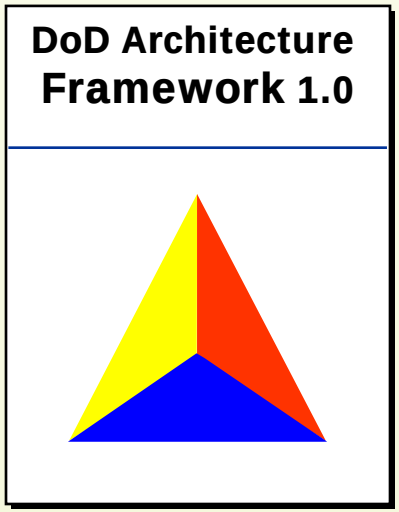
An Overview of the DoD Architecture Framework



Today's Objectives

- Communicate
  - What is DoD AF?
  - The reasons for doing DoD AF
  - An approach for building a DoD AF conformant architecture
- After this seminar you should:
  - Know each of the DoD Architecture views and work products within them.
  - Understand the relationships among the information the work products represent
  - Have an understanding of why you would want to build a DoDAF Conformant Architecture

Why Enterprise Architecture?

Enterprise Architecture: The Problem / Solution Space

- Linear, Text-based descriptions are no longer adequate for understanding and communicating complex requirements and interfaces.

- Help comes in the form of two or more dimensional symbol-based models supplemented with structured character-based facts.
  - They give better visibility to relationships and interfaces
  - Give expression to our visual thinking capabilities
  - Increase the effectiveness of communication
  - Improve Understanding
  - Facilitate quicker identification of missing elements of requirement specifications, errors in business and solution logic, risk management issues, process improvements, etc.

Basic Uses of an Enterprise Architecture

Keypoint
An EA answers basic questions about, and allows analysis of, an enterprise.

- An Enterprise Architecture allows you to answer who does what activity when, why, where, how and with what.
- It allows you to track changes within an enterprise, and analyze effects of those changes before implementation.
- It allows you to perform gap analyses As Is (now) and To Be (future) architectures of the same enterprise.

What is an Enterprise Architecture Framework?

Keypoint
A Framework organizes an Architecture.

- A Framework provides structure for architecture Information:
  - It organizes the information
    - Where to put it
    - Where to find it
  - It defines relationships within the architecture
  - It provides structure
    - Consistent structure allows for interoperability between architectures
    - Delineates whether information should be stored as diagrams or text

Framework Examples

Keypoint
There have been a number of frameworks developed for EA use.

- Zachman Framework
  - Used extensively in the commercial world
- TOGAF
  - The Open Group Architecture Framework
- TEAF
  - Treasury Enterprise Architecture Framework
- FEAF
  - Federal Enterprise Architecture Framework
- DoD AF

DoD AF

- The Department of Defense Architecture Framework allows easy organization and access to the specific data that comprise an Architecture within DoD applications.

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Why are we doing DoD AF?

- To speak the DoD language.
- To support the DoD procurement decisions.
- To deal with changes.
- To save time and money designing and building systems.
- To build horizontal integration into systems.
- To assist system engineers in their work.
- To assist software engineers in their work.

Importance of Architecture

Keypoint
Laws and Regulations

- OMB Circular A-130 mandates creation of Enterprise Architecture Framework
- CJCSI 3170.01C (6/24/2003) "JCIDS*…implements a capabilities-based approach that utilizes joint architectures and integrated architectures……"*Architectural views are mandatory appendices to ICD, CDD, and CPD"*
- DoD Directive 5000.2R – requires development of C4I Support Plan (C4ISP) by the customer, however the C4ISP is developed from information supplied by the contractor and must be sufficient to produce the required views.

*JCIDS - Joint Capabilities Integration and Development System

Importance of Architecture (cont.)

- Return on investment:
  - Desire for “plug-able” architectures across the services
  - Operator understands needs and requirements
  - Testing and training occur earlier in the requirements process
  - Reuse is easier to identify
  - Deals with smaller components
  - Provides open design space
  - Focus is on interfaces to systems

Acquisition Landscape Has Changed

- Statement Of Objectives (SOO)
- Architecture Driven
- Supplier Provides Architecture
- No Product Specification from Customer

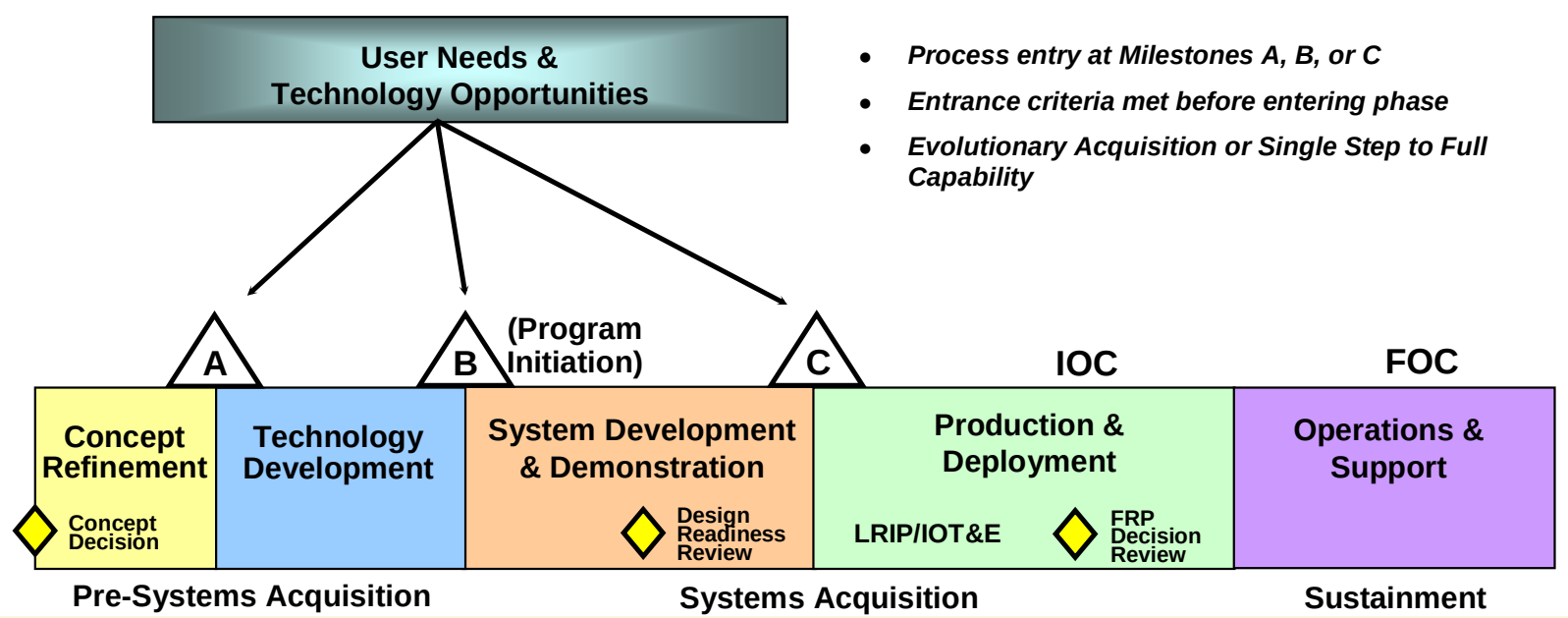
Acquisition Landscape Has Changed (cont.)

- The DoD is:
  - No longer telling the contractor the solution they have chosen.
  - Seeking to leverage the expertise of the contractor.
  - Seeking to have a their choice of the best options available against which they will write the SRD.
  - Stating their goals for the product in an SOO.
  - Asking the contractor to tell them what it really takes to achieve that SOO.

Why Enterprise Architecture?

DoD Directive 5000.2

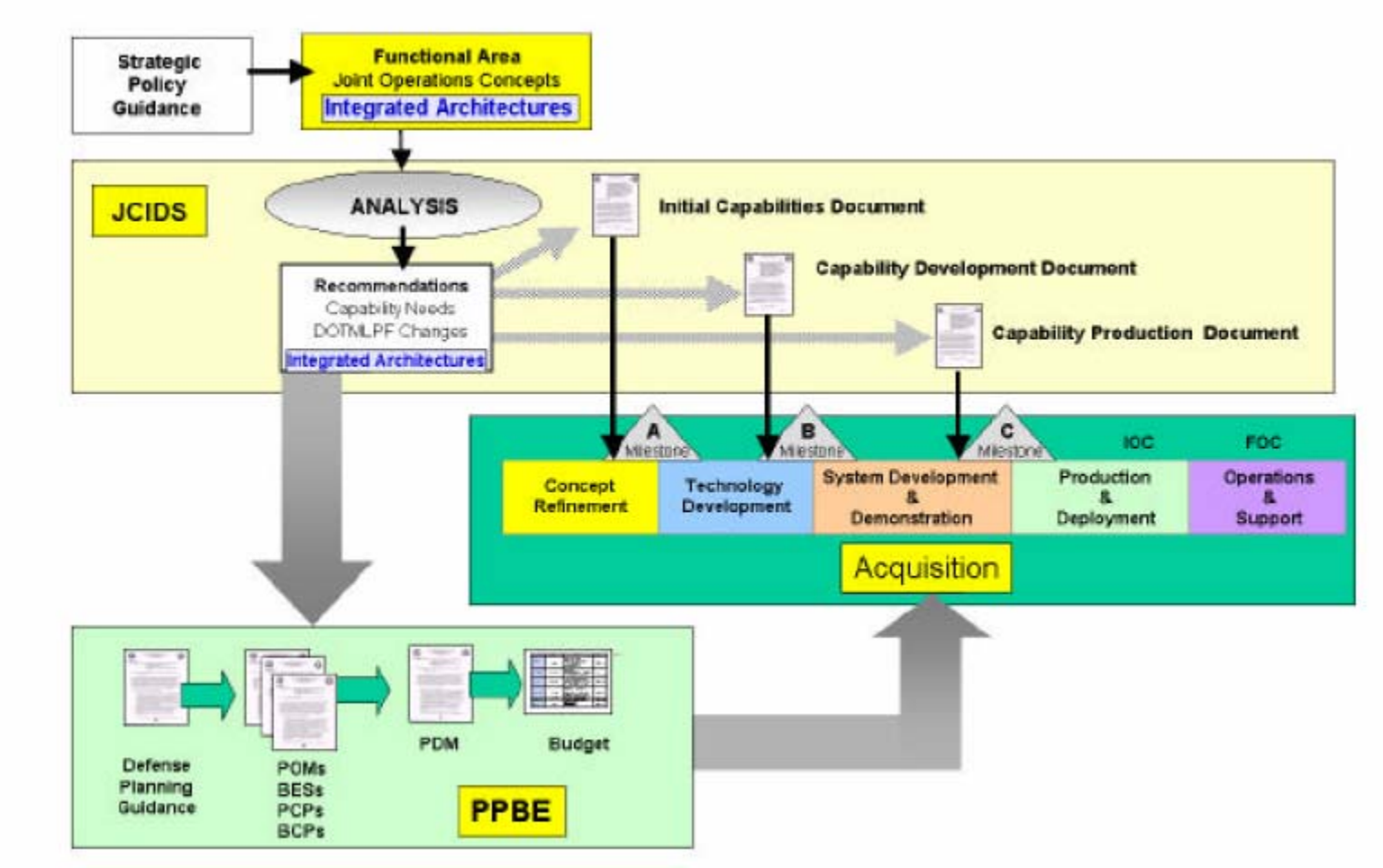
DoD Directive 5000.2
Defense Acquisition Management Framework



An EA is done prior to Milestone A and revised prior to milestone A, B and C in the Acquisition Process.

Why Enterprise Architecture?

Relationship to the Requirements, Acquisition and Budgeting Process



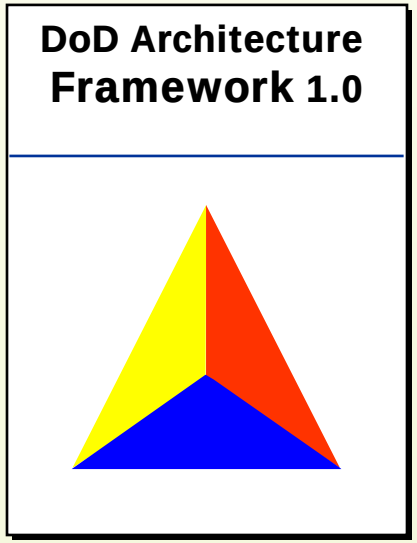
Requirements Documents

Keypoint
Keep these documents in mind, soon we will see that DoDAF is Capability Based and relates directly to these documents

Common element is CAPABILITIES

- Initial Capabilities Document (ICD) replaces MNS at Milestone A
  - Describes desired capability. Evaluates multiple materiel approaches. Recommends a materiel approach.
- Capability Development Document (CDD) replaces ORD at Milestone B
  - Describes the SDD effort and provides KPPs for the increment. Describes program to get to complete solution.
- Capability Production Document (CPD) replaces ORD at Milestone C
  - Describes the SDD effort to produce materiel solution for the increment and provides KPPs for the production increment.

Overview of the DoD Architecture Framework (DoD AF)



Enterprise Architecture

- Defines the mission, the information necessary to perform the mission and the technologies necessary to perform the mission.
- Is used to manage change when implementing new technologies in response to the changing mission needs.
- Includes a baseline architecture, target architecture, and a transition plan.

Important Definitions

- Framework
  - a logical structure for classifying and organizing information
- View
  - a perspective of the information within the architecture
- Model
  - representations of reality: the information, activities, relationships, and constraints
- Methodology
  - a prescribed way of approaching a particular problem
- Capability (according to DoDAF Vol II)
  - The ability to execute a specified course of action. (JP 1-02) It is defined by an operational user and expressed in broad operational terms in the format of an initial capabilities document or a DOTMLPF change recommendation. In the case of materiel proposals, the definition will progressively evolve to DOTMLPF performance attributes identified in the CDD and CPD. (CJCSI 3170.01C)

The DoD AF Version 1.0 Provides:

Keypoint
The DoD AF directs DoD Architecture projects.

- Guidance as to why enterprise architecture is done in the DoD and examples of how it is to be used.
- Definition of the data collected as part of the architecture effort and the Views and "Work Products" to used to present the data.
- Formats for presenting the architecture information
- A Logical Data Model (i.e. CADM) that defines the relationships between the information gathered in each work product.

Key Differences between DoD AF 1.0 and C4ISR 2.0/2.1

- AV-3 Capability Maturity Profile of C4ISR 2.1 (Draft) – removed.
- “Essential and Supporting” Work Product Notion of C4ISR 2.0 no longer used .
- System Element Deleted from SV-1.
- Better Definitions of Views and Work Products.
- OV-6c supports Event Trace and Process Flow Diagramming.
- CADM sub-sets included in the Architecture framework Documentation.
- Discussion of the use of UML work products included in the main body of the DoD AF documentation.

Results of applying the DoD AF

- An understanding of the mission needs of the customer.
- What the operational environment will need to do to deliver the mission needs.
- How the system (and/or system of systems) will support the operational environment and ensure the mission needs are met.
- How and where the required concepts (TPPU, TCPED, etc.) and technical standards (JTA/DISR) are included in the architecture .

All Views (AV)

Keypoint
The Overarching View.

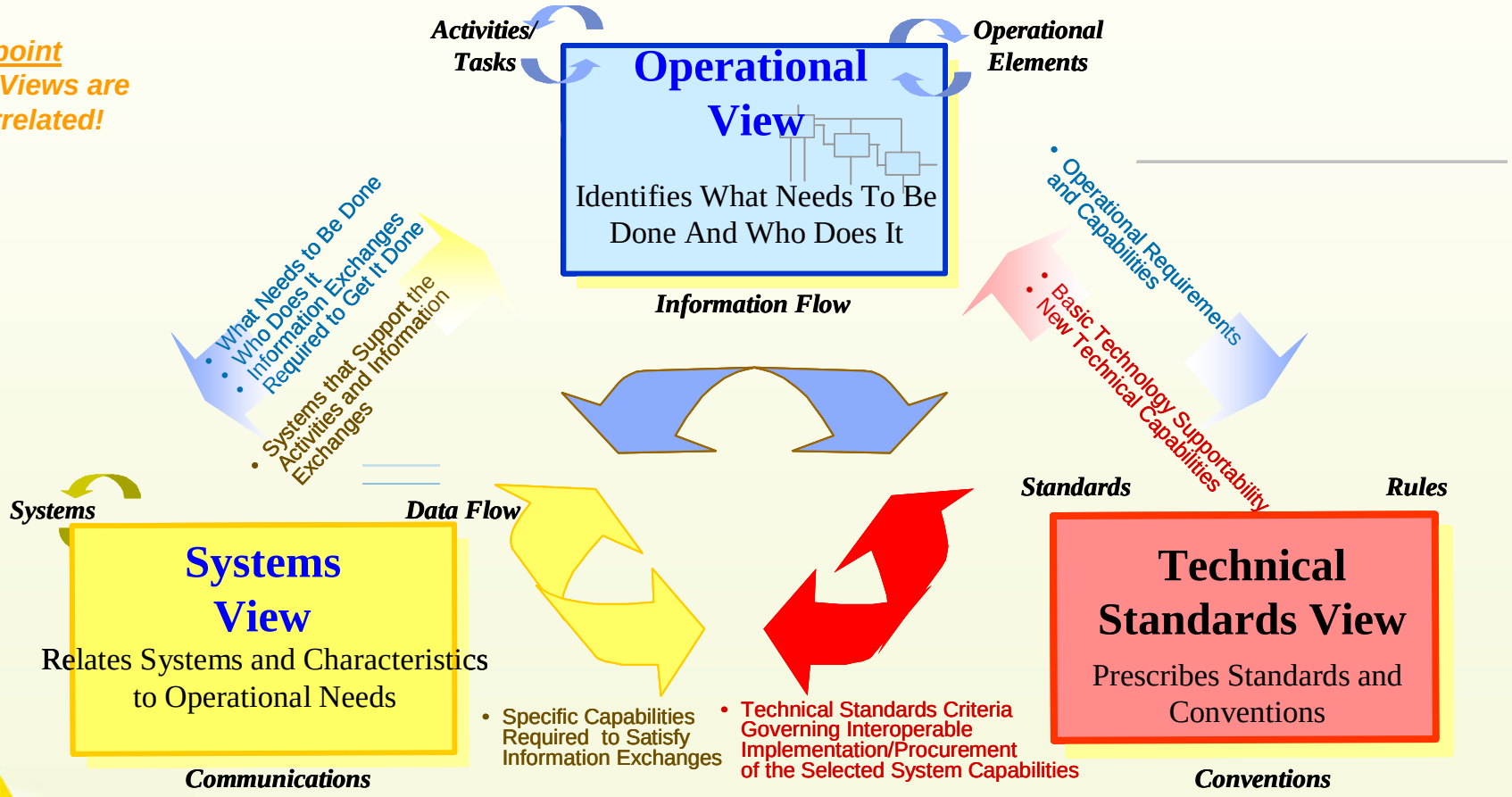
- States the PURPOSE of the architecture i.e. the GOAL that will be achieved.
- Captures the overarching aspects of the architecture that relate to the other three views.
- Sets the scope and context of the architecture.
- Provides information pertinent to the entire architecture (data dictionary).

DoD AF AV Work Products

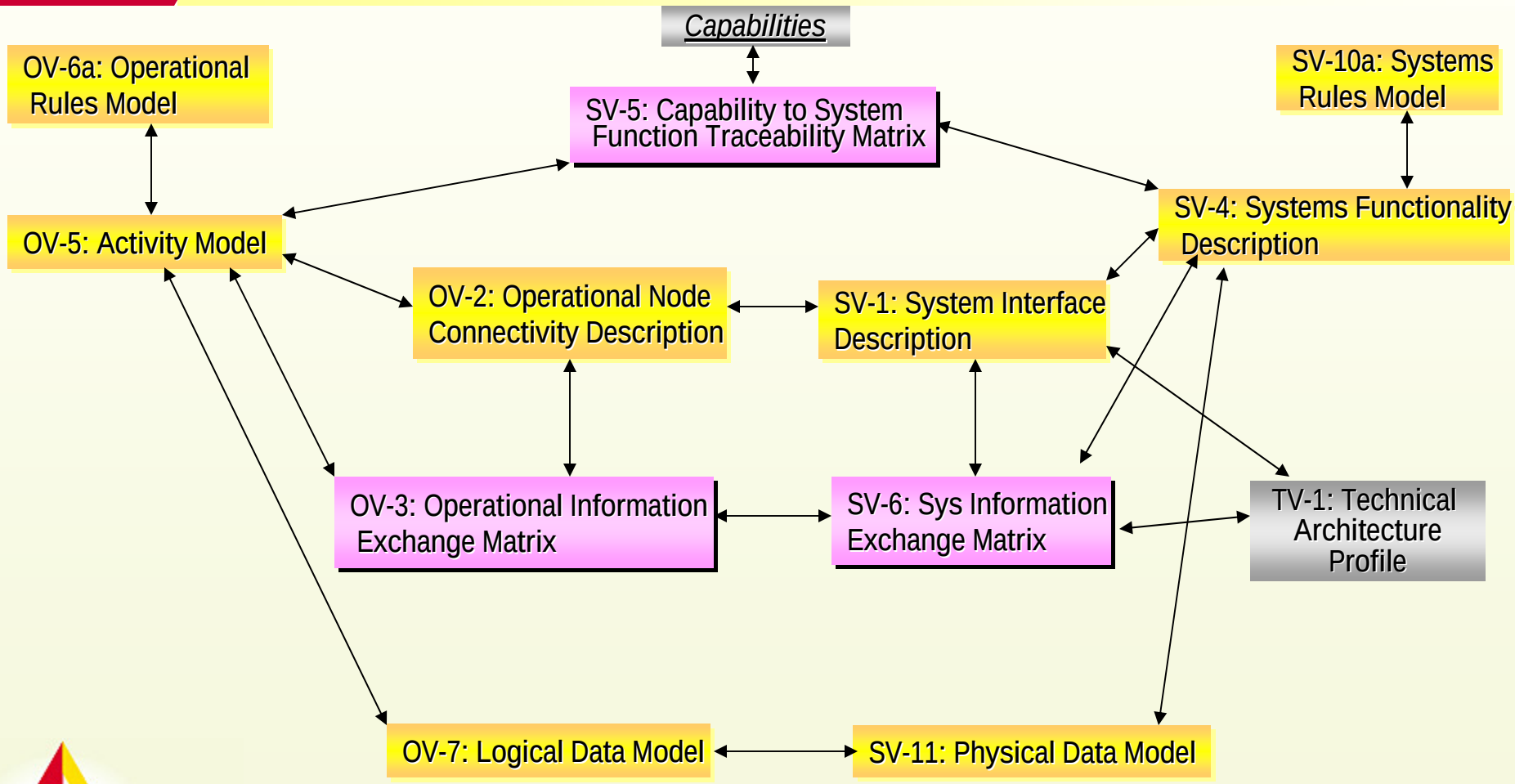
Product	Name	General Description
AV-1	Overview and Summary Information	Scope, purpose, intended users, environment depicted, analytical findings
AV-2	Integrated Dictionary	Architecture data repository with definitions of all terms used in all products

Fundamental Linkages Among Views

Keypoint
The Views are interrelated!



