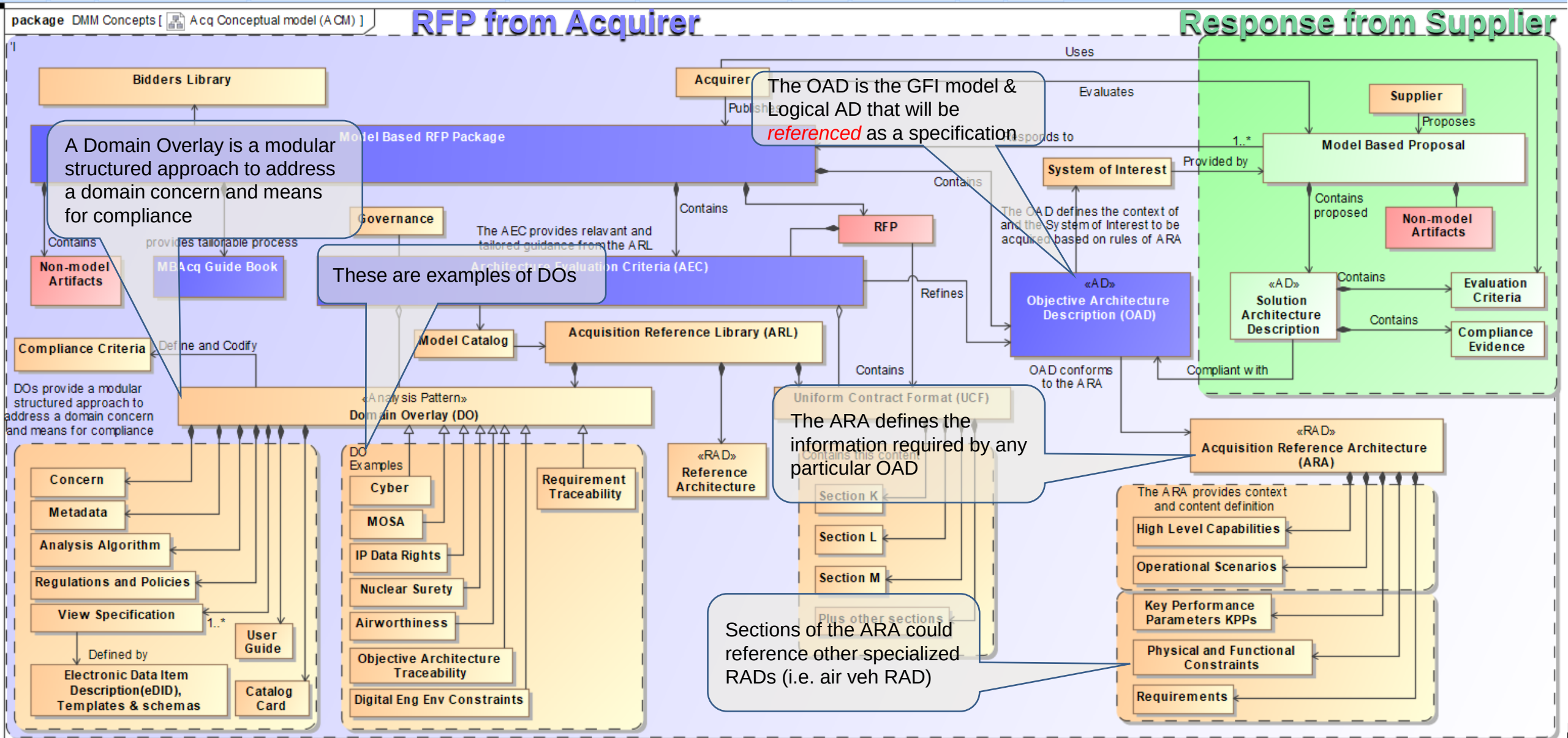
3. The Model-based RFP model contains the populated OAD&AC providing **RFP evaluation content, CDRL definitions** for documentation generation and **scoring tools** for solution validation and evaluation

4. UAF Process Guide provides the Acquisition Guidance for using MBAcq **to create, respond and evaluate a Model-based RFP.**

SOURCE: Laura Hart, MITRE 2017

MBAcq Future State

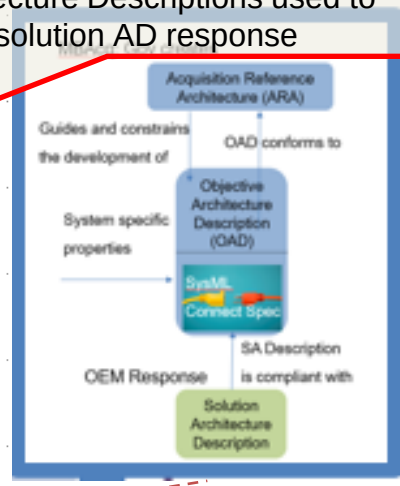
Bringing it all together!

