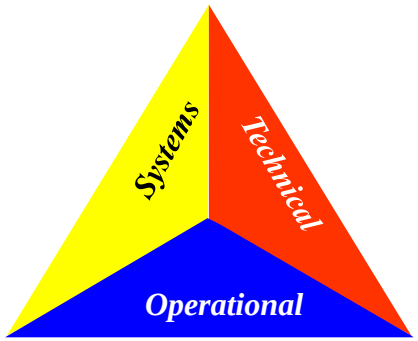
Lecture 8 Architecture Framework

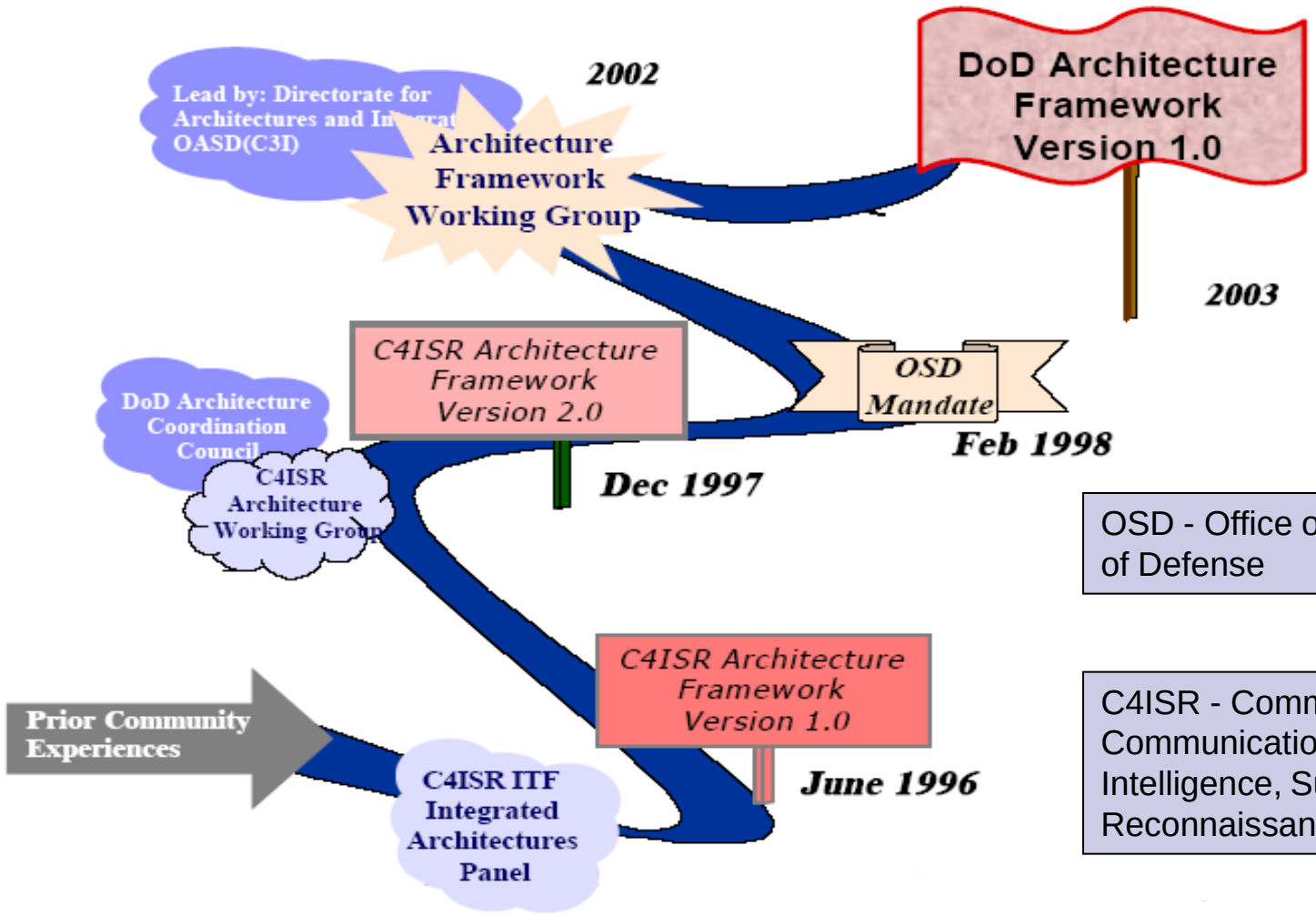
- DODAF Definitions and Purpose
- DODAF Products
- DODAF Documents Overview



