

Filling in the Ontology Space for C-BML

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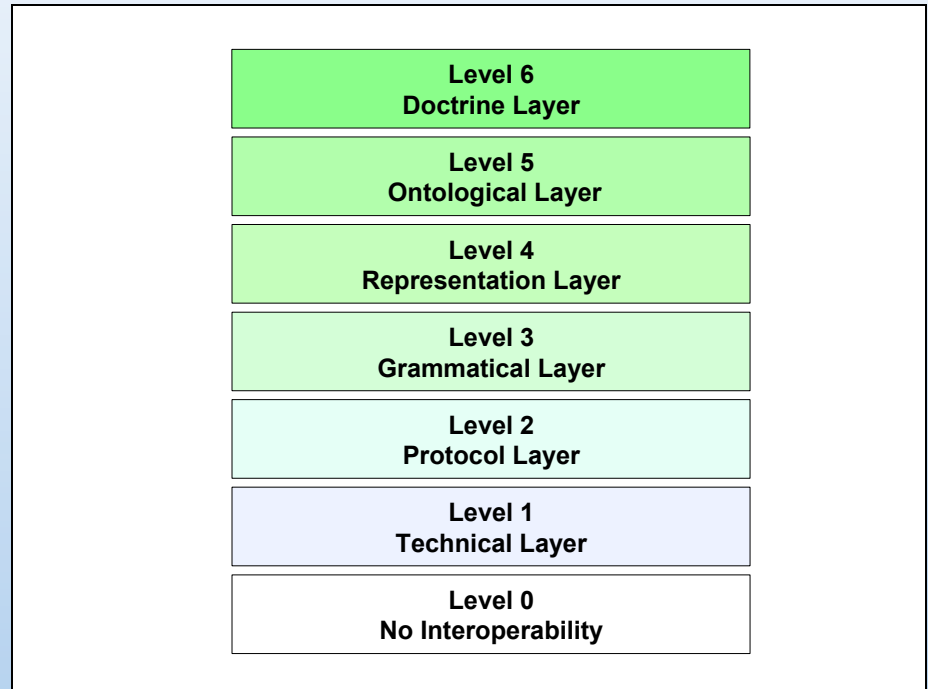
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Introduction and Motivation

- C-BML – Coalition Battle Management Language
- Ontology
- Ontology Space
- 07S-SIW-028 – Roadmap to this Presentation
 - Ontology Space, What is it?
 - Three Vertices
 - Candidate Sources
 - What we have, What we need

