Advancing MBSE via Unified Profile for DoD/AF MODAF (UPDM)
• UPDM is the Unified Profile for DoDAF/MODAF that provides industry standard UML/SysML representation of DoDAF/MODAF architecture artifacts

• UPDM Submitters: Adaptive, ARTiSAN Software Tools, Ltd., EmbeddedPlus Engineering, IBM (includes (Rhapsody and RSx), Mega, No Magic, Inc., Sparx Systems Pty Ltd., Visumpoint

• Supporters: Advanced System Management Group, Ltd., BAE Systems, Generic AB, Lockheed Martin Corporation, MITRE, DOD, MOD, Raytheon Company, Rolls Royce
Motivation for UPDM

- Enhance the quality, productivity, and effectiveness associated with enterprise and system of systems architecture modeling
- Improve the integration between system of systems modeling and system modeling to support post acquisition life cycle design modeling

Develop UML Profile for DoDADM/ MODAF that provides industry standard UML/ SysML representation of DoDADM/ MODAF architecture views
• UPDM emerged as a common profile from about a dozen separate tool implementations
• Spurred by DoD and OMB requirements to utilize architectures on any project of a significant size
• Provides support for the latest standards in modeling, including SOA component modeling and SysML systems modeling
• Recognizes the inevitable need to work with other modeling languages, systems, & standards, such as BPMN, IDEF, Excel, Personnel Systems, and Federal Information Exchange Standards

The diversity of approaches will make DoDAF stronger with a common method for comparison, reuse and evolution. UPDM provides that common structure that will help the DoD deal with emerging modeling issues
Benefits of Industry Based Standards-UPDM

- Promote architecture model reuse and maintainability
- Improve tool interoperability and communications between stakeholders
- Reduce training impacts due to different tool implementations and semantics

- UPDM is an emerging standard in DISR-online
- UPDM is endorsed by SAF/XC, Navy, OSD, MoD, and NATO/NAF as the UML/SysML Architecture modelling standard
OMG UPDM Scope

• Uses DoDAF v 1.5 as a baseline—working towards DoDAF v 2.0
• Incorporates MODAF’s additional views (Acquisition and Strategic views)
• Supports modeling system-of-systems architectures
  – Systems that include hardware, software, data, personnel, procedures, and facilities (DOTMLPF & MOD Lines of Development)
  – Service oriented architectures and net-centricity

RFC page: http://www.omg.org/spec/UPDM/1.0/Beta2/
Architecture Principles

- Single layer
  - UML / SysML Extension
  - Compliance against UPDM will be assessed via XMI interchange
- Core profile for all AFs and sub profiles for differences:
  - Additional elements that belong just to this AF
  - Different naming (Alias)
UPDM Principles

• Model-Based Development of the Specification
  – Specification and XMI generated from the model
• Open, Collaborative Process
  – Include all stakeholders in decision making
  – Open membership
• All Member Inputs Considered
  – Discuss, Debate, Decide, Prioritize, Defer
• 80-20 Rule
• “Keep it Simple”
• Re-Use Rather than Re-Define
  – MODAF 1.2/M3, DoDAF 1.5/2.0, NAF
  – UML 2, SysML 1, BMM, UPMS, BPMN, ...
  – Domain Meta-Model based on the above
UPDM Compliance

UPDM L0

UPDM L1

SoaML

SysML

UML

<<profile>>

UPDM

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UPDM L0

<<profile>>

DoDAF

<<profile>>

MODAF

<<profile>>

Core

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SysML

<<import>>

<<profile>>

SoaML

<<stereotype>>

Capability

<<stereotype>>

ServiceInterface

<<stereotype>>

Expose

<<stereotype>>

Attachment

<<stereotype>>

RequestPoint

<<stereotype>>

ServicePoint

<<stereotype>>

MessageType

<<stereotype>>

Property
• Extends UPDM Level 0 with SysML stereotype definitions
• Facilitates integration of DoDAF and MODAF models for system of systems modeling with SysML models for system modeling
• Enables UPDM to fully leverage SysML features
• Enables UPDM to leverage SysML features
  – SysML blocks to represent structural elements such as operational nodes, artifacts (systems), capability configurations, which enable the use of flow ports, item flows, and value properties with units and distributions
  – SysML activities to support continuous flow modeling, activity hierarchies, and support for enhanced functional flow block diagrams
  – SysML parametrics to enable the integration of engineering analysis with the architecture models (e.g., performance parameters in an SV-7 can be captured in parametric equations)
  – SysML allocations to support various types of mappings such as an SV-5 that maps system functions to operational activities
Remaining Challenges to Model Interchange

