

# **New Technologies for the New Strategic Environment**

## **Transformational Simulation, Analysis, and Decision Support Technologies for SOF**

**Dr. William G. Lese**  
**Director**

**Simulation, Analysis, and Training Systems**  
**Northrop Grumman Information Technology**  
**February 13, 2003**

(021203A)



# AGENDA

- Introduction
- Briefing Focus
- Challenges
- Transformation in Defense Modeling, Simulation, Analysis, and Decision Support
  - 3-D Visualization
  - Agent-based Modeling Tools
  - Cyberwarfare Modeling and Analysis Tools
  - NBC Warfare Modeling and Analysis Tools
  - Increased Speed and Flexibility in Analyses
  - Systems of Systems Decision Support Tools
- Summary

# Introduction



***“o Equip SOF with leading-edge technology to provide them the winning edge.***

***o We must infil/exfil undetected into denied areas, and provide survivability enhancements for SOF and their platforms.”***

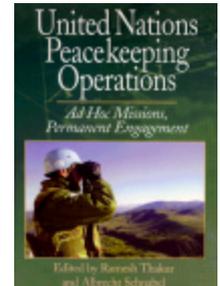
# Briefing Focus

- ***Simulation, Analysis, and Decision Support Technologies in Support of:***
  - Planning, analysis, and programming
    - Requirements identification
    - “What if” and “so what” analysis
    - Program development analysis
    - Resource allocation and optimization
    - Transformation/ joint experimentation assessments
  - Training, Education, and Mission Rehearsal
    - Distributed/ interactive
  - Operations and Consequence Management
    - Courses of action analysis
    - Common operating picture

# Challenges to Planning and Analysis Community

- **Post-Cold War Security Environment**

- Bosnia, Kosovo
- Smaller Scale Contingencies / Operations Other than War
- High levels of uncertainty
- Asymmetric Warfare



- **Department of Defense Initiatives**

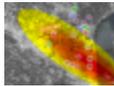
- Faster responses to analysis and operational questions
- Transformation / Joint Experimentation
- Faster/ more flexible planning process/ wider range of scenarios
- Effects-based operations
- Cyber warfare assessments/ network centric operations / C4ISR
- WMD assessments
- Improved Intelligence
- Improved management of information and knowledge
- More efficient use of manpower and other resources

- **Post-9/11 Security Environment**

- Homeland Defense / Combating Terrorism / Special Operations



# Transformation in Simulation, Analysis, & Decision Support Technologies

- Advanced 3-D Visualization 
- Agent-based Modeling / Genetic Algorithms
  - Asymmetric, and Afghanistan-type scenarios
  - Homeland defense and Combating Terrorism tools
- Cyberwarfare Models and Tools 
- NBC Models and Tools 
- Scoping Tools
  - Operational Synthesis
- Rapid data search tools
- Knowledge Management
- Improved synthetic environments for simulations
- Greater range of planning and training scenarios
- Improved distributed/Interactive simulation tools
- Faster low cost PCs and graphics cards 

# Technology Improvement Areas

- 3-D Visualization



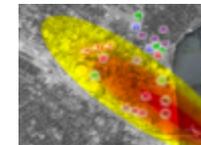
- Agent-based Models



- Cyberwarfare Modeling and Analysis



- NBC Warfare Modeling and Analysis



- Increased Speed and Flexibility in Analysis

- Systems of Systems Decision Support Tools

# Technology Improvement Areas

- **3-D Visualization** ←

- Agent-based Models
- Cyberwarfare Modeling and Analysis
- NBC Warfare Modeling and Analysis
- Increased Speed and Flexibility in Analysis
- Systems of Systems Decision Support Tools

# Advanced, “High functionality” 3-D Visualization

- Analytical and operational functionality
  - Not just pretty pictures
- Realistic portrayals of terrain, infrastructure, and forces
- Benefits
  - Mathematical and geospatial precision
  - Increased realism
  - Improved situational awareness
  - More intuitive (e.g., easy to comprehend icons)
  - Line of sight information
  - Playback capability (fast/ slow motion/ reverse time)
  - Review from multiple perspectives
  - Drill down capability
  - User friendly display of analytical information (e.g., strength of units)
  - Filtering (focus on selected units)
  - Rapid debugging of simulation tools



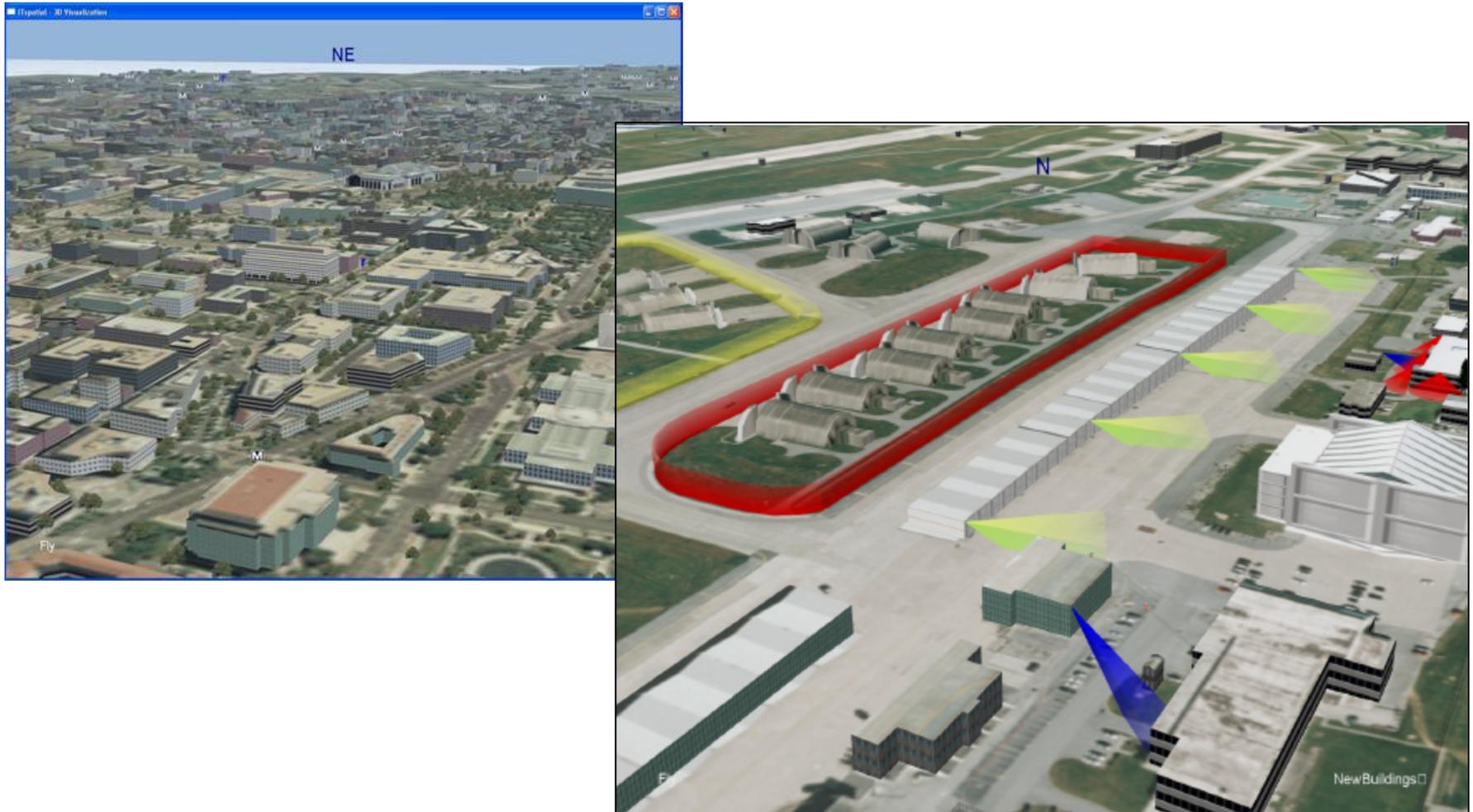
# 3-D Visualization (cont.)

