The Future of the JC3IEDM

Dr. Michael Gerz
michael.gerz@fkie.fraunhofer.de

NATO Modelling & Simulation Group MSG-079
2010 C-BML Workshop
Farnborough, UK – 25 February 2010

Fraunhofer FKIE

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
FEB 2010	**N/A**	**-**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
The Future of the JC3IEDM	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Fraunhofer.FKIE**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release, distribution unlimited

13. 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

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			
unclassified	**unclassified**	**unclassified**	**SAR**	**32**	

Table of Contents

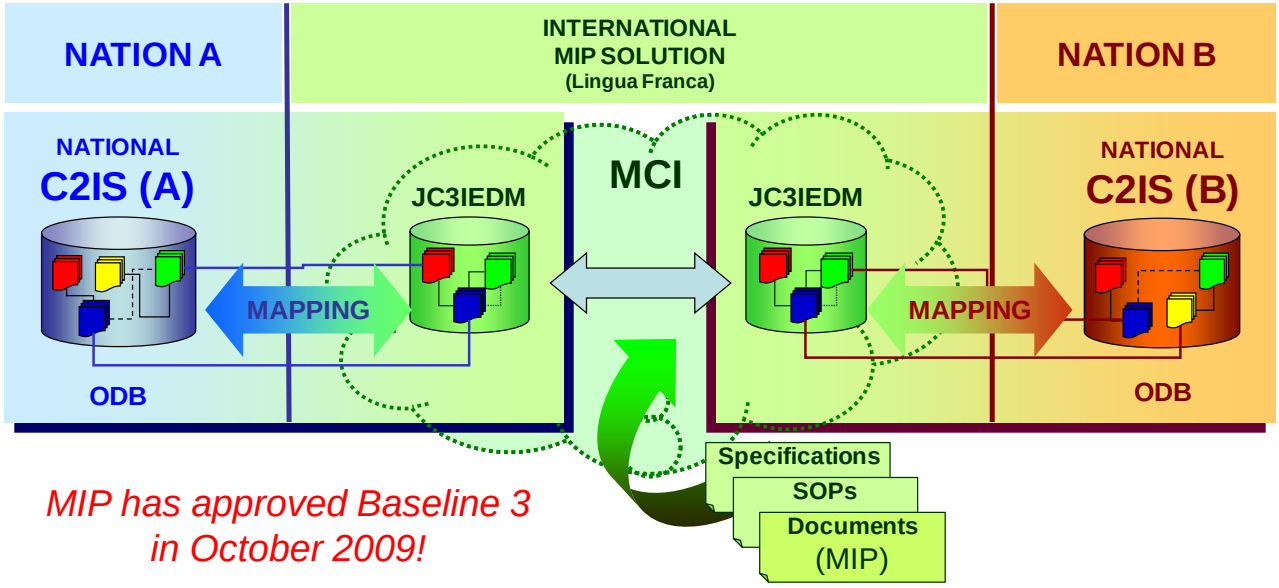
Disclaimer

- 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

Multilateral Interoperability Programme

"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."

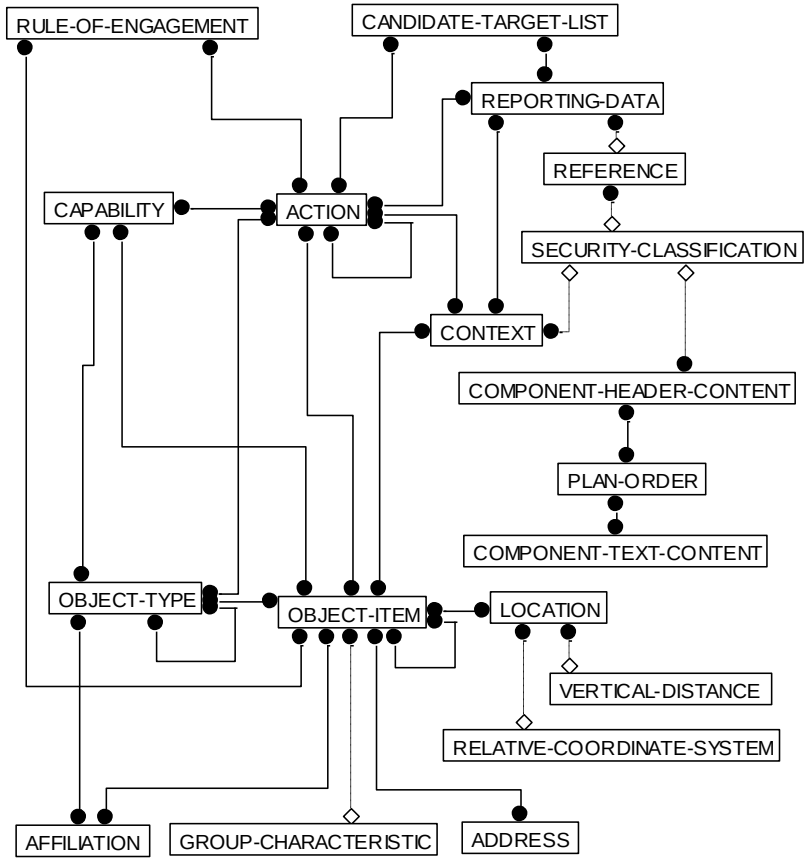


MIP has approved Baseline 3 in October 2009!

Fraunhofer FKIE

JC3IEDM

- **J**oint **C**onsultation, **C**ommand, and **C**ontrol **I**nformation **E**xchange **D**ata **M**odel
- 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



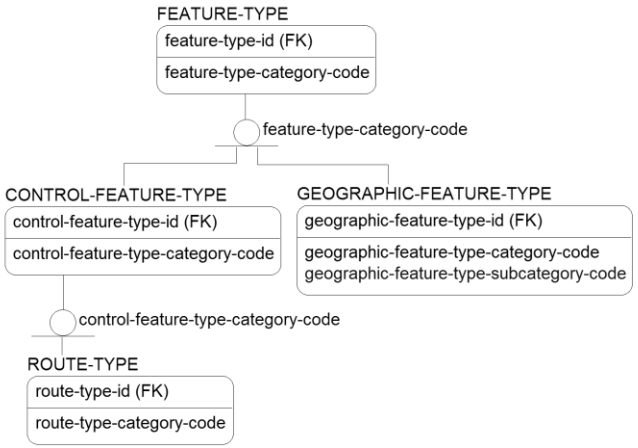
Fraunhofer FKIE

Configuration Management of the JC3IEDM

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



Logical/physical data model

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

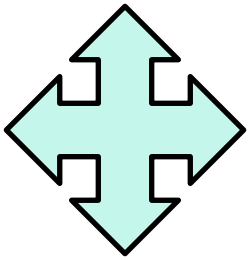


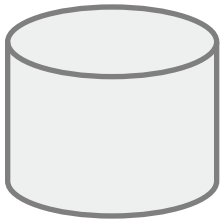
Table 42. Examples of EXECUTIVE-MILITARY-ORGANISATION-TYPE

