

**M & S 101**

*Introduction to Modeling and Simulation*

**Part 2**

## Prior to 1990s

**Focus was on  
two areas of  
the world!**



**What we thought would be the result  
of losing one focus area!**



*Now*

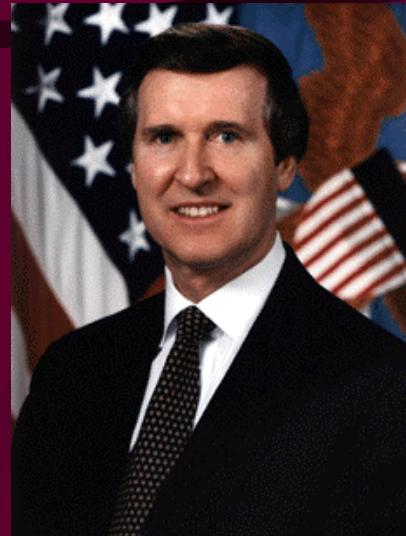
# Reality of Today: Less \$, Multi-Threats



2010

Chem/Bio  
Anti-Terrorism  
Counter  
Proliferation

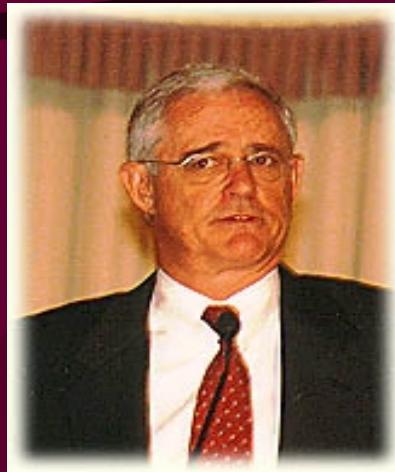
## Messages From The Top



**“The path for this is outlined in **Joint Vision 2010...**  
**blueprint for future military operations, which**  
***combines modern technology with new operational***  
***concepts and organizational structures designed to***  
***make the most of technological advances.”*****

**William S. Cohen**        
**Secretary of Defense**  
**1998 Annual Report to the President and the**  
**Congress.**

## *Messages From The Top*



**"We are *committed to reforming the acquisition system* and recognize that *an essential tool* for accomplishing that reform will be *modeling and simulation.*"**

**Dr. Jacques S. Gansler  
Under Sec Def (Acquisition and Technology)  
DMSO Industry Day  
2 Jun 1998**

## Messages From The Top



***“Simulations must be interconnected globally--creating a near-real-time interactive simulation super highway between our forces in every theater.*** Each CINC must be able to tap into this global network and connect forces worldwide that would be available for theater operations.”

**GEN Henry H. Shelton**  
**Chairman, Joint Chiefs of Staff,**  
**Joint Vision 2010**

### Continuing squeeze on DoD resources

- shrinking, dispersed force structure
- competition for resources limits field exercises
- need to carefully examine every investment

### More demanding operational requirements

- new complex missions
- expanding mission space
- complexity of systems and plans
- demand for joint/combined training
- security challenges

### Greater technical capability at lower cost

- communications
- computers
- advanced software technology
- displays/human-machine interfaces
- data storage and management



**Advanced M&S  
offers a  
cost-effective  
solution**

# Distributed Simulation

**WARFIGHTERS**

**ENGAGED  
IN THE  
SIMULATION**

**CONSTRUCTIVE**

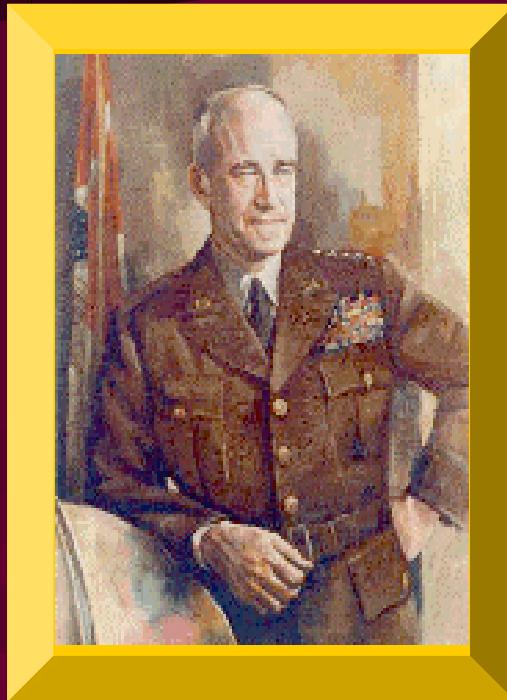
**LIVE**

**COMMUNICATIONS AND  
PROTOCOL STANDARDS**

**VIRTUAL**



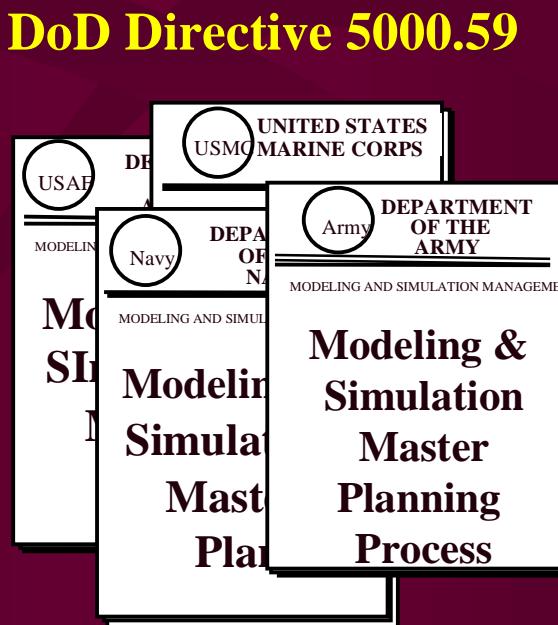
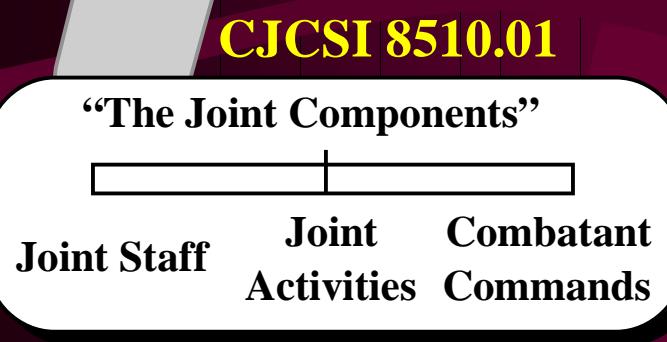
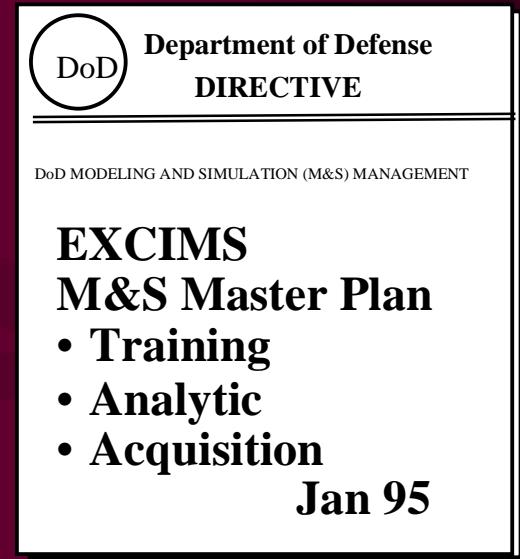
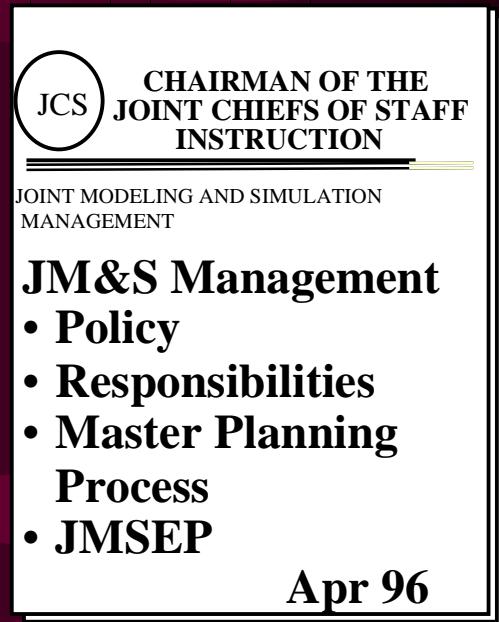
# **"A" BIG CAUTION!**



