A Concise Summary of Battle Management Language

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BML Motivation

The Problem

- Our current Command and Control language is tailored to interpersonal communication
- Our C2 vocabularies are founded in Doctrine, but lack clearly delineated rules governing their use (semantics and syntax)
- They are riddled with ambiguity and overlapping definitions
- As such, our current BML is incapable of supporting the full range of automation possible with Network-Centric Operations
- It will not support the integration of advanced decision support tools with digital Command and control
Example: Defining C2 for the Future Network Centric Forces – How will they Communicate Orders?

Network Centric
- Explicit understanding of orders and operations in a distributed environment
- Know precisely, in real-time, location of all friendly and enemy forces

Robotics Integrated into Force
- Amplify capability of manned elements
- Multi-functional (scouting, armed, sustainment)

Increased Reliance on Extended Range Engagement
- Organic plus strategic and tactical support
- Long range ISR and precision fires

Operational Advantages
- C2 operators can use their own C2 systems to perform unit training and mission rehearsal
- Faster Decision Cycles
- Reduce cost of training
- Consistency of Interpretation of Orders
BML Definition

BML is designed to be an unambiguous language to:

- Command and Control live and simulated forces conducting military operations
- Provide for situational awareness and a shared, common operational picture.
BML - A More Detailed Definition

BML is a precise, unambiguous, engineered representation of professional knowledge necessary for the Command and Control (C2) of Military Forces

- Captures C2 Business Logic based within the organization, processes and structures of the warfighting domain
- Results in a semantic and syntactic consistency required to achieve shared, common understanding for C2 data, information and knowledge

BML Principles - Operationalized

- BML expressions must reduce ambiguity to a minimum
- BML must be expressive enough to communicate the commander’s intent in a net-centric environment
- BML needs to be extendable into multiple functional domains
The vocabulary must be well defined in the context of operations within an application domain to facilitate exchange information, ensure coherent results and support automated reasoning.

Therefore, initial BML implementations use the Multilateral Interoperability Programme's (MIP) data model, the Joint Command Control and Consultation Information Exchange Data Model – JC3IEDM.

⇒ Initial BML Vocabulary: JC3IEDM
⇒ Future BMLs will be able to use a variety of C2 Data Models

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**JC3IEDM**

- Provides Core C2 Semantics
- Comprehensive
- Very well documented
  - Tables
  - Attributes
  - Relations
- Allows and supports
  - Doctrinal extension
  - Evolution of utility

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Formally, BML expressions have to be understandable by systems. Therefore, we have developed a grammar that assigns more detailed semantic (thematic) roles to the 5 Ws.

The 5 Ws in the JC3I EDM with some mappings to the structure
BML Example

Caspian Sea Task Organization

Combined Joint Forces Land Component Commander
Task Organization / Mission Flow

3rd Stryker Brigade

October 17th, 2007
Mission Flow and Tasks

CJFLCC – TA 1 Deploy/Conduct Maneuver (UJTL CJCSM 3500.04D)

3 Corps – ART 8.1.2 Conduct an Attack (AUTL FM 7-15)

2 ID(M) – ART 8.1.2 Conduct an Attack (AUTL FM 7-15)

3 SBCT – 07-6-1092 Conduct an Attack (ARTEP 7-32-MTP)

1 Battalion 3 SBCT – 07-1-1171 Conduct an Attack Against a Stationary Force (ARTEP 7-22-MTP)

A Company 1 Battalion 3 SBCT – 07-2-1256 Conduct an Attack by Fire (ARTEP 7-12-MTP)

BML Representation - 5Ws

Battalion Mission
1/3 SBCT attacks on order in zone to defeat 1/181MRB vic PL BANANA.

Battalion Concept of Operations
Main effort: B/1/3 SBCT
on order A/1/3 SBCT
Supporting effort: A/1/3 SBCT
C/1/3 SBCT

