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A pattern based approach to the development of UPDM Architectures

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Rational. Software

Agenda

- This presentation will cover
  - UPDM and a common approach to architecture
  - Viewpoint commonality
  - Identify the main viewpoints relevant for the Enterprise Architecture and Systems Engineering phases of development
  - Show the patterns across the views and viewpoints
  - Generic workflow
  - Relating UPDM architectures to SysML and UML

Note:- I am not getting into an ISO 42010 discussion on the terms Viewpoint and View

What is UPDM ?

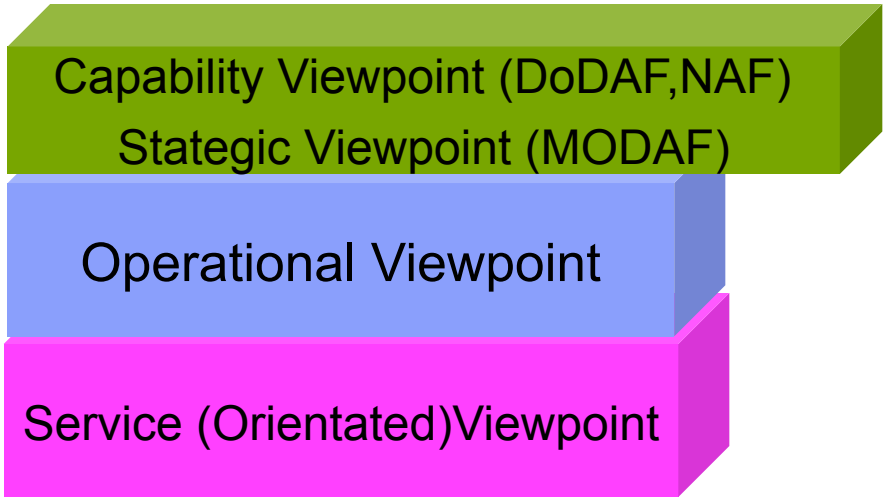
- Unified Profile for DoDAF and MODAF
  - It is not a new a framework
  - It is the implementation in UML/SysML of the metamodels that underpin DoDAF, MODAF and NAF
  - Defines a common standard metamodel to bring together MODAF, DoDAF and NAF
- The intent being to help interoperability between
  - Architectures
  - Government agencies
  - Military agencies
  - Customers and Suppliers
  - Provides a common standard to express the architectures used in these domains
- Relating Enterprise Architecture to Solution Architecture to Systems Architecture to Software
- I am aware that it is not perfect !

How does UPDM deal with commonality ?

- Uses a common core metamodel with some specialisations for DoDAF and MODAF
  - Approximately 90 % is core
  - Provides a mapping table between elements for the different frameworks
- Presentation layer is kept separate i.e. the views
  - Provides a mapping between the common DoDAF, MODAF and NAF views
- People get caught up with the names of the views and elements rather than what they are trying to do
  - They do not look behind the covers

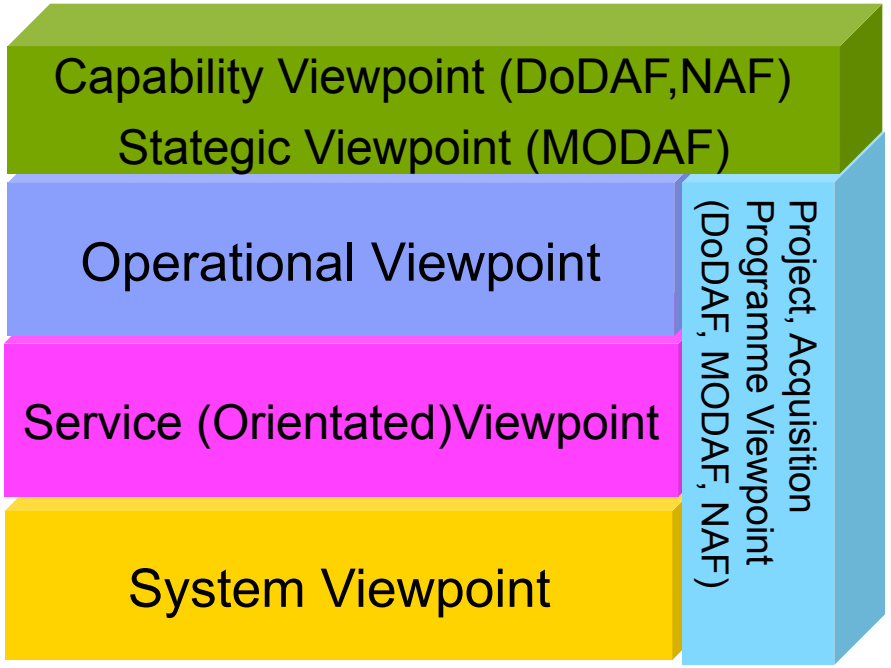
Viewpoint commonality

- Capability, Strategic Viewpoint:- Capture the capabilities that the enterprise is expected to realise, defines them and shows how they are deployed to organizations
- Operational Viewpoint:- Contains the views required to describe the Operational, Organisational and high level functional aspects of the architecture
- Service (Orientated) Viewpoint:- Captures the views required to specify of the Services (i.e. interface, no implementation) required to support the Operational objectives of the architecture



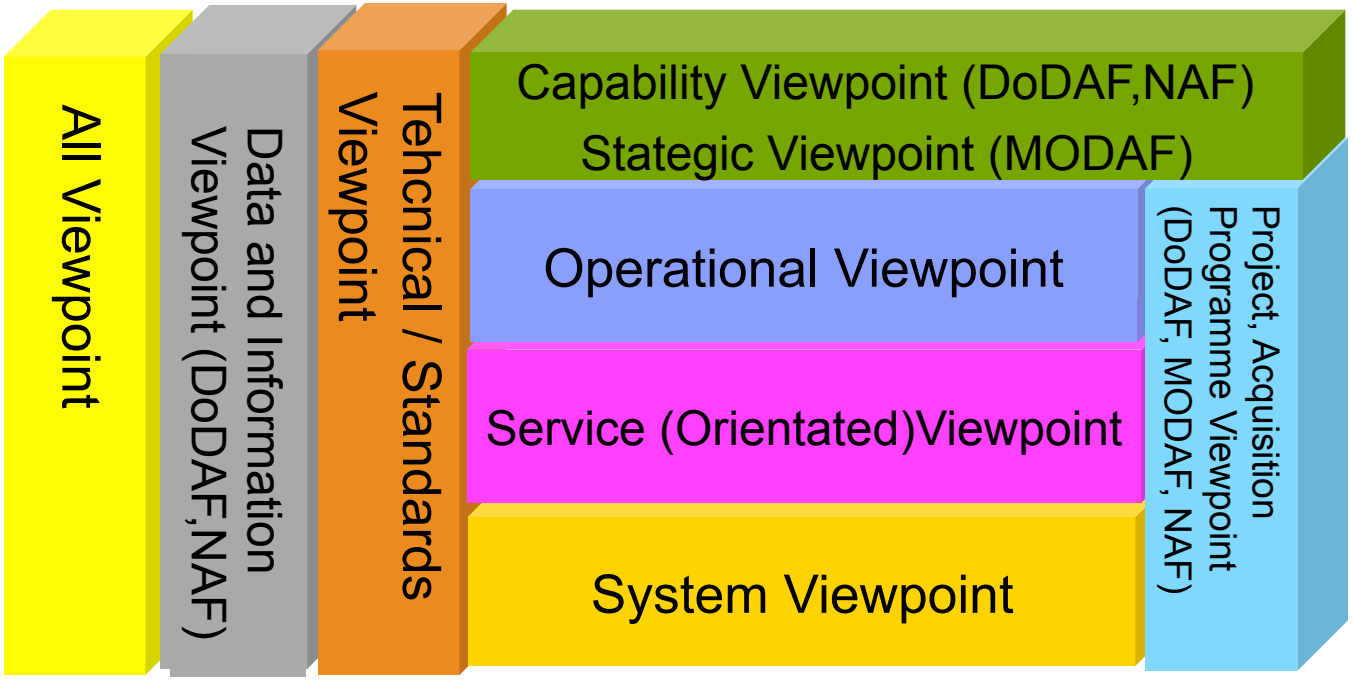
Viewpoint commonality

- Systems Viewpoint:-Captures the specification of the Systems that are required to be implemented or that already exist that help achieve the operational objectives
- Project, Programme and Acquisition Viewpoint:- Maps the enterprises to the projects and organisations that will realise the capabilities through the development of systems and services



