

C2-Simulation Interoperability for Operational Hybrid Environments

Dr. J. Mark Pullen

C4I and Cyber Center, George Mason University, USA
mpullen@c4i.gmu.edu

Lionel Khimeche

Direction générale de l'armement, France
lionel.khimeche@intradef.gouv.fr

Bharat Patel

Defence Science and Technology Laboratory, UK
bmpatel@dstl.gov.uk



Presentation Overview

- Introduction: C2SIM and MSG-145
- History of C2SIM in the NMSG
- SISO C2SIM
- MSG-145 Concepts
- MSG-145 Activities
- Conclusion

Introduction: C2SIM and MSG-145

- C2SIM : Command and Control – Simulation Interoperation
 - Technology that promises to enable expanded military operational capabilities in hybrid environments
 - Particularly promising for coalitions
 - Focus of recent NMSG Technical Activities and SISO standards development
 - New Technical Activity reported here is aimed at transition to operational capability and STANAG

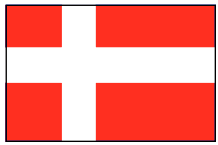
Vision for the Next Decade

- NATO multinational forces upon deployment will immediately interconnect their C2 and Simulation systems over a common, secure network to begin training together
- Each nation's forces will be commanded via their own C2 system, with which they have long experience
- Each nation's forces will be represented in combined virtual engagements by their own simulations, which reflect accurately their personnel, equipment, and doctrine
- Coalition force will be able to prepare rapidly for a new mission, learning to deal with unique aspects for each national force while preparing to work together
- Use the same systems for course of action development and mission rehearsal

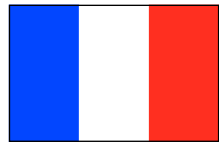
History of C2SIM in the NMSG

NMSG Exploratory Team ET-016

- France & US early work seeded early adopter interest
- Led to formation of MSG-048
 - Coalition Battle Management Language



Denmark



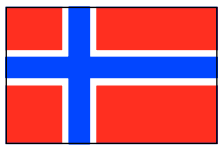
France (Lead)



