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C2I EDM for the GIG: A Tutorial

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C2IEDM for the GIG: A Tutorial

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Introduction

• Purpose
  – Educate about the C2IEDM
  – Show how its components work to show a very clear view of
    the Battle Space

• Scope
  – Overview, Overall Structure, Independent Entities
  – Introduce key areas, give some examples of their use

• Tutorial Objectives
  – Clear understanding of the Model
  – View of how it can serve as an Operational Vocabulary
The Challenge

• Composable Services – Service Oriented Architecture (SOA)
  – Functionality in Services
  – System Functionality composed from Service Functionality

• Central questions
  – How can we make sure that current services talk with each other unambiguously
  – How can we make sure that current services talk with future services unambiguously

The Proposal

• Common Reference Model
  – Unambiguous definition of entities and their relations
  – Information Exchange Data Model
    • Not to replace the interior model
    • Not to be used as the common enterprise wide data model

• Requirements/Constraints
  – Define current state of the art (messages, data replication, etc.)
  – Extensible to future solutions

• Is there such a model?
History of C2IEDM

- **1978**: NATO Long-Term Defense Plan (LTDP) Task Force on Command and Control (C2)
- **1980**: Army/Allied Tactical Command and Control Information System (ATCCIS) Permanent Working Group (APWG)
- **1998**: Multilateral Interoperability Program (MIP) replaces Battlefield Interoperability Program (BIP) and Quadrilateral Interoperability Program (QIP)
- **2002**: Merging ATCCIS and MIP, new name for the data model: Land Command and Control Information Exchange Data Model (LC2IEDM)
- **2003**: Name changed to Command and Control Information Exchange Data Model (C2IEDM)
- **2004**: Current version Generic Hub 6.1 on website http://www.mip-site.org

MIP/C2IEDM Organization

**Members/Systems**

<table>
<thead>
<tr>
<th>FULL MEMBERS</th>
<th>ASSOCIATE MEMBERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>CA LFC2IS</td>
<td>AS JCCS, BCSS</td>
</tr>
<tr>
<td>DA DACCIS</td>
<td>AU PHOENIX</td>
</tr>
<tr>
<td>FR SICF, SIR</td>
<td>BE SICBEL</td>
</tr>
<tr>
<td>GE HEROS-2/1</td>
<td>CZ GF-TCCS</td>
</tr>
<tr>
<td>IT SIACCON</td>
<td>FI</td>
</tr>
<tr>
<td>NL ISIS</td>
<td>GR HARCCIS</td>
</tr>
<tr>
<td>NO NORTac/NORCCIS</td>
<td>HU HAVIR</td>
</tr>
<tr>
<td>SP SIMACET</td>
<td>LH</td>
</tr>
<tr>
<td>UK ATacCS/ComBAT</td>
<td>PL SZAFRAN</td>
</tr>
<tr>
<td>US MCS (L)</td>
<td>PO SICCE</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>ASSOCIATE MEMBERS</th>
<th></th>
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<tr>
<td>RO</td>
<td></td>
</tr>
<tr>
<td>SI</td>
<td></td>
</tr>
<tr>
<td>SW</td>
<td></td>
</tr>
<tr>
<td>IS MARK</td>
<td></td>
</tr>
<tr>
<td>SLB</td>
<td></td>
</tr>
<tr>
<td>TU</td>
<td></td>
</tr>
<tr>
<td>TKKBS</td>
<td></td>
</tr>
<tr>
<td>AFNORTH</td>
<td></td>
</tr>
<tr>
<td>ACT</td>
<td></td>
</tr>
<tr>
<td>BISC AIS</td>
<td></td>
</tr>
</tbody>
</table>

**176 Messages**

**1500 Data Def.**
What is the C2IEDM?

- Command and Control Information Exchange Data Model
- Common specification for C2 data to be exchanged
- Expected to be compliant with NATO Level 5 System Interconnection
  - Automated Exchange of Data
  - User Imposed Constraints
  - Connecting C2I/S databases
What is the C2IEDM?

