

UNCLASSIFIED



Coalition Battle Management Services (CBMS) Final Report

Joint Staff (JS) J7
Environment Development (ED) Futures

Final Report Date: 11/06/2012

This cover page has been added to the final report for this Coalition Warfare Program project to conform to current policy that requires science and technical information (STI) created or acquired in the execution of research and engineering activities to be documented and sent to Defense Technical Information Center (DTIC) in accordance with DoD Instruction 3200.12 (Reference (a)). DTIC's mission focuses on the dissemination of science and serves as a library to the community.

DISTRIBUTION STATEMENT A.
Approved for public release:
distribution unlimited.

UNCLASSIFIED

Unclassified

COALITION WARFARE PROGRAM
OUSD AT&L INTERNATIONAL COOPERATION

Coalition Battle Management Services (CBMS) Final Report

Joint Staff (JS)

J7

Environment Development (ED)

Futures

6 November 2012

Distribution A – Approved for Public Release; Distribution is Unlimited

Unclassified

Coalition Battle Management Services (CBMS)
Coalition Warfare Program

Final Report

TABLE OF CONTENTS

1 Introduction..... 1

1.1 Executive Summary..... 1

1.2 Background..... 3

1.2.1 C2 Community Problem..... 4

1.2.2 Training Community Problem 4

2 CBMS Project 4

2.1 Project Objectives 5

2.1.1 Project Metrics 5

2.1.2 Project Use Cases..... 6

2.1.2.1 Primary Use Cases..... 7

2.1.2.2 Simulation Planner Use Cases..... 7

2.2 Project Development..... 8

2.2.1 System of Systems (SoS) Environment 8

2.2.2 Service-Oriented Approach..... 9

2.2.3 C2 to Simulation Interoperability..... 10

2.2.4 Open Standards/Freeware 12

3 Accomplishments..... 12

3.1 Activities 13

3.2 Successes..... 15

3.3 Related Initiatives/Forums 17

Unclassified

Coalition Battle Management Services (CBMS)
Coalition Warfare Program

Final Report

3.4 Demonstration - I/ITSEC 2011 Demo Harness Coalition Battle Management
Experimentation Event..... 28

4 Funding 30

5 Way Ahead..... 31

6 Summary 32

APPENDIX A – ACRONYMS 33

APPENDIX B – POINTS OF CONTACT 38

Unclassified

Coalition Battle Management Services (CBMS)
Coalition Warfare Program

Final Report

LIST OF FIGURES

Figure 1. CBMS External Component Integration 3

Figure 2. CBMS Use Cases – Format and Content Independent..... 6

Figure 3. CBMS Use Cases – Live Virtual Constructive 8

Figure 4. CBMS OV-1 “System of Systems Interoperability” 9

Figure 5. CBMS Interoperability Services..... 10

Figure 6. CBMS OV-3 “C2 to Simulation Interoperability” 12

Figure 7. Demonstration Architecture Overview..... 29

Figure 8. Concept Development Funded by Office Under Secretary of Defense, Acquisition,
Technology & Logistics, Coalition Warfare Program 30

1 Introduction

Coalition Battle Management Services (CBMS) is a technical infrastructure that provides common databases and information interchange capability between Coalition Command and Control (C2) and Modeling and Simulation (M&S) systems. It is currently implemented as a Service Oriented Architecture (SOA) with an interrupt mechanism, a filtering mechanism, and a data distribution mechanism that can be used to support the validation, storage, search, and exchange of structured information. Languages include, but are not limited to, the Coalition Battle Management Language (CBML), the Military Scenario Definition Language (MSDL), and the Order of Battle Services (OBS). CBMS is accessible via any commercially available web browser and uses only next generation web-based technologies in its implementation.

1.1 Executive Summary

Joint/Coalition warfighters require the ability to rehearse warfighting scenarios with operational "go-to-war C4ISR equipment" before deploying into Areas of Responsibility (AORs). This requires interoperable data exchange between C2 and M&S devices to train full spectrum joint mission requirements within the AOR. CBMS will:

- Enhance ability of warfighters to execute mission rehearsals prior to deploying.
- Enable execution of mission rehearsal/planning for emerging threats met in theater.
- Promote a data exchange process to compliment the ability for coalition forces to execute mission rehearsals.

Objectives include:

- Improving Joint and Coalition execution of pre-deployment mission rehearsals.
- Improving adaptive planning and mission rehearsal execution for emerging threats.
- Defining and refining a common standard and information exchange data model.
- Building an architecture for interoperable "machine-to-machine" interface between C2 systems/simulation systems.

Deliverables:

- CBMS demonstrations/infrastructure (functionality resident in the JS J7 ED-Futures, VMASC CBMS Lab).
- Net-Centric CBMS specifications, e.g., XML schema definitions.

Unclassified

Coalition Battle Management Services (CBMS)
Coalition Warfare Program

Final Report

- CBMS integration of national/coalition systems processes for future application.
- Supporting documentation (papers, tutorials, and helps files).

Interoperability between C2 systems and simulation systems is critical for efficient planning, training, experimentation, and operational support needs. The Coalition C2 community is focused on communicating plans, orders, and reports, while the Coalition M&S community is focused on replicating the Joint Operational Environment. Interoperability of C2 systems is ensured by C2 standards, and interoperability of simulations is ensured by simulation standards. This leaves a gap and that is the interoperability between C2 systems and simulation systems is not addressed in a coherent and standardized way. The Coalition C2 and M&S communities lack a standard for exchanging data between various C2 and M&S systems. Existing peer-to-peer data exchange strategies connecting C2 and M&S systems are too rigid, expensive, unreliable, and required significant expertise to implement. Stakeholders require an enhanced data exchange strategy that utilizes web services to connect heterogeneous C2 and M&S systems using a common reference data model that is more flexible, cost efficient, reliable, and easier to implement.

CBMS addresses the number one critical Combatant Command (COCOM) issue as identified by the 13 Nov 08 Senior Department of Defense Warfighter Forum (SWarF): the Common Operational Picture (COP). This technology proposes to advance the interoperability between selected Coalition mission rehearsal, operational planning and training simulations to the COP resident on key Coalition C2 systems by creating a “plug and play” web-based service that provides common integration and exchange of the needed data sets and information. The benefits of CBMS to the Coalition and the US Joint warfighters includes not only an improved integrated Coalition COP, but also addresses the need for a fully Collaborative Information Environment (CIE); the ability to enable mission partners; enhances planning; and accelerates the development of a global C2.

Coalition Battle Management Services (CBMS) External Component Integration

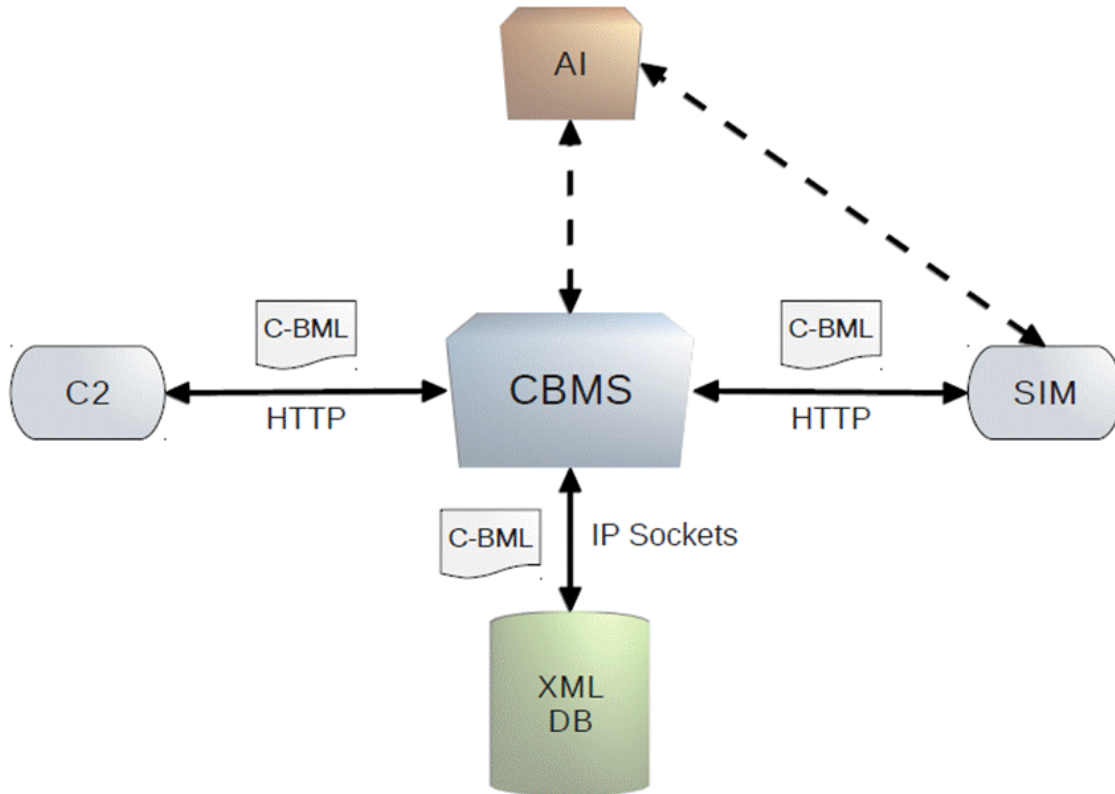


Figure 1. CBMS External Component Integration

1.2 Background

Each community has developed its own systems and standards. Neither the systems nor the standards are directly interoperable across communities. Although the communities (sensors, robotics, Command, Control, Communications, Computers, Collaboration, and Intelligence [C5I], and M&S) have developed interoperable systems and standards within their respective networks, integration becomes a challenge when operating between one another. CBMS software enables information exchange between systems regardless of origin or purpose.

