10th ICCRTS

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

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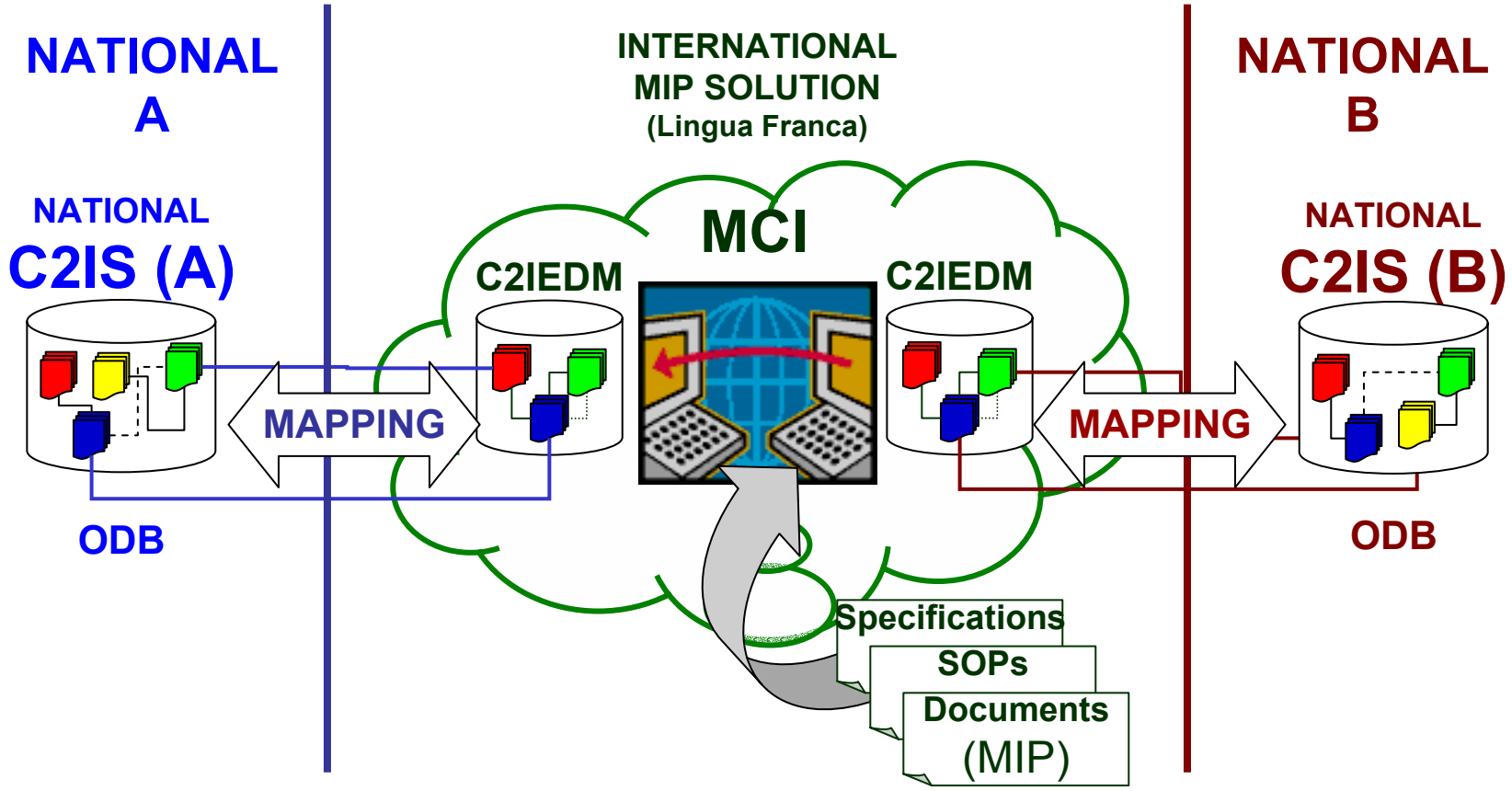
Overview
MIP & C2IEDM

- "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



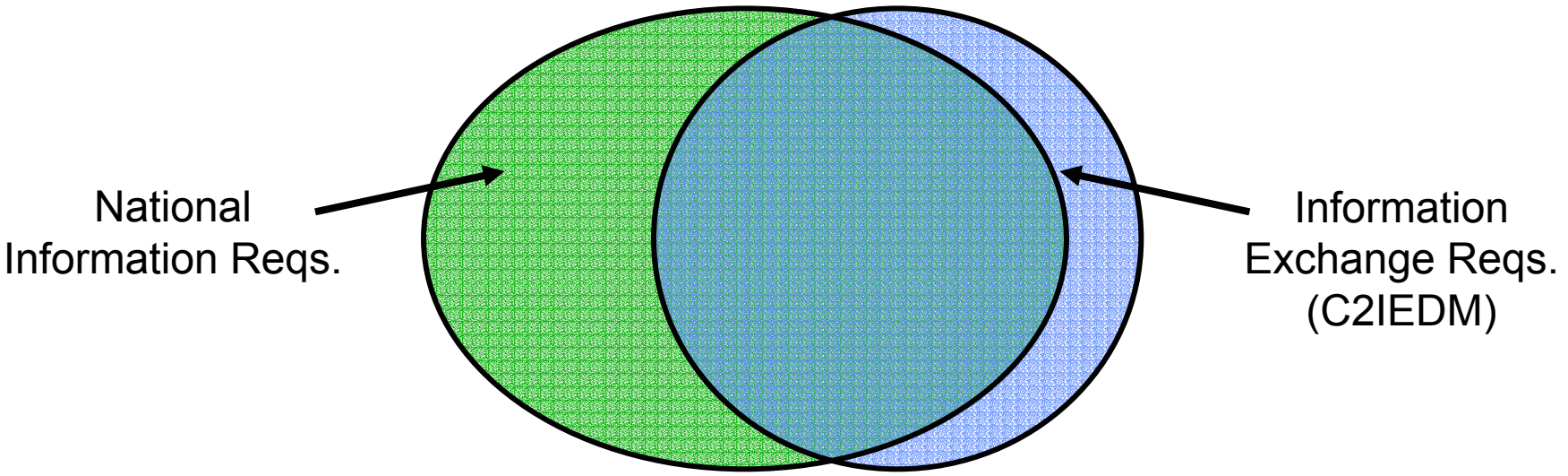
- Common Data Model: C2IEDM / JC3IEDM
- Common Exchange Procedures: DEM / MEM

MIP Data Model – Overview

- Entity-Relationship Model
- C2IEDM 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?

