UAF or SysML – Yes?

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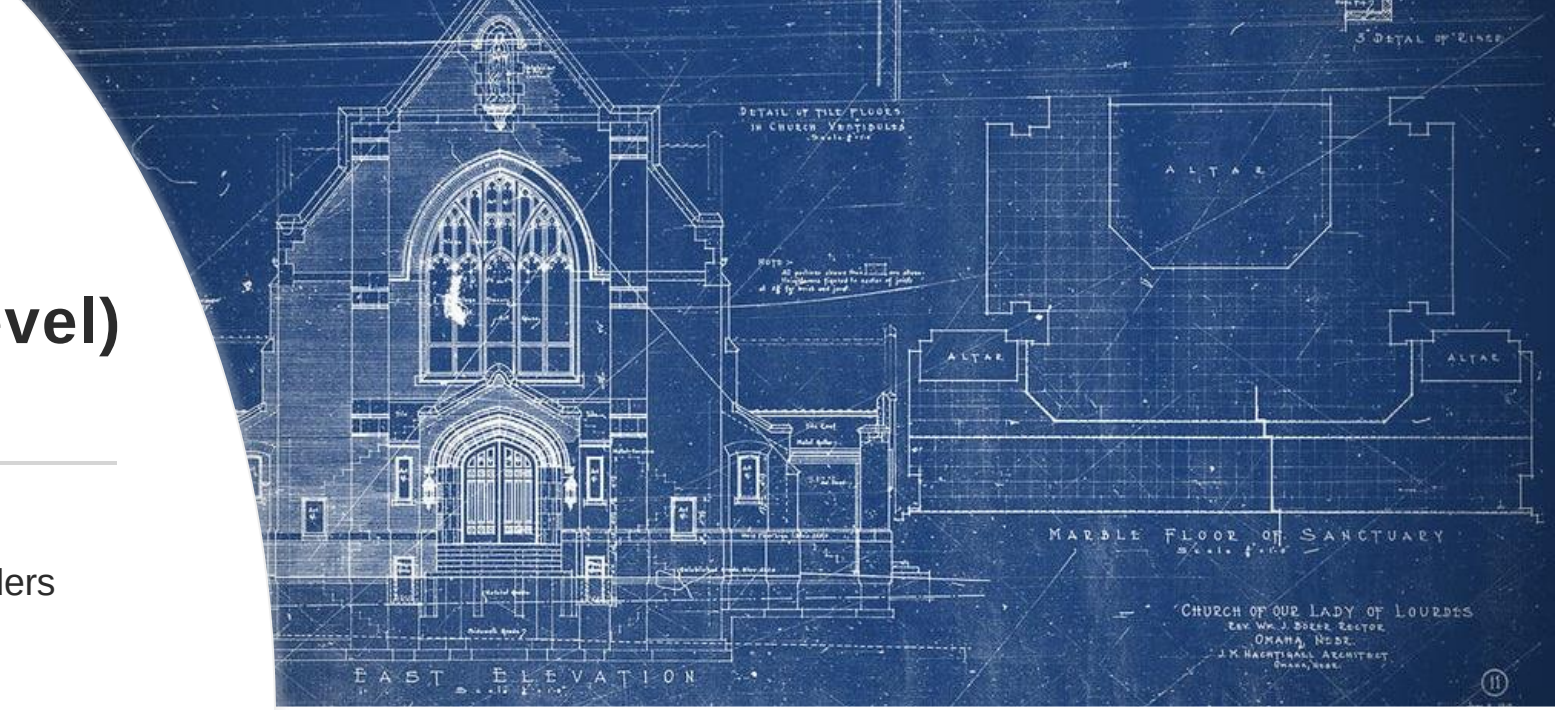
Agenda

- The Essence of Architecture
- Enterprise Architecture and UAF
- Systems Engineering and SysML
- Architecture Continuum with UAF and SysML
- Capability Roadmap to System Model Example
- Conclusions