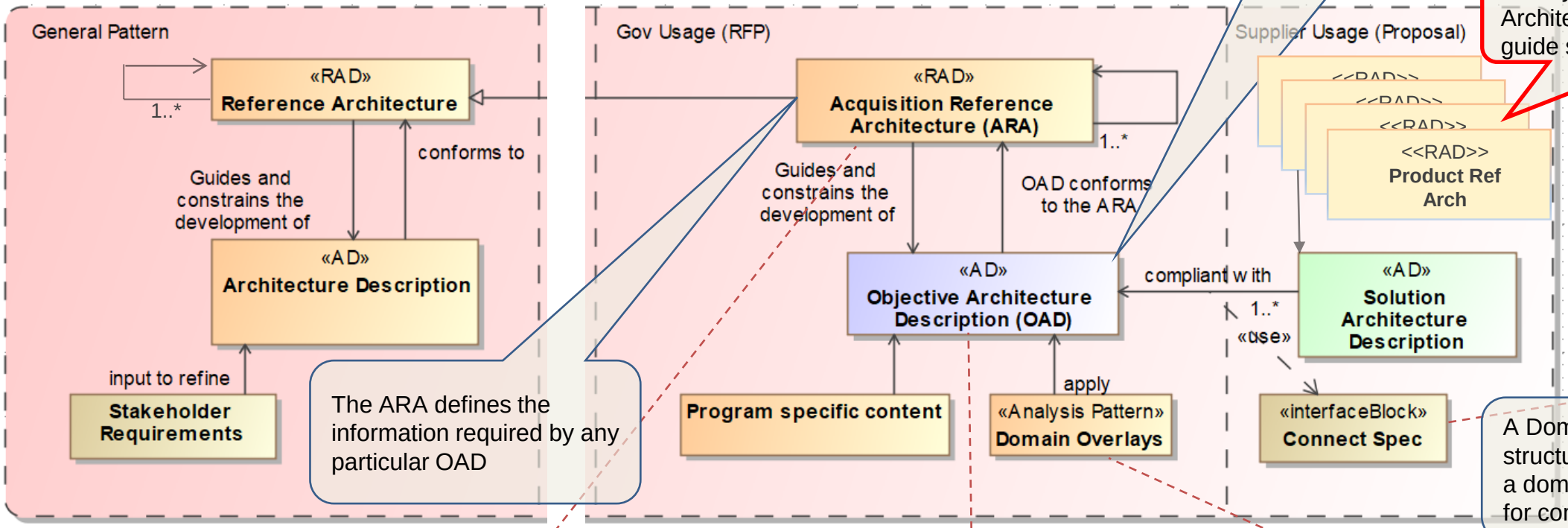


Usage of Standardized Concepts (2)

The OAD is the GFI model & Logical AD that will be *referenced* as a specification

Library of Product Ref Architecture Descriptions used to guide solution AD response



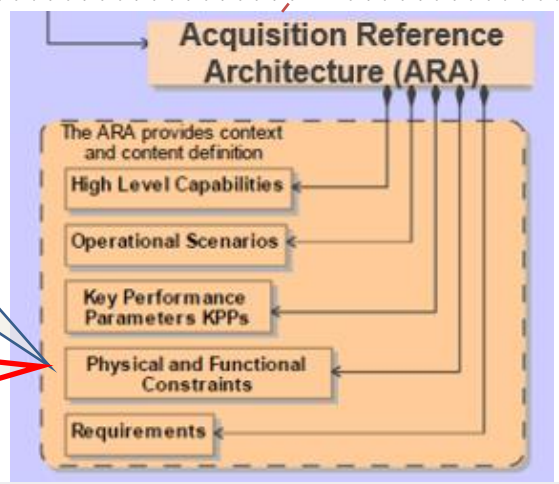


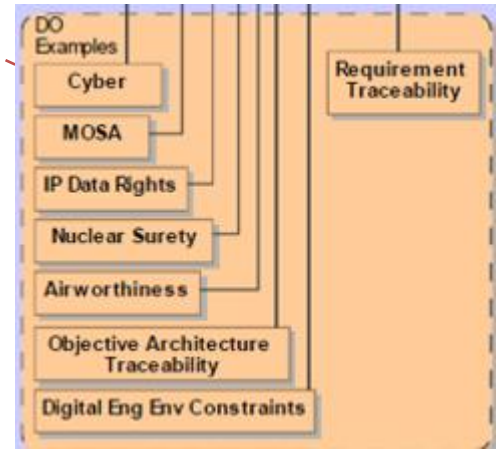
The ARA defines the information required by any particular OAD

A Domain Overlay is a modular structured approach to address a domain concern and means for compliance

