DoD Architectures and Systems Engineering Integration

NDIA 15th Annual Systems Engineering Conference

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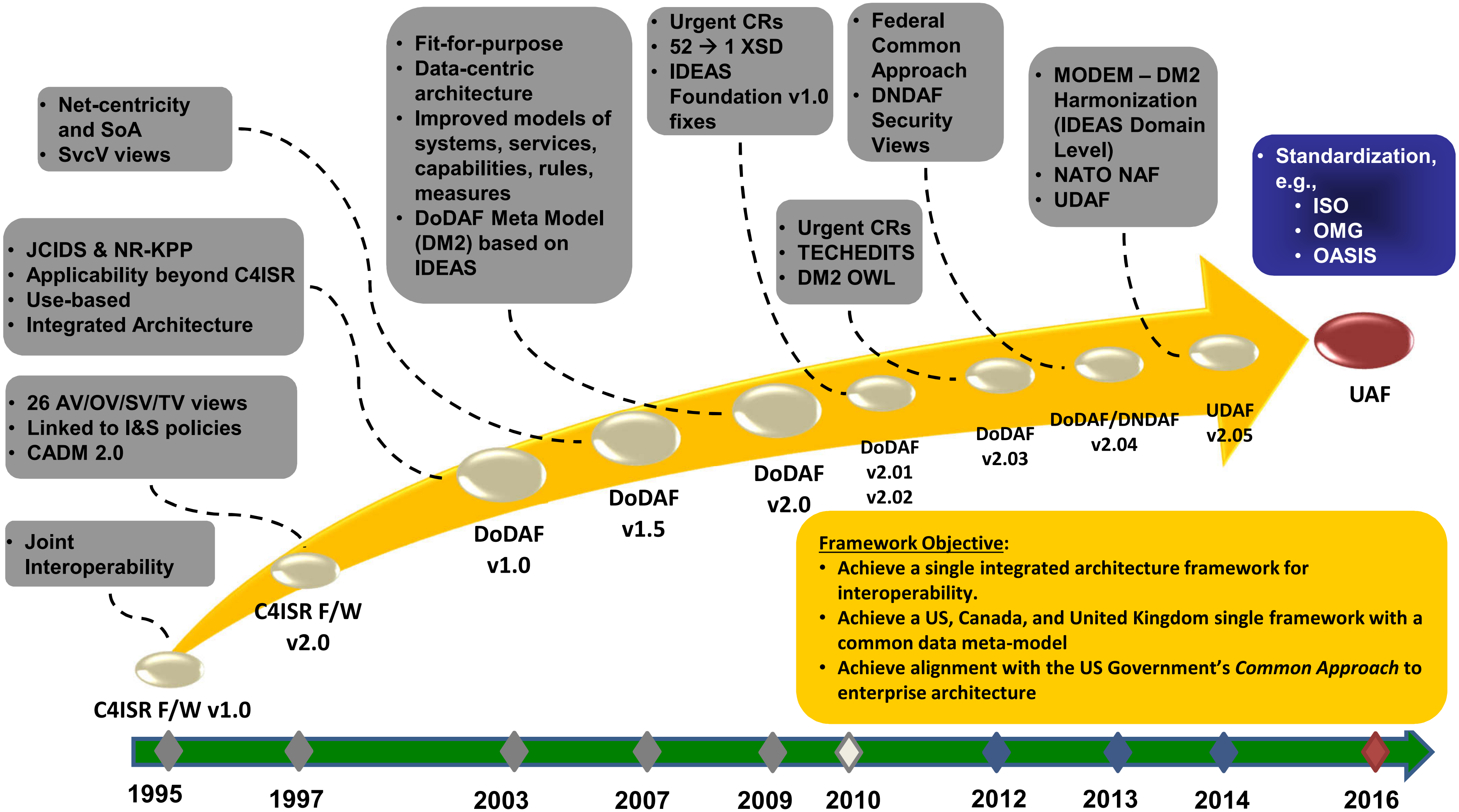
Office of the Chief Information Officer

Five Topics

1. DoDAF evolution plan
2. Fit-for-purpose (FFP) and legacy views
3. DoDAF reification, requirements, and SE “V” model
4. DoDAF meta-model for:
   – DOTMLPF
   – temporality, behavior, scenarios, M&S, executable architectures
5. DoDAF artifacts X SE documents and artifacts

DoDAF Evolution Plan

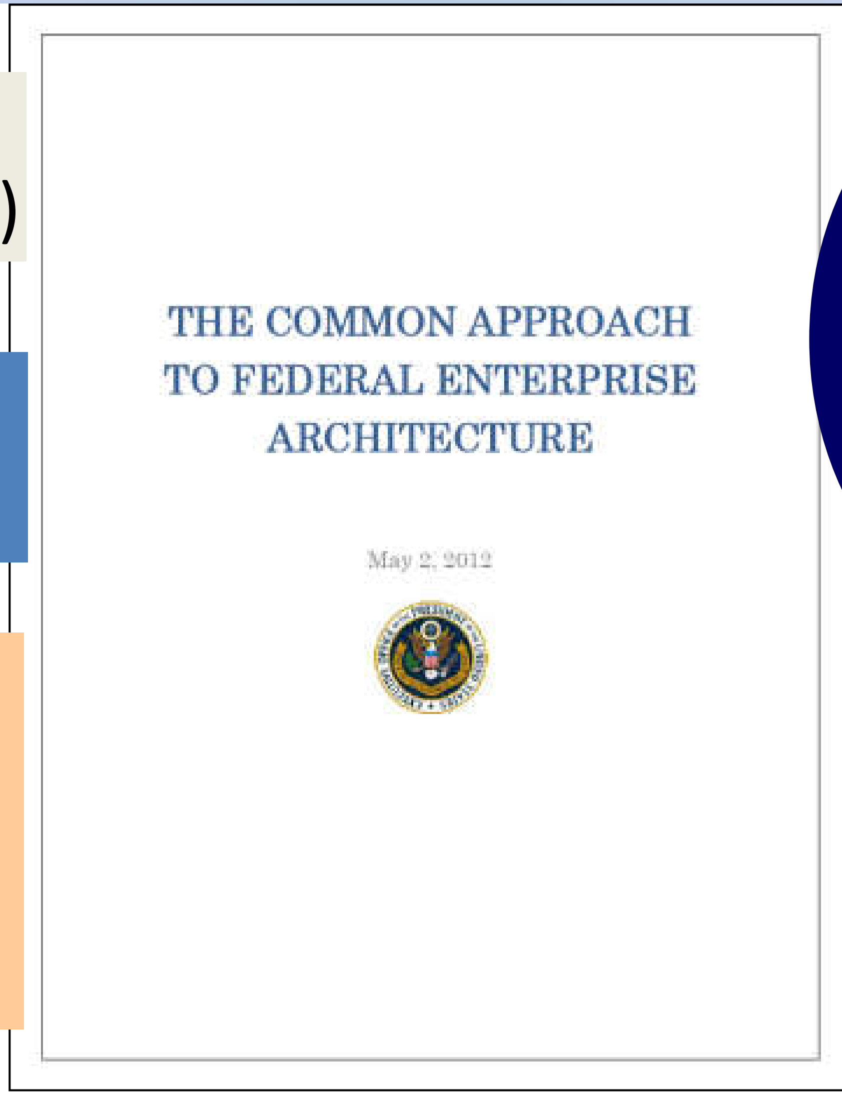


Initiatives: Federal Government Common Approach

primary outcomes (4)

levels of scope (8)

basic elements of an EA program (8)


THE COMMON APPROACH TO FEDERAL ENTERPRISE ARCHITECTURE

May 2, 2012

sub-architecture domains (6)

50 document artifacts

reference models (6)

