Rebuilding the Tower of Babel
Better Communication Through Standards

Presented by Matthew Hause

Presented at SoS Breakout Session

26 January 2013

Agenda

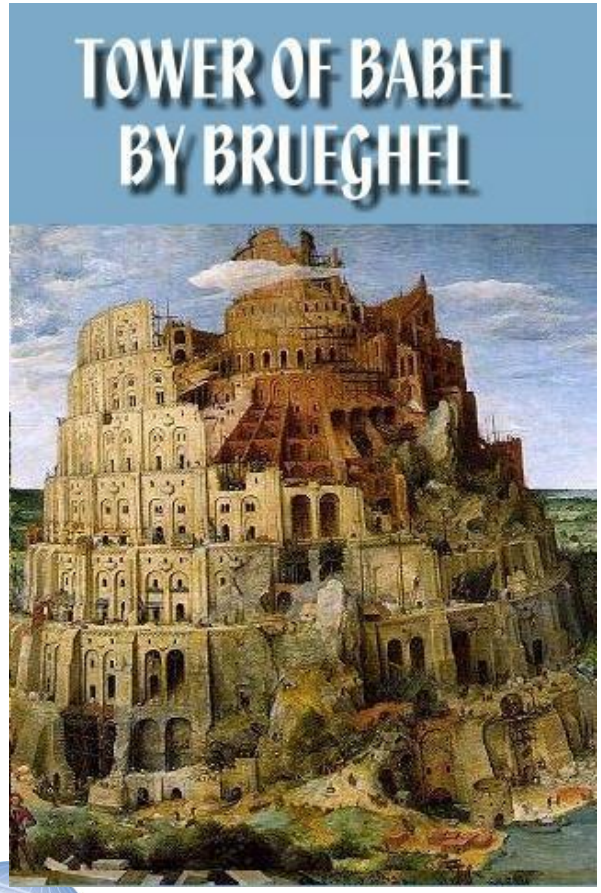
- Barriers to communication and collaboration
- The interoperability problems of frameworks
- Standards and standards organizations
- A brief history of Military Architectural Frameworks
- Working Towards a Common Framework
- Exchange of Architecture Data
- Using Reference Architectures for a common conceptual “dictionary”
- Systems engineering, acquisition, and process
- Vertical and horizontal complementary standards
- Future Problems and solutions

SoS Topics Addressed

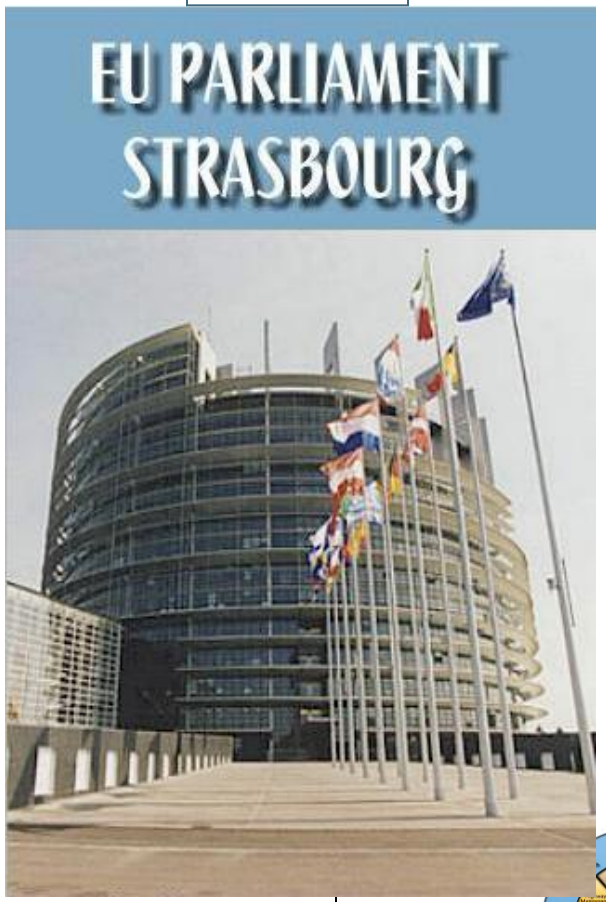
- Framework interoperability for constituent systems
- Models for capabilities
- Requirements traceability
- Testing and validation
- Process
- Reuse
- Integrated systems

The Tower of Babel – A Communications Fable for our Time

Ancient



Modern



European Union Parliament Translation Services

- The EU has 20 recognised languages, 380 language permutations and an annual interpreting and translation bill of €1bn.
- EU institutions currently require around 2,000 written-text translators. They also need 80 interpreters per language per day, half of which operate at the European Parliament.
- From 2007 Irish MEPs have been able to speak in the chamber of the European Parliament in the Irish language with interpretation, though no more than five Euro-MPs have the fluency to do so.
- Catalans and Basques have won more limited language rights. Welsh speakers are stepping up demands.
- Languages include Maltese despite the fact that Malta is largely Anglophone and has just 397,000 citizens.

USA/UK: Two Countries Separated by a Common Language

- Even speaking the same language doesn't always help. Picture this:
  - A man wearing a vest, pants, and a pair of suspenders.

The American Image

The British Image

Vest

UK: Waistcoat

Suspenders

UK: Braces

Pants

UK: Trousers

So, if communication is hard with spoken language, are models the answer?

MBSE Workshop

The Afghanistan Mission Network (AMN)

Reference Document 3195

NATO Consultation, Command and Control Agency

Agence de Consultation, de Commandement et de Conduite des Opérations de l'OTAN

DEVELOPMENT OF THE AMN ARCHITECTURE IN 2010 – LESSONS LEARNED

Torsten Graeber, NATO C3 Agency

June 2011

The Hague

What is the AMN?

