C-BML History and Standards

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ABSTRACT

This paper is one of a coordinated set prepared for a NATO Modelling and Simulation Group Lecture Series in Command and Control – Simulation Interoperability (C2SIM). This paper describes the Coalition Battle Management Language (C-BML). Including its history, its current form, and how it is evolving. The history of C2SIM is detailed, from early DARPA work through NATO MSG-048 and MSG-085 Technical Activities and including SISO contributions: current standards (MSDL, C-BML) and ongoing standards development activity.

1.0 INTRODUCTION

This paper was prepared to support a session in the NATO Modelling and Simulation Group Lecture Series in Command and Control – Simulation Interoperability (C2SIM). The session describes the Coalition Battle Management Language (C-BML). Including its history, its current form, and how it is evolving.

1.1 C-BML Background: SIMCI BML

C-BML development followed several experiments aimed at finding a good way to link command and control systems with simulations. This was based on the premise that a military force should "train as you fight", that is, should prepare for operations in ways as close as possible to the way they expect to execute those missions [6].

The most prominent experiments in linking C2 to simulations were CCSIL (pronounced "cecil") and the US Army SIMCI BML.

CCSIL was part of DARPA's 1995 Synthetic Theater of War program, which aimed at proving a realistic, simulation-based training environment. CCSIL provided a reasonable capability for C2 but unfortunately it proved complex and therefore unattractive to warfighters.

The SIMCI experiment grappled with ways to replace the natural language of battlefield C2, which is too ambiguous to be used as input to software, with an unambiguous but usable language.

1.1.1 SIMCI BML Scope

The vision of the SIMCI team working on BML that it could be used to exchange C2 Information among:

1) Individuals using C4I Systems;

2) Simulations; and

3) Future Robotic Forces.

While C4I systems can exchange primarily free-text based C2 directives designed for human consumption, Simulations require unambiguous input. Therefore, in the past simulations have needed a significant overhead in the form of trained military experts (often called "pucksters") to translate C2 free-text orders into Simulation Commands [39].

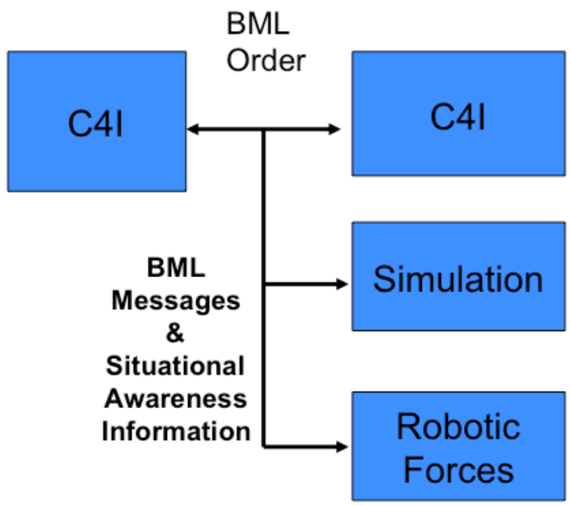

Figure 1. BML Scope

1.1.2 SIMCI BML Structure

The SIMCI BML Proof of Principle [38] was structured as shown in Figure 2. Input came from a planning system called CAPES that prepared military orders in Extensible Markup Language format. The input passed through a parsing program and came out as BML. Which was stored in:

- A Multi-Source Database,
- A Graphical User Interface or GUI displayed the BML and could edit it.
- Another program called C4ISI took the BML from the database and turned it into directions for the OneSAF Testbed (OTB) simulation.

This worked well – people who saw demonstrations were impressed – but it was too *ad hoc* to serve as a general solution.

