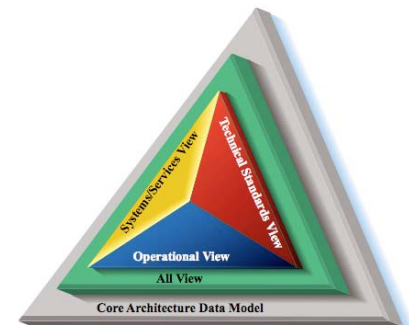# Interoperability Testing in a NetCentric Environment

Use of DoDAF & SysML Profile
in the Flight Test Environment

F. C. Alvidrez

MTSI - Edwards AFB

- Background, Introduction & Acknowledgements
- Why are we here?
  - Transformation & the Growth of NetCentric Warfare
  - Growth of NetCentric Warfare
  - System of Systems Engineering
- Interoperability Requirements
  - Integrated Architectures
  - NR-KPPs
  - DISA & JITC
- Approach to Testing
  - Example
- Summary

- ## Some Acknowledgements
  - DAU
  - DISA
  - DoDAF Working Group
  - OMG
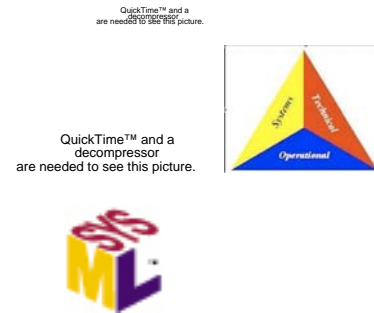
- ## Some Caveats
  - Not an official USAF or USG presentation
  - All Material is available on line through DAU, DISA, and other public DoD Sources

Interoperability

If you are not interoperable, you are…

<u>Not</u> on the net

<u>Not</u> contributing

<u>Not</u> benefiting

*Not part of the <u>information age</u>*

Source: USN War College NetCentric Warfare Presentation

- Increasing NetCentric upgrades and modifications since 9/11 (actually starting after Iraq 1)
- Link-16, FAB-T, B-1B FIDL, B-52 CONECT, B-2A EHF, etc.,
- Requirement to shorten the "Kill Chain" and to increase Situational Awareness
- Interoperability is about Integrated Architectures
- DoDAF is the language of Integrated Architectures in DoD
- DoDAF Integrated Architectures is the blueprint for Interoperability Test Requirements

Interoperability Concept

Source: DARPA J-UCAS 2004
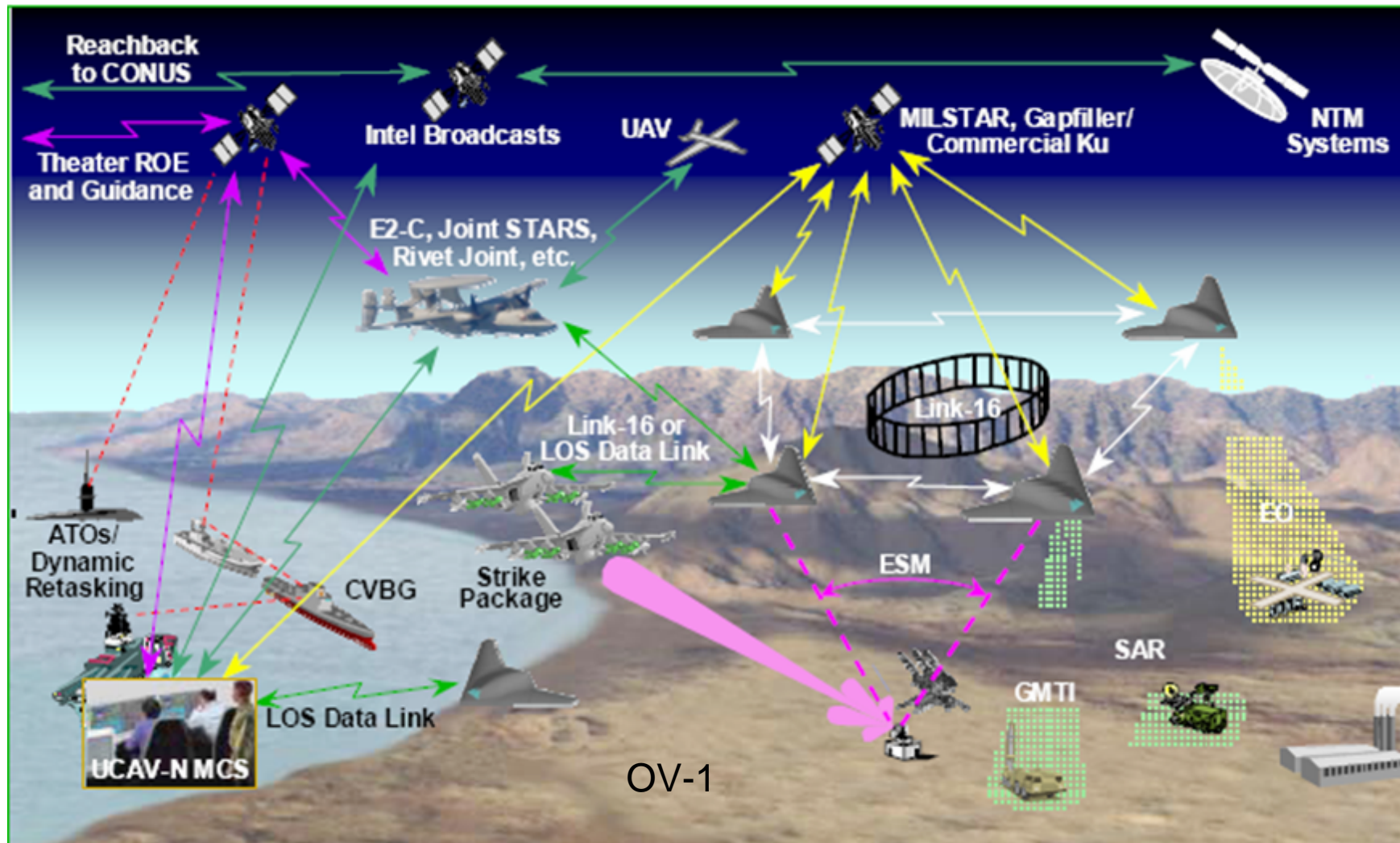
- Interoperability - Systems work at the subsystem level but do not work when in an operational environment