DoD Architecture Framework 1.0

- The Department of Defense (DoD) Architecture Framework (DODAF)
  - Defines a common approach for describing, presenting, and comparing DoD enterprise architectures
  - Facilitates the use of common **principles**, **assumptions** and **terminology**
- The principal objective is to
  - Ensure that architecture descriptions can be compared and related across organizational boundaries, including Joint and multi-national boundaries

History of the Framework



OSD - Office of the Secretary of Defense

C4ISR - Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance

DoD Policy

- Recent DoD policy highlights use of architectures for:
  - Understanding the DoD as an **enterprise**
  - Identification of operational requirements
  - Rationalization of IT investment decisions
  - Improvements to interoperability among various systems

Architecture Definition

- **"The structure of components, their relationships, and the principles and guidelines governing their design and evolution over time."**
  DoD Integrated Architecture Panel, 1995, based on IEEE STD 610.12

- **"An architecture is the fundamental organization of a system embodied in its components, their relationships to each other, and to the environment, and the principles guiding its design and evolution."**

  IEEE STD 1471-2000

Architecture vs. Design

- System Architecture is used to:
  - Make buy decisions
  - Discriminate between options
  - “Discover” the true requirements
  - Drive one or more systems to a common “use” or purpose
- System Design is used to:
  - Develop system components
  - Build the system
  - Understand configuration changes as the system is modified

Enterprise competitive edge

- An enterprise's **competitive edge** and ultimate success are enabled by its ability to rapidly respond to changing business strategies, governance, and technologies
- The DoD environment spells this competitive edge as ***victory***
- The competitive edge translates into higher levels of customer satisfaction, shorter work cycles, and reductions in schedules, maintenance costs, and development time, all resulting in lower overall cost of ownership

Enterprise Architecture

- Enterprise Architecture is the key facilitating ingredient providing a holistic view and a mechanism for enabling the design and development as well as the communication and understanding of the enterprise
- The overarching goals of enterprise architecture are to **manage the complexity** of the enterprise, align business strategies and implementations, and facilitate rapid change in order to maintain business and technical advantages

