Smart SensorWeb

National Military Sensing Symposium

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for Science and Technology

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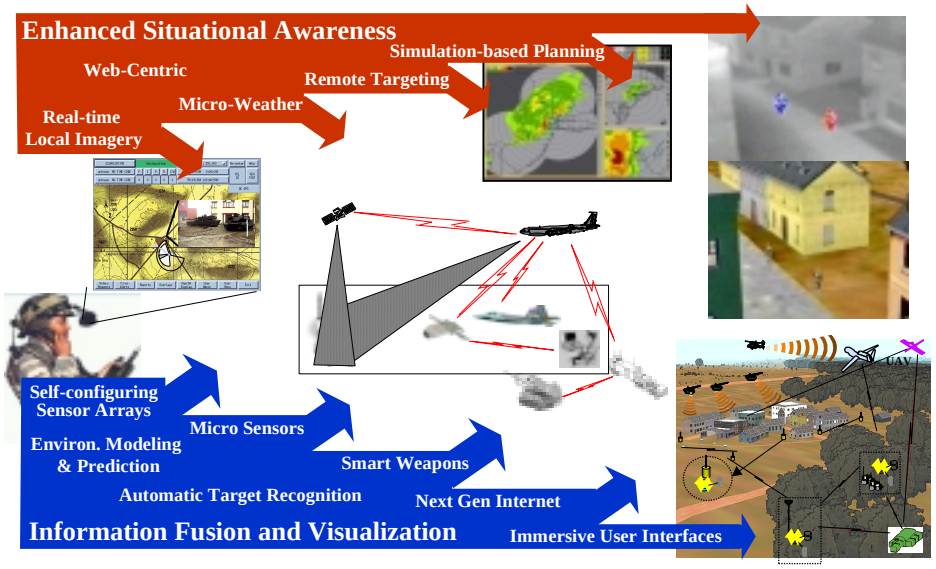
Smart SensorWeb



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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

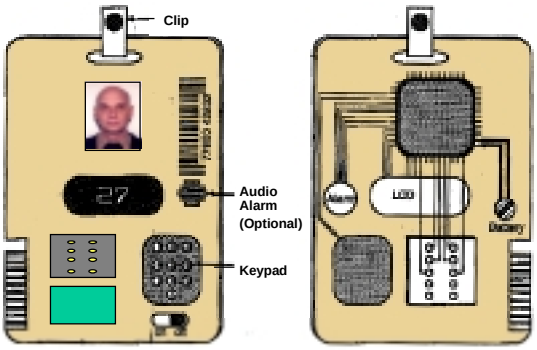
- **DARPA**
  - Sensor Progams
    - VSAM
    - AVS
    - SensIT
  - Knowledge-Base Programs
    - Dynamic Databases
    - Command Post of the Future
    - Warfighter Visualization
    - Intelligent Integration of Information Technology
    - Rapid Knowledge Formation
  - Comm Network Programs
- **Service 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 Mirco-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!

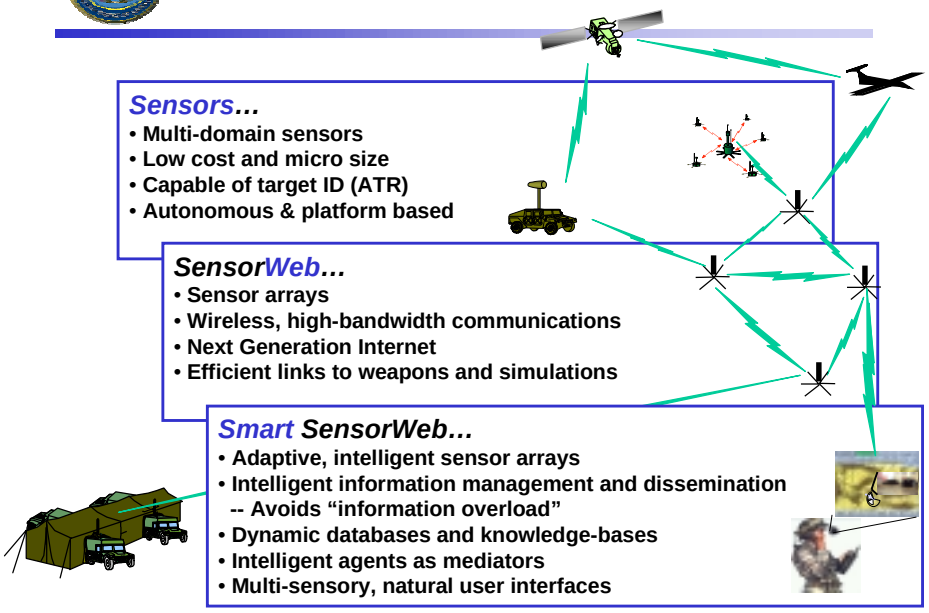
Phase I:
Chemical Dosimeter
(Non Real-time)