<table>
<thead>
<tr>
<th>Who</th>
<th>What</th>
<th>When</th>
<th>Where</th>
<th>Why</th>
</tr>
</thead>
<tbody>
<tr>
<td>A/13 SBCT</td>
<td>Movement to Contact</td>
<td>On order</td>
<td>Axis A1</td>
<td>Contact Enemy</td>
</tr>
<tr>
<td>A/13 SBCT</td>
<td>Attack by Fire</td>
<td>On order</td>
<td>ABF A1</td>
<td>Defeat A/1/81</td>
</tr>
<tr>
<td>A/13 SBCT</td>
<td>Attack</td>
<td>On order</td>
<td>Axis A2</td>
<td>Seize OBJ A1</td>
</tr>
<tr>
<td>B/13 SBCT</td>
<td>Attack</td>
<td>On order</td>
<td>Axis B1</td>
<td>Seize OBJ B1</td>
</tr>
<tr>
<td>C/13 SBCT</td>
<td>Movement to Contact</td>
<td>On order</td>
<td>Axis C1</td>
<td>Contact Enemy</td>
</tr>
<tr>
<td>C/13 SBCT</td>
<td>Attack by Fire</td>
<td>On order</td>
<td>ABF C1</td>
<td>Defeat C/1/81</td>
</tr>
<tr>
<td>C/13 SBCT</td>
<td>Attack</td>
<td>On order</td>
<td>Axis C2</td>
<td>Seize OBJ C1</td>
</tr>
</tbody>
</table>

Attack by Fire Positions developed with geoBML

Tasks to Subordinates
5 Ws: Who, What

- WHO
- WHAT
- WHEN
- WHERE
- WHY

5 Ws: When

- Start: On order
- End: As soon as possible after

Tasks to Maneuver Units

Current Unit: 1/3 SUCT

- Conduct an Attack
  - START: On order
  - END: After null null

Start: AO PITHON
End: Defeat 181 MECH BDE
5Ws: Where

Tasks to Maneuver Units

Current Unit: 1/3 SBCT

What | When | Where | Why
--- | --- | --- | ---
Conduct an Attack | On order | BML | After null null

5Ws: WHY

Definition:
The other armed or naval force commander's plan and continue his will to fight so that he is satisfied or unable to follow pursuer's adopted course of action and prove to the will of his opponent. (AFCOM)

Tasks to Maneuver Units

Current Unit: 1/3 SBCT

What | When | Where | Why
--- | --- | --- | ---
Conduct an Attack | On order | BML | After null null
BML Standardization

SISO C-BML

• The Simulation Interoperability Standards Organization (SISO) Coalition Battle Management Language
  – Study Group 2005-2006 recommended development of a standard for C2-Simulation interoperability
  – Product Development Group charter now pending

• Three phases:
  – Phase 1: XML schema using C2IEDM/JC3IEDM
  – Phase 2: Development of a BML grammar
  – Phase 3: Ontology-based Specification

• Currently focused on getting Phase 1 draft to ballot April 2008
NATO MSG Technical Activity 048

• MSG Exploratory Team 016 considered the potential of BML to facilitate C2-Simulation interoperability for coalitions
  – Recommended three-year technical activity to experimentally evaluate use of SISO C-BML
  – Wrapped up with France-US demonstration indicating relative ease (and potential pitfalls) of technique
• Technical Activity MSG-048 is undertaking experimental evaluation 2006-2008

MSG-048 I/ IITSEC’07 Demonstration

First major MSG-048 capability will build on US JBML in a multinational configuration
  – NOR, NLD, DEU, FRA, DEN, USA, SPA
  – USA: JBML configuration (with small changes) plus VMASC open-source JC3IEDM map viewer
  – NOR: NORTaC C2 System
  – NLD: ISIS C2 System
  – DEU: C2 Lexical Grammar (C2LG) GUI
  – FRA: SCPIPO simulation
  – SPA: SIMBAD simulation
MSG-048 I/ITSEC’07 Configuration

MSG-048 I/ITSEC’07 Scenario

- Six demonstration sessions will highlight different parts of the scenario and architecture
  - Briefers from participating nations
- Use US Caspian Sea terrain
- Context: former colony (failed state)
- NATO Task Force providing security assistance
- Mission: secure airport
  - US secures bridges providing access to airfield
  - NO/NL forces secure the airfield
MSG-048 Future Plans

• Improve the current architecture and scenario with other National C2 or simulation systems
  – GBR
    • ALPS: Simulation of Army-focused C2 application; MIP-compliant
    • JSAF: Customized for UK equipment, units, behaviors
    • Longer term: Operational C2 systems (e.g. Bowman/ComBAT and JADOCS) and Survey of UK requirements for C-BML
  – FRA: introduce C2 system SICF
  – DEN: adapt Sitaware as the commander C2 system
  – USA: improved geospatial and situational awareness

• Implement spot and intel reports
• Develop a new experiment next year
There are general constructs that must hold if BML is extended to other domains than Land Warfare

These deal with Operations through Space and Time in a unifying Geospatial Framework

A Command and Control Management Language can be developed to be a powerful foundation for future “BMLs”
A BML Specification is being developed as:

- A Standardized XML Schema supported by
  - a set of Web Services
  - standard semantics
- A Formal Grammar