Draft Artifact Working Group

Strategy Domain Artifacts			Business Domain Artifacts		
S-1	Strategic Plan	DoDAF CV-1, 2, 3, 5, 6 (Capability Effects, Hierarchy, Schedules, Deployments, and Activities)	B-1	Business Service Catalog	DoDAF SvcV-1 (Service Composition)
S-2	Concept Overview Diagram	DoDAF OV-1 (Operational Concept)	B-2	Business Service Capabilities	DoDAF CV-7 (Capabilities Services)
S-3	Capability Effects	DoDAF CV-1 (Capability Effects)	B-3	Business Case / Alternatives Analysis	OMB Exhibit 300
S-4	Capability Deployments and Dependencies	DoDAF CV-3, 4, 5 (Capability Schedules, Dependencies & Deployments)	B-4	Business Value Chain	DoDAF OV-2 (Organizations and Resources)
S-5	Capability Hierarchies	DoDAF CV-2 (Capability Hierarchies)	B-5	Business Process Model	DoDAF OV-5a&b (Operational Activities), Operational Activity Diagram, Business Process Diagram
S-6	Organization Chart	DoDAF OV-4 (Organizational Relationships)	B-6	Business Process Services	DoDAF SvcV-5 (Service Operational Activities Support)
S-7	SWOT Analysis		B-7	Business Process Sequences	OV-6c (Operational Activity Sequences)
S-8	Knowledge Management Plan		B-8	Concept of Operations (CONOPS)	DoDAF OV-6c (Operational Activity Sequences)
S-9	Architecture Summary	DoDAF AV-1 (Executive Summary)	B-9	Business Transition Plan	DoDAF PV-2 (Project Schedules), Business Operating Plan
S-10	Architecture Dictionary	DoDAF AV-2 (Dictionary)	B-10	Operational Performance Measures	DoDAF OV-6a (Operational Rules)
S-11	Balanced Scorecard (BSC)	Performance Measures Scorecard	B-11	Project Plan	DoDAF PV-2 (Project Schedules) and PV-3 (Projects and Capabilities)

Convergence Approach for NAF: IDEAS Layered Approach

1. Foundation (upper ontology) ✓

2. Common patterns

3. Common architecture domain objects & relationships

X X X X

NAF views	***national views***	***national views***	***national views***

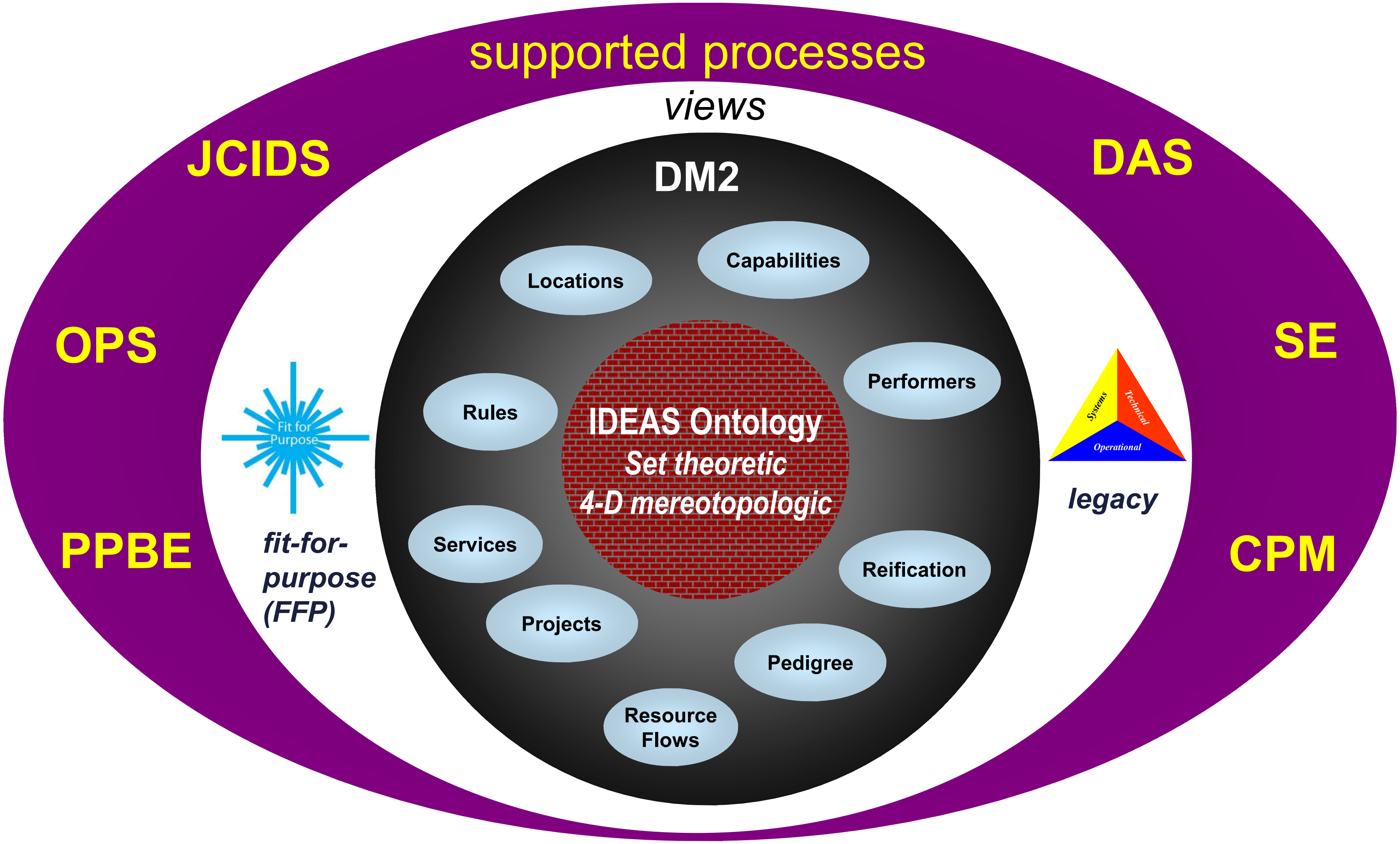
1. Ontologic concepts and relationships
2. Commonly used patterns (e.g., resource flow, exchange)
3. Consensus concepts and relationships (e.g., person, organization, material)

Views for:

1. *NATO "core" architecture views*
2. *specific to needs and policies of individual nations*

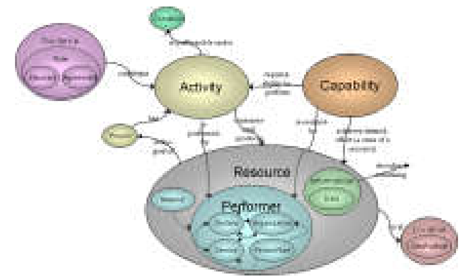
Fit For Purpose (FFP) Views

Fit For Purpose (FFP) and Legacy Views

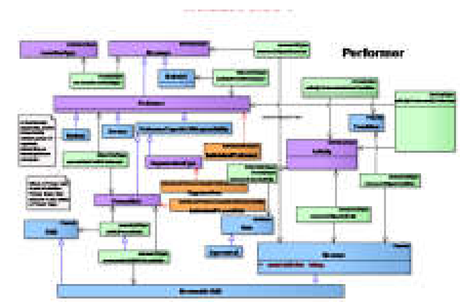


DM2 Has Three Model Levels

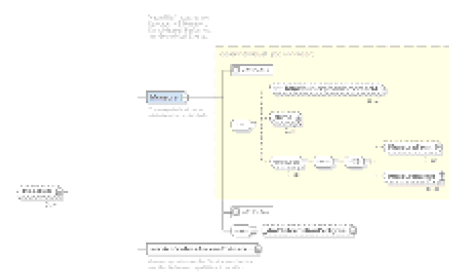
- Conceptual Data Model (CDM)
  - Concepts and concept relationships
  - Propositions and definitions validated by SMEs



