Developing
Battle Management Language

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Currently

- BML has been sponsored by a number of government agencies
- There is interest in BML from industry and academia
- The standardization process is in the Simulation Community at SISO
- There is an awareness of BML in the MIP but no formal proposal
What is needed

- More participation in developing a practical standard
- We need a viable business model to do this
- The current standardization process at SISO is slow and specific to Joint Operations
- We need other processes that can be used to define and build BML (and other similar C2 Management Languages) with a broader community

Standards Business Models

- Distributed Interactive Simulation
  - Discrete Prescriptive Standard
  - Broad Community Involvement
  - Excellent Business Model
- High Level Architecture
  - Broad Architectural Standard
  - Narrow Community Involvement
  - Adequate Business Model
- Multinational Interoperability Programme
  - Discrete Prescriptive and Architectural Standard
  - Broad Community Involvement
  - Business Model Still emerging
Motivation

A Formal Grammar - Syntax and Semantics

- Formal Languages provide a rigorous framework for automated processing.
- The military domain provides excellent structure to terms and actions in a formal language.
- Current Message and Data-based communications do not go far enough – a grammar is needed to give additional meaning.
- The lack of a formal grammar for Orders has led to a focus on Situation Awareness rather than Decision Support
Motivation

Desired features for such a language:

• **formal**
  in order to enable automatic processing

• **unambiguous**
  in order to avoid misunderstandings

• **expressive**
  in order to convey commander's intent

Motivation

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.
The need for a C2 Grammar: Completeness

Tasks are listed and verbally defined in the C2IEDM table
“action-task-category-code”

Example: *advance*

In C2IEDM, version 6.1.5e, its meaning is given as:
“*To move forward towards an objective in some form of tactical formation. This is a transitional phrase between operations which may or may not result in contact with the enemy.*”

This meaning is for humans, not for machines.
The machines have to be informed that advance needs an objective.

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Developing the Roles of BML

<table>
<thead>
<tr>
<th>Thematic Role</th>
<th>Initiator</th>
<th>Resource</th>
<th>Goal</th>
<th>Essence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Action</td>
<td>Agent, Effector</td>
<td>Instrument</td>
<td>Result, Recipient</td>
<td>Patient, Theme</td>
</tr>
<tr>
<td>Process</td>
<td>Agent, Origin</td>
<td>Matter</td>
<td>Result, Recipient</td>
<td>Patient, Theme</td>
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<tr>
<td>Transfer</td>
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<td>Instrument, Medium</td>
<td>Experencer, Recipient</td>
<td>Theme</td>
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<td>Origin</td>
<td>Path</td>
<td>Destination</td>
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<td>Start</td>
<td>Duration</td>
<td>Completion</td>
<td>PointIn.Time</td>
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<tr>
<td>Ambient</td>
<td>Origin</td>
<td>Instrument, Matter</td>
<td>Result</td>
<td>Theme</td>
</tr>
</tbody>
</table>

Thematic Role as suggested by Sowa (2000): *Knowledge Representation*
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” is 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

Rules for **basic expressions** (examples)

(“verbs” are taken from JC3IEDM-table “action-task-category-code”)

<table>
<thead>
<tr>
<th>B →</th>
<th>advance</th>
<th>Tasker</th>
<th>Taskee</th>
<th>Route-Where</th>
<th>Start-When</th>
<th>(End-When)</th>
<th>Why</th>
<th>Label</th>
</tr>
</thead>
<tbody>
<tr>
<td>B →</td>
<td>ambush</td>
<td>Tasker</td>
<td>Taskee</td>
<td>Affected</td>
<td>At-Where</td>
<td>Start-When</td>
<td>(End-When)</td>
<td>Why</td>
</tr>
<tr>
<td>B →</td>
<td>assist</td>
<td>Tasker</td>
<td>Taskee</td>
<td>Action</td>
<td>At-Where</td>
<td>Start-When</td>
<td>(End-When)</td>
<td>Why</td>
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<tr>
<td>B →</td>
<td>attack</td>
<td>Tasker</td>
<td>Taskee</td>
<td>Affected</td>
<td>Route-Where</td>
<td>Start-When</td>
<td>(End-When)</td>
<td>Why</td>
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<tr>
<td>B →</td>
<td>block</td>
<td>Tasker</td>
<td>Taskee</td>
<td>Affected</td>
<td>At-Where</td>
<td>Start-When</td>
<td>(End-When)</td>
<td>Why</td>
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<tr>
<td>B →</td>
<td>defend</td>
<td>Tasker</td>
<td>Taskee</td>
<td>(Affect.)</td>
<td>Route-Where</td>
<td>Start-When</td>
<td>(End-When)</td>
<td>Why</td>
</tr>
</tbody>
</table>

