# An Open Source
# Graphical User Interface Surrogate C2 System
# for Battle Management Language Experimentation

Lt. Col. Mohammad Ababneh, Jordan AF (Student)

Dr. Mark Pullen

George Mason University C$^4$I Center

{mababneh, mpullen} @ c4i.gmu.edu
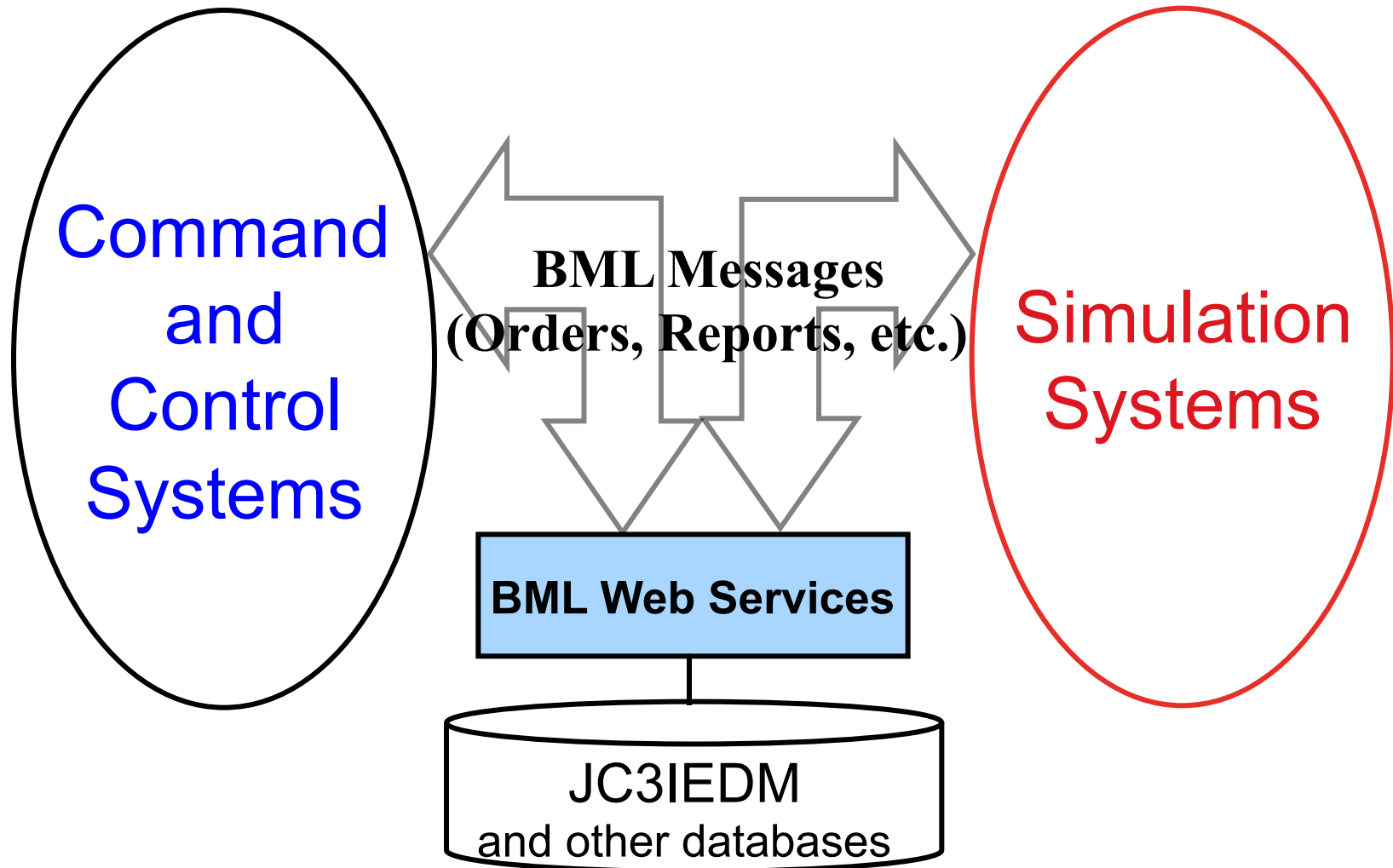
# Presentation Overview

- BML and BML experiments
- GMU open-source BML software
- BML C2 GUI requirements
- Open-source development
- Functionality
- Use as surrogate C2 system
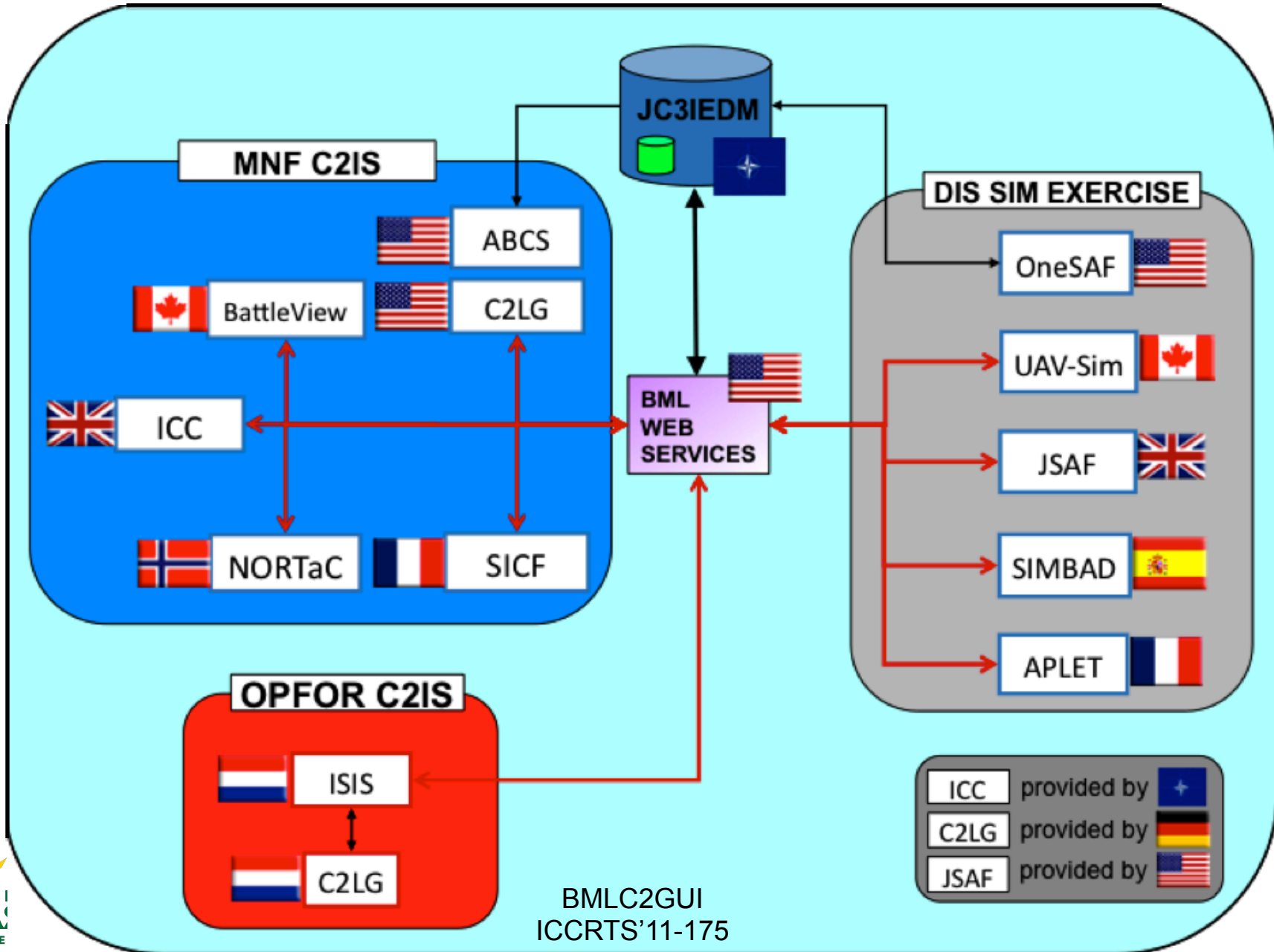- Conclusions

