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

(PAPER 117)

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Alexandria VA

Motivation

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****.*

Background

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 et al, *"Management of C4I and M&S Data Standards with Modular OWL Ontologies"*, SISO Interoperability Workshop, 12S-SIW-061, Mar 2012

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

Heffner et al, *"A Systems Engineering Approach for M&S Interoperability Standards Development: Application to C-BML",* SISO Interoperability Workshop, 13S-SIW-002, Apr 2013

Heffner & Gutpon, *"Implementing the Standard Development Framework for the Coalition Battle Management Language"*, ICCRTS 2013 Paper 122, Jun 2013

WHAT IS C-BML ?

Coalition Battle Management Language (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***.

Coalition Battle Management Language (C-BML)

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.

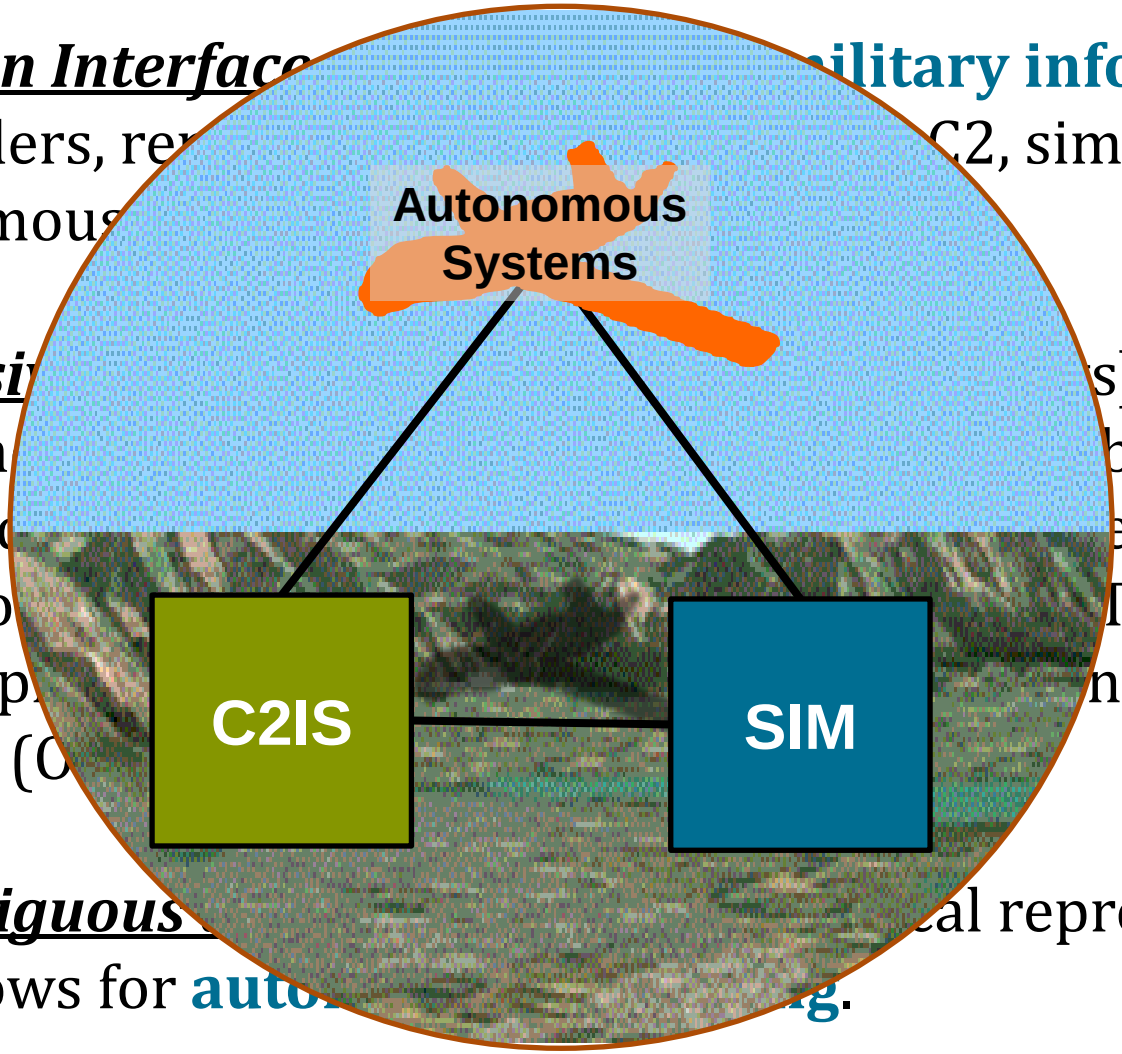
Unambiguous and Parsable: mathematical representation that allows for **automated processing**.

Coalition Battle Management Language (C-BML)

Common Interface **ilitary information**
(e.g. orders, re C2, simulation and
autonomous

Expressi s) to be
perform botic forces.
Intende ed in
operatio TO), 5-
paragrap nal General
Matters (C

Unambiguous al representation
that allows for **aut g**.



Coalition Battle Management Language (C-BML)

The 5Ws

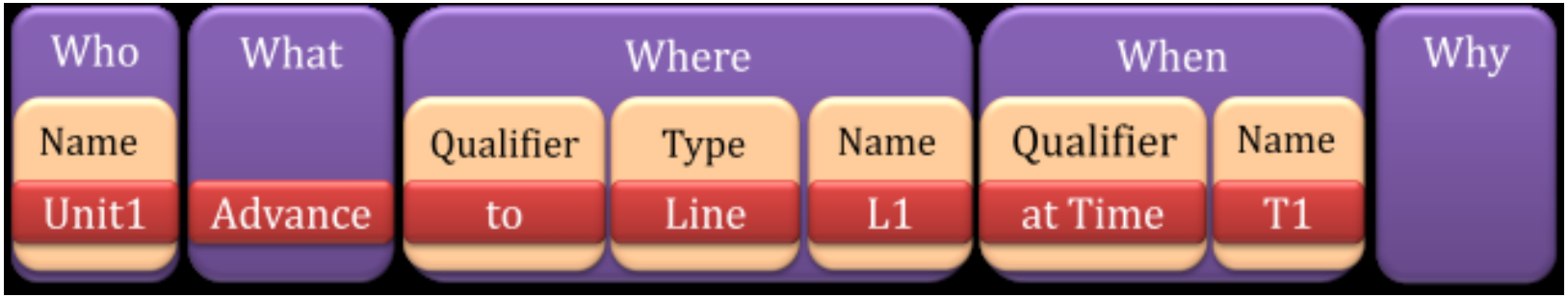
Who: The tasking unit; The tasked unit; The supported unit; The supporting unit; The target; The reporting unit; The object of a report.

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

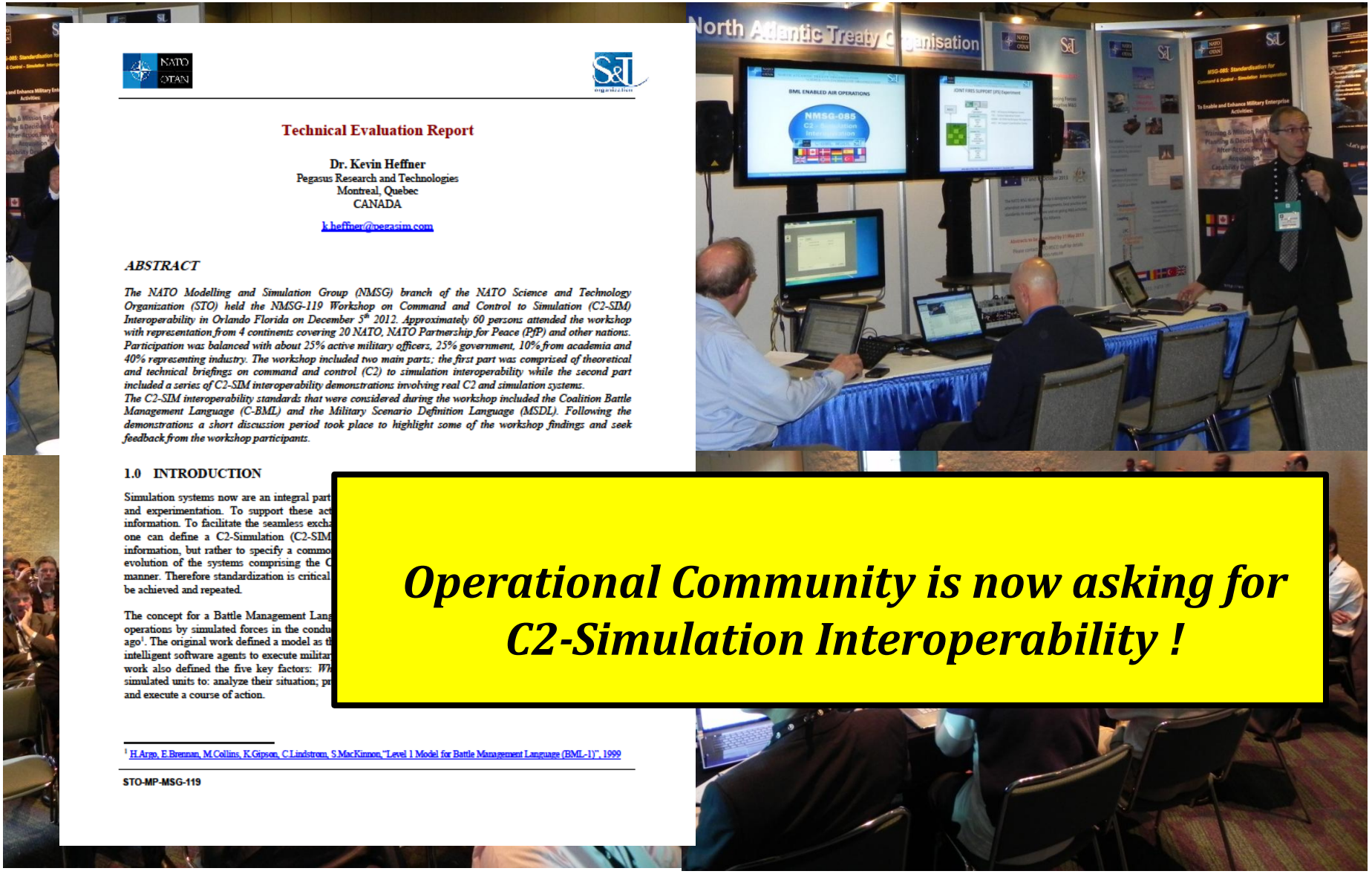
- Force Readiness;
- Support for Operations;
- Future Capabilities Development; and
- Simulation-Based Acquisition

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

NATO MSG-119 C2-Simulation Interoperability Workshop



Technical Evaluation Report

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ABSTRACT

The NATO Modelling and Simulation Group (NMSG) branch of the NATO Science and Technology Organization (STO) held the NMSG-119 Workshop on Command and Control to Simulation (C2-SIM) Interoperability in Orlando Florida on December 5th 2012. Approximately 60 persons attended the workshop with representation from 4 continents covering 20 NATO, NATO Partnership for Peace (PfP) and other nations. Participation was balanced with about 25% active military officers, 25% government, 10% from academia and 40% representing industry. The workshop included two main parts; the first part was comprised of theoretical and technical briefings on command and control (C2) to simulation interoperability while the second part included a series of C2-SIM interoperability demonstrations involving real C2 and simulation systems.
The C2-SIM interoperability standards that were considered during the workshop included the Coalition Battle Management Language (C-BML) and the Military Scenario Definition Language (MSDL). Following the demonstrations a short discussion period took place to highlight some of the workshop findings and seek feedback from the workshop participants.

1.0 INTRODUCTION

Simulation systems now are an integral part
and experimentation. To support these act
information. To facilitate the seamless excha
one can define a C2-Simulation (C2-SIM
information, but rather to specify a commo
evolution of the systems comprising the C
manner. Therefore standardization is critical
be achieved and repeated.

The concept for a Battle Management Lang
operations by simulated forces in the condu
ago[1]. The original work defined a model as t
intelligent software agents to execute militar
work also defined the five key factors: *Wh*
simulated units to: analyze their situation; pr
and execute a course of action.

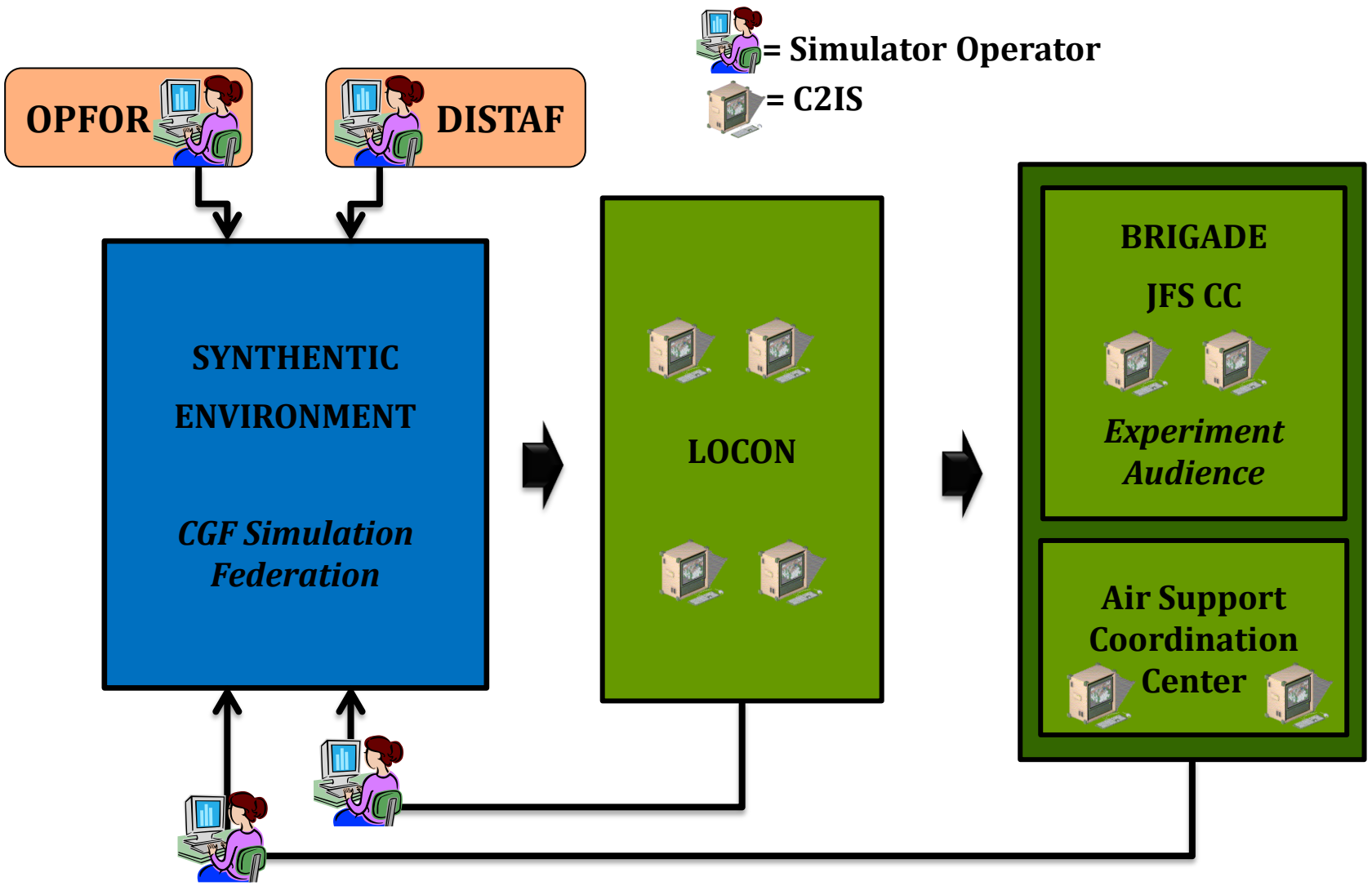
[1] H.Argo, E.Brennan, M.Collins, K.Gipson, C.Lindstrom, S.MacKinnon,"Level 1 Model for Battle Management Language (BML-1)", 1999

Operational Community is now asking for C2-Simulation Interoperability !

AN EXAMPLE

C-BML-Enabled JFS Experiment Example

JOINT FIRES SUPPORT (JFS) Experiment Architecture



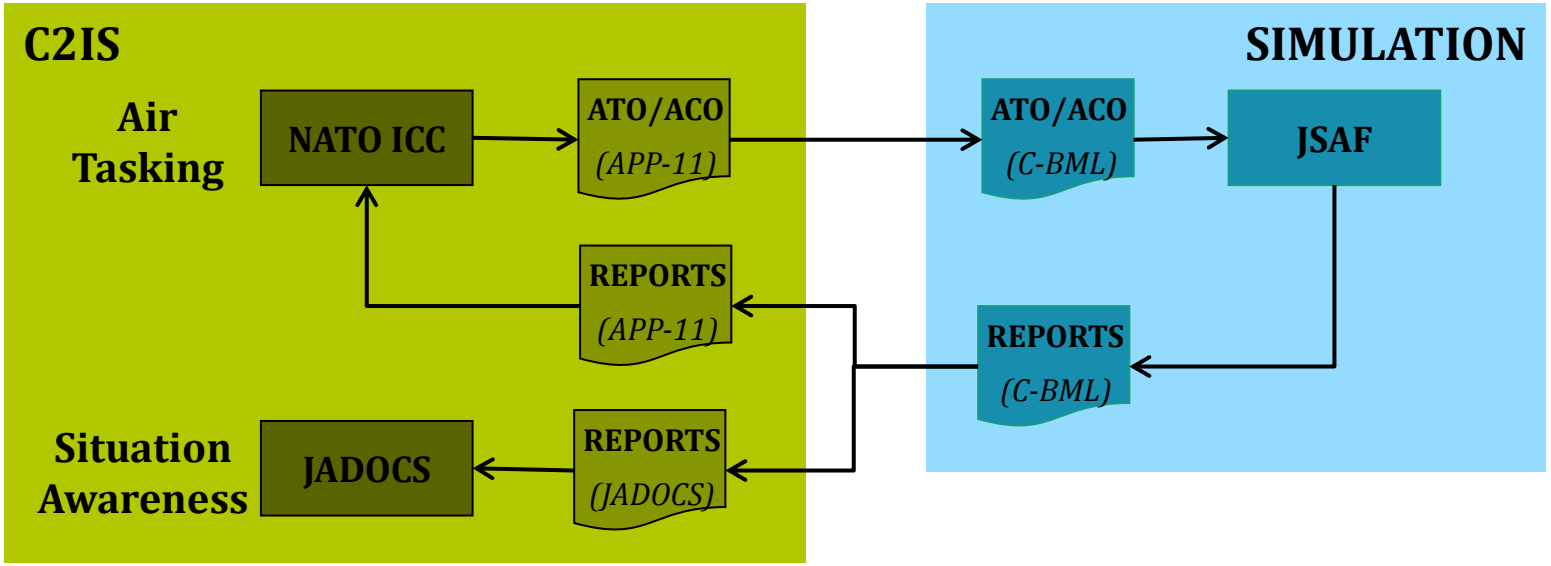
C-BML-Enabled JFS Experiment Example

JOINT FIRES SUPPORT (JFS) Technical Architecture

ATO/ACO issued by NATO ICC AIR C2IS as per operations;

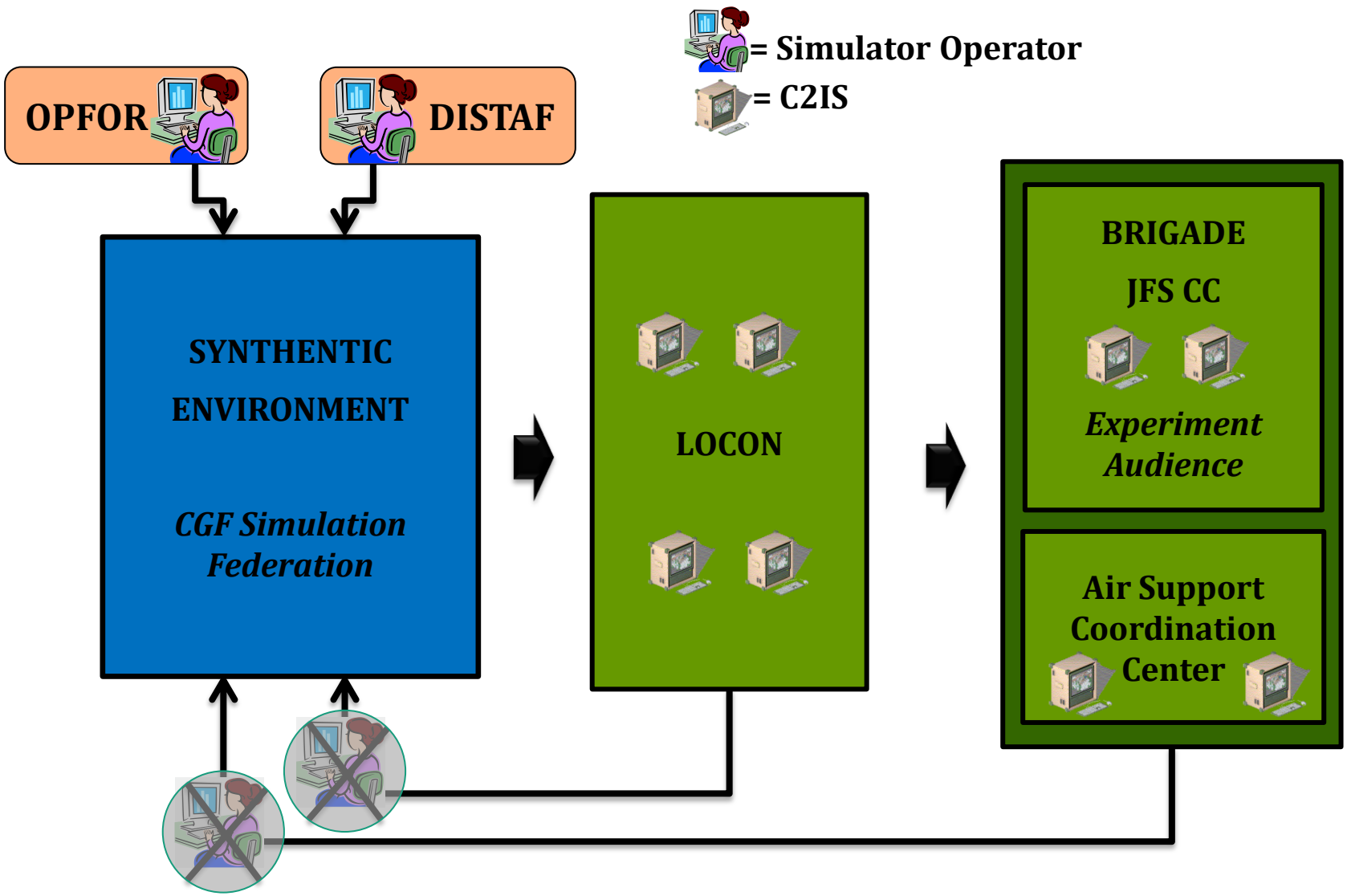
Information converted to C-BML for use by JSAF Simulation;

Reports generated by simulation are converted to C2IS format for JADOCS and for NATO ICC.



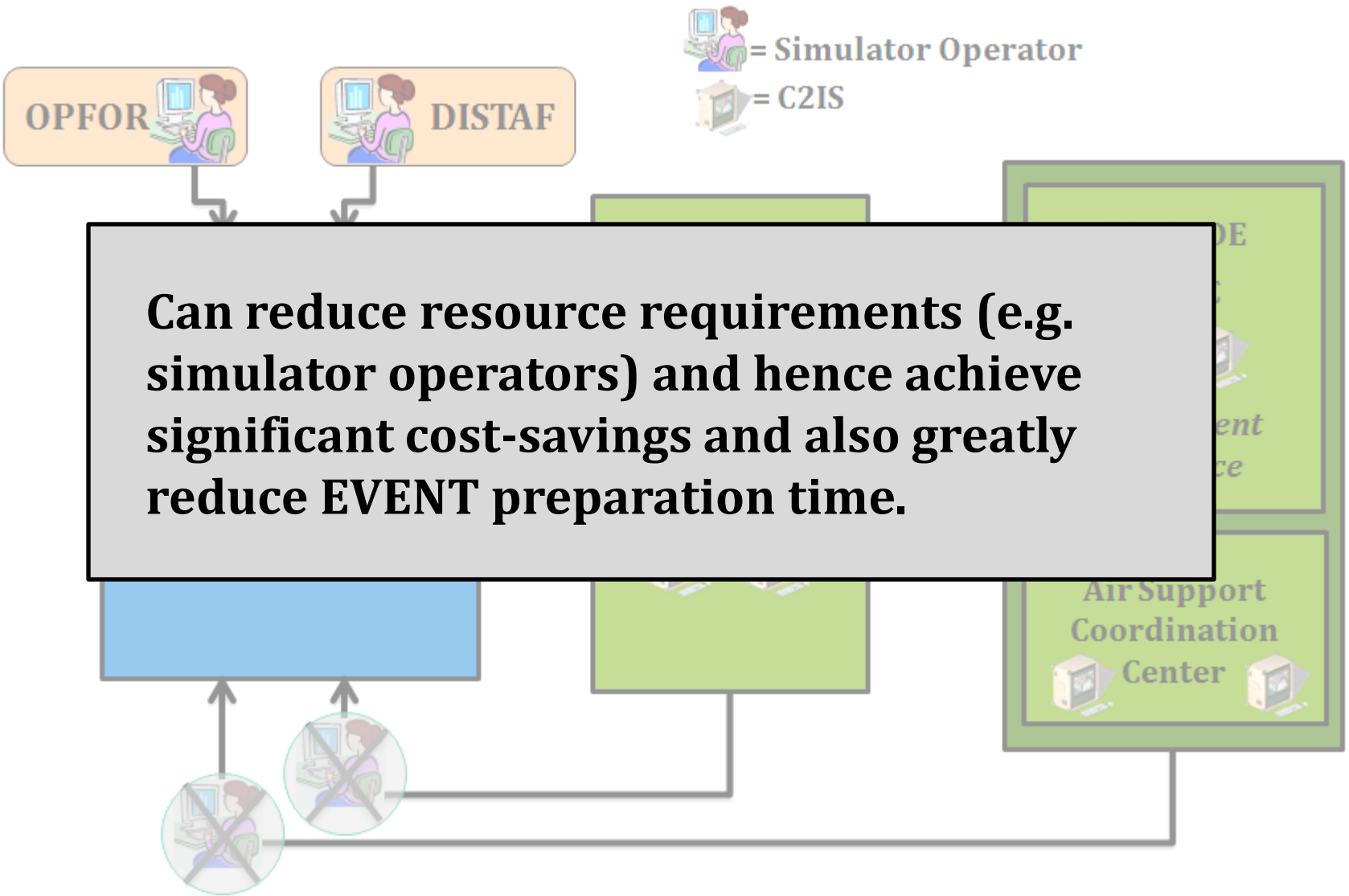
C-BML-Enabled JFS Experiment Example

JOINT FIRES SUPPORT (JFS) Experiment Architecture



C-BML-Enabled JFS Experiment Example

JOINT FIRES SUPPORT (JFS) Experiment Architecture



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>
         ...
```

C-BML Air Operations Example

C-BML Airspace Control Order (2/2)

```
    <Location type="SurfaceVolume">
      <LowerVerticalDistance>
        <ReferenceCode>TOPOSR</ReferenceCode>
        <Dimension>1500</Dimension>
      </LowerVerticalDistance>
      <UpperVerticalDistance>
        <ReferenceCode>TOPOSR</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>
  <Feature>
  …
<Order>
```

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></DepartureLocation>
        <ArrivalLocation type="ARRLOC"><ArrivalValue>HCMI
       </ArrivalValue></ArrivalLocation>
      </ActionTask>
    </What>
    <TaskeeWho>
      <OrganisationRef type="UnitRef">
        <OID>TIGER01</OID>
      </OrganisationRef>
    </TaskeeWho>
       …
```

