Overview and Future Promise of Battle Management Language

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Content

1. BML Definition
2. BML Motivation
3. BML Projects
4. BML Standardization
5. BML Research
6. BML’s Future
BML Definition

Battle Management Language

BML - 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 Principles

• BML expressions must have a minimum of ambiguity

• BML must be expressive enough to communicate the commander’s intent in a net-centric environment

• BML needs to be extendable into multiple dialects

Application of BML

BML is being developed as a standard representation of digitized C2 information for executable plans, orders, requests and reports for:

• military units,
• simulated forces, and
• future robotic forces.
BML Implementation

BML is being developed as:

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

- A Formal Grammar

BML Motivation
The Problem

- Our current “BML” is a language 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 “digitized” 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

Capable of Air-Mobile Operations
- Commercial and minimum DoD strategic and tactical lift
The vocabulary must be well defined in the context of operations within an application domain to facilitate exchange information, facilitate 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

**JC3IEDM**

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

C2 Domain Languages

Command and Control Systems

Ground BML
Army SIMC
geo BML
Maritime BML
Joint BML
NPS
Air BML
JFCOM
DMOC
Logistics BML
S&R BML

Modeling and Simulation Systems

BML Promise

Command and Control Applications

Ground BML
Maritime BML
Air BML
geoBML
Logistics BML
Peacekeeping BML
Crisis Management BML

Decision Support Services

JC3IEDM database
BML Projects

• Build and demonstrate an initial Joint Battle Management Language Capability to transmit Digital Orders to Joint and Combined Forces using a Battle Management Language Specification

• Leverages work done with the US Army on an initial Army BML and projects sponsored by the Defense Modeling and Simulation Office and Joint Forces Command extending the Army BML to Air Operations
JBML Service Architecture

JBML Scenario — Gulf of Caspia Joint Operations
geoBML is an Unambiguous Language
- Both domain specific and cross-cutting
- Defined by the role of actionable geo-information in the C2

Provides Unification...across
- Doctrine and terms
  - Explicit vocabulary and grammar
  - Specific context mapped to operations, missions and tasks
- Explicit Representation
  - Consistent extension to the JC3IEDM
    - Standard framework and exchange model
  - Computational structure
  - Both necessary and sufficient for shared, common understanding
- Protocols
  - Explicit structure for transmission / sharing

Mobility Corridor at the National Training Center generated in ArcGIS for geoBML
BML Standardization

BML Standardization Initiatives

SISO Product Group for Coalition Battle Management Group (C-BML)

- C-BML Study Group approved by SISO in September, 2004
- Participants represent a wide body of expertise, including:
  - Representatives from over 11 different nations
  - Over 100 participants at SG meetings
  - Industry, Academia, Government
- Product Development Group
  - Approved Spring of 2006
  - Three phases
  - Multi-National effort Co-Chaired by U.S. and UK
BML Standardization Initiatives

NATO Working Group MSG-048
- Exploratory Team (ET-016) developed need for a Working Group
- The formal Working Group was chartered for three years (FY06-08)
- 10 Nations currently participating
  US  UK  Holland
  France  Germany  Turkey
  Denmark  Norway
  Canada  Spain
- Will Evaluate C-BML SISO Specification through coordinated National Development
A formal language is defined by a **grammar**. The grammar provides

- **a lexicon**
  in order to determine the words which may be used as well as their semantics (their meaning);

- **a finite set of rules**
  in order to determine how to concatenate the words and to give meaning to the catenations.

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**The Development of a Formal Grammar**

Formally, a grammar $G$ consists of

- **a lexicon** $\Sigma$ (which is a set of terminal symbols, the words),
- **$N$, a set of non-terminal symbols,**
- **$P$, a set of production rules,** and
- **$S$, the start symbol.**

$G = \{\Sigma, N, P, S\}$

In addition, the following holds: $S \in N$ and $N \cap \Sigma = \emptyset$. 