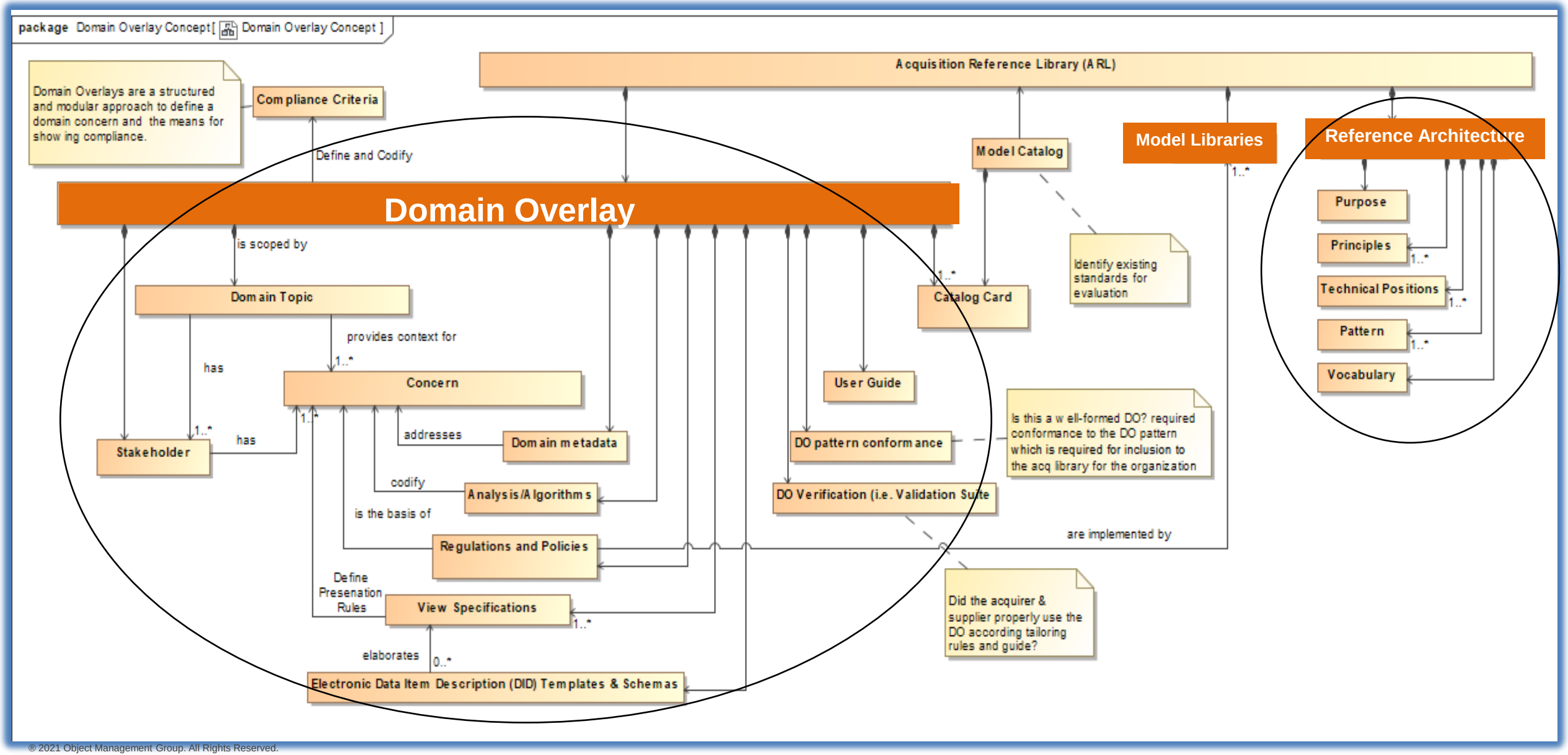
Sections of the ARA could reference other specialized RADs (i.e. air veh RAD)

Example, AF AV RAD





Standardized Concepts for Reusable Content



Domain Overlays (DOs)

Domain Overlay (DO) Description: A collection of constructs needed to support analysis for a **domain specific concern** using a standardized modular approach. Typical construct elements include:

Previously called Aspect Viewpoint Overlays (AVO)

- A set of regulations, constraints, rules…. driving the analysis (i.e. MOSA, safety, certification, airworthiness, Space …)These could be provided as an instrumented lib
- A set of Data/Metadata required to address or support analysis, compliance or fit-for-purpose. Implementation example (Domain model/profile)
- Logic/algorithm needed to perform analysis using the metadata and regulations
- A set of Viewpoints to support various analysis (Certification plan, coverage, design trades, schedule and resources…)

Characteristics

- Usually has associated regulations, governance that can be treated as pseudo requirements or constraints
- Cross-cutting both viewpoints/rows & aspects/columns
- Supports specific analysis associated with a Domain-Specific concern
- Can be created independent of a specific solution architecture description
- Can be applied or removed from a specific architecture description without impacting the AD, hence an overlay

Based on NDIA Actionable Architecture Using Aspect Modeling, L Hart 2018

Modular structured pattern to support standardization

OMG Standards Development Organization.

Domain Overlay (DO) Lifecycle - animated

1 Framing the Analysis Why & What is needed

- Identify the concern
  Certification of a nuclear system, cert plan, verification
  Define View specification content
- Identify the associated compliance documents:
  (AFI 91-107, AFI 91-118, AFI91-119…)
- Identify the properties needed to support analysis
  Critical Functions, Safety Category, SW/HW/FPGA/Operational
- Identify the logic or processing needed to support analysis

2 Creating the DO *Package for reuse*

- Create new stereotypes, properties and associated value types to label architecture elements
  <<Critical Function >> {Authorize, SW, high}
- Create a new extended requirement type with additional properties used for reasoning
  <<Nuc Surety Requirement>>
- Parse and Import as extended requirement elements. Provide additional extended data
- Parametric diagrams, constraint blocks, and scripts can be used to capture the rules on how various SW, HW, firmware, and processes are evaluated, tested, and certified.
- Create View specifications (electronic DID for visualization)
  Nuc Surety test plan, Validation Matrix
- Create documentation & Users Guide on DO usage

3 Using a Packaged DO

acquire/supplier may use differently

- Apply DO stereotypes to Architecture Model as directed
  <Critical Function>> Launch Console
- Provide additional attribute values
  Crtitical function = Launching
  Type=SW; Safety=3

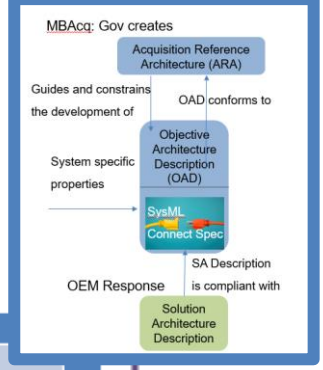
4 Evaluating the Results

Execute analysis, review populated views.
Follow guidance for success criteria.