Germany



Netherlands



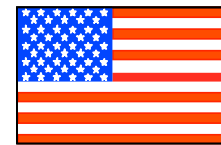
Norway



Spain



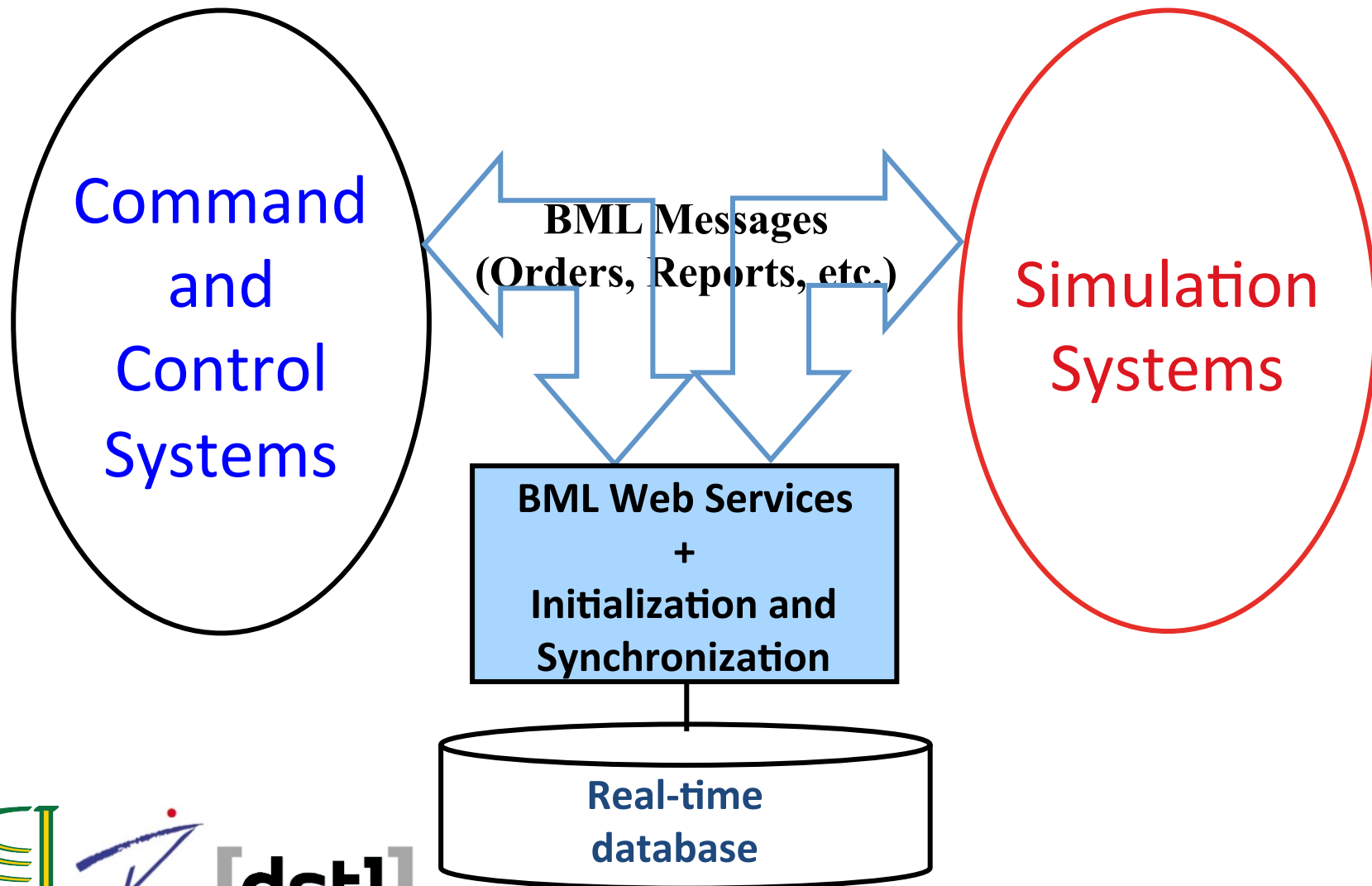
UK



USA (Co-Chair)



