

Battle Management Language: Proof of Principle and Future Developments

Nico de Reus, Paul de Krom
TNO
The Hague, The Netherlands,
Nico.dereus@tno.nl, paul.dekrom@tno.nl

Dr. Ulrich Schade
FGAN-FKIE
Wachtberg, 53343, Germany
schade@fgan.de

Dr. J. Mark Pullen
Center of Excellence for C4I, GeorgeMason Univ.
Fairfax, VA 22030 USA
mpullen@netlab.gmu.edu

ABSTRACT

The NATO Modeling and Simulation Group Technical Activity 048 (MSG-048) was chartered in 2006 to investigate the potential of a Coalition Battle Management Language (C-BML) for Multinational and NATO interoperation of command and control systems with Modeling and Simulation. At its May, 2007 meeting, MSG-048 decided to undertake, as its first technical project, a multinational demonstration using the US Joint Battle Management Language (JBML) Web services as the central infrastructure. The JBML Web services were developed for land, air and maritime operations. The MSG-048 demonstration was presented at the IITSEC'07 and consisted of three different operational national C2 systems interoperating with three different national simulations, supported by the JBML Web services. In all, eight software systems from five nations successfully interoperated on a complex Land Coalition scenario at the Brigade level. In '08 work was done to take this a step further and work towards an experiment involving military personnel using real C2 systems and simulators to support the military planning process. The systems used in the '07 demonstration were upgraded and new systems were added to present a realistic decision support environment to the operators. The initial results will be demonstrated at the IITSEC'08. This paper will provide an overview of the lessons learned from the '07 demonstration, the work done in '08 to be able to use the systems and a view towards the future of C2 – Simulation coupling using Battle Management Language. The MSG-048 results will be fed back to the SISO C-BML PDG.

ABOUT THE AUTHORS

Nico de Reus and Paul de Krom are members of the scientific staff in the M&S department at TNO Defense, Security and Safety in the Netherlands. Their current work focuses C2-Simulation interoperability.

Dr. J. Mark Pullen is Professor of Computer Science at George Mason University, where he serves as Director of the C4I Center and also heads the Center's Networking and Simulation Laboratory. He has served as Principal Investigator of the XBML and JBML projects.

DR. Ulrich Schade is a Senior Scientist at the Research Institute for Communication, Information Processing and Ergonomics that is part of FGAN financed by the German MoD and is Associate Professor for Linguistics to the Institute for Communication Science, Bonn University. He serves as principal investigator of Bundeswehr IT-Office's BML projects.

Battle Management Language: Proof of Principle and Future Developments

Nico de Reus, Paul de Krom
TNO
The Hague, The Netherlands,
Nico.dereus@tno.nl, paul.dekrom@tno.nl

Dr. Ulrich Schade
FGAN-FKIE
Wachtberg, 53343, Germany
schade@fgan.de

Dr. J. Mark Pullen
Center of Excellence for C4I, GeorgeMason Univ.
Fairfax, VA 22030 USA
mpullen@netlab.gmu.edu

1. INTRODUCTION

This paper reports on the plans for the second phase of a multinational project that is evaluating a capability for interoperation of Command and Control (C2) systems with Modeling and Simulation (M&S) systems for coalition operations. The first phase is reported in [1] and summarized in this paper.

The system provides for rapid, effective information sharing among coalition organizations. The key enablers of this capability are an emerging standard language for military operations, the Battle Management Language (BML) a Web service repository based on the Joint Command, Control and Consultation Information Exchange Data Model (JC3IEDM). The Web service schema and Reference Implementation software which provided the basis for interoperation was developed under the Joint Battle Management Language (JBML) project [2,3].

The need to interface C2 systems with simulation systems has long been established. However, while the simulation community has established general simulation-to simulation standards (e.g., High Level Architecture - HLA), work to establish standards for C2-simulation interoperability has been limited. As a result, almost every simulation has a unique C2 interface. A notable exception is the BML initiative, which uses the Multinational Interoperability Program (MIP) data standard JC3IEDM as a system-independent community vocabulary for passing plans orders, and reports between C2 systems and simulations. BML seeks to manage complex interactions among Service, Joint and Coalition C2-simulation interoperation by providing a common means of exchanging information that all C2 and simulation systems can implement.

The remainder of this paper first describes the background of BML and MSG-048, then it elaborates on the language aspects of BML (ordering and reporting). After that, the initial MSG-048

demonstration, held at the Interservice/Industry Training, Simulation and Education Conference (IITSEC) 2007 in Orlando FL and the planned (IITSEC) 2008 demonstration are discussed followed by follow on plans for future MSG-048 activities.

2. BACKGROUND

This section provides background on BML and on the NATO MSG-048 Technical Activity in order to set the stage for understanding of both the 2007 and 2008 demonstrations.