- The Afghanistan Mission Network (AMN) is the primary Coalition Command, Control Communication and Computers Intelligence, Surveillance and Reconnaissance (C5ISR) network in Afghanistan for all ISAF forces and operations. It is a federation of networks with the AMN Core provided by NATO and national network extensions.
- Planning for the AMN is supported by a multi-national, collaborative effort to develop and maintain the enterprise architecture for the AMN.
- This document is a working paper that may not be cited as representing formally approved NC3A opinions, conclusions or recommendations.

AMN Issues (1)

- In 2010, there was no proper governance structure for the AMN as a whole.
- Likewise there was no governance for the development of the AMN architecture.
- The development of the architecture was primarily coordinated through the AWG consisting of the architects of the nations participating in the AMN.
- This AWG usually received ad hoc tasking from different stakeholders involved in the development of the AMN without clear leadership defining the goals and deliverables upfront.
- As a direct result of this missing governance several issues arose that had a negative impact on the architecture development work.

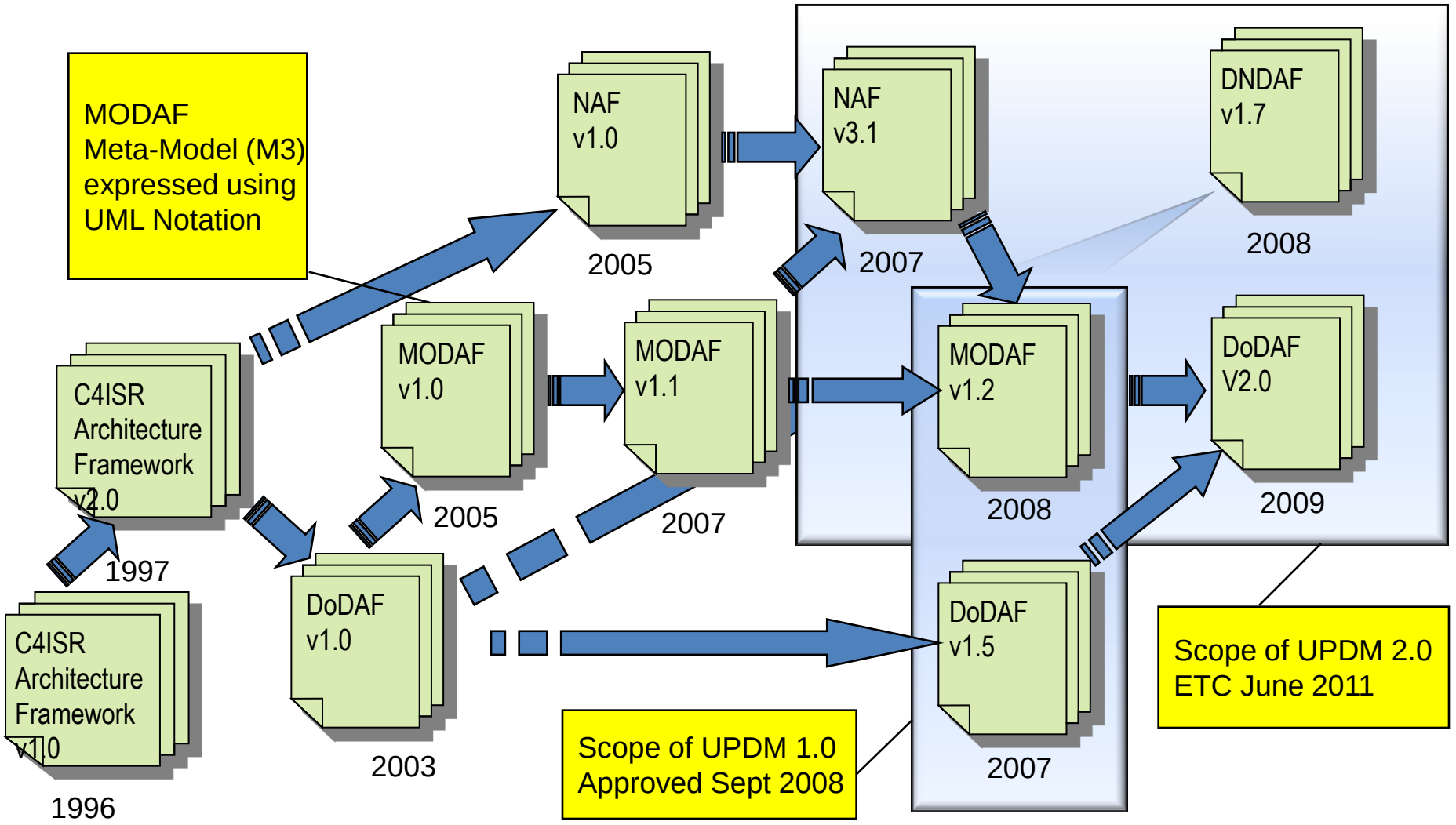
AMN Issues (2)

- These issues included:
  - Different expectations on content and usage of the architecture leading to ever changing requirements and deliverables
  - No enforcement of the architecture during implementation
  - Usage of different architecture frameworks
  - Usage of different architecture tools.
  - No interchange between the tools
- In late 2010, a governance structure for the AMN was endorsed by Chief Of Staff SHAPE and the AWG was included in this governance structure. As a direct consequence, the situation regarding clearer expectations, deliverables and enforcement of architecture has been improved in 2011.
- **However, as the architects are sponsored by their respective nations they have to implement national policies and requirements, so that improvements regarding the usage of a single framework and tool are not to be expected.**