The Essence of Architecture (at any level)



Manage Complexity

Manage Communications for a diverse set of Stakeholders

Enables MOSA & Reuse

Expression of a Solution (enterprise, system, system-of-systems)

Decision Analysis

Facilitates Change

Incremental Risk Buy Down

Caution:

- A good-looking model ≠ a good design
- A bad model could reflect a bad design
- A modeler ≠ Systems Engineer
  - System Architectures are the result of solid systems engineering work

Engineering & Architecture Program Lifecycle Value

Both Enterprise and System Architectures provide more than a guide to development

Early Architecture products enable the starting point and planning for later activities including System Integration & Verification, Deployment, Training, Maintenance

Program Activity	Benefits
Capability Evolution	Facilitates the quick evaluation of mission needs
Interface Migration	Facilitates the adoption of evolving interface standards and technology
System Integration	Identifies required inputs & outputs for System-of-Systems testing
System Verification	Defines needed verification cases
Technology Evolution & Obsolescence	Provides means for impact of technology changes

Enterprise Architecture (EA)

- Enterprise architecture (EA) is used to align organizations such as companies, government agencies, non-profits, and academic institutions, with their business strategy and goals
- EA takes a holistic view of an organization's technology ecosystem and its interdependencies to ensure that the technology infrastructure supports the business processes effectively and efficiently
- Enterprise architecture defines the principles, standards, and policies that govern an organization's technology infrastructure including People, and competencies as part of the ecosystem
- EA are “blueprints” for precisely and concisely defining an organizations current or future environment
- An EA is essential for evolving any organization’s objectives and goals, the development of new systems, or inserting new capabilities into an existing ecosystem
- A well-formed EA is the primary mechanism for establishing a basis for assimilating rapid deployment of state-of-the art capabilities and managing the knowledge base of an enterprise

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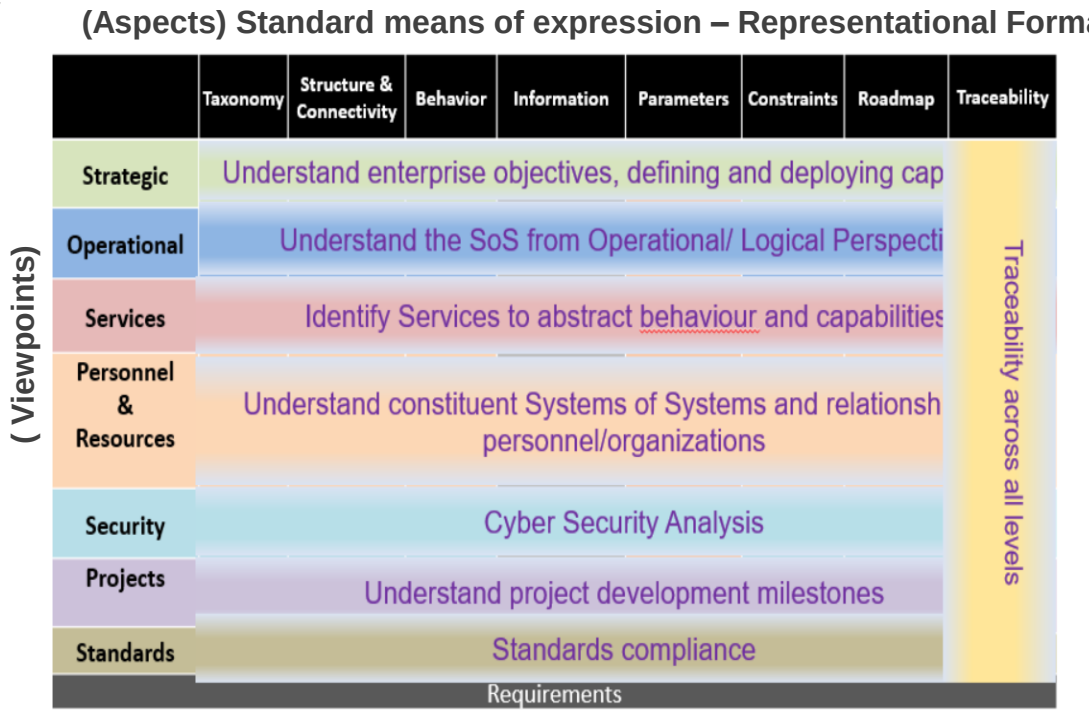
Unified Architecture Framework (UAF) for EA

