



Overview of C2 Systems – Simulation Systems Interoperation (C2SIM) Standard

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Outline

- C2SIM Vision
- C2SIM History in NATO & SISO
- MSG-145 video
- C2SIM architecture
- SISO C2SIM overview
- C2SIM in MSG-193/201

Note on Terminology

- We will use these terms interchangeably:
 - Command and Control (C2) system
 - Command and Control Information System (C2IS)
 - Mission Command (MC) system
- We use the collective term “Coalition” for a C2SIM system-of-systems
 - Reflecting the fact it is more loosely structured than an HLA Federation

C2SIM Vision

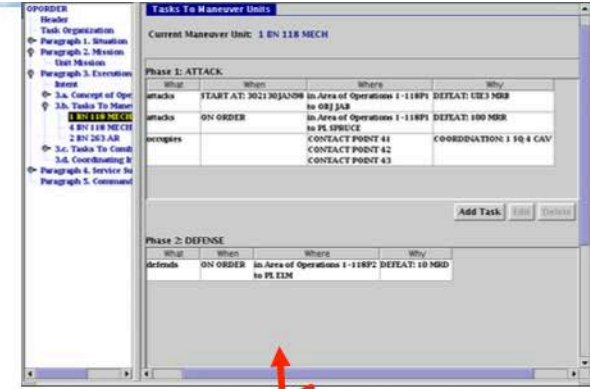
We are working toward a day when the members of a coalition interconnect their networks, command and control (C2) systems, and simulations simply by turning them on and authenticating, in a standards-based environment.

A C2SIM Coalition is a system of systems.

C2SIM History Pre-SISO

- Various ad-hoc interfaces between C2 and simulations supporting “train as you fight” concept
 - Motivated mostly by cost of human “puckster” interface
- 1995 DARPA Synthetic Theater of War (STOW) sponsored
 - Command and Control Simulation Interface Language (CCSIL)
 - Good first step but proved complex to use
- 2003 US Army Simulation to C4I (SIMCI) sponsored Battle Management Language (BML) experiment
 - Focus on eliminating ambiguity in task description
 - Successful proof of principle
 - Simulated NATO MSG and SISO development

US Army BML Proof of Principle



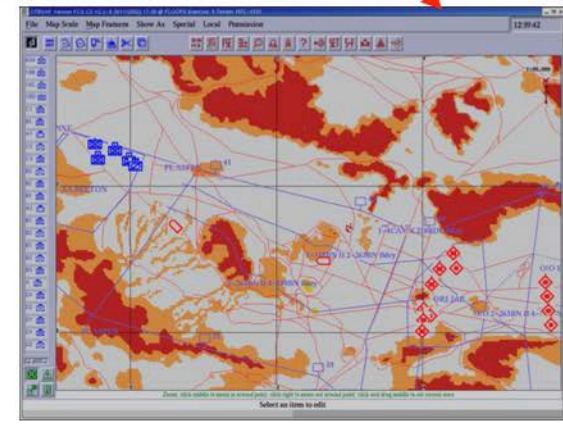
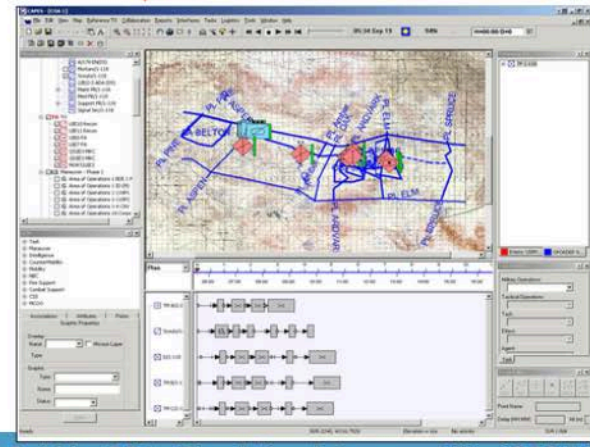
XML – BML
Parser