- Integration problems with legacy systems - Systems work but interfere with legacy systems such as IFF, TACAN or Defensive Avionics

- Lack of NetCentric & Interoperability Test expertise for early Test Planning -

- **DoD 5000.1 and DoD 5000.2**
  - Establishes DoD acquisition policy
  - Requires select integrated architecture views at each milestone
  - Content and Scope of architecture products used is determined by MDA / PM
- **DoD Architecture Framework (DODAF) Document**
  - Provides basis for developing standardized architecture views and products required by DOD, CJCS, and SECNAV policy documents
- **CJCSI 3170.01E**
  - Requires the development of integrated architecture products for supporting acquisition documentations:
    - Joint Capability Integration and Development System (JCIDS)
    - Capability gap and redundancy analysis
- **CJCSI 6212.01C**
  - Requires architecture products be used in the J-6 interoperability and supportability certification process
  - Specifies which architecture products are required for the ICD, CDD, and CPD
- **SECNAV INST 5000.2C**
  - Establishes DON acquisition policy
  - Directs the PEO / PM to develop mission integrated architectures in support of the CDD/CPD process
  - Directs ASN (RD&A) CHENG to assist PMs in the development of operational and system architectural views.

DoD 4630 - All IT & NSS must be *tested for interoperability* before fielding, and the test results evaluated and *system certified* by DISA (JITC)

DoD Dir. 4630.5 Interoperability and Supportability of Information (IT) and National Security Systems (NSS)

DoD 5000 Series – Defensive Acquisition System

Joint Capabilities Integration and Development System (JCIDS) CJCS 3710 Series

CJCSI 3180.01 Joint Requirements Oversight Council (JROC) Programmatic Process for Joint Experimentation and Joint Resource Change Recommendations

Others

How do you ensure interoperability? – Compliant DoDAF Architectures

- Provide _guidance_ on describing _architectures_
  - Warfighting Operations
  - Business Operations & Processes
- Provides guidance, rules & product descriptions for developing and presenting _"Integrated"_ architectures
- Defines three views
  - Operational View
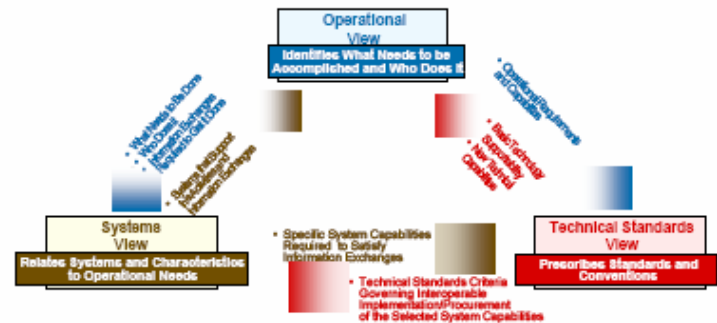 - System View
  - Technical Standards