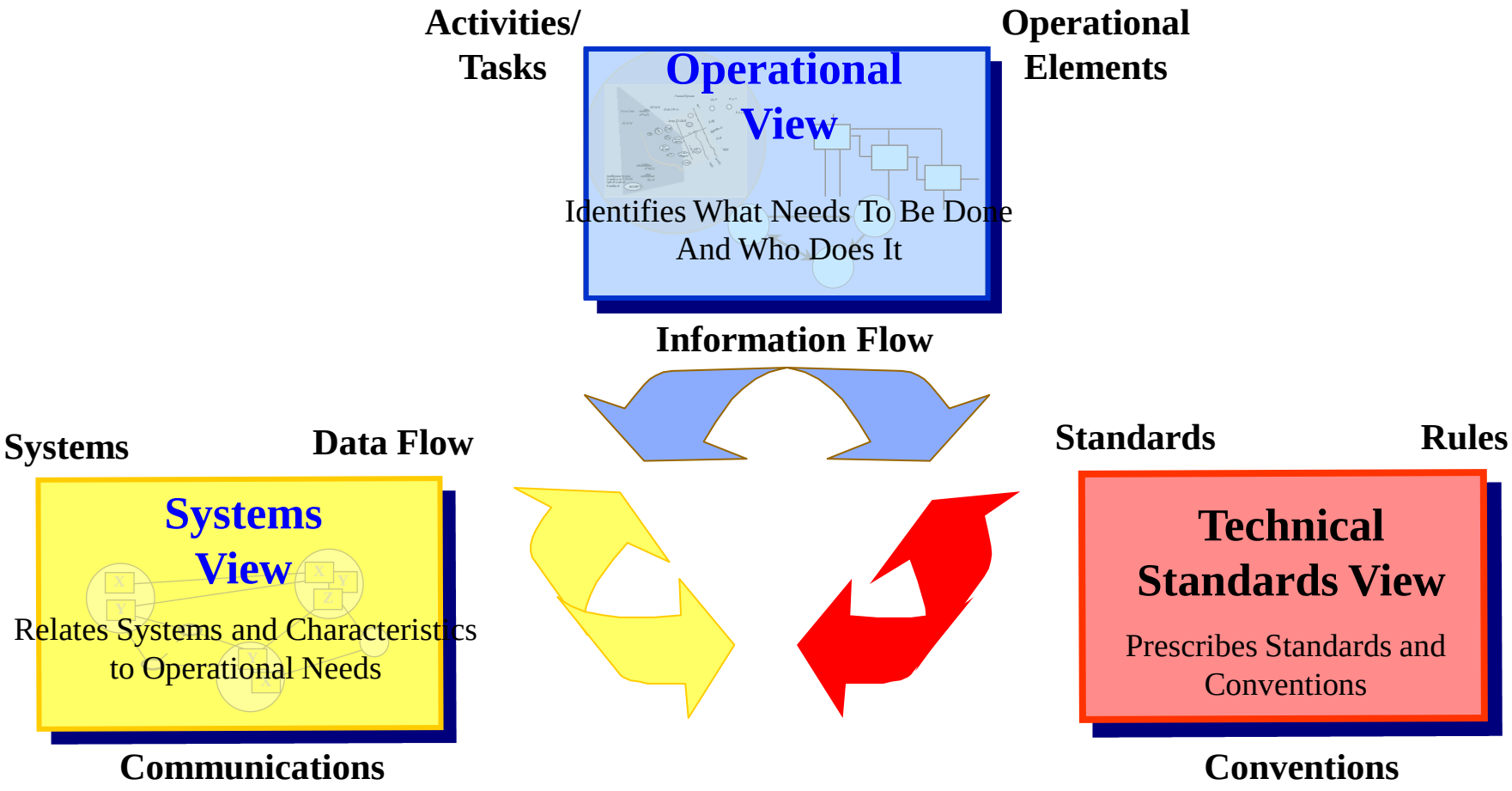
Enterprise vs. System

- System Architecture is like blueprints for a building
- Enterprise Architecture is like urban planning

Architecture Framework

- "An architecture framework is a **tool**… It should describe a method for designing an information system in terms of a set of **building blocks**, and for showing how the building blocks **fit together**. It should contain a set of tools and provide a **common vocabulary**. It should also include a list of recommended **standards and compliant products** that can be used **to implement the building blocks**." [TOGAF 8, OpenGroup]

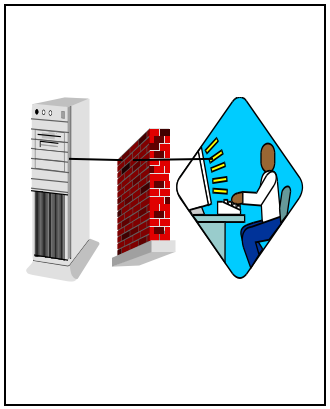
Basic Principles - An Integrated Architecture with Three Views



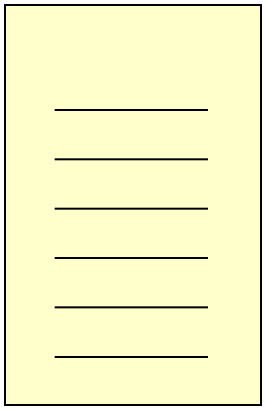
Software Architecture Framework

DODAF Products - Graphic, Textual, and Tabular

Graphic



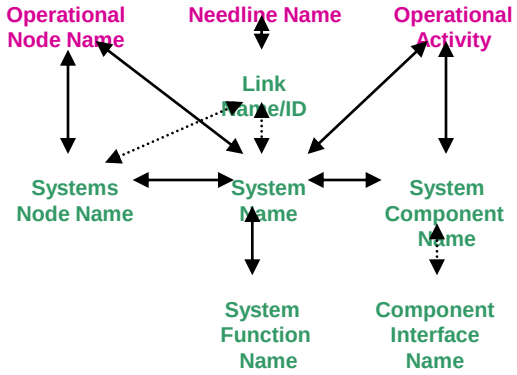
Text



Tabular

	Organizations	Locations	Functions	Applications	Entities	Database/file	Tech Platform
Organizations							
Locations	X						
Functions	X						
Applications	X	X	X				
Entities		X		X			
Database/file					X		
Technology Platforms	X		X	X			

Dictionary Relationships



Use products to:

Capture

Communicate

Analyze

DODAF Products

- The DODAF describes a set of **26 work products** to ensure uniformity and standardization in the documentation and communication of architecture
- The 26 DODAF views are designed to **document the entire architecture**, from requirements to implementation

DODAF Products - Views

- The list of products is refined into four views:
  - ***All Views (AV)***: is the overarching information describing the architecture plans, scope, and definitions
  - ***Operational View (OV)***: focuses on the behaviours and functions describing the enterprise mission aspects
  - ***System View (SV)***: describes the system and applications supporting the mission functions
  - ***Technical Standards View (TV)***: describes the policies, standards and constraints