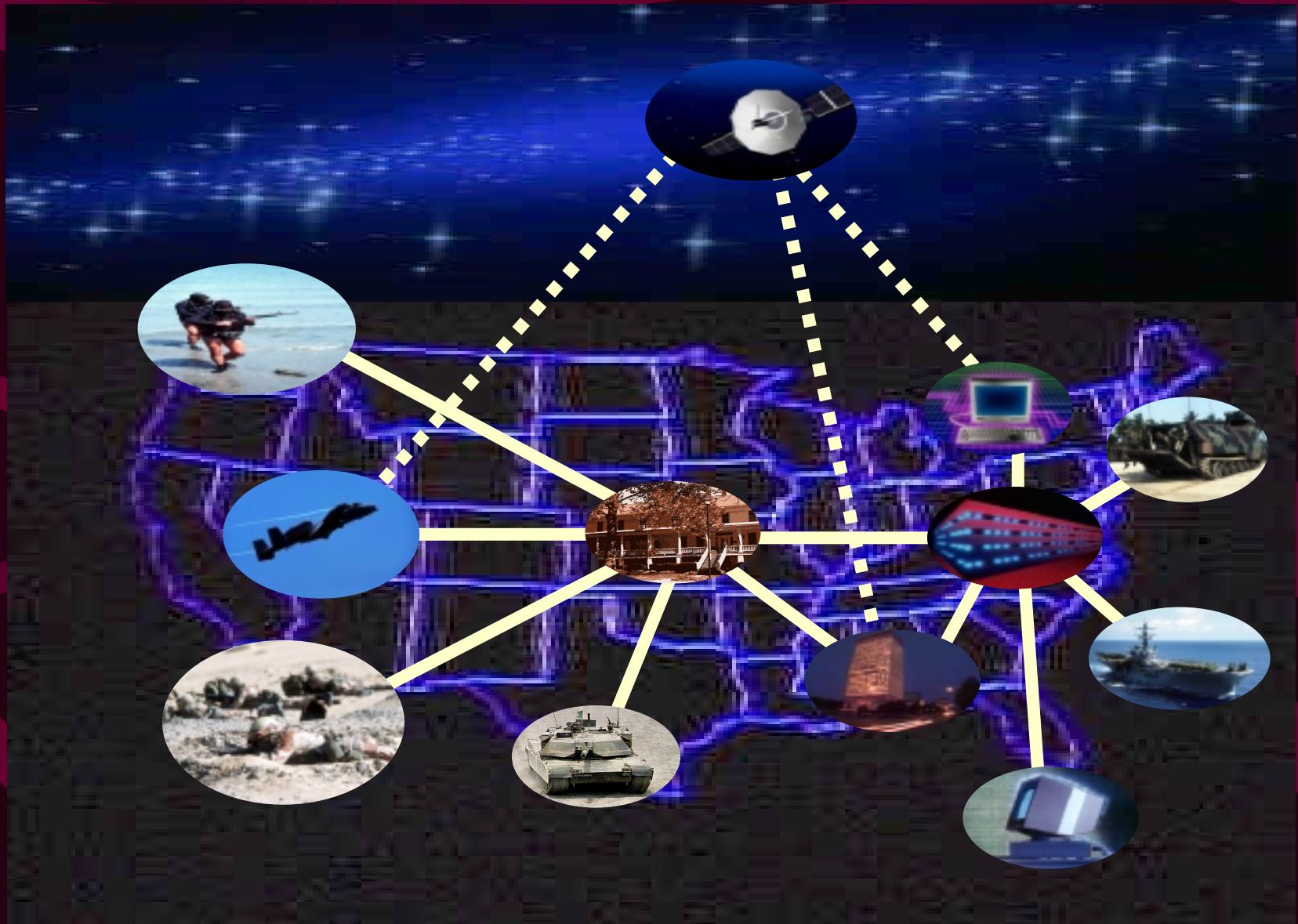
***"If we continue to develop our technology without wisdom or prudence, our servant may prove to be our executioner."***

**- General Omar Bradley**

# *The Strategy Is Being Executed Through a series of DoD-wide M&S Planning Documents*



*Move “trons”, not troops*



# DoD M&S Master Plan

Dev

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## Objective 6

Share the benefits of M&S

### Sub-objectives

6-1

Quantify impact

6-2

Education

6-3

Dual-use

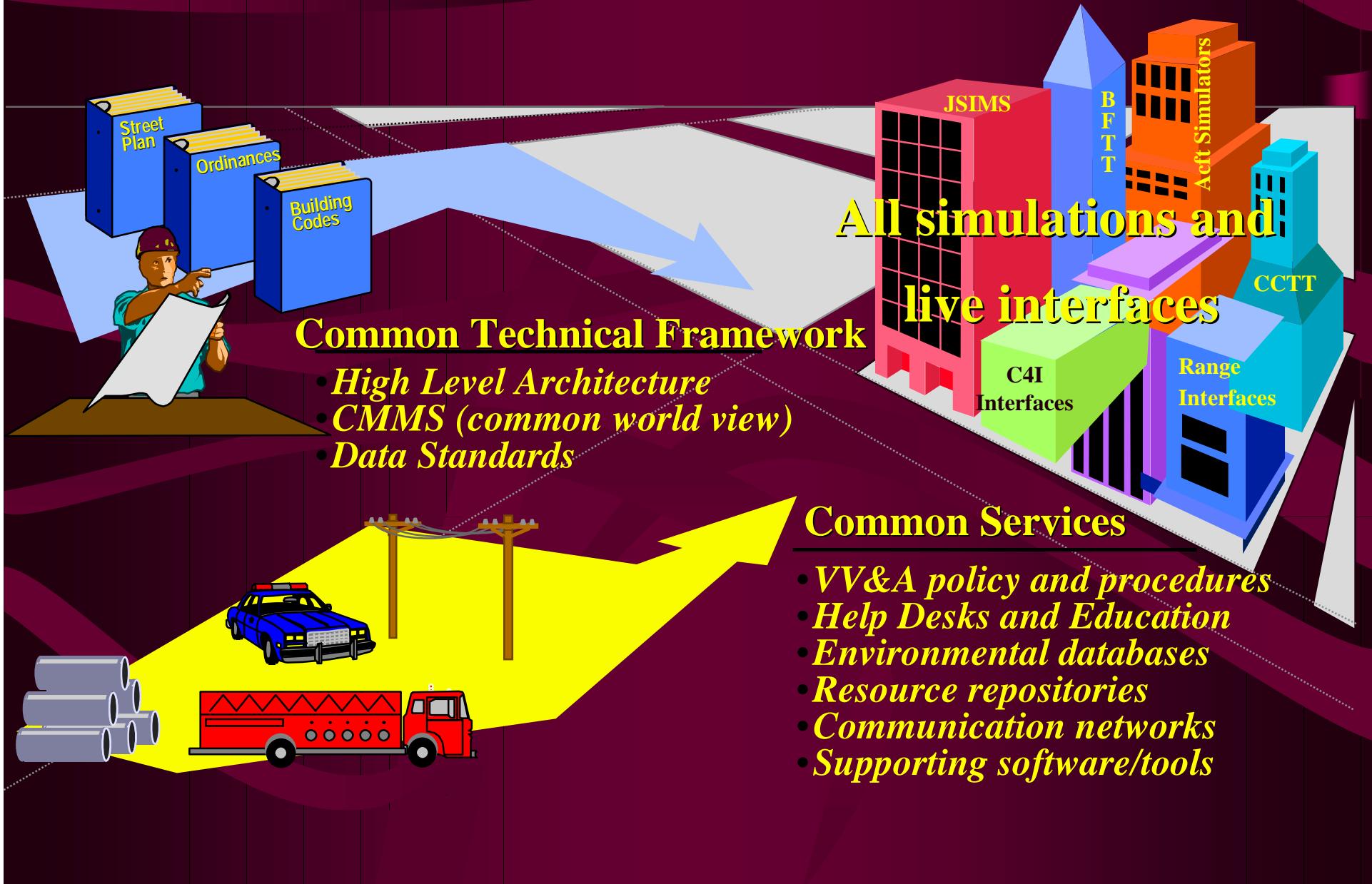
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# M&S: An Analogy to City Planning

Payoffs: Interoperability and reuse = capability and cost-effectiveness



# Objective 1

Interoperability

## *Common Technical Framework:*

- *High Level Architecture (HLA)*
- *Conceptual Models of the Mission Space (CMMS)*
- *Data Standards*

# Concept of Interoperability

**At the most basic level,  
Interoperability is the ability of two  
Simulations to Communicate.**



**Although more complicated it is not unlike  
talking on the telephone;  
internationally, when both the  
technology and the language are  
critical.**

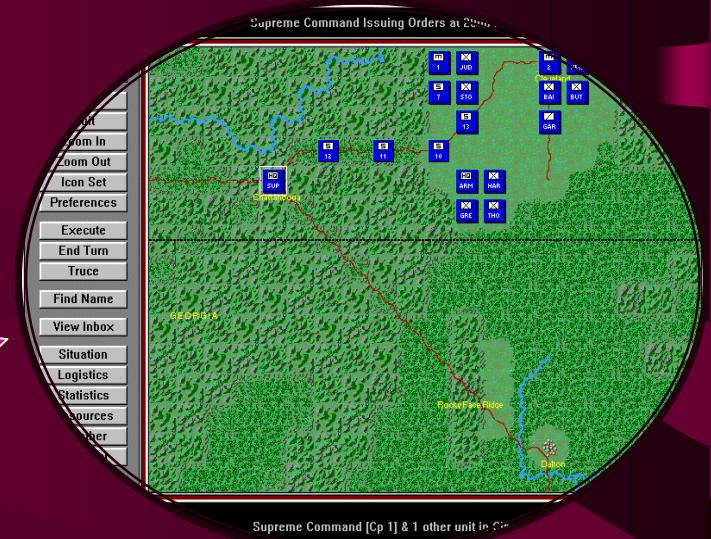
# Concept of Interoperability

**Every development team  
should create standards for  
interoperability to ensure a  
simulation will work well on  
its own and with other  
simulations**