(a) ORGANISATION-TYPE

organisation-type-id	*-category-code	*-command-function-indicator-code	*-command-and-control-category-code	*-description-text
12345631	GOVERNMENT-ORGANISATION-TYPE	Yes	Headquarters	Executive military organisation
12345632	GOVERNMENT-ORGANISATION-TYPE	Yes	Headquarters	Executive military organisation
12345633	GOVERNMENT-ORGANISATION-TYPE	Yes	Headquarters	Executive military organisation

Note: * = "organisation-type"

Examples



Metadata (MIRD)

Domain Name	absolute-point-category-code
Definition	The specific value that represents the class of ABSOLUTE-POINT with respect to the reference frame.
Source	MIP-NDAG

Domain Values

Value	Definition	Source	Physical Value	Identifier
CARTESIAN-POINT	An ABSOLUTE-POINT that has its position specified in a three-dimensional Earth-centred Cartesian system.	MIP-NDAG	CARTPT	1000001
GEOGRAPHIC-POINT	An ABSOLUTE-POINT that has its position specified with respect to the surface of the World Geodetic System 1984 (WGS 84) ellipsoid.	MIP-NDAG	GEOGPT	1000002

Usage

Entity	Attribute	Opt
ABSOLUTE-POINT	absolute-point-category-code	MA

Documentation

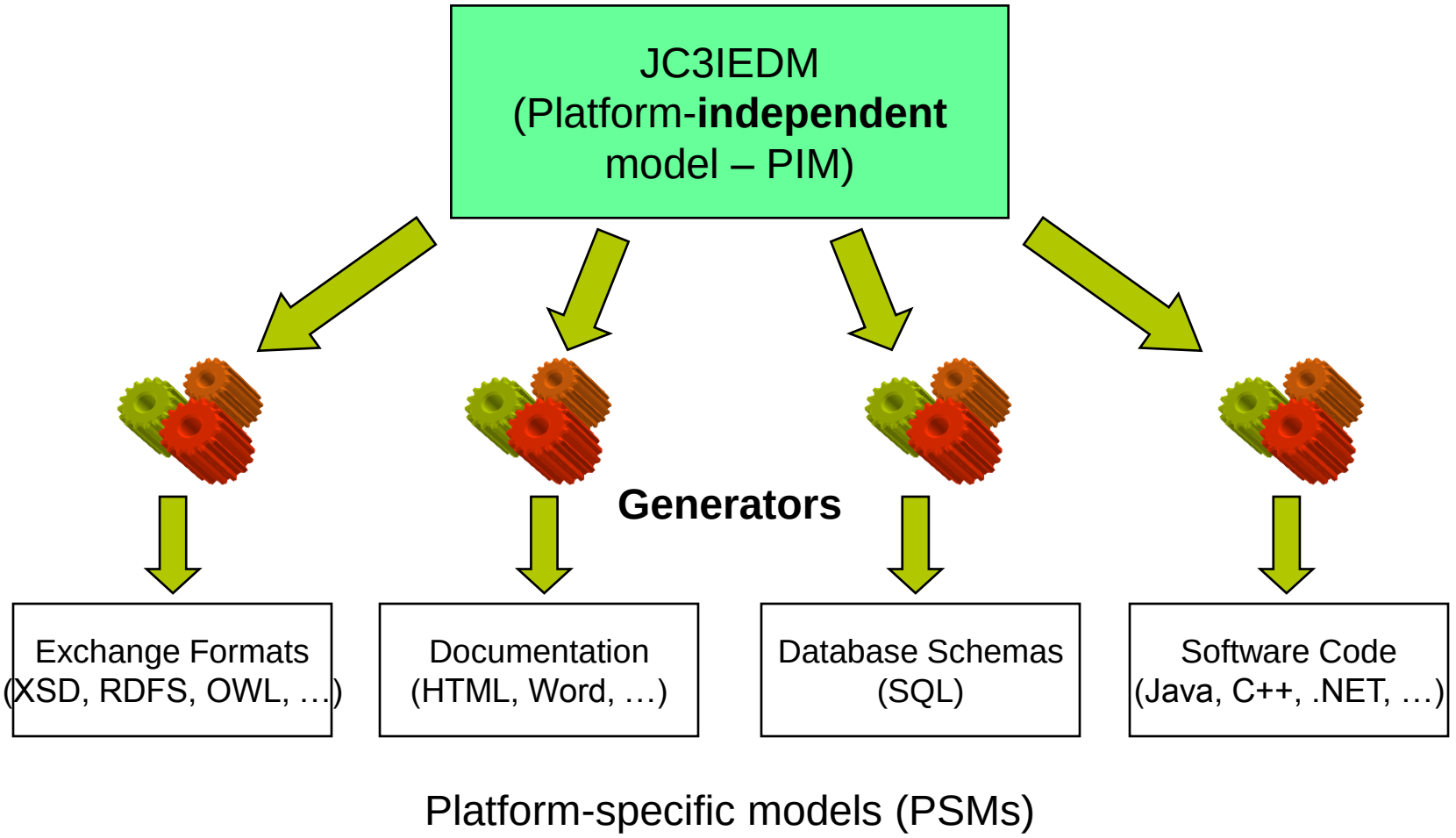
Fraunhofer FKIE

Platform-Independent Model (PIM)

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

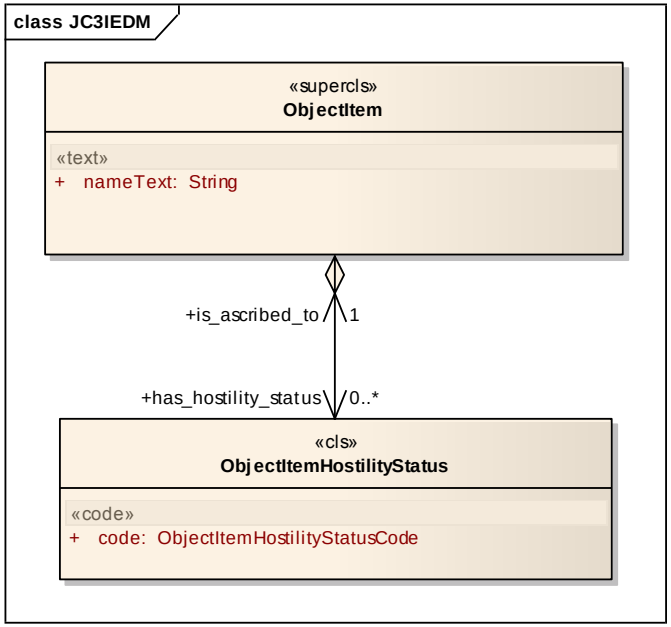
- Unified Modeling Language (UML)
  - Great acceptance among software developers
  - Excellent tool support
  - Recommended by NATO Architecture Framework (NAF)

