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Operationalization of Standardized C2-Simulation (C2SIM) Interoperability

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ABSTRACT

The North Atlantic Treaty Organization (NATO) has formed a Modeling and Simulation (M&S) Group (MSG) to investigate how M&S can enhance NATO's mission accomplishment and promote cooperation its use. The recently formed MSG-145, Operationalization of Standardized Command and Control-Simulation Interoperability (C2SIM), is tasked to mature the efforts of the MSG-085 and 048 from an academic study into a truly operational capability.

C2SIM provides individual nations a capability to use their national C2 and simulation systems during planning within a coalition military force. The use of Coalition Battle Management Language (C-BML) as the information exchange hub allows each nation to conduct planning in a distributed environment in collaboration with their coalition partners.

This paper provides the background of previous MSG efforts in C2SIM and current U.S. Army efforts in information sharing within a coalition force. It also describes process connections that must take place to establish the C2SIM capability envisioned by MSG-145 and identifies how the U.S. Army can leverage the C2SIM capability during coalition operations. The unique nature of C2SIM and C-BML allows commanders and their staff to conduct a planning process on their own C2 and simulation systems, yet is sharable with other forces within a NATO coalition. The U.S. Army has multiple venues where the C2SIM capability can be implemented to improve its coalition warfighting readiness within the NATO organizational construct.

1. Introduction: The Connected Battlespace in Coalition Operations

The formation of military alliances indicates the foreknowledge of coalition military operations to attain shared political goals and objectives. As coalition operations are considered and planned in today's networked military environment, it is imperative that the nations are connected in a manner that allow relevant information to be shared and acted upon in concert with command authority.

The United States (US) Army's Operating Concept (AOC), Win in a Complex World, identifies coalition operations as a common environment. The US Army has also established Army Warfighting Challenge 14 (AWFC14), titled Ensure Interoperability and Operate in a Joint, Interorganizational, and Multinational (JIM) Environment, that reflects necessary information sharing envisioned during normal, i.e. coalition, land operations. To mature the needed capabilities, the US Army has established lines of effort across multiple activities.

The US Army's doctrine of mission command (MC) is dependent on gaining situational awareness (SA) and situational understanding (SU), in complex operational environments [1], among all friendly forces. In order to accomplish this, relevant

information must be shared among the land forces provided by the nations of the coalition.

Interoperation among C2 and simulation systems is foundational in the transformation of modern military forces to support the execution of business activities and mission threads for operational training, information sharing and decision support [2]. NATO has established Modeling and Simulation Groups (MSG) to explore the technology that can be used to leverage simulation to support command and control (C2) during military operations.

Regardless of the capabilities that are available, US Army forces must train during peacetime in order to be ready to leverage digital connections between coalition forces and attain an unprecedented level of collaboration, planning, and execution during coalition operations.

2. Previous MSG efforts

Military leaders have sought to attain a "train as you fight" environment for commanders and their staffs for centuries. Before digital systems, a live training environment was established using Soldiers as both friendly forces and role playing as enemy forces. These training events required large amounts of resources (land, fuel, Soldiers, equipment, time, etc.) to execute and months, if not years, to plan and synchronize.

As digital C2 and simulation systems emerged, training events began to require fewer physical resources (land, fuel, equipment) to execute. The cost in terms of Soldiers time and preparation continued to be large. Friendly forces and opposing forces (OPFOR) required a train up period on how to operate the input system for the simulation and were informally known as "pucksters," who were required to input guidance to simulation entities in order for the simulation to represent military operations effectively.

Military forces across the globe were developing their own C2 to simulation interfaces in order to decrease complexity in executing training events. The US Army Simulation to Mission Command Interoperability (SIMCI) organization funded a Battle Management Language (BML) project in 2003 to standardize information exchanges. BML efforts soon began to include coalition efforts, leading to Coalition BML (C-BML).

Building technical interoperability standards is a complex and time-consuming process. Command and Control to Simulation (C2SIM) interoperability standardization efforts have engaged the Simulation Interoperability Standards Organization (SISO). Under the North Atlantic Treaty Organization (NATO) Science and Technology Organization (STO) umbrella, in parallel and often in concert with SISO, several efforts were formed to assist in the validation and development of proposed C2SIM interoperability standards. [2]

Developing standards that define common interfaces for the exchange of military information among C2 and simulation systems therefore can lead to significant cost-reduction and greatly facilitate systems integration. The benefits of standardizing C2SIM interoperation include: 1) Reduced cost and workload; 2) Reduced scenario preparation time; and 3) Increased realism and overall effectiveness. [2]