**Simulation “B”**

**Simulation “A”**



**Standards allow different  
simulations to work  
together**

***M&S Interoperability* is the ability of a model or simulation to provide services to and accept services from other models and simulations, and to use the services so exchanged to enable them to operate effectively together.**

**DoD M&S GLOSSARY, Jan 98**

# Concept of Interoperability

## *Examples of Standards*

Parameters

Analysis  
Approach and Tools

Scenarios

Timing

Mathematical  
Approaches

Units

Conversions

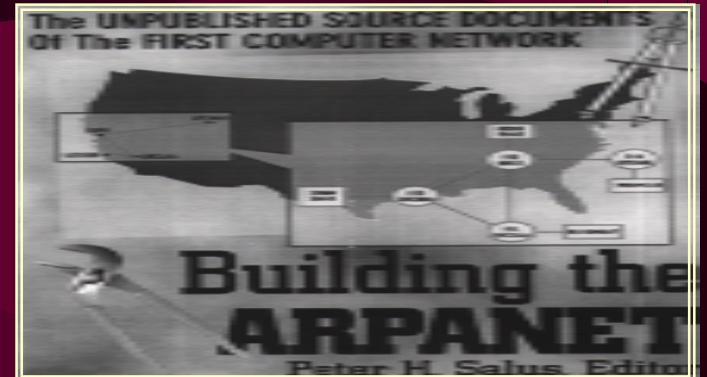
Data Formats

Languages

Coordinate  
System

# History of Interoperability

**1971 ARPANET, first  
distributed  
INFORMATION network.**

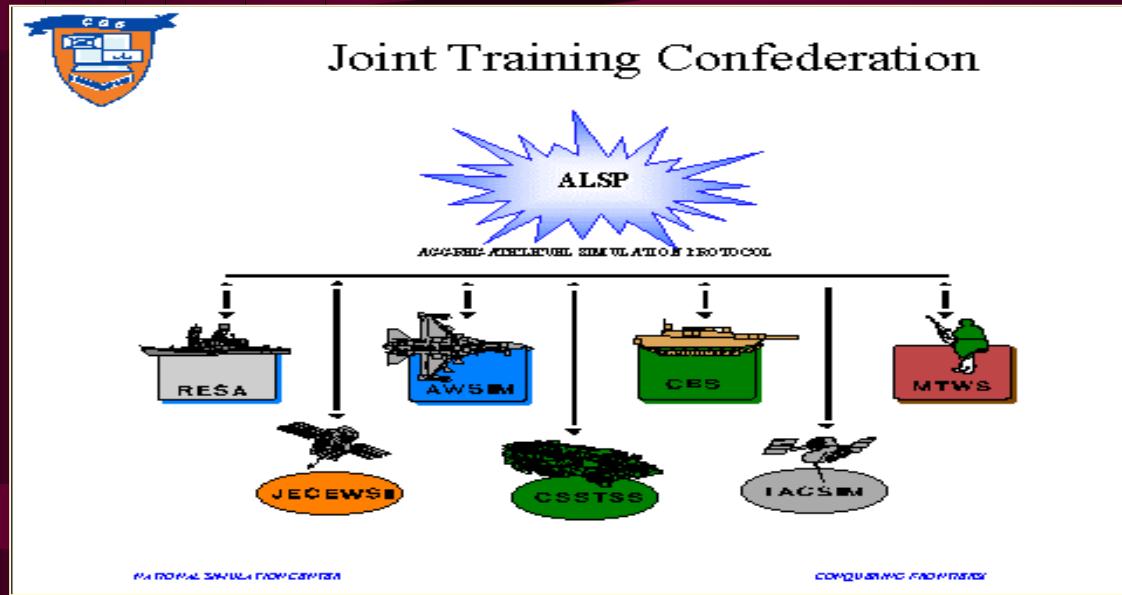


**1982 SIMNET, first  
distributed  
SIMULATION network.**

**Today -- CMMS, Data  
Standards, and  
HLA**



# ***Aggregate Level Simulation Protocol (ALSP)***

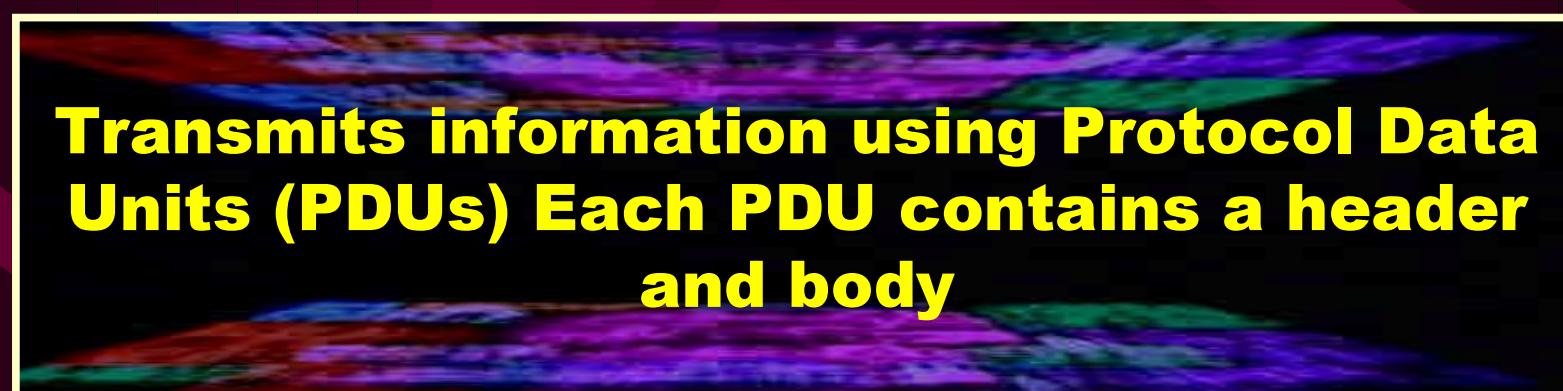


- **Connects multiple simulation groups**
- **Three main parts:**
  - Infrastructure software
  - Translation segment
  - Participating simulation adopted for use
- **Benefits of ALSP**

## **Distributed Interactive Simulations (DIS)**



**Means of linking  
simulators and  
simulations that  
are physically  
separated**



**Transmits information using Protocol Data  
Units (PDUs) Each PDU contains a header  
and body**

# Interoperability Today - CTF

## **KEY: Interoperability and Reusability**



**The CTF comprises  
the “city codes” for  
M&S in the area of  
Technical  
Components and  
Infrastructure.**

**High  
Level  
Architecture  
(HLA)**

**Conceptual Models  
of  
Mission Space  
(CMMS)**

**Data  
Standards**

# Interoperability Today - HLA

***High Level Architecture (HLA)* - Major functional elements, interfaces, and design rules, pertaining as feasible to all DoD simulation applications, and providing a common framework within which specific system architectures can be defined.**

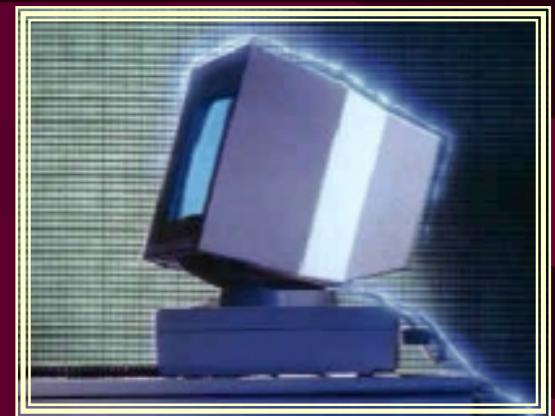
# Interoperability Today - HLA

## **HLA is the Cornerstone of CTF**

**In Simulations, “Stuff”  
Is Represented  
With Information  
About Characteristics  
and Processes.**



**HLA Allows for the  
Different  
Simulations to  
Exchange Object  
Attributes**



**This “Stuff” is Known  
As  
Object Attributes.**

# Interoperability Today - HLA

## **HLA RULES**

**Designed to achieve interaction. Include responsibilities of simulations and Runtime Infrastructure in HLA Federations.**

### **Object Model Template**

**Help characterize each object and interaction so all participating objects understand what it can do.**

### **Interface Specification**

**Coordinates functions and data between the Runtime Infrastructure and simulations in HLA**

# Interoperability Today - HLA

## *Object Model Template (OMT)*

*Provides a common framework  
for HLA object model  
documentation.*



Object Model Identification Table	
Category	Information
Name	Combat Soldier
Version	N/A
Date	Oct 96
Purpose	Use for Urban Terrain Operations
Domain	Trainig
Sponsor	Army STRICOM
POC	COL Rock
POC Organ	Army Simulation Center
POC Tele	
POC Email	
Name	Beach Assault FOM
Version	1.0 Alpha
Date	1 Jan 1998
Purpose	

# SOM

**Federation Object Model (FOM)** - An identification of the essential classes of objects, object attributes, and object interactions that are supported by a High Level Architecture federation. In addition, optional classes of additional information may also be specified to achieve a more complete description of the federation structure and/or behavior.

