AN APPROACH USING MIP PRODUCTS FOR THE DEVELOPMENT OF THE COALITION BATTLE MANAGEMENT LANGUAGE STANDARD

(PAPER 117)

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The first phase of development of the Coalition Battle Management Language (C-BML) standard has seen many challenges and has taken 7 years to complete.

In particular, the lack of a normalized model, inadequate requirements management, and the lack of structured approach and process have been identified as main causes of difficulty.

The MIP models, processes and tools currently under development can help to resolve many of the issues faced during the C-BML Phase 1 drafting activity. This aim of this work is to leverage the MIP Information Model and other MIP products to accelerate the Phase 2 C-BML drafting activity by creating a sustainable, controlled process & standard production chain.
The SISO C-BML Phase 2 Drafting Group has been proactive in exploring means to address the challenges faced during the Phase 1 drafting activity.

This exploratory work has resulted in a collaboration between the MIP Block 4 MIM Working Group and the C-BML Phase 2 Drafting Group and has been extended to include work being conducted with participation from several nations under the NATO MSG-085 Technical Activity on Standardization for C2-to-Simulation Interoperation.

The work presented in this paper has led to the Scenario INitialization and EXecution (SINEX) Initiative.
Background

Related Work


Gupton & Heffner, “A Standards Development Framework for C-BML Phase 2 and Beyond”, SISO Interoperability Workshop, 12F-SIW-045, Sep 2012


WHAT IS C-BML ?
The C-BML Standard is being developed by the Simulation Interoperability Standards Organization (SISO) as a set of specifications to facilitate the standardized exchange of military information such as:

orders, plans, reports and requests

among

Command and Control, Simulation and Autonomous Systems.
**Common Interface:** for exchange of military information (e.g. orders, reports and requests) among C2, simulation and autonomous/robotic systems.

**Expressiveness:** for all relevant actions (or events) to be performed (or reported) by real, simulated or robotic forces. Intended to represent the information contained in operational orders such as: Air Tasking Order (ATO), 5-paragraph Operations Order (OPORD), Operational General Matters (OPGEN) and other tactical messages.

**Unambiguous and Parsable:** mathematical representation that allows for automated processing.
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Unambiguous and Parsable: mathematical representation that allows for automated processing.
Coalition Battle Management Language (C-BML)

The 5Ws

Who: The tasking unit; The tasked unit; The supported unit; The supporting unit; The target; The reporting unit; The object of a report.

What: The type of operation or task to be executed; The event being observed.

Where: Where is the task to be executed; Where is the event being observed.

When: The time the task to be executed or has been executed; The time an event observed.

Why: The purpose, motivation, desired effect or result.
WHY USE C-BML?
Coalition Battle Management Language (C-BML)

Military Enterprise Activities

- Force Readiness;
- Support for Operations;
- Future Capabilities Development; and
- Simulation-Based Acquisition

Some of Expected Benefits

- Enhanced realism & overall training effectiveness;
- Decreased cost & workload;
- Reduced preparation and response times; and
- Facilitate and Augment Analysis Capabilities
NATO MSG-119 C2-Simulation Interoperability Workshop
Operational Community is now asking for C2-Simulation Interoperability!
AN EXAMPLE
C-BML-Enabled JFS Experiment Example

JOINT FIRES SUPPORT (JFS) Experiment Architecture

OPFOR  DISTAF

SYNTHETIC ENVIRONMENT

CGF Simulation Federation

LOCON

BRIGADE JFS CC

Experiment Audience

Air Support Coordination Center

= Simulator Operator

= C2IS
ATO/ACO issued by NATO ICC AIR C2IS as per operations; Information converted to C-BML for use by JSAF Simulation; Reports generated by simulation are converted to C2IS format for JADOCS and for NATO ICC.
Can reduce resource requirements (e.g. simulator operators) and hence achieve significant cost-savings and also greatly reduce EVENT preparation time.
C-BML Air Operations Example

C-BML Airspace Control Order (1/2)