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>
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          <TimeQualifier>AT</TimeQualifier>
        </AbsoluteTime>
      </StartWhen>
      <EndWhen>
        <AbsoluteTime>  <DateTime>20111116140000.000</DateTime>
          <TimeQualifier>AT</TimeQualifier>
        </AbsoluteTime>
      </EndWhen>
    </When>
  </Task>
</Order>
```
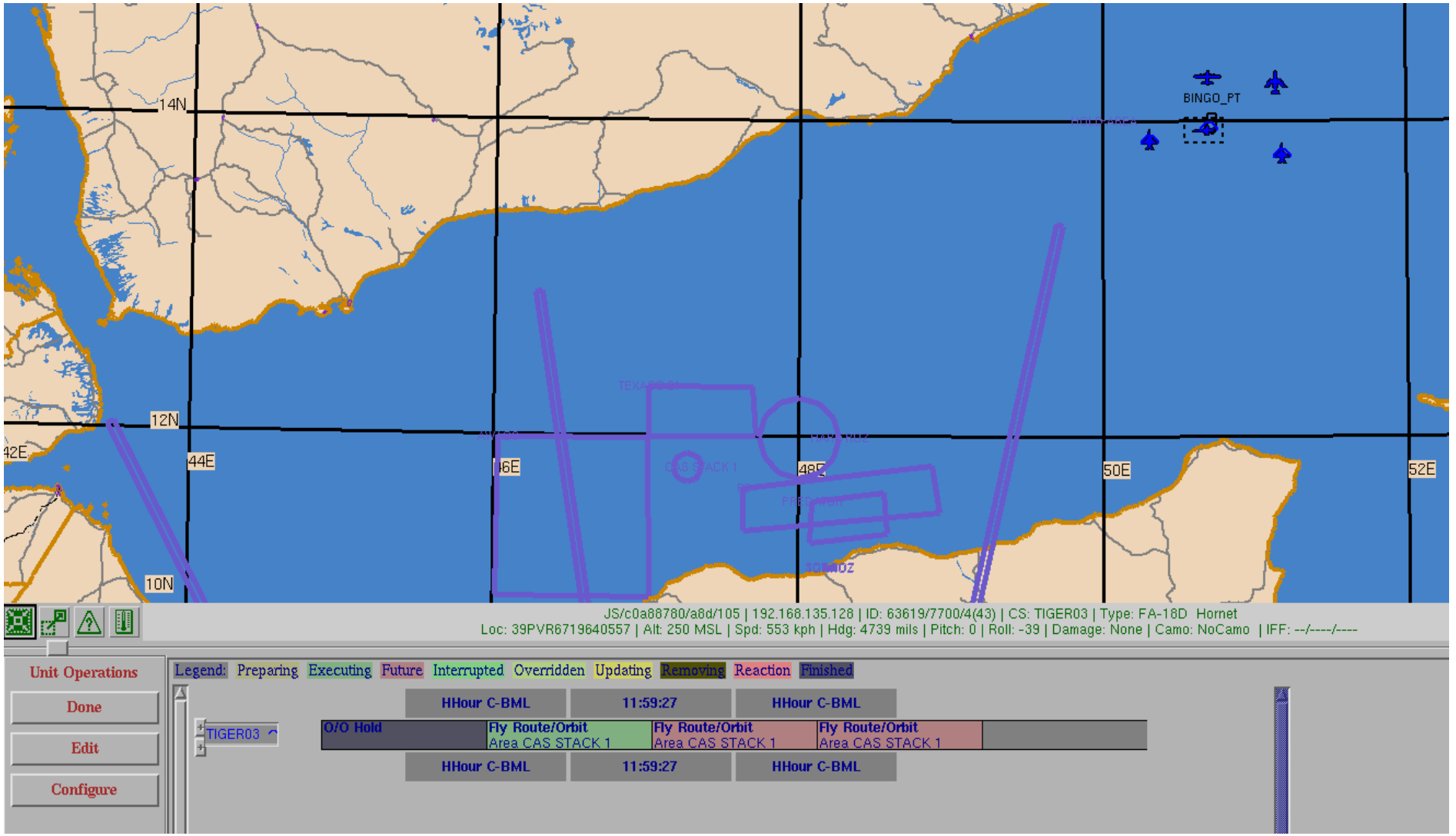

C-BML Air Operations Example

JSAF SIMULATION (Airspace Control Order)

NATO APP-11 → C-BML → JSAF



DEVELOPING THE C-BML STANDARD

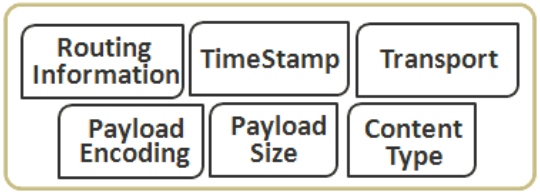
A MODEL-DRIVEN ARCHITECTURE APPROACH

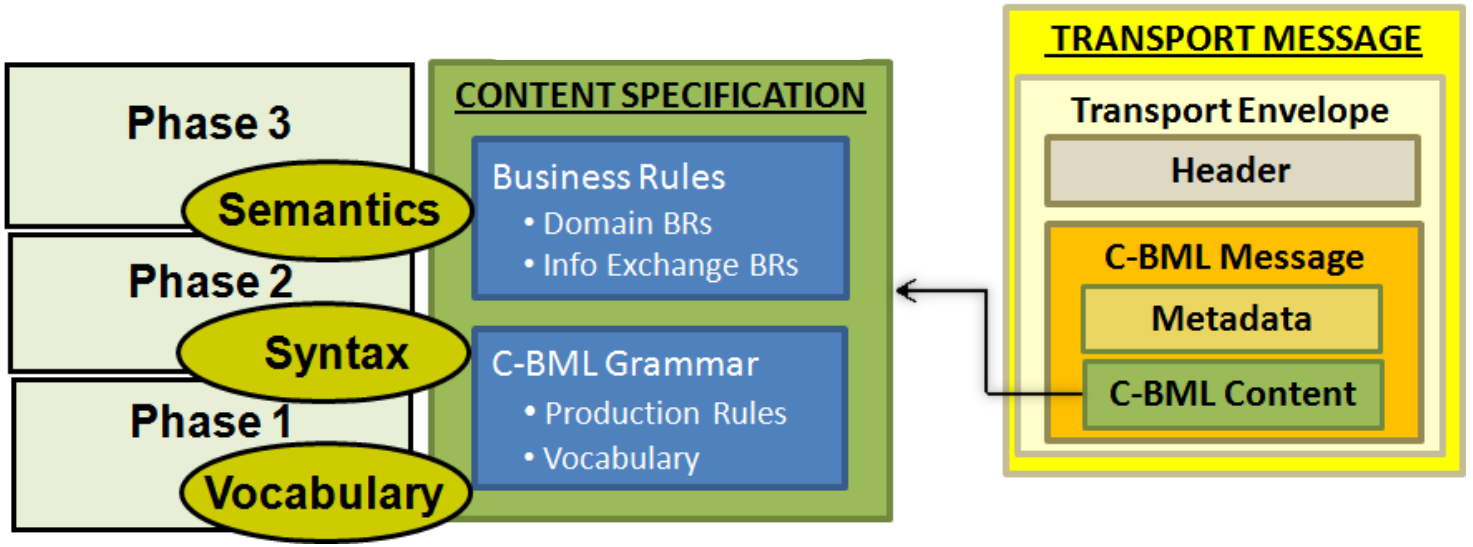
C-BML Product Development Group Phased-Approach

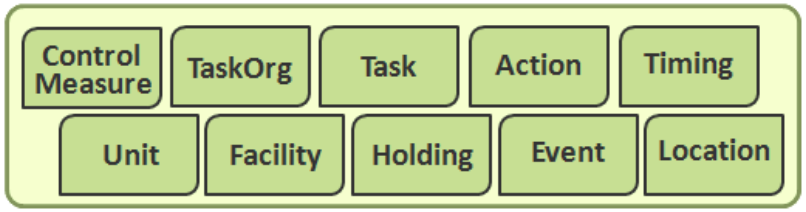
SISO C-BML STUDY GROUP RECOMMENDATION

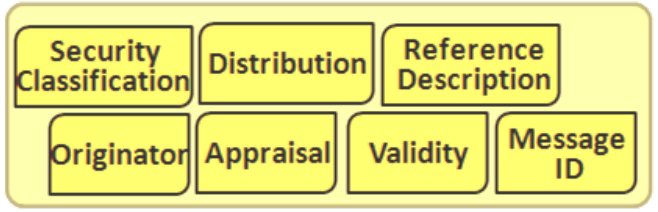
C-BML Will make "optimal" use of MIP Products

Don't re-invent the wheel !









C-BML Product Development Group Phased-Approach

SISO C-BML STUDY GROUP RECOMMENDATION

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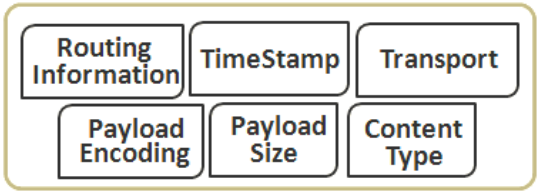
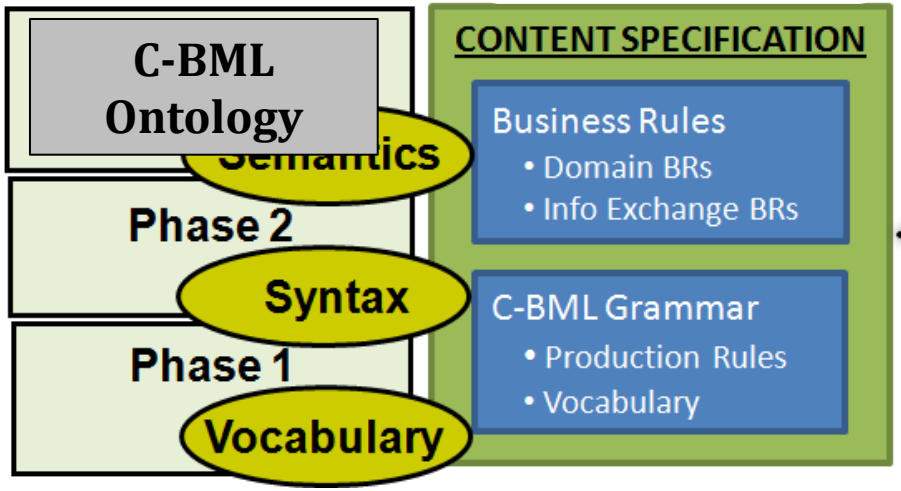
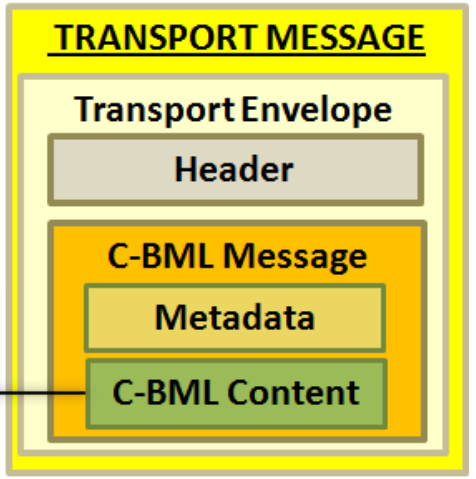
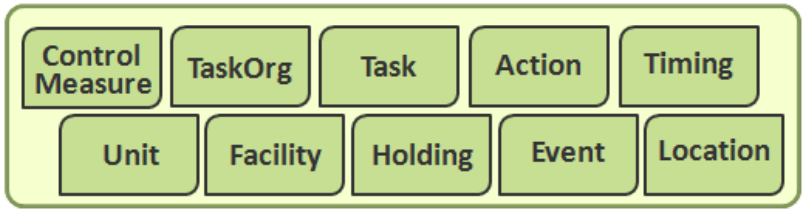
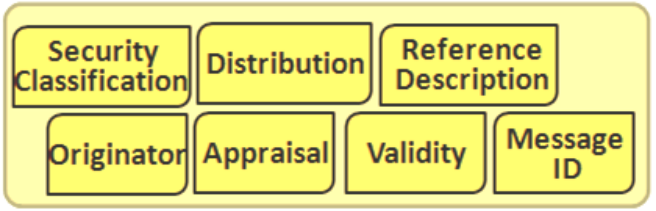


(for another paper…)



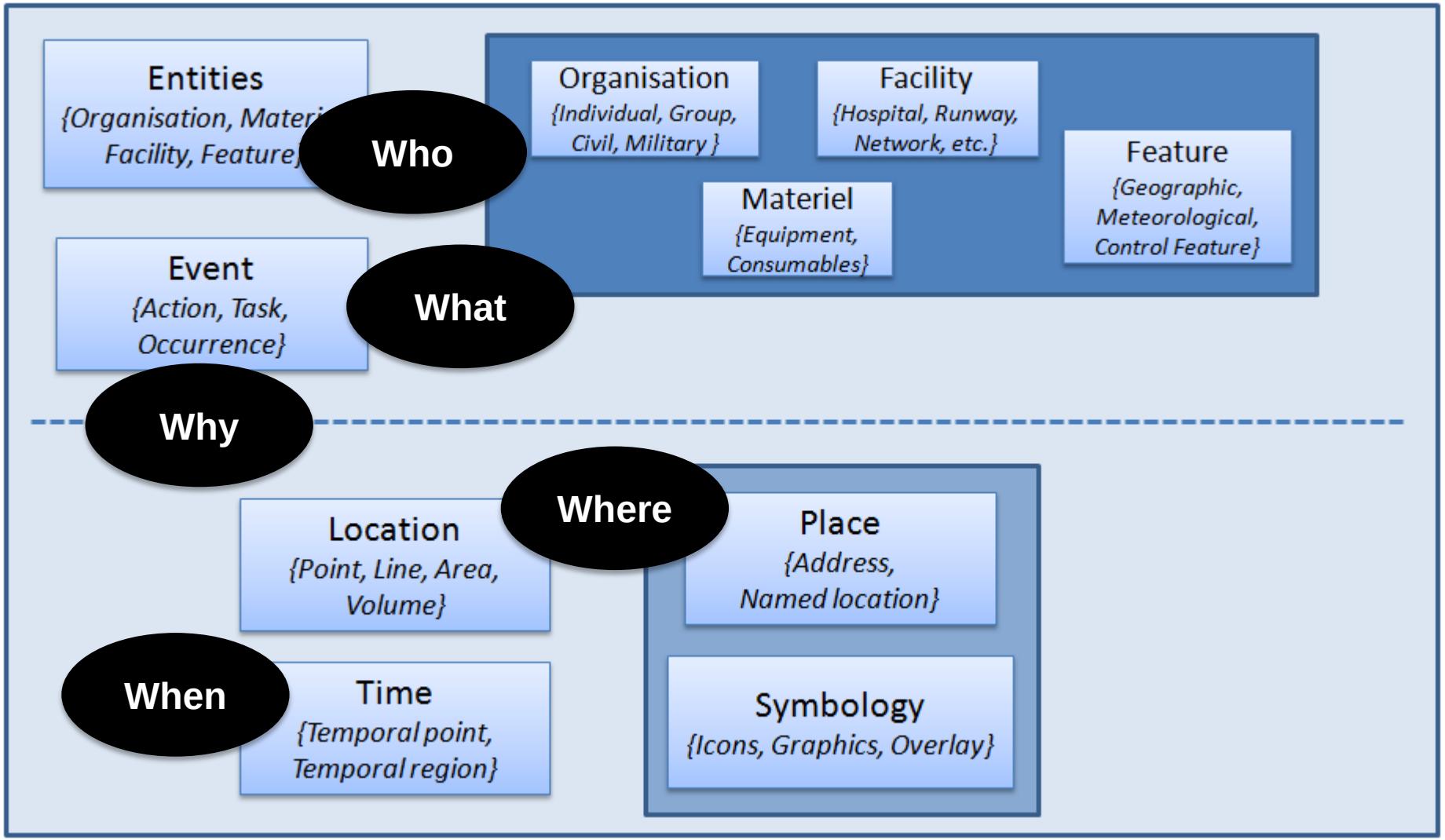






C-BML Vocabulary

Military Information Domain Elements



BUT THE MIP INFORMATION MODEL (MIM)

ALREADY DEFINES

MOST OF THESE ELEMENTS…

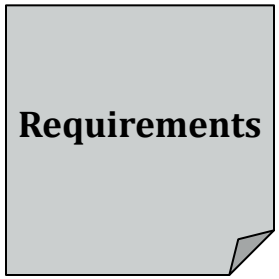
… AND USES A MODEL-DRIVEN ARCHITECTURE* APPROACH FOR PRODUCING STANDARDS PRODUCTS

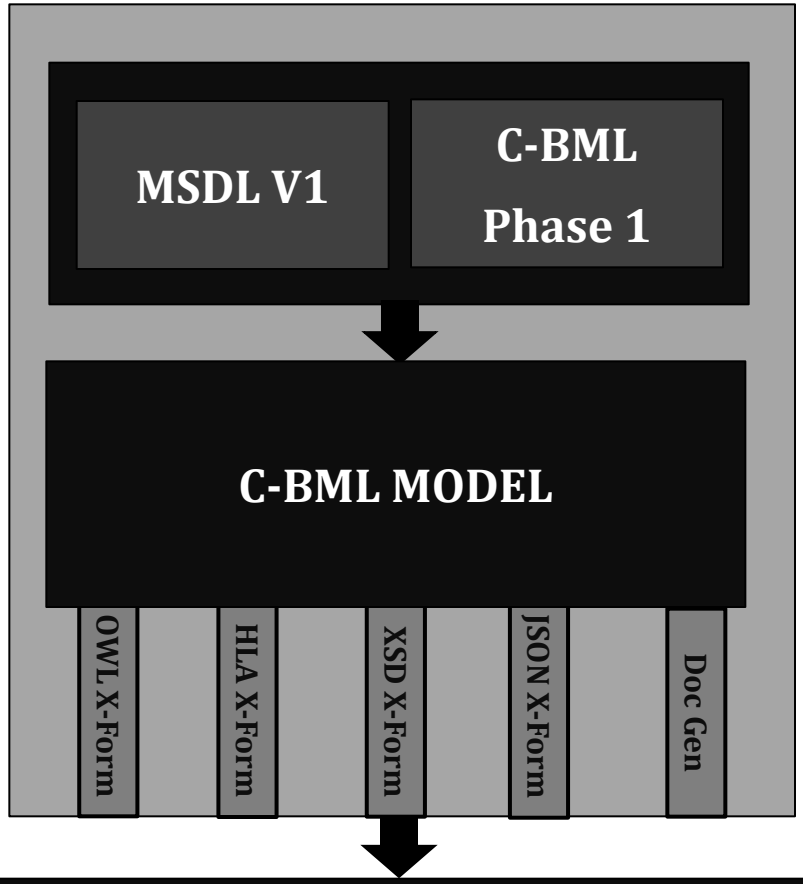
*Model-Driven Architecture (MDA), as defined by the Object Management Group (OMG)

(see http://www.omg.org/mda)

Model-Driven Architecture Approach

