Using Web Service-Based Command and Control to Support Coalition Collaboration

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Presentation Overview

• C2 – Simulation Interoperability
• Background: JBML and MSG-048
• BML Grammar and Schema
• BML Web Services
• MSG-048 Demonstration
• Conclusions
C2 – Simulation Interoperability

- Command and control – simulation is a long-time goal
  - Enable simulation in C2 for operations
  - Enable simulation in C2 for mission rehearsal
  - More realistic training using operational C2 system
  - Reduce cost of training by reducing support staff
- Individual systems have been interconnected but no standard way to interoperate exists
  - Battle Management Language (BML) aims to provide the capability
- A sequence of projects has moved toward a standardized BML
  - Army BML – XBML – AOBML – JBML – MSG-048
BML Overview

• BML - an unambiguous language to:
  • Command and control live and simulated forces conducting military operations, and
  • Provide for situational awareness and a shared, common operational picture.
• BML orders based on “Who, What, When, Where and Why.”
• Orders are transferred among C2 and simulation systems through a database built on the JC3IEDM standard.

Shared Semantics between C2 and M&S via a Common Tasking Description
# BML Activities

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Background: BML and MSG-048
BML and MSG-048

• NATO Modeling and Simulation Group (NMSG) is part of the NATO Research & Technology Organisation
• MSG-048 is a Technical Activity under NMSG
• Charter:
  • The requirement for improved M&S-C2 interoperability is well recognized by NATO bodies for defense planning, training, exercises and support to operations
  • A NATO effort is necessary to define and standardize M&S-C2 interoperability
  • The Coalition BML Technical Activity is based upon voluntary contributions from Nations and provides insights regarding the usefulness of M&S-C2 interoperability and capability it can offer to coalition forces
MSG-048 Objectives

• Provide support to the development of a NATO representation of digitized command and control information that is understood by military personnel, simulated and in future, robotic forces.

• Enable improved shared awareness and common operational picture through structured plans, reports and returns.

• Provide support to SISO in standardizing and improving M&S-C2 interoperability for automatic, rapid and unambiguous command and control of one by the other.
BML Grammar and Schema
C2 Lexical Grammar

• Command and Control Lexical Grammar (C2LG)
  • Based on work of Schade and Hieb
  • Tasking grammar formal language implementation looks forward to SISO C-BML Phase 2
  • C2LG GUI provides visualization of orders/tasks with plug-in interfaces
  • Augmented to accept incomplete JBML format and fill in missing elements
• Form of C2LG expressions:
  OB → Verb Tasker Taskee (Affected|Action) Where Start-When (End-When) Why Label (Mod)*
• See companion paper by I-155 by Schade and Hieb
Some Examples of C2LG for Tasking

OB $\rightarrow$ **advance** Tasker Taskee Route-Where Start-When (End-When) Why Label (Mod)*

OB $\rightarrow$ **ambush** Tasker Taskee Affected At-Where Start-When (End-When) Why Label (Mod)*

OB $\rightarrow$ **assist** Tasker Taskee Action At-Where Start-When (End-When) Why Label (Mod)*

OB $\rightarrow$ **rest** Tasker Taskee At-Where Start-When End-When Why Label (Mod)*

An actual order:

*begin{quote}
**pursue** BtlC CavB En **towards** Z at now in order to destroy En label_3_15;
\end{quote}
JBML Web Services

• JBML Phase 1 was reported in ICCRTS and elsewhere
  • Ground/Air/Maritime C2-Simulation capability
  • Real-world Army and Air Force C2 (C2PC, TBMCS)
  • Multiple JSAF simulations represented 4 simultaneous scenario threads
  • JBML Schema and Web Services documented at level intended to support SISO standardization
• Web service structure
  • Domain Configured Service (DCS) uses a schema informed BML grammar of Hieb & Schade that guarantees ability to describe tasks
    • no grammar checking; XML parsing only
  • BML Base Service (BBS) implements mappings to the JC3IEDM database
  • Common Data Access Service (CDAS) implements SQL access
JBML Layered Service Architecture

- Domain Knowledge
  - fully defines domain language

- BML Domain-Configured Service
  - Web Service Exchange Interface
  - BML Base Service
  - BML Common Data Access Software

- JC3IEDM Domain Specific Extensions
  - JC3IEDM Database
  - Non-JC3IEDM Databases/Sources

- Reference Implementation middleware common to all BML domains

1. WSDL
2. XML/WSHDL
3. XSD FILES
4. API
5. XML/WSHDL
6. API
7. SQL

NOTE: Interface 5 (push) and Interface 8 (push & pull) are provided for future use (they are not used in JBML Phase 1)
JBML Schema Task Fragment

```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>
</xsd:complexType>
```

```xml
<xsd:complexType name="GroundTaskType">
  <xsd:sequence>
    <xsd:element name="TaskeeWho"
      type="WhoType"/>
    <xsd:element name="What"
      type="GroundBMLWhatType"/>
    <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>
```

...
<xsd:complexType name="WhenType">
    <xsd:choice>
        <xsd:element name="DTG" type="DtgType"/>
        <xsd:element name="RelativeToTask" type="LabelType"/>
    </xsd:choice>
    <xsd:attribute name="modifier" type="WhenModifier" use="optional" default="AT"/>
</xsd:complexType>
<xsd:simpleType name="WhenModifier">
    <xsd:restriction base="xsd:string">
        <xsd:enumeration value="AFT"/>
        <xsd:enumeration value="ASAP"/>
        <xsd:enumeration value="ASAPAF"/>
        <xsd:enumeration value="ASAPNL"/>
        <xsd:enumeration value="AT"/>
        <xsd:enumeration value="BEF"/>
        <xsd:enumeration value="NLT"/>
        <xsd:enumeration value="NOB"/>
    </xsd:restriction>
</xsd:simpleType>
MSG-048 Demonstration
MSG-048 I/ITSEC Demonstration
November 2007