Model-Driven Architecture (MDA)



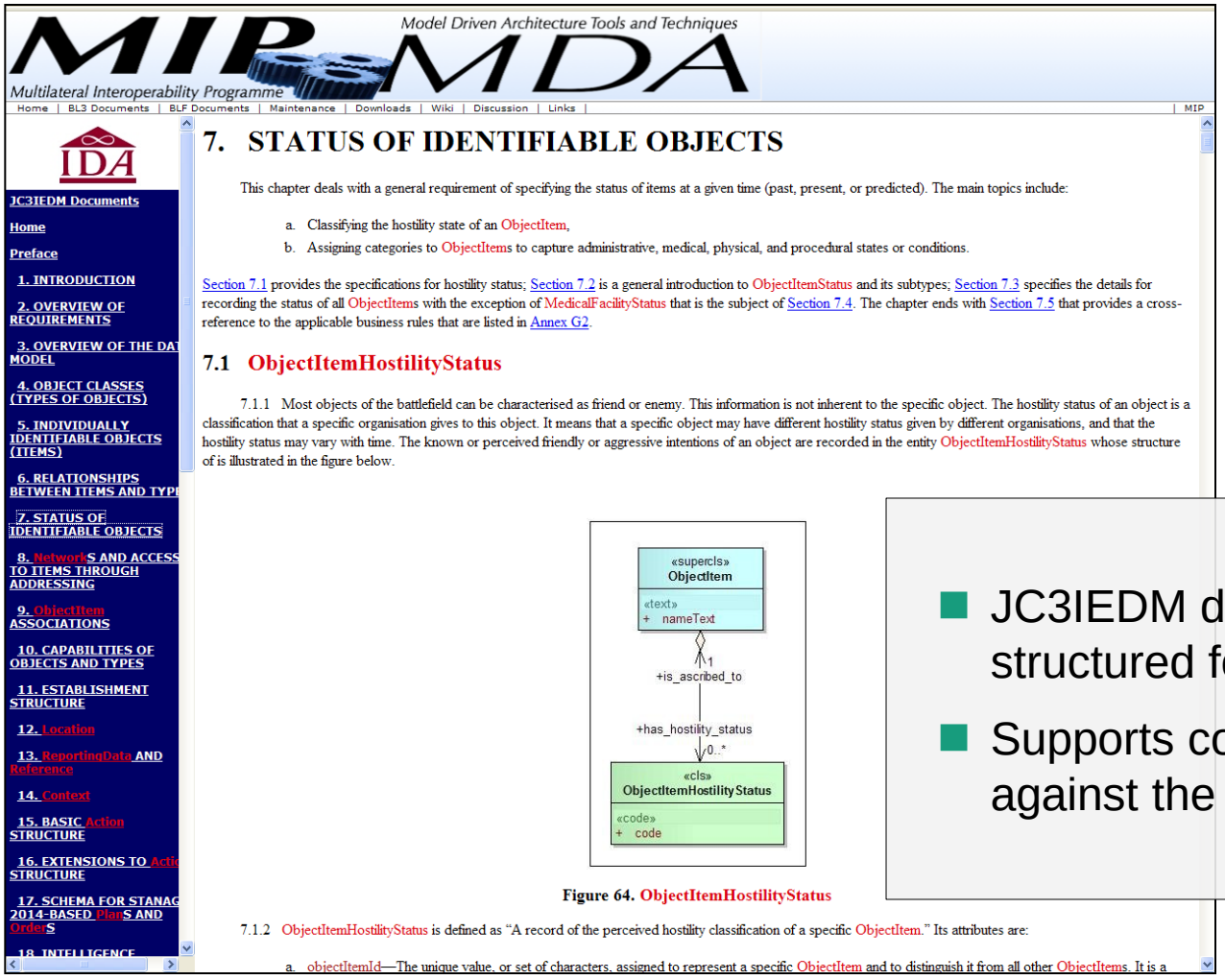
Formalization of Business Rules

- 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)



