



EFFICIENT USE OF ENTERPRISE AND SYSTEM ARCHITECTING IN COMBINED ENVIRONMENT

H. GANS, F. MARKHAM, M. OSAISAI, J PRATCHIOS, D WOOD

Contact info: Howard Gans, Harris Corporation, (321) 727-4379, hgans@harris.com

Today's architect must consider several levels

- Enterprise level
 - System-of-systems, business models, customer framework mandates
- System level
 - System architecture, interfaces, functional allocation, requirements development
- Design level
 - Code development, service development, performance analysis and simulation

Modeling languages have been developed to address these needs

- Profiles developed by the Object Management Group (OMG) as an aid for modeling
- Unified Modeling Language (UML) defines semantics and stereotypes for object-oriented modeling
- SysML extends UML to systems engineering
- Unified profile for DoDAF and MoDAF (UPDM) supports full compliance with UML, SysML, and elements of the Service Oriented Architecture Modeling Language (SoaML)

Enterprise Architecting

Why this program?
What's the process?



How to use the models for business

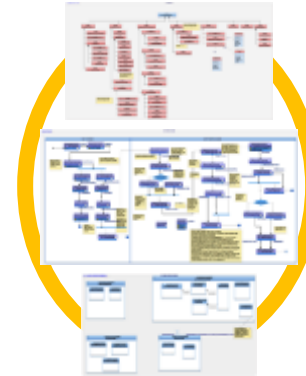
Model Based Architecting

End results – capability view
Desired effects

Operational view
What steps need to be done?

Systems/service views
What parts are needed?

(Others)



Understanding the problem domain from customer needs and platform capabilities to end user

Model Based System Engineering

System components
Requirements
Behavior
Structure
Interfaces



Engineering a reference system framework and instantiating specific solutions for customers

Mode Based Software Engineering

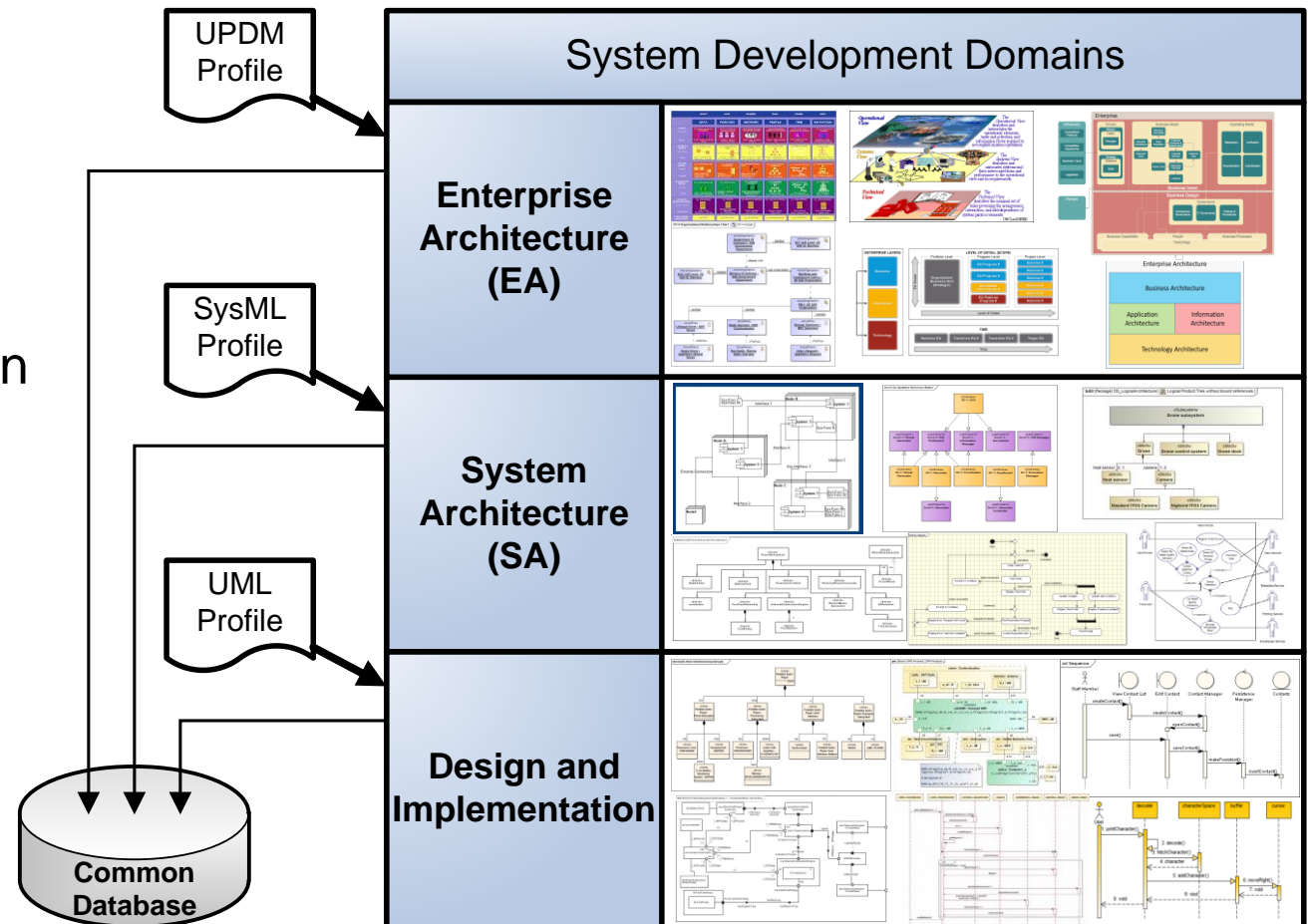
Software components
Implementation options,
analysis, simulation