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



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

The Evolution



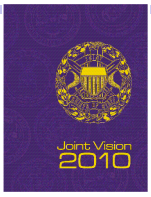
Sensors…
- Multi-domain sensors
- Low cost and micro size
- Capable of target ID (ATR)
- Autonomous & platform based

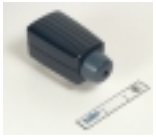
SensorWeb…
- Sensor arrays
- Wireless, high-bandwidth communications
- Next Generation Internet
- Efficient links to weapons and simulations

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

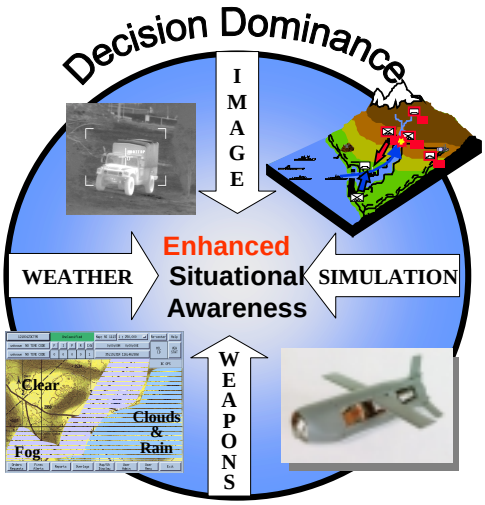
- Demonstrate enhanced situational awareness

- Assess utility to the Warfighter

- Identify future research priorities

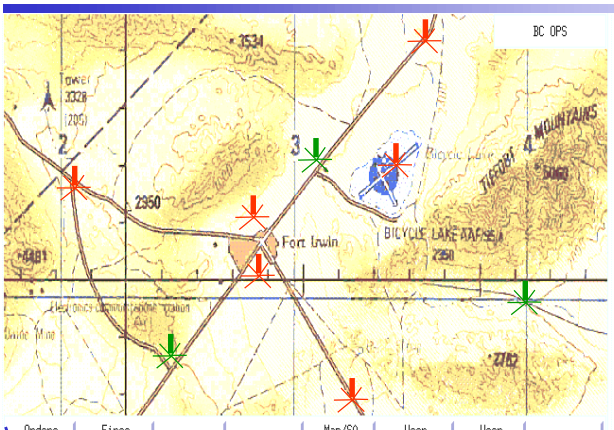
SSW Elements

- **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



No where to hide!