The applicability of enabling web services was demonstrated in a transatlantic experiment that operationally used C2 and simulation systems of France, Germany, Spain, Sweden, and the United States (US). C2 data was exchanged in CBML via services in a live coupling to generate a COP that was executable in the simulation systems. The result was a web-based capability that enabled net-centric exchange of C2 and simulation data based on a Community of Interest (COI)-derived common reference model.

1.2.1 C2 Community Problem

Commanders must have the ability to command, control, and coordinate an integrated and interoperable force in rapidly changing conditions involving complex, distributed, simultaneous, or sequential operations. Command, control, and coordination within DoD and with external mission partners requires employment of integrated and interoperable capabilities that allow assigned forces to have visibility and easy access to information to effectively organize, understand, plan, decide, direct, and monitor the execution of operations in support of a commander's intent.

1.2.2 Training Community Problem

The Joint Training Community publishes a “Program Goals and Objectives (PG&O)” document every year to provide strategic guidance on capabilities development.). An identified PG&O requirement is “Enhance Integration with Partners” that states: sustain and improve the ability to integrate with allies, coalition members, international partners, and non-governmental organizations. Another venue to identify joint training requirements is the Training Gaps Analysis Forum (TGAF). TGAF Program Area (PA) 44 titled “Exercise Design, Integration, Standards, and Data Management” states: “...revamp the management of both the federation and the simulation applications within the federation so users can plan and conduct exercises to include unilateral, coalition, and partner nation exercise.” What this means for coalition operations is the time and costs of architecting, integrating, and testing systems of systems impedes the timely deployment of technology solutions. This cost is associated with the technical complexities of satisfying data, software, and hardware interoperability within the coalition environment. Lacking guidelines and tools for integrating heterogeneous environments, the ability to deliver new capability and functionality is hindered, especially as information sharing, security, and force cohesiveness is anticipated to increase over time. Factors and criteria shaping development of CBMS capabilities include:

- Decrease in translators and/or gateways interface needed for Live, Virtual, Constructive (LVC), C2, and information technology systems interoperability.
- Re-use of CBMS infrastructure to allow –“map once-reuse multiple times” capability.
- Decrease in large footprint or “pucksters” to manage large collective training.
- Ability to track and manage in home station training using own national M&S and C2 devices that are now interoperable with US systems using CBMS infrastructure (web technology).

2 CBMS Project

CBMS provides a standardized set of services that reduces the need for gateways and bridges, facilitates the migration of legacy systems into a service-oriented environment, and improves

Unclassified

Coalition Battle Management Services (CBMS)
Coalition Warfare Program

Final Report

Joint and Coalition execution of pre-deployment training and mission rehearsals. It enables meaningful data exchange between C2 and M&S systems, migration of legacy systems into a SOA and significantly enhances the data interchange between selected US and Coalition M&S and C2 system.

CBMS supports the automation of C2 to M&S data exchange and could reduce the large footprint of M&S Operators needed to interpret C2 plans, orders, reports, and to operate the Sims. Thus, reducing the large footprint of “pucksters” required to execute a large collective CCMD Training Event. It also supports IT systems interoperability by providing a standard set of services and information exchange data model. It reduces the reliance on bridges, gateways, and translators to exchange information between multiple IT devices and domains (C2, M&S, unmanned aerial vehicle [UAV], and sensors).

2.1 Project Objectives

CBMS was proposed to accomplish the following objectives:

- Improve Joint and Coalition execution of pre-deployment mission rehearsals.
- Improve adaptive planning and mission rehearsal execution for emerging threats.
- Define and refine a common standard and information exchange data model.
- Build an architecture for interoperable "machine-to-machine" interface between C2 systems/simulation systems.

2.1.1 Project Metrics

Project objectives were accomplished utilizing the following metrics:

- Improvements in readiness (training, adaptive planning or mission rehearsal) of designated multinational partners.
- Improvements in utility of commanders' access to data elements.
- Increased multinational commonality regarding capabilities, requirements, systems data, architecture tool support, interfaces, interoperability, and understanding of doctrinal differences.
- Improvements in commanders' ability to plan and execute in a Joint and/or Coalition environment.

2.1.2 Project Use Cases

CBMS utilizes C-BML and MSDL as a common language to support both producer and consumer systems. However, CBMS is system-independent, allowing each consumer or producer system to map CBML or MSDL to their respective system language.

- C-BML is an unambiguous language to describe a commander’s intent, to be understood by both live forces and automated systems, for simulated and real world operations. The resulting language is intended to be applicable not only to simulation systems, but also to operational command and control systems, and robotic systems. CBML is under standardization by Simulation Interoperability Standards Organization in the CBML Product Development Group.
- MSDL provides a standard mechanism for loading Military Scenarios independent of the application generating or using the scenario. It utilizes an XML schema thus enabling exchange of all or part of scenarios between (e.g.) Command and Control (C2) planning applications, simulations, and scenario development applications.

This infrastructure promotes “build the interface once and reuse over and over again” (see Figure 2).

Use Case 1: Format and Content Independent

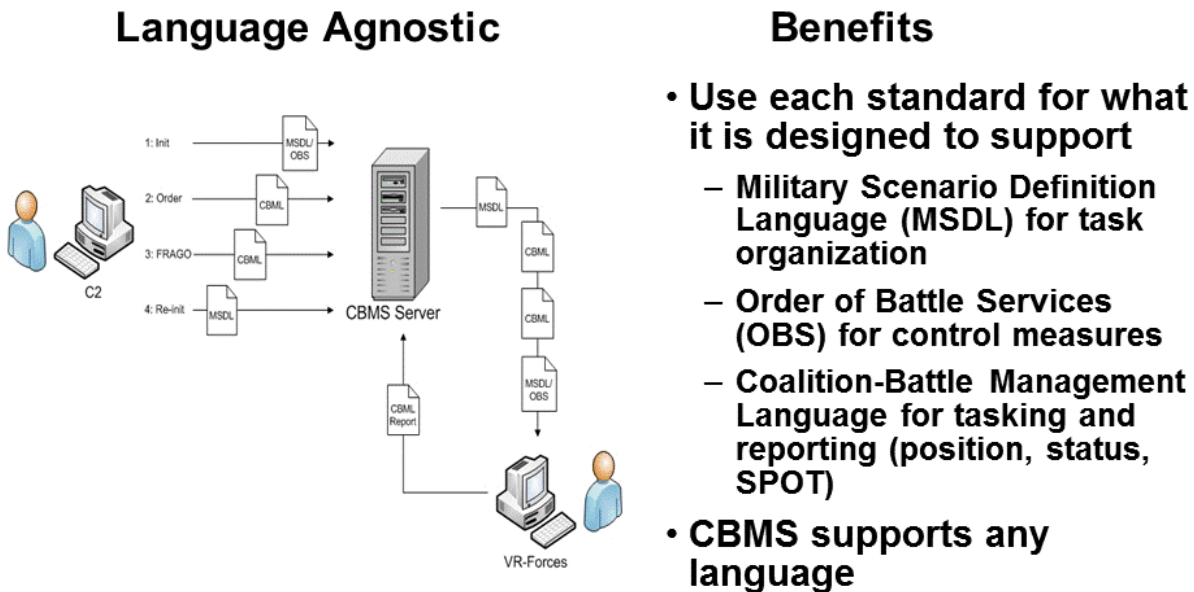


Figure 2. CBMS Use Cases – Format and Content Independent

Unclassified

Coalition Battle Management Services (CBMS)
Coalition Warfare Program

Final Report

The military problem set addressed by CBMS use cases includes:

- Communicating mission/intent from user to simulation.
- Interacting with Coalition systems.
- Operational C2 systems.

2.1.2.1 Primary Use Cases

Primary use cases to be supported by CBMS:

- Exchange of orders, reports, and requests between fielded legacy C2 and M&S systems.
- Data distribution management to ensure the right message is sent to the right system at the right time.
- CBML persistent store (database) with respective metadata to provide resend/replay capability.
- Time management capability to track and synchronize message passing for improved situational awareness.
- Parametric search/filtering to locate and provide relevant-only information.

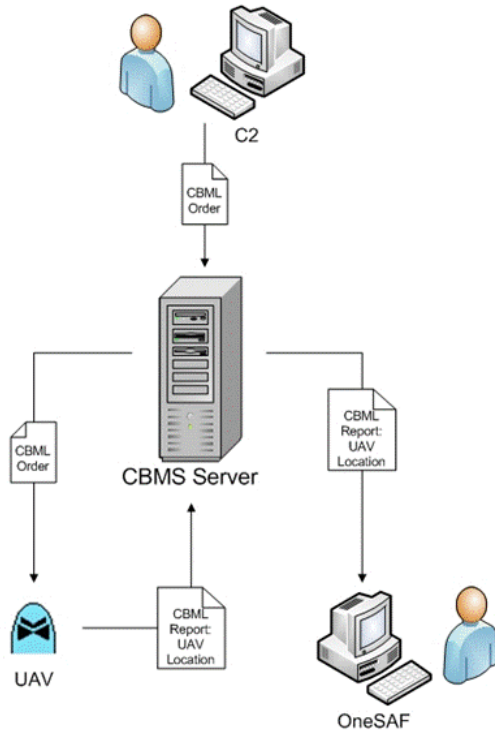
2.1.2.2 Simulation Planner Use Cases

The CBMS use cases for the Simulation Planner includes:

- Creating a written order (i.e., mission).
- Converting that written order to CBML.
- Transmitting to simulation.
- Creating and executing model in simulation.
- Viewing simulation results.
- Refining course of action (e.g., order).

