

C2-SIM IN COMPLEX ENVIRONMENTS

APPROVED FOR PUBLIC RELEASE

Outline of Presentation

- **Definition**
- **Review of MSG-048 and MSG-085**
- **SAFIR**
- **CAGE IIIb**
- **Robotic Systems**

Definition

- Complex Environments:
 - More than One Nation
 - Single or Multiple Domains
 - Multiple Service Branches
 - Multiple Systems, Networks and Processes
 - Distributed Environments

C2 to Simulation Interoperability in NATO (1)

- **NATO MSG-048: Standardization for C2-Sim Interoperability (2006-10)**
 - On the back of work in the USA through SISO an Exploratory Team – 016 (ET-016) was established to examine feasibility of adapting early BML within NATO. Uniquely a demonstrator was built and this resulted in formation of MSG 048. This group used the products being developed within SISO to examine C-BML as an enabler for NATO.
- **NATO MSG-085: C2-Sim Interoperation (2011-14)**
 - MSG-085 was a follow-on Technical Activity to MSG-048 which is focused on assessment and requirements for both C-BML and MSDL on advancing toward an operational employment.
 - Mission Statement: Assess the operational relevance of C-BML while contributing to C2-Simulation standardization and assist in increasing the Technical Readiness Level of C-BML technology to a level consistent with operational employment by stakeholders.

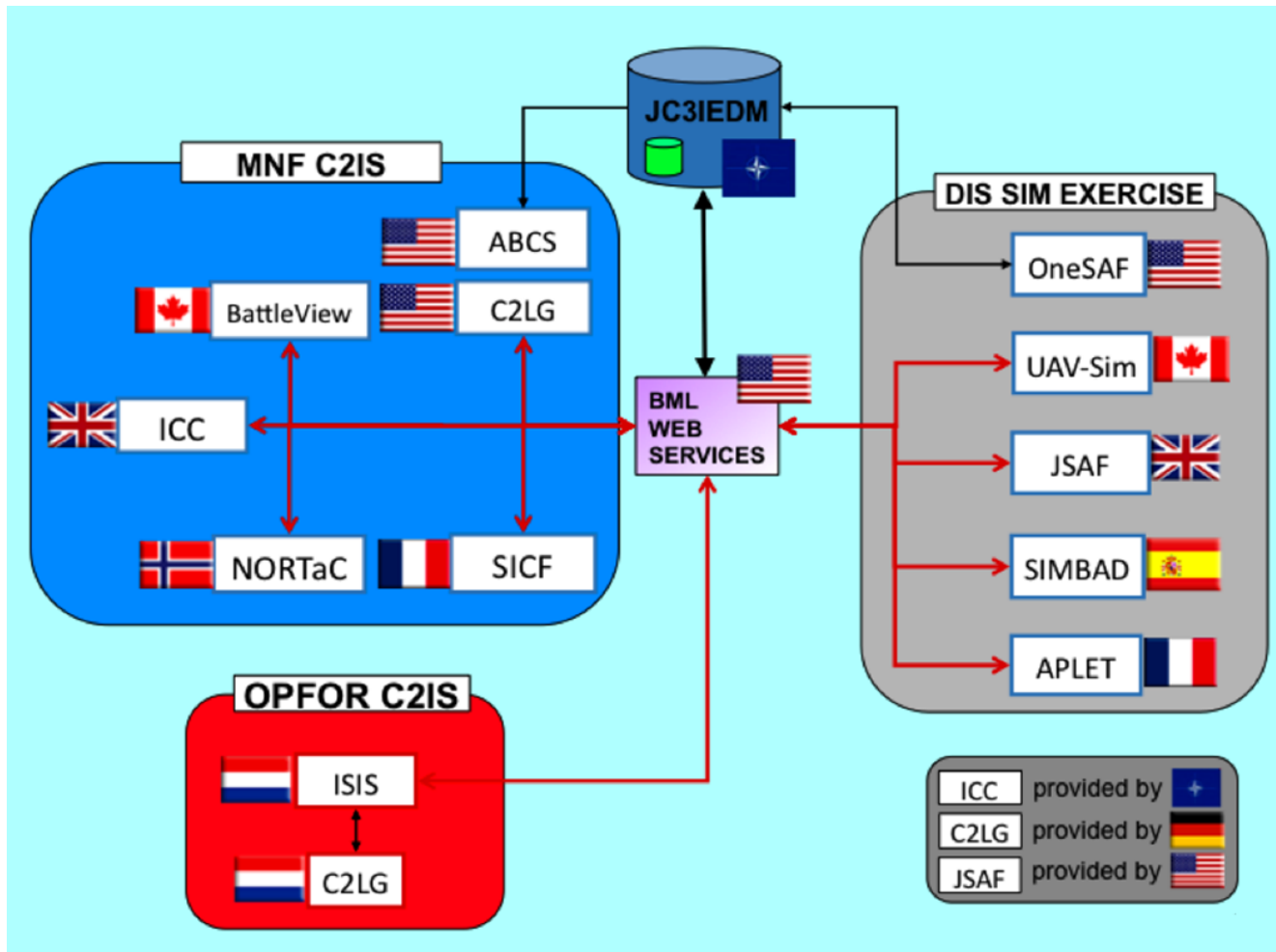
C2 to Simulation Interoperability in NATO (2)

- **NATO MSG-119: C2-Sim Interoperability Workshop (5 Dec 2012)**
 - Technical Evaluation Report Main Recommendations:
 - Create a Combined Scenario Initialization & Execution C2-SIM Interoperability Standard;
 - Establish an agile requirements-driven phased, controlled, evolvable, sustainable process capable of producing this standard;
 - Develop a comprehensive set of operational requirements to drive this process;
 - Leverage existing interoperability solutions, processes and tools, such as those available from the Multilateral Interoperability Programme;
 - Promote the definition of a Distributed Simulation Engineering & Execution Process (DSEEP) Overlay for C2-SIM Federations.

National Participation in NMSG 048/085

- Support to NATO Modelling and Simulation Group (NMSG) 048 (2006-10) and 085 (2011-2014) has been supported by many nations. For example in the UK under Dstl research funding
- This enabled the UK to participate in experimentation and demonstrations of both C-BML/MSDL capabilities.
- UK demonstrated use of Integrated Command & Control (ICC) Software for Air Operations and Joint Automated Deep Operations Coordination System (JADOCS) with Joint Semi Automated Forces (JSAF).
- Also used C-BML with its tactical C2 system; Bowman ComBAT Infrastructure Platform (BCIP) application to provide location and core tasking data.