Major Product Linkage (Capabilities Focused)



Operational View (OV)

Keypoint
What is being done, NOT what does it.

- Provides the specification of the tasks, operational elements, and information exchanges required to accomplish the GOAL (mission).
- Comprised of graphical and textual work products that identify the operational nodes, assigned activities, and information flows required between nodes.
- Defines the types of information exchanged, the frequency of exchange, which activities are supported by the information exchanges, and the nature of information exchanges.

DoD AF OV Work Products

Product	Name	General Description
OV-1	High-Level Operational Concept Graphic	High-level graphical/textual description of operational concept
OV-2	Operational Node Connectivity Description	Operational nodes, connectivity, and information exchange needlines between nodes
OV-3	Operational Information Exchange Matrix	Information exchanged between nodes and the relevant attributes of that exchange
OV-4	Organizational Relationships Chart	Organizational, role, or other relationships among organizations
OV-5	Operational Activity Model	Capabilities, operational activities, relationships among activities, inputs, and outputs; overlays can show cost, performing nodes, or other pertinent information

OV Work Products (cont.)

Product	Name	General Description
OV-6a	Operational Rules Model	One of three products used to describe operational activity—identifies business rules that constrain operation
OV-6b	Operational State Transition Description	One of three products used to describe operational activity—identifies business process responses to events
OV-6c	Operational Event-Trace Description	One of three products used to describe operational activity—traces actions in a scenario or sequence of events
OV-7	Logical Data Model	Documentation of the system data requirements and structural business process rules of the Operational View

OV-1 Is:

- Graphical in nature.
- An easy way to understand what is trying to be explained by the architecture as a whole.
- Provides an excellent summary of an architecture when combined with AV-1.
- A mission and highlighted primary operational nodes.

OV-1 Primary Features

- A freeform and variable format.
- Flexible.

Example OV-1

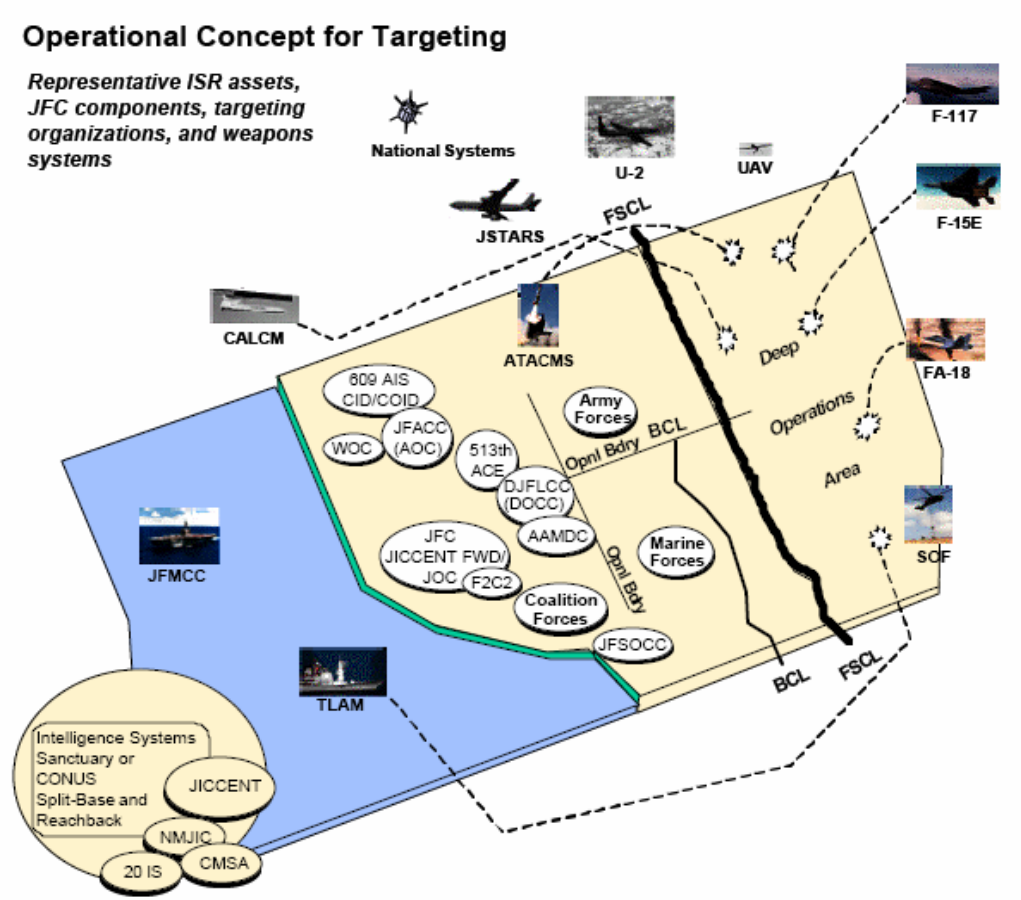


Figure 2.4-4. Example High-Level Operational Concept Graphic (OV-1)

OV-2 Is:

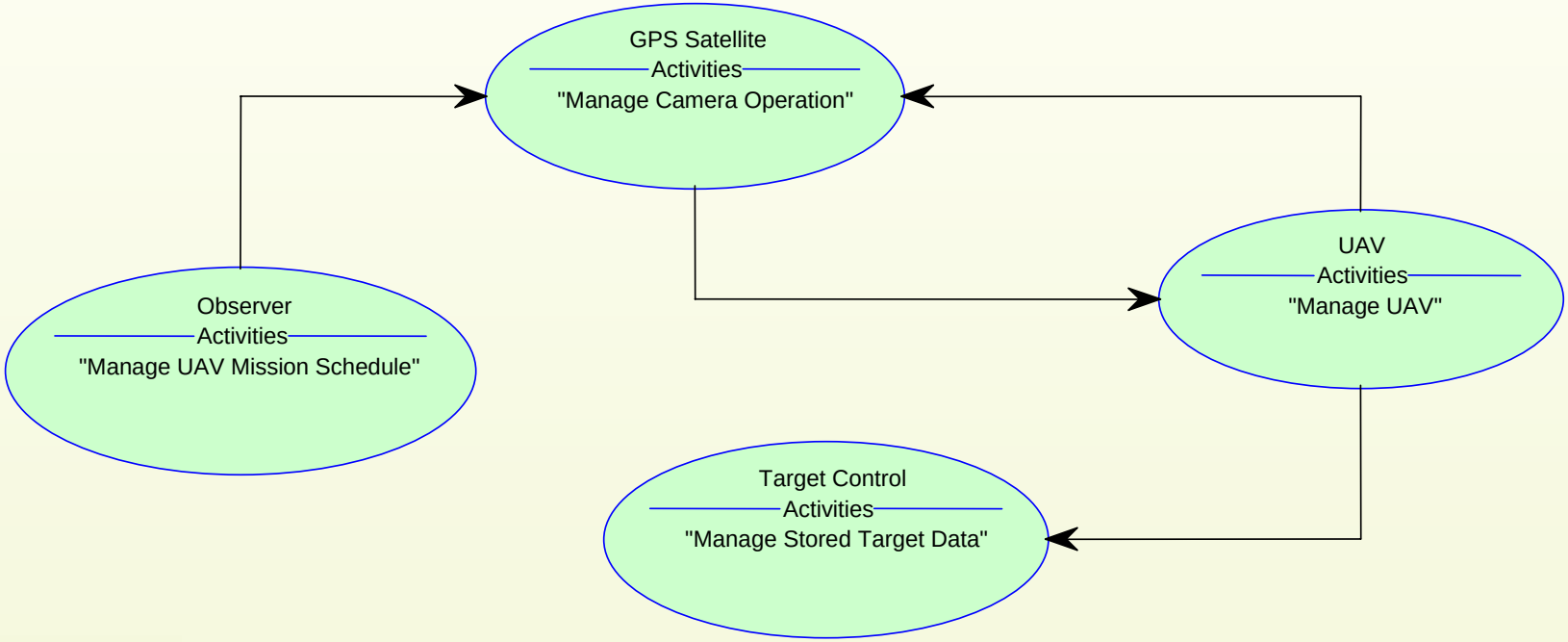
- Graphical in nature.
- One of the work products required for an integrated architecture.
- A way to track the need to exchange information from specific Operational Nodes (that play a key role in the architecture) to other Nodes.

OV-2 Primary Features

- Operational Nodes:
  - Operational Activities (from the OV-5 Operational Activity Model) performed by a given Node may be listed on the graphic, if space permits.
  - The notion of Operational Node will vary depending on the level of detail addressed by the architecture effort.
- Needlines:
  - Indicate a need to exchange information
  - An aggregation of specific Information Exchange Requirements
  - Have source and destination Nodes
  - System implementations are *not* included here

Example OV-2

Acquire Target Data



OV-5: Operational Activity Model

The OV-5 Activity Model definition:

The operations that are normally conducted in the course of achieving a mission or a business goal.

OV-5 Activity Model Is:

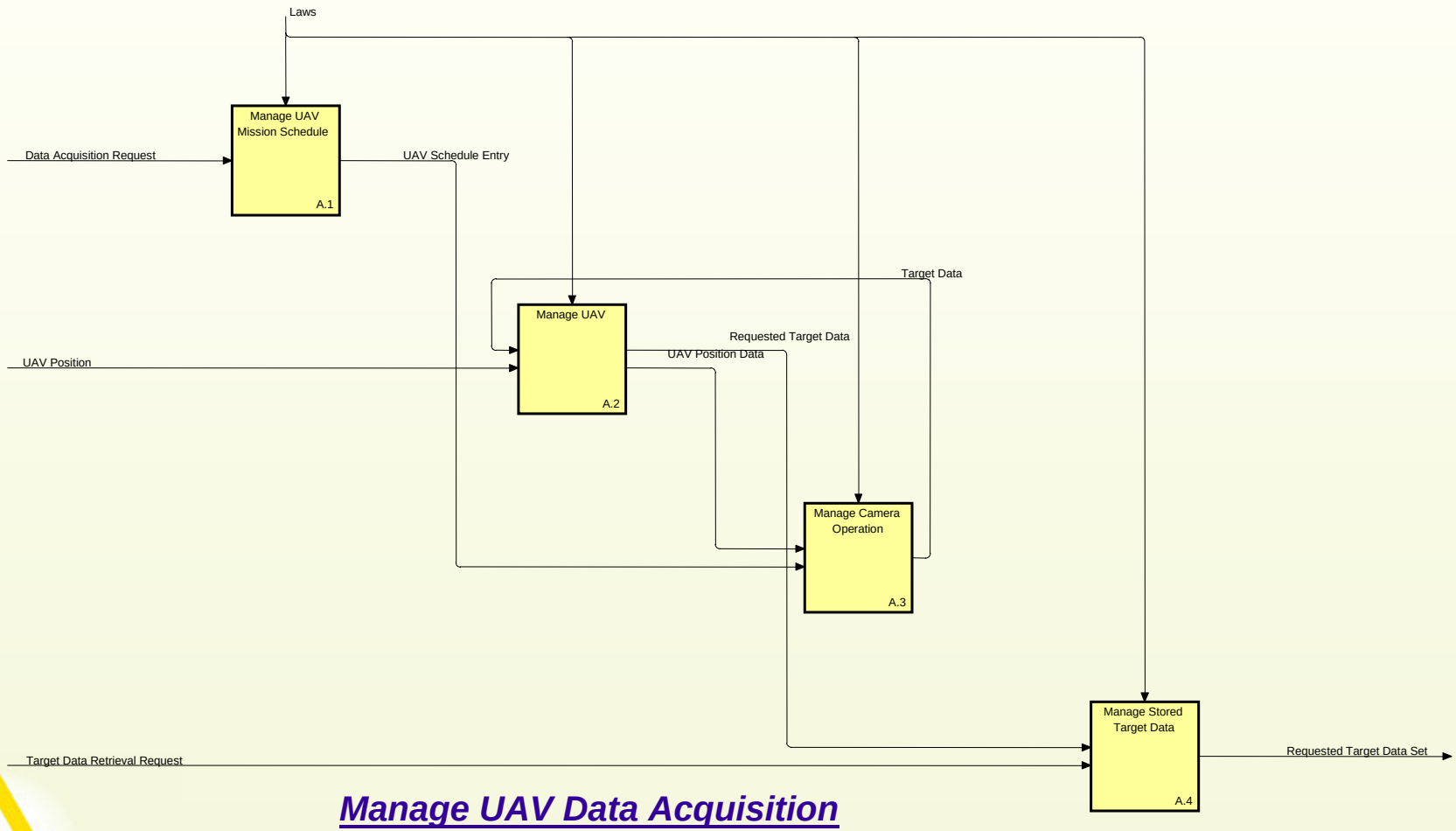
Keypoint
The Activity Model is the springboard to the architecture.

- Graphical in nature.
- One of the work products required for an integrated architecture.
- Seen by most as the primary work product of the architecture.
  - A simple Activity Model helps in understanding the architecture
- ***NOT*** a process model.
- Modeled starting at a very abstract level and then in ever increasing levels of detail until the desired analysis can be performed
  - Multiple diagrams are created and linked together in a parent/child fashion

OV-5 Primary Features

- OV-5 can be used to:
  - Clearly delineate lines of responsibility for activities
  - Uncover unnecessary operational activity redundancy
  - Make decisions about streamlining, combining, or omitting activities
  - Define or flag issues, opportunities, or operational activities and their interactions (information flows among the activities) that need to be scrutinized further
  - Provide a necessary foundation for depicting activity sequencing and timing in a process flow model such as an OV-6c

Example OV-5



Manage UAV Data Acquisition

OV-3: Operational Information Exchange Matrix

Information Exchange definition:

The act of exchanging information between two distinct Operational Nodes and the characteristics of the act.

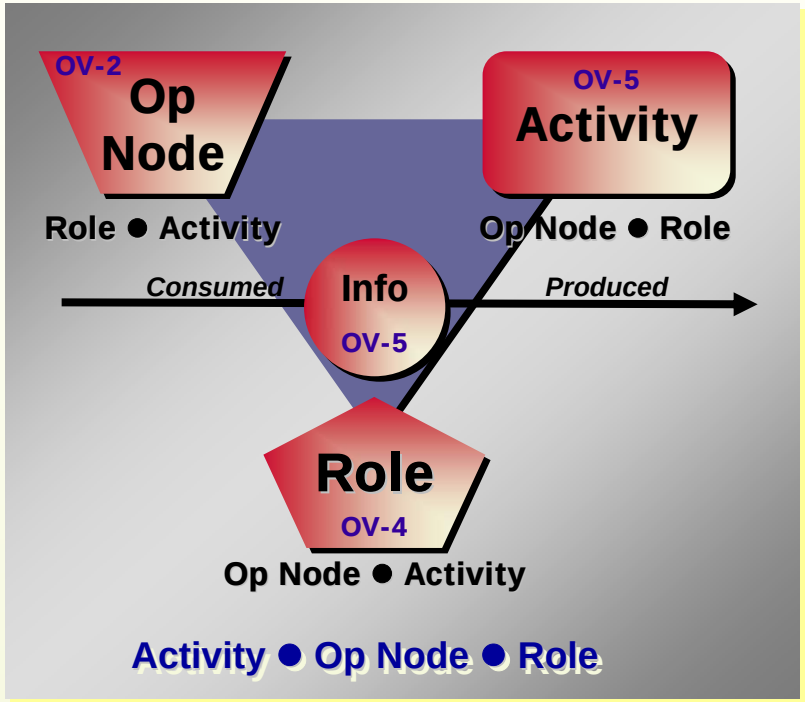
OV-3 Is:

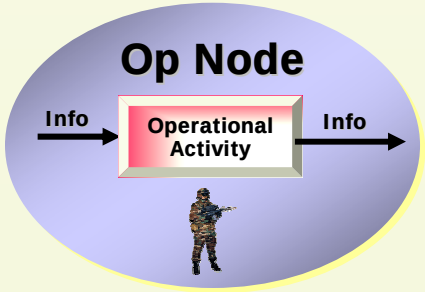
- Textual/tabular in format.
- One of the work products required for an integrated architecture.
- A description of *"who* exchanges *what* information, with *whom*, *why* the information is necessary, and *how* the information exchange must occur." [CJCSI 6212.01B, 2000].

OV-3 Primary Features

- Identifies information element (a formalized representation of information subject to an operational process (e.g., the information content that is required to be exchanged between nodes)).
- Includes all relevant attributes of an IE:
  - Information assurance, security
  - Timing, triggers, etc.
- Associates a particular IE with a particular Needline, and source & destination Operational Nodes.

Dependencies between Work Products





Example OV-3

IER	Valid	From Activity	From Node	To Activity	To Node	ICOM Arrow	From OpNodeActivity Roles	To OpNodeActivity Roles
Data Acquisition Request	T	Nominate	Control	Manage	Observer	Data		Operator
Requested Target Data	T	Manage	UAV	Manage	Target	Requested	Operator	"Contract
Requested Target Data	T	Manage	UAV	Manage	Target	Requested	"GPS Technician"	"Contract
Requested Target Data Set	T	Manage	Target	Issue Fire	Control	Requested	"Contract	
Target Data	T	Manage	UAV	Manage	UAV	Target Data	"Service Provider"	Operator
Target Data	T	Manage	GPS	Manage	UAV	Target Data		Operator
Target Data	T	Manage	GPS	Manage	UAV	Target Data		"GPS Technician"
Target Data Retrieval Request	T	Nominate	Control	Manage	Target	Target Data		"Contract
UAV Position	T	Nominate	Control	Manage	UAV	UAV		Operator
UAV Position	T	Nominate	Control	Manage	UAV	UAV		"GPS Technician"
UAV Position Data	T	Manage	UAV	Manage	UAV	UAV	Operator	"Service Provider"
UAV Position Data	T	Manage	UAV	Manage	GPS	UAV	Operator	
UAV Position Data	T	Manage	UAV	Manage	GPS	UAV	"GPS Technician"	
UAV Schedule Entry	T	Manage	Observer	Manage	UAV	UAV	Operator	"Service Provider"
UAV Schedule Entry	T	Manage	Observer	Manage	GPS	UAV	Operator	

OV-7: Logical Data Model

Logical Data Model definition:

An LDM describes the structure of an architecture domain's system data types and the structural business process rules (defined in the architecture's Operational View) that govern the system data.

OV-7 Is:

- Graphical in nature.
- A key element in supporting interoperability between architectures.

OV-7 Primary Features

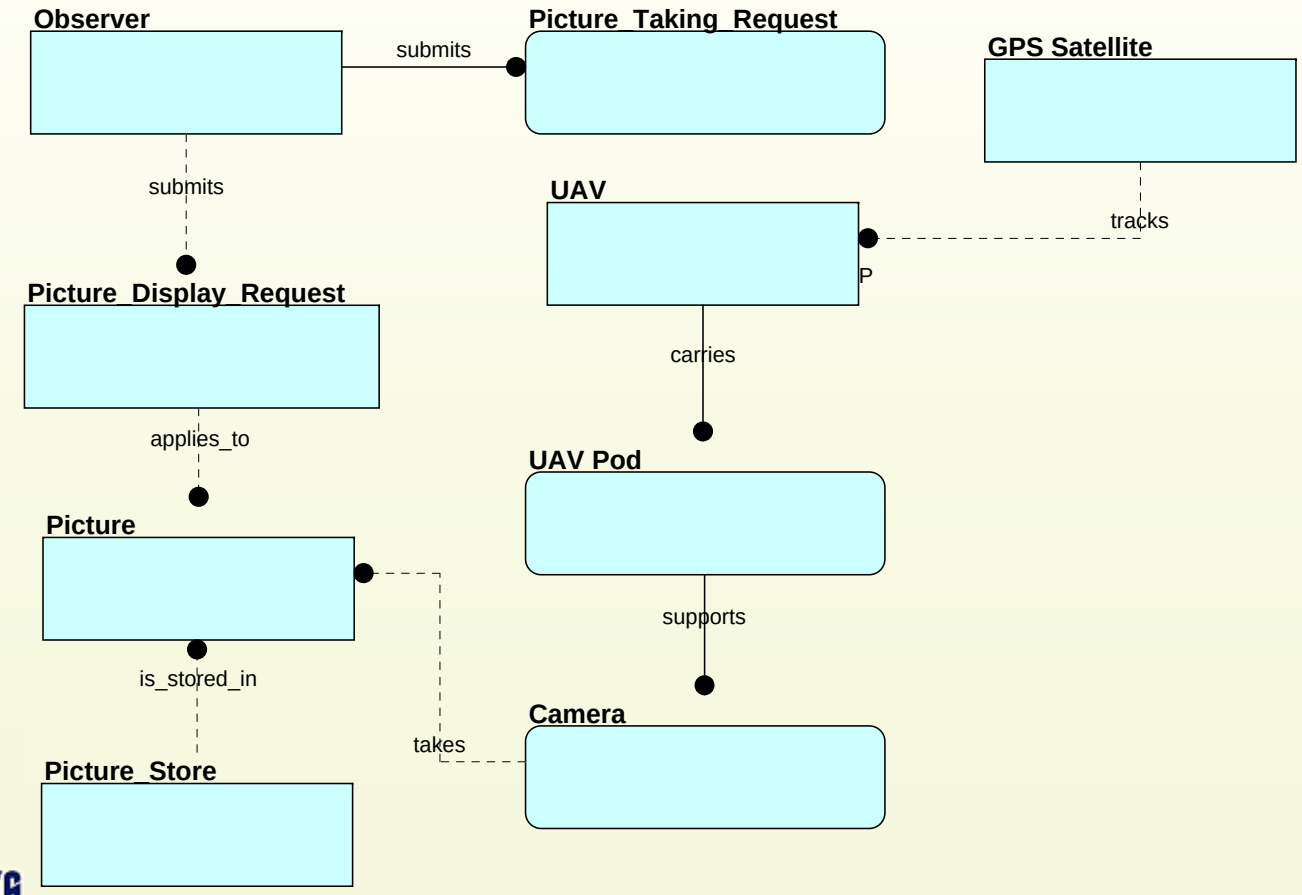
- Architecture data elements that describe entity, attribute, and relationship types.
- Various methodologies may be used:
  - Entity Relationship Diagrams (ERD)
  - IDEF1X
  - UML class diagram

An Example

- For example, if the domain is missile defense, some possible system data types may be *trajectory* and *target* with a relationship that associates a target with a certain trajectory.