Software Architecture Framework

DODAF Products

Applicable View	Framework Product	Framework Product Name	General Description
All Views	AV-1	Overview and Summary Information	Scope, purpose, intended users, environment depicted, analytical findings
All Views	AV-2	Integrated Dictionary	Architecture data repository with definitions of all terms used in all products
Operational	OV-1	High-Level Operational Concept Graphic	High-level graphical/textual description of operational concept
Operational	OV-2	Operational Node Connectivity Description	Operational nodes, connectivity, and information exchange needlines between nodes
Operational	OV-3	Operational Information Exchange Matrix	Information exchanged between nodes and the relevant attributes of that exchange
Operational	OV-4	Organizational Relationships Chart	Organizational, role, or other relationships among organizations
Operational	OV-5	Operational Activity Model	Capabilities, operational activities, relationships among activities, inputs, and outputs; overlays can show cost, performing nodes, or other pertinent information
Operational	OV-6a	Operational Rules Model	One of three products used to describe operational activity—identifies business rules that constrain operation
Operational	OV-6b	Operational State Transition Description	One of three products used to describe operational activity—identifies business process responses to events
Operational	OV-6c	Operational Event-Trace Description	One of three products used to describe operational activity—traces actions in a scenario or sequence of events
Operational	OV-7	Logical Data Model	Documentation of the system data requirements and structural business process rules of the Operational View

Software Architecture Framework

DODAF Products

Systems	SV-1	Systems Interface Description	Identification of systems nodes, systems, and system items and their interconnections, within and between nodes
Systems	SV-2	Systems Communications Description	Systems nodes, systems, and system items, and their related communications lay-downs
Systems	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.
Systems	SV-4	Systems Functionality Description	Functions performed by systems and the system data flows among system functions
Systems	SV-5	Operational Activity to Systems Function Traceability Matrix	Mapping of systems back to capabilities or of system functions back to operational activities
Systems	SV-6	Systems Data Exchange Matrix	Provides details of system data elements being exchanged between systems and the attributes of that exchange
Systems	SV-7	Systems Performance Parameters Matrix	Performance characteristics of Systems View elements for the appropriate time frame(s)
Systems	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
Systems	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
Systems	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

Software Architecture Framework

DODAF Products

Systems	SV-10b	Systems State Transition Description	One of three products used to describe system functionality—identifies responses of a system to events
Systems	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
Systems	SV-11	Physical Schema	Physical implementation of the Logical Data Model entities, e.g., message formats, file structures, physical schema
Technical	TV-1	Technical Standards Profile	Listing of standards that apply to Systems View elements in a given architecture
Technical	TV-2	Technical Standards Forecast	Description of emerging standards and potential impact on current Systems View elements, within a set of time frames

Software Architecture Framework

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																						
CapabilityBased 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

DODAF Products - Essential

- The current DODAF version indicates a subset of work products that should be developed at a minimum (essential)
  - AV-1: Overview and Summary Information
  - AV-2: Integrated Dictionary
  - OV-2: Operational Node Connectivity Description
  - OV-3: Operational Information Exchange Matrix
  - OV-5: Operational Activity Model
  - SV-1: System Interface Description
  - TV-1: Technical Standards Profile

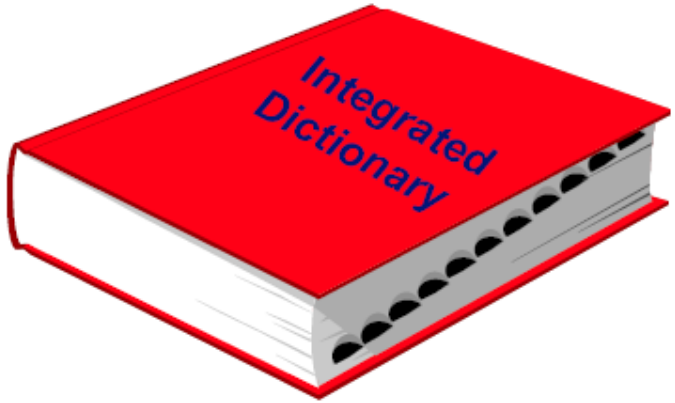
Software Architecture Framework

AV-1 & AV-2

AV-1 Overview and Summary Information

- Identification
  - Name
  - Architect
  - Organizations Involved
  - When Developed
- Purpose
  - Analysis Needs
  - Decision Support Needs
- Scope
  - Views and Products Used
  - Time Frames Addressed
- Context
  - -Mission
  - -Geographical
  - Rules, Criteria, and Conventions Followed
- Findings: Results, Recommendations
- Tools and File Formats