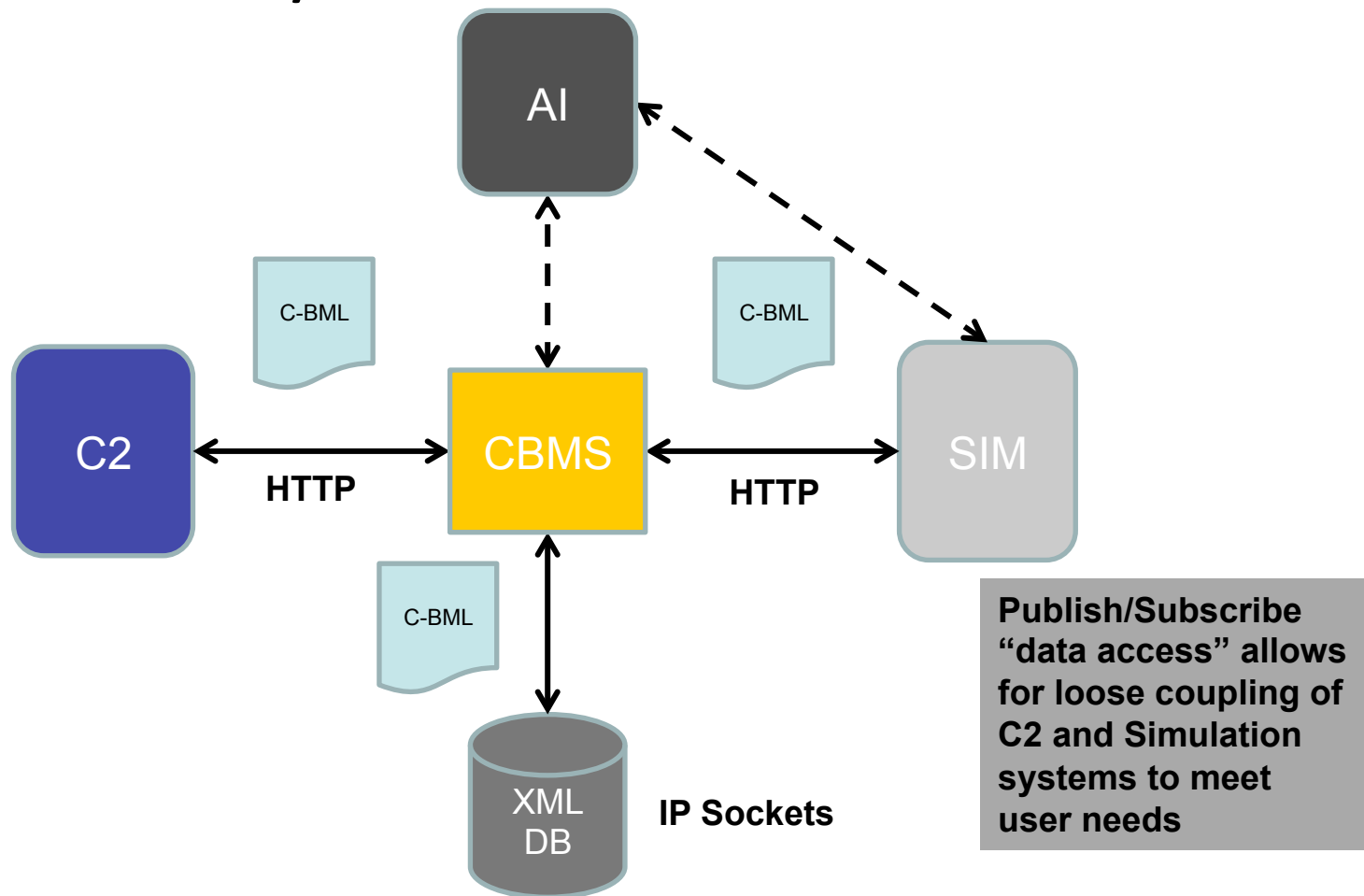
MSG-048 Demonstration Architecture – December 2009



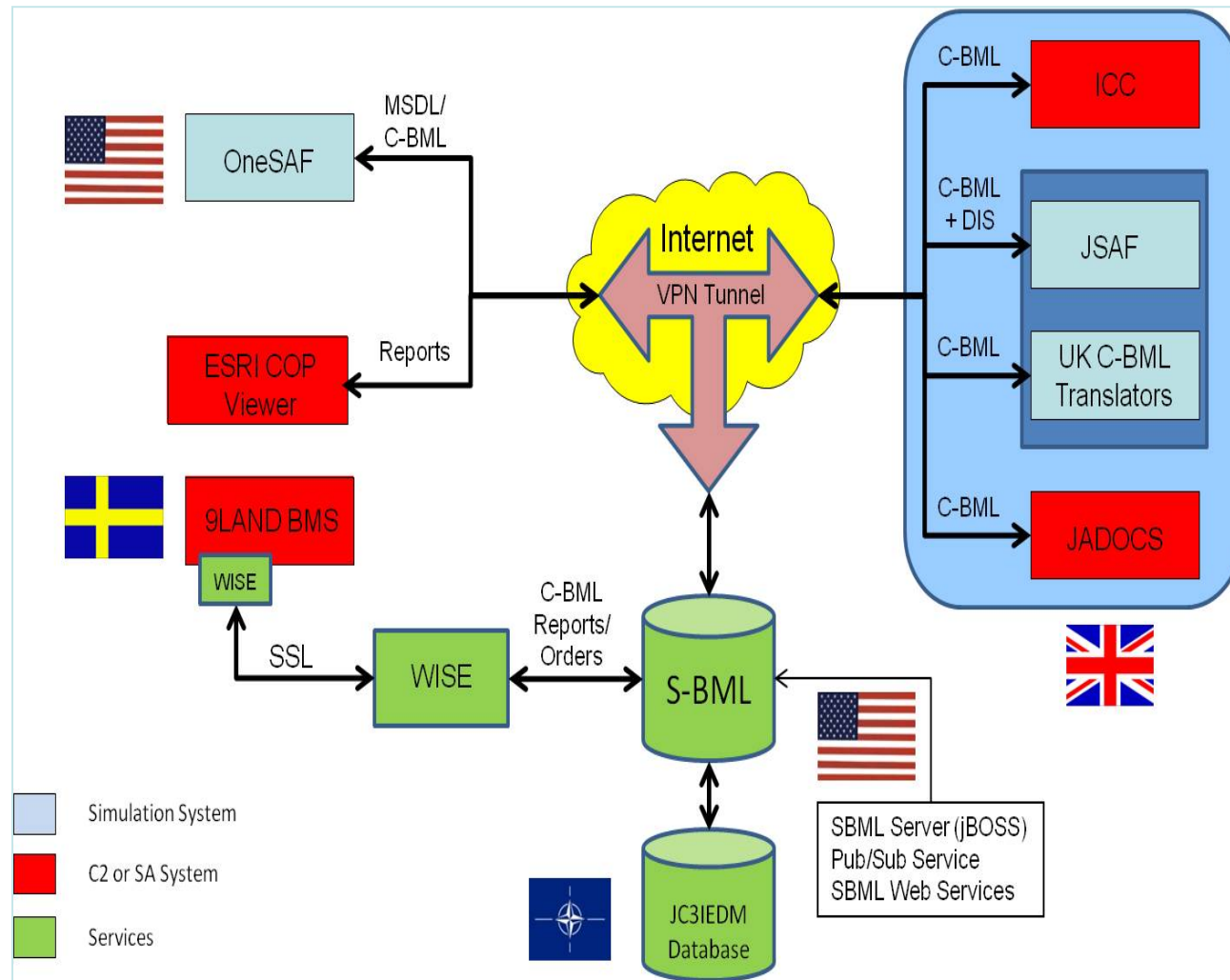
MSG-048 Lessons Identified

- Information exchange worked well – both orders and reports
- Excel-based Battlebooks are insufficient for complex, multi-national C2-Sim federations
- Whims of Exercise Controller need to be addressed!
- Consistent initialisation is required, consider MSDL