Viewpoint commonality

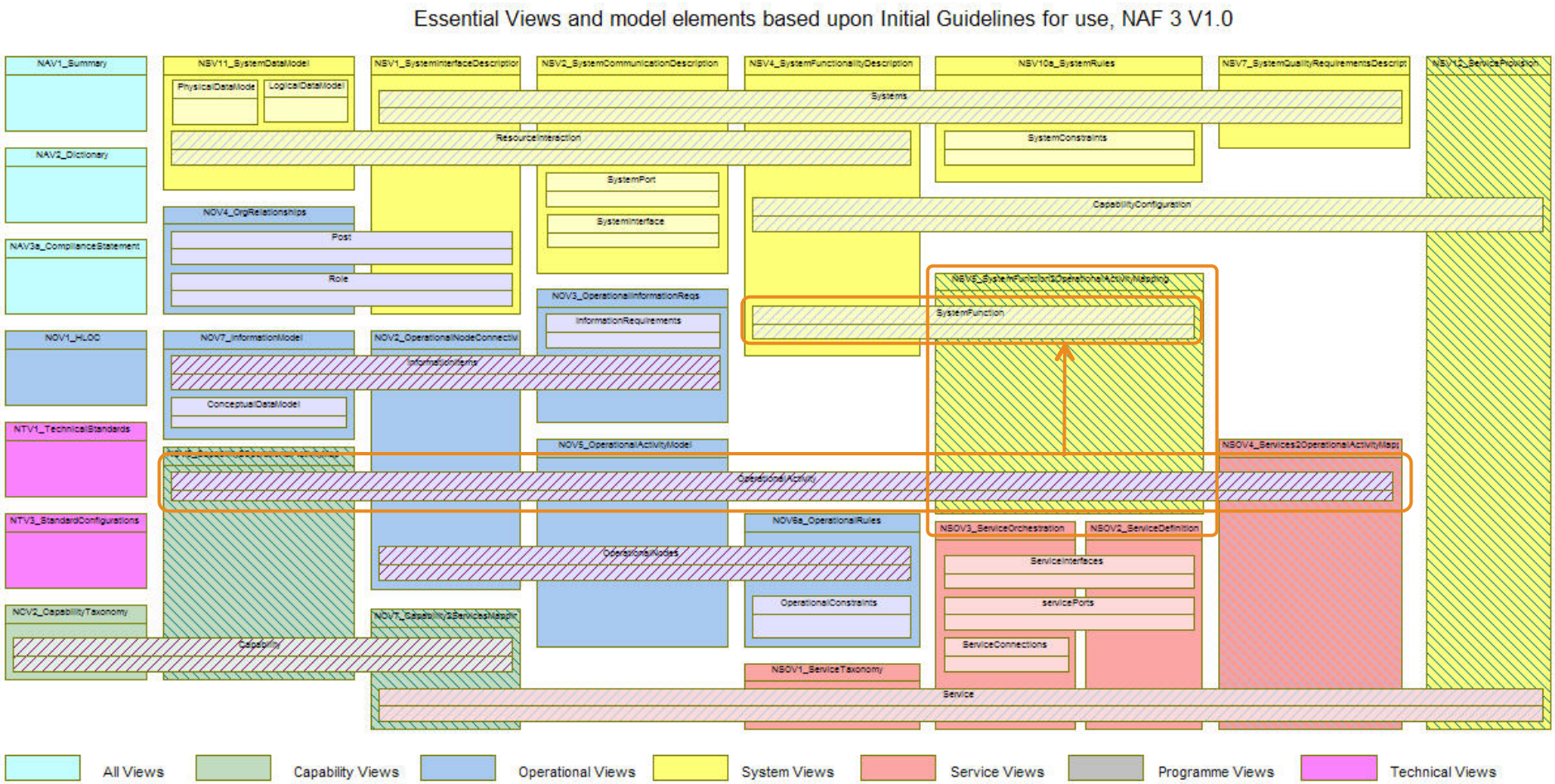
- Technical/Standards Viewpoint:-Contains all the information relating to the standards that constrain the other 3 viewpoints
- Data and Information Viewpoint:- Refactoring of views that already existed, used to define data and information concepts used in the other viewpoints
- All Viewpoint:- Contains the summary information about the architecture being developed including the data dictionary



Model Element interaction Across Views (NAF)

Separation of Elements and Views/Viewpoints

- Some elements seen in multiple views
- Some views ties the viewpoints together e.g. SV-5