*DO is a pattern for creating modular profiles

The Architecture Continuum

Defining Guidance!



View Specifications

Views

Architecture Continuum

RFP

Proposal

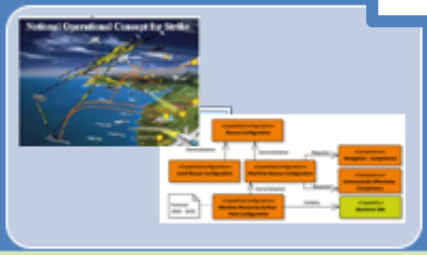
Enterprise Architecture (UAF)

- "Blueprint" for Organization
- Provides System Context
- MOEs, Enterprise Rs-Sr

OAD

- Operational Capabilities
- Operational Scenarios
- Key Performance Parameters
- Physical & Functional Constraints
- Requirements

St-Tx, Op-Sr, Ar-Ct

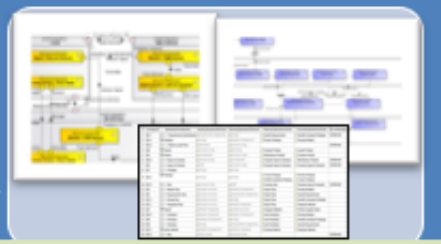


Traceability

Logical System Architecture (UAF or SysML)

- AOA Results, MOPs
- Customer Requirements
- System Rs-Sr

Rs-Sr, Op-Ra, bdd, ibd



Traceability Domain Overlays (DO)

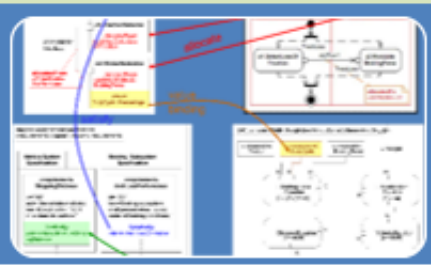
System Architecture (SysML)

- Derived Requirements
- Compliance Evidence (as defined in the DOs)

Proposed Solution

- Solution Architecture
- Compliance Evidence
- Traceability to OAD
- Requirements Allocation

bdd, ibd, par, req



UAFML

SysML

OMG Standards Development Organization.