C4ISI



CAPES

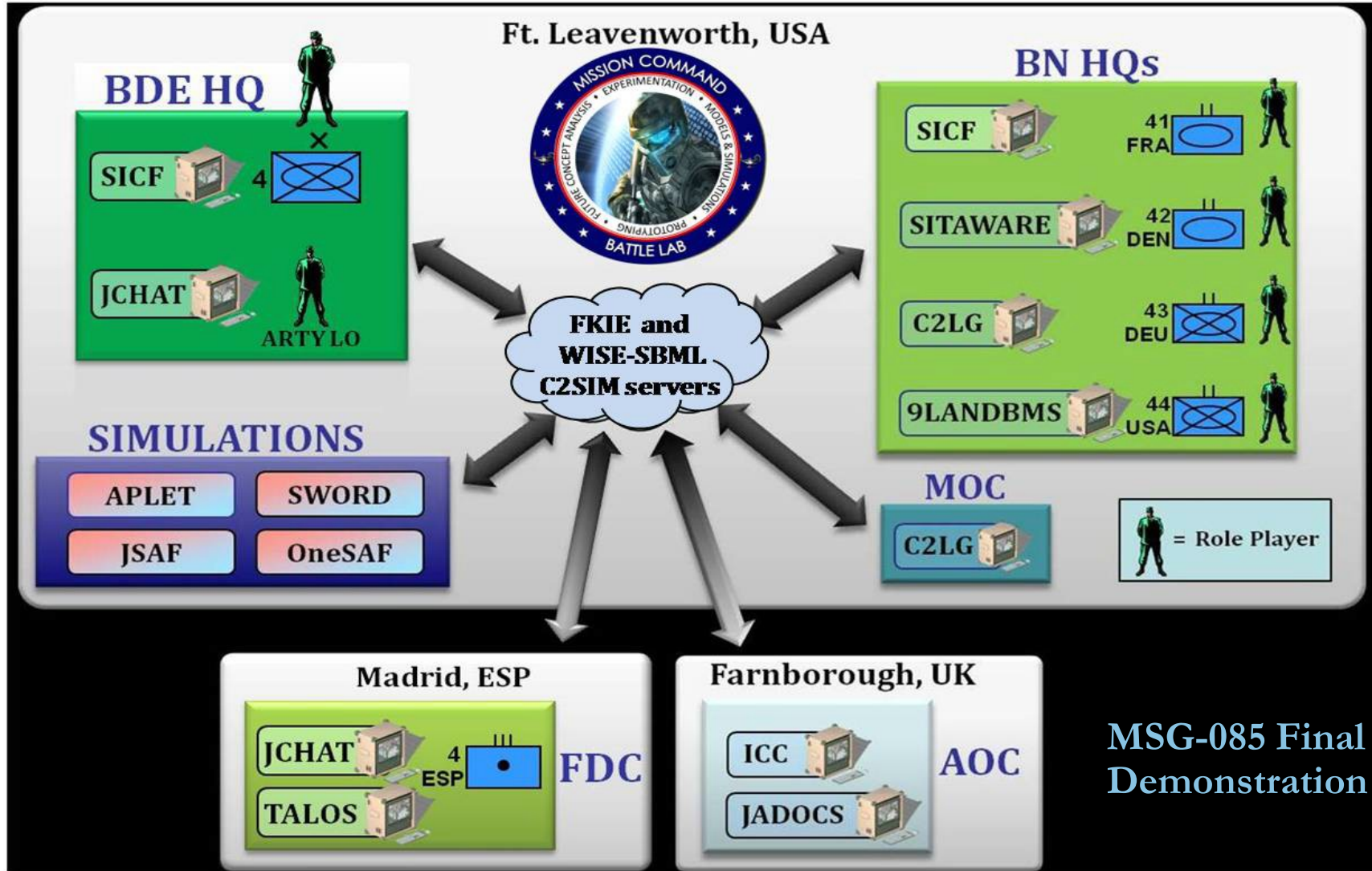
OTB



**BML acts as the
common
denominator**

C2SIM History SISO and NATO

- SISO BML Study Group chartered
- NATO ET-016 worked in parallel 2005
 - Prototype based on SIMCI experiment – demonstrated to NMSG at Warsaw
- SISO started MSDL and C-BML product development 2006
- NMSG chartered MSG-048 2006-2010
 - *Coalition Battle Management Language*
 - Goal: show technical feasibility met in experimentation Manassas
- NMSG chartered MSG-085 2011-2015
 - *Standardization for C2-Simulation Interoperability*
 - Goal: show military utility met in demonstration Fort Leavenworth
- SISO formed C2SIM PDG from MSDL & C-BML in 2016
- NMSG chartered ET-038 2016
 - Goal: organize MSG-145 to complete C2SIM development