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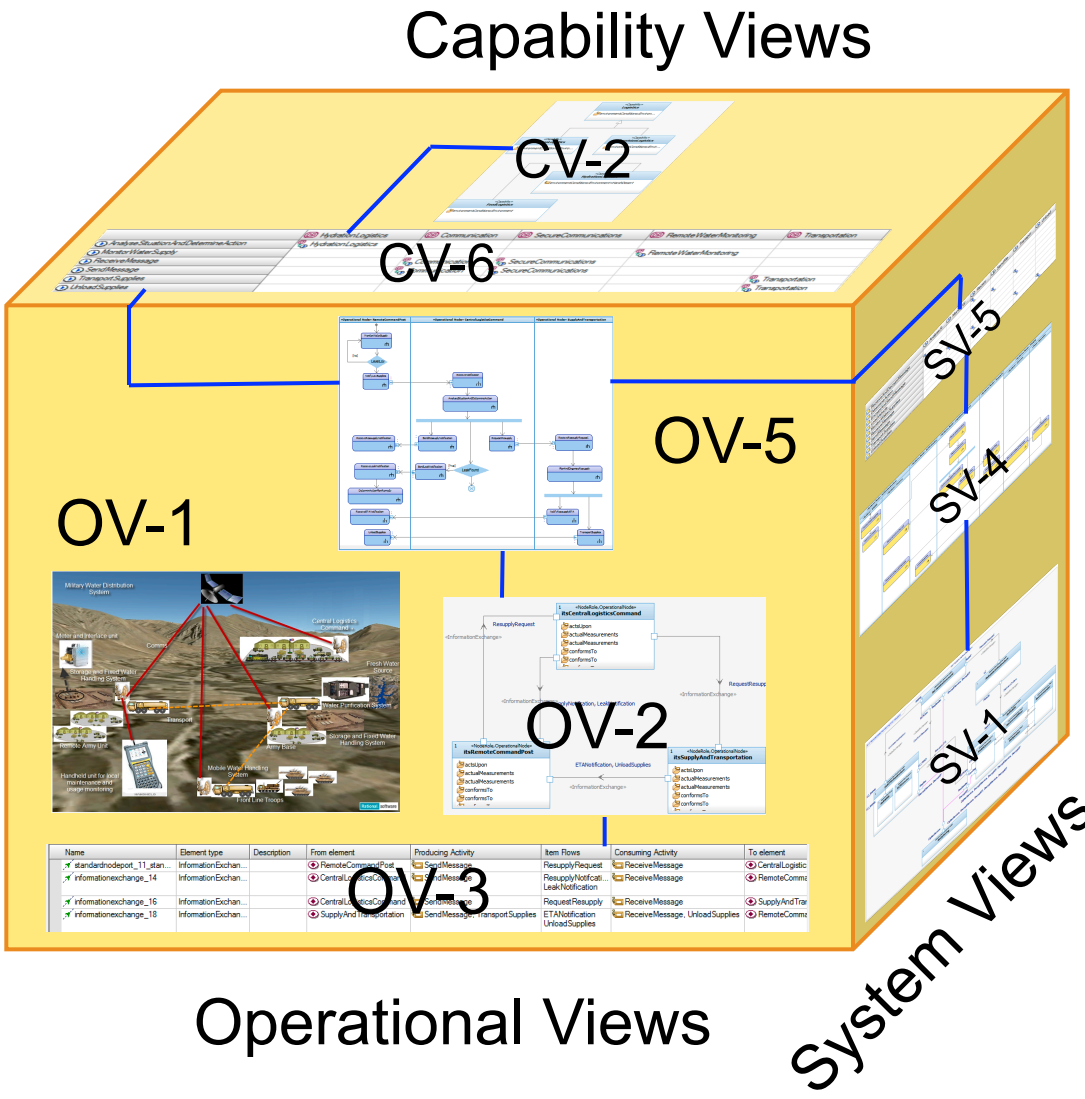
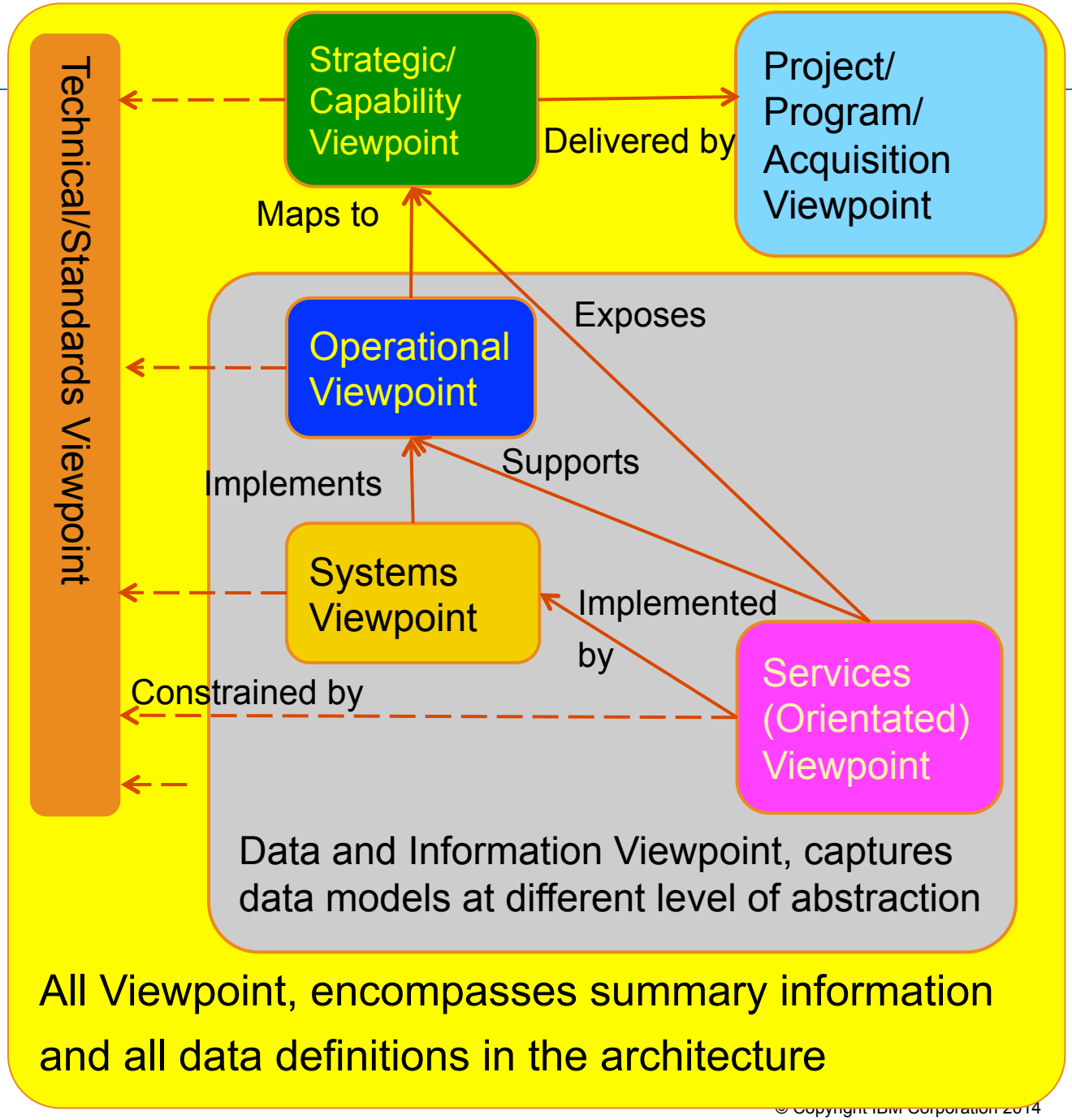
View and Viewpoint interrelationships (DODAF)

- The Viewpoints are not independent but are heavily interrelated
- Each face of Cube represents a viewpoint
- Each window a separate view or product
- Model Elements internal to cube used by multiple views
- Views can act as
  - Filters on the information in the architecture (OV-3, SV-5)
  - Diagrams allowing you to create the information that populates the architecture (SV-1, OV-2)