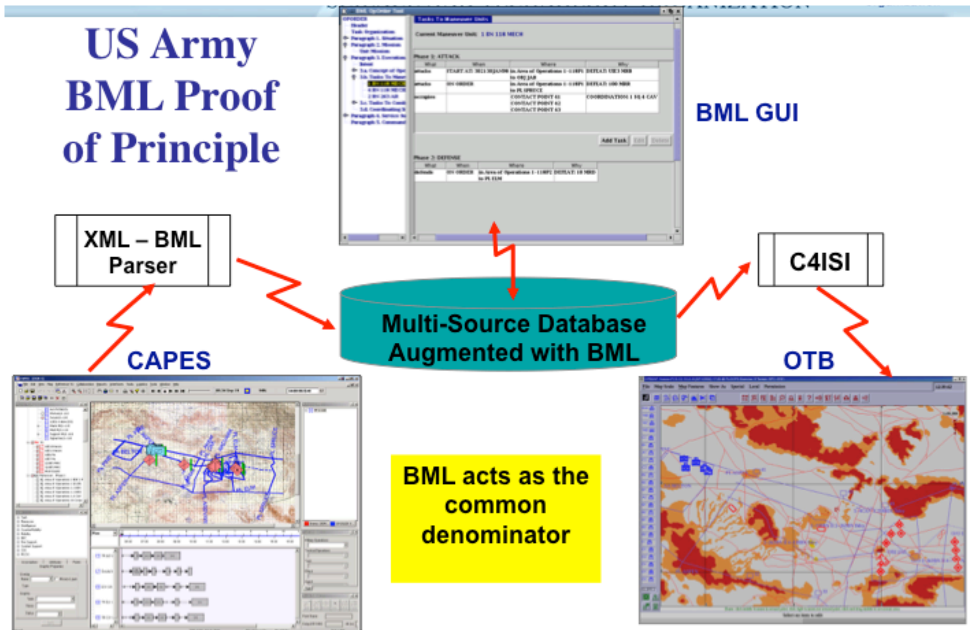

Figure 2. SIMCI BML Proof of Principle

1.2 C-BML Background: US-France Prototype

The first developments in what became C-BML were inspired by a US-France experiment in C2-simulation interoperation, which we'll take up below.

The work they inspired had two clearly different tracks:

- The NATO Modelling and Simulation Group implemented systems interfaces for experimentation and conducted validation on the results.
- The Simulation Interoperability Standards organization, SISO that we heard described earlier, worked to codify consensus standards based on NATO MSG results.

This is not to say that the people in NATO and SISO groups were totally separate; the two groups shared a few people, who served to link them. Some of those people are among our presenters today.

1.2.1 US-France Early Collaboration

The French and US systems came together after a chance meeting at the Interservice/Industry Simulation, Training and Education conference in 2005.

The US Defense Modeling and Simulation Office (DMSO, now MSCO) was at that time supporting an initiative by the Naval Postgraduate School Modeling, Simulation, and Virtual Environments Institute (NPS-MOVES), the GMU C4I Center, the Virginia Modeling, Simulation and Analysis center (VMASC), and SAIC San Diego. That initiative, known as the Extensible Modeling and Simulation Framework or XMSF, was intended to show the way to Web-based modeling and simulation.

The C4I Center led development of a Web-enabled version of the SIMCI 2003 experiment, called Extensible BML (XBML), which replaced the central database and its interfaces with a Web service repository. In

France, they were doing similar work, linking the French C2 system SICF with their simulation APLET. When they met at I/ITSEC in 2005, the two teams decided to collaborate and produced a multi-system prototype that excited teams from other NATO nations.

1.2.2 US-France Prototype Operation

Figure 3 shows how the US-France prototype worked [39]:

- The plan input came from CAPES, as with the SIMCI version.
- The US used the JSAF simulation, linked to CAPES via a Web service that stored information in C2IEDM format (more on this later).
- France used the APLET simulation, linked to the same Web service.