- Improvements in computer technology allow “high functionality,” / high resolution visualization graphics to run on moderately priced PCs
  - Reduced cost
  - More training simulations in the field

# 3-D Visualization Examples

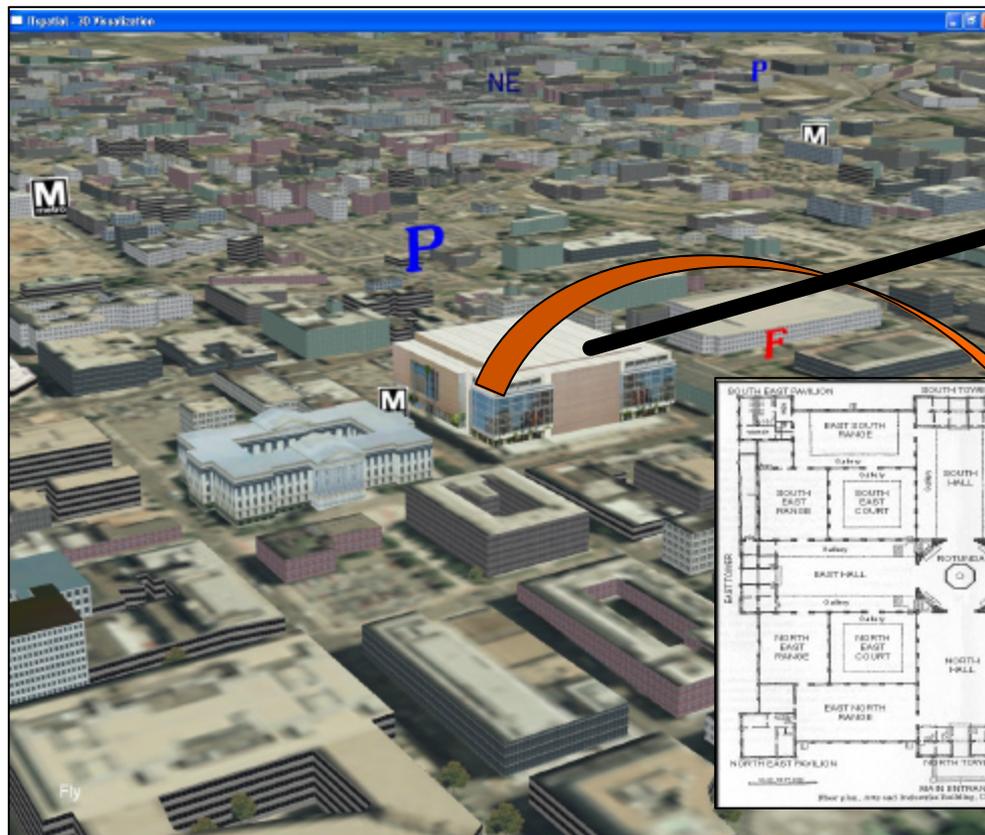
- War on Terrorism
- Smaller Scale Contingencies (SSCs)

# 3-D Infrastructure Visualization for War on Terrorism and SSCs



# 3-D Infrastructure Visualization for War on Terrorism and SSCs

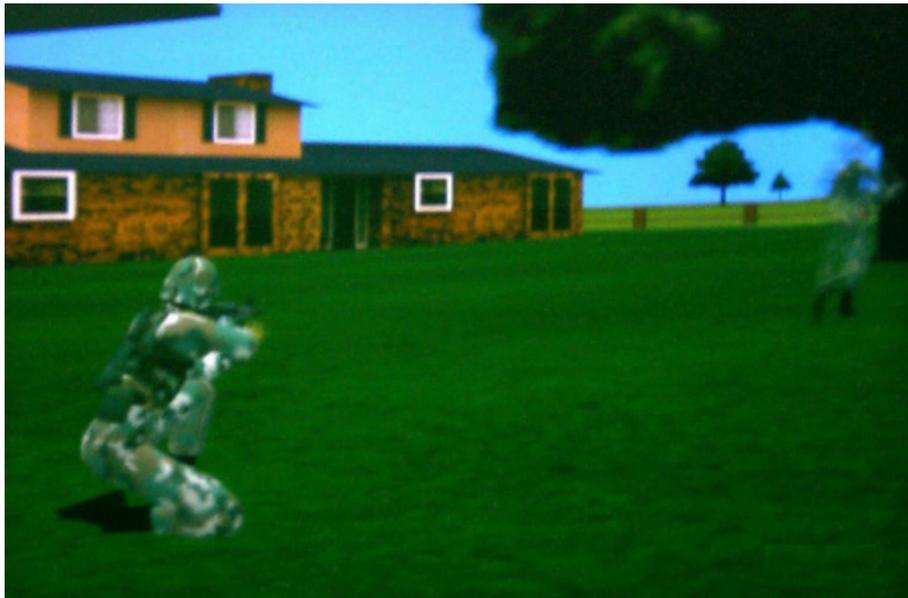
## *Multiple Linkages to Geospatial Objects*



