19th ICCRTS
"C2 in Underdeveloped, Degraded and Denied Operational Environments"

Incorporating C2--Simulation Interoperability Services Into an Operational Command Post (Paper 106)

Topics

Experimentation, Metrics, and Analysis
Modeling and Simulation
Architectures, Technologies, and Tools

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ABSTRACT

Historically, simulations have been focused on training and preparing leaders and units for military operations. With changes in technology, simulation services have matured from analog and manual processes to digital and automated processes and can be available to warfighters in a command post environment to support military planning. Using Coalition-Battle Management Language (C-BML) and Military Scenario Definition Language (MSDL) to exchange information between simulation systems and command and control (C2) systems can be beneficial. The use of these tools supports commander and staff assessments of the feasibility of selected courses of action, plan branches and sequels, further rehearse the resultant order, and enhances collaboration, planning, and preparation within a command structure of units. The paper summarizes the outcomes of an operational demonstration of C-BML and MSDL by the North Atlantic Treaty Organization (NATO) Modeling and Simulation Group 085 (NMSG-085), which focused on support of command post operations in coalition operations. The reviewed capability offers joint and combined forces a potential tool to maximize planning time at lower echelons and enhance mission rehearsal across the force.

1. Introduction

To assist the commander of a military organization, command and control (C2) systems are co-located within a facility to establish and maintain situational awareness/situation understanding (SA/SU). These same systems provide the information for the commander and staff to consider in determining the optimum course of action to accomplish their given mission. Effective military forces have a well defined process for considering the different methods and various courses of action that could be used to accomplish a mission and then issue orders to their units to do so.

Currently, course of action development and analysis is a linear, sequential, resource intensive, and human endeavor that the military unit's staff completes for the commander. The staff presents potential courses of action and their analysis to the commander for a decision, who then directs the production of an order to execute the approved plan.

Military C2 of operations has consistently been a key target for enhancement using technology advancements. The development of automated digital C2 systems has occurred at an exceedingly rapid pace as methods of communications change from human to human towards system to system [3]. The interoperation of simulation and C2 systems also supports an emphasis on collaboration between echelons. Leveraging simulations during course of action development and analysis to include collaboration

with subordinate unit commanders and staffs increases understanding at all echelons and maximizes planning time at lower echelons.

Additionally, it is impossible to imagine a situation in the future when a single U. S. Service or a single country's military forces will be unilaterally employed. Future military operations, as well as a significant amount of training, will be Joint and Combined/Coalition in nature [3]. All aspects of future military operations in this integrated, coalition environment must be deliberately considered for problem solving and information exchange.

This situation has driven the development of Battle Management Language (BML) and the Military Scenario Definition Language (MSDL). A well thought out and implemented BML supports communication of command and control information in a format that can be read, parsed, interpreted and acted upon by "intelligent agent" software whether in a simulation [3] or a C2 system. Accordingly, MDSL grew out of a desire to reduce scenario development time and cost and then be able to use the resulting scenario across multiple simulations running within a federated environment or as independent simulations. The resultant concept was to create a separable, simulation independent military scenario format, focusing on real-world military scenario aspects, using the industry standard data model definition eXtensible Markup Language (XML). This format could be dependably consumed by current and evolving simulations [7]. These two technologies underpin the efforts of the NMSG-085 and the ensuing operational demonstration.

2. Work of NMSG-085

The North Atlantic Treaty Organization (NATO) Modeling and Simulation Group 085 (NMSG-085) is a 3-year project sponsored by the NATO M&S Group (NMSG). It is focused on enabling NATO coalition C2-simulation interoperability through standards for initialization and execution, and supported by evolving coalition messaging infrastructures. The ultimate goal of the 13-country NATO project is to reduce C2-simulation integration time and support costs through automated initialization, and reduced response cell requirements during coalition course of action (COA) analysis, training or mission rehearsal. [4]

U.S. participants in NMSG-085 (also providing capabilities to the program) include representatives from:

- Army Modeling and Simulation Office (AMSO),
- Program Manger One Semi-Autonomous Force (PM OneSAF);
- Deputy Director J-7 (DD-J7) Joint and Coalition Warfighting (JCW),
- Virginia Modeling, Analysis and Simulation Center (VMASC), and

- George Mason University (GMU) Command, Control, Communications, Computers, and Intelligence (C4I) Center.