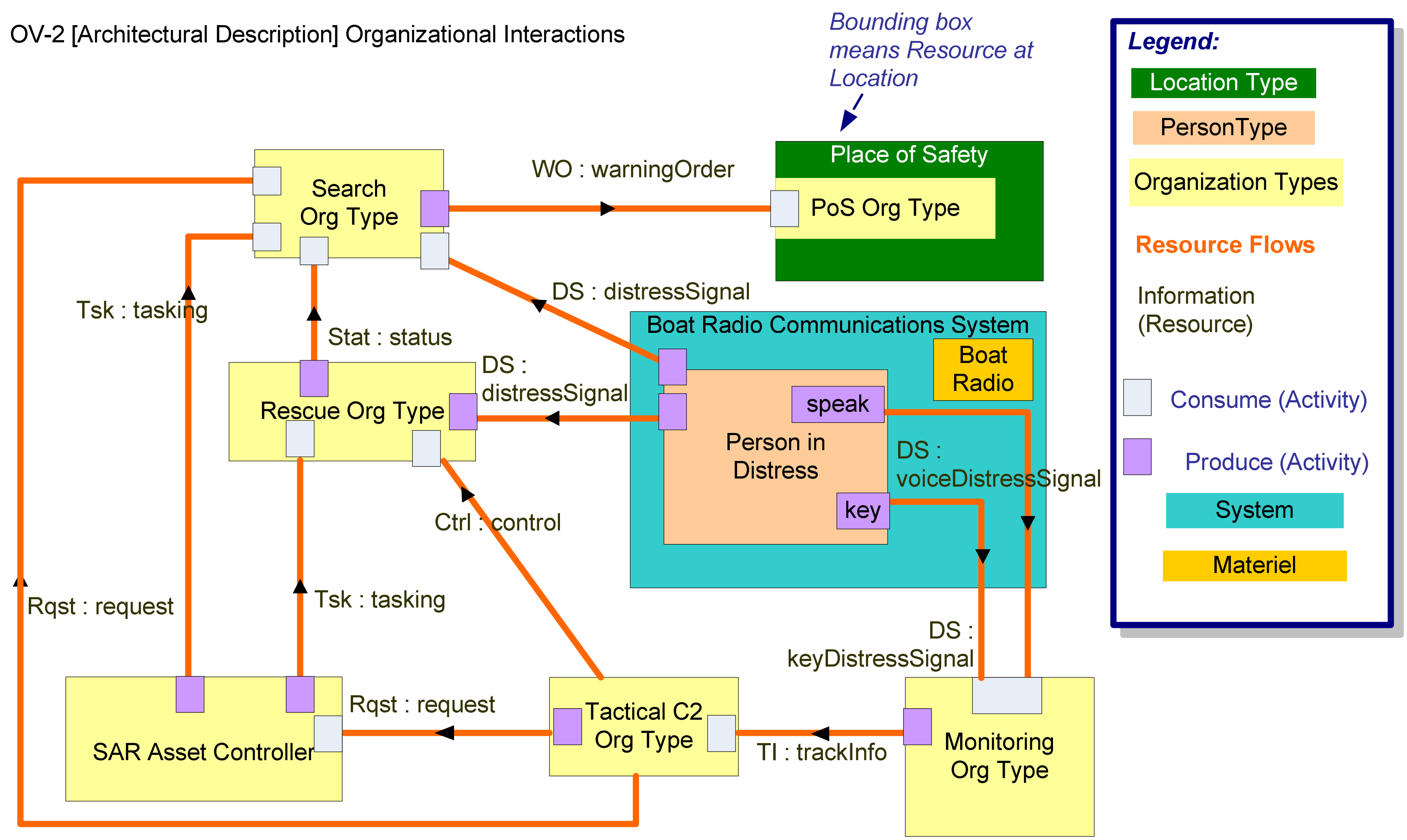
- Logical Data Model (LDM)
  - Reified and formalized relationships
  - This is where almost all DoDAF design and analysis work is done



- Physical Exchange Specification (PES)
  - XML encoding of LDM
  - Auto-generated from the LDM
  - No need to look at (unless you are a tool programmer)



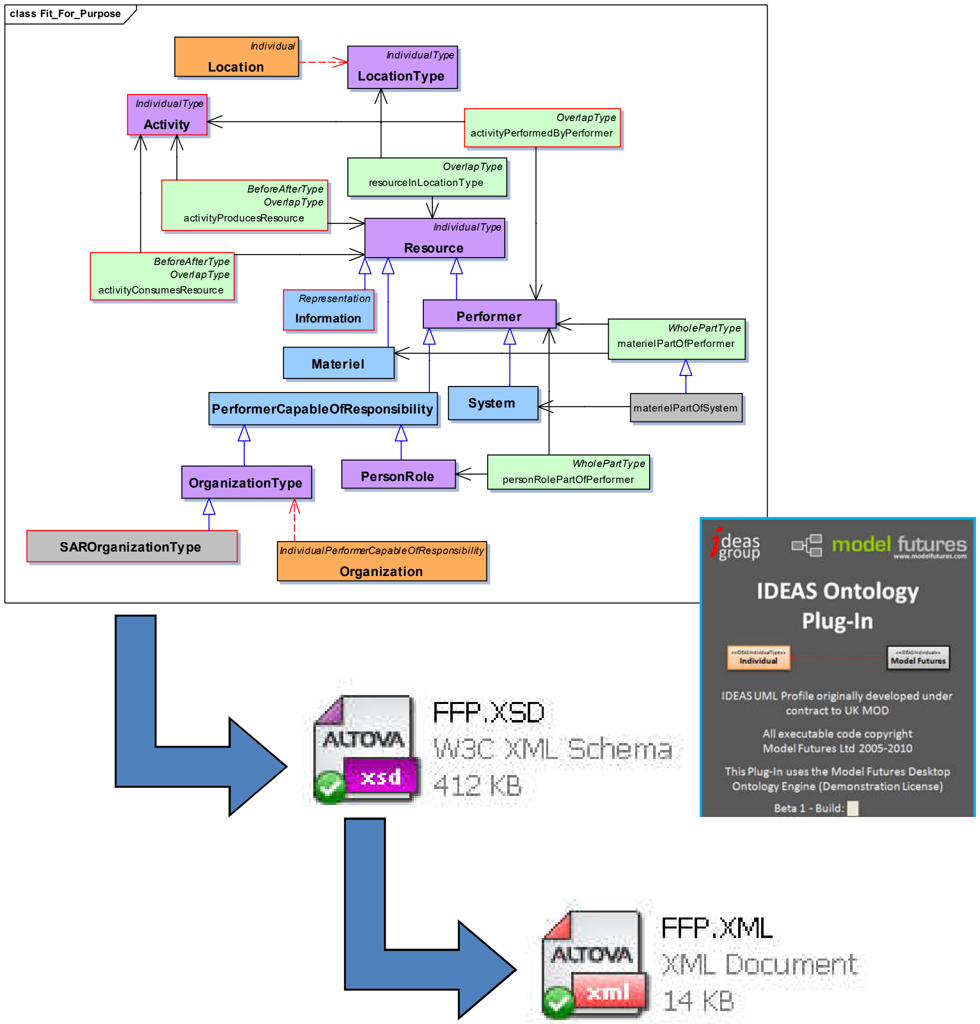
Example FFP: OV-2 / SV-1 Hybrid



Creating a FFP Model

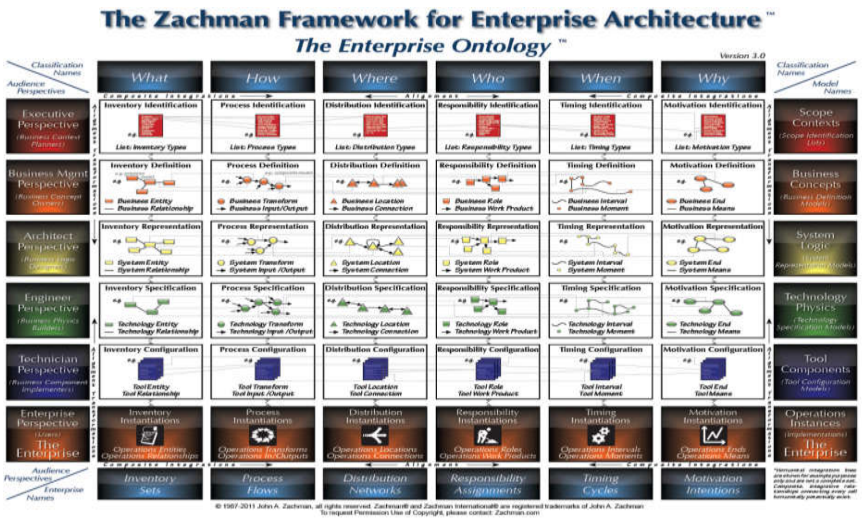
- Use the DM2 Logical Data Model.
- Create a new diagram. Drag DM2 elements onto the diagram.
- Extend classes (including relationship classes) as needed.
- Use the IDEAS Profile to generate XSD.
- Develop narrative documentation.
- Share XSD and documentation with your COI.