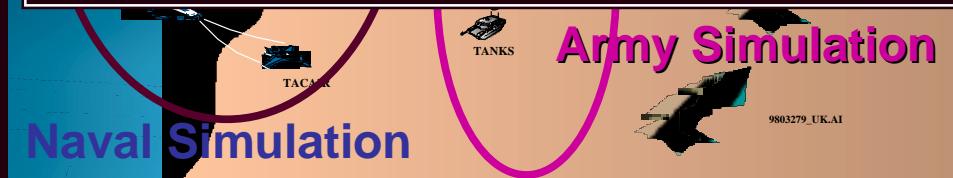
DoD M&S GLOSSARY, Jan 98

DO SHARE

# SOM

**Simulation Object Model (SOM)** - A specification of the intrinsic capabilities that an individual simulation offers to federations. The standard format in which SOMs are expressed provides a means for federation developers to quickly determine the suitability of simulation systems to assume specific roles within a federation.

DoD M&S GLOSSARY, Jan 98



essential to a particular federation. A subscription list for Federates in the Federation.

# Interoperability Today - HLA

*HLA is Viewed as Part of Broader Standards*

**DoD Joint Technical  
Architecture  
(JTA)**

**(Completed)**

**North Atlantic Treaty  
Organization  
(NATO)**

**(Completed)**

**Simulation Interoperability  
Standards Organization  
(SISO)  
for IEEE Standards**

**(In Process)**

**Object Management  
Group  
(OMG)**

**(Completed)**

## Interoperability Today - HLA

*DoD Policy: “Under the authority of [DoD Directive 5000.59], and as prescribed by y [the DoD Modeling and Simulation Master Plan], I designate the High Level Architecture as the standard technical architecture for all DoD simulations.”*

*HLA supersedes Distributed Interactive Simulation (DIS) and ALSP*

### **“No Can” Dates**

**-“No Can Pay”- first day of FY99**

- no funds for developing/modifying non-HLA-compliant simulations**

**-“No Can Play”- first day of FY01**

- Retirement of non-HLA-compliant simulations*
- Waivers must be decided on a corporate basis*

*Dr. Paul Kaminski, USD(A&T)  
10 September 1996*

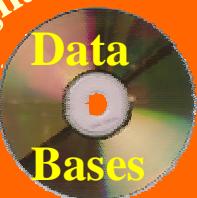
# Data Standards

## Knowledge Collection



P  
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E

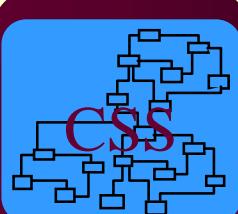
Component  
Designated Sources



Publications  
Doctrine  
Operations  
Tactics



Subject Matter  
Experts



Common  
Semantics  
& Syntax



Common  
Data  
Interchange  
Formats



# ***Conceptual Models of the Mission Space (CMMS)***

***CMMS is a bridge between the warfighter and the developer!***



## ***Conceptual Model***

**Front-end analysis to determine warfighter's representation of the real world**



***Functional descriptions of relevant aspects of the real (or projected) world, including:***

**- entities**

**- processes**

**- relationships and interactions  
(including environmental factors)**

# Objective 2, 3, & 4

Representation

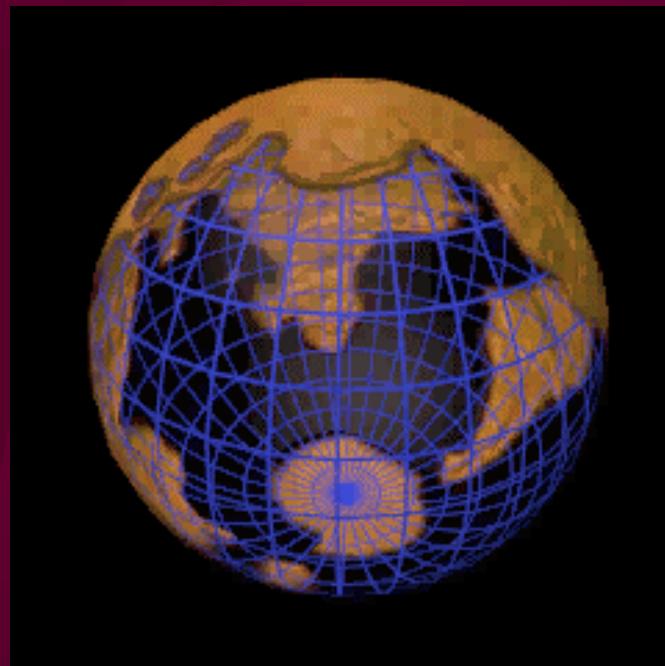
*Natural Environment*

*Systems*

*Human Behavior*

## Representation

**Old simulation engineering saying:**  
“We can make your simulation as real as you want,  
even if it takes every dollar you have.”