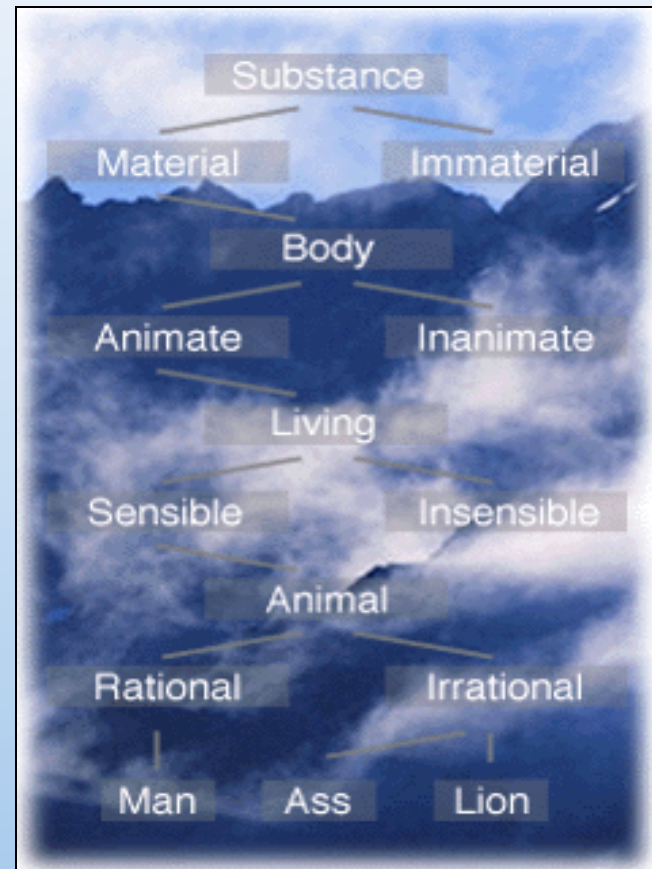
C-BML and Ontology

- C-BML is an ongoing research effort, involving SISO PDG work, as well as NATO MSG work
- Basic BML principle is observed
 - Protocol
 - Representation
 - Doctrine
- C-BML Development Phases
- Grammar and Ontology



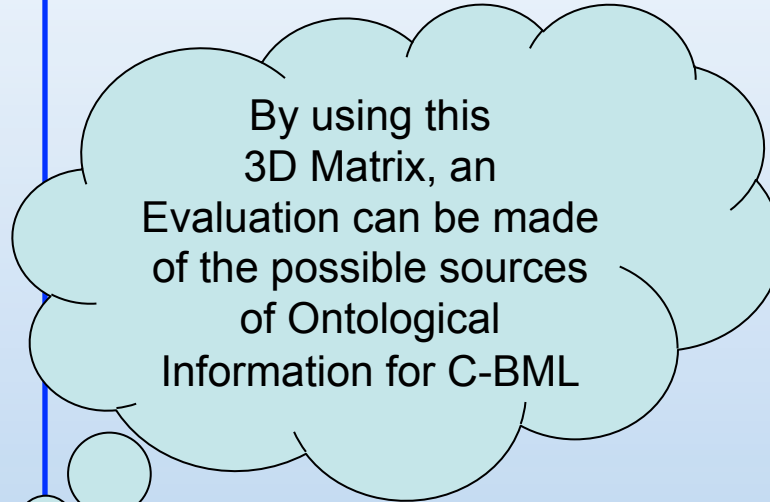
Ontology and Ontology Space

- Ontology – A method for representing Meaning
- Come in many different forms
 - Ontological Spectrum
- Serve different purposes in Interoperability
 - LCIM
- Unlikely that any one Ontology will cover Everything
 - Specified Domain
- Three Vertices of a complex Space



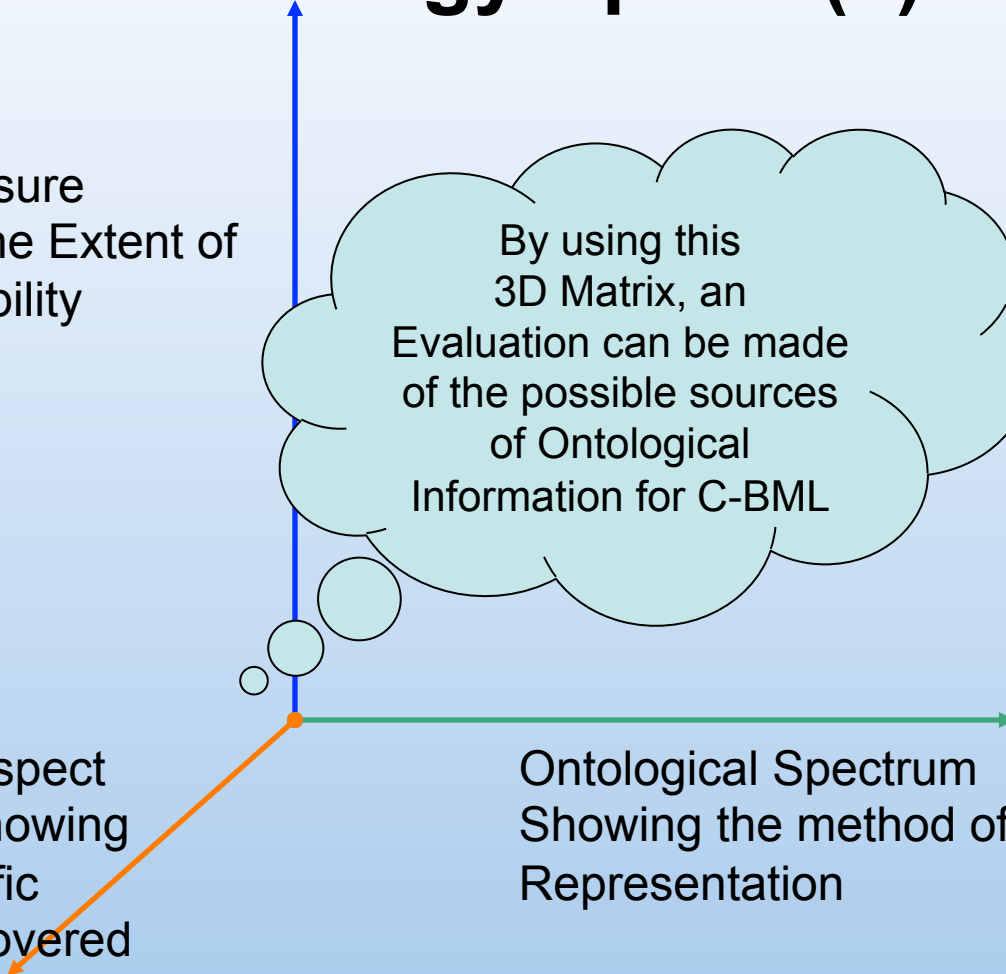
Ontology and Ontology Space (2)