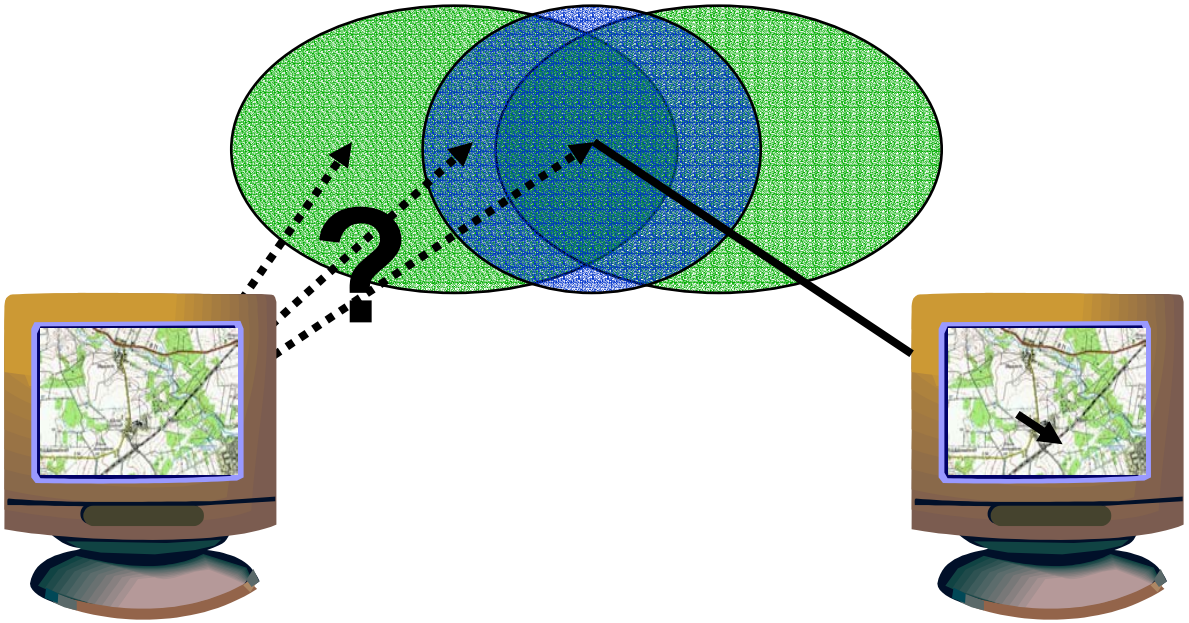
Ensuring the Shared Tactical Picture

C2IEDM Coverage



- 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

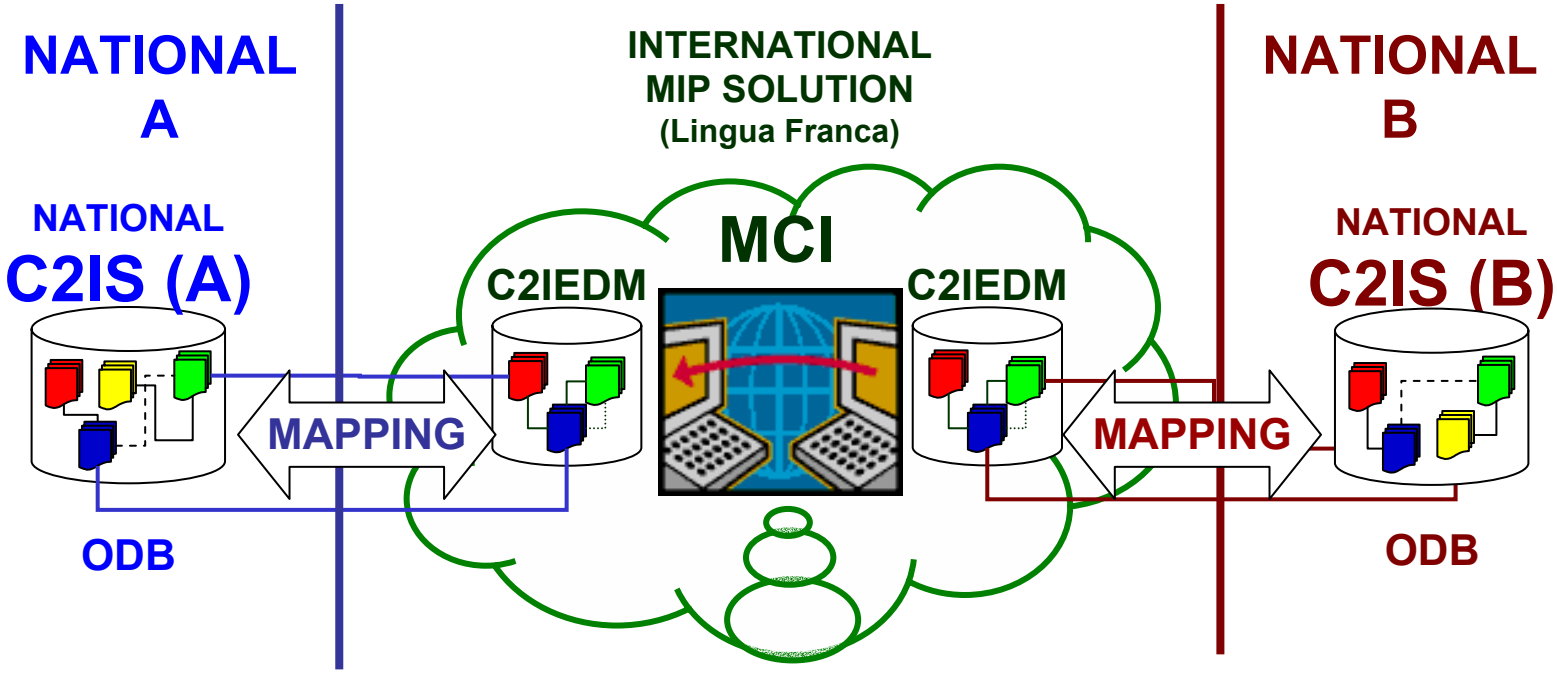
Ensuring the Shared Tactical Picture



- 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)!