- As a hub, the C2IEDM was designed to be extended.
- There are over 190 different entities.
- 15 of those entities are independent, the rest are dependent.
- The two most important trees are those of Object and Action.

What is the C2IEDM?

- Documentation is presented through the view of using IDEF1X notation.
- Integrated DEFinition (IDEF) method of presenting entity-relationship data
  - [http://www.idef.com/IDEF1X.html](http://www.idef.com/IDEF1X.html)
What is the C2IEDM?

• A number of different notations could have been used
  – UML
  – ER notation

**Crucial to realize that although the C2IEDM is based on Entity-Relationship ideas**

**IT IS NOT A RELATIONAL DATABASE!**

What is the C2IEDM?

• A valuable view as to what the C2IEDM is and how it can be used can be seen in the current C2IEDM/CROM work being done by ACS
  (see summary for reference)

• CROM (C4I-M&S Reference Object Model) exists to bridge the connection from C4I systems to M&S systems

• Based on the entities and relationships of the C2IEDM
Purpose:
Describing the Battle Space

Purpose:
Connecting C2IS Databases
Purpose:
Common Operational Vocabulary

Overall Structure:
Relational Model

- As stated, one of the purposes of the C2IEDM is in exchanging information, about Objects and Events of the Battle Space, between C2IS data systems

- To accomplish this, the model must have a very clear idea of what these Objects and Events are, and how to define and represent them

- The two main entities that satisfy this are the Object Tree and the Action Tree

- The entities comprising these two trees are related to each other and other defining entities through association relationships
Overall Structure:
Objects and the Object Tree

- **Objects** – Type and Item
- Defined in terms of Type and Item
  - Type gives Class Definitions
  - Item gives Instance Definitions
- Five main types of Object
  - Person
  - Organisation
  - Materiel
  - Feature
  - Facility

Overall Structure:
Actions and the Action Tree

- **Actions** – Task and Event
- Tasks are directed actions that an Entity (Object) can undertake
- Events are actions external to perceiving Entities
The Object Tree

People, Places, Things
And their Properties

Building Blocks of the Object Tree:
OBJECT_TYPE

- FACILITY-TYPE
  - facility-type-id (FK)
  - facility-type-category-code

- FEATURE-TYPE
  - feature-type-id (FK)
  - feature-type-category-code

- MATERIAL-TYPE
  - material-type-id (FK)
  - material-type-category-code
  - material-type-reportable-item-text
  - material-type-stock-number-text
  - material-type-maximum-height-dimension
  - material-type-maximum-length-dimension
  - material-type-maximum-width-dimension

- ORGANISATION-TYPE
  - organisation-type-id (FK)
  - organisation-type-category-code
  - organisation-type-command-function-indicator-code
  - organisation-type-command-and-control-category-code
  - organisation-type-description-text

- PERSON-TYPE
  - person-type-id (FK)
  - person-type-category-code
  - person-type-subcategory-code
  - person-type-rank-code
Building Blocks of the Object Tree: 
**OBJECT TYPE**

- Five basic sub-trees
- Captures the basic “class” specific data that are archetypical to the class of thing being designed
- Example: M1A1 Abrams MBT
  - Physical parameters
  - Class specific data
  - No organizational data
  - No location data
Building Blocks of the Object Tree:

**OBJECT_TYPE**

**MATERIAL_TYPE**

**EQUIPMENT_TYPE**

**LAND_WEAPON_TYPE**

<table>
<thead>
<tr>
<th>land_weapon-type-id</th>
<th>land_weapon-type-category-code</th>
<th>land_weapon-type-subcategory-code</th>
<th>land_weapon-type-calibre-text</th>
<th>land_weapon-type-fire-guidance-indicator-code</th>
</tr>
</thead>
<tbody>
<tr>
<td>081151</td>
<td>Artillery</td>
<td>155 MM</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>081152</td>
<td>Tank</td>
<td>120 MM</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>081153</td>
<td>Not otherwise specified</td>
<td>30 MM</td>
<td>No</td>
<td></td>
</tr>
</tbody>
</table>

Building Blocks of the Object Tree:

**OBJECT_ITEM**

**FEATURE**

* feature-id (FK)
* feature-category-code

**PERSON**

* person-id (FK)
* person-birth-date
* person-blood-type-code
* person-ethnic-group-code
* person-ethnicity-code
* person-religion-code

**FACILITY**

* facility-id (FK)
* facility-category-code
* facility-primary-construction-material-code
* facility-length-dimension
* facility-width-dimension

**MATERIAL**

* material-id (FK)
* material-category-code
* material-primary-construction-material-code
* material-long-dimension
* material-width-dimension

**ORGANIZATION**

* organization-id (FK)
* organization-category-code
* organization-nickname-name
Building Blocks of the Object Tree: 
**OBJECT_ITEM**

- Same sub-trees as **OBJECT_TYPE**
- Provides for the data required for identifying a specific instance
- Associates with **OBJECT_TYPE** for class data
  - Location
  - Status
  - ID
  - Unit

### Building Blocks of the Object Tree: **OBJECT_ITEM**

<table>
<thead>
<tr>
<th>object-item-id</th>
<th>object-item-category</th>
<th>object-item-name</th>
<th>object-item-alternate-identification-text</th>
</tr>
</thead>
<tbody>
<tr>
<td>78128</td>
<td>ORGANISATION</td>
<td>1 Bn 2 (US) Inf Bde</td>
<td>—</td>
</tr>
<tr>
<td>3651</td>
<td>ORGANISATION</td>
<td>— [Null: Enemy unit has been observed but not identified]</td>
<td>—</td>
</tr>
<tr>
<td>57</td>
<td>FEATURE</td>
<td>Rhone River</td>
<td>—</td>
</tr>
<tr>
<td>77709</td>
<td>FEATURE</td>
<td>Task Force Blue Goose FSCS, [Fire Support Coordination Line]</td>
<td>—</td>
</tr>
<tr>
<td>66499</td>
<td>PERSON</td>
<td>General Smith</td>
<td>—</td>
</tr>
<tr>
<td>4311</td>
<td>FACILITY</td>
<td>Blackburn Airfield</td>
<td>—</td>
</tr>
<tr>
<td>384753</td>
<td>FACILITY</td>
<td>MF432 [minefield]</td>
<td>—</td>
</tr>
<tr>
<td>5447</td>
<td>FACILITY</td>
<td>SFO-1210 [obstacle]</td>
<td>—</td>
</tr>
<tr>
<td>102</td>
<td>FACILITY</td>
<td>DIVISION TRUNK SYSTEM</td>
<td>—</td>
</tr>
<tr>
<td>5411334</td>
<td>FACILITY</td>
<td>Kharman Harbour</td>
<td>—</td>
</tr>
<tr>
<td>12950</td>
<td>MATERIEL</td>
<td>M-8066-YT [vehicle]</td>
<td>—</td>
</tr>
</tbody>
</table>
Supporting Structure for the Object Tree

- Actual Objects? Not necessarily
  - Networks are a type of FACILITY
  - Control Features are a type of FEATURE
  - Visibility as a type of FEATURE

- Multiple Instances of an Item are linked to a Type through the HOLDING association

- TO&E is shown through the ORGANISATION_MATERIAL_ASSOCIATION

Objects in Motion

STATUS, CAPABILITY, and ACTION

- All OBJECT_ITEMS have the capability to have their status reported on
  - Under Orders; Damaged; Loaded etc

- All OBJECT_ITEM associations have the capability to have their status reported on
  - Embarkation/Disembarkation; Join a Unit/Convoy

- Locations (point and relative) can be associated with OBJECT_ITEMS
Objects in Motion
STATUS, CAPABILITY, and ACTION

- The ability for objects to perform certain tasks is identified through the CAPABILITY entity
  - OBJECT_TYPE or OBJECT_ITEM