/* 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

Fraunhofer FKIE

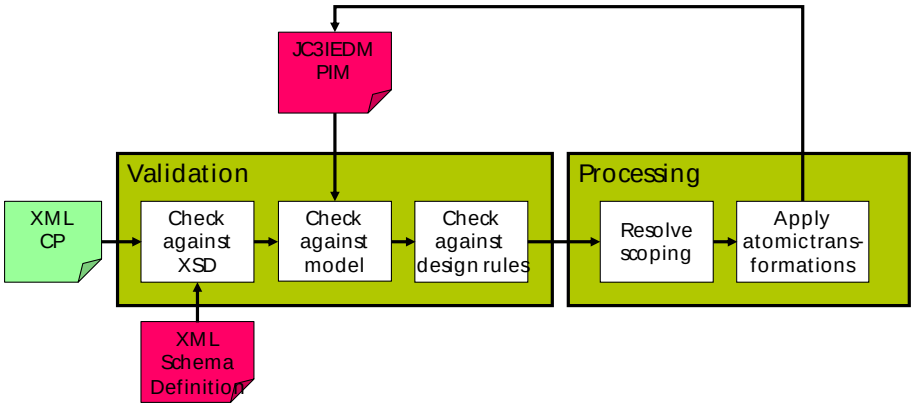
Improved Change Management

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

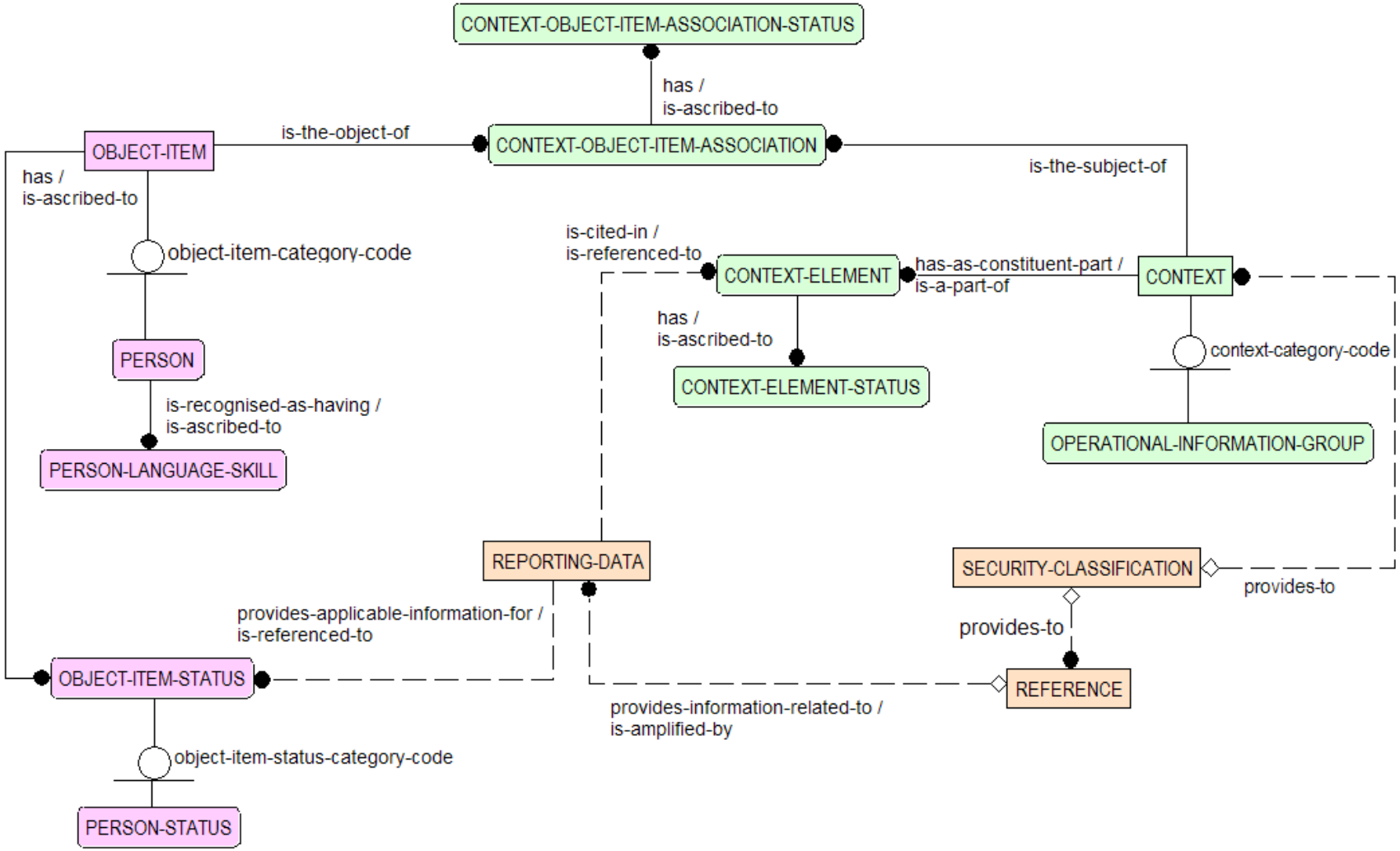


PIM Restructuring

Motivation

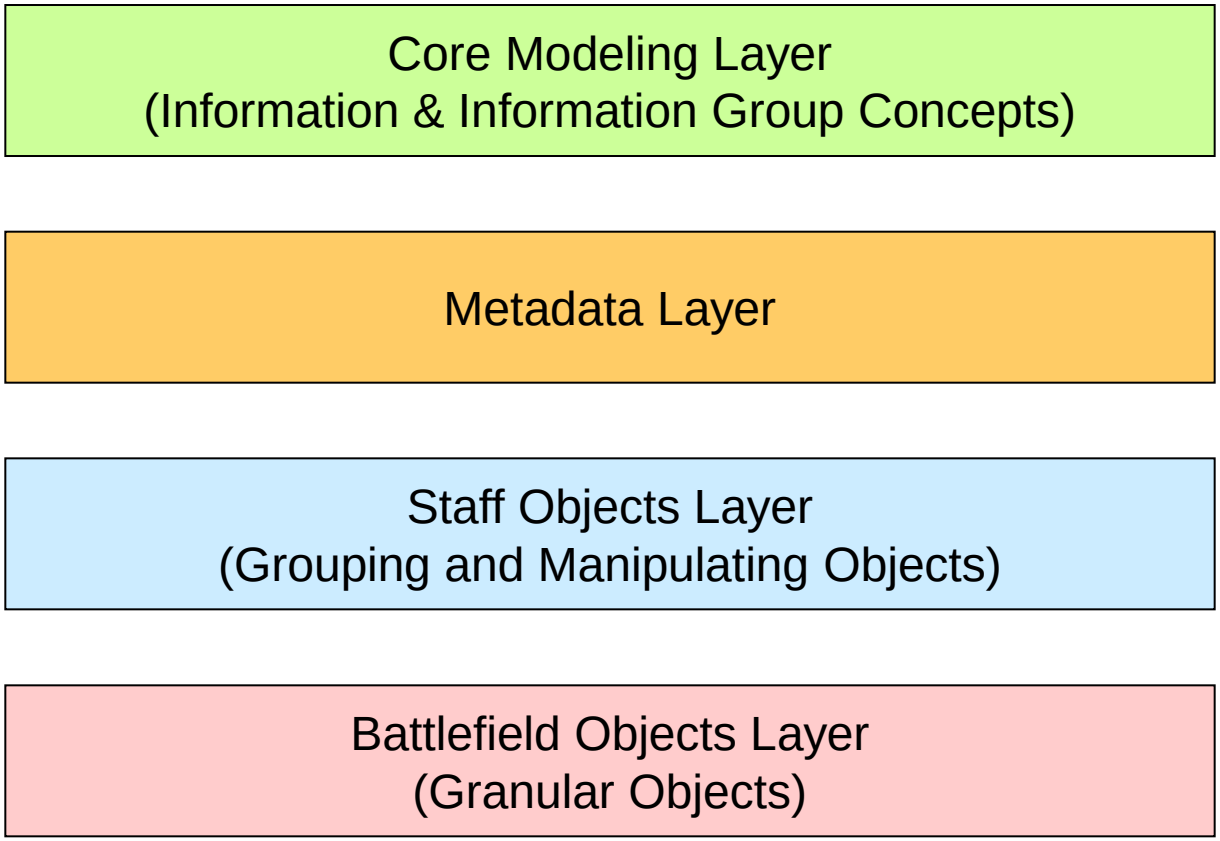
- Resolve well-known problems/workarounds, e.g.,
  - Deletion/update of information
  - Grouping of information
  - Archiving
- Make the model independent from a specific exchange mechanism
- Generalize existing concepts
- Provide a sound basis for the definition of capability-specific sub-models