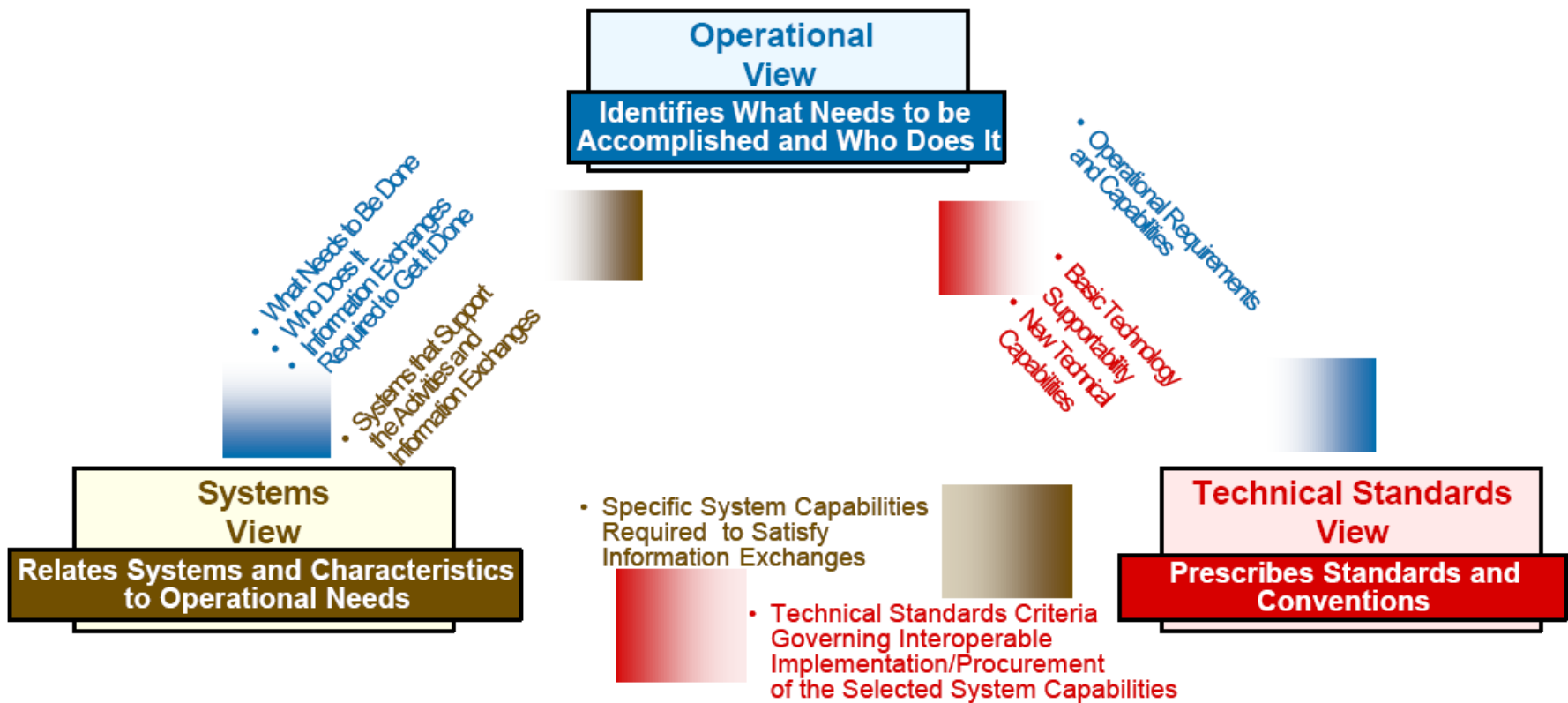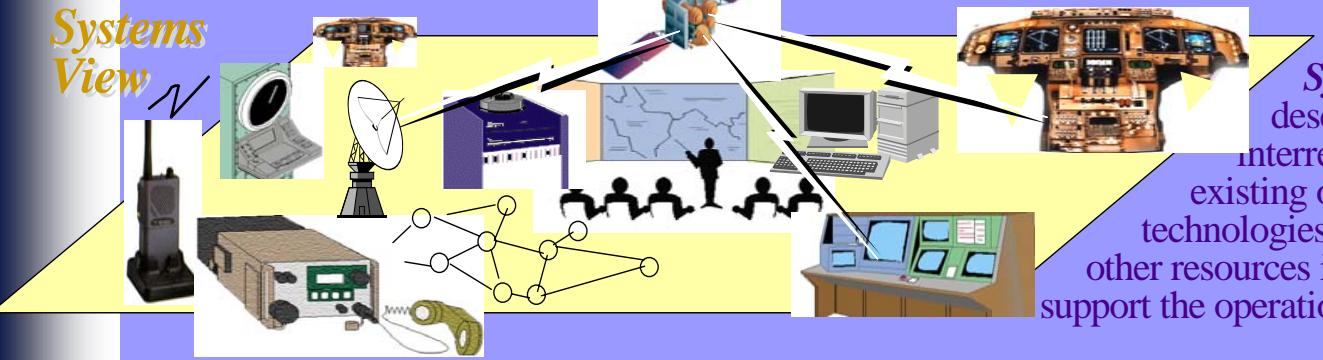Figure 3-2. Fundamental Linkages Among the Views

Figure ES-1. Linkages Among Views

The **Operational View** describes and interrelates the operational elements, tasks and activities, and information flows required to accomplish mission operations.

