Web Enabling HLA Compliant Simulations to Support Network Centric Applications

C4 Information Technology
Transformation Through Technology

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XMSF Overview

The Extensible Modeling and Simulation Framework (XMSF) is defined as a set of Web-based technologies and services, applied within an extensible framework, that enables a new generation of modeling & simulation (M&S) applications to emerge, develop and interoperate.

The specification of XMSF will be in the form of a collection of *profiles* detailing how to interoperate with XMSF compliant systems. These profiles will enable inter- and intra-domain interoperability. At a macro level, a profile will consist of:

- Applicable web technologies and protocol standards
- Applicable data and metadata standards
- Recommendations and guidelines for implementation

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The MOVES Institute Naval Postgraduate School

Old Dominion University

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XMSF Motivation

Transformational technologies are needed to scale up defense modeling/simulation to meet real-world needs

Web technologies provide a common framework:

- Dynamic capabilities, open standards, Web business model provide lift to support government and commercial success
- Easy use and open extensibility for developers and users, fueling rapid growth of interoperable simulations
- Bring defense modeling/simulation/tactical support into mainstream of enterprise-wide best-business practices

XMSF Precepts

Web-based technologies applied within an extensible framework will enable a new generation of modeling & simulation (M&S) applications to emerge, develop and interoperate.

Support for operational tactical systems is a missing but essential requirement for such M&S applications frameworks.

An extensible framework employing Extensible Markup Language (XML)-based languages can provide a bridge between forthcoming M&S requirements and open/commercial web standards, while continuing to support existing M&S technologies.

Compatible and complementary technical approaches are now possible for model definition, simulation execution, network-based education and training, network scalability, and 2D/3D graphics presentations.

Web approaches for technology, software tools, content production and broad use provides best business cases from an enterprise-wide (i.e. world wide) perspective.

"M&S is the next killer app for the Web."

Dr. Anita Jones, XMSF Strategic Opportunities Symposium, 6 September 2002

Web Enabled RTI Goals & Accomplishments

The High Level Architecture (HLA) is the DoD standard for interoperability of models and simulations

- A Run Time Infrastructure (RTI) is an implementation of the distributed services oriented architecture required to support the interaction of HLA-compliant simulations (federates)
- The HLA was specified and the extant RTIs built prior to the advent of web services

Our goal was to build HLA federations using XMSF compliant Web Services for communication between federates in a federation over a WAN without dedicated network links

- Effectively making a federate or federation callable as a Web Service

Using SOAP formatted RTI calls employing a BEEP communication layer, we created HLA compliant interface libraries that were used to web enable several federations

- HPAC and ITEM in DTRA's WMDOA federation
- Circuit simulator in HLA-ADL demo
- XDV in DCEE for JFCOM J9

Why is This Important?

Implements bi-directional communication initiation over the Web

- Superior to http with its uni-directional initiation
- http unsuitable for supporting simulation communication patterns

Enables existing HLA compliant federates to be integrated easily over the Internet

- Including through most firewalls with minimal reconfiguration!