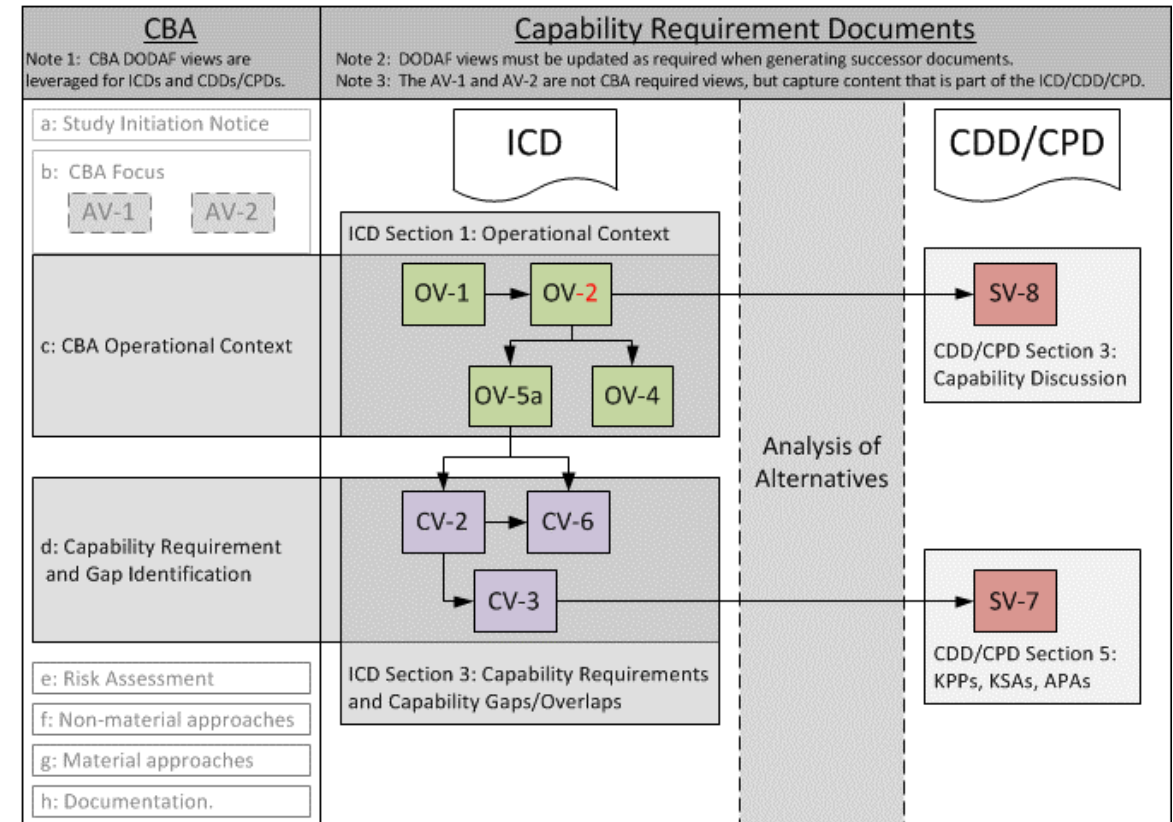
Engineering software solutions/options for specific customer needs

3 levels: enterprise, system, design

- Use the right tool for the job
 - EA for the mission domain
 - MBSE for the solution domain (SysML)
 - UML for the implementation domain
- With proper tools, all levels can exist within the same modeling framework
 - Linked together
 - Consistent
 - Same database
- The perspective is linked to the profile
 - Enterprise architecting – DoDAF (UPDM)
 - System architecting/design (SysML)
 - Implementation and coding (UML)



- **Per the JCIDS Manual (12 Feb 2015), “...DoDAF views and associated data provide a structured means to document data associated with the CBA (Capabilities Based Assessment)....”**
 - Focus for CBAs is on the Capability Viewpoint (CV) and the Operational Viewpoint (OV)
- **Requires use of DoDAF products for development and evaluation of the net ready key performance parameter (NR-KPP)**
 - Use of all viewpoint (AV), data and information viewpoint (DIV), System and service viewpoints (SV, SvcV)
- **Includes specific direction to “(p)roduce architectures using a tool that focuses on architectural data rather than only upon individual artifacts/views.”**