AMSO serves as the U.S. National Lead to coordinate U.S. activities in support of the objectives in the approved Program of Work (POW). [4]

Key to achieving NMSG-085 objectives is an experimentation program to demonstrate capabilities and gaps in evolving Simulation Interoperability Standards Organization (SISO) standards for MSDL and Coalition BML (C-BML) as well as messaging infrastructures provided by the U.S. to support distributed C2-sim operations.

NMSG-085 successfully completed initial experiments and demonstrations toward coalition C2-simulation interoperability at the Interservice/Industry Training, Simulation and Education Conference (I/ITSEC) in December 2011. The demonstration used three unique architectures and scenario vignettes (Recon, Ground Maneuver, Logistics) using a coalition federation of C2 devices and simulations being rapidly initialized with common scenario data, and synchronized for execution using the evolving SISO standards [4]. These initial experiments verified that the technology was capable of meeting NMSG-085 objectives and that input from an operational perspective was needed.

The value and impact of the NMSG-085 from the U.S. perspective:

- Supports Standards
- Provides venue to evolve, deploy & demonstrate key M&S standards
- Supports Coalition / Operations
- Enhances interoperability for coalition Training, Mission Rehearsal and COA
- Supports OneSAF reuse
- Improves and extends OneSAF (and tools) into Mission Command, Training, and International communities
- Support Army integration with Joint Projects for enhanced return on investment (ROI)
- Collaboration with DD-J7 JCW toward demonstration of Coalition Battle Management Services (CBMS) in a coalition environment [4]

3. Use of Simulation to Support Planning of Military Operations

The primary purpose of gathering and disseminating information is to allow commanders, and their staffs, to make better and faster decisions while getting inside the enemy’s decision cycle. The key to this is the ability to collect, fuse, and transmit accurate, timely, and relevant information with greater rapidity thus achieving a common understanding among the participating commanders and staffs [5]. To this end, technology provides copious amounts of information. C2 systems are designed to support operational information and allow commanders to visualize the battlefield.

Simulations are able to portray the potential outcomes of decisions before they are executed in the real world. Using information from the C2 and simulation domains in a common environment provides the commander and their staff a robust tool to support decision making. This tool is able to address not only the operation at hand, but also the implications of concurrent and sequential operations. [5]

One great challenge to using simulations in the C2 decision making process is making it acceptable to the military professional user. If the operational community does not accept the concept and use it, the software will only take up space on a computer. To make it acceptable to “field” users, it must have the comfortable look and feel of what they are using now. Wherever major changes are incorporated, the user must realize the benefits either through saving time or adding clarity [3]. Presenting it simply as a “better solution” does not support its acceptance and implementation. It must clearly provide an advantage to the user in order to be adopted.

Key points for introducing simulation support to the planning of military operations include:

3.1. Benefits of introducing simulation to operational headquarters

Military operations are complex and hard for the human mind to precisely and impartially portray. Computers, however, are capable of portraying large number of entities engaged in operations accurately and without bias. The MSDL and C-BML technologies provide a simple way to access simulation functionality from the command post C2 system and allow the command and staff an improved visual representation to support decision making.

Complexity increases in the blended military organization with forces from multiple nations. Culture and language differences impact effectiveness. Use of MSDL and C-BML allows each member of the coalition to use their own C2 and simulation systems while continuing to exchange information and plans with the entire force.

3.2. Simulation for training versus support to operational planning

Traditionally, simulation has been used to support training. For this purpose, the actions of hostile parties (enemy and assumed hostile) has been played by the RED (opposing forces) cell which operates independently from the main training audience. For planning purposes, however, the hostile parties and enemy should be controlled by the planning group also responsible for its own plan in order to modify behaviors in the simulation to compensate for recent changes in enemy tactics and operations.

Manual wargaming is an activity where G-3 planners initiated actions, G-2 planners reacted to that action and finally G-3 planners initiated counter-actions. When using

simulations to support planning, the same kind of action-reaction-counteraction process within the planning group must be allowed. Using the simulation in “free play” mode should be done only upon a command directive.

