

C2SIM Infrastructure

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APPROVED FOR PUBIC RELEASE

Presentation Overview

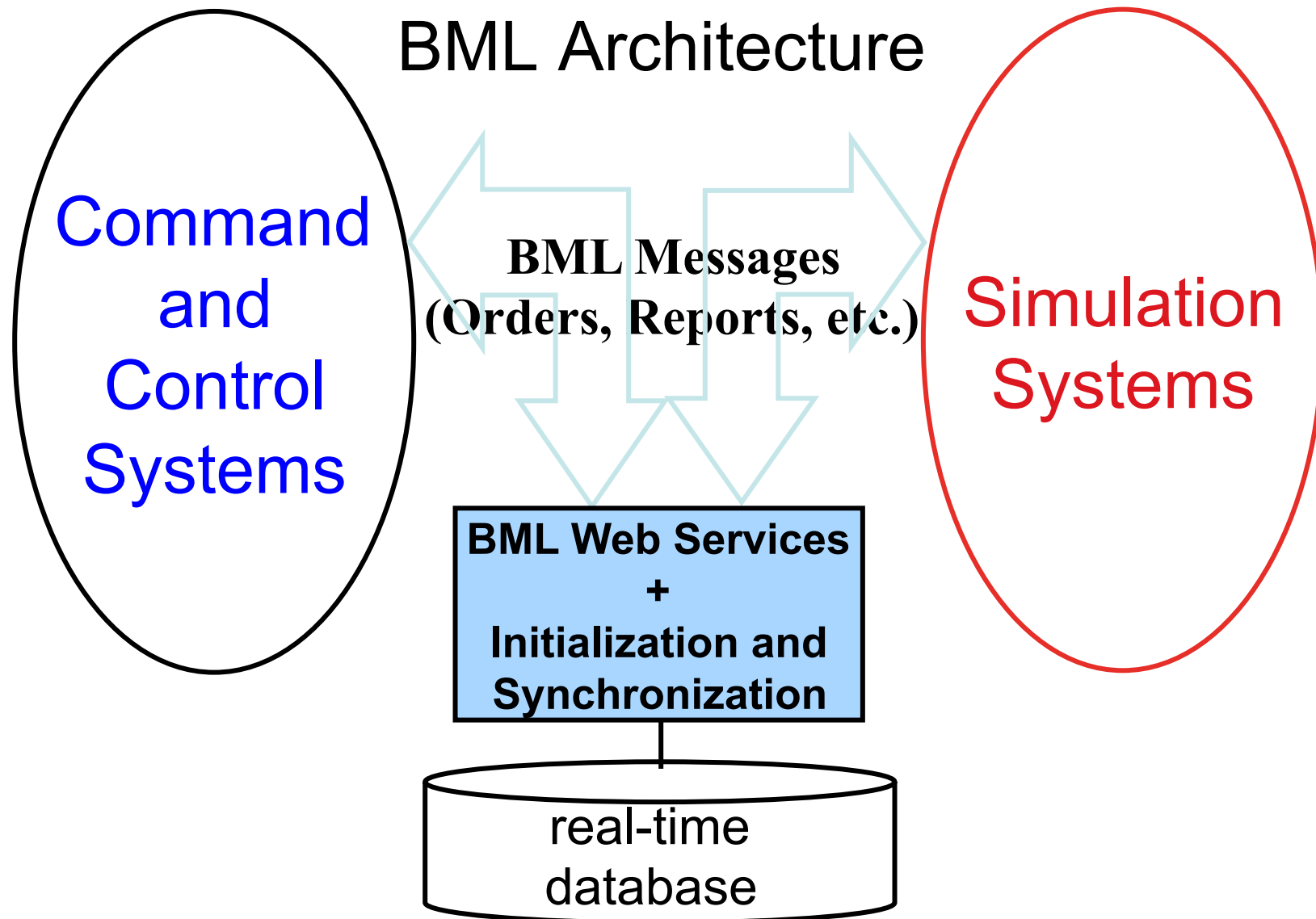
- C2SIM overall architecture
- Role of schema
- Role of C2 systems (C2IS)
- Role of simulations
- Role of servers
- Need for interfaces