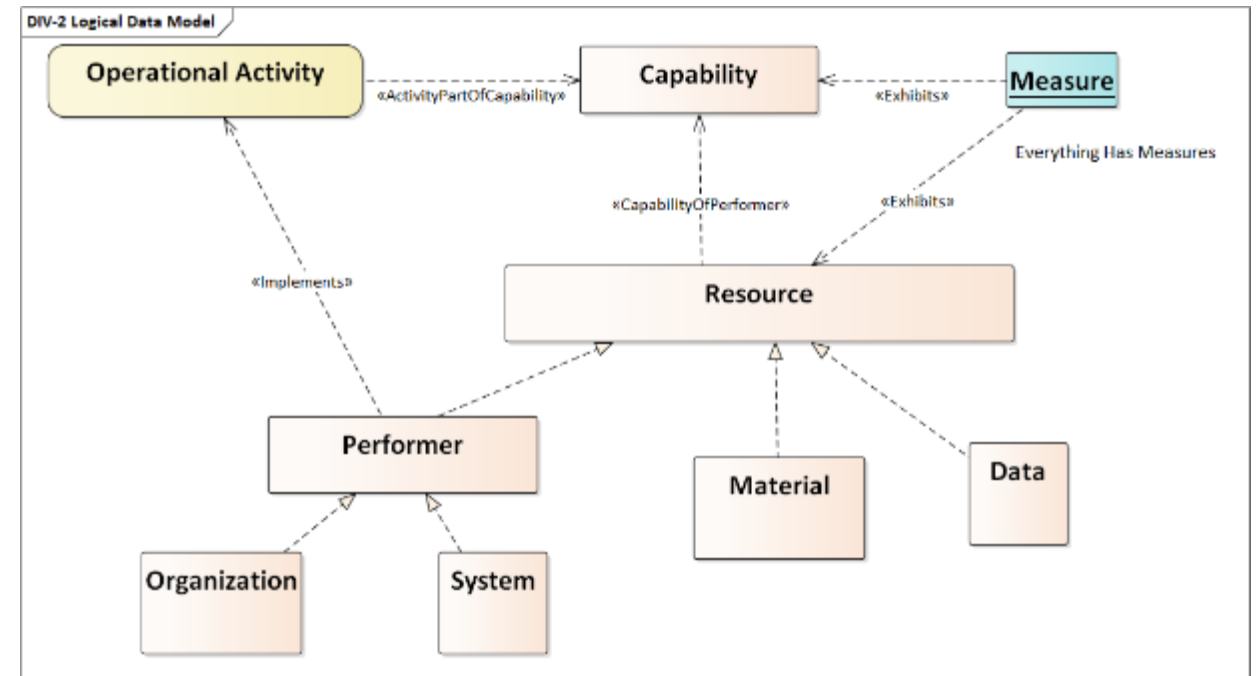
The DoDAF MetaModel (DM2)

DoDAF is an “...(O)vearching, comprehensive *framework and conceptual model* for architectural descriptions....” (DoDAF v2.02, Chng 1, Managers Guide)

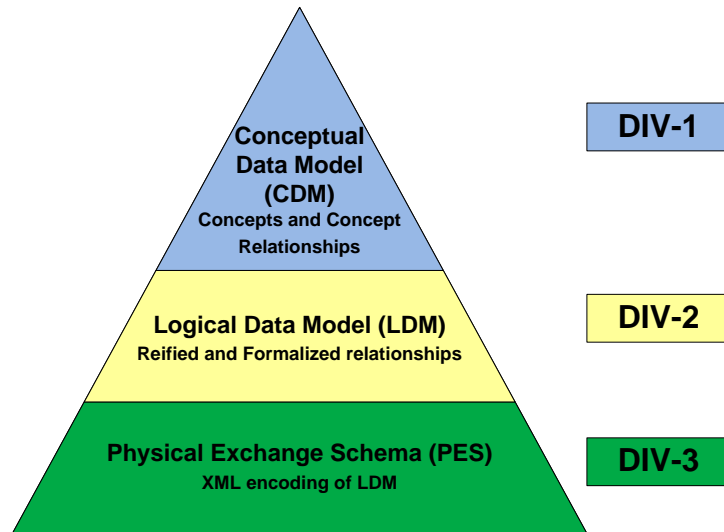
- Frameworks used to develop architectural descriptions (viewpoints)
- Conceptual model involves high-level data constructs supporting the architectural descriptions

DoDAF MetaModel (DM2)

- Establishes a basis for describing the relationship between architectural artifacts
- Used to build a set of strategic information about the architecture and are described in the DM2 Conceptual Data Model
- Forms the basis of defining data for the CBA and the NR-KPP



DM2 Conceptual Data Model
(Example)



❖ DIV-1 Conceptual Data Model (CDM)

- Description of the information flow between high-level resources in UPDM
 - OV-2 node connectivity
 - OV-5 activity diagrams
 - SV-2 communications descriptions

❖ DIV-2 Logical Data Model (LDM)

- Activity flow within the system model
 - SysML signals in activity diagram
 - SysML block operations in sequence diagrams
- Data at rest
 - SysML block attributes