Web Service Based Architecture



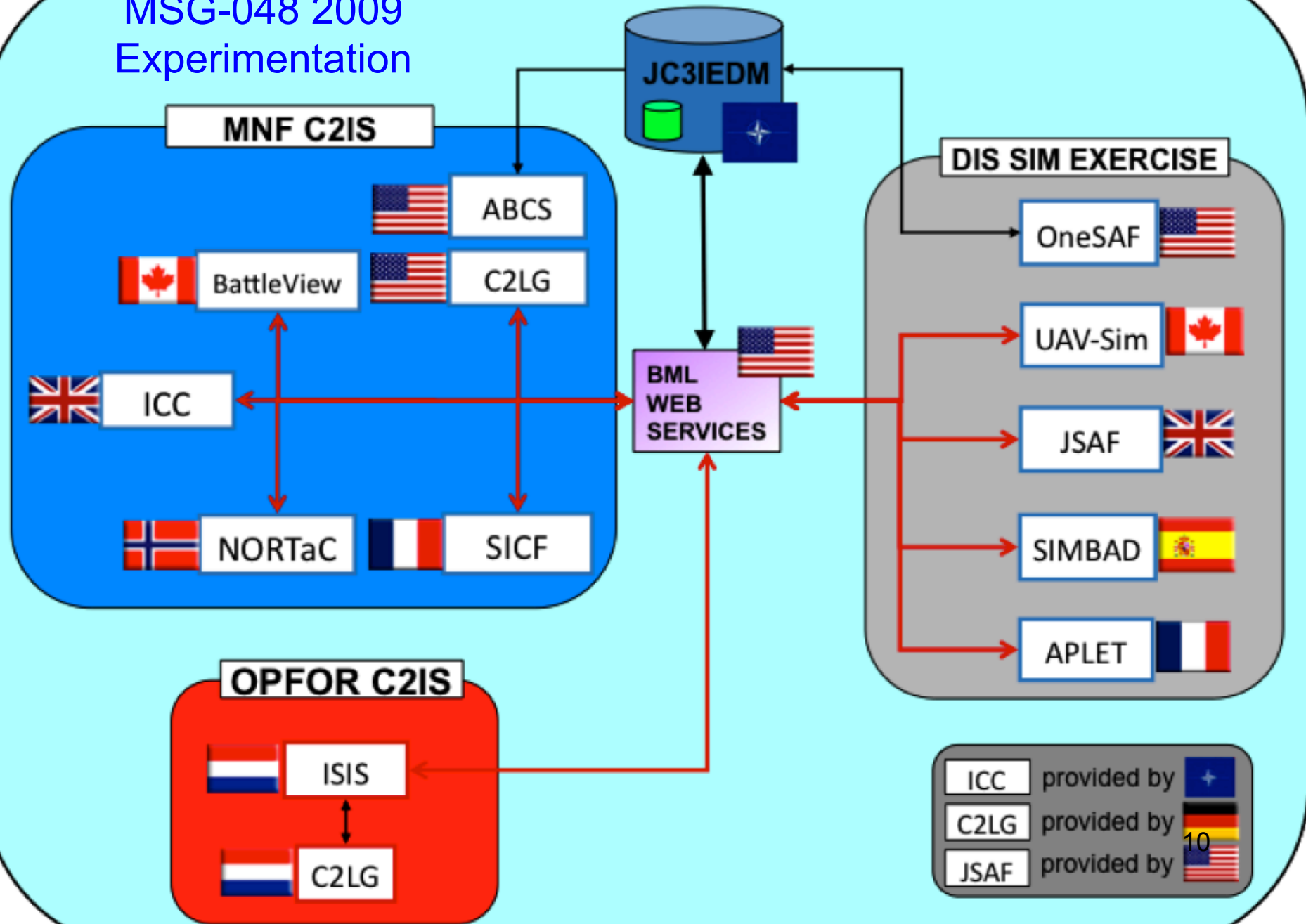
Technical Activity MSG-048

- ET-016 stimulated a multinational effort to show technical feasibility of Coalition BML (C-BML)
 - Canada, Denmark, Germany, the Netherlands, Norway, Spain, Turkey, UK and USA
 - Open framework to establish coherence C2 - M&S
 - New open, system-independent, community standards and protocols.
- Work areas:
 - Establish requirements for the C-BML standard
 - Assess its usefulness and applicability of C-BML in support of coalition
 - Educate and inform the C-BML stakeholders

MSG-048 Results

- Parallel activity by SISO C-BML PDG to define a standard
 - Progress made but not as smoothly
 - Slower than most stakeholder found satisfactory
 - Produced results during following phase
 - MSG-085 used schema from a US effort
- Final Experimentation 2009
 - Work with operational military SMEs acting as brigade staff
 - Intensive preparation over Internet (new approach at the time)
 - Integration events in Portsmouth, UK and Paris, France
 - Counter-insurgency scenario with Canadian, French, Norwegian, UK, USA simulated units
- Succeeded as Proof of Principle despite difficulties
- Won NATO Scientific Achievement Award 2013