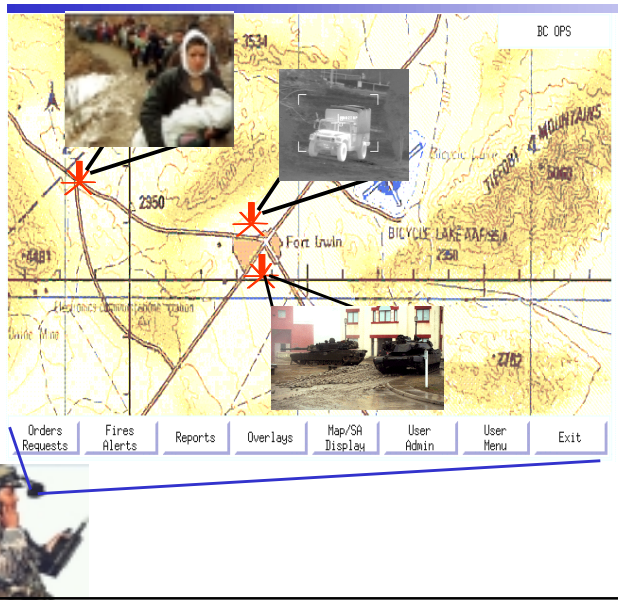
SSW Concept



Decision Dominance

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

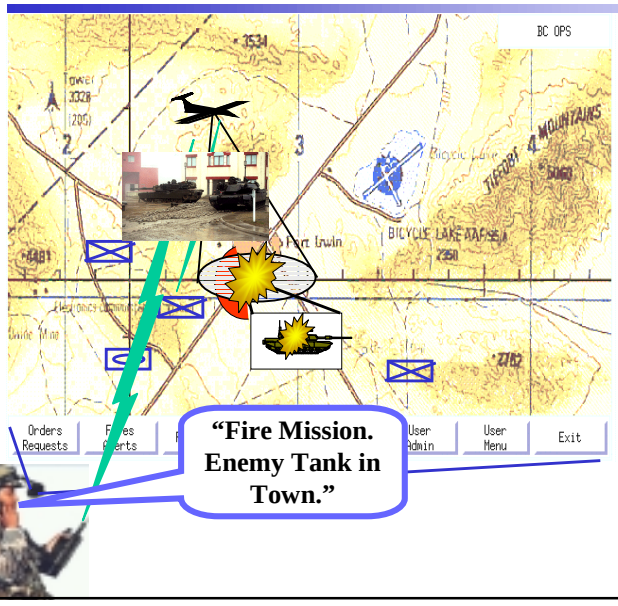
SSW Concept



Decision Dominance

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

SSW Concept



Decision Dominance

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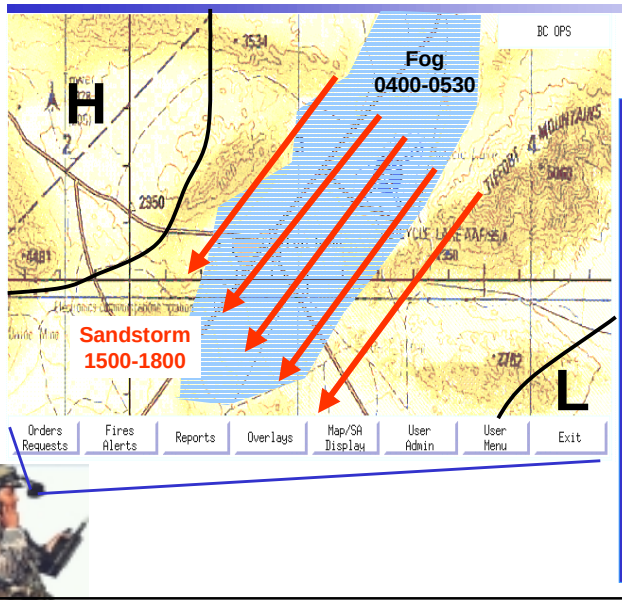
  - Visualize data
  - Obtain images
- WeaponsWeb
  - Determine threat
  - Friendly situation
  - Engage target
  - Assess damage

SSW Concept



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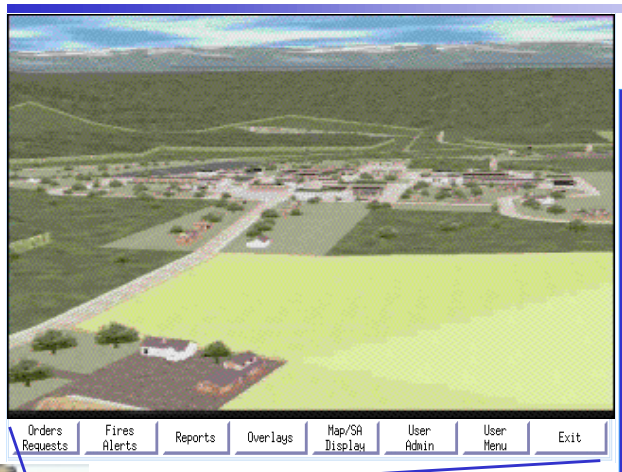
- WeatherWeb
  - Nowcasts & predictions
  - Dynamic effects