# BML Overview

# Background - BML

- Facilitates C2-Simulation interoperation
  - Exchange of Orders and reports in standard format
- Current architecture uses a repository service to hold state submitted by client C2 and Simulation systems
  - Web service with XML input – Network Centric
  - Data stored in JC3IEDM and can be replicated

# BML Architecture



Command and Control Systems

BML Messages
(Orders, Reports, etc.)

Simulation Systems

BML Web Services

JC3IEDM
and other databases

GEORGE MASON UNIVERSITY | C⁴I CENTER

# MSG-048 2009 Architecture



BMLC2GUI
ICCRTS'11-175

# C2LG GUI

- Command & Control Lexical Grammer (C2LG) Graphical User Interface (GUI) was constructed by the German research center FGAN.

- The C2LG GUI was created to generate "pure" BML statements that were valid grammar statements.

- In many BML activities, the C2LG GUI was used as an "integration hub" to take the input from C2 systems and construct a "valid" JBML Order that could be sent and ingested by different nation's simulations.

- FGAN operates under rules that would not allow them to release the C2LG GUI to the whole BML community.

# C2LG GUI
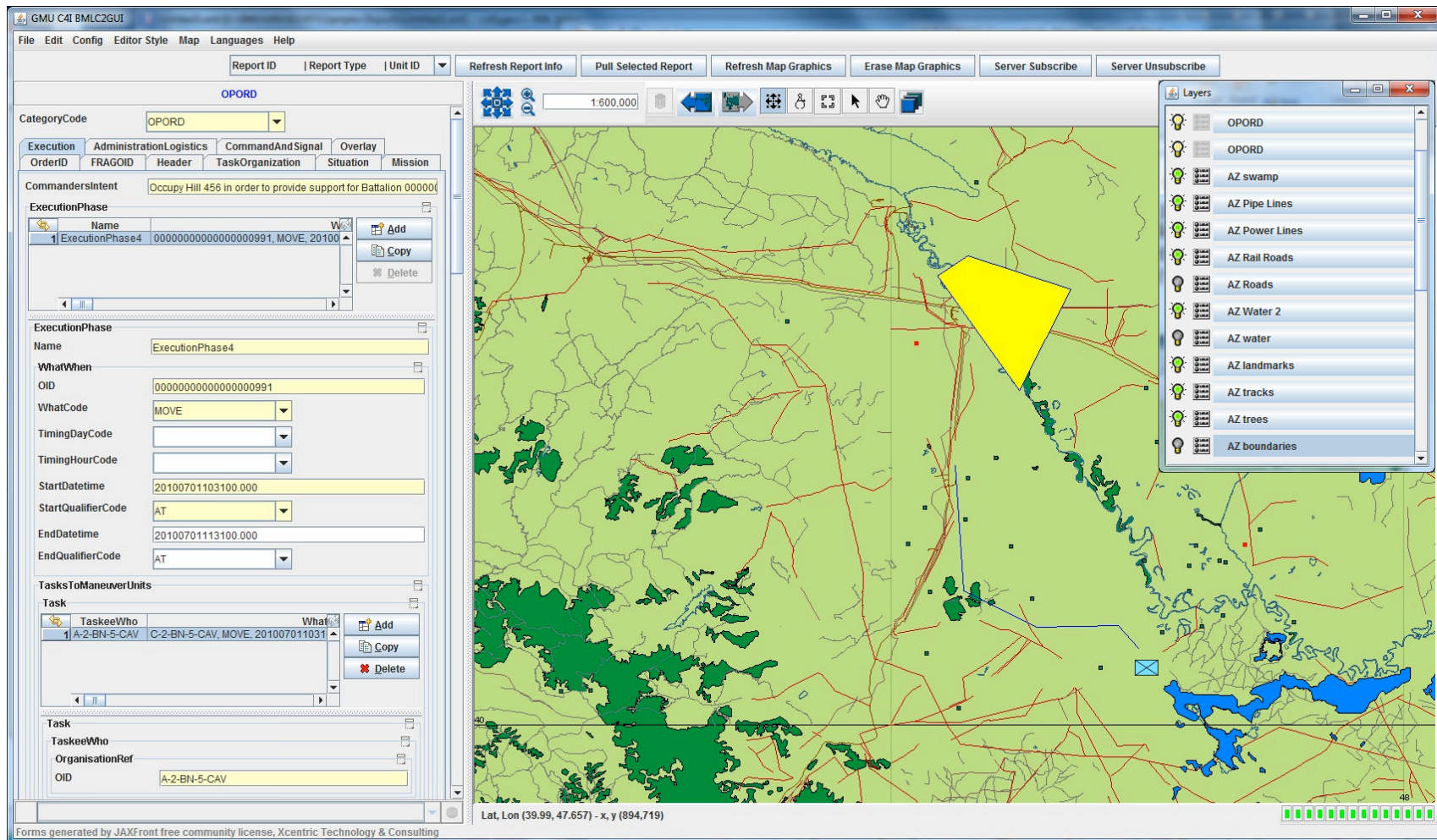
- Screen Shot
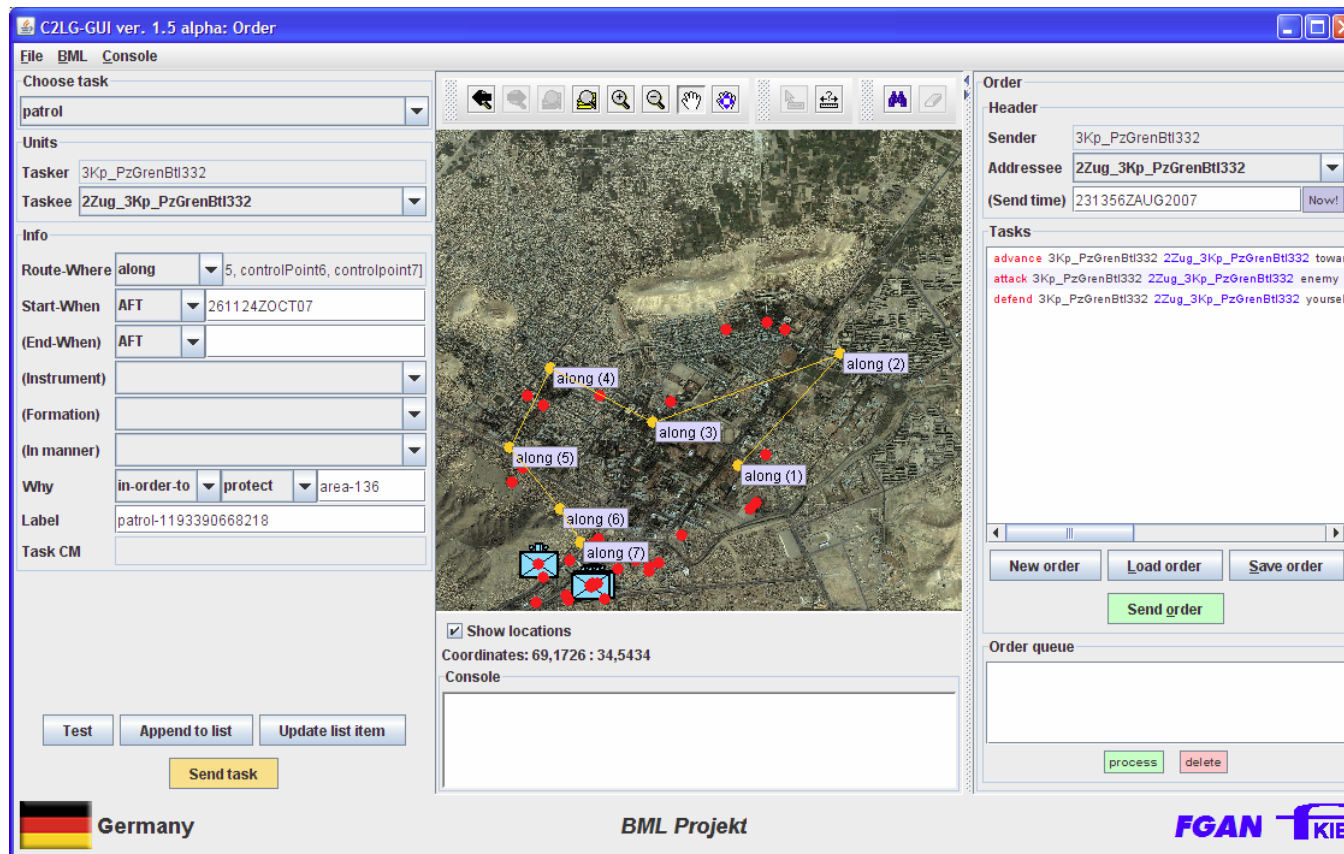
# BML C2 GUI

# BML C2 GUI

- Patterned after Fraunhofer-FKIE C2LG GUI
  - Usable as editor or monitor

  - Reads/writes Orders and Reports

  - Auto-configures to any BML schema

  - View and modify a BML-XML file

  - Map/image display shows 2525B icons from XML

  - Future version will enter geolocation data in BML-XML file

  - Open source at http://c4i.gmu.edu/BML

# BML C2 GUI

# BML C2 GUI : ORDER

# BML C2 GUI : CONTROL FEATURES
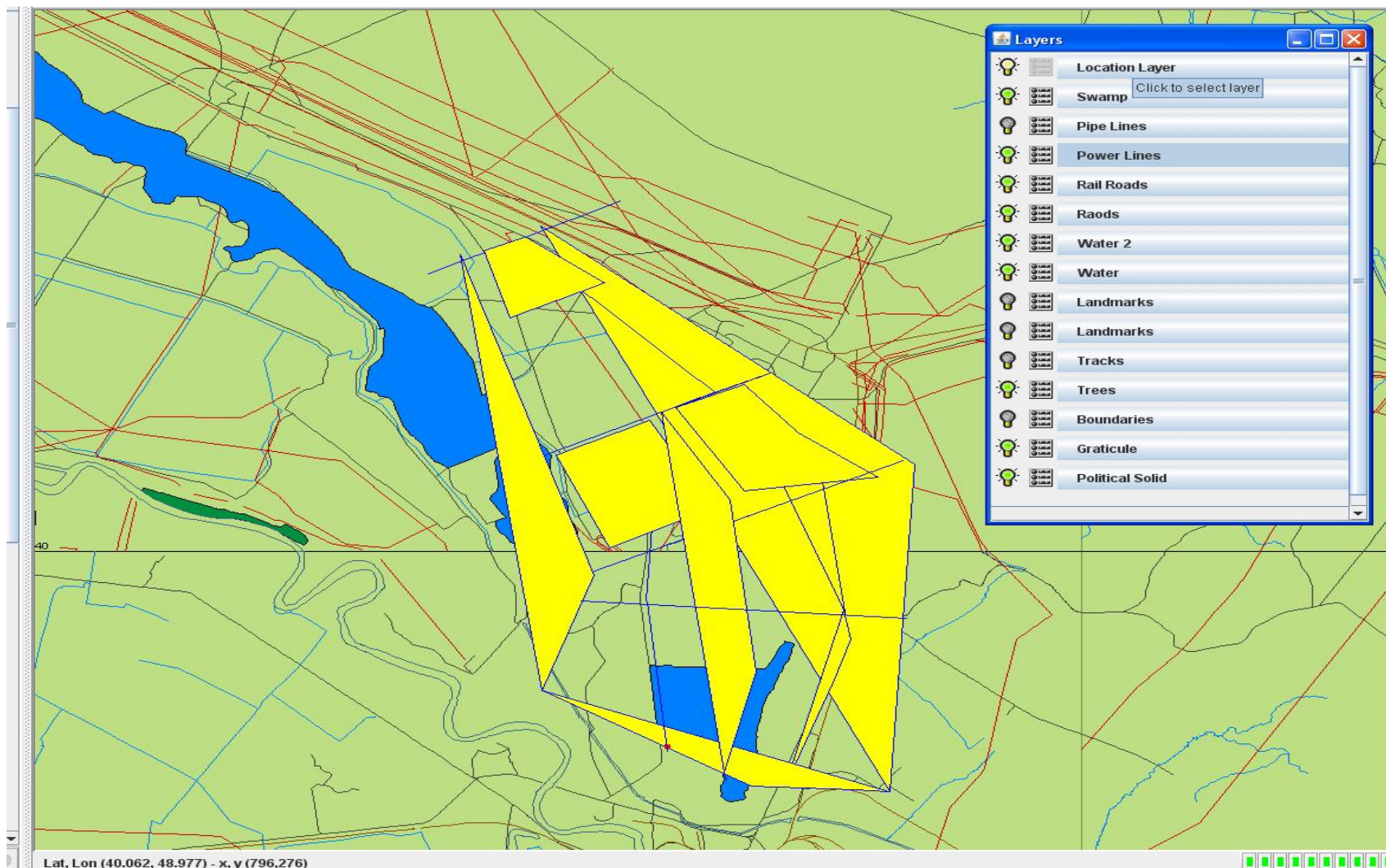
# Scripted BML Server

- Middleware functions don't change
  - Mapping BML to JC3IEDM and push/pull to database
  - Program these once and get them right
- Interpreted WS offers flexibility
  - Rapid implementation of new BML constructs
  - Easy to modify underlying data model
    - JC3IEDM also continues to change
  - Reduces time and cost for prototyping
  - Scripting language provides a concise definition of BML-to-data model mappings