BML: Definition

WHERE WE STARTED

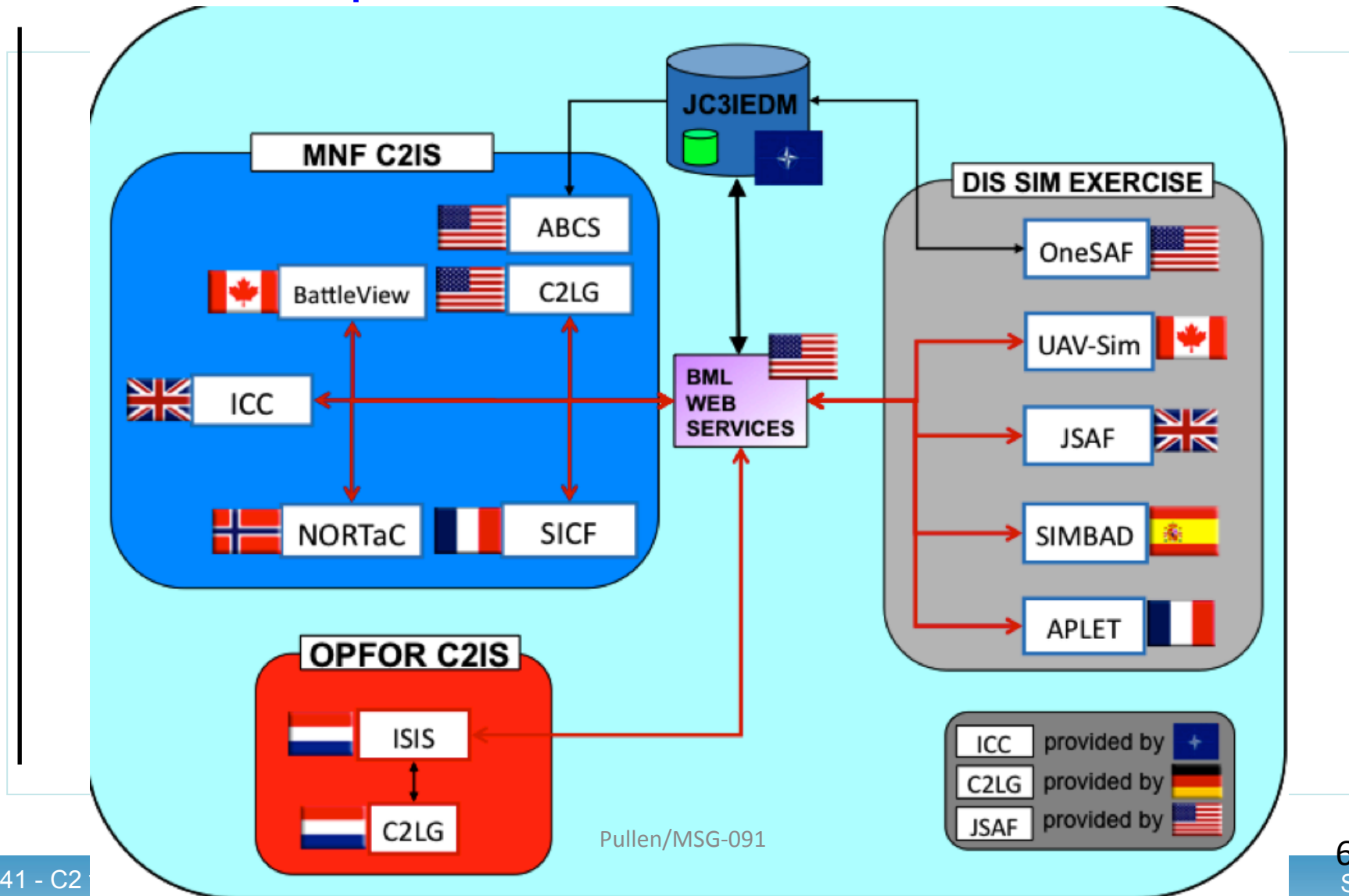
- **BML - an unambiguous language to:**
 - Command and control live and simulated forces conducting military operations, and
 - Provide for situational awareness and a shared, common operational picture.