SSW Concept



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  - Assess damage
- WeatherWeb
  - Nowcasts & pred.
  - Dynamic effects
- SimulationWeb
  - Fly-through
  - Planning/rehearsal

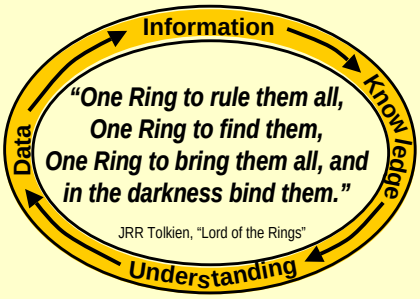
Smart SensorWeb: Testbed Approach

☆**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

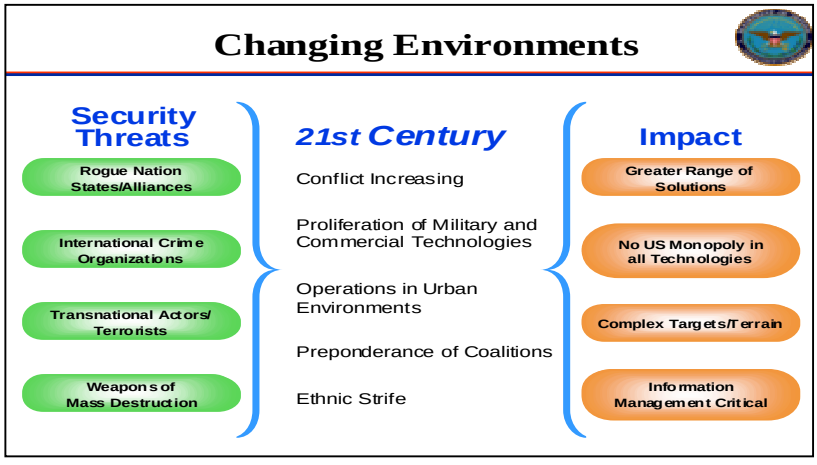
Information Integration → Decision Dominance



Focus on MOUT Scenario

Center for Army Lessons Learned

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



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

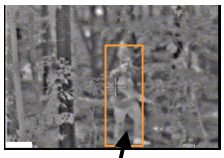
Smart SensorWeb:
Dr. Jasper Lupo, DUSD(S&T)/SS
Dr. Charles Holland, DUSD(S&T)/IS
LTC Bruce Gwilliam, DUSD(S&T)/SS
Mr. Jeff Paul, DUSD(S&T)/SS
Mr. Marshall Potter, DUSD(S&T)/IS
CAPT David Martin, DUSD(S&T)/IS