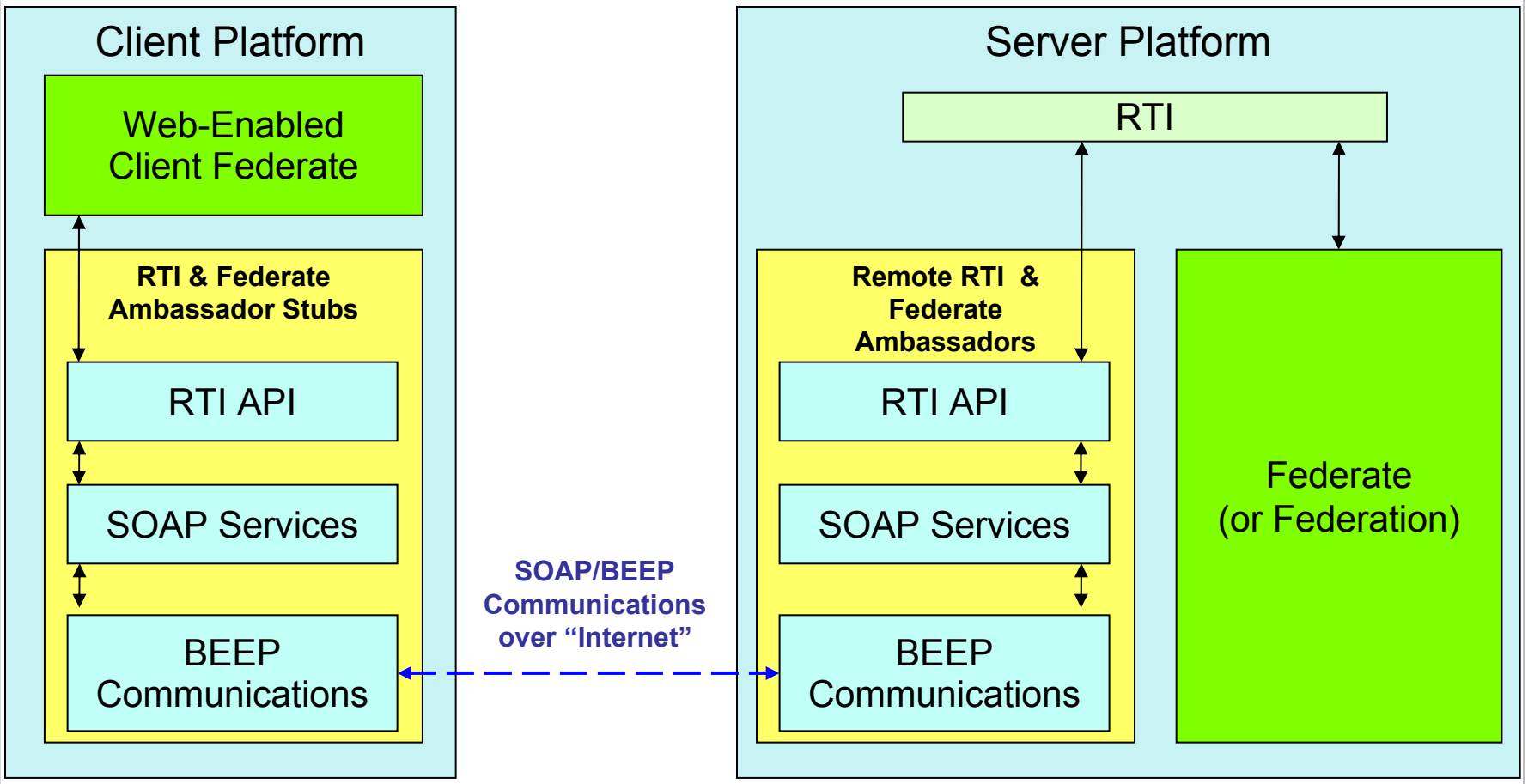
Demonstrates Web Service wrapping of existing architectures

- Approach can also be applied to DIS, ALSP, etc.

Makes existing federates and federations accessible as services as network centric services

- Analysis and decision support aids
- Training
- Testing

WE RTI Communication Architecture



WE RTI Communication Process Model

1. The user initiates the server side federate
    a. The server side federate starts the Federation
2. The user initiates the client side federate
    a. The client side federate spawns an RTI Ambassador Stub
    b. The RTI Ambassador Stub spawns a Federate Ambassador
    c. The Federate Ambassador spawns a Federate Ambassador Stub
    d. The stubs makes remote SOAP calls to initialize the remote RTI and Federate Ambassadors
3. The client side federate RTI calls go through the RTI Ambassador Stub, out to remote RTI Ambassador via SOAP, which passes the calls to the RTI
4. Communications from the RTI pass to the Remote Federate Ambassador, to the Federate Ambassador Stub via SOAP, and pass to the client side federate.

Example SOAP Data Exchange

Request to getAttributeHandle

```
<?xml version="1.0" encoding="UTF-8"?>
<soap-env:Envelope xmlns:soap-
        env="http://schemas.xmlsoap.org/soap/envelope/">
        <soap-env:Header/>
        <soap-env:Body>
          <getAttributeHandle>
            <whichClass>15</whichClass>
            <theName>testClass</theName>
          </getAttributeHandle>
        </soap-env:Body>
</soap-env:Envelope>
```

Response

```
<?xml version="1.0" encoding="UTF-8"?>
<soap-env:Envelope xmlns:soap-
    env="http://schemas.xmlsoap.org/soap/envel
    ope/">
    <soap-env:Header/>
    <soap-env:Body>
      <result_getAttributeHandle value="42"/>
    </soap-env:Body>
</soap-env:Envelope>
```