LCIM Measure
Showing the Extent of
interoperability
supported



Domain Aspect
Index – showing
The specific
Domain covered

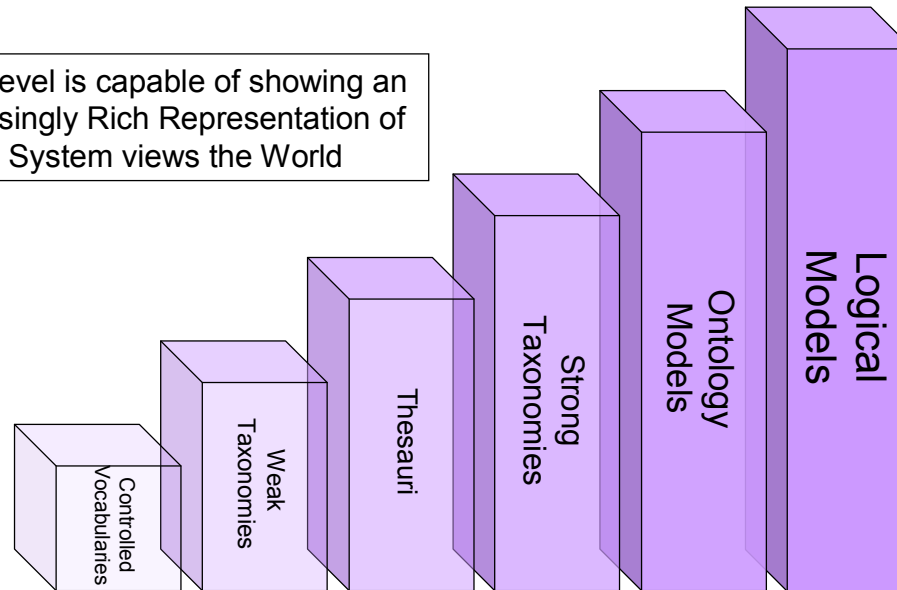
Ontological Spectrum
Showing the method of
Representation



First Vertex Ontological Spectrum

The Ontological Spectrum

Each level is capable of showing an
Increasingly Rich Representation of
How a System views the World