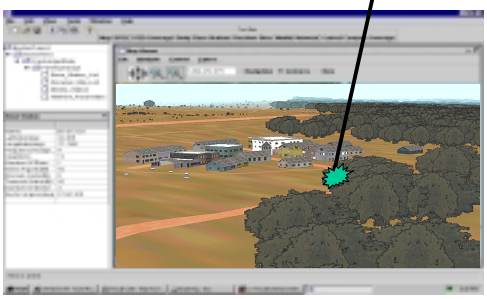
ImageWeb
Year 1 - Web on Line

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

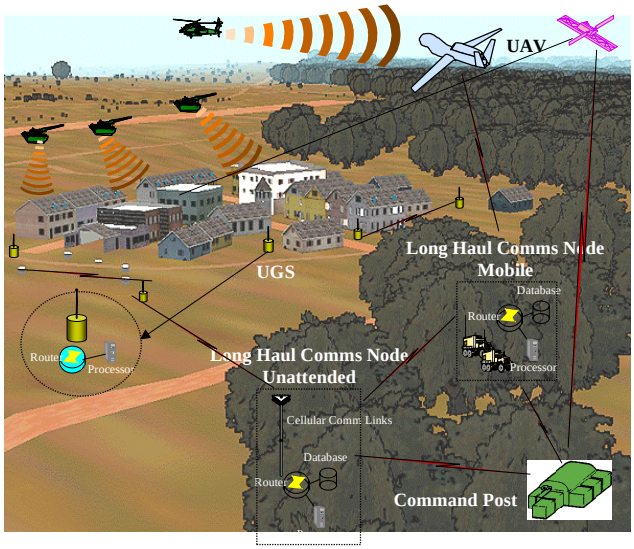
Multi-modal Data Fusion

Image to model registration

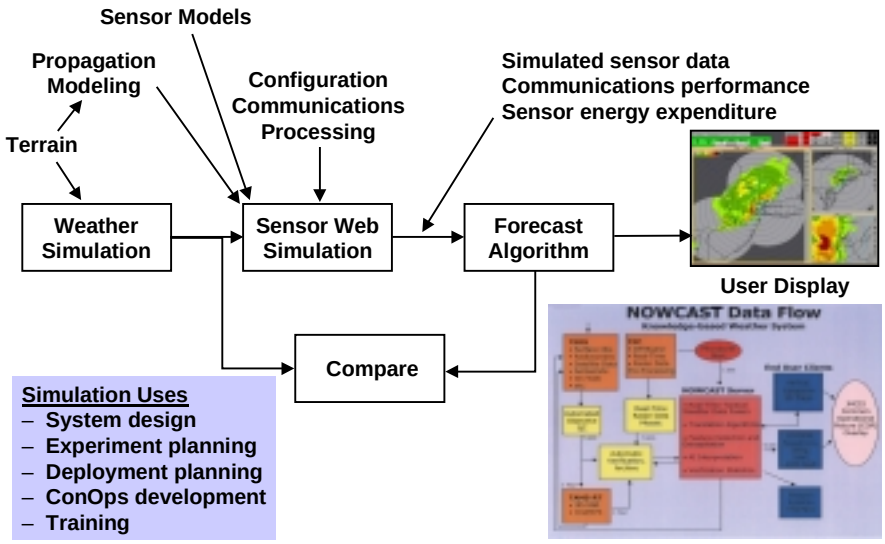
Year 3 - Intelligent Image Agent

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

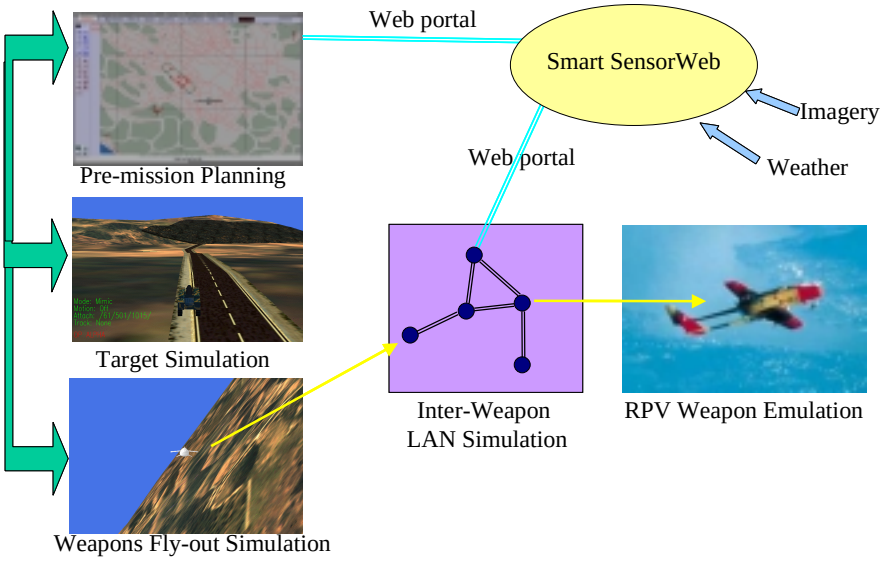


WeatherWeb

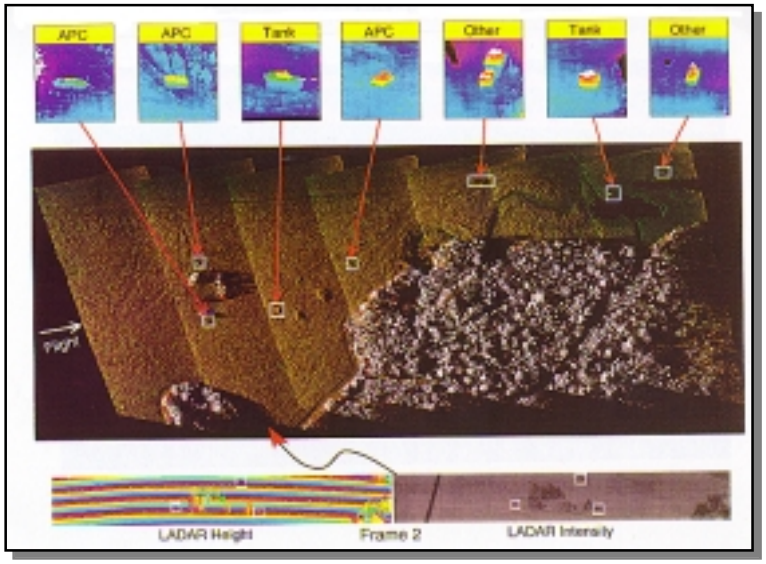


Simulation Uses