### CAPABILITY

<table>
<thead>
<tr>
<th>CAPABILITY</th>
<th>MANUFACTURING</th>
<th>CONSTRUCTION</th>
<th>DISTRIBUTION</th>
<th>INSTALLATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>100101</td>
<td>Machining</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>100102</td>
<td>Welding</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>100103</td>
<td>Casting</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>100104</td>
<td>Grinding</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>100105</td>
<td>Cleaning</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>100106</td>
<td>Painting</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>100107</td>
<td>Coating</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>100108</td>
<td>Taping</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>100109</td>
<td>Sealing</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

- Objects are given potential planning, or have their activity reported on by being linked, through association, to the Action tree.
The Action Tree

Move, Shoot,
Look, Communicate

ACTION

- Represents activity in the model: *something carries out an activity to affect something at some time*
- Includes mechanisms for specifying:
  - Items or classes as resources and objectives for activity
  - Recording effects of activity
  - Classifying activities as planned tasks or unplanned events
  - Keeping status of activities
  - Relating activities to each other functionally and temporally
Overall Structure: Actions and the Action Tree

- Actions – Task and Event
- Tasks are directed actions that an Entity (Object) can undertake
- Events are actions external to perceiving Entities

**ACTION Subtype Structure**

- ACTION-TASK: actions typically found in plans, orders, and requests
- ACTION-EVENT: an incident, phenomenon, or occasion that has occurred or is occurring but for which planning is not known
- Status entities (ACTION-TASK-STATUS and ACTION-EVENT-STATUS) allow progress of activities to be recorded
- NBC-EVENT and ACTION-EVENT-DETAIL are associated with ACTION-EVENT to handle specialized data requirements
ACTION-TASK

- Example: Planned times for ACTIONs that are part of an operational order

<table>
<thead>
<tr>
<th>Label</th>
<th>Resource</th>
<th>Activity</th>
<th>Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td>Action 1</td>
<td>52 Inf Dtr</td>
<td>Defend</td>
<td>Control Feature “Steel”</td>
</tr>
<tr>
<td>Action 2</td>
<td>1 (US) Corps</td>
<td>Destroy</td>
<td>5 Guards Tank Division</td>
</tr>
<tr>
<td>Action 3</td>
<td>1 RIR SH</td>
<td>Defend</td>
<td>MI 126</td>
</tr>
<tr>
<td>Action 4</td>
<td>2 RTR</td>
<td>Form a reserve</td>
<td>52 Inf Div</td>
</tr>
<tr>
<td>Action 5</td>
<td>1 RHA</td>
<td>Move</td>
<td>Hannin, GE</td>
</tr>
<tr>
<td>Action 6</td>
<td>3 GE Recce Sqn</td>
<td>Secure</td>
<td>Route Club</td>
</tr>
</tbody>
</table>

**ACTION-TASK Timing**

- action-task-minimum-duration
- action-task-estimated-duration
- action-task-maximum-duration
- action-task-planned-start-date
- action-task-planned-start-time
- action-task-start-qualifier-code: after, as soon as possible, at, before, no later than, not before
- action-task-planned-end-date
- action-task-planned-end-time
- action-task-end-qualifier-code

**Note:** “***” stands for action-task.
Timing Attribute Relationships

- Start
- End
- Time window
- Minimum duration
- Estimated duration
- Maximum duration

Basic ACTION Structure

- ACTION
- ACTION-FUNCTIONAL-ASSOCIATION
- ACTION-TEMPORAL-ASSOCIATION
- ACTION-RESOURCE
- ACTION-OBJECTIVE
- ACTION-EFFECT
- OBJECT-TYPE
- OBJECT-ITEM
Role of Objects

- **ACTION-RESOURCE**: OBJECT-ITEM or OBJECT-TYPE that is required, requested, allocated, or otherwise used or planned to be used in conducting a specific ACTION
- **ACTION-OBJECTIVE**: OBJECT-ITEM or OBJECT-TYPE that is the focus of a specific ACTION
  - E.g., helicopters transporting troops to a landing zone
- **ACTION-EFFECT**: perceived effectiveness of a specific ACTION against a specific item or its type
  - A quantity if the objective is an OBJECT-TYPE
  - A fraction if the objective is an OBJECT-ITEM
  - Can include unintended effects (e.g., collateral damage)