Example OV-7

OV-7 UAV Logical Data Model



OV-6: OPERATIONAL ACTIVITY SEQUENCE AND TIMING DESCRIPTIONS

The dynamic behavior concerning the timing and sequencing of events that capture operational behavior of a business process or mission thread. Thus, the behavior expressed in OV-6 is related to the activities of OV-5.

OV-6 Has Three Options

- OV-6a Operational Rules Model
  - Identifies business rules that constrain operational activities
- OV-6b Operational State Transition Description
  - Identifies business process responses to events
  - IDEF3 Object State Transition Network diagram used for this product
- OV-6c Event Trace Description
  - Traces actions in a scenario or sequence of events
  - A new diagram having the appearance of a UML Sequence diagram but whose symbols are related to DoDAF definitions was used
  - As an alternative, the IDEF3 Process Flow diagram can be used for this work product (OV-6a in C4ISR v2.0)

OV Summary

- Build OV-1 (High-Level Operational Concept Graphic) first, at least in draft form:
  - Continues to organize thoughts, involves graphical thinking team members
- Build OV-5 (Operational Activity Model):
  - Start with Node Tree, establish Operational Activity hierarchy
  - Complete Activity Model by connecting Activities with Information Exchanges
  - Repository based tools may be able to generate starting diagrams for Activity Model
- Determine Operational Nodes
- Assign Operational Activities to Nodes

OV Summary (cont.)

- Build OV-2 (Operational Node Connectivity Description):
  - Needlines determined by IEs
  - An automated option in some tools (Popkin System Architect©, Metis), as long as Activities have been assigned to Nodes
- Build OV-3 (Operational Information Exchange Matrix) Report:
  - All of the necessary information can be collected from OV-2 and OV-5
  - An automatic report in repository based tools
- Build OV-4 (Organizational Relationships Chart):
  - If needed
  - Assign Operational Nodes to Organizational Units

OV Summary (cont.)

- Build OV-7 (Logical Data Model):
  - If needed
  - Important if there is any potential conflict with entity terminology between architectures
- Build OV-6 (Operational Activity Sequence and Timing Descriptions), if needed:
  - Select one (a, b, or c) depending on needs
  - Can increase level of detail
  - Needed to run simulations
  - Based on OV-5

Systems View

The SV describes systems and interconnections providing for, or supporting, DoD functions.

Systems View (SV)

Keypoint
The Systems used to implement the Activities contained in the Operational View.

- Comprised of a set of graphical and textual work products that describes systems and interconnections providing for, or supporting, DoD functions.
- The SV associates systems resources to the OV indicating what system resources support the operational activities and facilitate the exchange of information among operational nodes.

DoD AF SV Work Products

Product	Name	General Description
SV-1	Systems Interface Description	Identification of systems nodes, systems, and system items and their interconnections, within and between nodes
SV-2	Systems Communications Description	Systems nodes, systems, and system items, and their related communications lay-downs
SV-3	Systems-Systems Matrix	Relationships among systems in a given architecture; can be designed to show relationships of interest, e.g., system-type interfaces, planned vs. existing interfaces, etc.
SV-4	Systems Functionality Description	Functions performed by systems and the system data flows among system functions
SV-5	Operational Activity to Systems Function Traceability Matrix	Mapping of systems back to capabilities or of system functions back to operational activities
SV-5	Capability to System Function Traceability Matrix	Mapping of Capability to System Function

SV Work Products (cont.)

Product	Name	General Description
SV-6	Systems Data Exchange Matrix	Provides details of system data elements being exchanged between systems and the attributes of that exchange
SV-7	Systems Performance Parameters Matrix	Performance characteristics of Systems View elements for the appropriate time frame(s)
SV-8	Systems Evolution Description	Planned incremental steps toward migrating a suite of systems to a more efficient suite, or toward evolving a current system to a future implementation
SV-9	Systems Technology Forecast	Emerging technologies and software/hardware products that are expected to be available in a given set of time frames and that will affect future development of the architecture

SV Work Products (cont.)

SV-10a	Systems Rules Model	One of three products used to describe system functionality—identifies constraints that are imposed on systems functionality due to some aspect of systems design or implementation
SV-10b	Systems State Transition Description	One of three products used to describe system functionality—identifies responses of a system to events
SV-10c	Systems Event-Trace Description	One of three products used to describe system functionality—identifies system-specific refinements of critical sequences of events described in the Operational View
SV-11	Physical Schema	Physical implementation of the Logical Data Model entities, e.g., message formats, file structures, physical schema

SV-5: Operational Activity to Systems Function Traceability Matrix

SV-5 Is:

- A tabular work product.
- The bridge between the Operational View and the Systems View.
- An explicit map of the System Functions to the Operational Activities they support.
  - This notion aligns with the idea that the system architecture is designed to meet the mission/operational needs of the enterprise.
  - Therefore a vast majority of the system functions will support an operational activity in some way.
- An excellent analysis tool!

SV-5 Primary Features

- Can be extended to depict the mapping of capabilities to Operational Activities, Operational Activities to System Functions, System Functions to Systems, and thus relates the capabilities to the Systems that support them.
- Allows discovery of gaps and/or redundancies.

Example SV-5

System Function \ Operational Activity	"Disseminate and Process Mission Orders"	"Receive - Validate Field Orders"	"Receive - Validate Unit Orders"	"Send Orders to Field Division"	"Send Orders to Support Units"
"Decrypt Field Order"		X			
"Decrypt Unit Order"			X		
"Display + Acknowledge Unit Order"			X		
"Display + Approve Order"		X			
"Encrypt Field Order"				X	
"Encrypt Unit Order"					X
"Field Order Processing"					
"HQ Enter Order"				X	
"HQ Order Processing"					
"Mobile Order Processing"					
"Order Processing"					
"Receive Encrypted Field Order"		X			
"Receive Encrypted Unit Order"			X		
"Retreive HQ Order Type"				X	
"Transmit Field Order"				X	
"Transmit Unit Order"					X

From Popkin System Architect, version 9.1.40

Example SV-5

Red: functionality planned
but not developed

Yellow: partial functionality provided
or full functionality provided
but system has not been fielded

Green: full functionality provided
and system fielded.

		Capability 1			Capability 2			Capability 3			
		Operational Activity A	Operational Activity B	Operational Activity C	Operational Activity D	Operational Activity E	Operational Activity F	Operational Activity A	Operational Activity E	Operational Activity G	Operational Activity H
System 1	System Function A	Red		Red				Red		Red	
	System Function B					Green			Yellow		
	System Function C		Red								Red
System 2	System Function B				Green						
	System Function D						Yellow			Yellow	
	System Function E				Red						
	System Function F										Yellow
System 3	System Function G			Green							
	System Function H		Green				Red				
	System Function I			Yellow							

Figure 5-23. Capability to System Traceability Matrix (SV-5)

From DoD AF Version 1.0, Volume II

SV-1: Systems Interface Description

System Definition:

A Family of Systems (FoS), System of Systems (SoS), nomenclatured system, or a subsystem.

SV-1 Is:

- Graphical in nature.
- One of the work products required for an integrated architecture.
- An identification of Systems Nodes and Systems that support Operational Nodes.
  - And as such, related to OV-2
- An identification of the Interfaces between Systems and Systems Nodes.

SV-1 Primary Features

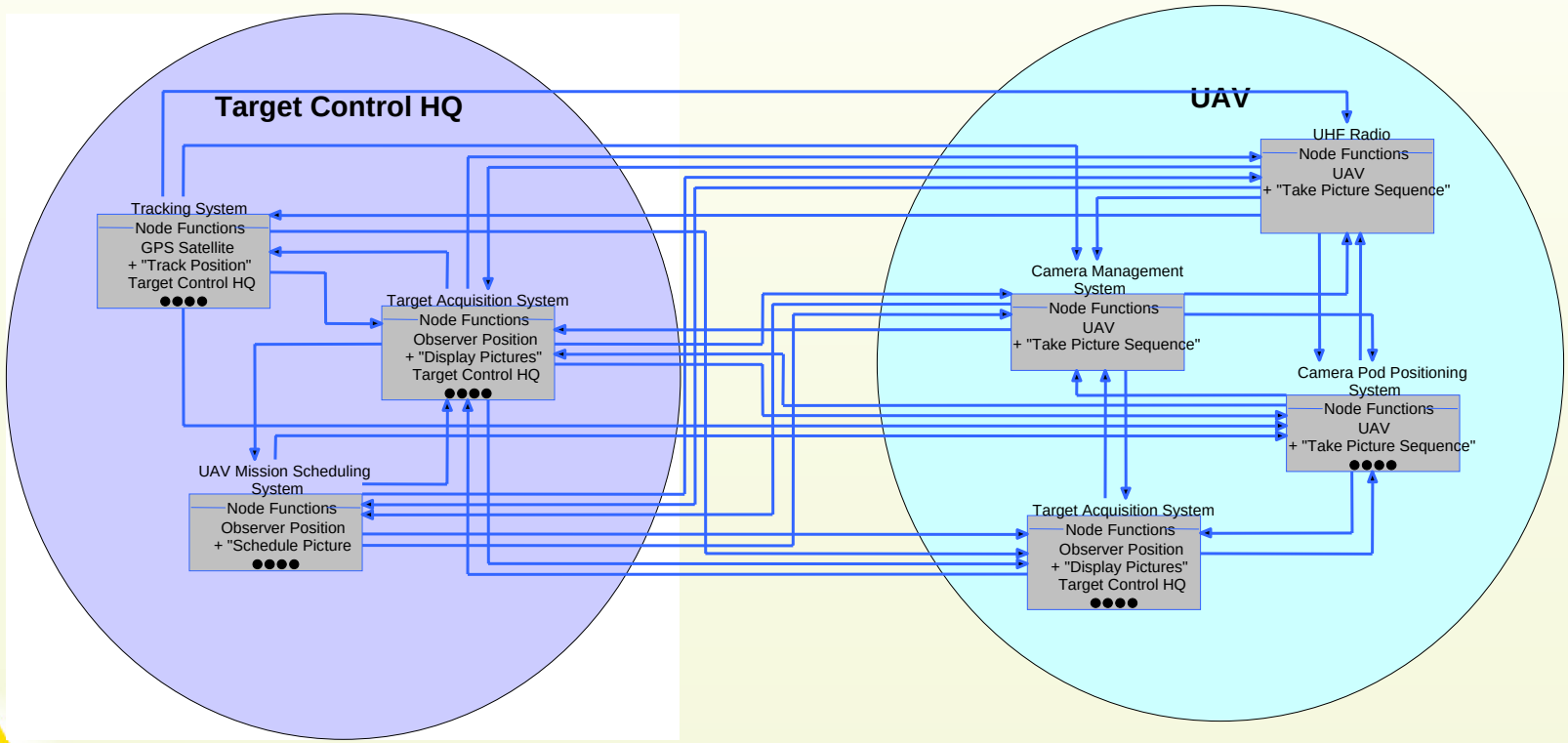
- Systems Nodes.
- Systems.
- System Functions.
- Interfaces:
  - The systems representation of an OV-2 Needline
  - Details of the communications infrastructure are not included, but documented in the Systems Communication Description (SV-2)
  - An abstract representation of one or more communications paths
  - Key Interfaces may exist

Key Interfaces

- Meet one or more of the following criteria:
  - The interface spans organizational boundaries (may be across instances of the same system, but utilized by different organizations)
  - The interface is mission critical
  - The interface is difficult or complex to manage
  - There are capability, interoperability, or efficiency issues associated with the interface

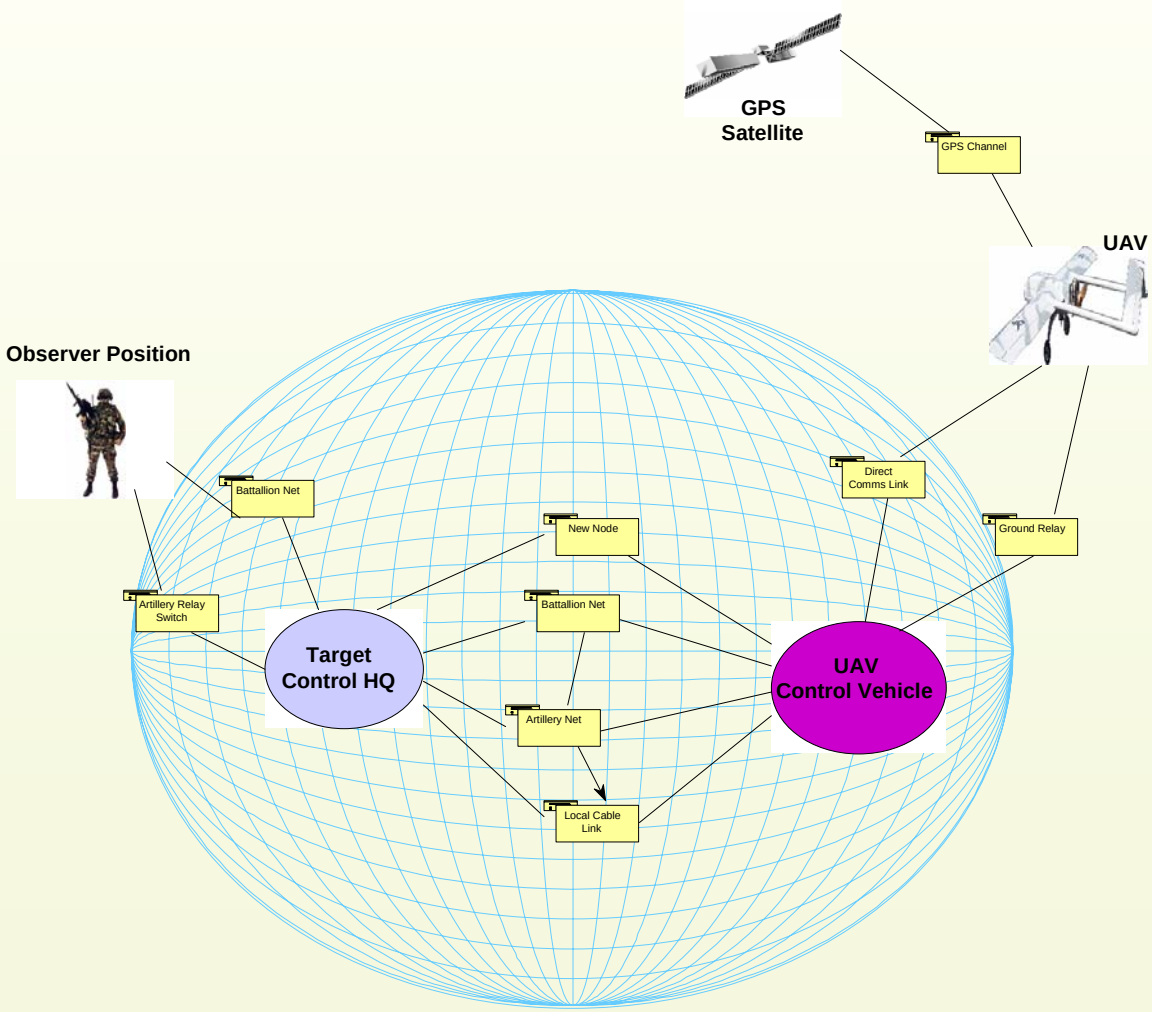
Example SV-1

UAV Targeting Systems Interface Connections



Example SV-2

SV-2 UAV Targeting Systems Communication



SV-4: Systems Functionality Description

Systems Function definition:

An action (or task), executed by automated systems, that consumes or produces system data.

SV-4 Is:

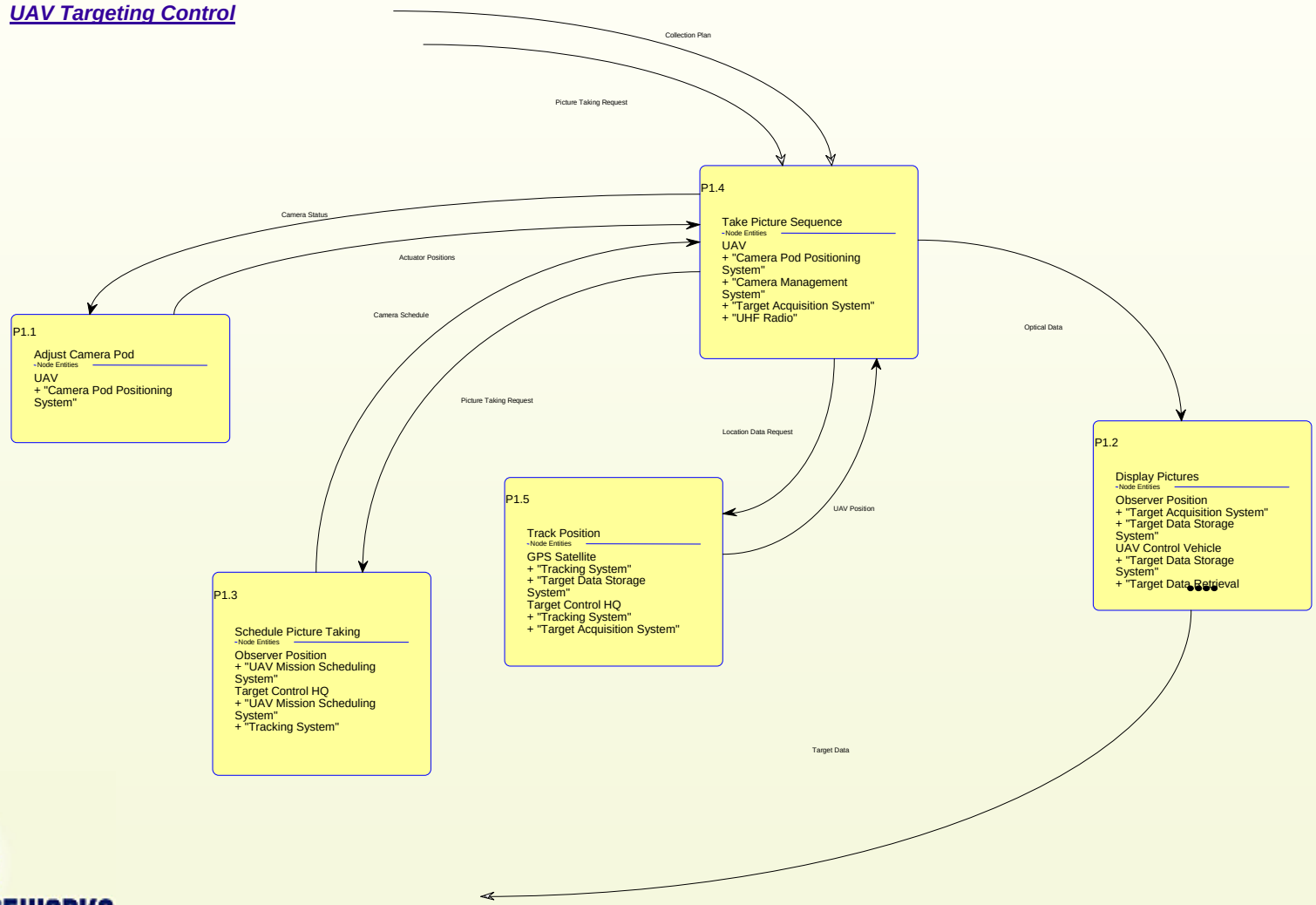
- Graphical in nature.
- May be either a Functional Decomposition Diagram or a Data Flow Diagram (DFD).
- The systems description of OV-5.
- A way to track System Data Flows.

SV-4 Data Flow Diagrams Primary Features

- External sources and sinks
  - External to the diagram scope but not external to the architecture scope
- System Functions
- Flows of system data
- Internal system data repositories (system data stores)
- Does not necessarily map System Functions directly to Operational Activities

Example SV-4

UAV Targeting Control



SV-6: Systems Data Exchange Matrix

System Data Exchange definition:

An implementation of how system data is exchanged between Systems, in system-specific details covering periodicity, timeliness, throughput, size, information assurance, and security characteristics of the exchange.