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Lexical Functional Grammar (LFG) is a theory of grammar -- that is, in general terms, a theory of:

- syntax (roughly, how words can be combined together to make larger phrases, such as sentences)
- morphology (how morphemes --- parts of words can be combined to make up words),
- semantics (how and why various words and combinations of words mean what they mean), and
- pragmatics (how expressions are used to transmit information)

We use the Lexical Functional Grammar as the basis for the Formal BML Grammar which we call:

**Command and Control Lexical Grammar**

An Extensive Literature on LFG

http://www.essex.ac.uk/linguistics/LFG/

A Selection:


Developing the Command and Control Lexical Grammar (C2LG)

Doctrine (STANAG 2014): The C2LG is designed to be consistent with a standard five paragraph order

OpOrderSection3 → Command_Intent OB* Coord_Space* Coord_Time*

Command_Intent → [Expanded Purpose] [Key Tasks] [End State]

OB* is a basic order expression that consists of a tasking verb and constituents. (constituents = linguistic mirror image of the 5 Ws)

A BML Tasking Grammar

The production rules for the basic expressions have the following general form:

B → Verb Tasker Taskee (Affected | Action) Where Start-When (End-When) Why Label (Mod)*

“Verb” is an action, normally a task
“Tasker” is a “Who”, the unit which commands the task
“Taskee” is a “Who”, the unit which executes the task
“Affected” is a “Who”, the unit which is affected by the task
“Action” is another action/task affected by the task
“Where” is a “location phrase”
“When us a “time phrases”
“Label” is a label given to a task to allow it to be referred in other basic expressions
“Mod” refers to conditional modifiers necessary for specific production rules
A BML Tasking Grammar

Rules for basic expressions (examples)
(“verbs” are taken from JC3IEDM-table “action-task-category-code”)

B \to advance Tasker Taskee Route-Where Start-When (End-When) Why Label
B \to ambush Tasker Taskee Affected At-Where Start-When (End-When) Why Label
B \to assist Tasker Taskee Action At-Where Start-When (End-When) Why Label
B \to attack Tasker Taskee Affected Route-Where Start-When (End-When) Why Label
B \to block Tasker Taskee Affected At-Where Start-When (End-When) Why Label
B \to defend Tasker Taskee (Affect.) Route-Where Start-When (End-When) Why Label

Rules for constituents (examples)

Start-When \to start Qualifier1 Point_in_Time
Start-When \to start Qualifier2 Action
Qualifier1 \to (AFT, ASAP, ASAPNL, AT, BEF, NLT, NOB)

JC3IEDM-table “action-task-start-qualifier-code”

A BML Reporting Grammar

In the same way, we develop a formal reporting grammar.

We differentiate

• reports about military tasks
• reports about events
• reports about status
• reports about positions
A BML Reporting Grammar

Task Report

\[
\text{RB} \rightarrow \text{Verb Executer (Affected|Action) Where When (Why) Certainty Label (Mod)*}
\]

Event Report

\[
\text{RB} \rightarrow \text{EVerb (Affected|Action) Where When (Why) Certainty Label (Mod)*}
\]

Status Report

\[
\text{RB} \rightarrow \text{Hostility Regarding (Identification Status-Value) Where When Certainty Label (Mod)*}
\]

Implementation of C2LG for Patrol Order

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May 18th, 2007 GMU C4I Center Review 33
Patrol Order C2LG Expression

OB → *patrol* Tasker Taskee Route-Where
Start-When (End-When) Why Label (Mod)*

*patrol* 3Kp_PzGrenBtl332 1Zug_3Kp_PzGrenBtl332
*along* [base1_PzGrenBtl332, patrolRouteCheck4, patrolrouteCheck8, controlPoint1, controlPoint3, controlPoint6, patrolRouteCheck3]
*start* AFT 291341ZJAN07 *end* AT 291541ZJAN07
deny
patrol-1170074465084

R&D towards application of MSDL and C-BML in The Netherlands
07S-SIW-025

Erik Borgers, Nico de Reus,
Jeroen Voogd, Wim Huiskamp
C2LG Research Papers – Widely Recognized

April 2006 - On the Conference “Recommended Reading List”

June 2006 - Nominated for Best Paper

April 2007 - Latest Paper Published

June 2007 - To Appear

Future of BML
Growing BML Portfolio

- Growing community of investment
  - Shared belief that BML is a necessary component of Networked C2
- Challenges
  - Technological infrastructure enabling distributed, multi-national development and extension of BML
    - Operational Domains and specific requirements of National entities
  - Development of a BML Formal Grammar

<table>
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<th>Ground</th>
<th>Air</th>
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Integration Framework - Today
Integration Framework - Future

BML Conference

Battle Management: Interoperability for C2, Simulation and Geospatial Services

Date: October 16-17, 2007
Location: GMU Prince William Campus, Manassas

Sponsored by:
- US Army Engineer Research and Development Center
- George Mason C4I Center
- ESRI
- MÄK Technologies
- Systematic Software Engineering, Inc.
Conclusion