  - Although bugs still happen, the number of possible mistakes is far smaller
- Scripted operation may, however, be slower
  - We've multithreaded the server
  - 8 processors achieved over 10 Reports/sec
  - Believe it will scale at least to 16 processors (20 Reports/sec)

# Scripted BML WS Configuration
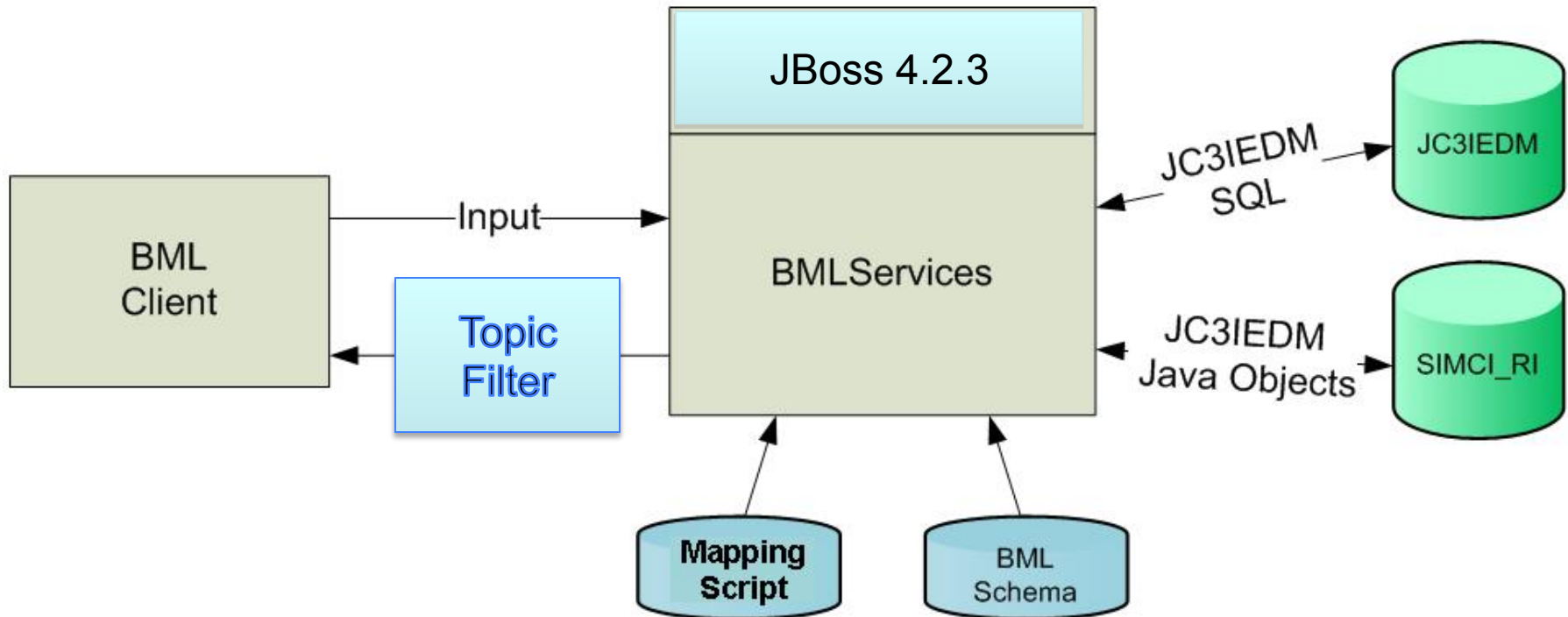


## Two implementations: MySQL and SIMCI RI

# Polling vs Publish/Subscribe

- "Pure" Web Service is always accessed by *push* or *pull* transaction from client
  - No provision for server to initiate action
- For clients to stay up to date they must pull latest status from server at rate determined by their need for up-to-date information (called *polling*)
  - Result: MSG-048 server in 2008 spent most of its time responding to status pulls
- Publish/subscribe gets around this by letting clients identify the categories of information they need – they *subscribe* to *Topics*
  - Server sends them a copy of every update associated with each subscribe Topic
  - More timely updates and a dramatic reduction in overhead

