21-23 June 2005, at US Military Academy, West Point, NY

Please complete this form 712CD as your cover page to your electronic briefing submission to the MORSS CD. Do not fax to the MORS office.

**Author Request** (To be completed by applicant) - The following author(s) request authority to disclose the following presentation in the MORSS Final Report, for inclusion on the MORSS CD and/or posting on the MORS web site.

Name of Principal Author and all other author(s):

Michael J. Leite

Principal Author’s Organization and address:

Phone: 703-824-3426

Fax: 703-998-0667

Email: michael.leite.ctr@dmso.mil

Original title on 712 A/B: Modeling and Simulation Applications on the Global Information Grid

Revised title: [Same]

Presented in (input and Bold one): **WG 06**, CG___, Special Session ___, Poster, Demo, or Tutorial:

This presentation is believed to be:

UNCLASSIFIED AND APPROVED FOR PUBLIC RELEASE
**Modeling and Simulation Applications on the Global Information Grid**

1. **REPORT DATE**
   
   **01 JUN 2005**

2. **REPORT TYPE**
   
   **N/A**

3. **DATES COVERED**
   
   **-**

4. **TITLE AND SUBTITLE**

   **Modeling and Simulation Applications on the Global Information Grid**

5. **AUTHOR(S)**

6. **PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)**

   **Defense Modeling and Simulation Office**
   
   **1901 North Beauregard Street, Suite 500 Alexandria, Virginia 22311-1705**

7. **SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)**

8. **PERFORMING ORGANIZATION REPORT NUMBER**

9. **DISTRIBUTION/AVAILABILITY STATEMENT**

   **Approved for public release, distribution unlimited**

10. **SUPPLEMENTARY NOTES**

    **See also ADM201946, Military Operations Research Society Symposium (73rd) Held in West Point, NY on 21-23 June 2005. The original document contains color images.**

11. **ABSTRACT**

12. **SUBJECT TERMS**

13. **SECURITY CLASSIFICATION OF:**

    | a. REPORT | b. ABSTRACT | c. THIS PAGE |
    |----------|-------------|-------------|
    | unclassified | unclassified | unclassified |

14. **LIMITATION OF ABSTRACT**

    **UU**

15. **NUMBER OF PAGES**

    **38**

16. **NUMBER OF RESPONSIBLE PERSON**

    **19a NAME OF RESPONSIBLE PERSON**
Modeling and Simulation Applications on the Global Information Grid

Michael J. Leite, PE
Modeling & Simulation Project Manager
Science Applications International Corporation
SETA Support to the—
Defense Modeling and Simulation Office
1901 North Beauregard Street, Suite 500
Alexandria, Virginia 22311-1705
703-824-3416 mleite@dmsa.mil
Purpose

• To examine the ways in which modeling and simulation (M&S) can be integrated into the Global Information Grid (GIG) to provide enhanced capabilities to GIG participants.
Introduction

• The Global Information Grid (GIG) is:
  - Major Restructuring of DoD Communications and Information Infrastructure
  - Implementation of Net-centric Warfare Concept
  - Modeled on Internet
  - Major Opportunity for M&S to Support Operating Forces
GIG Architecture

• Consolidation of separate protocols and media into integrated backbone
  - Network
  - Broadcast
  - Point to point

• Medium is Transparent to User

• Use of Internet Protocol (IP V-6) and Web Services to Exchange Data
GIG Architecture (Ctd.)

• The GIG is:
  - An Integrated, Scalable, Fully Distributed Processing and Transport Environment
  - Based on Commercial Technology

• GIG Capabilities include:
  - Move data from any source to any destination
  - Tailored Information—"Intelligent Pull"
  - Integrates Legacy Systems
  - Exploits sensor, weapon and platform capabilities
GIG Architecture (Ctd.)

GIG Enterprise Services (GES)

Warfighting Domains
- Intel Domain
- Intel
- SA
- Etc.

Business Domains
- Logistics
- Finance
- Personnel
- Etc.

Comms Backbone

Core Enterprise Services (CES)*
- ESM
- Mediation
- Messaging
- Collaboration
- App Hosting
- User Asst

Community of Interest (COI) Capabilities

GLOBAL INFORMATION GRID

Scale: Several Million Users; Tens of Thousands of Information Services
Net-centric Warfare on the GIG

- Ensure Data are Visible, Accessible & Understandable
- Tag with Metadata to Facilitate Discovery
- Post Data to Shared Spaces
- Organize around Communities of Interest (COIs)
Net-centric Warfare on the GIG

Information Infrastructure: Layered, Adaptable, Tightly Coupled

Entities (Objects)

Applications

Net-centric Enterprise Services

Distributed Computational Resources

Intranetworked Information Transport

Entities: Sources & Users of Information

UAVs

Logistics Platforms

Weapons

Weapon Platforms

Sensors

Sensor Platforms

Robots

Force Structures

People
DoD Net-centric Data Strategy

• Ensuring that data are visible, accessible and understandable

• Tagging with metadata to enable discovery

• Posting data to shared spaces

• Organizing around Communities of Interest (COIs)
DoD Net-centric Data Strategy (Ctd.)