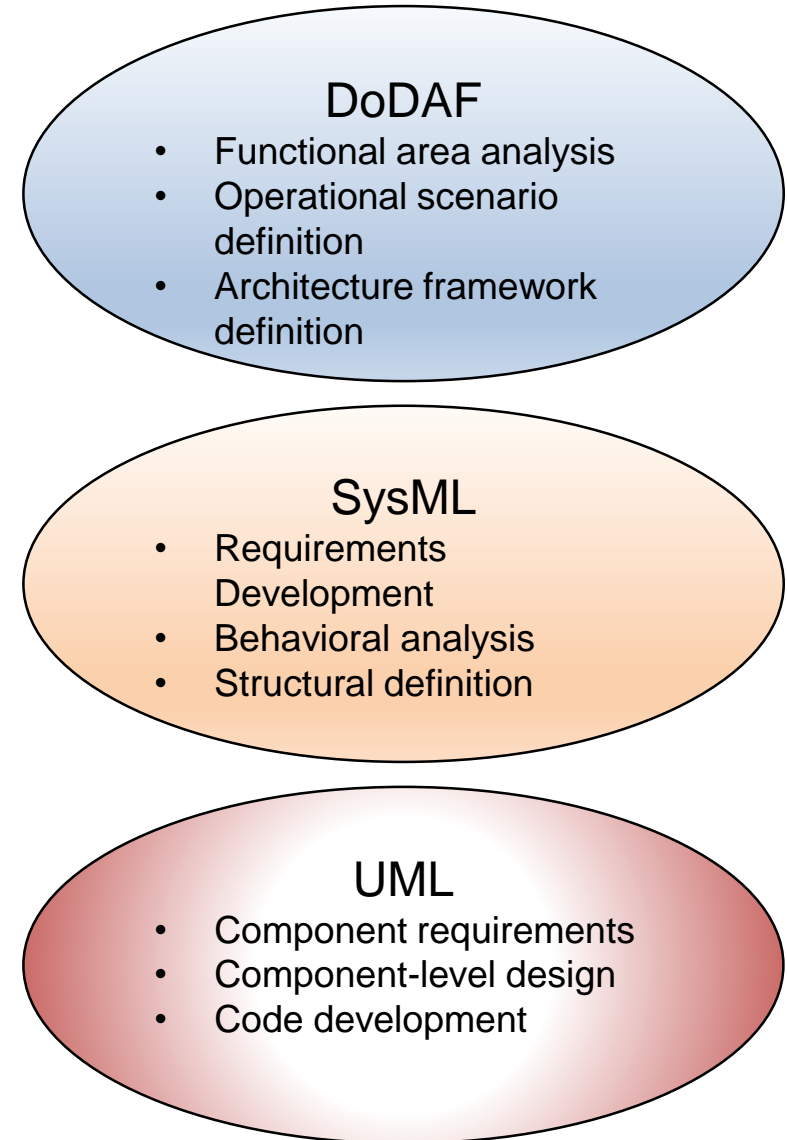
❖ DIV-3 Physical Exchange Schema (PES)

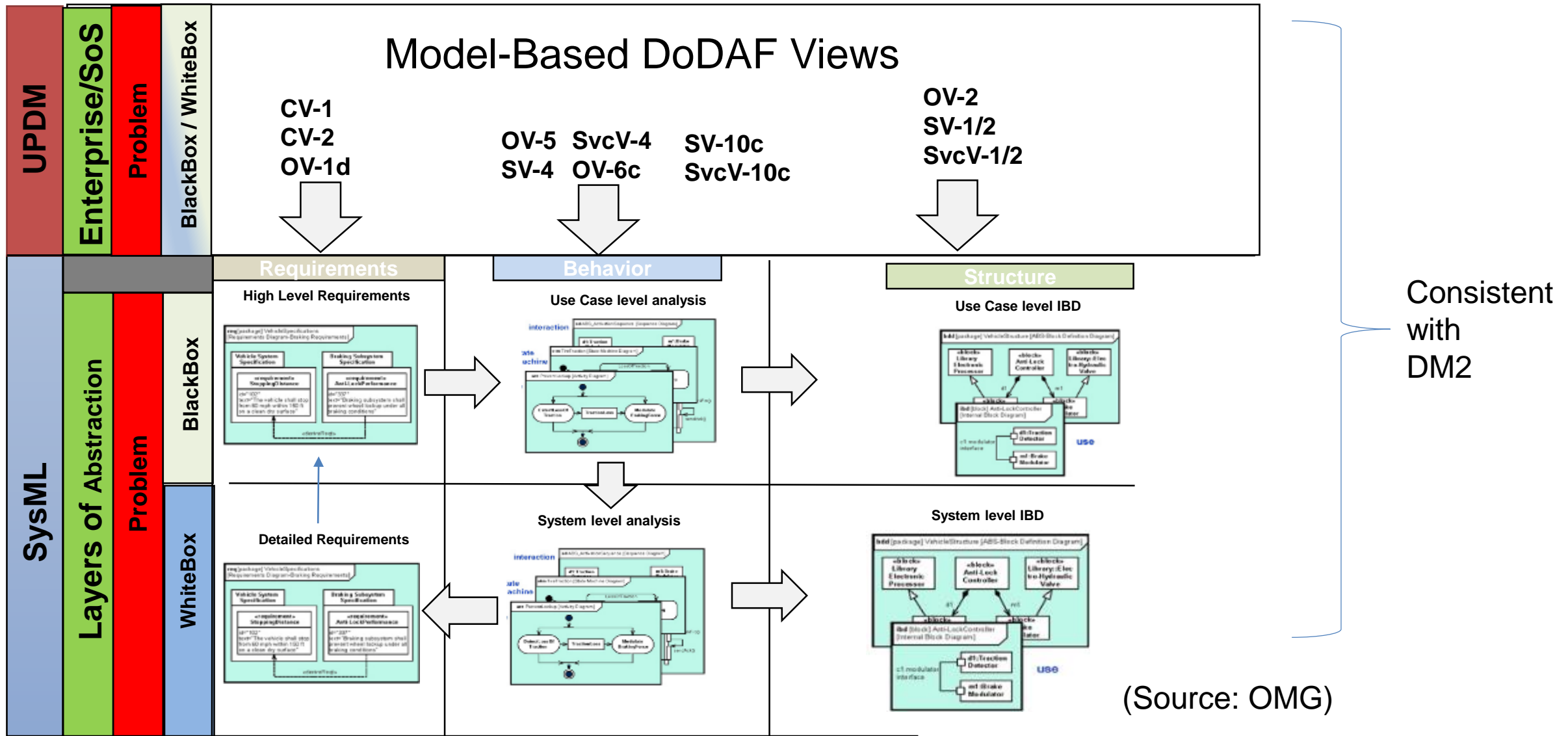
- Creating and using interface definitions (WSDL) for use in UML sequence and activity diagrams
- Creating (and importing) source code with the UML structural model