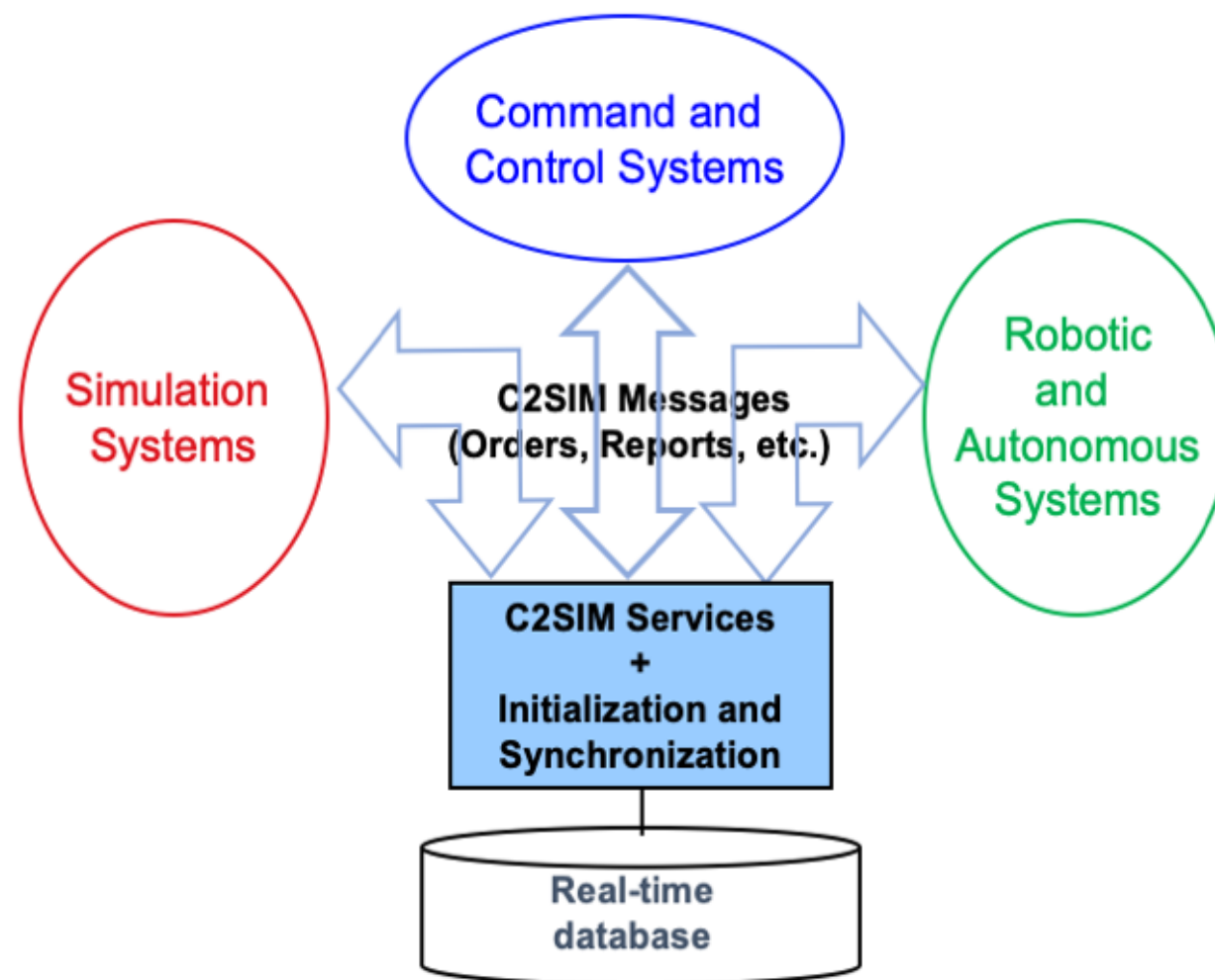
NATO MSG-145 Mission Statement

Assess the C2SIM standard in development 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 STANAG 4856 (which was approved in 2023)

Video Introduction to MSG-145 C2SIM

https://www.youtube.com/watch?v=3L_Hhxuh6Zc

C2SIM Basic Architecture



C2SIM Ontologies

- Ontology: Set of concepts and categories in a subject area or domain that shows their properties and the relations between them
- Core: data classes and properties that are needed by all C2 and simulation systems to interoperate: Who, what, when, where
- Standard military extension (SMX): classes and properties that are needed by all military C2 and simulation systems
 - Mostly more properties for core classes, e.g. Entity has a ForceSide
- Land Operations Extension (LOX): ground warfare classes and properties
 - Separate standard; example for other new extensions

C2SIM Messaging

- Standard header for all C2SIM messages