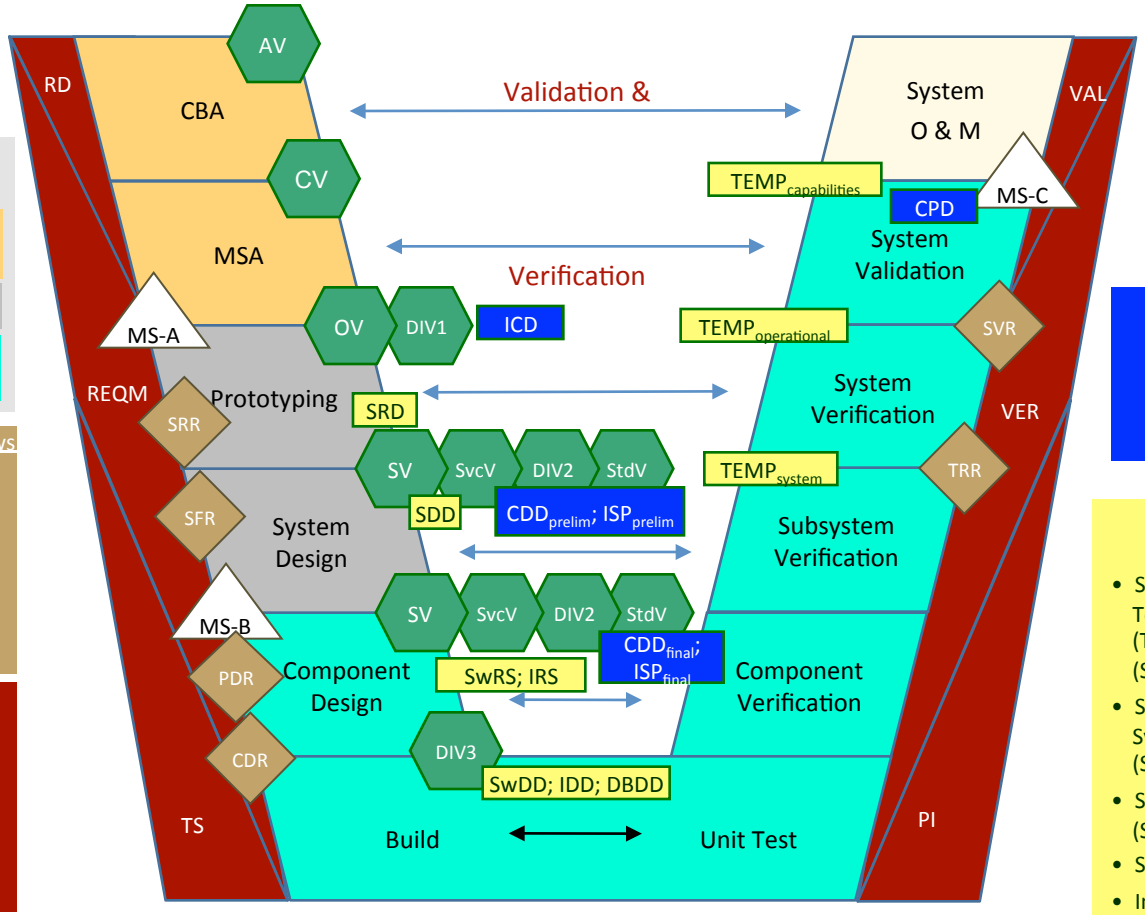
Viewpoint relationships

- These are AFs are a set of traceability matrices
  - Systems and Services support and implement Operational elements
  - Services expose capabilities (service as an interface)
  - Operational elements (activities) map to capabilities
  - Capabilities are delivered by Projects
  - Systems and Services are the realized by projects
  - Everything constrained by standards
- These relationships are captured in the various matrix views



Systems Engineering and Architecture Harmonization and Efficiency

- Slide Courtesy of Dave McDaniels



Notional Systems Development "V"

Acquisition Model Decisions & Milestones

- Capabilities Based Assessment (CBA)
- Material Solutions Analysis (MSA)
- Technology Development (TD)
- Engineering & Manufacturing Development (E&MD)

System Engineering Technical Reviews

- System Requirements Reviews (SRR)
- System Functional Reviews (SFR)
- Preliminary Design Reviews (PDR)
- Critical Design Reviews (CDR)
- Test Readiness Review (TRR)
- System Verification Review (SVR)

Process Areas

- Requirements Development (RD)
- Requirements Management (REQM
- Technical Solution (TS)
- Product Integration (PI)
- Verification (VER)

DoDAF Viewpoints

- All (AV)
- Capabilities (CV)
- Operational (OV)
- Data / Information (DIV)
- Systems (SV)
- Services (SvcV)
- Standards (StdV)

ICIDS Documents

- Initial Capabilities Doc (ICD)
- Capabilities Design Doc (CDD)
- Capabilities Production Doc (CPD)
- Information Support Plan (ISP)

Typical Systems Engineering Work Products

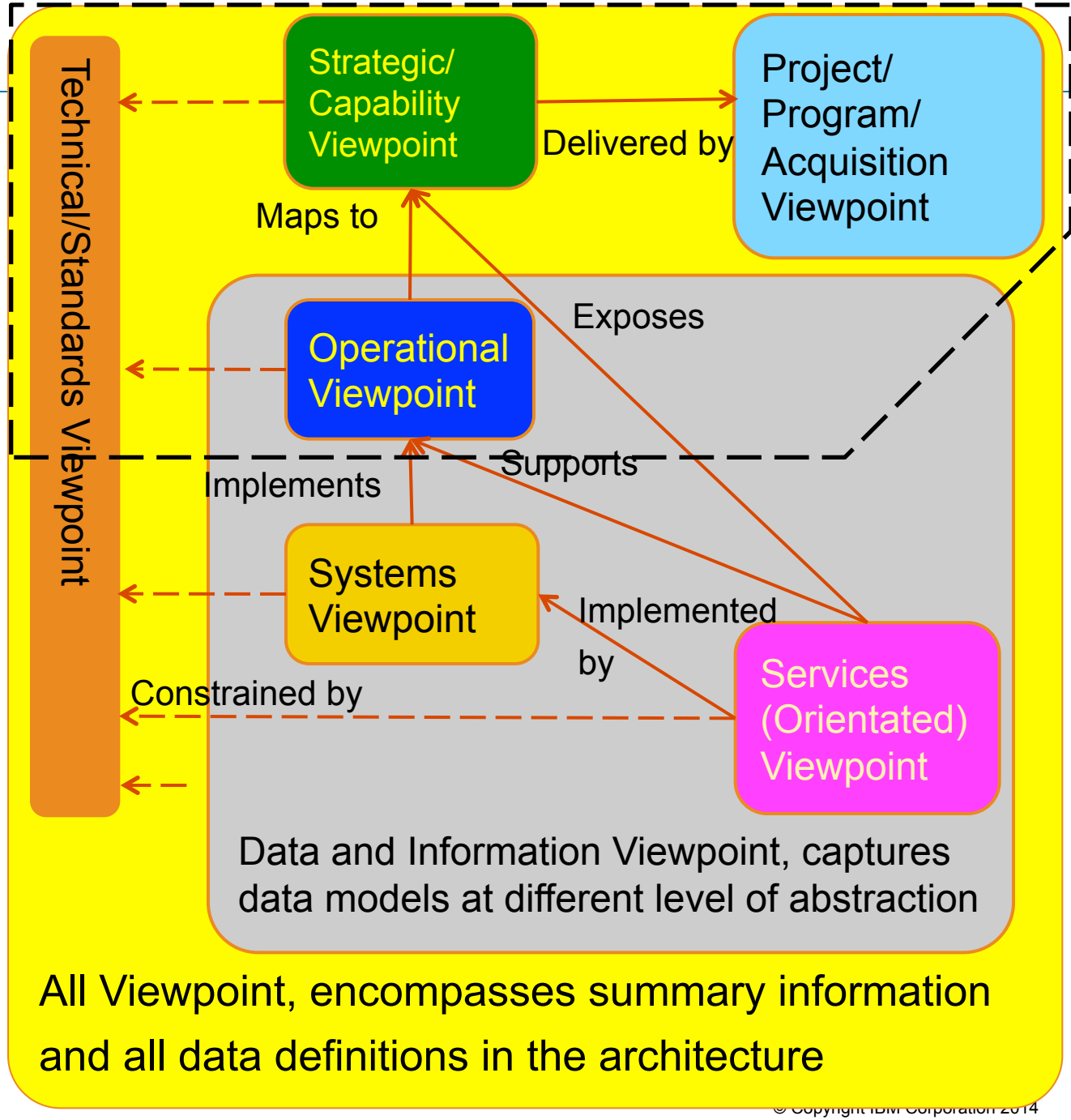
- System Requirements Document (SRD) / Technical Requirements Document (TRD) / System Segment Specification (SSS)
- System Design Document (SDD) / System Segment Design Document (SSDD)
- Software Requirements Specification (SwRS)
- Software Design Document (SwDD)
- Interface Requirements Specification (IRS)
- Interface Control Document (ICD) / Interface Design Document (IDD)
- Data Base Design Document (DBDD)
- Test and Evaluation Master Plan (TEMP)

Enterprise Views

Used by
- Planning
- JCIDS
- Operations
- Portfolio management

For
- Capability management
- Operations Planning
- Develop High level requirements for prime suppliers

Still need the
- All view,
- Standards view
- Parts of the Data and Information view