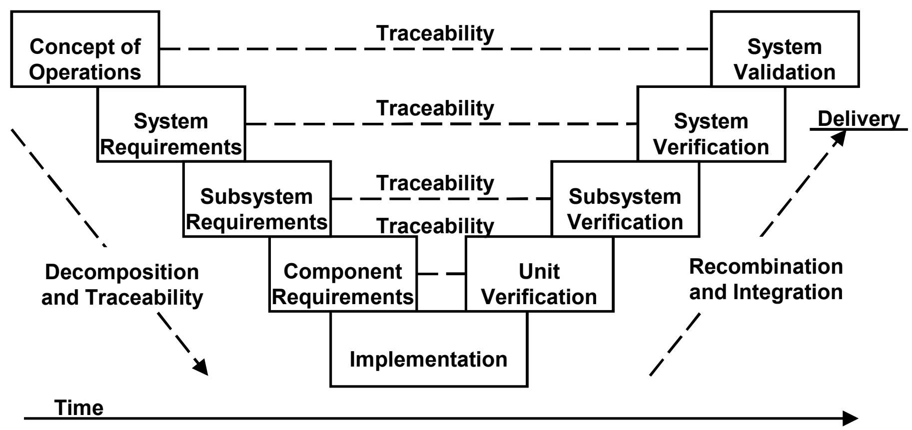
Tutorial at www.rdte.us/FFP tutorial



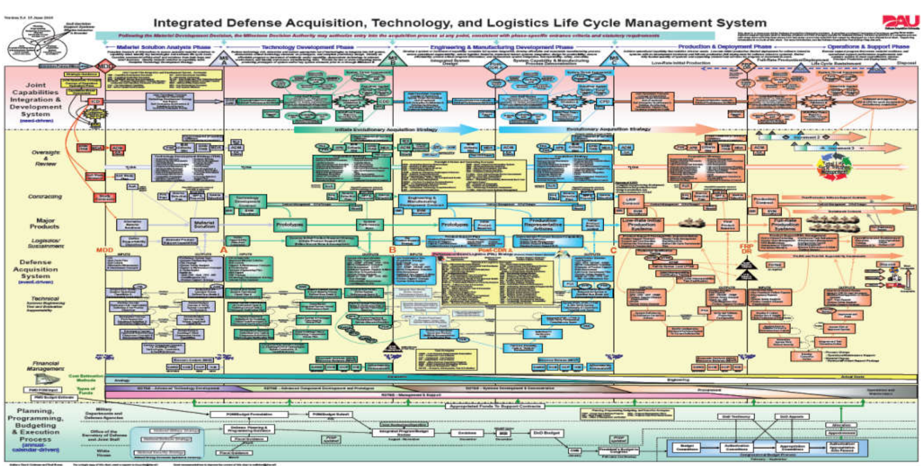
DoDAF reification, requirements, and SE "V" model

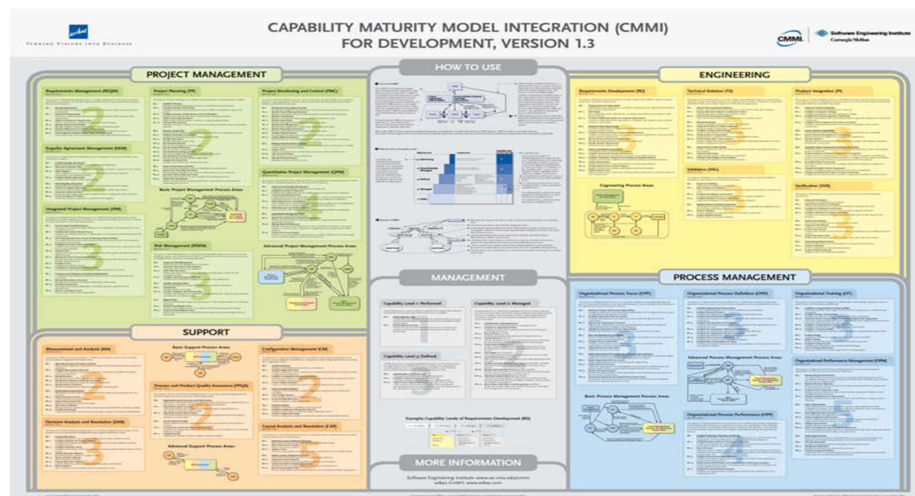
Some Life-Cycle Models





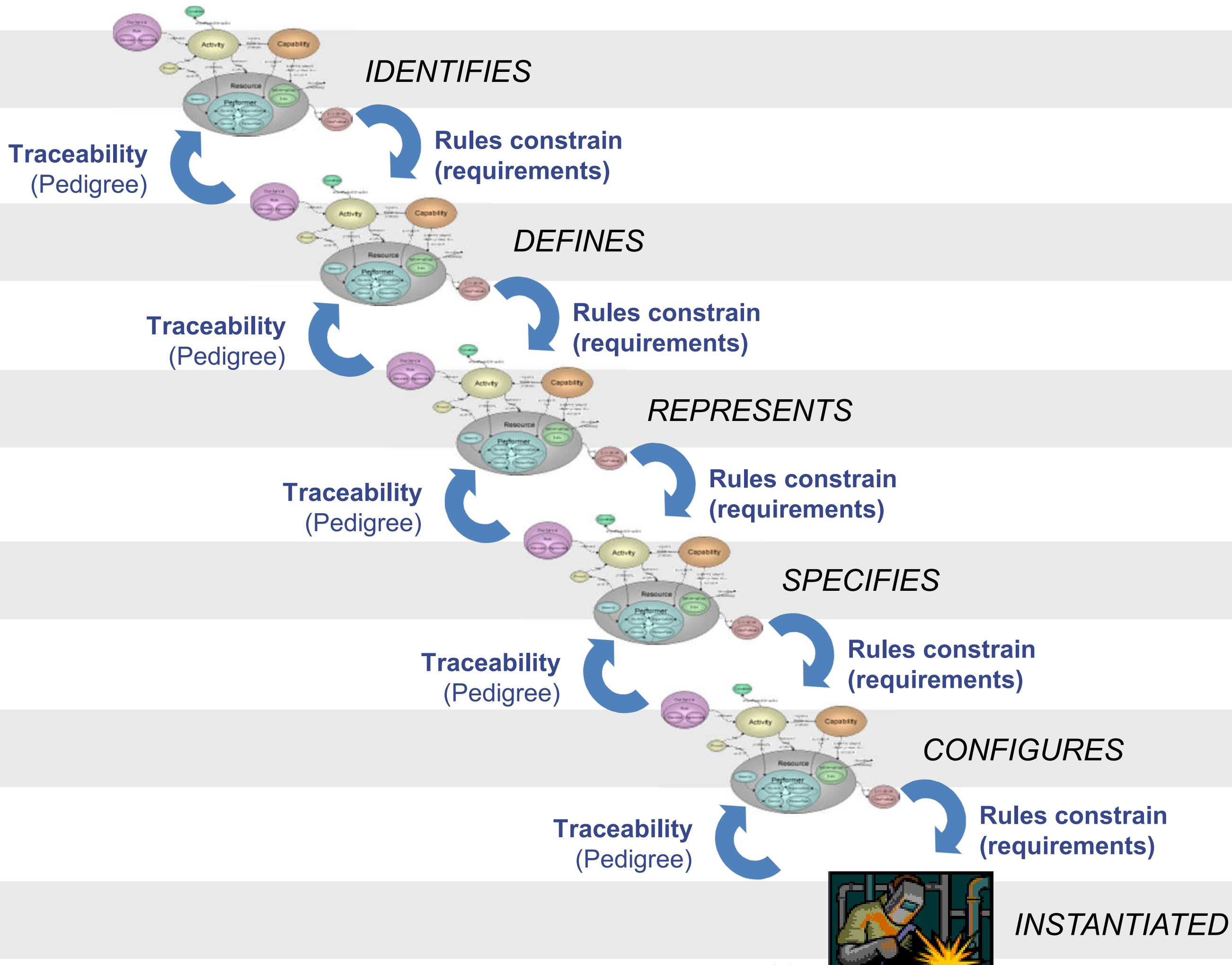
When you look up it's requirements
When you look down it's design