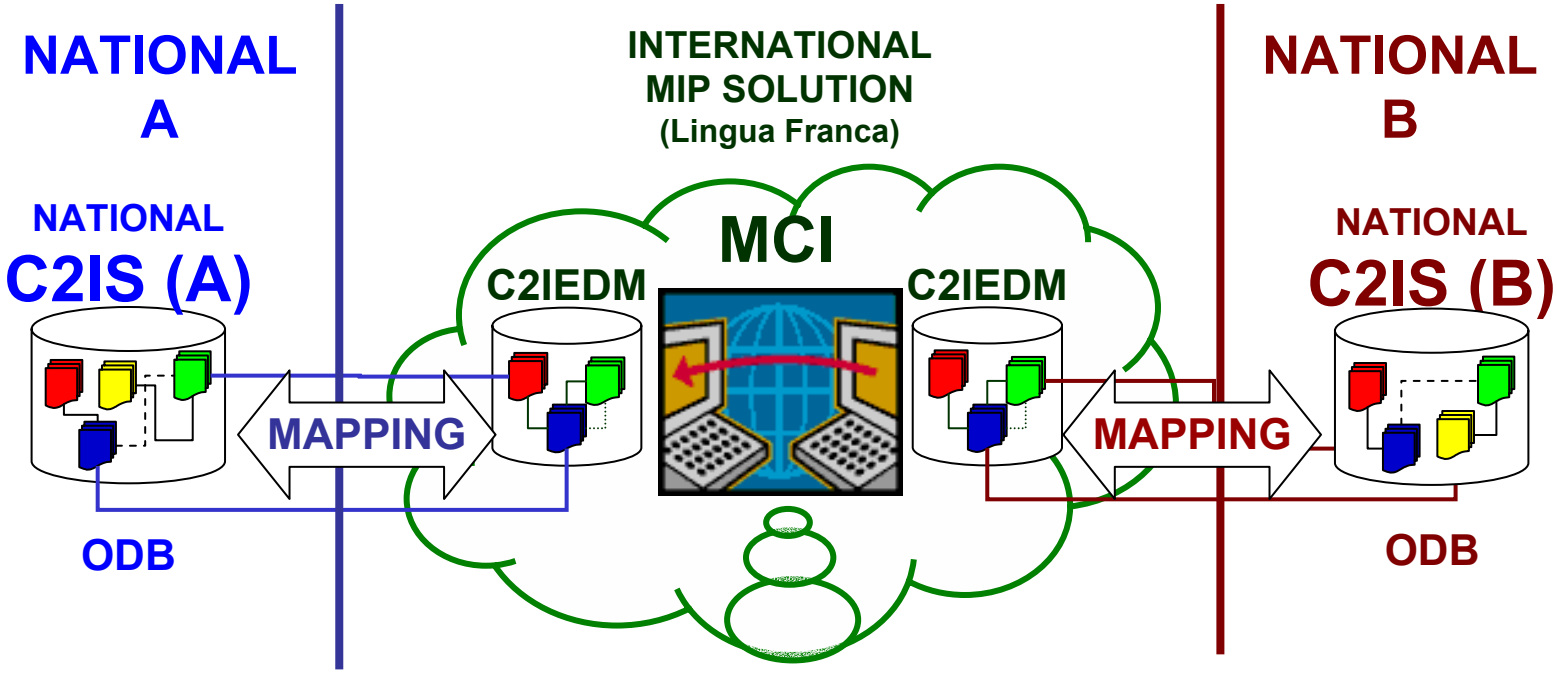
Integration on the Data Base Level

Operational DB vs. C2IEDM (1)



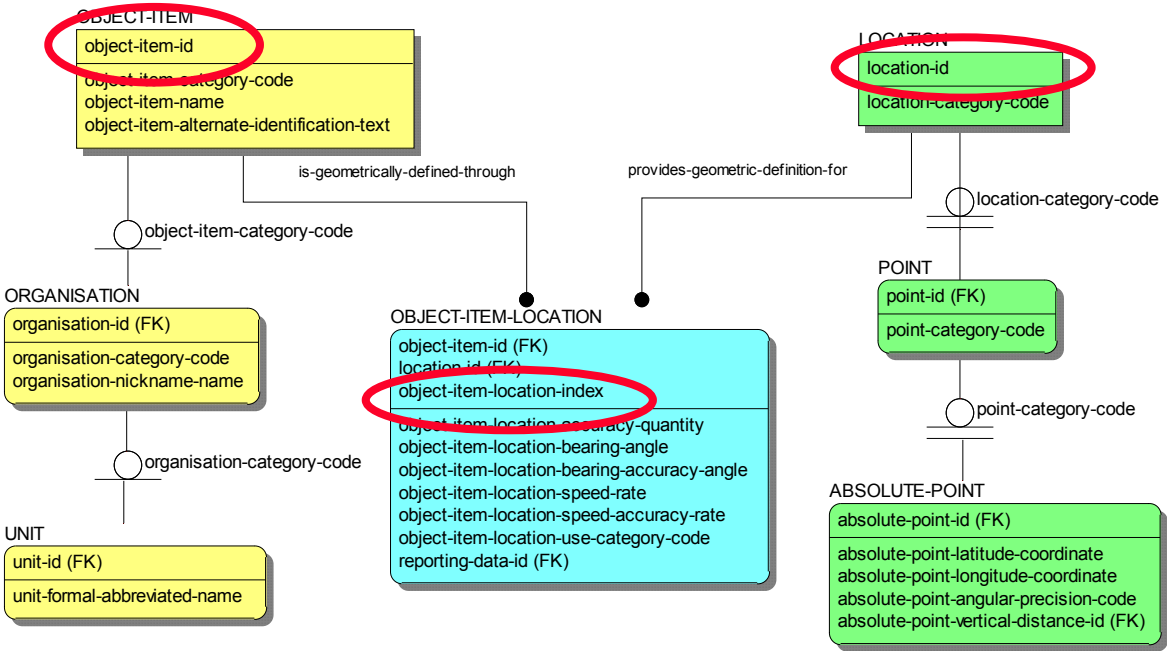
- Alternative 1: Data model of ODB ≠ C2IEDM
  - Technically and/or logically
  - Specific, complex mapping
    - Attributes (domain values)
    - Structures (entities, relationships, combinations of attributes)