WE RTI in WMDOA

Weapons of Mass Destruction Operational Analysis Federation

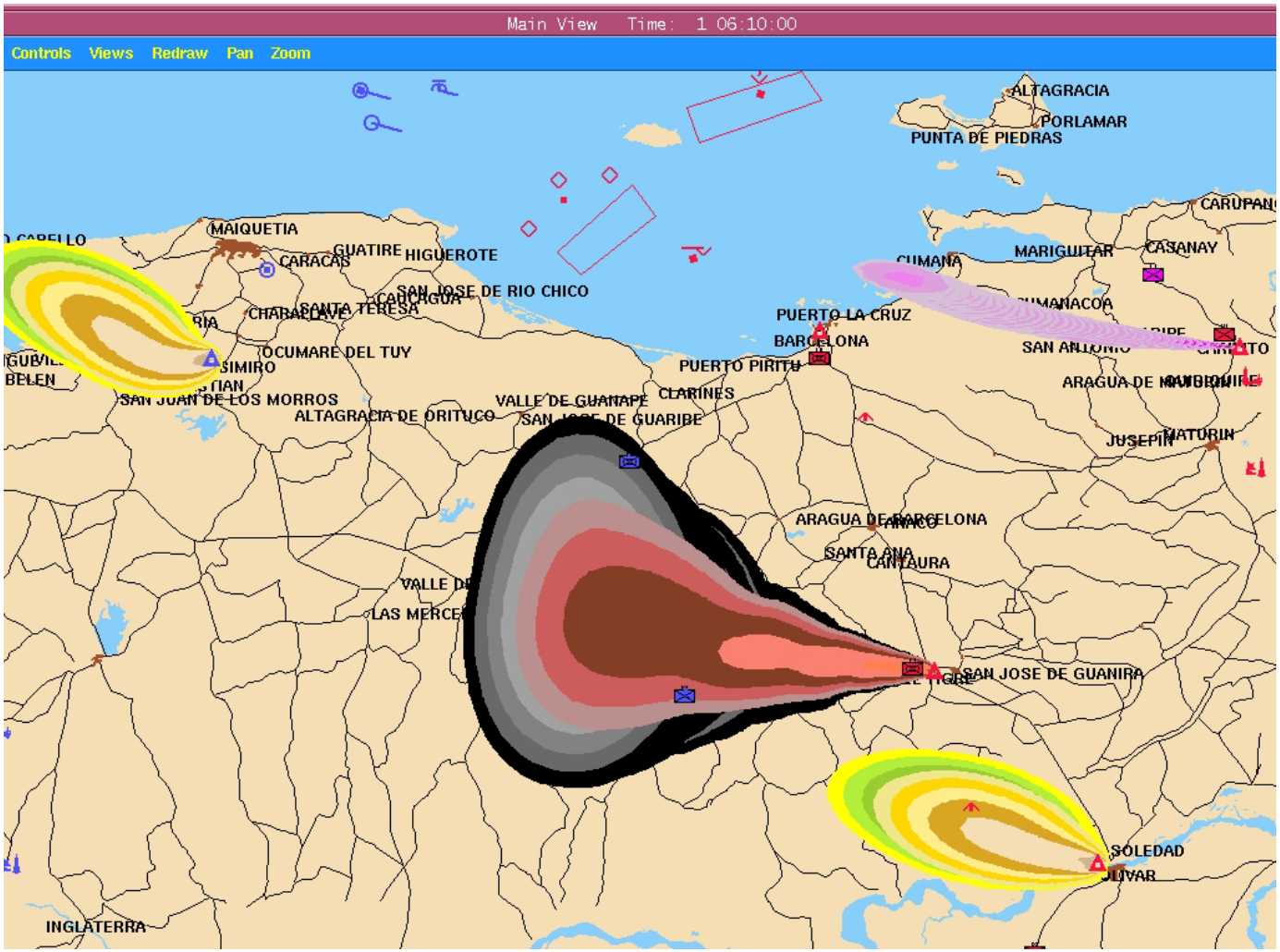
- Developed for Defense Threat Reduction Agency (DTRA)

Provides an analyst with the capability to model the effects of nuclear, biological, and chemical weapons and facilities within a joint force campaign

Includes combat model and WMD model

- Integrated Theater Level Model (ITEM)
  - Interactive, animated computer simulation of military operations in theater-level campaigns
  - Provides fully integrated air, land, and naval (including amphibious) warfare modules
- Hazard Prediction and Assessment Capability (HPAC)
  - Capability for modeling various aspects of release of nuclear, biological, and chemical (NBC) materials

ITEM and HPAC Integrated Display



XMSF DCEE Viewer (XDV)

