A Practical Example of the Integration of Simulations, Battle Command, and Modern Technology

International European Multi Conference
And Simulation Interoperability Workshop 2009

Dr. J. Mark Pullen
C4I Center
George Mason University
Fairfax, VA 22030
mpullen@netlab.gmu.edu

Lori Topor
Northrop Grumman IT
3045 Technology Parkway
Orlando, FL 32826
ltopor@ideorlando.org

Ted Troccola
PM Battle Command
Building 2525
Ft. Monmouth, NJ 07703
ted.troccola@us.army.mil

Dr. Stan Levine
Simulation to C4I Interoperability (SIMCI) OIPT
StanLevine13@gmail.com

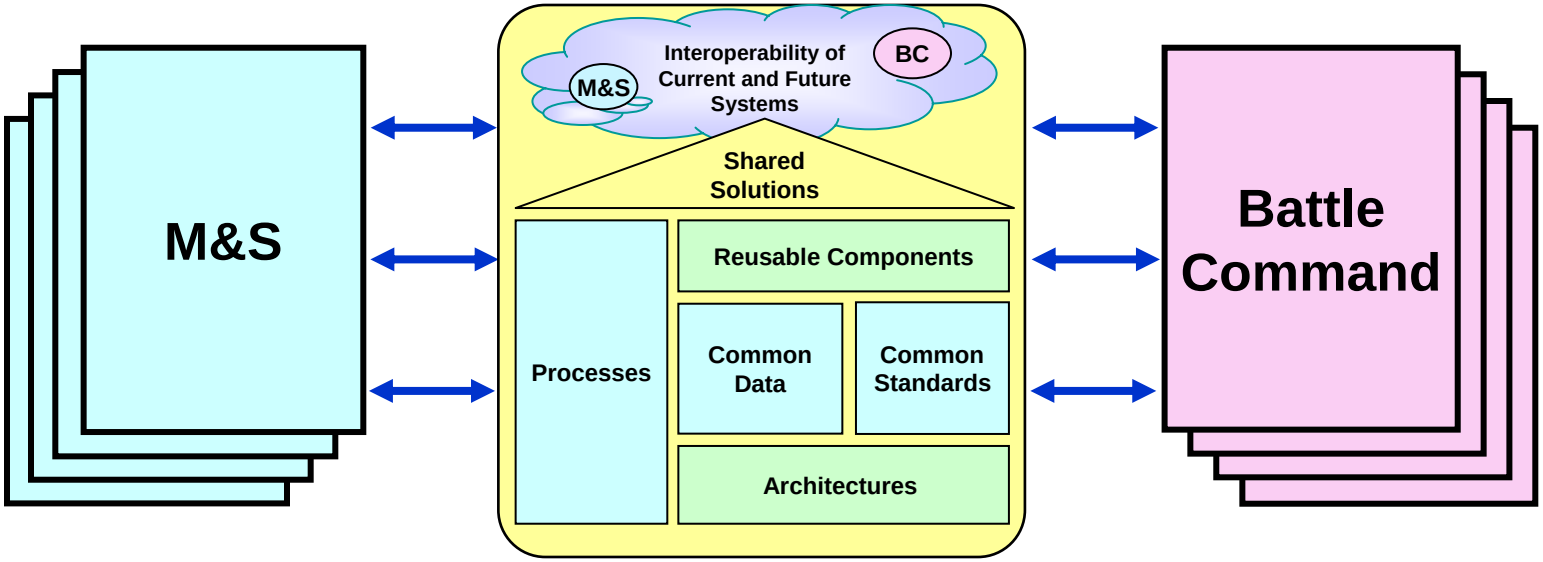
Outline

- SIMCI Background
- Combined Project Description
  - Battle Command Design & Implementation
  - M&S Design & Implementation
  - Battle Management Design & Implementation
- Reference Implementation
- Operational Concept
- Demonstration
- Summary

Simulation-to-C4I Interoperability Overarching IPT (SIMCI OIPT)

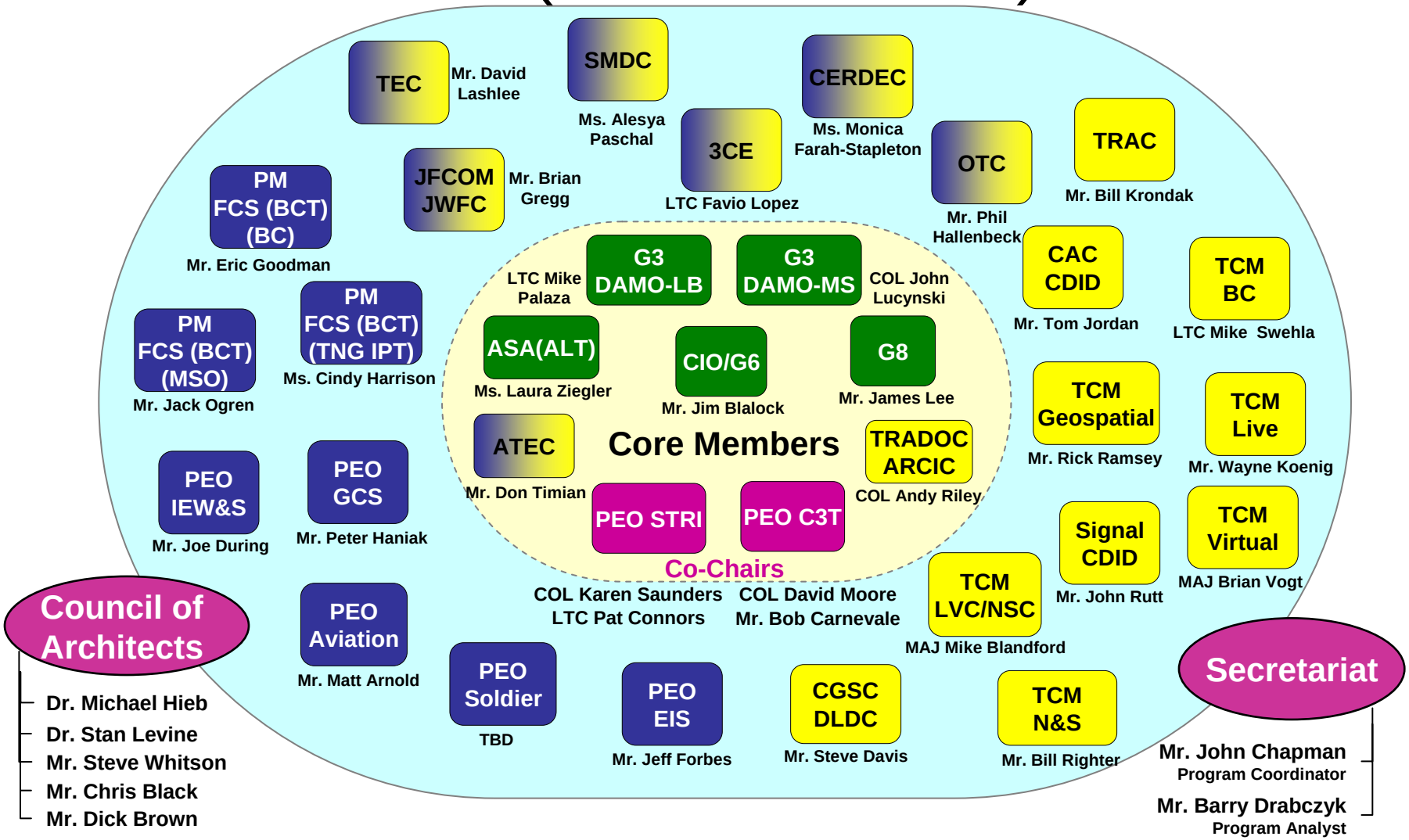
Vision: Achieve full interoperability between Modeling and Simulation (M&S) systems and Battle Command (BC) systems as an integral part of the acquisition process, from capabilities determination through fielding and sustainment.