Rules for **constituents** (examples)

<table>
<thead>
<tr>
<th>Start-When</th>
<th>→</th>
<th>start</th>
<th>Qualifier1</th>
<th>Point_In_Time</th>
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</thead>
<tbody>
<tr>
<td>Start-When</td>
<td>→</td>
<td>start</td>
<td>Qualifier2</td>
<td>Action</td>
</tr>
</tbody>
</table>

| Qualifier1 | → | { AFT, ASAP, ASAPNL, AT, BEF, NLT, NOB } |

JC3IEDM-table “action-task-start-qualifier-code”
Implementation of C2LG for Patrol Order

Patrol Order C2LG Expression

OB → patrol Taskee 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
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

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

Event Report

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

Status Report

\[ RB \rightarrow \text{Hostility Regarding} \ (\text{Identification Status-Value}) \ \text{Where} \ \text{When} \ \text{Certainty Label} \ (Mod)^* \]
C2LG Research Papers - Widely Recognized

April 2006 - On the Conference “Recommended Reading List”

June 2006 - Nominated for Best Paper

April 2007 - On the Conference “Recommended Reading List”

June 2007 - At the ICCRTS

Future of BML
BML is being developed in multiple programs with various funding sources.

This briefing provides an overall vision showing the potential projects for BML Development and the specific resource requirements for each project.

This plan covers FY08 through FY10 and addresses Training, Experimentation and Coalition technology objectives.

**BML Capability FY08 to FY10**

Goal: specify and prototype an open, grammar-based interface for C2 Information to which any program or company can develop, that

1. Provides a level of interoperability supporting automated exchange of information for decision-making;
2. Has a sufficient semantic representation that Command Intent is preserved; and
3. Provides the capability to more rapidly and efficiently link C2 systems, simulations, and geospatial information systems in support of Training, Experimentation, and Coalition Operations.
BML Portfolio

- The table below shows that there is a growing community of investment
  - Based on shared belief that BML is a necessary component of Networked C2
- Challenges in sustaining success
  - Providing technical infrastructure enabling distributed, multi-national development and extension of BML
    - Across operational domains and participating National entities
  - Coordinating different funding sources to ensure effective use of resources

<table>
<thead>
<tr>
<th>Component</th>
<th>Specification</th>
<th>Ground</th>
<th>Air</th>
<th>Naval</th>
<th>Implementation</th>
<th>Software Services</th>
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BML Portfolio Components

- Joint Battle Management Language (JBML)
  - Ground/Air/Maritime/Littoral operations
  - Exploit in spinoffs
- Geospatial BML (geoBML)
  - Geospatial information for C2 and Simulation
- Situational Awareness BML
  - Converges geoBML with JBML
  - Integrates reporting capability
- BML Integration in US Army systems (SIMCI)
  - Exploit JBML Web Services
- NATO C-BML Experimentation
  - Validates SISO C-BML for coalition use
- C-BML/MSDL Integrated Standard
  - Brings simulation standards together

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Community Resources

- The Network-Enabled future opens up many horizons
  - If we can achieve horizontal interoperability

- Recent work has produced base capabilities for a new community of C2/Simulation/GIS practice
  - Open source Schema and Web Services resulting from JBML phase 1
  - Tasking grammar with demonstrated utility
  - Vision for integration of GIS in C2 and Simulation that can empower dramatically enhanced capability

- We should build on these by working together to move toward that future
Objective Integration Framework

A Process View of Using BML and geoBML for Battle Command
Discussion