



Smart SensorWeb

National Military Sensing Symposium

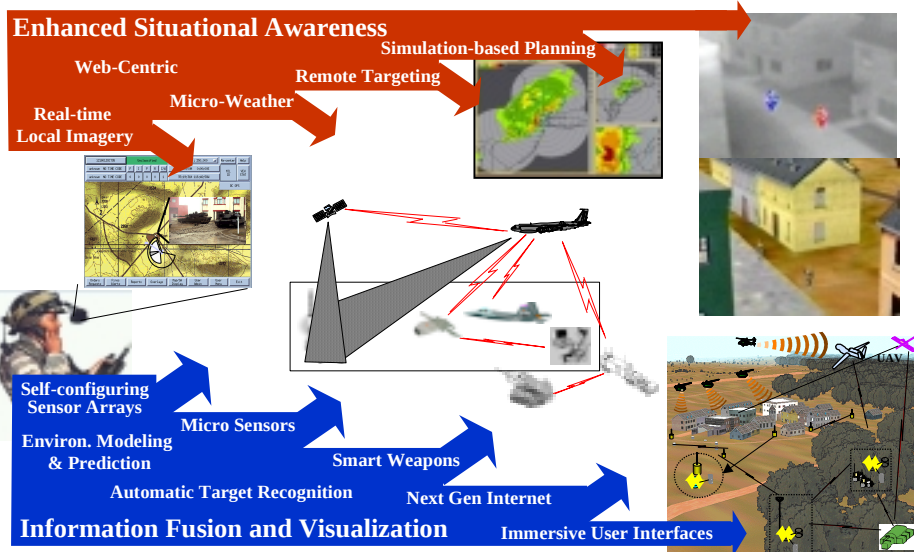
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**Director, Sensor Systems
Deputy Under Secretary of Defense
for Science and Technology**

16 November 1999



Smart SensorWeb



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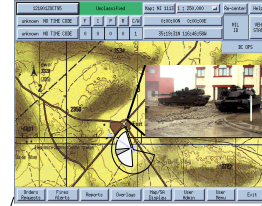
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Smart SensorWeb

Vision: An intelligent, web-centric distribution and fusion of sensor information . . . that provides greatly enhanced situational awareness, on demand, **to Warfighters at lower echelons.**

“... emphasizes **large arrays of local sensors** joined with other assets: imagery, weather, weapons, simulations, etc. . . .”



Unprecedented Advances in Commercial Technologies

- Mobile wireless networks
- Micro computers
- Tele-presence
- Geo-location and tracking devices
- Wireless internet connectivity
- Virtual reality (entertainment, video games, immersive interaction)





Relevant DoD S&T

- **DARPA**
 - Sensor Programs
 - VSAM
 - AVS
 - SensIT
 - Knowledge-Base Programs
 - Dynamic Databases
 - Command Post of the Future
 - Warfighter Visualization
 - Intelligent Integration of Information Technology
 - Rapid Knowledge Formation
 - Comm Network Programs
- **Service Programs**
 - ACTDs: MOUT, ELB, JISR, FMP
 - Warrior Extended Battlespace Sensors
 - Multifunction RF Sensor Technology
 - Cooperative Engagement Capability
 - Battlespace Infosphere
- **DUSD(S&T) Initiatives**
 - Cognitive Readiness, ATR, etc.
- **DMSO**
 - HLA
 - Environmental & HB Reps
- **Basic Research**
 - MURI
 - Data Fusion in Large Array Micro-sensors
 - Mobile Augmented Battlespace Visualization
 - Real-Time Fault-Tolerant Network Protocols
 - Adaptive Mobile, Wireless Networks for Highly Dynamic Environments
 - Basic Research Plan efforts
 - Sensors, algorithms, environmental and cognitive modeling, etc.



Force Medical Protection ACTD

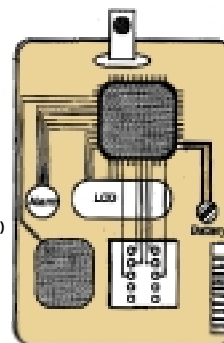


*Providing force protection
through superior
technology!*

Phase I:
Chemical Dosimeter
(Non Real-time)



Phase II:
Chemical Dosimeter (Real-time)/
Biological Dosimeter
(Non Real-time)



Estimated unit cost for production:
Between \$10-\$100 per badge



The Evolution

Sensors...