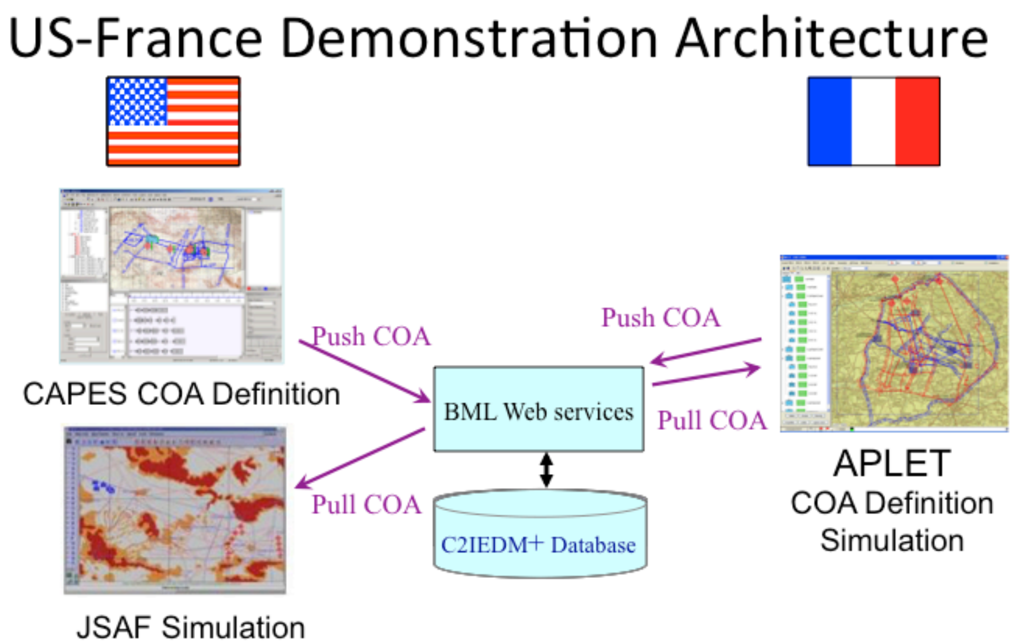

Figure 3. US-France BML Prototype

1.2.3 US-France Prototype Results

We can see the result from figures 4 and 5 [9]. Figure 4 shows the starting conditions, which had been entered in CAPES.

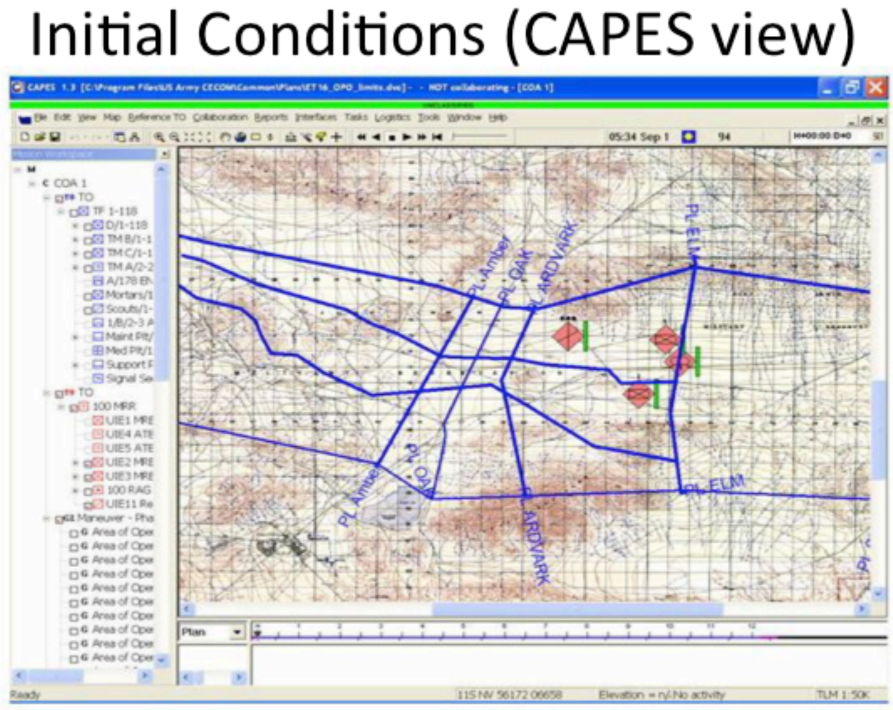

Figure 4. Initial Conditions (CAPES View)

Figure 5 shows the combined plan achieved by the French and US forces collaboratively. It is a screenshot from APLET, and you can see that both CAPES data and also the order that went to JSAF were made available through the Web service to APLET.