AMN Recommendations

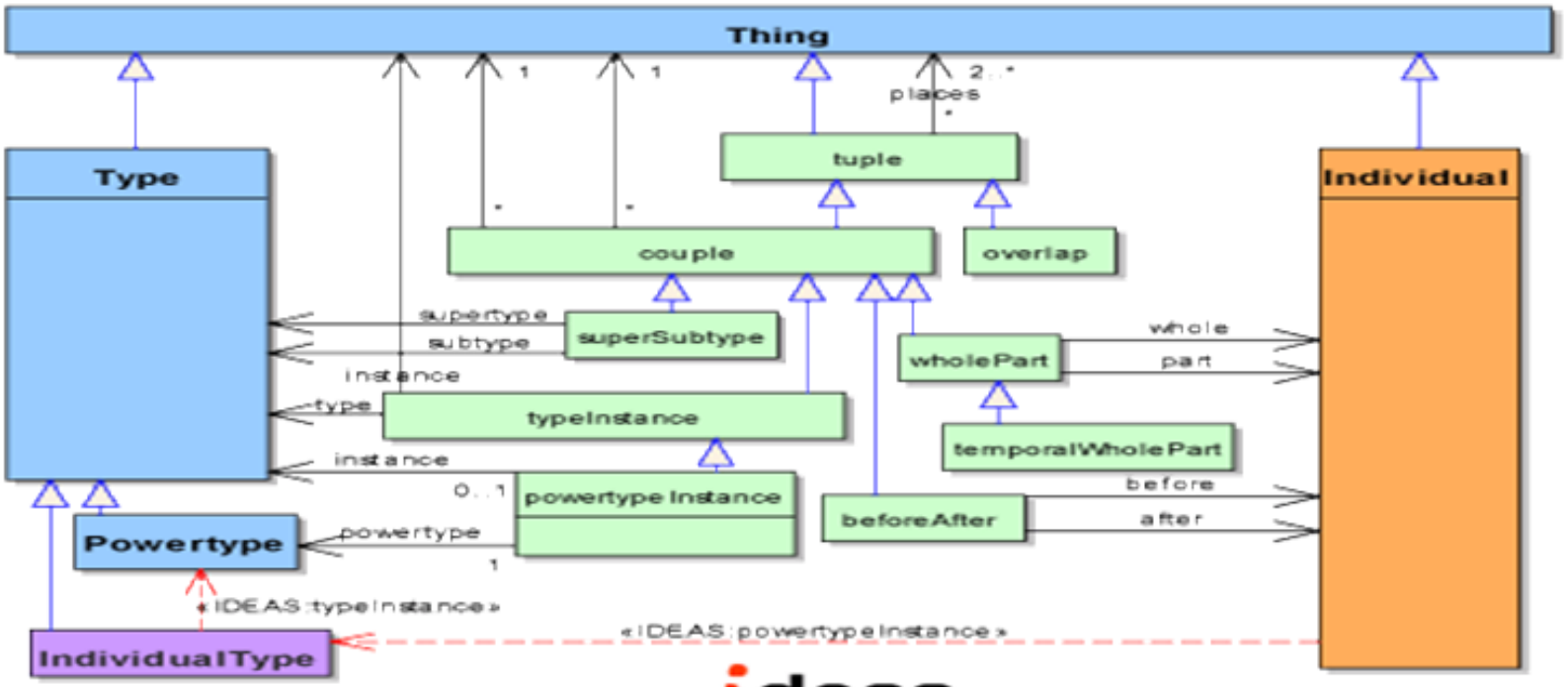
- Recommendation 1
  - Before starting, establish the governance structure.
- Recommendation 2
  - Ensure availability of a common infrastructure allowing remote access to a single repository
- Recommendation 6
  - Harmonize national and NATO policies related to architecture development and reference architectures.
- Recommendation 16
  - Develop common reference models
- Recommendation 18
  - Standardize on one tool and a single repository. Synchronization is expensive as is training.
- Recommendation 19
  - Develop a formal exchange mechanism for data

Historical Development of AF's.



IDEAS - Top-Level Foundation

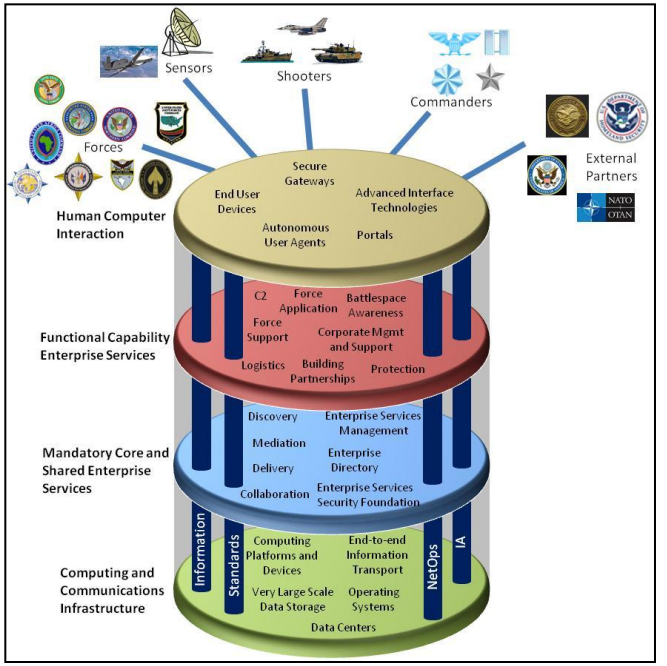
- Developed by an international group of computer scientists, engineers, mathematicians, and philosophers under defense sponsorship.
- See http://www.ideasgroup.org or http://en.wikipedia.org/wiki/IDEAS_Group



Elements of Quality Architecture

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

Enabling efficient and effective acquisition of hardware, software and services used by DoD in missions deliverables.