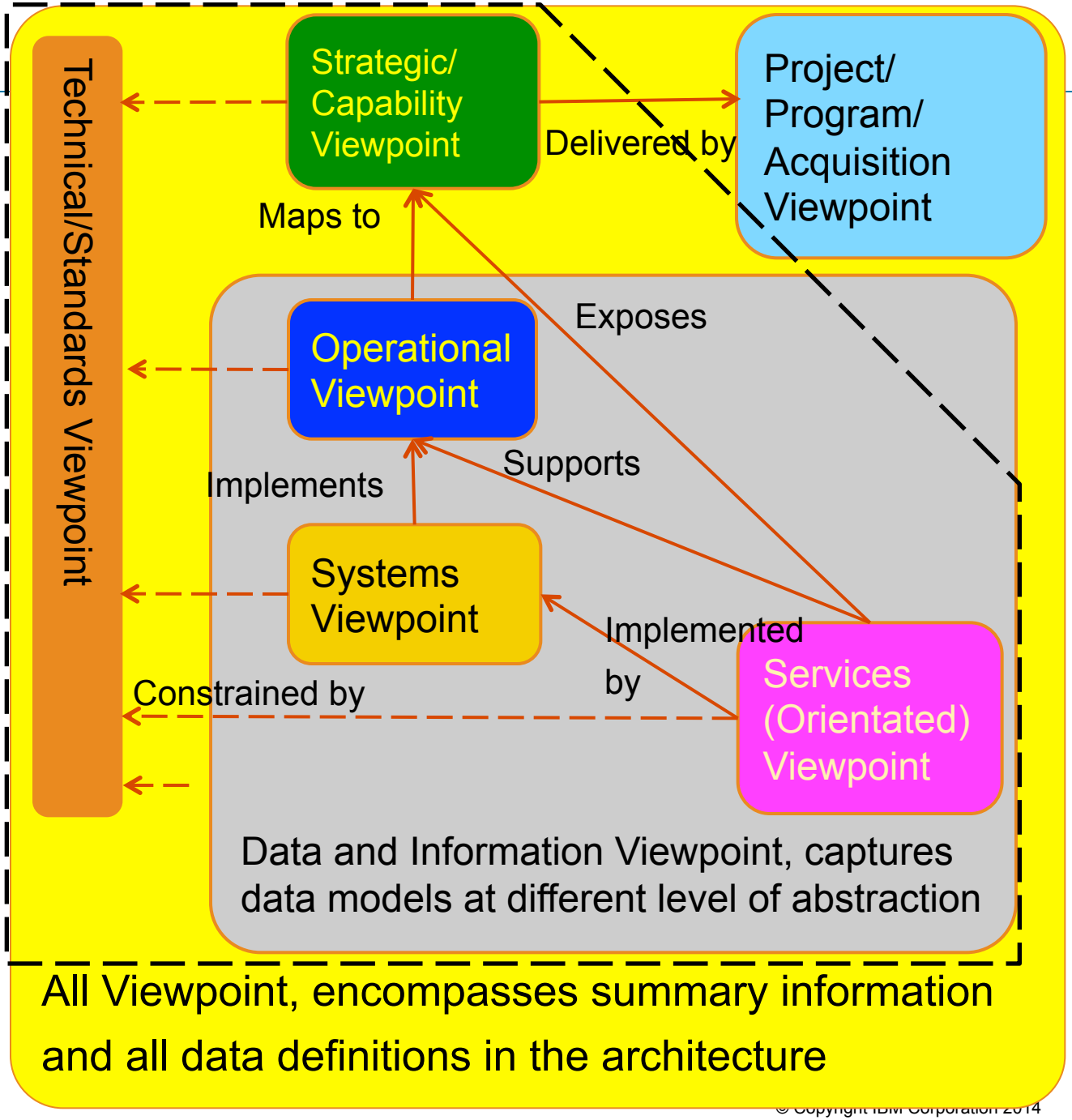
Solution Architecture Systems Engineering Views

Used by

- Portfolio management
- Operations planning
- Defense Acquisition System
- Systems Engineering teams
  - In forces
  - Primes/Tier ones
- Provides requirements to engineering teams

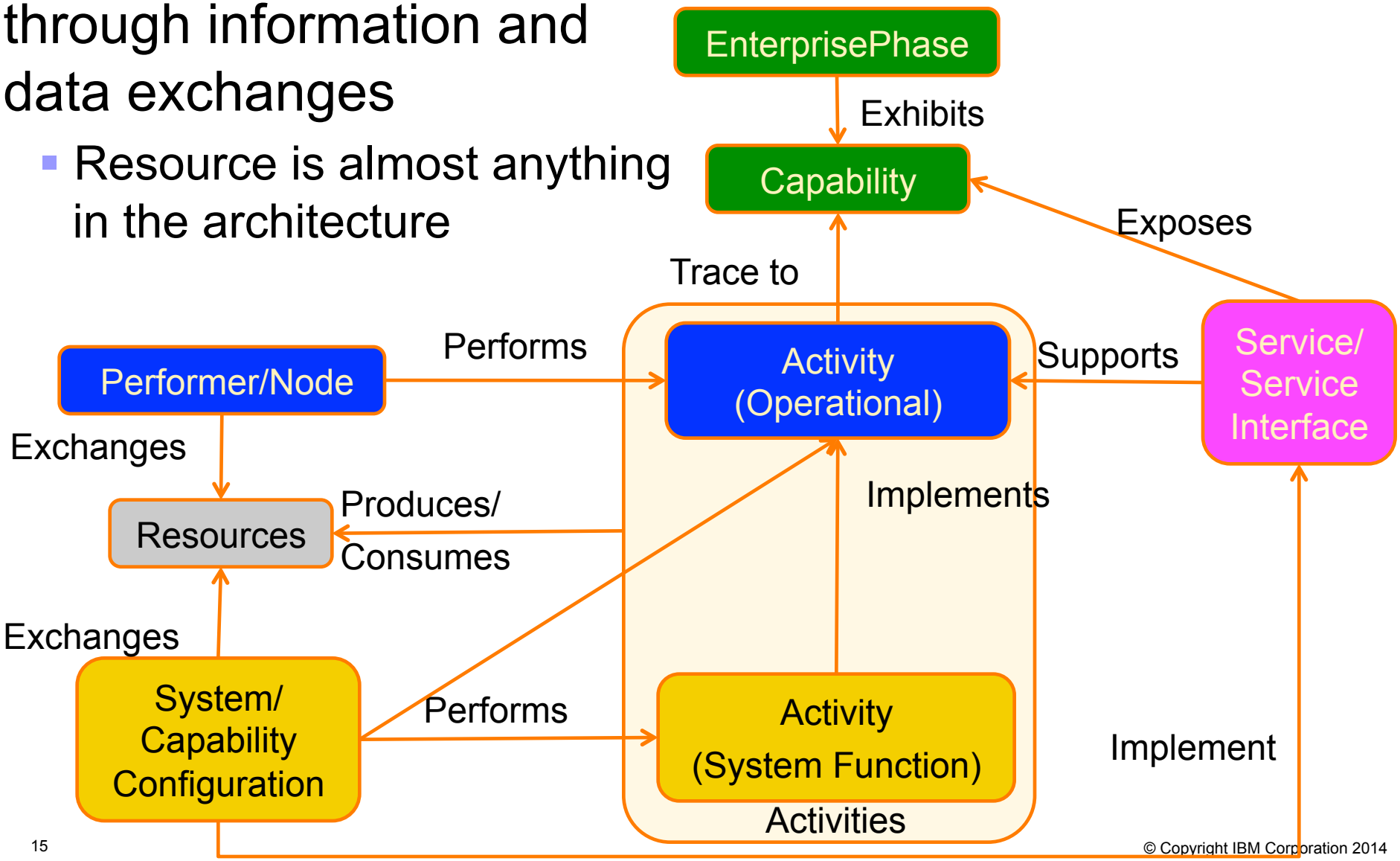
Still need the

- All view,
- Standards view
- Parts of the Data and Information view



Key relationships for Systems Engineering

- Resources exchanged through information and data exchanges
  - Resource is almost anything in the architecture