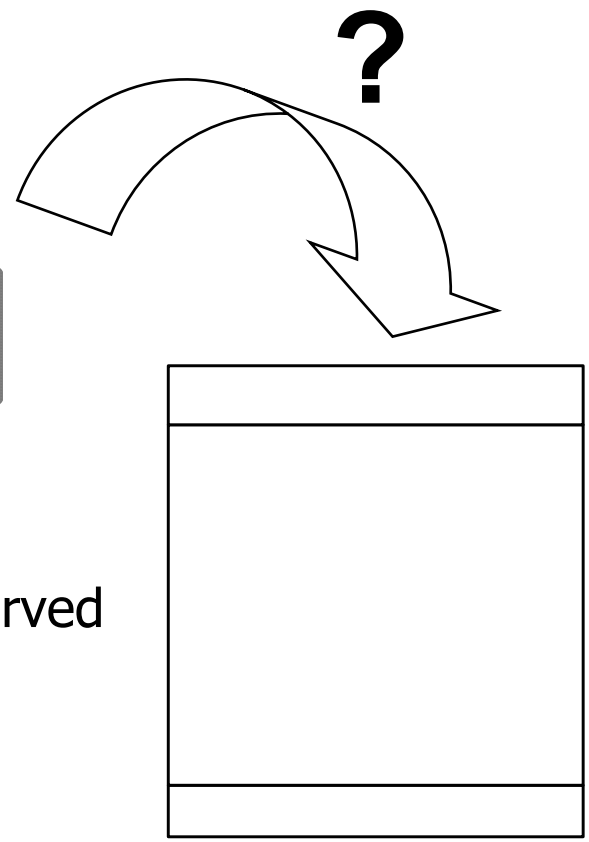
Operational DB vs. C2IEDM (2)



- Alternative 2: Data model of ODB = C2IEDM+
  - C2IEDM and its schema as a basis for the operational database
  - National extensions added to the C2IEDM

Key Management



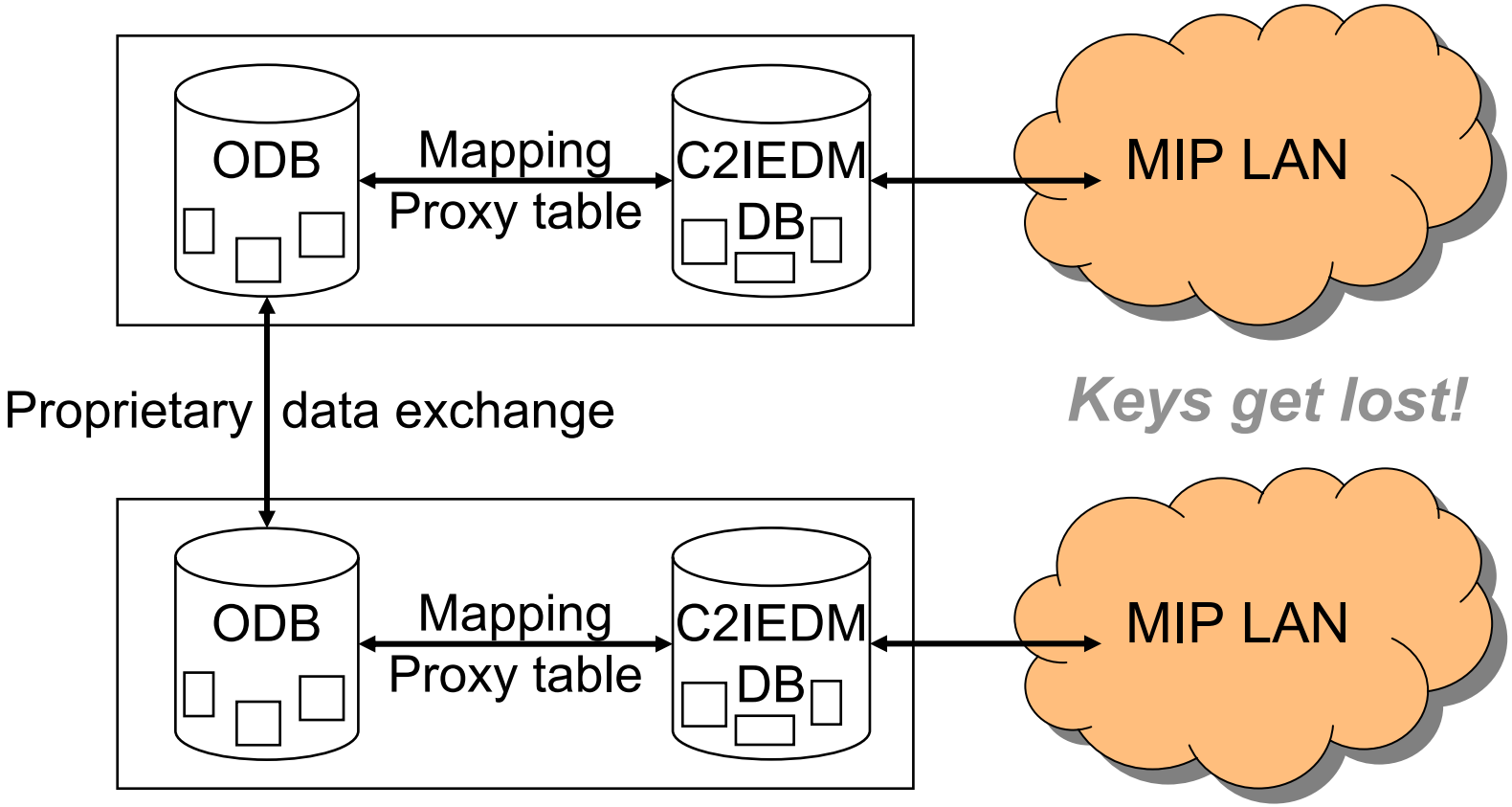


- Assumption: Data model of ODB ≠ C2IEDM
- Synthetic keys of the C2IEDM must be preserved
  - Add keys attributes to ODB or
  - Maintain proxy table