Shared Semantics between C2 and M&S via a Common Tasking Description

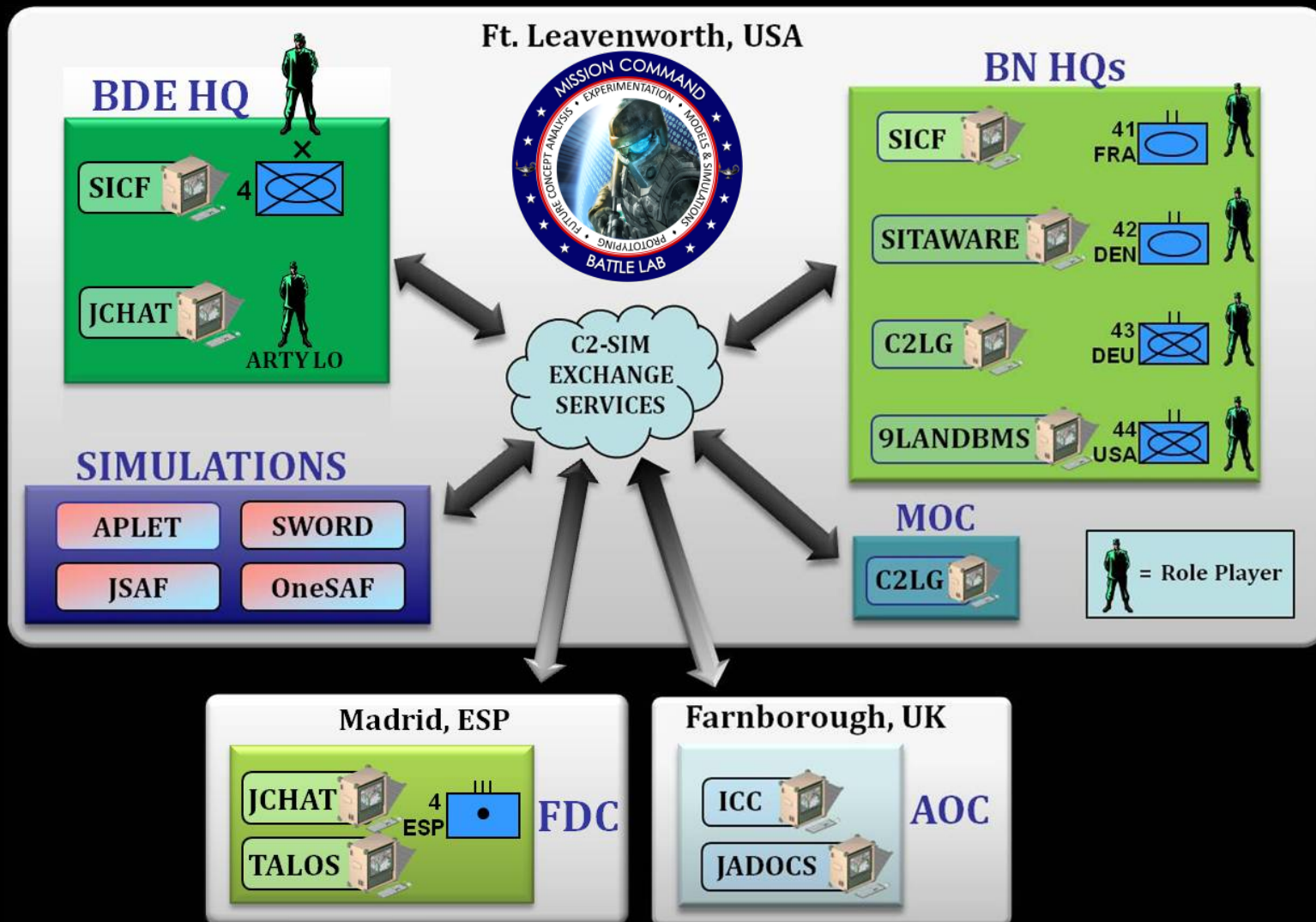


A C2SIM coalition is a system of systems.

Example: MSG-048 2009 Architecture



Later Example: MSG-085 Demonstration



What is a Web Service?

- Generalization of servers that provide webpages in the Internet
- Functions on a single transaction basis (stateless)
 - Get/Pull and Post/Push
- Makes a TCP connection for each one
- Can be seen as a Remote Procedure Call
 - Using Simple Object Access Protocol (SOAP)
- Or as a way to share and fetch XML documents
 - Could use Representational State Transfer (REST)
 - REST is more efficient so is used more often

Publish/Subscribe for Web Services

- Message must go to all interested systems
- Polling by clients is inefficient
- Streaming Text Oriented Messaging Protocol (STOMP) takes care of distribution
 - Systems subscribe for Topics of interest
 - STOMP server copies each message to subscribing systems

Why XML?