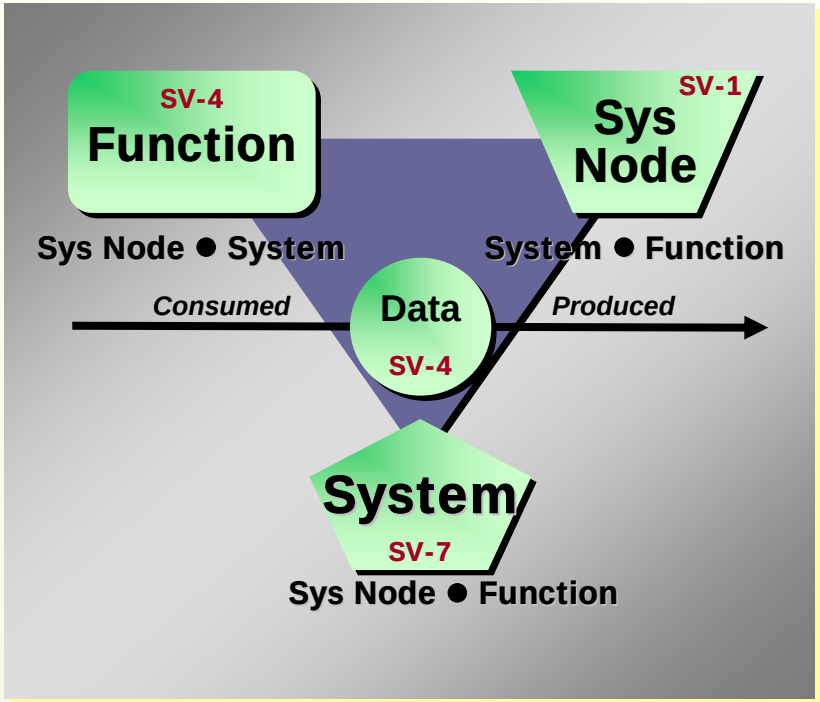
SV-6 Is:

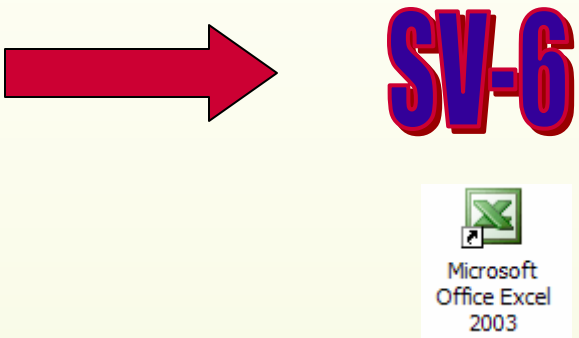
- Tabular in format.
- Focused on automated information exchanges (from OV-3) that are implemented in Systems.

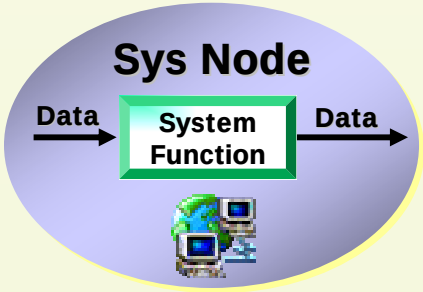
SV-6 Primary Features

- Detailed descriptions of individual System Data Exchanges.
  - An *Information Exchange* is to a *System Data Exchange* as a *birthday wish to a relative* is to a *Hallmark card (*or a *phone call*, or an *email*, or an *e-card*, etc.).
- Includes all relevant attributes of an SDE:
  - Information assurance, security
  - Timing, triggers, etc.
- Associates a particular SDE with a particular Systems Interface, and source & destination Systems Nodes/ Systems/ Systems Functions.

Dependencies between Work Products







Example SV-6

SDX	Valid	From System Function	From System Node	To System Function	To System Node	From System Entity	To System Entity	Data Flow	From SysNodeFunction Systems	To SysNodeFunction Systems
Actuator Positions	T	Adjust	UAV	Take Picture	UAV	Camera Pod	UHF Radio	Actuator	"Camera Pod	"Camera Pod
Actuator Positions	T	Adjust	UAV	Take Picture	UAV	Camera Pod	Camera	Actuator	"Camera Pod	"Camera Pod
Actuator Positions	T	Adjust	UAV	Take Picture	UAV	Camera Pod	Target	Actuator	"Camera Pod	"Camera Pod
Actuator Positions	T	Adjust	UAV Control	Take Picture	UAV	Camera	UHF Radio	Actuator	"Camera	"Camera Pod
Actuator Positions	T	Adjust	UAV Control	Take Picture	UAV	Camera	Camera	Actuator	"Camera	"Camera Pod
Camera Schedule	T	Schedule	Observer	Take Picture	UAV	UAV Mission	UHF Radio	Camera	"UAV Mission	"Camera Pod
Camera Schedule	T	Schedule	Observer	Take Picture	UAV	UAV Mission	Camera	Camera	"UAV Mission	"Camera Pod
Camera Schedule	T	Schedule	Observer	Take Picture	UAV	UAV Mission	Camera	Camera	"UAV Mission	"Camera Pod
Camera Schedule	T	Schedule	Observer	Take Picture	UAV	UAV Mission	Target	Camera	"UAV Mission	"Camera Pod
Camera Schedule	T	Schedule	Target	Take Picture	UAV	UAV Mission	UHF Radio	Camera	"UAV Mission	"Camera Pod
Camera Schedule	T	Schedule	Target	Take Picture	UAV	UAV Mission	Camera	Camera	"UAV Mission	"Camera Pod
Camera Schedule	T	Schedule	Target	Take Picture	UAV	UAV Mission	Camera	Camera	"UAV Mission	"Camera Pod
Camera Schedule	T	Schedule	Target	Take Picture	UAV	UAV Mission	Target	Camera	"UAV Mission	"Camera Pod
Camera Schedule	T	Schedule	Target	Take Picture	UAV	Tracking	UHF Radio	Camera	"UAV Mission	"Camera Pod
Camera Schedule	T	Schedule	Target	Take Picture	UAV	Tracking	Camera	Camera	"UAV Mission	"Camera Pod
Camera Schedule	T	Schedule	Target	Take Picture	UAV	Tracking	Camera	Camera	"UAV Mission	"Camera Pod
Camera Schedule	T	Schedule	Target	Take Picture	UAV	Tracking	Target	Camera	"UAV Mission	"Camera Pod

SV-10: SYSTEMS FUNCTIONALITY SEQUENCE AND TIMING DESCRIPTIONS

The dynamic behaviors concerning the timing and sequencing of events that capture system performance characteristics of an executing system.

SV-10 Has Three Options

Keypoint
SV-10 is the Systems View version of OV-6.

- SV-10a Systems Rules Model
  - Identifies business rules that constrain operational activities
- SV-10b Systems State Transition Description
  - Identifies business process responses to events
  - IDEF3 Object State Transition Network diagram used for this product
- SV-10c Systems Event-Trace Description
  - Traces actions in a scenario or sequence of events
  - A new diagram having the appearance of a UML Sequence diagram but whose symbols are related to DoDAF definitions was used

SV-11: Physical Schema

Physical Schema Definition:

The structure of the various kinds of System Data that are utilized by the Systems in the architecture.

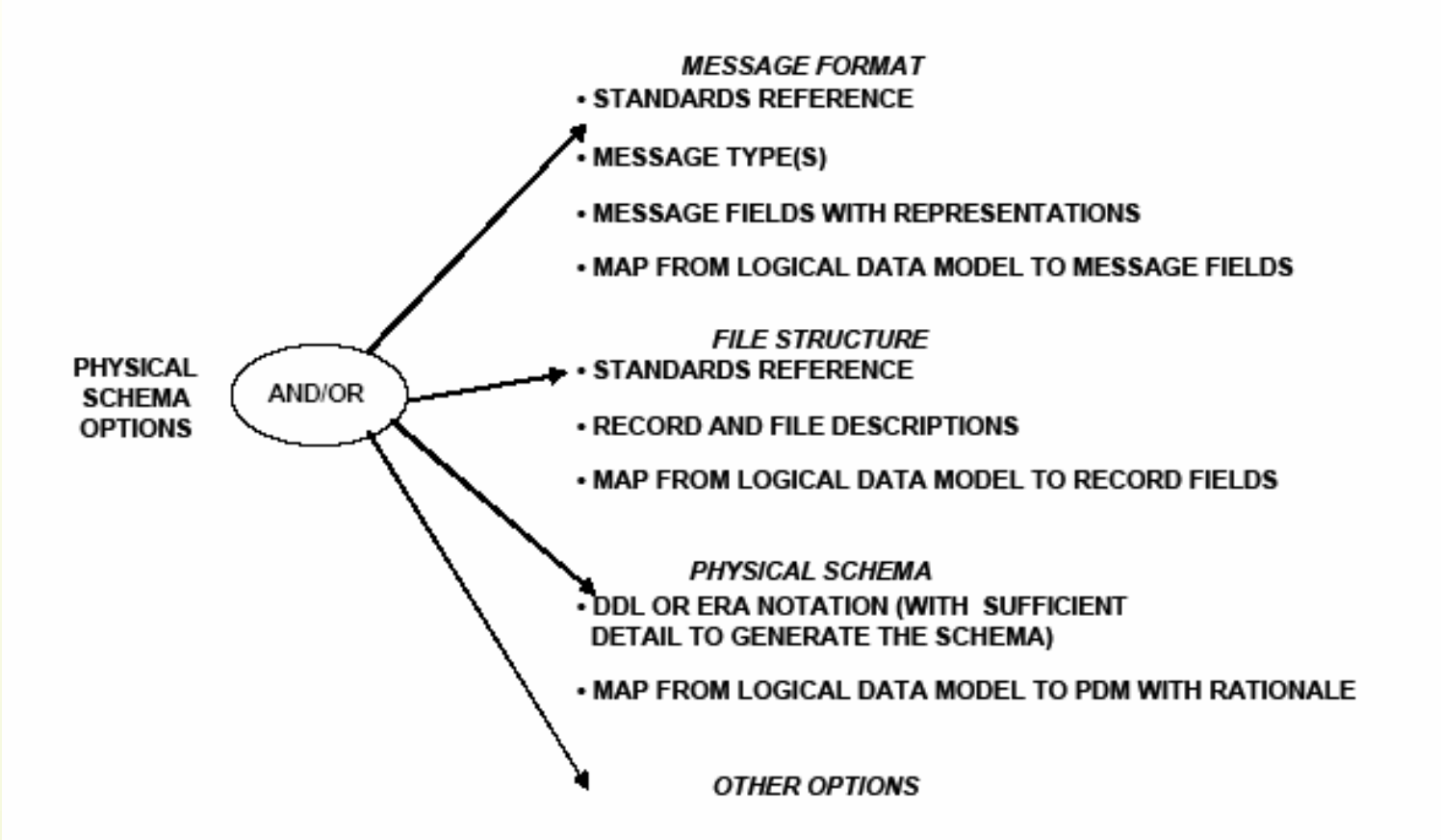
SV-11 Is:

- A graphical work product.
- An implementation-oriented data model that is used in the Systems View to describe how the information requirements represented in Logical Data Model (OV-7) are actually implemented.

SV-11 Primary Features

- A mapping from a given OV-7 to SV-11 (if both models are used).
- Entities that represent:
  - System Data flows in SV-4
  - System Data elements specified in SV-6
  - triggering events in SV-10b and/or events in SV-10c

SV-11 Representation Options



From DoD AF Version 1.0, Volume II

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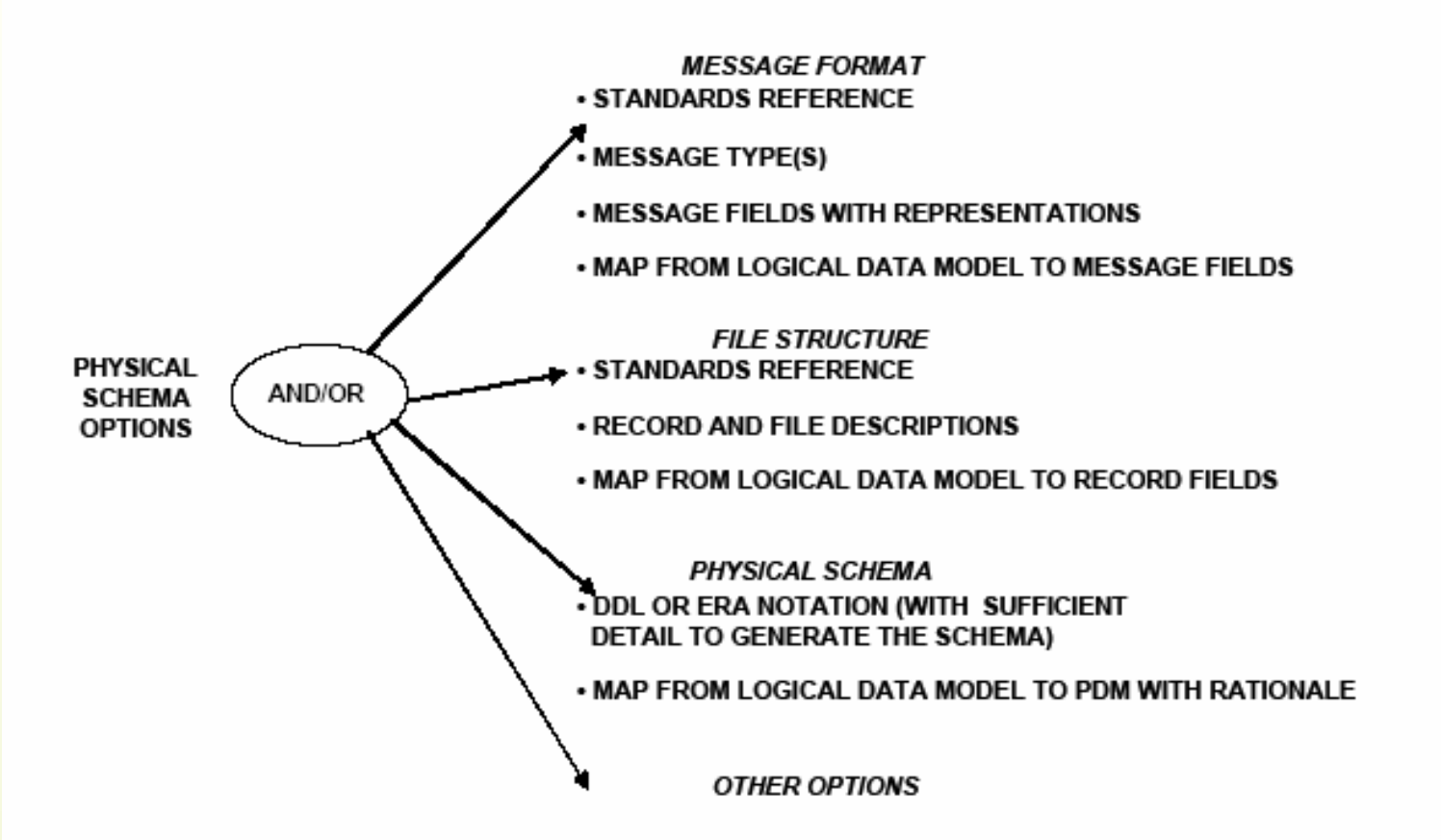


From DoD AF Version 1.0, Volume II

Technical Standards View

The TV is the minimal set of rules governing the arrangement, interaction, and interdependence of system parts or elements.

Technical Standards View (TV)

Keypoint
Standards that affect the Systems.

- Specifies the minimal set of rules governing the arrangement, interaction, and interdependence of system parts or elements.
- Provides the systems implementer with the knowledge upon which to base engineering specifications, common building blocks, and product lines.
- Is the collection of the technical standards, implementation conventions, rules, and criteria that govern the systems of an architecture.

DoD AF TV Work Products

Product	Name	General Description
TV-1	Technical Standards Profile	Listing of standards that apply to Systems View elements in a given architecture
TV-2	Technical Standards Forecast	Description of emerging standards and potential impact on current Systems View elements, within a set of time frames

TV-1 Primary Features

- Systems Standards rules.
- A source document is used for identifying each standard:
  - OMB's Technical Reference Model (TRM) [OMB, 2003]
  - DoD TRM
  - DISR

Example TV-1

IA/Security

Service	Standards	Description
Data Interchange	XML	
	SOAP	
	Data Access Policy	
	Data Acquisition Policy	
Secure Voice	Voice	
EMSS	MIL-STD-188-164	UHF (SATCOM): Interoperability and Performance Standards for C-Band, X-Band and Change 1 9 September 1998
	MIL-STD-188-181B	UHF (SATCOM) Standard for Single Access 5-Khz and 25-Khz UHF Satellite Communications Channels, 20 March 1999
	UAV Track	

DoD AF Overview

Some Important Notes

Some Important Notes

- Work product numbering does not correlate to the order in which they are created.
- Leveraging the relationships between views and work products is CRITICAL to building and using the architecture.
  - Corollary: Do Not have people working separately on related work products such as OV-2, OV-3, and OV-5.
- Pictures are worth a thousand words BUT make sure they are the correct and meaningful words.
  - That being said, a pretty picture is only eye-candy if it does not portray the meaning intended. Ensure the Architecture information is capture by the work products prior to engaging in “Art-itecture”.

The Minimum Requirements for an Integrated Architecture

- According to the DoD AF, an architecture is integrated when products and their constituent architecture data elements are developed such that data elements defined in one view are the same (i.e., same names, definitions, and values) as data elements referenced in another view.
- According to DoDAF, these work products must be included in order for an architecture to be considered integrated:
  - AV-1, AV-2
  - OV-2, OV-3, OV-5
  - SV-1
  - TV-1
- However, as you will see later this minimal set is not sufficient to get the full use and benefit of the DoDAF.

Building an Architecture

Suggested Products Based On Use of Architecture

APPLICABLE ARCHITECTURE PRODUCTS

RECOMMENDED USES OF ARCHITECTURE:	All View		Operational View (OV)							Systems View (SV)											Tech Stds View	
	1	2	1	2	3	4	5	6	7	1	2	3	4	5	6	7	8	9	10	11	1	2
Planning, Programming, Budgeting Execution Process																						
Capability-Based Analysis for IT Investment Decisions	●	●	●	●	●	●	●	●	◎	●	◎	●	●	●	●	●	●	●	●		●	◎
Modernization Planning and Technology Insertion/Evolution	●	●	◎	●	◎	◎	●	◎		●	◎	◎	◎	●	◎	●	●	●			●	●
Portfolio Management	●	●		●			●	◎		●			◎	●		◎	●				◎	
Joint Capabilities Integration and Development System																						
JCIDS Analysis (FAA, FNA, FSA)	●	●	●	●	◎	◎	●	●		●	◎		◎	●							◎	
ICD/CDD/CPD/CRD	●	●	●	●	●		●	●		●	◎	◎	●	●	●	◎	◎	◎	●		●	◎
Analysis of Alternatives (AoA)	●	●	●	●	◎		●	●		●	◎	◎	●	●	◎	◎	◎	◎			◎	◎
Acquisition Process																						
Acquisition Strategy	●	●	●	●	◎		●	◎		●	◎			●							●	
C4ISP	●	●	●	●	●		●	●		●			◎		●	◎					●	◎
System Design and Development	●	●		●	●		●	●	◎	●	●	●	●	●	●	●	●	◎	◎	◎	●	◎
Interoperability and Supportability of NSS and IT Systems	●	●	●	●	●	◎	●	◎	◎	●	◎	●	●		●	●	◎	◎	◎	◎	●	◎
Integrated Test & Evaluation	●	●		●	●	◎	●	●	◎	●	●	●	●	●	●	●			●	◎	●	
Operations (Assessment, Planning, Execution, ...)																						
Operations Planning & Execution	●	●	●	●	●	●	●	●	◎	●	●	◎	◎	●	◎	◎					◎	
CONOPS & TTP	●	●	●	●	●	●	●	●		●	◎	◎	◎	◎							◎	
Communications Plans	●	●	●	●		◎	◎			●	●						◎	◎			●	◎
Exercise Planning & Execution	●	●	●	●	●	●	●	●		●	●	◎	◎	◎	◎						◎	
Organizational Design	●	●	●	●	●	●	●	◎	◎	◎	◎			◎								
BPR/FPI	●	●	◎	●	●	●	●	●	◎													

● = Product is highly applicable
◎ = Product is often or partially applicable
▇ = Product is specifically addressed in policy
▭ = Product is required for an integrated architecture
blank = Product is usually not applicable

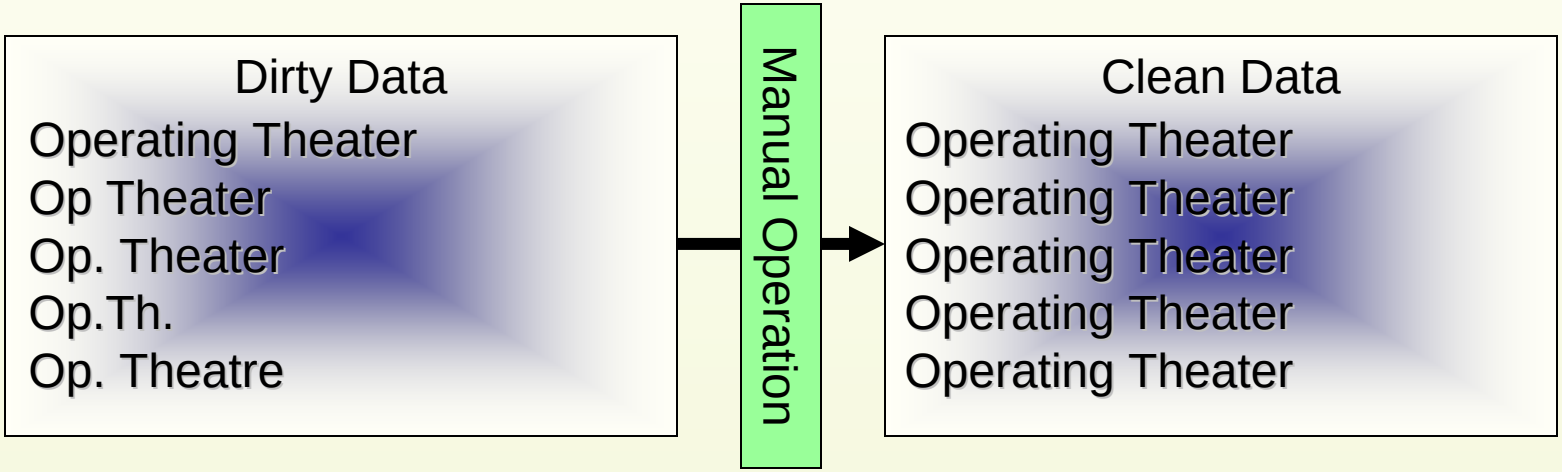
From DoD AF Version 1.0, Volume I

Architecture Prerequisites

- Define the “Enterprise”
- Define the stakeholders of the enterprise
- Define the perspective of the architecture to be built
- Define what ‘System’ and other key architecture terms mean to the enterprise.
- Organization wide (as a minimum), determine naming conventions for new data.
- Clean Data!