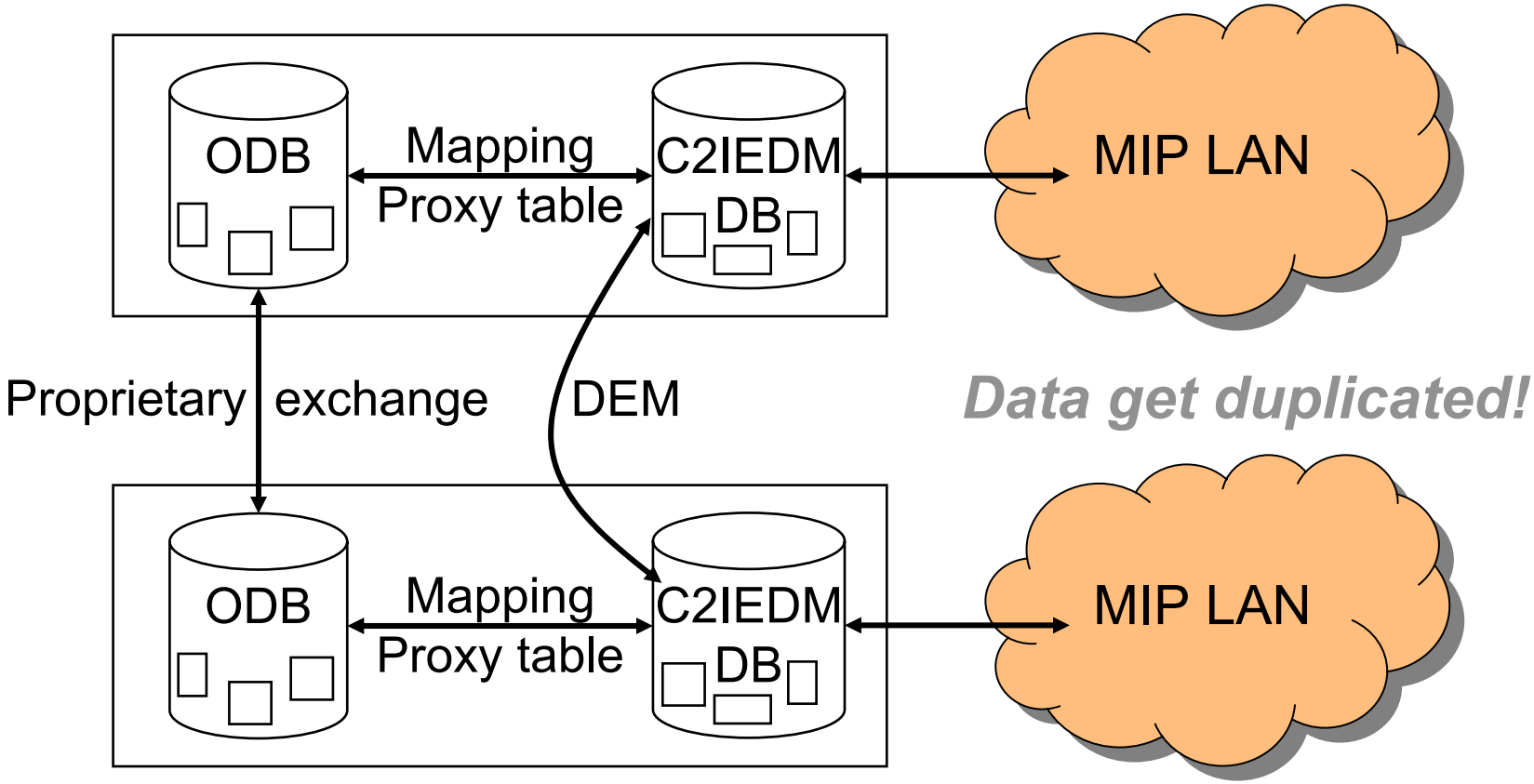
Information Forwarding (1)

- 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

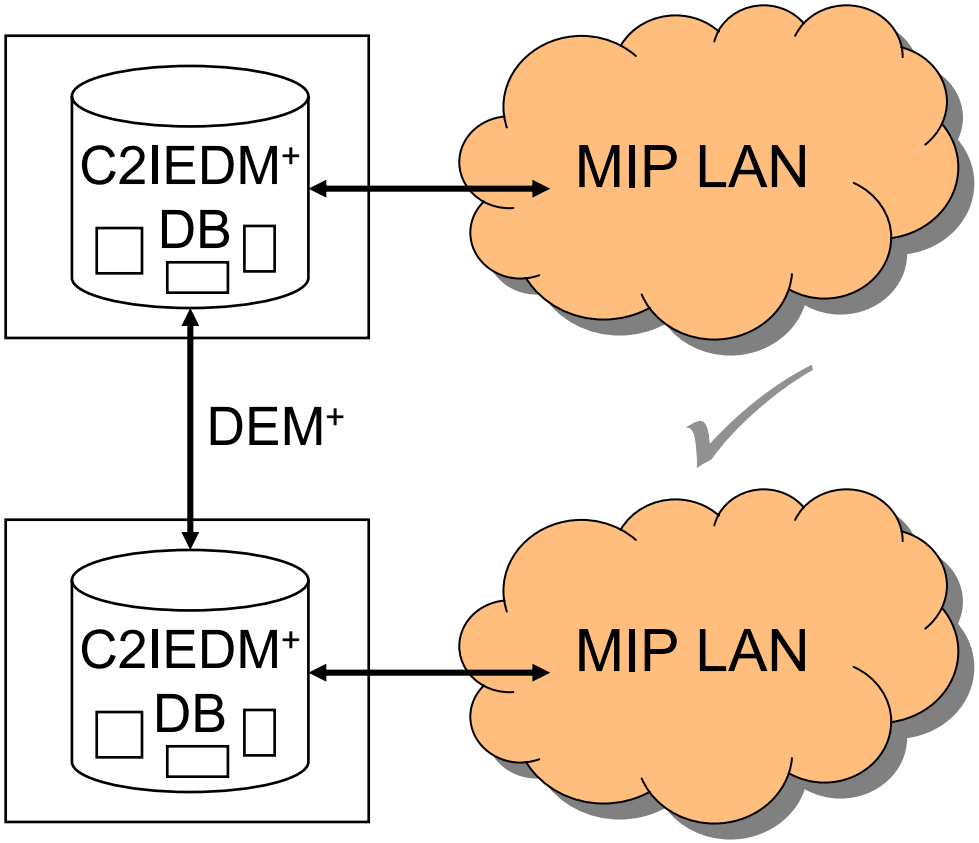
- Approach 1: Proxy table at the MIP Gateway