CBMS provides is the ability to exchange live protocol information into constructive simulations. Figure 3 demonstrates Helix helicopter with tracking device integrated into OneSAF and VRFORCES.

Use Case 2: Live Virtual Constructive



- **Initialization**
 - C2 surrogate initializes OneSAF with constructive UAV
- **Live UAV flies to a area and continuously reports its position through CBMS using C-BML**
 - Position reports are reflected by constructive UAV in OneSAF
- **C2 surrogate shows common operating picture**

Figure 3. CBMS Use Cases – Live Virtual Constructive

2.2 Project Development

2.2.1 System of Systems (SoS) Environment

CBMS was designed to operate in a System of Systems (SoS) environment (Figure 4). Design considerations included:

- Multiple Systems
 - LVC
- Multiple Sources and Formats
 - Voice, Chat, Binary, Free Text, XML, etc.

- Multiple Levels of Decision
 - Strategic, Operational, Tactical
- Multiple Standards
 - Message formats, M&S standards, etc.

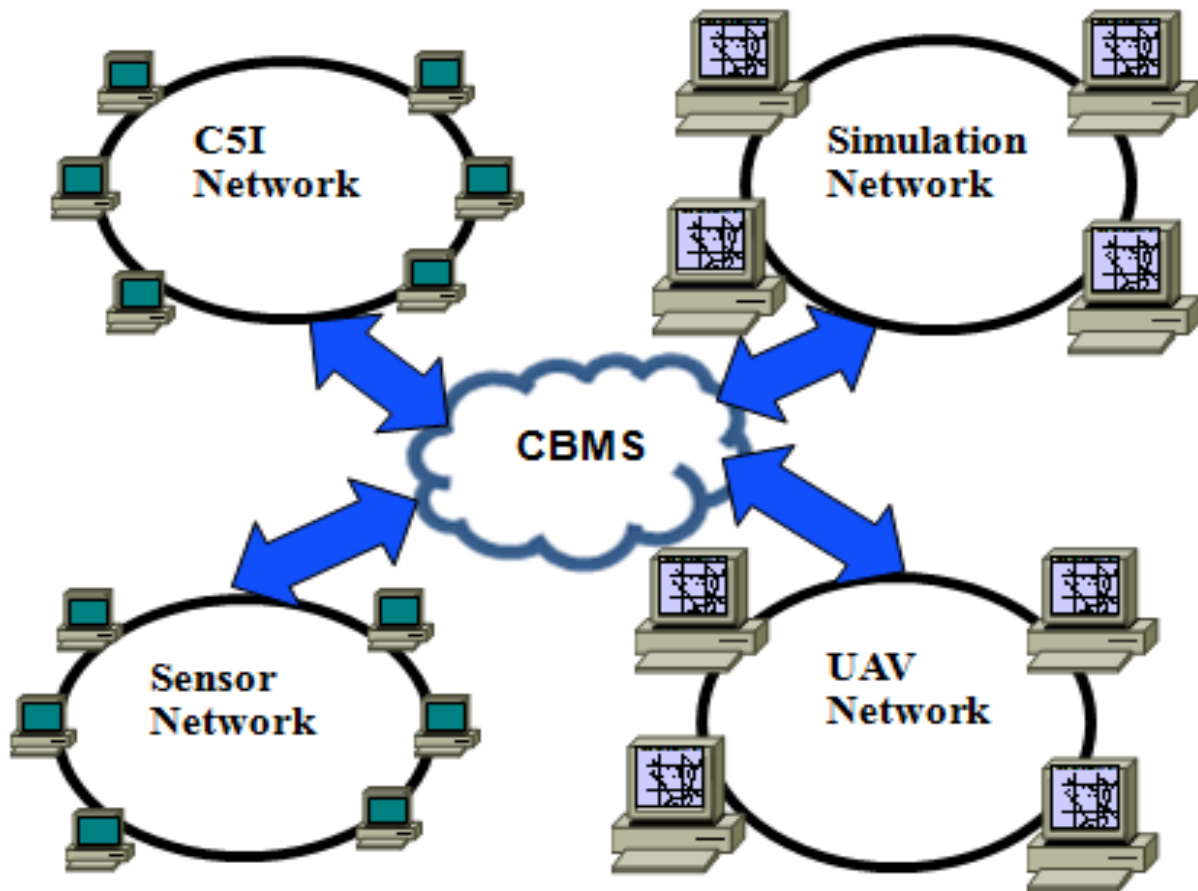


Figure 4. CBMS OV-1 “System of Systems Interoperability”

2.2.2 Service-Oriented Approach

The CBMS system is architected following a service-oriented approach. The CBMS system is partitioned into technical, syntactic, semantic, pragmatic, and conceptual interoperability components that can be combined to deliver an overall interoperability solution. Interpretation and use of information is determined by the system. Figure 5 shows the CBMS interoperability services (grouped into two functional areas).

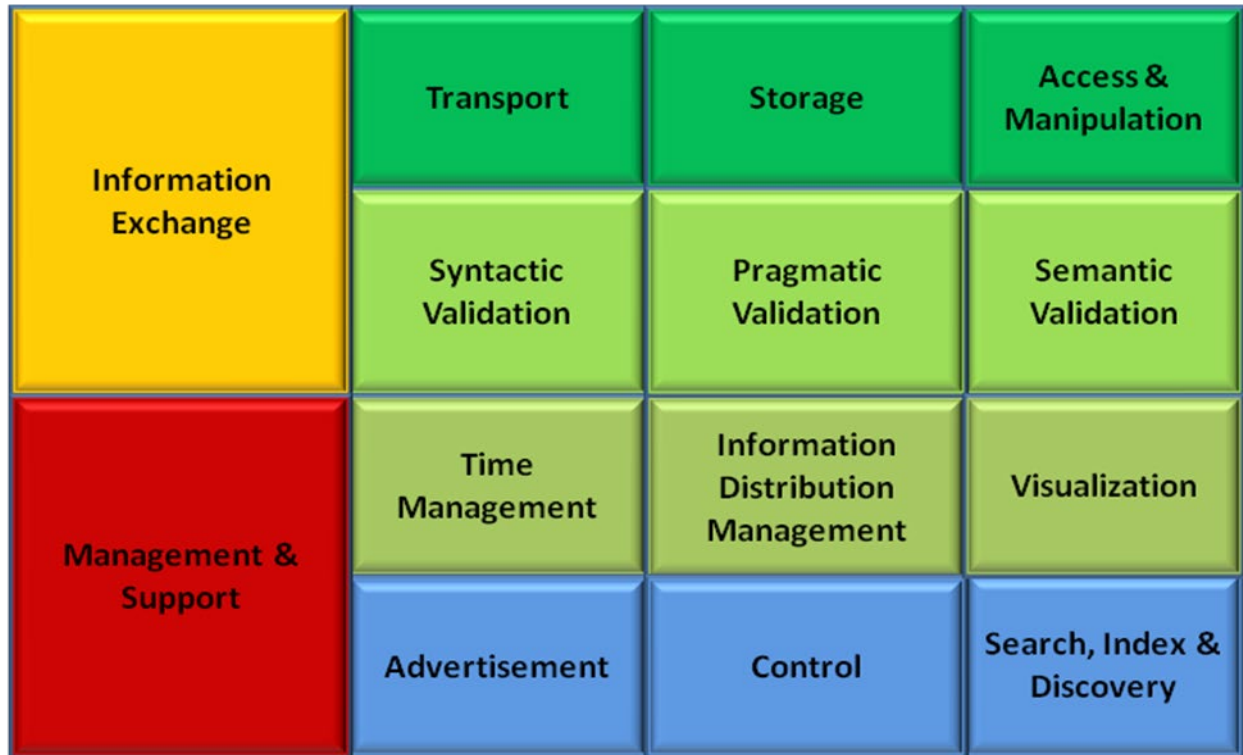


Figure 5. CBMS Interoperability Services

The information exchange components support all aspects of information exchange including its transport, storage, and validation. The second functional area has components that focus on the management and support of system of system interoperability in terms of search, control (start, stop, save) and synchronization as well as visualization (COP).

2.2.3 C2 to Simulation Interoperability

The approach was to develop a single common interface and standardized environment. The following considerations were incorporated:

- Develop a stable technical interoperability framework.
 - Changes to the infrastructure do not impact connecting systems.
 - Changes in systems do not impact the infrastructure.
- Developers focus only on their systems.
 - Produce information.
 - Consume information.

Unclassified

Coalition Battle Management Services (CBMS)
Coalition Warfare Program

Final Report

- Move from interface-centric interoperability to document-centric interoperability.
 - Information is described in documents and not embedded in interfaces.
 - Content of documents does not affect the infrastructure.
 - Documents are manipulated by systems without affecting others.
- Use web standards.
 - Internet as the inspiration.
 - Open standards.
 - Open source products.
- Provide reusable services in support of interoperability.
 - Each service provides a unique functionality.
 - Services can be orchestrated as needed.

Implementation features the following:

- Support the transport of structured documents between C2 and simulation systems. The Hyper Text Transport Protocol (HTTP) used by the World Wide Web (WWW) is the standard of choice because it decouples the transport of information from its format. The Representational State Transfer (REST) software architecture design is used for distributed systems as a best practice because it allows CBML documents to be treated as resources that are exchanged over HTTP.
- Support syntactic, semantic, and pragmatic validation of information contained in CBML documents. The use of the XML schema definition (XSD) standard, the standard web ontology language (OWL) and the Java Community Process standard 94 (JSR-94) respectively allows support for each level of validation.
- Support a subscription service that makes information available to users on demand and as soon as it is available (similar to subscribing to a newsletter). Server-Sent Event (SSE) is used, which is in the process of being standardized as part of the HyperText Markup Language (HTML) 5 specification by the World Wide Web Consortium (W3C).