**Interior Images**

**Floor Plans**

# 3-D Infrastructure Visualization for War on Terrorism

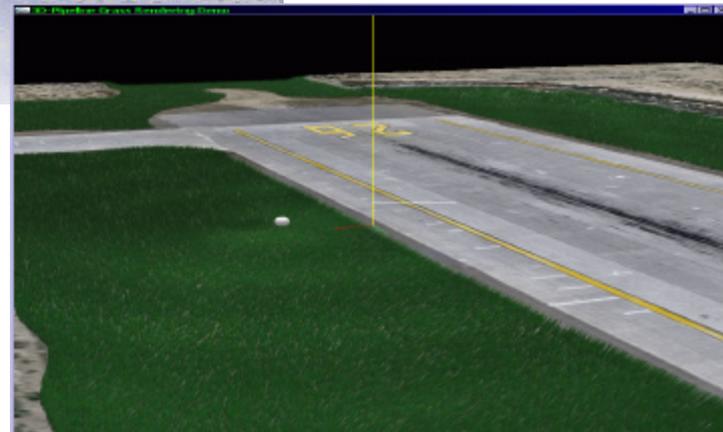


# 3-D Visualization Examples

- Training and Mission Rehearsal

# 3-D Infrastructure Visualization for Mission Rehearsal

## *Helo Rotor Effect Over Water and Grass*



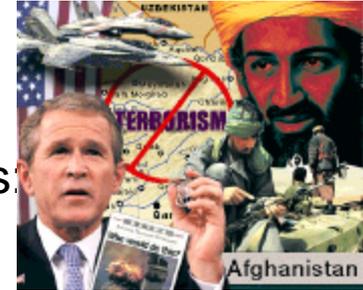
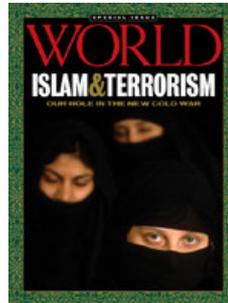
# Improvement Areas

- 3-D Visualization
- **Agent-based Models ←**
- Cyberwarfare Modeling and Analysis
- NBC Warfare Modeling and Analysis
- Increased Speed and Flexibility in Analysis
- Systems of Systems Decision Support Tools

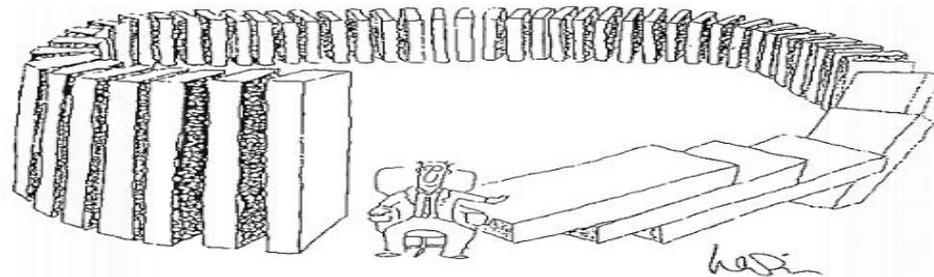
# Agent-based Models

- Asymmetric threats present critical challenge to DoD planners
  - Adaptive / less predictable
  - Command structures and membership hard to identify
  - Support base diffuse and intertwined with complex factors.

- Historical
- Social
- Political
- Economic
- Religious



- Countering these threats can result in unintended consequences



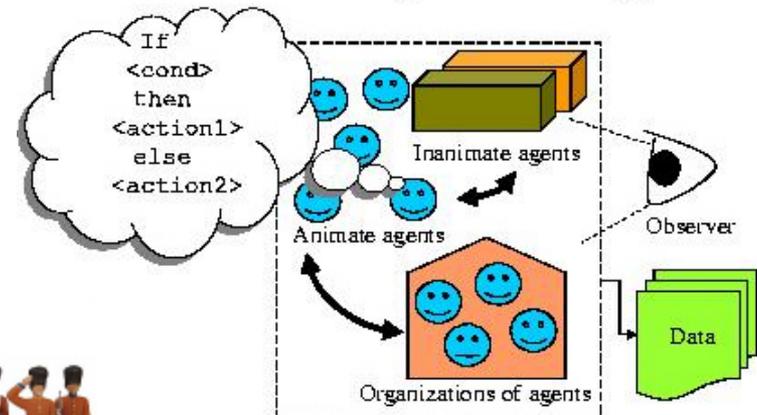
- Current planning and training simulations unable to fully address these new factors

# Agent-based Models

- New analysis tools, technologies can address asymmetric challenges
- Multiple disciplines
  - Agent-based modeling
  - Genetic algorithms
  - Operational Synthesis
  - Complexity science
  - Open systems dynamics
  - Artificial intelligence

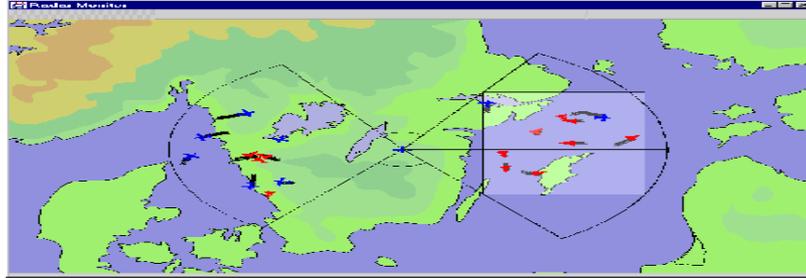


## Bottom up modeling



- Artificial agents
  - Responsive to social, political, economic, religious, military factors
  - Can represent multiple participants in complex scenarios:
    - Terrorist groups and rogue nations
    - Local governments
    - Non-Governmental organizations
  - Adaptive / reactive / representation of intangible (e.g, fear, hunger)
  - Fast running simulations

# Agent-based Models



- Example
- Factors causing population NOT to sympathize with terrorists
  - Political liberalization
  - Participatory democracy
  - Economic progress
  - Influence of religious moderates
- Third party elements (e.g., local warlords)
  - Remain neutral unless provoked
- Simulation becomes multi-sided competitive game
  - Entities vie for support of local population
  - Use combination of incentives
- Addresses
  - Unintended consequences
  - Point/ counterpoint actions
  - Rapidly evolving contingencies

