The Future of the JC3IEDM

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# The Future of the JC3IEDM

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**SUPPLEMENTARY NOTES**
See also ADA564685. 2010 Coalition Battle Management Language Workshop (Atelier 2010 sur le langage de gestion du champ de bataille pour les operations en coalition). RTO-MP-MSG-079

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  - Generalization of concepts

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  - Consistency between sub views of the JC3IEDM

- Summary
Disclaimer

- Concepts and products are based on results from MIP working parties
  - Model-Driven Architecture & MDA Evaluation
  - Future Architecture
  - MIP System Architecture Design

- with contributions from many different people/institutions, e.g.
  - Institute for Defense Analyses (IDA)
  - Fraunhofer FKIE
  - …

- MIP has not yet taken any formal decision on the future of the JC3IEDM
Introduction
“The aim of the Multilateral Interoperability Programme (MIP) is to achieve international interoperability of Command and Control Information Systems (C2IS) at all levels from corps to battalion, or lowest appropriate level, in order to support multinational (including NATO), combined and joint operations and the advancement of digitization in the international arena.”

MIP has approved Baseline 3 in October 2009!
JC3IEDM

- Joint Consultation, Command, and Control Information Exchange Data Model
- NATO ratification as STANAG 5525
- Latest version: JC3IEDM 3.0.2
  - Plans & Orders, ATO, MMW, CBRN, …

- Complex data model based on generic core concepts
- Entity relationship model
- Semantic definitions
  - Business Rules
  - Free-text documentation
Configuration Management of the JC3IEMDM
Motivation

- JC3IEDM has been transformed from a small, generic hub into a comprehensive data model
  - LC2IEDM 2.2 (MIP Baseline 1): 149 entities
  - JC3IEDM 3.0.2 (MIP Baseline 3): 273 entities

- Growing size and complexity results in configuration management challenges

- Tracking and applying changes is laborious

- Entity-Relationship model in IDEF1X is platform-specific
  - Database concepts, e.g., key attributes, discriminator codes for sub-typing
  - Not perfectly suited to other application areas
Consistency of Different Products

G1.3.1 Rule for minefield-destruction-datetime

For the instances where the MINEFIELD is a MINEFIELD-LAND, then the minefield-destruction-datetime is filled only where minefield-land-persistence-code is “Remote activated destruction” or “Timed automatic destruction”. 

Business Rules

Examples

<table>
<thead>
<tr>
<th>organisation-type</th>
<th>category-code</th>
<th>command-function-indicator-code</th>
<th>command-and-control-category-code</th>
<th>description-text</th>
</tr>
</thead>
<tbody>
<tr>
<td>GOVERNMENT-ORGANISATION-TYPE</td>
<td>yes</td>
<td></td>
<td></td>
<td>Headquarters</td>
</tr>
<tr>
<td>GOVERNMENT-ORGANISATION-TYPE</td>
<td>yes</td>
<td></td>
<td></td>
<td>Executive military organisation</td>
</tr>
<tr>
<td>GOVERNMENT-ORGANISATION-TYPE</td>
<td>yes</td>
<td></td>
<td></td>
<td>Executive military organisation</td>
</tr>
</tbody>
</table>

Metadata (MIRD)

Documentation
Platform-Independent Model (PIM)

- Platform-independent model
  - Remove platform-specific elements
  - Improved comprehensiveness
  - Use generators to derive platform-specific models

- Unified Modeling Language (UML)
  - Great acceptance among software developers
  - Excellent tool support
  - Recommended by NATO Architecture Framework (NAF)
Model-Driven Architecture (MDA)

JC3IEDM
(Platform-independent model – PIM)

Generators

- Exchange Formats (XSD, RDFS, OWL, …)
- Documentation (HTML, Word, …)
- Database Schemas (SQL)
- Software Code (Java, C++, .NET, …)

Platform-specific models (PSMs)
Formalization of Business Rules

- **Object Constraint Language (OCL)**
  - Rules can be validated against the JC3IEDM (statically)
  - Rules can be evaluated by a MIP gateway/C2IS (dynamically at run-time)

```ocl
/* G1.4.1 Part b */
context ObjectItem
inv:
  (self.oclIsKindOf(GeographicFeature) or
   self.oclIsKindOf(MeteorologicFeature))
  implies
  self.has_hostility_status->size() = 0
```
Documentation with DocDB

- JC3IEDM documentation in structured format (annotations)
- Supports consistency checks against the UML PIM

7. STATUS OF IDENTIFIABLE OBJECTS

This chapter deals with a general requirement of specifying the status of items at a given time (past, present, or predicted). The main topics include:

a. Classifying the hostility state of an ObjectItem.
   b. Assigning categories to ObjectItem to capture administrative, medical, physical, and procedural states or conditions.

Section 7.1 provides the specifications for hostility status. Section 7.2 is a general introduction to ObjectItemStatus and its subtypes. Section 7.3 specifies the details for recording the status of all ObjectItems with the exception of MedicalFacilityStatus that is the subject of Section 7.4. The chapter ends with Section 7.5 that provides a cross-reference to the applicable business rules that are listed in Annex G2.