3.3. Synchronization matrix delivered as a shared service between command posts

The synchronization (sync) matrix is a common product from the MDMP and often the foundation of the operations order (OPORD). Prior to digital communications, each command post developed its own sync matrix and published to subordinates. Now, collaboration between unit commanders and staffs within a military force or coalition enhances the sync matrix development process. The use of simulation has the potential to improve this process through better visualization of actions directed by the sync matrix.

3.4. Rehearsal support

Simulations provide an environment to support rehearsal in a similar manner as they support training. When used in an operational context, the simulation records the actions of units and outcomes of engagements. These capabilities allow the commander and staff to adjust the plan, “re-fight” it, and determine the impacts of any changes. The military force or coalition is able to rehearse their actions on their own C2 systems and focus on sync matrix actions while minimizing language and cultural differences.

4. Conduct of the Operational Demonstration

To show the operational relevance of using simulation to support planning of military operations, a location known for operational experiments was approached to host the event: The United States Army Mission Command Battle Lab (MCBL) at Fort Leavenworth, Kansas. The MCBL agreed to provide a venue and planners with military experience to act as role players/subject matter experts during the event.

The primary purpose of the event was to demonstrate the operational relevance of C2 system-simulation interoperation in support of multi-level, multi-domain and coalition military enterprise activities such as coalition mission planning and mission rehearsal. The secondary goal was to demonstrate that NATO Coalition Operational Planning Directive (COPD) activities can be conducted in a distributed manner and more quickly than is currently possible. Benefits of this approach to a commander are:

- Ability to conduct an integrated planning process
- Increase the number of subordinates aware of future plans
- Improve understanding at multiple levels
- Earlier identification of risks associated with operations

- Higher quality plan that maximizes planning time at lower echelons.

In accordance with U.S. Army security guidelines, the demonstration featured six national non-U.S. C2 systems and five national simulations, supported by servers from two different nations, linked into a single system of systems. Standards used were C-BML and MSDL, along with elements of the Joint Consultation, Command and Control Information Exchange Data Model (JC3IEDM).

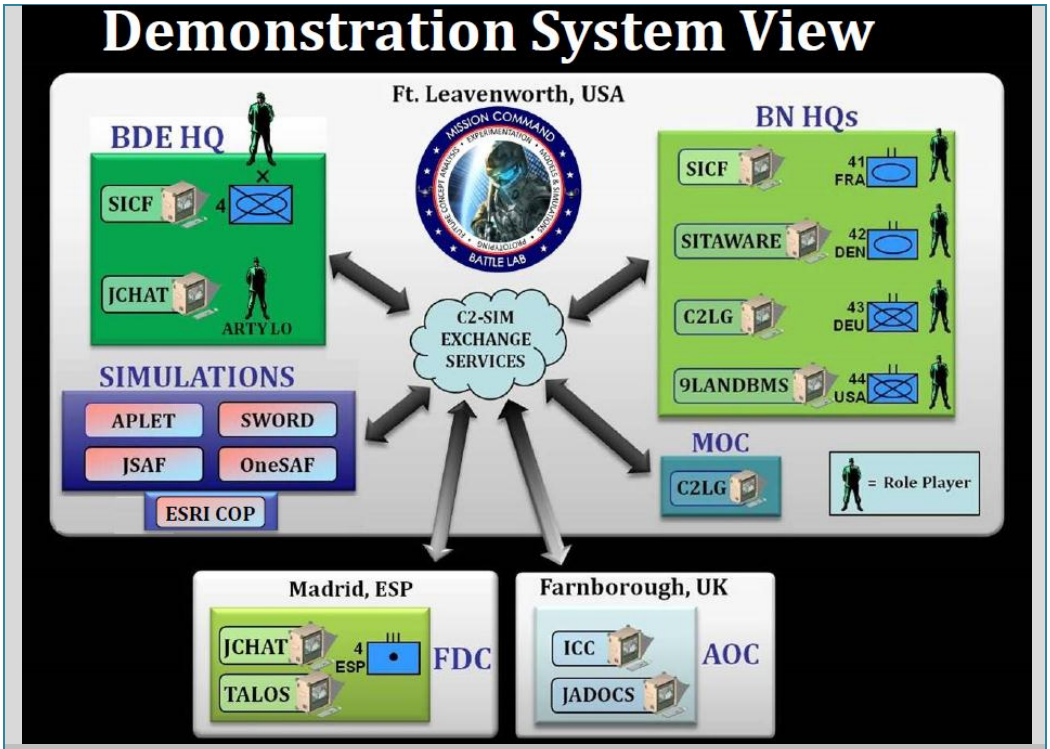

Figure 1 – Systems layout for demonstration [xx]

Personnel and systems from nine nations (23 personnel) participated at Leavenworth while personnel from the United Kingdom and Spain participated from their home locations via Internet links.