- Approach 2: Proxy table + DEM

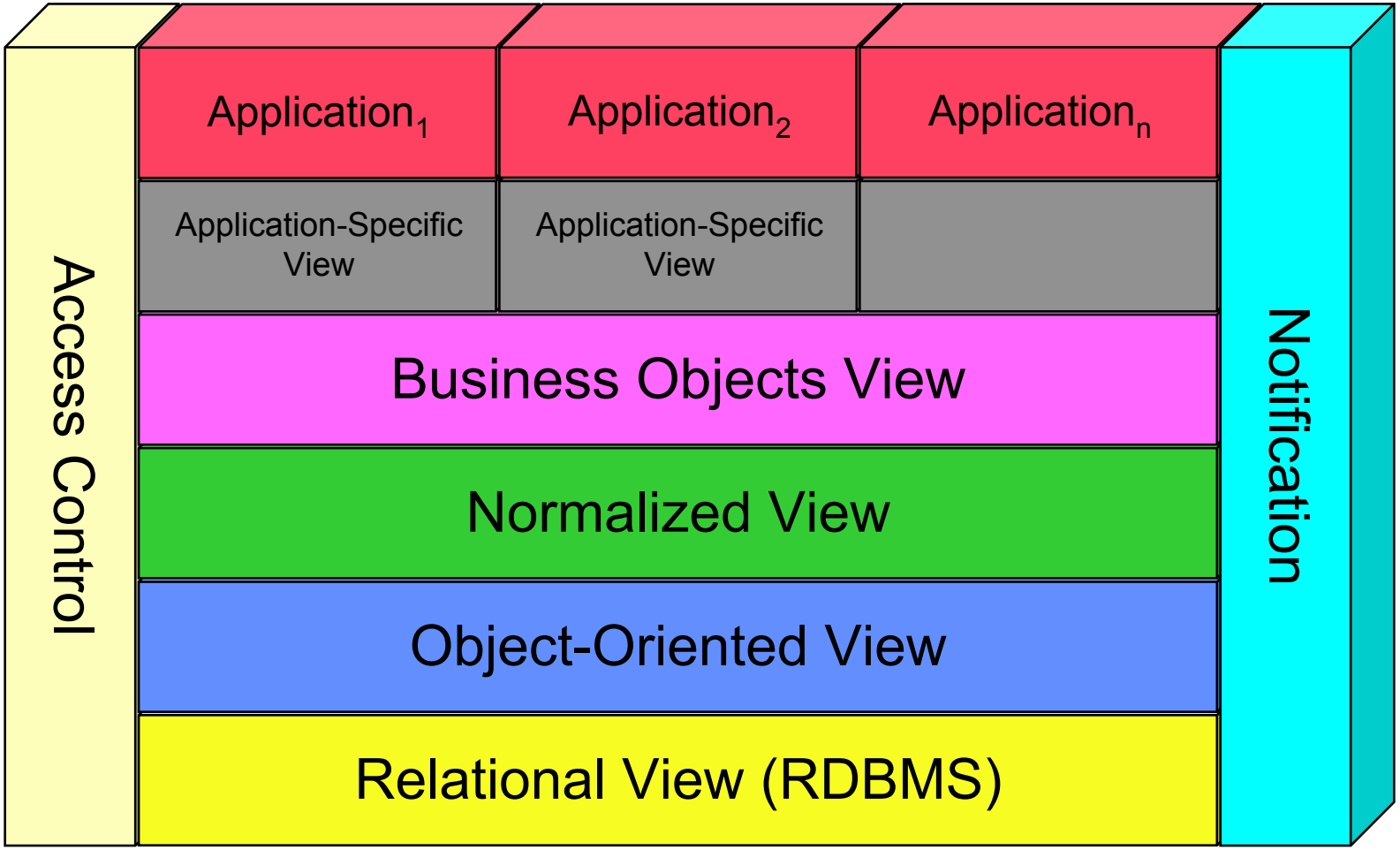


- Approach 3: DEM & C2IEDM-based ODB

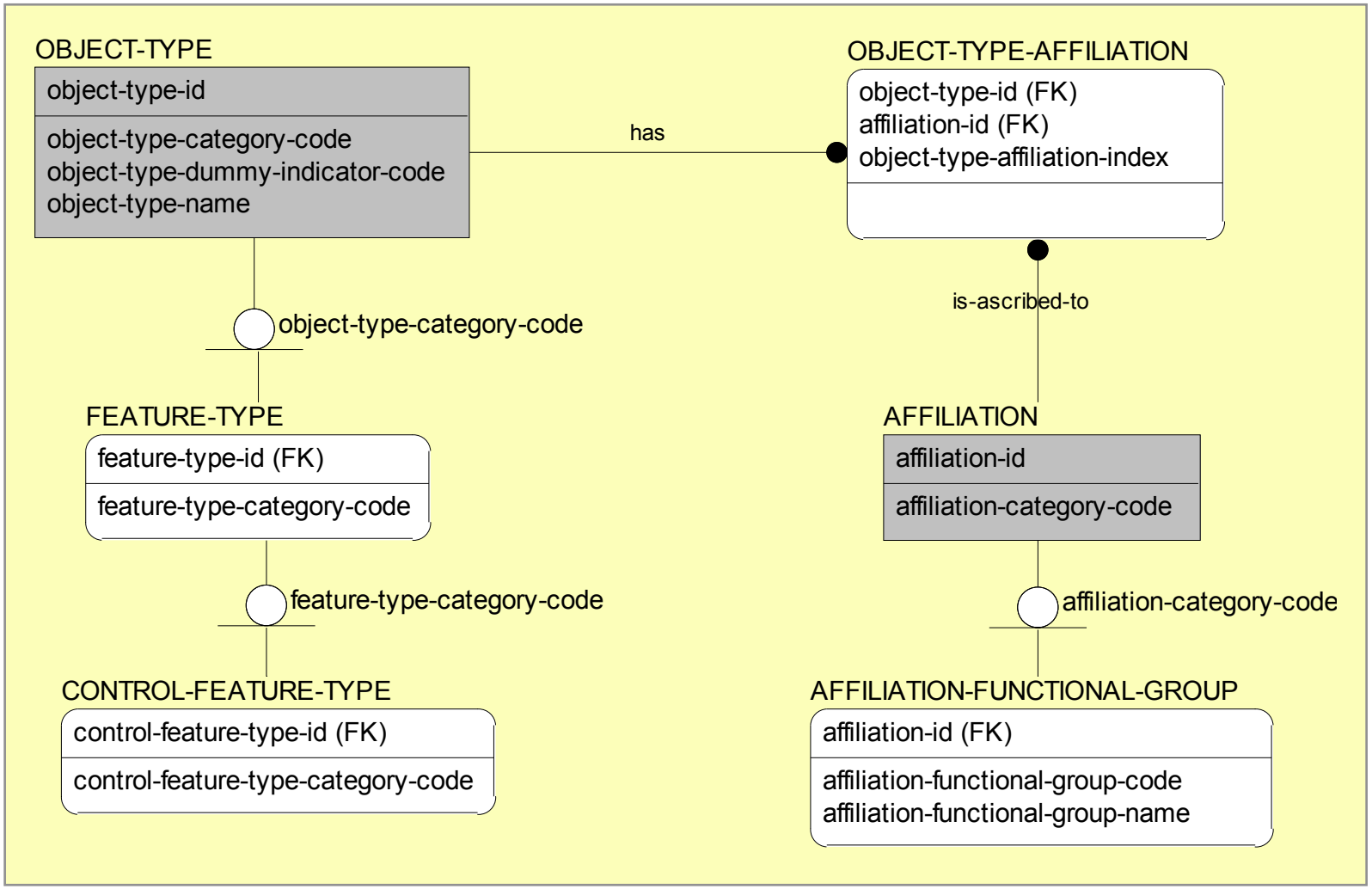