MSG-085 I/ITSEC Demo – December 2011

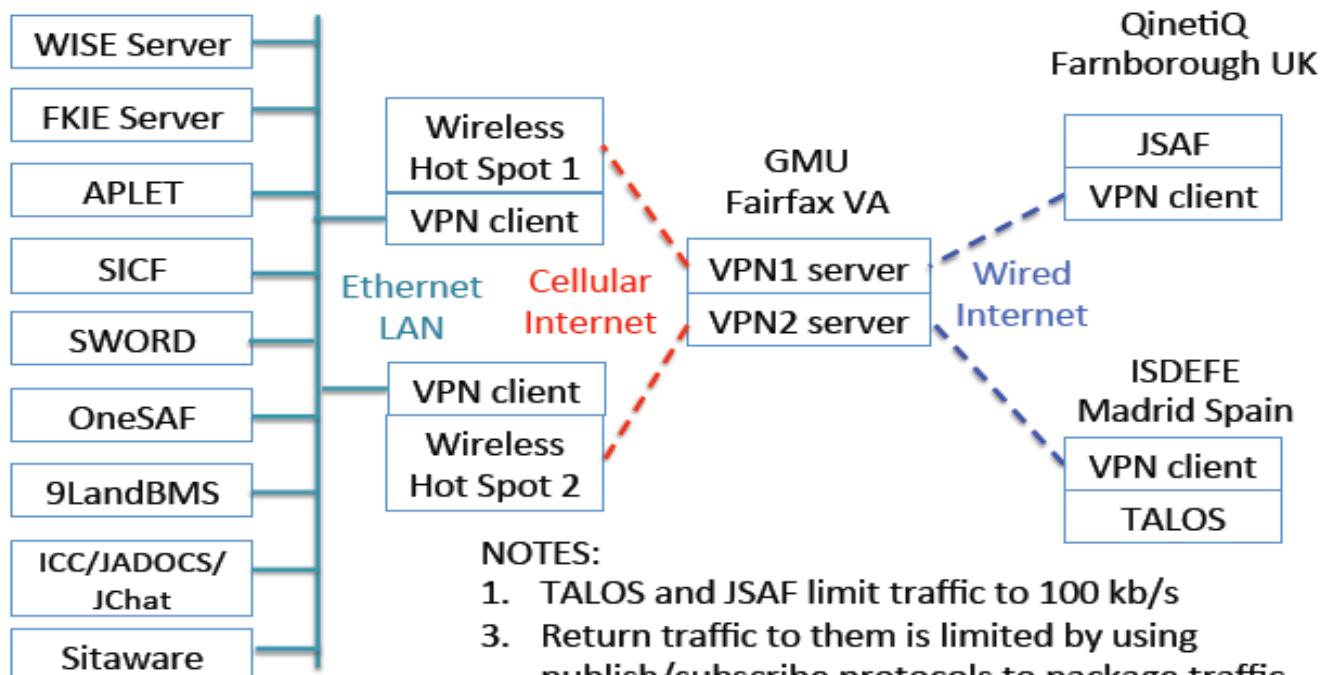


MSG-085 Land-Air Recce Demo – December 2012



MSG-085 Final Demo BML Network Plan

McHugh Center
Ft Leavenworth



NOTES:

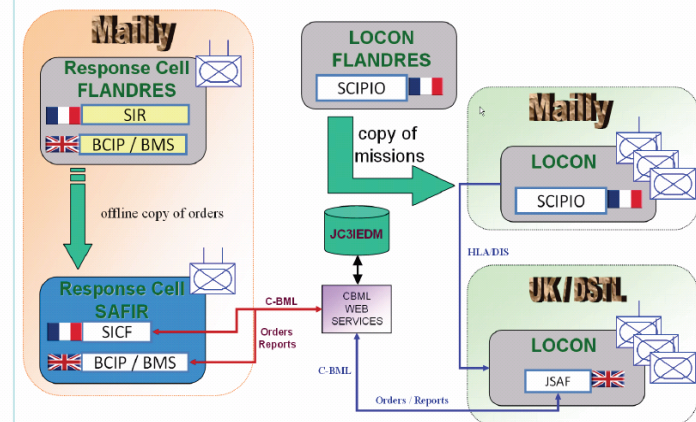
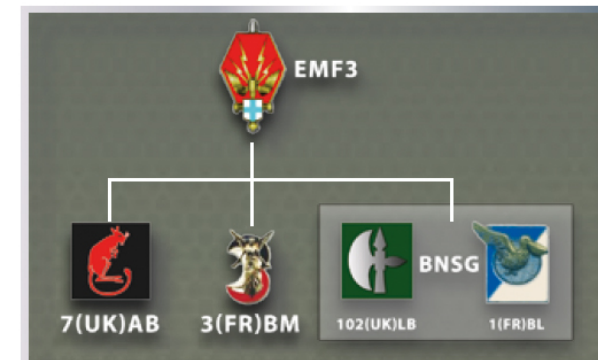
1. TALOS and JSAF limit traffic to 100 kb/s
3. Return traffic to them is limited by using publish/subscribe protocols to package traffic
4. Separate DCO path to Internet via NIPRNET with US Govt Laptop
5. Prototype to be tested by GMU NLT 1 Nov2013

MSG-085 Lessons Identified

- Integration of C2-Sim into COTS system, 9LandBMS, showed the potential capability of a C2-Sim-enabled planning tool
- The chosen vignettes showed how C2-Sim-enabled tools could be used to support the development of complex, multi-echelon, multi-discipline military orders in a COPD process
- Geographic distribution of systems is not a technical challenge using VPN tunnelling or dedicated networks
- C-BML works well on low bandwidth connections
- C-BML translation and forwarding services worked well
- CBMS system is very reliable, RESTful, i.e. HTTP-based communication system for messages
- CBMS, as implemented here, processes and stores *any* XML messages

Support to Anglo-French Interoperability and Readiness (SAFIR)