 - Implements IEEE FIPA formal communication rules
 - Handled by standard library to ease implementation
- Standard message bodies for various required content
 - Object and System Initialization information
 - Domain Messages: Order, Report and Plan information
 - System Commands: Synchronize initialization and execution
 - Acknowledgement: Confirm information receipt where needed

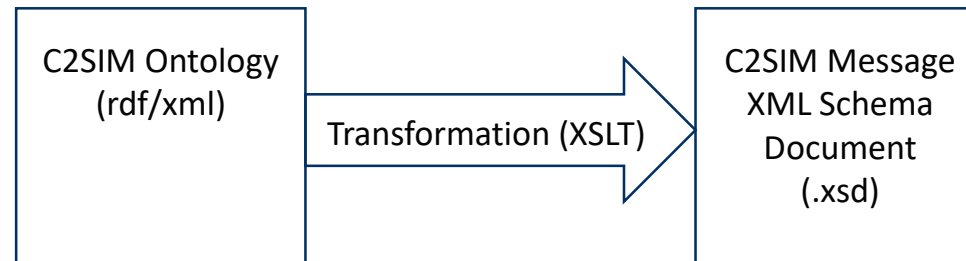
Reference Implementation Server and Client Library

- Implements C2SIMv1.0.0 standard XML schema and CWIX extensions
- Supports a *Coalition* of C2 and Simulation systems interoperating
- Aggregates initialization data and serves it to all systems
- Passes control messages to start/pause/stop execution, recording & playback
- Distributes orders and reports based on subscription
- Logs all messages for playback and analysis
- Can translate between C2SIM and legacy formats (MSDL/C-BML)
- Compatible client library simplifies implementation (Java & C++)