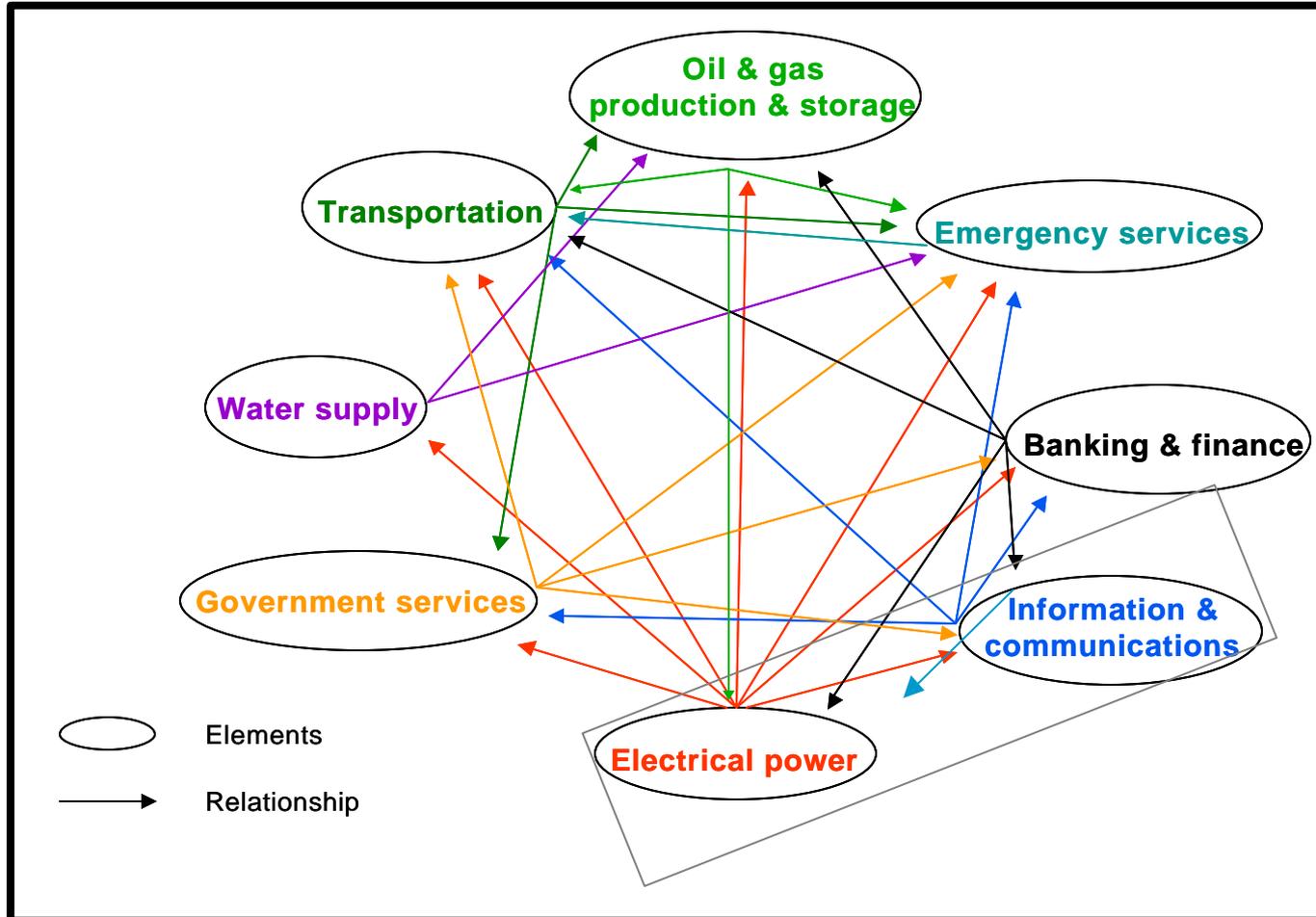


# Improvement Areas

- 3-D Visualization
- Agent-based Models
- **Cyberwarfare Modeling and Analysis ←**
- NBC Warfare Modeling and Analysis
- Increased Speed and Flexibility in Analysis
- Systems of Systems Decision Support Tools

# ***Critical Infrastructures:***

*Now a crucial part of the new world security environment, especially with respect to Cyber Warfare...*

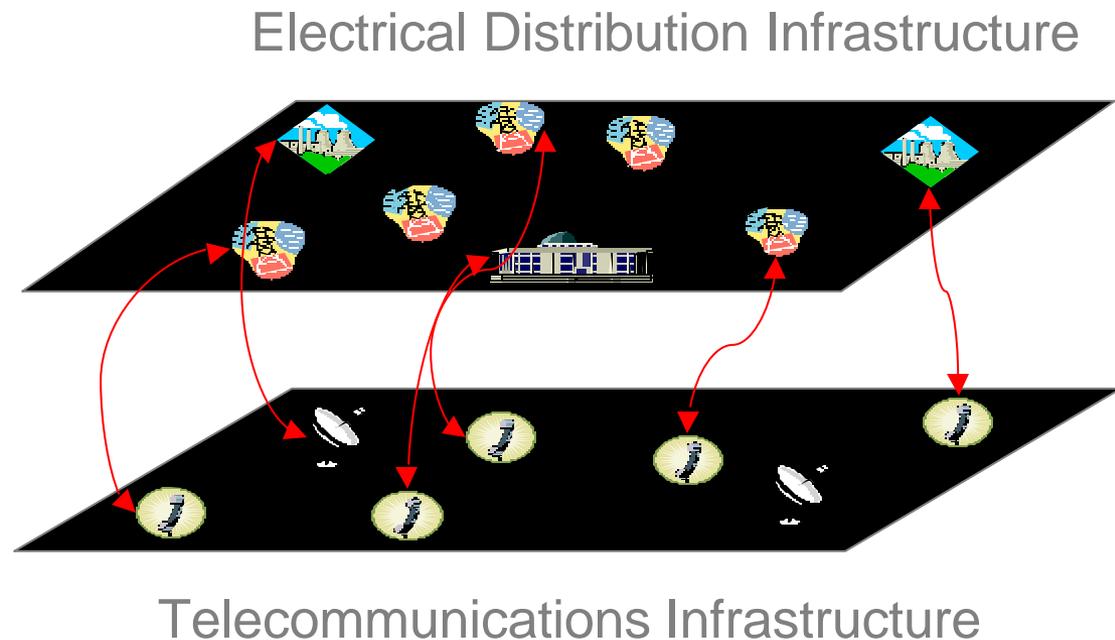


# Addressing Cyberwarfare Issues in Simulations

- New prototype modeling technologies enable planners and trainers to portray effects of cyberwarfare in
  - Military campaign scenarios
    - Offensive (e.g., U.S. use of cyberweapons in effects-based operations)
    - Defensive (e.g., Potential impact of enemy cyber attacks on U.S.)
  - Homeland defense scenarios
- Cyber modeling tools permit one to:
  - See primary and secondary effects of cyberwarfare employment
  - Measure impact of offensive use by U.S.
    - Compare to effects of traditional kinetic weapons
- Following charts illustrate functions and features of cyberware assessment tools for potential use in training scenarios