<Order>

<Feature>

<OID>1157</OID>

<NameText><AWACS</NameText>

<ObjectType type="ControlFeatureCategoryCode">ACM</ObjectType>

<ObjectSubType type="ControlFeatureTypeCategoryCode">RCNSAR</ObjectSubType>

...<EffectiveWhen>

<StartWhen>

<Datetime>20100525163000.000</Datetime>

</StartWhen>

<EndWhen>

<Datetime>20100526163000.000</Datetime>

</EndWhen>

</EffectiveWhen>

...
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    <ReferenceCode>TOPOS R</ReferenceCode>
    <Dimension>1500</Dimension>
  </LowerVerticalDistance>
  <UpperVerticalDistance>
    <ReferenceCode>TOPOS R</ReferenceCode>
    <Dimension>1800</Dimension>
  </UpperVerticalDistance>
  <DefiningSurface type="Circle">
    <Radius><Dimension>5000</Dimension></Radius>
    <Center>
      <GeographicPoint>
        <LatitudeCoordinate>44.2</LatitudeCoordinate>
        <LongitudeCoordinate>43.34</LongitudeCoordinate>
      </GeographicPoint>
    </Center>
  </DefiningSurface>
</Location>
C-BML Air Operations Example

C-BML Air Tasking Order (1/2)

<Order>
  <Context type="OtherContext">
    <OID>JFSTASK39DEMO</OID>
    <NameText>ATO CFEC JFSTASK39DEMO NOV - -</NameText>
    <CategoryCode>NOS</CategoryCode>
  </Context>
  <Task>
    <What>
      <ActionTask type="OtherActionTask">
        <OID>N 0105</OID>
        <ActivityCode>DCA</ActivityCode>
        <DepartureLocation type="DEPLOC"/>
        <DepartureValue>HCMI</DepartureValue>
        <ArrivalLocation type="ARRLOC"/>
        <ArrivalValue>HCMI</ArrivalValue>
      </ActionTask>
    </What>
    <TaskeeWho>
      <OrganisationRef type="UnitRef">
        <OID>TIGER01</OID>
      </OrganisationRef>
    </TaskeeWho>
  </Task>
</Order>
C-BML Air Operations Example

C-BML Air Tasking Order (2/2)

...<RequesterWho>
  <OrganisationRef type="UnitRef">OID>FAC-1</OID></OrganisationRef>
</RequesterWho>
<Where>
  <DerivedLocationRef type="OtherControlFeatureRef">
    <OID>AWACS</OID>
  </DerivedLocationRef>
  <Altitude>9144.0</Altitude>
</Where>
<When>
  <StartWhen>
    <AbsoluteTime> <DateTime>20111116000200.000</DateTime> <TimeQualifier>AT</TimeQualifier> 
    </AbsoluteTime>
  </StartWhen>
  <EndWhen>
    <AbsoluteTime> <DateTime>20111116140000.000</DateTime> <TimeQualifier>AT</TimeQualifier> 
    </AbsoluteTime>
  </EndWhen>
</When>
</Task>
</Order>
C-BML Air Operations Example

**JSAF SIMULATION (Airspace Control Order)**

NATO APP-11 → C-BML → JSAF
DEVELOPING THE C-BML STANDARD

A MODEL-DRIVEN ARCHITECTURE APPROACH
SISO C-BML STUDY GROUP RECOMMENDATION

C-BML Will make “optimal” use of MIP Products

Don’t re-invent the wheel!

C-BML Product Development Group Phased-Approach
SISO C-BML STUDY GROUP RECOMMENDATION

C-BML Will make “optimal” use of MIP Products

Don’t re-invent the wheel!

C-BML Product Development Group Phased-Approach
C-BML Vocabulary

Military Information Domain Elements

- **Who**
  - Entities
  - Organisation {Individual, Group, Civil, Military}
  - Facility {Hospital, Runway, Network, etc.}
  - Feature {Geographic, Meteorological, Control Feature}
- **What**
  - Organisation
  - Materiel {Equipment, Consumables}
- **Why**
  - Event {Action, Task, Occurrence}
- **Where**
  - Location {Point, Line, Area, Volume}
  - Place {Address, Named location}
  - Symbology {Icons, Graphics, Overlay}
- **When**
  - Time {Temporal point, Temporal region}
BUT THE MIP INFORMATION MODEL (MIM) ALREADY DEFINES MOST OF THESE ELEMENTS...

... AND USES A MODEL-DRIVEN ARCHITECTURE* APPROACH FOR PRODUCING STANDARDS PRODUCTS

*Model-Driven Architecture (MDA), as defined by the Object Management Group (OMG) (see http://www.omg.org/mda)
Requirements-driven process, requirements are part of UML model.

MDA Transforms to generate documentation and standard products

Existing MSDL and C-BML standards are inputs into process.