2.1 MSG-048 Background

The need for C2-simulation interoperability in coalition operations is even greater than that of national Service and Joint operations. Coalitions must function despite greater complexity due to significant differences among doctrine and human language barriers; thus the agility to train and rehearse rapidly before the actual operation is highly important [4]. The NATO Modeling and Simulation Group (MSG), in recognition of this need, chartered Technical Activity MSG-048 to explore the promise of BML in coalitions combined with SOA technologies [5].

The MSG048 objectives as given in the Program Of Work are:

- Evaluate the available specification of a Coalition BML (from Simulation Interoperability Standards Organization (SISO) or Nations)
- Assess operational benefits to C2 and M&S communities

After completing the above assessment a C-BML specification for standardization consideration must be recommended to NATO. Specific BML requirements may also lead to a recommendation for JC3IEDM core extensions.

2.2 BML development path

BML began in work sponsored by the US Army's Simulation-to-C4I Interoperability Overarching Integrated Product Team (SIMCI OIPT). Carey *et al.* [6] describe the overall process used to show the feasibility of defining an unambiguous language, based on manuals capturing the doctrine of the US Army. This first BML project started by analyzing more than 70 doctrinal manuals related to tasking and reporting, beginning with general manuals, such as the Field Manual 3-0 on Operations and the US Joint Staff's Universal Joint Task List. The review included field manuals of Army elements such as Field Artillery, Air Defense Artillery, Engineers, Military Police, down to the platoon level. This work resulted in definition of an unambiguous Operational Order (OPORD) using the traditional "5 Ws" (who-what-when-where-why) to describe military tasks [7]. This first effort developed a prototype for battalion operations orders demonstrating the principles of BML in 2003.

Under sponsorship of the US Defense Modeling and Simulation Office (DMSO) and the US Joint Forces Command (JFCOM), the Extensible BML (XBML) project was chartered to build on the US Army's initial work, with two main objectives: (1) using Service Oriented Architecture (SOA) technology for information exchange among the systems' interfaces and (2) using the MIP's Command and Control Information Exchange Data Model (C2IEDM, an earlier version of the JC3IEDM) as a basis to represent the information to be exchanged between the systems. JFCOM was particularly interested in the XBML project's potential to increase interoperability between C2 systems and simulations of the US military Services. The Air Operations BML (AOBML) effort was supported by JFCOM J7 to evaluate whether the concepts of BML are applicable to air forces as well as ground forces, using Theater Battle Management Control System (TBMCS) and Air Warfare Simulation (AWSIM) systems with positive results [8]. XBML also became the basis for an international experiment, driven by interest of the Exploratory Team which was formulating the proposal that led to MSG-048, as described in [9].

2.2.1 JBML

The latest progression in US work on BML is the JBML, which expanded BML into the Joint arena including ground, air and maritime domains and urban warfare and was successfully demonstrated in May 2007. JBML achieved considerable technical progress by creating a revised Web service schema, based on lexical grammar and designed to facilitate expansion

into other military realms, which was implemented in the open source JBML Web Services as described below [2,3]. In parallel with JBML, the US Army Topographic Engineering Center (TEC) has been developing a geospatial BML (geoBML) which will bring a wealth of geospatial data to the C2-M&S environment [10].

2.2.2 IBML Schema and Web Services

The line of development in the US that led to the JBML Schema and Web Services used in the MSG-048 IITSEC'07 demonstration has continued. Significant developments include a geospatial BML (geoBML) and its combination with the JBML work in a new project called Integrated BML (IBML). The goals of IBML are (1) to integrate the JBML and geoBML schemas and Web services, (2) to include support for Situational Awareness (SA) reports, and (3) to ensure that the resulting schema and Web services are extensible and consistent with the C2LG grammar. While IBML is being developed for US use, it is open source software that also provides a significant enhancement for MSG-048 activities.

The IBML team consists of the George Mason University C4I Center (lead), the MSG-048 technical group (coordinated by TNO), and US industry participants Atlantic Consulting Services (ACS) and NBM, Inc. The IBML schema is intended to support the original JBML capability, as extended for MSG-048; the US Army digitized Operations Order (OPORD) Schema as developed for geoBML, including a basic operations order and Fragmentary Order (FRAGO); and a Reports schema. Primary input for the OPORD and FRAGO schemas are being developed by ACS, while MSG-048 is providing primary inputs for the Reports schema. An initial schema, IBMLv1.0, has been created for use both by geoBML and by the MSG-048 2008 experimentation effort.

Development of IBML Web Services to be used by MSG-048 is accelerated considerably by a new capability generated by the GMU C4I Center under support from the US Army Simulation to C4I Interoperability (SIMCI) program. Whereas the JBML Web Services were coded in the Java language based on IDEF1x diagrams that define the mapping process, the IBML Web Services provide a scripting environment where the mapping information is coded in machine-readable XML files. The scripting environment, in turn, is composed of Java code using the JAXB and DOM parsers that are available, open source, as part of the Java support environment. As a result, future changes and enhancement to the IBML

Web Services will require only changes to the IBML schema and the associated XML script. This will expedite the development process and also will simplify validation of the service design. The scripted BML Web Service is available as open source software on the IBML web site.