# Publish/Subscribe Architecture
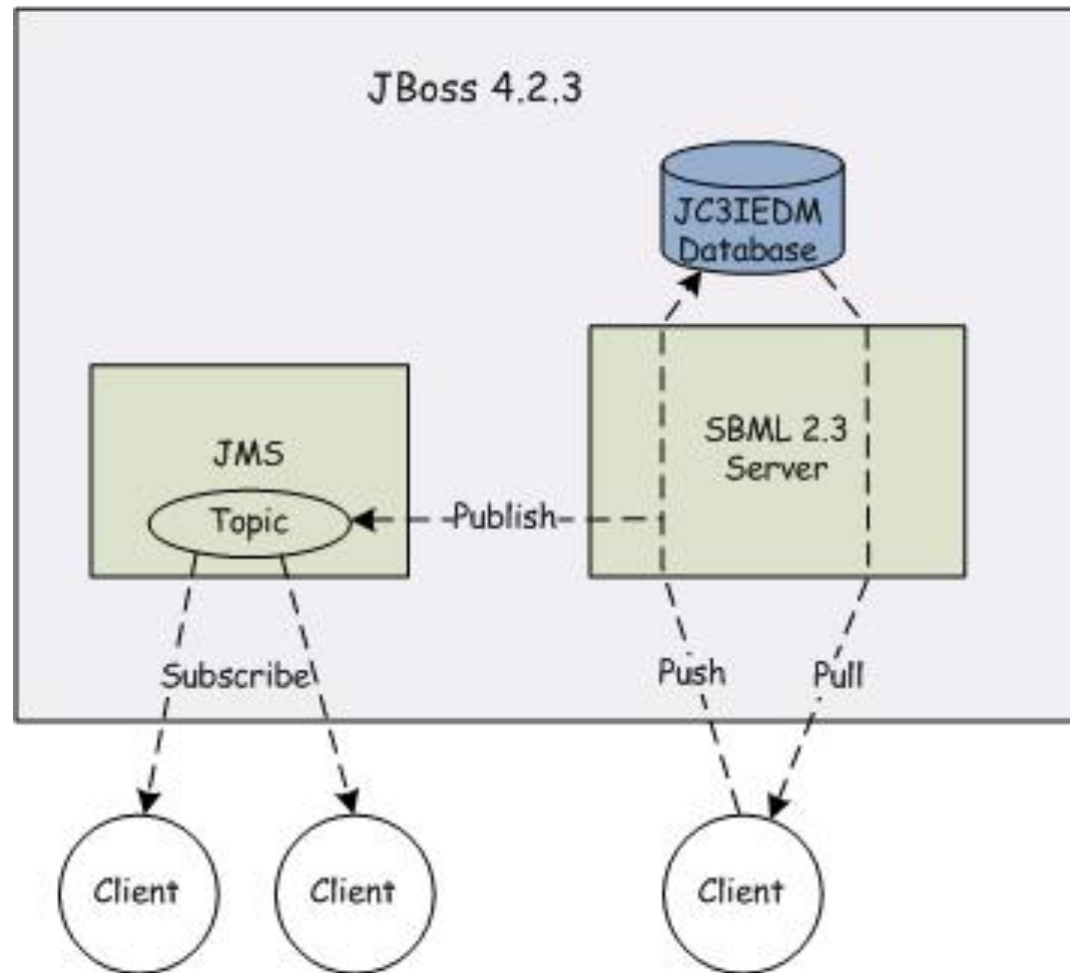
# SBML in NATO MSG-048

- Paper 10S-SIW-049 describes a significant NATO Technical Activity that used SBML

- Six national C2 systems and five national simulations interoperating

- Six months of preparation culminated in a week of experimentation at Manassas, VA

- Publish/subscribe essential to meet performance needs

- See companion paper for more information

# SBML Services in the BML C2 GUI

- The BMLC2GUI uses the Web Services maintained by SBMLServer through the SBMLClient application.
  - CallListWho: is used by the GUI to bring up all the necessary information about a unit given its UnitID in order to compose the MILSTD2525b key (String characters) that enables the tool to draw the correct unit symbol in its desired position.

```
<callListWho>
<UnitID>3</UnitID>
</callListWho>
```

- The BMLC2GUI is open source - could be modified to use other source of Unit information

# SBML Services in the BML C2 GUI

- The BMLC2GUI uses the following Web Services maintained by SBMLServer through the SBMLClient application.
  - GetLatestReportIDs: is used by the GUI to build a list of report information:

    ```
    <GetLatestReportIDs>
    </GetLatestReportIDs>
    ```

  - ReportPull: is used by the GUI to pull a report from the SBML Web Service so that it can be viewed or edited and its geospatial information be extracted and illustrated on the map.

    ```
    <ReportPull>
    <ReportID>410</ReportID>
    </ReportPull>
    ```

# BML C2 GUI Requirements

# JaxFront – Open Source XML Java Editing

- JaxFront is a technology developed by Switzerland's Xcentric Technology & Consulting GmbH.

- It is "a technology to generate graphical user interfaces on multiple channels (Java Swing, HTML, PDF) on the basis of an XML schema".

- Web site http://www.jaxfront.org

- The BML C2 GUI uses the Free Community version (Open-Source) of JaxFront as a major component for editing BML documents.

- The user can dynamically generate GUIs that allow the user to edit XML data without being exposed to the underlying XML technology.

# JaxFront – Open Source XML Java Editing

- JAXFront architecture



Source:
http://www.jaxfront.org.
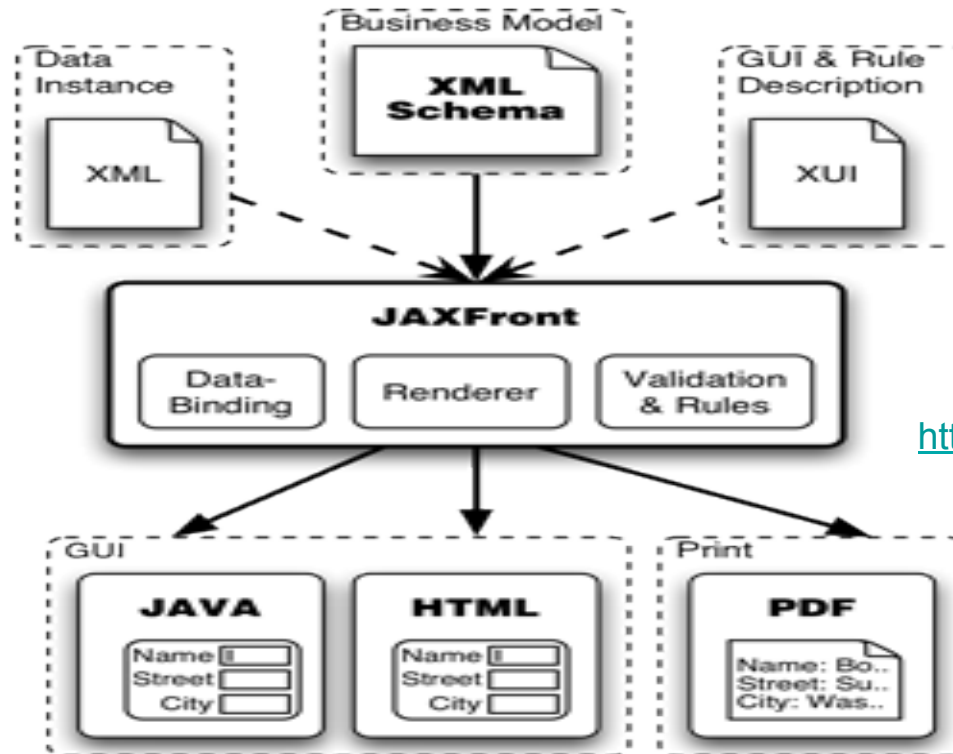
- JAXFront also provides XML User Interface (XUI) Editor to customize its forms

# BML C2 GUI Development Goals

- Core functions like C2LG GUI

- Differences from C2LG GUI:

  - Open resource

  - Quick response to changes

  - Ease of use

  - Low development cost

# Open-Source Development

# BML C2 GUI Development

- The core of the BMLC2GUI is the use of JAXFront's libraries to build a new and a customized type of XML Document Object Module (DOM) that can be rendered as Java Swing objects.