Mission: Provide policy, process, organizational, and technical recommendations to Army Leadership that will improve M&S and BC systems interoperability.



SIMCI OIPT Membership

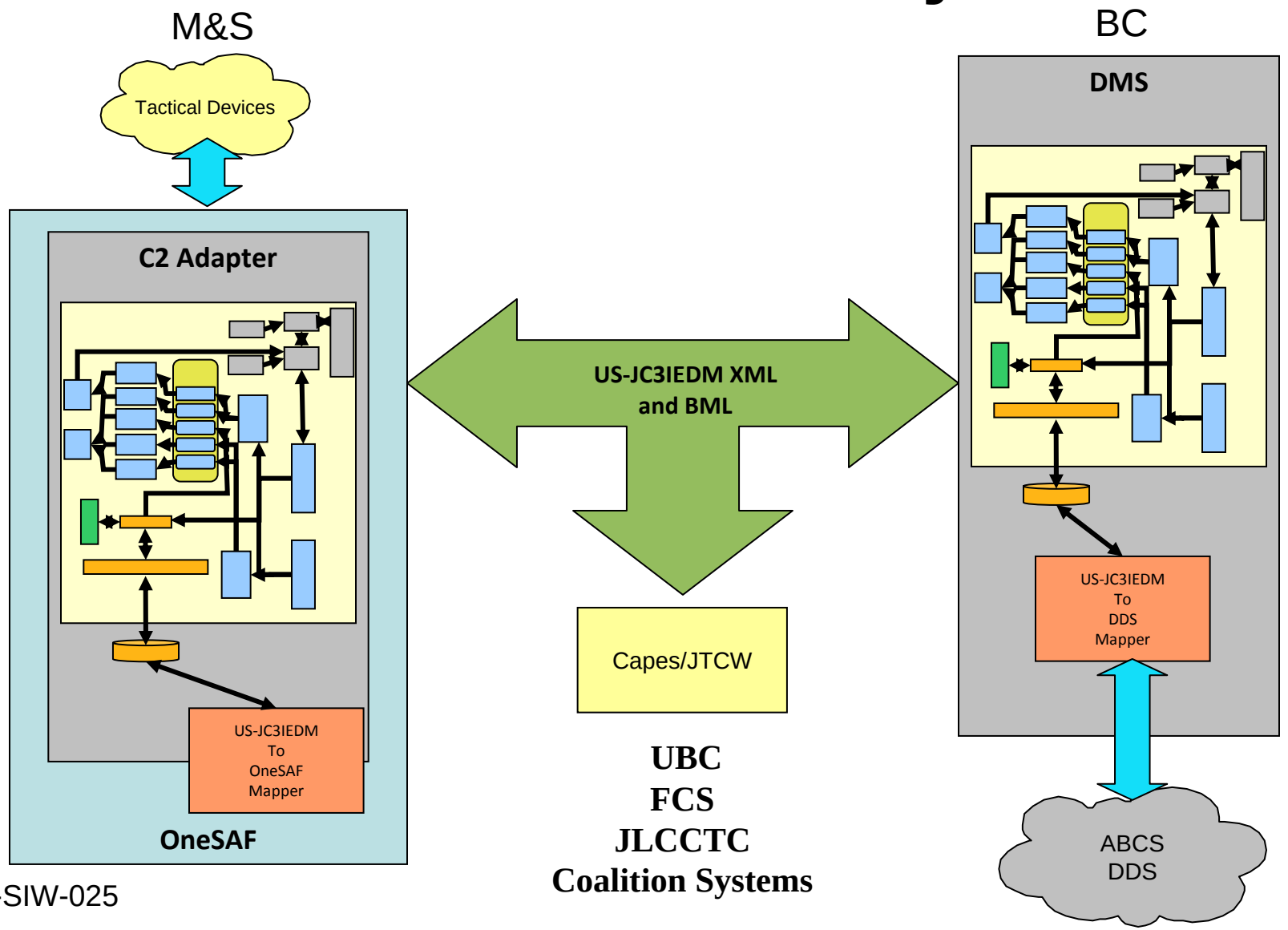
(as of 18 Feb 09)



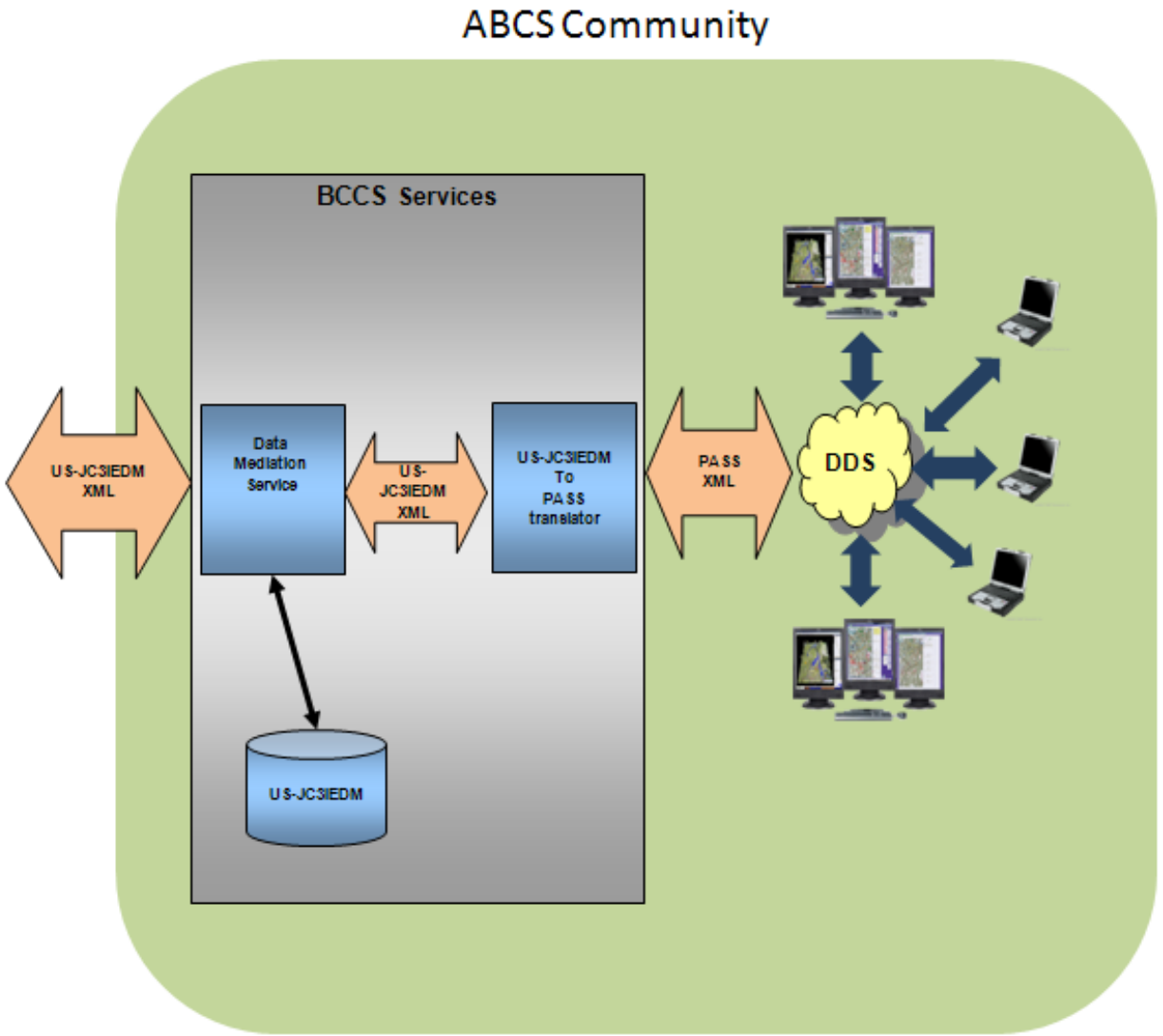
SIMCI BC – M&S Interoperability Web Service Project

- Provide standard Net-Centric Enterprise Services (NCES) compatible web-service interface between M&S and BC which can be re-used readily.
- Provide standard secure JC3IEDM compliant mediation capability for use by BC and M&S systems.
- Provide standard NCES compatible web service for Battle Management Language support for automated Tasking (part of Operations Order) and Reports.