- Extensible Markup Language (XML) uses a generalization of the HyperText Markup Language (HTML) used for webpages
 - Information expressed as `<tag>value</tag>`
 - For example:
`<title>Battle Management Language</title>`
 - Permissible tags defined by a “schema”
- Defined set of metadata tells how to use document
 - Data about the data
- Document organized as a “tree” starting from “root”

XML Example Report

```

•<?xml version="1.0" encoding="UTF-8"?>
•<BMLReport
•  xmlns:jc3iedm="urn:int:nato:standard:mip:jc3iedm:3.1a:oo:2.0"
•  xmlns:bml="http://netlab.gmu.edu/IBML"
•  xmlns:msdl="http://netlab.gmu.edu/JBML/MSDL">
•  <Report>
•    <CategoryOfReport>StatusReport</CategoryOfReport>
•    <TypeOfReport>GeneralStatusReport</TypeOfReport>
•    <StatusReport>
•      <GeneralStatusReport>
•        <ReporterWho>
•          <bml:UnitID>1-22</bml:UnitID>
•        </ReporterWho>
•        <Hostility>FR</Hostility>
•        <Executer>
•          <bml:Taskee>
•            <bml:UnitID>1-22</bml:UnitID>
•          </bml:Taskee>
•        </Executer>

```

XML Example Report

```
<OpStatus>MOPS</OpStatus>
  <WhereLocation>
    <bml:GDC>