MSG-048 2009 Experimentation



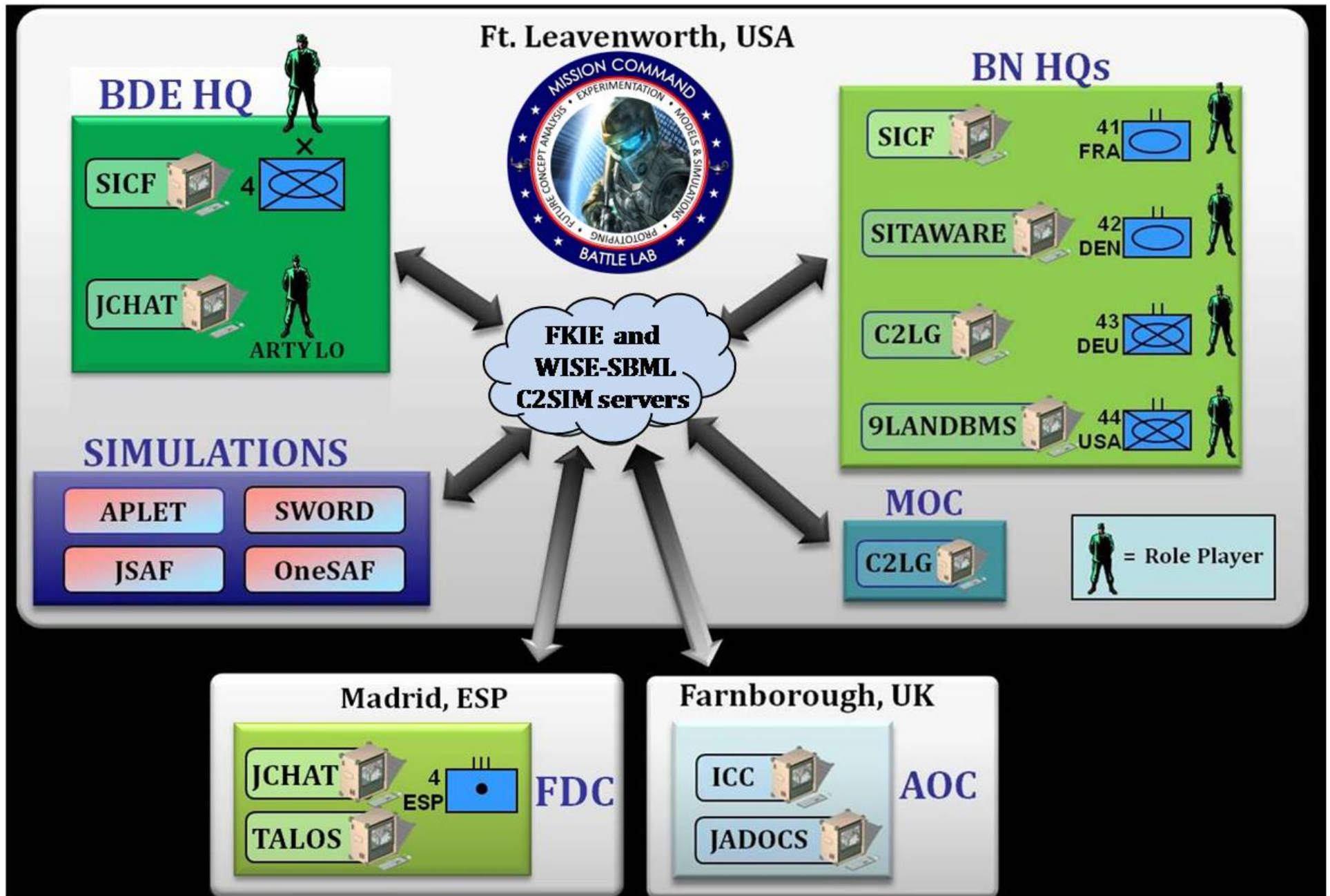
Technical Activity MSG-085

- Follow-on TA chartered near end of MSG-048
 - To support standardization and show operational relevance
 - Added participating nations: Belgium and Sweden
 - Also added operational military expertise
- Organized into Technical and Operational Subgroups
 - Also, orthogonally, Common Interest Groups:
 - Autonomous/Air, Land, and Maritime Operations; Joint Mission Planning, and Infrastructure
- Recognized need to add MSDL to C-BML
 - In first year (2010), participants implemented MSDL
 - Which in turn showed need for greater MSDL/C-BML

MSG-085 Final Demonstration

- Conducted at Fort Leavenworth Kansas
 - Collaboration with US Army Mission Command Battle Lab
- Featured Joint and Combined Mission Planning
- Complexity similar to MSG-048 but with major differences:
 - Network sophistication: two linked servers; three schemata; two sites participated via Internet
 - Setup process: where MSG-048 was chaotic; MSG-085 “just worked”
 - Audience impression: MSG-085 worked very well
- Proved concept: C2SIM in the form of MSDL and C-BML ready to be tested in real coalition operations.