JC3IEDM 3.0.2 – Metadata & Information Groups

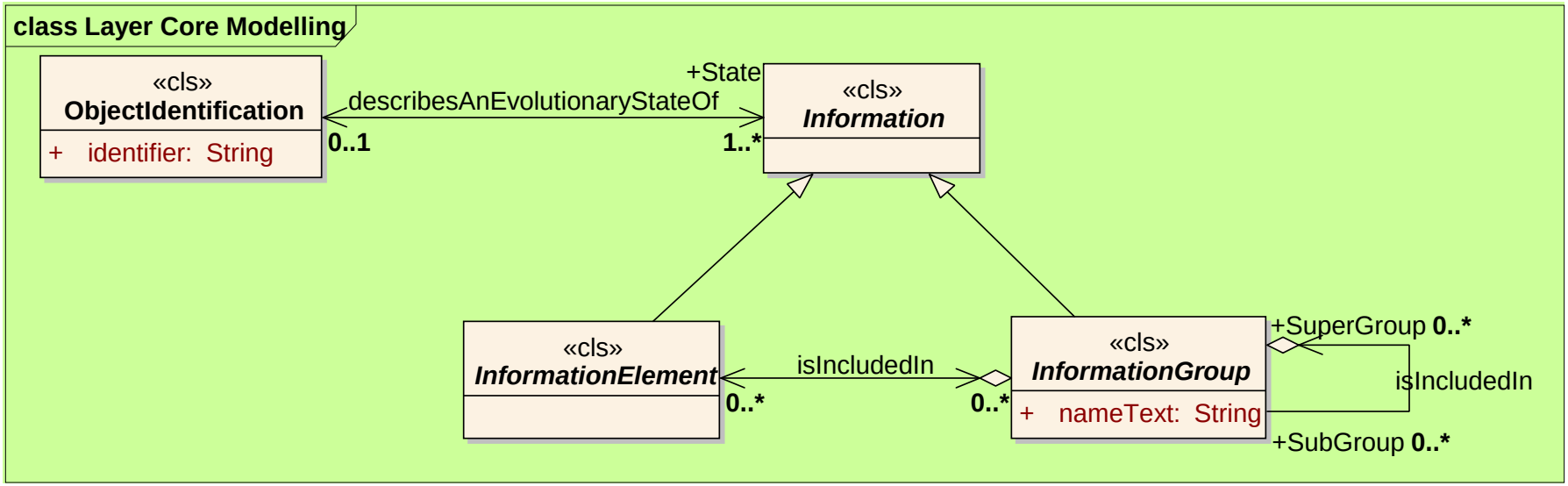


Fraunhofer FKIE

Logical Layers in the Data Model

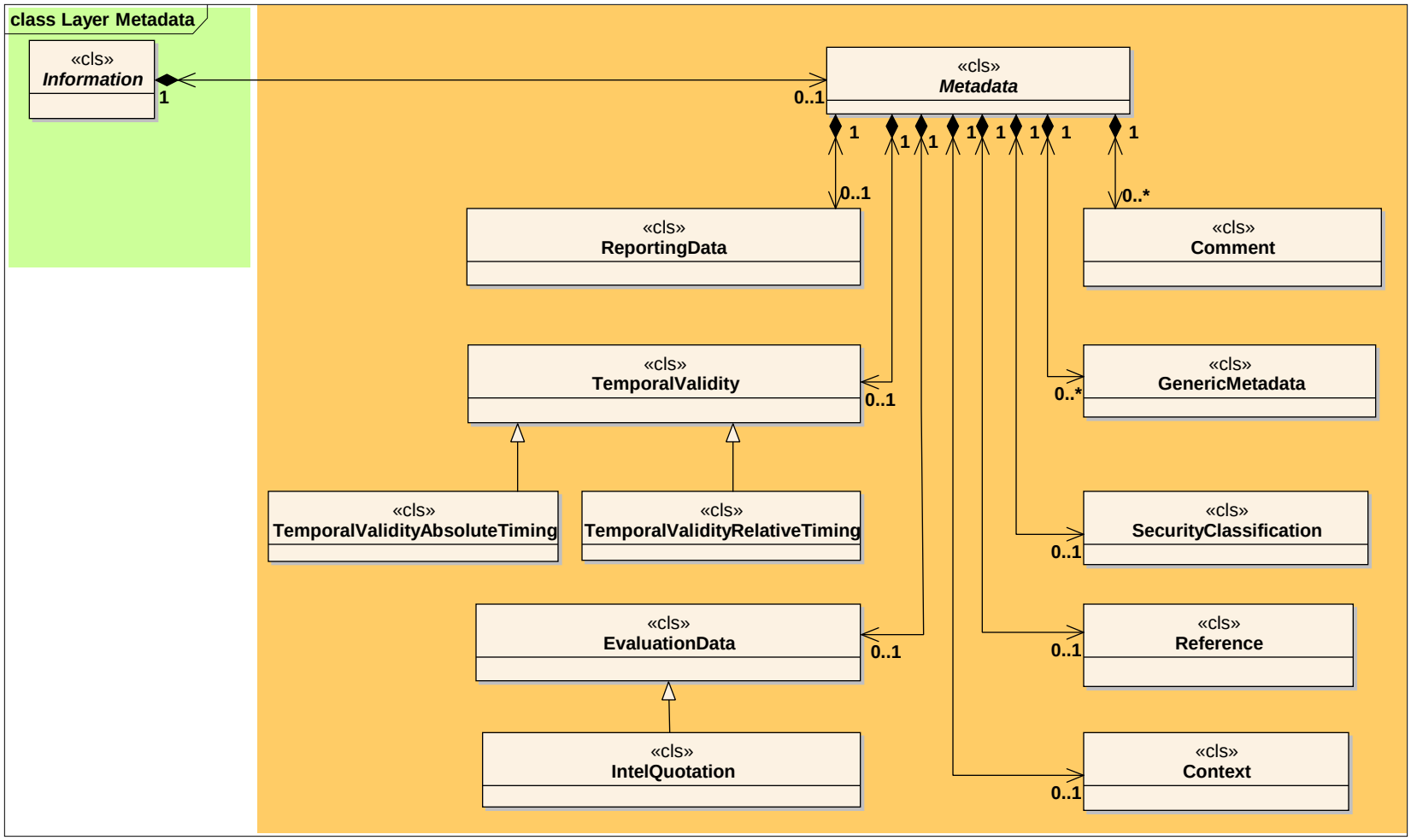


Core Modelling Layer



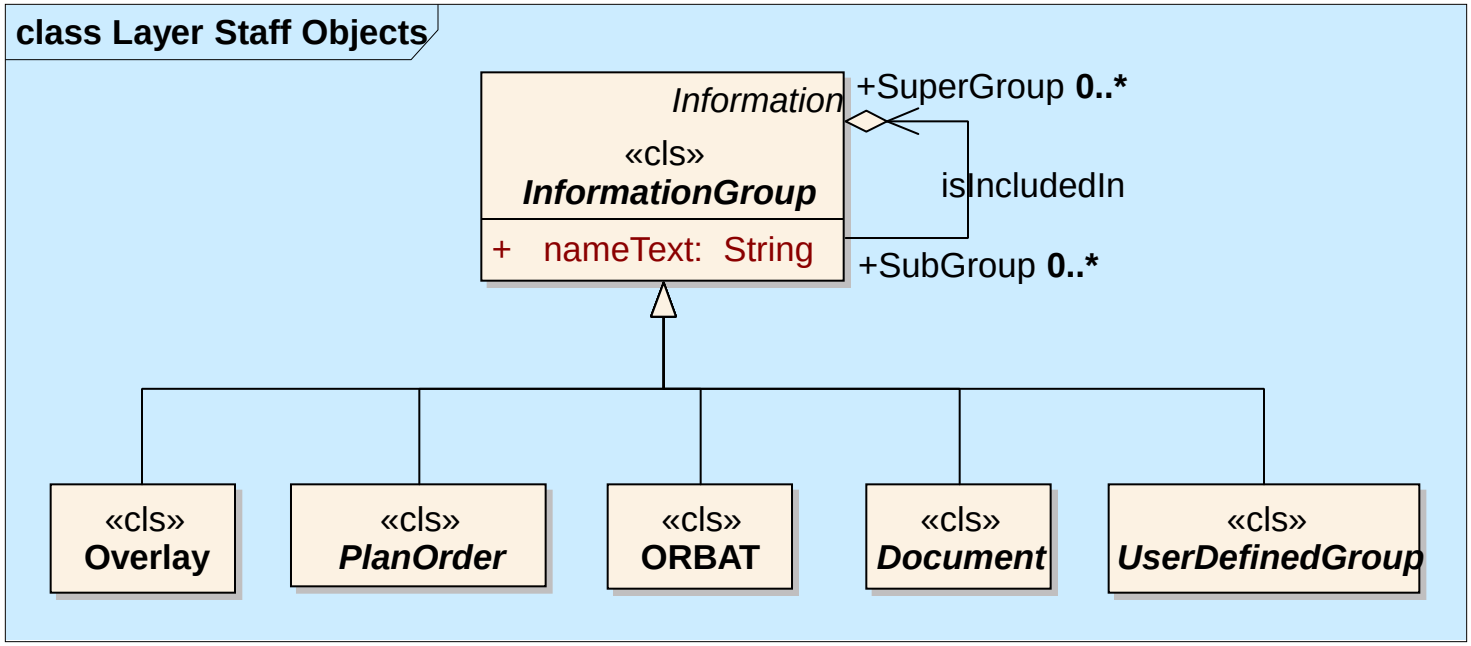
Fraunhofer FKIE

Metadata Layer



