IMPLEMENTING A STANDARDS DEVELOPMENT FRAMEWORK FOR THE COALITION BATTLE MANAGEMENT LANGUAGE (C-BML) (PAPER 122)

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The development of the **Coalition Battle Management Language (C-BML) Phase 1** standard has seen many challenges and has taken 7 years to complete. In particular, the **lack of a normalized model, inadequate requirements management**, and the **lack of structured approach and process** have been identified as main causes of difficulty.

The C-BML Standard Development Framework was first proposed in September 2012 and defines a methodology for the C-BML Phase 2 Standard Development. This paper presents the recent work in implementing this approach with the **goal of ensuring that the C-BML Phase 2** standard can be developed **rapidly and efficiently** & will **meet stakeholder expectations**.
C-BML Standard Development Framework

Related Work


Gupton & Heffner, “A Standards Development Framework for C-BML Phase 2 and Beyond”, SISO Interoperability Workshop, 12F-SIW-045, Sep 2012


C-BML Standard Development Framework

Motivation (C-BML Phase 1 → Phase 2)

- Increase C-BML Stakeholder Participation
- Introduce Requirements Management
- Define a Reference Architecture to Organize C-BML Standard Products and Components
  - Normalized Model;
  - XML Schema; Grammar,
  - Tactical Message Equivalents; Future Ontology Modules;
  - Exchange Services
- Produce Usable, Maintainable, Evolvable C-BML Interoperability Solution
  - Support “simple” use-cases in short term
  - Be capable of evolving to support complex C4I Architectures
- Ensure Extensibility for specific communities and events
  - Services; Domains; Nations;
  - Exercises; Experiments
C-BML Standard Development Framework
Building Standards-Based C2-SIM-Autonomous SoS

JTEA
JLVC 2020
C-BML
OBS
MSDL
RDG
NIEM MilOps
GFM DI
STANAG 4586
JC3IEDM & MIM

STANAG 4586
Building usable C2 and M&S standards is challenging, but we ALSO need to make sure that we can EVOLVE and EXTEND them, as required, quickly and efficiently.

Building usable C2 and M&S standards is challenging, but systems of systems use MULTIPLE OVERLAPPING standards!

To consistently effectively build C2-Simulation-Autonomous system of systems, we need to do both!
WHAT IS C-BML?
The C-BML Standard is being developed by the Simulation Interoperability Standards Organization (SISO) as a set of specifications to facilitate the

**standardized exchange**

of military information such as:

**orders, plans, reports and requests**

among

**Command and Control, Simulation** and **Autonomous Systems**.
Common Interface: for exchange of military information (e.g. orders, reports and requests) among C2, simulation and autonomous/robotic systems.

Expressiveness: for all relevant actions (or events) to be performed (or reported) by real, simulated or robotic forces. Intended to represent the information contained in operational orders such as: Air Tasking Order (ATO), 5-paragraph Operations Order (OPORD), Operational General Matters (OPGEN) and other tactical messages.

Unambiguous and Parsable: mathematical representation that allows for automated processing.
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**Unambiguous and Parsable:** mathematical representation that allows for automated processing.
The 5Ws

Who: The tasking unit; The tasked unit; The supported unit; The supporting unit; The target; The reporting unit; The object of a report.

What: The type of operation or task to be executed; The event being observed.

Where: Where is the task to be executed; Where is the event being observed.

When: The time the task to be executed or has been executed; The time an event observed.

Why: The purpose, motivation, desired effect or result.
WHY USE C-BML?
Coalition Battle Management Language (C-BML)

**Military Enterprise Activities**
- Force Readiness;
- Support for Operations;
- Future Capabilities Development; and
- Simulation-Based Acquisition

**Some of Expected Benefits**
- Enhanced realism & overall training effectiveness;
- Decreased cost & workload;
- Reduced preparation and response times; and
- Facilitate and Augment Analysis Capabilities
Operational Community is now asking for C2-Simulation Interoperability!
Requirements and Capability Development

Sustaining versus Disruptive Technologies

C-BML

Short-Term

Emerging Requirements

Train & Adapt TTP

Optimize use of Existing Products & Tools

Revised TTP

Improve/Extend Existing Product & Tools

New/Expected Products & Tools

FUTURE REQUIREMENTS

New/ConEMP

New/ConOPS

Long-Term

SUSTAINING

DISRUPTIVE

TECHNOLOGY
Requirements and Capability Development

Sustaining versus Disruptive Technologies

Short-term

“Translation” of current operational tactical messages

Agent-based systems (inference, reasoning)