A Model for C2IEDM Data Access

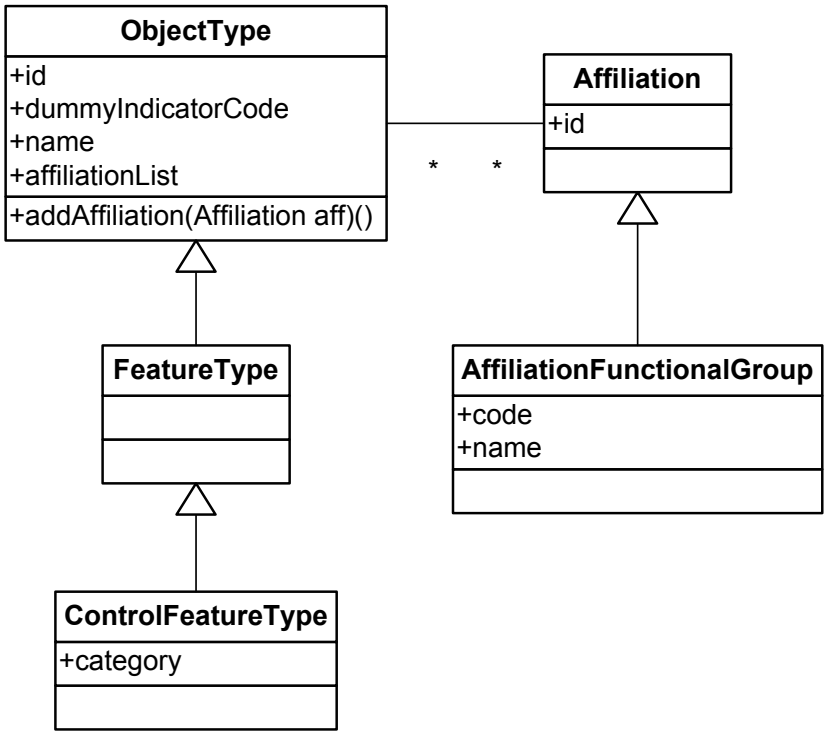
Data Access Stack



Object-Relational Mapping (1)



Object-Relational Mapping (2)