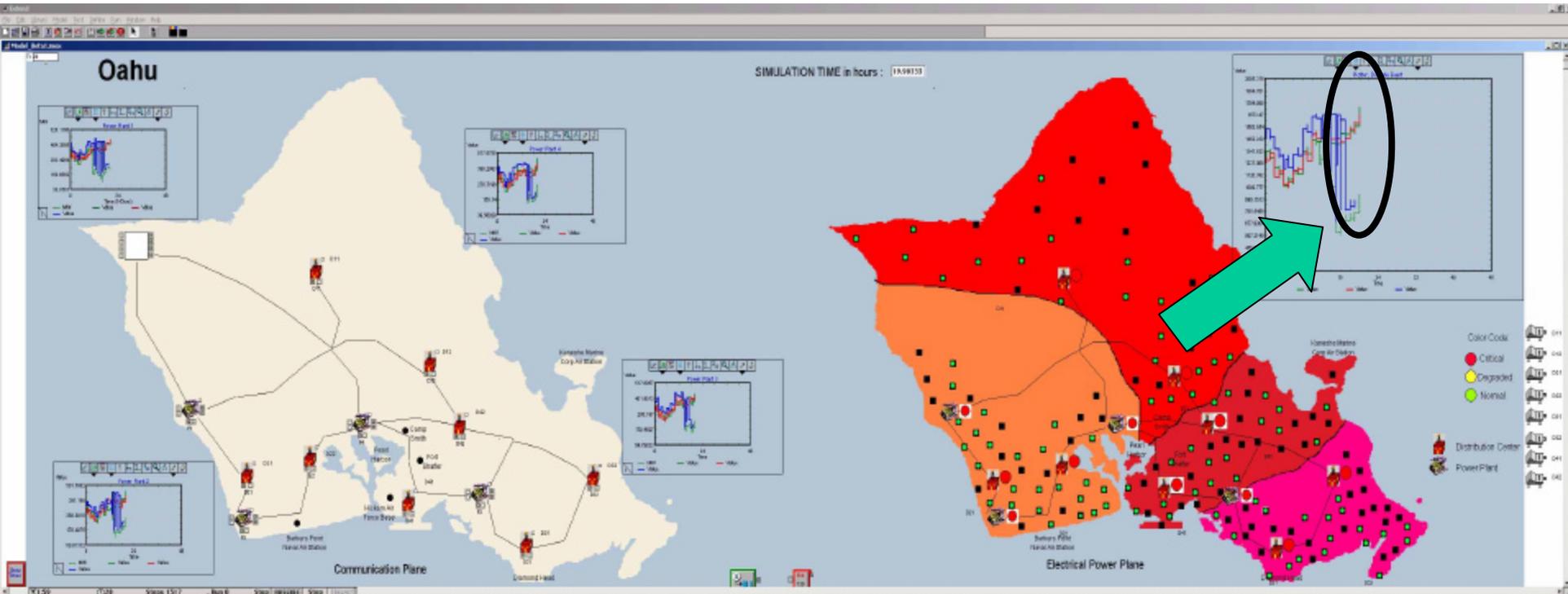
# Addressing Cyberwarfare Issues in Simulations

## Power and Telecom Grids Interactions



# Screenshot Example

## Cyber Warfare Model User Interface: Shown at Simulation Hour 20



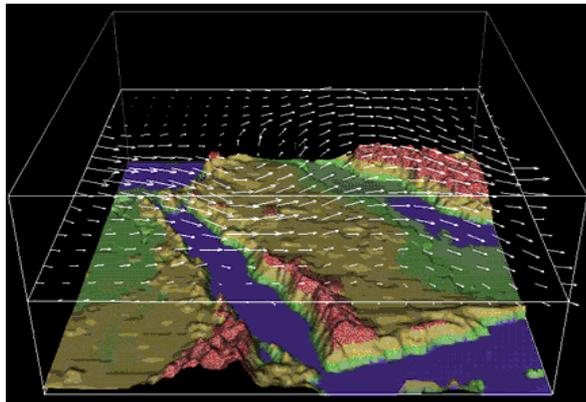
- Many nodes affected by two pronged cyber attack:
  - Power Producers at hour 11
  - Communications at hour 16
- Graphic boxes depict the magnitude and duration of Effects
  - Red line is demand, Blue Line is production, horizontal axis is time and vertical axis is units of power

# Improvement Areas

- 3-D Visualization
- Agent-based Models
- Cyberwarfare Modeling and Analysis
- **NBC Warfare Modeling and Analysis ←**
- Increased Speed and Flexibility in Analysis
- Systems of Systems Decision Support Tools

# Chem/Bio / WMD

## Warning, Reporting, and Decision Aids

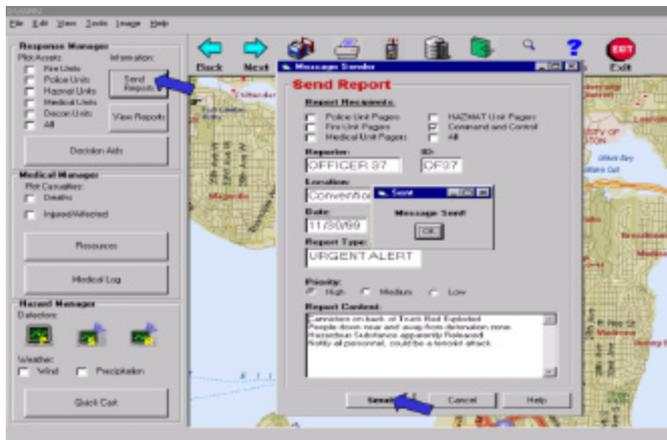


Complex weather information automatically ingest from authoritative weather sources

Community models (Military, civilian) are integrated into ensemble, and unique algorithms adjust models for actual detector inputs



Robust decision aids translate complex information into user action on their C4I platform



# Models Predict Hazard Plume



# Medical Information

**DWARN**  
File Edit View Tools Image Help

**Response Manager**  
Plot Assets: Information:  
 Fire Units  
 Police Units  
 Hazmat Units  
 Medical Units  
 Decon Units  
 All  
 Send Reports  
 View Reports  
 Decision Aids

**Medical Manager**  
Plot Casualties:  
 Deaths  
 Injured/Affected  
 Resources  
 Medical Log

**Hazard Manager**  
Detectors:  
 P  
 S  
 R  
 Weather:  
 Wind  
 Precipitation  
 Quick Cast

**Medical Resources**  
 Facilities Personnel Supplies  
**Seattle Medical Facilities Directory:**  
 UW Medical Center [Load]  
 Doctors: 72  
 Nurses: 101  
 Technicians: 82  
 Specialists: 56  
 Resources:  
 Total Patient Rooms: 300  
 Current Room Usage: 265  
 Total Patient Beds: 600  
 Current Bed Usage: 510  
 Emergency Room Patient Capacity: 55  
 Current Emergency Room Usage: 37  
 OK Help