The XDV is unclassified Internet/web protocol-based software

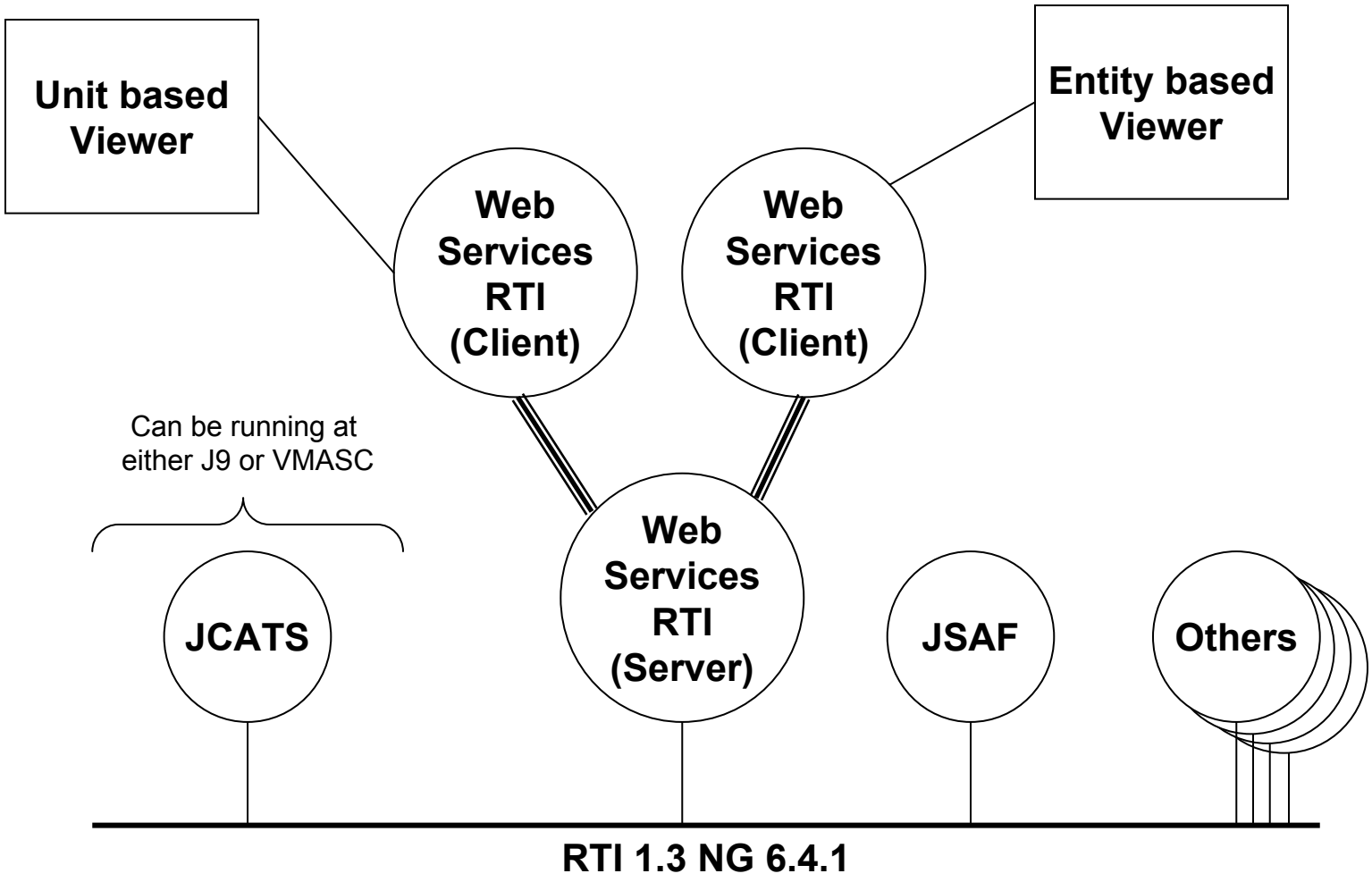
- Although it may be used to view classified data

Eligible stakeholder downloads software to a COTS PC or COE compliant system and executes it after installation