Specific BMLs (such as the Army BML) will use the BML Specification and add “engineered knowledge” to create a functional BML that has the ability to relate specific Missions to Geospatial products and other Information.
Joint Battle Management Language

Building upon work done to extend the US Army BML Implementation, a specification was developed in FY07 to be:

- A Joint BML Specification for Land, Naval and Air Operations
- A draft Phase 1 Standard for the SISO C-BML process

JBML is implemented as a set of Open Source Web Services
JBML Service Architecture

JBML Layered Services

- **Top layer:** Domain-Configured Service
  - XML-encoded "language"
  - Characterized by XML schema
  - Implemented as Web service
- **Middle layer:** BML Base Service
  - Composite "building block" transactions applicable to multiple domains
  - Characterized by mappings from XML schema to JC3IEDM entities (database tables)
  - Implemented as software service (optionally accessible as Web service)
- **Bottom layer:** Common Data Access Service
  - Software service providing wrapper around SQL
  - Optionally accessible as Web service
J BML Domain-Configured Service (DCS)

Purpose:
- Provide a high-level, semantically consistent, XML-based language definition
- Modular and readily extensible
- Structure based on C2 Lexical grammar of Hieb & Schade
  - Gives high confidence the language will meet BML needs
  - No actual grammar processing yet; just a way to structure JBML

<task> (verb)  <tasker-who>
<taskee-who>   <affected-who>
<what> (action)  <where>
<start-when>   <end-when>
<why>         <label>
<modifier>

J BML Service Architecture Top Layer

Domain Knowledge fully defines domain language
**J BML DCS OrderType**

```xml
<xsd:complexType name="OrderType">
  <xsd:sequence>
    <xsd:element name="OrderMode" type="OrderModeType" default="SINGLE" minOccurs="0"/>
    <xsd:element name="TaskersIntent" type="FreeTextType" minOccurs="0"/>
    <xsd:element name="Task" type="TaskType" maxOccurs="unbounded"/>
    <xsd:element name="OrderIssuedWhen" type="WhenType"/>
    <xsd:element name="OrderID" type="OrderIDType"/>
    <xsd:element name="TaskerWho" type="WhoType"/>
    <xsd:element name="TaskOrganization" type="msdl:TaskOrgType" minOccurs="0"/>
    <xsd:element name="EnemyTaskOrg" type="msdl:TaskOrgType" minOccurs="0"/>
    <xsd:element name="ControlMeasures" type="MultipleControlMeasuresType" minOccurs="0"/>
    <xsd:element name="TargetList" type="TargetListType" minOccurs="0"/>
  </xsd:sequence>
</xsd:complexType>
```

**J BML DCS Joint TaskType**

```xml
<xsd:complexType name="TaskType">
  <xsd:choice>
    <xsd:element name="GroundTask" type="GroundTaskType" minOccurs="0" maxOccurs="unbounded"/>
    <xsd:element name="AirTask" type="AirTaskType" minOccurs="0" maxOccurs="unbounded"/>
    <xsd:element name="MaritimeTask" type="MaritimeTaskType" minOccurs="0" maxOccurs="unbounded"/>
  </xsd:choice>
</xsd:complexType>
```
JBML DCS GroundTaskType

```xml
<xsd:complexType name="GroundTaskType">
  <xsd:sequence>
    <xsd:element name="TaskeeWho" type="WhoType"/>
    <xsd:element name="What" type="GroundWhatType"/>
    <xsd:element name="Where" type="WhereType"/>
    <xsd:element name="StartWhen" type="WhenType" />
    <xsd:element name="EndWhen" type="WhenType" minOccurs="0"/>
    <xsd:element name="AffectedWho" type="WhoType" minOccurs="0"/>
    <xsd:element name="Why" type="GroundWhyType" minOccurs="0"/>
    <xsd:element name="Label" type="LabelType"/>
  </xsd:sequence>
</xsd:complexType>
```

JBML BML Base Service (BBS)

- **Purpose:**
  - Provide basic building blocks that can be used by multiple domains
    - push/pull API and push/pull Web service
  - who/what-when/where/why/controlMeasures etc.
  - Logical transactions that are “atomic” in the Computer Science sense
    - Must be committed to database all-or-nothing
  - Avoids need to recode the building blocks for every new domain
    - "Where" touches up to 14 tables
    - And requires 373 lines of code, including comments/whitespace
    - To be interoperable, this must be done right – why do it over for every system that is interfaced?
JBML mapping to J C3I EDM Schema field <Why>
J BML Service Architecture Top Two Layers

- Web Service Exchange Interface
- Domain Knowledge fully defines domain language
- BML Domain-Configured Service