The NATO Modeling & Simulation Group 048 (MSG-048) conducted a Technical Activity (TA) from 2006 to 2009 that involved an assessment of the concept of Coalition Battle Management Language (C-BML). [3] MSG-048 performed preliminary analyses and performed a series experiments and thus was able to provide an initial set of requirements and recommendations for subsequent BML standardization efforts and also considered the use of the Military Scenario Definition Language (MSDL) for scenario initialization. [2]

The MSG-048 work confirmed the workability, usefulness and applicability of using a standardized, digitized form (i.e. C-BML) for the exchange of military orders and reports among C2 and simulation systems to increase the efficiency and effectiveness of coalition forces during training exercises, planning activities and coalition operations. The operational related conclusions of the MSG-048 Technical Activity were 1) development of a NATO STANAG, 2) Continuing involvement with the operational community in order to ensure the operational relevance of C-BML as it is used in the experimentation program and toward the goal of bringing C-BML toward operational deployment, and 3) C-BML will be useful in training [3].

The follow-on to MSG-048 was MSG-085, which had a mission to assess the operational relevance of C-BML while contributing to C2SIM standardization and assist in increasing the Technical Readiness Level of C-BML technology to a level consistent with operational employment by stakeholders [2].

MSG-085 found that the majority of Command Posts perform COAA with little use of simulation systems. Few systems are able to support the C2 staff for the analysis of future situations, which have become increasingly complex. In general, MSG-085 succeeded in achieving the main demonstration goal of technically proving the concept of C2SIM, using C-BML and MSDL, and recommending that it should be tested in actual coalition operations [2]. Confirming stakeholders' operational requirements is a critical next step that will support this testing.

3. Current US Army approaches to coalition partners

The US Army uses the Mission Command (MC) concept to describe the interrelation between a commander and the elements of their command. MC is the exercise of authority and direction by the commander using mission orders to enable disciplined initiative within the commander's intent to empower agile and adaptive leaders in the conduct of unified land operations [4]. Future US Army forces implement MC while

operating within many ambiguous and complex environments simultaneously [1], which is a clear description of coalition operations.

The US Army Operating Concept (AOC), Win in a Complex World, describes how future Army forces will prevent conflict, shape security environments, and win wars while operating as part of a Joint Force and working with multiple partners [5]. The US Army envisions forming expeditionary joint task force headquarters capable of integrating and synchronizing joint, interorganizational and multinational (JIM) capabilities to seize, retain, and exploit the initiative [6].

From the AOC, the US Army developed Army Warfighting Challenges to focus efforts to reach AOC goals and objectives. AWFC #14, Ensure Interoperability and Operate in a JIM Environment, is maturing a strategy to that develops US Army forces to operate as part of JIM teams. It is envisioned that the US Army, except for immediate response to a national emergency, normally will conduct operations as part of a JIM team. [7]

The Chief of Staff of the US Army, General Milley, stated on September 11, 2015:

> "Nothing's sacred. Nothing about the Army or the way we do business is sacred. We must, all of us, collectively challenge how we fight; we must, all of us, collectively, challenge how we organize, how we train, how we equip."

> "We must not allow ourselves to accept the status quo. The enemy is not static. We must adapt. ... I want to challenge everything; I want to overturn every stone."

In terms of seeking optimum solutions to improve its ability to operate as part of a JIM team, the US Army is participating in multiple lines of effort: 1) Focused End State 4 (FES 4), 2) Mission Partner Environment (MPE), and 3) Multi-national Interoperability Programme (MIP).

The US Army formed Focused End State (FES) Working Groups within the Network Synchronization Working Group (NSWG) construct. FES 4 relates to Mission Command (MC) Interoperability with Unified Action Partners (UAP). UAPs are any non-US Army organization working alongside the US army to accomplish a given mission. FES 4 consolidates MC interoperability efforts under a single Army-level authority using clearly defined Joint and Army policies to develop a concept of Operations (CONOPS) and terms of reference.

The US Army also participates in the Department of Defense (DoD) Information Services Agency (DISA) Mission Partner Environment (MPE). Mission Partners are non-US or non-DoD organizations who operate along-side US military forces to support the accomplishment of an assigned mission. This environment is characterized by increased and open information sharing and data exchange. MPE emphasizes trusted peer-to-peer information sharing and data exchange which necessitates capability

advancements across doctrine, organization, training, materiel, leadership and education, personnel, and facilities-policy (DOTMLPF-P) domains [8].