The result was a standardized interoperability infrastructure as depicted in Figure 6.

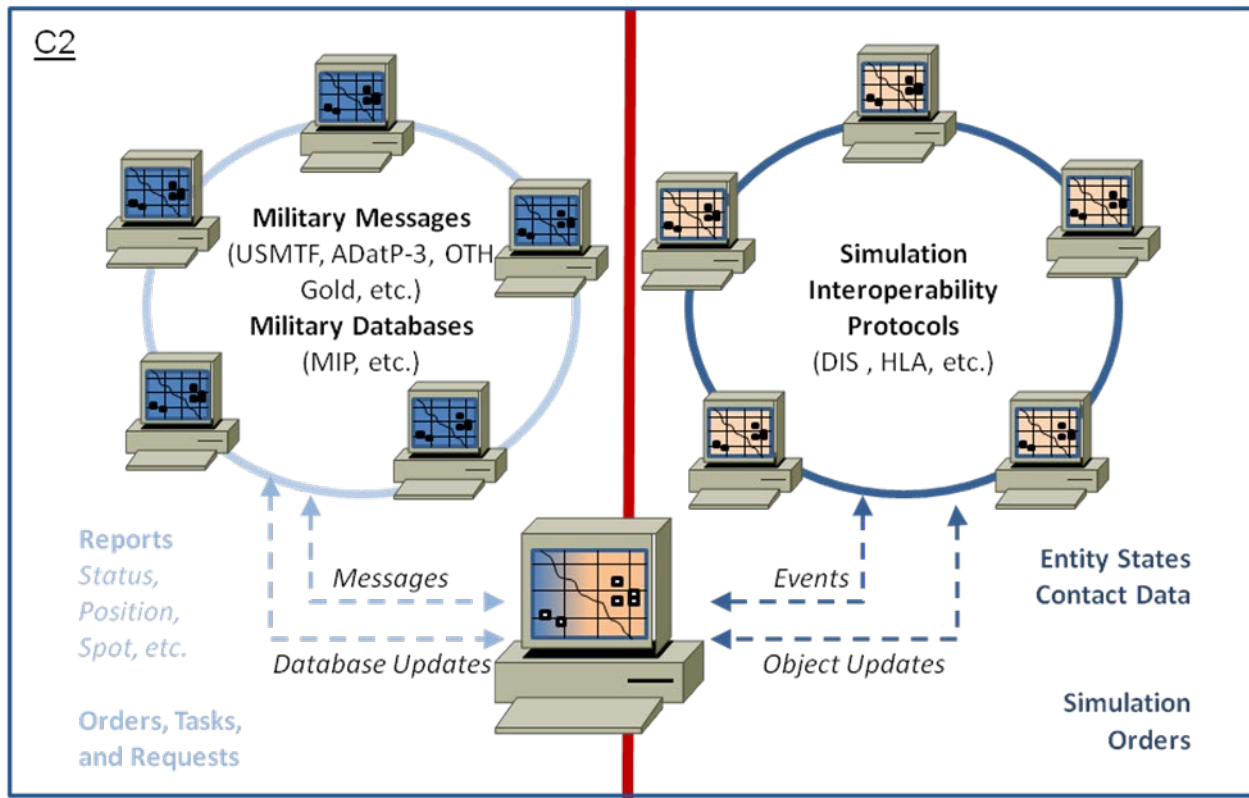


Figure 6. CBMS OV-3 “C2 to Simulation Interoperability”

2.2.4 Open Standards/Freeware

Because CBMS uses open standards and freeware, the cost of integration is negligible because there is no up-front purchase cost; integration might be less costly than alternatives given the basis in documented standards. In addition, the tools used are maintained and updated by the open source community, which reduces maintenance and improvement cost. All of the standards used are existing industry standards that are extensively used. These standards are applicable to the problem set, and could be used extensively to make military systems interoperable.

3 Accomplishments

CBMS has demonstrated an ability to improve the readiness of designated multinational partners and the commanders’ ability to plan and execute in a Joint and/or Coalition environment. CBMS executable code is used by France, Spain, the United Kingdom (UK), and Canada. Each nation has a Term of Reference (TOR) agreement signed on a bilateral basis. The US government has unlimited access to both source and executable code. We are currently working on extending

Unclassified

Coalition Battle Management Services (CBMS)
Coalition Warfare Program

Final Report

access to the source code to our Coalition partners. The following sections demonstrate CBMS' accomplishment of the project's objectives.

3.1 Activities

- Synchronized initialization and execution of C-BML using MSDL.
- Demonstrated CBMS to Joint Staff (JS) J7.
- Prepared a Joint Close Air Support (JCAS) mission thread for execution.
- Completed initial CBMS C2 Data Pilot.
- Prepared CBMS C2 Data Pilot report.
- Prepared/submitted request for One Semi-Automated Forces (OneSAF) and Joint Semi-Automated Forces (JSAF) for integration in CBMS.
- Development Milestone – Technical Readiness Level – 5 “In-lab Prototype Demonstration”:
 - Initialized a scenario with MSDL.
 - Used CBML to task and Fragmentary Order (FRAGO) entities within that scenario.
 - Dynamically read-in new MSDL files.
 - Dynamically linked MSDL and CBML schema as a coherent whole problem/challenge.
 - Advanced the CBML Graphical User Interface (GUI) and iPad applications.
- Coordinated with Modeling and Simulation Coordination Office (MSCO) leadership on focus of The Technical Cooperation Program (TTCP) National partners and an anticipated request to expand M&S Group (MSG)-91 to look at broad SIM-C2 interoperability issues.
- Coalition Attack Guidance Experiment (CAGE II) experiment and use of CBMS technologies:
 - CWP-CBMS Canadian partner has requested use of CBMS executables within this venue; representing a spin-off of the core CWP effort.

Unclassified

Coalition Battle Management Services (CBMS)
Coalition Warfare Program

Final Report

- The CAGE II experiment assessed interoperability of current and future C2 systems (and other decision support tools) in the Joint and Coalition domains.
- As a lead partner, Canada invested R&D funds into this venue.
- The Canadian Forces Warfare Centre (CFWC) will be using CBML/CBMS technologies for integration.
- Researched holding a North American CBML workshop in conjunction with the Multinational Interoperability Programme (MIP) in response to Action Item AI-M01-20.
- Participated in US-US technical interchanges with MSG-085 and CBMS projects.
- Prepared and submitted a white paper to the CWP Program Office on “Building a Scalable Web-Based Knowledge Sharing Infrastructure in Support of Coalition Interoperability” as justification for additional funding in FY-12 for \$200K.
- Collaborated with North Atlantic Treaty Organization (NATO) Research Technology Organization (RTO) MSG-085, as well as Australia-Canada-Great Brittan-US (ACGU) TTCP promoting C2 to M&S interoperability.
- Drafted Canada – US CBMS Terms of Reference (TOR). This document will be used as information exchange vehicle to provide CBMS executable code, documentation and documentation of future software releases to facilitate research, development, test and evaluation to optimize CBMS operational effectiveness.
- Drafted NATO MSG-085 – US CBMS TOR.
- Drafted GB – US CBMS TOR.
- Prepared and submitted CWP-CBMS input into JS J7 Coalition Engagement Strategy Brief.
- Researched the possibility of MSG-085 Prototype/Experiment participation in VIKING event supported by JS J7’s Partnership-for-Peace (PfP) Division.
- Submitted a Professional Abstract Paper titled “Coalition Battle Management Services (CBMS)” to the FY-12 Inter-service/Industry Training, Simulation, and Education Conference (I/ITSEC) 2012 for consideration.
- Drafted CBMS User Document.
- Drafted CBMS Systems Design Document.

Unclassified

Coalition Battle Management Services (CBMS)
Coalition Warfare Program

Final Report

- Provided CBMS brief to the JS J7 Technical Working Group (TWG) to consider emerging technologies for implementation, transition, and consideration into the Joint Training Environment baseline. Received favorable comments and consideration as a potential technology to pursue.
- Provided a demo of CBMS to JS J7 Joint Adaptive Cloud Computing for Experimentation and Training (JACCET) as a potential infrastructure for use within this projects middleware. Received favorable feedback for consideration into development baseline.
- Prepared and submitted FY13-14 CWP Proposal “Coalition System-of-Systems Integration Framework” (CSSIF) as a follow-on technology capability.
- Established Dynamic Multipoint Virtual Private Network (DMVPN) between Canada, Spain, VMASC, and I/ITSEC test beds for more secure integration work on unclassified commercial network.
- Conducted Coalition C2 and M&S Integration Infrastructure Requirements Meeting to address 2012-2014 goals and what each of the respective organizations/governments are funding for developing an environment in which C2 systems, M&S systems, UAVs, and other devices can be easily combined and recombined to support Coalition operations.
- Released Open Source License Agreement for CBMS to start the distribution to OneSAF and Canada.
- Prepared draft CBMS Annual Questionnaire.
- Conducted CWP IPR for CBMS to JS J7 ED Branch – Futures Unit in concert with VMASC academia.

3.2 Successes

- CBMS software usage agreement signed between US and Canada for use in the CAGE program.
- CBMS software usage agreement signed between US and the MSG 085 participating nations for the duration of the MSG activity. Signatories included NATO MSG – 085 co-chair partners from France and Canada, and US - JS J7 CBMS Programmatic Lead. This supports CBMS activities with the NATO RTO MSG-085 C2 to Simulation Interoperation project.
- CBMS usage agreement signed between the US and the UK for use in Defense Science and Technology Laboratory (DSTL) activity.