J BML BBS WhyType

```xml
<xsd:annotation>
  <xsd:documentation>Defines Why a Task is undertaken</xsd:documentation>
</xsd:annotation>
<xsd:simpleType name="WhyTypeEffectDescriptionCode">
  <xsd:restriction base="xsd:string">
    <xsd:enumeration value="DSTRYK"/>
    <xsd:enumeration value="FKIL"/>
    <xsd:enumeration value="IDNT"/>
    <xsd:enumeration value="ILLUMN"/>
    <xsd:enumeration value="INTREC"/>
    <xsd:enumeration value="KILL"/>
    <xsd:enumeration value="LDAM"/>
    <xsd:enumeration value="LGTRST"/>
    <xsd:enumeration value="MKIL"/>
    <xsd:enumeration value="MODDAM"/>
    <xsd:enumeration value="NORSTN"/>
    <xsd:enumeration value="NOS"/>
    <xsd:enumeration value="SDAM"/>
    <xsd:enumeration value="SUPRSD"/>
  </xsd:restriction>
</xsd:simpleType>
```
JBML Common Data Access Software (CDAS)

- **Purpose:**
  - Access the JC3IEDM database (push/pull API and WS)
  - Since the database is SQL-based, this only needs to be a wrapper
    - With validation that only the intended tables are accessed
  - We run this in pull-only mode
  - If it is intended to push BML input directly through JC3IEDM, the CDAS push service needs much better validation of data values
  - We didn’t build that sort of service because it lacks the control needed for multiple users to update
    - All tables for a transaction must be updated together with no intervening access by other users
    - We keep this turned off

JBML Service Architecture Three Layers

- Domain Knowledge
  - fully defines domain language

- BML Domain-Configured Service
  - Web Service Exchange Interface
  - XSD/FILES

- BML Common Data Access Software
  - JC3IEDM Domain Specific Extensions

- JC3IEDM Database
  - JC3IEDM

Reference Implementation middleware common to all BML domains

Defined Interfaces
all layers include validation
JBML Service Architecture Future

JBML Web Services Available

Available at http://netlab.gmu.edu/JBML:
- Descriptive documents
  - Architecture overview
    - Domain Configured Service (DCS); BML Base Service (BBS); Common Data Access Service (CDAS)
  - Code documentation (narrative & Javadoc)
  - XSD Web service schema
  - Supporting JC3IEDM mappings
  - SQL database schema
- Open source code
  - Latest version of all Web services
    - CDAS and BBS made possible by open source bootstrap of VMASC Atomic and Composite services
    - GUI to inspect JCDIEDM database using CDAS
JBML XML Schema Definition (xsd) on JBML website

- DCSOrderPush, DCSOrderPull
  - Top-level definition of Joint order C2 and Simulation services
- OrderTypes
  - Defines Joint operations order consisting of multiple Air, Ground, and Maritime commands
- AirTypes, GroundTypes, MaritimeTypes
  - Define domain-specific information
- FiveWTypes
  - Defines common Who / What-When / Where / Why etc.
- msdlTypes
  - Describes reusable MSDL schema from their webpage
  - This approach implements SISO guidance to make MSDL and C-BML interoperable

JBML Demonstration 3 May 2007
Joint BML OV-1

C2 Domain Language(s)

Command and Control Systems

- Ground BML
  - SIMCI

- Maritime BML
  - NPS

- Joint BML
  - DMSO

- Cultural
  - ERDC

- Logistics

Modeling and Simulation Systems

- Air BML
  - JFCOM
  - DMDC

- Joint BML
  - DMSO

- Cultural
  - ERDC

- Logistics

JC3IEDM database

J BML Demo Environment

BML – C2 Interfaces

- C2 Specific Interface
- USMTF plus
- XML

NATIVE BML

JTC

Maritime

GCSS/TBMCS

Air

C2PC/CAPES

Ground

BML

October 17th, 2007 BML Conference
Direct connection is feasible but JBML did not do
Requires all systems fully operational at once
Demo Concept of the Operation

• **Army** units proceed through **Urban Areas**, seizing designated objectives and destroying enemy forces, in order to reestablish an international border.

• They are preceded by:
  – **Navy** and **Air Force** strikes on key C2 and communication nodes
  – Close Air Support strikes
  – Pre-planned Navy Tomahawk strikes
Conclusion
In the Past ...

Integration Framework - Today
Integration Framework - Future

Operational Advantages

- C2 operators can use their own C2 systems to perform unit training and mission rehearsal
- Reduce cost of training
- Eliminate unambiguous orders
- Enhance coalition operations