- The JaxFront's DOM Builder takes the following parameters to generate a JAXFront document:
  - The XML document.
  - The Schema.
  - The XUI (optional): XML User Interface file used to customized the view of the XML document. The default is a tree view.
  - The XML root node

# BML C2 GUI Development

- JaxFront's EditorPanel renders the generated DOM using Java Swing compnents with the help of the XUI file.

```
currentDom = DOMBuilder. getInstance(). build
("default-context", xsdUrl, xmlUrl, xuiUrl, root);
```

# BML C2 GUI Development

- After the successful rendering of the XML document, we start extracting the geospatial information (Latitude, Longitude coordinates representing positions or dimensions of objects) on the map.

- We parse the document and pass the elements and values to OpenMap's MapHandler

- The MapHandler draws and controls the following types of layers:

  – Country or area of interest geospatial data layers. In our case (ESRI shape files).

  – BML objects and geospatial information: unit, minefield, bridge, spot, track.

  – MIL-STD-2525b symbols

# Open Map

- Open Source JavaBeans based Geospatial development tool.

- From BBN Technologies, now part of Raytheon.
  http://openmap.bbn.com

- BMLC2GUI is using the latest version of OpenMap 4.6.5, released March 5, 2009.

- It provides various capabilities to allow users to see and manipulate geospatial information.

- OpenMap supports various map data file formats.

# Open Map

- This release of the BMLC2GUI is using ESRI shape files.
- The BMLC2GUI uses OpenMap to display the different data layers on the map in addition to drawing BML objects, units and control measures at their corresponding locations.

# Open Map - MIL-STD-2525B

- The BMLC2GUI makes use of the OpenMap's implementation of MIL-STD-2525B symbols

- The unit/object symbol is constructed from the UnitID / objectType during the geospatial information extraction.

- The corresponding unit/object symbol is drawn at the Lat-Lon coordinates

- Objects can be minefield, bridge, spot,…
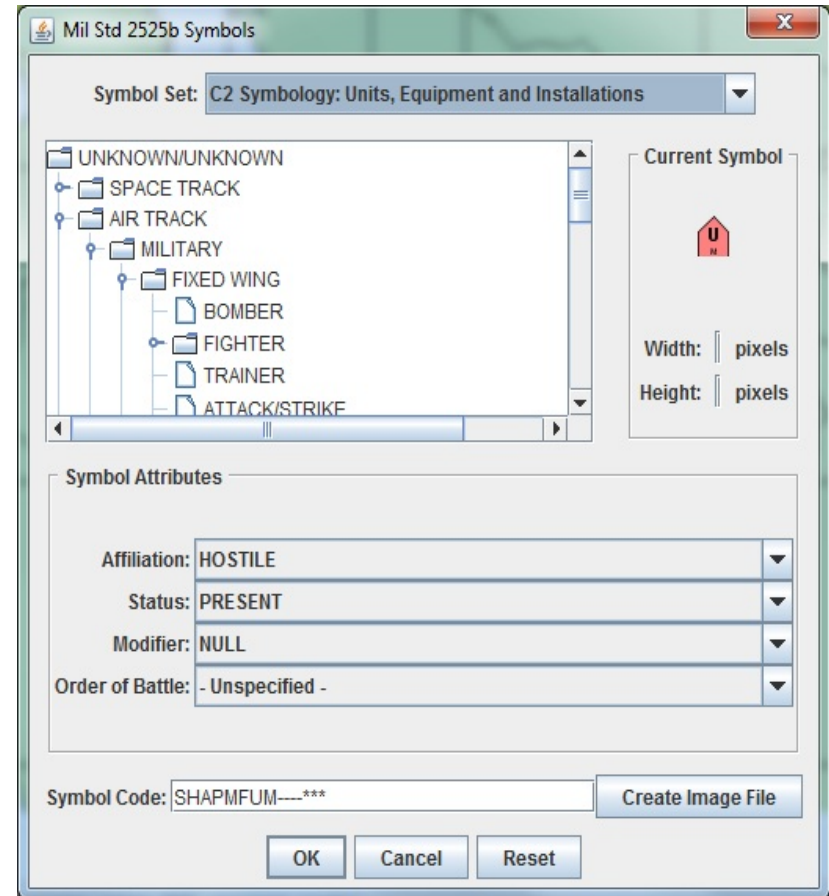
# BML C2 GUI
# Capabilities & Functionality

# BML C2 GUI - Functions

- Editing a BML Document
- Serialization of a BML Document
- Validation of a BML Document
- Pulling a BML Document
- Pushing a BML Document
- Retrieving Latest Reports
- C2 Capability
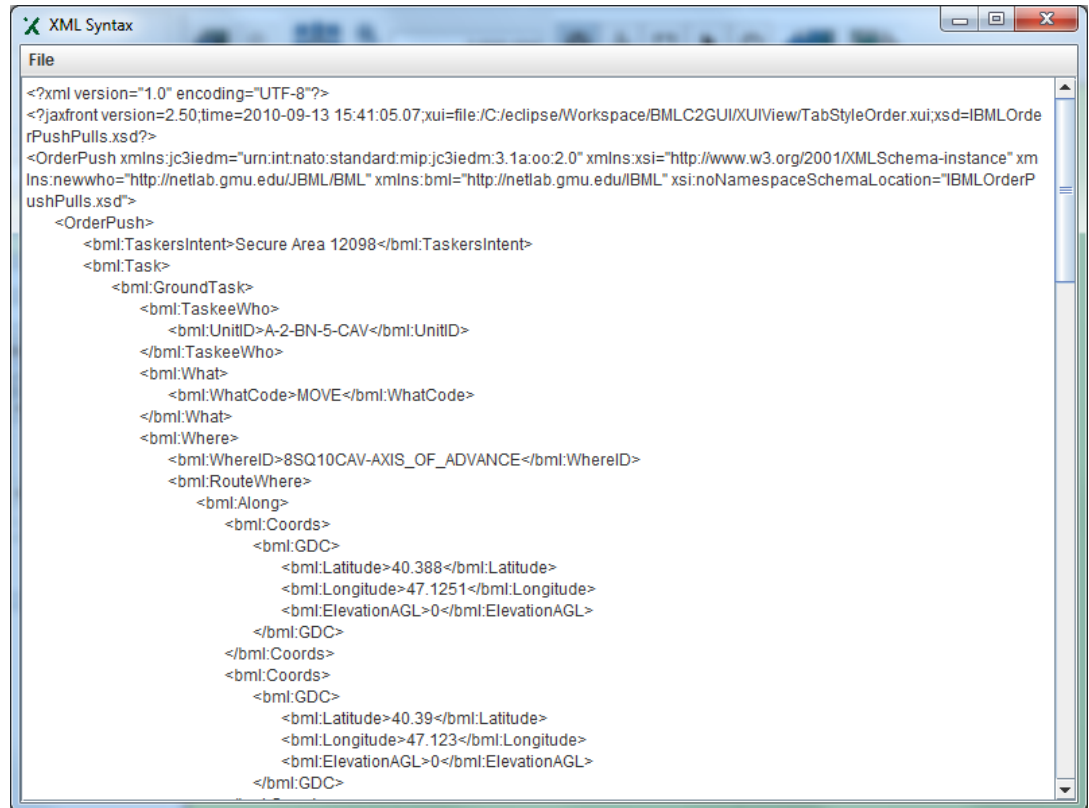
# BML C2 GUI - Functionality

- **Editing a BML Document**

– The BML C2 GUI can edit any type of BML documents.