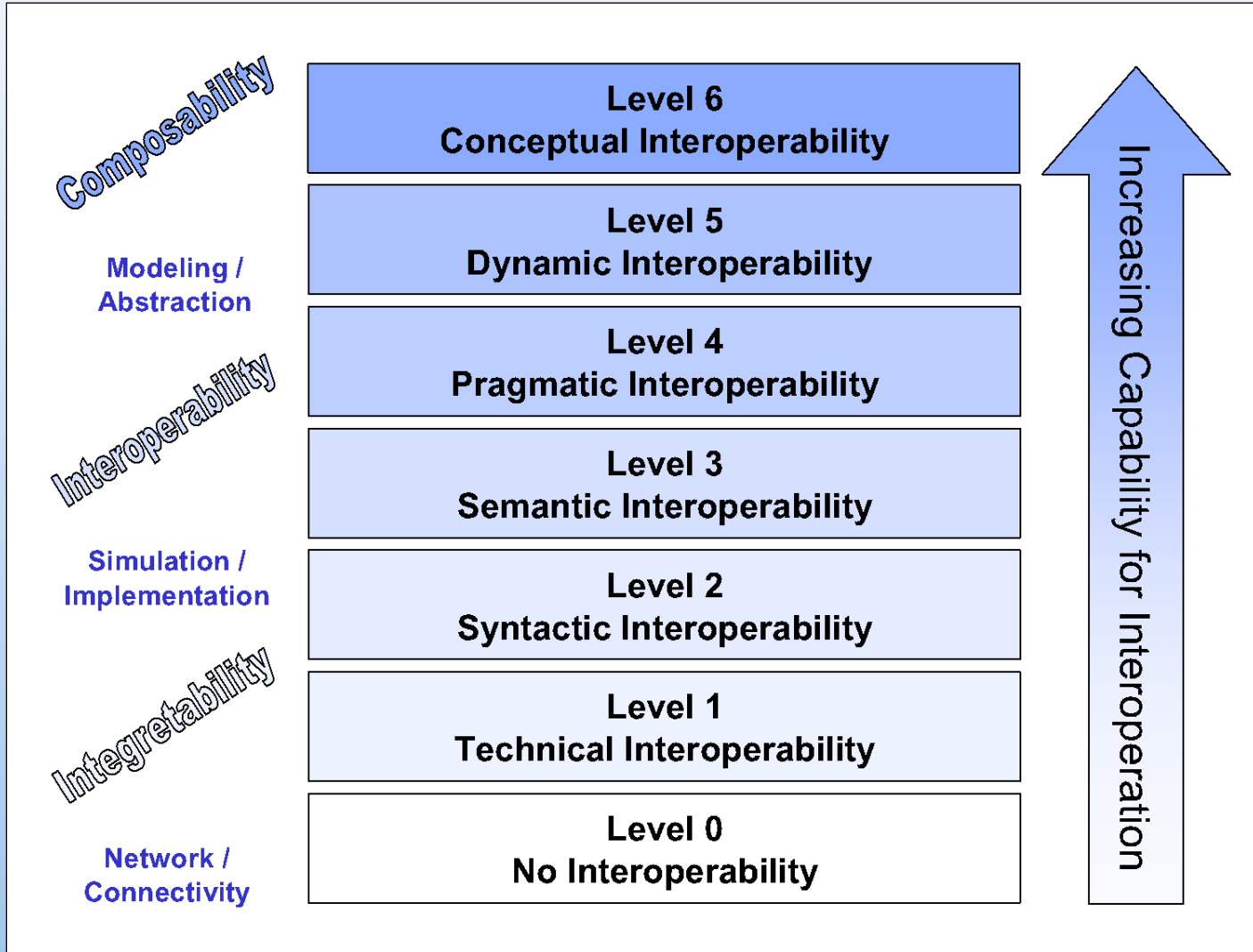


First Vertex

Ontological Spectrum (2)