Data Traceability from
concept to
implementation

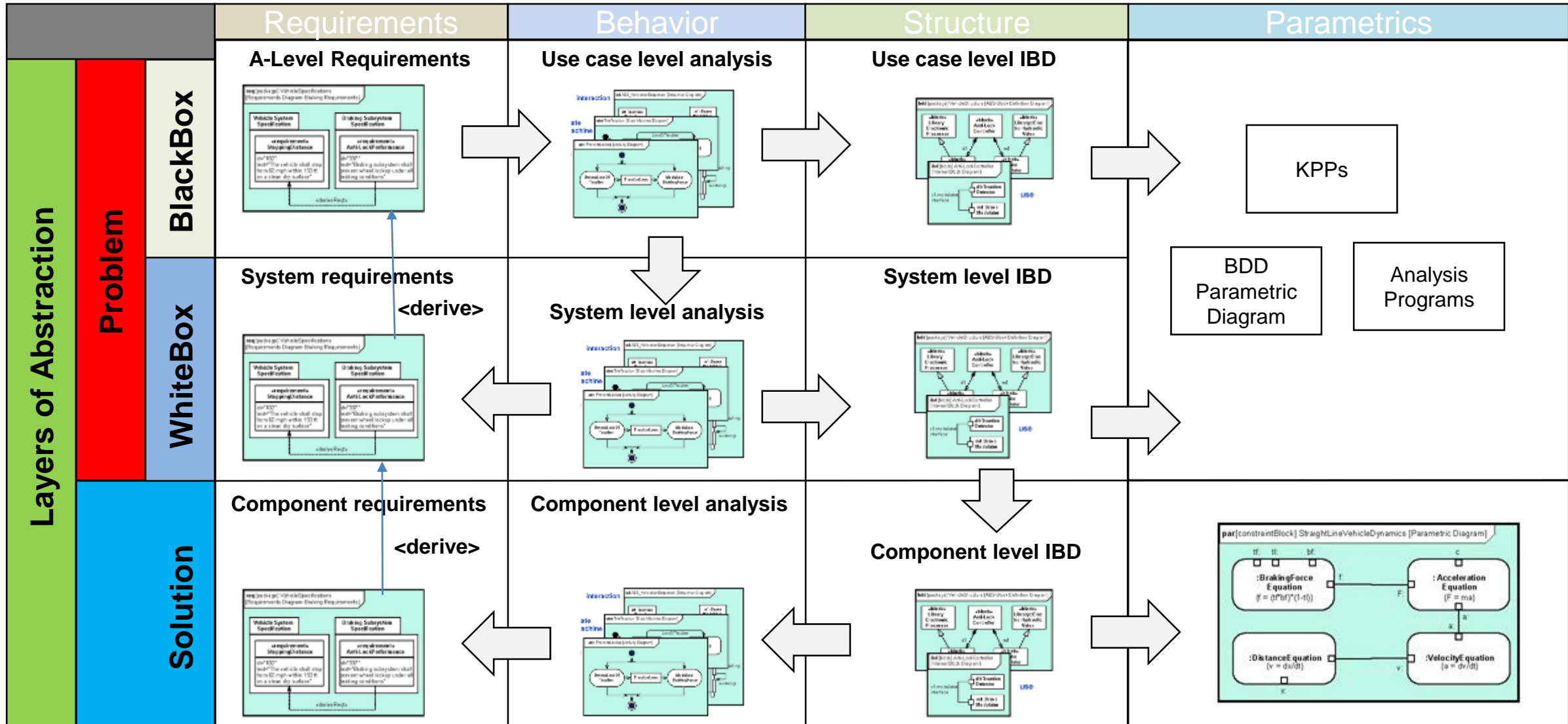
We are doing this now with Linked UPDM – SysML – UML models