Normalized C-BML model constructed using MIM-based approach.

Requirements-driven process, requirements are part of UML model.

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History of the MIP Data Model

Generic Hub 4

LC2IEDM 2.2

C2IEDM 6.15

JC3IEDM

3.0.2 / 3.1.4

MIM 1.1

ATCCIS

NCDM RM

MIP Baseline 1

View Models

MIP Baseline 2

MIP Baseline 3.0/3.1

The Future of MIP

MIP/NDAG-Merger

MOA 2004-02-04
Objectives of the MIP Information Model

- Fix known issues of MIP Baseline 3.x
  - Changing, deleting, grouping, and archiving information

- Quick and low-cost interoperability solution
  - Rapid realization of user requirements
  - Incremental specification of independent capabilities
  - Modular interoperability solution
  - Improved backwards compatibility

- Improved interoperability

- Simplified configuration management
Characteristics of the MIP Information Model

- **Platform-Independent**
  (not restricted to a specific exchange technology)

- **State-of-the-art Modeling Languages**
  (Unified Modeling Language, Object Constraint Language)

- **Modern Tools**
  (Sparx Enterprise Architect, Model-Driven Architecture)
Summary of MIM Improvements (1/2)

- MIM is a radical revision of the JC3IEMD
  - More than 3 years of development
  - More than 12,500 individual changes
  - Clear cut with former modeling approach

- MIM covers all operational aspects of the JC3IEMD 3.1.4

- Significant improvements
  - Fixes known errors and weaknesses of the JC3IEMD
  - Modularity, extensibility, comprehension, unambiguity, …
  - Overall quality assurance across the entire model
MIM is considered a semantic reference for
- MIP’s future capability-based approach
- Potentially other COIs/organizations (e.g., C-BML, NATO LCG/1 JDSS, AMN TPT, MAJIIC, OMG SOPES, …)

Modern modeling approach
- Open-source MDA tools support simple adoption

MIP Programme Management Group (PMG)
- … supports the collaboration with other COIs
- … provides the MIM to interested parties
- … asks for feedback to improve the model
The MIP has defined a **process** and developed a **toolset** to **BUILD** and/or **MODIFY** a model based on existing types, attributes, relationships, stereotypes and packages.

- **Subview**: a subset of a MIP model models generated automatically based on “Subview Definition” files
- **Extended/Modified Subview**: Changes (additions, modifications and deletions) can be defined using “Change Proposals”.

**Provides Traceability, Automation and Control**
The C-BML MODEL is therefore defined as a “MIM-SUBVIEW”.

It is expressed as a set “SUBVIEW DEFINITION FILES” and “CHANGE PROPOSALS”.

But how can we EASILY create these files?
Building Subview Definitions & Change Proposals

- Write a formal Subview Definition or Change Proposal
- Metadata (Creator, Source of Requirement,..)
- Model /Problem description (free text)
- Overall modelling approach or concept for addressing the problem (free text)
- Formal Changes
- Test the CP by letting the CPProcessor apply it to the Model
- Generate a readable/commentable RTF document
### Building Subview Definitions & Change Proposals

#### CP Header
- **Identifier**: CP_F_37019
- **Title**: Split ActionTemporalAssociation
- **Version**: 1
- **Status**: Validated
- **Creator**: Nico Bau
- **Publisher**: PIM Restructuring WPT

#### Contributors
- **Date**: 2011-02-16
- **Source**

#### Textual Description
- **AddClass**
- **Enumerations**
- **CategoryCode**
- **DeleteAttribute**
- **Remarks**

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enumerations:ActionTemporalAssociationCategoryCode</td>
<td>SAEAST</td>
</tr>
</tbody>
</table>