Systems View

The **Systems View** describes and interrelates the existing or postulated technologies, systems, and other resources intended to support the operational requirements.

Technical View

The **Technical View** describes the profile of rules, standards, and conventions governing systems implementation.

DoD Architecture Framework Version 1.5

Volume II: Product Descriptions

23 April 2007

Core Architecture Data Model

2 AVs
9 OVs
16 SVs
2 TVs

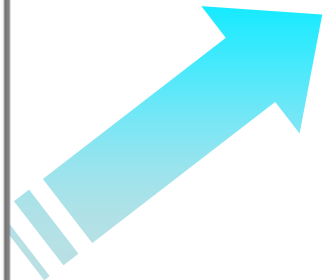**Table 2-1: List of Products**

Applicable View	Framework Product	Framework Product Name	Net-Centric Extension	General Description
All View	AV-1	Overview and Summary Information	✓	Scope, purpose, intended users, environment depicted, analytical findings
All View	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 need lines 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
Systems and Services	SV-1	Systems Interface Description / Services Interface Description	✓	Identification of systems nodes, systems, system items, services, and service items and their interconnections, within and between nodes
Systems and Services	SV-2	Systems Communications Description / Services Communications Description	✓	Systems nodes, systems, system items, services, and service items and their related communications lay-downs
Systems and Services	SV-3	Systems-Systems Matrix / Services-Systems Matrix / Services-Services Matrix	✓	Relationships among systems and services in a given architecture; can be designed to show relationships of interest, e.g., system-type interfaces, planned vs. existing interfaces, etc.
Systems and Services	SV-4a	Systems Functionality Description		Functions performed by systems and the system data flows among system functions
Systems and Services	SV-4b	Services Functionality Description	✓	Functions performed by services and the service data flow among service functions
Systems and Services	SV-5a	Operational Activity to Systems Function Traceability Matrix		Mapping of system functions back to operational activities
Systems and Services	SV-5b	Operational Activity to Systems Traceability Matrix		Mapping of systems back to capabilities or operational activities
Systems and Services	SV-5c	Operational Activity to Services Traceability Matrix	✓	Mapping of services back to operational activities
Systems and Services	SV-6	Systems Data Exchange Matrix / Services Data Exchange Matrix	✓	Provides details of system or service data elements being exchanged between systems or services and the attributes of that exchange

Applicable View	Framework Product	Framework Product Name	Net-Centric Extension	General Description
Systems and Services	SV-7	Systems Performance Parameters Matrix / Services Performance Parameters Matrix	✓	Performance characteristics of Systems and Services View elements for the appropriate time frame(s)
Systems and Services	SV-8	Systems Evolution Description / Services Evolution Description	✓	Planned incremental steps toward migrating a suite of systems or services to a more efficient suite, or toward evolving a current system to a future implementation
Systems and Services	SV-9	Systems Technology Forecast / Services 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 and Services	SV-10a	Systems Rules Model / Services Rules Model	✓	One of three products used to describe system and service functionality—identifies constraints that are imposed on systems/services functionality due to some aspect of systems design or implementation
Systems and Services	SV-10b	Systems State Transition Description / Services State Transition Description	✓	One of three products used to describe system and service functionality—identifies responses of a system/service to events
Systems and Services	SV-10c	Systems Event-Trace Description / Services Event-Trace Description	✓	One of three products used to describe system or service functionality—identifies system/service-specific refinements of critical sequences of events described in the Operational View
Systems and Services	SV-11	Physical Schema	✓	Physical implementation of the Logical Data Model entities, e.g., message formats, file structures, physical schema
Technical Standards	TV-1	Technical Standards Profile	✓	Listing of standards that apply to Systems and Services View elements in a given architecture
Technical Standards	TV-2	Technical Standards Forecast		Description of emerging standards and potential impact on current Systems and Services View elements, within a set of time frames

Test & Evaluation Process Flow

Start → T&E Step 1 Identify Information Requirements → T&E Step 2 Pre-test Evaluation → T&E Step 3 Conduct Test Activities → T&E Step 4 Post-test Synthesis and Evaluation → T&E Step 5 Decision Maker Utilizes Data → End