**Form13**

**Medical Log**

**Reported Casualties:**

Deaths  
Injured

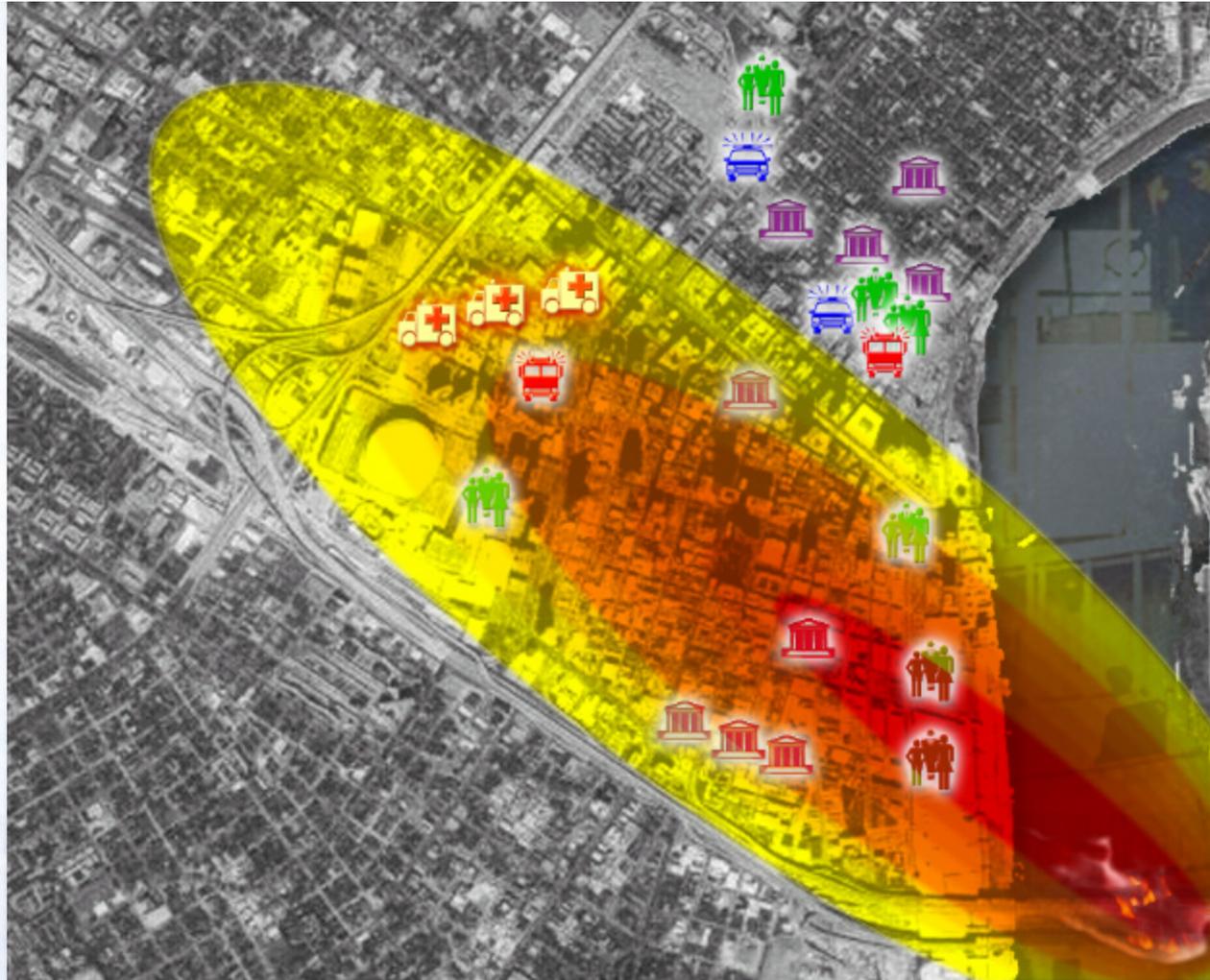
Details  
Trace

**Casualty Versus Time Plot:**

Time Period	Injured	Deaths
1	440	311
2	325	264
3	234	200
4	134	107
5	76	54
6	52	38
7	32	31
8	27	27
9	27	27
10	27	27
11	27	27

OK Help

# Emergency Situation



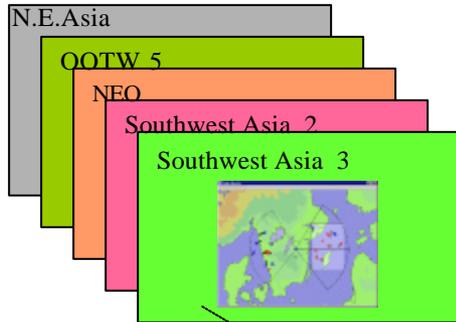
-  Fire
-  Police
-  Hospital
-  Museum
-  Population Centers

# Improvement Areas

- 3-D Visualization
- Agent-based Models
- Cyberwarfare Modeling and Analysis
- NBC Warfare Modeling and Analysis
- **Increased Speed and Flexibility  
in Analysis ←**
- Systems of Systems Decision Support Tools