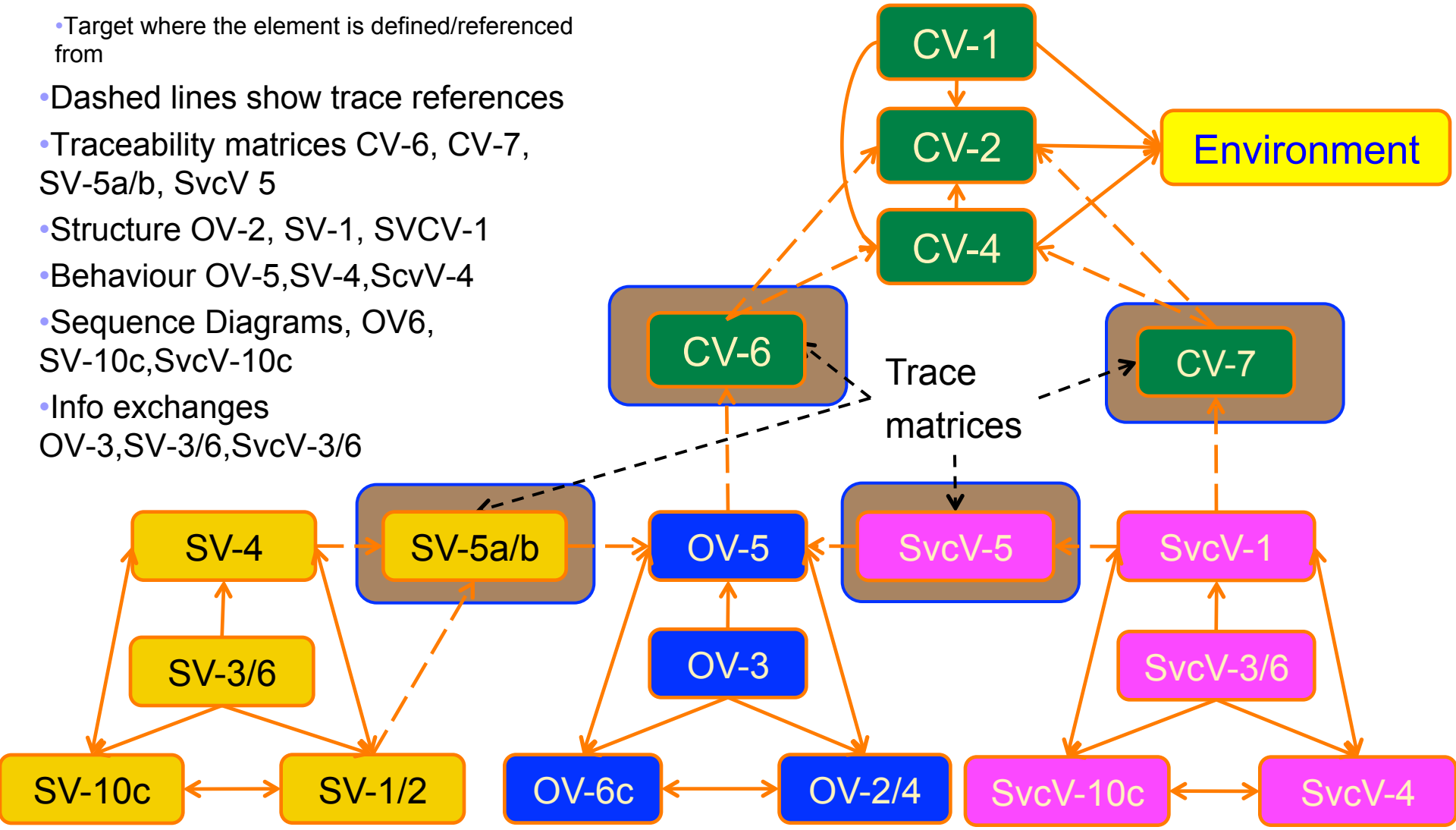
View Patterns in the Framework (DoDAF)

Capability

Operational	Systems	Services	Represented in UPDM as
OV-2	SV-1/2	SvcV-1/2	Structure (definition, instance) (BDDs & IBDs)
OV-5	SV-4	SvcV-4	Behaviour (activity diagrams)
OV-6b	SV-10b	SvcV-10b	Behaviour (statemachines)
OV-6c	SV-10c	SvcV-10c	Behaviour (sequence diagrams)
OV-3	SV-3/6	SvcV-3/6	Data exchange Summaries (Table/Matrix views)
CV-6/7	SV-5a/b	SvcV-5a	Traceability matrices

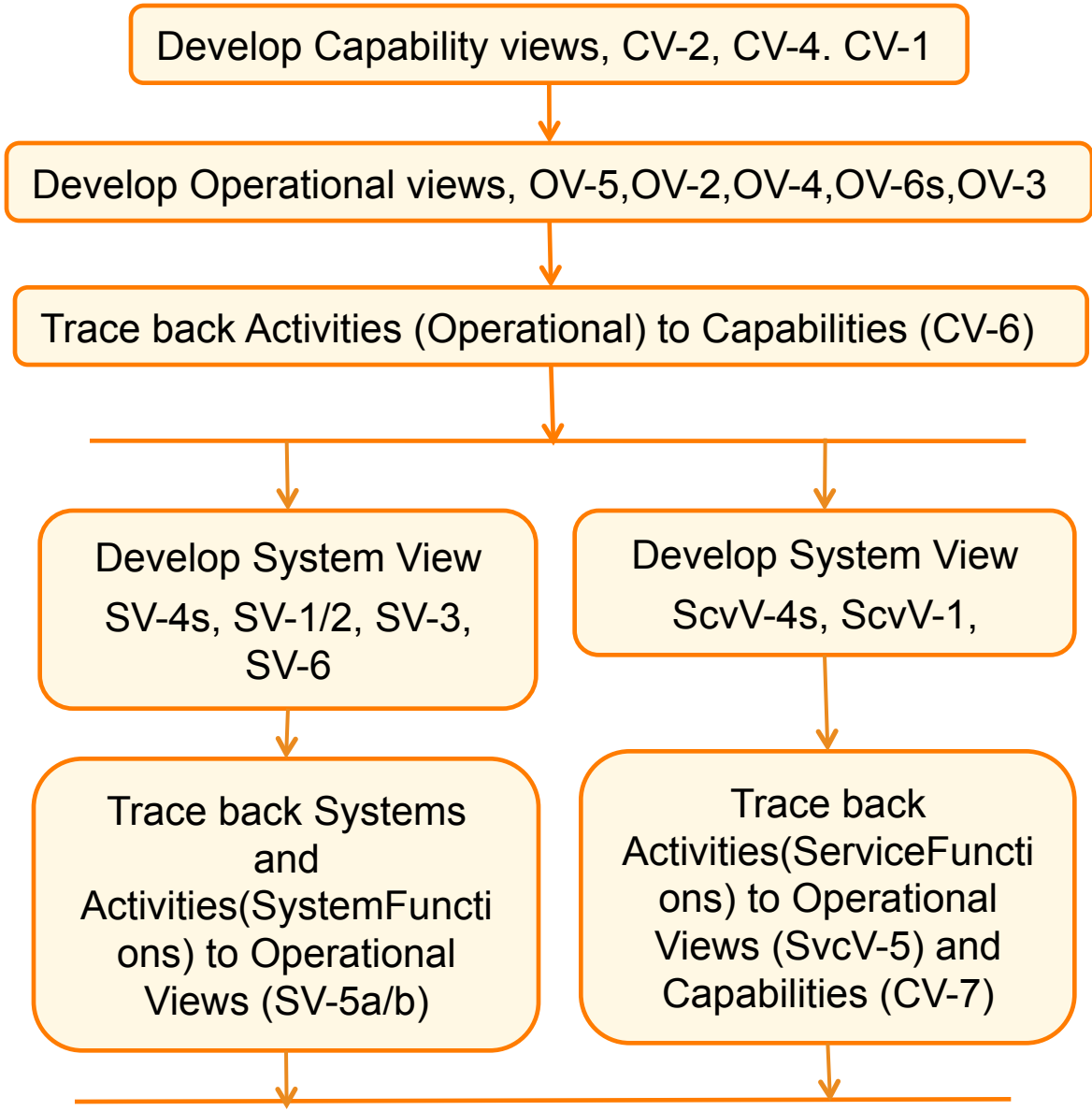
Key View dependencies for systems engineering