Relating ACTIONs Functionally

- **ACTION-FUNCTIONAL-ASSOCIATION**
  - One ACTION being dependent on, supporting, or derived from another ACTION
    - Has a provisional sub-ACTION
    - Has as a sub-ACTION
    - In order that
    - In response to
    - Is a modification of
    - Is a prerequisite for
    - Is a template for
    - Is an alternative to
    - Uses as a reference
Relating ACTIONs Functionally

- Complex statements, such as operations orders, can be constructed by relating simple statements in cascading hierarchies

ACTION 2 is the major action supported by ACTION 1. ACTION 1 consists of 4 ACTIONs, three that are directly subordinate to ACTION 1 and one subordinated to ACTION 5.

Relating ACTIONs Temporally

- ACTION-TEMPORAL-ASSOCIATION
  - Assignment of an ACTION (i.e., ACTION-TASK) to be time-dependent for its execution on another ACTION (e.g., ACTION-TASK or ACTION-EVENT)
    - Relative: e.g., starts at the end of, starts during and ends after, starts at the same time and ends after
    - Offset: subject ACTION is to start at some specified time interval before or after a particular reference point in the object task
    - Note: Absolute start and end times are specified in the attributes of ACTION-TASK
Extensions to the ACTION Structure

- ACTION-CONTEXT
  - Links ACTION to CONTEXT to state enabling, constraining, or otherwise relevant conditions on an ACTION
**ACTION-CAPABILITY**

- For resource employment planning and for in-progress management of resources during the life of an ACTION

**ACTION-RESOURCE-EMPLOYMENT**

- Additional guidance in the employment of resources either in relation to a specific objective or independently of it
**ACTION-OBJECTIVE**

- List of rules, authorizing organization, and status of request (application, cancellation, authorization)

**ACTION-TASK-RULE-OF-ENGAGEMENT**
CANDIDATE-TARGET-LIST

- Links candidate targets to operations planning

ORGANISATION-ACTION-ASSOCIATION

- Identifies the kind of responsibility an ORGANISATION may have for an ACTION (initiates, plans, disseminates, oversees, etc.)
C2IEDM Application Initiatives

Various C2IEDM Initiatives

- Interoperability, Data Control and Battlespace Visualization
- MOOTW FAST Toolbox Data Interchange
- Common Maneuver Network (CMN) and Mobility Common Operational Picture (M-COP)
- C4I-M&S Reference Object Model (CROM)
- Coalition Secure Management and Operations System (COSMOS)
- Autonomous Vehicle Control Language (AVCL)
- Schema and Ontology Development Efforts
Scenario Authoring and Visualization for Advanced Graphical Environments

• Maj Shane Nicklaus, USMC, *Scenario Authoring and Visualization for Advanced Graphical Environments (SAVAGE)*, Master’s Thesis, September 2001

http://MovesInstitute.org/Theses/ShaneNicklaus.pdf

• “This research presents an integrated Web access and 3D visualization strategy for Department of Defense (DOD) tactical messaging and operation orders using the Generic Hub data model and the Extensible Markup Language (XML).”
Interoperability, Data Control and Battlespace Visualization

• Capt James Neushul, USMC, *Interoperability, Data Control and Battlespace Visualization Using XML, XSLT, and X3D*, Master’s Thesis, September 2003

• “The application of structured data methodologies using the Extensible Markup Language (XML) allows organizations and systems to exchange and process battlespace information cooperatively.”

---

Battlespace Generic Hub (BGH) – XML Schema Extensions

- ARM: ATCCIS Replication Mechanism
- C2IEDM: Command and Control Information Exchange Data Model
- SQL
- ERWin™
- MS Access™
- Direct Mapping of BGH-ARM to BGH-TML captures all entities and preserves database oriented referential links. This allows extensibility while maintaining inter-database connectivity capability.