Unclassified

Coalition Battle Management Services (CBMS)
Coalition Warfare Program

Final Report

- CBMS was included in NATO's MSG-085 I/ITSEC 2011 demonstration.
- Spain will adapt CBMS as their infrastructure for system-to-system interoperability.
- Norway has expressed strong interest, but is assessing their programmatic needs.
- France and Spain have proposed to use CBMS infrastructure and architecture in upcoming activities with MSG-106.
- US OneSAF design team is considering integration of CBMS into its baseline.
- Successfully showed ability to simultaneously support multiple interoperability standards, including but not limited to:
 - JC3IEDM (NATO STANAG 5525): NATO C2 information exchange interoperability standard.
 - MSDL (SISO-STD-007-2008): Simulation initialization interoperability.
 - OBS (JFCOM/J7): C41 and simulation common scenario generation de facto standard.
 - C2 Core (JFCOM/J9): Standardized core of data element in support of C2 data modeling.
- Presented the CBMS strategy for supporting multiple standards and embedding simulation systems into future C2 systems to the DSSC.
- Presented CBMS to the Concept Development and Experimentation Community as an alternative to High Level Architecture (HLA) and Distributed Interactive Simulation (DIS).
- Conducted successful CBMS IPR on 11 May 2011. Col Joe Leonard, CWP Senior Leadership, recognized the value of CBMS Technology and applauded the research and integration efforts.
- Demonstrated the value added of project execution at JS J7C as it affords opportunity to leverage other operational training technologies and events being conducted.
- TTCP and CAGE II events replicated the complex Coalition airspace deconfliction environment and compared emerging C4I technologies using CBML standards. CAGE II replicated the as-is environment with "to-be" technologies, and then compared and contrast benefit gained with the emerging C2/decision support devices.

Unclassified

Coalition Battle Management Services (CBMS)
Coalition Warfare Program

Final Report

- Canada testimonial regarding use of CBMS within the Coalition Attack Guidance Environment (CAGE) II Experimentation venue between US-CN-AS: “We used CBMS main features for passing CBML messages between ICC [Integrated Command and Control] and JSAF, and our initial assessment is that CBMS worked beautifully; it never crashed, and had all the features needed for this specific development. So in summary, we are very satisfied with the level of capability and quality of the CBMS product.”
- US MSCO recognizes the foundational impact CBMS research could provide each event.
- Successfully showed to ability to simultaneously support multiple interoperability standards.
- Received favorable feedback on IPR and demonstration noting JS J7, US Army, and Coalition partner interest in the technology.
- Joint Staff (JS) J6 showed interest in CBMS as potential development tool in assisting the Future Mission Network (FMN).
- “Coalition Battle Management Services (CBMS)” technical paper and presentation accepted for I/ITSEC 2012 as a continuing education credit.

3.3 Related Initiatives/Forums

The following were attended in support of the CBMS development process.

ENGAGEMENT	DATE	DESCRIPTION	SUMMARY
NATO MSG - 085 Kick-Off Meeting	7-9 Mar 2010	Meeting was held in France	<ul style="list-style-type: none">• Intent:<ul style="list-style-type: none">- MSG-085 national appointments.- Technical Activity Proposal (TAP) review and proposed changes.- MSG-085 organization.• Outcome:<ul style="list-style-type: none">- National leads were designated.- Presentation of MSG-085 Focus Areas and proposed organization.- Final changes and vote on modified TAP.
MSG 085 2 nd Meeting	29-30 Nov 2010	Meeting was held in Orlando, Florida	<ul style="list-style-type: none">• Intent:<ul style="list-style-type: none">- Presentation of RTO and MSG-085 procedures.- Kick-off meeting minutes and action item review.

Unclassified

ENGAGEMENT	DATE	DESCRIPTION	SUMMARY
			<ul style="list-style-type: none"> - Programme of Work (POW) presentation and discussion. - MSG-091 de-brief. - Multi-Sensor Aerospace-Ground Joint Intelligence, Surveillance and Reconnaissance (ISR) Interoperability Coalition (MAJIIC) experimentation opportunities. - NATO ACT-MSG-085 coordination. - Discussion on initial experimentation. - Operational Sub Group (OSG) briefing. - Technical Sub Group (TSG) briefing. - National contributions based on draft POW. • Outcome: <ul style="list-style-type: none"> - National appointments, national participation in sub groups, participation in meetings, and other administrative matters should conform to the RTO procedures. - The definition of a COI was discussed and there was a consensus that a CBML COI would be of benefit. - As per the proposed POW, it was recommended to conduct experimentation to show results and build confidence among the user community – including early demonstrations and involving several operational events such as DNET, Coalition Warrior Interoperability Exploration, Experimentation, and Examination Exercise (CWIX), and MAJIIC. - MAJIIC is an excellent opportunity for an early MSG-085 experimentation event involving the operational community.

Unclassified

Coalition Battle Management Services (CBMS)
Coalition Warfare Program

Final Report

ENGAGEMENT	DATE	DESCRIPTION	SUMMARY
MSG 085 3 rd Meeting	15-17 Mar 2011	Meeting was held in Madrid, Spain	<ul style="list-style-type: none"> • Intent: <ul style="list-style-type: none"> - POW discussion. - Participated in OSG-lead workshop. - Participated in TSG-lead workshop. • Outcome: The POW was approved by all of the nations present.
Information Exchange Documentation (IED) Coordination	11 Apr 2011	Conducted meeting between Joint Coalition Warfighting Center (JS J7C) and Canadian partners	<ul style="list-style-type: none"> • Prepared and implemented information exchange documentation that provides a vehicle to exchange executable and source sharing. • Set up CBMS server at Virginia Modeling, Analysis & Simulation Center (VMASC) lab for development and integration. • Provided access to VMASC server and support integration with CBMS to CWP-CBMS Project; TTCP AA-18 and MSG-085 events (minimal – share executables). • Provided laptop server during integration meetings (minimal – share executables).
Data Pilot Working Group (DPWG) and C2 Data and Steering Committee (DSSC) In Progress Review-IPR	19 Apr and May 2011	Provided CBMS – C2 Core Pilot Update	<ul style="list-style-type: none"> • Discussed CBMS’ need to integrate multiple XML payloads to support C2 to M&S interoperability, including the initialization/joining phase (MSDL, OBS, and C2 Core) and the execution phase (CBML). • Evaluated how C2 Core aligns and supports C2 authoritative data sources. • Identified C2 initialization requirements from existing authoritative data sources. Used C2 Core to model information that is suited for C2 initialization. Integrated CBMS C2 Pilot with MSDL and OBS. Success will be measured by the number of Change Requests (CR) to align C2 Core based format with MSDL. • Schedule: <ul style="list-style-type: none"> - Mar 11 – DSSC approve nomination

Unclassified

Coalition Battle Management Services (CBMS)
Coalition Warfare Program

Final Report

ENGAGEMENT	DATE	DESCRIPTION	SUMMARY
			<ul style="list-style-type: none"> - Apr/May/June 11 – evaluate OBS authoritative data sources - Jun/Jul/Aug 11 – build Unit Order of Battle (UOB) and C2 Core schema - Aug/Sep/Oct 11 – submit CRs • Objectives/Accomplishments: Integrated CBML with MSDL within CBMS (achieved).
IED Coordination	25 Apr 2011	Conducted IED coordination between JS J7C and French Partners for MSG – 085 Support	<ul style="list-style-type: none"> • Synchronization to address CBMS’ availability during MSG-085 events, development activities, and in what form/when to address with Coalition partners. • Processed IED vehicle to provide remote access to executable to support MSG-085 testing, development and integration events, and to bring product to meetings and experimentation events.
NATO MSG-085 TSG Coordination	03 May 2011	Participated in MSG-085 TSG teleconference	<p>Meeting to define use case template to be used by the OSG and to begin defining a technical demonstration to be used by the OSG. Satisfied MSG-085 TSG action items:</p> <ul style="list-style-type: none"> • AI-M02-18: The TSG needs to provide a template for the use case definition to the OSG. • AI-M03-12: TSG to define a technical demonstration for the October meeting.
Coalition Warfare Program (CWP) CBMS Project In-Process Review (IPR)	11 May 2011	Old Dominion University (ODU) VMASC, Suffolk, Virginia	<ul style="list-style-type: none"> • CBMS team provided an IPR that was well received and that demonstrated the value added of project execution at JS J7 as it affords opportunity to leverage other operational training technologies and events being executed by JS J7. • The presentation/demonstration included the CBMS background, current capability, and future efforts. It was conducted locally and via teleconference with twelve participants

Unclassified

Coalition Battle Management Services (CBMS)
Coalition Warfare Program

Final Report

ENGAGEMENT	DATE	DESCRIPTION	SUMMARY
			<p>from government, academia, and industry.</p> <ul style="list-style-type: none"> • The outcome and way ahead was to develop a modular visualization capability that will support existing web browsers and applications for portable devices.
CWC Brief to International Training Equipment Conference (ITEC) 2011	22-24 May 2011	CWP - CBMS addressed as major effort	<ul style="list-style-type: none"> • Senior Leadership from JS J7 received overview brief of JS J7 support to Coalition partners in preparation to attend ITEC. • Senior Leadership from JS J7 attended UK Paper presentation on use of CBMS/CBML in C2 to Simulation interoperation ISO MSG-085.
DPWG and C2 DSSC IPR	31 May and 15/16 Jun 2011	CBMS – C2 Core Pilot Update	<ul style="list-style-type: none"> • Objectives/Accomplishment : <ul style="list-style-type: none"> - Integrated CBML with MSDL within CBMS. - Assessed C2 initialization requirements from existing authoritative data sources. - Developed a C2 initialization schema using C2 Core for UOB. - Worked to identify gaps and provide feedback in the form of design recommendations (approach to integrate different schemas). • VMASC support included: <ul style="list-style-type: none"> - Preparing report for CBMS C2 data pilot. - Completed initial CBMS C2 data pilot. - Briefed the DSSC on the CBMS approach to use C2 Core.
MSG 085 4 th Meeting	4-6 July 2011	Meeting was held in Hague, Netherlands	<ul style="list-style-type: none"> • Intent: <ul style="list-style-type: none"> - Propose a technical interoperability framework that connects Coalition systems. - Participate in the OSG. • Outcome: <ul style="list-style-type: none"> - CBMS framework was offered for use within the experimentation campaign of the MSG. This offer was well received