In addition to the scripting capability, the IBML Web Services will replace the previous JBML database

access layer with the SIMCI JC3IEDM Combined Project System Development Kit (SDK) Reference Implementation (RI), which is implemented as open source software, incorporating a publish/subscribe mechanism and JC3IEDM validation. The overall architecture of the SDK RI with scripted BML is shown in Figure X below.

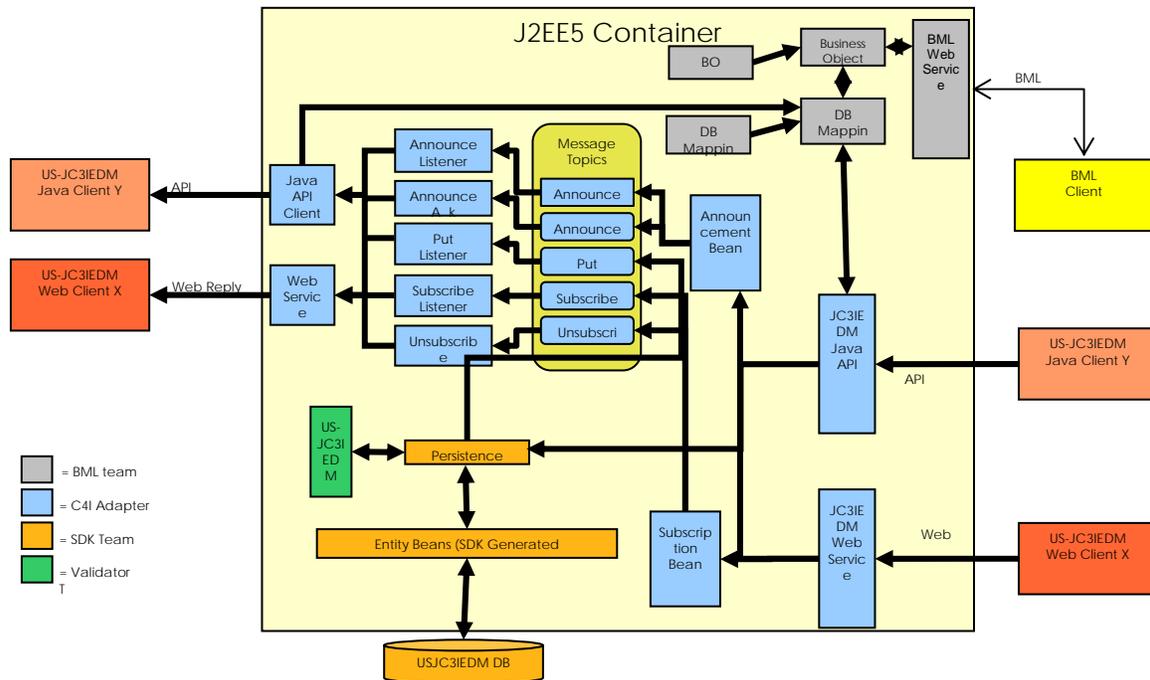


Figure 1. JC3IEDM Combined Project SDK RI with Scripted BML Capability

2.3 C-BML

As described in MSG-048's charter, the SISO Product Development Group (PDG) on Coalition Battle Management language will propose a Battle Management Language to be used, among other available BML's, in the experimentation of MSG-048. This C-BML definition process is underway and the PDG is using all available BML initiatives, like JBML/IBML as input.

3. BML language

This section elaborates on BML definition aspects. First the orders, then the report are discussed.

3.1 Orders

The German (FGAN-FKIE) contribution to JBML is the so-called Command and Control Lexical Grammar (C2LG) [11]. This section describes this contribution which provided the rationale for the JBML Web Services schema and also provided support to the NORTaC and ISIS C2 systems in the (I/ITSEC) 2007 demonstration. Since the JBML schema was based on the C2LG, it was possible to transform JBML-formatted orders automatically into C2LG format. To

ensure that the orders can be processed automatically, C2LG defines how orders are to be expressed in a BML that is a formal and unambiguous language. The C2LG can be used to formulate reports as well as orders [11]. In this section, we consider the scope needed for tasking units. These rules form the subset of the C2LG rules known as “Tasking Grammar”. In the tasking grammar, a single task is assigned to a unit by a basic order expression. These expressions have the form:

(1) **OB** → Verb Tasker Taskee (Affected|Action) Where Start-When (End-When) Why Label (Mod)*
 Representing the task, the values for Verb have been taken from JC3IEDM’s table “action-task-category-code”. Tasker represents the unit or individual that assigns the task, and Taskee is the unit that has to execute it. Start-When and End-When express when the task has to start and has to be finished, respectively. End-When is optional as indicated by the brackets. Why denotes a reason for the assignment. Label is a unique identifier for the task. It is introduced such that the task can be referred to in other expressions. Mod (modifier) is a wild card. It has been used for describing formation or for denoting the manner in which the task has to be executed, e.g. as fast as possible or cautiously and without any risks. Affected and Action are only used in some basic order rules.