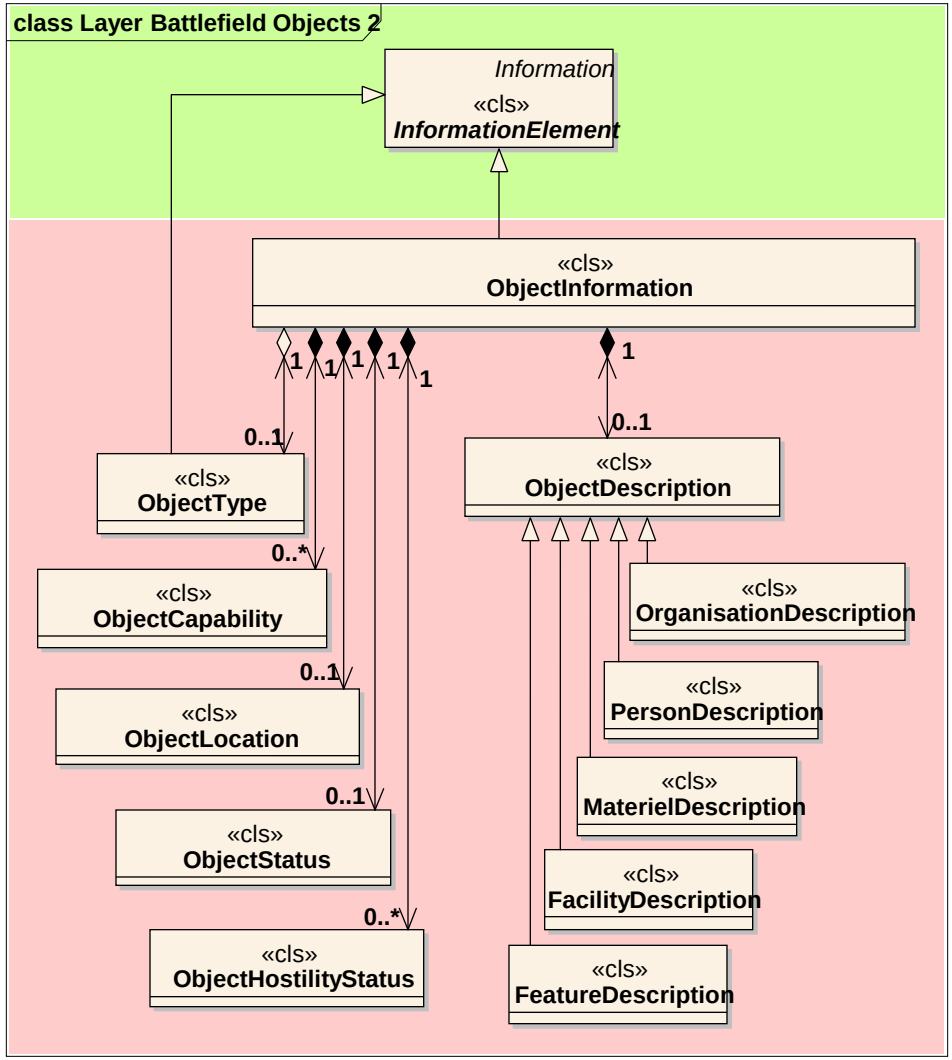
Fraunhofer FKIE

Staff Objects Layer



Fraunhofer FKIE

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

Fraunhofer FKIE

Modularization

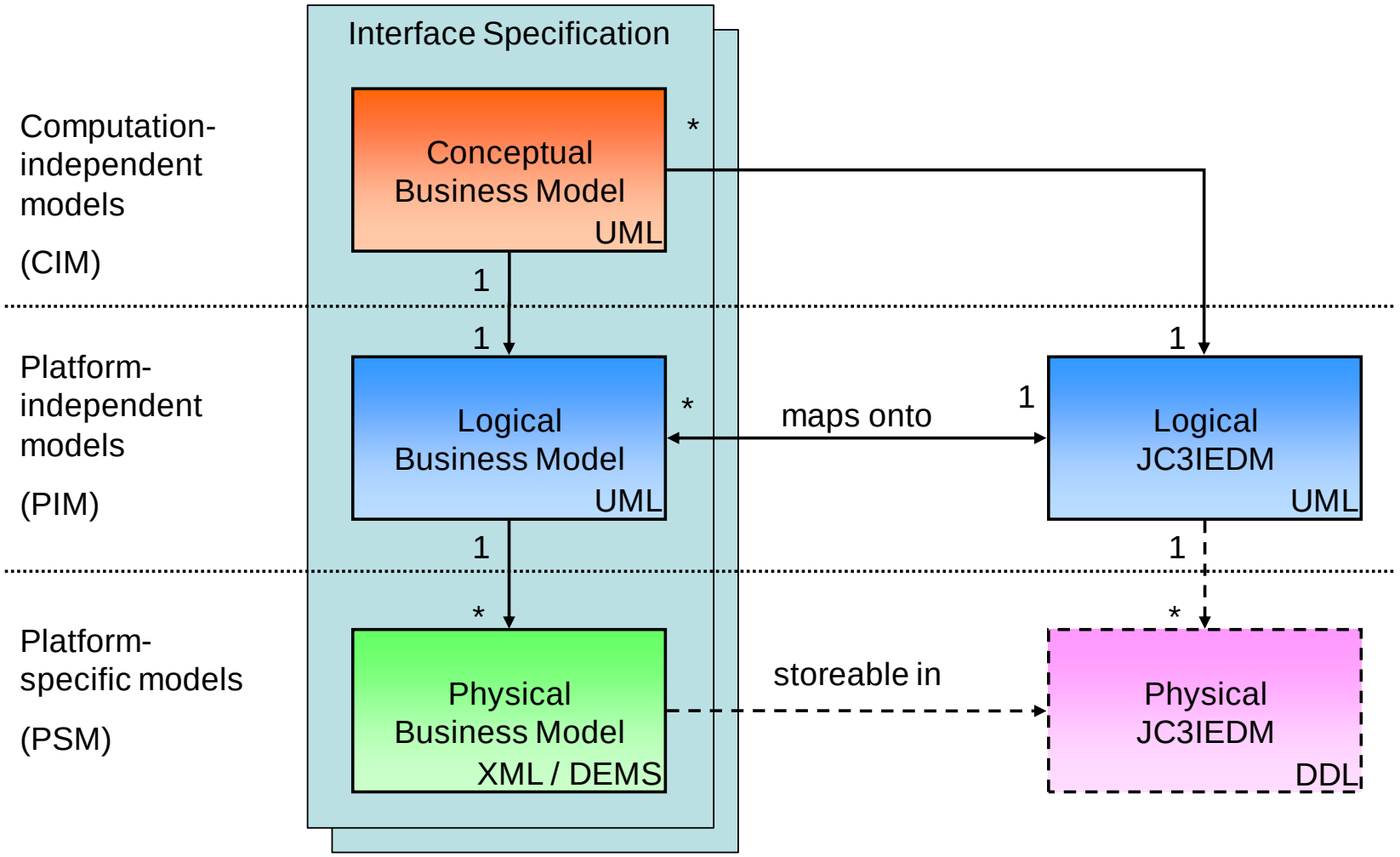
Motivation

- 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