SIMCI BC – M&S Interoperability Web Service Project



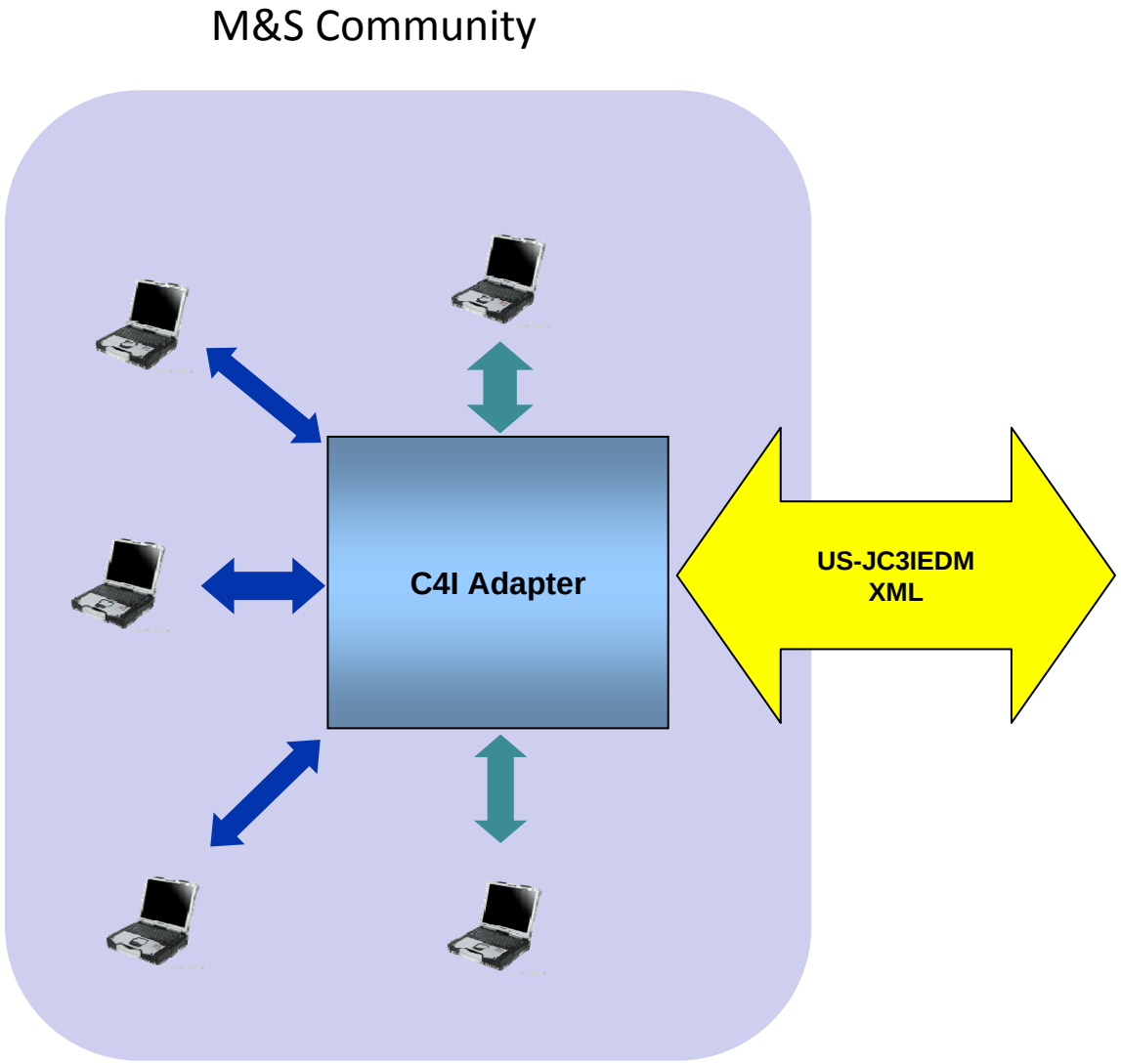
ABCS DDS DMS Architecture



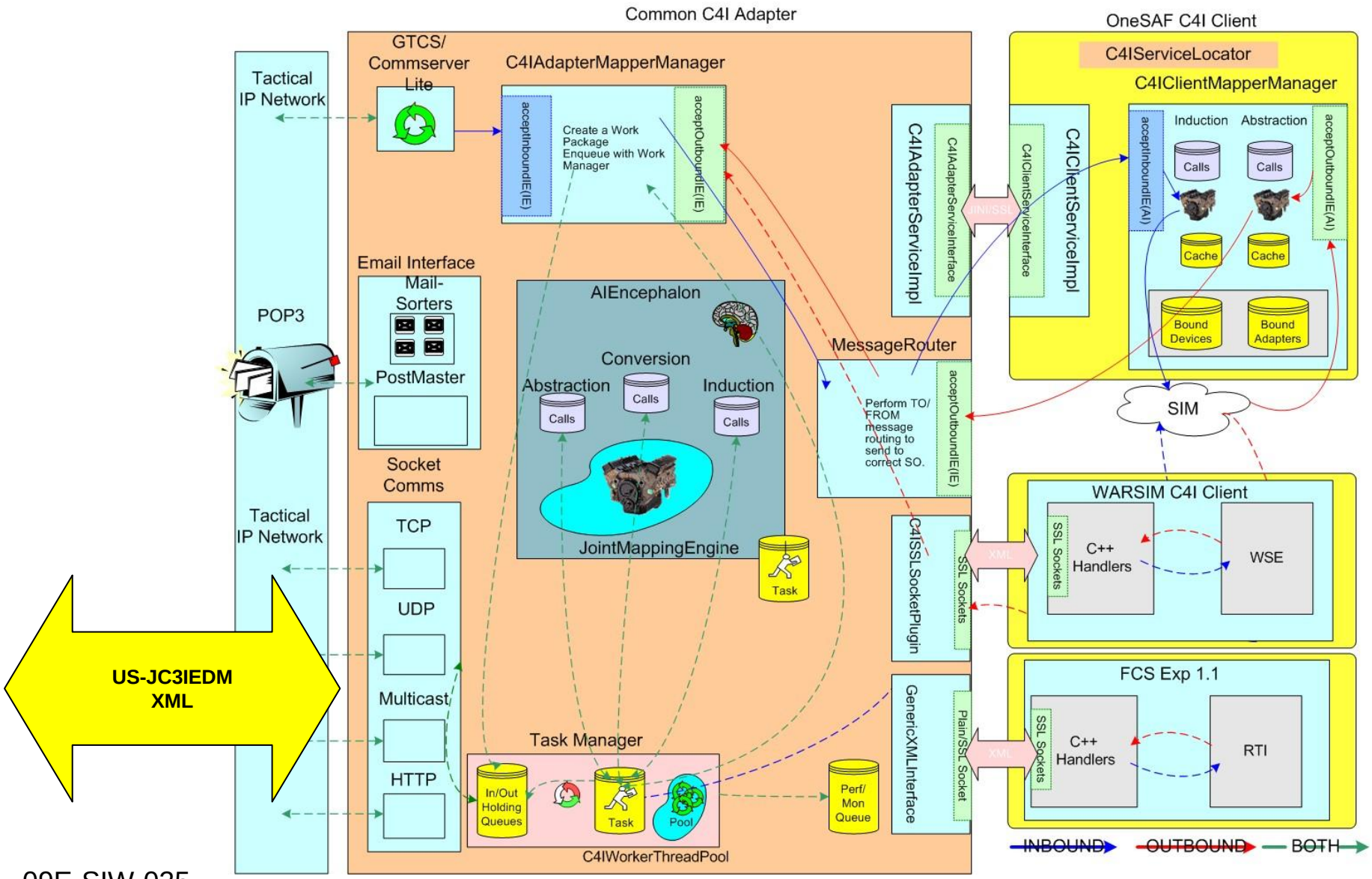
PASS Schema to US-JC3IEDM Data Mapping

PASS SCHEMA	US-JC3IEDM DATA
POS-RPT	Friendly/Neutral organizations
ENEMY-SIT	Hostile/Unknown organizations, features and facilities
OBS-POS	Uncorrelated hostile/unknown organizations
GEO-REF	Uncorrelated unknown facilities and features
GRAPHICS	Friendly/Neutral/Hostile non-organizations
TASK-ORG	Friendly Organization Structures
ORG-STAT	Organization Status
IND-WARN	Same or similar mapping as ENEMY-SIT
CTFP	Same or similar mapping as ENEMY-SIT
SIG-ACT	Same or similar mapping as ENEMY-SIT