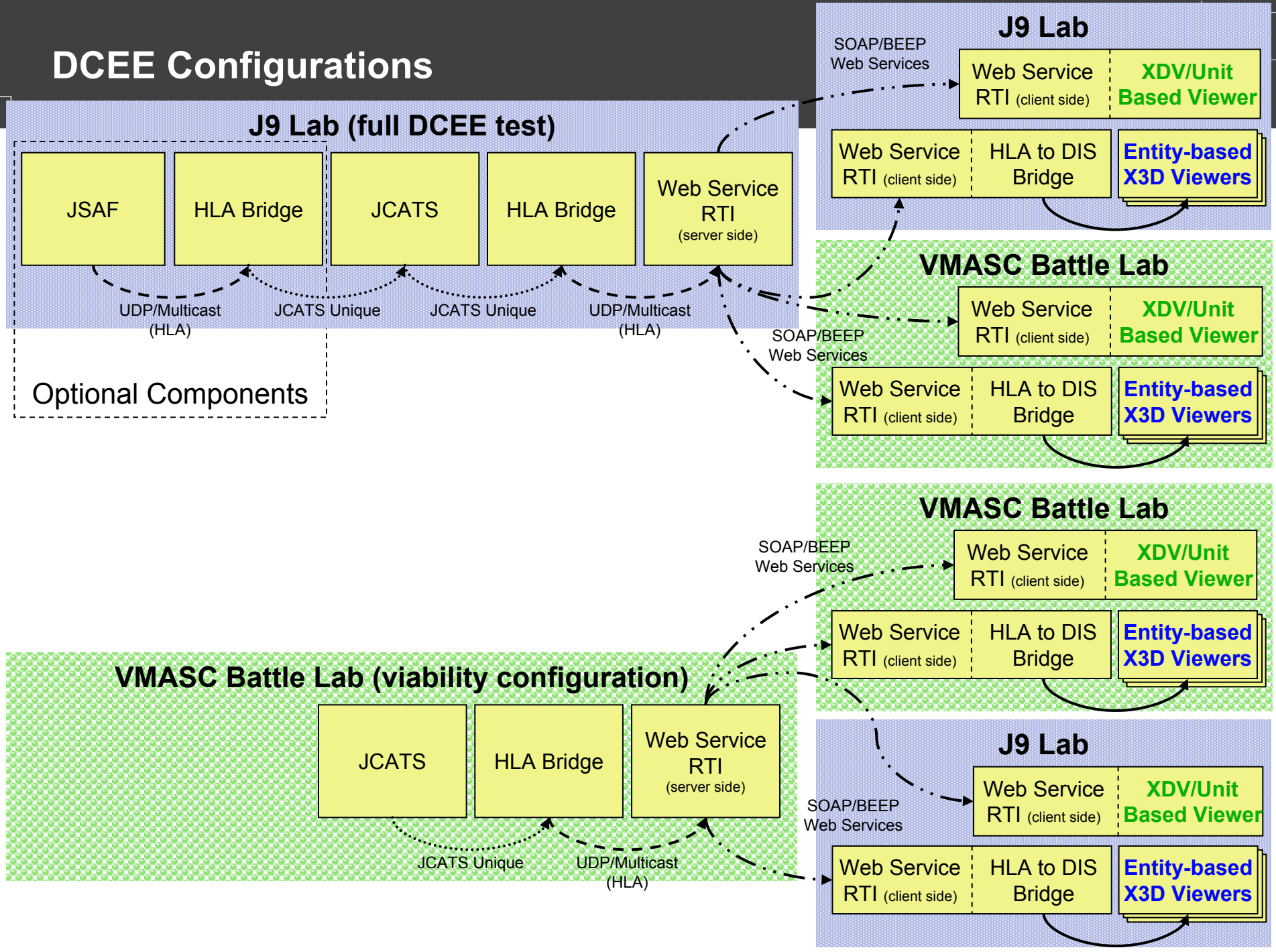
The XDV can display all information exchanged within the DCEE

- All information elements in the DCEE FOM are mapped to at least one element of the XDV GUI
- Because the XDV is a passive subscriber, its execution does not slow down the execution of the experiment

XDV Logical Architecture



DCEE Configurations



XDV Similarity to the CROP

Like the CROP, various information pieces of the C4I systems of the services have to be unified.

However, there are two key differences between the challenges in creating a CROP and in displaying the experiment during execution:

- There is no need for data fusion in experiment monitors. Other than in the C4I domain, the data from the participating simulations are “ground truth” data, and variances are caused by aggregation/disaggregation procedures or variances within the resolution of the models, i.e., variations are reproducible and of interest to those monitoring the experiment.
- Dynamic aspects are more important in experiment monitoring than in the CROP.

Future Work

Extend these concepts to a viewer/controller called the Experimental Command & Control Interface (XC2I)

- Support JFCOM J9's Joint Urban Operations experiments

Integrate access control mechanisms supported by standard web security mechanisms

Investigate making the IEEE 1516 HLA specifications more suitable for implementation as web services for further extension of its application in a network centric environment