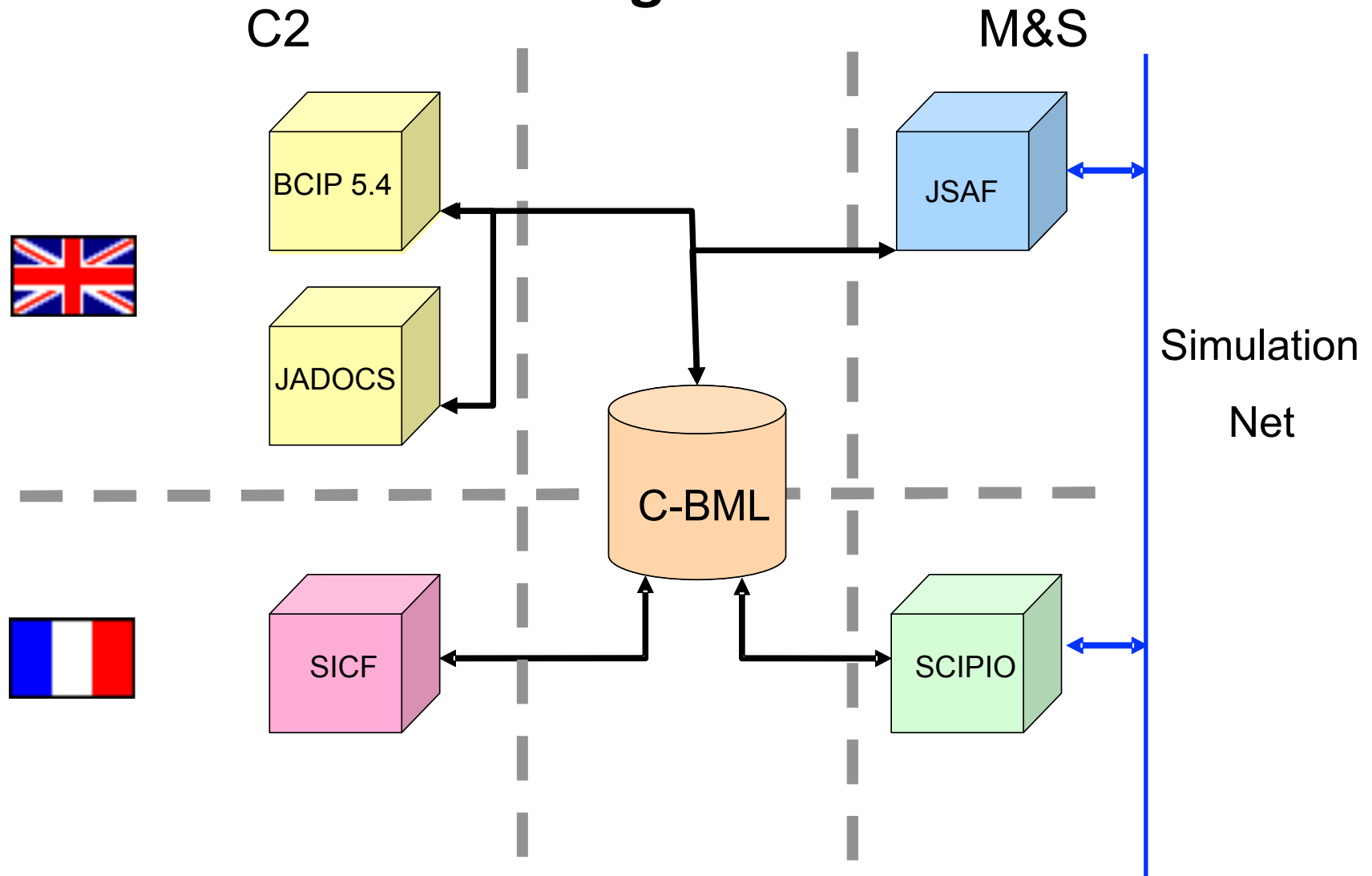
- **Ex FLANDRES** was a UK-FRA Interoperability Exercise between FRA 3 Bde & UK 7 Bde conducted at Mailly-le-Camp in June 2011
- **SAFIR** provided a Command & Control environment integrated with a distributed simulation environment controlled using Coalition Battle Management Language (C-BML).
- **An Anglo-French Government-Industry-Army team provided:**
 - Integrated C2: UK (BCIP 5.4) and French (SIR and SICF)
 - Constructive simulation through JSAF and SCPIO
 - C-BML middleware applications
 - Advice and expertise to other team members
- **SAFIR was demonstrated to senior FRA & UK Army leaders, e.g. CDS**



SAFIR

- **Operational Objective:**
 - To conduct experimentation and support military training exercises through simulation to enhance UK/FR force interoperability and readiness.
- **Experimentation Objective:**
 - To conduct visualisation and exploratory experiments to evaluate UK/FR operational architectures and interoperability.
- **Simulation Objective:**
 - To initiate a permanent simulation capability between UK and France that allows rapidly reconfigurable, distributed experimentation and training.
- **SAFIR demonstrated:**
 - A sustainable distributed simulation capability to support UK/FR experimentation and training exercises.
 - How C-BML can be used to exchange operational information between C2 systems
 - How Simulation can be used to support bi-lateral and coalition training events
 - That distributed simulation can be used to enable cost-effective coalition training

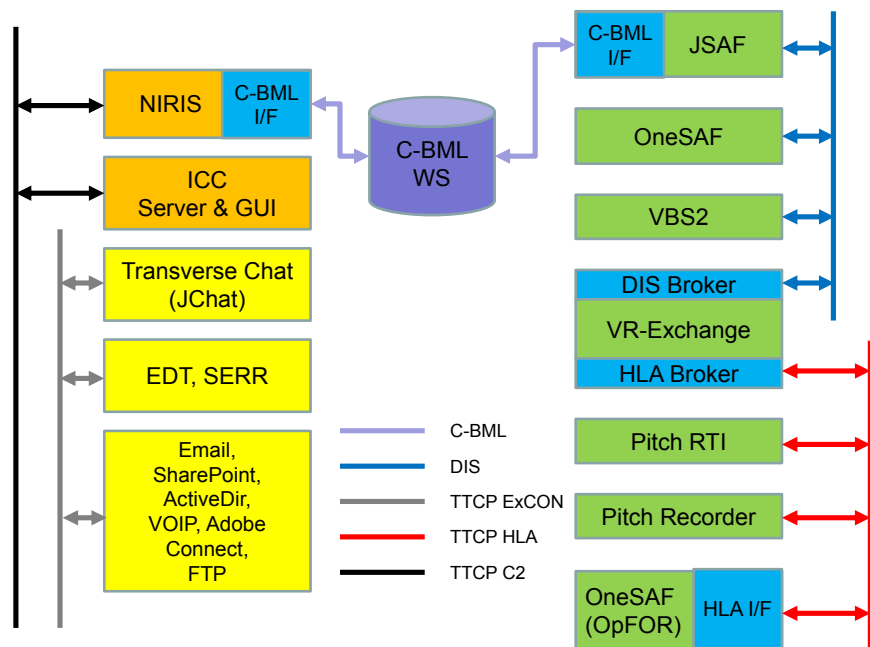
SAFIR Design Overview



TTCP CAGE IIb 2015

- Coalition Attack Guidance Experiment
- Nodes in AUS(1), CAN(3) and UK(2)
- Used national C2 equipment and M&S
- John Nichol – Experimentation technical lead (CAN):

➤ *“My keen interest in this case is looking at trying to make C2-Sim, Sim-C2 and Sim-anything easier to implement at least here at CFWC”*