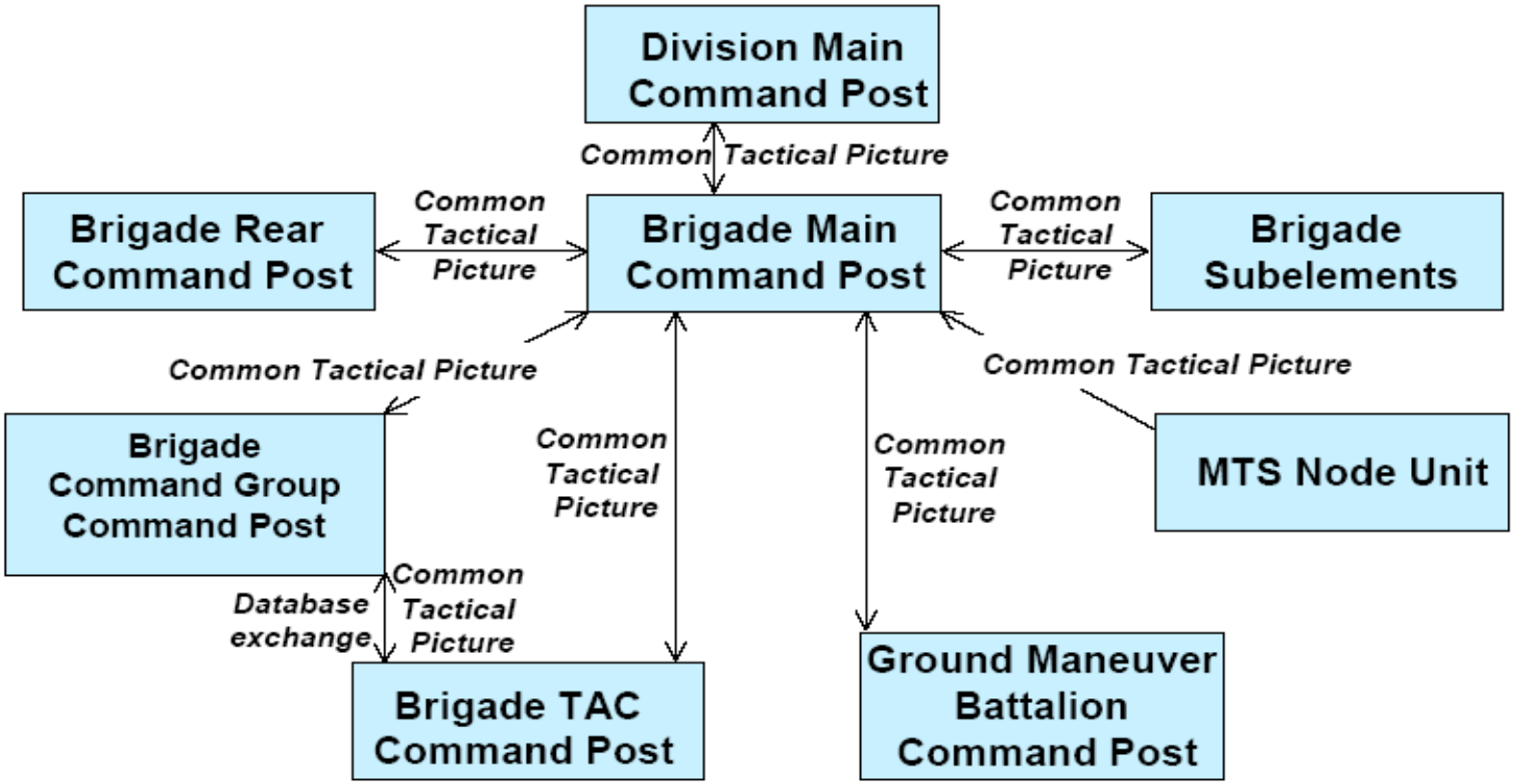
AV-2 Integrated Dictionary



At a minimum, the integrated Dictionary is a glossary with definitions of terms used in the given architecture description. Each labeled graphical item in the graphical representations should have a corresponding entry in the Integrated Dictionary.