- System design
- Experiment planning
- Deployment planning
- ConOps development
- Training

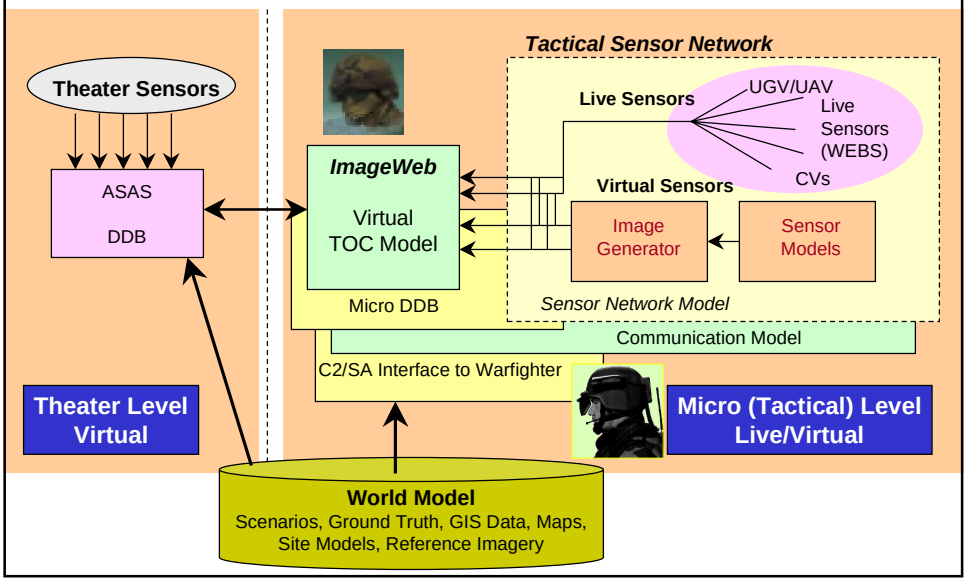
WeaponsWeb



LADAR Automatic Target Recognition Captive Flight Test Results

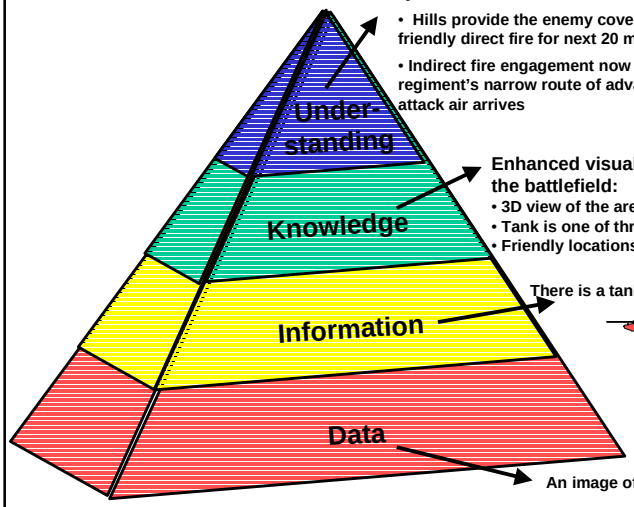


SimulationWeb

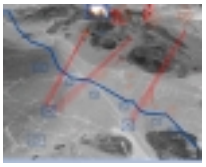


SSW: From Data to Understanding

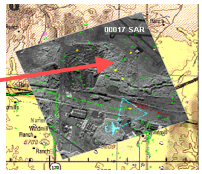
Column of enemy tanks is reconnaissance element of larger tank regiment