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



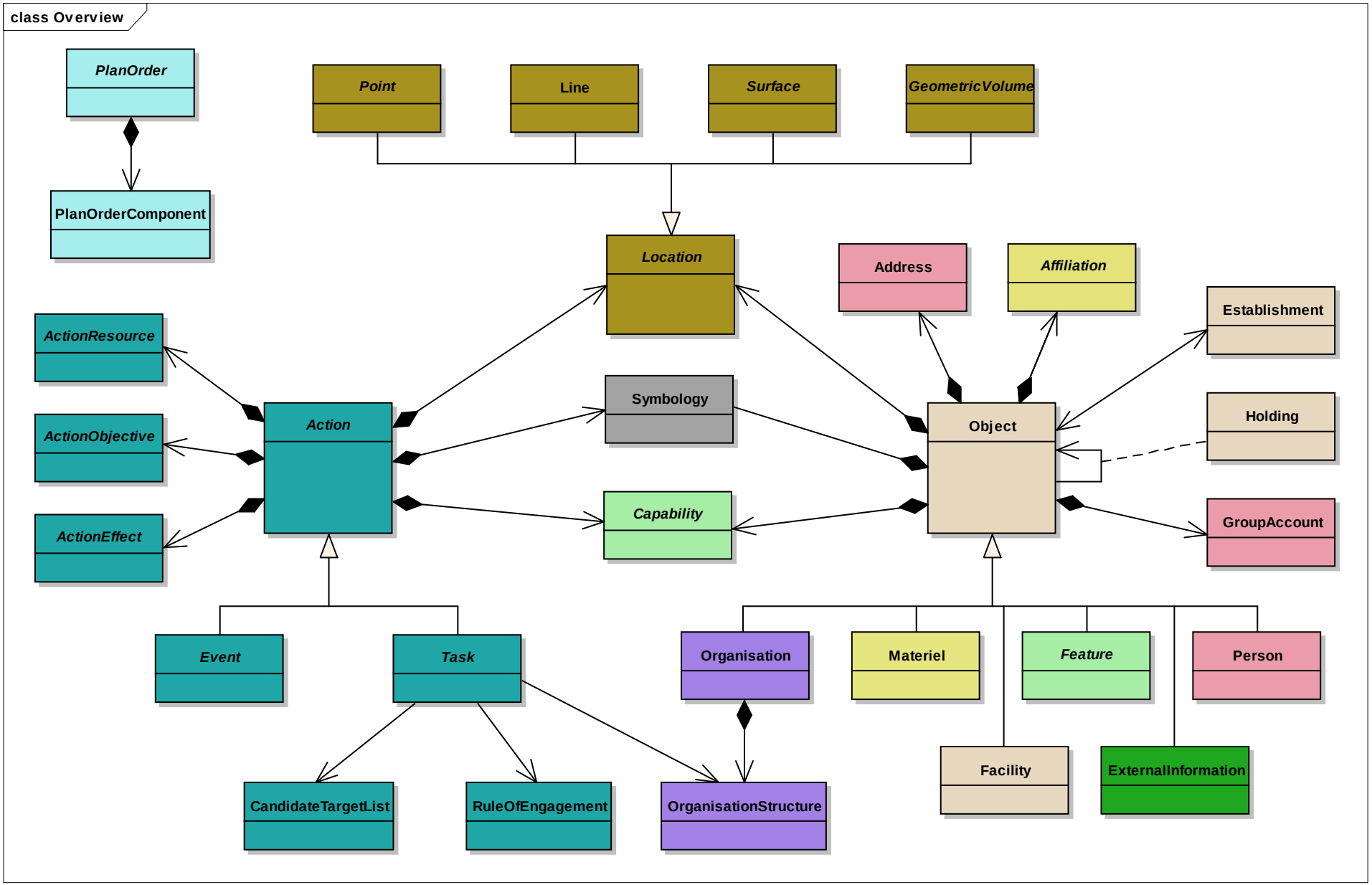


Existing MSDL and C-BML standards are inputs into process.

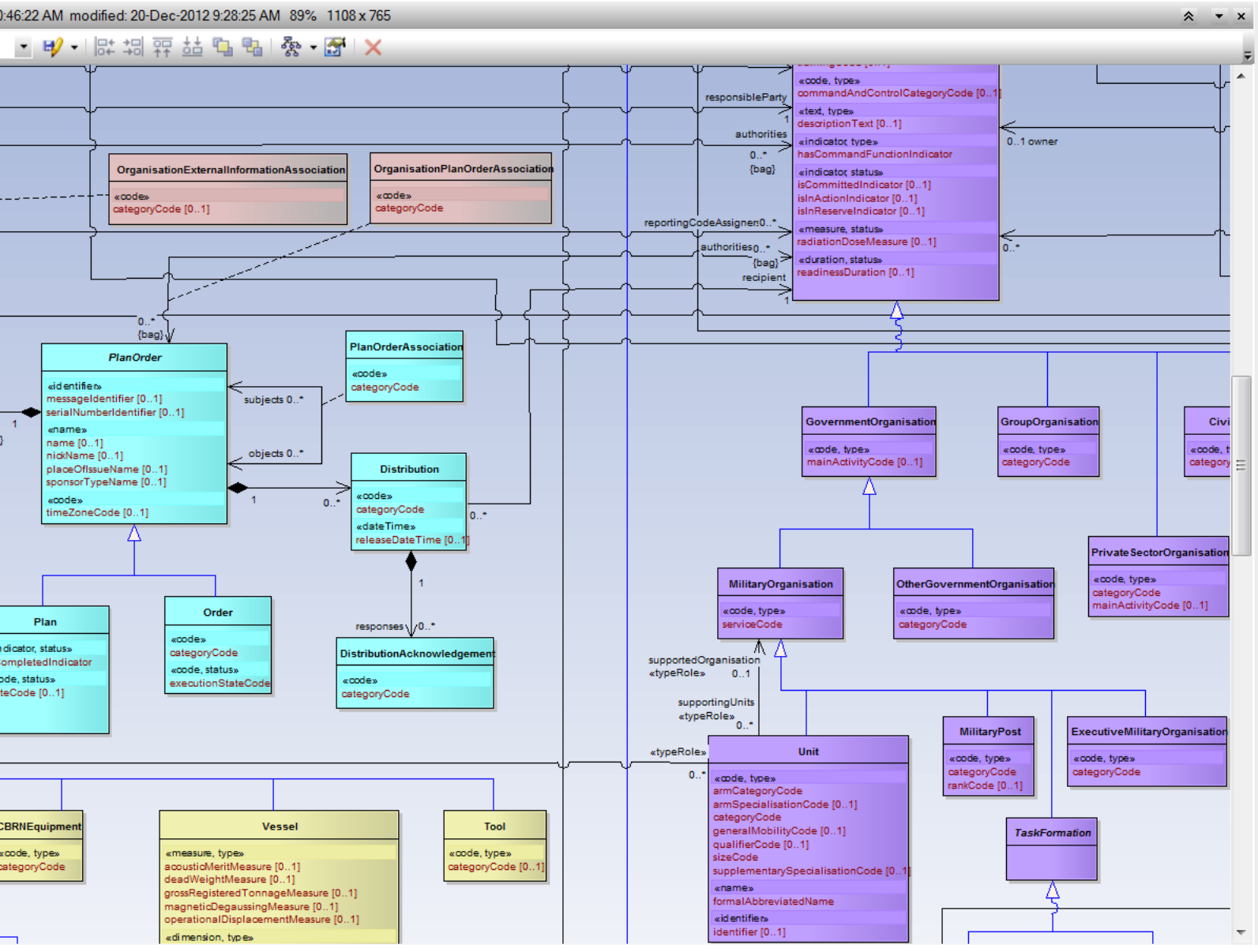
Normalized C-BML model constructed using MIM-based approach.

MDA Transforms to generate documentation and standard products

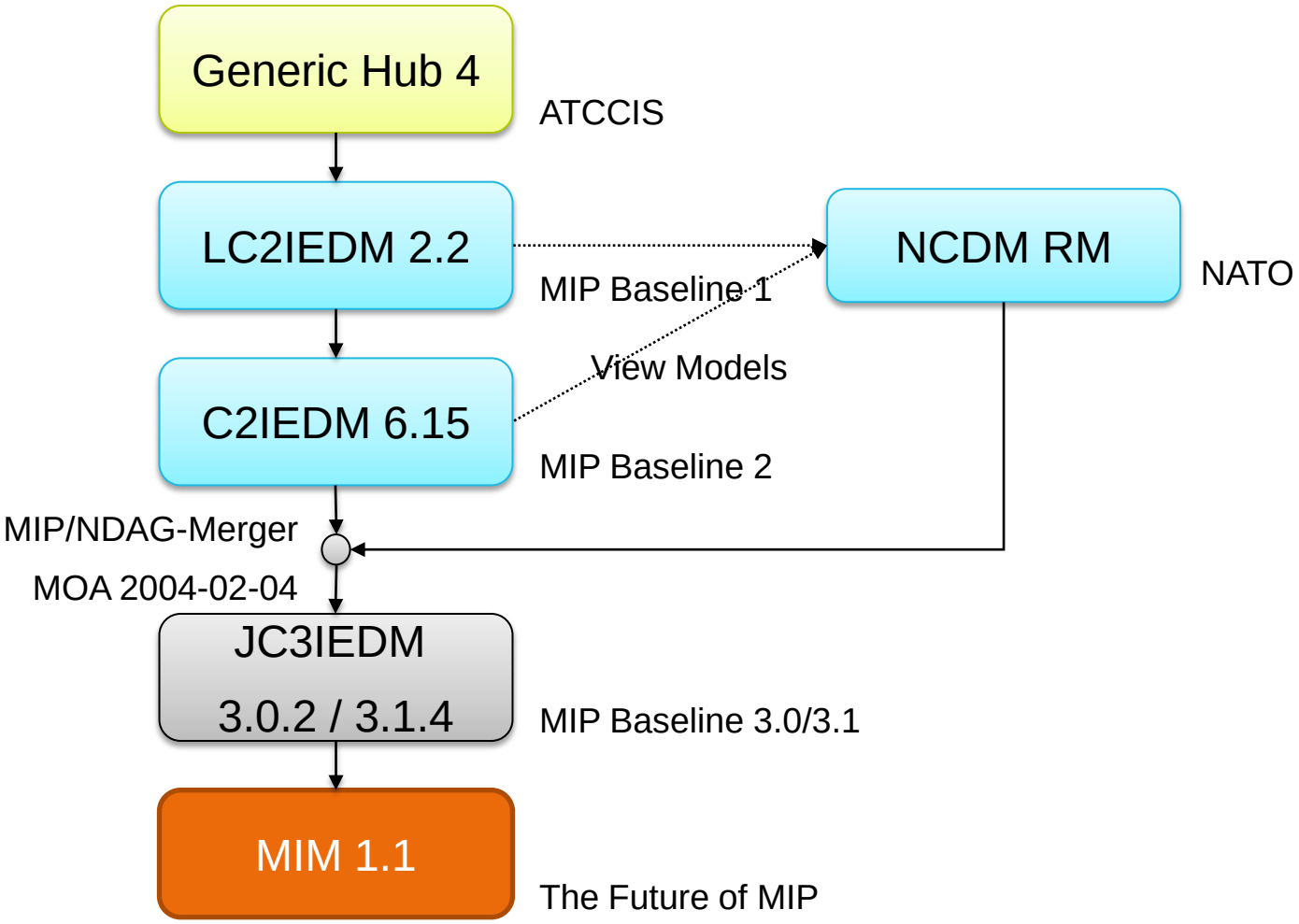
MIP INFORMATION MODEL (MIM) CORE ELEMENTS



MIP INFORMATION MODEL (MIM) & MIP TOOLS

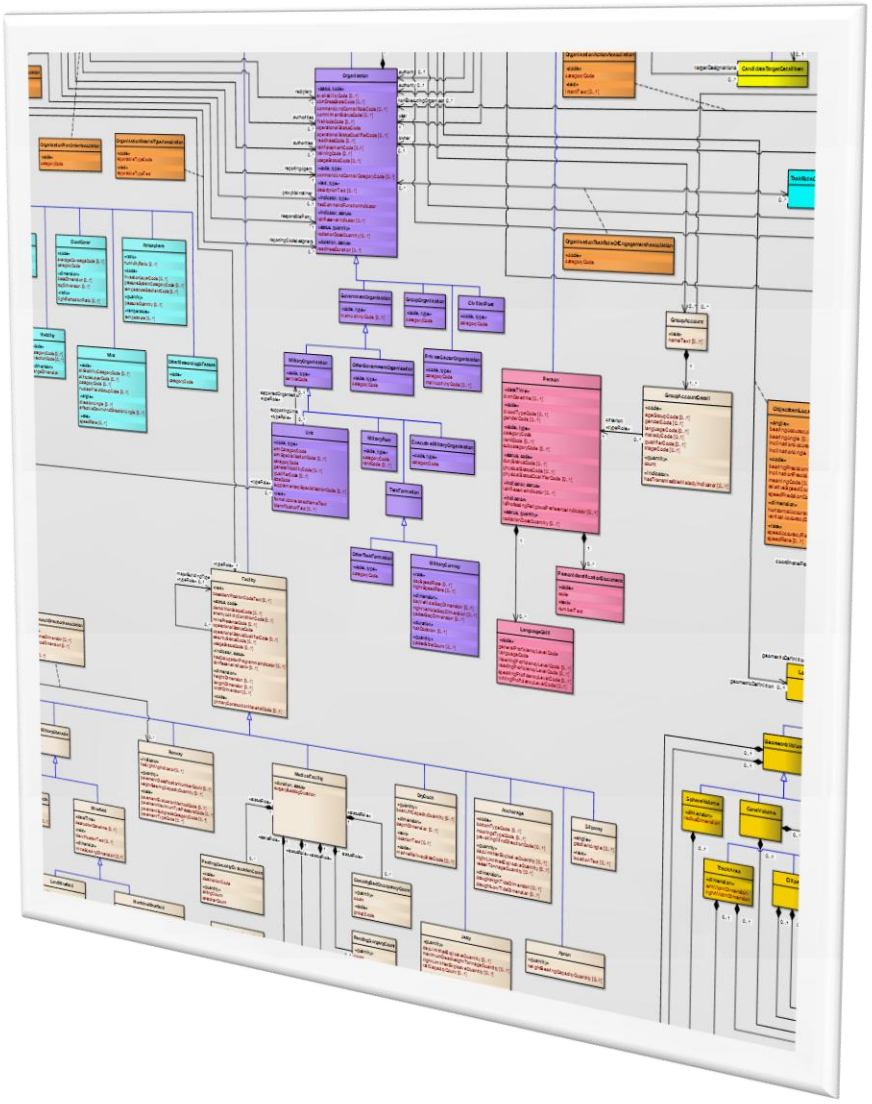


History of the MIP Data Model



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

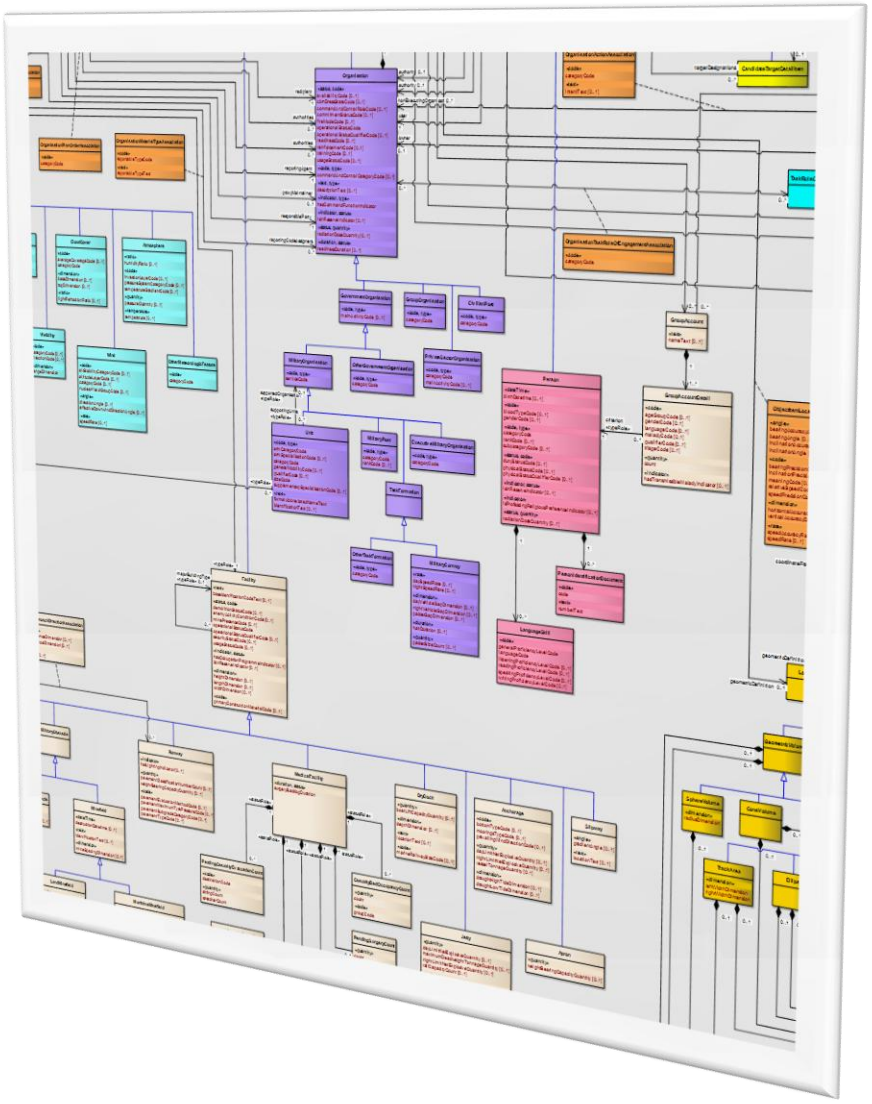


Characteristics of the MIP Information Model

- 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 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

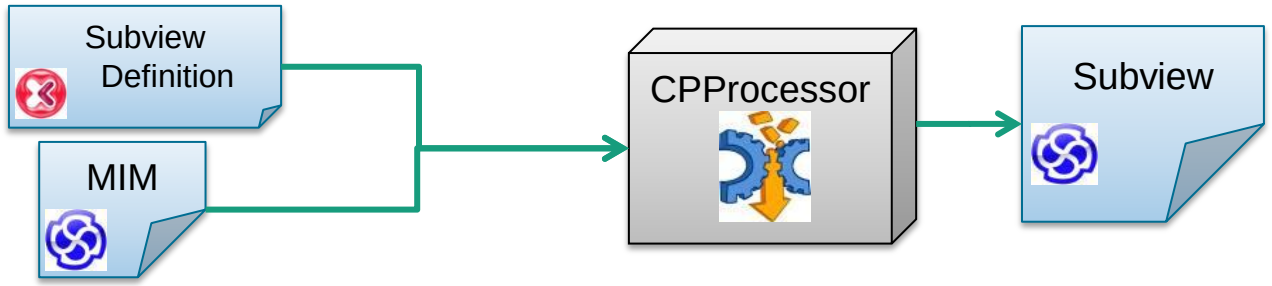
Summary of MIM Improvements (2/2)

- 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

MIP INFORMATION MODEL (MIM) SUBVIEWS

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

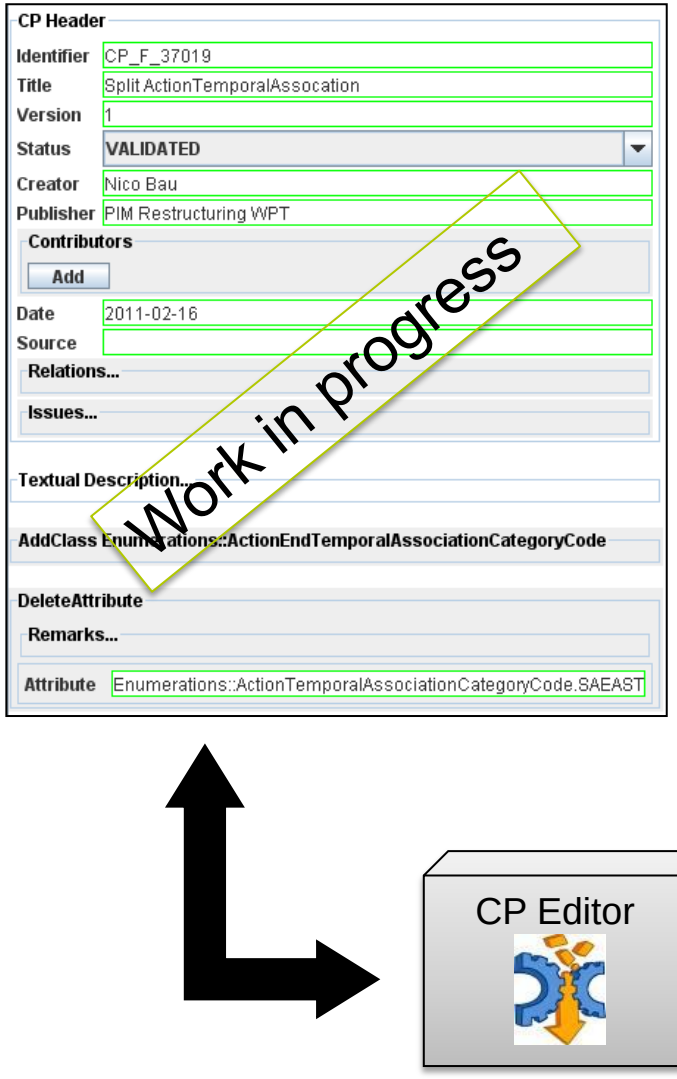
MIP INFORMATION MODEL (MIM) SUBVIEWS

The C-BML MODEL is therefore defined as a "MIM-SUBVIEW".

It is expressed as a set "SUBVIEW DEFINITION FILES" and "CHANGE PROPOSALS"

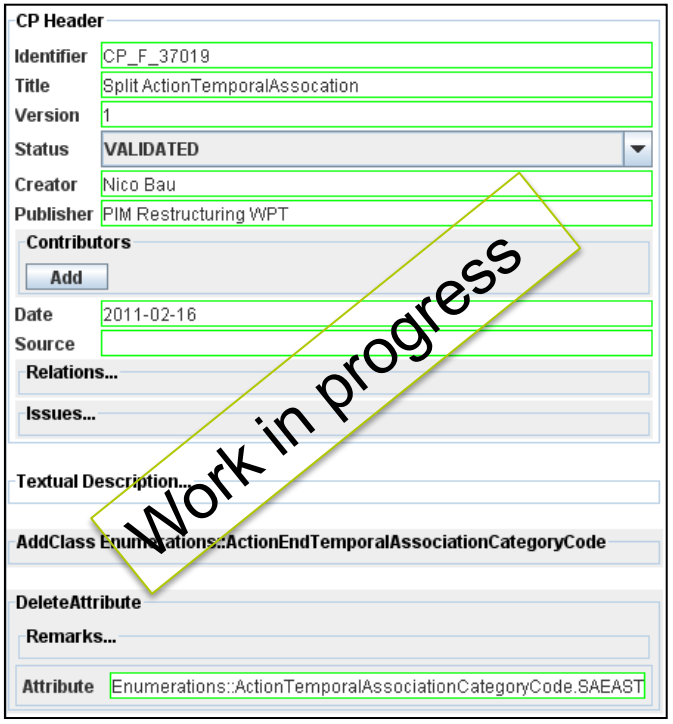
But how can we EASILY create these files ?

Building Subview Definitions & Change Proposals

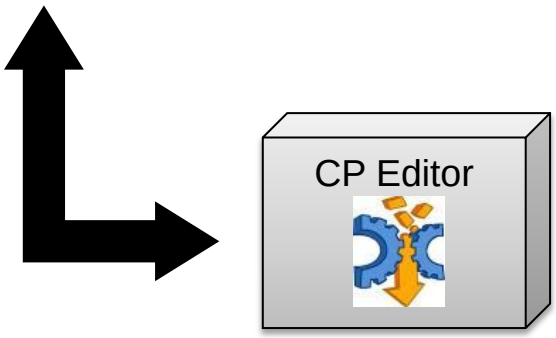


- Write a formal Subview Definition or Change Proposal
  - Metadata (Creator, Source of Requirement,..)
  - Model /Problem description (free text)
  - Overall modelling approach or concept for addressing the problem (free text)
  - Formal Changes
- Test the CP by letting the CPProcessor apply it to the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

Building Subview Definitions & Change Proposals



- Write
  - M
  - M
  - C a
  - F
- Test t Mode
- Gener