Affected is used if the task directly affects someone or something, e.g. the enemy in the case of **ambush**. Action is used in a similar way, namely if the assigned task affects another action, e.g. in the case of **assist**. As different task verbs demand (and allow) different constituents like Affected or Action, there is one basic order rule for each task verb in the tasking grammar. (This is one of the reasons the grammar is a “lexical” grammar.) The type of the Where also depends on the tasking verb. Some tasks demand a Route-Where – to denote a route – whereas others demand an At-Where – to denote a location. In order to show how C2LG’s basic order rules look like, (2) lists four of them (there are 65).

(2a) **OB** → **advance** Tasker Taskee Route- Where Start-When (End-When) Why Label (Mod)*
 (2b) **OB** → **ambush** Tasker Taskee Affected At-Where Start-When (End-When) Why Label (Mod)*

(2c) **OB** → **assist** Tasker Taskee Action At-Where Start-When (End-When) Why Label (Mod)*

(2d) **OB** → **rest** Tasker Taskee At-Where Start-When End-When Why Label (Mod)*

Here is an example of an actual order using the grammar:

(3) **pursue** BtlC CavB En towards Z at now in order to destroy En label_3_15;

To use such orders in the experiment’s simulation systems, they are processed in two steps. First, for each basic order expression, its constituents are identified. Second, the constituents are mapped into JBML. Because JBML’s schema is based on the C2LG, the XML tags of the JBML schema correspond to the non-terminal symbols (Tasker, Taskee, Affected, etc.) used by the C2LG to represent the constituents formally. For example, in (3) CavB is the Taskee constituent. It is tagged <TaskeeWho> in JBML. FGAN-FKIE has developed a GUI (see the figure below) to allow and to facilitate the formulation of orders (and reports) according to C2LG’s rules.

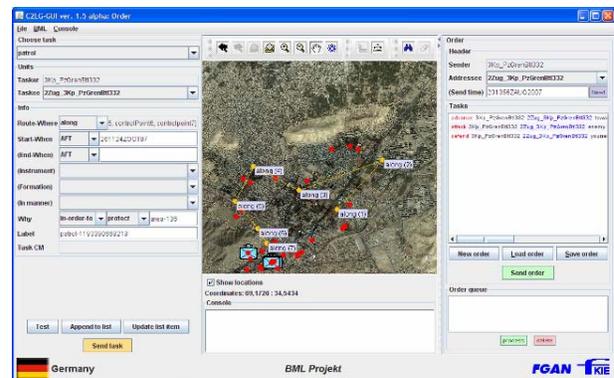


Figure 2. Example of One Column Figure

As can be seen in the figure, the GUI uses drop-down menus and a map. In the map, units, facilities, features and locations can be selected (by mouse click) to speed up formulation, especially formulation of the Where elements.

3.2 Reports

In the initial phase, only the ordering part of BML was investigated because only the ordering part of BML was available at that time. Developments have continued and IBML is currently being upgraded to include reports. So the second phase of BML evaluation which is currently going on will focus on IBML reports. This phase is planned to be supported by experimentation which will lead to a demonstration at the Interservice/Industry Training, Simulation and Education Conference (IITSEC) 2008 in Orlando FL.

Situation reports enable all systems (C2 systems, simulations, robotic forces, humans) to know what the situation is. The first focus in the MSG-048 is to report the current situation in a simulator back to a C2 system.

Implementation of situation reports is supported by XML schemas. The report schemas are still under development, but the schema depicted below is the current version that is used in IBML.

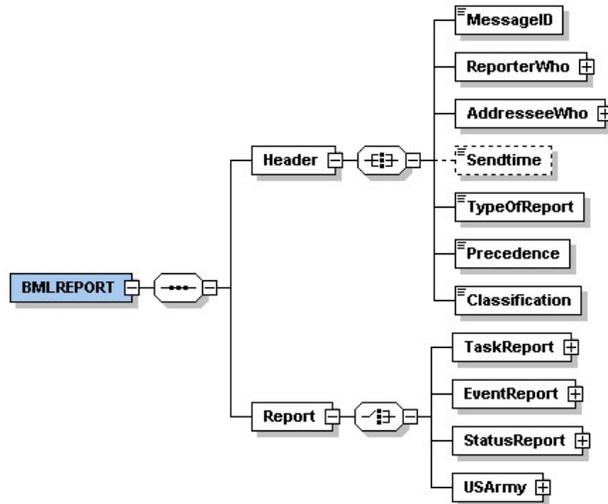


Figure 3 Schematic display of a report

A report will start with a header explaining who is reporting to whom. It may also contain the time the report was made. The 'Precedence' will make it possible for systems to prioritize different reports. The 'MessageID' will help to identify the report. The 'TypeOfReport' will make it easier for computer systems to catalogue and interpret the reports. Finally, the 'Classification' will describe how secure the data needs to be handled.