- Controlled Vocabularies
 - Agreed to list of terms and values
- Weak Taxonomies
 - Lists categorized according to convenience
- Thesauri
 - Lists showing morphological relations (narrower-than, broader-than, etc)
- Strong Taxonomies
 - Lists categorized according to strict hierarchy of meaning
- Ontology Models
 - Strong Taxonomy, with the additional feature of all semantic relations shown
- Full Logical Models
 - Ontological model, with the additional feature of being based on a strict, formal logical representation method, fully axiomatized

Second Vertex LCIM



Second Vertex LCIM (2)

- Levels of Conceptual Interoperability Model is an interoperability metric
 - Developed to show (1) how much interoperability is possible between systems, based on the nature of the information being exchanged
 - Also shows (2) what is needed in order to support a given level of interoperability

- The upper levels of the model (past levels 2/3) rely on some exchange of information based on either an agreed-to or exchanged representation of meaning – an ontology

- Certain methods of the Ontological Spectrum are necessary to exhibit the required ontological depth of representation for higher levels of the LCIM

Third Vertex

Domain to be Covered

- Domain to be covered includes a number of possible characteristics, which can define the portions of the Universe of Discourse (in the case of C-BML, C2 related elements of the battlespace) are to be addressed

- Characteristic examples can include:
 - Functional Area (Land Operations, Air Operations, Civic Structure, etc)
 - Aspects of UoD (terrain, entity representation, orders, reports, etc)
 - Focus of Representation (aggregate/entity, process/results)

- For a non-trivial Universe of Discourse, being addressed by a number of different systems, it is not likely that any one ontology source can cover all of these

Third Vertex

Domain to be Covered (2)

- For the purposes of our evaluation, we limited the characteristics in this vertex to the aspects of the Universe of Discourse for C-BML
- The universe of discourse for C-BML (C2 perspective of the battle space) may mandate consideration of other characteristics
- The choice of characteristics is based, somewhat, on the sources evaluated

Characteristics Considered

Entity/Unit Representation

C2 Messages/Report

Battlefield Effects/Affects

Environment (Natural/
Manmade)