- **Our tools provide profiles and perspective for working in all 3 domains**
- **The selected perspective not only “guides” the diagram creation, but also our mindset while modeling**
- **Mission domain (DoDAF views) speak to the stakeholder’s viewpoint**
- **Using the profiles and perspective for mission domain while working in the solution (system) domain does not focus on the correct level**
 - Functional system models are required by the software teams
 - Structural models are required by the hardware and integration teams
- **System modeling must be reused by other engineering disciplines**
 - Successful programs develop their system details in the model
 - Struggling programs develop their system details in the integration lab



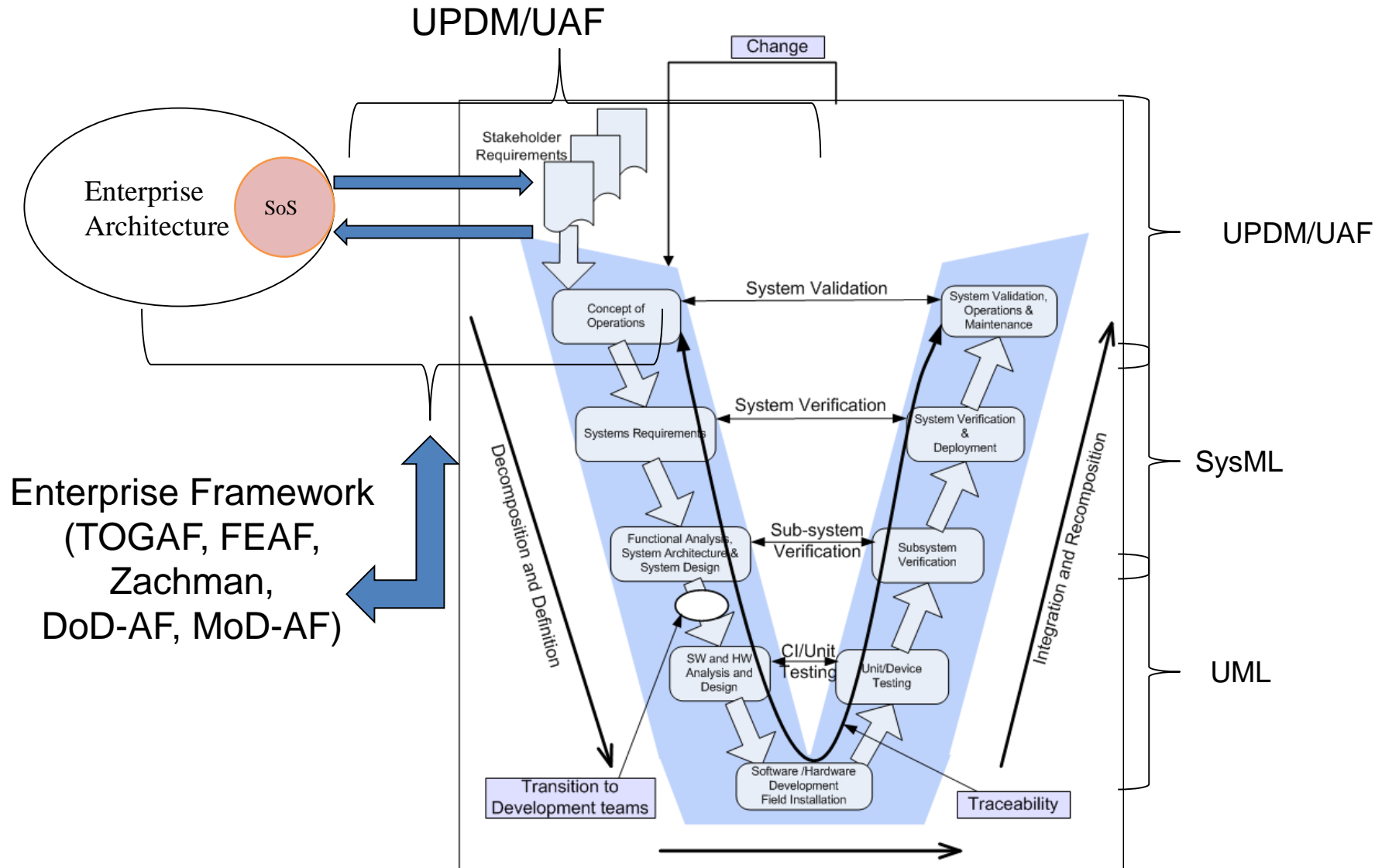


Alternative strategies (SysML to UML)



(Source: OMG)