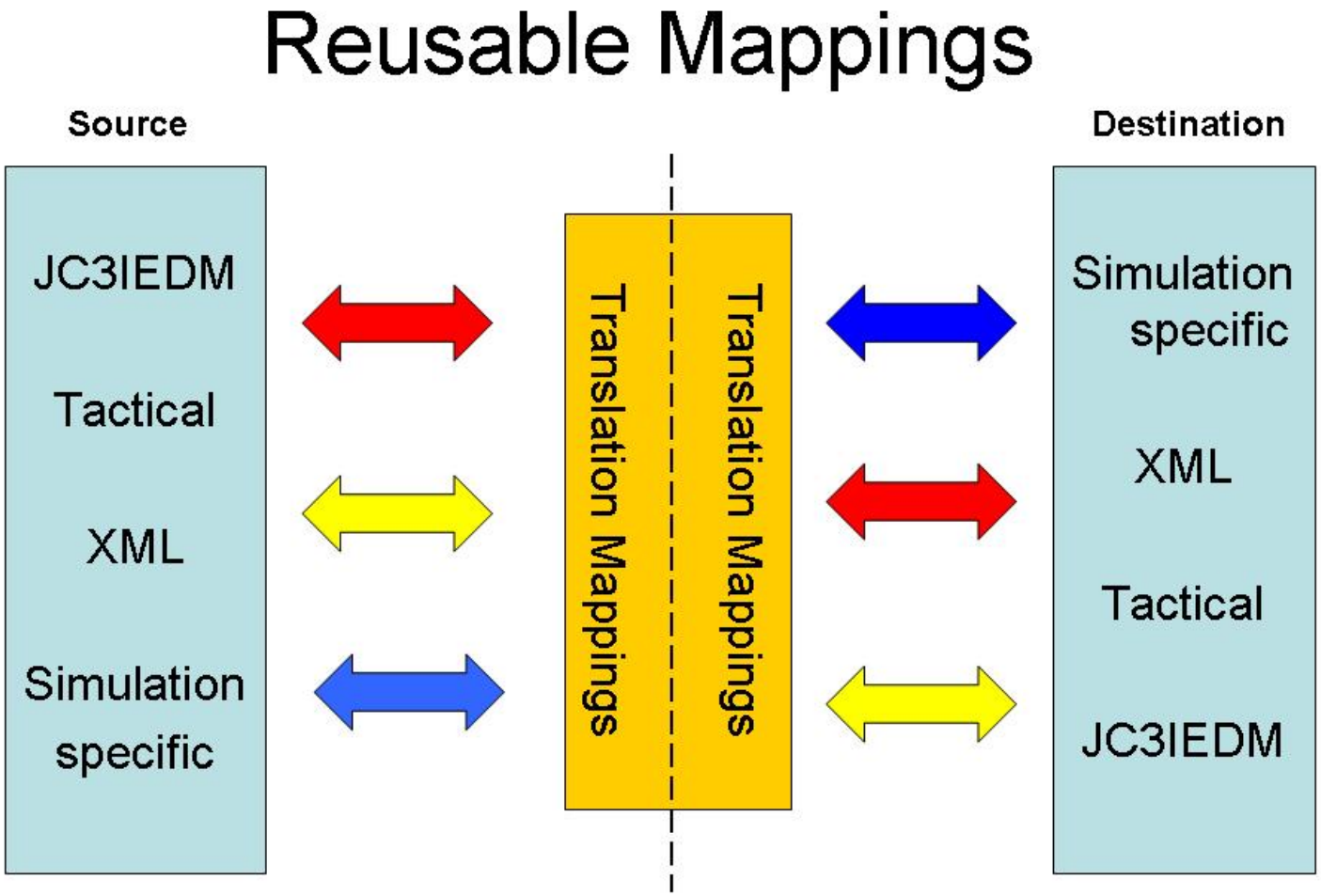
C2 Adapter Architecture



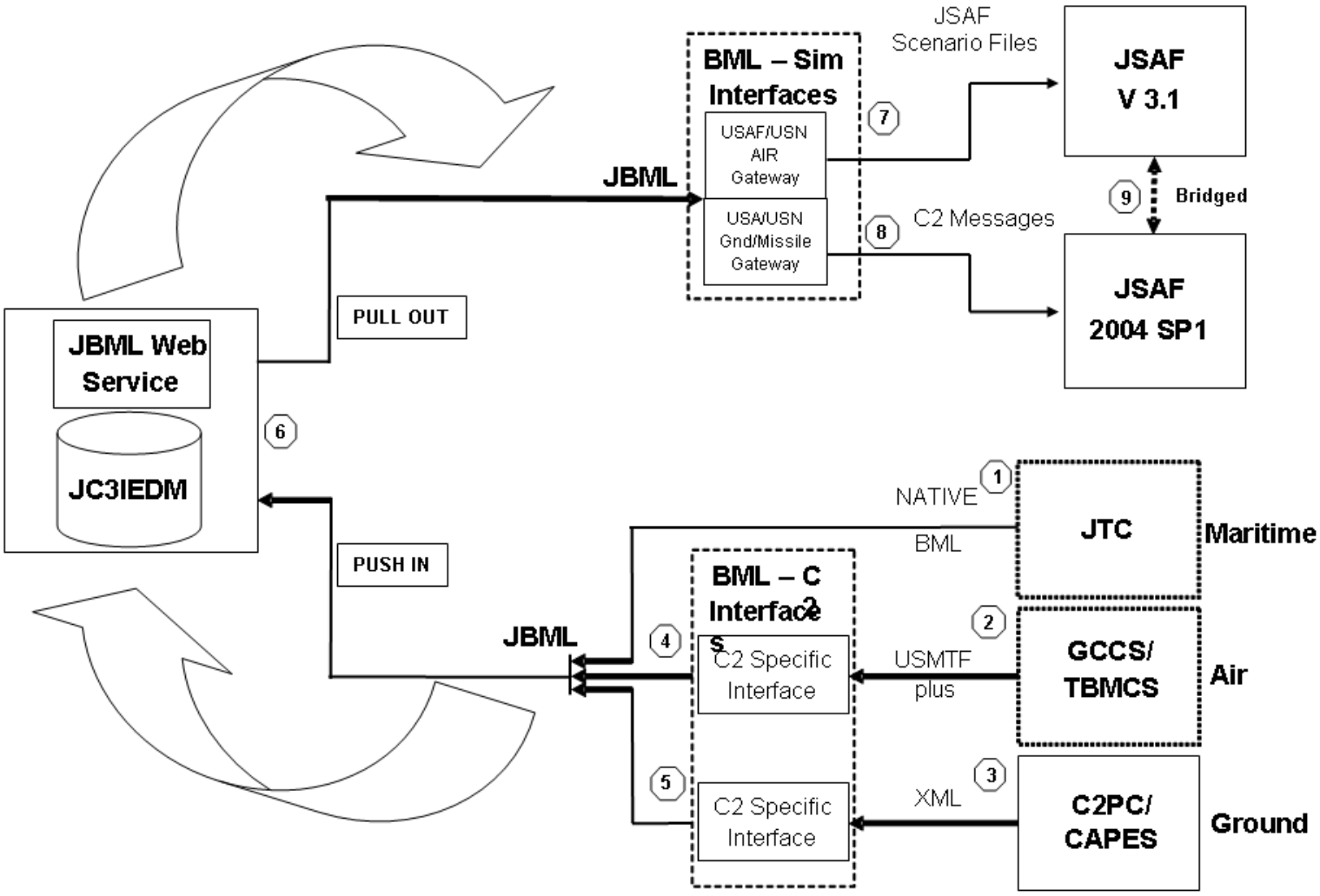
C2 Adapter Architecture



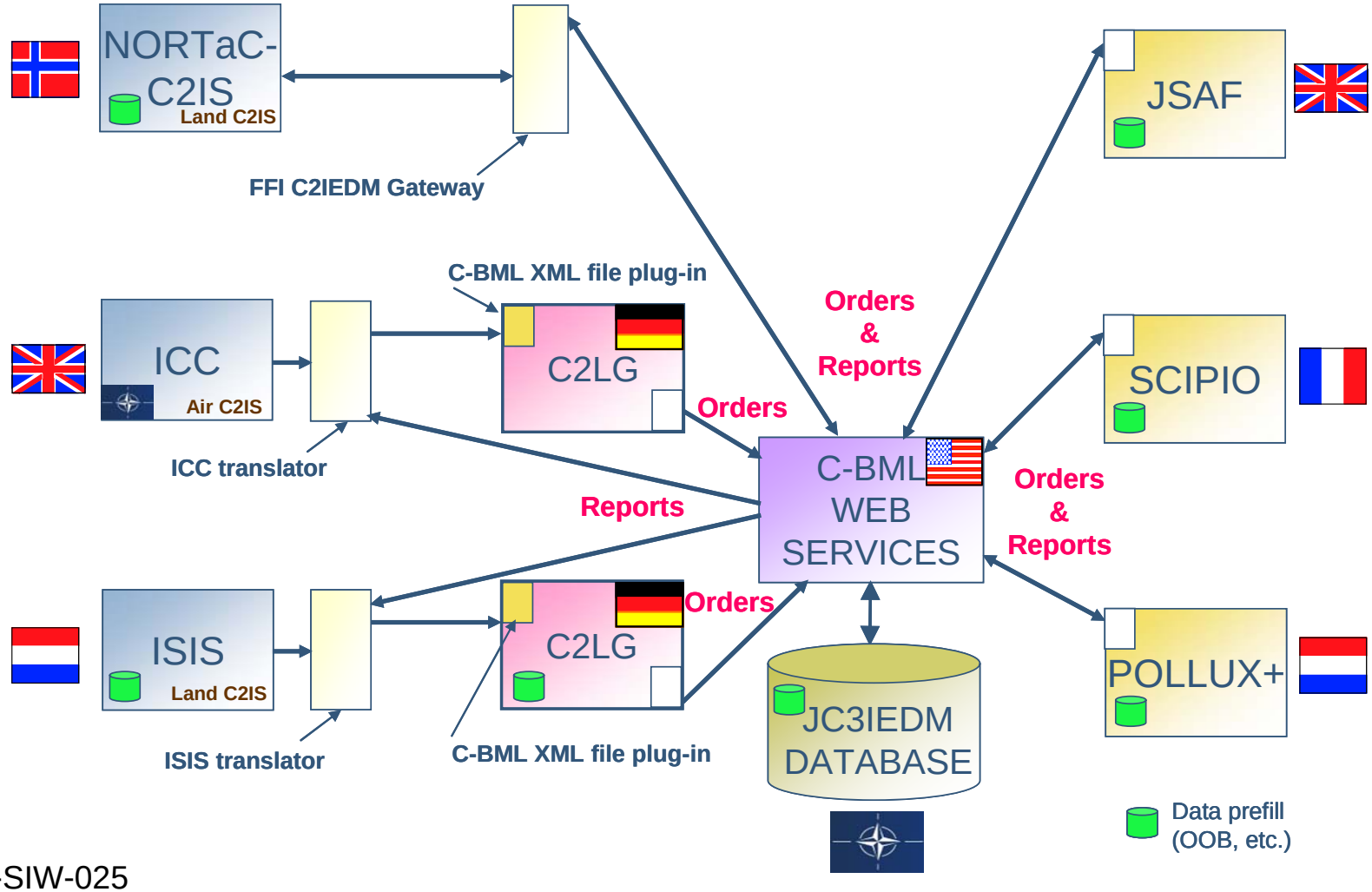
Mapper Generator



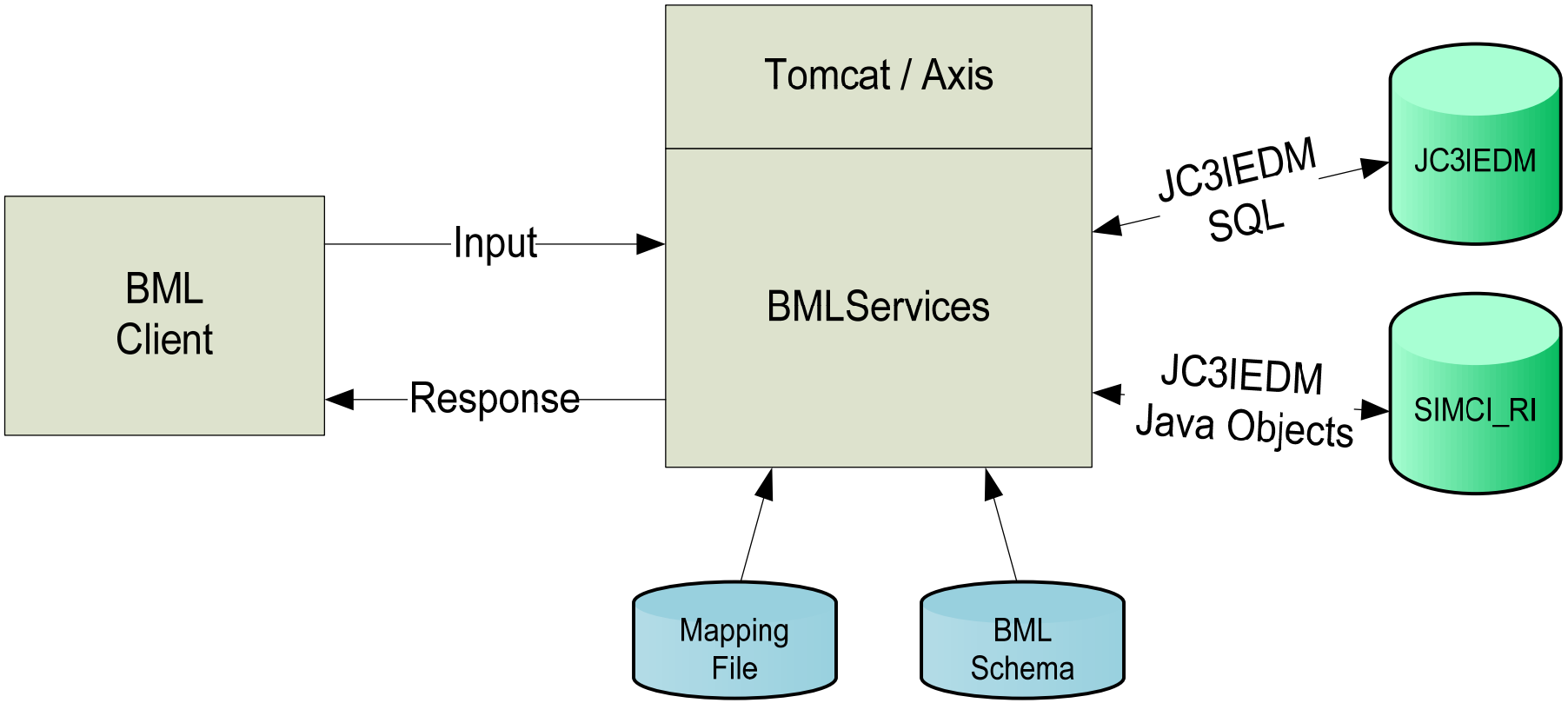
Joint Battle Management Language



MSG-048 I/ITSEC Demonstration Configuration



Scripted BML Architecture



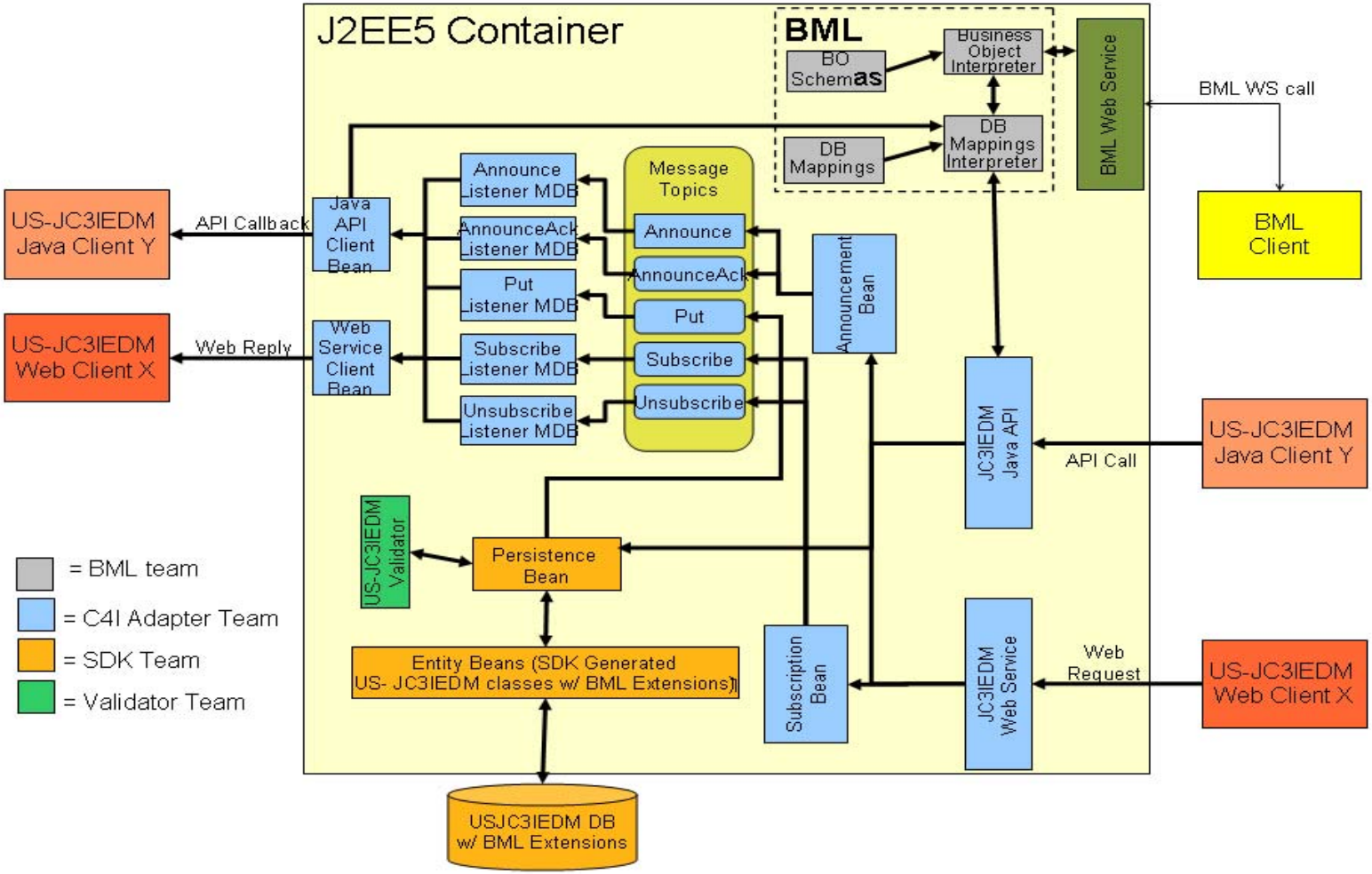
Scripted BML WS Design

- Basic operations: *push* and *pull*