DoDAF

Source: DAU TST
102

DISA
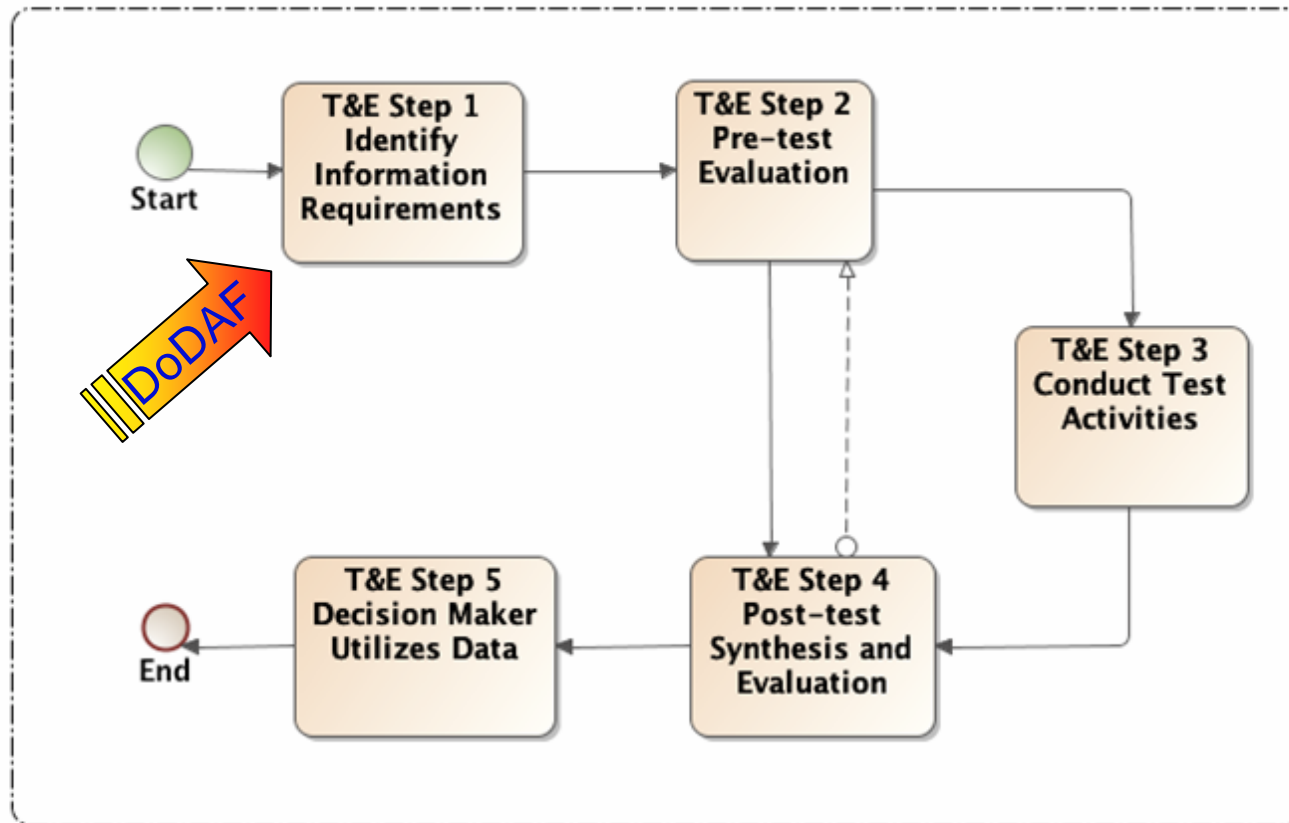
Joint Interoperability Directives & Instructions

UNCLASSIFIED

DODD 4630.5

IT and NSS interoperability shall be verified early, and with sufficient frequency throughout a system's life ...

DODD 8500.1

ALL IT must be evaluated and validated for IA

CJCSI 6212.01D

All IT and NSS must be evaluated and certified for Joint interoperability by DISA (JITC).

DOD 4630/5000

Interoperability is "the ability to provide and accept data, information, materiel, and services ... ...includes both the technical exchange of information and the end-to-end operational effectiveness of that exchange, as required for mission accomplishment."

DODI 4630.8

All IT and NSS ... must be tested for interoperability before fielding ... and certified by DISA (JITC).