Clean Data

- Be aware of Synonyms: DoD and Department of Defense mean the same thing
- And also Homonyms: a tank means one thing to an Army General and another to a Navy diver



- Where can naming conventions be found?
  - DARS
  - Organizational resources (e.g. Navy Common Operational Activity List)

Using an Activity-Based Methodology* to create an Integrated Architecture

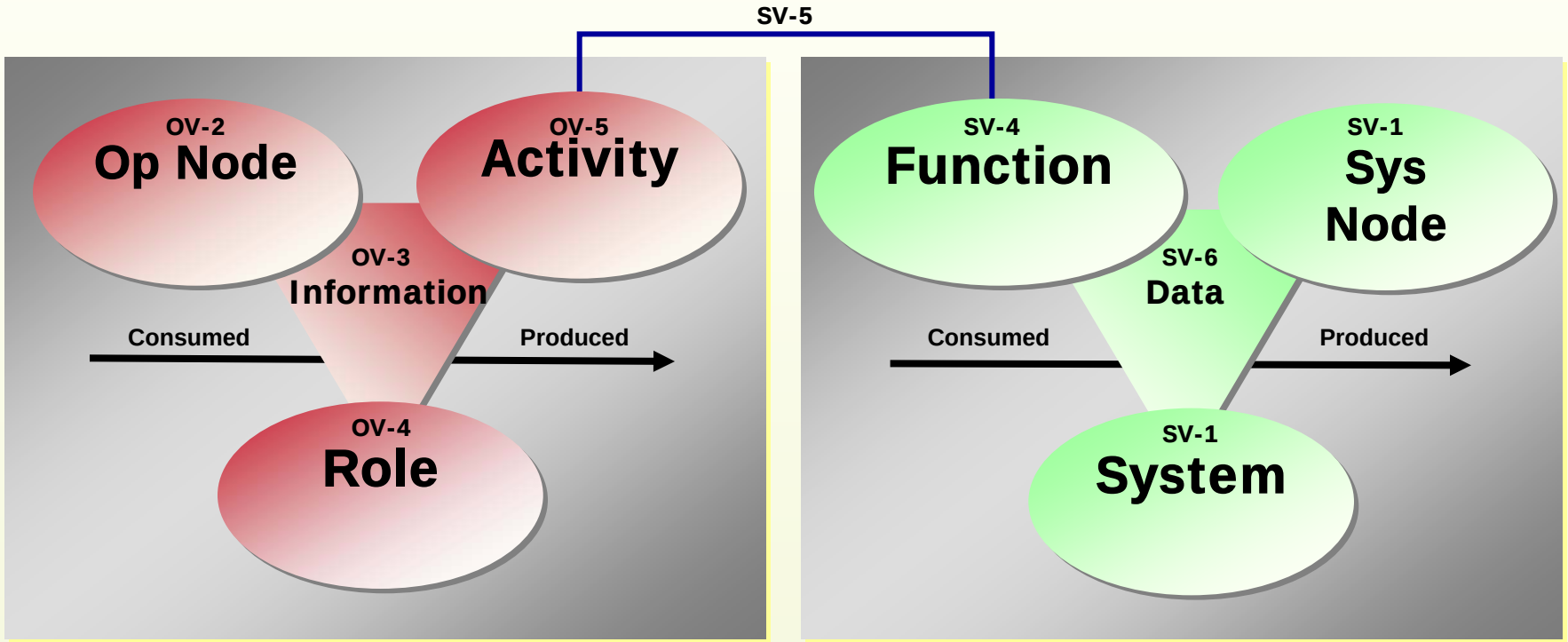
- Consists of a tool-independent approach to developing fully *integrated, unambiguous, and consistent* DoD AF views.
- Enables both:
  - "*As-Is*" (now) architectures - all details known
  - "*To-Be*" (future) architectures - based on unknowns and abstract elements where not all details known
    - "To-Be" architectures must support "*gap-analysis*" to discover future unknown rules, patterns, practices, relationships, and requirements

*Activity-Based Methodology is a concept developed by The MITRE Corporation and Lockheed-Martin, Copyright © 2003

Activity-Based Methodology (cont.)

- Uses *data centric* approach for architecture element and product rendering:
  - Supports cross-product relationships based on core set of architecture elements
  - Simplified "architecture specification model" of architecture elements and their associations/relationships based on DoD AF and <u>not</u> CADM
- Captures sufficient representations of architectures models to transition to "*dynamic*" executable process models

DoD AF "Core" Artifacts



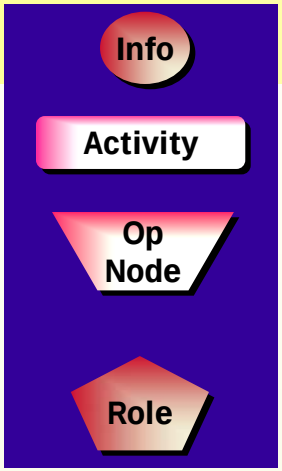
Activity ● Op Node ● Role ● Information

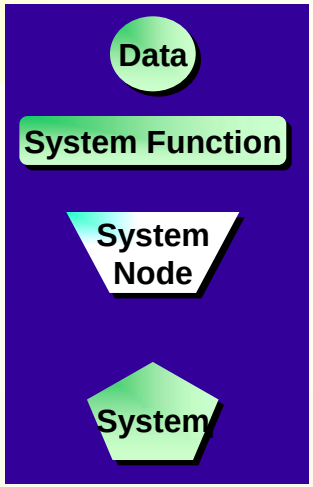
Function ● Sys Node ● System ● Data

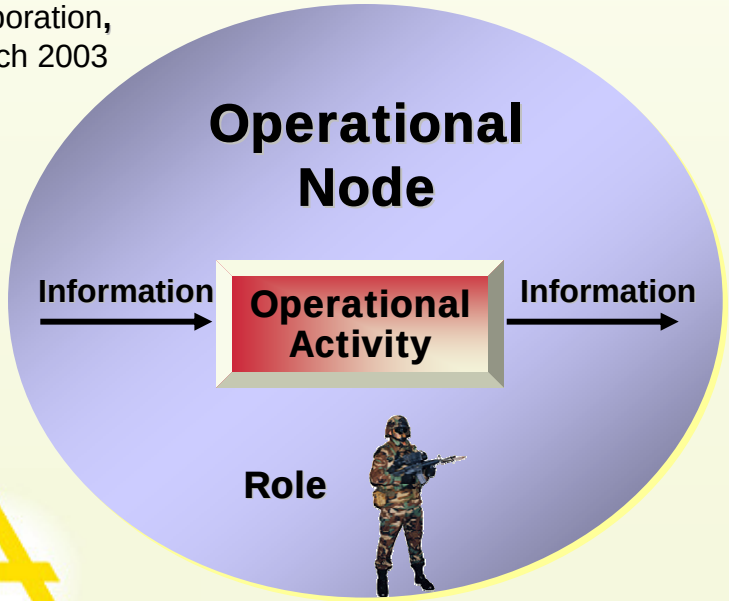
From *An Activity-Based Methodology for Development and Analysis of Integrated DoD Architectures*, Steve Ring, Mitre Corporation, March 2003

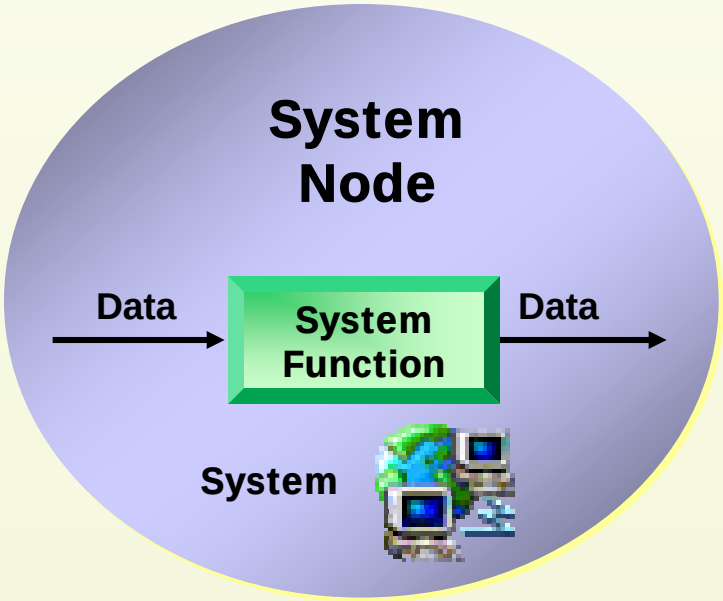
Core Artifacts in an Integrated Architecture

From *An Activity-Based Methodology for Development and Analysis of Integrated DoD Architectures*, Steve Ring, Mitre Corporation, March 2003



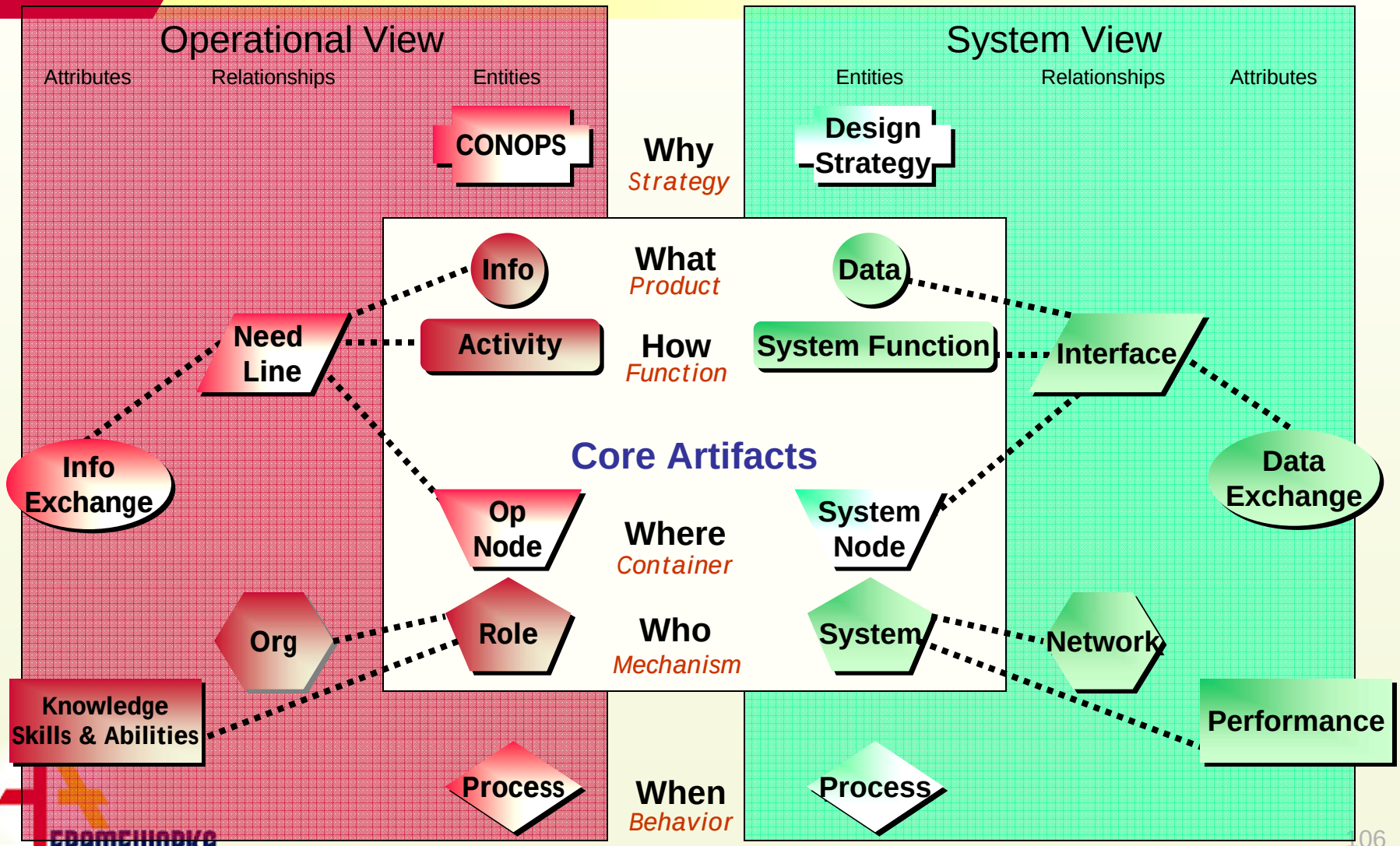






Building an Architecture

Relationships of Core Artifacts



A Suggested Architecture Development Process

- Begin With:
  - AV-1: It starts to organize the architecture
    - Defining the scope and purpose delineates the workspace and allows the selection of work products
    - Serves as a comparison reference when the architecture is complete
  - OV-1: Again, it helps to organize thinking. However this product may be updated and adjusted throughout the development process

A Suggested Architecture Development Process

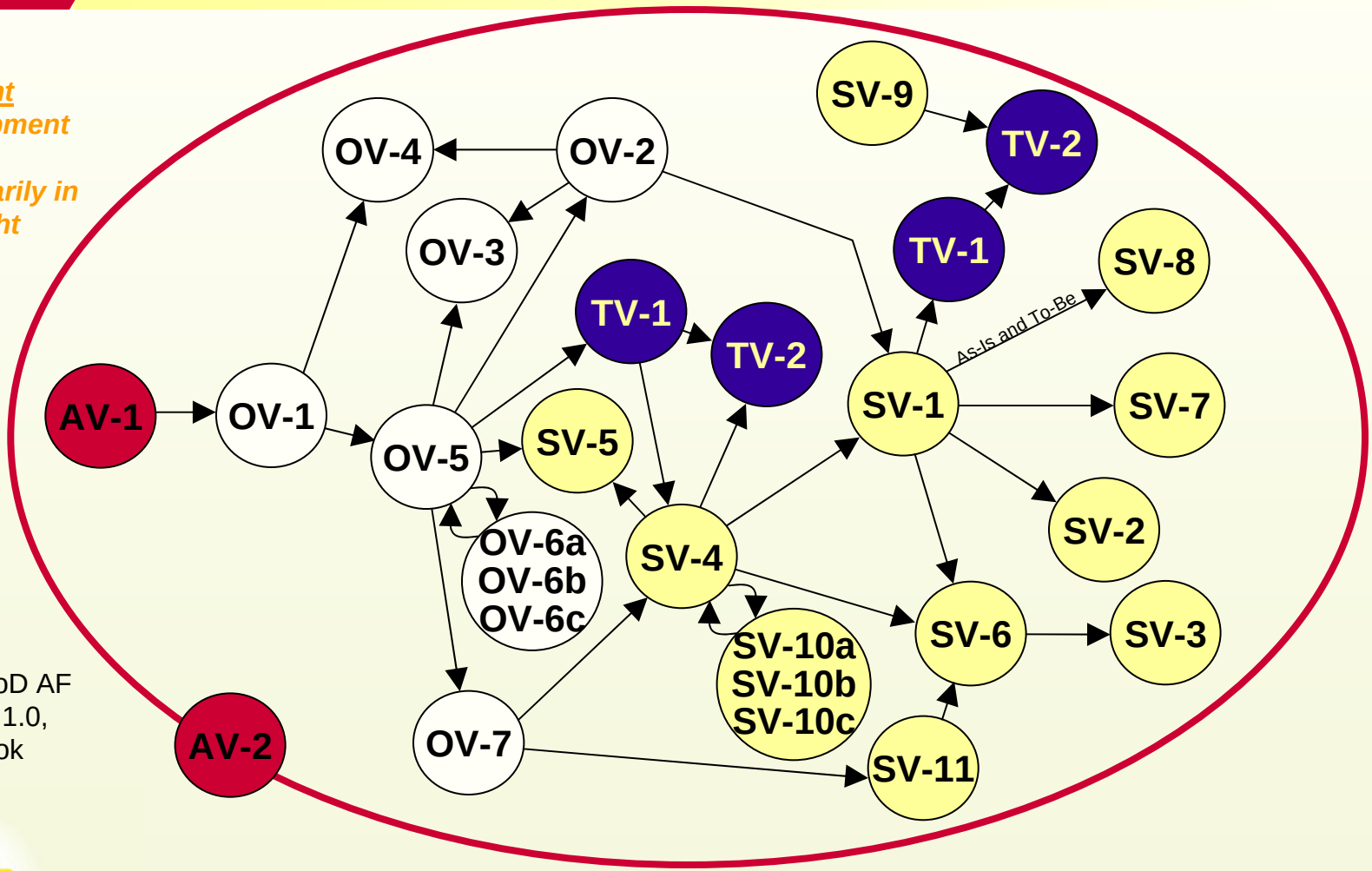
- Operational View:
  - Develop OV-5
  - Assign Operational Activities to Nodes
  - Build OV-2
  - Build OV-3 Report
  - Build OV-4 (optional)
  - Build OV-7
  - Build OV-6 (if needed)
- System View:
  - Develop SV-5
  - Develop SV-4
  - Develop SV-1
  - Assign System Functions to Systems
  - Build SV-6 Report
  - Build SV-7 Report
  - Build SV-2; SV-3; SV-10; SV-11; SV-8; SV-9 as needed

A Suggested Architecture Development Process

- Technical Standards View:
  - List the standards that apply to Systems View elements (TV-1)
  - Describe the emerging standards and potential impact on current Systems View elements (TV-2)
- AV-2:
  - This work product is automatically created in a repository based tool

A Work Product Development Sequence

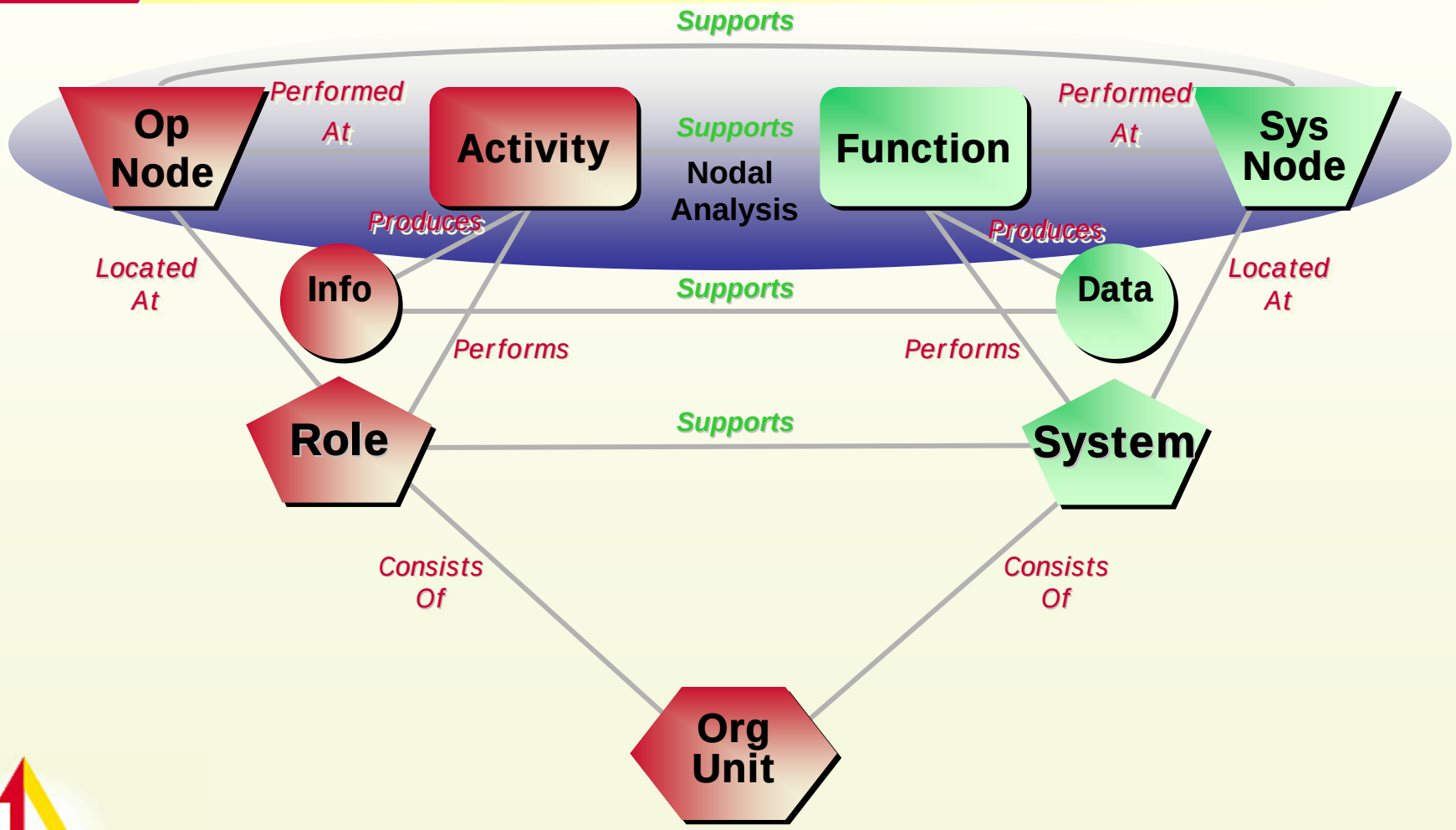
Keypoint
Development is not necessarily in a straight line!