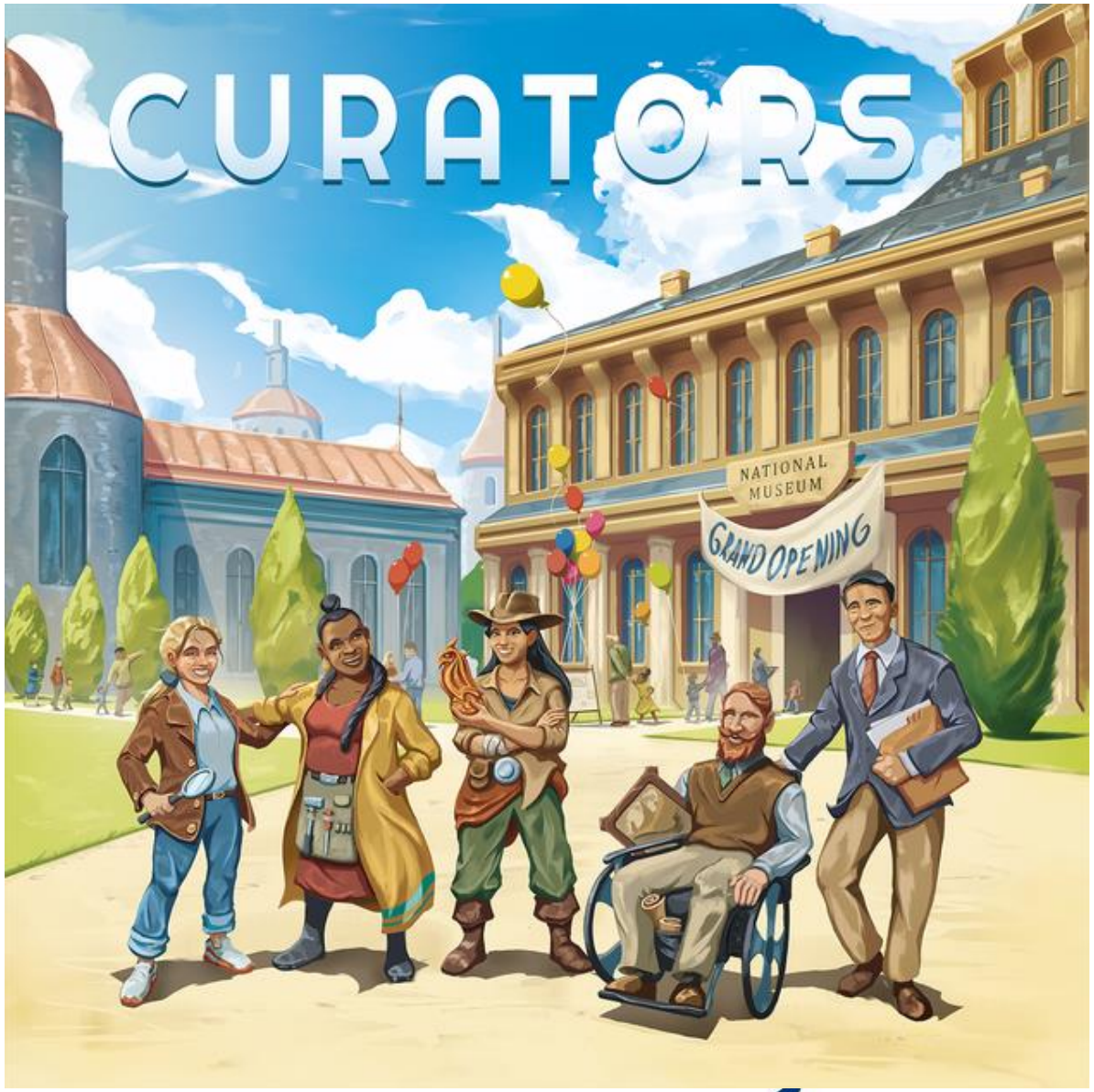
REUSABLE ASSETS AND MODEL CURATION

System Strategy, Inc.

Model/Asset Reuse: The Problem

- **So, we need to share, search for, find (hopefully), reuse, publish, update, notify, trust, protect, etc.:**
  - Models
  - Model Libraries
  - Reference Architectures
  - Components
  - Interfaces
  - Types
  - Patterns
  - Keywords
  - Solution Elements
  - Etc.
- **What is the solution to this?**

MODEL CURATION



https://boardgamegeek.com/thread/2707441/curators-short-review

Model Curation

- **“If we build it, they will come.” *Field of Dreams***
  - However, ***“they”*** need to know that ***“it”*** exists.
- **For a library to be of any use, people need to know where it is, be able to enter it, search through a catalog system, check out the elements that they need, and suggest new items to be added. Regarding model reuse, most organizations have a hidden library that few people know about, with no doors, card catalogue or search capability, where you can’t check out or add any objects. We need a solution for model curation.**

Model Curation Definition

- “Model Curation is the lifecycle management, control, preservation and active enhancement of models and associated information to ensure value for current and future use, as well as repurposing beyond initial purpose and context.”

[Rhodes D.H., Interactive Model-Centric Systems Engineering Technical Report, Phase 5. SERC-2018-TR 104, Feb 28, 2018]

- “Curation activities include model identification, acquisition, accession, composition, evaluation, valuation, presentation, preservation, and archiving.
- Curation practices promote formalism and provide for the management and control of models and associated digital artifacts, particularly when managed as a collection, at the program and/or enterprise levels.
- Data associated with a model includes model technical data, model metadata, and model pedigree.”

https://www.omgwiki.org/MBSE/doku.php?id=mbse:curating_digital_artifacts

Glossary

1. “**Model Accession**: The formal process of accepting and recording a model as a collection object in the enterprise level model portfolio. Accessioning addresses the legal, IP and ethical issues in model acquisition and development [1].
2. **Model Curator**: A designated professional role entrusted with the ownership, tracking and use of model collection objects, and possessing designated authorities for managing and controlling models [1].
3. **Model Metadata**: Descriptive metadata is contextual data about the model object(s). Metadata documents characteristics and used for indexing, discovering, identification. It provides user discovery of, access to, and management of an object [1].
4. **Model Pedigree**: Model-associated information that describes model origin, development process, originators and developers, assumptions, expert knowledge, model enhancements, investment costs, versions, change history, etc. [1]
5. **Data Pedigree**: A record of traceability from the data's source through all aspects of its transmission, storage, and processing to its final form used in the development of an M&S. [5]”

[1] Rhodes D.H., Interactive Model-Centric Systems Engineering Technical Report, Phase 5. SERC-2018-TR 104, Feb 28, 2018
[5] NASA, NASA-STD-7009A w/CHANGE 1, Standards for Models and Simulations, Dec 17, 2016, https://standards.nasa.gov/standard/nasa/nasa-std-7009 [accessed 18 Nov 2018]

https://www.omgwiki.org/MBSE/doku.php?id=mbse:curating_digital_artifacts

Barriers to Reuse

- “The lack of access to models, mistrust of models, and perception of legitimacy of models are all barriers in model reuse and longevity, which can be mitigated by model curation.
- Model curation provides formalism to ensure both technical and non-technical data and information concerning a model is created and maintained, including model metadata and model pedigree.”