Unclassified

ENGAGEMENT	DATE	DESCRIPTION	SUMMARY
			<p>and an agreement was signed by the co-leads (France and Canada) of MSG, thus establishing a legal framework under which participating nations can use CBMS. Spain signed up to adopt CBMS as their interoperability solution, agreed to conduct an operational experiment, and present a demonstration with their national systems using CBMS. This demonstration will involve several other nations in parallel as part of the first MSG experiment. Norway (NOR) expressed strong interest in adopting CBMS as their infrastructure for system-to-system interoperability.</p> <ul style="list-style-type: none"> - Defined a roadmap and a set of operational messages that need to be supported. - Defined a high-level scenario with land, air, and maritime components along with the information flow within and across the three components. - Began coordinating with the US planners of the VIKING events (2014) to assess how the experimentation campaign defined by the MSG can be incorporated or used (integrated, parallel, repeat) in the future. <ul style="list-style-type: none"> • Accomplishments: <ul style="list-style-type: none"> - Established the use of CBMS as part of the MSG 085 experimentation plan and interoperability architecture. - Established a partner in Spain, who is an immediate user of the technology and plans to use it in the future. - Established a strong relationship with Army M&S Office (AMSO) and Program Executive Office (PEO) OneSAF. - Established JS J7 as a major player in

Unclassified

Coalition Battle Management Services (CBMS)
Coalition Warfare Program

Final Report

ENGAGEMENT	DATE	DESCRIPTION	SUMMARY
			Coalition interoperability activity in both the C2 and simulation community.
US to US Technical Interchange Meeting (TIM)	2 Aug 2011	CBMS team, US rep to MSG-085, US rep to MIP	<p>Purpose of the meeting was to receive briefs on respective programs to gain situational awareness and to identify potential leverage opportunities.</p> <ul style="list-style-type: none"> • AMSO/JS J7 to discuss potential US/SWE bilateral participation in VIKING 14 as an OneSAF/CBMS demonstration opportunity outside of MSG-085. PM BC to investigate and provide any documentation from DASA (DEC) on approval to proceed in MIP support as an unentitled Working Group. • AMSO/JS J7 to continue CBML/MSDL/CBMS synchronization with Rapid Data Generation (RDG) High Level Task (HLT). Ensure AMSO POC tied in with JS J7 activities. • AMSO/JS J7 to support alignment of current MSDL/OBS schemas/activities. • AMSO to establish US dialogue to share information and synchronize MSG-085 and MSG-068 (and follow-ons) teams and activities. • AMSO to coordinate better business rules validation regarding capability gap for MSDL/CBML. • AMSO to investigate Unfunded Requirement (UFR) list or other M&S projects that may be relevant and releasable to VA Office of Technology for consideration. • JS J7 to continue to keep US MSG-085 lead apprised of current FY12-13 CBMS funding gap and risk mitigation activities. • JS J7 to schedule demonstration of CBMS at VMASC lab in Nov 11 timeframe. • JS J7/VMASC to ensure C2 Core/MSDL mapping effort synchronized.

Unclassified

ENGAGEMENT	DATE	DESCRIPTION	SUMMARY
			<ul style="list-style-type: none"> • AMSO/JS J7 to coordinate on consistent communication and differentiation of standards vice infrastructure activities. • AMSO to supplement PM BC MIP "Considerations for Use" slide with complementary capabilities provided by CBML in comparison to MIP/JC3IEDM. • PM BC to provide schedule and supporting information for next CWIX and related planning conferences.
DPWG and C2 DSSC IPR	DPWG 25 Jul, DSSC 04 Aug, and DPWG 01 Sep 2011	CBMS – C2 Core Pilot Update	<ul style="list-style-type: none"> • Pilot Description: <i>Sponsor-JS J7</i> <ul style="list-style-type: none"> - CBMS needs to integrate multiple XML payloads to support C2 to M&S interoperability, including the initialization/joining phase (MSDL, OBS, and C2 Core) and the execution phase (CBML). - Evaluate how C2 Core aligns and supports C2/M&S authoritative data sources. • Architecture: <ul style="list-style-type: none"> - Identify C2 initialization requirements from existing authoritative data sources. - Use C2 Core to model information that is suited for C2 initialization. - Integrate CBMS C2 Pilot with MSDL and OBS. Success will be measured by the number of CRs to align C2 Core based format with MSDL and OBS standards. • Schedule: <ul style="list-style-type: none"> - Mar 11 – DSSC approve nomination - Apr/May/Jun 11- evaluate OBS authoritative data sources - Jun to Nov 11-build UOB and C2 Core schema - Aug to Dec 11-submit CRs • Objectives/Accomplishments: <ul style="list-style-type: none"> - Integrated CBML with MSDL within

Unclassified

ENGAGEMENT	DATE	DESCRIPTION	SUMMARY
			<p>CBMS (achieved).</p> <ul style="list-style-type: none"> - Modified architecture to identify Joint C2 and simulation initialization requirements from a Coalition standpoint. - Provided updated CBMS – C2 Core Data Pilot quad chart. - Recommended C2 Core Subject Matter Expert (SME) participation within the CBMS – C2 Core Data Pilot for metrics development using a repeatable process. - Prepared C2 Core Survey to assess C2 Core development costs and level of effort for the CBMS – C2 Core Pilot venue.
<p>Fall Simulation Interoperability Workshop (SIW) as part of the Simulation Interoperability Standards Organization (SISO)</p>		<p>Semiannual event encompassing a broad range of M&S issues, applications, and communities.</p>	<p>The Workshop consists of a series of forums and special sessions addressing interoperability issues and proposed solutions; tutorials on state-of-the-art methodologies, tools, and techniques; standards product development working groups; and exhibits displaying the latest technological advances.</p> <ul style="list-style-type: none"> • Attended the C2/M&S Services Forum, which addressed standards to ensure interoperability between simulation and C2 systems; standards to ensure composability when integrating simulation components and C2 components into a common framework; and standards to represent C2 systems and the underlying infrastructure within simulation applications. • Presentations were made that support CBMS in the following sub-areas: <ul style="list-style-type: none"> - Metadata/data interchange standards. - Use of BML and its variants; the C2 Information Exchange Data Model (C2IEDM) and/or C2IEDM extensions. - M&S services development and use in an SOA. - Network centric services/web-based

Unclassified

Coalition Battle Management Services (CBMS)
Coalition Warfare Program

Final Report

ENGAGEMENT	DATE	DESCRIPTION	SUMMARY
			<p>services.</p> <ul style="list-style-type: none"> • Participated in the CBML Product Development Group (PDG). CBMS equities within the CBML PDG were identified and addressed. • Participated in the MSDL PDG. CBMS equities within the MSDL PDG were identified and addressed.
MSG 085 5 th Meeting	04-07 Oct 2011	Meeting was held in Ottawa, Canada	<ul style="list-style-type: none"> • Intent: <ul style="list-style-type: none"> - Finalize I/ITSEC 2011 demonstration. - Converge on an Experimentation Plan. • Defined experimentation procedures.
MSG 085 6 th Meeting	14-16 Feb 2012	Meeting was held in Farnborough, UK	<ul style="list-style-type: none"> • Intent: <ul style="list-style-type: none"> - Demonstrated the new discovery and advertisement capabilities of CBMS. • Accomplishments: <ul style="list-style-type: none"> - Using a simple web connection to a OneSAF system located in Suffolk, VA, the following capabilities were demonstrated: <ul style="list-style-type: none"> • Connect to OneSAF over the web. • Retrieve tasks and orders from OneSAF given a list of entities. • Send tasks and orders that are executed in OneSAF. • Send control measures to be used in the execution of the tasks and orders. • Generate and retrieve location, status, and SPOT reports that can be viewed in a C2 system. - France indicated that they would use CBMS during EUROSATORY 2012. - The US received the JSAF BML connectivity package from the UK (the plan is to integrate JSAF with CBMS). - The US took the task to create a way to

Unclassified

ENGAGEMENT	DATE	DESCRIPTION	SUMMARY
			<p>track return on investment of CBMS, CBML, and MSDL operationally, technically, and economically. VMASC will develop a simulation to calculate Return on Investment (ROI) based on budget, requirements, goals, and objectives.</p> <ul style="list-style-type: none"> - The US participated in the operational sub-group to develop a set of operationally relevant scenario. - The US joined the infrastructure Common Interest Group (CIG) that will focus on issues related to technical interoperability (scalability, robustness, resilience, etc.). - The MSG-085 MIP liaison role currently is being filled by NOR. The goals of this role need to be further refined. - Future US to US meeting will continue to seek leverage opportunities between AMSO, JS J7, and MIP activities: <ul style="list-style-type: none"> • US will explore opportunities with MSG-105-106. They are focusing on Cyber, Weapons of Mass Destruction (WMD) with USA/BUL leads. • US will continue to act as MSG-085-VIKING liaison via JS J7 support.
MSG 085/106 Synchronization and Planning Meeting	14 May 2012	Meeting was held at VMASC in Suffolk, VA	<ul style="list-style-type: none"> • Intent: <ul style="list-style-type: none"> - Review MSG-085 and MSG-106 TAPs - Identify leverage opportunities. - Coordinate activities to ensure optimized R&D is achieved. - Avoid duplication.
MSG 085 7 th Meeting	18-21 Jun 2012	Meeting was held in Paris, France	<ul style="list-style-type: none"> • Intent: <ul style="list-style-type: none"> - CIG#1 focus - incremental development and evolution of infrastructure services supporting distributed simulation and C2 initialization and runtime management

ENGAGEMENT	DATE	DESCRIPTION	SUMMARY
			and coordination services in preparation for operational use.
MSG 085 8 th Meeting	25-28 Sept 2012	Meeting was held in Istanbul	<ul style="list-style-type: none"> • Intent: <ul style="list-style-type: none"> - Establish status of POW deliverables. - Establish CIG status (finalize outputs and capability status). - Prepare for November workshop. - Plan/coordinate various communication events (I/ITSEC 2012 Science & Technology Organization (STO) booth demo and MSG-119 C2-Sim Workshop). - Start to consider 2013. • Proposed having the CIG Workshop in the Washington DC area on the George Mason University campus.