– The user has the capability to create a new order or a report in the GUI or open an existing document from the file system.

– The user has the flexibility of modifying, validating, serializing the document

# BML C2 GUI - Functionality

- **Serialization of a BML Document**

  – The BML C2 GUI provides the user with the capability to see the XML source of any document he is editing.

  – This feature is very useful, especially to the experienced and advanced users.

# BML C2 GUI - Functionality

- Validation of a BML Document
  - The BML C2 GUI provides the user with the capability to validate the BML document against its schema.

  - This serves as a validation option **before** sending the document to any web service in order to guarantee well conformance with the schema.

  - When the validation option is selected, all the possible validation problems can be displayed in the GUI's status bar and also a red box can be drawn around the text area having the problem.

# BML C2 GUI - Functionality

- Pulling a BML Document
- The BML C2 GUI provides the user with the capability to pull reports from the SBMLServer through two paths:
  - Subscriber: By activating the "SBMLSubscriber" listener application, which listens to any coming new report and automatically detects its type and displays it in the editor area. It will also extract any geospatial data from the report and display it on the map.
  - Manually: By selecting the desired report from a Report Information list of the latest reports added from the web service.
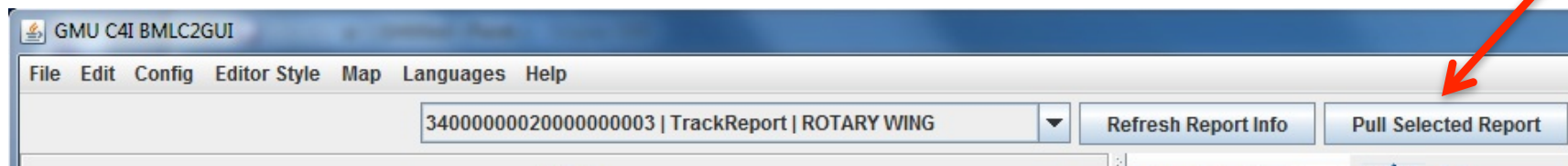
# BML C2 GUI - Functionality

- **Pushing a BML Document**

  – The BMLC2GUI provides the capability to create, edit, validate (optional) and push any type of BML document

  – When a user decides that the order or report is ready to be pushed, the GUI provides him with a simple user interface to do so with a click of a button.

  – Off-course this interface is a shell to the call of the SBMLClient.
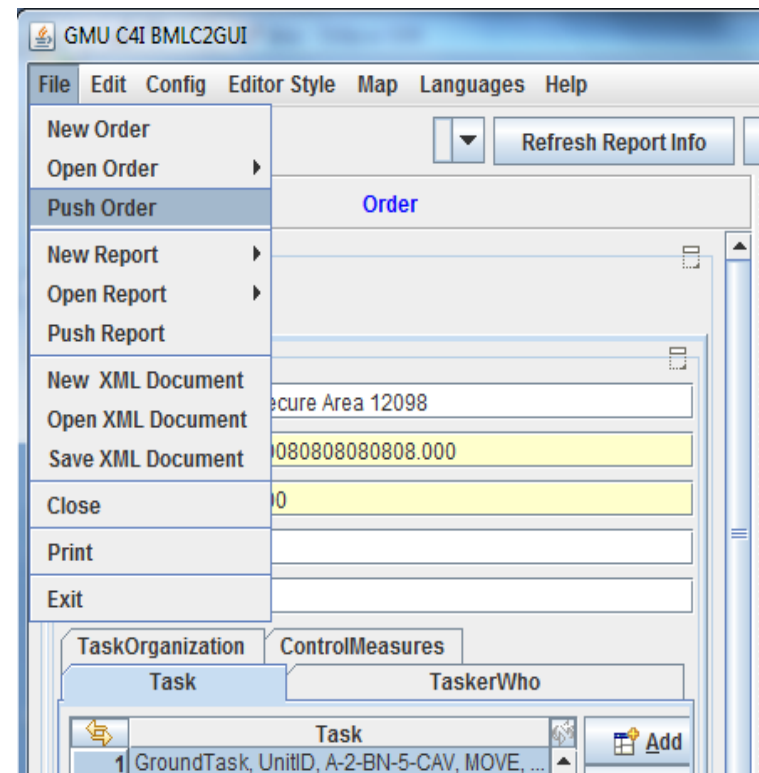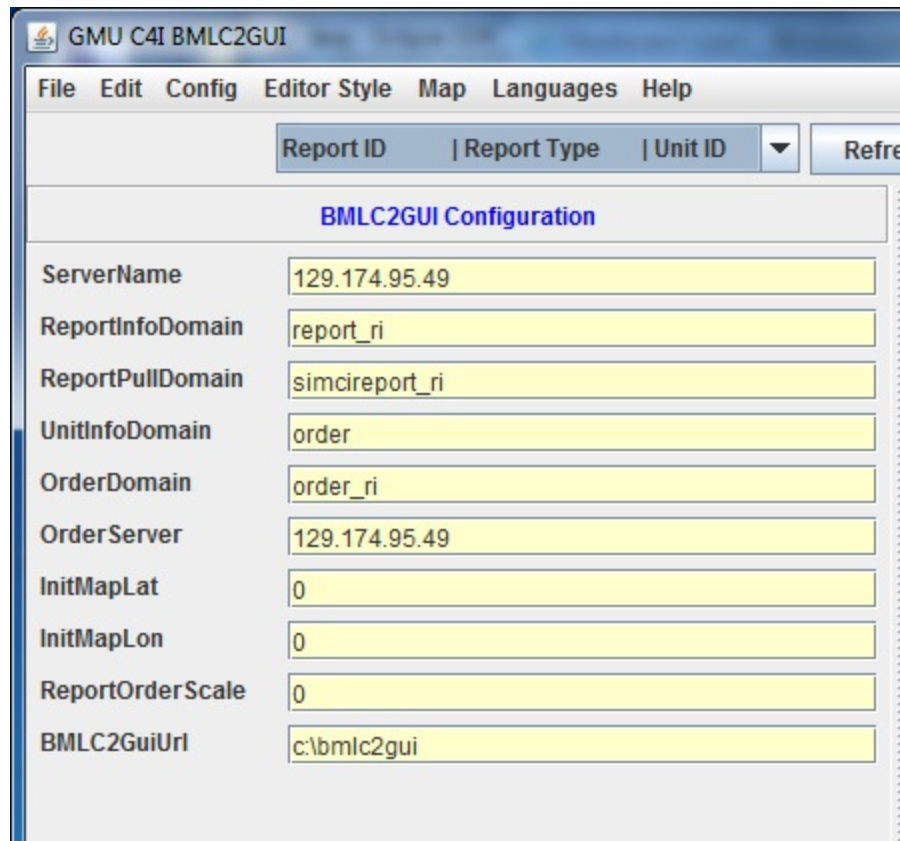
# BML C2 GUI - Functionality