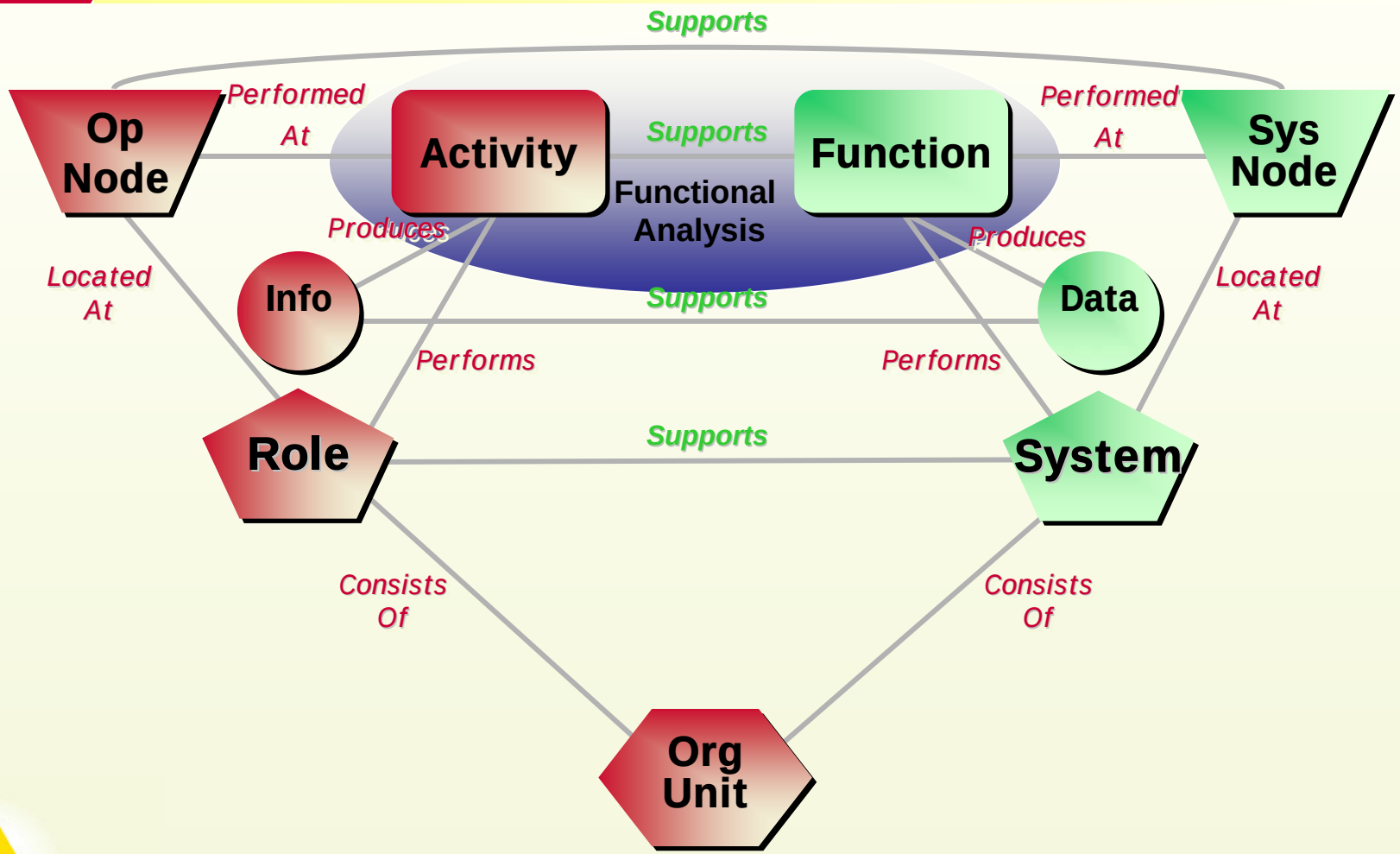
From DoD AF Version 1.0, Deskbook

Figure 2.2-2. Data-Centric Build Sequence

Uses of a Completed Architecture



Uses of a Completed Architecture



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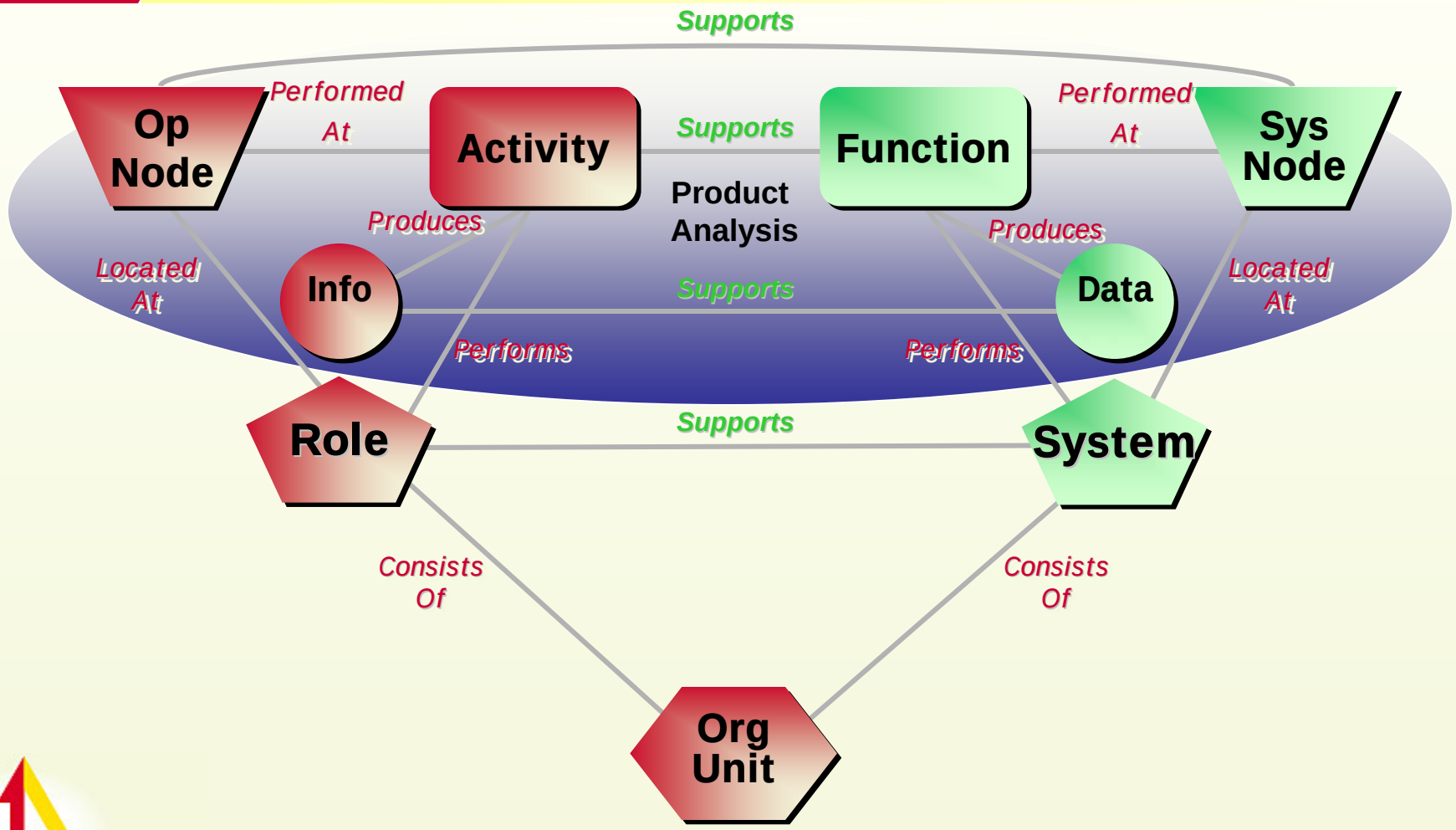

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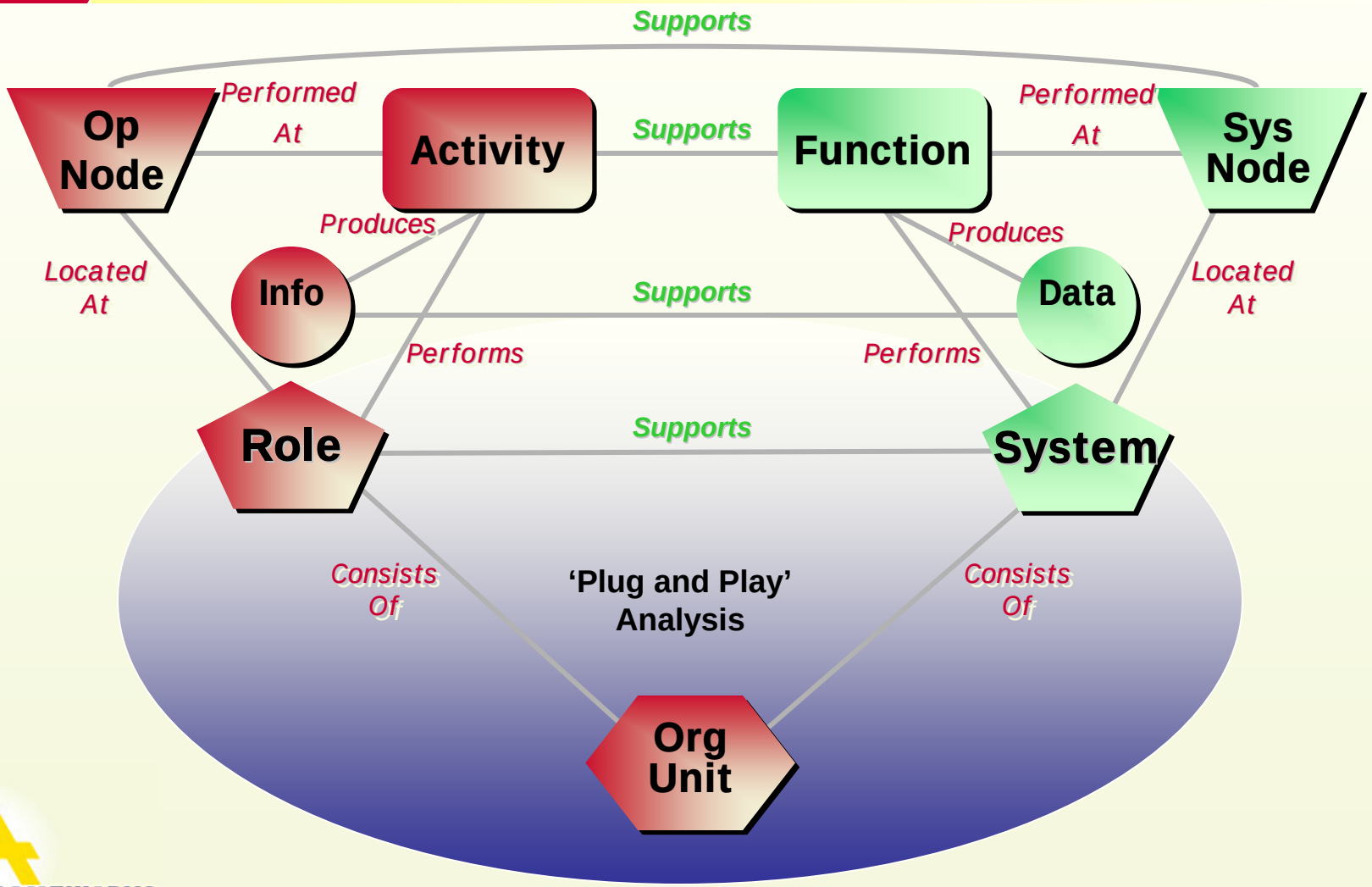
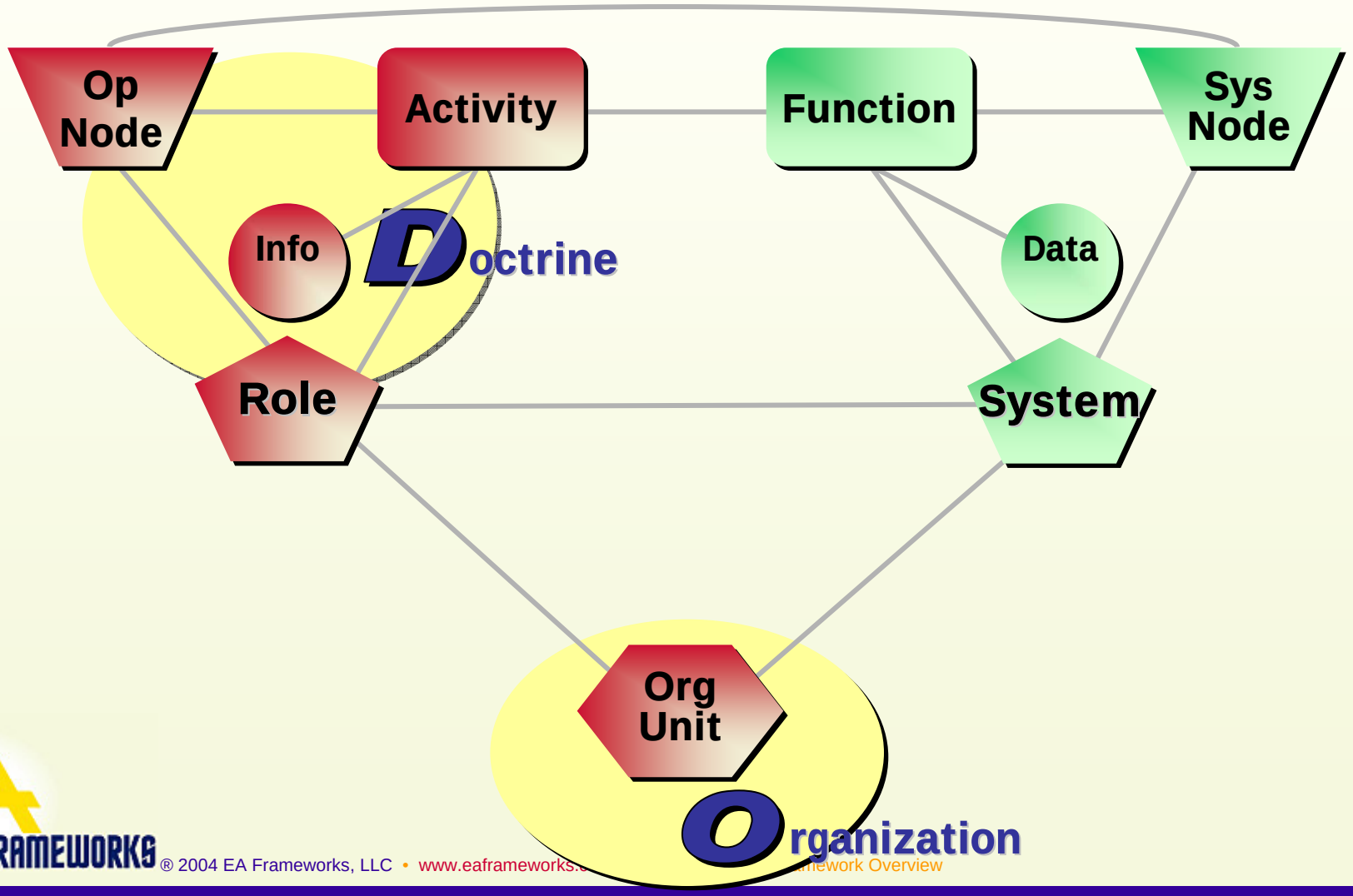


The Relationship to DOTLMPF



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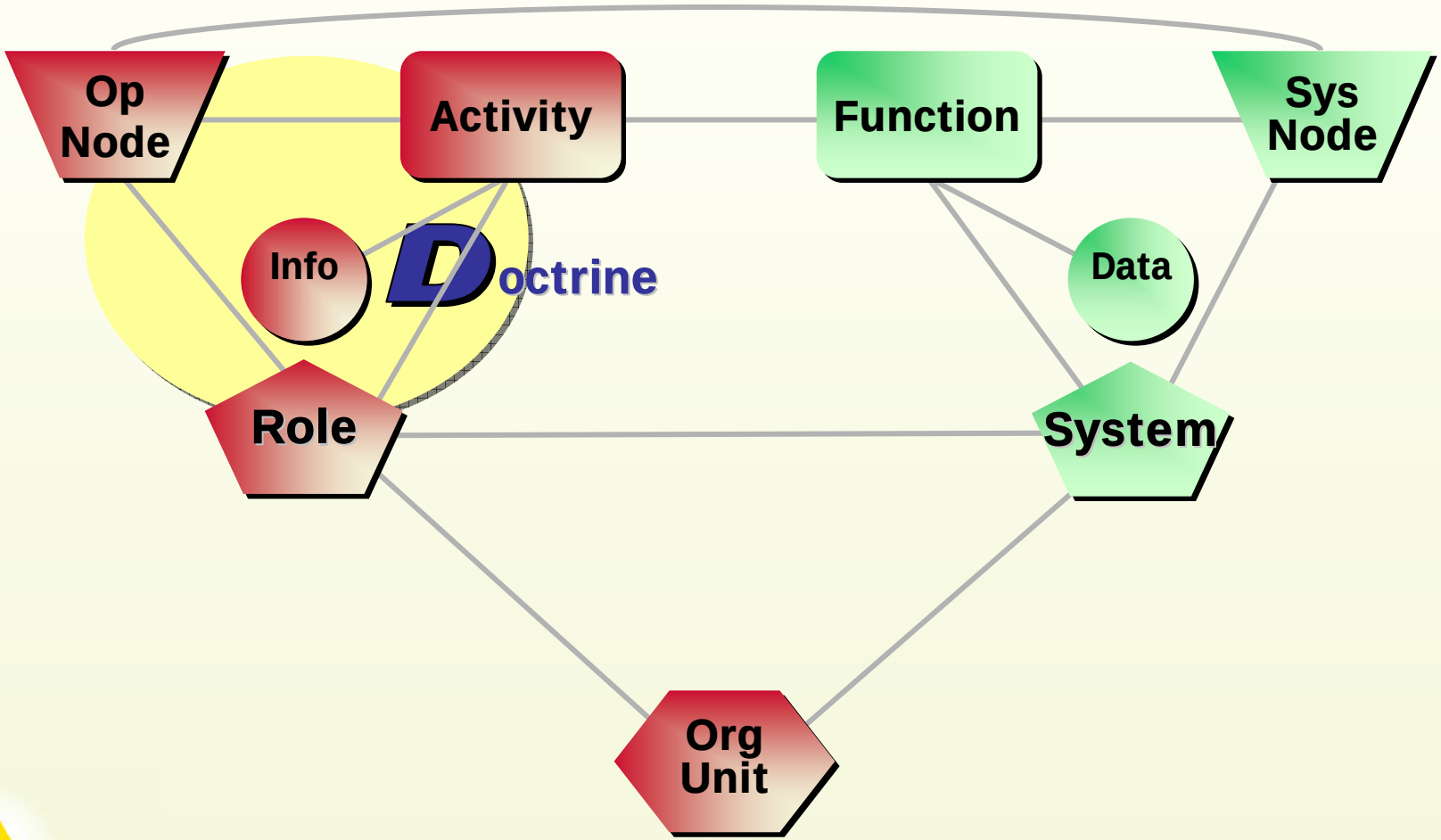

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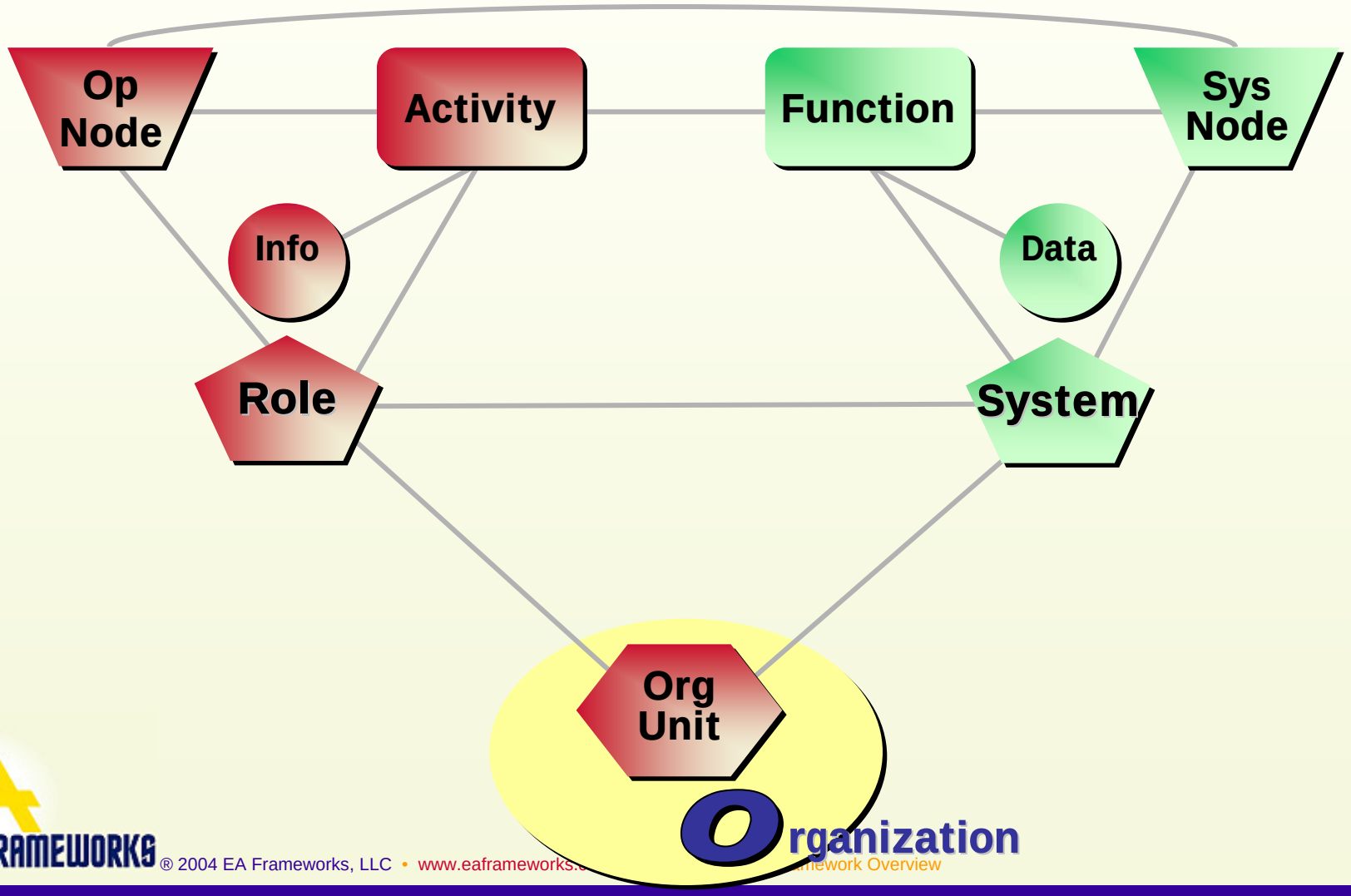