# Representation

*Simulation is at best an imperfect replication of the real world!*

Reality



One User's Concept  
of Reality



Simulation  
End-Product



## Representation - What's Involved (Baseball Analogy)



***CTF provides the rulebook!***



**Playing Field**



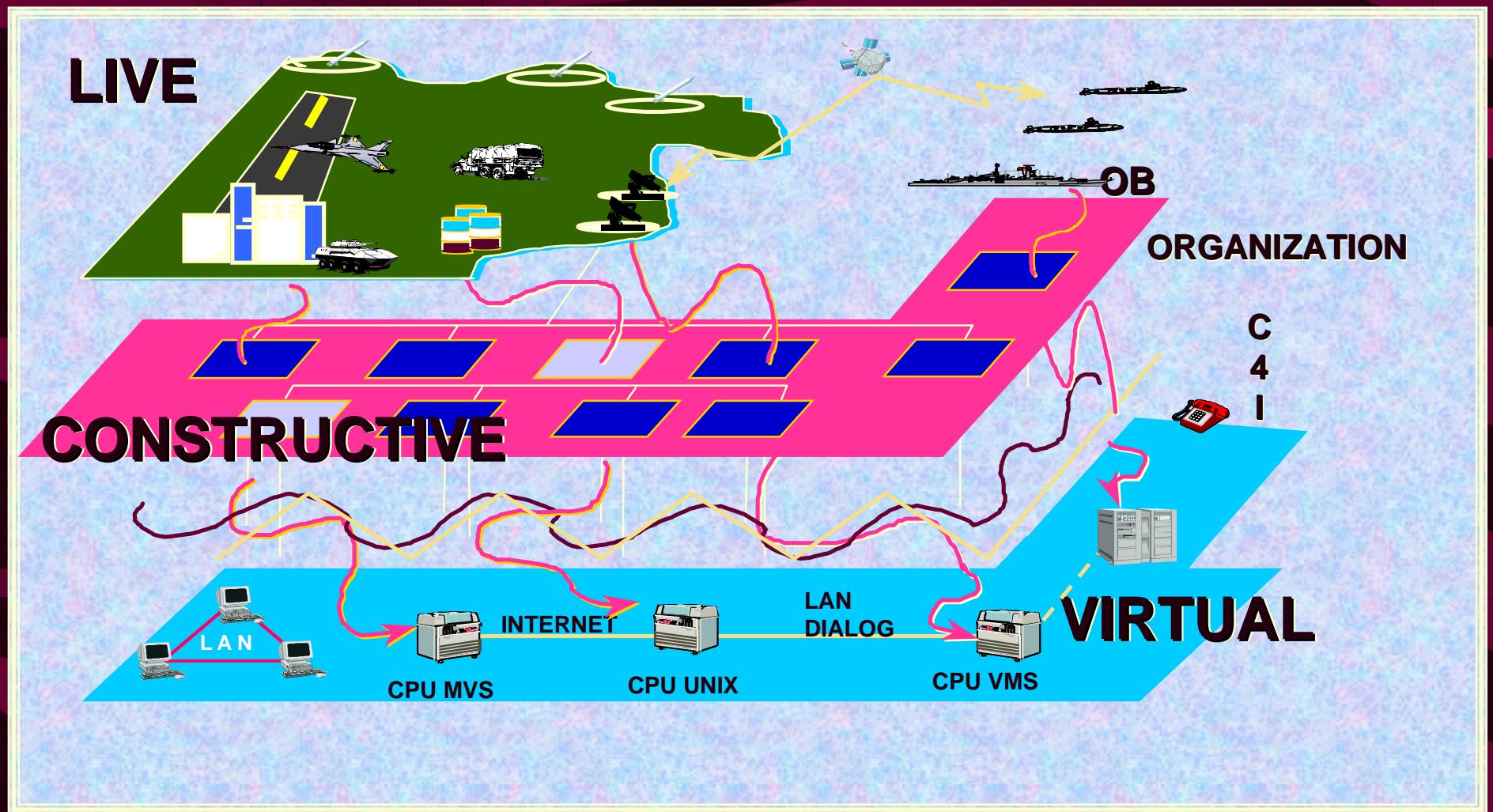
**Equipment**



**Players**



# Types of M&S

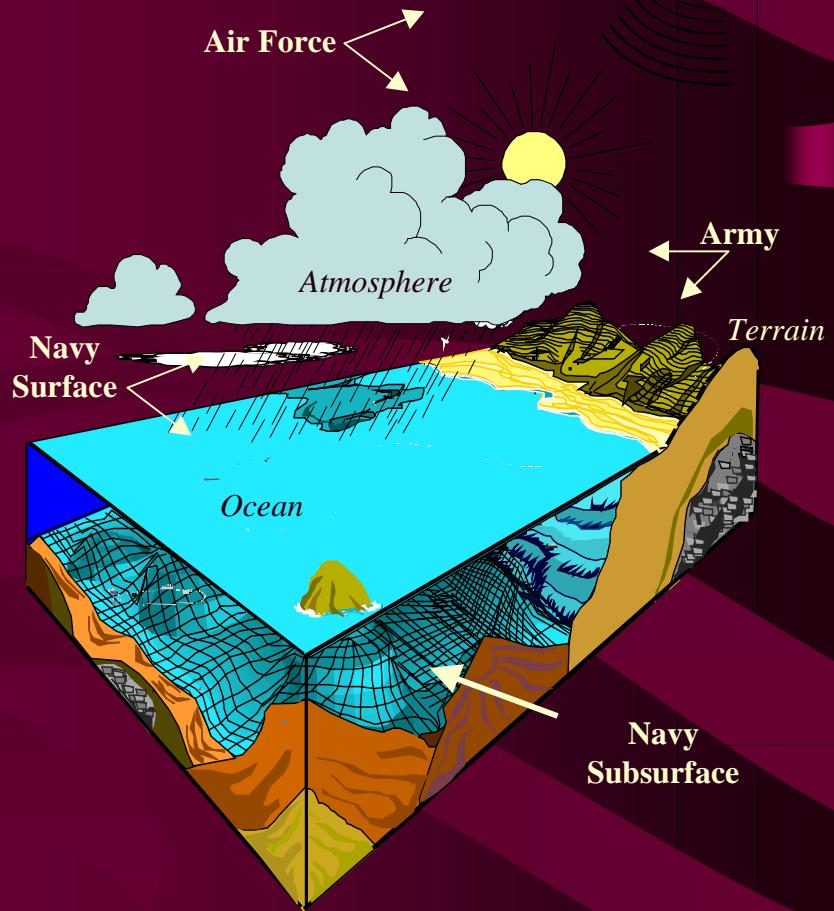


# Representation - Specific Issues



## **Environment**

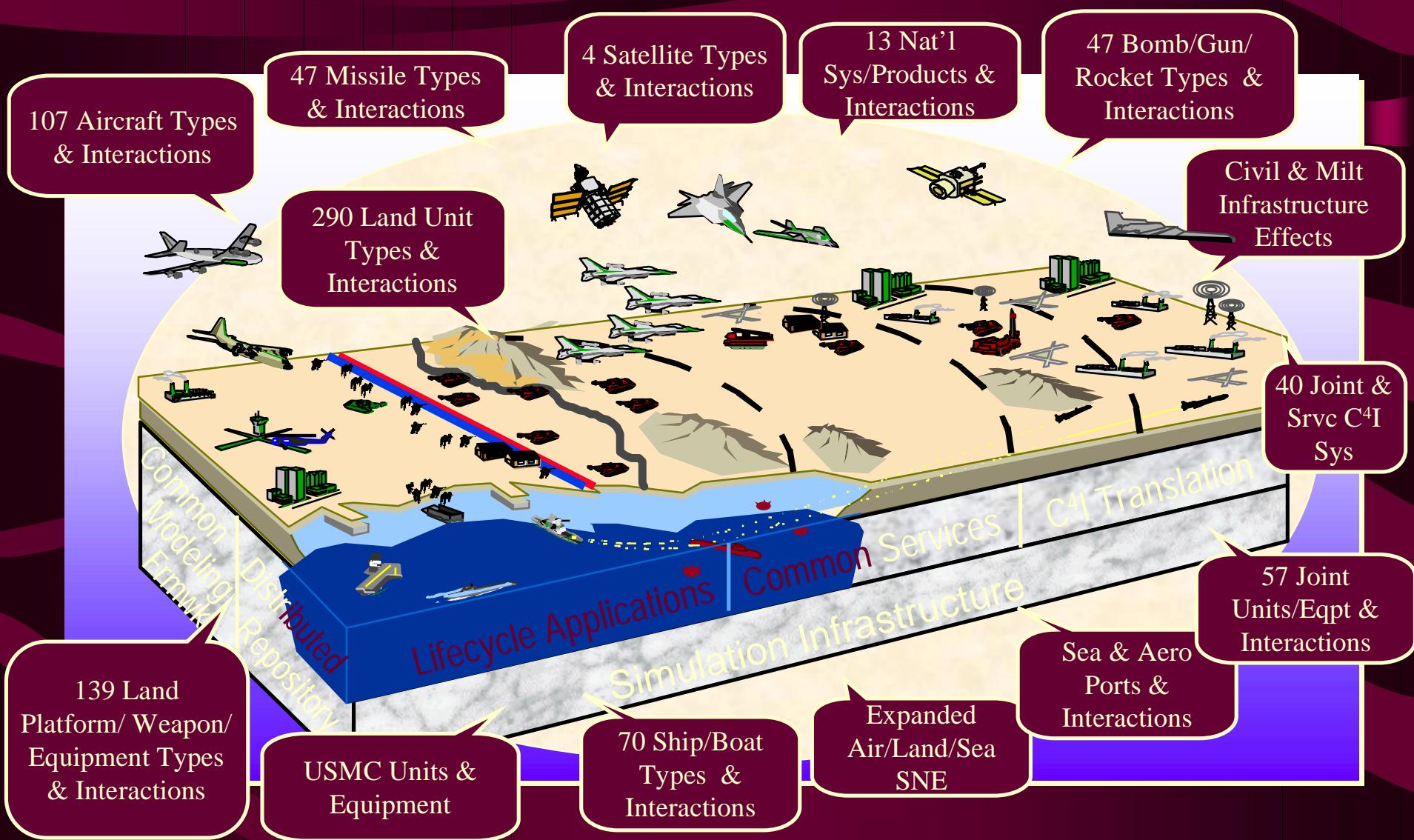
- **Data Collection**
  - Information complexity
  - Level of focus
  - Authoritative source
  - Consistency across categories
- **Boundaries between areas**
  - When does one stop and other start
  - Lack of available information
- **Obtaining agreement across simulations**
  - Specific needs within & between services
  - Level of detail varies across tasks/objectives
  - Bandwidth vs. realism
- **Players interference with environment**



# Representation - Systems Specific Issues



# Balanced, Joint Battlespace



# Representation - Human Behavior Specific Issues

## Complexity of Human Performance

Working Memory

Long-Term Memory

Multitasking

Sensing & Perceiving

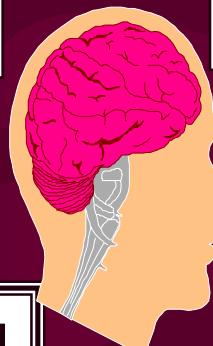
smell

touch

see

hear

taste



Planning

Information Processing

Situation Assessment

Decision Making

Reaction to Stress/  
Emotions

Motor Behavior

Individual



Group



## Data Collection and Validation

# Objective 5

Common Services

VV&A

*Repositories*

*Information Sources*

# ***Verification, Validation & Accreditation (VVA)***



***Verification*** - The process of determining that a ***model or simulation*** implementation ***accurately represents*** the developer's ***conceptual description and specification***. Verification also evaluates the extent to which the model or simulation has been developed using sound and established software engineering techniques.      DoD M&S GLOSSARY, Jan 98

# **Verification, Validation & Accreditation (VVA)**



**Validation - The process of determining the degree to which a model or simulation is an accurate representation of the real-world from the perspective of the intended uses of the model or simulation.**

**DoD M&S GLOSSARY, Jan 98**

# ***Verification, Validation & Accreditation (VVA)***



***Accreditation*** - The official certification that a model or simulation is acceptable for use for a specific purpose.

**DoD M&S GLOSSARY, Jan 98**

# Information Services

## *CONFERENCES*



## *EDUCATION*



## *WEB SITES*



## *MSRR / MSOSA*

## *Resource Access is Confusing*



**Unique data collection programs, archiving methodology, and data distribution methods leads to duplication of model, algorithm, and database development.**

## DMSO Homepage - Microsoft Internet Explorer

File Edit View Go Favorites Help

Back Forward Stop Refresh Home Search Favorites History Channels Fullscreen Mail Print

Address:  Links

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 Defense Modeling & Simulation Office

About DMSO  
DoD M&S Master Plan  
Document Library  
Events  
Projects  
Services  
M&S Community  
M&S Calendar  
DoD Warning

Welcome to the Defense Modeling and Simulation Office, or DMSO.

The DMSO is the lead for modeling and simulation (M&S) activities within the U.S. Department of Defense. We're a technology transition and support organization charged with maximizing efficiency and effectiveness of M&S efforts across the Department and fostering interoperability and reuse among the DoD's models and simulations. We approach those tasks through the promotion of cooperation among the DoD components and the broader domains of interest -- training, analysis and acquisition.

We've recently revitalized our web site -- offering a cleaner window into our operation, checking for currency of available information and adding some features. Hopefully you'll find it easier to find out about us, the things we do, the support available to the overall M&S community and where DoD M&S is headed in the future. We'd appreciate your comments or criticisms of the changes. Send them to our [webmaster](#).