- To develop architectural descriptions for **commercial industries**, **federal governments** and **military organizations**
- Is compatible with **DoDAF** and **NAF**
- Has many different use cases from **Enteprise as a System** and **Cyber-Systems engineering** to enabler for **Digital Transformation planning**
- Developed by Object Management Group (OMG) with the leadership from Dassault Systemes, Lockheed Martin
- Is an international ISO standard ***ISO/IEC 19540:1*** *and* ***ISO/IEC 19540:2***
- Current version of UAF specification is 1.2 https://www.omg.org/spec/UAF/1.2/About-UAF

Why Use Frameworks such as (UAF)

Frameworks such as Unified Architecture Framework (UAF):

- Supports semantic interoperability using a common vocabulary enabling:
  - Portfolio and capability management
  - Operational planning and Mission Engineering
- UAF is methodology-agnostic (structured, OO, etc.)
- Extended UPDM with additional architectural dimensions:
- Security
- Personnel
- Requirements
- Analysis
- Simulation with cross-cutting Traceability using a common semantic vocabulary



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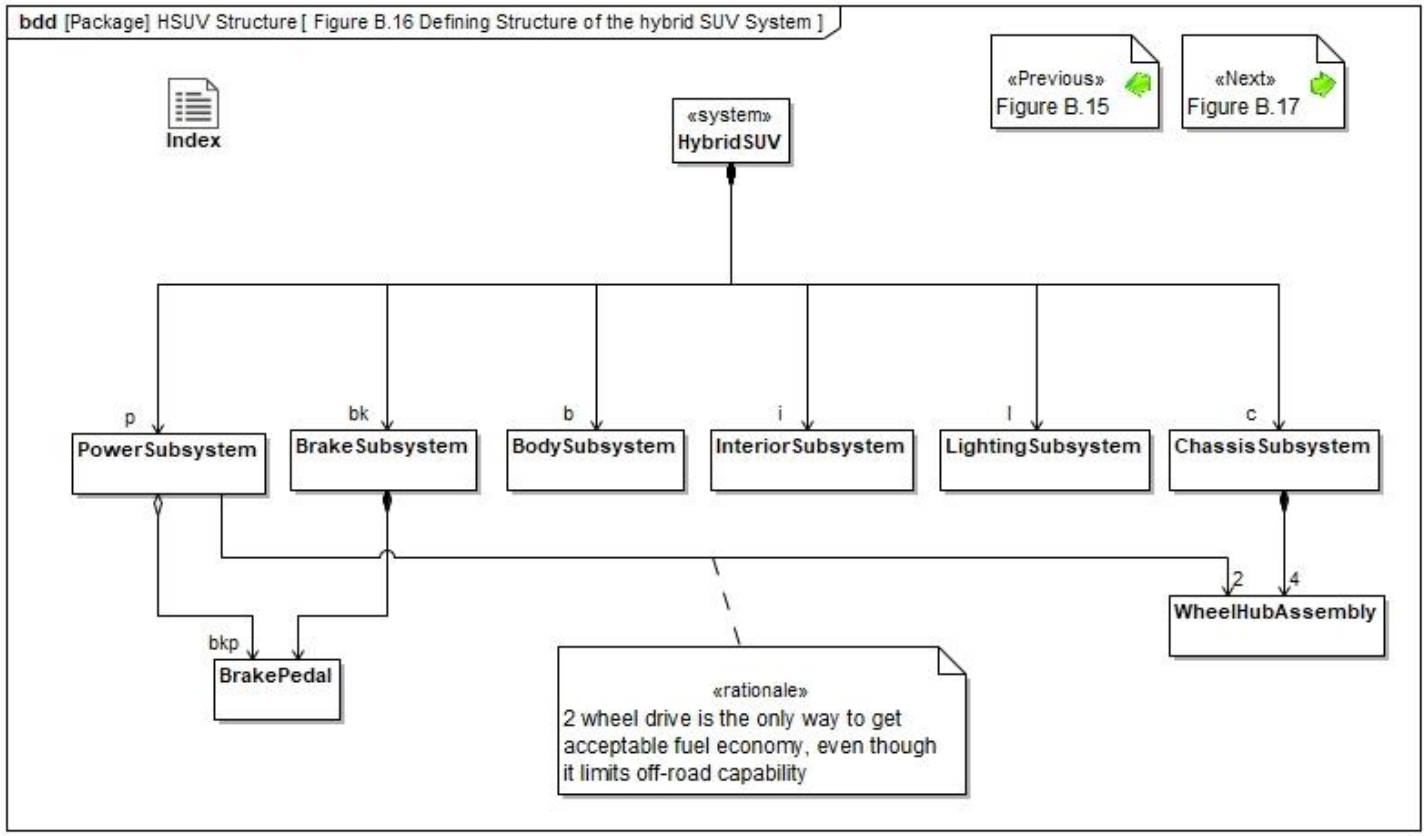
Systems Architecture (SA)