3.4 Demonstration - I/ITSEC 2011 Demo Harness Coalition Battle Management Experimentation Event

Demo Harness 2 provided the experimentation architecture to connect Virtual Reality Forces and OneSAF in order to execute a ground maneuver scenario consisting of a multinational (Spain, US) company working together to clear a house. The demonstration showcased common initialization and execution between the two simulations using MSDL and CBML respectively through the CBMS infrastructure. The operational goal was to show how Simulation Interoperability Standards Organization (SISO) standards could be used to support Coalition training. The technical objective is to demonstrate that a C2 system can be used to command and control entities in multiple simulations. This demonstration architecture (Figure 7) shows that MSDL, CBML, and CBMS can be used to support both C2 to simulation and simulation-to-simulation interoperability.

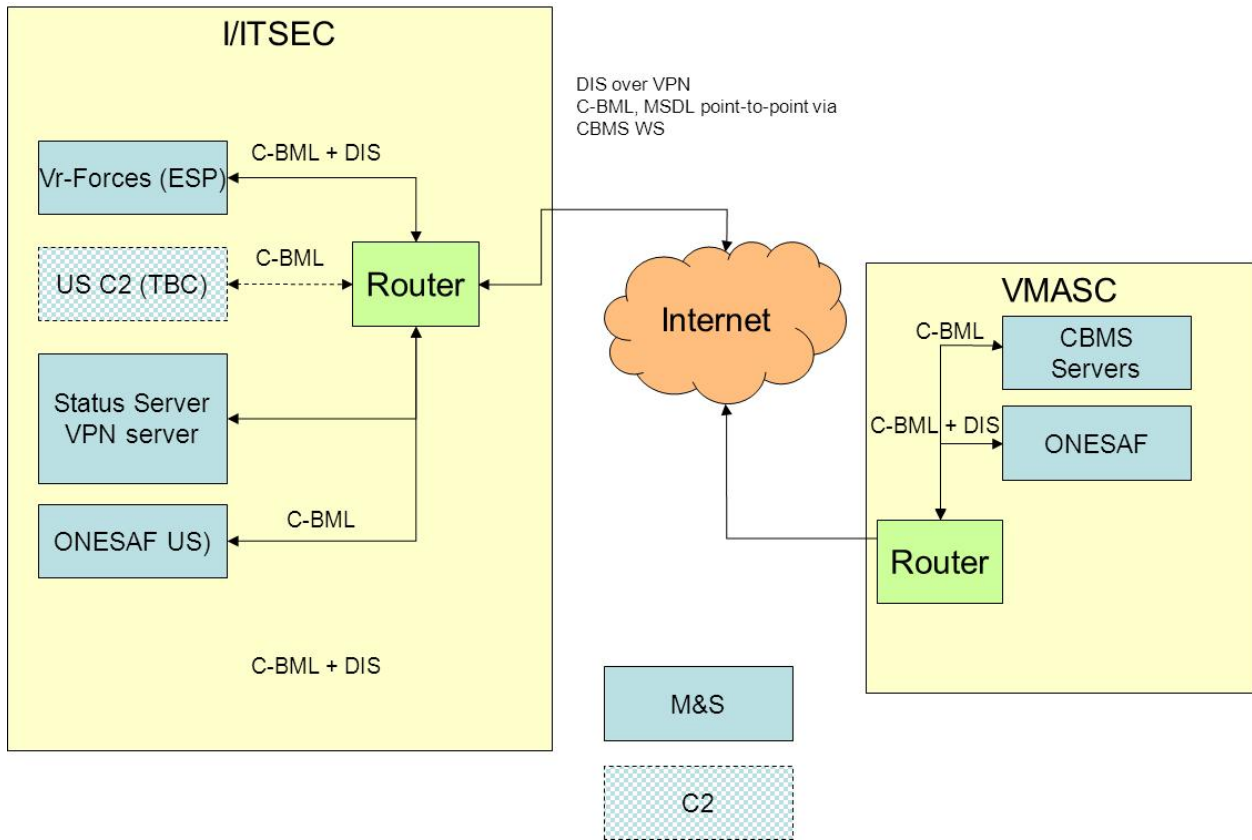


Figure 7. Demonstration Architecture Overview

Unclassified

Coalition Battle Management Services (CBMS)
Coalition Warfare Program

Final Report

4 Funding

Project Title: CBMS		Sponsor: OSD/CWP								Data as of: 06 November 2012					
Project Activities	Performing Org	FY 2010				FY 2011				FY 2012				Symbol	
		1	2	3	4	1	2	3	4	1	2	3	4	Key	
Project Approval	OSD	Δ□♦													
Initial Funding Issued	OSD	Δ		□♦											
Contract Prep & Award		Δ□♦													Δ = Sched Start
CBMS Infrastructure Developed	USJFCOM		Δ		□♦										□ = Sched Complete
IPR & Demo	USJFCOM					Δ□♦			Δ□		Δ□				♦ = Actual Complete
CBMS Refinement						Δ□♦									
Test Plan & CONOPS	USJFCOM					Δ	□♦								
Lab Testing	USJFCOM					Δ	□♦								
MSG-085 Experiment / IITSEC Demo	USJFCOM									Δ□					
CBMS processes	USJFCOM					Δ				□					
Final Test Report	USJFCOM										Δ□				
Technology Transfer	USJFCOM										Δ□				
Education material	USJFCOM										Δ□				
CWP Close-out Report	USJFCOM											Δ□			
Cost Elements / Funding Plan (\$K)														Totals	
Labor															\$ -
FY 2010	\$625K	\$0	\$0	\$156	\$156	\$156	157	\$0							\$ 625,000.00
FY 2011	\$700K					\$0	\$0	\$175	\$175	\$175	175				\$ 700,000.00
FY 2012															\$ -
Travel															\$ -
Miscellaneous															\$ -
Totals by Quarter		\$0	\$0	\$156	\$156	\$156	\$157	\$175	\$175	\$175	\$175	\$0	\$0		\$ 1,325,000.00
Symbology Key															
Funding Summary		FY 2010				FY 2011				FY 2012				Totals	%
CWP Funds Received		\$625				\$700				\$TBD				\$1,325	100.00%
Expended Funds		\$0	\$0	\$58	\$97	\$157	\$181	\$195	\$116	\$145	\$196	\$144	\$34	\$1,323	99.85%
FY 2010	Committed	\$125	\$500	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	625	
	Obligated	\$125	\$500	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	625	100.00%
CWP	Expended	\$0	\$0	\$58	\$97	\$157	\$176	\$135	\$0	\$0	\$0	\$0	\$0	623	99.68%
	Committed	\$0	\$0	\$0	\$0	\$0	\$250	\$450	\$0	\$0	\$0	\$0	\$0	700	
FY 2011	Obligated	\$0	\$0	\$0	\$0	\$0	\$250	\$450	\$0	\$0	\$0	\$0	\$0	700	100.00%
	Expended	\$0	\$0	\$0	\$0	\$0	\$5	\$60	\$116	\$145	\$196	\$144	\$34	700	100.00%
FY 2012	Committed	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$TBD	\$0	\$0	0	
	Obligated	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	0	0.00%
CWP	Expended	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	0	0.00%

Figure 8. Concept Development Funded by Office Under Secretary of Defense, Acquisition, Technology & Logistics, Coalition Warfare Program

5 Way Ahead

Within the coming months, we will perform formal performance testing on every component, as well as conduct an overall performance test using operationally relevant use cases. Those results will be reported. While the initial feasibility in terms of exchange frequency has been demonstrated, future work includes:

- Scaling CBMS to very large federations across multiple levels of security to exchange information near real-time or faster than real-time.
- Working towards rapid integration with portable devices and any technology that supports web standards.
- Supporting LVC integration and testing environments by using CBMS as the information exchange mechanism for LVC systems.
- Working on extending access to the source code to our Coalition partners.
- Researching and informing JLVC 2020 designers how CBMS could be used in the next generation cloud enabled modular services and the JLVC 2020 as a system of systems interoperability enabler.

CBMS is mainly used to support C2 to simulation interoperability where the requirements for information exchange frequency range in minutes or hours. Future research will investigate whether interoperability frameworks such as CBMS should support real-time or faster than real-time information exchange frequency. In order for CBMS and other web-based approaches to survive and to be adopted within the military community, they must exceed the performance of current approaches in terms of scaling and efficiency in addition to their already demonstrated capability.