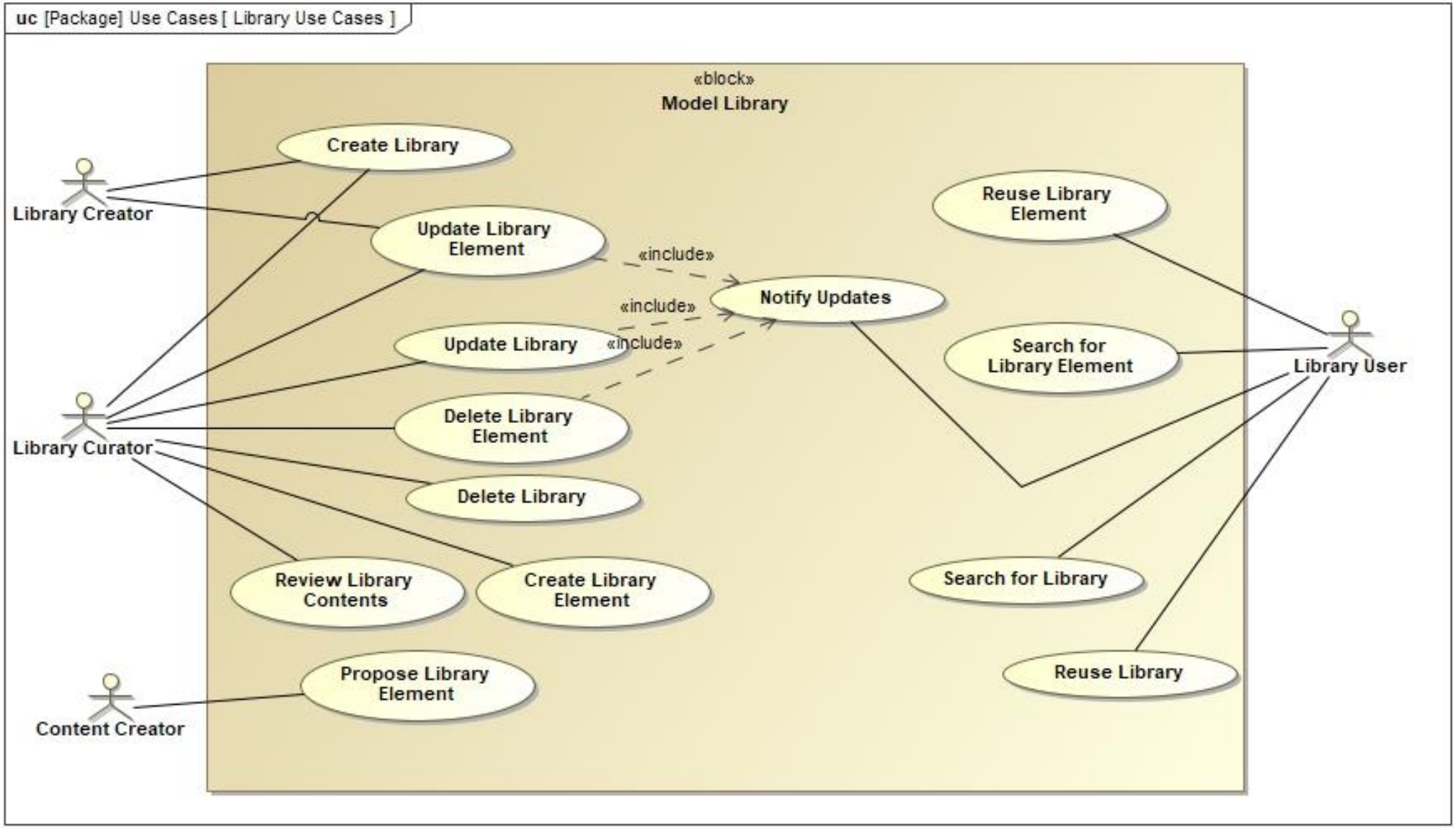
https://www.omgwiki.org/MBSE/doku.php?id=mbse:curating_digital_artifacts

- There is no standard for sharing parts of a model, just the entire model.
  - Similar to wanting to check out a library book and finding you need to take the entire library or at least the bookshelf.