- Systems architecture is a specialized type of architecture that focuses on the design and integration of individual systems, such as an application, service, weapon system or platform.
- It defines the requirements and relationships for the structure, components, interfaces, and interactions of a system.
- Systems architecture ensures that a system is designed to meet the operational and programmatic requirements such as costs, schedule, performance, scalability, security, and reliability.
- Example: Hybrid SUV car, F35 aircraft, Radio, ….



What's in the Systems Architecture Model

A System Architecture Model is an Integrated Structured Representation of the Requirements, Behaviors, Structure, Properties, and Interconnections

Requirements

- What are the system's operations, stakeholders' goals, purposes, and success conditions?

Behavior

- What the system needs to do to meet requirements
- Transformation of inputs to outputs
- Responses to External stimulus

Structure

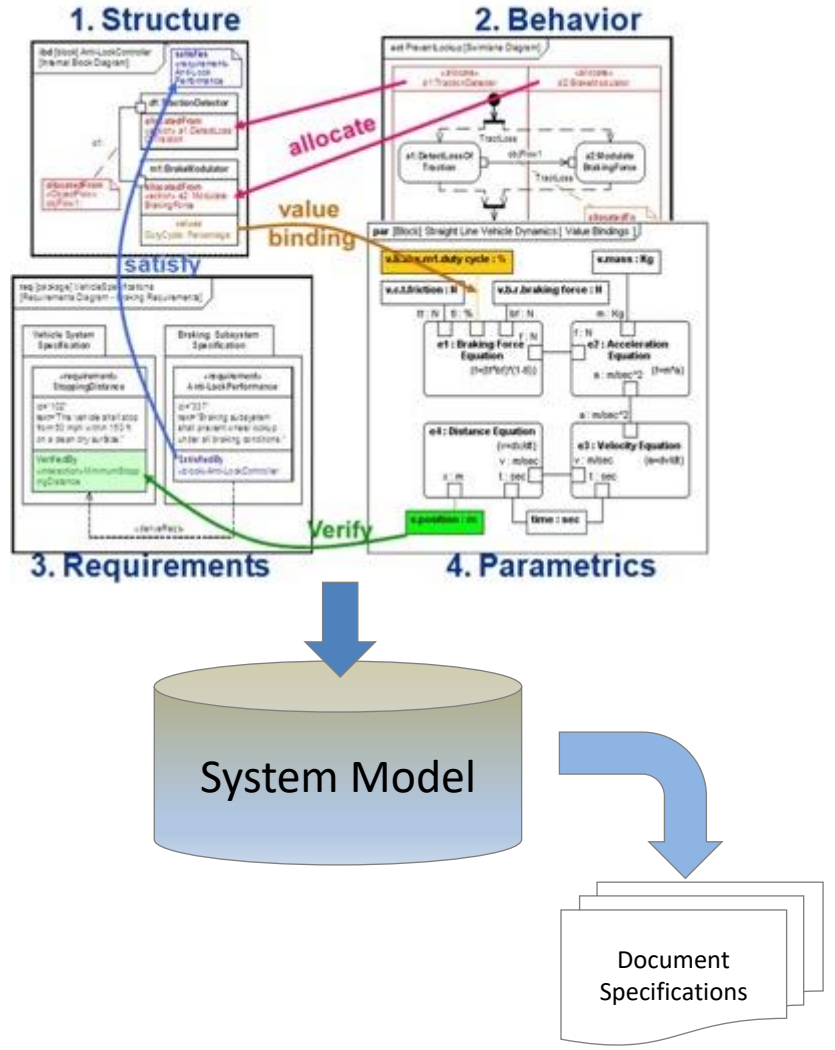
- The parts of the system that are responsible for the behaviors
- The component hierarchy, elements and stores