• Tool vendors may:
  – implement different versions of the XMI*
  – support a different subset of the versions
  – use proprietary extensions of the UML‡ meta-model
  – provide XMI exporter that generates non-compliant XML code

*XMI: eXtensible Markup Language (XML) Metadata Interchange
‡UML: Unified Modeling Language™
• To improve the interoperability of MOF/XMI-based tools
• Initial focus is on model interchange among UML, SysML, and UPDM-capable tools

• http://www.omgwiki.org/model-interchange/doku.php
Search and Rescue

Example
UK Search and Rescue Framework

- Describes the use of UPDM as it applies to a Maritime Search and Rescue (SAR) operation of a yacht in distress. A monitoring unit picks up the distress signal from the yacht and passes it on to the Command and Control (C2) Center. The C2 Center coordinates the search and rescue operation among helicopters, a naval ship and a Royal National Lifeboat Institution (RNLI) Lifeboat.
OV-1: Operational Context

Graphic

This view sets the scene by illustrating the search and rescue operation at sea which involves a yacht in distress. A monitoring unit picks up the distress calls of the yacht and passes them to a Command and Control (C2) centre which coordinates the operation which involves helicopters, a naval ship and a RNLI Lifeboat.
The strategic context for Search and Rescue Capabilities outlining the vision for a capability area over a specified period of time. It describes how high level goals and strategy are to be delivered in terms of capability.
StV-2: Capability Taxonomy

StV-2 [Architectural Description] Capabilities

- «Capability»
  - «block»
  - Maritime SAR

- «Capability»
  - «block»
  - Land SAR

- actualMeasurements
  - «ActualMeasurementSet» Initial Values
  - «ActualMeasurementSet» Required Values

«Capability» «block» SAR
StV-4: Capability Dependencies

StV-4 [Capability] SAR Capability

«Capability»
«block»
SAR

- DSM : Distress Signal Monitoring
- SC2 : SAR C2
- Mic2: Military C2
- Inf : Inform
- Srch: Search
- Asst: Assistance
- Rec : Recovery
This view specifies the hierarchy of services as well as the relationships between them. In this case, the hierarchy of services within the Search and Rescue Service with Land and Maritime Search and Rescue Services as specializations of the SAR Service.
SOV-2: Service Interface Specification

Defines the interfaces that will provide access to the services
SOV-3: Capability to Service Mapping

Graphical Form

SOV-3 [Architectural Description] SAR Services [2]

- «Capability» «block» Land SAR
- «Expose»
- «ServiceInterface» Land Search and Rescue Service
- «Capability» «block» Maritime SAR
- «Expose»
- «ServiceInterface» Maritime Search and Rescue Service

Tabular Form

<table>
<thead>
<tr>
<th>«ServiceInterface»</th>
<th>«Capability» (Land SAR)</th>
<th>«Capability» (Maritime SAR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land Search and Rescue Service</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Maritime Search and Rescue Service</td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

Shows which services contribute to the achievement of a capability. The Land Search and Rescue Service achieves the Land SAR Capability, and the Maritime Search and Rescue Service achieves the Maritime SAR Capability.
[Architectural Description] SAR Services [SOV-4a]

<table>
<thead>
<tr>
<th>Service Interface</th>
<th>Service Policy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>Name</td>
</tr>
<tr>
<td>Land Search and Rescue Service</td>
<td>Driving Record</td>
</tr>
<tr>
<td>Maritime Search and Rescue Service</td>
<td>Swim</td>
</tr>
<tr>
<td>Search and Rescue Service</td>
<td>First Aid</td>
</tr>
<tr>
<td></td>
<td>Danger</td>
</tr>
</tbody>
</table>