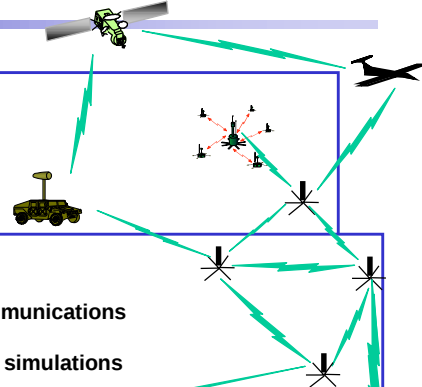
- Multi-domain sensors
- Low cost and micro size
- Capable of target ID (ATR)
- Autonomous & platform based

SensorWeb...

- Sensor arrays
- Wireless, high-bandwidth communications
- Next Generation Internet
- Efficient links to weapons and simulations

Smart SensorWeb...

- Adaptive, intelligent sensor arrays
- Intelligent information management and dissemination
 - Avoids "information overload"
- Dynamic databases and knowledge-bases
- Intelligent agents as mediators
- Multi-sensory, natural user interfaces



Smart SensorWeb: Objectives (FY00 - FY02)

- Identify Warfighter requirements for SSW



- Showcase/illuminate current S&T products and capabilities



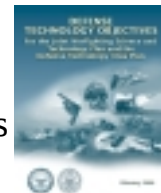
- Demonstrate SSW technical feasibility



- Demonstrate enhanced situational awareness

- Assess utility to the Warfighter

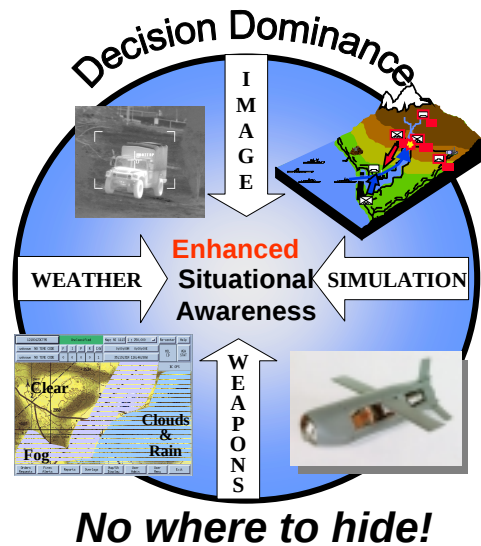
- Identify future research priorities



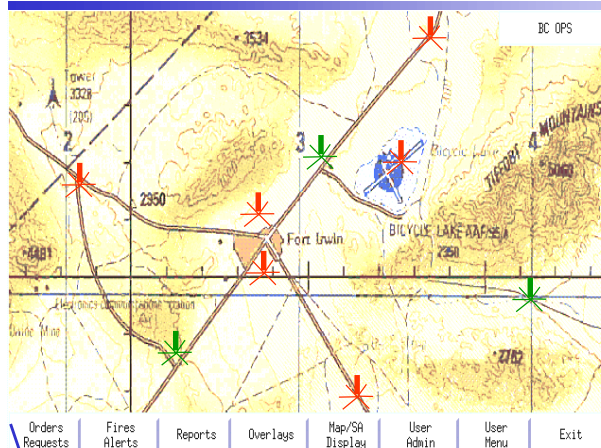


SSW Elements

- **ImageWeb**
 - Adaptive sensor arrays
 - Intelligent data fusion
- **WeatherWeb**
 - Nowcasts & predictions
 - Dynamic weather effects
- **WeaponsWeb**
 - Sensor-shooter links
 - Optimized engagements
- **SimulationWeb**
 - Simulation-based development
 - Mission planning, rehearsal, & training
- **Information Integration**
 - Info fusion & visualization
 - Data standards