Properties

- Performance, physical characteristics and rules that constrain the structure and behaviors

Interconnections

- Ability of the structured elements to exchange information and execute their required behaviors



Primary use of the System Model is to enable the design of a system that satisfies its requirements

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SysML Work in Progress

Increase adoption and effectiveness of MBSE
by enhancing…

- Precision and expressiveness of the language
- Consistency and integration among language concepts
- Interoperability with other engineering models and tools
- Usability by model developers and consumers
- Extensibility to support domain specific applications
- Migration path for SysML v1 users and implementors

SysML V2 is in Beta Release

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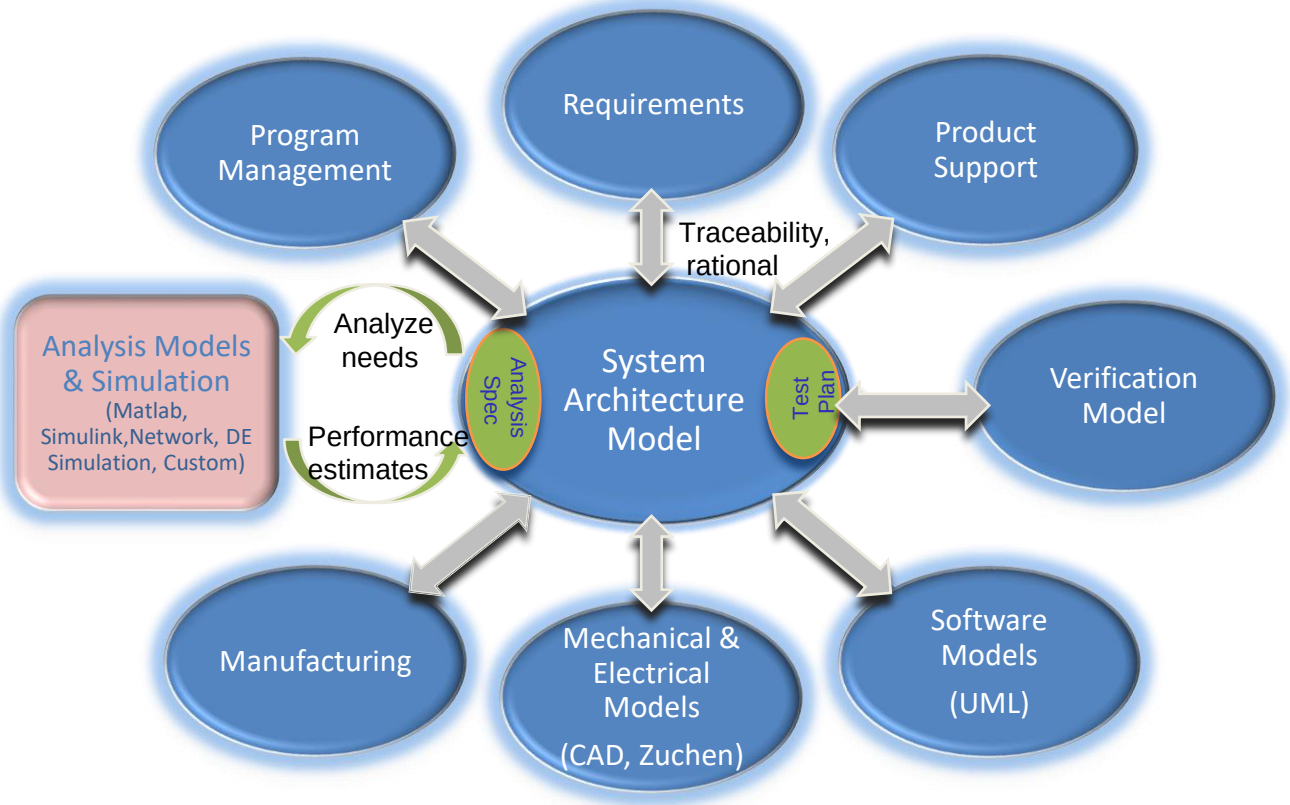
Descriptive vs. Analytical Architectures