Defines constraints that must be adhered to by Consumers and Providers of the Services via Service Policies.
Defines the Service Functions to describe the abstract behavior of each Service Operation. It specifies the set of functions that the service implementation is expected to perform.
StV-6: Operational Activity to Capability Mapping

**StV-6 [Architectural Description] Capabilities [1]**

- **Capability** «block» Search
  - MapsToCapability «MapsToCapability» StandardOperationalActivity Find Victim
  - MapsToCapability «MapsToCapability» Monitor Health

- **Capability** «block» Inform
  - MapsToCapability «MapsToCapability» StandardOperationalActivity Track Victim
  - MapsToCapability «MapsToCapability» Transit to SAR Operation

- **Capability** «block» Recovery
  - MapsToCapability «MapsToCapability» StandardOperationalActivity Recover Victim

- **Capability** «block» Assistance
  - MapsToCapability «MapsToCapability» StandardOperationalActivity Assist Victim
  - MapsToCapability «MapsToCapability» Provide Medical Assistance
OV-7: Logical Data Model

**Search Object**
- name : String
- registration : String
- tonnage : Integer
- color : String
- markings : String
- superstructure : String
- characteristics : String
- ownerOrOperator : String
- personsOnBoard : Integer
- emergencyEquipmentCarried : String

**Search Area**
- waypoints : String
- activationTime : String
- duration : String
- driftDirection : String
- driftSpeed : Integer
- commenceSearchPoint : String

**SAR Operation**
- caseName : String
- caseNumber : String
- taskingAuthority : String

**Search Status**
- status : String

**Assignment**
- description : String

**Stranded Person Info**
- name : String
- condition : String

**Last Known Position**
- latitude : String
- longitude : String
- time : String
- sourceOfReport : String

**Warning Order**
- representedBy «InformationElement» warningOrder

**Tasking**
- representedBy «InformationElement» tasking

**Control**
- representedBy «InformationElement» control

**Track Info**
- representedBy «InformationElement» trackInfo

**Distress Signal**
- representedBy «InformationElement» distressSignal

**Request**
- representedBy «InformationElement» request

**Objects**
- representedBy «InformationElement» representedBy

**Location**
- location

**Operational Area**
- operationalArea

**Asset Assignments**
- assetAssignments

**Person**
- person
This view defines the structure and internal flows of the Capability Configuration. The figure shows the Capability Configuration of a Maritime Rescue Unit. It is comprised of the Maritime Rescue Team (MRT), and the roles that make up the MRT, as well as the components that enable them to fulfill their role. This example shows that the Role of Driver is filled by a MRT Member who must interact with a MR Boat.
SV-2a: System Port Specification

SV-2 [CapabilityConfiguration] Maritime Configuration

- **UsedConfiguration**: Yacht
  - ResourceComponent: Distress Beacon
    - Signal: Distress Beacon
    - Transmitter
    - Receiver

- **UsedConfiguration**: RN ASR Helo
  - ResourceComponent: ESM System
    - Monitor: ESM System
    - FrequencyScanner
    - TrackInterface

- **UsedConfiguration**: RNLI Lifeboat
  - ResourceComponent: Link 16
    - Digital Service: Link 16
    - TDM Receiver
    - TDM Transmitter
  - ResourceComponent: Link 18
    - Digital Service: Link 18
    - TDM Receiver
    - TDM Transmitter
SV-4: Functionality Description

- **Reported Location**
- **Name**
- **Reported Condition**

**Capability Configuration**
- Maritime Rescue Unit

**Post**
- MRT Searcher
  - «FunctionAction»: Move
  - «FunctionAction»: Reassure Victim
  - «FunctionAction»: Apply First Aid
  - «FunctionAction»: Recover Victim

**Updated Condition**

**Updated Location**

- «FunctionAction»: Determine Destination
- «FunctionAction»: Transport
### SV-7: Resource Performance Parameters