As can be seen in figure 3 there are 4 different kinds of reports:

1. *TaskReport*. A task report will describe a task that is being executed by a unit. This may be the reporting unit itself, a friendly unit or some other unit (hostile, neutral, suspect, pending). If the reporting unit reports about a task it performs, the start, the ongoing, or the end of the task can be reported. In the other cases, the reporting unit reports that it observes the execution of a task by another unit. In that case referring to the executor can be less accurate and does not have to contain the ID of the unit performing the task (this is called the taskee). Instead the executing unit can be referred to by its unit type (this is called agent) or even by the type of observed vehicles (this is called theme). The different

tasks that can be reported using IBML are the same as the ones that can be ordered using IBML.

2. *EventReport*. An event report will report about some major event that is happening or might happen in the future. This ranges from drive by shootings to earthquakes.
3. *StatusReport*. A status report will report about the status of a unit or facility (again friendly or observed). This can be a position, percentage operational or how many personnel are still active.
4. *USArmy*. US army reports are an extension of the normal reports and will not be used for the MSG48 demo. They follow the so-called US Army digitized Operations Order (OPORD) that will be used in the US to demonstrate geoBML. If there are any interesting reports here that can not be formatted in the aforementioned reports, they will be added in. For now it will be the example of how the different nations can extend IBML to cater for specific needs in coupling between national simulator and national C2 system. The preferred solution is to use the other reports and get them changed by all nations so that information can be sent and received from all the other C2 systems and simulations.

In the current version, all the reports contain a "Credibility" which contains the source of the report, the reliability of the source and the "certainty level" of the report.

4. MSG-048's BML language experimentation

This section elaborates on both the past 2007 as well as planned 2008 MSG-048 experiment.

4.1 I/ITSEC 2007 demonstration/experiment

4.1.1 Scenario

The 2008 demonstration focused on a land scenario that is located in the Caspian Sea area and set in the 2025 timeframe.

In this scenario the Commander Joint Forces Land Component Commander (CJFLCC) has decided to commit the 43rd Multi-National Brigade (43 MNB - Figure 4) composed of three Battalion (Bn) Task Forces (TF) to secure the "Kazi Magomed Airport". For this mission, the Commander 43 MNB requires the use of two of his three BN TFs. He has selected 1 (USA) TF, a US Combined Arms Battalion, and has to

decide between 2 (NLD) TF (Netherlands) and 2 (NOR) TF (Norway) for his second TF.

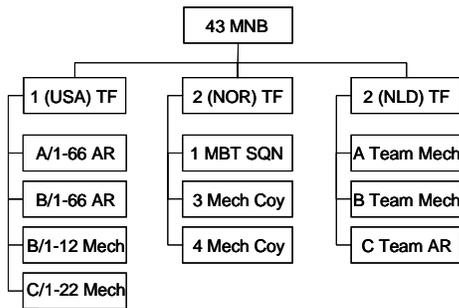


Figure 4 ORBAT 43 MNB

Commander 43 MNB has tasked the commanders of NLD (Maneuver Battalion) and NOR (Telemark Battalion) both to plan for the same assignment. The outcome of the simulation based COA-analysis will support the commander's decision.

Figure 5 shows the overall plan. On 10 August 2025, the CJFLCC orders 43 MNB to seize and defend the Kazi Magomed Airport intact to deny the expected enemy occupation of the airport and to deny interference by the enemy rebels. Operation PERSEUS is planned to start at first light on 11 August. The key to success for 43 MNB is for 1 (USA) TF to seize the bridges intact and then conduct a passage of lines as the stationary force to support the onward movement of either the NLD or NOR Bn TF in order to secure the Airport. The assigned second TF will seize and defend the Airport in order to deny any Opposing Military Forces (OMF).

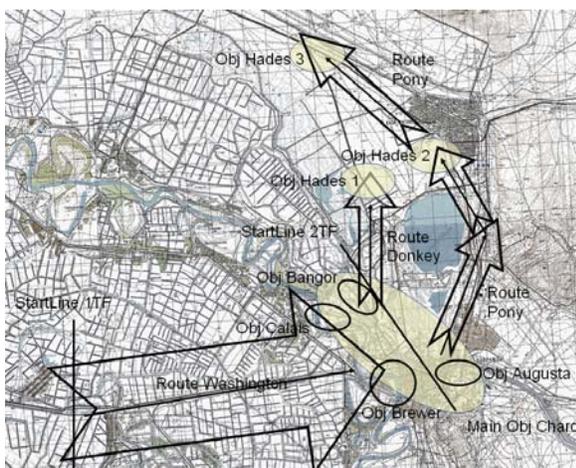


Figure 5 43 MNB Plan

4.1.2 Architecture

The following systems were used in the COA analysis.