Workflow consistent with systems engineering “VEE” diagram

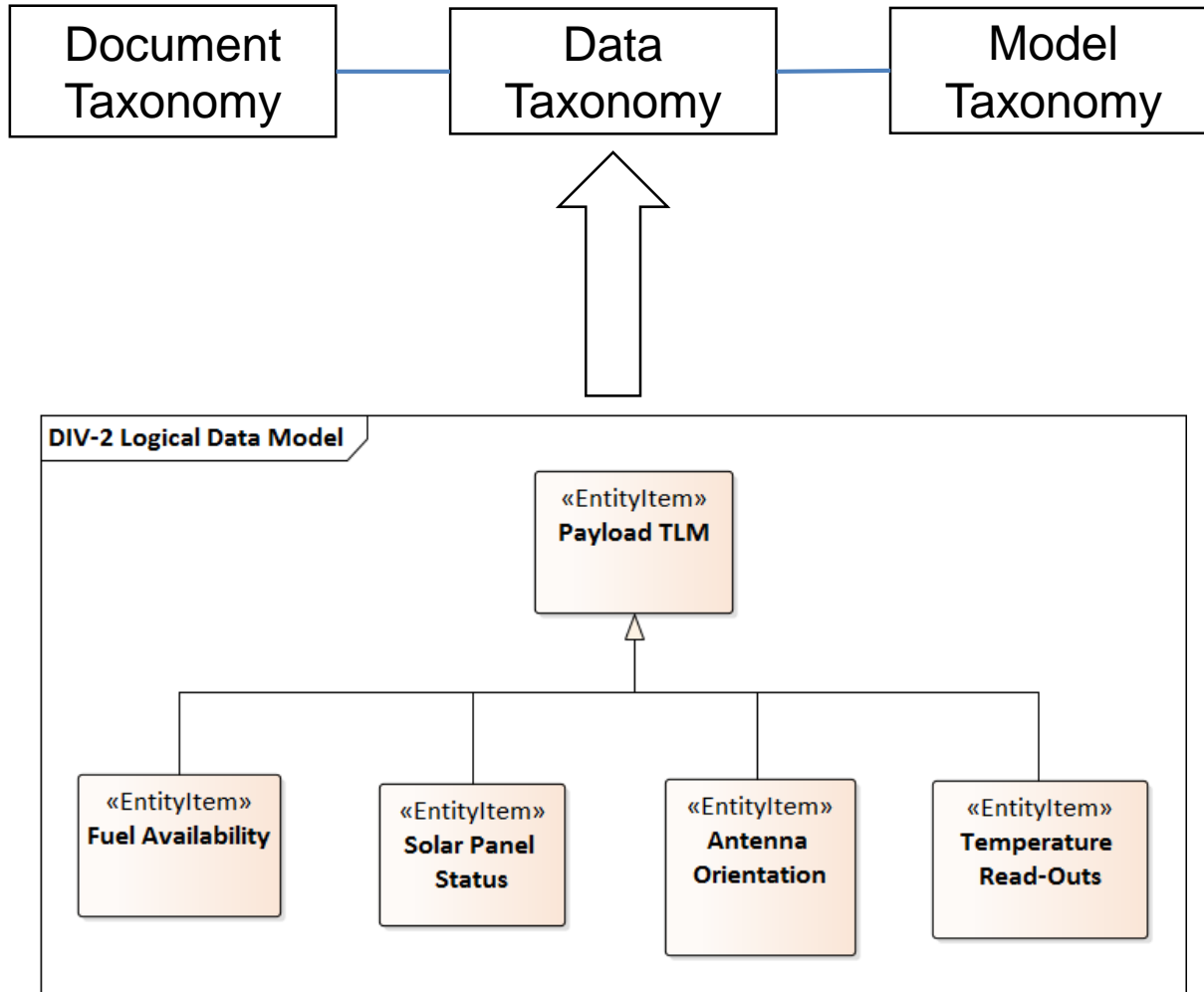


- ❖ Tier 1- Specifier: EA develop stakeholder views (DoDAF/MoDAF)

- ❖ Tiers 2 & 3 – Implementer: Functional requirements analysis, behavior analysis and system decomposition, system solution implementation

- An initiative developed and championed by Office of the Deputy Assistant Secretary of Defense for Systems Engineering (ODASD-SE)
- This initiative rebrands Model Based Engineering (MBE) and Model Based Systems Engineering (MBSE) to some extent. DE is basically the DOD chosen name for MBE
- DE Working Group (DEWG) represented by stakeholders of various segments of the acquisition community – (Program Executive Officers, Program Manager Engineering and Science and Technology components)
 - Promote DE principles throughout the services and in other government agencies
 - Explore ways to transfer traditional acquisition processes to a digital model-centric environment
 - Develop and implement the digital engineering concept across engineering functions and within the Defense Acquisition System
- Initiative is tool agnostic; emphasis is on integration of technical data employing a modeling ecosystem of varying tools