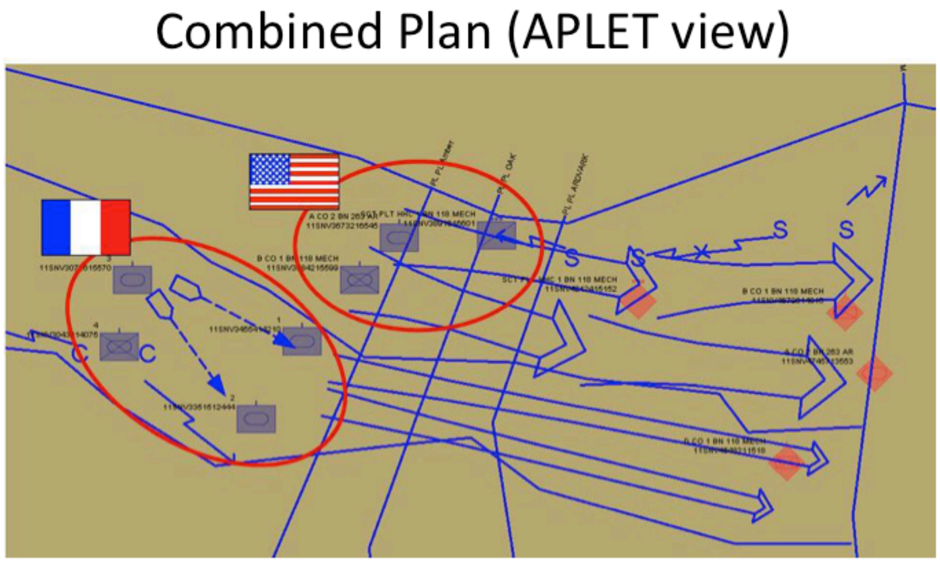

Figure 5. US-France Combined Plan

2.0 NATO MSG-048 TECHNICAL ACTIVITY

In recent years it has become very clear that where NATO countries must fight wars they will be doing it in coalitions. Several NATO nations, inspired by the BML concept, joined an exploratory team (ET) under French leadership and organized by the NATO MSG, to consider how to proceed. The prototype from France and the USA helped them decide that the time had come to work together to determine whether BML could be used by coalitions [12].

2.1 MSG-048 Framework and Requirements

Teams from Canada, Denmark, Germany, the Netherlands, Norway, Spain, Turkey, UK and USA came together to work out the way forward and prototype it. They planned to develop an open framework that could provide for coherent exchange of information among C2 and simulation systems. This fed the SISO effort, resulting in open, system-independent standards for interoperation. They intended to establish requirements for C-BML, assess its value to support coalitions, and educate stakeholders in the C2 and simulation communities.

2.1.1 General C-BML Architecture

From the outset, C-BML implementations have used the architecture shown in Figure 6 [28]. C2 systems may interchange information as a system of C2 systems, for example using the JC3IEDM. Simulation systems also may work as a system of systems. But the two types of systems will exchange Orders, Reports and other C2 information through a Web service that is connected to database using JC3IEDM format.