#### Work in progress

- **Problem**
- **Changes**

#### Formal Content

```xml
<ChangeProposal xmlns="urn:int:nato:standard:mip:cp:3.0"
                xsi:schemaLocation="urn:int:nato:standard:mip:cp:3.0 ChangeProposal.xsd">
  <Header>
    <dms:Identifier>CP_F_37019</dms:Identifier>
    <dms:Title>Split ActionTemporalAssociation</dms:Title>
    <dms:Version>1</dms:Version>
    <dms:Status>Validated</dms:Status>
    <dms:Creator>Nico Bau</dms:Creator>
    <dms:Publisher>PIM Restructuring WPT</dms:Publisher>
    <dms:DateCreated>2011-02-16</dms:DateCreated>
    <dms:Source/>
  </Header>
  <Description>
    <Problem>...</Problem>
    <Changes>...</Changes>
  </Description>
  <FormalContent>
    <Change xsi:type="AddEnumeration">
      <Class package="Enumerations">NewEnumeration</Class>
      <Definition>Some definition.</Definition>
      <Abstract>false</Abstract>
      <ClassType>Enumeration</ClassType>
    </Change>
    ...
  </FormalContent>
</ChangeProposal>
```
XML Document

```xml
<ChangeProposal xmlns="urn:int:nato:standard:mip:cp:3.0"
    xmlns:dms="urn:int:nato:standard:mip:cp:3.0">
  <Header>
    <dms:Identifier>CP_F_37019</dms:Identifier>
    <dms:Title>Split Action Temporal Association</dms:Title>
    <dms:Version>1</dms:Version>
    <dms:Status>Validated</dms:Status>
    <dms:Creator>Nico Bau</dms:Creator>
    <dms:Publisher>PIM Restructuring WPT</dms:Publisher>
    <dms:DateCreated>2011-02-16</dms:DateCreated>
    <dms:Source/>
  </Header>
  <Description>
    <Problem>...</Problem>
    <Changes>...</Changes>
  </Description>
  <FormalContent>
    <Change xsi:type="AddEnumeration">
      <Class package="Enumerations">NewEnumeration</Class>
      <Definition>Some definition.</Definition>
      <Abstract>false</Abstract>
      <ClassType>Enumeration</ClassType>
    </Change>
    ...
  </FormalContent>
</ChangeProposal>
```

RTF Document

```
<table>
<thead>
<tr>
<th>Identifier</th>
<th>CP_4_45003</th>
</tr>
</thead>
<tbody>
<tr>
<td>Title</td>
<td>Rename ConsumableMaterialIssuingElementCode</td>
</tr>
<tr>
<td>Version</td>
<td>1</td>
</tr>
<tr>
<td>Status</td>
<td>Validated</td>
</tr>
<tr>
<td>Creator</td>
<td>Henritte Schüller</td>
</tr>
<tr>
<td>Publisher</td>
<td>MIP</td>
</tr>
<tr>
<td>Date Created</td>
<td>2013-01-07</td>
</tr>
<tr>
<td>Source</td>
<td>UT Model</td>
</tr>
</tbody>
</table>

Description

Problem

This CP applies the following changes:
* Change enum/attr ConsumableMaterialIssuingElementCode to ConsumableMaterialIssuingUnitCode.

FormalContent

Change Set

<table>
<thead>
<tr>
<th>Modify Enumeration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class</td>
</tr>
<tr>
<td>Name</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>
```

Viewing Model Definition Files & Change Proposals
Benefits of Change Proposal Approach

- Nations/Stakeholders can comment on proposed Changes
- Change Control Board can vote on proposed changes
- Agreed Changes then can easily be applied to the Model using the CPProcessor (fully automated)
- Can make concurrent Change Proposal definitions
- Change Proposals and Model Definition Files become part of Model;

Simple yet effective traceability is maintained!
MIM-BASED C-BML DEVELOPMENT TOOL CHAIN
MIM-Based C-BML Model Generation Process

CPProcessor → CBML Model → UML→XSD → C-BML XSD V1.0

MIM 1.0 → MIM 1.1 → MIM 2.0

C-BML Model Description V1.0 → C-BML Model Description V1.1 → C-BML Model Description V2.0

CP Editor

C-BML Model Generation Process
MIM-Based C-BML Model Generation Process

C2IEDM  
JC3IEDM  
MIM 1.0  
MIM 1.1  
MIM 2.0  

C-BML XSD Schema Naming and Design Rules

CPProcessor  
CBML Model  
UML->XSD  

C-BML XSD V2.0

C-BML Model Description V1.0  
C-BML Model Description V1.1  
C-BML Model Description V2.0  

C-BML Model V2.0

CP Editor
MIM-Based C-BML Model Generation Process

C2IEMD
JC3IEMD
MIM 1.0
MIM 1.1
MIM 2.0

CPProcessor
CBML Model
UML->XSD

C-BML XSD V2.0.1

C-BML Model Description V1.0
C-BML Model Description V1.1
C-BML Model Description V2.0

CP Editor

C-BML Model Description V2.0.1

C-BML XSD Schema Naming and Design Rules
C-BML Standard leverages MIP Models and tools but can evolve independently and/or be updated to new versions of MIM, as required and planned.
BUILDING THE C-BML PHASE 2 STANDARD

*** THE C-BML MODEL STRUCTURE ***
Proposed C-BML Model Structure

- Layered Structure, as per SISO C-BML Phase 1
- Re-use MIM types as foundation
Proposed C-BML Model Structure

- Layered Structure, as per SISO C-BML Phase 1
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MESSAGE FRAMEWORK
(Common, Air, Land, Maritime)

C-BML does NOT define operational messages, it allows one to represent the information contained in operational messages so that it can be shared with simulations and other systems.