System Architecture Model (SAM)

- Descriptive in nature
- Emphasizes how pieces fit together into a *consistent* whole
- Provides context for analysis

Analysis Models and Simulation Models

- Emphasize specific aspects of performance, *consistent* with the Architecture Model.
- Mathematically-based computation or simulation
- Reduces risks thru analysis, validation and optimization of:
  - MOE, MOP, KPP, TPM timing, probability of hit/survival reliability/availability, MTBF cost, total cost of ownership
- A vehicle to solve some problem or verify a solution



SAM provides a "hub" for data integration and transformation across the product lifecycle

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Enterprise vs. Systems Architecture

How does an Enterprise differ from a Systems Architecture?

- Different stakeholders
- Different scope – EA typically (not always) focused on one aspect of the EA
- SA Concerns/Issues/problems are system focused and not on the entire organization

All systems play a role in some operational capability

An operational capability often has dependencies to other capabilities and may includes many systems

- For example, a Fires capability will have a dependency on a Track, capability that is implemented by people, processes and one-to-many systems

We need the Enterprise Architecture to define the Family-of-Systems interoperability requirements

UAFML or SysML- How to decide?

WELL, IT DEPENDS!

The question of UAF or SysML is a question of scope

- What is the concern, issue or problem you are trying to address?
- Who are the stakeholders?
- What information is needed to support the stakeholders and their decisions?
- Is the question more Enterprise or Systems Oriented?
  - Sometimes the answer is BOTH!
- UAFML is a standard language intended to address the needs of an enterprise
- SysML is a standard language intended for the development of specifications and analysis of a system

There is a need to federate across a broader enterprise (multi service, multi-country) with common semantics to avoid miscommunications and improved cooperation