SSW Concept



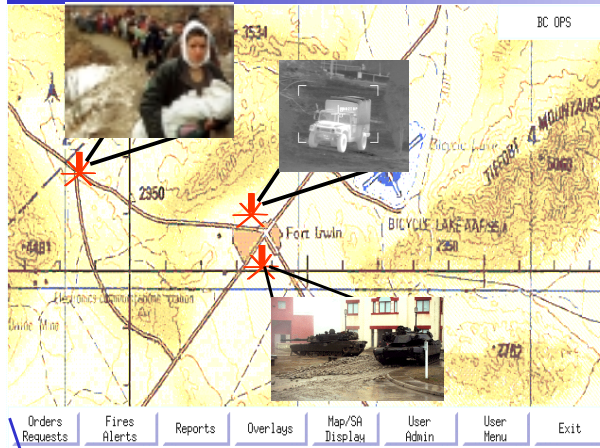
Decision Dominance

- **ImageWeb**
 - ID Sensor Arrays
 - Add Sensor Arrays





SSW Concept



Decision Dominance

- ImageWeb
 - ID sensor arrays
 - Add sensor arrays
 - Sensor alerts
 - Visualize data
 - Obtain images



SSW Concept



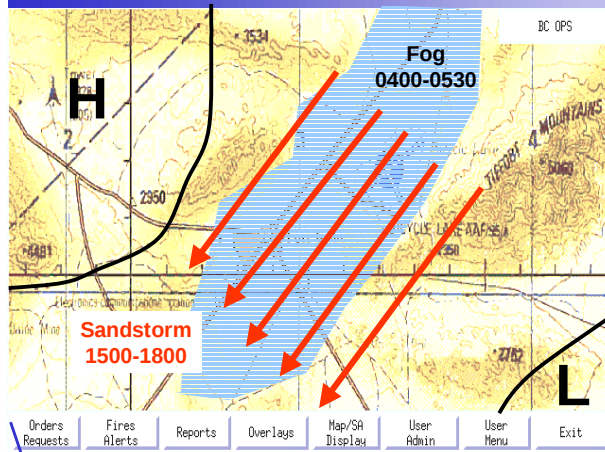
Decision Dominance

- ImageWeb
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 - Obtain images
- WeaponsWeb
 - Determine threat
 - Friendly situation
 - Engage target
 - Assess damage





SSW Concept



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- WeatherWeb
 - Nowcasts & predictions
 - Dynamic effects



SSW Concept



Decision Dominance

- ImageWeb
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 - Visualize data
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- WeaponsWeb
 - Determine threat
 - Friendly situation
 - Engage target
 - Assess damage
- WeatherWeb
 - Nowcasts & pred.
 - Dynamic effects
- SimulationWeb
 - Fly-through
 - Planning/rehearsal





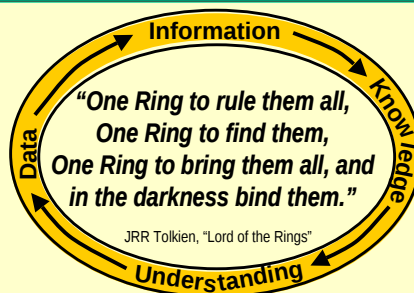
Smart SensorWeb: Testbed Approach

☆ **Testbeds** allow a near-term technology “build-and-demonstrate” that **evolves** to the long-term vision

☆ **Four Key Testbed Projects to Demonstrate Capability:**

- ◆ ImageWeb
- ◆ WeatherWeb
- ◆ WeaponsWeb
- ◆ SimulationWeb

Information Integration → Decision Dominance



Focus on MOUT Scenario

Center for Army Lessons Learned

- Majority of MOUT casualties due to **inadequate situational awareness**
- Commanders have difficulty “seeing” the fight

Changing Environments



Security Threats

- Rogue Nation States/Alliances
- International Crime Organizations
- Transnational Actors/Terrorists
- Weapons of Mass Destruction

21st Century

- Conflict Increasing
- Proliferation of Military and Commercial Technologies
- Operations in Urban Environments
- Preponderance of Coalitions
- Ethnic Strife

Impact

- Greater Range of Solutions
- No US Monopoly in all Technologies
- Complex Targets/Terrain
- Information Management Critical



Smart SensorWeb: Key Players

ImageWeb:

Dr. Don Reago, Army NVESD
Ms. Mun-Won Fenton, ONR

WeatherWeb:

Dr. Douglas Brown, ARL
Dr. John McCarthy, NRL, Monterey

WeaponsWeb:

Col Norman Leonpacher, AFRL-Eglin AFB
Dr. James Chew, ONR

SimulationWeb:

Mr. William Jarvis, US Army NVESD
CAPT Robert Eberth, MCWL

Information Integration:

Mr. John Graniero, AFRL
Mr. George Lukes, DARPA
Dr. Lee Hammarstrom, NRO

Smart SensorWeb:

Dr. Jasper Lupo, DUSD(S&T)/SS
Dr. Charles Holland, DUSD(S&T)/IS
LTC Bruce Gwilliam, DUSD(S&T)/SS
Mr. Jeff Paul, DUSD(S&T)/SS
Mr. Marshall Potter, DUSD(S&T)/IS
CAPT David Martin, DUSD(S&T)/IS

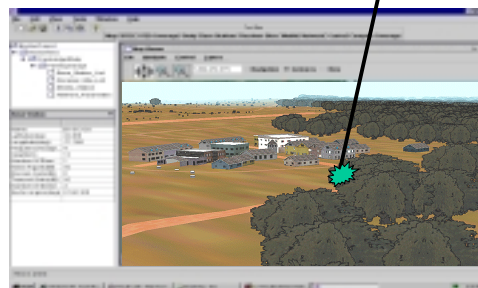
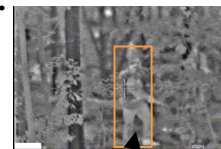


ImageWeb Year 1 - Web on Line

Point, click and see in an urban environment:

- Priority alert to operator
- 3-D visualization
- Multiple sensors
 - IR/EO,
 - acoustic, &
 - seismic
 - μ -sensors
- Internet/LAN real-time access
- Images registered to site map (Compact Terrain Data Base)
- Target classification
- Target geolocation
- Target tracking
- Target hand-off

Alerting icon queried
for imagery





Year 2 - ImageWeb Assistant

Building on Year 1 to automate target of interest detection/recognition and tracking

- Data fusion between multiple viewpoints
- Multi-modal data fusion (thermal /daylight)
- Random sensor placement experiments
- Weather Web integration
- Image to model registration
- MTI/Change Detection/Cross-cueing
- Sensor arbitration for 'best view'
- Geolocation via N-camera registration
- Simulation integration via HLA protocol