MIP Information Model (MIM)
How can we ensure that Stakeholder Requirements are properly managed and tracked?
Requirements Traceability

- Collect and refine requirements as part of UML Model
- Build model in layers
- Maintain links between model elements & requirements

Requirements Traceability is still a work in progress.
EXAMPLE C-BML MODEL
Example C-BML Model Cycle

Development Environment
Example C-BML Model Cycle

Subview Definition and Change Proposal Editor
Example C-BML Model Cycle

C-BML Base Model Definition
Example C-BML Model Cycle

Details for Organisation Class
Example C-BML Model Cycle

Subview Model Description
Example C-BML Model Cycle

Generate C-BML Model
Example C-BML Model Cycle

C-BML Model Generation ✔

MIM 1.x

CPProcessor

C-BML Model Definition V 1.0

CBML Model 1.0
Example C-BML Model Cycle

C-BML Model Evolution

- CBML Model 1.0
- MIM 1.y
- C-BML Change Proposal x
- CBML Model 1.x
Example C-BML Model Cycle

Browse C-BML Model
Example C-BML Model Cycle

C-BML XML Schema Generation

CBML Model → UML→XSD → C-BML XSD V1.0
Example C-BML Model Cycle

Message Framework Schema
Example C-BML Model Cycle

Message Acknowledgement
Model-Driven Architecture Approach

Requirements

Subview Definition

MIM

CPProcessor

Subview

MSDL V1

C-BML Phase 1

C-BML MODEL

OWL X-Form

HLA X-Form

XSD X-Form

JSON X-Form

Doc Gen

OWL Ontology Modules

HLA-FOM Modules

XML Schemas

Documentation
Current & Future Work

• Requirements Traceability Tool Development

• Automation
  ▪ Refining UML→XSD Transform to meet C-BML Requirements
  ▪ Developing UML→HLA FOM\(^1\) Transform
  ▪ Auto-generate specifications and other documentation

• Ontology Support
  ▪ Business Rule Expressions and Editor
  ▪ Support for ODM\(^2\) in MIP tools
  ▪ Generation of OWL Ontology Modules

\(^1\) SISO High Level Architecture (HLA) Federation Object Model (FOM)
\(^2\) Ontology Definition Metamodel profile from the Object Management Group (OMG)
Summary & Conclusions (1/3)

• The MIM is much improved with respect to the JC3IEDM.

• The MIP tools also are much improved and allow to easily create models called subviews that can re-use a subset of the MIM. The tools also allow the user to construct change proposals to re-define and add to the subview as required.

• The MIP Subview approach described in this paper allows for easy and controlled re-use of the MIM.

• The collaboration between the MIP and the C-BML communities has been mutually beneficial. It has led to changes on both sides.

• This work has shown that it is possible and can be beneficial to achieve effective re-use across interoperability standards without creating undue coupling by employing an MDA approach.
• SISO C-BML now is entering the 2nd phase of development. It is important that Phase 2 achieve results faster than in Phase 1.

• The approach described in this paper is a structured, controlled methodology and toolset for streamlining the C-BML Phase 2 drafting activity to rapidly produce a quality Phase 2 standard.

• Stakeholder involvement is key – and traceability of stakeholder requirements is essential to the success of any standard.

• The approach presented in this paper embraces the Model-Driven Architecture approach wherein the normative model is maintained and all other standard artefacts are generated and builds upon the work of the MIM Working Group of the Multilateral Interoperability Programme.
Interest in this approach within NATO MSG-085 has led to the formation of the Scenario INitiialization and EXecution (SINEX) initiative.