MSG-085 Final Demonstration



SISO C2SIM

Simulation Interoperability Standards Organization

- **Open Standards Development** Org established 1996
- **Mission**
 - To develop, manage, and promulgate user-driven Modeling and Simulation (M&S) standards that improve the technical quality and cost efficiency of M&S implementations across the **worldwide M&S community**.
- **Principles**
 - Responsive and Responsible to the communities we serve
 - Quality in our activity and resulting products
 - Discipline in all activities
 - Fairness at all levels
 - Openness to any person in all forums
 - Consensus of the community

SISO Products and Services

- Standards
- Guidance Products
- Reference Products
- Papers & Presentations
 - Spring Technical Interchange Meeting
 - M&S Seminar @ ITEC
 - Fall Simulation Interoperability Workshop
- M&S Professional Education/Collaboration
- See <http://www.sisostds.org>

SISO C2SIM Standards

- International, open standards
- Initial versions
 - Military Scenario Definition Language (MSDL) supports initialization
 - Coalition BML (C-BML) provides for exchange of Tasking (orders and requests) and Reporting information
- Unified Version 2 under development as **C2SIM**
 - Logical Data Model (LDM)
 - Initialization
 - TaskingReporting
 - Extendable to many domains – start with Manouever Warfare

Military Scenario Definition Language (MSDL)

STANDARD APPROVED 2009

- Scenario ID
- Options to be applied across the scenario
- Environment
 - scenario time
 - extents of the geographic area
 - weather, meteorological and oceanographic conditions
- ForceSides – forces and their relationships for a scenario
- Organization (order of battle)
- Overlays – tactical graphics
 - associations among them and owners of units
- Installations – physical facilities
- Tactical Graphics –iconic information (e.g. NATO APP-6)
- Military Operations Other Than War (MOOTW) graphics

SISO C-BML Standard

- Focus on Tasking (Orders) and Reporting
- In 2012 SISO completed balloting C-BML Phase 1
- Two versions approved:
 - “full” intended to address very wide range that can be represented by the JC3IEDM
 - “light” facilitates rapid implementation
- Standard approved May 2014
- Delays in approval resulted in MSG-085 nations having 3 different schemas implemented

Path to STANAG: 2nd Gen SISO C2-Simulation

- MSG-085 showed that MSDL and C-BML could work together effectively, but with some difficulty
 - They should be converged/harmonized
- Experience with C-BML “Full” schema indicates it is cumbersome to use
 - Yet it only covers maneuver warfare – not all types of operations
- MSG-085 technical work indicated that the approach taken by Multilateral Interoperability Programme (MIP) is more useful
 - Define data to be exchanged as data model, expressed as UML (not XML schema)
 - Extend data model to new domains as needed
 - Derive XML schema from the data model

SISO C2SIM

- SISO MSDL and C-BML Product Development Groups agreed to merge, forming C2SIM
 - A single Product Development Group with multiple Drafting Groups
 - And a Product Support Group to maintain MSDL and C-BML
 - Reduced administrative overhead
- New approach in SISO: PDG and PSG form a lifecycle product group empowered over the product lifecycle to develop and support products.
 - Membership common to both PDG and PSG

C2SIM Combines MSDL and C-BML

- C2SIM-LDM (Logical Data Model)
 - Core set of data elements
 - Standard way of extending the core
- C2SIM-Initialize
 - Intended to supersede MSDL version 1
 - Defines startup and checkpoint information
- C2SIM-TaskingReporting
 - Intended to supersede C-BML phase 1
 - Major issue: be able to expand to new domains without being cumbersome
 - Derived from extended LDM

Interdependency of NATO and SISO C2SIM

NATO MSG depends on SISO for open industry-based C2SIM standards

SISO depends on NATO Technical Activities to field and validate C2SIM technology

MSG-145

Technical Activity MSG-145

- *Operationalization of Standardized C2-Simulation Capability* started 2016
- Build experience in deploying C2SIM with operational NATO forces
- Provide continued support of the SISO standardization process
- Work toward wrapping the SISO C2SIM standard in a NATO Standardization Agreement (STANAG)