Self-synchronization

Long-term

Integrated Dynamic Command & Control

Current Command & Staff Training

But lower cost, Reduced lead-time

Natural Language Translation Interfaces

Intelligent Chat, NG C2 Operator Interface

Voice-to-Message (e.g. 9-Liners)

Sustaining

Disruptive

Also, NATO COPD
A Standard Development Framework is required to build these products.
The objectives of the C-BML SDF are to:

- Define a comprehensive model for requirements, domain-specific information products, information exchange interactions and service components.
- Separate normative and guidance documents.
- Provide a set of examples and usage guidance documents for technology-independent and technology-specific utilization.
Mission threads, use-cases, derived requirements from stakeholders.

Content model, Message Structure, Interaction Protocols and Services Components.

Defines: (1) Content & Structure specification; (2) Services Specification.

Examples that illustrate use of normative specifications for specific protocols.

Technology-specific examples of how standard can be implemented.

*This work is based in part on the US Joint Intelligence Community/DoD Content Discovery and Retrieval (IC/DoD CDR) Model*
C-BML Standard Development Framework

Requirements

Consistent with Architecture Frameworks (AF):
NATO AF........(NAF)
UK MoD AF...(MoDAF)
US DoD AF....(DoDAF)

Operational Message is a Information Product

Information Object satisfies Information Requirement

Exchanged in:
Use Case

Mission Thread

Operational Activity

Information Flow

Information Exchange Requirement

Specification

Guidance

Implementation

Reference

Architecture

Specifications
NOTE: C-BML does not seek to create operational messages; the goal is to create documents that can represent the information contained in operational (and other) messages and can be shared across C2, simulation and autonomous systems.
## C-BML Standard Development Framework

### C-BML relation to MoDAF/DoDAF/NAF

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Architectural Frameworks are being utilized increasingly in conjunction with Standards-based Capability Development.
C-BML Standard Development Framework

Reference Architecture Overview

- Requirements
- Reference Architecture
- Normative Specifications
- Specification Guidance
- Reference Implementation

Content Model
Vocabulary & Semantics
Grammar & Message Structure

Interaction Protocols
Message interaction protocol definition and examples.

Service Components
Service components for C-BML-based information exchange.
C-BML Standard Development Framework

Reference Architecture – Content Model

Military Information Domain Elements

- Who
  - Entities
    - Organisation, Material, Facility, Feature
  - Organisation
    - Individual, Group, Civil, Military
  - Facility
    - Hospital, Runway, Network, etc.
  - Feature
    - Geographic, Meteorological, Control Feature

- What
  - Event
    - Action, Task, Occurrence
  - Materiel
    - Equipment, Consumables

- Why

- Where
  - Location
    - Point, Line, Area, Volume
  - Place
    - Address, Named location
  - Symbology
    - Icons, Graphics, Overlay

- When
  - Time
    - Temporal point, Temporal region
C-BML Standard Development Framework

Reference Architecture – Content Model

**Who**
- Entity
  - Facility
  - GeospatialFeature
  - GroupOfThings
  - LivingThing
    - Animal
    - Person
  - Materiel
  - Equipment
  - Organization
- Event
  - Action
    - CommunicationAct
- Property
  - Capability
  - PhysicalProperty
  - Role
- SpatialRegion
  - GeospatialRegion
  - GeospatialBoundary
  - GeospatialLocation
- TemporalRegion
  - TemporalBoundary
  - TemporalInstant
  - TemporalInterval

**What**
- CommunicationAct
- Acknowledgement
- Assertive
- Report
- EventReport
- StatusReport
- TaskReport
- Commissive
- RequestReply
- AcceptRequest
- DeclineRequest
- Declarative
- Directive
- Order
- Request
- RequestAction
- RequestInformation

**Where**

**When**

**Core**

- Content Model
  - National Extensions
    - Domain Extensions
  - Message Framework
  - Interaction Protocols
  - Service Components
  - Constituents

**References**
- Report/Task Primitives
- Constituents
- National Extensions
- Domain Extensions
- Message Framework
- Interaction Protocols
- Service Components