- Solid arrows show
  - Source where element is shown
  - Target where the element is defined/referenced from
- Dashed lines show trace references
- Traceability matrices CV-6, CV-7, SV-5a/b, SvcV 5
- Structure OV-2, SV-1, SVCV-1
- Behaviour OV-5,SV-4,ScvV-4
- Sequence Diagrams, OV6, SV-10c,SvcV-10c
- Info exchanges OV-3,SV-3/6,SvcV-3/6



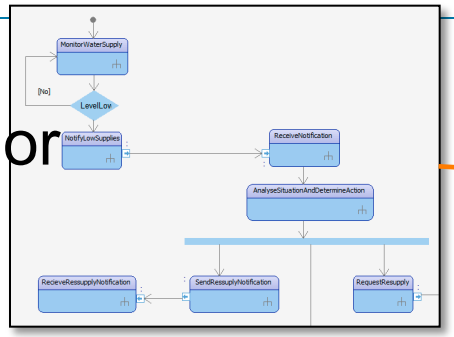
High level workflow (core)

- Develop capability views
  - Enterprise visions
  - Capability hierarchy and dependencies
- Develop Operational views
  - Behavior, structure,
  - Derive data exchange matrices
  - Trace back to capabilities
- Develop systems/service views
  - Behavior, structure,
  - Derive data exchange matrices
  - Trace back
    - Systems to operations that they implement
  - Trace back Services to the
    - Operations they support
    - Capabilities they expose



The generic workflow applied to the OVs

Step-1 BlackBox behavior



Step-3 Allocate behavior to structure (WhiteBox)

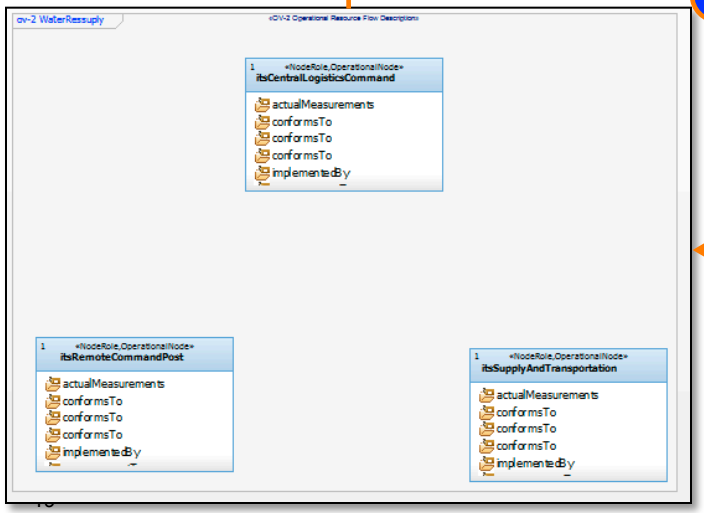
OV-5

OV-3

OV-2/ 4

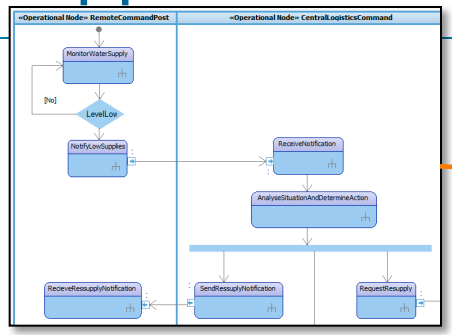
OV-6 c

Step-2 Define Structu

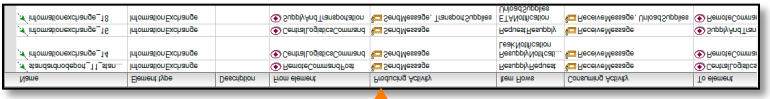


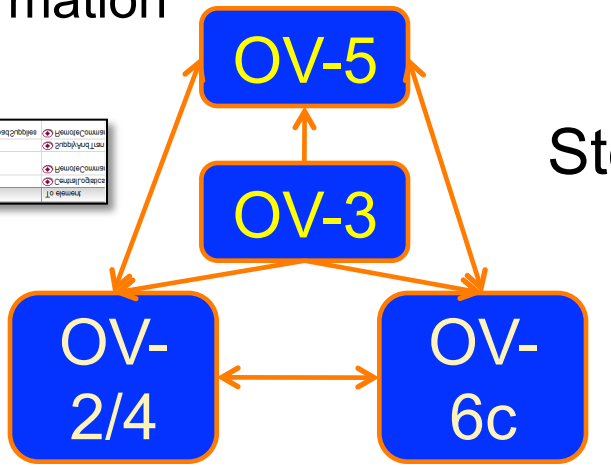
The generic workflow applied to the OVs

Step-3 Allocate behaviour to structure (WhiteBox)