MSG-145 Mission and Benefits

- Mission: *Assess the C2SIM in development standard and implement extensions to the unified C2SIM Logical Data Model (LDM) for specific functional areas in order to demonstrate its usability to the simulation community and support the definition of a STANAG.*
- Benefits:
 - Enhanced realism and overall effectiveness
 - Decreased cost and risk
 - Reduced preparation and response time

MSG-145 National Interests (1)

- Display simulation results in operational C2 systems (Germany)
 - support “train as you fight”
- Facilitate eventual experimentation related to the Autonomous Systems (Italy/M&S COE)
- Contribute to the assessment of the SISO C2SIM draft standard (Norway)
 - coverage and structure of the core LDM and the extension mechanism
- Develop C2SIM Reference Architecture and Distributed Simulation Engineering and Execution (DSEEP) overlay (Netherlands)
- Support development of C2SIM as a Service (Netherlands, UK)

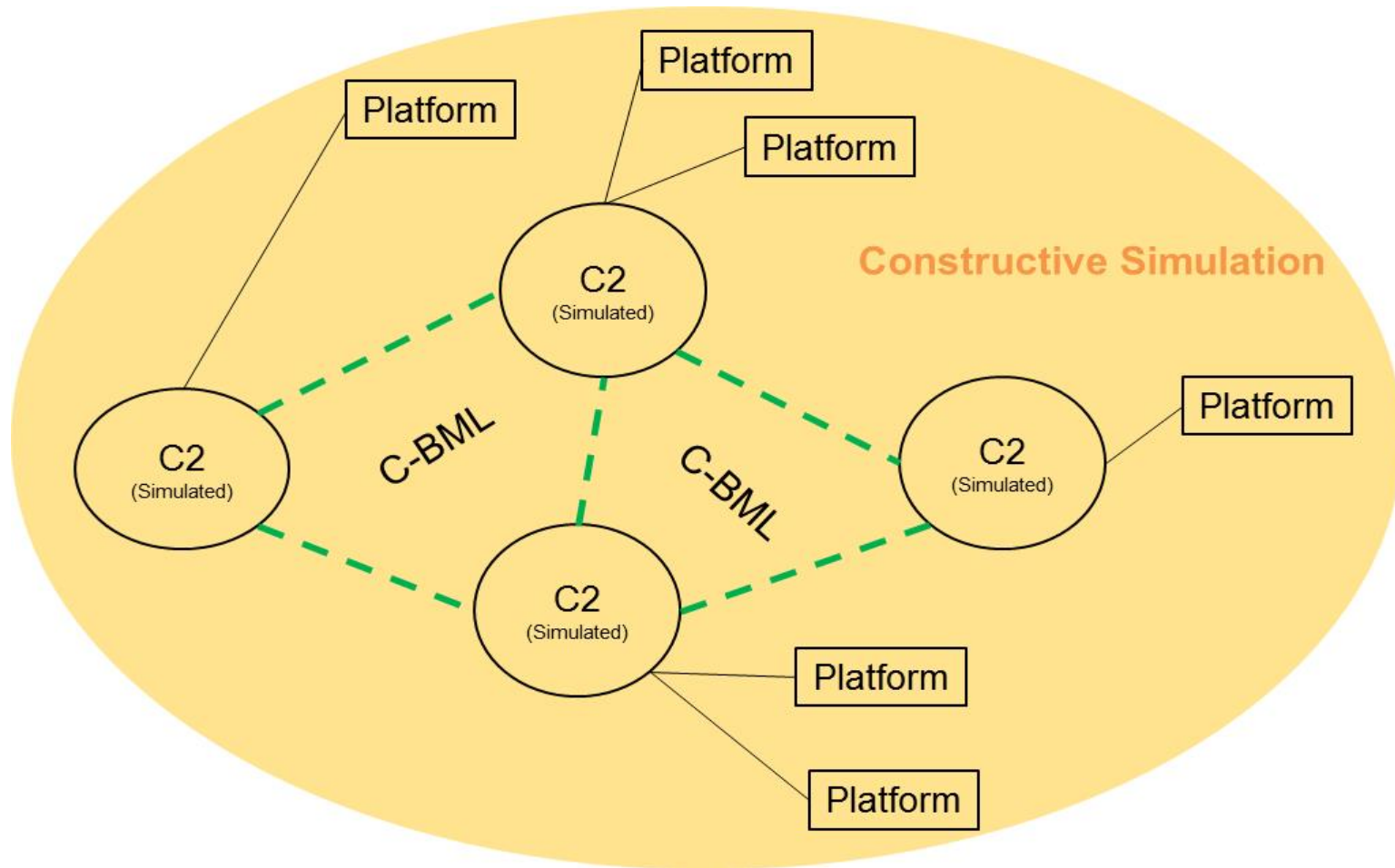
liaison with MSG-136 *Modelling and Simulation as a Service*

