Integration of the MIP Command and Control Information Exchange Data Model into National Systems

Dr. Michael Schmitt
(m.schmitt@fgan.de)

FGAN – FKIE
GERMANY
Table of Contents

- Overview MIP & C2IEDM
  - Objectives, MIP Solution
- Ensuring the Shared Tactical Picture
  - Coverage of Information (Exchange) Requirements
- Integration on the Data Base Level
  - Key Management, Information Forwarding
- A Model for C2IEDM Data Access
  - Abstraction from the complexity of the C2IEDM
- Summary
Overview
MIP & C2IEDM
Objectives of MIP

“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 the lowest appropriate level, in order to support combined and joint operations; [...] MIP meets the requirements of the Land Component Commander of Allied Joint and Combined Operations (including Article 5 and Crisis Response Operations).”

„MIP TACTICAL C2IS INTEROPERABILITY REQUIREMENT“ (MTIR, 2004)
MIP Solution

- Common Data Model: C2IEDM / JC3IEDM
- Common Exchange Procedures: DEM / MEM
MIP Data Model – Overview

- Entity-Relationship Model
- C2I EDM 6.15b:
  - 203 entities
  - 1020 attributes
  - 4781 fixed domain values
- Physical and logical view on the MIP DM
  - Explicit definition of primary and foreign keys
  - Schema for RDBMS can be derived
  - Data Exchange Mechanism (DEM) format coupled with schema
- Business rules
  - Valid combinations of attribute values
  - How to model frontiers?
  - How to model object locations?
Ensuring the Shared Tactical Picture
By definition, the C2IEDM does not cover the full set of national information requirements.

National C2ISs are not capable of processing and exchanging all C2IEDM data. ⇒ Capability matrix.
Ensuring the Shared Tactical Picture

- Operator must know the interoperability capabilities of his C2IS!
  - Which information is exchanged? In what form? To whom?
  - Which information cannot be processed/presented?
- Interoperability capabilities must be visualized at the user interface!
- Minimal solution for unsupported capabilities (e.g., generic forms)!
Integration on the Data Base Level
Alternative 1: Data model of ODB ≠ C2IEDM

- Technically and/or logically
- Specific, complex mapping
  - Attributes (domain values)
  - Structures (entities, relationships, combinations of attributes)
Alternative 2: Data model of ODB = C2IEDM+  
- C2IEDM and its schema as a basis for the operational database  
- National extensions added to the C2IEDM
Assumption: Data model of ODB ≠ C2IEDM

Synthetic keys of the C2IEDM must be preserved
  ➔ Add keys attributes to ODB or
  ➔ Maintain proxy table
Information Forwarding (1)

- Information must be distributed over several echelons

- MIP System Requirement Specification: "The National implementation of MIP Gateways shall allow data that is received by one Gateway on a MIP LAN to be available at other gateways on other MIP LANs. The ‘internally forwarded’ data must be identical at all gateways."

- Integrity of synthetic keys must be preserved
Information Forwarding (2)

- **Approach 1:** Proxy table at the MIP Gateway

![Diagram showing the process of information forwarding with proxy tables at the MIP gateway and proprietary data exchange.]

*Keys get lost!*
Information Forwarding (3)

- **Approach 2: Proxy table + DEM**

Data get duplicated!
Approach 3: DEM & C2IEDM-based ODB
A Model for C2IEDM Data Access
Data Access Stack

- Relational View (RDBMS)
- Object-Oriented View
- Normalized View
- Business Objects View
- Application-Specific View

Access Control

Application\(_1\)  
Application\(_2\)  
Application\(_n\)
Object-Relational Mapping (1)
Example:

```java
bufZone = new ControlFeatureType(NO, "UN mandated buffer zone", NOS);
affNato = new AffiliationFunctionalGroup(MULTINATIONAL, "NATO");
bufZone.addAffiliation(affNato);
```
Normalization (1)

- Information can be represented in multiple ways
- **Ambiguities** in the model
  - Violation of orthogonality
  - Missing business rules
- Example: Affiliation of a person
Normalization (2)

- Duplicate type information
  - Several MIP partners create identical object types
  - Identical operational information but different keys

- Problem
  - Queries, e.g., statistical evaluations

- Solution
  - Normalization of C2I EDM data
  - Applications operate on unique types
C2IEDM
- Designed for information exchange...
- ... not for efficient data access!

- Structural complexity due to multi-dimensional data space
  - Time (old data remain in the DB)
  - Operational Information Groups (OIGs)
Most recent status of a given unit in a given OIG

- Status information
  - ... has an effective start date/time
  - ... may also have an effective end date/time
  - ... can be negated
  - ... may be different in each OIG

- OIGs
  - Multiple instances of the same category (only one active instance at each point in time)

...
Summary

- C2IEDM – solely an Information *Exchange* Data Model?
  - Implications on national applications
    - Domain values, available objects/functions
    - Realize the Shared Tactical Picture concept
  - Information Forwarding
    - Rule of the MIP game: Synthetic keys must be preserved!

- Integration of the C2IEDM into national systems
  - Abstraction from RDBMS-specific properties
  - Increased maintainability, efficiency, correctness

- Multinational interoperability cannot be ensured at the interfaces – it must be established in the core of the C2ISs!