      <bml:Latitude>33.424079</bml:Latitude>
      <bml:Longitude>44.682716</bml:Longitude>
      <bml:ElevationAGL>2.054</bml:ElevationAGL>
    </bml:GDC>
  </WhereLocation>
  <When>20070101000000.000</When>
  <ReportID>506</ReportID>
  <Credibility>
    <bml:Source>HUMINT</bml:Source>
    <bml:Reliability>A</bml:Reliability>
    <bml:Certainty>RPTFCT</bml:Certainty>
  </Credibility>
</GeneralStatusReport>
</StatusReport>
</Report>
</BMLReport>
```

XML Schema

- *Schema* is a representation of the organization and format that is allowable for a given XML file, for example this slice:

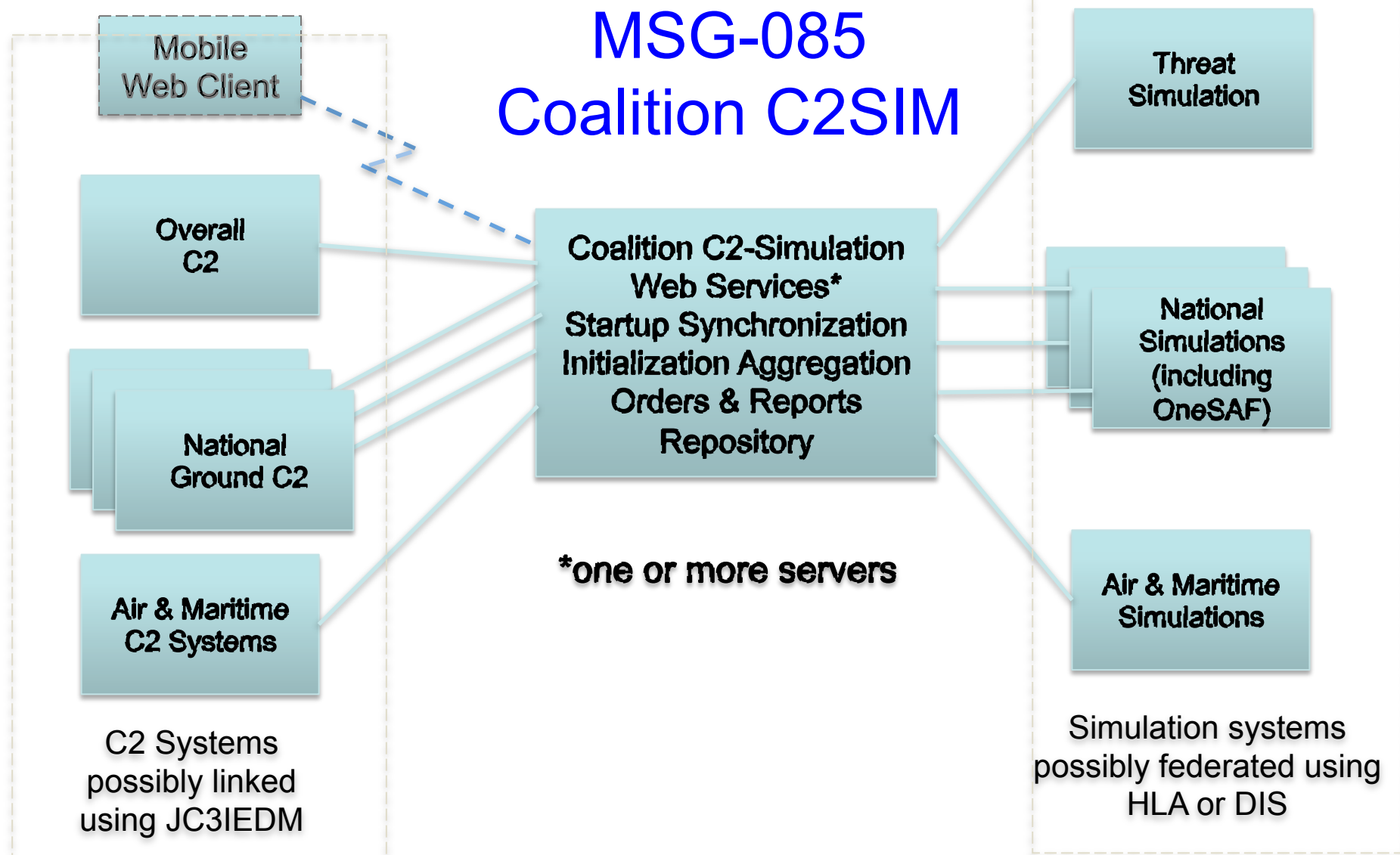
```
<xs:complexType name="ReportHeaderLightType">  
  <xs:sequence>  
    <xs:element name="ReporterWho" type="cbml:ReporterWhoType"/>  
    <xs:element name="ReportingData" type="cbml:ReportingDataType">  
      <xs:choice>  
        <xs:element name="AbsoluteReportedWhen"  
          type="cbml:AbsoluteReportedWhenLightType"/>  
        <xs:element name="RelativeReportedWhen"  
          type="cbml:RelativeReportedWhenLightType"/>  
      </xs:choice>  
    </xs:sequence>  
  </xs:complexType>
```