The US Army has been engaged with the MIP since its inception in the 1990s. The MIP organization provides a channel to the US Army as a multinational forum to promote international interoperability of Command and Control Information Systems (C2IS) at all levels of command through the development and improvement of interface specifications that reduce the interoperability gap between different C2IS. [9]

4. U.S. Army Venues that can leverage C2SIM capabilities

The US Army's Mission Command Center of Excellence (MCCoE) has identified challenges associated with JIM/UAP operational environments that consistently return to two areas: situational understanding (SU) and training.

The MCCoE has received recommendations to incorporate coalition forces into future training events at all levels and to include these forces during experimentation efforts. Partnerships must be developed and executed that allow SU and MC processes to be exercised. These partnerships should be developed at all US Army echelons and process matured that provide access to appropriate sources of relevant information and intelligence in in the area of operations. [1]

With its emphasis on coalition operations, the US Army has several venues that can leverage C2SIM capabilities in training and experimentation: 1) Joint Multinational Readiness Center (JMRC), Mission Command Training Program (MCTP), and 3) Mission Command Battle Lab (MCBL).

The JMRC is one of the seven directorates falling under the leadership of U.S. Army Europe's 7th Army Joint Multinational Training Command headquartered in Grafenwoehr, Germany. JMRC is the only Army Combat Training Center outside the continental U.S. It provides world-class opposing forces to training participants and trains all warfighting functions. It trains leaders, staffs, and units up to Brigade Combat Teams(+) and multinational partners, to dominate in the conduct of Unified Land Operations (ULO) [10]

The MCTP supports the collective training of Army units as directed by the Chief of Staff of the Army and scheduled by Forces Command in accordance with the ARFORGEN process at worldwide locations in order to train leaders and provide Commanders the opportunity to train on Mission Command in Unified Land Operations. The program has a specific objective to increase Joint and Allied participation in Warfighters (WFX) [11].

The MCBL mitigates risk to current and future Army forces by examining and evaluating emerging concepts and technologies through experimentation, studies, prototyping, and network integration, while simultaneously informing the combat development and acquisition processes. The MCBL facilitates and expedites the effective development,

assessment and delivery of improved MC capabilities and more integrated capabilities across the Warfighting Functions to the Warfighter, including the JIM environment, to the Warfighter [12].

5. MSG-145 C2SIM Vision

The NATO STO has established MSG-145 to mature the successful efforts of the MSG-048 and MSG-085. Specific MSG-145 objectives include:

1) Develop needed extensions to the unified C2SIM (MSDL/C-BML) core Data Model for specific functional areas (e.g. Autonomous systems)
2) Exploit C2SIM with use cases through an operational, conceptual and executable scenario development process by engaging the operational community
3) Educate the community of practice on C2SIM technology employment and encourage nations to use the standards, and
4) Make recommendations for "covering" the C2SIM standard with a STANAG. [13]

For core data model work, MSG-145 will leverage the technical work of SISO in an aligned C2SIM program development group [13].

C2SIM use cases will be investigated in the following process domains: Policy and Procedures, Acquisition, Training, Mission Rehearsal, Planning/Military Decision Making Process (MDMP), Mission Execution, and After Action Review [13]. Each of these areas have touch points to existing US Army AFWC 14 and FES 4 activities.

Each use case provides operational linkages to define the process and resulting products in order to translate operational information exchange requirements into conceptual requirements. All use case activities will include stakeholder engagement to identify their requirements and ensure traceability throughout the execution of MSG-145. [13]

Regardless of the relevance of any standard, newly promulgated standards must be publicized and effectively integrated into development processes for future implementation.

C2SIM provides individual nations a capability to use their national C2 and simulation systems during planning within a coalition military force. The use of Coalition Battle Management Language (C-BML) as the information exchange hub allows each nation to conduct planning in a distributed environment in collaboration with their coalition partners.

6. Conclusion

The operationalization of standardized command and control simulation (C2SIM) clearly moves the US Army towards meetings their key objectives of interoperability with multi-national forces in JIM/UAP environments as envisioned by existing MC doctrine.

The technical aspects of C2SIM are well underway. The US Army can provide operational expertise to clarify stakeholders' needs in the JIM/UAP environment during the course of MSG-145 execution.

Additionally, the US Army can integrate MSG-145 C2SIM capabilities into JRMC, MCTP, and MCBL activities as a test of the C2SIM prototype in order to inform its AWFC 14 and FES 4 activities.

The MSG-145 provides the US Army with another venue to explore solutions for operations in the JIM/UAP environment. This opportunity allows existing US C2 and simulation systems to connect to other coalition forces C2 systems and support the planning for and execution of military operations. These same connections can support the training environment that the US Army seeks.

An operational demonstration in an US Army venue would support MSG-145 objectives while verifying JIM/UAP recommendations.

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