**Requirements**
- Reference Architecture
- Normative Specifications
- Specification Guidance
- Reference Implementation

**Flow**
- Requirements
  - Reference Architecture
    - Normative Specifications
      - Specification Guidance
        - Reference Implementation
C-BML Standard Development Framework

Reference Architecture – Interaction Protocols

- Requirements
- Reference Architecture
- Normative Specifications
- Specification Guidance
- Reference Implementation

Content Model
Message Framework
Interaction Protocols
Service Components

Represent military communications as interaction protocols using communicative acts:

- request
- refuse
- agree
- inform
- propose
- accept
- query
- subscribe
- etc...
C-BML Standard Development Framework

Service Components

- Requirements
- Reference Architecture
- Normative Specifications
- Specification Guidance
- Reference Implementation

Content Model
Message Framework
Interaction Protocols
Service Components

Messaging Infrastructure

Core C-BML Services
- Register
- Deliver
- Persist
- Initialize
- Publish & Subscribe
- Search

SYNTHETIC ENVIRONMENT
CGF Simulation Federation

HICON
C2IS C2IS C2IS

C2-Simulation Federation

LOCON
C-BML Standard Development Framework

Normative Specifications

- Requirements
- Reference Architecture
- Normative Specifications
- Specification Guidance
- Reference Implementation

- Interaction Protocols
  - Interaction protocol template.
- Content Model
  - Information Exchange Structure & Content Specification
- Vocabulary & Semantics
- Grammar & Message Structure
- Services Specification
  - Definition of services.
- Message Framework
  - Normative Specifications
  - Information Exchange Mechanism Specification

- Service Components
C-BML Standard Development Framework

Information Exchange Mechanism Specification

- Requirements
- Reference Architecture
- Normative Specifications
- Specification Guidance
- Reference Implementation

TRANSPORT MESSAGE

Transport Envelope

Header

C-BML Message

Metadata

C-BML Content

Messaging

JMS
AMQP
OMG-DDS

Email

SMTP
MIME

WS

WSDL
SOAP

HLA Object

HLA 1516

WS

HTTP
XML
C-BML Standard Development Framework

Relationship between Normative & Guidance Specifications

NORMATIVE SPECIFICATIONS

- Content Model
- Message Framework
- Interaction Protocol Definition Rules
- Service Specifications

APPLICATION OF NORMATIVE SPECIFICATIONS

- Extensions
- Example Message Catalog
- Interaction Protocol Definitions
- Service Implementations

Requirements
Reference Architecture
Normative Specifications
Specification Guidance
Reference Implementation

Based on national doctrine and service specific procedures.
Based on specific standard transport protocols.
C-BML Standard Development Framework

Example Interaction Protocol – Call For Fire

Represent military communications as interaction protocols using communicative acts:

- request
- refuse
- agree
- inform
- propose
- accept
- query
- subscribe
- etc...

CFF – Call For Fire
FDC – Fire Direction Center
MTO – Message To Observer
OBS – Forward Observer
Guidelines include examples for:

- Model extensions and derived products (e.g. XML schemas);
- Documents (e.g. messages & initialization data);
- Exchange rules (aka Business Rules or Interaction Protocol Definitions); and
- Services Implementations.

Based on national doctrine and service specific procedures.

Based on specific standard transport protocols.
DEFINITION:
A reference implementation is an implementation of a standard that is by definition conformant to that standard. Such an implementation provides a proof of concept of the standard and also provides a tool for the developers of the conformance test suite (by generating expected values, testing the test suite, etc.) A reference implementation has maximum value in the early stages of a conformance program.

http://www.nist.gov/itl/ssd/is/conformancetesting.cfm

A reference implementation is, in general, an implementation of a specification to be used as a definitive interpretation for that specification.
IMPLEMENTING THE STANDARD DEVELOPMENT FRAMEWORK
The SINEX Process depicted above follows the Iterative Vee-Model (see Introduction), where the Process Components have been adapted to the needs of constructing and maintaining the "system" that is comprised of an Information Exchange Data Model (IEDM) and derived products. Click on the individual process component packages to see more information.

**Release Versions** are intended for balloting or constitute subsequent product revisions as produced by Product Support Groups for use by the community.