- C2PC/CAPES is a US Army C2 / planning system
- NORTaC-C2IS is the Norwegian C2 system for planning, establishing, sharing and maintaining the recognized land picture and order of battle management.
- ISIS is the Netherlands C2 system for planning, establishing, sharing and maintaining the recognized land picture and order of battle management.
- JSAF is a constructive simulation that can represent objects down to individual platforms and combatants. It can represent a very wide range of land, air, and maritime elements and was used in the MSG-048 demonstration to simulate the US Combined Arms Battalion. JSAF can function in HLA federations
- SIMBAD is the Spanish constructive simulator. It was designed to train battalion-level task force command posts in course of action and logistic support. Military units are typically represented in SIMBAD at the level of aggregation of platoons.
- SCIPPIO is the French constructive simulator used for command post training. It is built for the French Army training center for training brigade and division HQs.
- C2LG GUI is the German built editor that enables a user to complete grammatically correct BML orders.
- JC3IEDM Visualizer is a tool that was provided by the Virginia Modeling, Analysis and Simulation Center (VMASC) under NATO funding. It consists of an open source software map viewer that is capable of displaying all units in the JC3IEDM database, in order to provide a common operating picture for all participants.

The figure below depicts the systems and their interconnection architecture that was used.

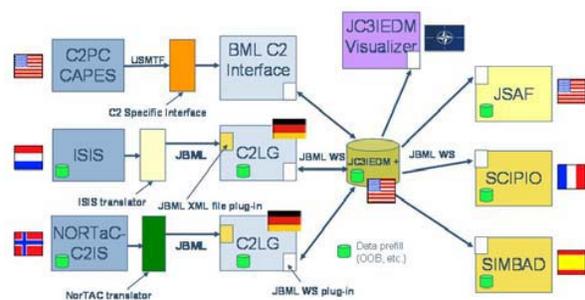


Figure 6 Architecture of IITSEC-07 demonstration

In the demonstration the C2LG GUI was used to enable the Norwegian NORTaC and Netherlands ISIS

to generate BML orders. The US C2PC/CAPES used his own BML C2 interface.

The focus of the 2007 experiment was the ordering part of BML. Orders were generated on coalition C2 systems and transferred to coalition simulators using Web services. In this way the feasibility was evaluated of having unambiguous orders being assembled on national C2 systems could be read and executed by simulators.

4.1.2 Lessons learned

The OPLANs, developed by military personnel, were mapped to JBML with only minor changes. Some challenges were:

- There was a lot of flexibility built into the plan, e.g. it included back up tasks like “on order be prepared to support unit x”.
- The order of battle could change during the operation (attachment and detachment of units).
- Control measures might be activated and deactivated during the operation, e.g. fire coordination lines.
- The demonstration required more elaborate task scheduling: The conditional starting of orders (start order B after finishing order A) was not possible. Extending BML with situation reports flowing from the simulation to C2IS is one step towards solving this problem. This will allow the implementation of external scheduling mechanisms or allowing a human to perform this task. Situation reports are planned to be part of the next phase of JBML development.

While the JBML is rooted in the JC3IEDM, the JBML XML Schema and the C2 language grammar make it easy to use the language without being a JC3IEDM expert. The JBML XML Schema allowed us to describe and validate our plans in JBML in parallel with the development of C2IS gateways and JBML Web services plug-in for C2LG GUI. The use of the C2LG GUI as a generic module to generate JBML has proven to be very powerful and flexible.

In the current version of JC3IEDM there are structures to represent plans and orders according to STANAG 2014. It is questionable, though, whether this will make any significant impact (or any at all) regarding the ability to represent an order formally. The details would still be captured in the current action structure; and the additions will basically cater for more textual structuring in between these actions.

Only a small number of extensions have been made to the JC3IEDM in the JBML specification. Furthermore, the major challenges listed in the beginning of this section may be modeled fairly well. This underpins the suitability of JC3IEDM as a basis for further development of BML.

4.2 IITSEC 2008 demonstration

The focus of MSG-048’s 2008 work is twofold:

- To evaluate the higher to lower level ordering (C2 – C2 coupling)
- To evaluate reporting using BML

4.2.1 C2 Systems and Simulators

In the second phase of the MSG-048 (2008) the following systems are added/changed, compared to the 2007 demonstration.

- SITAWARE, the Danish C2 system.
- LC2IS, the NATO Land C2 system
- SIMACET, the Spanish land C2 system.
- ICC (Integrated Command & Control system), the NATO Air C2 system (by the UK)
- JADOCS (Joint Automated Deep Operations Coordination System), the Situational Awareness C2 system (by the UK)
- JCATS (Joint Conflict and Tactical Simulation), the U.S. Joint Forces Command (USJFCOM) sponsored simulator (by NC3A)
- JTLS (Joint Theater Level Simulation), (by NC3A)
- SWORD, the French constructive simulation solution (replaces SCIPPIO that was used in 2007)

4.2.2 Scenario

The basic settings of the scenario (Area, Situation, Objective) stay the same as in the 2007 demonstration but the following changes were made in order to accommodate the new focus (C2 – C2 coupling and reports evaluation) and the change in systems as discussed in the previous section.