```
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  <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>
…
```

Viewing Model Definition Files & Change Proposals

XML Document

```
<ChangeProposal xmlns="urn:int:nato:standard:mip:cp:3.0
 <Header>
   <dms:Identifier>CP_F_37019</dms:Identifier>
   <dms:Title>Split ActionTemporalAssocation</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>
…
```

RTF Document

CP_4_45003 - Rename ConsumableMateriellssuingElementCode - 1

Header

Identifier	CP_4_45003
Title	Rename ConsumableMateriellssuingElementCode
Version	1
Status	Validated
Creator	Henriette Schüller
Publisher	MIP
Date Created	2013-01-07
Source	UT Model

Description

Problem

Changes

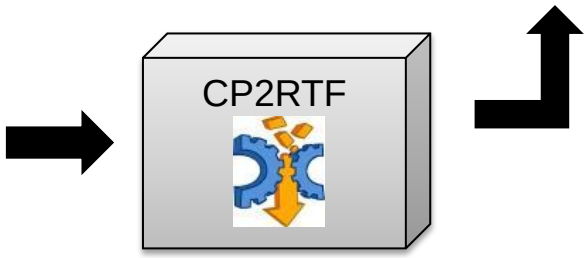
This CP applies the following changes:

* Change enum/attr ConsumableMateriellssuingElementCode to ConsumableMateriellssuingUnitCode.

FormalContent

Change Set

Modify Enumeration	
Class	Enumerations::ConsumableMateriellssuingElementCode
Name	~~ConsumableMateriellssuingElementCode~~ ConsumableMateriellssuingUnitCode



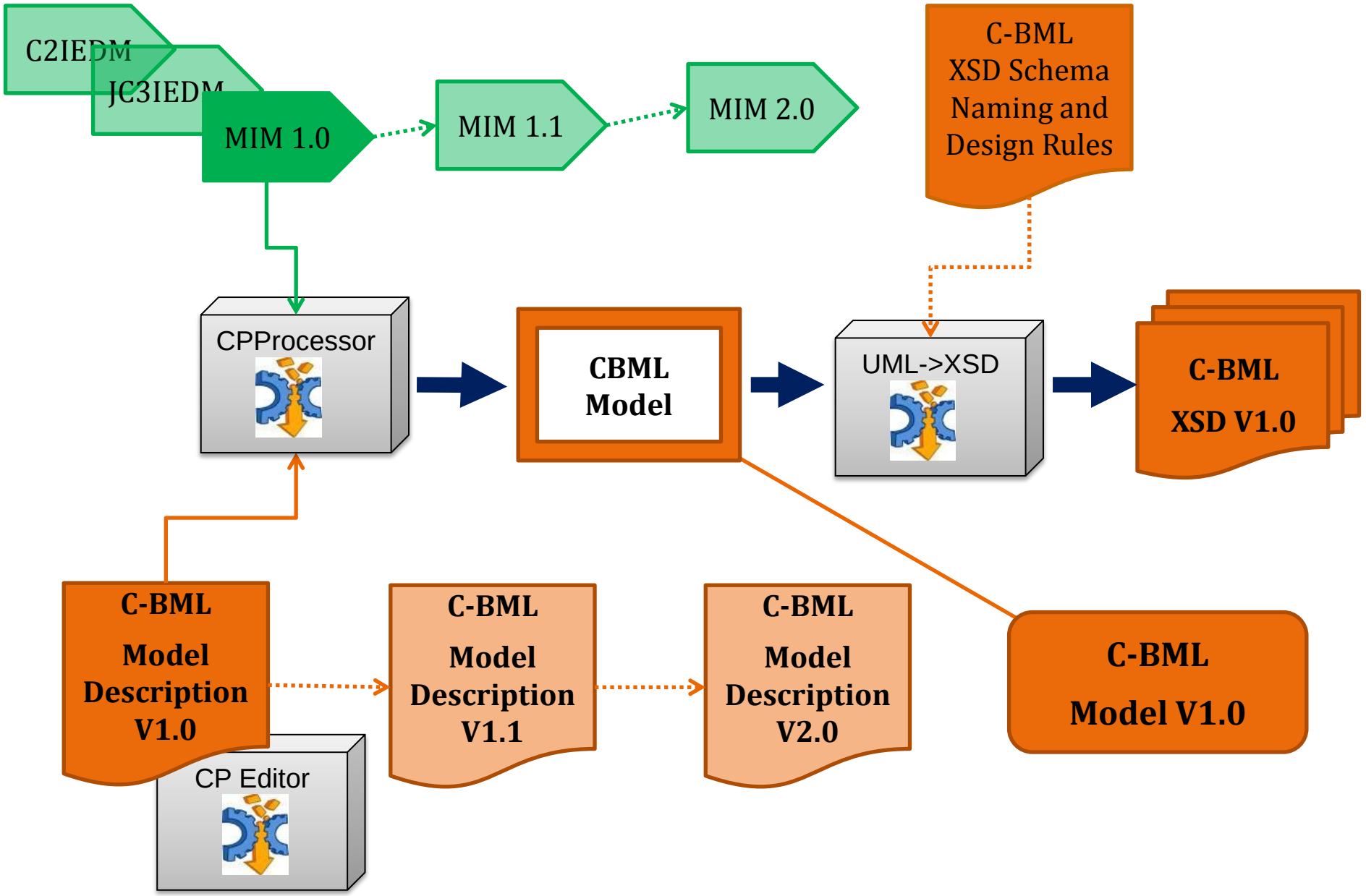
Benefits of Change Proposal Approach

- 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;

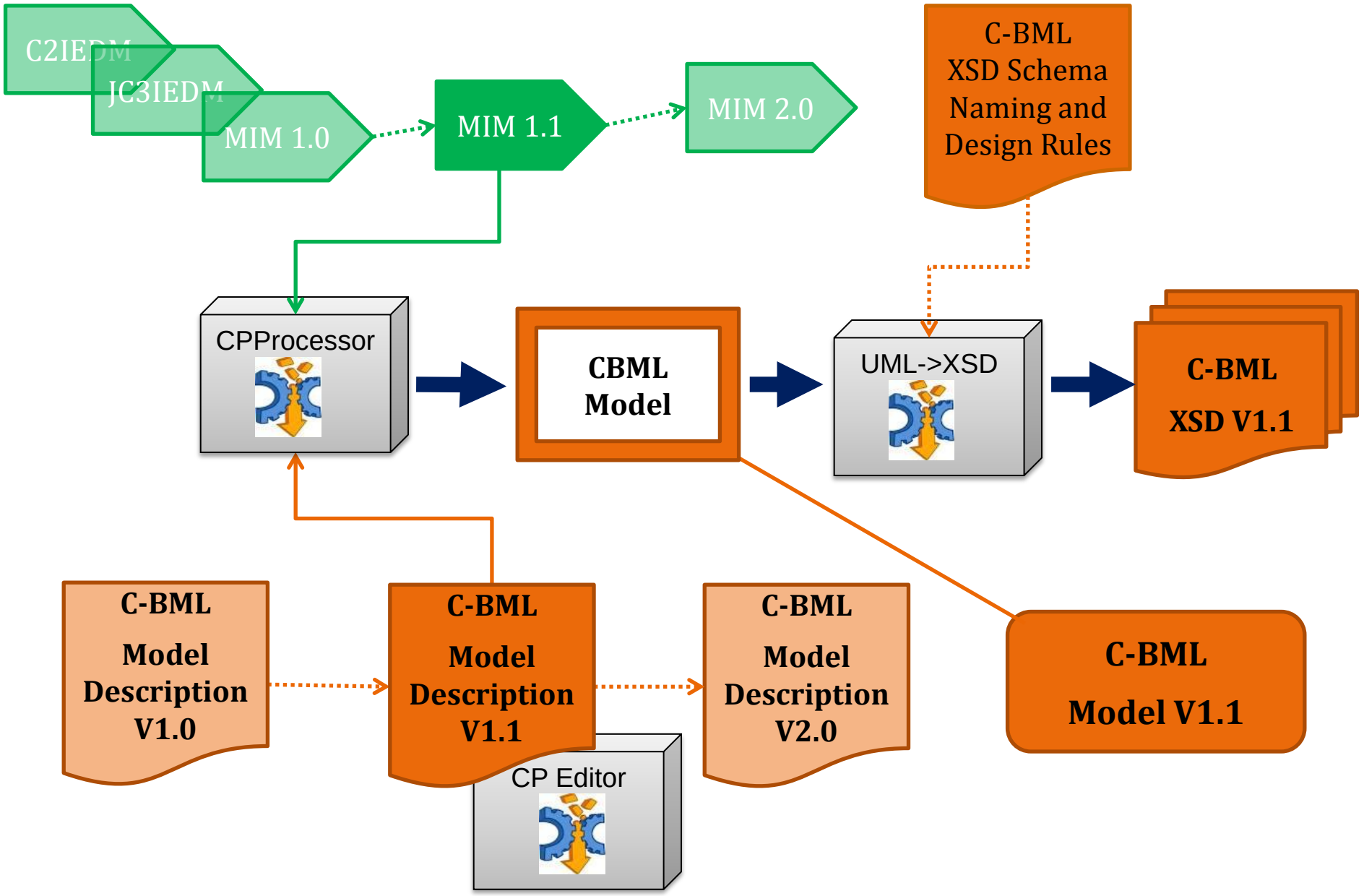
Simple yet effective traceability is maintained !

MIM-BASED C-BML DEVELOPMENT TOOL CHAIN

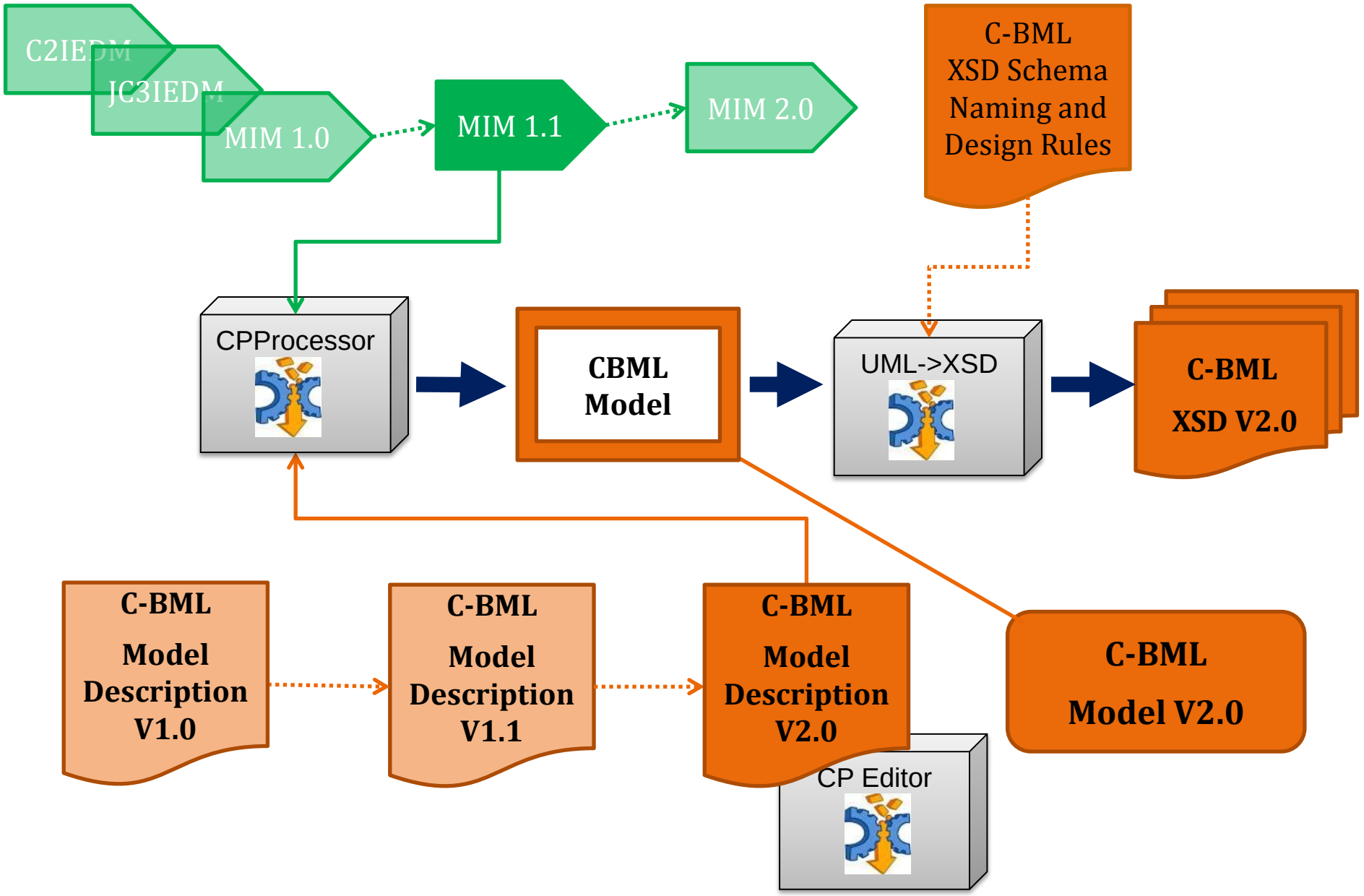
MIM-Based C-BML Model Generation Process



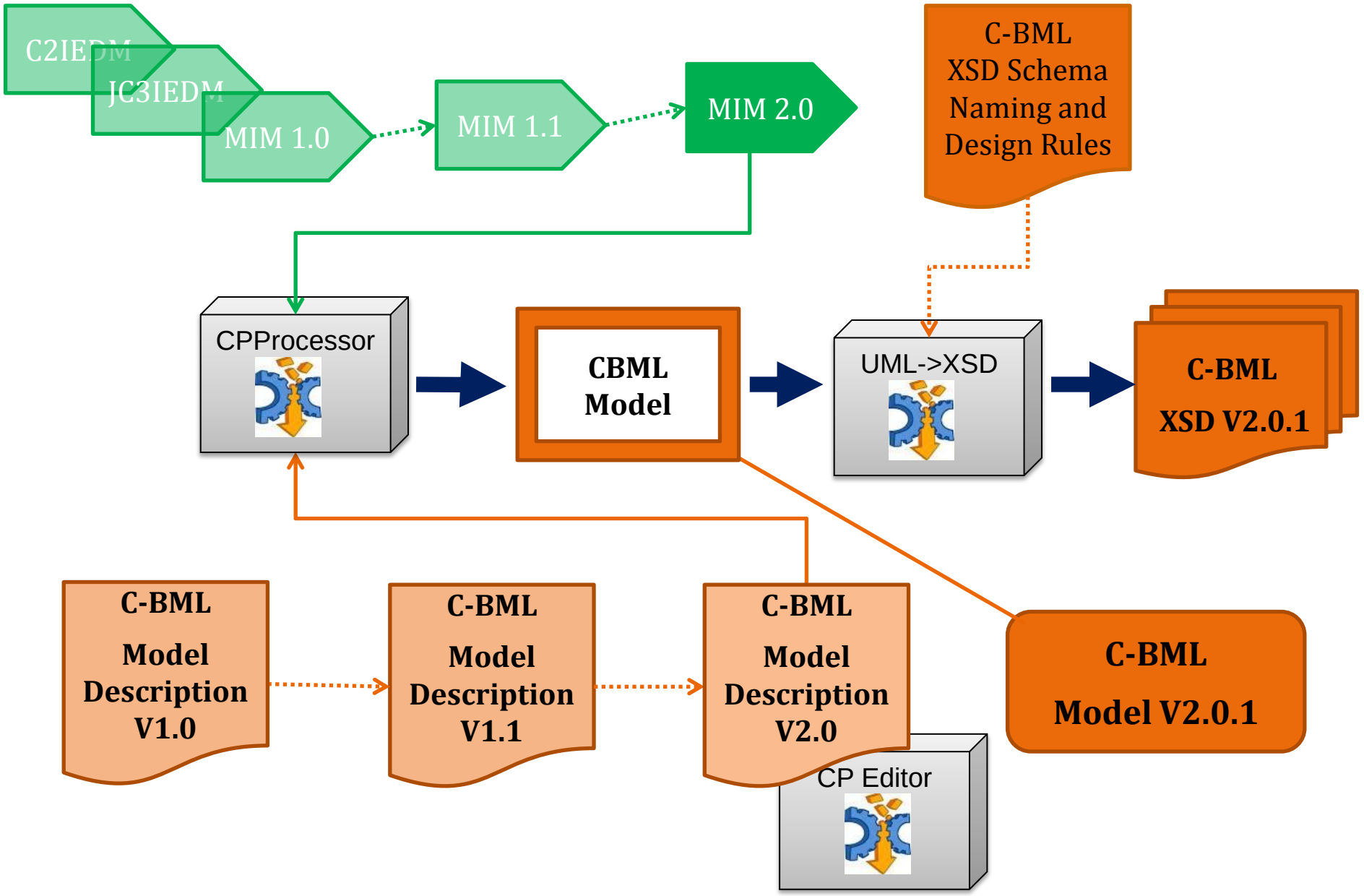
MIM-Based C-BML Model Generation Process



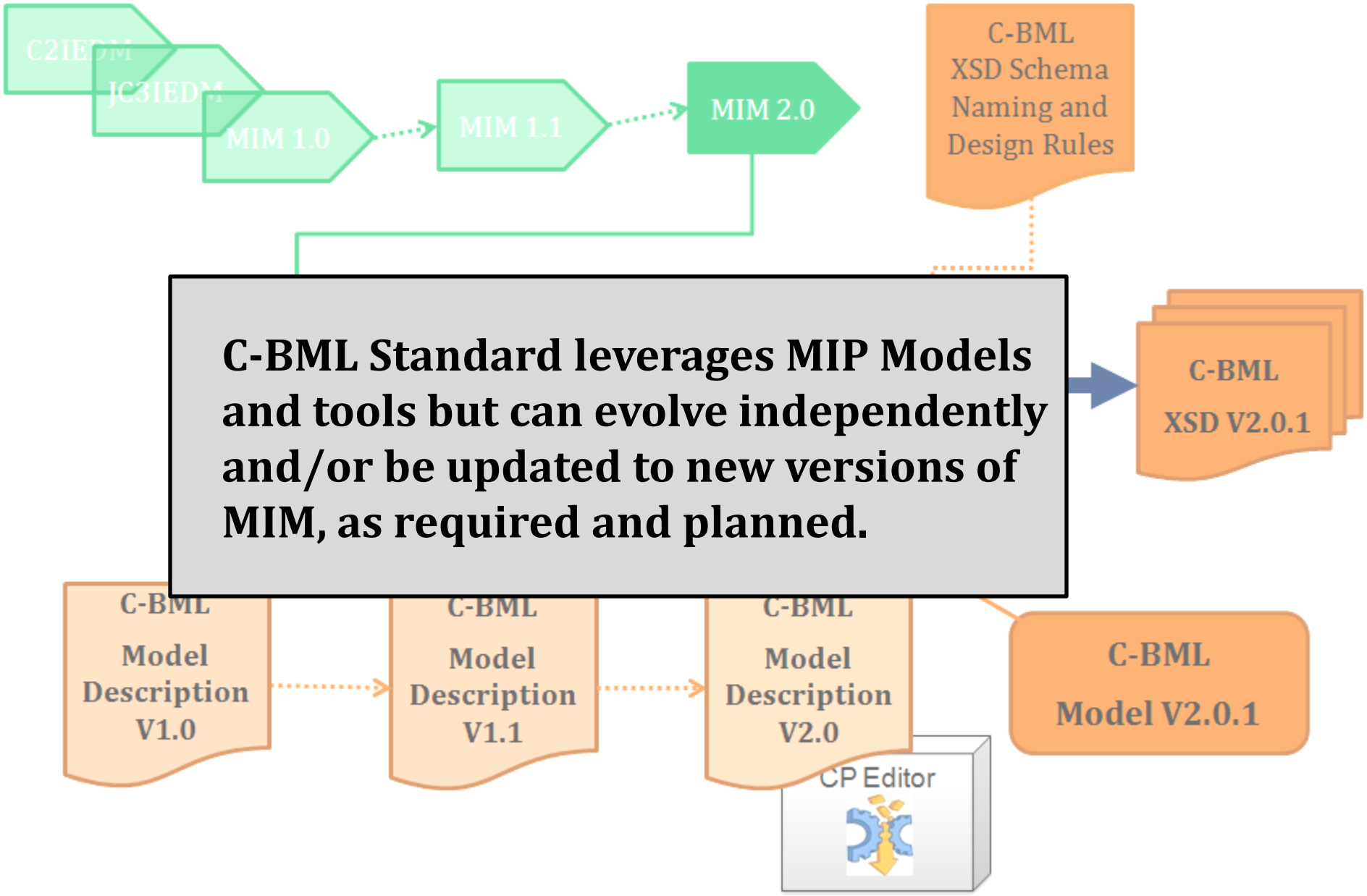
MIM-Based C-BML Model Generation Process



MIM-Based C-BML Model Generation Process



MIM-Based C-BML Model Generation Process

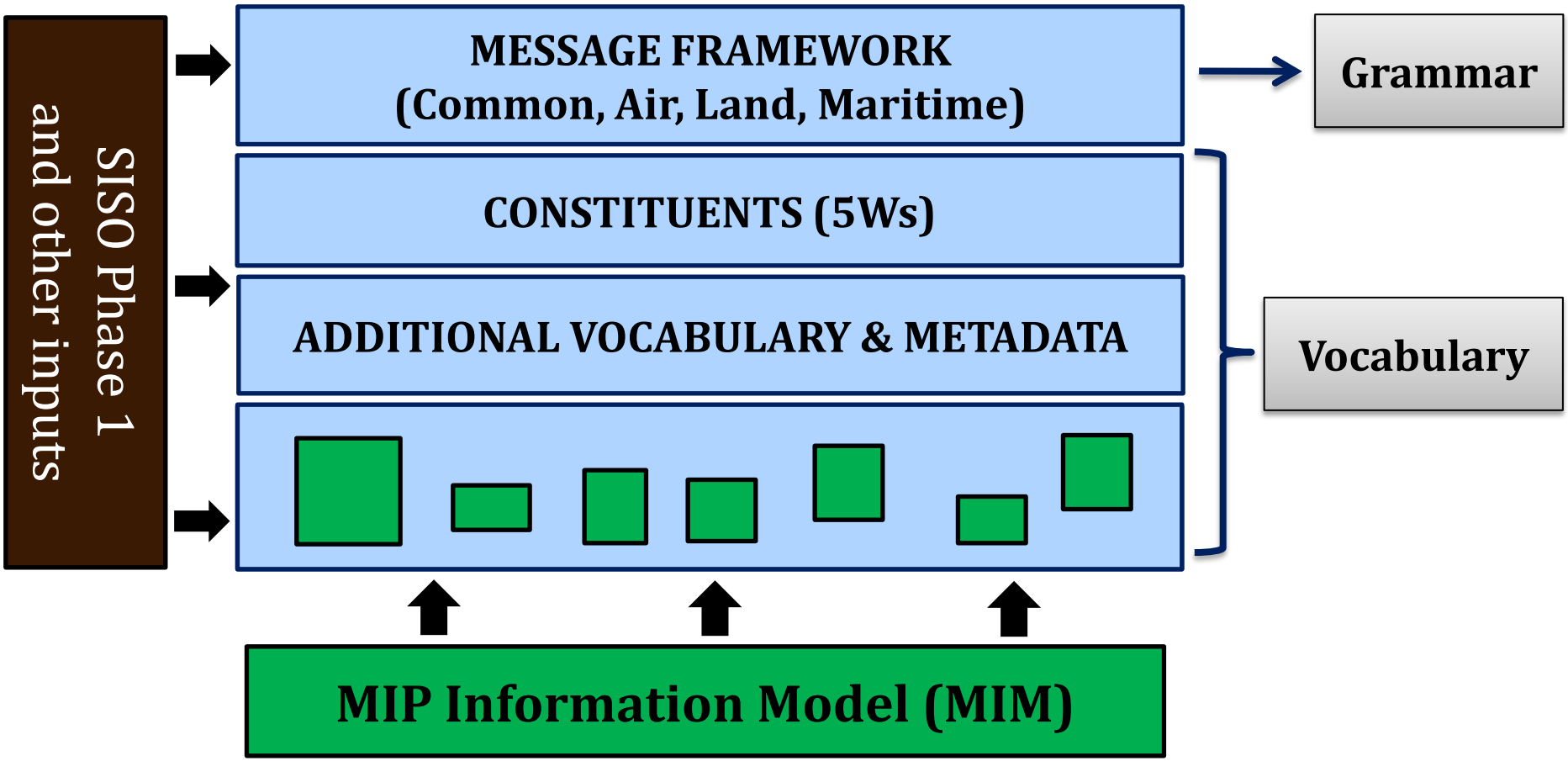


BUILDING THE C-BML PHASE 2 STANDARD

*** 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
- Re-use MIM types as foundation

MESSAGE FRAMEWORK
(Common, Air, Land, Maritime)

Grammar

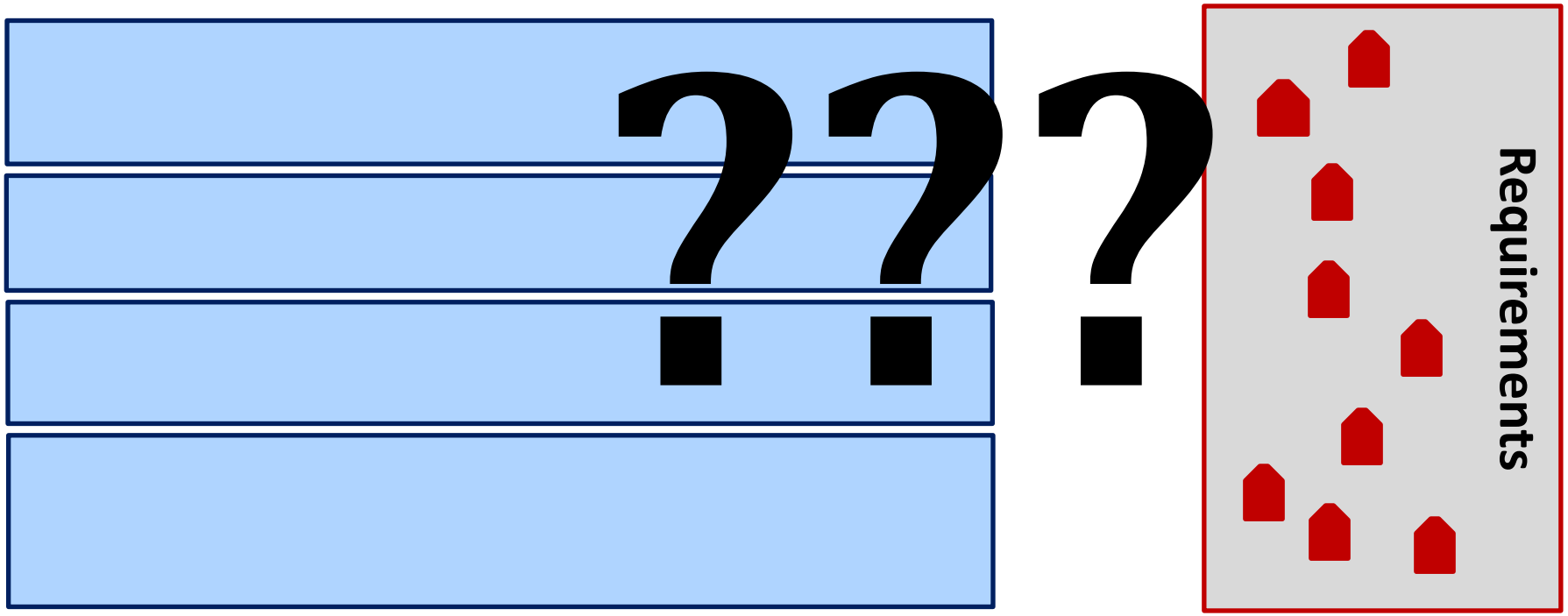
C-BML does NOT define operational messages, it allows one to represent the information contained in operational messages so that it can be shared with simulations and other systems.

Vocabulary

MIP Information Model (MIM)

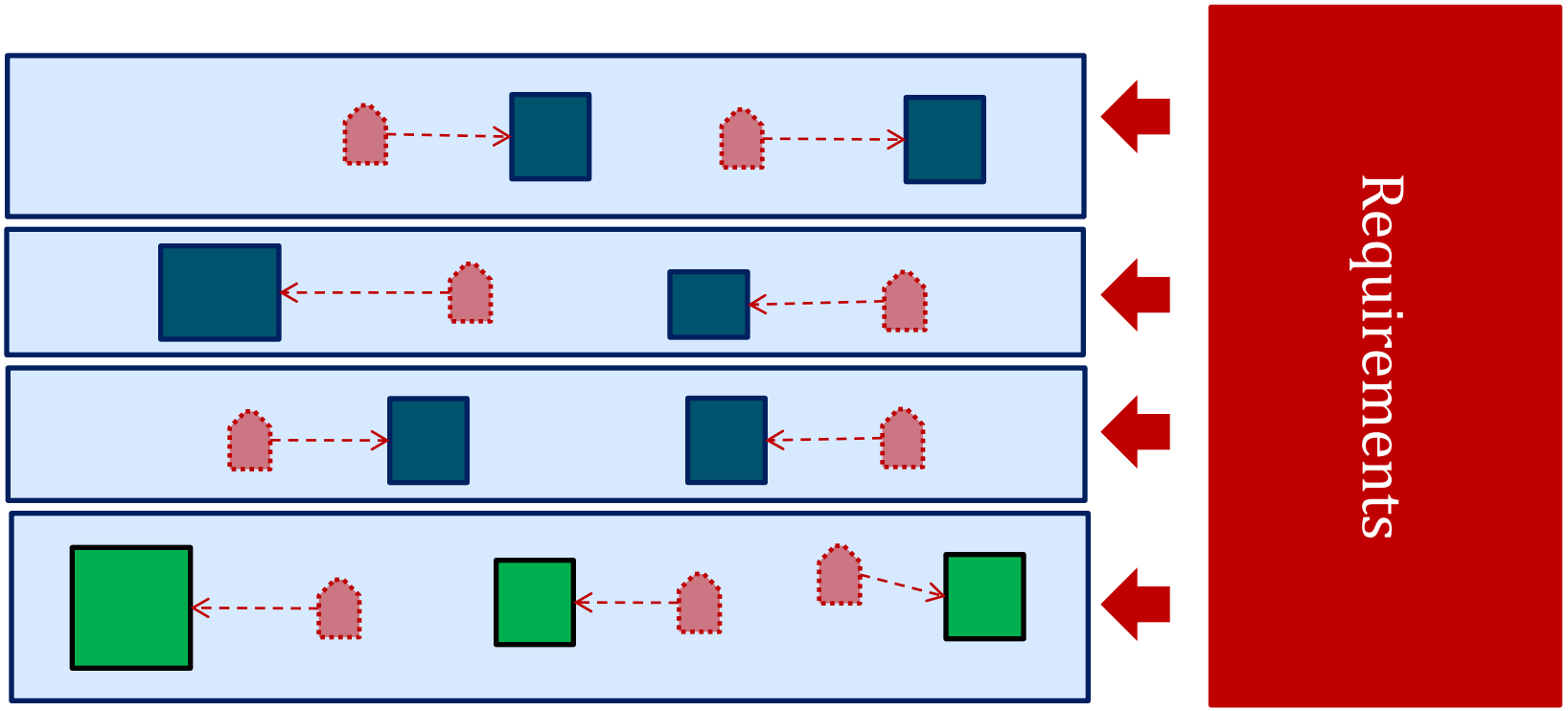
Requirements Traceability

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

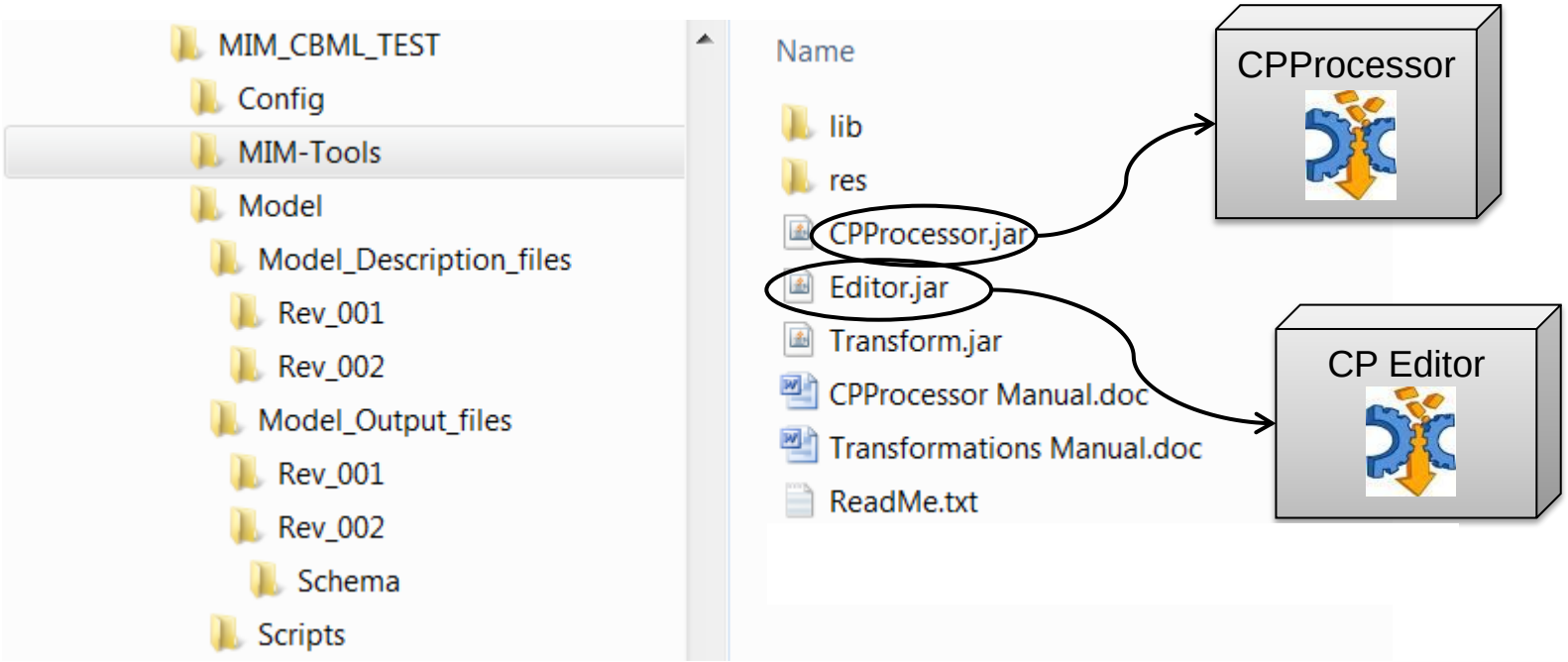


Requirements Traceability is still a work in progress.