Unified Architecture Framework

Unified Architecture Framework NATO Architecture CaT Introduction

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10-11 September 2012

Office of the Chief Information Officer

4.1 ARCHITECTURE FRAMEWORKS

- **4.1.2 Observations [Need for a Unified Architecture Framework]**
- **Differences in DoDAF, MODAF, and NAF make it difficult to match the meta-model one to one.**
  - **some of the concepts in the frameworks have the same name but different definitions, i.e. different semantics.**
- **Difficult to cross-walk the concepts between the different frameworks leads to miscommunication between architects using different frameworks.**

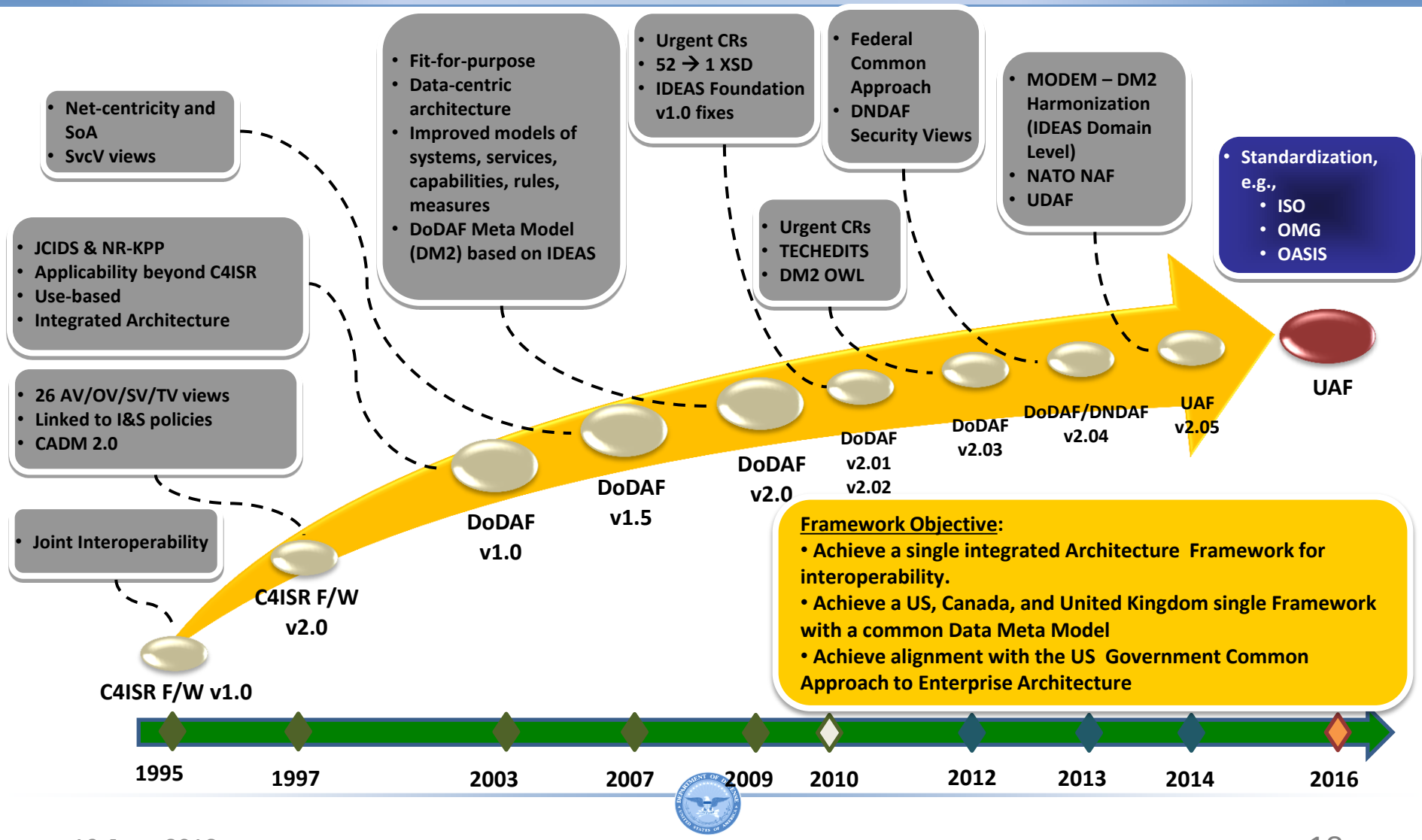
Unified Architecture Framework

Unified Architecture Framework Strategic Direction

- **Move towards a Single Architecture Framework to achieve Interoperability**
- **Development of the AMN architecture in 2010**
- **Development of Unified Profile for DoDAF and MODAF (UPDM) Versions 1.0, 2.0, and 3.0**
- **Meeting at Object Management Group (OMG) March 2012**
- **Ideas Meeting in June 2012**
- **Plan for NATO CAT workshop 10/11 Sept 2012**

Launchpad for Unified Architecture Framework (UAF)

Architecture Framework Convergence Vision



The Unified Profile for DoDAF and MODAF

- UPDM is a standardized way of expressing DoDAF and MODAF artefacts using UML and SysML
  - UPDM is NOT a new Architectural Framework
  - UPDM is not a methodology or a process
  - UPDM implements DoDAF 2.0, MODAF & NAF
- UPDM was developed by members of the OMG with help from industry and government domain experts.
- UPDM is a DoD mandated standard and has been implemented by multiple tool vendors.
- UPDM is a proof of concept of the UAF
- Future versions of UPDM will implement the UAF