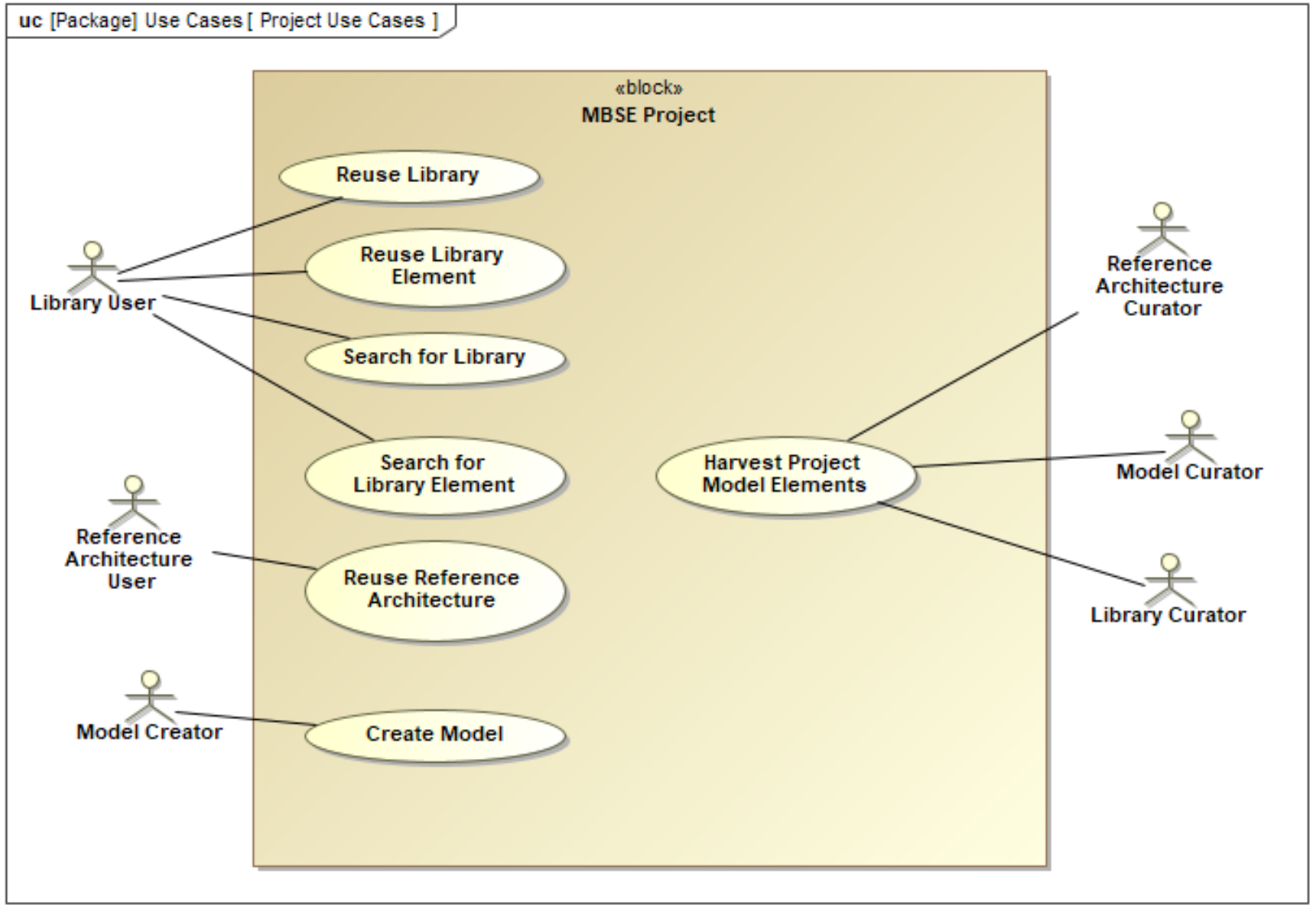
A Few Requirements – NOT A COMPLETE LIST!!

- Standard API – Extended SysML v2 API?
- Multiple libraries with access control
- Permissions at multiple levels - Library, Element, etc.
- Role-based permissions – Curator, user, creator, owner, etc.
- Configuration management of libraries, elements, patterns, ref architectures, etc.
- Search capabilities using keywords, types, purpose, domain, etc.
- Support for Vendor independent/dependent data formats
- Support for UML, SysML, UAF, etc.
- Support for non-UML tools (future?)
- Local, Department, Enterprise, Global, etc. hosted libraries
- Black box & White box sharing
- Interest registration
- Update notifications
- Global element ID’s – the same component in multiple models has the same ID
- Etc.

A Few Model Library Use Cases – NOT A COMPLETE LIST!!



A Few Project Use Cases – NOT A COMPLETE LIST!!



Model Curation – The Status Quo

- **Rouse (2015) stresses that "the wealth of existing models is often not used because of a lack of knowledge of these resources and the difficulty in accessing them.**
- **Lack of access to models, mistrust of models, and perception of legitimacy of models are all barriers in model reuse and longevity.**
- **Reymondet et al. (2016), 'model expertise is largely resident in individuals, and the ability to select and compose sets of models is typically limited to the original use. Lack of a centralized leadership authority results in models being owned and managed primarily at a local level.**
- **Rhodes & Ross (2015 "Modeling efforts are often duplicated across programs, and the individual programs may lack model experts preventing benefit from the collected wisdom of the enterprise.**
- **Models have been employed for numerous purposes in recent years (McBurney, 2011) and it is likely that digital engineering transformation may extend model use even further.**
- **A question arises as to whether a model curation function at the enterprise level could lead to more effective use of models and digital assets at all levels." (Rhodes, 2019)**

Model Curation – The Future

- **Wu et al (2021) describes a maturity assessment of Systems Engineering reusable assets to facilitate MBSE adoption, basically a Capability Maturity Model (CMM) for model and asset reuse.**
- **Hause (2014), defines how the OMG Reusable Asset Specification (RAS) was used to build an asset library to harvest, curate, and share SysML model assets to promote and enable model asset reuse.**
- **The OMG RAS was published in 2005 and provides a means of categorizing assets for reuse.**
  - The PTC Asset Library is the only implementation the authors are aware of that is still in use.
  - The solution may be a standard for a library for sharing these reusable assets, whether they are for security or any other purpose.
  - The authors will be proposing this to INCOSE and the OMG.
  - We will continue to build and promote these patterns as a means of improving system security and promoting reuse of model assets.
  - Could also be added to the OMG UAF standard page as are other documents and models.

Reusable Assets and Model Curation Timeline

3/13/2024

The Reusable Asset Specification (RAS)

Date: November 2005

Reusable Asset Specification

OMG Available Specification
Version 2.2

formal/05-11-02

OBJECT MANAGEMENT GROUP

What is the RAS?