  - Currently, servers for SQL and RI databases
  - Scripts implement BML Orders and Reports
- Script defines implementation of Business Objects (constituents of the higher-level BML grammar) over the JC3IEDM data model
  - BO is an XML subtree rooted at a defined node in the XML file – can invoke other BO
- Interpreter uses two files plus WS input
  - Mapping file contains script
  - BML schema file provides necessary context

Scripted Interpreter Advantages

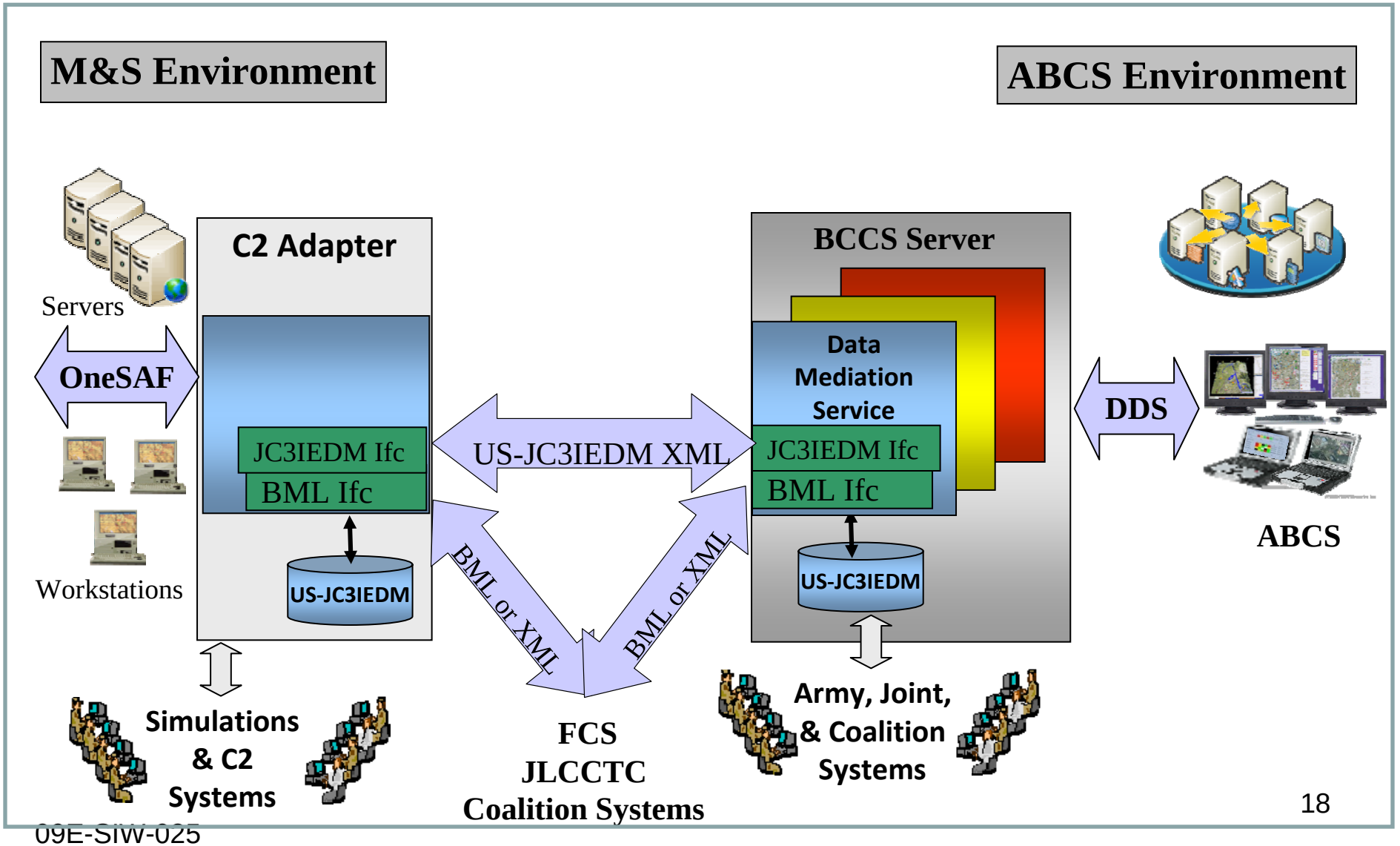
- A way to implement composite transactions where:
  - Validation requires only understanding of the object and JC3IEDM (but not Java)
  - Changes to the mapping are simple to implement
  - New business objects are easy to define and implement
    - Student did six of them in two weeks while learning
- Scripting language provides a highly concise definition of BML mapping
  - SISO C-BML should use it for that