Data Exchange Case Study: CAD

- Computer Aided Design (CAD) data exchange involves a number of software technologies and methods to translate data from one Computer-aided design system to another CAD file format. This PLM technology is required to facilitate collaborative work (CPD) between OEMs and their suppliers.
- The main topic is with the translation of geometry (wireframe, surface and solid) but also of importance is other data such as attributes; metadata, assembly structure and feature data.
- There are basically three methods of transferring data from one CAD system to another.
  - Direct CAD system export/import
  - Direct 3rd party translators.
  - Intermediate data exchange formats

Data Exchange Case Study: CAD

- Intermediary Format.
  - Some by standards organisations
  - Others are private and regarded as quasi industry standards.
- Examples
  - STEP – ISO 10303, a replacement for IGES and VDA-FS with the CAD specific parts: STEP AP203 and AP214: Mechanical CAD systems
    - STEP AP210: CAD systems for printed circuit board
    - STEP AP212: CAD systems for electrical installation and cable harness
    - STEP-NC AP238: CAD, CAM, and CNC machining process information
    - STEP AP242, Managed Model-Based 3D Engineering – the merging of the two leading STEP application protocols, AP 203 and AP 214
  - Others: IGES, VDA-FS, DXF, Parasolid XT, JT Open, DRG, etc.
- In short: multiple incompatible standards offering partial solutions.

DoDAF Physical Exchange Specification (PES) – A Solution?

- PES is a direct translation of a DoDAF model into XML based on the data in the DoDAF 2 Data Dictionary and Viewpoint Mappings
- Proprietary standard, developed, owned and maintained by the DoD.
- New versions of DoDAF means new versions of PES automatically generated from the DM2.
  - No tools to support backwards compatibility of a means of converting between different versions of the PES.
  - No formal verification and validation of the DM2.
- Currently no significant level of support within tools.
- Tests of complete/interoperable implementation of PES across tools have not been performed nor have interchange standards been defined.

DoDAF Physical Exchange Specification (PES) – A Solution?

- Parsing a PES file will be problematic
- In the DM2 there is only one definition of activity. Is this:
  - a project activity?
  - a system activity?
  - a service activity?
  - an operational activity?
  - All of them?
- How does one know to which model the activity belongs?
- The PES will need significant work before it can be used to successfully interchange models.
- Most important, it will not solve the interchange problem between DoDAF and MODAF models.
- The DoD is considering RDF as an alternative.

Modelling Tool Interoperability

- **OMG publishes standard for MOF model interchange**
  - **XML Metadata Interchange (XMI)**
  - **UML, SysML, UPDM all based on MOF models**
- **Sadly, publishing standard doesn't guarantee separate good-faith implementations can interchange models**
  - **Tiny ambiguities & programming errors kill interoperability**
- **Multi-vendor testing drives out bugs, assures interoperability**
  - **OMG Model Interchange Working Group compiles tests**
  - **Vendors run tests, fix their tools or file spec. bug reports**
  - **UPDM OV-2 interchange demonstration at April 2012 DoD Enterprise Architecture Conference**
  - **Result: assures tool interoperability & model longevity**

Reference Architectures: A common dictionary

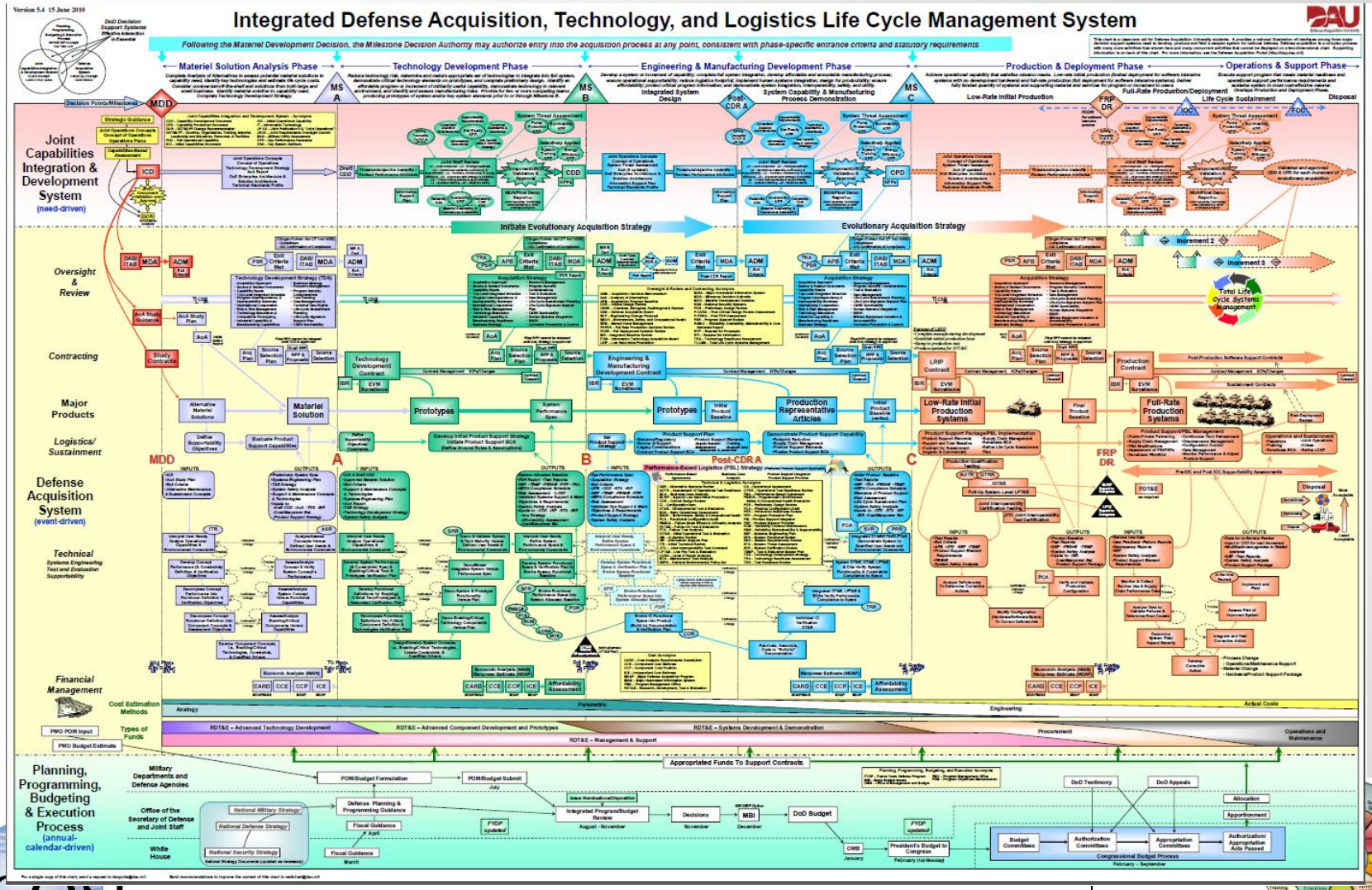
- Provides a template solution for an architecture for a particular domain.
- Provides a common vocabulary to discuss implementations
  - Stresses commonality.
- Defines functions and interfaces and interactions
- Can be defined at different levels of abstraction.
- Set of patterns of successful implementations.
  - Shows how to compose these parts together into a solution.
  - Will be instantiated for a particular domain or for specific projects.
- Accelerates delivery through the re-use of an effective solution and provides a basis for governance to ensure the consistency and applicability of technology use.
- Dependent on a common data/interchange format, storage and distribution capability, configuration management, etc.