Software Architecture Framework

OV-2 – Operational Node Connectivity Description

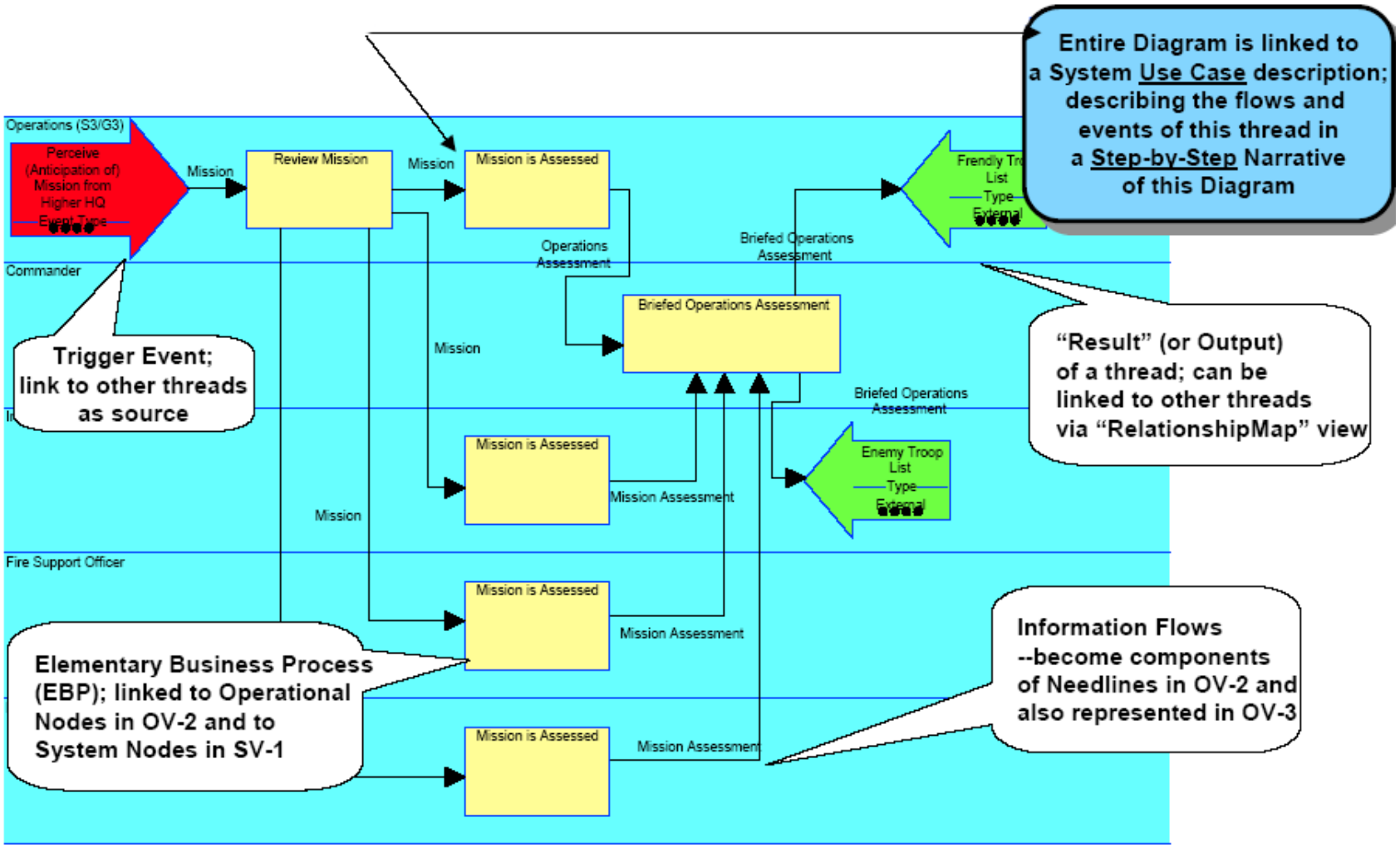


- Nodes show who communicates with whom
- Needlines show WHAT is communicated.