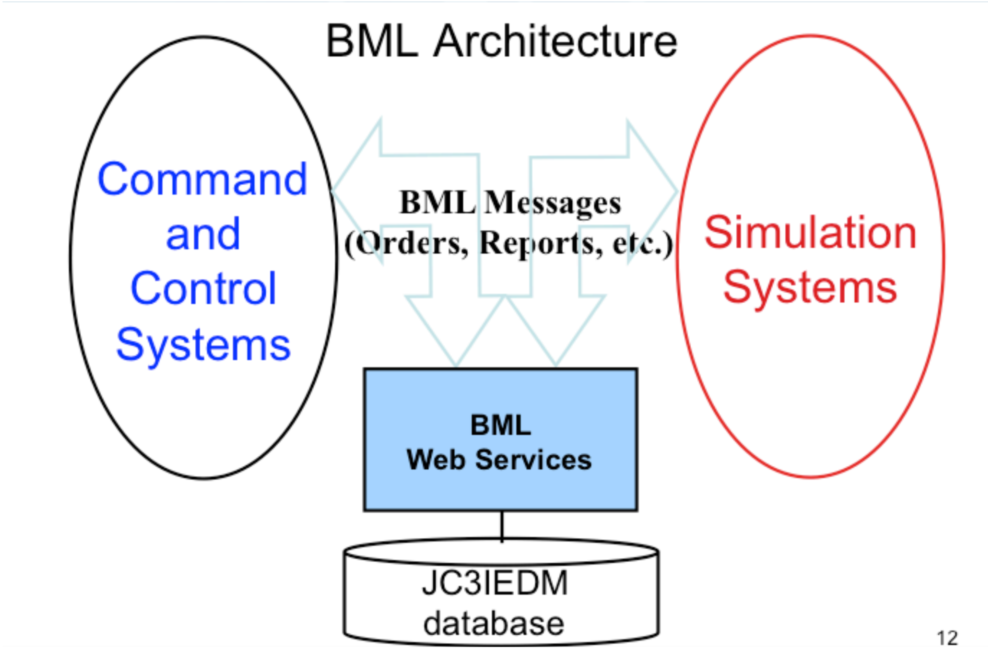

Figure 6. BML Architecture

2.1.2 Systems Used in MSG-048

Over its four-year lifespan, MSG-048 interfaced a lot of systems, all using the same BML schema in the Web service architecture.

C2 systems engaged were:

- Canada brought Battle View
- France continued with SICF
- Netherlands interfaces their ISI system
- Norway did so with their NORTaC-C2IS
- The UK interfaced the NATO air C2 system ICC
- The US interfaced its ABCS mission command system

Simulation systems engaged were:

- Canada brought a UAV simulation system
- France continued with APLET
- Spain interfaces their SIMBAD system
- The UK interfaced the JSAF system (originally from the US)
- The USA interfaced the US Army OneSAF system

Supporting all of this was the C2LG Graphical User Interface (GUI) from Germany and the SBMLserver from the US.

2.1.3 MSG-048 Final Experimentation

Figure 7 shows the MSG-048 final experimentation, held at Manassas Virginia in 2009 [12]. It shows how all of the systems listed above were connected and how they were used to represent friendly (blue) and opposing (red) forces.

2.1.4 Role of Machine Grammar

A particular note is due regarding the role of machine grammar in the MSG-048 work. Researchers from FGAN (now FKIE) in Germany and the GMU C4I Center worked together to arrive at an effective, unambiguous representation for machine input. They came up with the Command and Control Lexical Grammar or C2LG [33].

The need for a grammar also was recognized in SISO, where it became the second of three planned phases:

1. XML schema for packaging information
2. C2LG grammar for syntactic interoperability
3. An ontology to provide for semantic interoperability

This is the top level of the C2LG grammar:

OB -> Verb Tasker Taskee (Affected|Action) Where Start-When (End-When) Why Label (Mod)*

To a computer grammarian this defines a simple but complete way to represent an order. Here is an example that meets the specification:

pursue BtlC CavB En **towards** Z **at** now

in order to destroy En label_3_15;

It is appropriate to point out here that the originally planned three phases got folded into two as SISO C-BML proceeded, so while the current C-BML standard is Phase 1 it is inspired by C2LG. The next phase now is planned to be the final one and will involve both grammar and ontology.