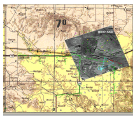
- Hills provide the enemy cover from friendly direct fire for next 20 minutes
- Indirect fire engagement now can halt regiment's narrow route of advance until attack air arrives



Enhanced visualization of the battlefield:
- 3D view of the area
- Tank is one of three in a column
- Friendly locations



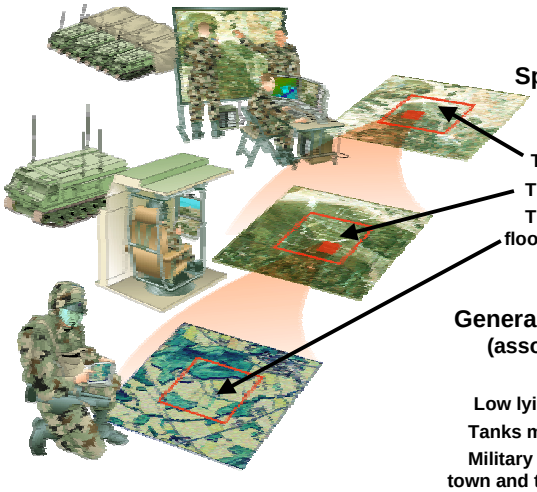
There is a tank in the image



An image of a section of a map

Managing SSW Information

Approaches for Handling Information



Specific Information Management (registered to discreet objects, locations, & events)

This patch of ground is swampy.

These four vehicles are tanks.

This building is a military HQ. Click for floor plan.

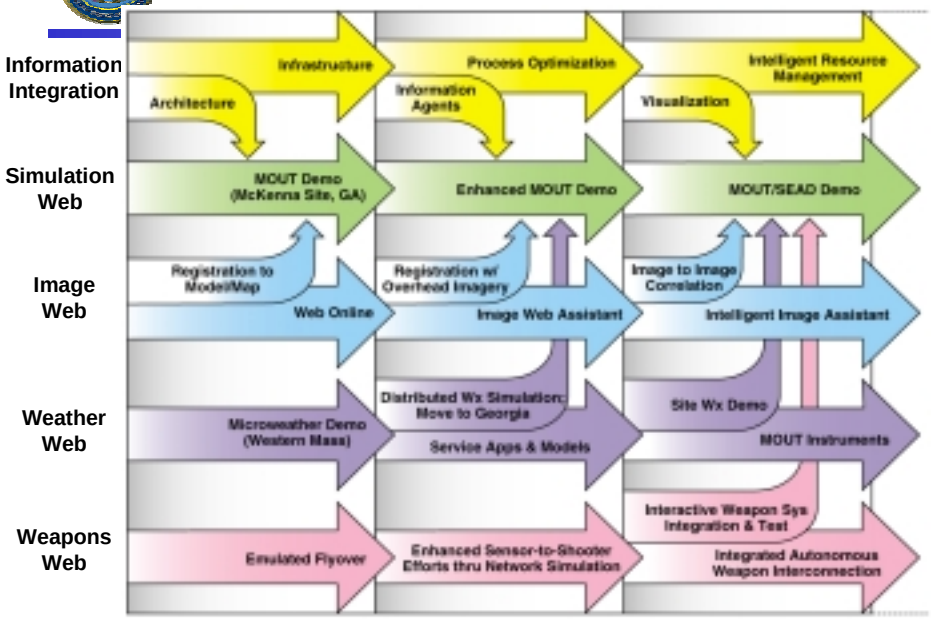
Generalized Information Management (associated with classes of objects, locations, & events)

Low lying ground tends to be swampy.

Tanks move in platoons of four.

Military buildings are located at the edge of the town and the headquarters building is the largest in the group.

SSW Testbed Plan



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


SMART
SENSORWEB