EXAMPLE C-BML MODEL

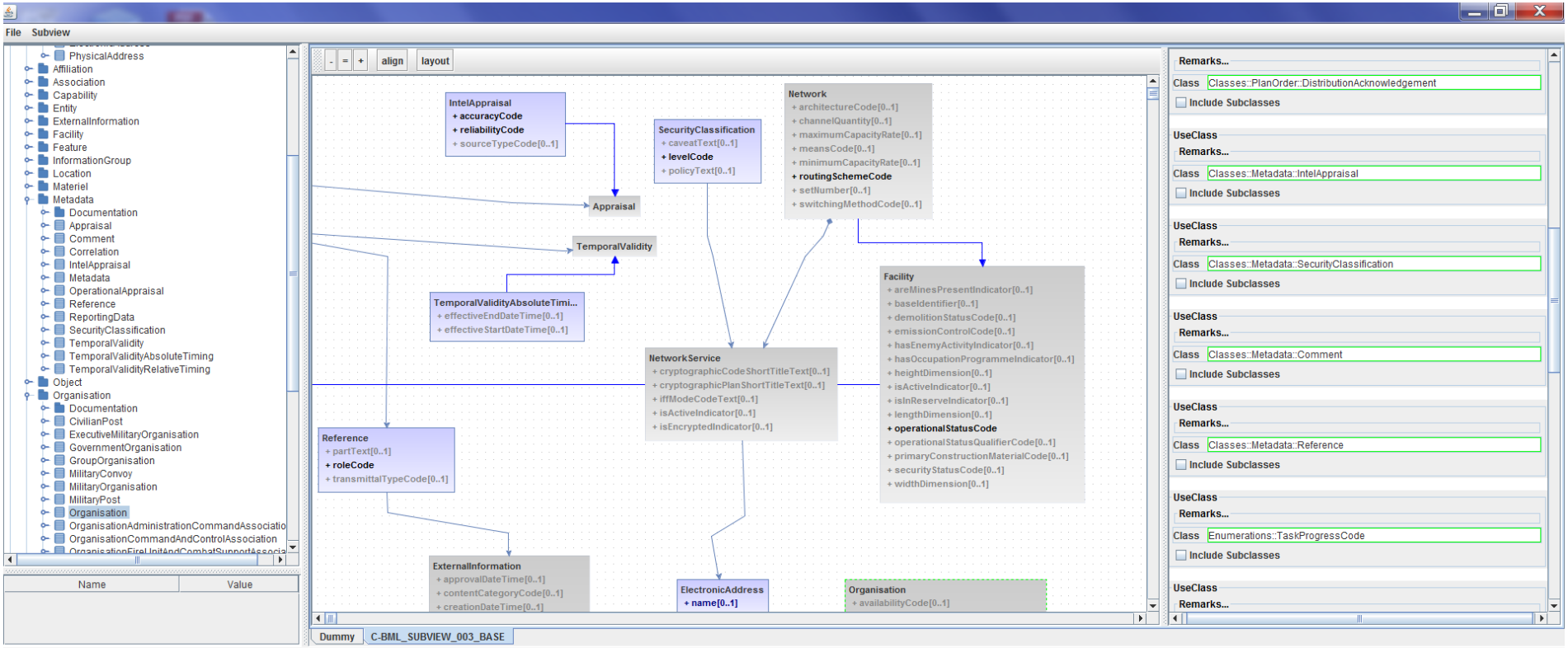
Example C-BML Model Cycle

Development Environment



Example C-BML Model Cycle

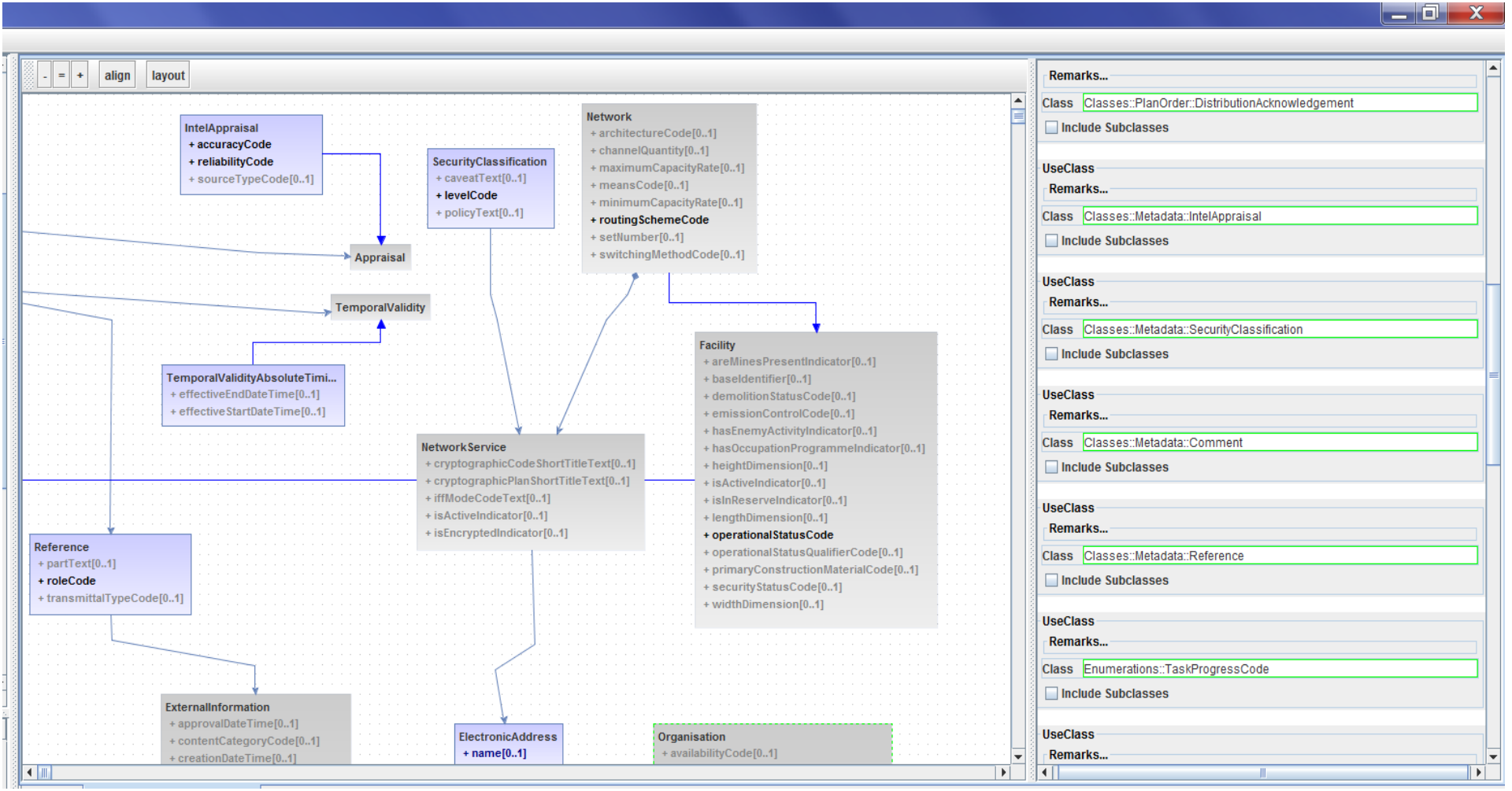
Subview Definition and Change Proposal Editor



Class	AggregationType	Nav	Mult	Role	Name	Role	Mult	Nav	AggregationType	Class
Organisation	None	☑	0..*	nonExecutingOrganisations	OrganisationActionAssociation		0..*	☑	None	Action
Organisation	None	☑	0..*	authorities	OrganisationExternalInformati...		0..*	☑	None	ExternalInformation
Organisation	None	☑	1	recipient			0..*	☐	None	Distribution
Organisation	None	☑	0..*	authorities	OrganisationPlanOrderAssoci...		0..*	☑	None	PlanOrder
Organisation	None	☑	1	reportingAgent			0..*	☐	None	ReportingData
Organisation	Composite	☐	1			configurations	0..*	☑	None	OrganisationStructure
Organisation	None	☑	0..*	reportingCodeAssigners	OrganisationMaterielTypeAss...		0..*	☑	None	Materiel
Organisation	None	☑	1	user			0..*	☐	None	ActionObjectiveItemMarking
Organisation	None	☑	0..1	authority			0..*	☑	None	ActionObjective
Organisation	None	☑	0..1	authority			0..*	☑	None	ActionResource
Organisation	None	☑	0..1	owner			0..*	☑	None	RuleOfEngagement
Organisation	None	☑	0..*		OrganisationTaskRuleOfEnga...		0..*	☑	None	TaskRuleOfEngagementAssociation
Organisation	None	☑	1	responsibleParty		populatedGroups	0..*	☑	None	OperationalInformationGroup

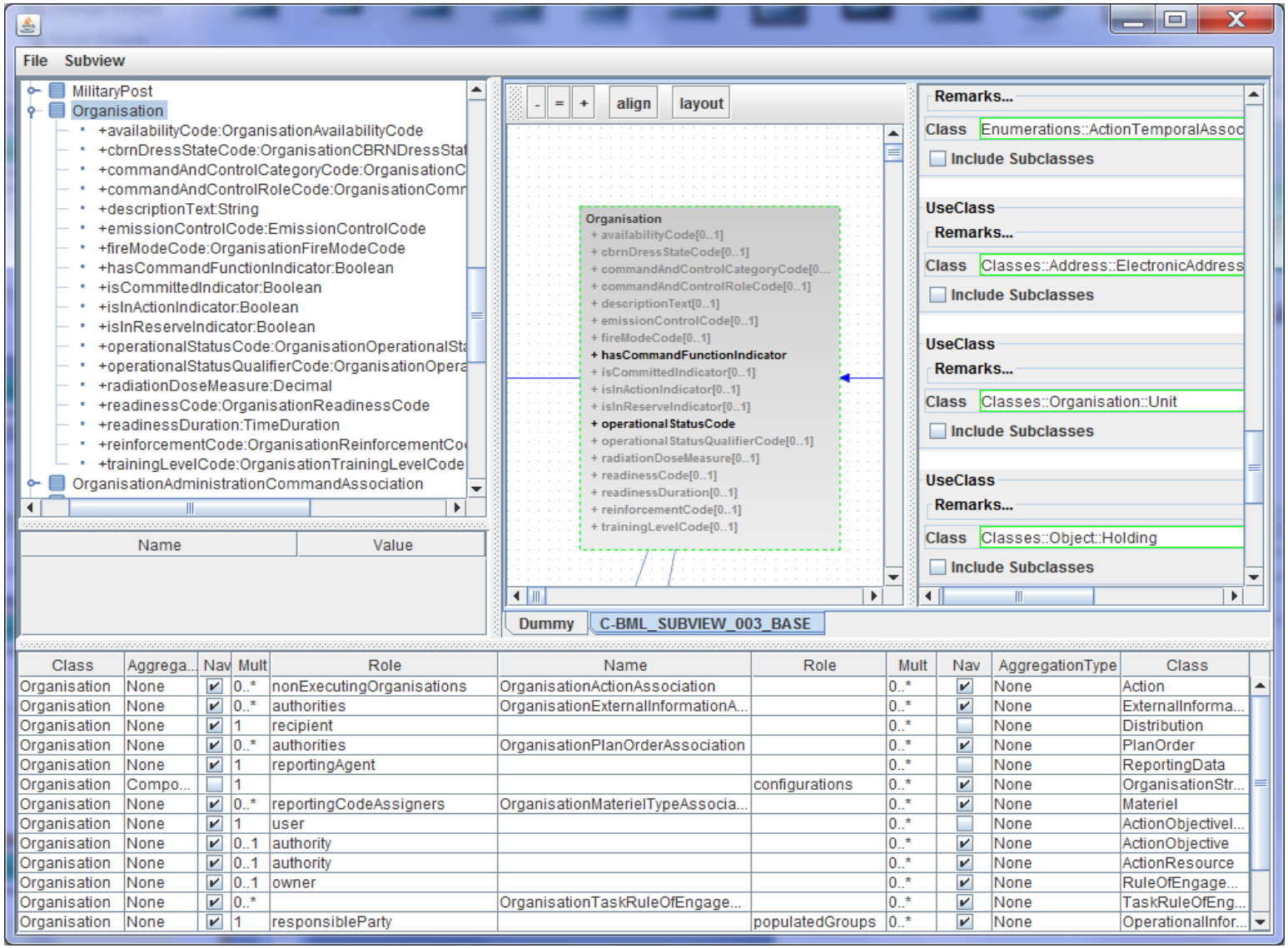
Example C-BML Model Cycle

C-BML Base Model Definition



Example C-BML Model Cycle

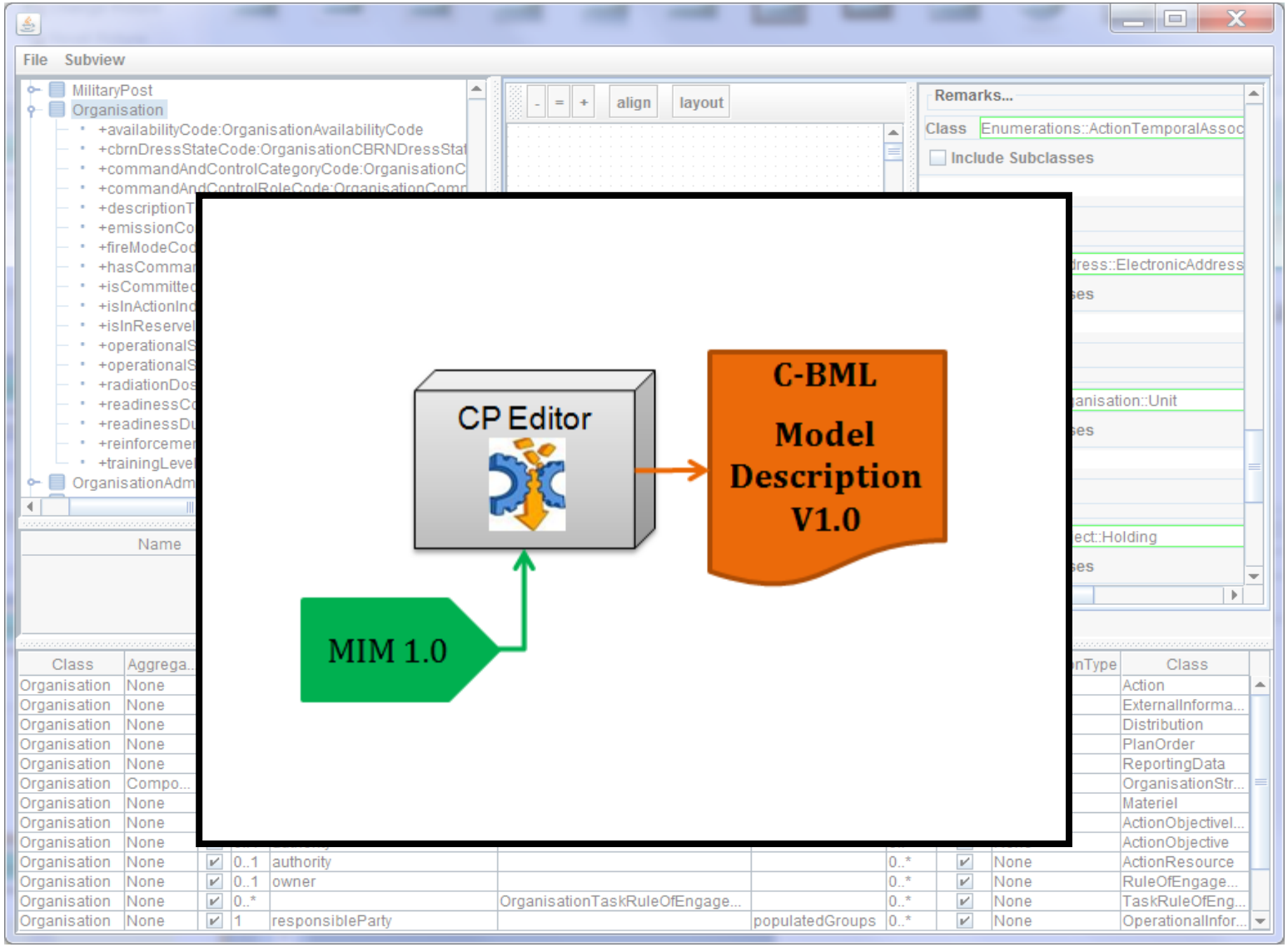
Details for Organisation Class



Class	Aggrega...	Nav	Mult	Role	Name	Role	Mult	Nav	AggregationType	Class
Organisation	None	✔	0..*	nonExecutingOrganisations	OrganisationActionAssociation		0..*	✔	None	Action
Organisation	None	✔	0..*	authorities	OrganisationExternalInformationA...		0..*	✔	None	ExternalInforma...
Organisation	None	✔	1	recipient			0..*		None	Distribution
Organisation	None	✔	0..*	authorities	OrganisationPlanOrderAssociation		0..*	✔	None	PlanOrder
Organisation	None	✔	1	reportingAgent			0..*		None	ReportingData
Organisation	Compo...		1			configurations	0..*	✔	None	OrganisationStr...
Organisation	None	✔	0..*	reportingCodeAssigners	OrganisationMaterielTypeAssocia...		0..*	✔	None	Materiel
Organisation	None	✔	1	user			0..*		None	ActionObjectivel...
Organisation	None	✔	0..1	authority			0..*	✔	None	ActionObjective