CJCSI 3170.01E
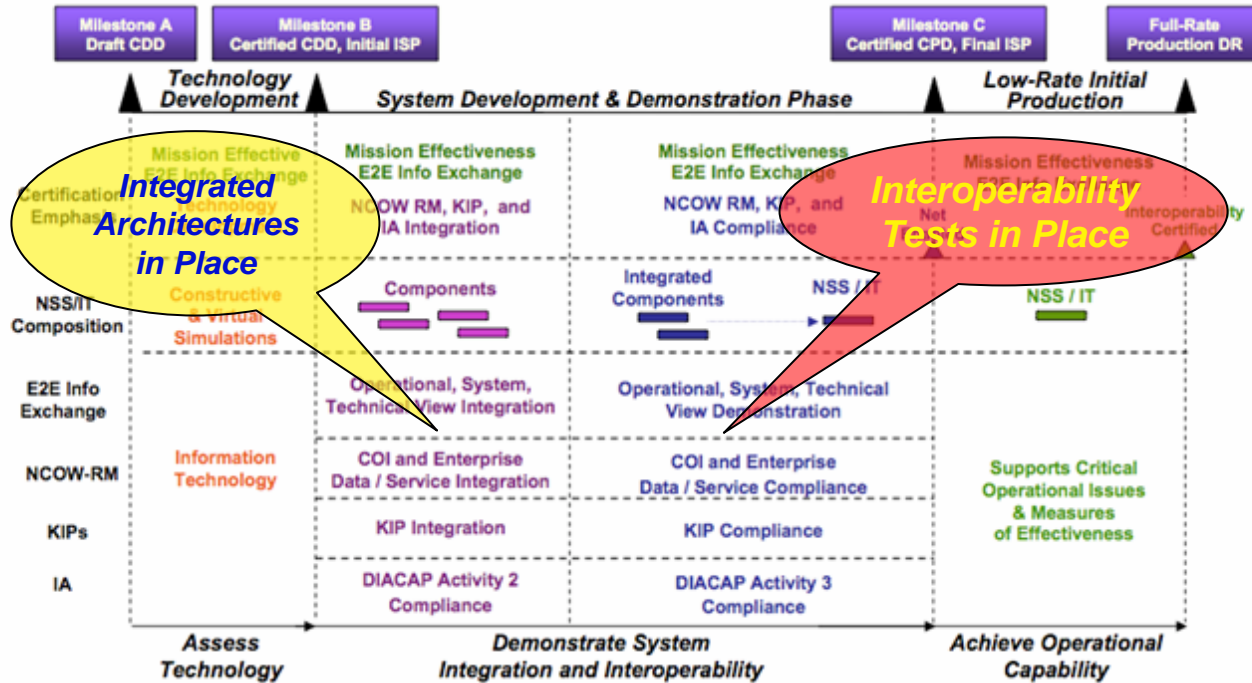Establishes JCIDS w/ NR-KPP for CRD, CDD and CPD.

DOD 5000 series

For IT systems, including NSS, ... JITC shall provide system interoperability test certification memoranda ... throughout the system life-cycle and regardless of ACAT.