- Retrieving Latest Reports

– The BMLC2GUI provides the user with the capability to see a list of reports consisting of the Report ID, Type and Object/Unit ID.

– The user has the capability to refresh this list manually in addition to the automatic update while the subscriber is running.

– The user can select any report from the list and get a view of that report: document view and geospatial information representation.
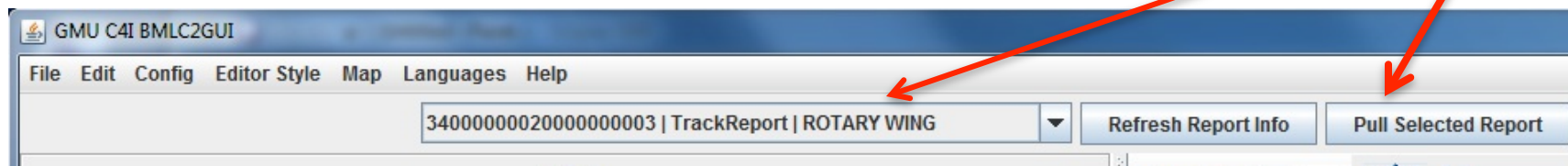
# BML C2 GUI - Configuration

- The BMLC2GUI makes use of the same JAXFront editing capabilities to configure its environment variables

# BML C2 GUI - Functionality

- C2 Capability

  – The BMLC2GUI implements the SBMLSubscriber Client application to connect to the subscription service of the SBMLServer.

  – This client connectivity enables the GUI to listen to any BML activity such as reports being generated.

  – The main usage of the Subscriber in the GUI is to pull new BML reports of any type and display them immediately on the screen in the editing/viewing panel in addition to extracting the geospatial information and display it in the map panel.

  – Some modifications to the code can make it a more advanced C2 system.

  – Examples to be shown in the coming integration demo slides

# BML C2 GUI in the Integration Process
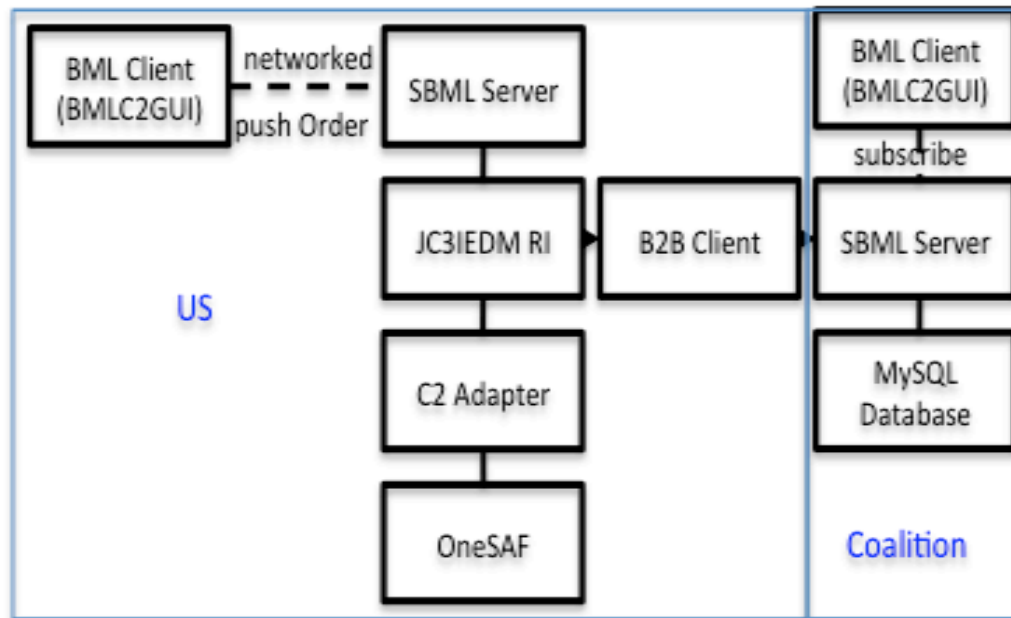


a. Orders
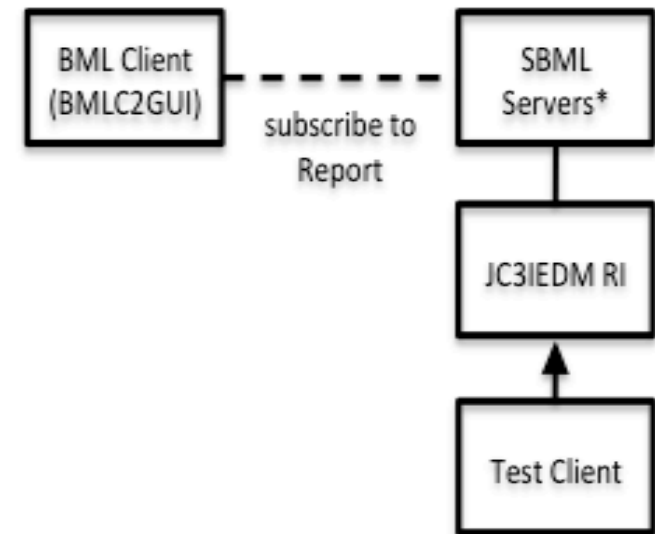
b. Reports

# Use as Surrogate C2 System

# Reports in BML C2 GUI

# OPORD using SISO C-BML

# OPORD Mapping Capabilities

# Conclusions

- The BMLC2GUI provides an easy-to-use, comprehensive tool for the BML developer and end user

- Platform-independent and command-line free BML editing and viewing

- Geospatial capabilities

- Validation and Serialization

- Being open-source makes it less expensive to own and operate

- Customization and enhancements possible by the BML community

- Open source at http://c4i.gmu.edu/BML