- Each Type specifies data order and format for a “chunk” of XML

Interconnected C2SIM Systems

- Command and Control systems
- Simulation systems
- Servers
- Graphic User Interfaces
- Status monitoring and control

MSG-085 Coalition C2SIM



Interfacing C2 Systems

- C2 systems produce Orders, consume Reports
- To enable C2SIM, add an interface module that follows the agreed schema so the C2 system can:
 - Send the server an XML document for each Order
 - Subscribe to Reports distributed by the server and present them as situational awareness
- Clearly identify when running in simulated mode
- Support start/stop of simulated operation

Interfacing Simulation Systems

- Simulation systems accept Orders, produce Reports
- To enable C2SIM, add an interface module that follows the agreed schema so the simulation system can:
 - Send the server an XML document for each status change that requires a Report
 - Subscribe to Orders distributed by the server and follow the directions they contain
 - Start/stop simulation operation under coalition control

C-BML/MSDL Servers

Primary Server Functions

- Accept Push/Post of XML documents and store
 - C-BML Orders and Reports; MSDL scenario files
- Accept Subscriptions by Topic
 - e.g. all General Status Reports
- Publish documents to subscribers as they arrive
 - And respond to Get/Pull for them

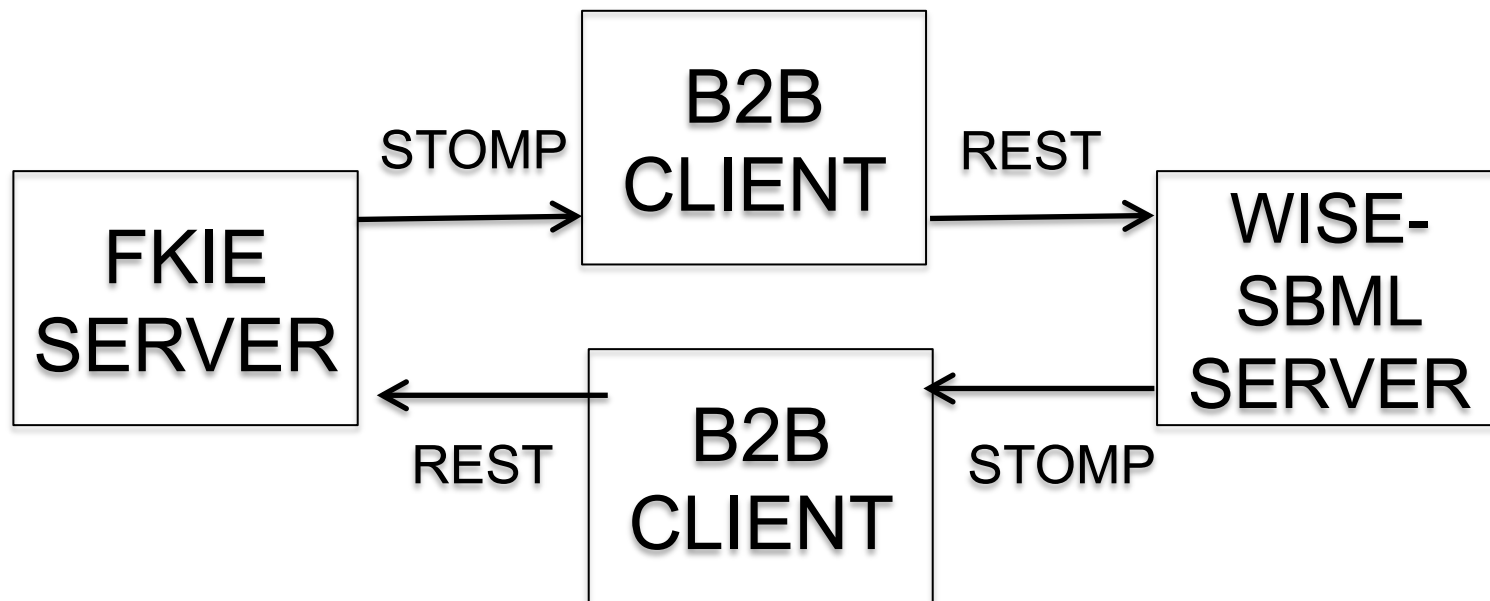
Additional Server Functions

- **Namespaces**
 - XML tagnames can be qualified by addition of a “namespace” code: <bml:Report>
 - This allows tagnames from different sources to work together safely
- **Schema validation**
 - Server confirms that each document received conforms to the schema
 - This identifies a likely source of incompatibilities
 - However, it slows the service
- **Filtering data**
 - Restrict delivery based on user-defined criteria

More Server Functions

- **Logging/replay**
 - Server writes a file showing every transaction it receives, with time stamps
 - Server is capable of replaying this file to recreate the original sequence of Orders and Reports at original time intervals
- **Distributed servers**
 - Multiple servers can be tied together to increase load capacity and geographic scope of the C2-Sim coalition