Organisation	None	✔	0..1	authority			0..*	✔	None	ActionResource
Organisation	None	✔	0..1	owner			0..*	✔	None	RuleOfEngage...
Organisation	None	✔	0..*		OrganisationTaskRuleOfEngage...		0..*	✔	None	TaskRuleOfEng...
Organisation	None	✔	1	responsibleParty		populatedGroups	0..*	✔	None	OperationalInfor...

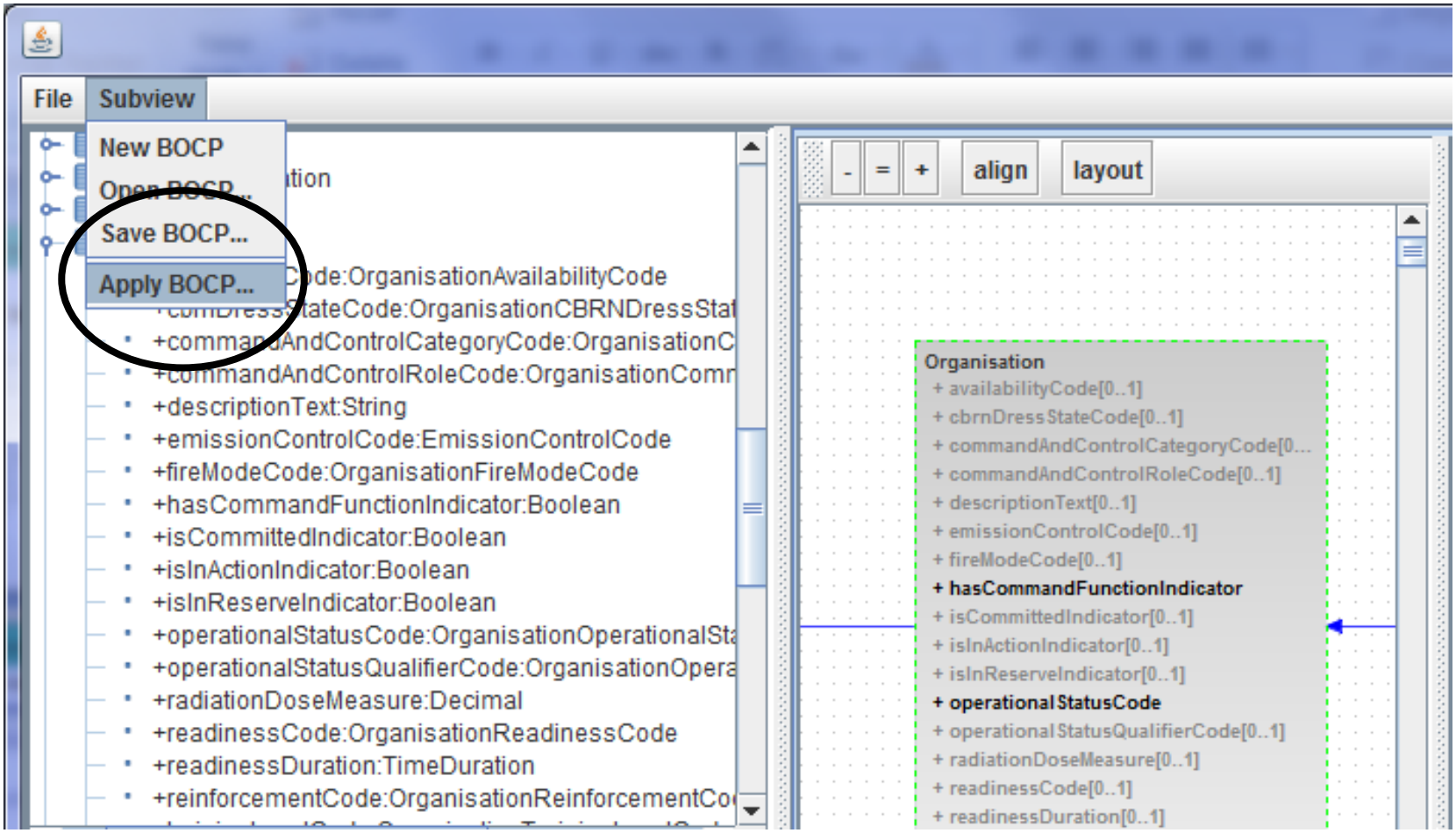
Example C-BML Model Cycle

Subview Model Description ☑



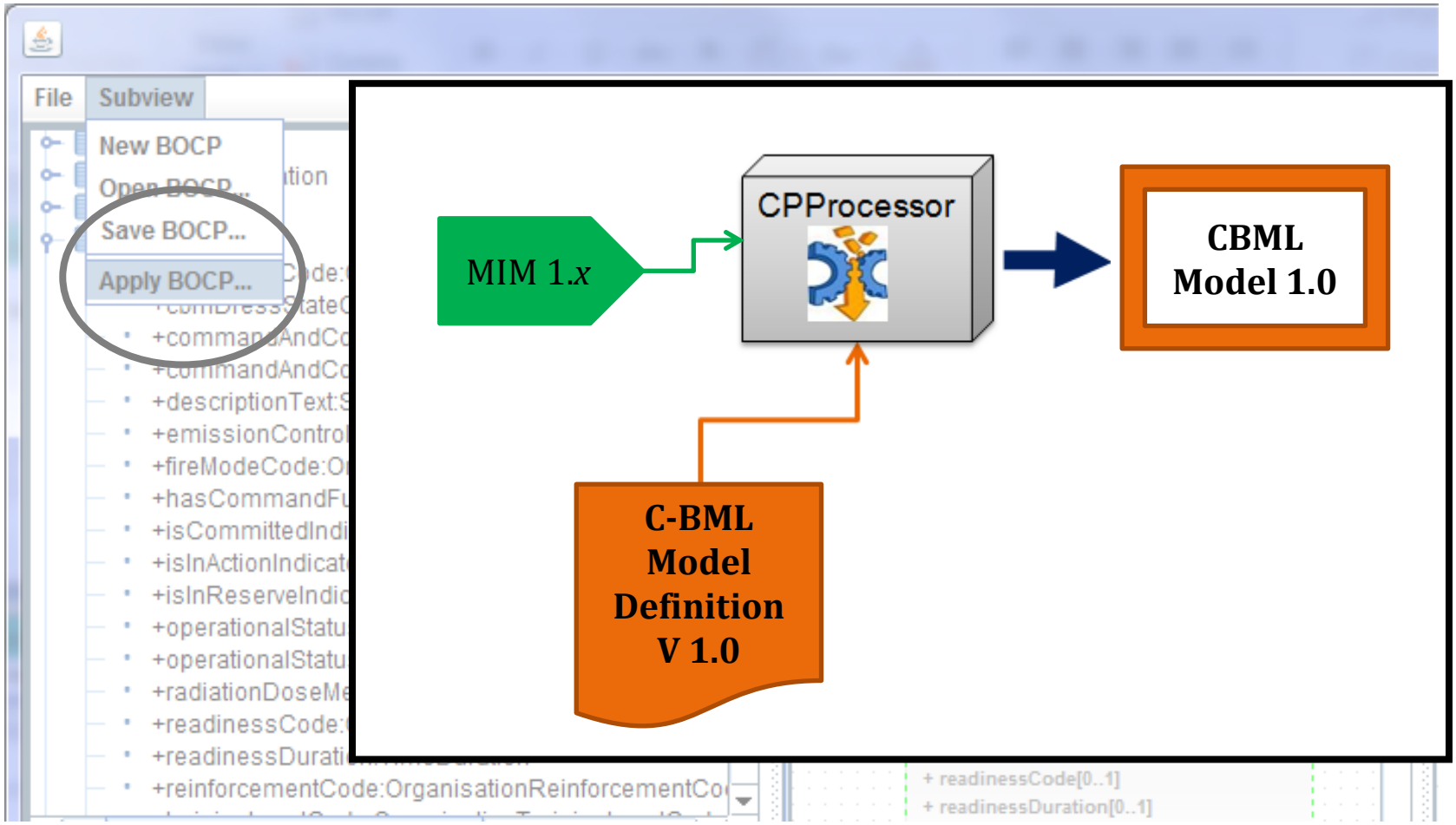
Example C-BML Model Cycle

Generate C-BML Model



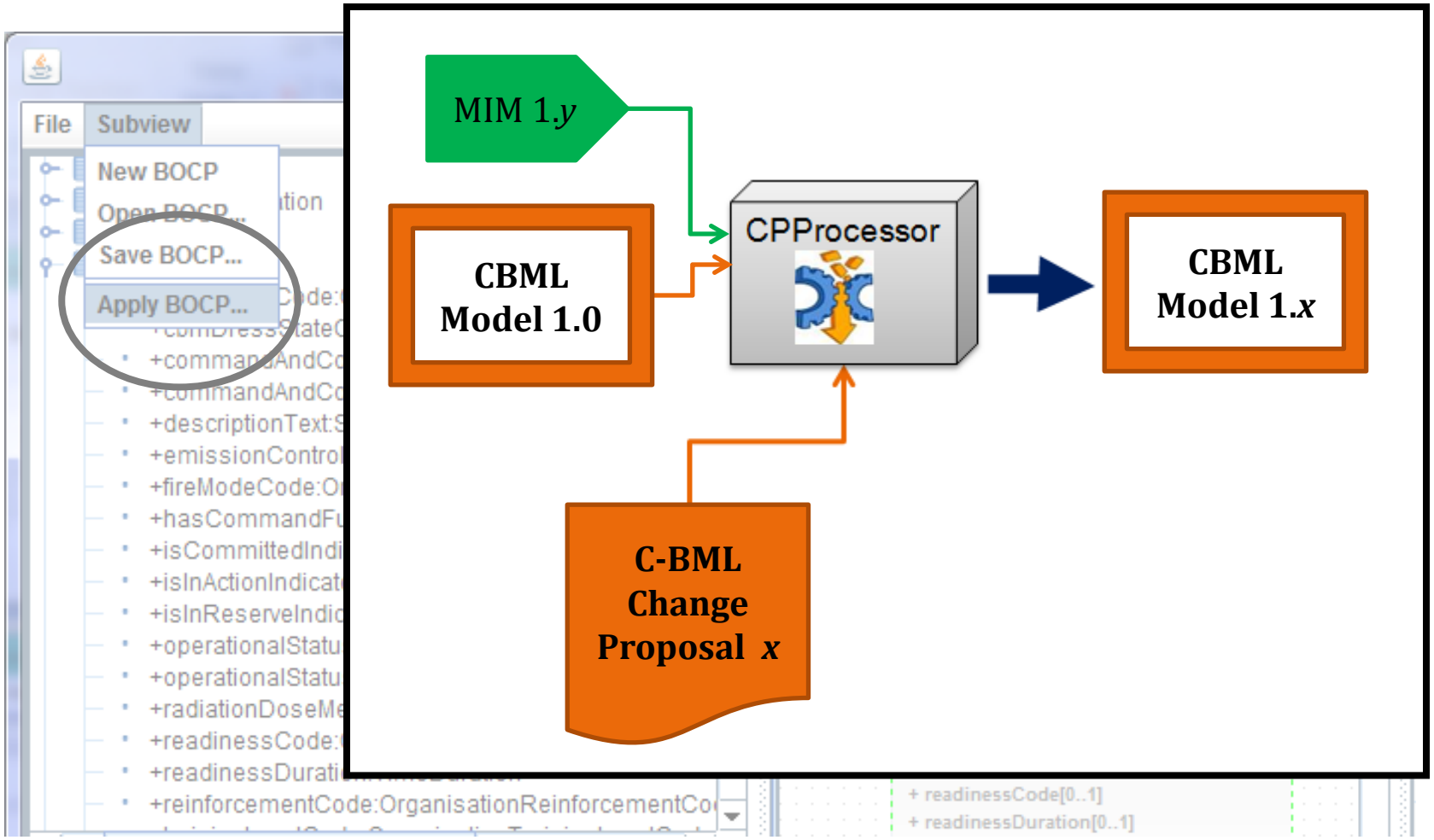
Example C-BML Model Cycle

C-BML Model Generation ☑



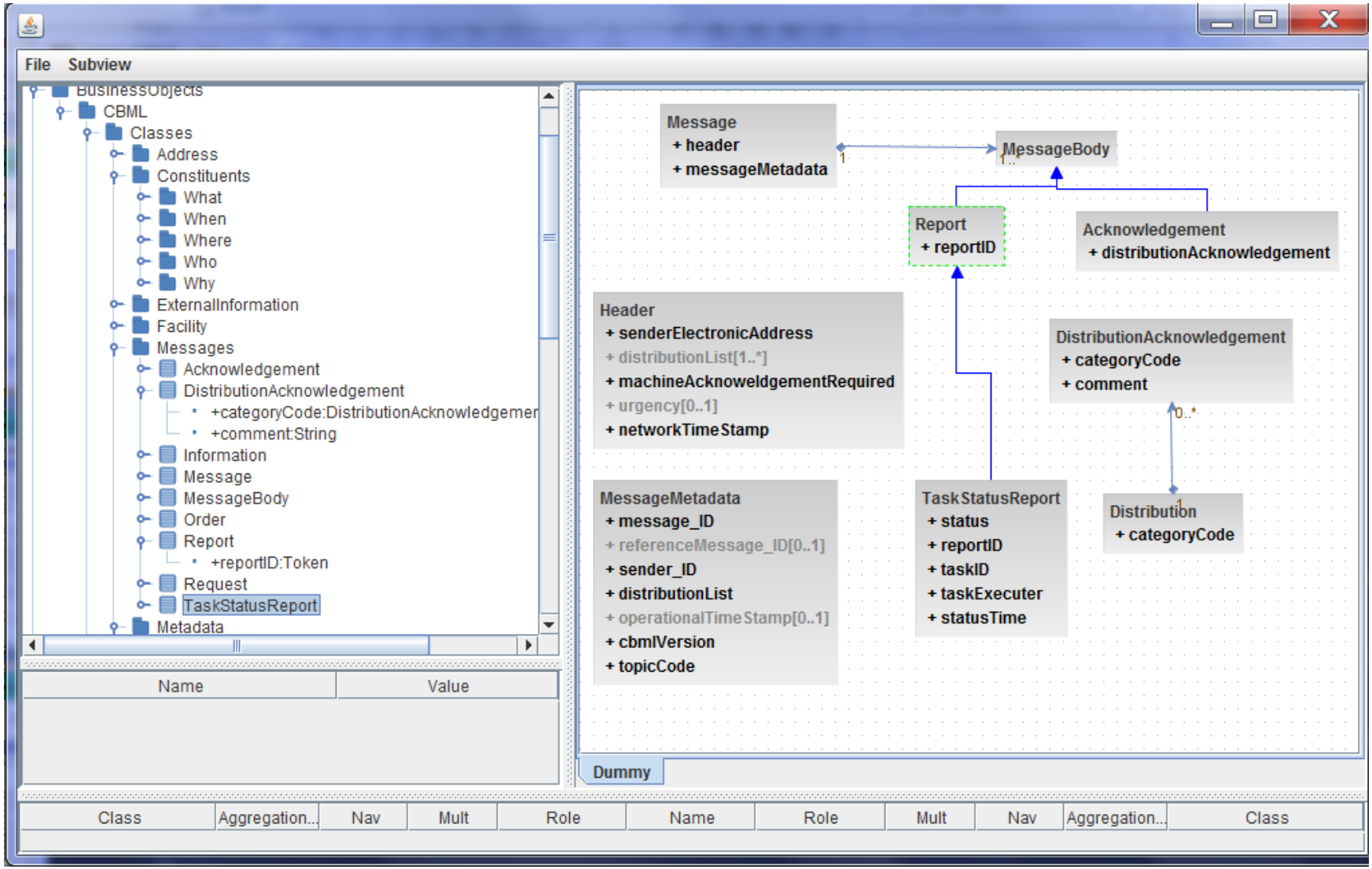
Example C-BML Model Cycle

C-BML Model Evolution ☑



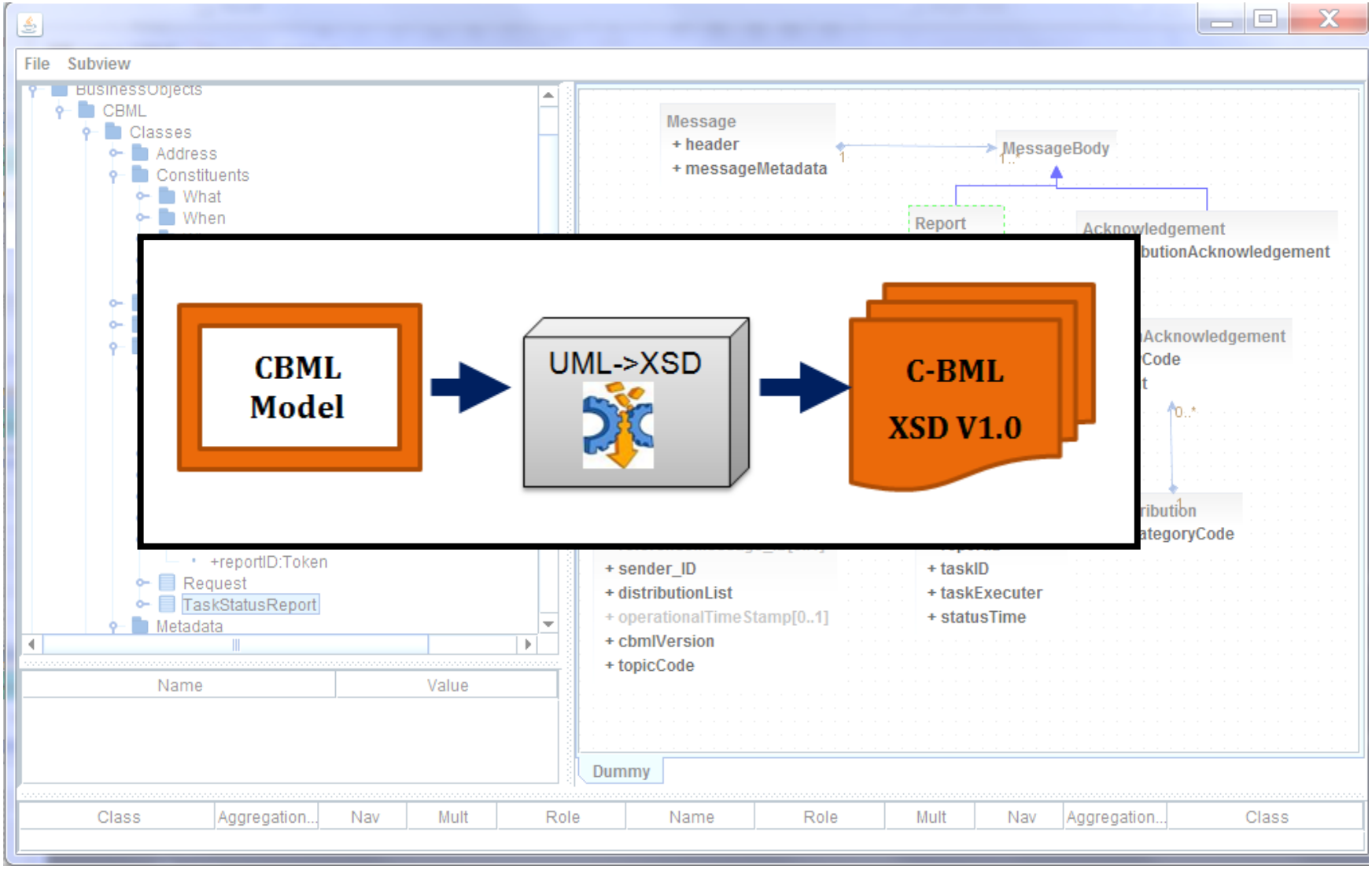
Example C-BML Model Cycle

Browse C-BML Model



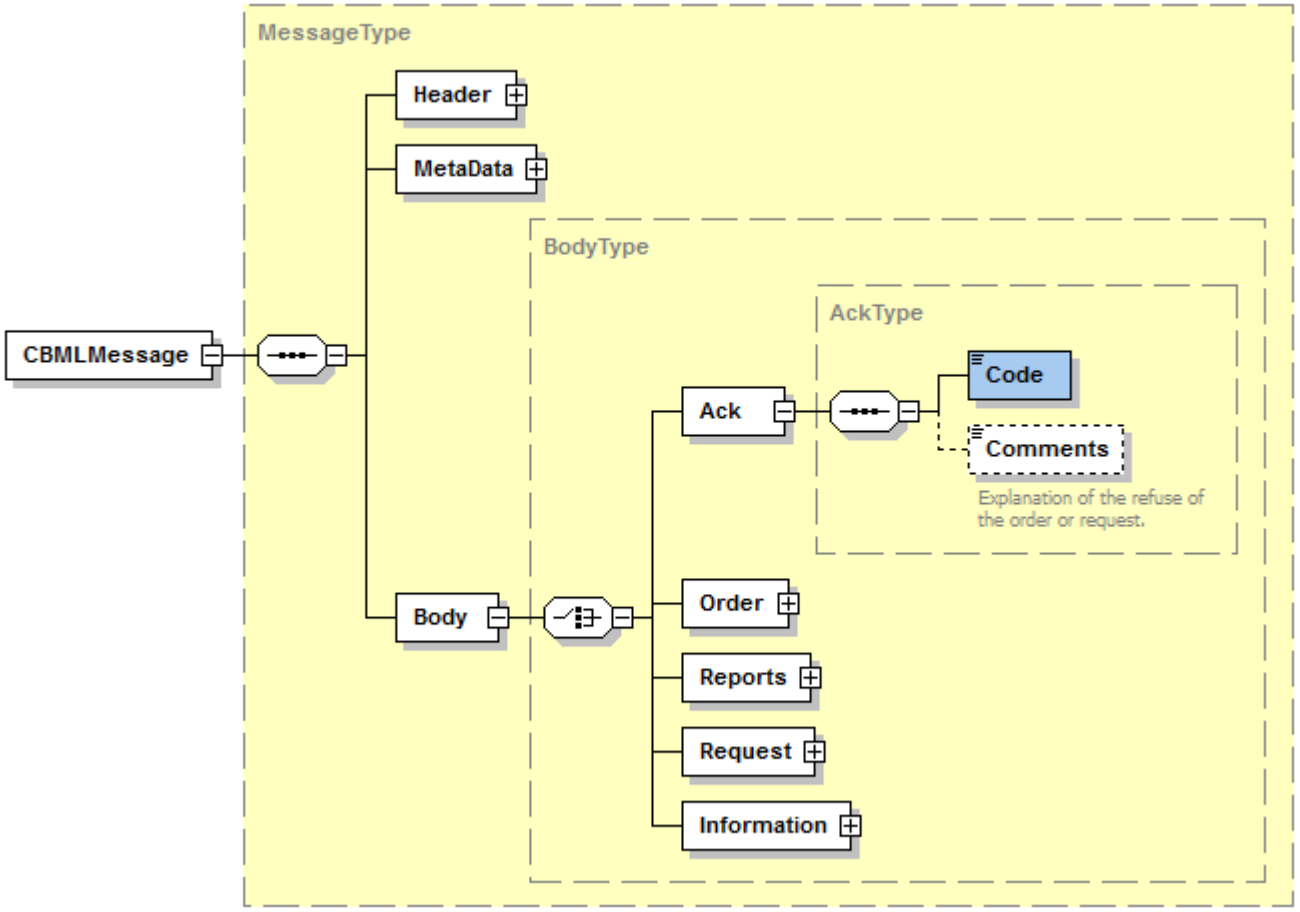
Example C-BML Model Cycle

C-BML XML Schema Generation ☑



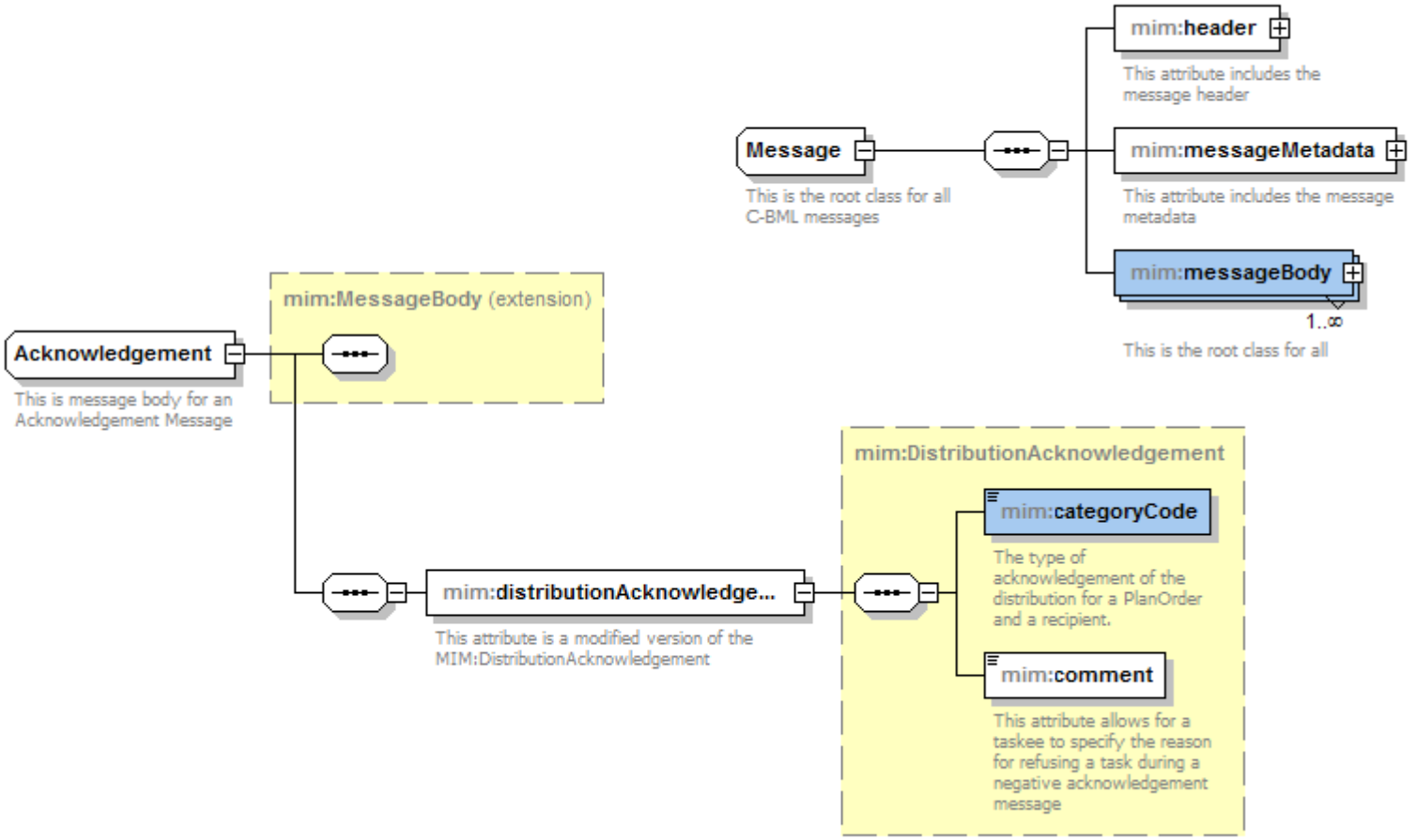
Example C-BML Model Cycle

Message Framework Schema

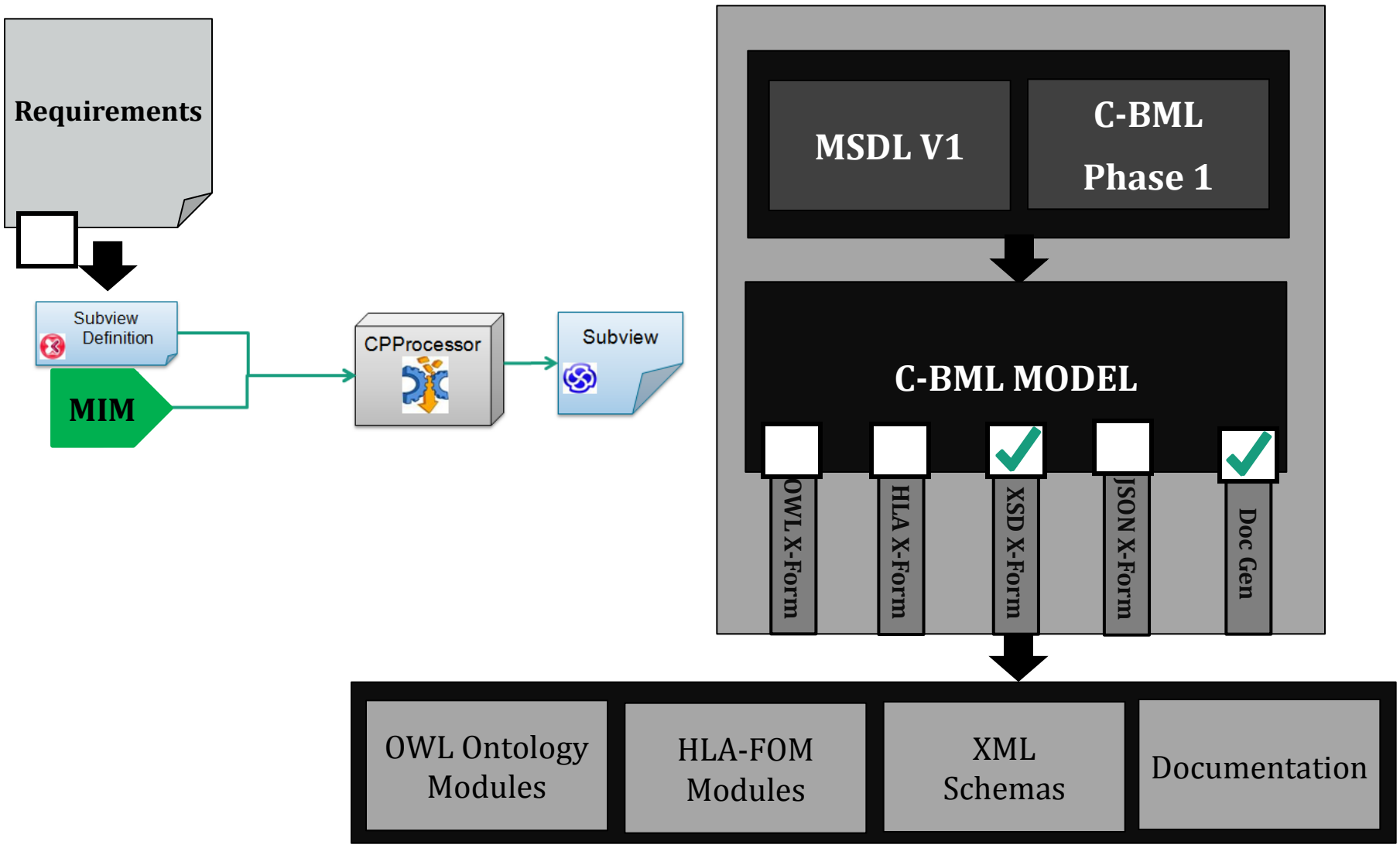


Example C-BML Model Cycle

Message Acknowledgement



Model-Driven Architecture Approach



Current & Future Work

- Requirements Traceability Tool Development
- Automation
  - Refining UML→XSD Tranform 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.

Summary & Conclusions (2/3)

- 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.

Summary & Conclusions (3/3)

- Interest in this approach within NATO MSG-085 has led to the formation of the **S**cenario **IN**itialization and **EX**ecution (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

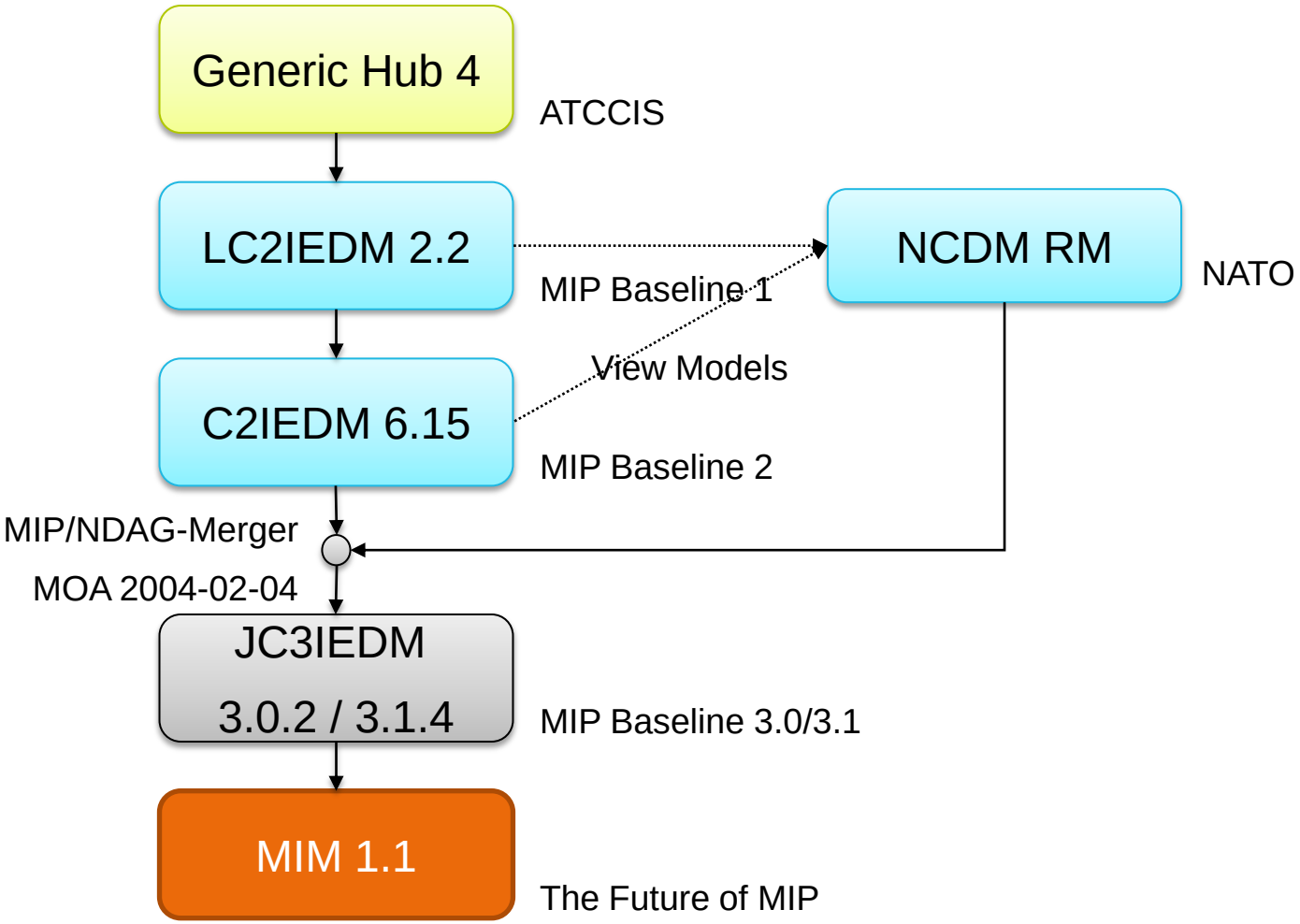
Dr. Michael Gerz

10th MSG-085 Meeting – Fraunhofer FKIE – 13-Feb-2013

Fraunhofer

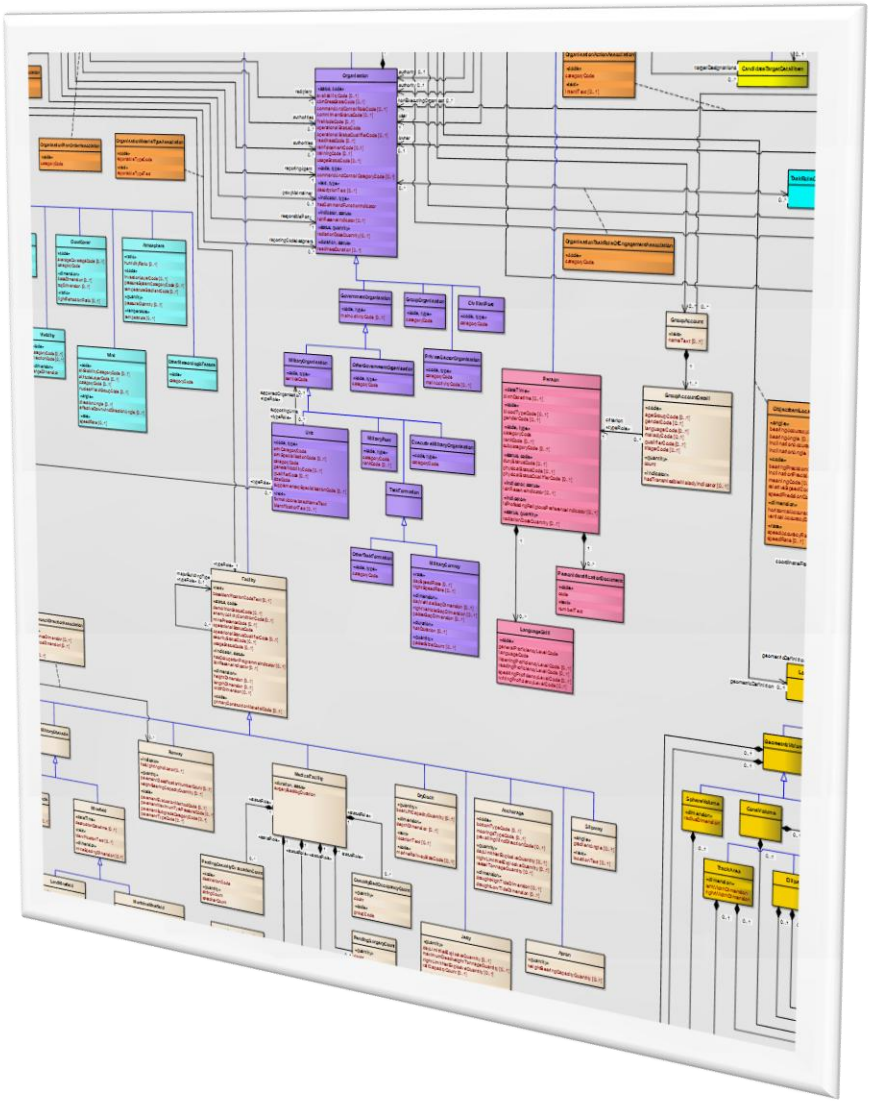
FKIE

History of the MIP Data Model



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

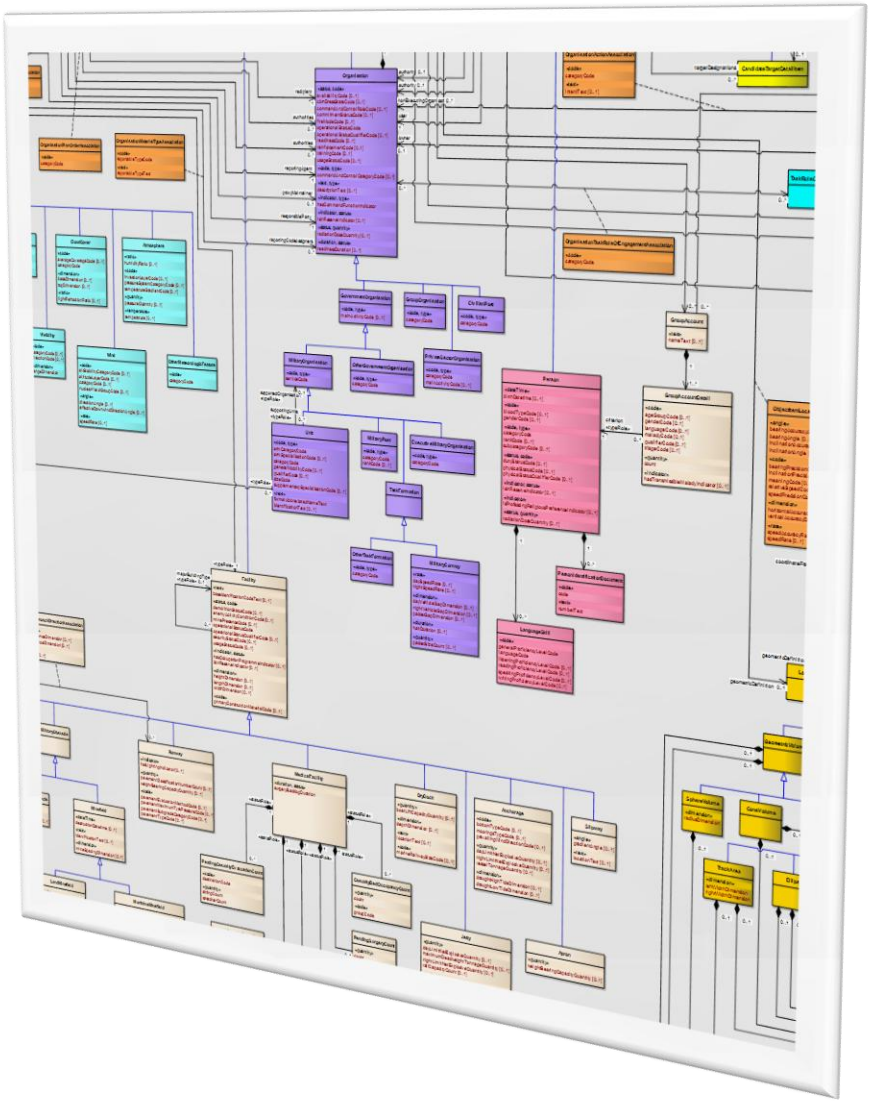


Characteristics of the MIP Information Model

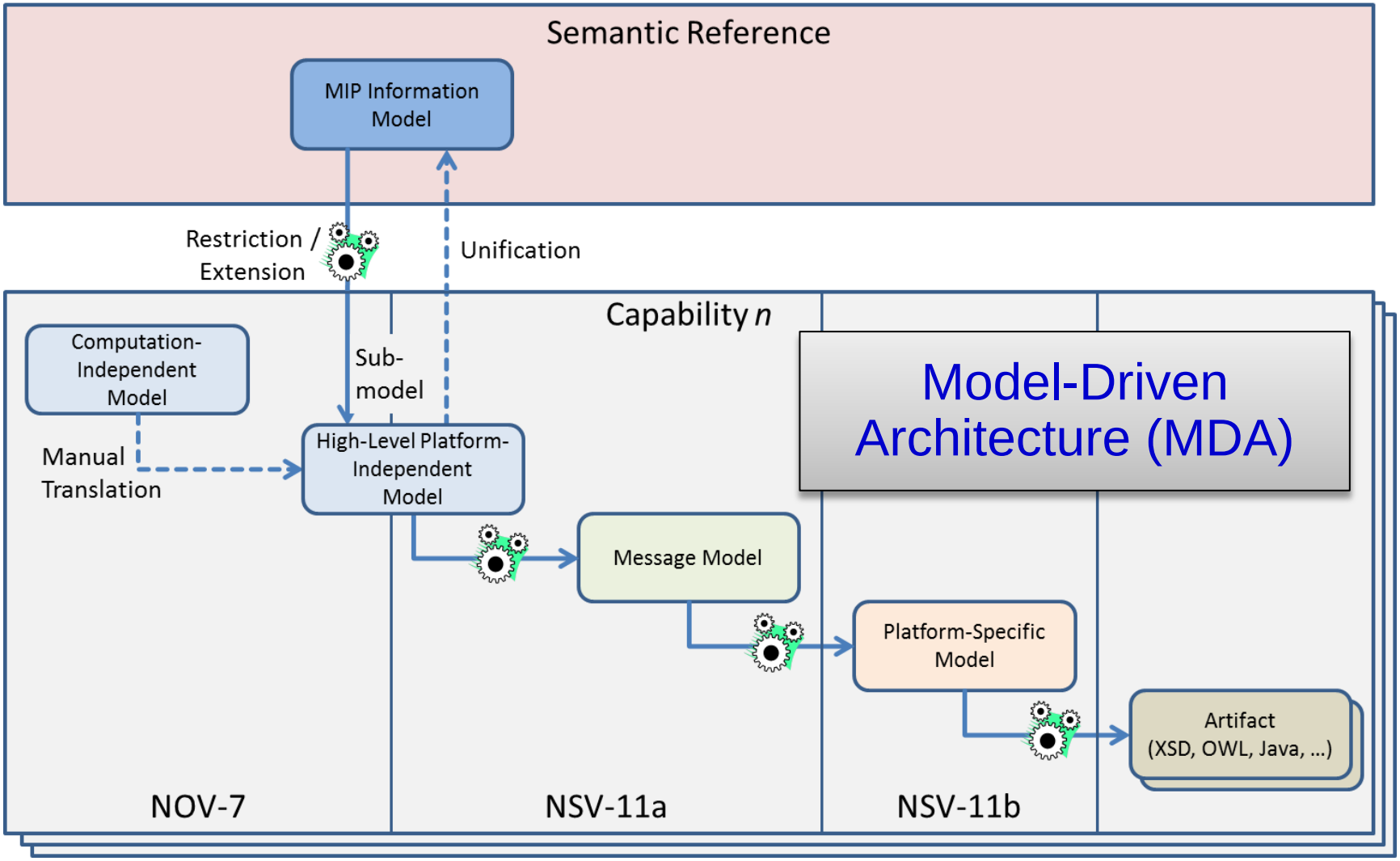
- Platform-Independent
  (not restricted to a specific exchange technology)

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

- Modern Tools
  (Sparx Enterprise Architect,
  Model-Driven Architecture)



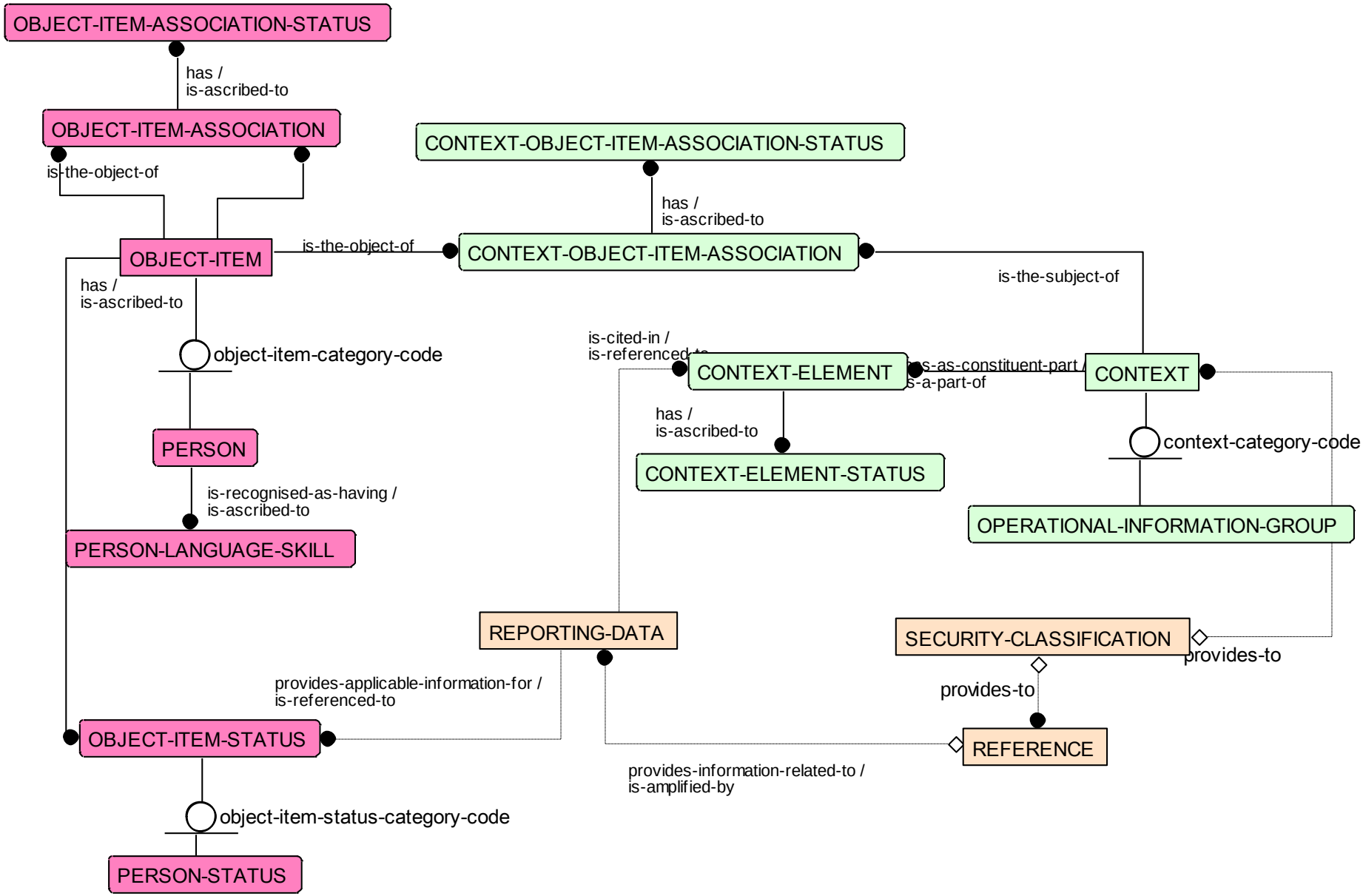
How the MIM Fits in Our Capability-Based Approach



Improvements in Comparison to the JC3IEDM

- 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