DE Initiative is encouraging increased MBE/MBSE use across the community

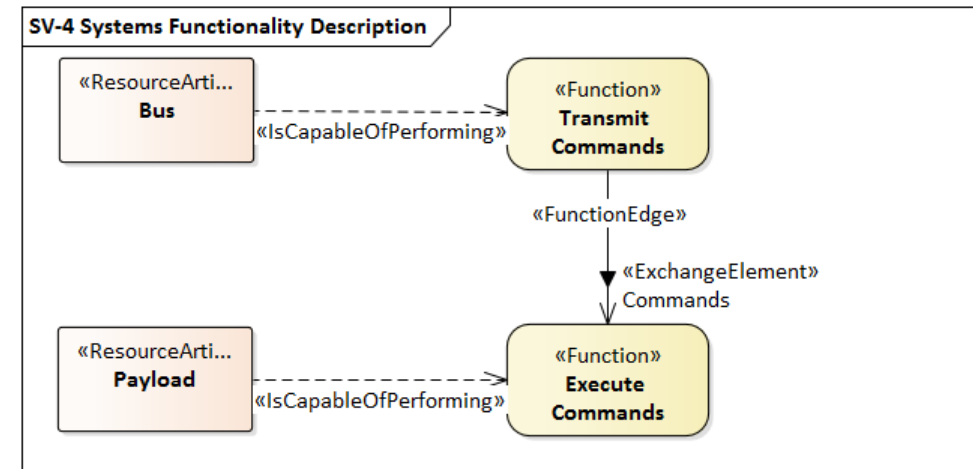


Model DM2

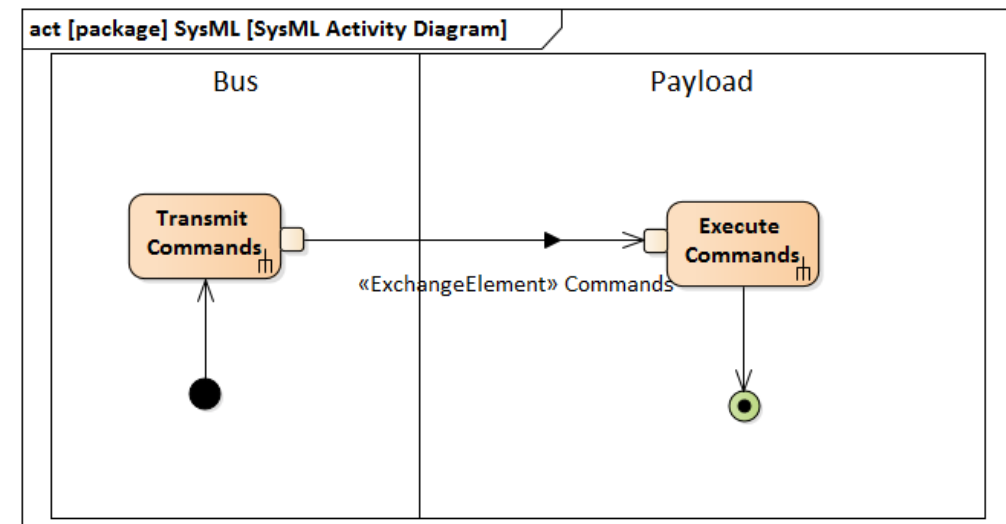
- DM2 can be used as an element of the data taxonomy
- DM2 represents data classes and data types organized in a consistent framework
- Each program should have a single, consistent DM2 compatible with all profiles in the model
- Data elements once defined can be reused, linked to information flows, and traced via model utilities
- Candidate presentations for model taxonomy:
 - Sequence of model views
 - Structural block definition diagrams as developed during modeling process

DoD guidance places DoDAF viewpoint mandates on Program Office, but gives discretion on details

- Seek to define architecture goals rather than specific DoDAF view requirements
 - Use modeling best practices
- Perform modeling in a tool using a profile-consistent database that will satisfy DM2 requirements
- Tailor required views based on consensus between Program Office and contractor
 - Produce an integrated architecture with consistent data, not just views
 - Focus program efforts on vision and system development vs. detailed CDRL
 - Permit the required views to be combined in documents as a single CDRL, e.g., Architecture Description Document
 - Avoid duplicative views (e.g., OV-6b vs SV-10b)
- Build views using appropriate modeling language but in a consistent environment



DoDAF SV-4



SysML Activity Diagram

Industry has made significant progress in model since DoDAF 2.02 roll out

- DoDAF 2.02 was the last published direction from OSD-CIO
- Industry (OMG lead, tool vendors cooperating) is making necessary changes and defining consistent representations of DoDAF views
- Continued efforts at joint industry-USG architecture development; example, DE Initiative

CJCSI 6212.01 (cancelled) goals are now in CJCSI 3170.01I and the JCIDS Manual. These goals can be met in heterogenous model environments.

- DM2 PES XML schema (XSD) provides a neutral format for data exchange
- Limits exist among the tools during import (views lose layout, folder hierarchy lost)

CJCSI 3170.01 now drives DoDAF view and similar artifact inclusion

- CJCSI 3170.01 now invokes DoDAF views from several topic areas and programmatic needs within the context of the entire list of required program documentation
- There needs to be negotiations between customer and contractor as to acceptable alternatives to DoDAF views and where they may be used

Issues with use of UPDM/UAF at all levels of architecting

- Can be done but there are challenges
- Different Architectural levels have different abstractions and relationships
- Model representations may not be preferred by practitioners at all architectural levels

Technical alternatives

- Separate models with import/export integration
- Common model with individual profiles for appropriate architectural levels

Tailoring of CDRLS

- Accept equivalent diagrams from other models in place of DoDAF views (i.e., SysML)

Policy changes

- Relax rigidity on use of DoDAF views in favor of accepting SysML diagrams as tailored CDRL equivalents
- Negotiate format of MBSE artifacts; support customer needs versus contractor needs