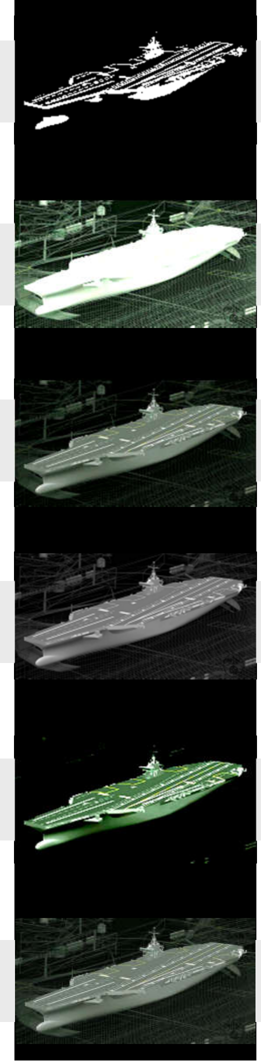




How DoDAF Supports Reification

AN ARCHITECTURAL DESCRIPTION:

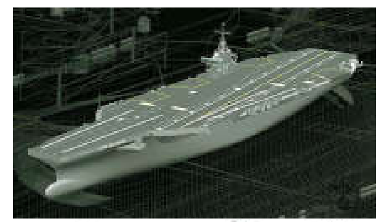




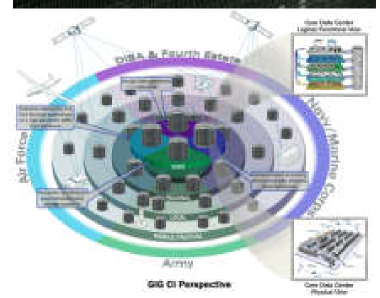
Reification Pattern Applies To:

- Capabilities
- Acquisitions
- Consolidations
- Migrations
- Life-Cycle Sustainment

JIE



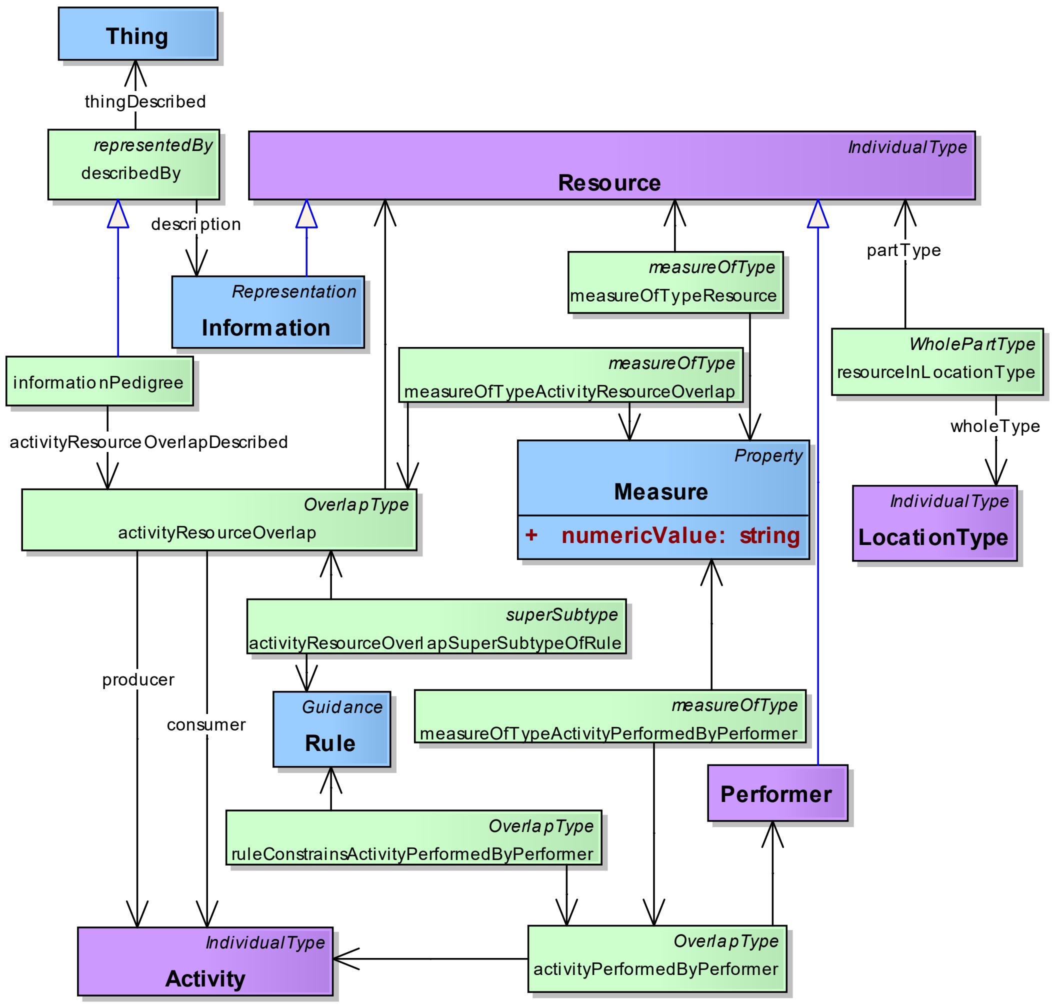
CVN-79



Data Center Consolidation

DoD Enterprise Cloud Environment

Plumbing is via Pedigree (Provenance)