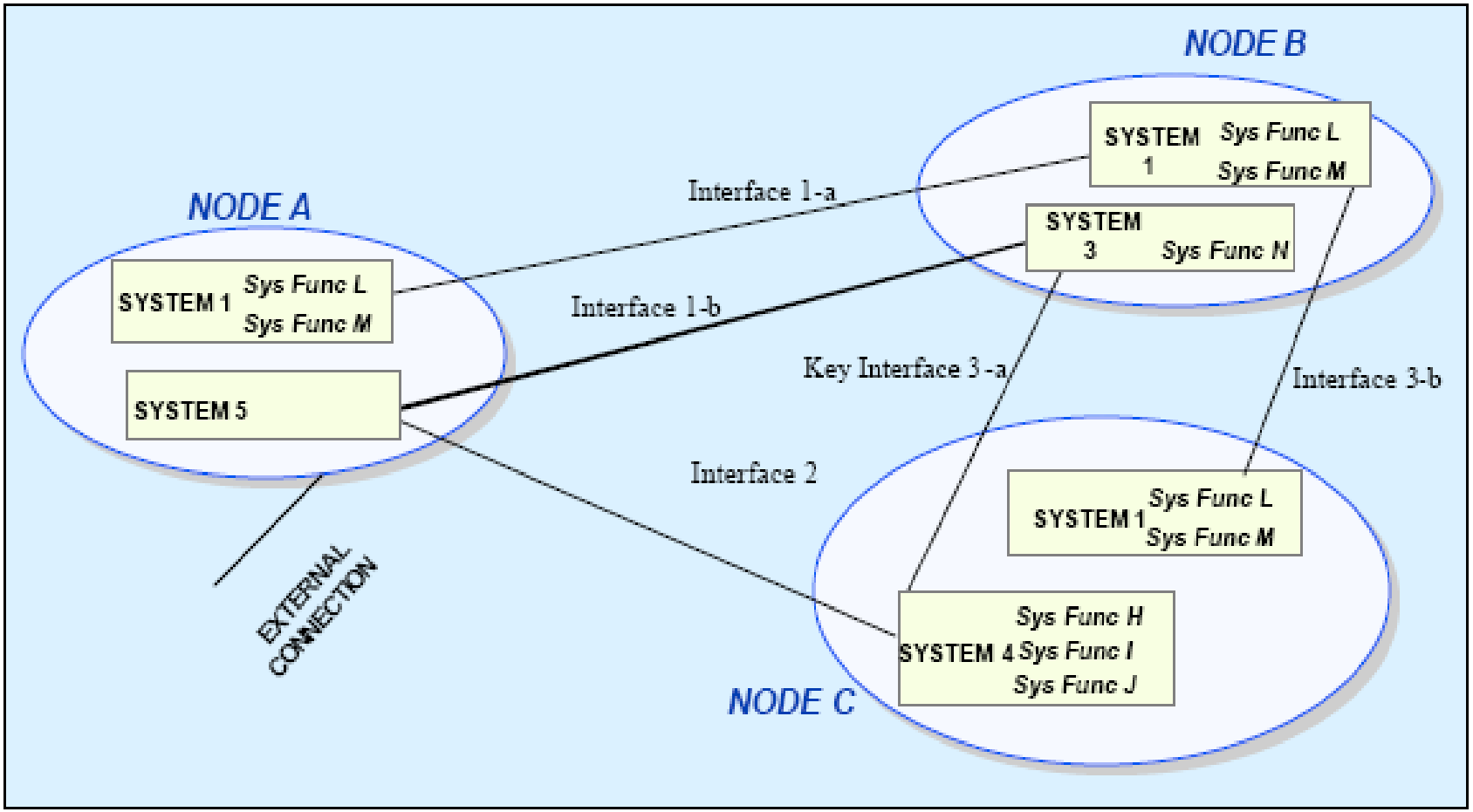
OV-3 – Operational Information Exchange Matrix

- **Table Headers Specified in Framework**:
  - Name of Operational Needline Supported (from OV-2)
  - Name of Information Exchange
  - Nature of Transaction (Mission/Scenario, Language, Content, Size/Units, Media, Collaborative or One-Way?)
  - Purpose or Triggering Event
  - Information Source (ID of Producing Node Element, Owning Organization of Node, Name of Producing Activity, UJTL ID)
  - Information Destination (ID of Receiving Node Element, Owning Organization of Node, Name of Receiving Activity, UJTL ID)
  - Performance Requirements (Frequency, Timeliness, Throughput, Other)
  - Information Assurance Attributes (Classification Restrictions, Criticality/Priority, Integrity Checks Required, Assured Authorization to Send/Receive)
  - Threats (Physical, Electronic, Political/Economic)
  - Operational Environment (Weather, Terrain, Policy/Doctrine Constraints)

OV-5 – Operational Activity Model



SV-1 – System Interface Description



Software Architecture Framework

TV-1 – Technical Standards Profile

SERVICE AREA	SERVICE	SERVICE CATEGORY	STANDARD
SYSTEM SERVICES	OPERATING SYSTEM	KERNEL OPERATIONS	FIPS 151-2: Portable Operating System Interface (POSIX)-C System Application Program Interface
		SHELL AND UTILITIES	FIPS 189: Portabl… Interface (POSIX) Utilities
APPLICATION SERVICES	INFORMATION INTERCHANGE	DOCUMENT INTERCHANGE	FIPS 152: Standard Ge… Markup Language (SGML)
	DATA MANAGEMENT	RELATIONAL DATABASE MANAGEMENT SYSTEMS	FIPS 127-2 Entry L… Language SQL
COMMUNI-CATIONS	DATA TRANSPORT	OPEN SYSTEMS INTERNET-WORKING	FIPS 146-2: Profil… Internetworking T…
• • •			