# Speed and Flexibility in Modeling, Simulation, & Analysis

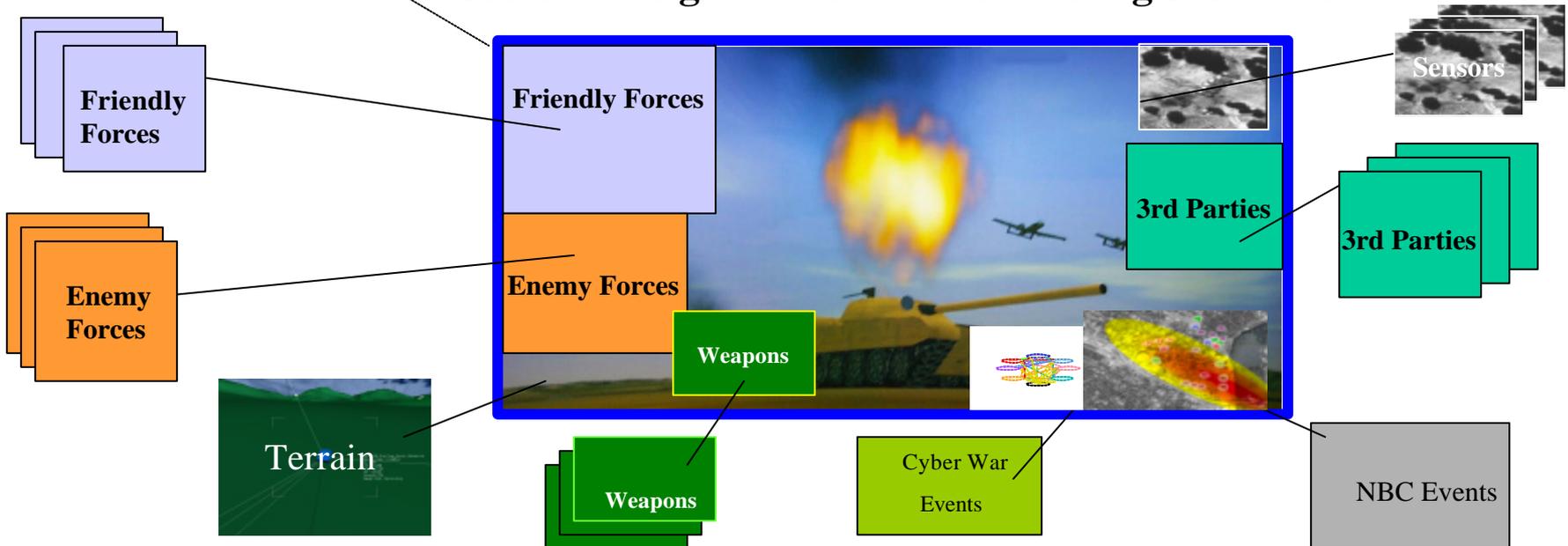
## Rapidly Find Existing Scenarios



## Transformational Technologies

- Advanced, High Functionality Visualization
- Agent Based Modeling /Genetic Algorithms
- Knowledge Management
- Rapid Info Search Technologies

## Custom Design New or Refine Existing Scenarios

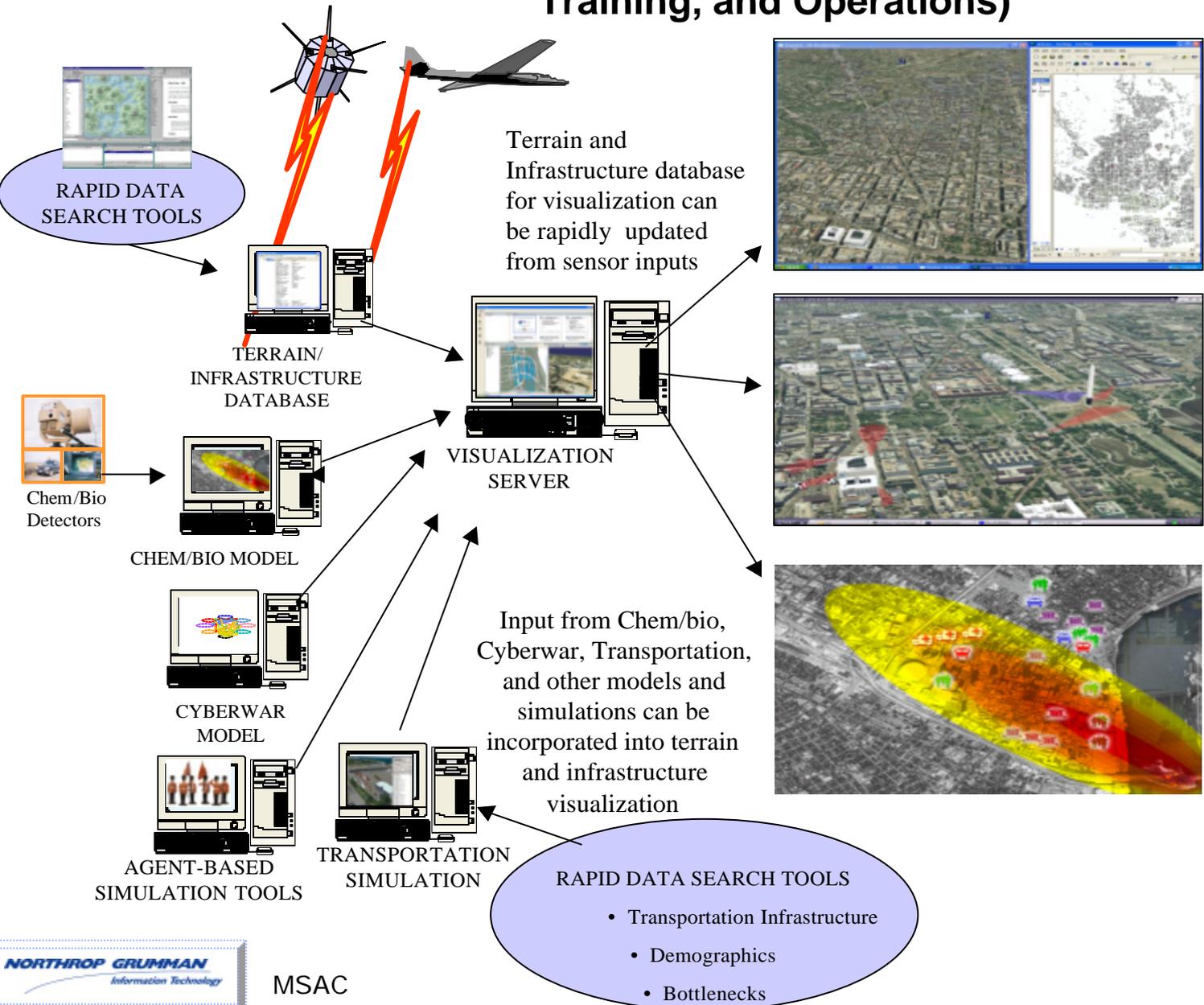


# Improvement Areas

- 3-D Visualization
- Agent-based Models
- Cyberwarfare Modeling and Analysis
- NBC Warfare Modeling and Analysis
- Increased Speed and Flexibility in Analysis
- **Systems of Systems Decision Support Tools ←**

# Fight as We Plan, Analyze, and Train

## (System of Systems Decision Support Tools for Planning/Analysis, Training, and Operations)



### Planning & Analysis

- What if Assessments
- Resource Allocation
- Cost-effectiveness

### Training

- Agent-based Sims
- Playback
- AAR
- Distributed-Interactive

### Operations / Consequence Management

- Course of Action Assessments
- Predictive Decision Support Tools, e.g.,
  - Blast area damage area
  - Chem/bio cloud movement and lethality area