#### [Architectural Description] System View [SV-7]

<table>
<thead>
<tr>
<th>Resource</th>
<th>Actual Measurement Set</th>
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<tbody>
<tr>
<td></td>
<td><strong>Type</strong></td>
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<tr>
<td>Maritime Configuration</td>
<td>Initial Values</td>
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<td>Maritime Configuration V2</td>
<td>Final Values</td>
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<td>Maritime Rescue Unit</td>
<td>Initial Values</td>
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</tbody>
</table>
Definition of the required measurements

**SysML Example: SV-7**

**CLD**  
SV-7 : Measurement Set Definition

- **Standard SAR Measurements**
  - areaCoverage : String
  - findTime : String
  - persistence : String
  - searchCoverage : String
  - weatherConditions : String

- **Maritime SAR Measurements**
  - seaConditions : String

- **Land SAR Measurements**
  - terrainType : String
UPDM Background
UPDM 1.0 Roadmap

• Submission – Sept 2008
• OMG vote to adopt UPDM Dec 2008
  – Start of FTF process
• Completion of FTF/UPDM 1.0 June/Sept 2009
The Case for UPDM

• The specification is technically sound
  – Model-based to ensure consistency
    • The specification was generated from the model
    • XMI generated from the same model
  – UPDM profile derived from the Domain Meta-Model (DMM)
  – Consensus based
    • Architects included major tool vendors who worked together to ensure an implementable solution
    • Domain experts ensured correctness

• Supports current architecture frameworks
  – Traceability analysis performed against DoDAF 1.5, MODAF 1.2, NAF 3.0
  – Largely convergent with DoDAF 2.0 current direction – reduces the risk of conflict with later DODAF 2.0 releases
The Case for UPDM

• Demonstrated to be practical, useful and correct
  – Example model demonstrates proof of concept
  – Profile already defined in Artisan, EmbeddedPlus, No Magic, and Visumpoint(Borland), and the implementation is actively under development. They all plan on releasing a commercially available product supporting this version of UPDM within the this year.
    • Implementation currently under way

• Major stakeholder support
  – DoD and MOD involvement throughout
    • DoDAF 2.0 and MODAF 1.2 teams
  – Guidance from NATO and the Canadian Dept of National Defence (DND)

• Integration with SysML and UML
  – Allows easy flow-down and traceability from architecture frameworks to system models.
UPDM History

DoDAF v 1.0
(2004)

OMG Kickoff
Feb 2005

MODAF v 1.0

RFP issued
Sept 2005

Three Initial Submissions
Raytheon + Team
Telelogic
IBM + Team

June 2006

DoDAF v 1.5
Draft Inputs

Two Revised Submissions

Nov 2006

MODAF v 1.1

Dec 2006

MODAF v 1.2

March 2007

Unified Submission

June 2007

OMG Adopts UPDM

March 2008

UPDM FTF Voted Down

June 2008

UPDM RFC Formed

Sep 2008

UPDM RFC Submission

Dec 2008

UPDM RFC Vote to Adopt

June 2009

UPDM FTF2

DoDAF v 2.0
Draft for review Dec 2008

UPDM History

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Models replace documents as the primary product or artifact of SE processes

Document centric
Model centric
The Current Status of UPDM

• Specification released for 60 day review in September, 2008
• Issues were resolved by the architecture group
  – Members are tool vendors Adaptive, Artisan, Embedded Plus, Mega, IBM, No Magic, Sparx
  – List of issues is available to the whole group
  – Solutions proposed for over 90% of issues
• Issue resolutions accepted by UPDM team
• UPDM finalized spec published, OMG vote in June/Sept. 2009
The Future of UPDM

• Post submission
  – DoDAF 2.0 released June 2009
  – OMG vote to adopt UPDM June/Sept. 2009
  – UPDM available in tools available shortly after
  – Preparation of RFP for UPDM 2.0
    • Complete implementation of DoDAF 2.0
    • Security views from DNDAF
    • Support for NAF
    • Others?

  – Issue UPDM 2.0 RFP
  – ....