MSG-145 National Interests (2)

- Work with military operators and support moving to C2SIM from previous systems developed using C-BML and MSDL (UK)
- Support outreach and education to the military C2 and simulation communities (USA)
- Facilitate a continuously available distributed environment for test, evaluation, and experimentation (USA)
- C2SIM for acquisition (France)
 - select the most cost-effective mix of individual systems for development and fielding

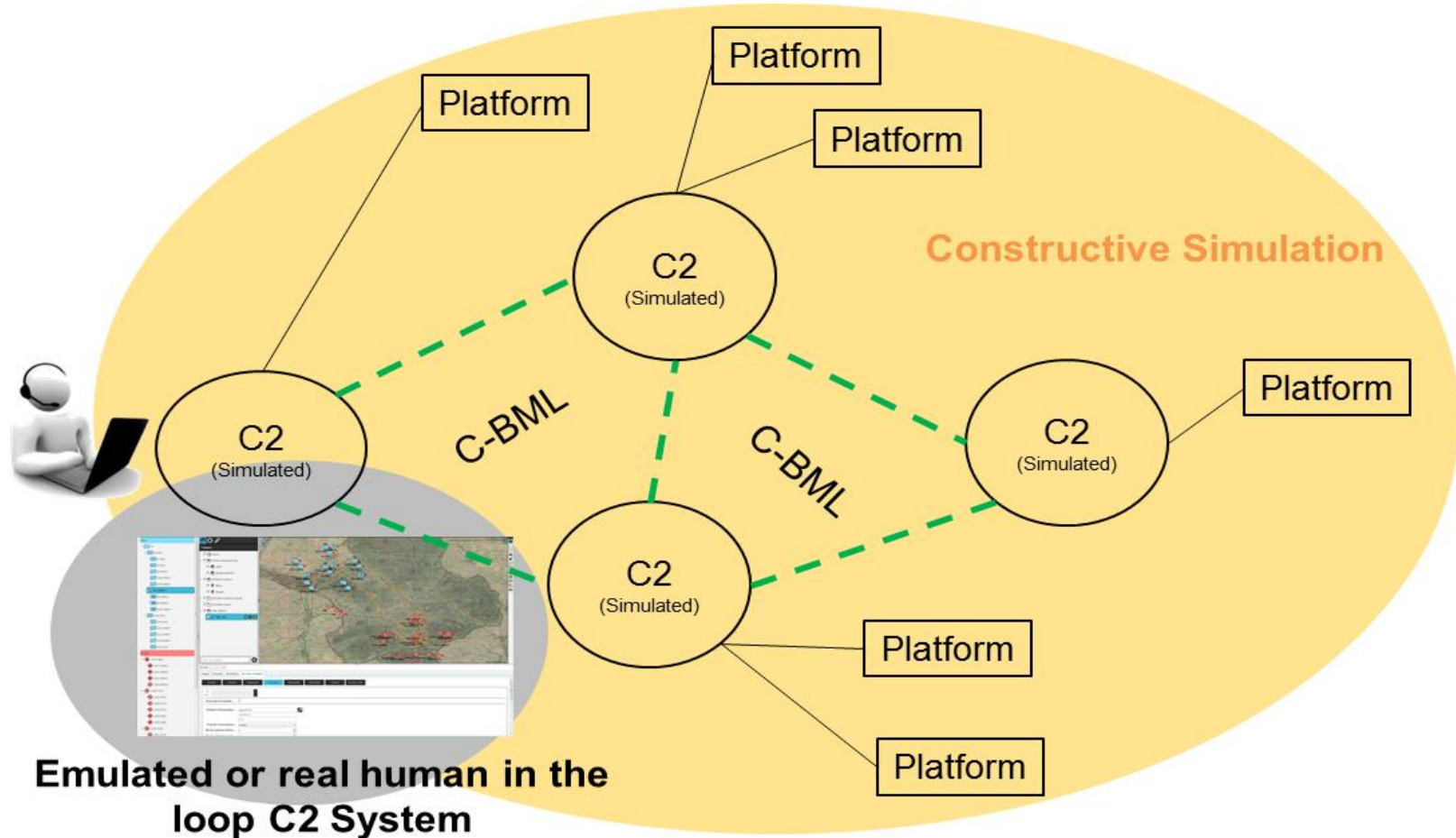
C2SIM for Acquisition (France)