As described in [1] and [2], the context of the demonstration is the U.S. Army Military Decision Making Process (MDMP) with a focus on course of action (COA) development, analysis (wargame), and comparison. The operational scenario focused on the following:

As a result of a broken ceasefire agreement in BOGALAND, a NATO Response Force (NRF) has been activated and will conduct combined and joint operations in order to separate the parties and reinstate adherence to the peace agreement. The 4th Multi-National Brigade (4 MNB) is tasked to defeat the aggressor and restore a safe and secure environment and therefore must perform operational planning.

The demonstration used a mission planning cycle consistent with the NATO COPD (see Figure 2) and used C2-simulation linkages to facilitate collaborative planning between the role players as brigade and battalion commanders.

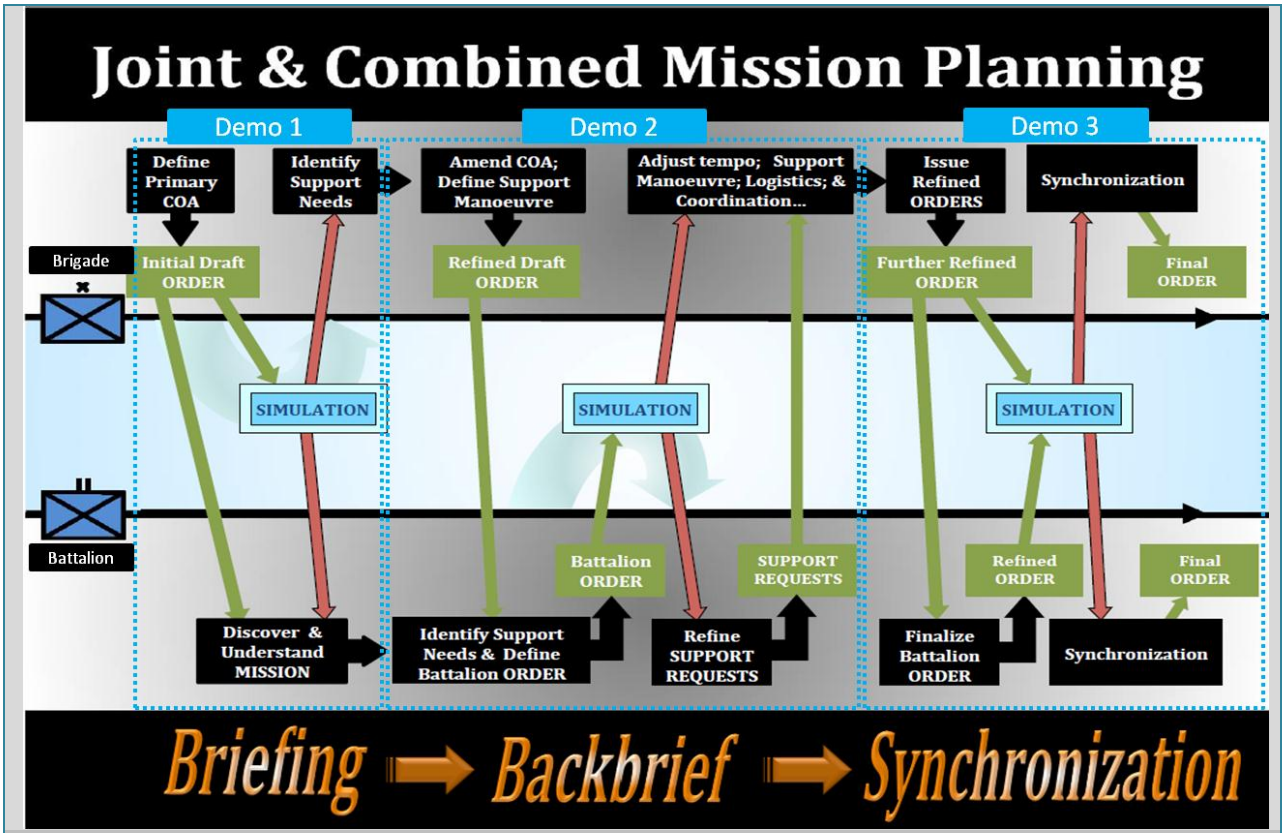

Figure 2 – Joint and Combined Mission Planning process used in the demonstration with vignette boundaries for each demonstration. [6]