- SINEX proposes a means to merge the SISO Military Scenario Definition Language (MSDL) and C-BML standards
- SINEX also suggests an end-to-end approach for building C2-Simulation Federations based on the SISO DSEEP\(^1\)

\(^{1}\)Distributed Simulation Engineering and Execution Process
Backup Slides
MIP INFORMATION MODEL
Objectives, Principles, and Structure of the Successor of the JC3IEDM

Dr. Michael Gerz

10th MSG-085 Meeting – Fraunhofer FKIE – 13-Feb-2013
History of the MIP Data Model

- **Generic Hub 4**
- **LC2IEDM 2.2**
- **C2IEDM 6.15**
- **JC3IEDM 3.0.2 / 3.1.4**
- **ATCCIS**
- **NCDM RM**

- **MIP Baseline 1**
- **View Models**
- **MIP Baseline 2**
- **MIP/NDAG-Merger MOA 2004-02-04**
- **MIP Baseline 3.0/3.1**

The Future of MIP
Objectives of the MIP Information Model

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- **Modern Tools**
  (Sparx Enterprise Architect, Model-Driven Architecture)
How the MIM Fits in Our Capability-Based Approach

Semantic Reference

MIP Information Model

Restriction / Extension

Unification

Sub-model

High-Level Platform-Independent Model

Computation-Independent Model

Manual Translation

Capability n

Model-Driven Architecture (MDA)

Message Model

Platform-Specific Model

Artifact (XSD, OWL, Java, ...)

NOV-7

NSV-11a

NSV-11b
Improvements in Comparison to the JC3IEMD

- Significant **structural simplifications** while preserving all operational concepts
- Improved **comprehension**
- Consistent use of **meta data**
- Consistent and simplified **grouping** of information
- Improved **modularity**
- Strict and unique **semantics**
- Formal specification of all **integrity rules** by means of OCL
- **Consistency** of all relevant artifacts (UML class model, OCL constraints, documentation, examples, diagrams)
- Generation of **efficient exchange schemas**
MIM Design Principles – Separation of Concerns

**Meta Data**
Each information can have metadata

**Information Groups**
Each information can be grouped

**Core Elements**
Objects, actions etc. and their relationships as a “snapshot” of the real world

Stateless – no change of objects over time

„Sourceless“ – no contradicting information from different sources

Context free – no distinction between, e.g., current and planning situation

⇒ Stricter/unambiguous semantics
Information Groups

class Model Overview

Assessment

«code»
limitingFactorsCode [0..1]
«text»
text

InformationGroup

«name»
name [0..1]

InformationGroupAssociation

objects 0..*

AssessmentGroup

OperationalInformationGroup

PredictionGroup

Overlay

CorrelationGroup

1

1..*

objects 0..*
Model Restructuring – Selected examples

- Merging of the three hierarchies
  OBJECT-ITEM, OBJECT-TYPE und OBJECT-ITEM-STATUS

- Resolution/Formalization of business rules

- Rework of Associations
Merging the Object Hierarchies (1)
Merging the Object Hierarchies (2)
Merging the Object Hierarchies (3)

At most one status at a given time in a given context

Exactly one classification at a given time in a given context
Merging the Object Hierarchies (4)
Merging the Object Hierarchies (5)

- **Object**
  - «name»
    + name

- **Organisation**
  - «code, status»
    + availabilityCode [0..1]
    + cbmDressStateCode [0..1]
    + commandAndControlRoleCode [0..1]
    + fireModeCode [0..1]
    + operationalStatusCode
    + operationalStatusQualifierCode [0..1]
    + readinessCode [0..1]
    + reinforcementCode [0..1]
    + trainingCode [0..1]
  - «indicator, status»
    + isCommittedIndicator [0..1]
    + isInReserveIndicator [0..1]
    + isInActionIndicator [0..1]
  - «quantity, status»
    + radiationDoseQuantity [0..1]
  - «duration, status»
    + readinessDuration [0..1]

- **MilitaryConvoy**
  - «rate»
    + daySpeedRate [0..1]
    + nightSpeedRate [0..1]
  - «dimension»
    + dayVehicleGapDimension [0..1]
    + nightVehicleGapDimension [0..1]
    + packetGapDimension [0..1]
  - «duration»
    + haltDuration [0..1]
  - «quantity»
    + packetSizeQuantity [0..1]

- **MilitaryOrganisation**
  - «code, type»
    + serviceCode

- **GovernmentOrganisation**
  - «code, type»
    + mainActivityCode [0..1]
Resolution/Formalization of Business Rules (1)