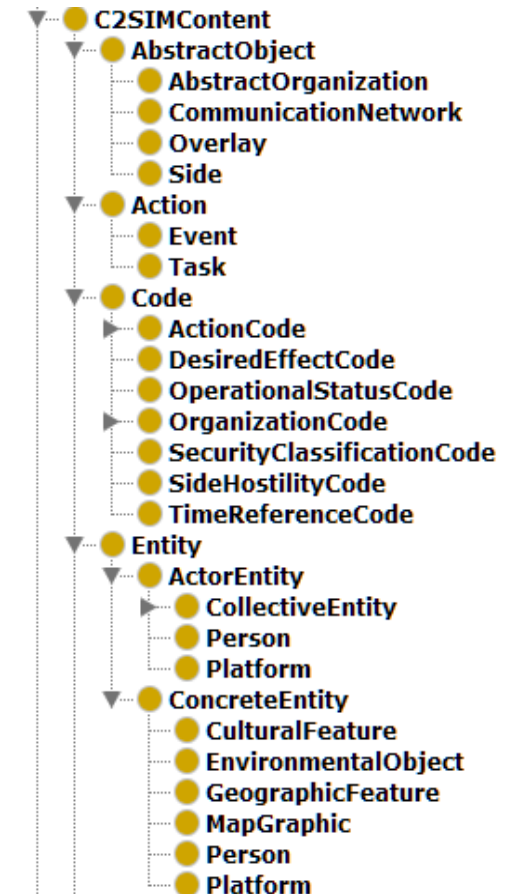
C2SIM Editor and Control

- The C2SIMGUI editor provides a means of creating, editing, and observing C2SIM message flow to the simulation and C2 systems in the coalition (generally, these flow via the C2SIM Server). Heavily used in CWIX.
- The C2SIMcontrol provides a simplified set of control messages (start/stop/pause etc) to the coalition, via the C2SIMserver. It is much simpler than the Editor, but also less powerful. It is intended for operation via a C2 User who is in charge of an exercise.

Ontology to XML Schema transformation



- Starting with the C2SIM ontology, generate an XML schema document suitable for use by the community (e.g., for CWIX)
- Transformation process does not need to be modified ontology changes
 - Transformation will auto-generate the target schema directly from ontology
 - Re-execute transformation to generate XML schema document
- Transformation available in XSLT and Java



C2SIM and MIP

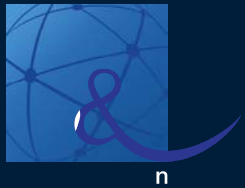
- MIP is Multilateral Interoperability Programme (for C2)
- C-BML schema and C2SIM ontology data classes reference MIP3.1 JC3IEDM definitions wherever possible
 - So interface with MIP is straightforward
 - Main difference is C2SIM packaged as XML
- MIP has a new version MIP4
 - SISO C2SIM PDG is looking into a C2SIM-MIP4 interface to extend C2-simulation operations to many NATO nations' C2IS

NMSG in CWIX 2019 to 2023 and beyond

- CWIX is NATO Coalition Warrior Interoperability eXploration, eXperimentation, eXamination eXercise
 - Focus on testing: do the systems interoperate?
 - Robust testing methodology supports FMN specifications
- MSG-145 and MSG-201 national teams have interfaced simulations, server and editor to C2SIM and tested in CWIX
 - Mostly via Internet VPN; used GMU Editor and surrogate C2
 - Growing use of operational C2 (SitaWare and Sketch-thru-Plan)
 - National teams from DEU, FRA, GBR, ITA, NLD, NOR, SWE, USA have participated
 - Included simulation-based Mission Rehearsal with many systems working together to show support for FMN goals



NORTH ATLANTIC TREATY ORGANIZATION
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The screenshot shows the NATO STO website homepage. At the top left is the NATO OTAN logo. To its right is the text "NORTH ATLANTIC TREATY ORGANIZATION" and "SCIENCE AND TECHNOLOGY ORGANIZATION". On the far right is a "Sign In" link and social media icons for YouTube, Facebook, and LinkedIn, along with the S&T organization logo. Below the header is a navigation menu with links for ORGANIZATION, NEWS, PROGRAMME, ACTIVITIES, PUBLICATIONS, and CONTACT. The main content area features a "NEWSROOM" section with a large banner for "2022 HIGHLIGHTS" from the Science and Technology Organization. Below the banner is a news item titled "NATO STO releases 2022 Highlights publication". To the right of the banner are two smaller news items: "NATO STO hosts wargame on Space Deterrence ..." and "NATO STO releases 2023 Collaborative Programme of Work Report ...".