Architecture Reference Models

- The intent of this Australian Government Architecture (AGA) framework is to assist in the delivery of more consistent and cohesive services to citizens and support cost-effective delivery of Information and Communications Technology (ICT) services by government, providing a framework that:
  - provides a common language: provides a common language for agencies involved in the delivery of cross-agency services
  - enhances collaboration: supports the identification of duplicate, re-usable and sharable services
  - assists in describing and analyzing ICT investments: provides a basis for the objective review of ICT investments by government
  - assists in transforming Government (citizen-centric, results-oriented, market-based): enables more cost-effective and timely delivery of ICT services through a repository of standards, principles and templates that assist in the design and delivery of ICT capability and, in turn, business services to citizens.

MBSE Workshop

Systems Engineering, Acquisition, and Process: JCIDS



Systems Engineering, Acquisition, and Process

- National acquisition processes have evolved over time
  - Unique to each country and established by law
  - Fiendishly complex
  - Not necessarily fit for purpose
  - Resistant to change
- Adoption of a common process across countries is neither likely nor practical
  - Need to concentrate on MBSE best practice
  - Architecture standards
  - Certified Architect Standards
  - System Lifecycle Standards (15288)
  - Competency Frameworks
  - Etc.
- Most important, a process should NOT tie itself directly to a specific tool or tool vendor.

Vertical and Horizontal Complementary Emerging Standards

- CA-FEA: The Common Approach to Federal Enterprise Architectures
- UML: The Unified Modelling Language.
- SysML: The Systems Modelling Language
- SoaML: The Service Oriented Architecture language
- NIEM: UML Profile for NIEM - provides a common method for defining XML schema conforming to the NIEM Specifications
- IEPV: Information Exchange Policy Vocabulary – provides a method for defining the business rule for the aggregation, transformation, tagging and filtering data and information to a specified message format.
- SOPES IEDM: Codified set of business rules for the JC3IEDM (STANAG 5525) conforming to compliance point 1 of the IEPV
- Etc.