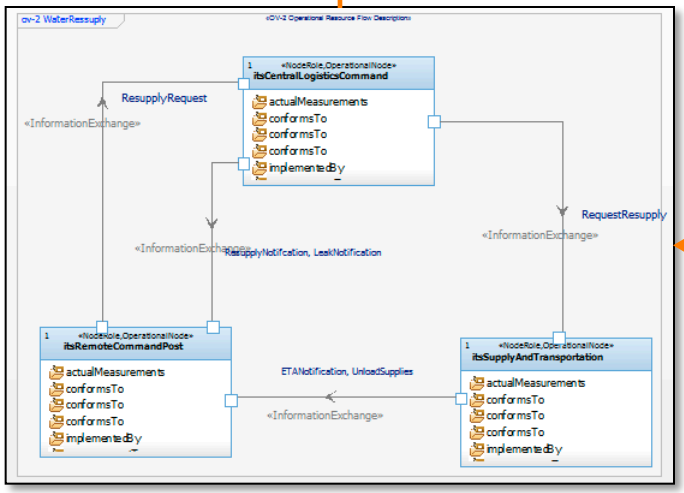


Step-6 generate OV-3 Information exchange summary

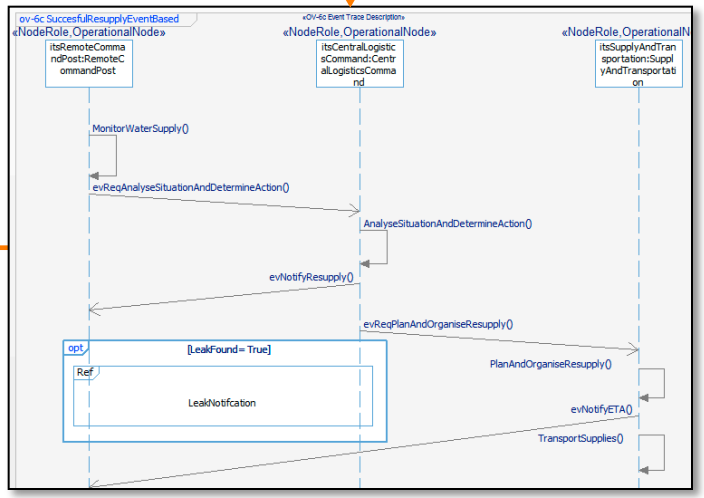




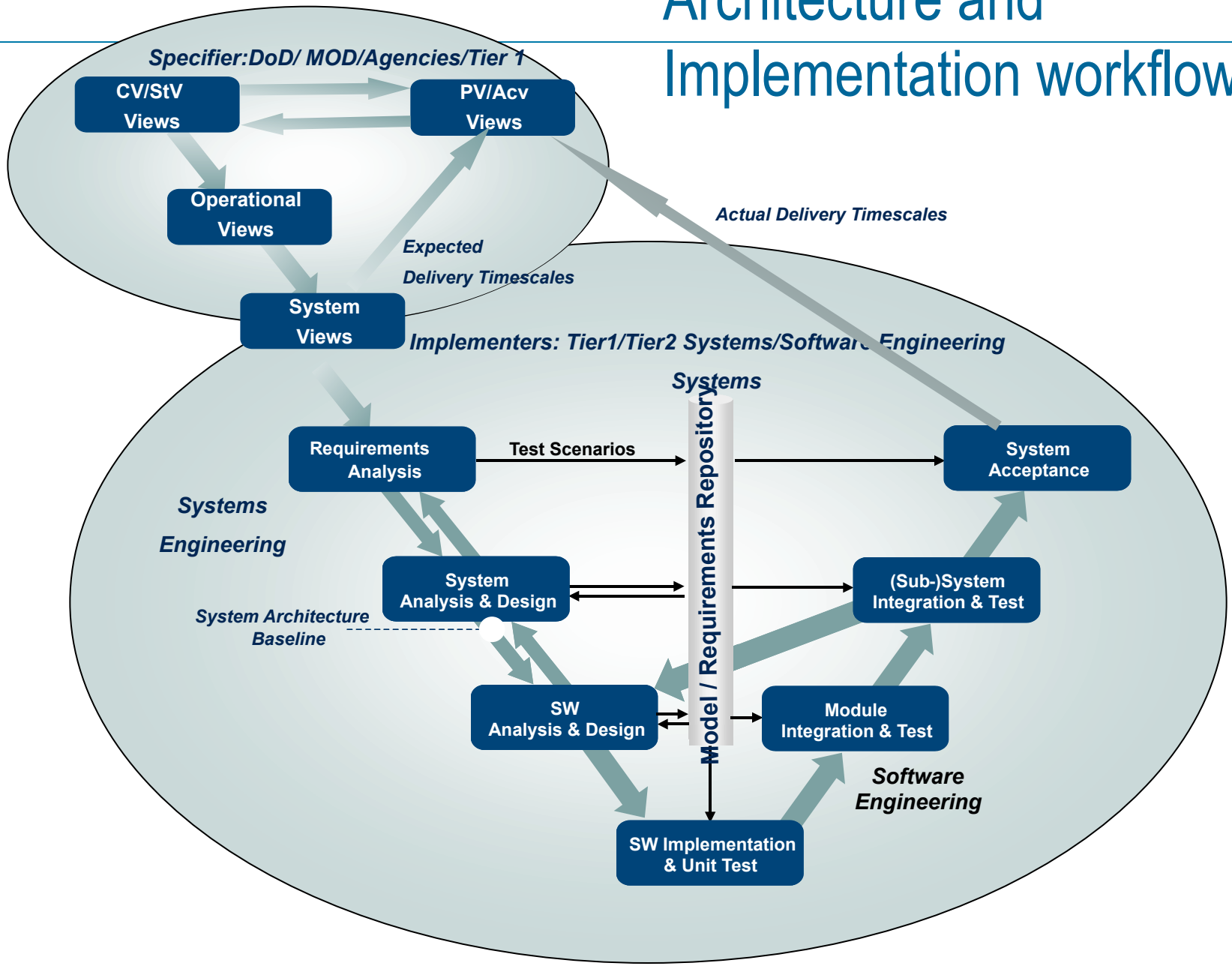
Step-4 Define Scenarios



Step-5 Define Information Exchanges



Architecture and Implementation workflow

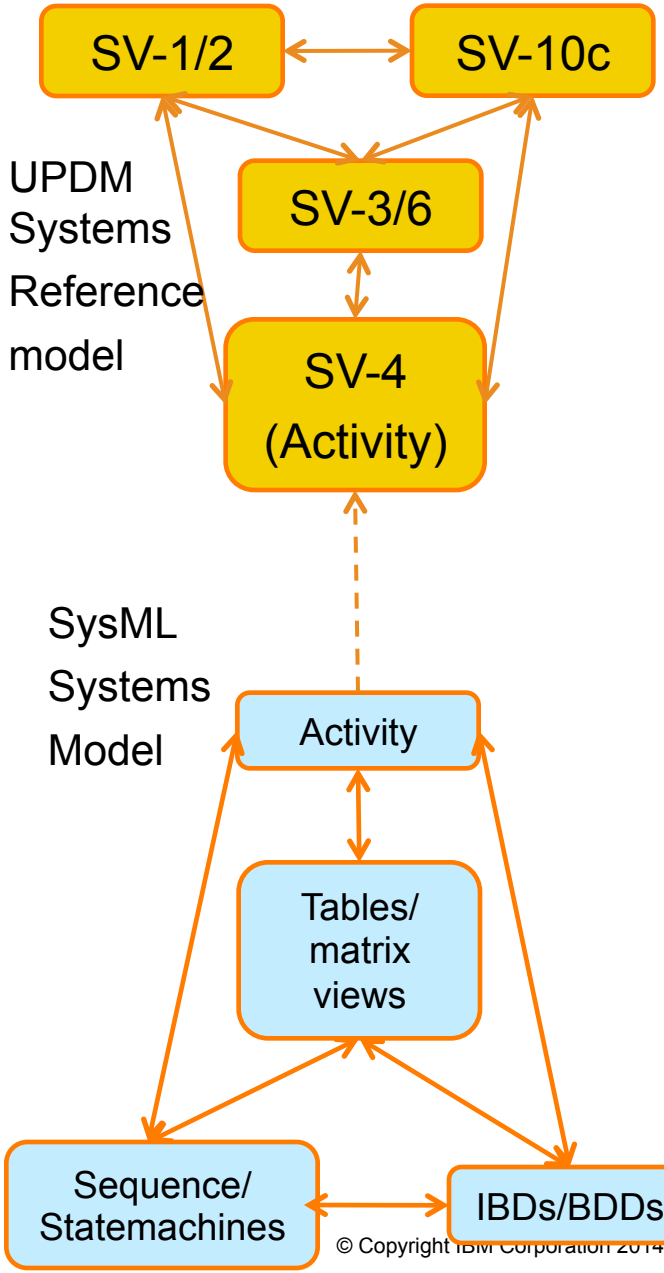


Relating UPDM and SysML models

- Handling requirements
  - In UPDM requirements driven from the level above
  - Non functional requirements captured as constraints
    - Also work with Parametric diagrams
  - It is possible to bring requirements into UPDM models and tie them to Capabilities
- 3 main options
  - Keep SysML models as part of UPDM models
  - Import parts of UPDM models directly into a SysML model
  - Reference UPDM elements from SysML models
  - Separate UPDM and SysML models and trace through using requirements
- Best option is single source of truth
  - Use referenced models or link across architectures
    - Can be supported by OLSC across different tools

Relating UPDM and SysML models (simple example)

- Reference UPDM elements from SysML models
  - Maintain the consistency of the UPDM model
  - Maintain the patterns of the UPDM structure in the SysML model
  - Trace between SysML and UPDM easily
  - End up with a number of Branch SysML models that reflect the lower level system structure
  - Cannot use the UPDM elements as they are read only (Advantage)



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