- “The scope of this Specification is a set of guidelines and recommendations about the structure, content, and descriptions of reusable software assets. We recognize that there are different categories of reusable software assets. The specification identifies some categories, or rather types or profiles and provides general guidelines on these profiles.
- The Reusable Asset Specification (RAS) addresses the engineering elements of reuse. It attempts to reduce the friction associated with reuse transactions through consistent, standard packaging.”
- Basically, it allows users to define, store, publicize and share components.
- Originally only SW components, but implementations included other MOF-based elements.

Goals of the Update

- Goal #1: Write clear needs statements to enable discovery of models across the ecosystem, in support of Model Based Acquisition.

Goals of the Update

- Goal #2: Distinguish amongst metacard needs vs. catalog needs vs. repository needs vs. other ecosystem or industry needs
- Catalog (asset records and discoverability) / Repository = Library (asset storage)
  - Search
  - Data access, transport
  - Interacts with the cards
  - User management
  - Access control
  - Interfaces
- Metacard / Reusable Asset Tagging / Library Card
- Enable model and data discoverability and searchability using a human-readable and machine-readable standard.
  - Supports heterogenous model types and asset types
  - Clear taxonomy
  - Implementation-independent, portable metacards
- Ecosystem / Industry Needs
  - Broad awareness

Goals of the Update

- Goal #3: Review scope and contents of current Reusable Asset Specification, and other similar specifications, to find gaps
- Goal #4: Scope the RAS update to address those gaps, (in coordination/collaboration/alignment with other specs/stakeholders if needed)
- Also review if any other specifications already provide this capability.

Projected Timetable (1)

- March 2024
  - Group formed and work officially begins on the new RAS 3.0 specification.
- August 2025 – RAS 3.0 RFC document sent to OMG for comment
- September 2025 OMG Meeting – OMG members vote to release the RFC 3.0 for comment
  - 60 days of comments open to the OMG and the general public
  - 60 days for comments expire on November 10th
- December 2025 OMG Meeting – RAS 3.0 Spec approved and enters the Finalization stage
  - Beta specification released
  - FTF committee is formed to address outstanding issues.
  - Open to all OMG members
  - Previously received comments need to be processed officially. This involves issuing tracking numbers and making traceable changes to the specification. All changes must reference an issue number.
  - Comments will continue to be received and processed during the FTF period.

Projected Timetable (2)

- Dec 2026 OMG Meeting – RAS 3.0 FTF specification hopefully will be approved and finished.
  - RAS 3.0 becomes official
  - RTF for RAS 3.1 issued
  - RAS 3.1 team will be formally created.

Summary and Conclusion

- **Design patterns serve as a building block for promoting reusable knowledge.**
- **Software patterns enable architectural solutions for software design and architecture problems.**
- **Patterns accelerate software design and development while promoting reusability.**
- **Software implementation may differ only in the programming language or the OS.**
  - Implementation in the physical world can vary greatly.
- **This paper contributes to the foundation of the design pattern concept and has crafted new design patterns for both physical (fire prevention and detection) and cyber-security (CDS).**
- **Concepts need not be limited to just the security domain.**
- **The paper further specified the usability of a system library concept to facilitate a catalog of solution elements of security pattern libraries.**
- **Finally, the UAF Modeling Language (UAFML) standard serves as the primary modeling approach to realize the design of the security patterns presented.**
- **We just need to find the right way to share them.**

About the Authors

Matthew Hause is an SSI Principal and MBSE Technical Specialist, a former PTC Fellow, a co-chair of the UAF group and a member of the OMG SysML specification team. He has been developing multi-national complex systems for over 45 years as a systems and software engineer. He started out working in the power systems industry and has been involved in military command and control systems, process control, manufacturing, factory automation, communications, SCADA, distributed control, office automation and many other areas of technical and real-time systems. His roles have varied from project manager to developer. His role at SSI includes mentoring, sales presentations, standards development, presentations at conferences, specification of the UAF profile and developing and presenting training courses. He has written over 100 technical papers on architectural modeling, project management, systems engineering, model-based engineering, and many other subjects.

Ademola (Peter) Adejokun has over 20 years' experience in systems and software engineering; he currently works as a cyber systems security engineer at Lockheed Martin Aeronautics in Fort Worth, Texas. Ademola is a licensed professional engineer in Texas, an INCOSE ESEP, Six Sigma Black Belt, a certified PMP. Ademola is a senior member of the IEEE and ACM. He serves on the Object Management Group UML Testing Profile, UAF and System Assurance Task Force. He also serves on the National Council of Examiners for Engineering and Surveyors (NCCEES) Software and Electrical/Computer Engineering PE Licensure Exam Committees.

Mitchell Brooks is a cyber systems engineer at SSI, specializing in modeling cybersecurity aspects of larger systems. He also instructs a course designed to introduce systems engineers to UAF. He has previously been included on research teams helping to examine how we approach IT security in order to improve efficiency and effectiveness. He holds a degree in cybersecurity from Stevens Institute of Technology and an MBA from Saint Mary's College of California.

System Strategy, Inc.

LOCKHEED MARTIN

Don’t be an Octopus; Share Your Knowledge!

https://rare-gallery.com/108495-finding-dory-hank-nemo-fish-octopus-animation.html

QUESTIONS?

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