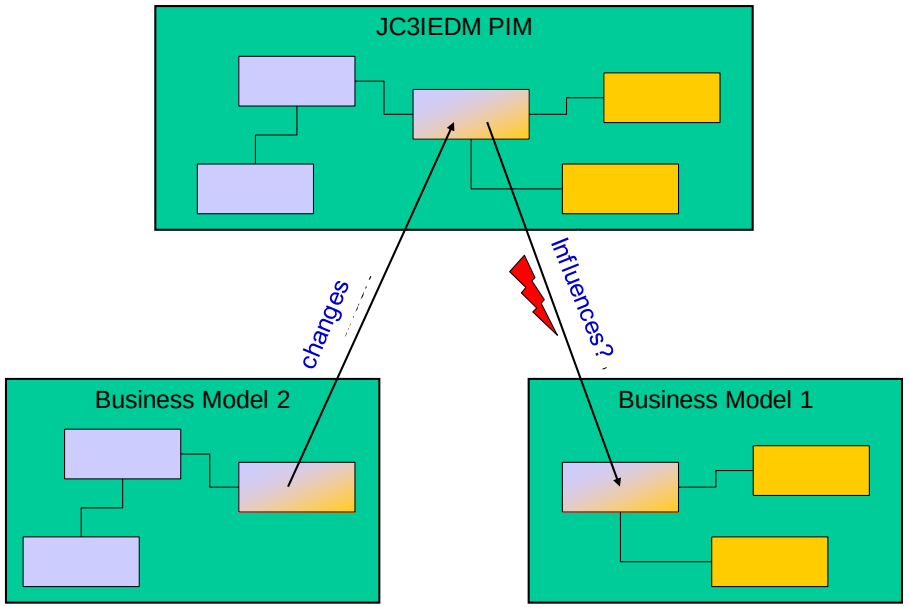
- Complete specification of information exchange capabilities
  - Data modeling is considered part of the overall modeling process!
  - NATO Architecture Framework
    - Operational Views
    - Service Views
    - System View