JC3IEDM 3.0.2 – Meta Data & Information Groups



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

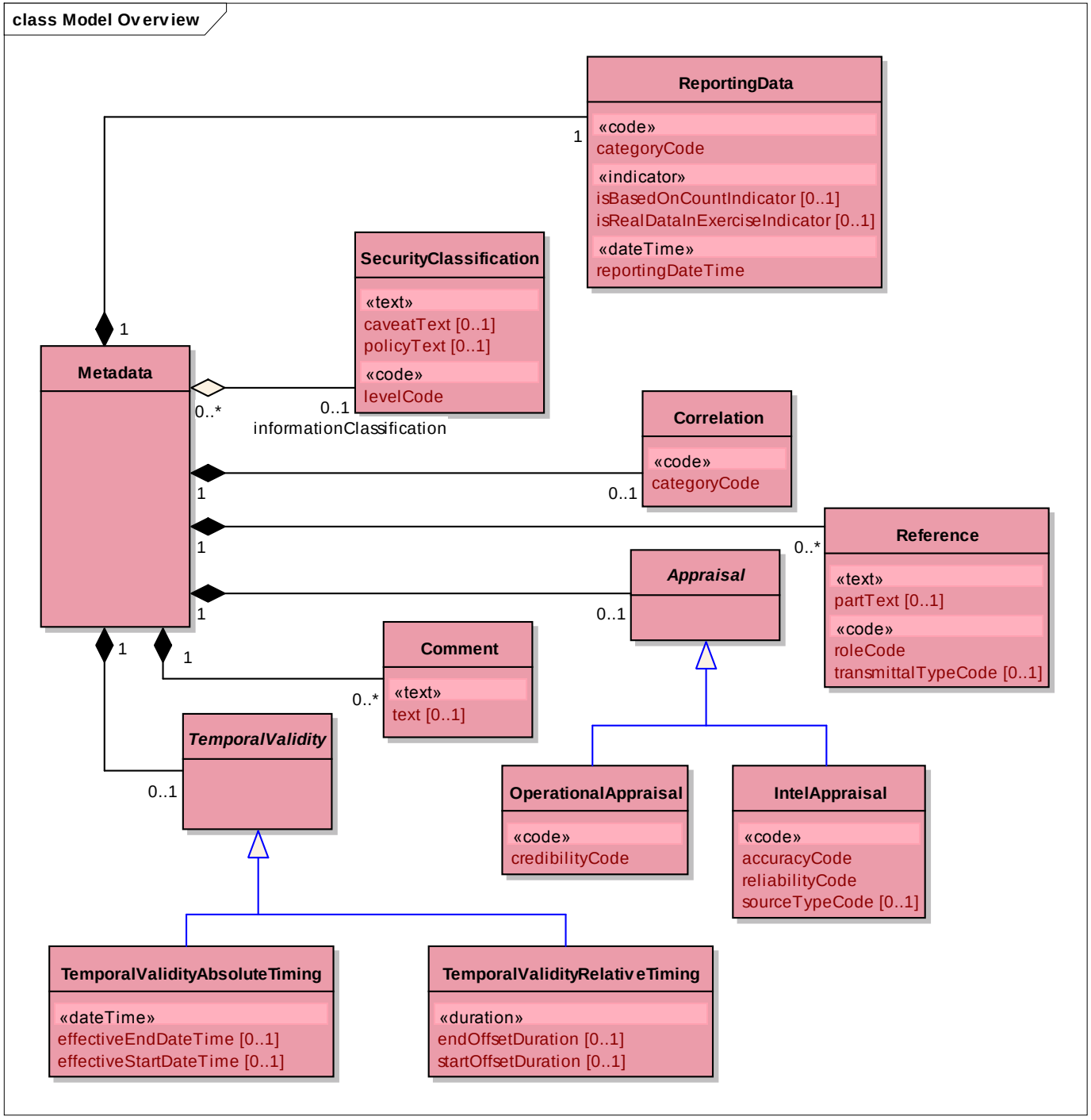
Stateless – no change of objects over time

„Sourceless“ – no contradicting information from different sources

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

➡ Stricter/unambiguous semantics

Meta Data


class Model Overview
ReportingData
«code»
categoryCode
«indicator»
isBasedOnCountIndicator [0..1]
isRealDataInExerciseIndicator [0..1]
«dateTime»
reportingDateTime
1
SecurityClassification
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caveatText [0..1]
policyText [0..1]
«code»
levelCode
1
Metadata
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0..1
informationClassification
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categoryCode
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0..1
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Reference
0..*
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partText [0..1]
«code»
roleCode
transmittalTypeCode [0..1]
Appraisal
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0..1
1
1
Comment
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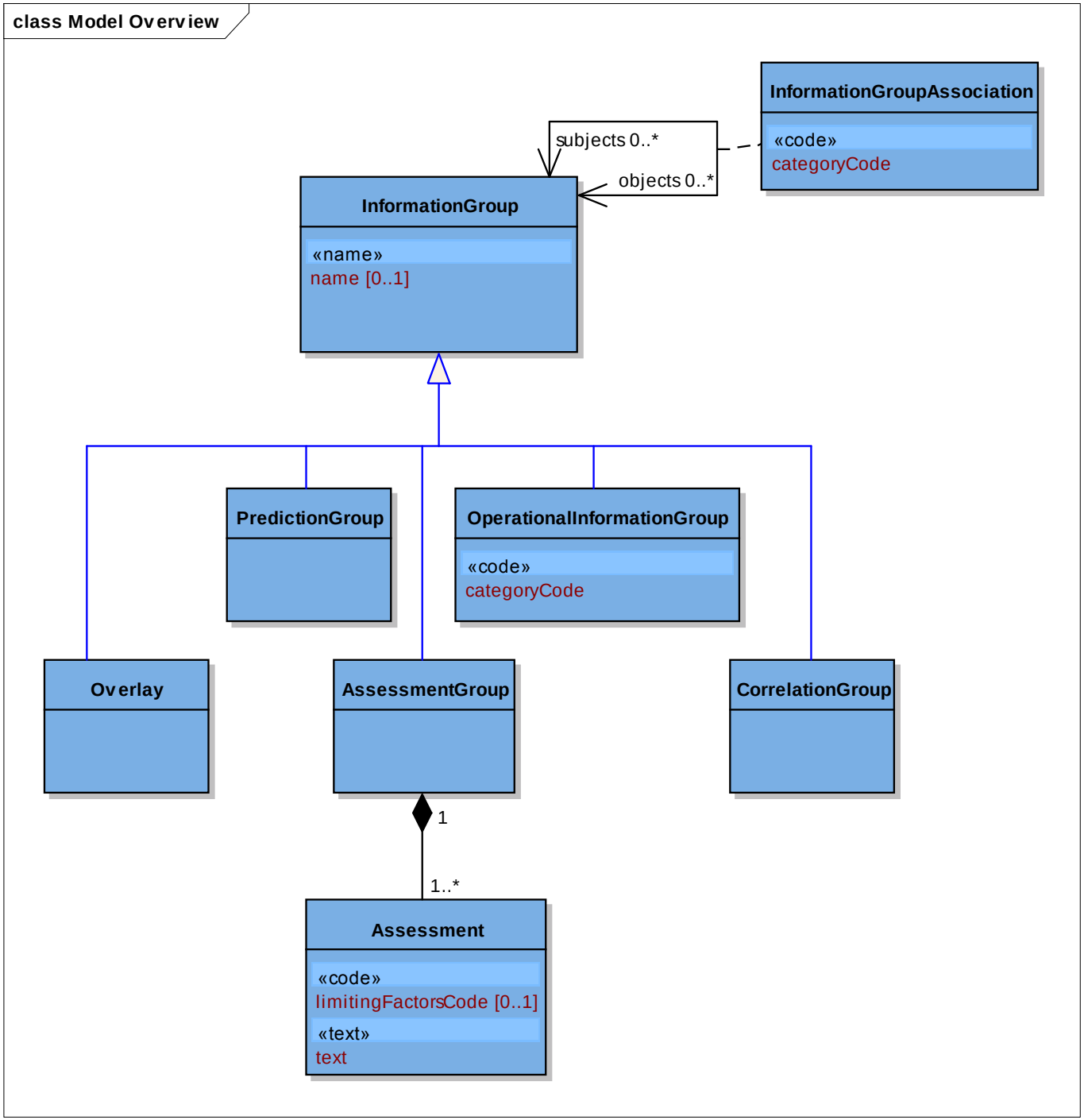
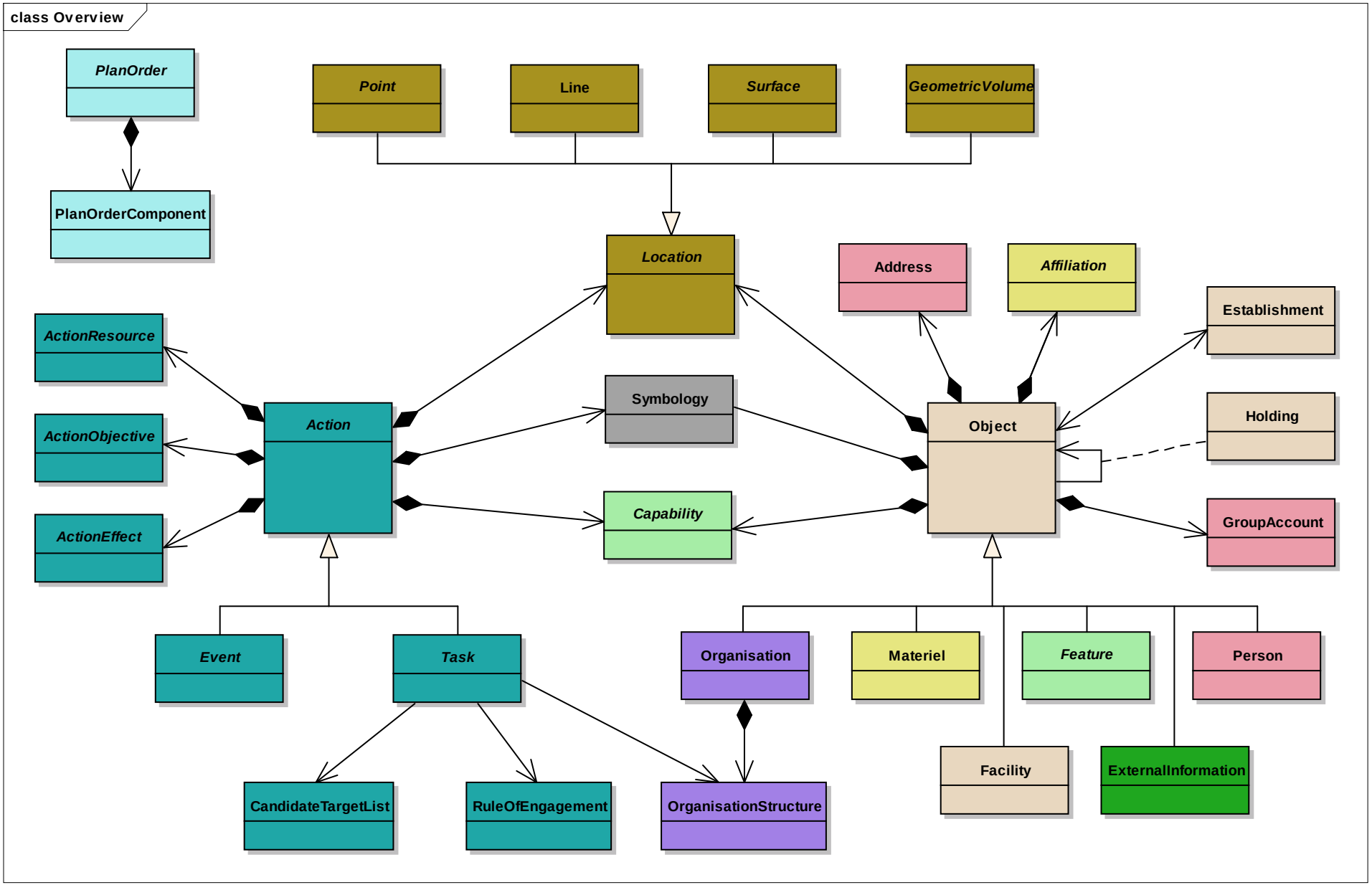
text [0..1]
0..*
TemporalValidity
0..1
OperationalAppraisal
«code»
credibilityCode
IntelAppraisal
«code»
accuracyCode
reliabilityCode
sourceTypeCode [0..1]
TemporalValidityAbsoluteTiming
«dateTime»
effectiveEndDateTime [0..1]
effectiveStartDateTime [0..1]
TemporalValidityRelativeTiming
«duration»
endOffsetDuration [0..1]
startOffsetDuration [0..1]

Information Groups



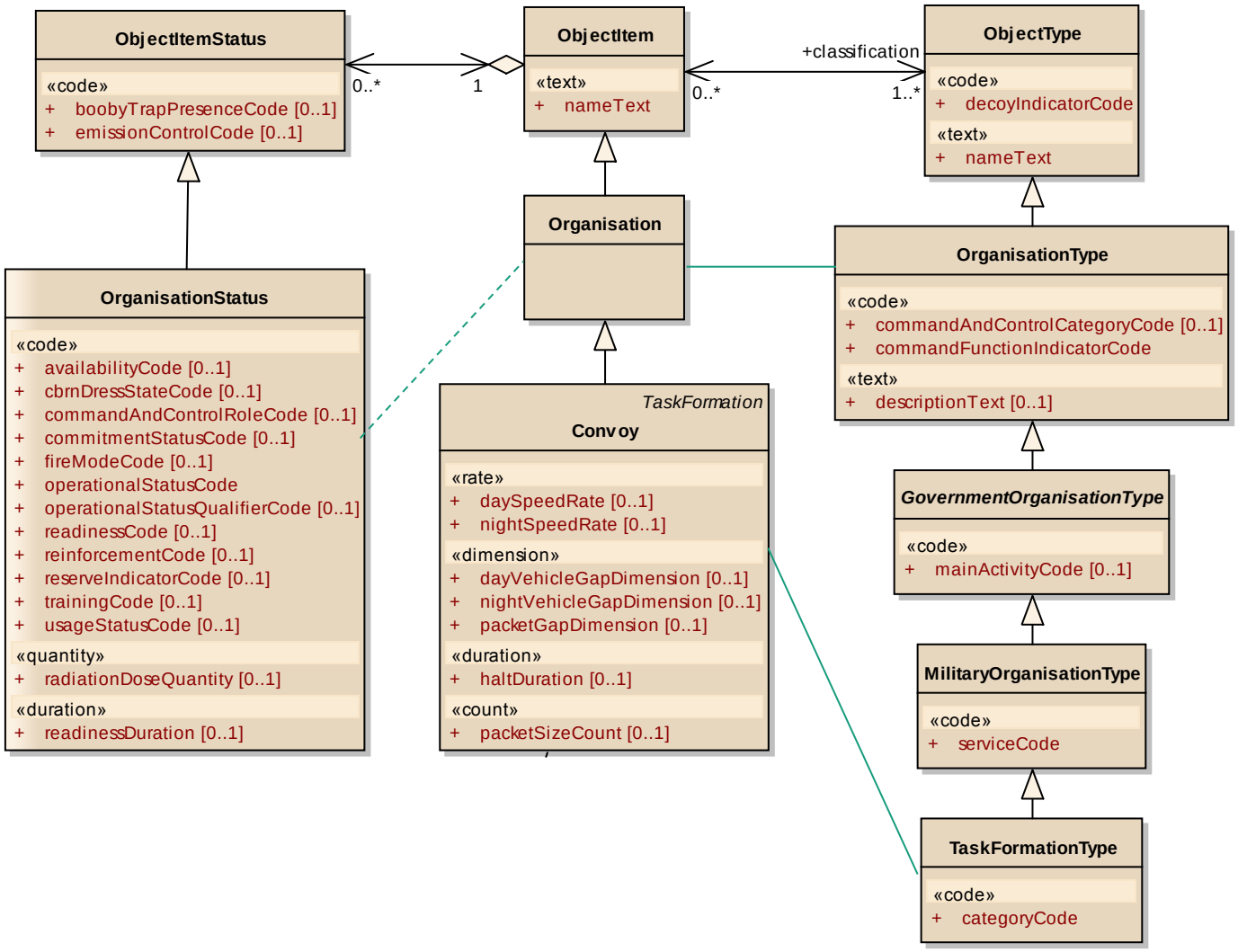
Core Elements



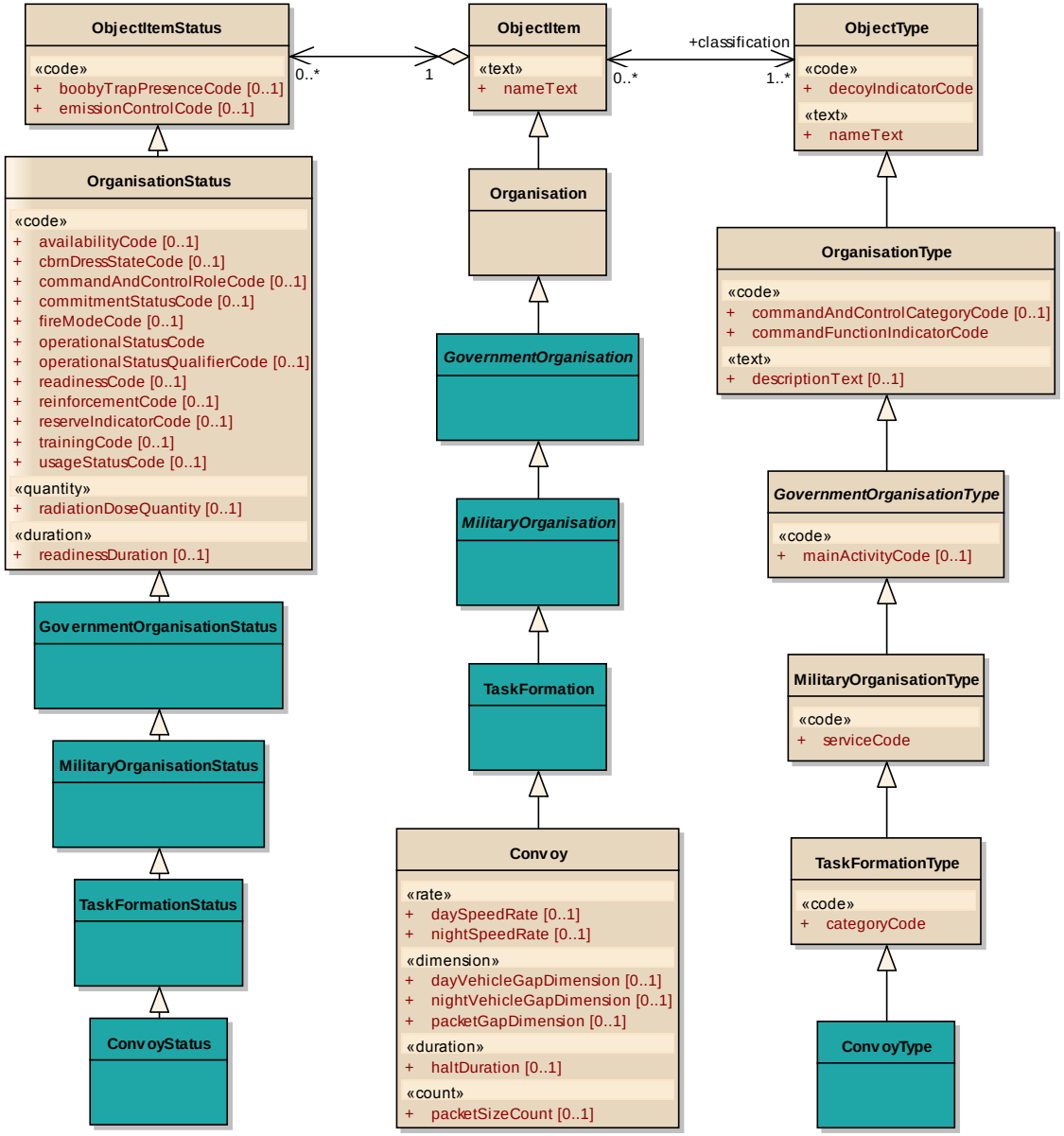
Model Restructuring – Selected examples

- Merging of the three hierarchies
  OBJECT-ITEM, OBJECT-TYPE und OBJECT-ITEM-STATUS
- Resolution/Formalization of business rules
- Rework of Associations

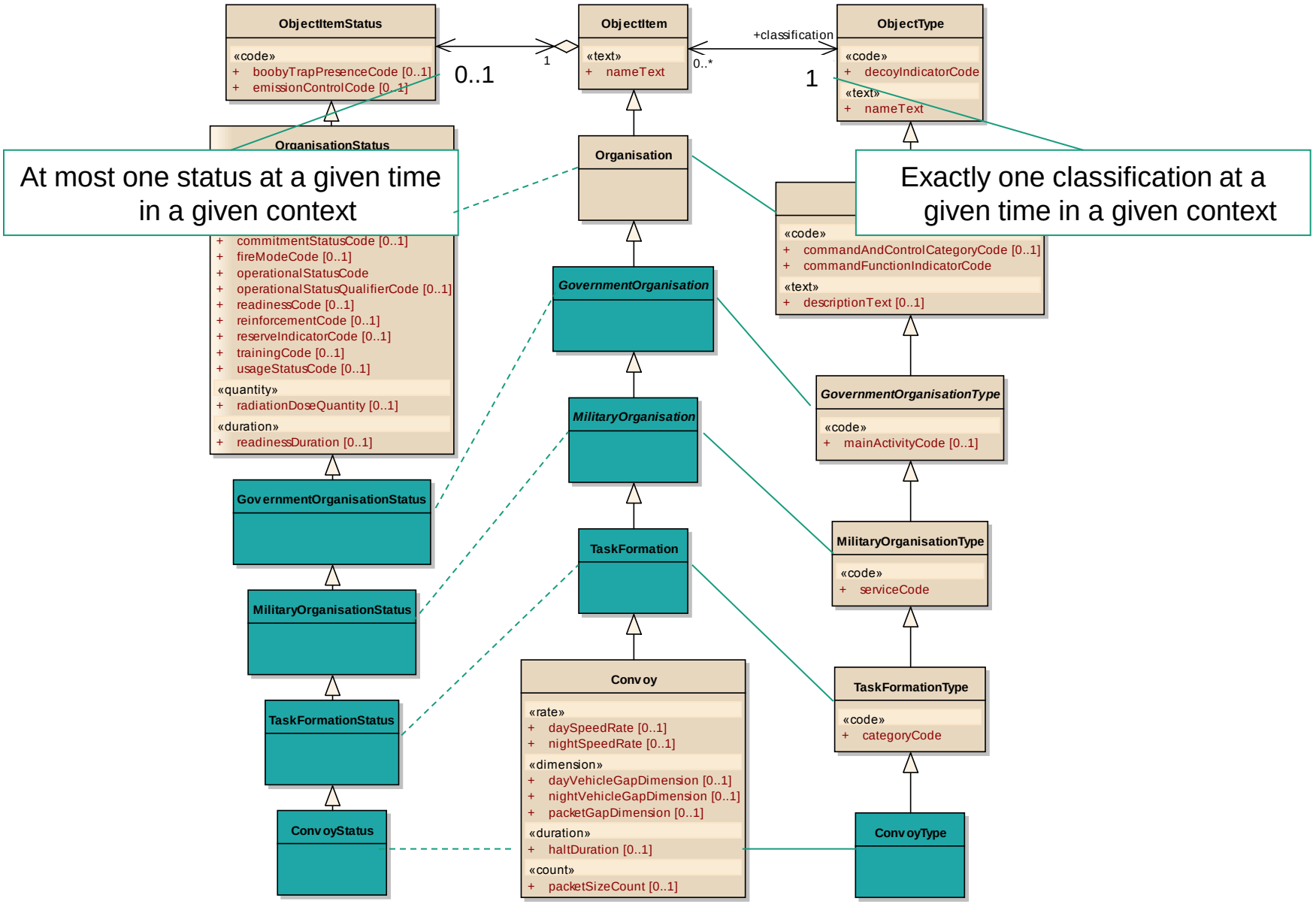
Merging the Object Hierarchies (1)



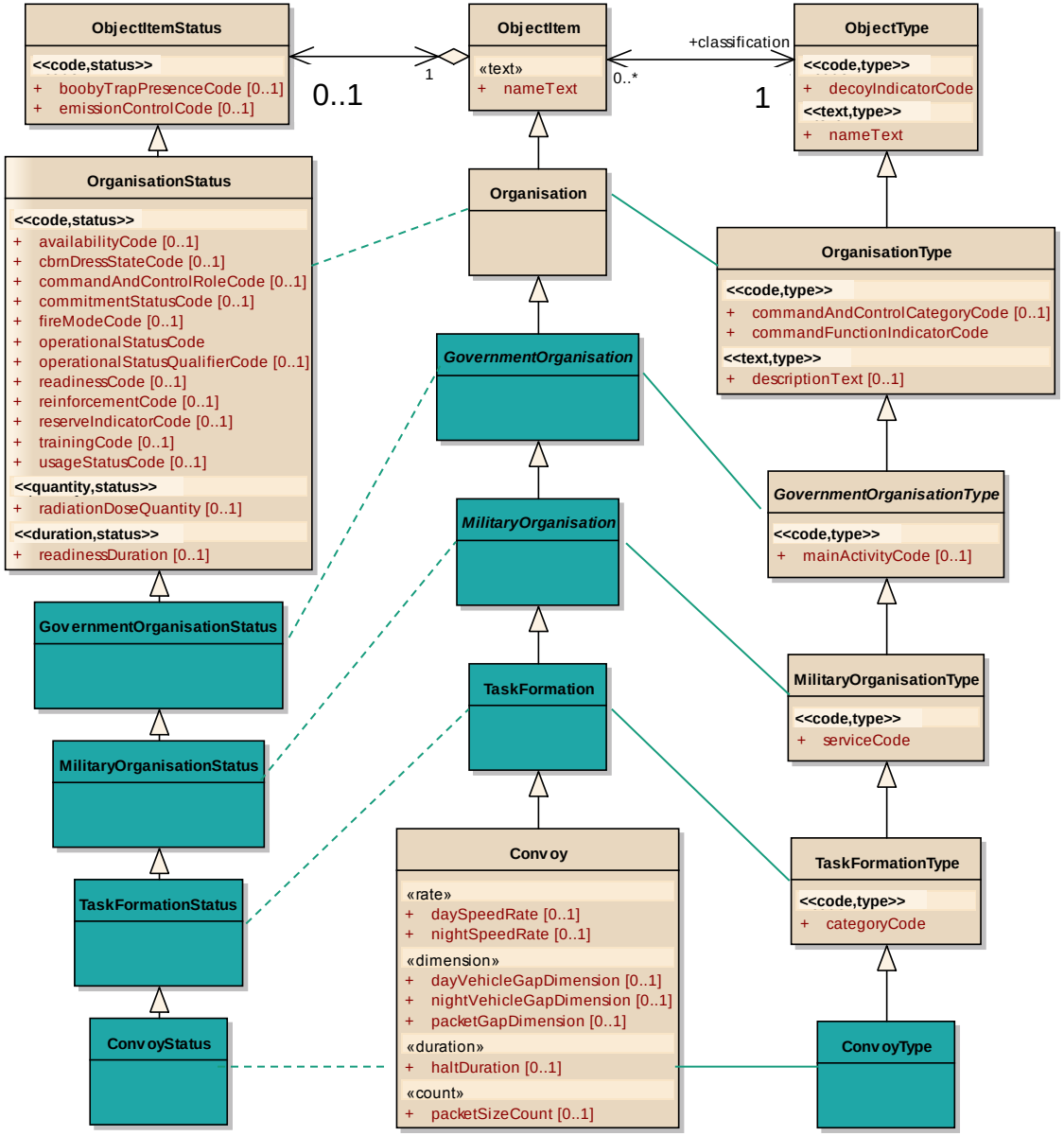
Merging the Object Hierarchies (2)



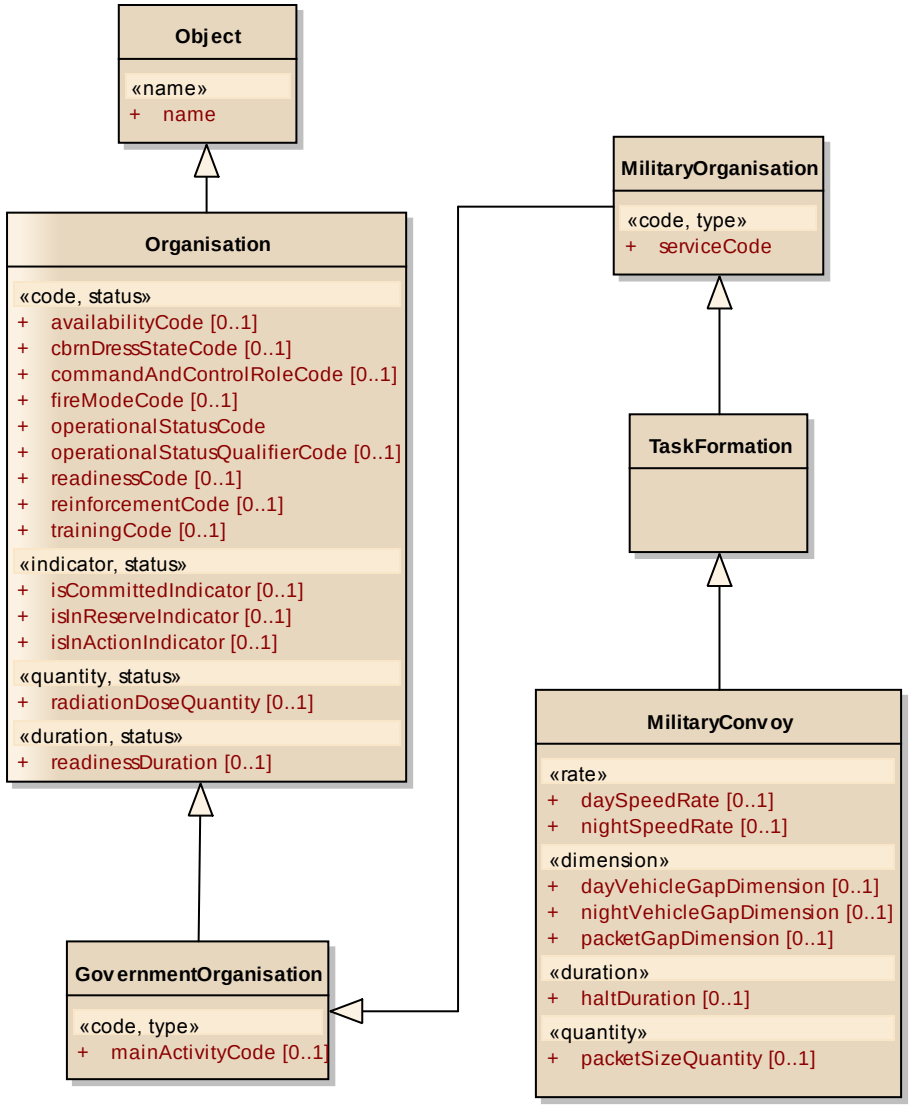
Merging the Object Hierarchies (3)



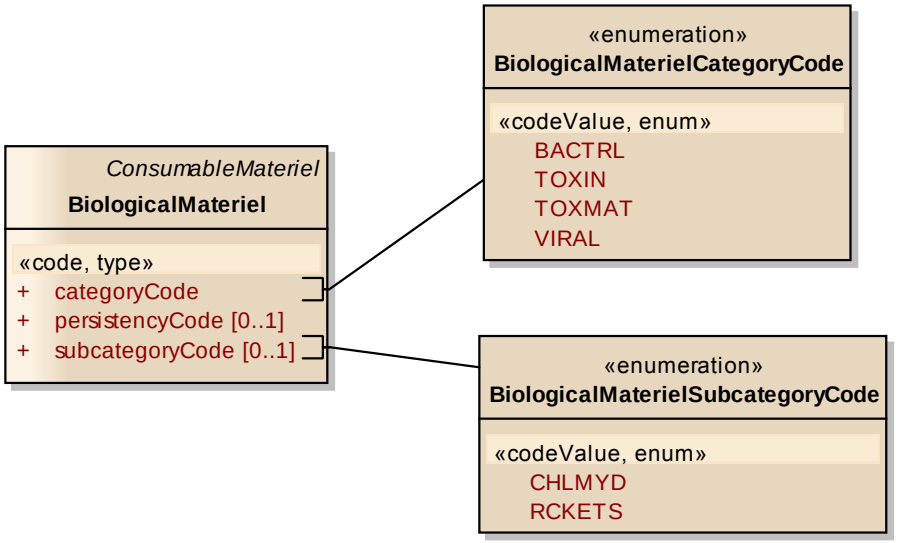
Merging the Object Hierarchies (4)



Merging the Object Hierarchies (5)

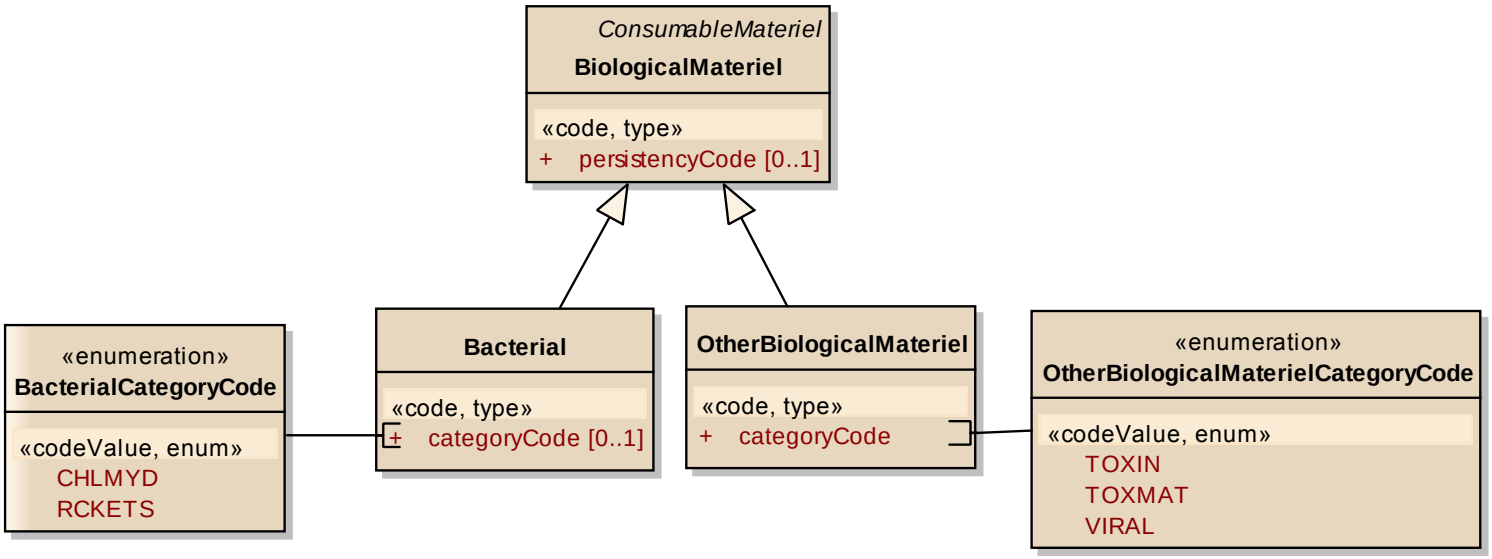


Resolution/Formalization of Business Rules (1)