Multi-modal Data Fusion

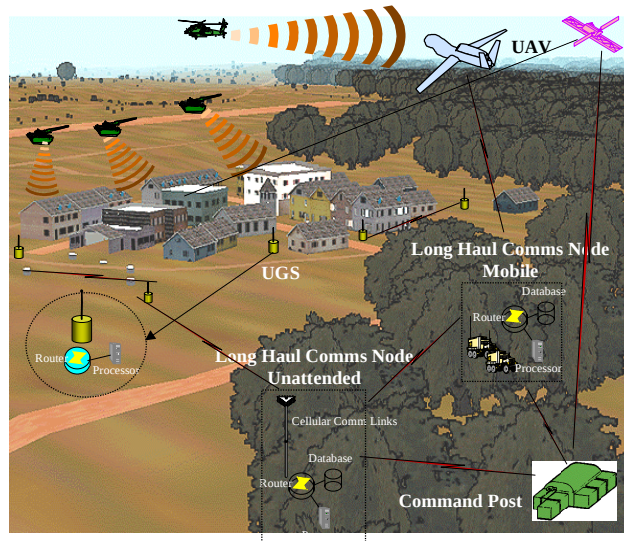
Image to model registration



Year 3 - Intelligent Image Agent

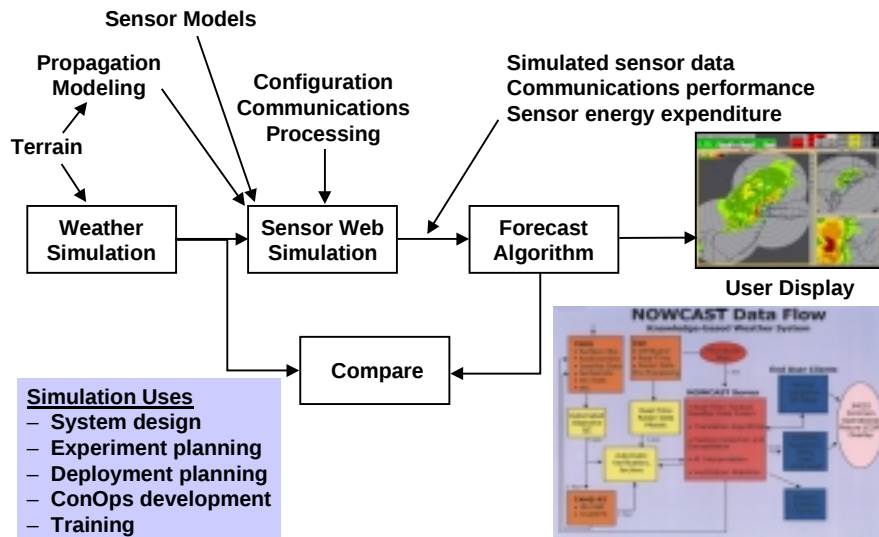
Smart Sensor Webs

- Mobile Ad Hoc Network
- Air dropped sensors
- Tactical mobile robots
- Multi-sensor coordination
- Leveraging DARPA's SUO, IU, DDB, MEMS Programs
- Novel sensors
- Managed video/data streams
- Tactical sensor integration
- 4-D model - live simulation