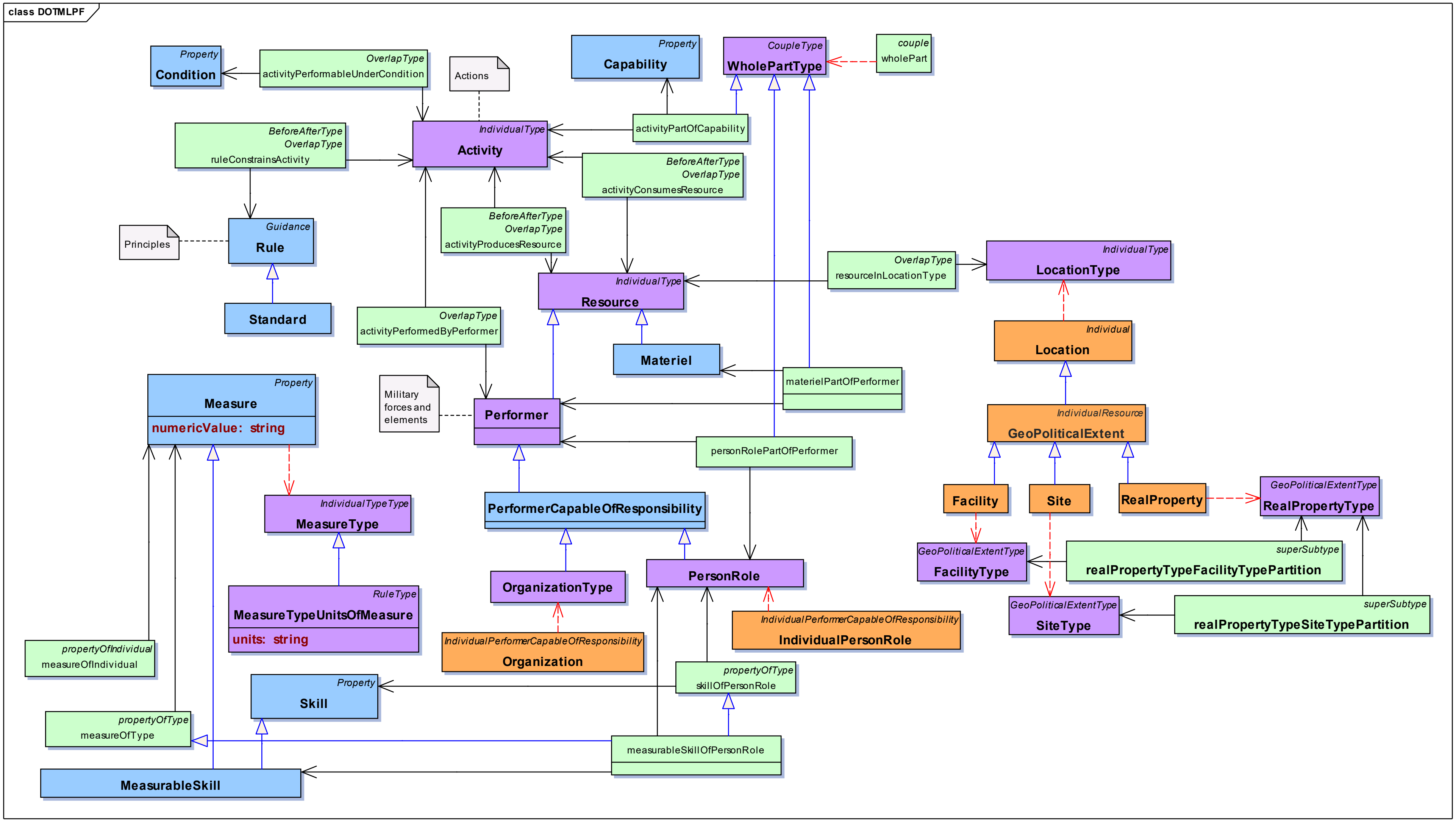


- workflow model, e.g., open provenance model (provenance = linked together pedigrees)
- = activity model (OV-5 + 6c)
- “link while you think”

DoDAF meta-model for:

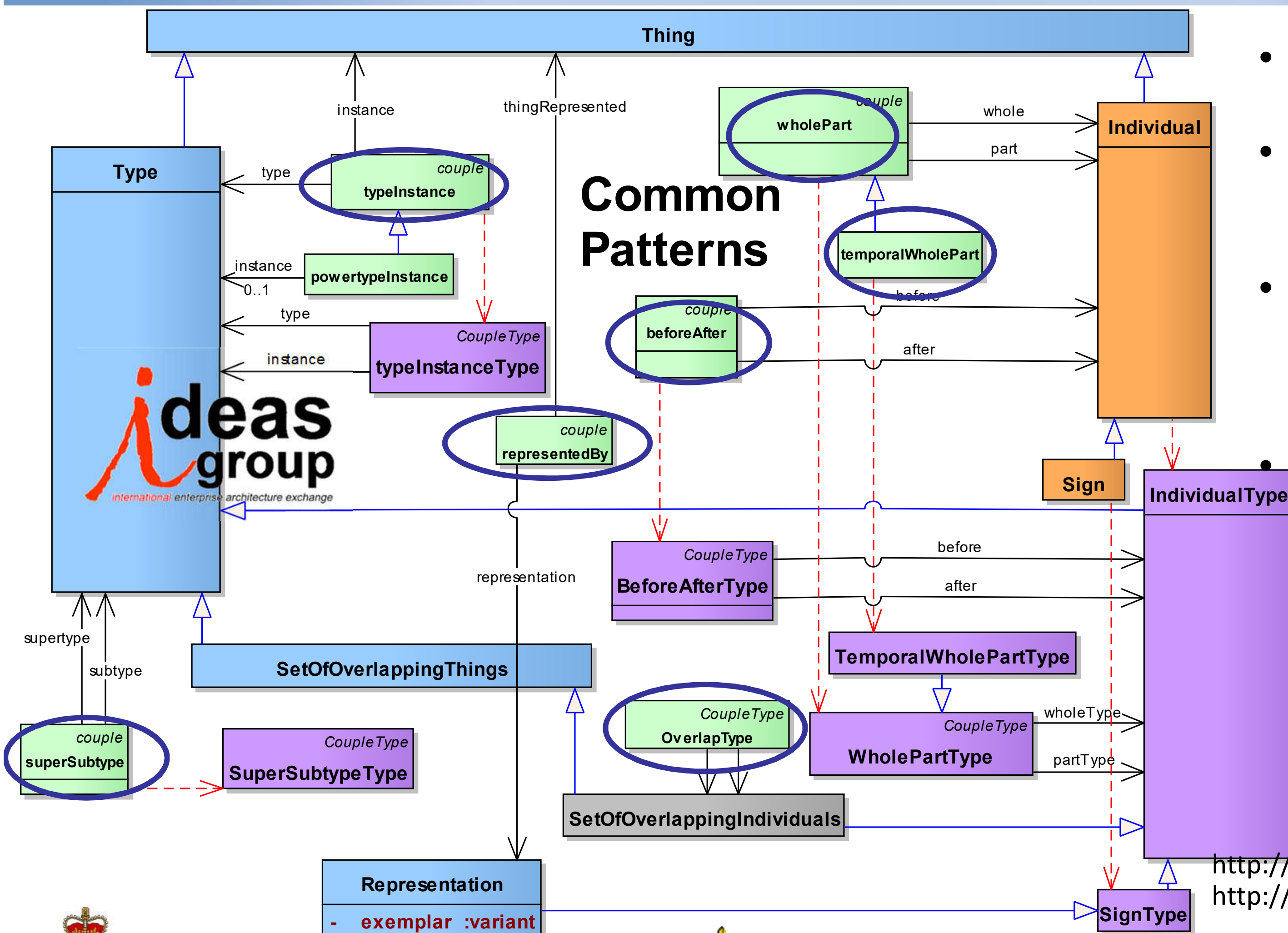
- DOTMLPF
- temporality, behavior, scenarios, M&S, executable architectures

DOTMLPF


class DOTMLPF
Property
Condition
OverlapType
activityPerformableUnderCondition
Actions
Property
Capability
CoupleType
WholePartType
couple
wholePart
BeforeAfterType
OverlapType
ruleConstrainsActivity
IndividualType
Activity
activityPartOfCapability
BeforeAfterType
OverlapType
activityConsumesResource
Principles
Guidance
Rule
BeforeAfterType
OverlapType
activityProducesResource
OverlapType
resourceInLocationType
IndividualType
LocationType
IndividualType
Resource
Standard
OverlapType
activityPerformedByPerformer
Individual
Location
Materiel
materielPartOfPerformer
Property
Measure
numericValue: string
Military forces and elements
Performer
IndividualResource
GeoPoliticalExtent
personRolePartOfPerformer
IndividualTypeType
MeasureType
PerformerCapableOfResponsibility
Facility
Site
RealProperty
GeoPoliticalExtentType
RealPropertyType
GeoPoliticalExtentType
FacilityType
superSubtype
realPropertyTypeFacilityTypePartition
RuleType
MeasureTypeUnitsOfMeasure
units: string
OrganizationType
PersonRole
GeoPoliticalExtentType
SiteType
superSubtype
realPropertyTypeSiteTypePartition
IndividualPerformerCapableOfResponsibility
IndividualPersonRole
IndividualPerformerCapableOfResponsibility
Organization
propertyOfIndividual
measureOfIndividual
propertyOfType
skillOfPersonRole
Property
Skill
propertyOfType
measureOfType
measurableSkillOfPersonRole
MeasurableSkill