- Messaging via Web Services

- The BGH-TML is restructured to reflect the C2IEDM Key Entity relationships in XML

- MSG: Simulations
- RII
- MCCS
- CCE

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MOOTW FAST* Toolbox Data Interchange

- Capt Glenn Hodges, USA, *Designing a Common Interchange Format for Unit Data using the Command and Control Information Exchange Data Model (C2IEDM) and XSLT*, Master’s Thesis, September 2003
  
  http://www.movesinstitute.org/Theses/Hodgesthesis.pdf

- “Using a common data representation like C2IEDM coupled with the power of XML and XSLT, unit information can be transformed and interchanged between applications.”

*Flexible Asymmetric Simulation Technologies

Unit Data Interchange
Common Maneuver Network

- Common data representations across C4I systems and M&S (embedded M&S in FCS)
  - Battlespace Terrain Reasoning and Awareness (BTRA)
  - OneSAF Objective System (OOS)
- Various maneuver network representations under investigation
  - C2IEDM
  - Battle Management Language (BML)
  - Military Scenario Definition Language (MSDL)
  - Geography Markup Language (GML)
C4I-M&S Reference Object Model (CROM)

- **Goal:** Standard reference for simulation interoperability and alignment with C4I
- **Alignment studies**
  - Simulation representations are not aligned with tactical data models
  - Simulation community has no standard for interoperability with C4I systems
- **Created initial Army C4I Object Model from C2IEDM aligned with Joint Common Data Base Data Model**
  - Converted from LC2IEDM to Unified Modeling Language (UML)
  - Added JDM table entities for materiel and organization
  - Upgraded to C2IEDM v6.1 (CROM Baseline Version 1.1)
- **Follow-on Work:** Incorporate new and updated Battle Management Language (BML) hierarchies into CROM baseline (support BML mapping to C2IEDM)

COSMOS ACTD

- **Coalition Secure Management and Operations System (COSMOS) Advanced Concept Technology Demonstration (ACTD), 2005-2009**
  - “Enable rapid information exchange among MIP-compliant coalition C2 applications using the MIP specifications and procedures.”
- **Various initiatives planned:**
  - C2IEDM-enabled data interchange under role-based access controls
  - C2IEDM for description of roles
  - C2IEDM for description of the network
  - C2IEDM-based tactical chat (controlled vocabulary)
Autonomous Vehicle Control Language (AVCL)

- Autonomous Vehicle Control Language (AVCL)
  - XML language for arbitrary autonomous vehicle mission definition, inter-vehicle communication and mission-data storage
  - CDR Duane Davis, USN, PhD dissertation, in progress – designing the language for compatibility with JC3iEDM
  - May be useful to Battle Management Language (BML) development in defining a control language for robotic forces

- Adapt the Battle Management Language (BML) to context of Naval operations
  - Work proposed; not yet started
  - Scenarios: Anti-Submarine Warfare (ASW), SSBN / Special Operations Forces

AVCL in the Autonomous and Unmanned Vehicle (AUV) Workbench
Schema and Ontology Development Efforts

• NUWC/IDA: Physical and Logical representations of the C2IEDM in XML Schema posted to DoD Metadata Repository
• NATO M&S: Expressing an Object-Oriented representation of the C2IEDM in XML Schema
• IDA and others: Expressing C2IEDM data concepts and relationships in Web Ontology Language (OWL)
  – Future work to express business rules in OWL and Semantic Web Rule Language (SWRL)
• Domain extensions: Chemical, Biological, Radiological, and Nuclear (CBRN)

What Is Battle Management Language (BML)?

• BML is the unambiguous language used to:
  – Command and control forces and equipment conducting military operations, and
  – To provide for situational awareness and a shared, common operational picture.

Commander's Intent becomes Data!
BML Views

Doctrine

Protocols

Representation

Terms root in Doctrine, such as FM 101-5-1 AAP-6 ...