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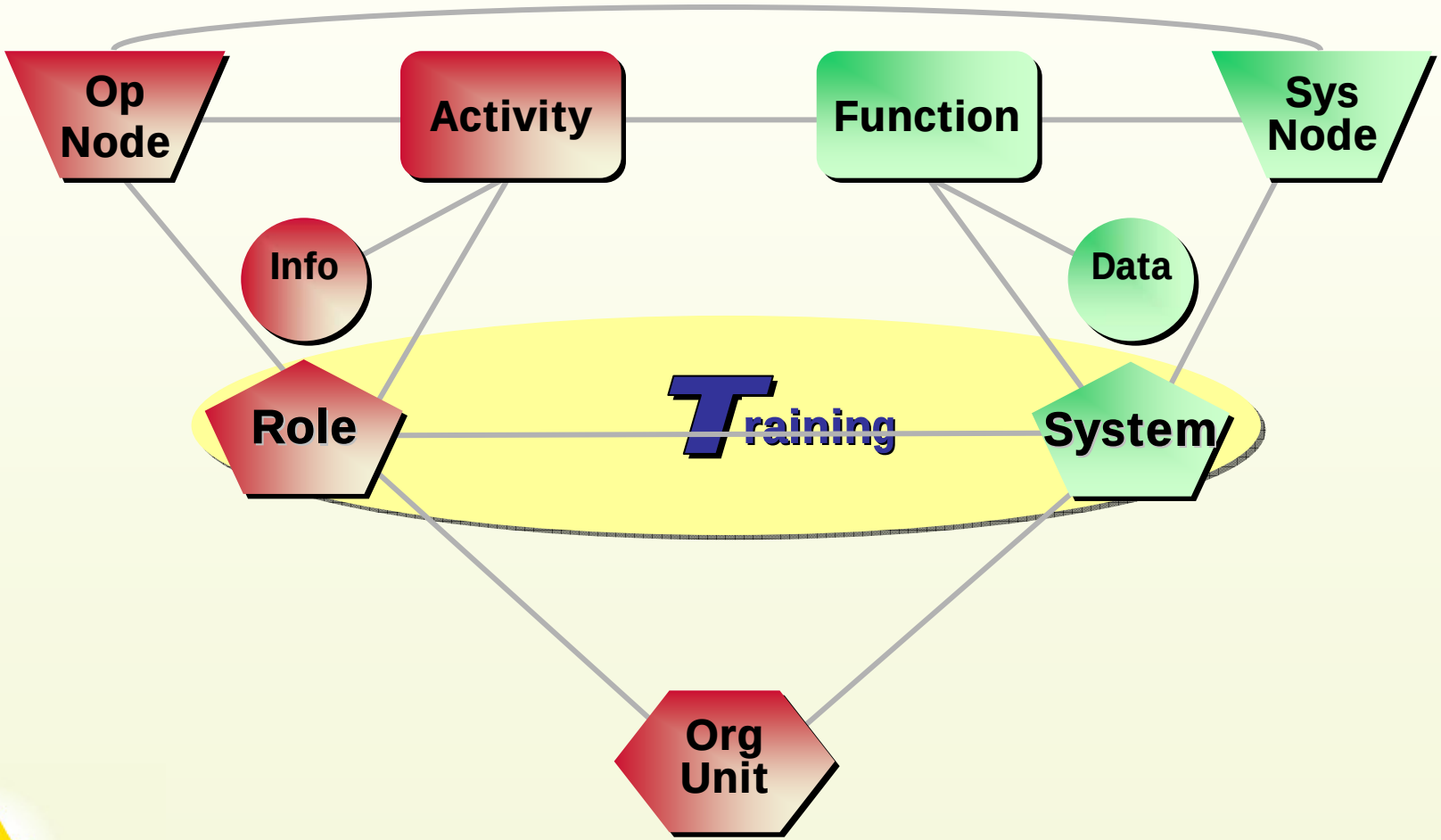

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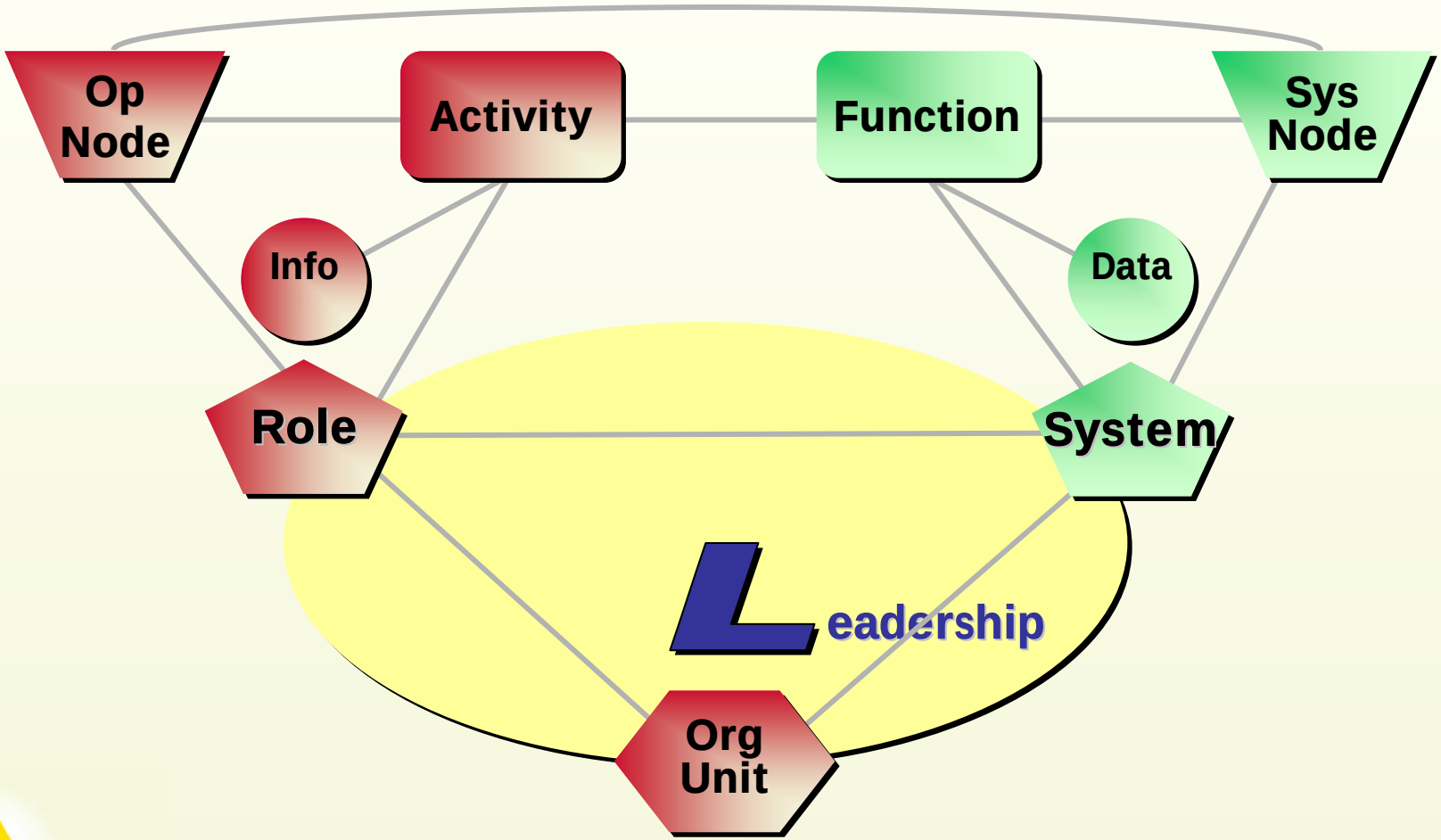

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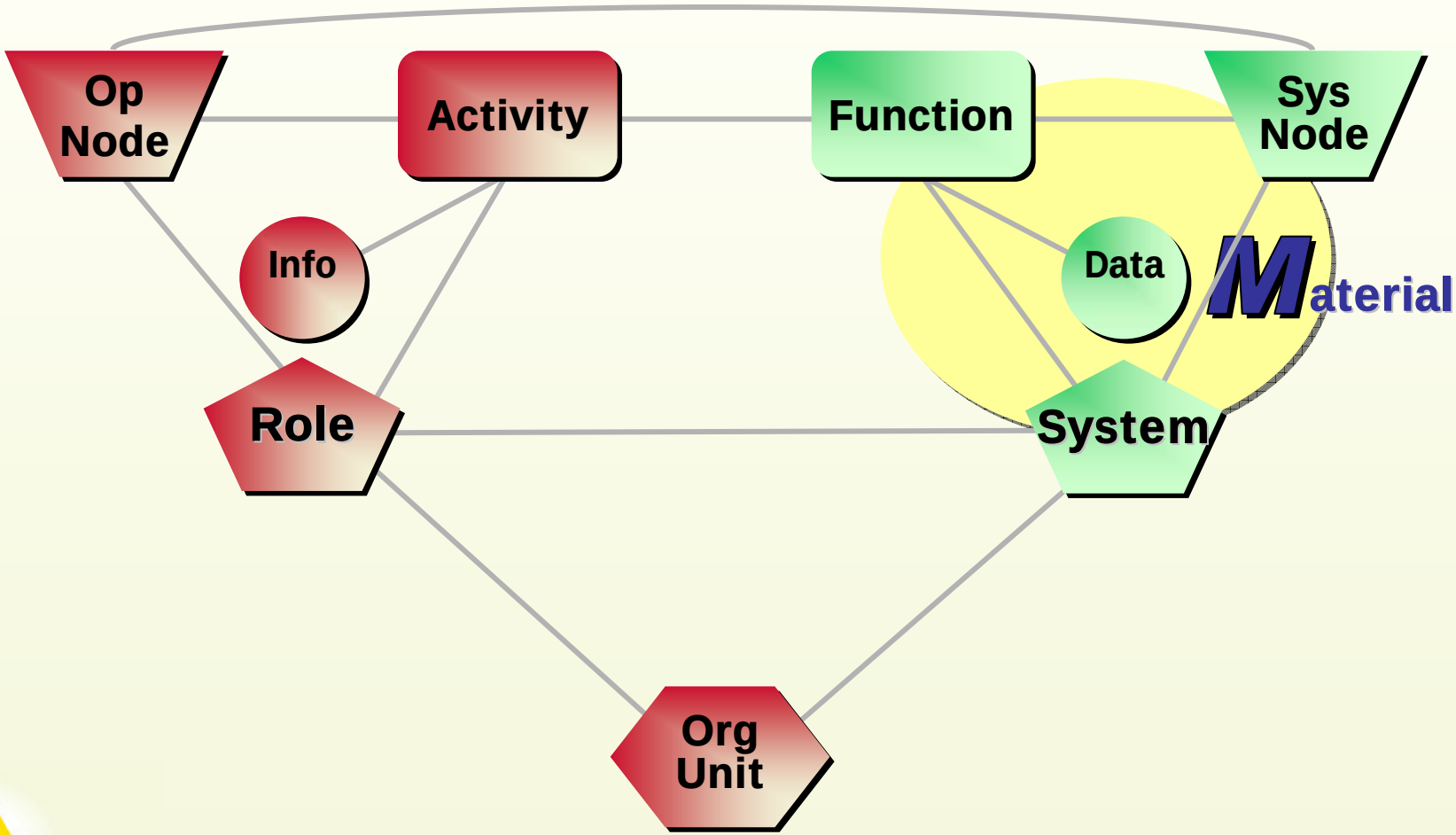

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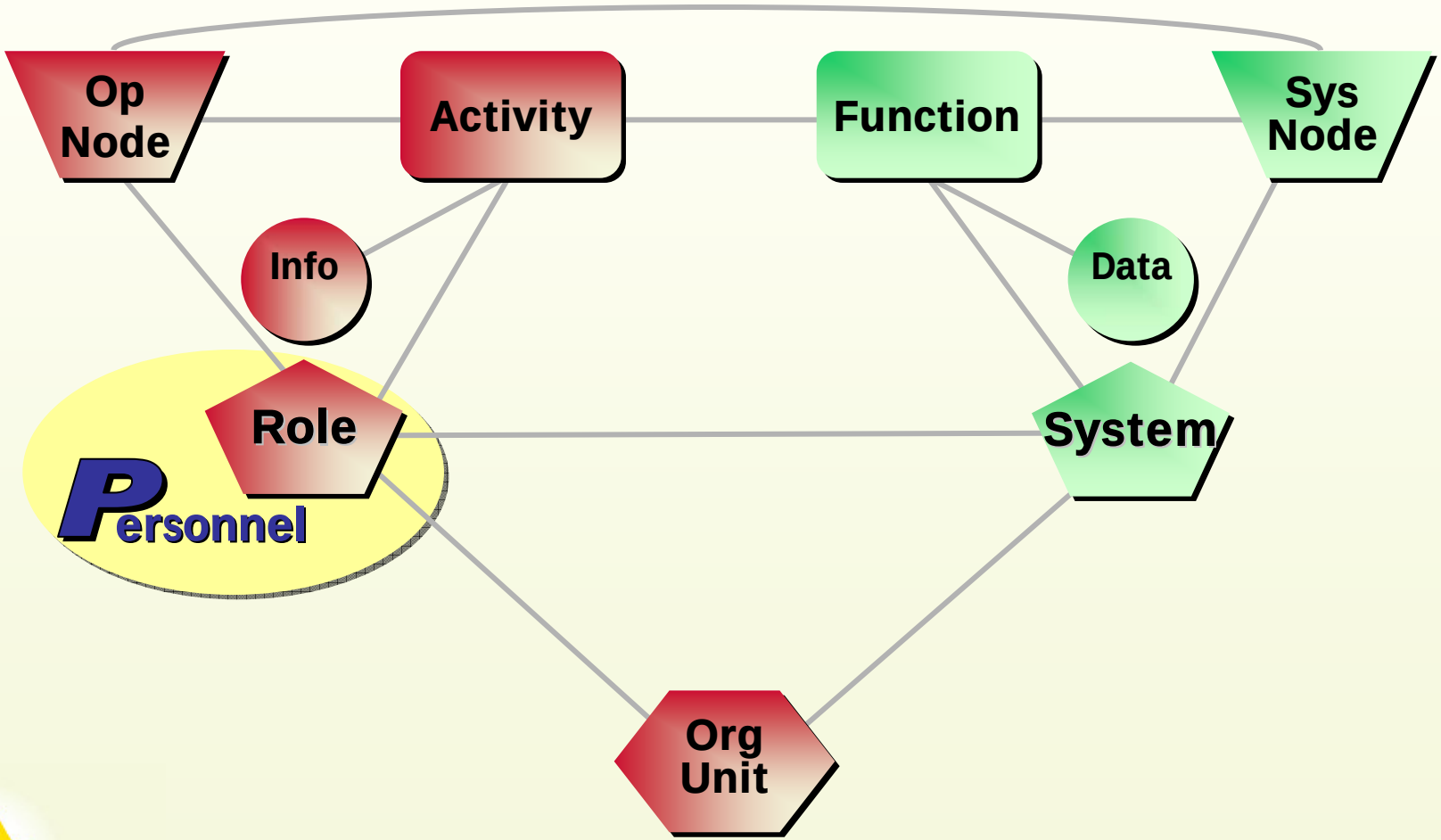
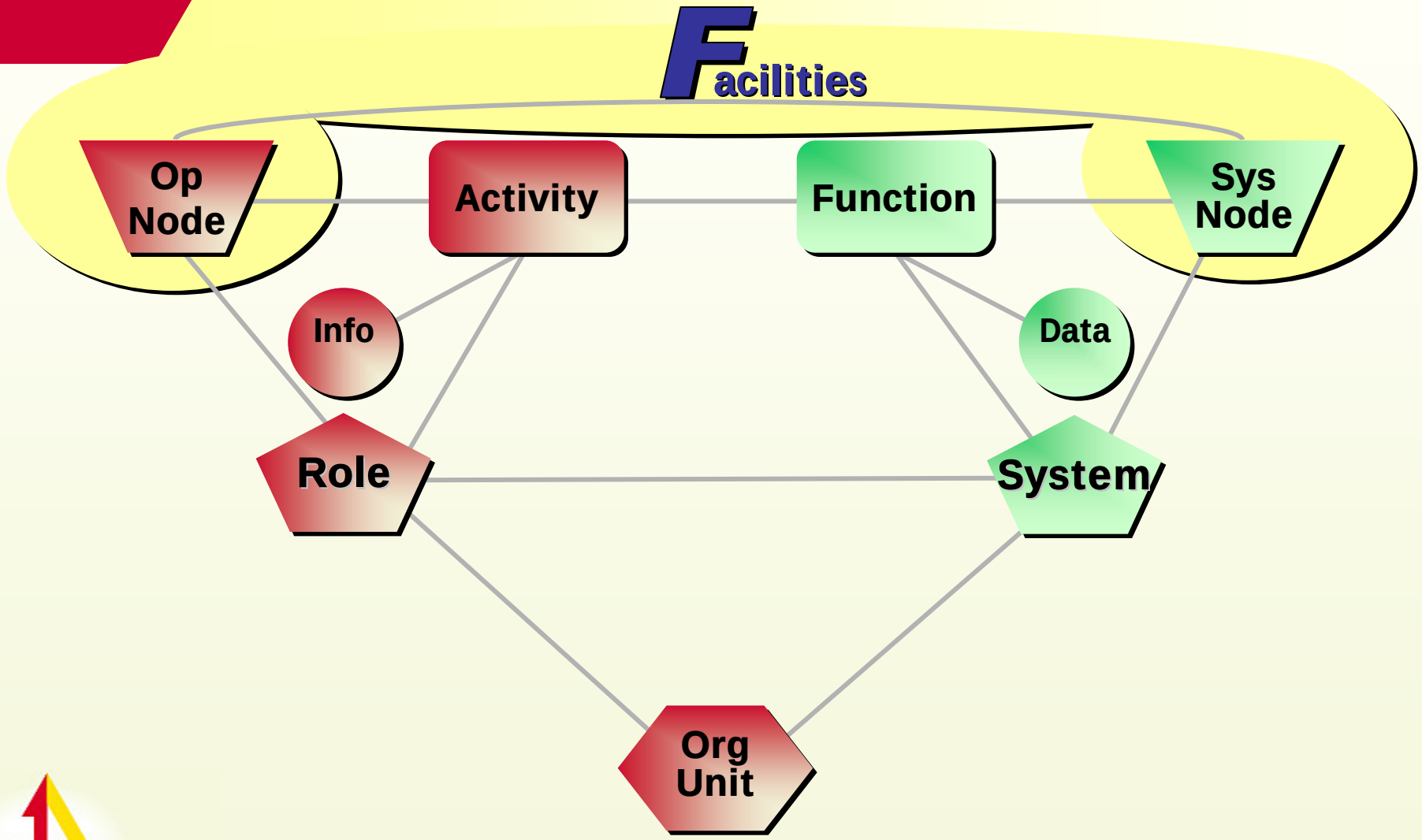


The Relationship to DOTLMPF



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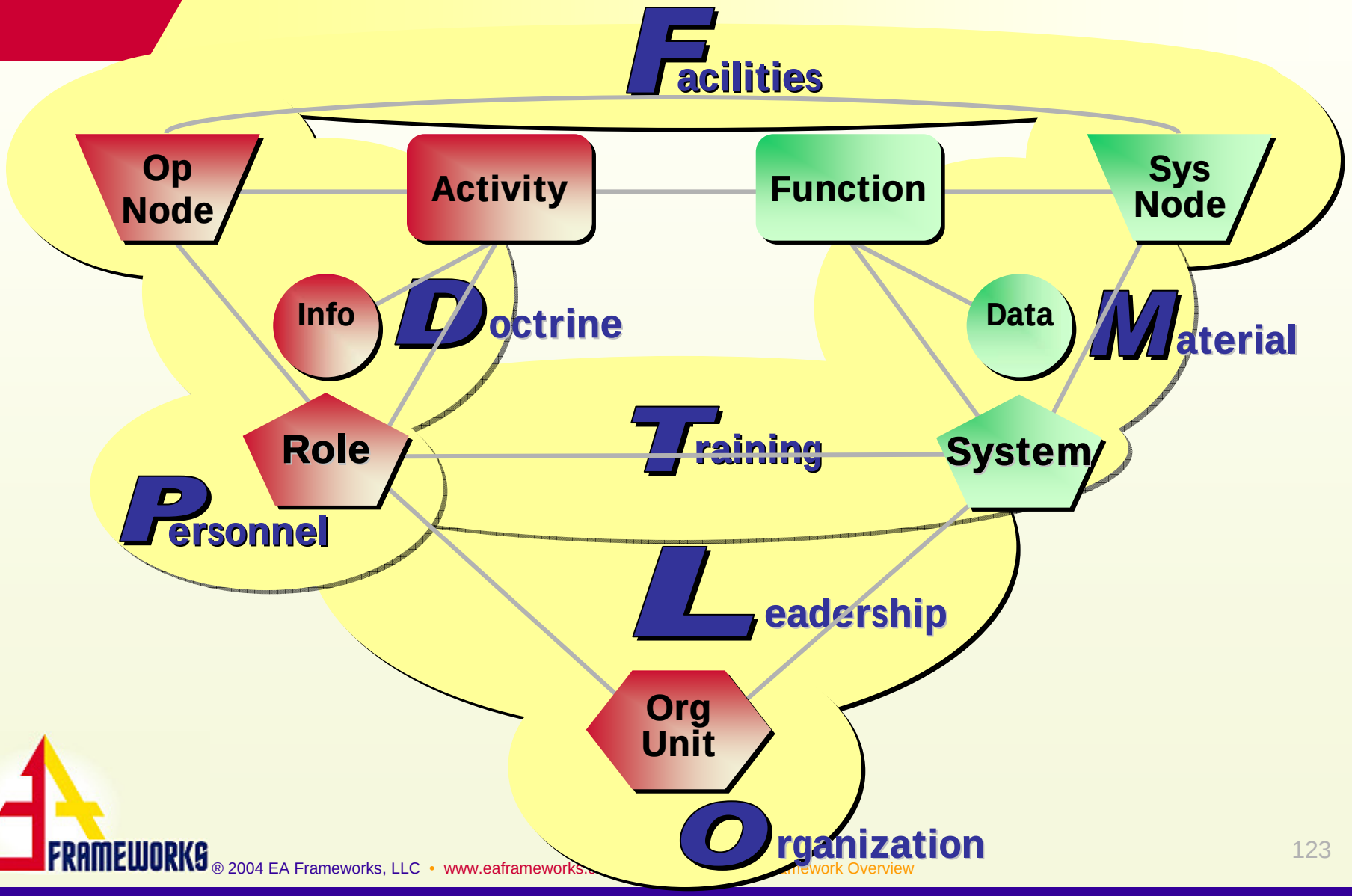


Core Architecture Data Model (CADM)

- The Framework defines standard architecture product names, data elements, data attributes, and relationships between products and data.
- The CADM defines the standard for these architecture data elements as entities and defines their relationships.
- The CADM provides the logical basis for moving architectures from compendiums of documents, spreadsheets, and graphics to architecture data that can be stored in architecture data repositories and manipulated with automated tools.