Simulation Of System Of Systems Architecture



C2SIM for Acquisition (France)

Integrating a virtual prototype



MSG-145 Technical Objectives

- Exploit C2SIM with use cases developed by engaging the operational community.
- Develop required extensions to the C2SIM Logical Data Model Core, beginning with Manoeuvre Warfare
- Inform the standards development process and motivate suppliers to develop products by demonstrating C2SIM in operational military context.
- Educate the community of practice at conferences
 - SISO Simulation Interoperability Workshop
 - NATO Computer Assisted Exercise Forum
 - I/ITSEC
- Recommendations for STANAG

C2SIM "Sandbox" Testbed

- Continually available by VPN over Internet to demonstrate C2Sim and test compatibility
- Assembled from one or more each of C2 Systems, Simulations, and Servers
 - Commercial and government products
- Graphic interfaces accessible remotely via VPN
 - Pre-loaded scenario
 - MSG-145 participants can operate remotely
 - But will not have access to software internals

MSG-145 Operational Activities

- Demonstrations during major simulation/C2 events
 - I/ITSEC and ITEC
 - NATO CAX Forum and TIDE Sprint
 - ICCRTS
 - Viking 2018 Exercise
 - Coalition Warrior Interoperability Exercise (CWIX)
- Liaison
 - NATO Allied Command Transformation (ACT)
 - NATO Joint Warfare Centre (JWC)
 - NATO Modelling and Simulation Centre of Excellence (M&S COE)
 - Similar national centers contacted by national teams

Use Cases for Uncertain & Hybrid Threats

- Cyber Warfare and Information Operations
- Autonomous Systems and Robotics
- Joint Mission Planning and Battlespace Management
- Army Mission Planning and Command Post Training
- NATO Mission Threads and Tactical Data Link

MSG-145 Management

- Phase 1: Development of the Programme Of Work activity (ongoing)
- Phase 2: C2SIM assessment, use case analysis, and extensions development
- Phase 3: Experiments to evaluate, and demonstrations to showcase, use cases
- Phase 4: Recommendation for STANAG

MSG-145 Time Phasing

	2016	2017	2018	2019
Phase 1	POW developmt			
Phase 2		Standard assessme nt	Use case requirements	
			C2SIM extension development	
			Review STANAG	
Phase 3		Identify target events	Conduct experiment and demonstration	
Phase 4				Final Report developmt
				STANAG definition spt
Communication, workshops and symposiums				

Conclusions

- C2SIM holds exceptional promise for coalition military operations
- MSG-145 is building on MSG-048 and MSG-085 successes
- Working toward future when coalition C2 and Simulation systems will simply "plug together"
- Technical readiness level is ready to engage military operators