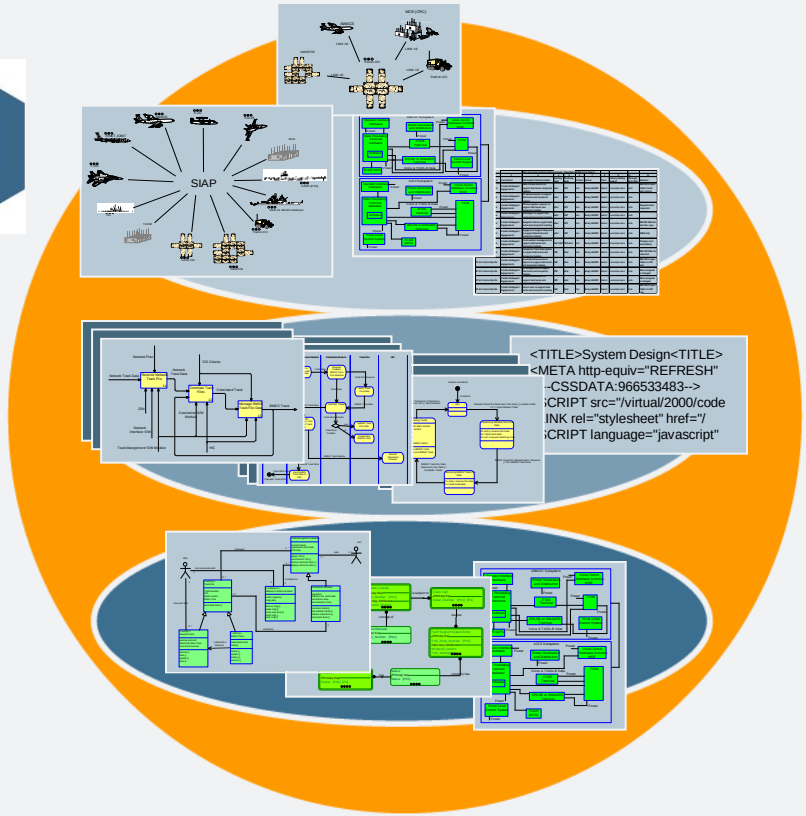
OBJECT MANAGEMENT GROUP

Modeling at Multiple Levels of the System

UPDM GROUP

OMG SYSTEMS MODELING LANGUAGE SysML™

UNIFIED MODELING LANGUAGE UML™



Architecture Models

Systems Models

Component Models

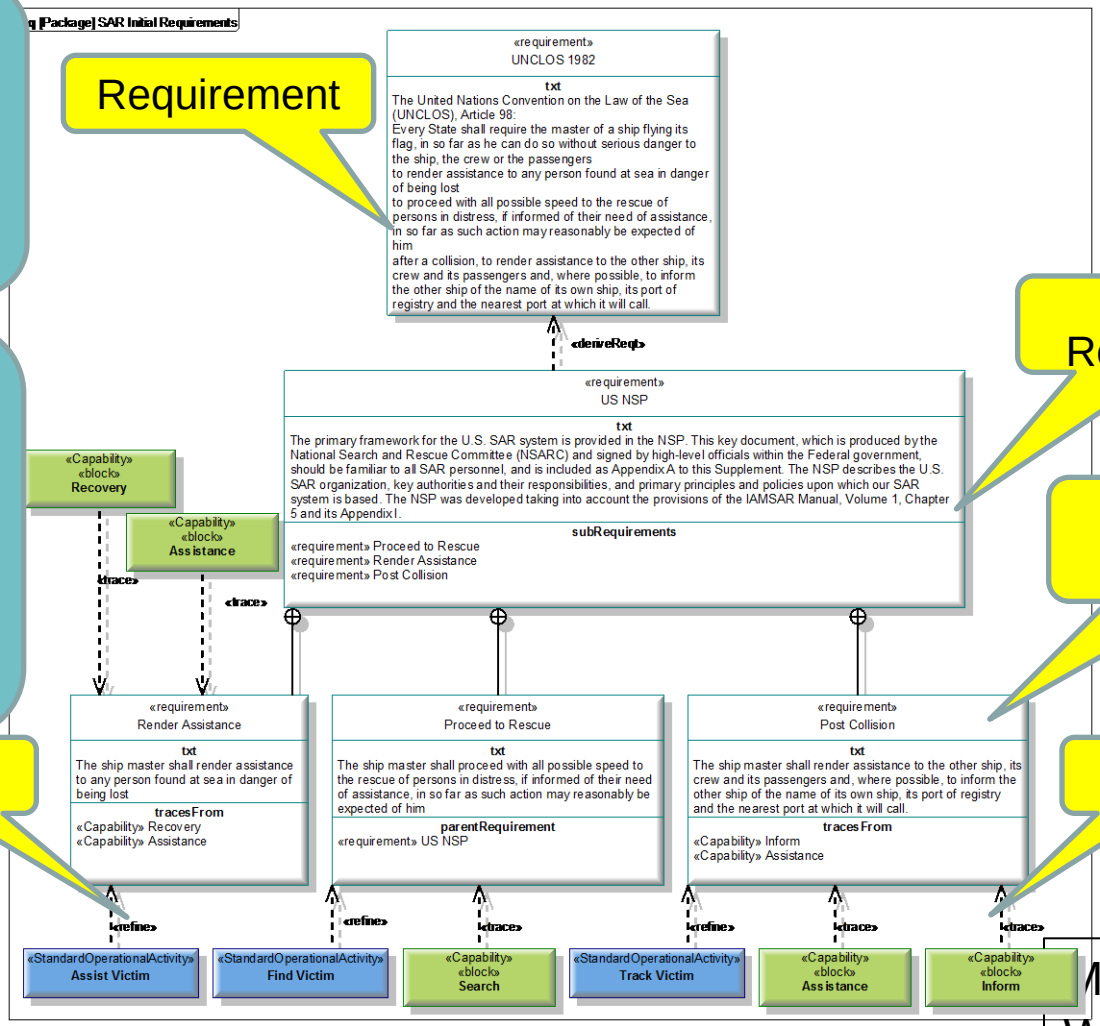
INCOSE International Council on Systems Engineering

MBSE Workshop

Requirements Traceability

Integrates requirements into the model for direct traceability

Requirements and traceability can be synchronized with RM tools such as DOORS



Common Approach

National IT Architecture Movement in the United States across all Government Departments, Agencies, and Organizations