Reference Implementation



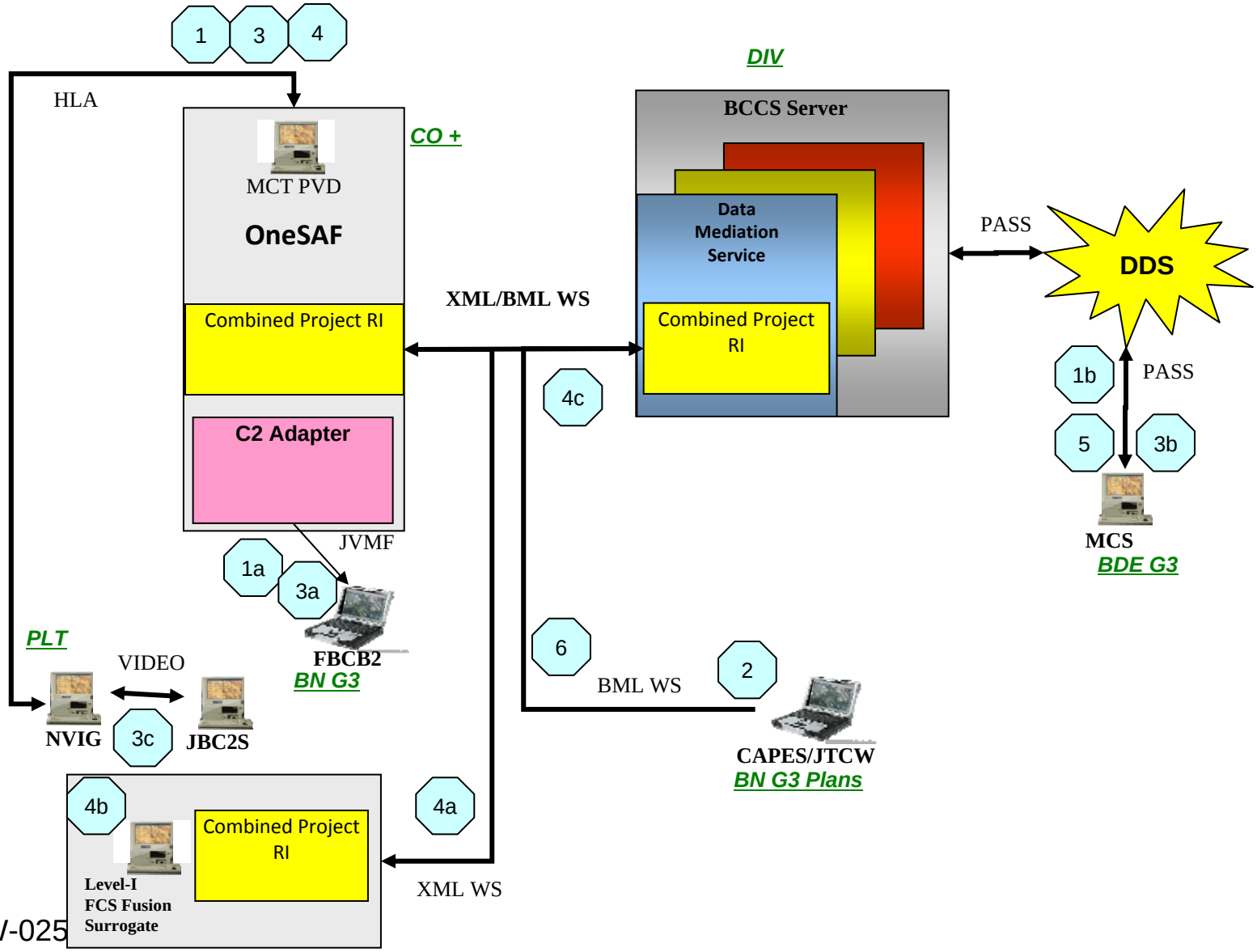
Supports distributed BML repository, replicated across instances of RI

Operational Concept



2008 SIMCI CP DEMO

C2-Sim Interoperation via JC3IEDM with BML



Conclusion

- This project will result in standard interfaces for BC to M&S interoperability that will support both current capabilities and future capabilities.
  - It will support more efficient and effective transition to NCES and Army JC3IEDM compliance.
  - It has been estimated that this project will provide for significant cost savings as a result of becoming a standard M&S to BC interface standard.
- The modifications/extensions to the C4I Adapter capabilities (including the RI) will be included in C4I Adapter employment managed by PM OneSAF.
- The DMS (including the RI) will be fielded by PM BC as part of the BCCS within the ABCS system of systems.
- The tools and reusable components (including the RI) will be provided along with the JC3IEDM SDK for standard common Army use (M&S and BC).