Purpose:
• Demonstrate C2-Sim interoperability
  • 8 systems/components (from 6 different Nations)
  • Work in concert orchestrated by the use of C-BML
• Show simulated units can be commanded directly
  • The commander (nor the operator of the C2 system) does not need any knowledge about the simulation system
• Demonstrate the potential of BML
  • Easy to expand and to adjust to new kinds of tasks
Demonstration Terrain
Demonstration Scenario

• “Operation Perseus”
  • Caspian Sea region
  • 2025 timeframe
• Fictional countries Donovia, Minaria, Gorgas and Atropia
  • Successor states to a collapsed empire
  • Long history of fighting, factionalism, unrest
• Area is a source of oil and gas resources
  • International interest lies in stability
  • Ariana government supported by Donovian rebels threatens oil-rich region of Atropia
  • Rebels expected to try to occupy airport and harass traffic between river and airport
• Commander Joint Forces Land Component responsible for security
  • Selects task forces from USA, Netherlands and Norway
  • Simulation of their plans is needed for COA analysis
Demonstration Task Organization

43 MNB

1 (USA) TF
- A/1-66 AR
- B/1-66 AR
- B/1-12 Mech
- C/1-22 Mech

2 (NOR) TF
- 1 MBT SQN
- 3 Mech Coy
- 4 Mech Coy

2 (NLD) TF
- A Team Mech
- B Team Mech
- C Team AR
Demonstration 43 MNB Plan
Demonstration Opposing Military Forces
Demonstration System of Systems
C2LG GUI Screen
Enabling BML Generation with C2LG GUI

Diagram:
- National C2 System
  - C2 Format
  - C2 BML Order Output converter

- C2LG GUI
  - Pre-fill
    - Initialization Input Plugin
    - Pre-fill data
    - BML W/S Output Plugin
    - Pre-fill data
    - BML (JBML push)
    - Complete BML

- JBML web services
  - BML W/S
  - Pre-fill data
  - Complete BML
  - Incomplete BML

- Simulator
  - Sim format

- Central JC3IEDM
  - BML sim interface
French Contribution: SCIPIO

Command post training system for Brigade and Division HQs

- Automated simulation control based on command agents
- Generation of formatted reports to C2IS (SICF)
- HLA interface
Connection Architecture of SCIPIO

ISIS \rightarrow JC3Iedm DB \rightarrow JBML Web Services \rightarrow Pull ORDERS \rightarrow SCIPIO

SCIPIO

- GUI client component
- BML client component
- Server component (Object Request Broker)
- SIM component

Low Controller Interface

C2LG

NORTac
Netherlands Contribution: ISIS

Integrated Staff Information System at Battalion and above.

- Fielded in 2002
- C2 Framework (C2FW) is the architecture.
- Baseline for a suite of C2 applications (OSIRIS, XANTHOS)

Tactical data

commander

ISIS

Oporder

(5 paragraph NATO Document) (free text)

ORBAT

Corresponding overlay
Norwegian Contribution: NORTaC-C2IS

Tactical C2IS fielded in 2002, supporting
- Situation awareness
- Plan / Order
- Intelligence
- Order of Battle
Spanish Contribution: SIMBAD

- SIMBAD main features are
  - Predefined ROEs
  - Tactical Events Manager
  - GIS-based GUI with geographical and tactical overlays
  - HLA interface (proprietary C2IEDM-inspired FOM)

- SIMBAD Has no command agents so a custom gateway was built to accept BML tasks
JBML Task → SIMBAD Actions

Task: B/2(NLD)TF SEIZE AreaOfInterest HADES 1 AFT 110930ZAUG2025

- Action1: B/2(NLD)TF MOVE Path1 AT 110930ZAUG2025
- Action2: B/2(NLD)TF ENGAGE OMF3 AFT Action1
- Action3: B/2(NLD)TF MOVE Path2 AFT Action2
US Contributions

• C2PC software developed by USMC
  • also used by US Army
  • CAPES injector exports plan in XML
  • JBML interface translates this to BML
• JSAF constructive simulation from US JFCOM
  • Represents objects to platform level
  • Command agents accept orders
  • JBML interface translates BML to this format
• JC3IEDM visualizer from VMASC
  • Open source software map viewer
  • Displays Common Operational Picture exported from JC3IEDM database by VMASC Web service
• Funded by NATO RTA
US Contributions

C2PC/CAPES → JC3IEDM → BML WS

BML WS → VMASC WS

VMASC WS → JSAF

BML WS

JC3IEDM Visualizer
Conclusions

• First step in NATO MSG-048 experimentation with BML
• Strong evidence in favor of the techniques employed
  • SOA for interoperation
  • C2LG-inspired schema
  • JC3IEDM database and vocabulary
• Network-centric development methodology allowed very rapid development
  • Six months requirements to demonstration
  • National development teams with highly cooperative spirit also helped a lot
  • As did availability of military SMEs
• Increasingly experimental approach planned for 2008 and 2009
  • Based on national work becoming available
  • Looking forward to SISO C-BML standard that can be evaluated experimentally per MSG-048 charter