Business Models



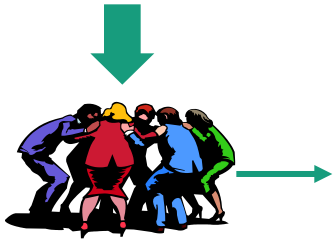
Data Management Challenges

- 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

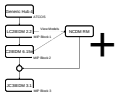


Interoperability Based on Monolithic Model

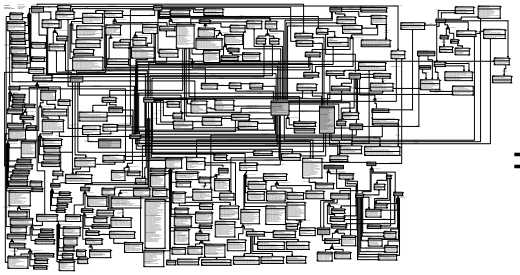
Operational Requirement / Feedback



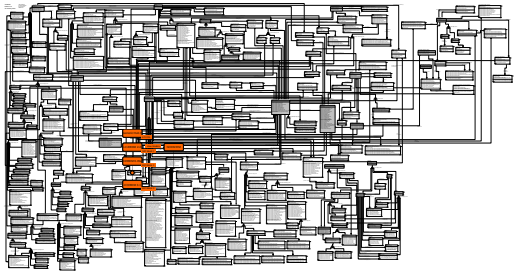
Data Modellers



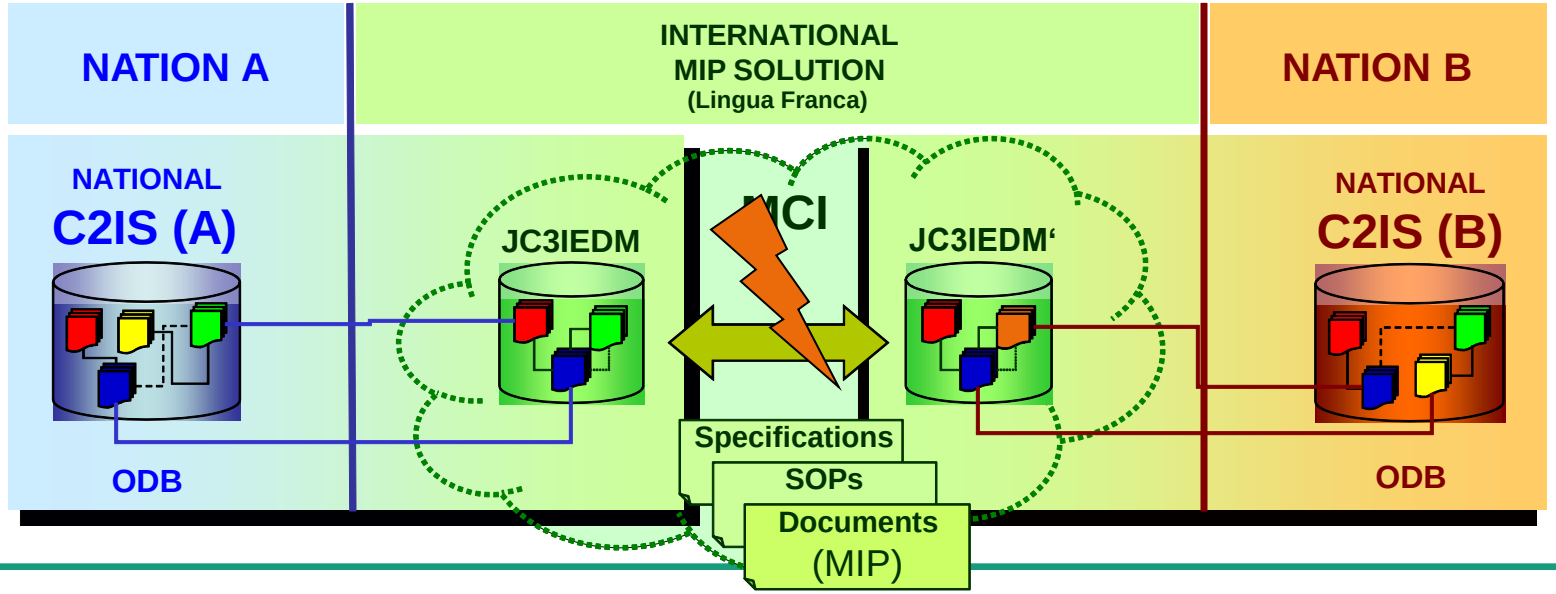
CP



JC3IEDM

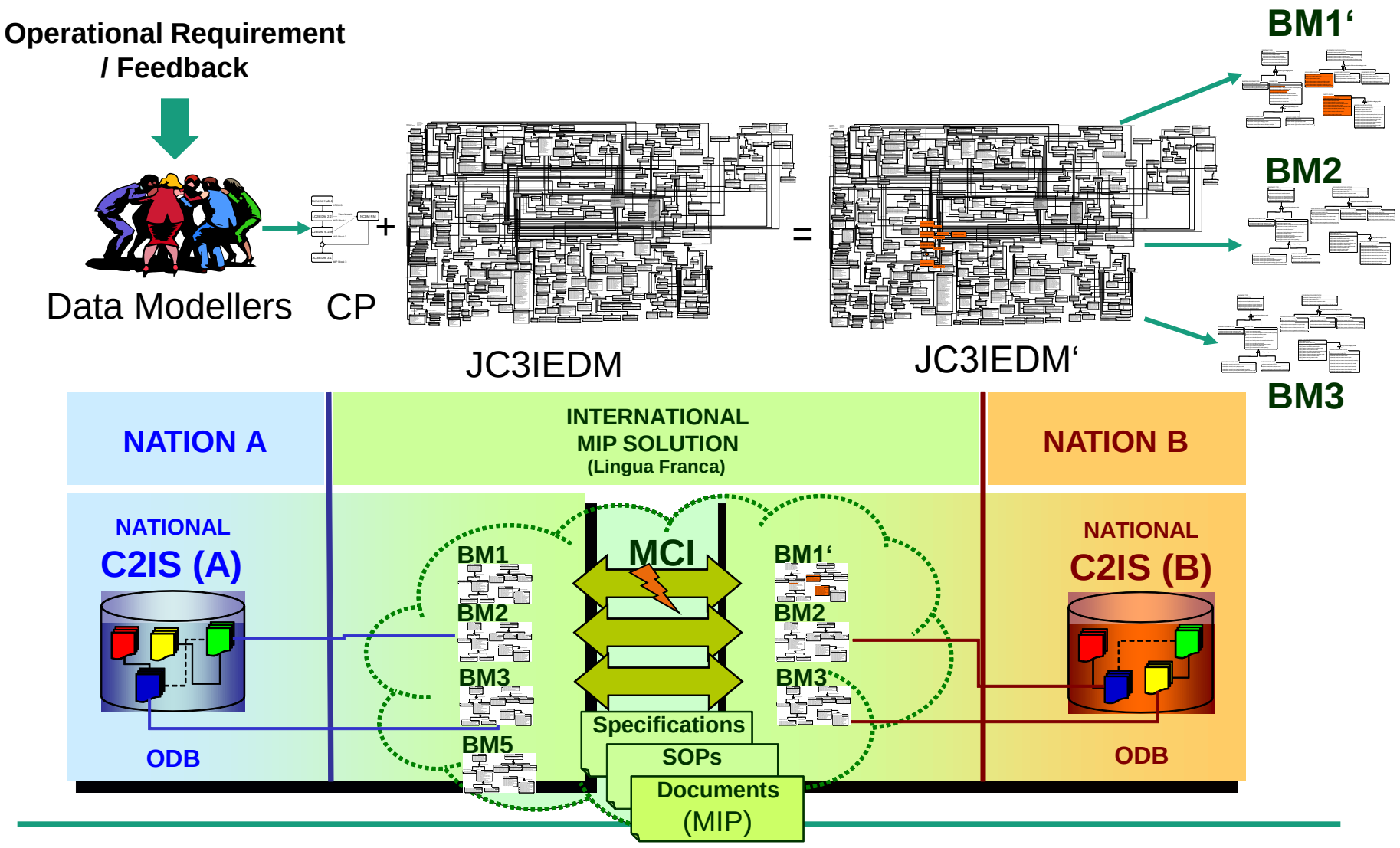


JC3IEDM‘



Fraunhofer FKIE

Interoperability Based on Business Models



Fraunhofer FKIE

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!