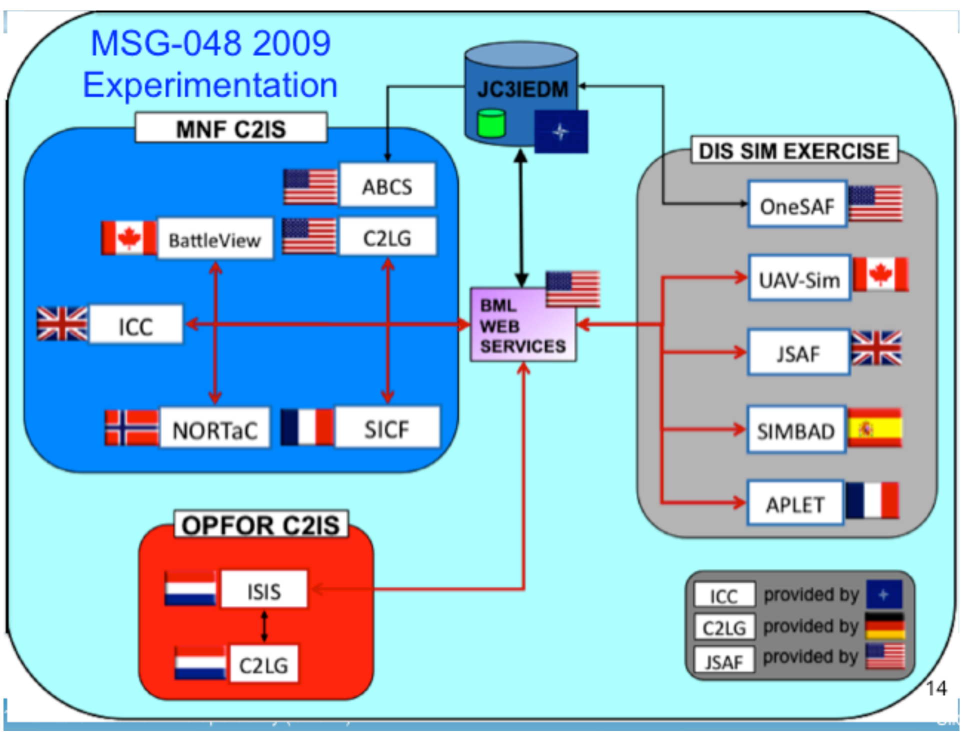

Figure 7. MSG-048 2009 Experimentation

2.1.5 MSG-048 Outcomes

Outcomes of MSG-048 were [12]:

1. Informed parallel activity by SISO. That progress was not a swift so did not produce a standard until the next MSG Technical activity; but eventually ti did bear fruit.
2. A successful, if somewhat stressful, Final experimentation in 2009. This brought in military SMEs from several nations, led by a recntly retired US Army officer who had served as a Brigade Commander in Iraq. Intensive preparation including Internet-based development and testing were necessary. A scenario with coalition elements from five NATO nations was used.
3. At the end, the SMEs agreed the approach deserved to be developed farther; thus a successful Proof of Principle.
4. And a few years later, a pleasant surprise: MSG-048 won the NATO Scientific Achievement Award in 2013. This reflected not only solid technical results but strong collaboration among the national teams that participated.

3.0 NATO MSG-085 TECHNICAL ACTIVITY

MSG-048 was such a clear success that the NATO MSG chartered a follow-on Technical Activity before it concluded. Having demonstrated technical feasibility of Coalition BML, the goal now was to show operational military relevance and also support the standardization process.

The new Technical Activity, MSG-085, consisted of the previous nations plus Belgium and Sweden, with interest expressed by others also. The national teams also brought more operational military expertise which of course was needed to meet the goal.

MSG-085 was again led by France; more organizational structure was needed as it grew. The participants were divided into Technical and Operational subgroups and, later in the project, into orthogonal Common Interest Groups focusing on Autonomous/Air, Land, and Maritime Operations; Joint Mission Planning, and Infrastructure [4], [5], [10], [37].

A particularly significant lesson learned from MSG-048 was that a standardized approach to system initialization was needed, in addition to C-BML. We did not have to look far for such a standard, since SISO already had standardized MSDL. The national teams of MSG-085 pitched in and implemented MSDL in the first year, demonstrating at ITEC. A side effect of this was to expose some incompatibilities between MSDL and C-BML that had to be resolved to move forward.