Also, e-mail links for points of contact for the various projects and subject areas are provided throughout the web site. You may direct your specific questions to them, or if you have a question about the DMSO or DoD M&S policy, but don't know who to contact, simply send your query to [ASK\\_DMSO@nmsis.dmso.mil](mailto:ASK_DMSO@nmsis.dmso.mil). We'll sort it out, send your question to the right people and get you an answer.

Again, welcome to the DMSO.

M&S POC: [web@nmsis.dmso.mil](mailto:web@nmsis.dmso.mil)

Last Update: November 19, 1998

Submit

Search:

<http://www.dmso.mil/dmso/subscriptions/>

# ***M&S Resource Repository (MSRR)***

***What is the MSRR?***

- ***A cooperative effort across the Department of Defense M&S community to enable sharing of resources***
- ***A distributed network of servers, on both the Internet (unclassified) and SIPRNet (classified), sponsored by DMSO, with central access sustained by the MSOSA***

***The MSRR includes:***



***A central catalog of resources***



***A search engine to index M&S related sites***

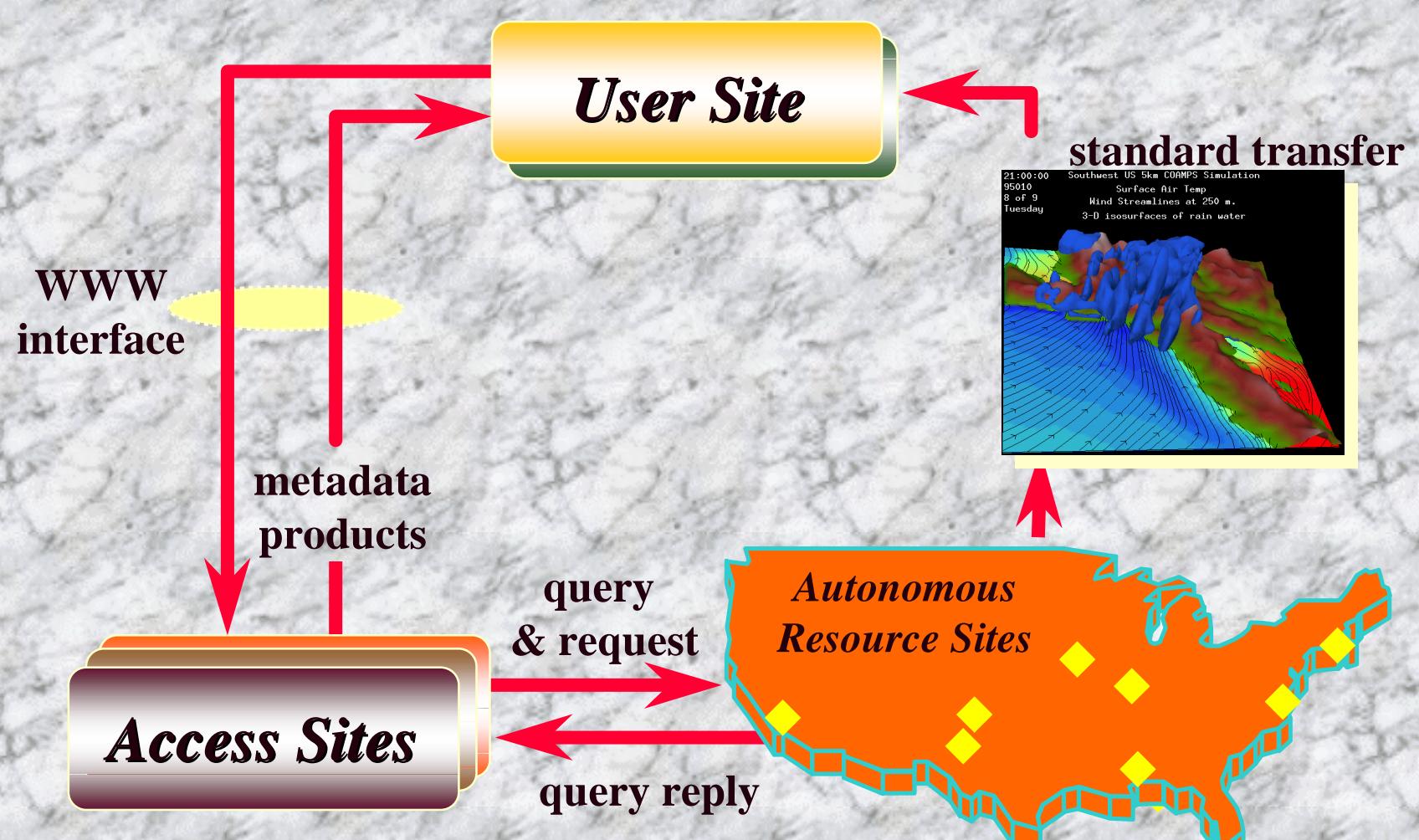


***An administrative and service infrastructure***

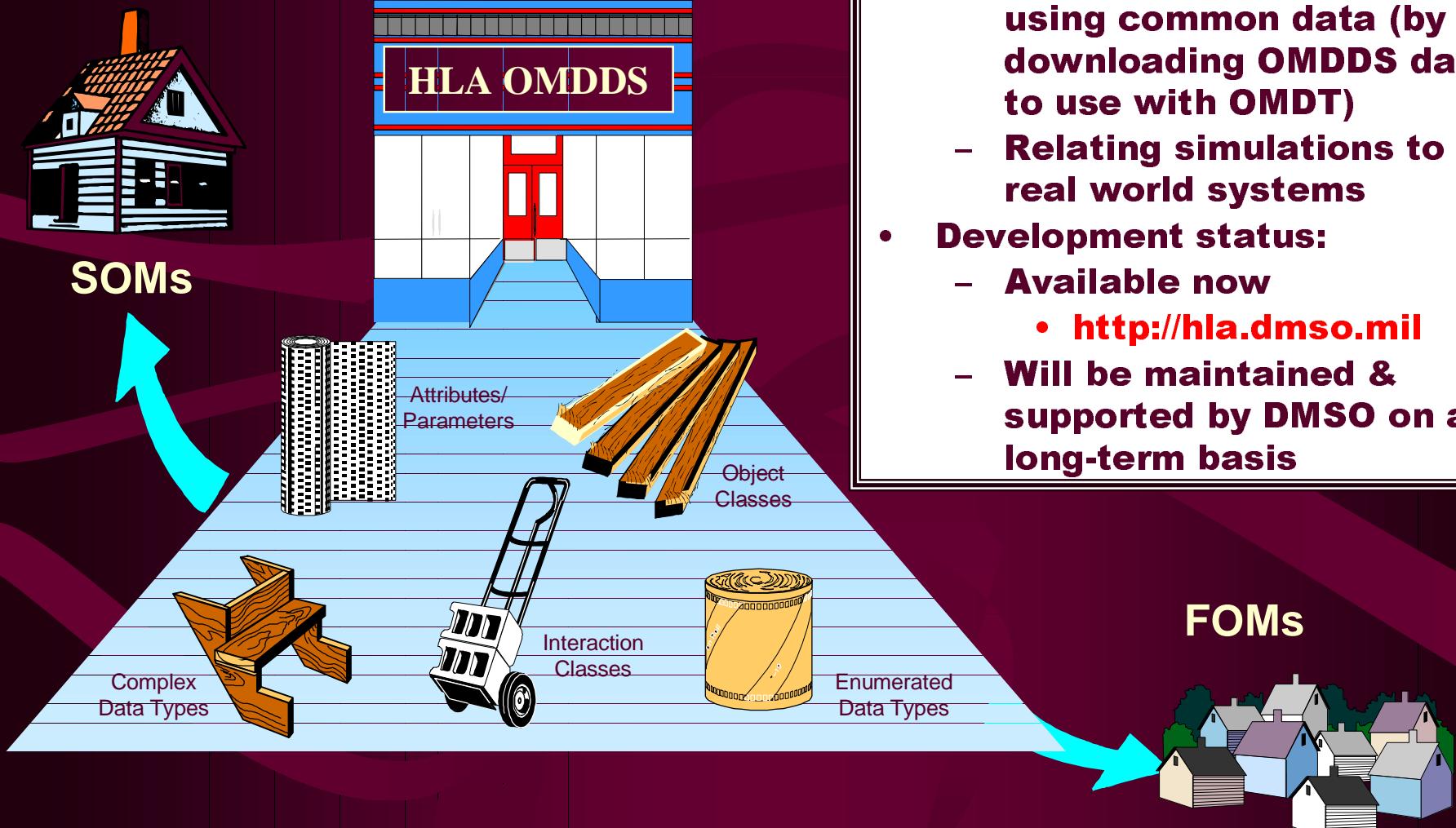


***A security system to prevent unauthorized disclosure of resources***

# MEL Node



# Object Model Data Node



# **M&S Operational Support Activity (MSOSA)**

## **MSOSA--Your First Stop for M&S Support!**

**The Mission.** MSOSA's mission is to assist DoD activities in meeting their M&S needs by providing operational advice and facilitating access to M&S information and assets.