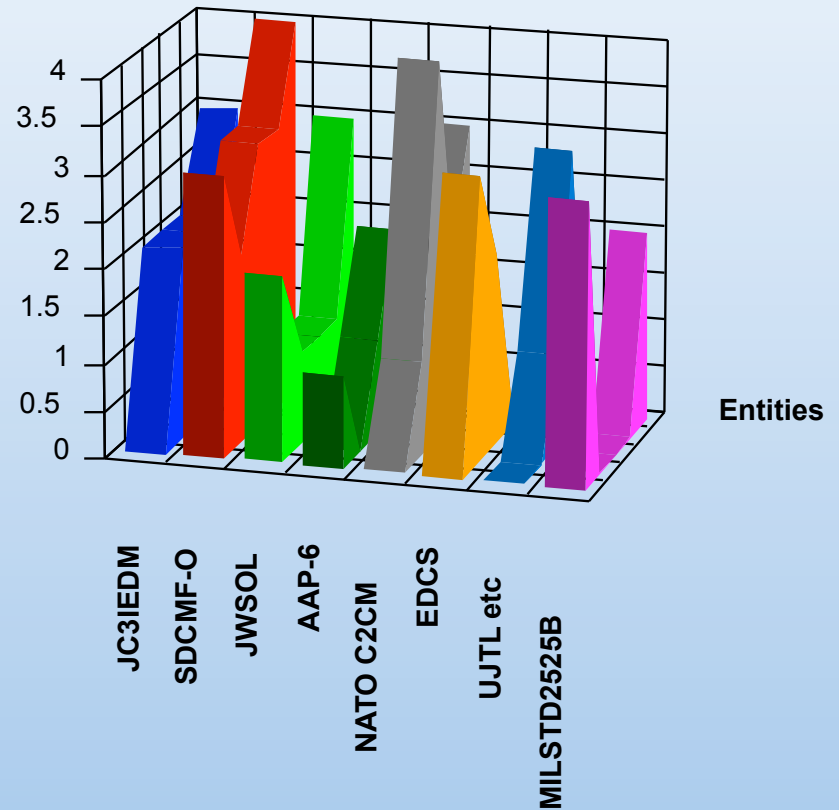
Symbology/Visual
Representation

Candidate Sources

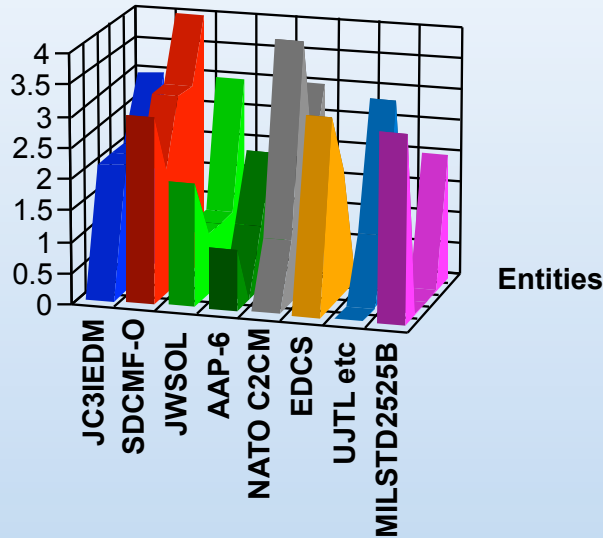
- JC3IEDM Enumerations
 - Objects and Actions (and related data), for C2 messaging exchange
- Swedish Defence Conceptual Modeling Framework – Ontology
 - Defense Domain (C2, M&S, Operations, Planning, etc)
- Joint Warfare Simulation Object Library
 - Agreed-to terms for US Joint Warfare Simulations
- NATO Glossary of Terms and Definitions (AAP6)
 - Bi-lingual glossary of terms and definitions
- NATO C2 Conceptual Model
 - C2 related terms and concepts (command, group attributes, etc)
- SEDRIS
 - Synthetic Environment – terrain, weather, etc
- UJTL/AUTL
 - Universal Task Lists (joint, army, etc)
- MilStd 2525B
 - Unit Symbology

Component Analysis and Dimensionality Reduction

- For the purposes of comparison of sources, a reduction in the number of these dimensions (vertices) was necessary (as one axis was reserved for the candidate sources)
- The level of representation achieved in the Spectrum is a driver for how high of a level in the LCIM is attained, so these components can be reduced (second axis)
- The domain characteristics provided the third axis



Sources Compared Resulting Metrics



	Entities	C2 Msgs	Battlefield	Environment	Symbology
■ JC3IEDM	3	2	2	2	0
■ SDCMF-O	4	3	3	2	3
■ JWSOL	3	1	1	1	2
■ AAP-6	1	2	1	0	1
■ NATO C2CM	3	2	4	1	0
■ EDCS	0	0	2	3	0
■ UJTL etc	0	3	1	0	0
■ MILSTD2525B	2	0	0	0	3

Assessment and Future Work

- Some areas are very well covered, according to our measured Characteristics
 - Entities and Units are very well represented (level 4 – strong taxonomy) by the Swedish Conceptual Modelling Framework
 - Battlefield Effects are very well represented (again, level 4) by the NATO C2 Conceptual Model

- Other areas are not so well covered (most, however to the level of a thesaurus of terms)

- What is missing are the other potential characteristics to be considered (the functional area needs to be taken in, as well as the focus of representation)

Assessment and Future Work (2)

- What is needed moving forward?
 - Additional Sources
 - Consideration of the additional characteristics in evaluation

- With what we have, or with what we will have, what must we do?
 - Choose a method for capturing the representation
 - Apply to the C-BML standard in a way that supports the methods listed in SIW 06F-SIW-002 (Ontology Applications for M&S)
 - Ontology-Based Search
 - Neutral Authoring
 - Ontology as Specification
 - Common Access to Information

- Of these four methods, the third and fourth are most important to C-BMI

Questions?

Thank You!

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