Source: DARPA J-UCAS 2004
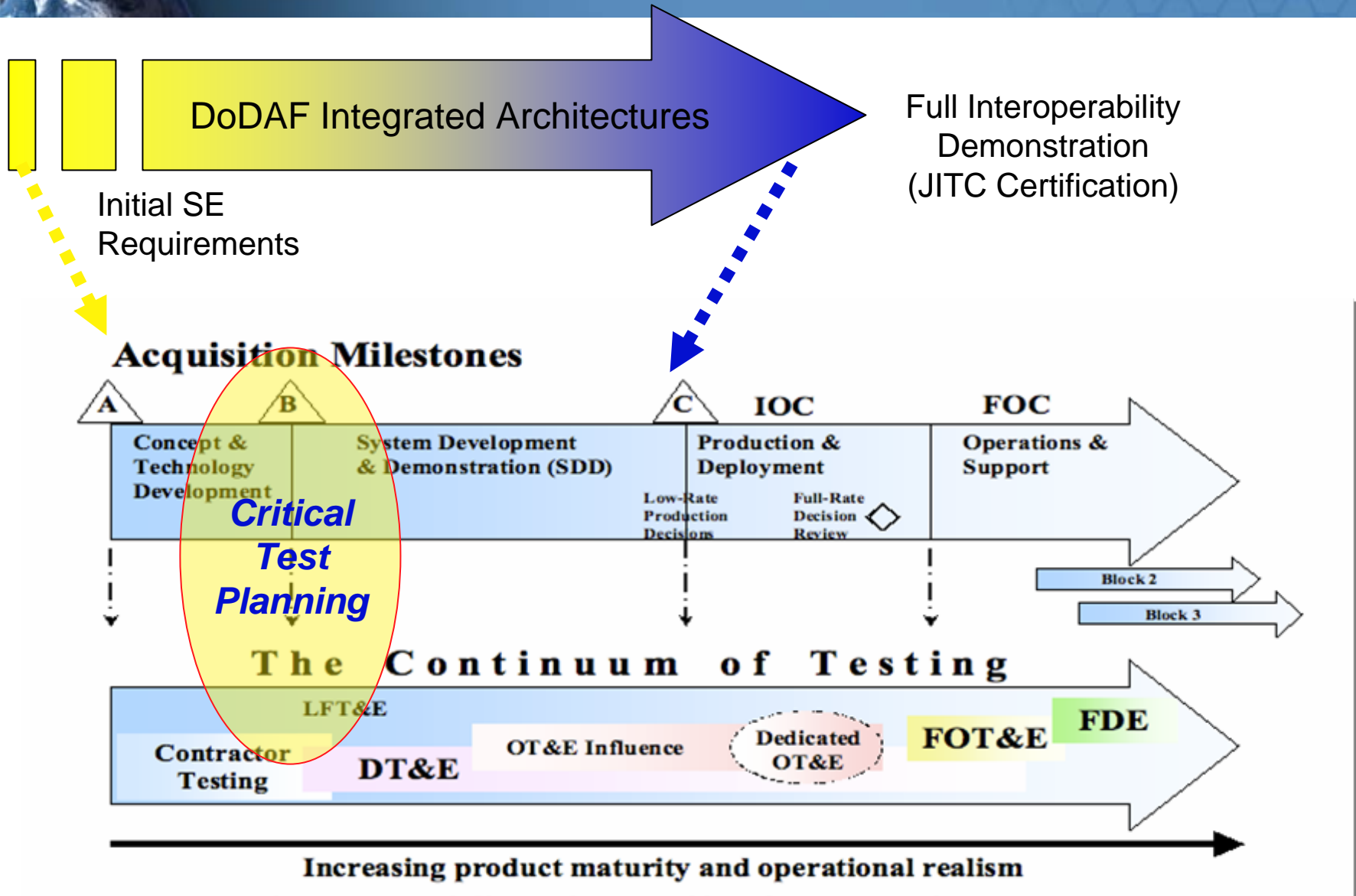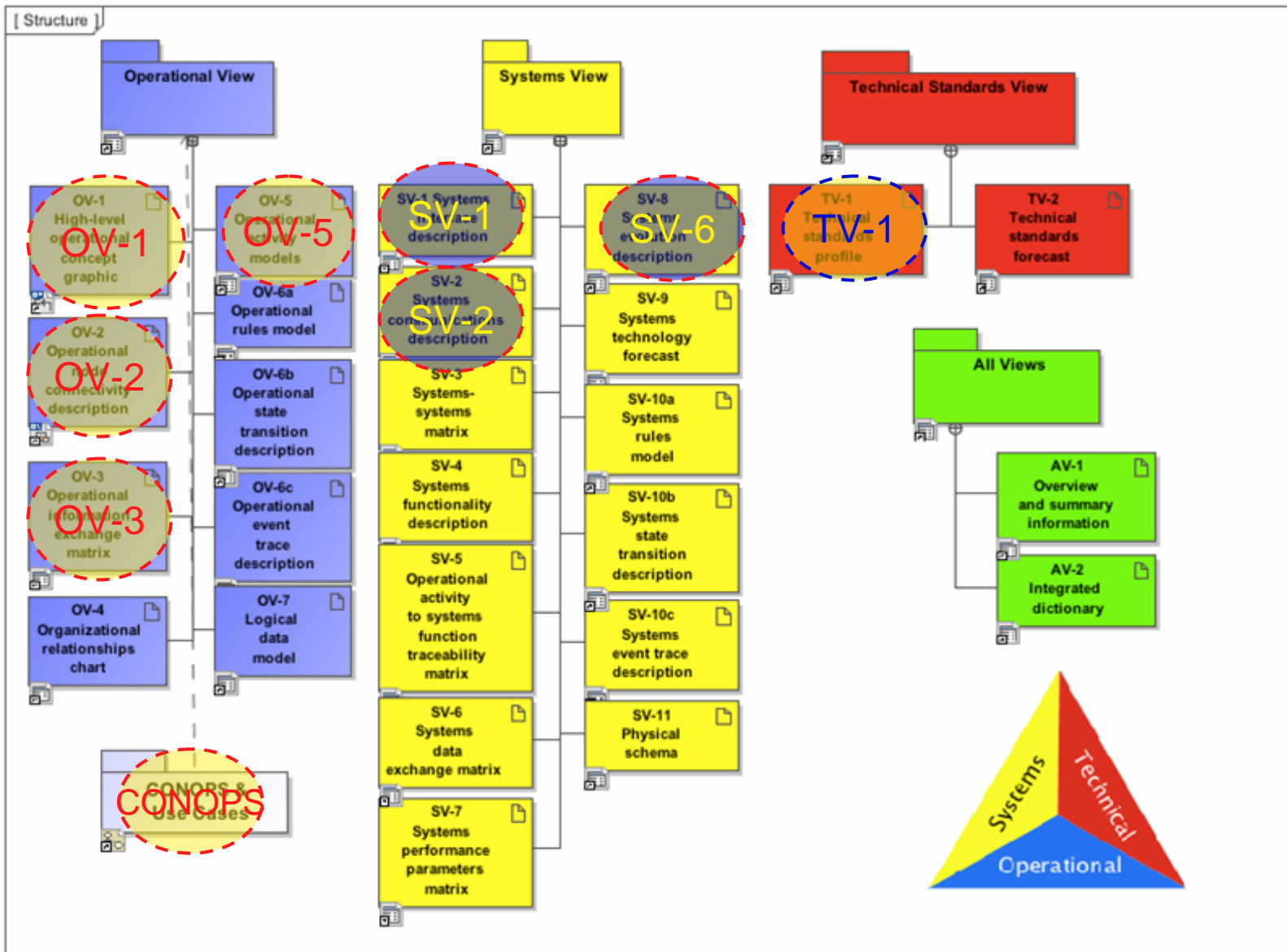
Example OV-2
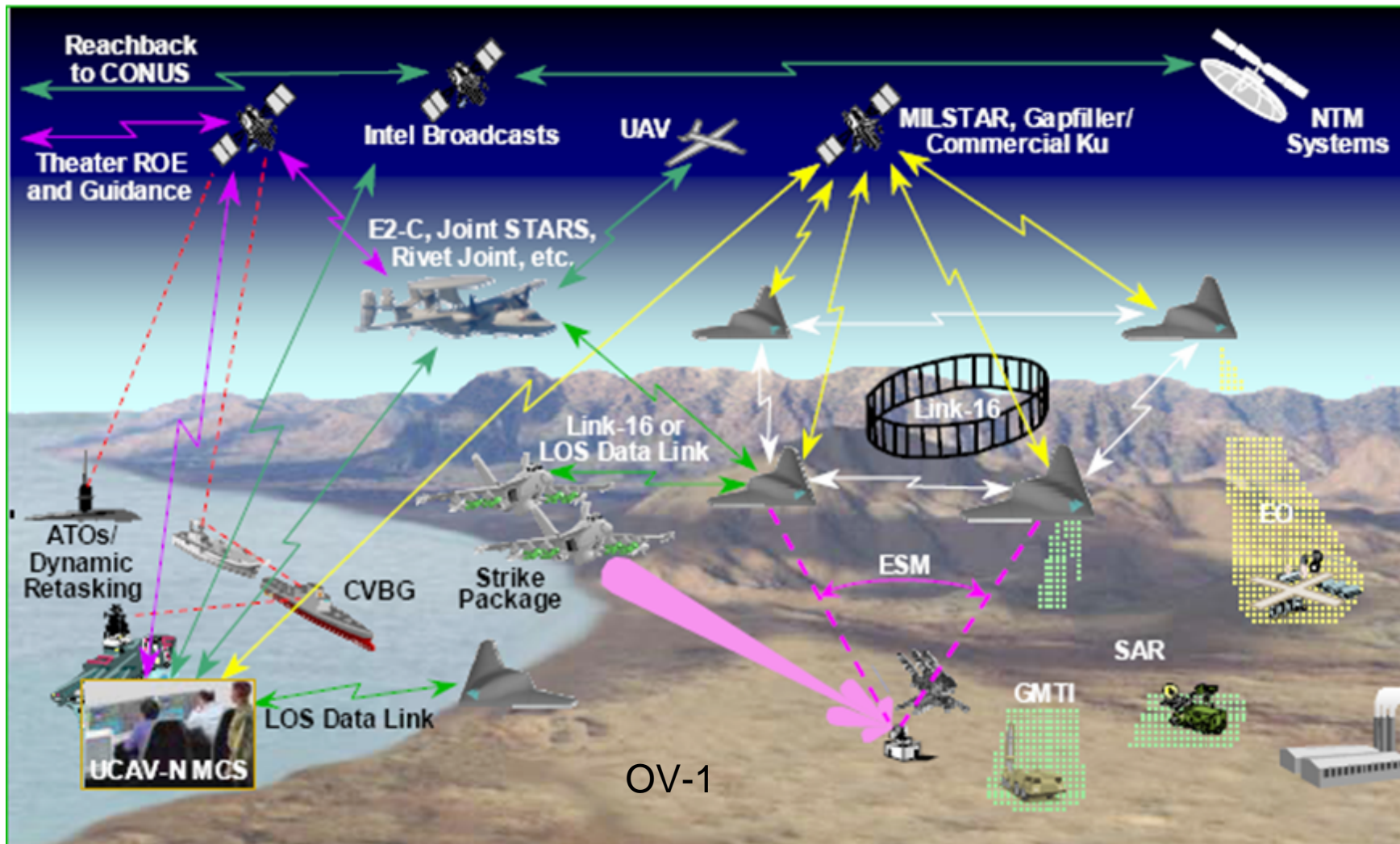
- DAU NR-KPPs Web Course (CLM 029)

- DAU Fundamentals of Test & Evaluation Web Course (TST 102)

- DISA / JITC (http://www.disa.mil/index.html) / (http://jitc.fhu.disa.mil/jitc_dri/jitc.html)

- DARS – DoD Architecture Repository System (https://dars1.army.mil/IER/welcome.jsp)

- Interoperability modifications and upgrades are increasing

- Interoperability is System of Systems Engineering

- Interoperability Testing has special considerations (other nodes and players)

- Can use simulations as well as hardware in the loop. Will require flight demonstrations in a representative environment (JITC Certification)

- DoDAF Architectures are required in all phases of Interoperability Testing (TES - TEMP - Flight Test Plan - JTIC Certification)

- Recommendation - Have a DoDAF Architect on the TRWG (Test Requirements Working Group) early