BiologicalMateriel.categoryCode	BiologicalMateriel.subcategoryCode
Bacterial	Chlamydia Rickettsiae [NULL]
Toxic Industrial Material	[NULL]
Toxin	[NULL]
Viral	[NULL]

Resolution/Formalization of Business Rules (2)

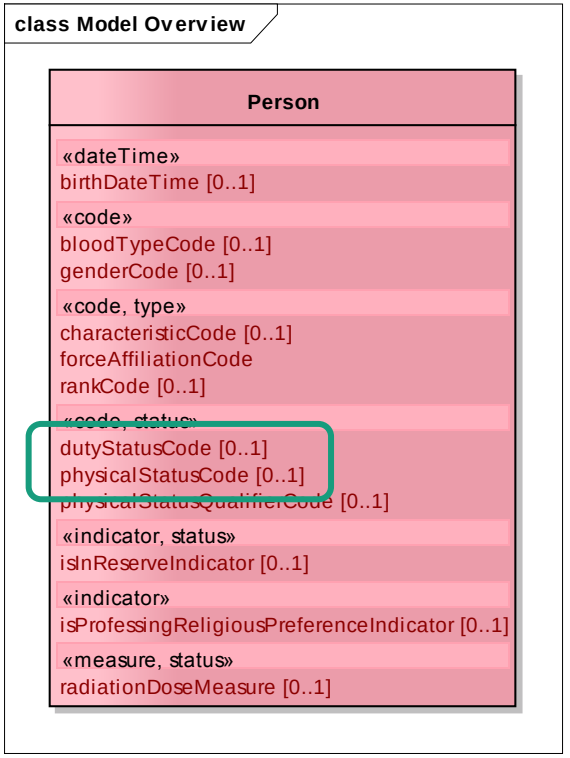


Resolution/Formalization of Business Rules (3)

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

dutyStatusCode_Hospitalised

inv: dutyStatusCode = Enumerations::PersonDutyStatusCode::HSP **implies**
physicalStatusCode.oclIsUndefined() **or**
physicalStatusCode = Enumerations::PersonPhysicalStatusCode::IN **or**
physicalStatusCode = Enumerations::PersonPhysicalStatusCode::IW **or**
physicalStatusCode = Enumerations::PersonPhysicalStatusCode::SI

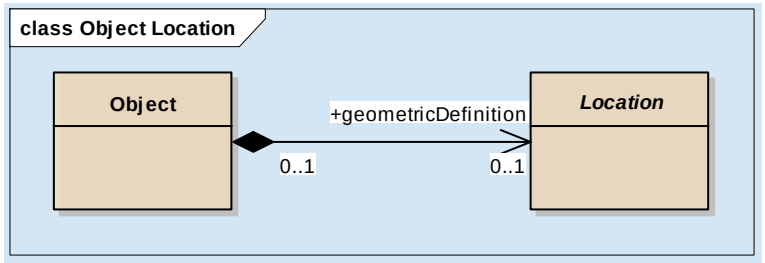


- JC3IEDM 3.1.4: approx. 14,800 MIRD database records
- MIM 1.1: approx. 300 OCL constraints

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)

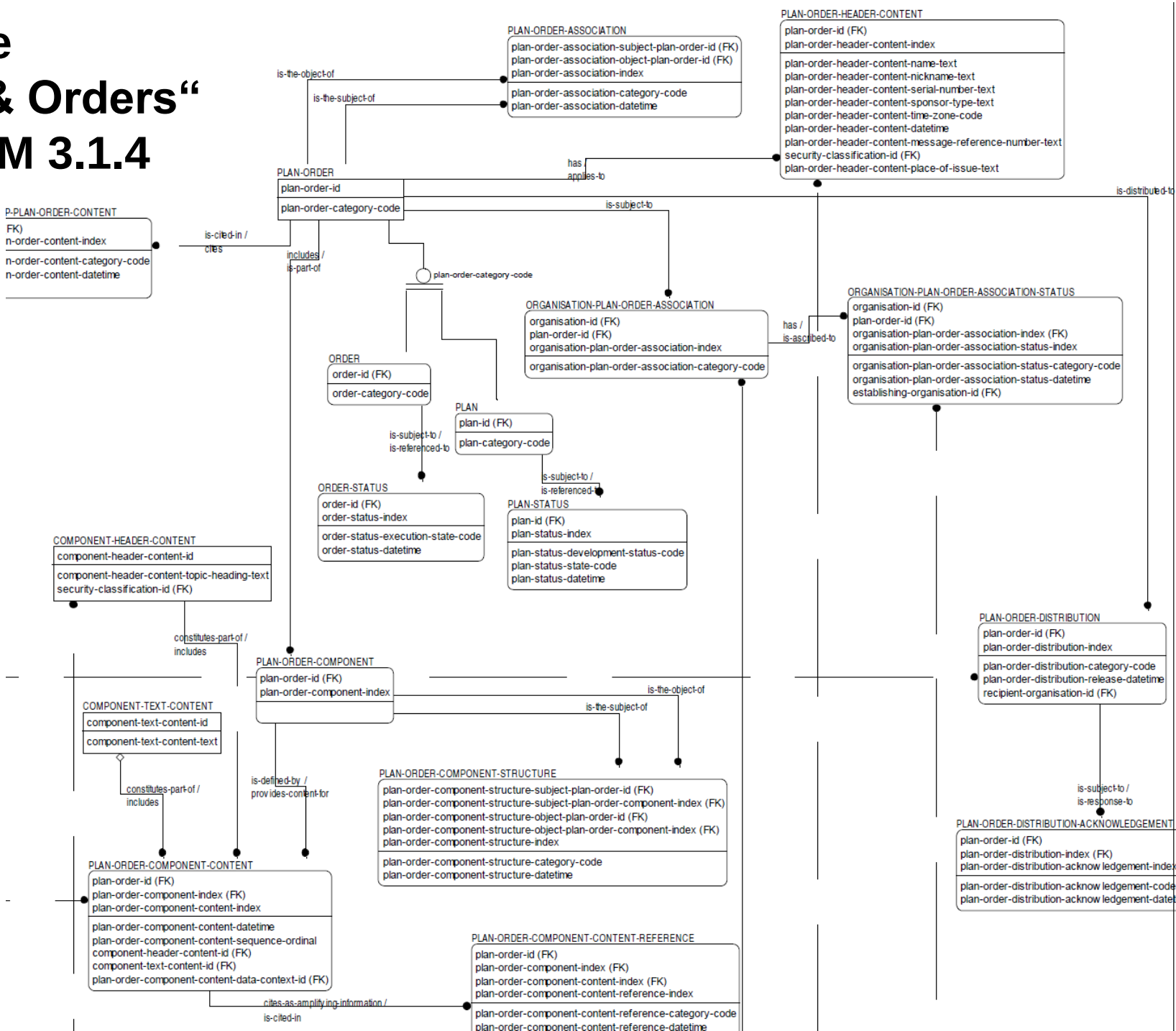
Consistent rework throughout the entire model!



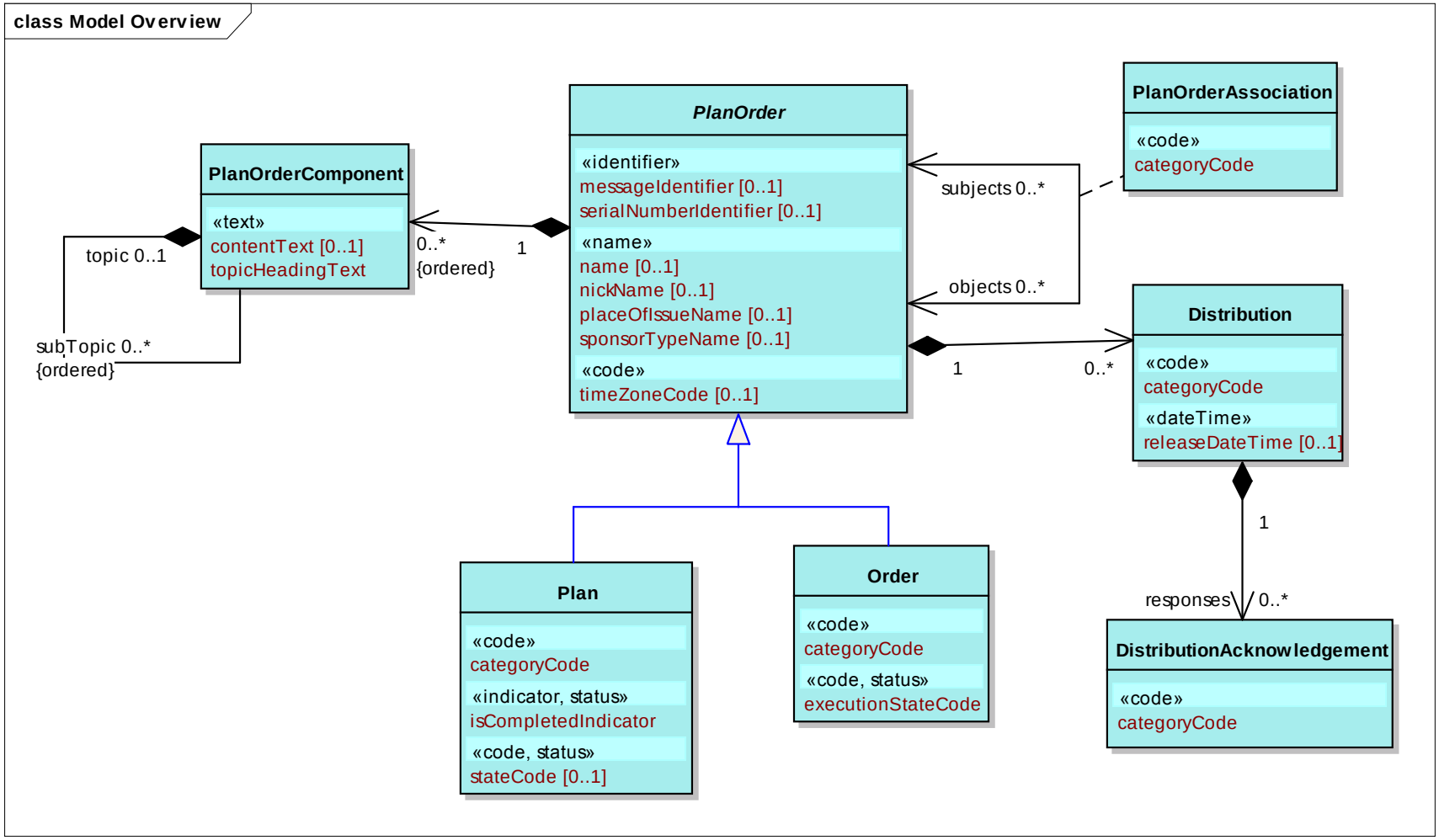
Other Model Restructuring Measures (excerpt)

- 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

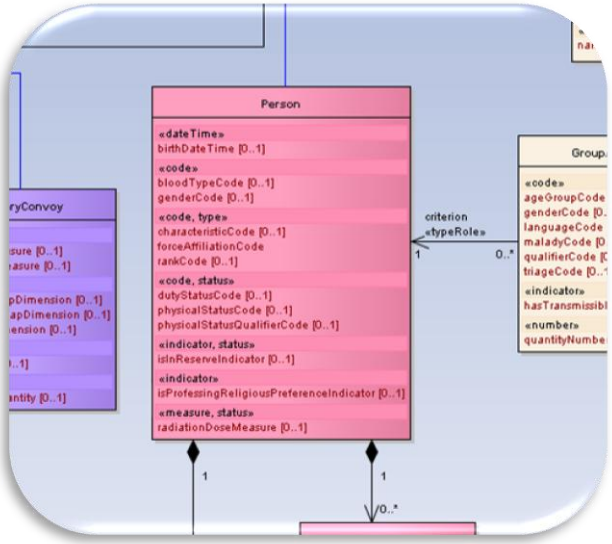


Improved Modeling Process

```
15      <Problem>Enumerations 'MilitaryPostRankCode' and 'PersonRankCode
    enumerations results in redundancy.</Problem>
16      <Changes>This CP drops one of the two enumerations ('MilitaryPostRa
    ('PersonRankCode'). In addition, definitions are adjusted accordingly.</Chan
17    </Description>
18    <FormalContent>
19      <Change xsi:type="ModifyEnumeration">
20        <Class package="Enumerations">PersonRankCode</Class>
21        <NewName>RankCode</NewName>
22        <OldName>PersonRankCode</OldName>
23        <NewDefinition>The military grade that establishes the relative positio
24        <OldDefinition>The military, naval, or civil grade that establishes the re
25      </Change>
26      <Change xsi:type="ModifyMIPAttribute">
```

Modify·Enumeration¤	
	Enumerations::PersonRankCode¤
	~~PersonRankCode~~·RankCode¤
	The·military,~~·naval,·or·civil~~·grade·that·establishes·the·relative·or·status·of·a·Person·in·an·organisation.¤

Modify·MIP·Attribute¤
Classes::Organisation::MilitaryPost.¶ rankCode¤



- 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/
  - 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
  - Follow instructions on the webpage