Coalition Interoperability Ontology:  
Sharing Situational Awareness with Allies and Agents

Erik Chaum  
Naval Undersea Warfare Center, Division Newport,  
TTCP, Maritime Systems Group, TP1 US National Leader  
Chaume@npt.nuwc.navy.mil

Dr. Andreas Tolk  
Virginia Modeling Analysis & Simulation Center  
Atolk@ODU.edu
**Coalition Interoperability Ontology: Sharing Situational Awareness with Allies and Agents**

**Naval Undersea Warfare Center, Division Newport, 1176 Howell Street, Newport, RI, 02841**

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Disclaimer

• This presentation is not based on the paper prepared by Dr. Michael Wunder, FGAN.
• However, the presenters strongly support the idea to use data model driven ontologies to support coalition interoperability.
• In particular, both of them are supporting the use of the NATO Generic Hub model, also recommended by Dr. Wunder.
• It is highly recommended to read the paper of Dr. Wunder to gain insights in his viewpoints.
Decision Support Essentials

• Military decision maker
  – Intelligent part of today’s system

• Scenario
  – Well trained
  – Perfect Tactical Picture

• Decision makers need context to make decisions

Operational Context is today maintained in the warfighter “part” of tactical and command and control systems.
Operational Context

- The wide range of static and dynamic information about the military operations and the battlespace including:
  - the scope of operations
  - command relationships
  - task force order of battle
  - mission assignments/objectives
  - Commander's Intent
  - rules of engagement (ROE)
  - coordination guidelines
  - schedule of operations
  - communication schedules
  - battlespace management
  - sensor employment and management plans/guidance
  - threat assessment
  - environmental guidance
  - common tactical picture [CTP]

This information and knowledge is understood by people but must also be available and used by automated systems!
Global Information Grid

Operational Context

Shared Sensed Picture

Applications

Agents

Autonomous Systems

Sensor Driven

Context Driven

Sensing

Future Systems: Sensor and Context Driven
Achieving Shared Understanding
Core Ontology

- Special Ops
- Air Support
- Combat Service Support & Logistics
- Administration (Personnel)
- Engineer Operations
- Air Defense & Airspace Control
- Communications and Electronics
- Fire Support
- Intelligence/Electronic Warfare (IEW)
Coalition Interoperability Ontology

Cross Domain Interoperability

- Operations Planning & Analysis
- Command and Control & Tactical Systems
- Knowledge Mgmt., Decision Support
- Visualization
- Translation, Meta-model
- Relational DB Systems & Services
- Modeling & Simulation
- XML, Web Services, Meta-data
- Intelligent Agents, Autonomous Systems
- Core Ontology
 Capability Gaps

Global Exchange Ontology

Top-down “Unified”

Bottom-up “Negotiated”

Capability Shortfall

Today

Objective Capability

N

N²

8. ICCRTS
Why migrate to C2IEDM?

- History of LC2IEDM now C2IEDM
  - Developed by NATO data modeling experts (ATCCIS Permanent Working Group)
  - Based on the Information Exchange Requirements on the Battlefield
    - Unambiguous Representation of Information
    - Extensible Data Model
- NATO Standard ADatP-32
- Use by the NATO Data Administration Group
- Core Data Model for various C4I Systems
- Reference Data Model for various Simulation Systems
- Data Model for Multilateral Interoperability Program (MIP)
High Level View of C2IEDM

- Very well documented
  - Tables
  - Attributes
  - Relations
  - Extension rules
- XML tags
Who is using C2IEDM

• International
  ▪ NDAG
    • IER between C4I Systems
    • Standard Data Elements
  ▪ MIP
    • Data Exchange
  ▪ German Data Management Group
    • Reference Data Model for Simulation Systems
  ▪ France, Italy, Spain, …
  ▪ New NATO Nations

• United States
  ▪ Joint Staff
    • Situational Awareness Data Interoperability (SADI)
  ▪ US Army
    • MCS, BML, CROM, and Other
  ▪ NUWC, Newport, RI
    • The Technical Corporation Program (TTCP)
  ▪ Naval Postgraduate School, Monterey, CA
    • Battlefield Generic Hub
  ▪ Institute for Defense Analysis, Alexandria, VA
    • Data Alignment Studies

Overall, growing interest in C2IEDM
C2IEDM as an Extensible Ontology/Epistemology

- **Ontology:**
  - Theory about the nature of being or the kinds of existents

- **Epistemology:**
  - Typology for the ontology, theory of the nature and grounds of knowledge (in particular limits and validity)

- **Characteristics** of C2IEDM
  - Describe everything that is known actually
  - Define rules for extension in a way that will not affect the already modeled knowledge
How to use the C2IEDM

- C2IEDM is not “a relational data model”
  - Unambiguous semantic by standardized data elements (SDE)
  - Unambiguous extension rules
  - Notation using IDEF1X
    - UML Object Model
    - XML SDE Repository
    - HLA FOM

- C2IEDM is a **Common Reference Model**
  - Information Exchange Definition
  - Extension on an As-Needed Basis
Coalition Interoperability Ontology

Global Application

External

Federation Services

Export

Component

Export

Component

Local Application

DBMS 1

Database 1

System 1

DBMS N

Database N

System N

8. ICCRTS
Coalition Interoperability Ontology

Data Management

Data Mediation

Data Modeling

Data Administration

Data Alignment
First Version of the C2SIM-Proxy

Simulation Systems Federation

C2Sim-Proxy

RTI-Access-Layer

HLA / RTI

ATCCIS FOM

C4I Systems Data Replication

ATCCIS DB

DB-Access-Layer

ARM / Data Replication
Target Architecture for the C2SIM-Proxy

XML Document with arbitrary DTD

Data Mediation Services

RTI-Access-Layer

Data Replication using arbitrary Data Models

RTI with objects described in arbitrary FOMs

/ The Way Ahead
Summary

• To achieve the information age transformation envisioned by DoD leadership will require sharing a broader range of information and context.
  – Shared semantics and syntax make this more practical and affordable
• To enable information systems to find and reason about the information on the GIG we will also need to carefully mark it up with meta-data that has known semantics and syntax.
• C2IEDM provides a well designed, international, generic, extensible core ontology for military operations.