<table>
<thead>
<tr>
<th>BiologicalMateriel.categoryCode</th>
<th>BiologicalMateriel.subcategoryCode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bacterial</td>
<td>Chlamydia</td>
</tr>
<tr>
<td></td>
<td>Rickettsiae</td>
</tr>
<tr>
<td></td>
<td>[NULL]</td>
</tr>
<tr>
<td>Toxic Industrial Material</td>
<td>[NULL]</td>
</tr>
<tr>
<td>Toxin</td>
<td>[NULL]</td>
</tr>
<tr>
<td>Viral</td>
<td>[NULL]</td>
</tr>
</tbody>
</table>
Resolution/Formalization of Business Rules (3)

- Object Constraint Language (OCL)
- Validation against the model (statically)
- Validation against data (at run-time)

- JC3IEMD 3.1.4: approx. 14,800 MIRD database records
- MIM 1.1: approx. 300 OCL constraints
Rework of Associations

- Adapt multiplicities / uniqueness
  - Adaption of association ends to „stateless“ core model

- Adapt navigability
  - „Semantic direction“ of associations
  - Simplified generation of efficient (XML) schemas

- Rework/introduce role names
  - Clarify semantic roles of association ends

- Determine aggregation types (composition vs. Aggregation vs. association)
  - Determine life-time of objects
  - Composition simplifies object management (archiving)

Consistent rework throughout the entire model!
Other Model Restructuring Measures (excerpt)

- Refined definitions for
  - Classes, attributes, enumerations, code values (literals)

- Refined names
  - Classes, attributes, enumerations

- Replace enumerations by Booleans

- UML profile based on UN/CEFACT Core Components Data Type Catalogue
  - Consistent use of „representation terms“ for attributes
  - Formal metadata (e.g., physical units, range restrictions)
Example
„Plans & Orders“
JC3IEDM 3.1.4
Example „Plans & Orders“ – MIM 1.1

class Model Overview

PlanOrderComponent
«text»
contentText [0..1]

PlanOrder
«identifier»
messageIdentifier [0..1]
serialNumberIdentifier [0..1]
«name»
name [0..1]
nickName [0..1]
placeOfIssueName [0..1]
sponsorTypeName [0..1]
«code»
timeZoneCode [0..1]

PlanOrderAssociation
«code»
categoryCode

Plan
«code»
categoryCode
«indicator, status»
isCompletedIndicator
«code, status»
executionStateCode

Order
«code»
categoryCode
«code, status»

Distribution
«code»
categoryCode
«dateTime»
releaseDateTime [0..1]

DistributionAcknowledgement
«code»
categoryCode

subjects 0..*
objects 0..*
responses 0..*

1 0..*
{ordered}
Improved Modeling Process

- High-Quality Change Proposals
  - Formal description
  - Validation prior to voting
  - No error-prone manual steps needed
  - All CPs approved by all MIP stakeholders
Summary (1)

- MIM is a radical revision of the JC3IEDM
  - More than 3 years of development
  - More than 12,500 individual changes
  - Clear cut with former modeling approach

- MIM covers all operational aspects of the JC3IEDM 3.1.4

- Significant improvements
  - Fixes known errors and weaknesses of the JC3IEDM
  - Modularity, extensibility, comprehension, unambiguity, …
  - Overall quality assurance across the entire model
Summary (2)

- MIM is considered a semantic reference for
  - MIP’s future capability-based approach
  - Potentially other COIs/organizations (e.g., C-BML, NATO LCG/1 JDSS, AMN TPT, MAJIIC, OMG SOPES, …)

- Modern modeling approach
  - Open-source MDA tools support simple adoption

- MIP Programme Management Group (PMG)
  - … supports the collaboration with other COIs
  - … provides the MIM to interested parties
  - … asks for feedback to improve the model
References

- MIP Information Model
  - [https://mipcee-svn.lsec.dnd.ca/DEV/SVN/PIM/tags/Releases/](https://mipcee-svn.lsec.dnd.ca/DEV/SVN/PIM/tags/Releases/)
  - Free reader application (Sparx EA Lite) available
  - Download with Subversion client or web browser
  - MIM 1.2 to be ready in March 2012
  - Request access from michael.gerz@fkie.fraunhofer.de

- MIM Mailing List
  - [http://lsec.ca/mailman/listinfo/ipt4-mim_lsec.ca](http://lsec.ca/mailman/listinfo/ipt4-mim_lsec.ca)
  - Follow instructions on the webpage