7.1 ObjectItemHostilityStatus

7.1.1 Most objects of the battlefield can be characterised as friend or enemy. This information is not inherent to the specific object. The hostility status of an object is a classification that a specific organisation gives to this object. It means that a specific object may have different hostility status given by different organisations, and that the hostility status may vary with time. The known or perceived friendly or aggressive intentions of an object are recorded in the entity ObjectItemHostilityStatus whose structure is illustrated in the figure below.
Improved Change Management

Problem:
- Change Proposals (CPs) are provided as semi-structured Word documents
- Approved CPs must be applied manually to the JC3IEDM by a core group of experts
- National/COI-specific extensions are inadequately tracked

Solution: Formal technical CPs
- Atomic operations (e.g., add new attribute, modify domain value)
- Meta information inspired by NATO Discovery Metadata Specification (NDMS)
- CPs are tracked in the model itself
  - Early validation of CPs
  - Automatic processing of CPs
PIM Restructuring
Motivation

- Resolve well-known problems/workarounds, e.g.,
  - Deletion/update of information
  - Grouping of information
  - Archiving

- Make the model independent from a specific exchange mechanism

- Generalize existing concepts

- Provide a sound basis for the definition of capability-specific sub-models
Logical Layers in the Data Model

- Core Modeling Layer
  (Information & Information Group Concepts)
- Metadata Layer
- Staff Objects Layer
  (Grouping and Manipulating Objects)
- Battlefield Objects Layer
  (Granular Objects)
Core Modelling Layer

class Layer Core Modelling

| «cls» ObjectIdentification |
| + identifier: String |

| «cls» Information |
| + State |
| describesAnEvolutionaryStateOf |
| 0..1 |
| 1..* |

| «cls» InformationElement |
| + SuperGroup 0..* |
| is Included In |
| 0..* |

| «cls» InformationGroup |
| + nameText: String |
| + SubGroup 0..* |
| is Included In |
| 0..* |
Metadata Layer

class Layer Metadata

- Information
  - ReportingData
  - TemporalValidity
    - TemporalValidityAbsoluteTiming
    - TemporalValidityRelativeTiming
  - EvaluationData
  - IntelQuotation
  - Context
- Metadata
  - Comment
  - GenericMetadata
  - SecurityClassification
  - Reference

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Staff Objects Layer
Battlefield Objects Layer

- Only `ObjectInformation` are linked to an information group.
- Value objects such as `Location` and `Status` are linked implicitly.
- `ReportingData` is no longer abused for grouping.
Modularization
Motivation

- Faster response to user requirements
  - From operational requirement to the field
- Keep existing information exchange services stable

- Incremental delivery of independent capabilities
- Modular interoperability solution

- Complete specification of information exchange capabilities
  - Data modeling is considered part of the overall modeling process!
  - NATO Architecture Framework
    - Operational Views
    - Service Views
    - System View
Business Models

- **Interface Specification**
  - Conceptual Business Model (UML)
  - Logical Business Model (UML)
  - Physical Business Model (XML / DEMS)

**Computation-independent models** (CIM)

**Platform-independent models** (PIM)

**Platform-specific models** (PSM)

**Logical JC3IEDM** (UML)

**Physical JC3IEDM** (DDL)

- Interface Specification maps onto Logical Business Model
- Logical Business Model maps onto Logical JC3IEDM
- Physical Business Model is storeable in Physical JC3IEDM
Data Management Challenges

- New business models may require extensions/changes to the JC3IEDM
- Changes to the JC3IEDM may have impact on existing business models
  ➔ Need for impact analysis (configuration management, versioning, …)
- Proposed solution: Define business models by transformation scripts
Interoperability Based on Monolithic Model

Operational Requirement / Feedback

Data Modellers

\[ + \text{CP} \Rightarrow \text{JC3IEDM} = \text{JC3IEDM}' \]

NATION A

NATIONAL C2IS (A)

INTERNATIONAL MIP SOLUTION (Lingua Franca)

NATION B

NATIONAL C2IS (B)

Specifications

SOPs

Documents (MIP)
Interoperability Based on Business Models

Operational Requirement / Feedback

Data Modellers CP

JC3IEDM = JC3IEDM'

NATION A

NATIONAL C2IS (A)

NATIONAL C2IS (B)

INTERNATIONAL MIP SOLUTION (Lingua Franca)

Specifications

SOPs

Documents (MIP)

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Summary
Summary (1)

- Improved configuration management
  - UML platform-independent model of the JC3IEDM 3.0.2
    - Available in Sparx Enterprise Architect format
    - Semantically equivalent to ER model
  - PSM generators available for XSD, OWL, SQL, Java
  - CPProcessor for automatic processing of change proposals
  - Unofficial web site: http://mda.cloudexp.com/

- PIM Restructuring
  - Concept proposal addresses issues, constraints, and workarounds
  - Semantics of the JC3IEDM operational concepts is basically maintained
  - Technical CPs currently under development
Summary (2)

- Modularization
  - Supports incremental delivery of new capabilities/services
  - Smaller, but clearer specified capabilities
  - Data modelling is not an isolated task
  - Clear traceability to individual capabilities/services
  - No data modelling for the sake of it!
  - JC3IEDM is used as a semantic reference

- Potential collaboration between MIP and C-BML community
  - Provide feedback on operational & structural aspects
  - Identify relevant subview of the JC3IEDM
  - Harmonization of IERs by NATO APP-15?
Thank you for your attention!