CAGE IIb at Dstl PDW, UK

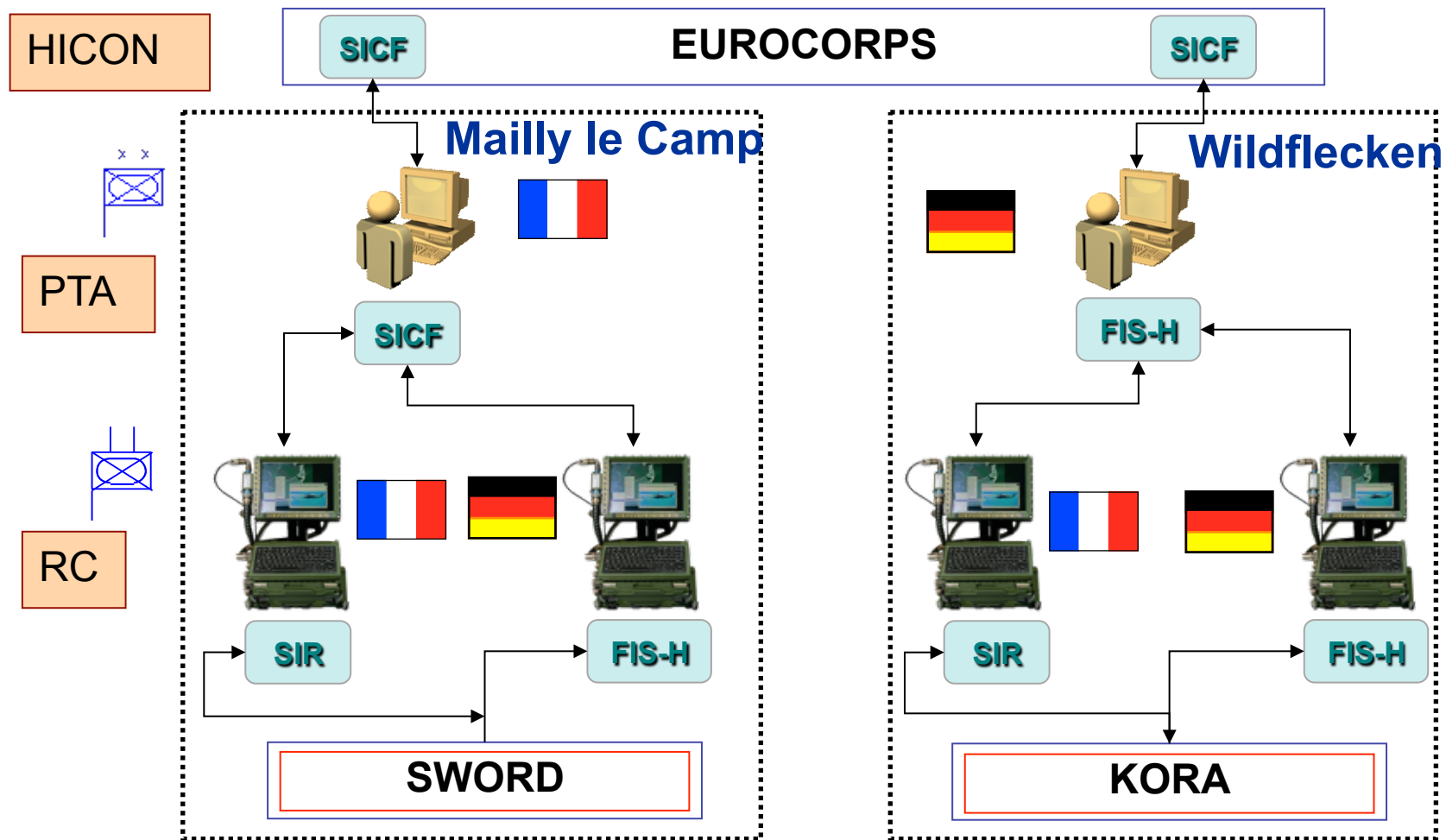
TTCP CAGE IIIb – Lessons identified

- There is still a need to run C2Sim alongside conventional networked applications and services
- There is a need for a readily-available, distributed, open, scalable and reusable capability to support experimentation across multiple initiatives
- This environment would need to be pre-accredited (as far as possible) with a standard toolset including national C2 systems and simulations.
- The Coalition Battle Management Language (C-BML) is a key enabler to integrate Live C2 systems with the underpinning synthetic environment.
- TTCP has created a new initiative, the Virtual Interoperability Prototyping and Research Environment (VIPRE) to deliver this persistent, scalable environment.

Single and Multi-domain Events

- **Land**
 - MSG-085 Mission Planning capability – uses a simulation running FTTR to demonstrate Phase 4 of the NATO COPD
 - FRA-DEU Land logistics C2-Sim federation
 - UK C2-Sim experimentation programme using C-BML with OneSAF to support Joint Mission Planning processes
- **Air**
 - Using C-BML to translate ACOs, ATOs for use in JSAF to de-risk planning for LiveEX events
 - Land-Air – Use C-BML to coordinate CAS, troop deployment and recovery by helicopter
- **Maritime**
 - C-BML extensions have been developed by MSG-085 [see, e.g. 13S-SIW-022]
 - Naval Gunfire Support developed in OneSAF
 - Turkey has modelled a USV patrol mission with C-BML [see JDMS, April 2015]

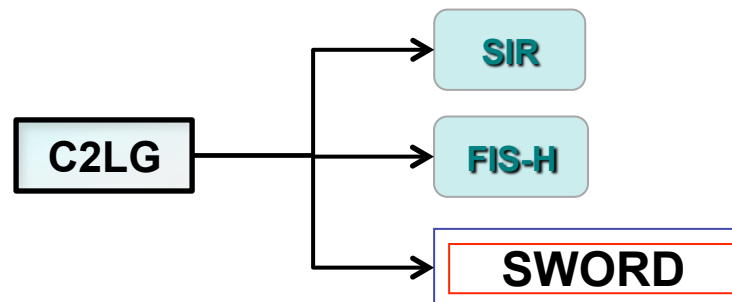
FRA-DEU TRAINING



Initialization Capabilities

- **Military Scenario Definition Language (MSDL)**
 - Force structure
 - APP6 symbols
 - Units Name
 - Logistics (Fuel, ammunitions, resources, ...)
- **C2 and simulation systems enable to share MSDL scenario definition file**

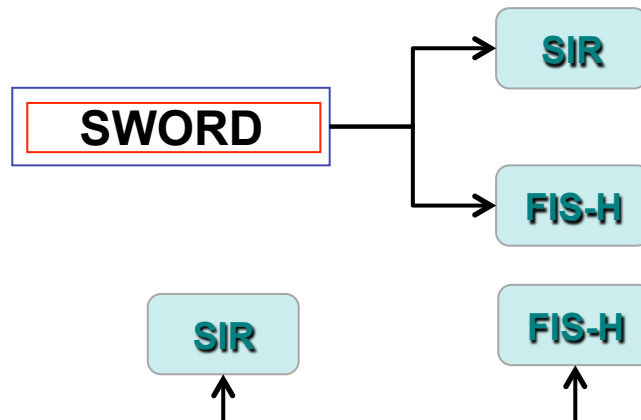
Semi-automated configuration of systems



Execution Capabilities

- **Coalition Battle Management Language (C-BML)**
 - Orders
 - Reports (Blue Force Tracking, Situation Report)
 - Free Text Message
- **C2 and simulation systems enable to exchange C-BML Information**