3.1 MSG-085 Architecture

Figure 8 shows the evolution that occurred in the BML architecture with MSG-085. The web services now include the MSDL initialization information and the database is no longer tied to JC3IEDM but must be capable of real-time support [28].

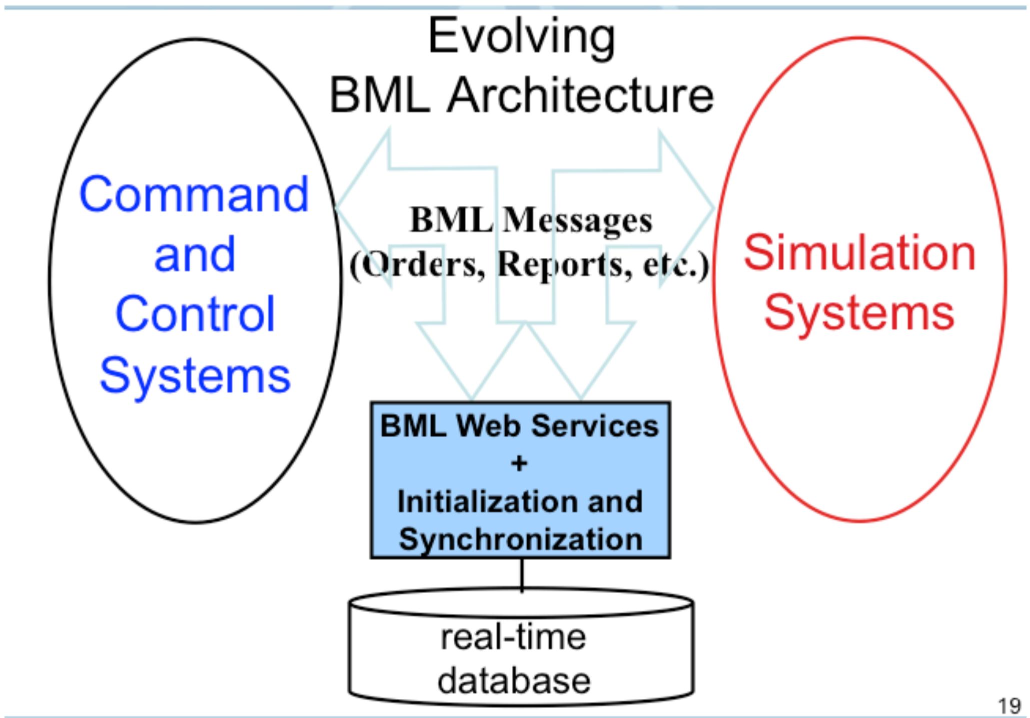

Figure 8. Evolving BML Architecture

3.2 SISO C-BML Standard and MSG-085

At long last, SISO approved the C-BML standard in 2014 [35], five years after MSDL [36]. Balloting had been completed in 2012 but details remained to be resolved.

One issue was the fact that the "full" C-BML Phase 1 schema, intended to address the full range of C2 information that can be expressed in the JC3IEDM, was objectionably cumbersome to many participants. As a result, the C-BML Phase 1 schema includes a "Light" subschema that facilitates rapid implementation.

An effect of the delayed standardization was that, when the MSG-085 Final Demonstration was held, three different and not completely compatible schemata had been used in various national systems. (These did not include the "Full" schema.) Happily, a way was found to interoperate the three, using a clever server technology.

3.3 MSG-085 Final Demonstration

Figure 9 shows the MSG-085 Final Demonstration configuration. Participating system are similar to MSG-048, with some updates. But note the participants removed via Internet, the use of PN and Chat technologies, and also the collaborative configuration of Brigade and Battalion commanders.