- A Spanish three company Task Force is added to the 43 MNB Order of Battle.
- 43 MNB elaborates the COA at Brigade level on the SITAWARE system by doing a Brigade level COA analysis. The choice is made for the path around the lake instead of the “turn” from west to east. See the figure 7 below. The chosen COA is the starting point of the experiment.

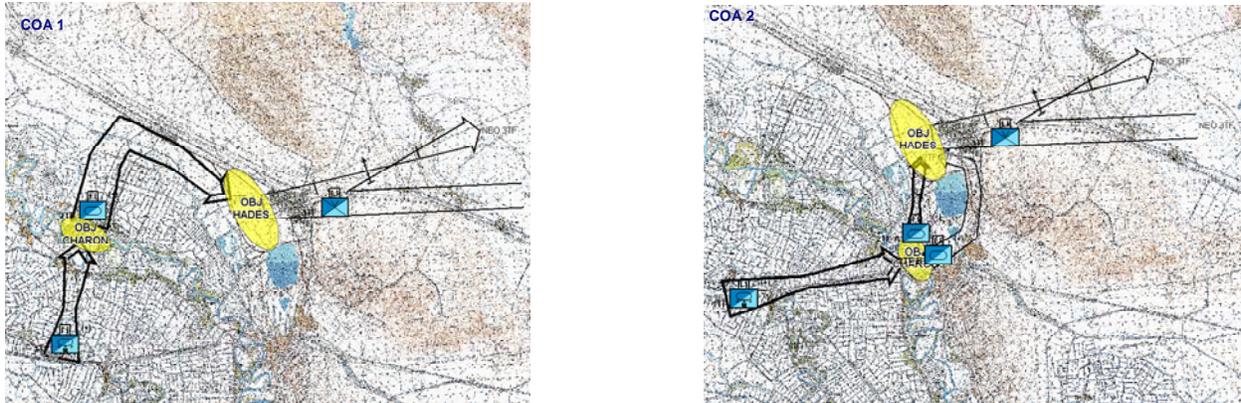


Figure 7 43 MNB COA alternatives

- 43 MNB distributes the plan by putting the plan in the plan database using Web services in order to enable the USA (1TF), NOR (2TF), NLD (2TF) and ESP (2TF) to get Brigade level plan from the database, start the planning for their Task Forces and report to 43 MNB the TF results.
- USA (1TF), NOR (2TF), NLD (2TF), ESP (2TF) all appear to expect too heavy enemy resistance when they perform their COA analysis that cannot be countered by their own ORBAT.
- For USA (1TF) this is mainly the case in de objectives BREWER and CALAIS.
- For (2TF) (NOR, NLD and ESP) this is mainly the case on the line halfway the lake. In any case west of the lake and possibly also east.
- Given the fact that no additional ground troops are available, Commander 1TF and Commander 2TF report to Commander 43 MNB that they cannot perform this mission without close air support (CAS).
- Commander 43 MNB therefore tasks Commander ATF (GBR) to support both Commander 1TF as well as Commander 2TF from the air and to decide among them when exactly which air support will be required.
- Commander ATF coordinates and decides about his own plan and ORBAT within the boundaries of the intent and coordinating measures of 43 MNB.
- De addition of ATF units means that OMF will suffer greater damage before the ground units will come into contact with OMF. Then from new simulations it appears that 1TF and 2TF can counter the expected enemy who will act in the endgame conform the 2007 demonstration and will allow 43 MNB to take the airport.

4.2.3 Demonstration architecture

The pictures below display the Brigade to Battalion level ordering architecture and the flow of reports.

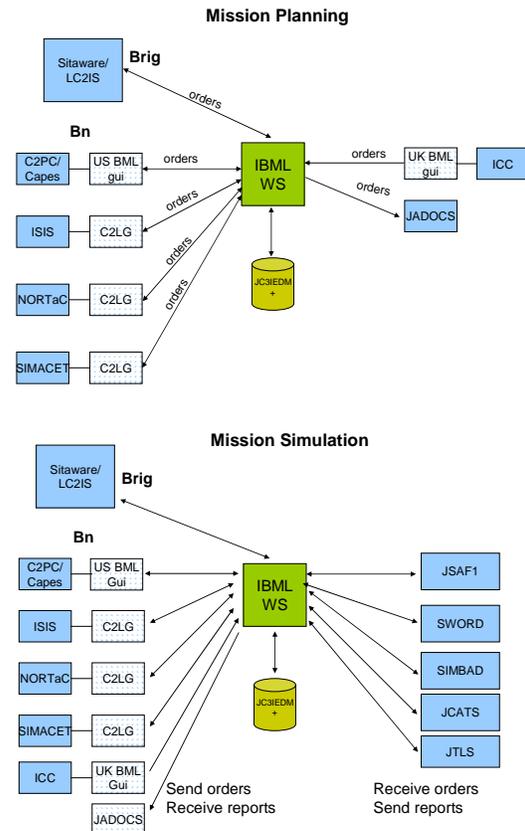


Figure 8 Demonstration architecture

5. Concluding remarks and follow on plans

With the implementation of mechanisms for high C2 level to lower C2 level interaction and reporting within the international MSG-048 group, a step forward is made towards a full use of BML capabilities. This enables the experimentation that is required to fully evaluate the possibilities and recommend on improvements of BML.