Security Layer

Resource Description Layer

Format Description Layer

Content Description Layers

COI Defined Layers

Security markings layer. Obligation based on top-level security classification.

Resource maintenance and administration metadata (e.g., date created, author, publisher, title etc).

Format-specific metadata (e.g., picture size, database record count, multimedia stream duration, file size, etc.)

Rich content descriptive metadata structure. Structured approach to provide robust method for discovery.

Community of Interest defined metadata structure(s). Must be registered with DoD XML Registry for integration with Enterprise-wide capabilities.
GIG Implementation

• Internet Protocol (Version 6)
• GIG Bandwidth Expansion (GIG-BE)
• Transformational Communications System
• GIG Information Assurance
GIG M&S Implementation

- By Technique
  - Live
  - Virtual
  - Constructive

- By Application
  - Analysis
  - Test and Evaluation
  - Training
  - Operations Planning

- Within Internet Context
  - Local
  - Remote
  - Distributed

- Model Elements
  - Data Set
  - Algorithm
  - Operating System
  - Communications (input/output or I/O)

For the purposes of this paper, we will consider models and simulations in terms of the Internet Context
M&S Implementation Terminology

• Local—Functionality Resident in Controlling Processor
  Base Case is “Stand-alone” when all functionalities resident in one processor

• Remote—Functionality Resident in non-local Processor

• Distributed—Functionality Resident in Multiple Processors
GIG M&S Techniques

• Evolution Process
  - Standalone
  - Dedicated Network
  - Local Area Network (LAN)
  - Internet and GIG (Internet Protocol)

• GIG Processes
  - Remote Processing and Data Acquisition
  - Distributed Simulation
Internodal Diagram—Remote Processing and Data Acquisition

Local User                      Remote Processor             Remote Data

Global Information Grid
Remote Data Acquisition Process

1. Data Need Identified
2. Application Interrogates Metadata Registry
3. Registry Returns Available XML Metadata & Info Resources
4. Application Interrogates GIG Using Metadata
5. Potential Sources Respond
6. Application Selects Data Sources
7. Application Requests Data
8. Data Passed Via GIG
9. Application Parses Data Per XML
10. Data Utilized in Application
Remote Data Acquisition

• DoD Implementation
  - Metadata Guided Search
  - Data Discovery
  - Parsing for Retrieval
Remote Data Acquisition

A Use Case...

1. I’m looking for …
2. What web services are available that implement the Federated Content Discovery Query that are relevant to the user’s request?
3. Call the individual Content Discovery Queries
4. Aggregate, organize and return a list of links
5. Select Data sources
6. Gather & parse selected data
7. Return selected data

GIG Portal

Service Discovery Services (e.g. UDDI)

Content Mgmt Systems

Enterprise Information Integration

Federated Search API

Enterprise Search API

MSE

RDBMS’s

Catalog

Storage

Catalog

(Source: DISA)
Remote Data Acquisition

• Examples
  - Accessing reference data
  - Accessing classified sources
  - Interrogating multiple sources

• Benefits
  - Timeliness of data and turn-around
  - Speed of set-up, execution and analysis
  - Accuracy--Authoritative Sources Selection
  - Reduced Reply Bandwidth Requirements
Remote Execution Process

• One Data Processor Accesses Another
  - Initializes and Executes a Program
  - May Involve Remote Data Sources
  - Minimum Data Exchange
Remote Execution Process

User Logs Onto Remote Model or Simulation → Application Downloads Set-up Screen → User Inputs Set-up Data → Application Executes Model or Simulation

Application Formats Output for User → Data Passed Via GIG → User Analyzes Output, Makes Decision or Reiterates Process
Remote Execution Process

• Examples
  - Purchases Made Over the Internet
  - Accessing Scientific & Engineering Models Over the Internet
  - Internet Email Access

• Benefits
  - Ability to Utilize Remote Sources
  - Program Owner Can Maintain Software Without Need for Mass Distribution
  - Control Over Input Data
  - Minimum Processor Requirement for Remote Users
Distributed Simulation Execution

• Data Exchange Medium and Protocol
  - Ensure Connectivity
  - Prevent Data Latency from Affecting Solution

• Execution Control Medium and Protocol
  - Sequencing
  - Prevent Control from Influencing Solution

• Synchronization via Master Clock
  - GPS for Real Time
  - Event Time Control
Internodal View—
Distributed Simulation Execution

Master Federate  Distributed Federates  Distributed Data Sources

Tactical Communications Link

Global Information Grid

Work Stations (May, or may not, be at specific distributed federates)
Main Frame or Tactical Data Processor
GIG Network

Mass Data Storage (May, or may not, be at specific distributed federates)
Communications Suite--Routers/Modems/Tactical Radios
Tactical Communications Link (Selected Federates Only)