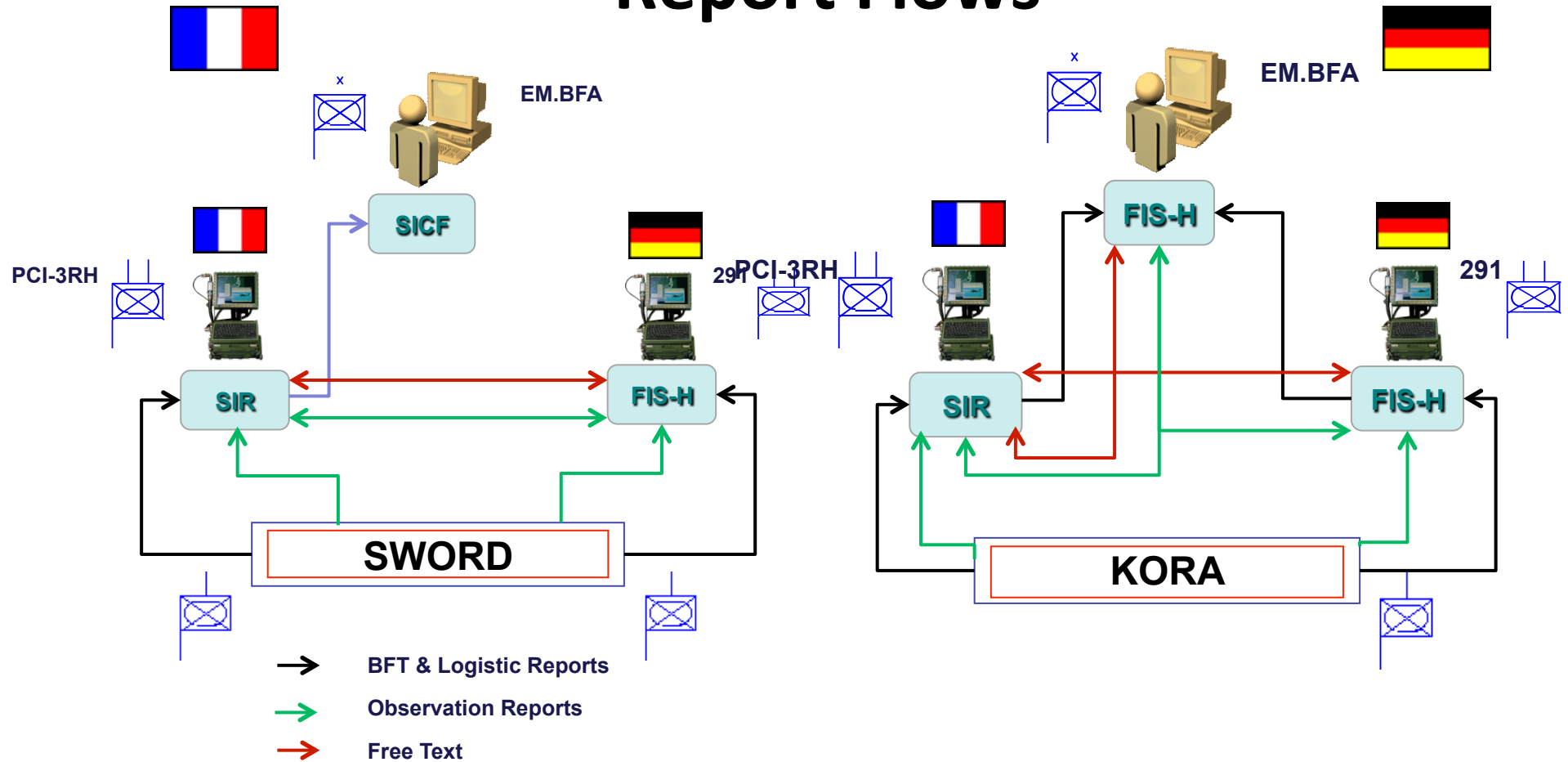
REPORT



FREE TEXT



Report Flows



FRA-DEU Lessons Identified

- C2-Sim extensions need developing to cater for new specialisms, e.g. Logistics
- MSDL: Consistent C2 and Simulation Initialization
- CBML: Automated C2-Simulation connection for orders and reports
- Successful validation of the new CBML schema (IBML-2.2d)

FRA-DEU Lessons Identified (II)

- Overwhelmed C2 Mailbox: a solution could be the reduction of reports according to the following rules:
 - under detection, or when a point or a line in the terrain is reached).
 - Simulation generates reports only when changes occurred
- Simulation should comply with operational requirements (on time, under detection, or when a point or a line in the terrain is reached).

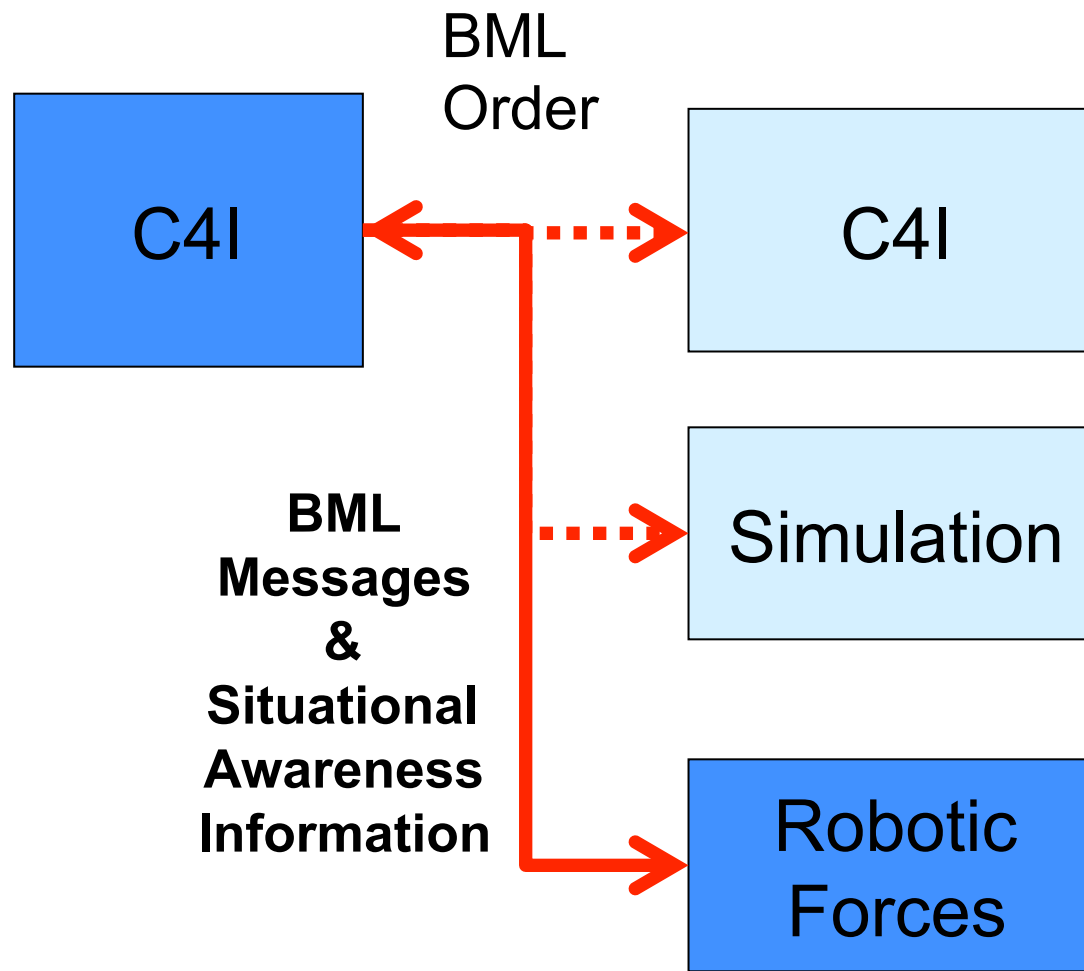
FRA-DEU Lessons Identified (III)