Several down range research activities are planned that continue integration of CBMS capabilities into US and Coalition environments. This includes C2 Data Pilot with the Joint Staff (JS) J6 community; FY 13/14 prototype demonstrations with NATO MSG – 085 “C2 to Simulation Interoperations”; transition of CBMS Research to NATO MSG -106 Enhanced Computer Assisted Exercise (CAX) Architecture, Design and Methodology in support of France-US CBML-HLA Prototype; US Army’s Simulation-to-Mission-Command Interoperability (SIMCI) “Mission Rehearsal Web Services” Project; The Technical Cooperation Program (TTCP) C2 to Simulation Interoperability Project between Australia-Canada-Great Britain-US (ACGU); Coalition Attack Guidance Experiment (CAGE) II and CAGE III participation (US-CN-AS-UK); and research a CBMS enabled JLVC 2020 infrastructure to inform designers how a semantic web based technology could support JLVC 2020 design. We continue to research the “Open Technology Development” license approach that would support CBMS source code

sharing of CBMS to NATO Coalition Partners. A copy of the “Open Technology Development” license used by the CBMS Project team will be provided to the CWP Office as a deliverable.

6 Summary

The CBMS Project proved to be quite successful in meeting the objectives of the Coalition Warfare Program mission and objectives to support near-term, interoperability-enhancing solutions for current operations and assist in the identification of coalition solutions to long-term or persistent interoperability issues (architectures, coalition requirements, system acquisition). The CBMS Project team was able to prototype CBMS at the Technical Readiness Level -5 (TRL-5 prototype capability in a lab environment). Several coalition partners recognized the immediate benefit of adopting the CBMS approach and are promulgating this standard within their research and development organization as has been highlighted throughout this final report.

The emergence of language-based standards such as CBML and MSDL has generated a change in focus from an interface-centric approach to a system of system information-centric approach that parallels how the World Wide Web is orchestrated. CBMS’ approach was to capitalize upon that. In other words, CBMS provides an approach applicable to different situations by focusing on information exchange instead of ad hoc solutions that change with respect to federates. As an infrastructure that rapidly integrates systems that are not compliant with simulation standards, CBMS provides a reusable set of services based on web standards that support interoperability at the technical, syntactic, and semantic level.

CBMS has been used to exchange messages from C2 to simulation, to initialize multiple simulations using MSDL, to task entities within simulations using CBML, to C2 simulations using MSDL and CBML simultaneously, and to interoperate multiple simulations using CBML. CBMS has also been used to exchange binary files such as images and video between live unmanned vehicles developed at VMASC and simulation systems.

CBMS uses existing open standards and freeware for development, has a wide community of users, and COI. It has community-based maintenance and upgrades, and is interoperable with commercial devices out of the box. CBMS’ web service approach provides an infrastructure for easy integration of future addition/modifications of standards as well as supporting easy integration and interoperability of legacy standards and protocols.

Unclassified

Coalition Battle Management Services (CBMS)
Coalition Warfare Program

Final Report

APPENDIX A – ACRONYMS

ACRONYM/TERM	DESCRIPTION
AA	Action Areas
ACGU	Australia-Canada-Great Brittan-US
ACGU	Australia/Canada/Great Britain/US
ADS	Authoritative Data Source
AI	Action Item
Air C2 system	NATO ICC
AMSO	Army M&S Office
AOR	Area of Responsibility
BC	Battle Command
BML	Battle Management Language
C2	Command and Control
C2IEDM	Command and Control Information Exchange Data Model
C4I	Command, Control, Communications, Computers, & Intelligence
C5I	Command, Control, Communications, Computers, Collaboration, and Intelligence
CAGE	Coalition Attack Guidance Experiment
CBML	Coalition Battle Management Language
CBMS	Coalition Battle Management Service
CECOM	Communications-Electronics Command
CFWC	Canadian Forces Warfare Centre
CIE	Collaborative Information Environment
CIG	Common Interest Group
CM/DR	Crisis Management/Disaster Response
COA	Course of Action
COCOM	Combatant Command
COI	Community of Interest
CONEMP	Concept of Employment

Unclassified

Coalition Battle Management Services (CBMS)
Coalition Warfare Program

Final Report

ACRONYM/TERM	DESCRIPTION
COP	Common Operational Picture
COTS	Commercial Off-The-Shelf
CR	Change Requests
CSSIF	Coalition System-of-Systems Integration Framework
CWIX	Coalition Warrior Interoperability Exploration, Experimentation, and Examination Exercise
CWP	Coalition Warfare Program
DASA	Deputy Assistant Secretary of the Army
DEC	Defense Exports and Cooperation
DIS	Distributed Interactive Simulation
DMVPN	Dynamic Multipoint Virtual Private Network
DNET	Is a proprietary software suite of network protocols created by DIAB
DPWG	Data Pilot Working Group
DSSC	Data and Services Steering Committee
DSTK	Dynamic Sim ToolKit
Dstl	Defense Science and Technology Laboratory
ED	Environment Development
FMN	Future Mission Network
FRAGO	Fragmentary Order
GOTS	Government Off-The-Shelf
GUI	Graphical User Interface
HLA	High Level Architecture
HLT	High Level Task
HTTP	Hyper Text Transport Protocol
ICC	Integrated Command and Control
I/ITSEC	Interservice/Industry Training, Simulation, and Education Conference
IED	Information Exchange Documentation
IPR	In Progress Review

Unclassified

Coalition Battle Management Services (CBMS)
Coalition Warfare Program

Final Report

ACRONYM/TERM	DESCRIPTION
JACCET	Joint Adaptive Cloud Computing for Experimentation and Training
JC3IEDM	Joint Consultation, Command and Control Information Exchange Data Model
JCAS	Joint Close Air Support
JS J7	Joint & Coalition Warfighting
JS J7C	Joint Coalition Warfighting Center
JOSE	Joint Operational Systems Environment
JS	Joint Staff
JSA	Joint Systems and Analysis
JSAF	Joint Semi-Automated Forces
JSR	Java Specification Requests
LVC	Live, Virtual, and Constructive
M&S	Modeling and Simulation
MAJIC	Multi-Sensor Aerospace-Ground Joint Intelligence, Surveillance and Reconnaissance (ISR) Interoperability Coalition
MIP	Multinational Interoperability Programme
MSCO	Modeling and Simulation Coordination Office
MSDL	Military Scenario Definition Language
MSG	M&S Group
NATO	North Atlantic Treaty Organization
NOR	Norway
OBS	Order of Battle Services
ODU	Old Dominion University
OneSAF	One Semi-Automated Forces
OSG	Ops Support Group
OWL	Web Ontology Language
PDGs	Product Development Groups
PE	Project Engineer

Unclassified

Coalition Battle Management Services (CBMS)
Coalition Warfare Program

Final Report

ACRONYM/TERM	DESCRIPTION
PEO	Program Executive Office
PfP	Partnership-for-Peace
PM	Project Manager
POC	Point of Contact
POW	Programme of Work
R&D	Research and Development
RDG	Rapid Data Generation
REST	Representational State Transfer
ROI	Return on Investment
RTO	Research Technology Organization
S&I	Synchronization & Integration
SBSI	Special Broadcasting Service Independent
SISO	Simulation Interoperability Standards Organization
SIW	Simulation Interoperability Workshop
SME	Subject Matter Expert
SOA	Service Oriented Architecture
SSE	Server-Sent Event
STO	Science & Technology Organization
SWarF	Senior Department of Defense Warfighter Forum
SWE	Sweden
TAP	Technical Activity Proposal
TIM	Technical Interchange Meeting
TOR	Term of Reference
TP2	Technical Panel #2
TSG	Technical Support Group
TTCP	The Technical Cooperation Program
TTPs	Tactics, Technique and Procedure
TWG	Technical Working Group

Unclassified

Coalition Battle Management Services (CBMS)
Coalition Warfare Program

Final Report

ACRONYM/TERM	DESCRIPTION
UFR	Unfunded Requirement
UOB	Unit Order of Battle
US	United States
VMASC	Virginia Modeling, Analysis and Simulation Center
VPN	Virtual Private Network
W3C	World Wide Web Consortium
WIF	Warsaw Initiative Funds
WMD	Weapons of Mass Destruction
WTD 81	Bundeswehr Technical Centre for Information Technology and Electronics
WWW	World Wide Web
XML	Extensible Markup Language
XSD	XML Schema Definition

Unclassified

Coalition Battle Management Services (CBMS)
Coalition Warfare Program

Final Report

APPENDIX B – POINTS OF CONTACT

PROJECT MANAGEMENT (Primary):

NAME: Winston Wood
TITLE: Technical POC 1
COMMAND: Joint Staff J7 Environment Development (ED) – Futures
ADDRESS: 116 Lakeview Parkway Suffolk, VA 23452
PHONE: (757) 203-7375 FAX: (757) 203-7056

PROJECT MANAGEMENT (Alternate):

NAME: Robert Grimes
TITLE: Technical POC 2
COMMAND: Joint Staff J7 ED – Futures, General Dynamics Information Technology
ADDRESS: 1030 University Blvd. Suffolk, VA 23452
PHONE: (757) 638-6563 FAX: NA

FINANCIAL/CONTRACTING MANAGEMENT (Primary):

NAME: Warren Bizub
TITLE: Program Director
COMMAND: Joint Staff J7 ED – Futures
ADDRESS: 116 Lakeview Parkway Suffolk, VA 23452
PHONE: (757) 203-6969 FAX: (757) 203-7056