The demonstration was comprised of three vignettes: 1. Initial COA Development; 2. COA Refinement; and 3. Mission Synchronization. (See Figure 2)

During the first vignette, the brigade informs the battalion commanders in the coalition force of the initial COA and sends it to the simulation for execution. Using the results of the simulation, the brigade refined their COA and communicated the update to the battalions. The battalions then generated their orders and sent them to the simulation for subordinate companies. These actions were conducted in parallel across brigade and battalion echelons.

Continuing to the second vignette, the simulation results were used by the battalions to substantiate further refinements to their support requests.

Finally, in the third vignette, the brigade performs final adjustments to the orders that are communicated to the battalions for the purposes of mission synchronization. These

actions were conducted in parallel with collaborative across brigade and battalion echelons of a multi-national coalition force

As each demonstration/vignette was executed, the planners from the U.S. Army MCBL participated as commanders at the brigade and battalion level. Assessments from the iterations were recorded and shared.

Table 1. Assessments from Demonstration Iterations

Demo	Positive	Improve
1	• Visualization of Brigade graphics • Collaborative modification of plan • Initial stages of synchronization matrix supported	• Control speed of the simulation
2	• Able to better control speed of the simulation • Battalion Commanders were able to achieve a better understanding of Brigade plan, express their requirements to Brigade, and modify plans with immediate coordination with other Battalions and Brigade across the coalition • Visualization of other Battalion sectors	• Battalion Commanders ability to synchronize support for their plans
3	• Shared Common Operating Picture (COP) allowed for collaboration • Battalion Commanders were able to interactively exchange information with the Brigade Commander and adapt their plans in coordination with the Brigade planners • Using simulation gave the opportunity to question why things might not happen as planned • Brigade Commander visualized the Battalion Commanders' sectors to enable a focus on high priority events	• Accurate portrayal of Warfighting Function for better analysis • Perception of enemy engagement and combat power in C2 and simulation systems

During all iterations, the demonstration quickly revealed the necessity for a shared and common sync matrix. First, the planning groups experienced the need for coordinating their own operation. Phases and steps were based on the Brigade plan but were further refined by the Battalion planners. These changes and amendments were then shared with other command posts. For example, changes to phase lines and fire coordination lines were fully coordinated across all planners and echelons.

Additionally, the planners realized they needed to coordinate the timeline and speed for the actual simulation itself. The simulation systems had the functionality to monitor

elapsed time even when the simulation was advanced or ran faster than true time. This allowed planners to run several different force or organizational arrangements, determine risks to mission success, and make refinements to address those risks.

The demonstration was well attended by U.S. and international military and supporting civilian personnel, who offered mainly positive comment and also recommendations to improve operational utility, for example the need to resolve security issues before deployment.

5. Outcomes of the Operational Demonstration and Conclusion

The operational demonstration accomplished:

- An operational focus on joint and combined mission planning, operating in a breakthrough parallel, collaborative mode across brigade and battalion echelons of a multi-national coalition force.
- Military planners, provided by the MCBL, in roles of brigade and battalion commanders that contributed a critique of the operational employment which was highly positive while identifying avenues for future improvement.
- A NMSG-085 culminating event which, along with others technical events, demonstrate significant potential cost and time savings associated with the use of C2-simulation interoperability technologies for command post training.
- Shows the strong potential for improving the COA development process through increased collaboration among brigade and battalion commanders using C2-simulation interoperation.
- Sets the stage for NATO to move toward employing C2-simulation interoperation in coalition warfighting capabilities.

In conclusion, a representative multinational Coalition demonstrated the potential for positive outcomes when C2-simulation interoperability is used for planning a military operation. The future clearly indicates the likelihood of Coalition military operations and increased technological capabilities in C2 and simulation systems. The methods of C2-simulation interoperability demonstrated is part of the prospective solution set for conducting collaborative military planning.

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