### **Responses**



**Quick Response**

**Customer Requests**

**WWW information support  
MSOSA Net  
On Line Service**

General Support Team



**Cases**



**Missions**

**M&S Help Desk**

### **Responses**

**MSOSA**

Dedicated Support Team

**Internet:**  
<http://www.msosa.dmso.mil>  
**SIPRNet:**  
<http://www.msosa.dmso.contractor.dis.smil.mil>

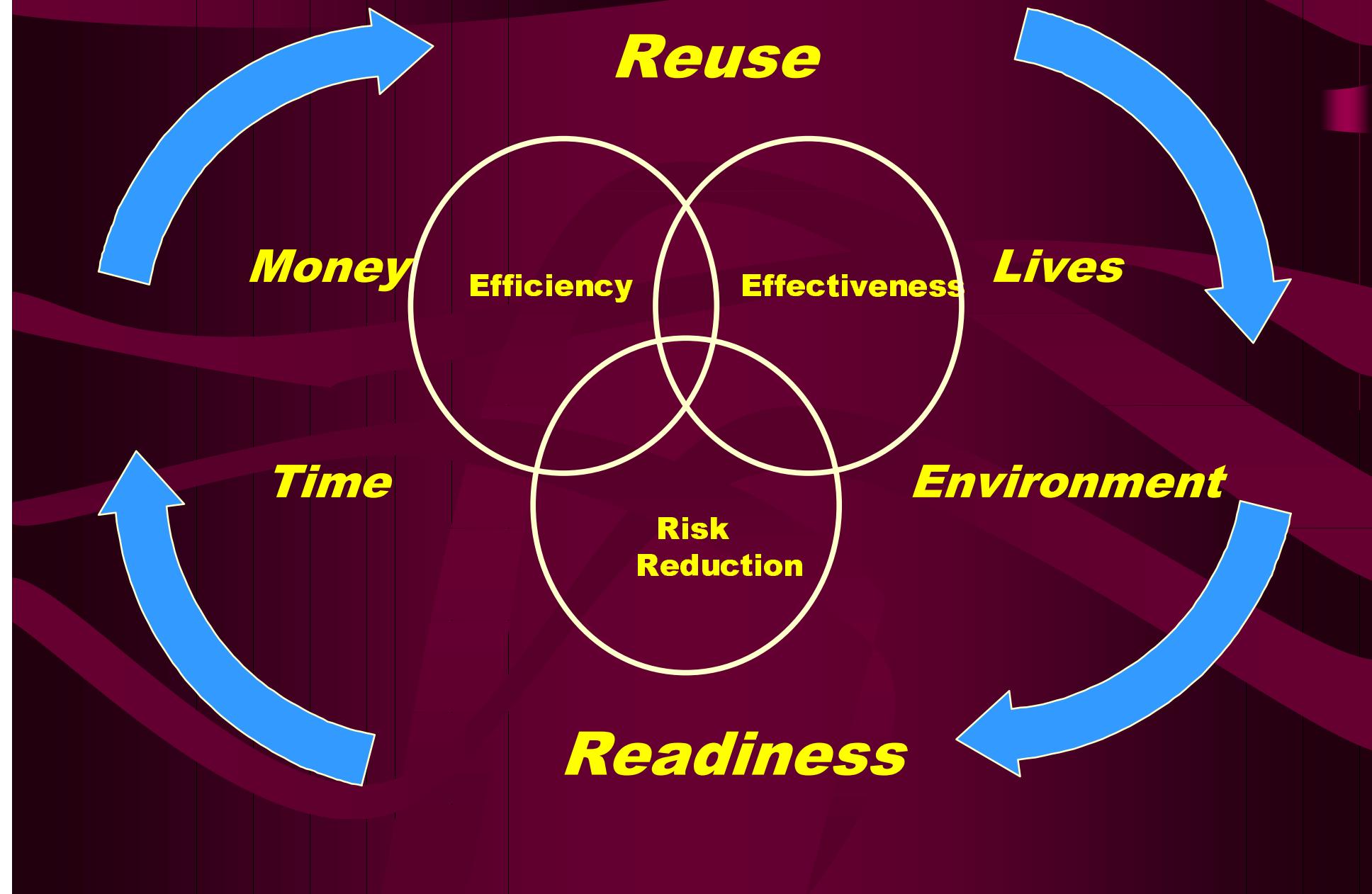
## *Objective 6*

*Share the  
Benefits of M&S*

*Quantify Impact*

*Education*

# *Quantifying the Benefits of M&S*





*Colleges*



*M&S Demo &  
Exhibits*



*Conferences*

# Educating the Community

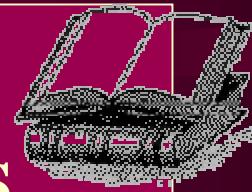
*Military  
Education*



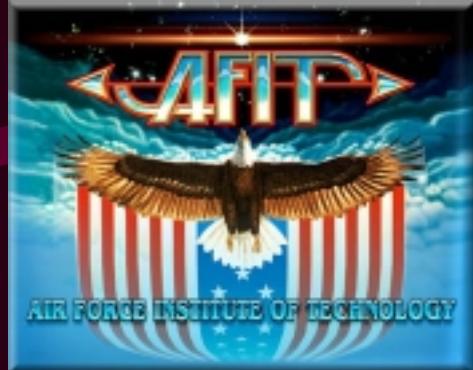
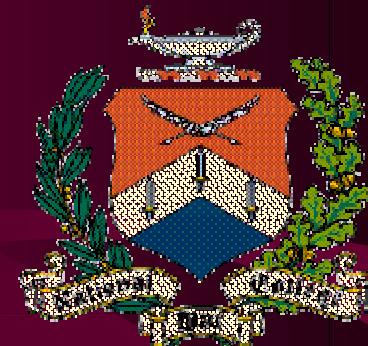
*DMSO  
Courses*



# ACADEMIC AND DoD COLLEGES/UNIVERSITIES



*Georgia Tech*



Armed Forces Staff College

The UNIVERSITY  
of DAYTON



# M & S COURSES



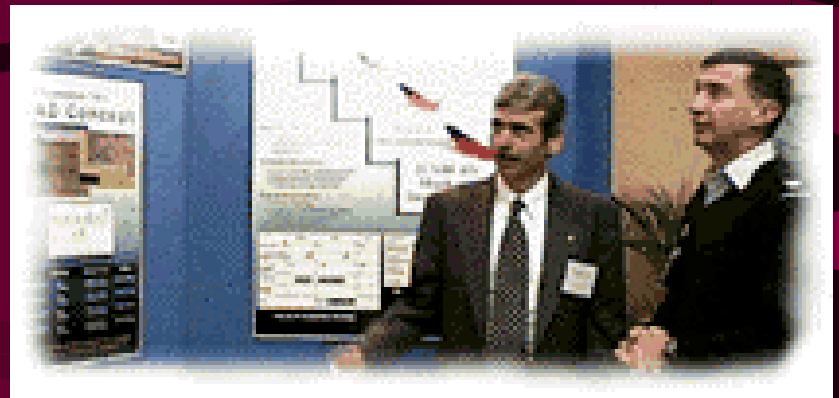
- Regional Comprehensive introduction
- Implementer-level Hands-on training in use of HLA
- CD education materials
- HLA Video

- M&S Staff Officers Course (MSSOC)
- Executive Level Orientation (ELO)
- Program Management Office M&S Workshop
- MS 101

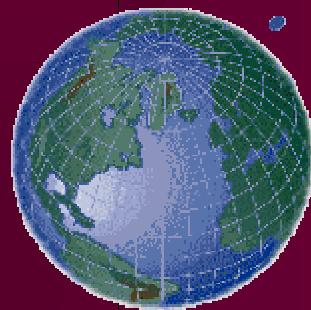


Information/Applications: [www.dmso.mil](http://www.dmso.mil)