Local Area Network (LAN)
Distributed Execution Process

1. **Lead Participant** Initializes Simulation
2. **Individual Federates Join Federation**
3. **Initial Data Passed to Individual Federates**
4. **Live & Remote Data Sources Disclosed to Federates**
5. **Federation is Synchronized**
6. **Federation Executes Simulation**
7. **Federates Request Data**
8. **Data Passed Via GIG**
9. **FINEX, Event Data Gathered**
10. **After-action Data Passed Via GIG**
11. **Output Formatted for Users**
12. **Data Passed Via GIG**
13. **Participants Analyze Output, Make Decisions or Reiterate Process**
M & S Applications

• Remote Data Acquisition
  - Access
    ♦ Reference/Authoritative Data Sets
    ♦ Classified Data—Secure Connections
    ♦ Utilize Multiple Sources
  - Advantages
    ♦ Improved Timeliness
    ♦ Faster—Set-up, Execution & Analysis
    ♦ Increased Accuracy—Better Data
    ♦ More Efficient Use of Bandwidth
M & S Applications (Ctd.)

• Remote Execution
  - Access
    ◆ More Complex M&S Applications
    ◆ Larger Processors
  - Advantages
    ◆ Security of Data and M&S Application
    ◆ Standardization/Configuration Control
    ◆ Reduced Field Unit Processor Requirements
    ◆ Smaller Software Load for Remote Users
Remote Execution Example

NOAA On-line Tide Model

A. Executed for Current/Historical Data

B. Executed for Future Conditions
M & S Applications (Ctd.)

• Distributed Execution
  - Access
    ◆ Multiple Processors
    ◆ Multiple Sites
    ◆ Different Operating Systems
  - Advantages
    ◆ Synchronous or Asynchronous Execution
    ◆ More Accurately Represent “Real World” Operation
    ◆ Incorporate Operational Applications/Processors.
M & S Applications (Ctd.)

• Distributed Execution Example
  - Horizontal Fusion Program

  • Build-out the Collateral Space
    - ISP-like provider
    - Implement Standard Specifications
      • NCES
    • Data Mgt Strategy

  • Continuously add data stores

  • Implement “sense-making” applications
    • Complex pattern recognition
    • Large Data Set Visualization
    • User profiling
      • Subscription
      • Portal tailoring
      • Alerts

Warrior’s Edge
DCGS-A
DCGS-N
PKI
Common Services
E-Mail
Collaboration
Community Applications
Collateral Space
Full Service Directory
IP Networks – IPv6
Data Cached on the Net
CEC
P-3
Welcome to: Free Online Multiplayer Interactive Games
The ultimate directory of free multi-player games you can play online through your web browser (Netscape, Internet Explorer, AOL browser, WebTV,...).
Hundreds of games sorted into 6 categories: strategy & war games, role-playing games, board & card games, sports games, action & fight games, other games.
All the games are FREE to play and require no additional software to download and install on your computer!

Welcome to Free Online Multiplayer Interactive Games
This site is not a general site about computer games or online gaming. It is a directory dedicated to free multi-player webgames. What's that? Well, in short:
1. The games you will find on this site are absolutely FREE to play. Nothing to pay, ever. Enjoy!
2. The games are all multi-player. The Web allows you to play with thousands of people from all over the world, so why would you want to play alone? ;-)
3. The games are designed to be played right in your web browser. No plug-ins are needed, and you don’t need to download and install anything on your computer.
Summary

• Required Technology is Here Today
• Infrastructure is Growing to Meet Need
• Need to Change Current Practices
  - Adapt M&S as Web Service/Application
  - Facilitate Discovery/Increase Visibility
• Commercial World has Implemented Elements of All Application Types
The Way Ahead--Considerations

• Data Posted for Discovery on GIG
  - Common Metadata Throughout Community
  - Example: DoD Metadata Registry

• Data In Machine-useable Format
  - Data Structure Published in Metadata
  - Example: ISO/IEC 18025, Environmental Data Coding Specification

• Model Accessibility
  - Large: Remote Execution
  - Small: Downloadable Format

• Time Management
  - Revised IEEE 1516 (Series), High Level Architecture
Conclusion

• **M&S on the GIG . . .**
  - Is A Concept whose Time has Come
    - Based on Commercial Technology
  - Will Benefit Users and Developers
    - Designers
    - Trainers
    - Analysts
    - Warfighters
  - Information Assurance is a Major Hurdle
    - Being Solved through Horizontal Fusion Demos and follow-on efforts
Gig Structure—Alternate View 2

GIG Governance

Business Mission Area
- Installations & Environment Domain
- Human Resources Domain
- Acquisition Domain
- Strategic Planning & Budgeting Domain
- Logistics Domain
- Accounting & Finance Domain

Warfighter Mission Area
- Governance
- Financial Domain
- Force Application Domain
- Protection Domain
- Focused Logistics Domain
- Battlespace Communications Systems Domain

National Intelligence Mission Area
- Governance
- In work

Information Assurance Domain

Communications Domain

Computing Infrastructure Domain

Core Enterprise Services Domain

Governance

Enterprise Information Environment Mission Area

National Intelligence Enterprise Information Environment Mission Area

In work