POSIX

SGML

SQL

Specific languages and protocols to collect and reduce

Problems

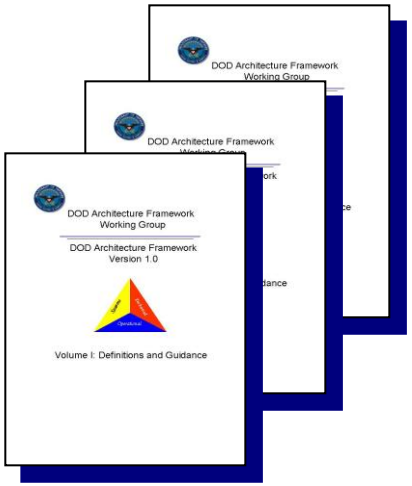
- Conspicuously absent are the all-important business, financial, and technical analysis of alternatives – information needed to drive enterprise architectural decisions

Software Architecture Framework

DoD Architecture Framework

- Volume I: Definitions, Guidelines , and Background
  - Covers value of architectures, measures, use in DoD processes
- Volume II: Product Descriptions
  - Covers Structured Analysis and UML Representations
- Deskbook: Architecture Guidance
  - Provides guidance on development, use, incorporating security into the architecture
- Release Date – November 2003
- Web Site:

http://aitc.aitcnet.org/dodaf/



Key Changes in Volume II

- Guidance on developing architecture products using UML
- Greater emphasis on architecture data underlying the architecture products

DoD Architecture Framework (DODAF)

Common approach for developing an architecture description

Common Underlying Meta Model

Common underlying structure for capturing architecture data

Future Evolution Areas

Define a DODAF Object Model to:

- Validate and Clarify the **information** definitions provided by the DODAF
  - To capture the architecture data elements (object and relationships) described by DODAF
  - Use DODAF definitions to define an object model
- Validate and Clarify the **notation** definitions intended by DODAF
  - Adjust the object and relationship definitions to include graphics (e.g., modeling notation) and/or formatting characteristics that are required to be common
- Facilitate the common usage of such a model
  - Define an ontology: identify the generalizations / specializations (supertypes / subtypes) that are appropriate
  - Provide clear, concise descriptions for all the data elements

Future Evolution Areas (Cont'd)

- Benefits - A DODAF object model will:
  - Provide a common set of objects and relationship definitions (requirements) that can be used by tool vendors to supply software tools that support the development of DODAF-Compliant architectures
  - Provide a common set of objects and relationship definitions against which a standard interface can be defined to:
    - Enable the sharing of architecture model / products between different tools
    - Enable the implementation of a common repository for architecture data

Future Evolution Areas (Cont'd)

- Define a common ontology of architecture elements
- Address baseline (current) and objective (target) architectures
- Address use of architectures to measure mission effectiveness (capabilities and measures of effectiveness)

DoDAF prospect

- *February 9, 2004.* Department of Defense CIO John P. Stenbit approved Version 1.0 of the Department of Defense Architectural Framework (DODAF) for immediate use. All architectures developed or approved after December 1, 2003 must comply with the new framework. Architectures developed prior to that date must be converted upon any version updates

- Not only for “military mission” and for DoD
- Also for civilian enterprise

References

- Department of Defense Architecture Framework Working Group. “DoD Architecture Framework Ver. 1.0.” Washington, D.C.: Department of Defense, Nov. 2003 http://aitc.aitcnet.org/dodaf

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- Leveraging DoD/C4ISR Architecture Framework Products for Developmental and Operational Testing – Annette Ensing (The MITRE Corporation) and LTC Phil Hallenbeck (USA Operational Test Command) – The Software Technology Conference, May 2002 http://www.stc-online.org/stc2002proceedings/SpkrPDFS/ThrTracs/p728.pdf

- DoD Architecture Framework and Software Architecture Workshop Report – March 2003 http://www.ichnet.org/DODAF%20SEI%20report.pdf

- Breakout Session 10B Outbriefing – James Martin – Ground System Architectures Workshop, 2004 http://sunset.usc.edu/gsaw/gsaw2004/s14/10b_outbrief.pdf

- Sotware Productivity Consortium http://www.software.org/

Open Group

- **Open Group** is an international vendor and technology-neutral consortium

- **TOGAF**, The Open Group Architecture Framework, is an industry standard architecture framework that may be used freely by any organization wishing to develop an information systems architecture for use within that organization

End of the Lecture

Thanks!