# Exhibits



# Conferences



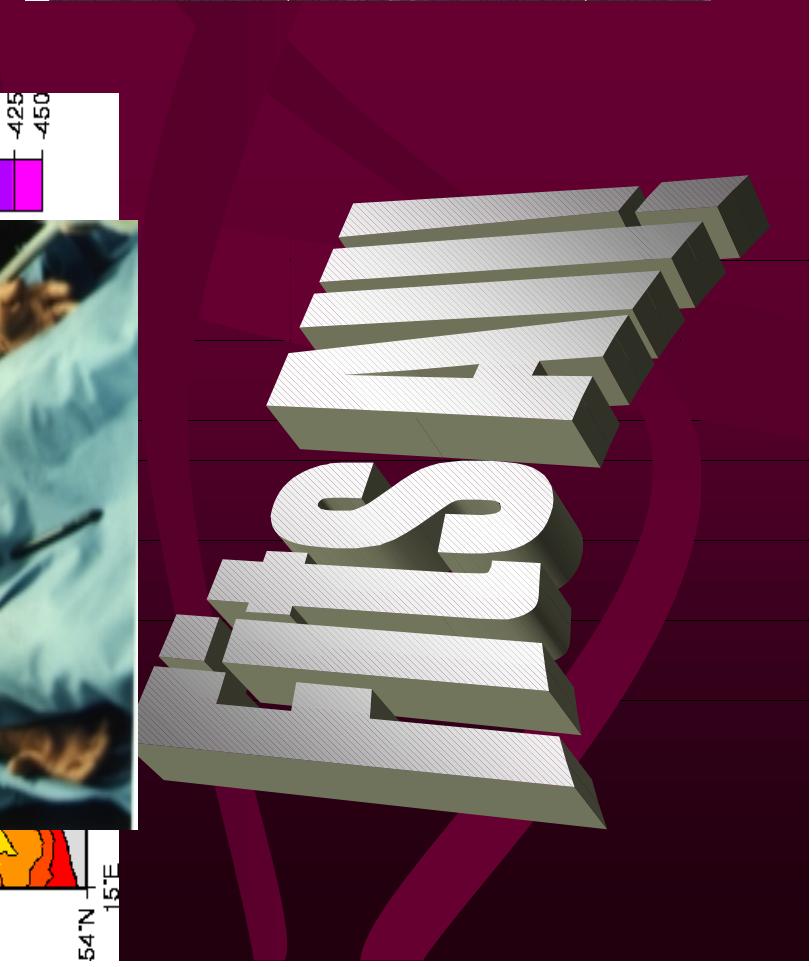
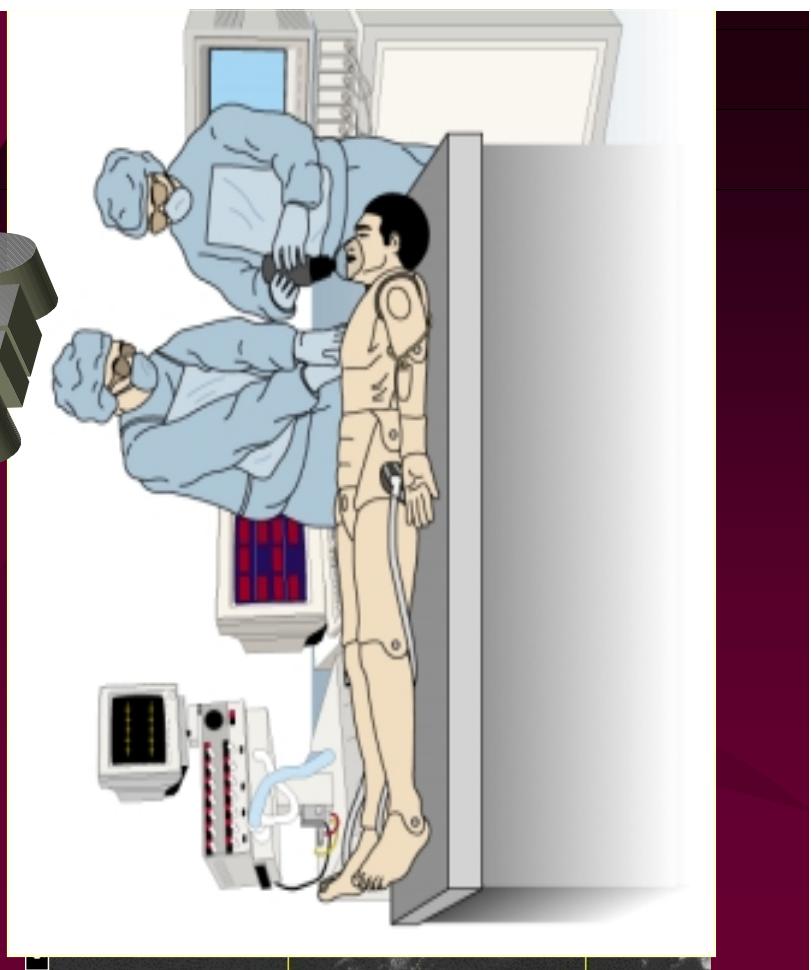
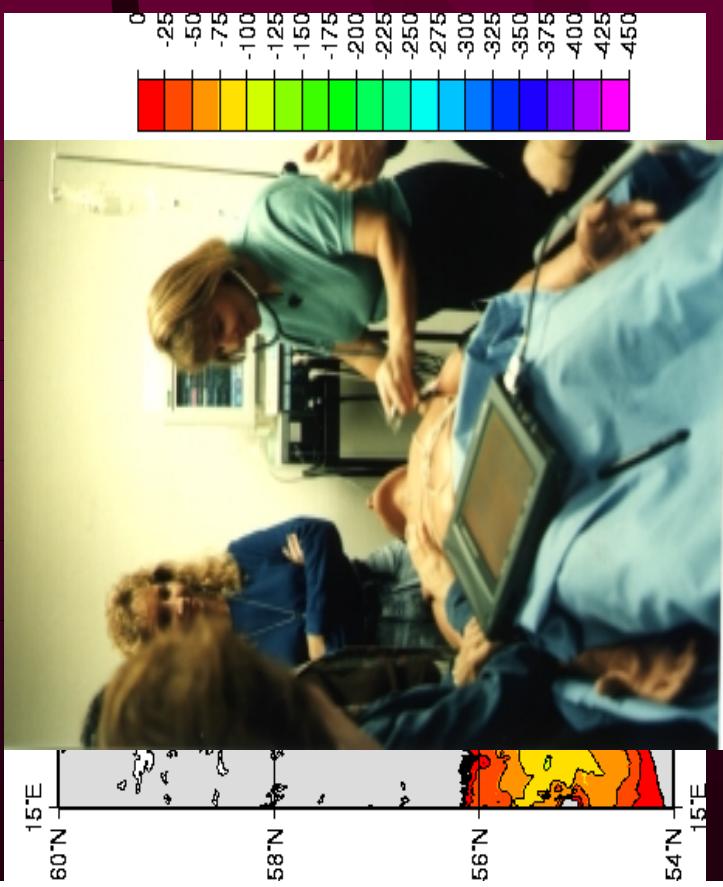
**SISO**

Simulation Interoperability Standards Organization

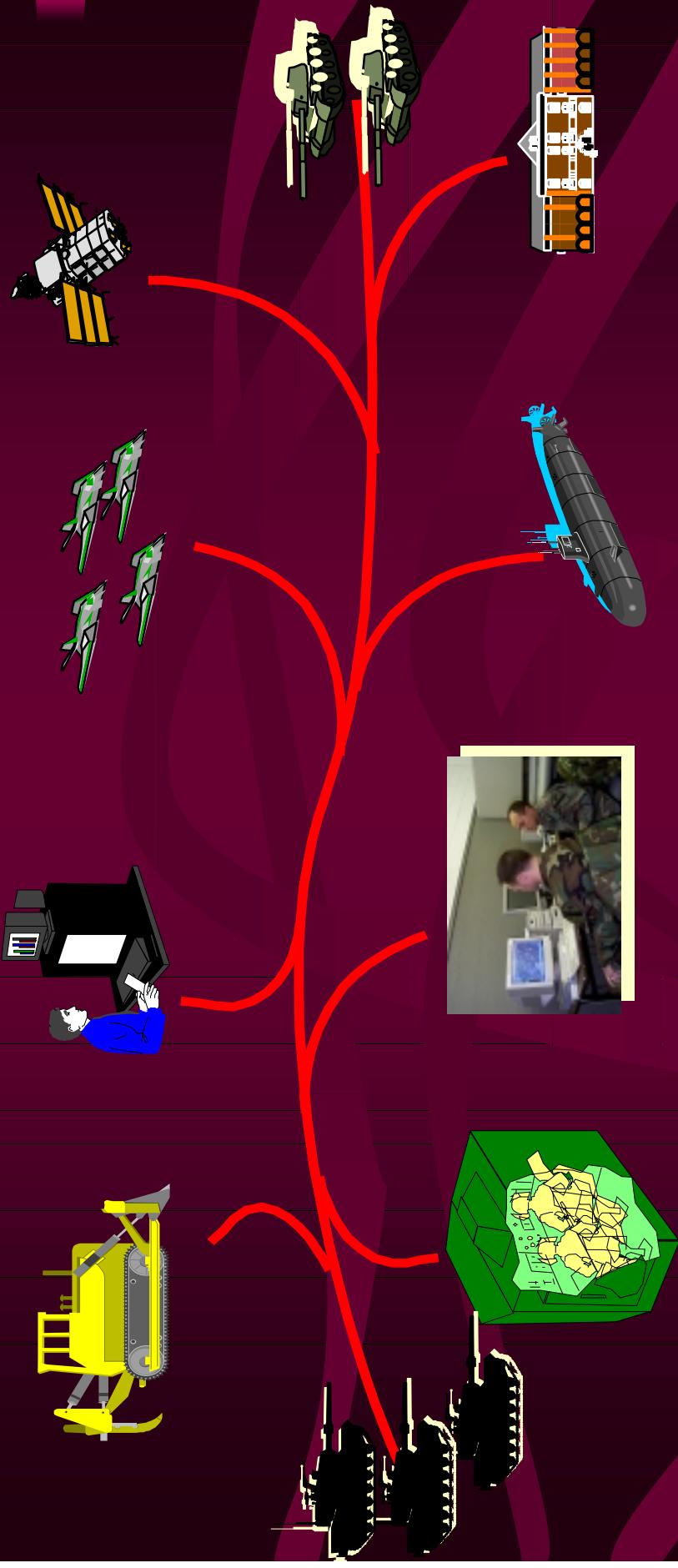
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# *Summary & Issues*



# Levels of Simulation Interoperability



"Sharing the same experience"

# M&S May Look Simple....



# But it is very Complex!

**COINCENTRATION:**

**M&S is Key to DoD's Future**

**To Succeed M&S must be Cost-Effective**

**To Do That, it must Maximize Interoperability & Reuse**

**To Achieve our Goal, You must Stay Involved**