**Working iterations** facilitate the SINEX Model development process by allowing for separation of concerns while ensuring that stakeholder and technical requirements are satisfied.
SISO C-BML Phase 1 did not have a well-defined requirements management process.
Grounding Standards Requirements in Operations

Operational Activity Description Example

Call For Fire OV1a

Forward Observation Officer (FOO)

Observed Fire on Target

Message to Observer

Voice or Data

Call or Request for Fire

Fire Detection Center/Regimental or Battery Command Post

Voice or Data

Operational Message

Information Object

Information Product

Operational Activity

Information Flow

Information Exchange Requirements

Mission Thread

Digital Device and supporting Application e.g. UK Fire Control BISA

Firing Unit(s)

Fire on Target

2013 Spring
### Event

FO identifies Target in Battlefield

### Actor Activity and Tools Used

- FO, Target, Battlefield, map and compass, Radio, Speech Recognition System (SRS), Translator, FDC
- FO transmits CFF Warning Order (WO)
  - Radio, SRS, Translator, FDC

### Description of Processing

- FO identifies Target in Battlefield and decides that he will need to adjust fire (i.e. he is not sufficiently confident of the target location to justify a FFE warning order).
  - He transmits the CFF WO.
  - SRS converts speech to text.
  - Translator validates WO text to ensure proper formatting.
  - If valid, it translates the validated text to a C-BML message, and sends the C-BML message to the FDC.

### Information Producer

FO

### Information Receiver

FDC

### Information to be Exchanged

A57 this is A71, Adjust Fire, over

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**Operational Activity Description Example**

**Call For Fire OV1a**

- Forward Observation Officer (FOO)
- Message to Observer
- Voice or Data
- Observed Fire on Target
- Firing Unit

**Fire Detection Center/Regimental or Battery Command Post**

- Call or Request for Fire
- Digital Device and supporting Application (e.g. UK Fire Control BDA)

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**Operational Activity**

- Information Flow
- Information Product
- Information Exchange Requirements
- Information Object

**Information**

- Producer
  - FO
- Receiver
  - FDC

**Information to be Exchanged**

A57 this is A71, Adjust Fire, over
MESSAGE LANGUAGE REQUIREMENTS

Message definition

Message Header definition

Message meta-data definition

Message body definition

Message sender

Message recipients

Message security classification

Message sending time

Message urgency

Message recipient is for information

Message operation time

Message operation time simulation

Unique message identifier

Message reference

Recipient 'read' acknowledgement required

Recipient 'roger' acknowledgement required

Recipient 'refuse' acknowledgement explanation

Read acknowledgement body

Roger acknowledgement body

Refuse acknowledgement explanation

Requirements Model

Grounding Standards Requirements in Operations

Requirements Model
Example C-BML Model Cycle

Generate C-BML Logical Data Model

Browse C-BML Model
Example C-BML Model Cycle
Generate C-BML XML Schema

C-BML XML Schema Generation ✓
Example C-BML Model Cycle

C-BML XML Schema

Message Framework Schema
Scenario INitialization and EXecution (SINEX) INitiative

Model Driven Architecture Environment and Toolset

- MSDL V1
- C-BML Phase 1

- OWL Ontology Modules
- HLA-FOM Modules
- XML Schemas
- Documentation

Subview Definition

CPProcessor

C-BML MODEL

OWL X-Form
HLA X-Form
XSD X-Form
SON X-Form
Doc Gen

INitialization and EXecution (SINEX) INitiative
Scenario INitialization and EXecution Initiative

Collaborative UML Environment

- Collaborative UML has been created.
- Initial capability already functional
We have previously proposed a Standard Development Framework for C-BML Phase 2 based on lessons learned from Phase 1 Drafting Activity.

The C-BML Phase 2 SDF defines a Reference Architecture and separates C-BML areas of concern for: Requirements, Vocabulary, Grammar, Message Structure, Message Exchange, Interactions and Services.

The SDF organizes the C-BML specification and frames future drafting discussions and allows for controlled, development and evolution.

It poses C-BML in terms of enterprise architecture, including the Architecture Framework initiatives of NATO, US DoD, UK MoD.

We have implemented framework as a UML model uses the MIP Products and tools to generate C-BML Standard Products such as XML schemas and ontology modules using an automated process.

This approach has been applied to the SINEX Initiative that is currently being developed in NATO MSG-085.