- Coy Symbol was sent when simulation starts but was never updated
- Coy symbol was defined in the MSDL but never used during the exercise execution. It is the commander's job to locate this symbol on the map. Therefore this information is not part of the MSDL file
- Time synchronization / time management
 - For training/exercises it is desired to run the simulation faster than real-time or to jump back to earlier time stamps.
 - This is not possible. Time management solutions to investigate could be:
 - Gateways to change DTG reports with wall clock time
 - Use of fake NTP, GPS server being connected with simulation to provide reference time (backward could be difficult due to C2 database integrity check)

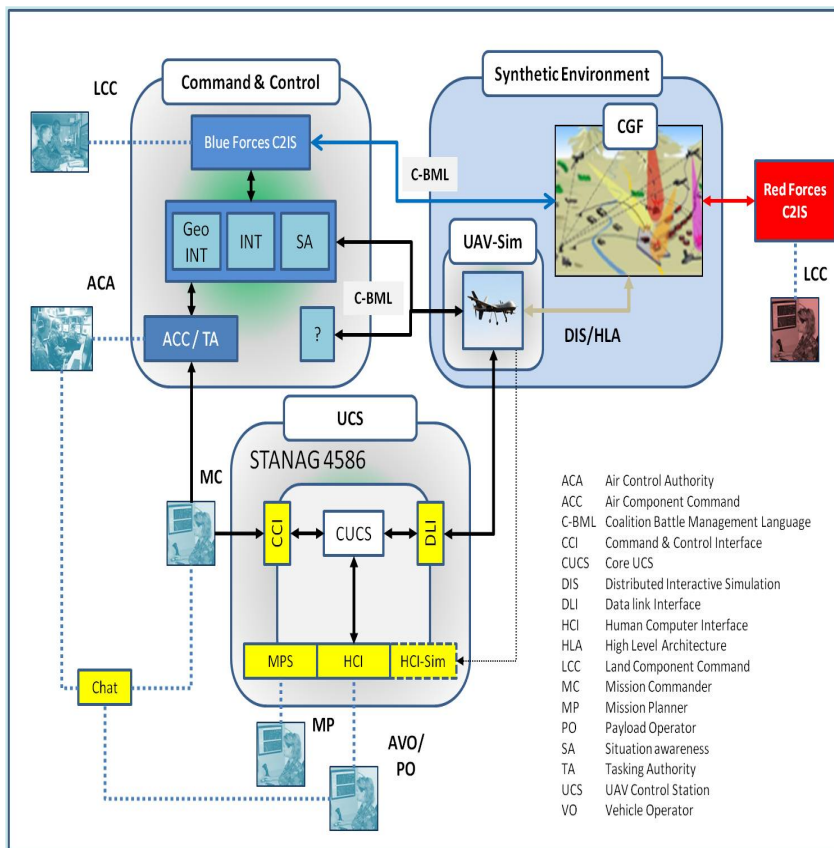
C-BML WITH ROBOTIC SYSTEMS

Examples of C-BML used with conceptual, simulated and live, robotic vehicles

C-BML is for Robotics Too



Canadian Concept for C2 to Autonomous Systems Testbed



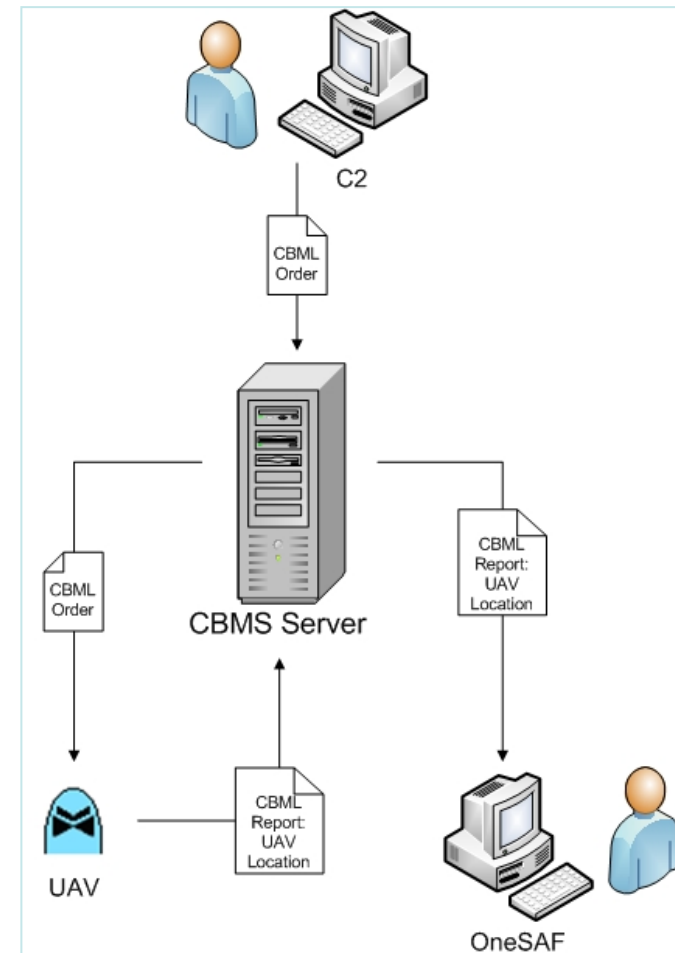
- This diagram illustrates a proposed Canadian testbed for UAV concept exploration using C-BML. Expected benefits include:
 - Elimination/reduction of air-gaps
 - Shorter decision making cycles with both commander and payload operator able to control UAV
 - Exploration of new C2ISR concepts
 - Benefit from advances in UAV automation in order to achieve greater autonomy:
 - Operator (software agent) assisted control
 - Multiple Vehicle, single-operator control

NAVAL USV Concept

- **Ömer Ünal** and **Okan Topçu** of the Turkish Naval Academy – study published in JDMS 2014
- Multi-echelon system:
 - Coalition Task Force
 - Patrol and Surface Warfare Task Groups
 - Patrol Task Units
 - Autonomous USVs
- Use C-BML for high and low-level tasking of USVs
- Include *logic* control in the C-BML extensions for this project