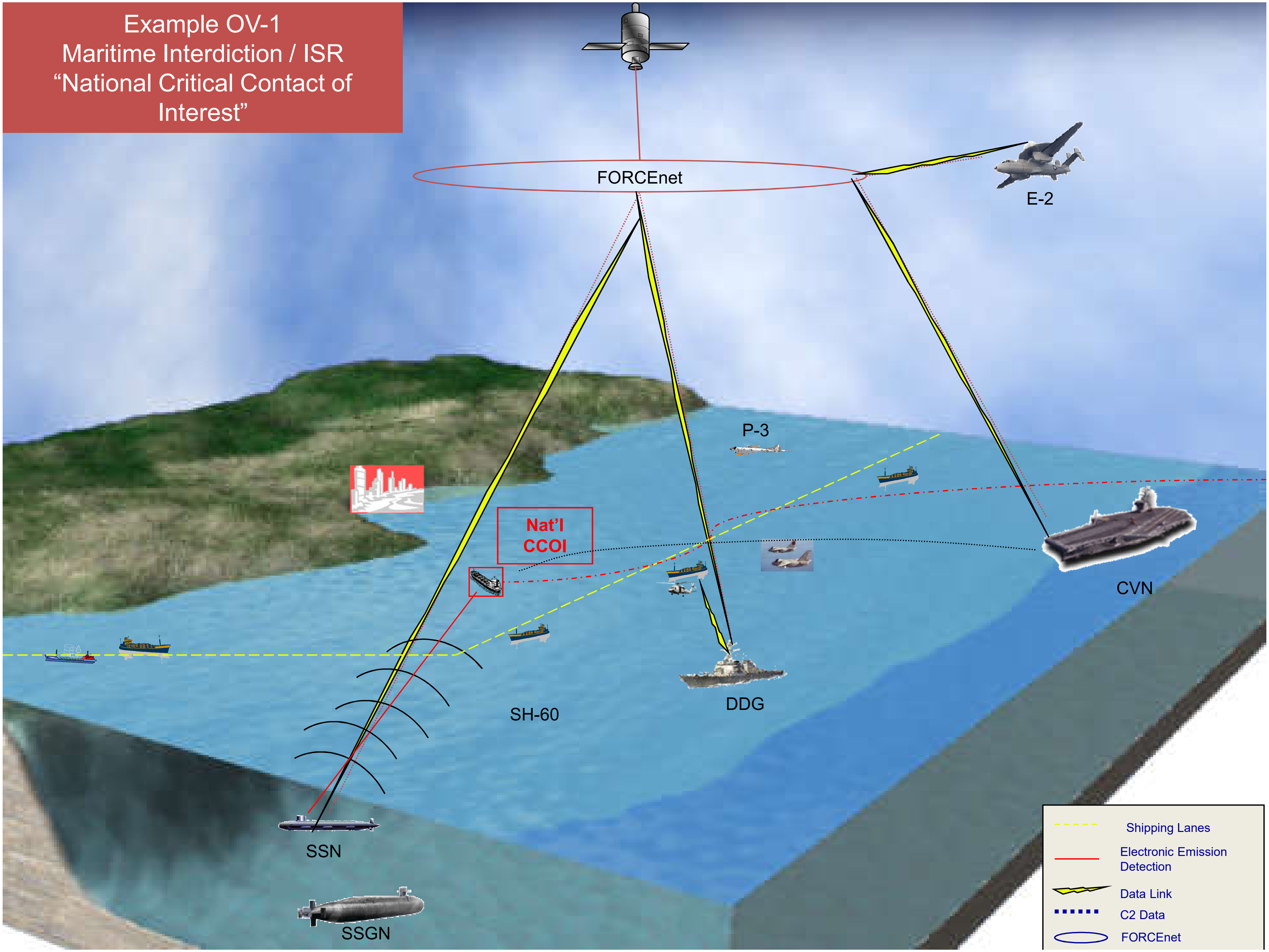
Temporality, Behavior, Scenarios, M&S, Executable Architectures

DM2 is founded on 4D ontology

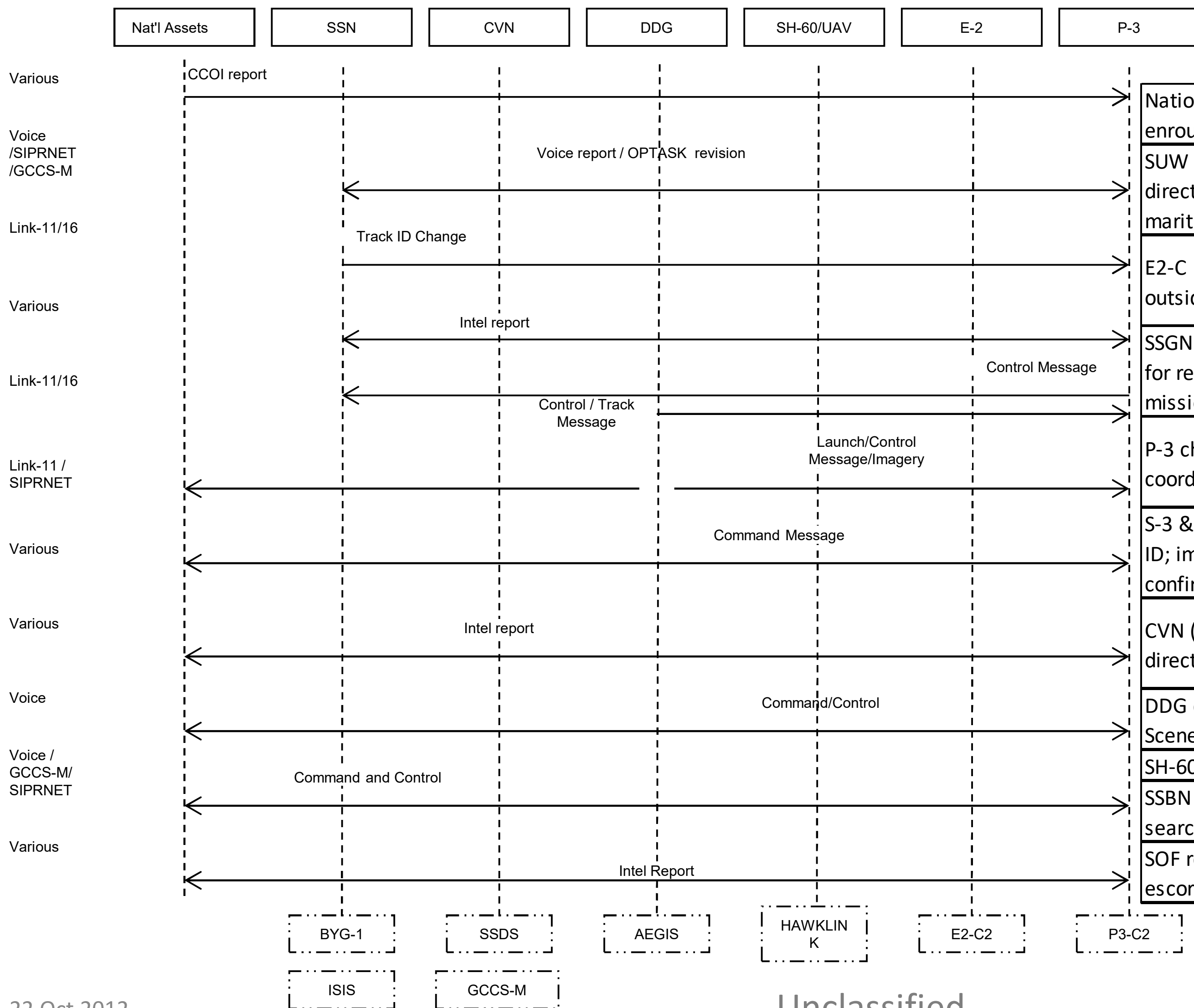


- Four dimensionalist -- xyzt
- Extensional -- physical existence is the criterion for identity
- Signs and representations are separated from referents
- Mathematics:
  - Type theory ~ Set theory
  - Mereology (wholes and parts)
  - 4D Mereotopology (spatio-temporal relations)

http://www.ideasgroup.org or
http://en.wikipedia.org/wiki/IDEAS_Group


Example OV-1
Maritime Interdiction / ISR
“National Critical Contact of Interest”
FORCEnet
E-2
P-3
Nat’l CCOI
CVN
SH-60
DDG
SSN
SSGN
Shipping Lanes
Electronic Emission Detection
Data Link
C2 Data
FORCEnet