MSAC

# Summary

- **Post-Cold War/ post-9/11 era poses great challenges and opportunities to SOF and DoD analysis community**
- **Modeling, simulation, analysis, and decision support technologies**
  - Are undergoing a fundamental transformation
  - Have taken on enhanced importance in current security environment
- **New analysis technologies permit more sophisticated, flexible, rapid, and easy to comprehend assessments of complex post-Cold War/ post-9/11 issues**
- **Could be of great benefit to SOF in**
  - Planning and analysis
  - Training/ exercises/ mission rehearsal
  - Combat operations

# BACKUP CHARTS



Document Browser

myfiles.ppt

Document Viewer

1

### Product Marketing Goals

- Low cost/low risk for users/clients
- Efficient repeat order approach
- Alternative approach paths from state data to 3D maps
- Aligned with a specific process for a product
- Support for ongoing releases of data

2

### Addressing the Market

- **Mid-2004 - 2004 (20)**
  - Focus on 2D maps
  - High quality
  - Scalability of the product
  - Set the stage for making the transition to 3D
- **Early 2005 - 2005 (20)**
  - Focus on 3D maps
  - High quality
  - Scalability of the product
  - Set the stage for making the transition to 3D

3

### InterSCOPE® Standalone Products

- InterSCOPE PE Analyst/OC

### InterSCOPE® Enterprise Products

- InterSCOPE PE Enterprise Server

### InterSCOPE® Enterprise Clients

- InterSCOPE PE Client Software

MultiFunction Display 2D Map

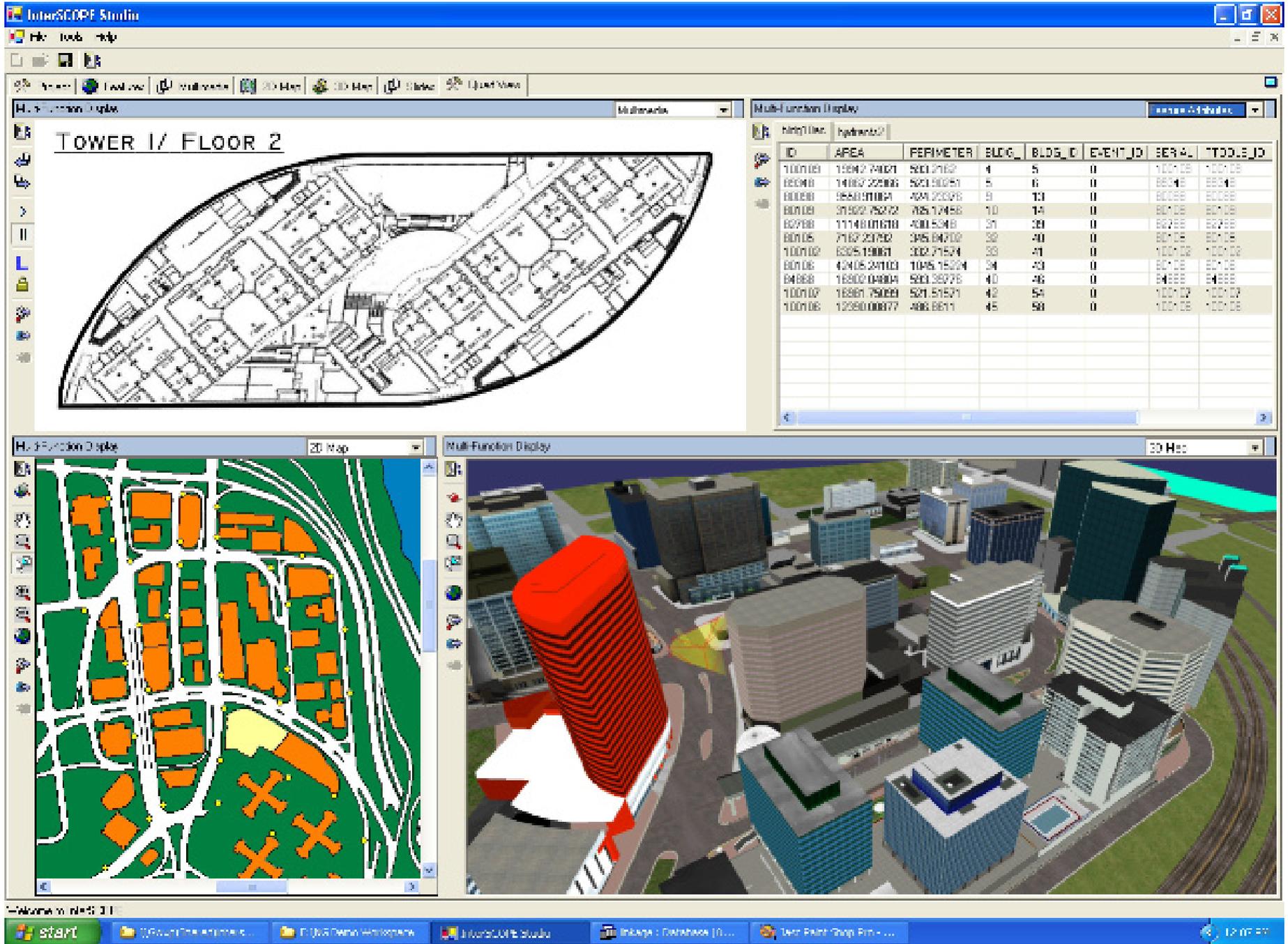
Layers:

- ani\_streets
- bldg10ac
- bldgpol
- clip\_rectangle
- hydrants2
- saxcont
- water

MultiFunction Display 3D Map

InterSCAPE Studio interface showing four main views:

- Top Left (3D Map):** A 3D perspective view of a city model with various buildings and a prominent white tower structure.
- Top Right (2D Map):** A 2D top-down view of a city street grid.
- Bottom Left (Slide Show):** A presentation slide titled "Organizational Situational Awareness" with the following bullet points:
  - InterSCAPE Provides organizations with the ability to:
    - Prepare and deploy complex multi-dimensional geographic information
    - Perform spatial analysis and make decisions in a site specific geographic environment
    - Plan and prepare for operations within complex geographic environments
    - Communicate and collaborate on operations within complex geographic environments
- Bottom Right (Image):** A photograph of a modern building complex with a large glass facade and a parking area.



# Rescue Scenario Demonstration

## Agent-Based Evaluation of Mogadishu-like Scenario

MANA - Do

File

Pause Run

Reset

Width: 200  
Height: 200

TimeStep [ms]  
1

Sound

Show Flags

Steps  
1000

Rec Run

Seed  
1197582066

Lock

197, 140 Step: 0 Run: 1

# 3-D Infrastructure Visualization for War on Terrorism and SSCs