XML Web Services/Grid Services

Command & Control Information Exchange Data Model
5Ws in C2IEDM

- **WHAT**
  - ACTION-TASK
    - id (FK)
    - minimum-duration
    - maximum-duration
    - estimated-duration
    - planned-start-date
    - planned-end-date
    - planned-start-time
    - planned-end-time
  - ACTION
    - id
    - ACTION-id
    - ACTION-category-code
    - ACTION-name
  - ACTION-OBJECTIVE
    - ACTION-id
    - ACTION-OBJECTIVE-index
    - ACTION-OBJECTIVE-category-code
- **WHERE**
  - LOCATION
    - id
    - category-code
  - UNIT-TYPE
    - id (FK)
    - category-code
    - mobility-code
    - service-code
    - size-code
- **WHO**
  - ORGANISATION
    - id (FK)
    - ACTION-id (FK)
    - ACTION-OBJECTIVE-index
    - ACTION-OBJECTIVE-category-code
    - ACTION-TASK
    - ACTION-EVENT
  - UNIT-TYPE
    - id (FK)
    - category-code
  - POST-TYPE
- **WHEN**
  - ORGANISATION-ACTION-ASSOCIATION
    - id (FK)
    - ACTION-id (FK)
    - ACTION-TASK
    - ACTION-EVENT
    - effective-date
    - effective-time
    - intent-text
  - MATERIAL-POINT
  - FACILITY-LOCATION
  - PERSON-POINT
  - ORGANIZATION-POINT
  - FEATURE-LOCATION

XBML Testbed Distributed Interfaces

- **BML GUI**
- **SOAP**
- **ODBC**
- **XML**
- **C4IISI**
- **C2IEDM**
- **XML Parser**

- Distributed, Flexible Interfaces
- Common Syntax and Semantics between Services, and Coalition Partners
- Unambiguous terms needed for Plan Execution (Soldiers, Robots, Simulation Systems)
Joint BML Implementation Concept: Extend the C2IEDM

- Nation X Land
- Nation X Subsurface
- Coalition Joint
- Agency Z Disaster Relief
- Nation Y Air/Space
- Nation Y Submarines

in C2IEDM

Using XBML in Coalition Operations

- Coalition Planning System
- Coalition C4I System
- Ground Simulation
- Air Simulation
- XML Format C2IEDM Semantics
- 5 Ws Representation
- http transport
**Components of Data Engineering**

**Data Administration**
- Managing the information exchange needs incl. source, format, context of validity, fidelity, and credibility

**Data Management**
- Planning, organizing and managing of data, define and standardize the meaning of data as of their relations

**Data Alignment**
- Ensuring that data to be exchanged exist in all participating systems

**Data Transformation**
- Technical process of mapping information elements to each other (often implemented in gateways and interfaces)
Web-based Standards supporting Data Engineering

- XML as the common syntax and format of all components
- Data source registers data description following the idea of Universal description, discovery, and integration registries (UDDI)
- Mapping of data will be management of tag sets
- After data management using tag set, data alignment becomes one-to-one comparison
- Data management can lead to XSLT schema for data translation

Potential for Automation of Data Administration, Data Alignment and Data Translation based on Data Management

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Bringing in all together – XML Data Mediation Services based on the C2IEDM

1. Data Modeling and Data Documentation
   - XML Document

2. Data Administration

3. Data Management
   - Mapping to C2IEDM
   - Extending C2IEDM
   - Enhancing C2IEDM

4. Data Alignment

5. Data Transformation
   - Generate XSLT (+)

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Bringing in all together – XML Data Mediation Services based on the C2IEDM

1. Data Modeling and Data Documentation - XML Document
2. Data Administration
4. Data Alignment
5. Data Transformation - Generate XSLT (+)

Functionality of MapForce

MapForce Engine to preview output
Code Generators to automate transforms
XML, DB, EDI, Flat files

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Mapping Example I

Mapping Example II
Summary

- C2IEDM (and in the future JC3IEDM) is applicable for Common Reference Model
- Commercial tool sets available
  - Common documentation is required
  - Common configuration of solutions is the ultimate objective (configure mapping, not program it)
- More information during the workshop
  - 05S-SIW-007 Tolk/Blais
  - 05S-SIW-019 Tolk/Diallo/Dupigny/Sun/Turnitsa
  - 05S-SIW-068 Dobbs/DeMasi/Ritchie/Sudnikovich