Use right tool (or language) for the right job

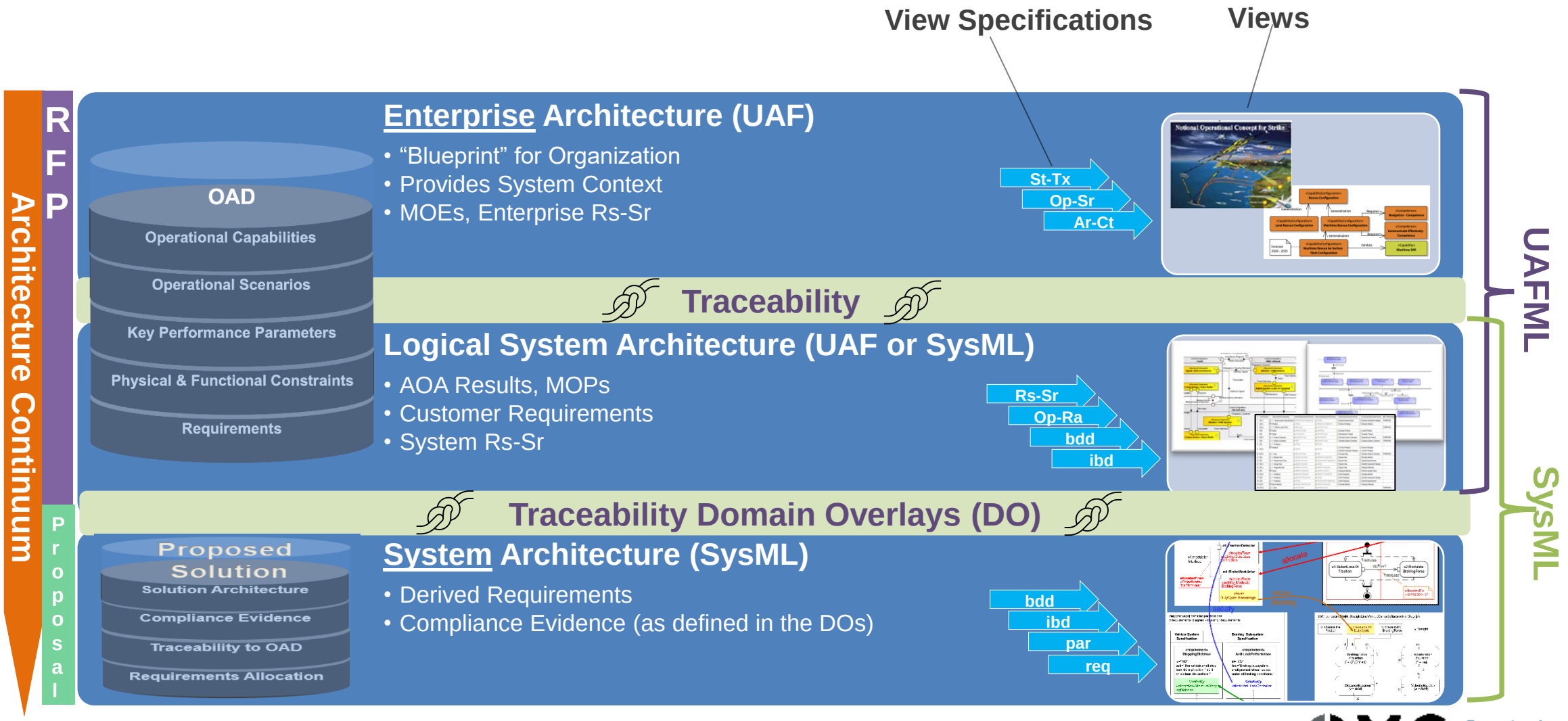
System of Systems Architecture

- System-of-Systems Architecture (SoSA) describes the integration and interaction of multiple systems to achieve one or more objectives, goals, or outcomes for an organization, process, or mission
- SoSA defines the interfaces, interactions, and interdependencies among the systems and their components to ensure that they work together seamlessly
- SoSA address the challenges of integrating heterogeneous systems, such as different technologies, platforms, and standards
- SoSA is closely related to Mission Engineering which provides the mission requirements and objectives of the SoS

Example: Command and Control systems for Air and Ground Combat Systems

Is SoSA Enterprise or a Systems Architecture?