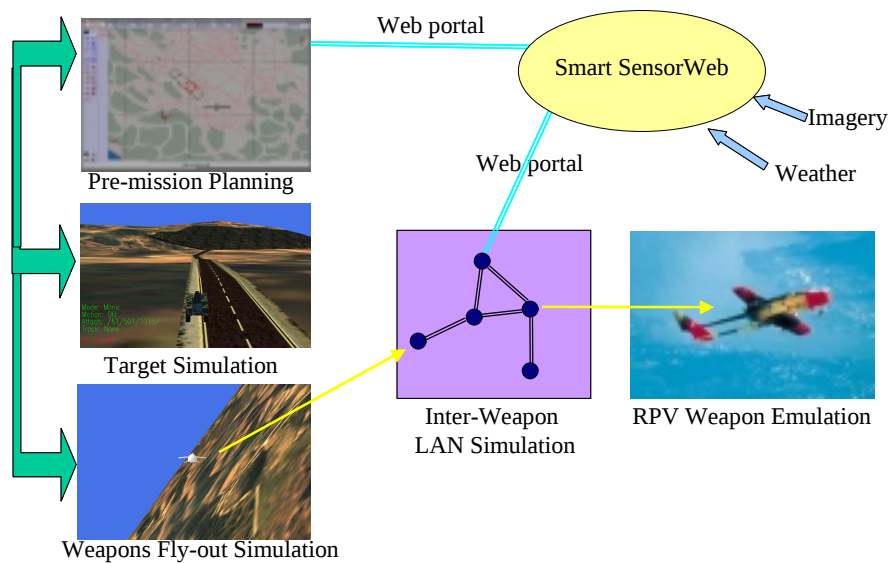




WeatherWeb

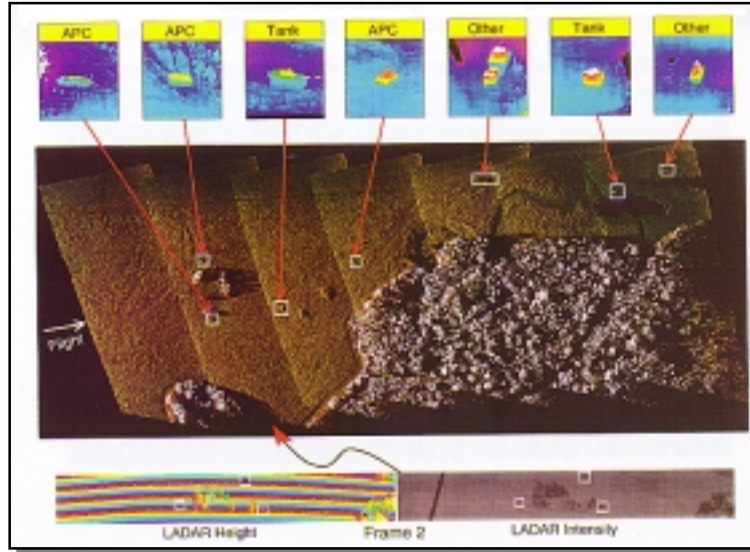


WeaponsWeb

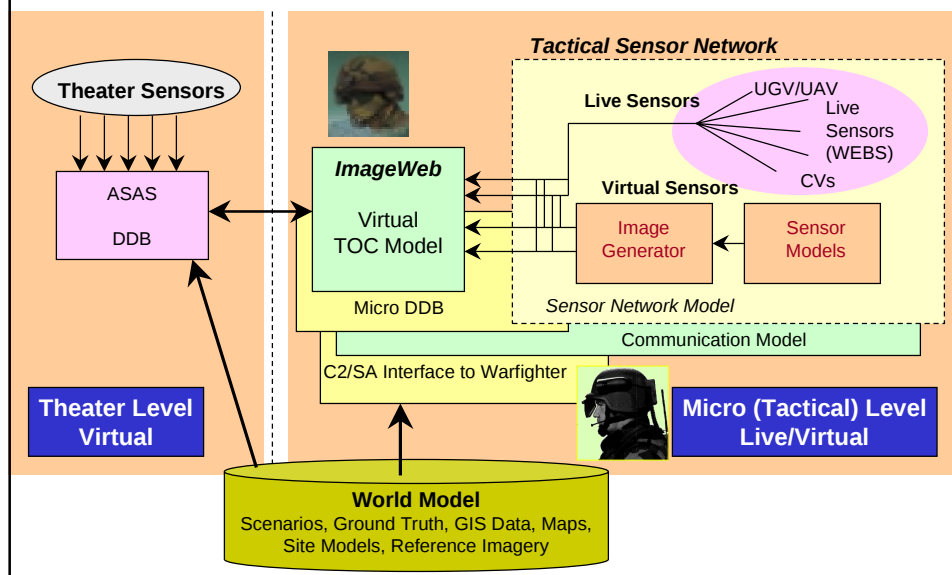




LADAR Automatic Target Recognition Captive Flight Test Results

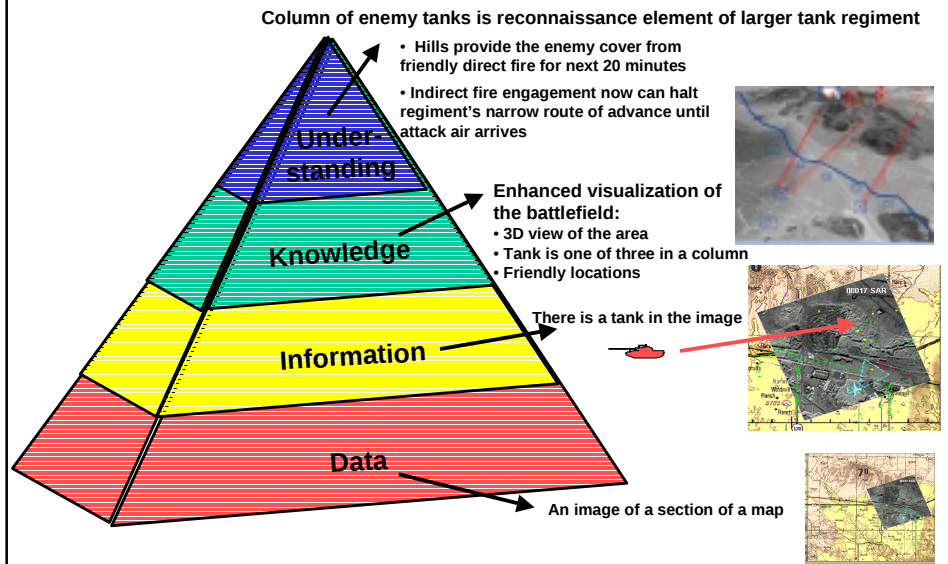


SimulationWeb



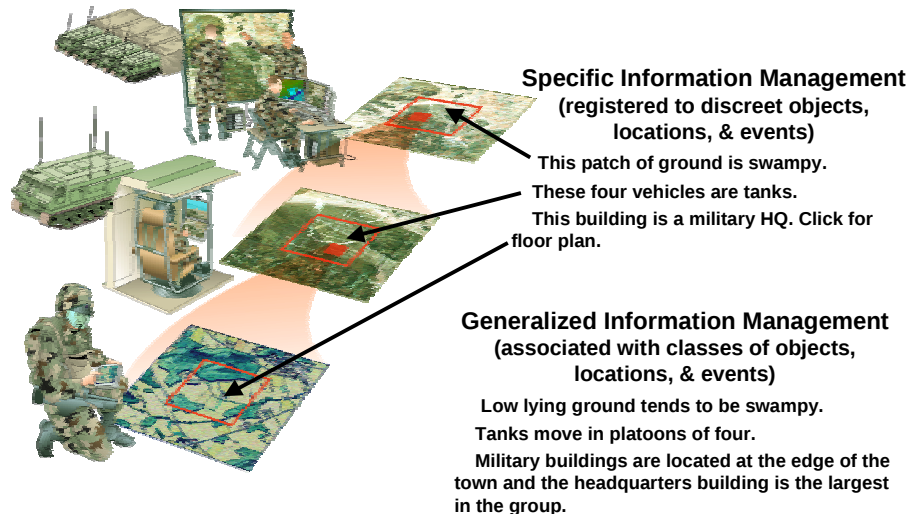


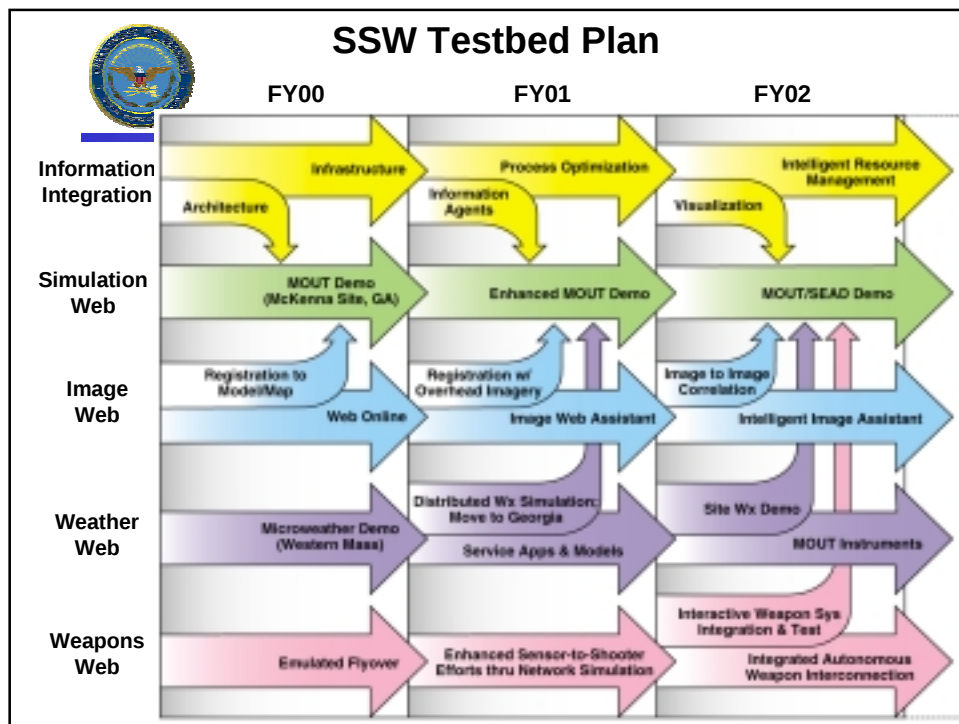
SSW: From Data to Understanding



Managing SSW Information

Approaches for Handling Information





Summary

- Broad initiative
 - Large arrays of local sensors
 - Testbed emphasis to prove concept
- Leverages DoD and commercial investments
- Long term research opportunities

Operational Decision Dominance



"seeding" the battlefield with a network of distributed sensors