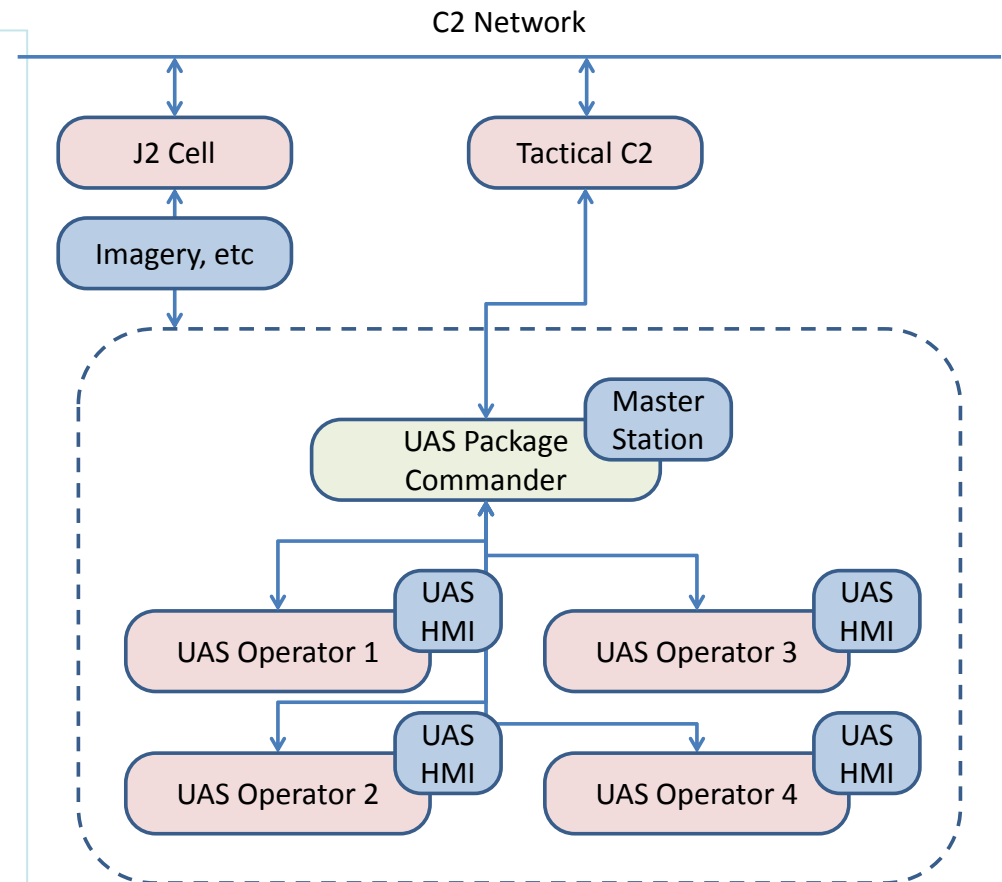
VMASC LVC Demonstration

- **Initialization**
 - C2 surrogate initializes OneSAF with constructive UAV
- **Live UAV (quadcopter) flies to a area and continuously reports its position through CBMS using C-BML**
 - Position reports are reflected by constructive UAV in OneSAF
- **C2 surrogate shows common operating picture**



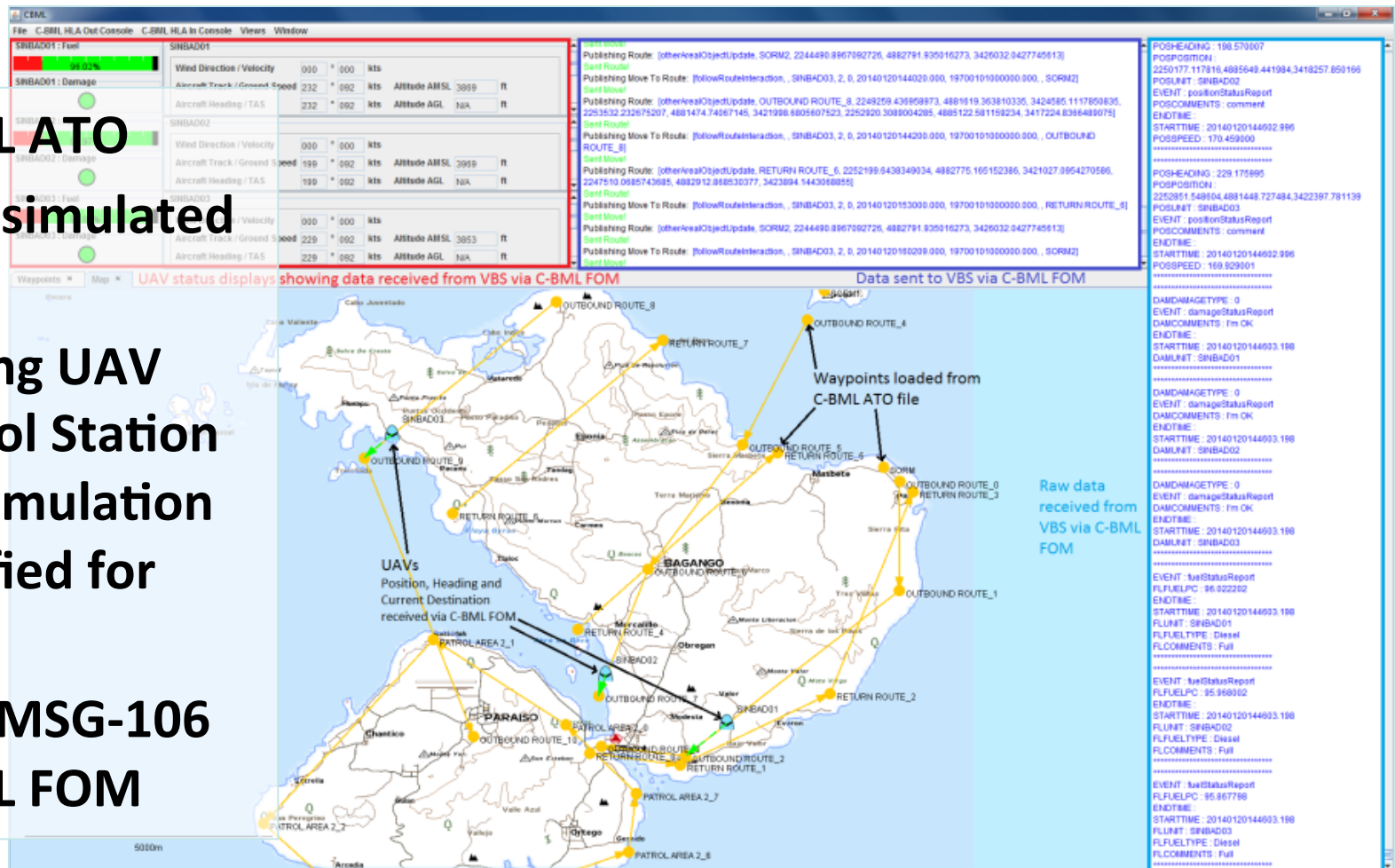
C-BML with Autonomous Systems (UK)

- C-BML used to integrate a UAS package commander's work-station with a coalition C2 network environment
- Initial work conducted under TTCP CAGE IIIa (2014)



UK UAV Simulation

- C-BML ATO
- VBS2-simulated UAVs
- Existing UAV Control Station and simulation modified for demo
- Used MSG-106 C-BML FOM



Control of Multiple Robotic Vehicles (Fraunhofer Institute)

The Multi-Robot System Platforms



- Longcross Chain
- Weight: ~450kg
 - 20 km/h
 - 200 kg Payload



- RUAG „Garm“ Chain
- Weight: ~500kg
 - 20 km/h
 - 200 kg Payload

Robotic Systems Lessons Identified

- C-BML complements autonomous systems well
- Swivel chair interfaces can be eliminated
- Improved message throughput changes the workload of the GCS operator, he spends more time solving operational
- C-BML may be used with augmented chat systems
- Initialisation is not a major problem, very few units to worry about
- C-BML FOM (High and Low level) is a practical proposition, but of questionable application

Questions