The Architecture Continuum



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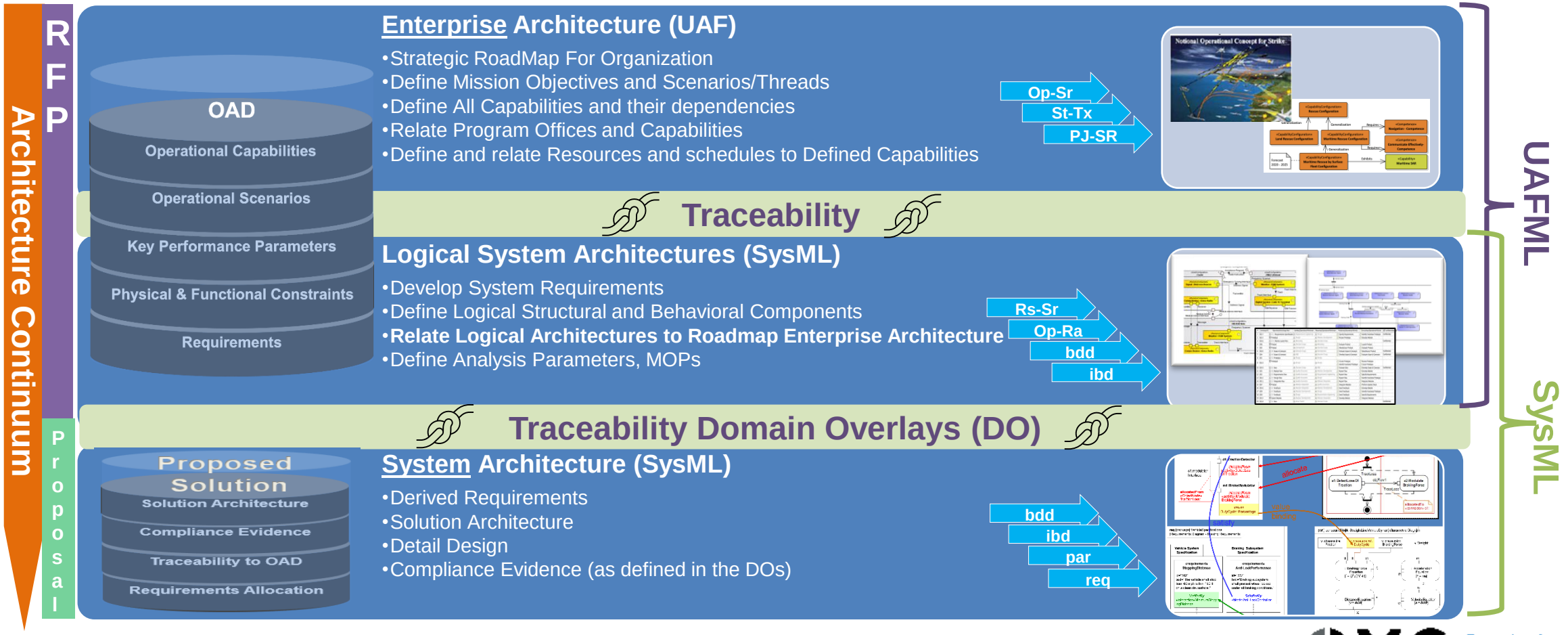
Architecture Continuum Example

Fires Capability – Multiple program offices responsible for fielding some part of a Fires capability

Stakeholder – PEO needs to know what the impact on a mission objective (negate a target) if any of the program offices fall behind their development schedule

Scope determination: Stakeholder concern involves multiple organizations, products and their schedules

Architecture Continuum – Roadmap to System



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Conclusions

- The question of UAF or SysML is a question of enterprise or systems architecture
- Ideally, a systems architecture is always related to an enterprise architecture
- UAF is intended to address the needs of an enterprise organization
- SysML is a modeling language intended to define and analyze systems
- Together UAF and SysML provide a robust “tool suite” for addressing the needs of any stakeholder and any level
- DOD CIO and OUSD R&E working with OMG UAF and SysML for V2 Transitions

The relationship between an enterprise architecture constituent system exist – So model it!

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