Summary

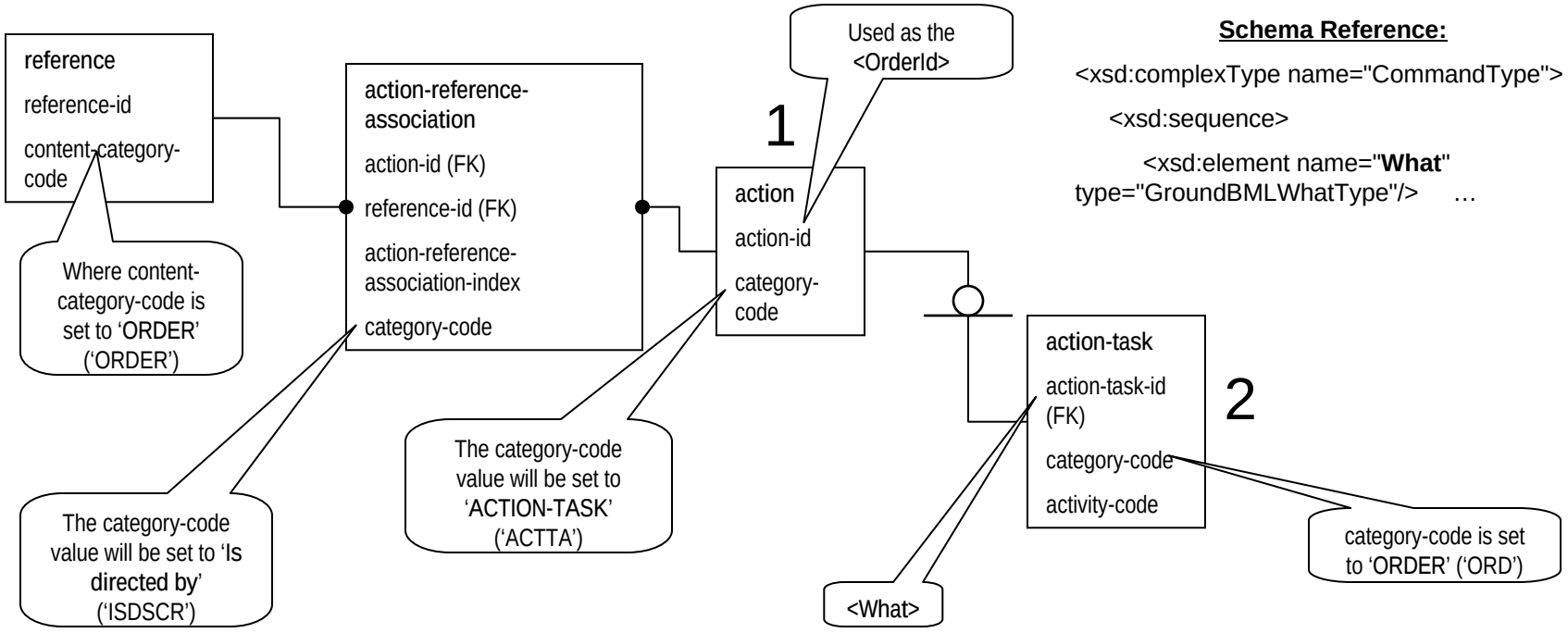
- The project will transition many products:
- The modifications/extensions to the C2 Adapter capabilities (including the BML interface) will be included in C2 Adapter employment managed by PM OneSAF.
- The DMS (including the RI and BML interface) will be included as part of the BCCS within the ABCS system of systems.
- The tools and reusable components (including the RI) will be provided along with the US-JC3IEDM SDK for standard common Army use.
- Planning for integrated CM and processes for the maintenance of products and documentation will be included in standard Army processes.

BACKUPS

Previous Mechanism: IDEF1x Mapping

JBML mapping to JC3IEDM

Schema field <What>



- Diagram not machine readable but highly structured
- In its place we have created an XML coded script

Example BML to JC3IEDM Script Fragment

```
<!-- Name: PositionStatusReportPush-->
<BusinessObjectTransaction>
    <transactionName>PositionStatusReportPush</transactionName>
    <tableQuery>
    <!-- 0 GET act name_txt = OrderID -->
        <mappingSequence>0</mappingSequence>
        <JC3IEDMTable>act</JC3IEDMTable>
        <queryAction>GET</queryAction>
        <resultName>act_id</resultName>
        <columnReference>
            <columnName>NAME_TXT</columnName>
            <businessObjectTag levelsUp="2">
                Header/ReferenceOrderID
            </businessObjectTag>
        </columnReference>
    </tableQuery>
    <tableQuery>
        <!-- 1 GET act_ref_assoc name_txt = OrderID -->
        <mappingSequence>1</mappingSequence>
        <JC3IEDMTable>act_ref_assoc</JC3IEDMTable>
        <queryAction>GET</queryAction>
        <resultName>ref_id</resultName>
        <columnReference>
            <columnName>act_id</columnName>
            <workingVariable>act_id</workingVariable>
        </columnReference>
    </tableQuery>
    …
```

Concept for Scripted DCS

- Two levels of schemas
  - Pure Business Object schema: one level of tags define parameters
  - Complex schema using Business Objects: XML tree branches define instances of Business Object
- This requires that the script include the sequence of XML nodes in BML schema that will invoke it
  - Specification requires both schema and script
- We have implemented two set of services
  - JBMLv1.5 BML Web Service as used in MSG-048 November 2007 Demo at I/ITSEC (08S-SIW-082)
  - Integrated BML Reports for MSG-048 2008 experiment
  - Performance 4 times faster than hard-coded service

Invoking XML for PostitionStatusReportPush (Header)

```
<BMLREPORT …>
    <Header>
        <MessageID>10000</MessageID>
        <ReporterWho>
            <Equipment >AMBUL</Equipment>
        </ReporterWho>
        <AddresseeWho>
            <Equipment>ARMORD</Equipment>
        </AddresseeWho>
        <ReferenceOrderID>12345</ReferenceOrderID>
        <Precedence>ROUTINE</Precedence>
        <Classification>2</Classification>
        <Sendtime>101201ZSEP2008</Sendtime>
    </Header>
```

Invoking XML for PostitionStatusReportPush (Report)

```
<Report>
    <CategoryOfReport>StatusReport</CategoryOfReport>
    <TypeOfReport>PositionStatusReport</TypeOfReport>
    <StatusReport BusinessObject = "PositionStatusReportPush">
        <PositionStatusReport>
            <Hostility>FRIEND</Hostility>
            <Executer>
                <Taskee><Equipment>AMPH</Equipment></Taskee>
            </Executer>
            <AtWhere>
                <WhereLabel>Objective_Alpha</WhereLabel>
                <WhereCategory>OBJECTIVEAREA</WhereCategory>
                <WhereClass>POINT</WhereClass>
                <Latitude>39.9476491008418</Latitude>
                <Longitude>48.9353472265578</Longitude>
                <ElevationAGL>0</ElevationAGL>
                <WhereQualifier/>
            </AtWhere>
            <When>
                <WhenTime>
                    <WhenQualifier>AT</WhenQualifier>
                    <DateTime>101201ZSEP2008</DateTime>
                </WhenTime>
            </When>
            <ReportID>802</ReportID>
            <Credibility>
                <Source>AOBSR</Source>
                <Reliability>A</Reliability>
                <Certainty>IND</Certainty>
            </Credibility>
        </PositionStatusReport>
    </StatusReport>
</Report>
```

DEMO Steps

- 0 – All systems are Pre-initialized with the Task Organization – DIV – BDE - BN – CO – UAV Plt
- 1 - OneSAF sends starting location and materiel information for all Friendly Units
- A - Location information will be received by the FBCB2 (via JVMF)
- B - Location and Material information will be received by MCS via the RIs, JC3IEDM, DMS, and DDS
- 2 – CAPES/JTCW tasks UAV Recon PLT to go to and recon area of operation through OneSAF RI to OneSAF
- 3 – OneSAF moves 1 UAV to area of operation
- A - OneSAF sends UAV PLT LDR position reports to FBCB2 by JVMF
- B - OneSAF sends UAV position reports to MCS through the RIs, JC3IEDM, DMS, and DDS
- C - OneSAF notifies NVIG of UAV movement through HLA and NVIG simulates the video feeds on the JBC2S

DEMO Steps

- 4 – OneSAF creates 12 UAV sensor reports (4 UAVs sensing 3 enemy units each)
- A – OneSAF sends the reports to the FBCB2 (via JVMF) and through the RI to the ***Level-1 FCS Fusion Surrogate*** RI via XML WS
- B – ***Level-1 FCS Fusion Surrogate*** correlates the 12 reports into 3 enemy units
- C – ***Level-1 FCS Fusion Surrogate*** sends the correlated report through the DMS RI, JC3IEDM, and DDS to the MCS
- 5 - MCS sends CTRL Measures via DDS through the DMS, JC3IEDM, RIs, to OneSAF
- 6 – The CAPES/JTCW orders OneSAF unit (1 Company) to move and attack (the order includes the route to take and when to start)