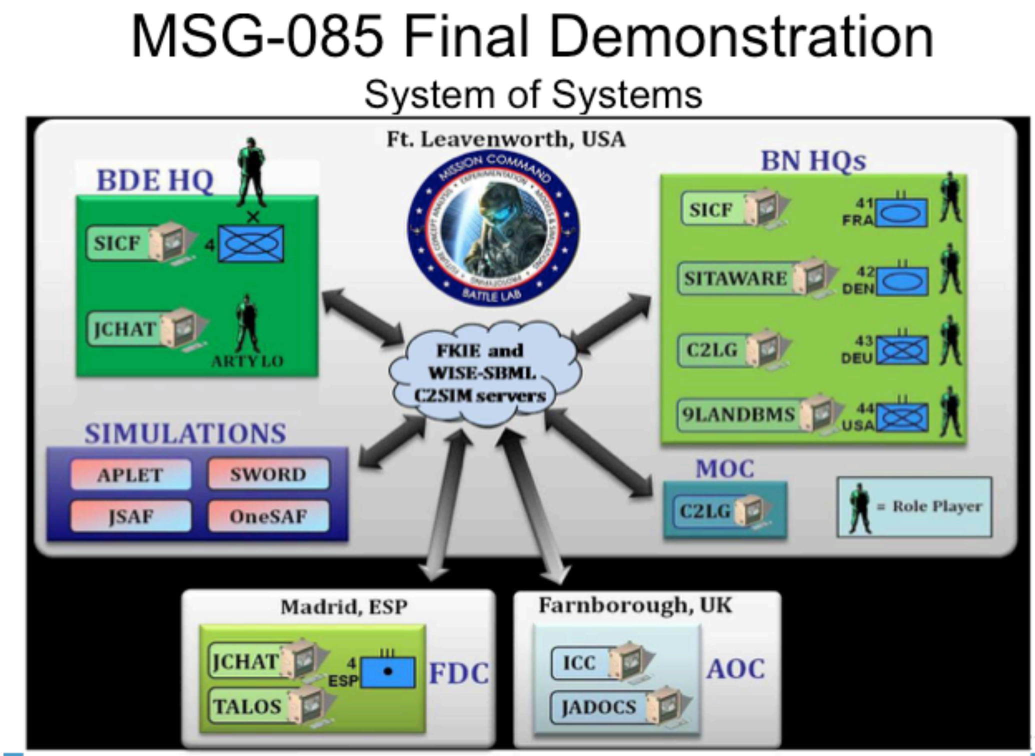

Figure 9. MSG-085 Final Demonstration

The final Demonstration of MSG-085 was conducted at Fort Leavenworth, Kansas, in collaboration with the US Army Mission Command Battle Lab. operational focus was Joint and Combined Mission Planning [29].

The final Demonstration had a complexity similar to that of MSG-048 but there were some significant differences:

1. It was supported by a heterogeneous system of distributed servers, and two remote sites participated via Internet, which was supported by cellular technology since the coalition systems were not approved for connection to a US Army network.
2. The setup process was achieved quickly and with little difficulty, whereas MSG-048 had not been fully functional until its last day.
3. The audience, including US Brigadier General Franklin, pronounced themselves highly impressed by the results.

MSG-085 met its goal proving the concept that C2SIM as implemented by MSDL and C-BML is ready to be tested operationally.

4.0 FUTURE C2SIM STANDARDS

The Path to a C2SIM STANAG lies through the next generation of SISO C2SIM standards.

The SISO C2SIM team has been reorganized: the MSDL and C-BML Product Development Groups have come together into a single C2SIM group that also is responsible for sustaining the existing MSDL and C-BML standards [34].

The approach being taken to the second generation came out of the MSG-085 technical group. It addresses the problem that the C-BML schema, even though cumbersomely large, does not cover the full range of military operations; only maneuver warfare. The MIP, that developer JC3IEDM, had this same problem and came up with a solution that they communicated to MSG-085: Standardize not an XML schema but a data model (expressed in Unified Modeling Language, UML); extend this data model to new domains as needed; but for any given application, extract only the needed elements as an XML schema.

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