Maritime Interdiction / ISR Scenario
“Critical Contact of Interest Surveillance and Prosecution”
OV-6c Sequences



National Assets report CCOI (Critical Contact of Interest) enroute Battlegroup ‘Alpha’

SUW CDR embarked aboard DDG generates cueing order and directs launch of SSC aircraft from CVN; request P-3 for maritime surveillance

E2-C locates COI with radar approaching surveillance area outside normal shipping traffic lanes

SSGN + embarked SOF teams monitor situation by searching for relevant reports from area; study possibility of take-down mission

P-3 checks into TADIL; SUW CDR provides search area coordinates and possible CCOI track information

S-3 & SH-60 assets are coordinated for shipping lane traffic ID; imagery fm H-60 provided for Intel cell analysis; CCOI ID confirmed

CVN (SOF Capable) provides assets for board & search; SSBN directed to scene for inspection/seizure if required

DDG directed to provide area security; designated OSC (On-Scene-Commander)

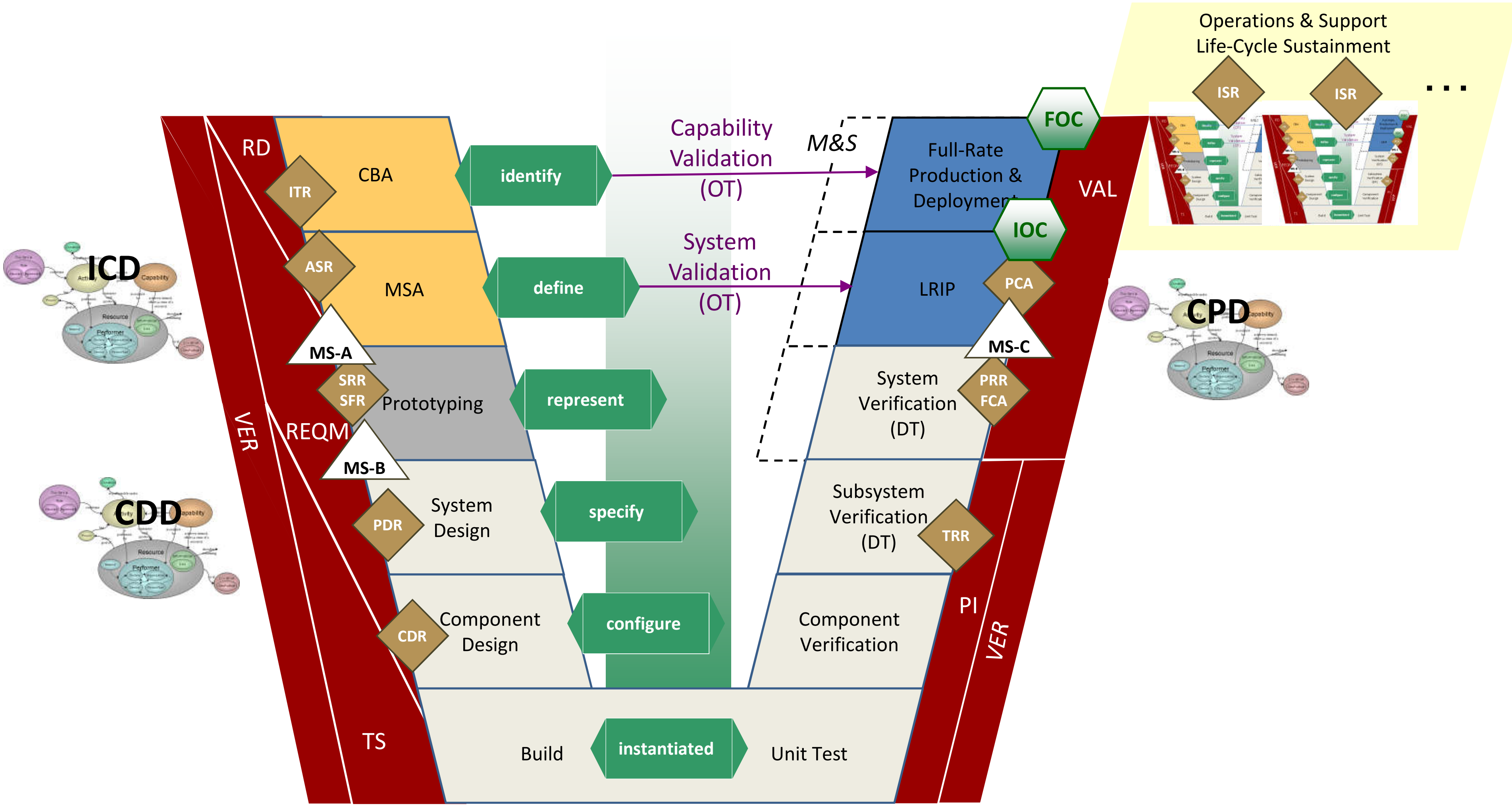
SH-60 reports SOF onboard vessel; no resistance

SSBN reports on station; on board SOF disembarks to assist search

SOF reports sensitive material secured; vessel underway and escorted by DDG

DoDAF and SE Documents and Artifacts

DoDAF Artifacts Overlaid on "V"



Notional Systems Engineering Documents with embedded DoDAF artifacts

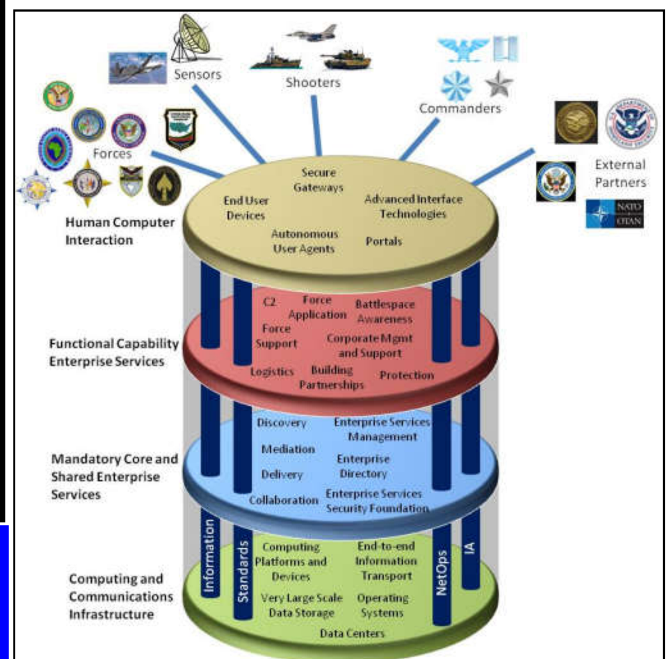
- System Specification (SSS, SDS, SDD, etc.)
  - Functional Description – SV-4
  - Performance Specification – SV-7
  - Interfaces – SV-1, high-level SV-2 and 6
  - Standards to Comply – StdVs mapped to SV's
  - Components – SV-1
- Interface Specification (IRS, ICD, etc.) – SV-2 and 6, possibly linked to DIV-2 and 3

Elements of Quality Architecture

- *Single Architecture Framework*
- *Policy, Direction, Guidance*
- *Exchange*
- *Architecture Tools*
- *Certified Architects*

Enabling efficient and effective acquisition of hardware, software and services used by DoD and Partners in mission performance.

Unified Architecture Framework



Summary

- DoDAF is foundational to Federal Government and NATO
- FFP + DM2 enables more sophisticated modeling than legacy views
- DoDAF's model for reification supports many life-cycle models, including SE "V"
- The DoDAF Meta Model (DM2) was designed to allow modeling beyond the legacy views
- DoDAF artifacts, SE documents, and artifacts should be complimentary

Questions?