DoD Architecture Repository System (DARS)

- The Office of the Assistant Secretary of Defense for Networks and Information Integration is developing DARS as a DoD AF-compliant, CADM-compliant architecture data repository for hosting accredited DoD architecture data.
- The repository is intended to be a central location for storing approved/ accredited architectures developed by the Commands, Services, and Agencies (C/S/As), and includes both legacy and newly accredited architectures.

DoD AF Tool – DARS Interface

Successful demonstration of round trip via CADM XML – 30 Sep 03

COTS Architecting Tool A

CADM XML

COTS Architecting Tool B

CADM XML

COTS Architecting Tool C

CADM XML

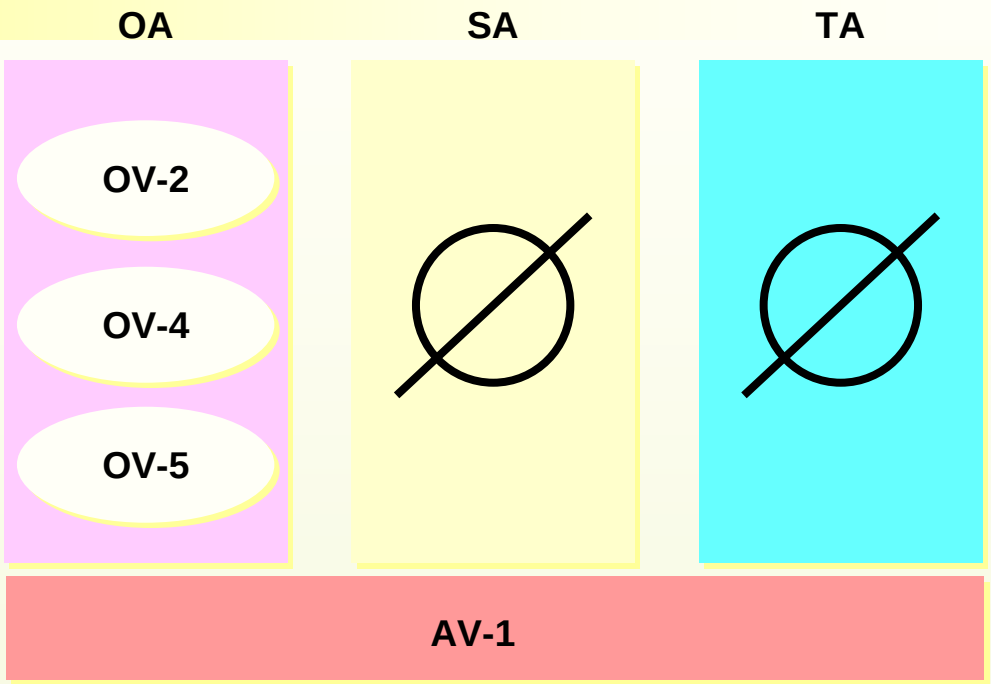
DARS

DARS full round trip supported

Not doing tool interoperability

DARS AIPP PHASE I – PROOF OF CONCEPT

- Achieve a Structured architecture data interface between COTS tools and DARS for data required for integrated Architecture Products as defined in DODAF ver 1 using CADM XML
- Achieve 'full' data-centric architecture creation and maintenance
- Develop technical know-how and expertise for the entire 'data layer' needed to support the entire DoDAF requirements (ultimate goal)

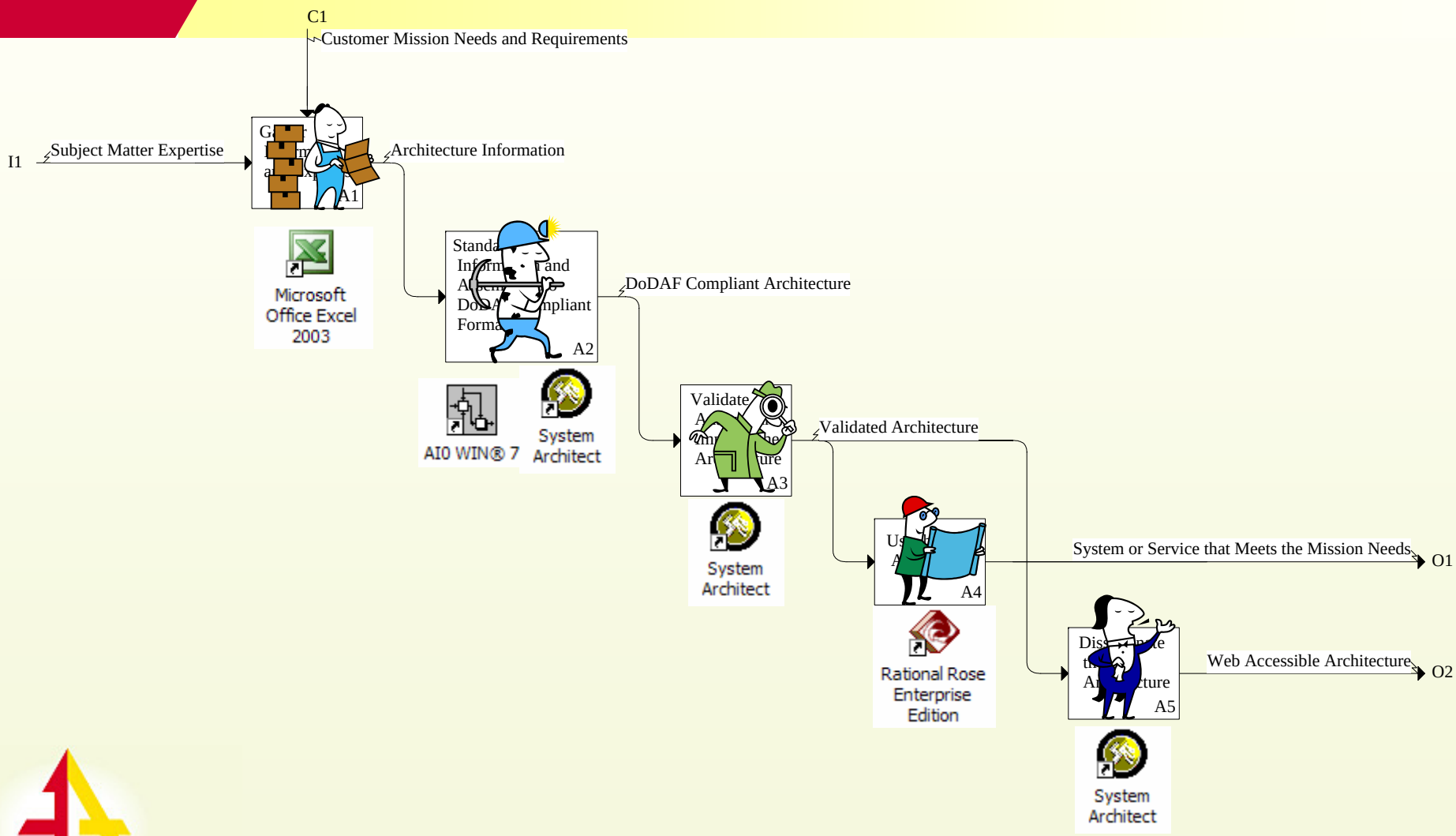


- Original Vendors
  - Popkin (System Architect)
  - Proforma
  - IBM / Rational (Rose)
  - Computas (Metis)

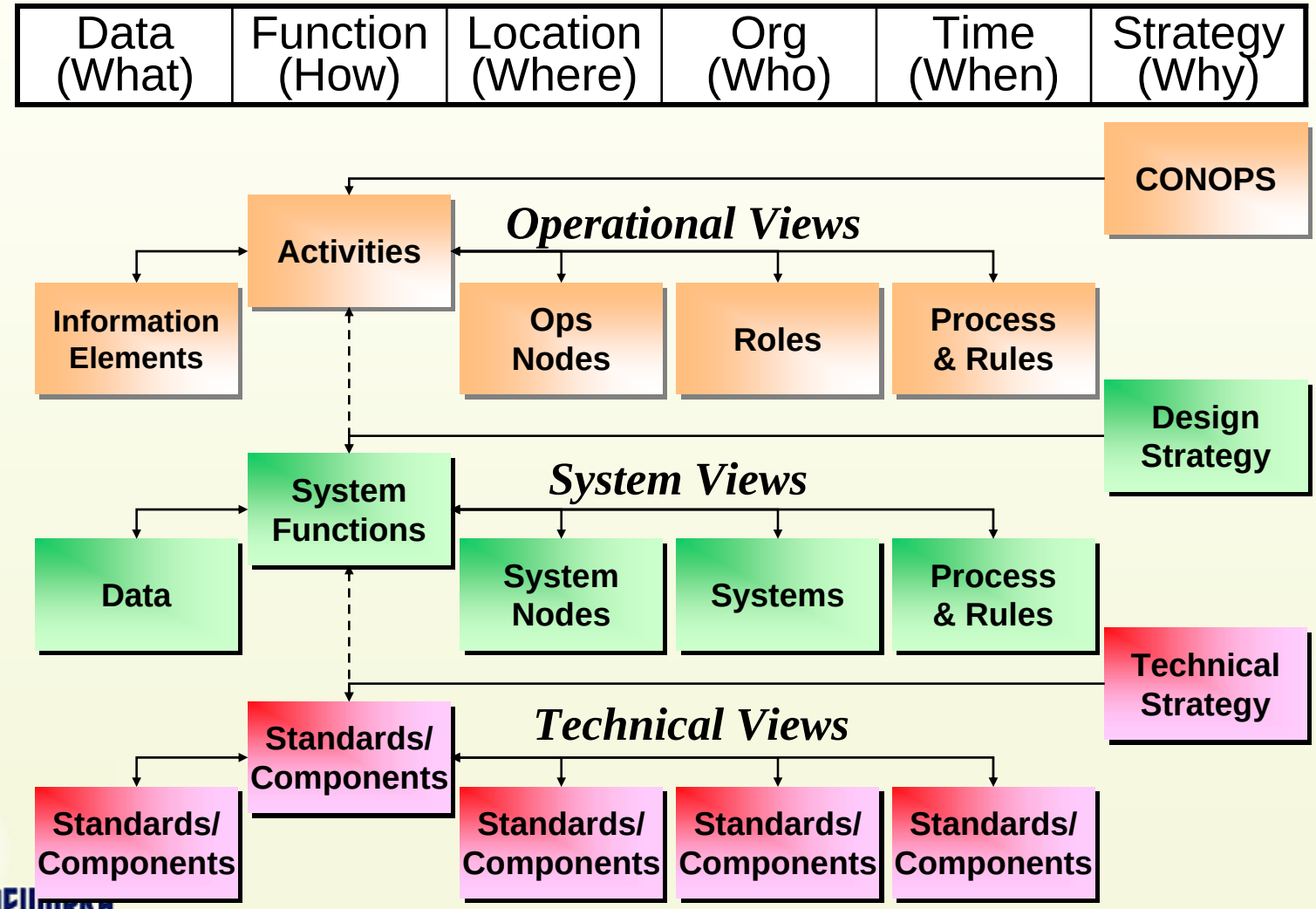
"DoD AF Tools"

- Data Gathering Tools
- Requirements Tools
- Modeling Tools
- Repository Tools
- Configurations Management and Version Control Tools
- Analysis Tools
  - Simulation Tools
  - Reporting Tools
  - Costing Tools, etc.
- Presentation Tools

One Concept


C1
Customer Mission Needs and Requirements
I1
Subject Matter Expertise
Architecture Information
A1
Microsoft Office Excel 2003
DoDAF Compliant Architecture
A2
AI0 WIN® 7
System Architect
Validated Architecture
A3
System Architect
A4
Rational Rose Enterprise Edition
System or Service that Meets the Mission Needs
O1
Web Accessible Architecture
O2
A5
System Architect

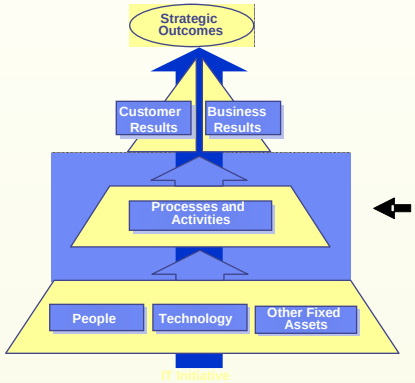
DoD AF and the Zachman Framework



Building an Architecture

The FEA is Five (5) Reference Models

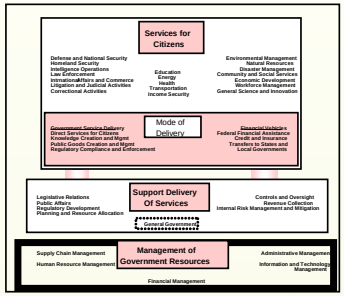
Performance Reference Model (PRM)



Outcomes, Measures, Metrics
- Desired Outcome: Unqualified Audit Opinion
- Measure example: No. of Passed Audits
- Indicator Example: No. of Certified Processes

Agency specifies Measure detail for business function

Business Reference Model (BRM)

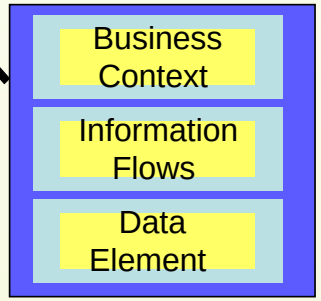


Business Areas (e.g., Mgt of Gov't Resources)
Lines of Business (e.g., Financial Mgt)
Sub-Functions (e.g., Accounting)

Service Components support business function

Used by business process & component

Data Reference Model (DRM)*

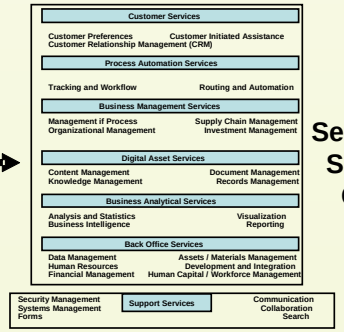


e.g., Account / General Ledger

e.g., Asset-Account

*Under Development

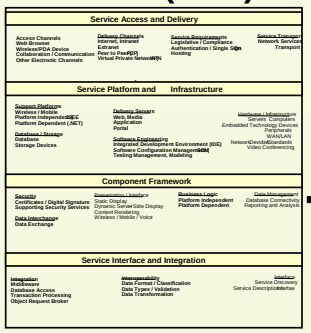
Service Component Reference Model (SRM)



Service Domains (e.g., Back Office Svcs)
Service Types (e.g., Financial Mgt)
Components (e.g., Billing and Acctg)

Standard or Specification for specific component

Technical Reference Model (TRM)



Svc Areas (e.g., Component Framework)
Svc Categories (e.g., Data Mgt)
Svc Stds (e.g., Reporting and Analysis)

These documents are located at www.FEAPMO.gov.

DoD AF and the FEA Reference Models

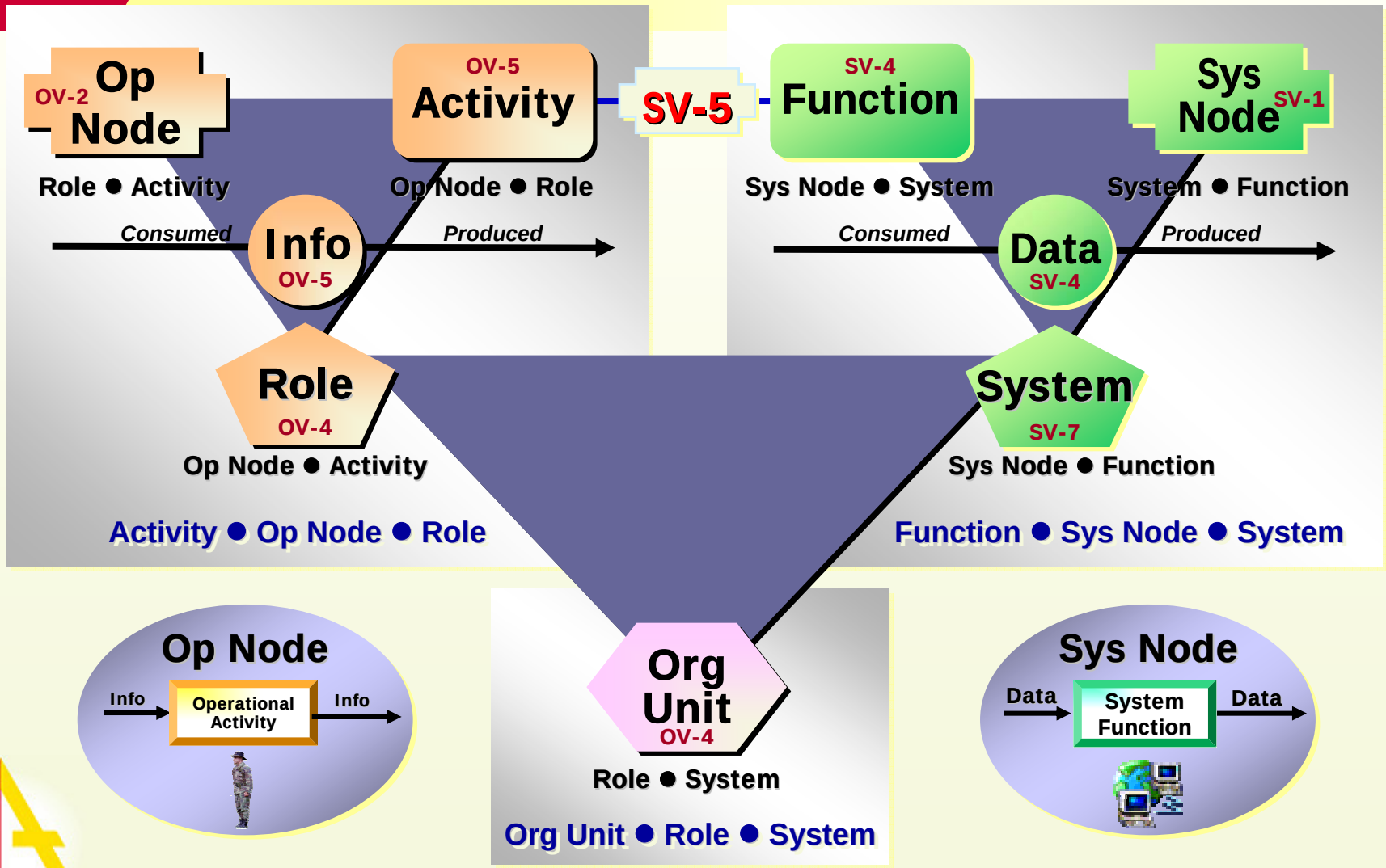
- The Views created in the DoD AF will be mapped to the appropriate artifacts in the FEA Reference Models.
- The DoD AF Instructs that the OV-5 be created as additional detail of one or more appropriate levels of the FEA BRM line of business or sub-functions.

DoD AF and UML

- Pros:
  - UML is widely used and understood
  - Fits well with Software design
  - DoD AF documentation relates UML and work products*
- Cons:
  - Some work products have to be represented with UML adornments (therefore it is not 'standard')
  - Some work products cannot be represented in UML at all

*See UML/DoD AF Table on the EAF web site

Summary


OV-2
Op Node
Role ● Activity
OV-5
Activity
Op Node ● Role
SV-5
SV-4
Function
Sys Node ● System
Sys Node
SV-1
System ● Function
Consumed
Info
OV-5
Produced
Consumed
Data
SV-4
Produced
Role
OV-4
Op Node ● Activity
System
SV-7
Sys Node ● Function
Activity ● Op Node ● Role
Function ● Sys Node ● System
Op Node
Info
Operational Activity
Info
Org Unit
OV-4
Role ● System
Org Unit ● Role ● System
Sys Node
Data
System Function
Data

Thank You!