Simple Distributed Server Architecture



B2B: back-to-back client

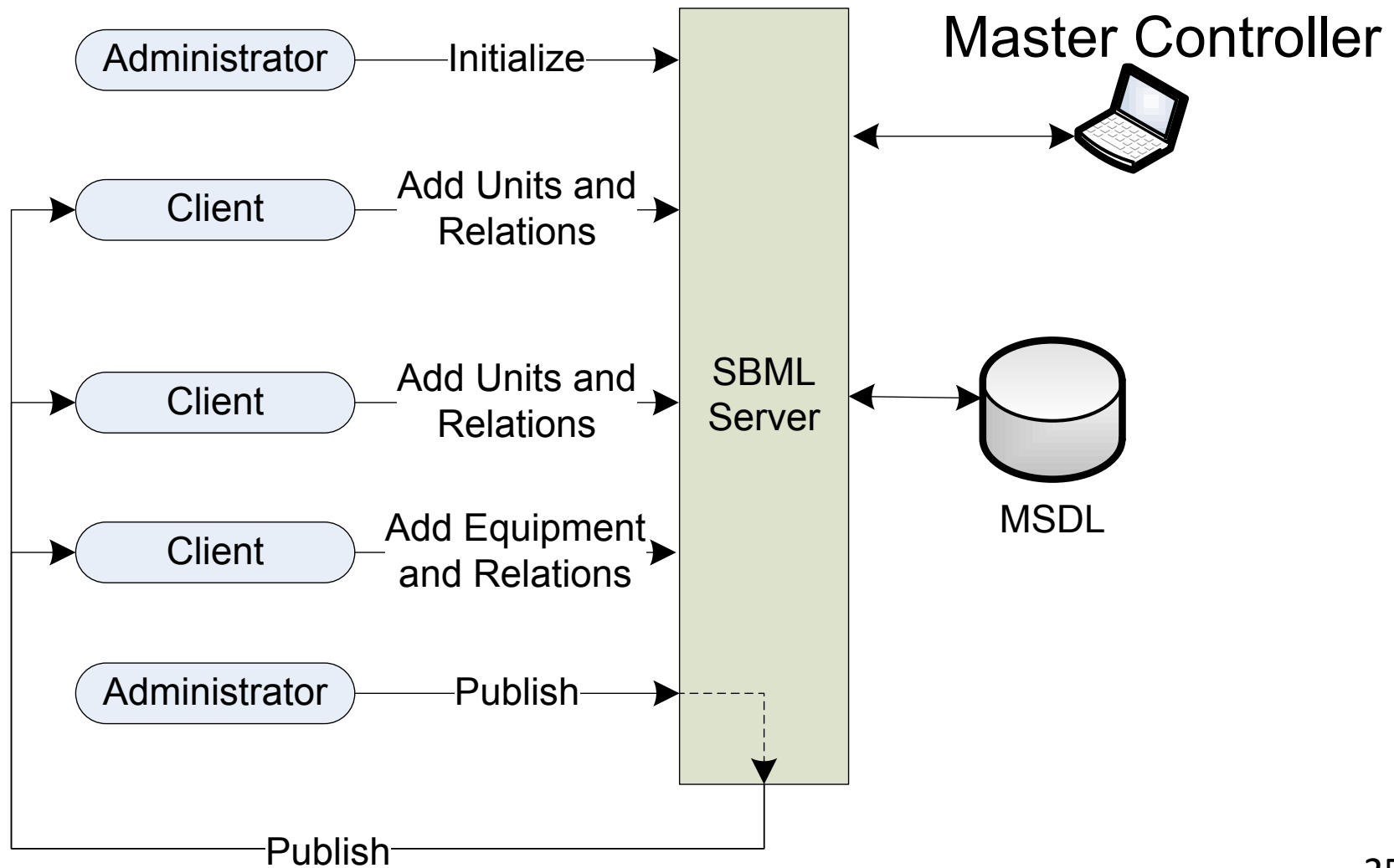
Server Schema Translation

- Needed because developing organizations are reluctant to change their interface each time a new schema is developed
 - So we end up with C2 and simulation systems interfaced to different (but mostly equivalent) schemas
- Server parses the XML document according to appropriate schema; produces output conforming to different designated schema
 - Possible only where data support the same semantics
- This capability allowed MSG-085 to interoperate C2 and simulation systems that had been interfaced under various previous schemas

MSDL Server

- MSDL inputs must be aggregated from all participating systems
 - In a coalition each C2 and simulation system can have different initialization requirements
 - A consolidated MSDL file is needed for consistency
 - Server can aggregate them automatically
 - A change on any system is reflected to all

MSDL Server Operation



Other Supporting Software For C-BML/MSDL Communications

Graphical User Interfaces (GUIs)

- During development it is very useful to have a generic way to generate and inspect BML documents
 - Create an Order, Report, Request etc. and introduce it to server
 - Accept and display Order, Report, etc. from client system or server
 - Edit either of the above
- The GUI can serve as a limited/surrogate C2 system for experimentation

BML GUI Functions

- Editing a C-BML or MSDL document
- Merging MSDL documents
- Serialization of document
- Grammar validation of document
- Schema validation of XML document
- Auto-configuration to schema
- Pulling a document
- Pushing a document
- Subscription to server Topics
- Retrieving latest reports
- C2 capability
- Displaying maps with overlays
- Geolocation entry from maps

BML GUIs in Use Today

- C2LG GUI
 - by Fraunhofer FKIE
 - Additional features for C2 of robots
- BML C2 GUI
 - Open source by GMU
 - Generic

C2LG GUI

Groundtask

Create Order, Request or Commission

☒ Order
☐ Request
☐ Commission

Regarding:

Action

Choose an action verb:

Units

Choose taskee:

Tasker:

Taskee:

Info

Task Control Features

1:301.537

Date & Time

SymbolLayer

polylayer

PluginLayer

Ground Order

Header

Common information

Sender:

Addressee:

OrderID:

Time:

Security:

Ground Tasks

#	BML
1.	m...
2.	re...
3.	fo...
4.	at...

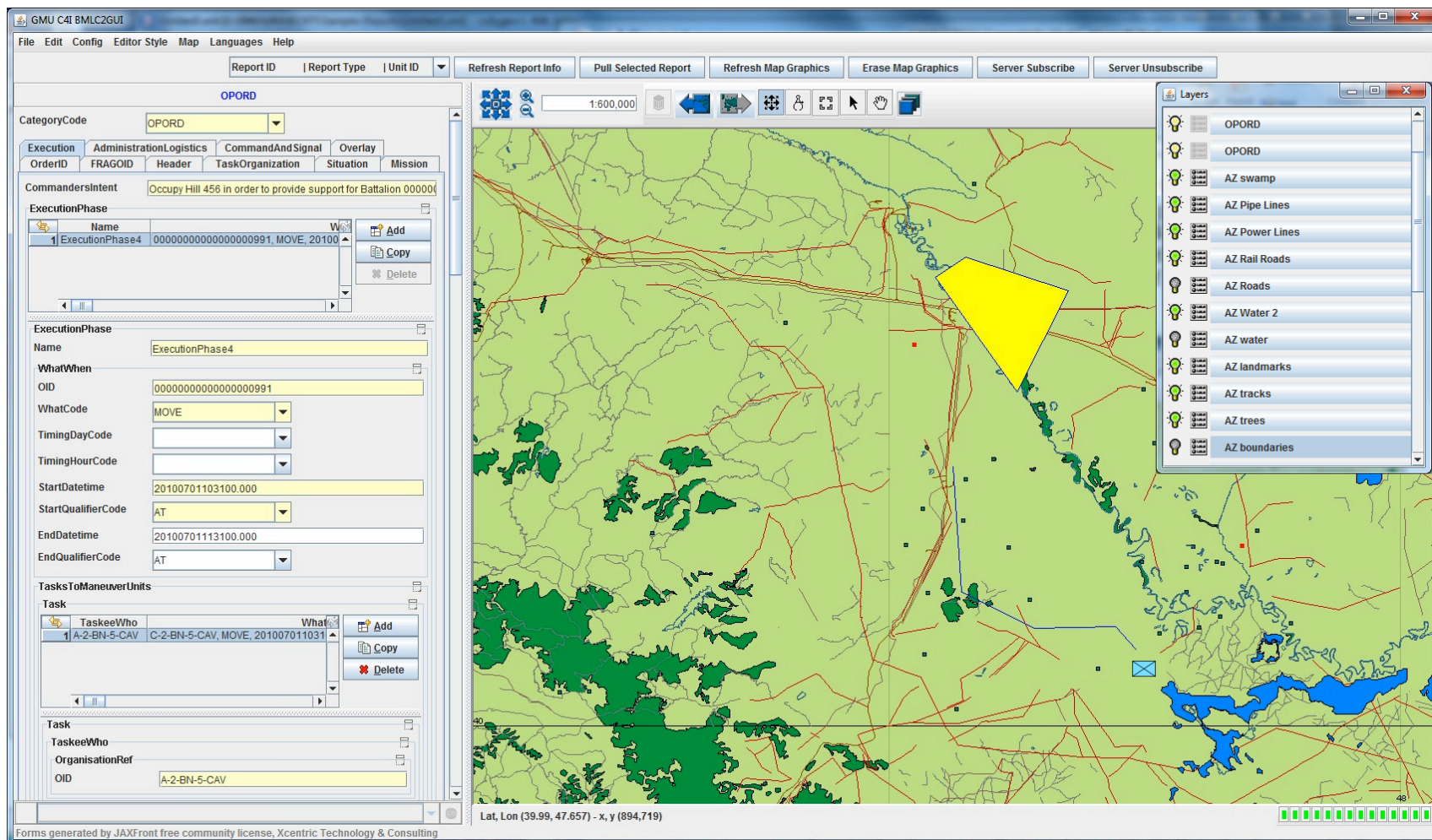
Optionen

Console

```

Std Console
pf-1
Line: S->0.6455193:1.1681396 E->0.6440625:1.1683503
seize-1
Line: S->0.64511675:1.1662419 E->0.6457876:1.1659927
cover-1
Line: S->0.6471293:1.1675837 E->0.64582586:1.1681012
          
```


BML C2 GUI



Virtual Private Network (VPN)

- Enables a private, distributed enclave over Internet
 - Commercial and open source versions available
 - Good for sensitive but unclassified information
- Used by MSG-085 for
 - Development and testing
 - Remote participation in Final Demonstration
- We are working to establish C2SIM service
 - available by VPN 24x7