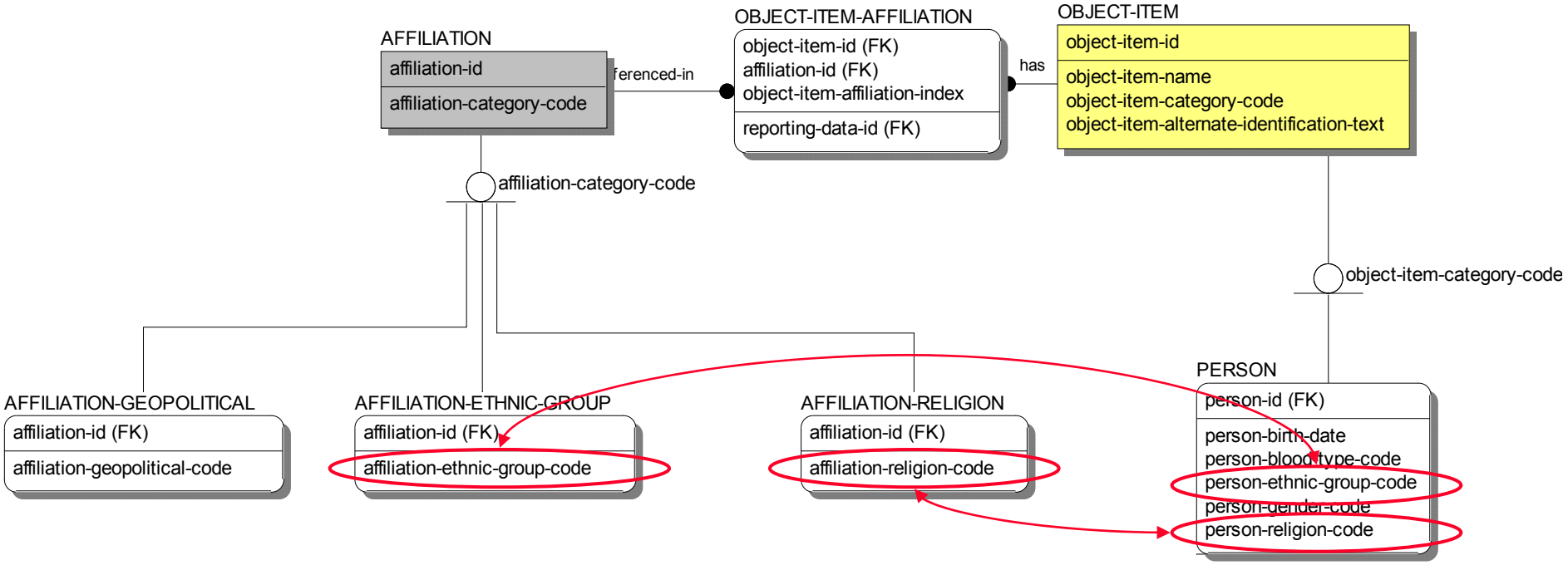


- Example:

```
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 C2IEDM data
  - Applications operate on unique types

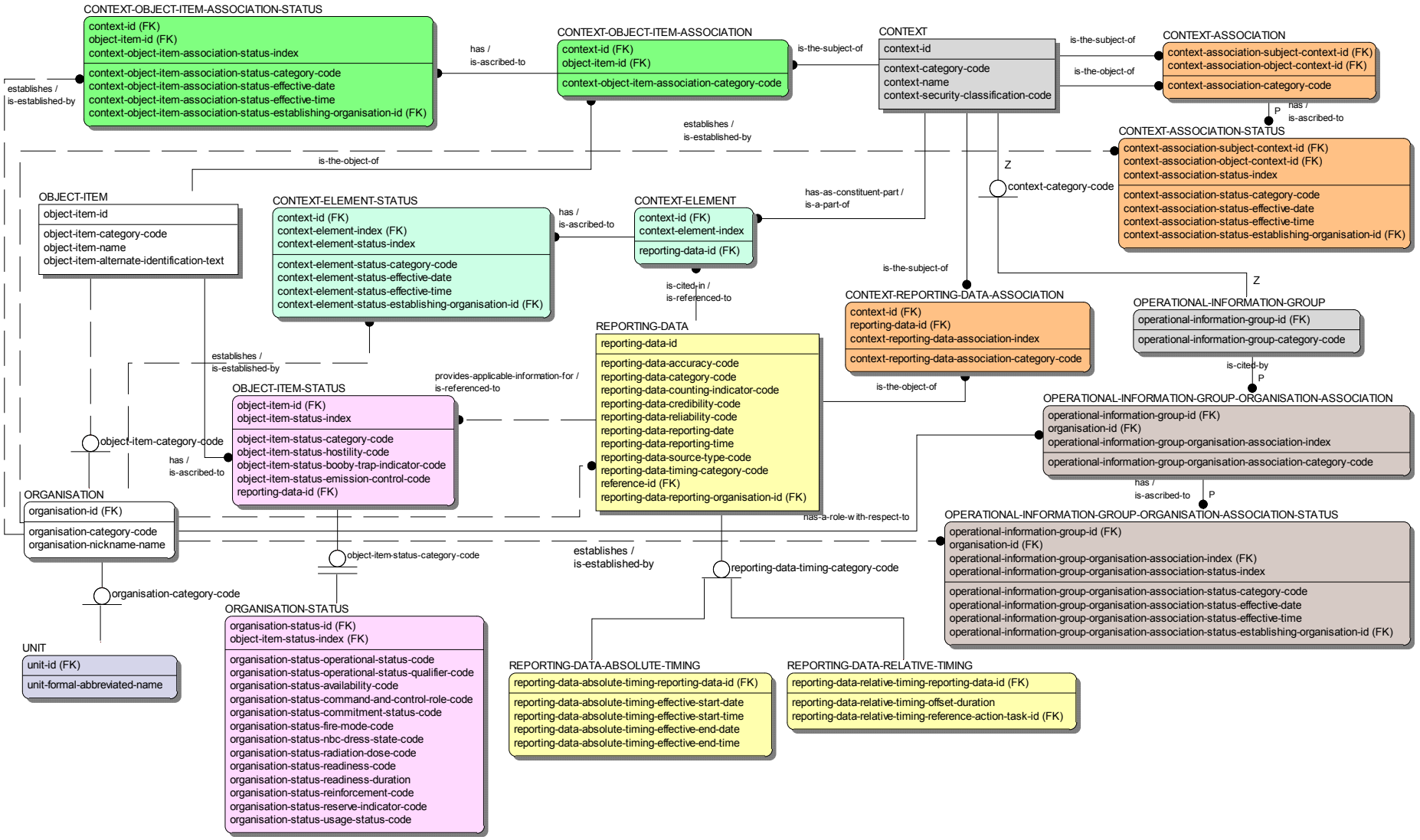
Business Functions (1)

- 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)
- …

Business Functions (3)



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!**