Federal, State, and Local

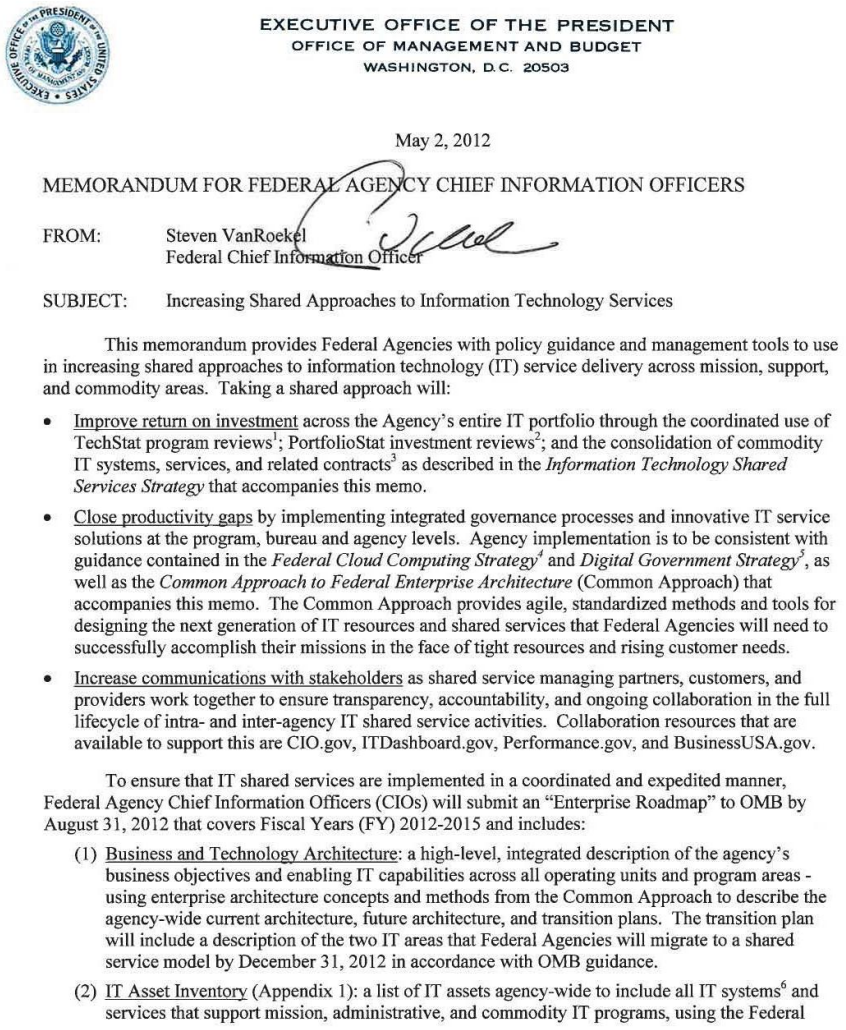
Industry

Academia (Colleges and Universities)

Common Approach

Increasing Shared Approaches To Information Technology Services

- **Implements Governance Process**
- **Provides Authority to the Common Approach to a Unified Architecture Framework**
- **Provides Standards Methods and Tools**
- **Design and Implement Shared Services**
- **Design architectures that facilitates interoperability and information-sharing**



EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF MANAGEMENT AND BUDGET
WASHINGTON, D.C. 20503

May 2, 2012

MEMORANDUM FOR FEDERAL AGENCY CHIEF INFORMATION OFFICERS

FROM: Steven VanRoekel
Federal Chief Information Officer

SUBJECT: Increasing Shared Approaches to Information Technology Services

This memorandum provides Federal Agencies with policy guidance and management tools to use in increasing shared approaches to information technology (IT) service delivery across mission, support, and commodity areas. Taking a shared approach will:

- Improve return on investment across the Agency's entire IT portfolio through the coordinated use of TechStat program reviews[1]; PortfolioStat investment reviews[2]; and the consolidation of commodity IT systems, services, and related contracts[3] as described in the *Information Technology Shared Services Strategy* that accompanies this memo.
- Close productivity gaps by implementing integrated governance processes and innovative IT service solutions at the program, bureau and agency levels. Agency implementation is to be consistent with guidance contained in the *Federal Cloud Computing Strategy*[4] and *Digital Government Strategy*[5], as well as the *Common Approach to Federal Enterprise Architecture* (Common Approach) that accompanies this memo. The Common Approach provides agile, standardized methods and tools for designing the next generation of IT resources and shared services that Federal Agencies will need to successfully accomplish their missions in the face of tight resources and rising customer needs.
- Increase communications with stakeholders as shared service managing partners, customers, and providers work together to ensure transparency, accountability, and ongoing collaboration in the full lifecycle of intra- and inter-agency IT shared service activities. Collaboration resources that are available to support this are CIO.gov, ITDashboard.gov, Performance.gov, and BusinessUSA.gov.

To ensure that IT shared services are implemented in a coordinated and expedited manner, Federal Agency Chief Information Officers (CIOs) will submit an "Enterprise Roadmap" to OMB by August 31, 2012 that covers Fiscal Years (FY) 2012-2015 and includes:

(1) Business and Technology Architecture: a high-level, integrated description of the agency's business objectives and enabling IT capabilities across all operating units and program areas - using enterprise architecture concepts and methods from the Common Approach to describe the agency-wide current architecture, future architecture, and transition plans. The transition plan will include a description of the two IT areas that Federal Agencies will migrate to a shared service model by December 31, 2012 in accordance with OMB guidance.

(2) IT Asset Inventory (Appendix 1): a list of IT assets agency-wide to include all IT systems[6] and services that support mission, administrative, and commodity IT programs, using the Federal

Future Problems

- Systems of systems will grow in complexity and scale
  - Architectures will be necessary for understanding and governance
  - Essential for proper management and control
  - Tools will need to evolve to support this
- Individual national support of proprietary architecture frameworks will become unsupportable
  - Unaffordable
  - Not interoperable
  - A barrier to communications
- The ROI case for MBSE has not yet been made
  - Some evidence exists, but it is not yet overwhelming
  - PowerPoint Engineering is still the status quo

Action List

- Development of the UAF will solve many problems (but not all)
  - Requires immediate support and funding from national governments
  - A change from “individual cars” to shared transport
  - Local variants will be necessary
- An interchange standard will be essential
  - Problems with PES or its replacement must be overcome
  - Work on interchange using RDF is looking promising
- Reference Architectures need to be created and shared
  - At both the capability and component level
- A fundamental change in process needs to happen
  - MBSE needs to change from “extra work” to “how things are done”
  - Tools need to evolve to better enable this change in process
- The case for MBSE ***Must*** be made
  - Industry partners ***Must*** publish more success stories
  - Governments ***Must*** require MBSE starting with the concept phase, the bid process and throughout the acquisition lifecycle

Questions, Comments, Discussion

Contact Details

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