Further steps are required and will be made to have experiments with real military operators. In this way Measures of Merit (MoMs) can be determined answering questions about the benefits of having BML compared to having no BML.

Such MoM questions can be posed in various areas, of which three important ones are: Information handling, Decision making and Ease of use. In these areas the following details and detailed questions are relevant.

With respect to Information handling, (the ability to combine all available information and extract relevant information) such that commanders:

- receive all pertinent information faster than at present
- comprehend the information better than at present

- receive less incorrect information than at present
- receive less irrelevant information than at present
- address available information (possible more than at present) more effectively

With respect to Decision making.

The availability of pertinent information and decision aiding tools such that:

- A Headquarter is able to comprehend the information and establish a complete Intelligence Picture (Situational Awareness faster than at present)
- Commanders can evaluate possible Causes of Action and thereby come to a final decision faster than at present
- Commanders can compile and disseminate complete 5-point order faster than at present

With respect to Ease of use:

- How easy is the coupling of C2 to Simulators
- How easy is the set up of simulators with the use of C-BML
- How easy is the use of C-BML in operational conditions
- How easy is the understanding of C-BML as a language (learning curve)

ACKNOWLEDGEMENTS

Special acknowledgements go to the non-authors among the MS-048 members; Micheal Powers, Dr. Micheal Hieb, Scott Carey, Nanne Le Grand, Lionel Khimeche, Nicolas Cordonnier, Ludwig Vandeweghe, Ole Martin Mevassvik, Karl Johan Simonsen, Sabas González Godoy, Erkan Ertugrul, Major Kevin Galvin, Adam Brook., Jean Francois Cosse.

REFERENCES

- [1] Pullen J., et al, (2008), "NATO MSG-048 Coalition Battle Management Initial Demonstration, Lessons Learned and Way Forward", IEEE Spring Simulation Interoperability Workshop, Providence, RI
- [2] Pullen, J., M. Hieb, S. Levine, et al, (2007) "Joint Battle Management Language (JBML) – US Contribution to the C-BML PDG and NATO MSG-048 TA", IEEE European Simulation Interoperability

Workshop, Genoa Italy

- [3] Levine, S., M. Pullen, M. Hieb, C. et al, (2007) "Joint Battle Management Language (JBML) Phase 1 Development and Demonstration Results," IEEE Fall Simulation Interoperability Workshop, Orlando, FL,
- [4] Tolk, A, M. Hieb, K. Galvin, et al, (2005) "Developing a Coalition Battle Management Language to facilitate Interoperability between Operation CIS and Simulations in support of Training and Mission Rehearsal", 10th Command and Control Research and Technology Symposium, McLean, VA
- [5] Galvin, K., W. Sudnikovich, P. deChamps et al, (2006), "Delivering C2 to M&S Interoperability for NATO - Demonstrating Coalition Battle Management Language (C-BML) and the Way Ahead," IEEE Fall Simulation Interoperability Workshop
- [6] Carey, S., M. Kleiner, M. Hieb et al, (2001), "Standardizing Battle Management Language – A Vital Move Towards the Army Transformation," IEEE Fall Simulation Interoperability Workshop, Orlando, FL
- [7] Sudnikovich, W., J. Pullen, M. Kleiner et al, (2004), "Extensible Battle Management Language as a

Transformation Enabler,” in *SIMULATION*, 80:669-680

[8] Perme, D., M. Hieb, J. Pullen, et al, (2005) “Integrating Air and Ground Operations within a Common Battle Management Language”, IEEE Fall Simulation Interoperability Workshop, Orlando FL

[9] Sudnikovich, W., A. Ritchie, P. de Champs et al, (2006), “NATO Exploratory Team – 016 Integration Lessons Learned for C2IEDM and CBML,” IEEE

Spring Simulation Interoperability Workshop, San Diego CA

[10] Hieb, M., S. Mackay, M. Powers, et al,(2007) “The Environment in Network Centric Operations: A Framework for Command and Control,” 12th International Command and Control Research and Technology Symposium, Newport, RI, 2007

[11] Schade, U. & Hieb, M.R., (2007) „Battle Management Language: A Grammar for Specifying Reports”, Spring Simulation Interoperability Workshop, Norfolk, Virginia