Future Combat Systems

11th Annual US Army
Ground Vehicle Survivability Symposium
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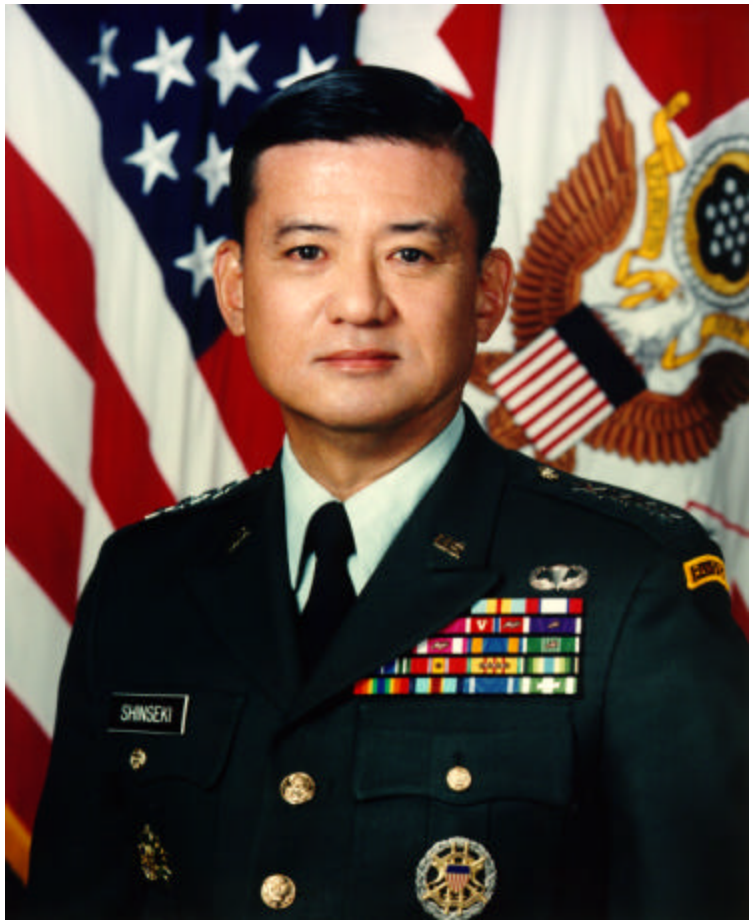
Agenda

- The Problem
- The Challenge
- Technical Approach
- System Technology Options
- FCS Survivability
- Summary

CSA Statement of the Problem



"We must provide early entry forces that can operate jointly, without access to fixed forward bases, but we still need the power to slug it out and win decisively. Today, our heavy forces are too heavy and our light forces lack staying power. We will address those mismatches." -- GEN Shinseki, CSA, 23 June 1999

The Challenge:

Lethal, Effective Early Entry Forces

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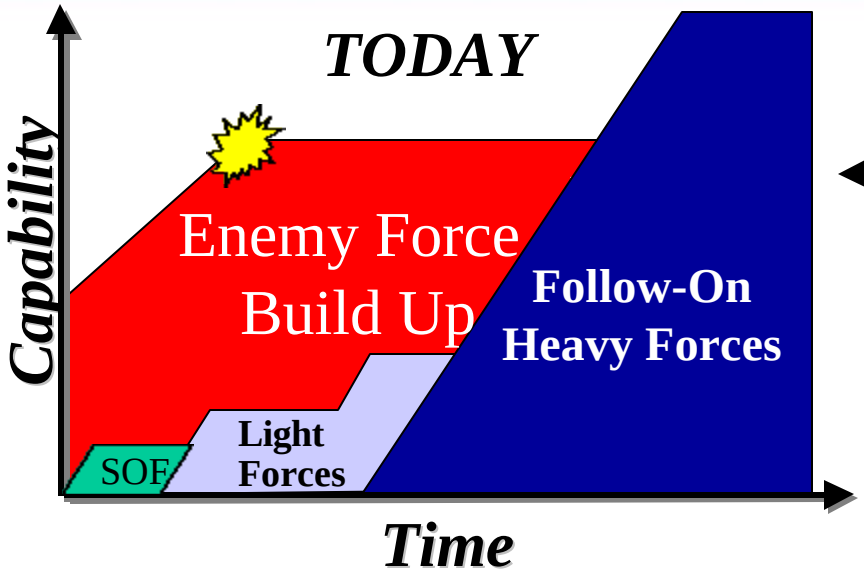


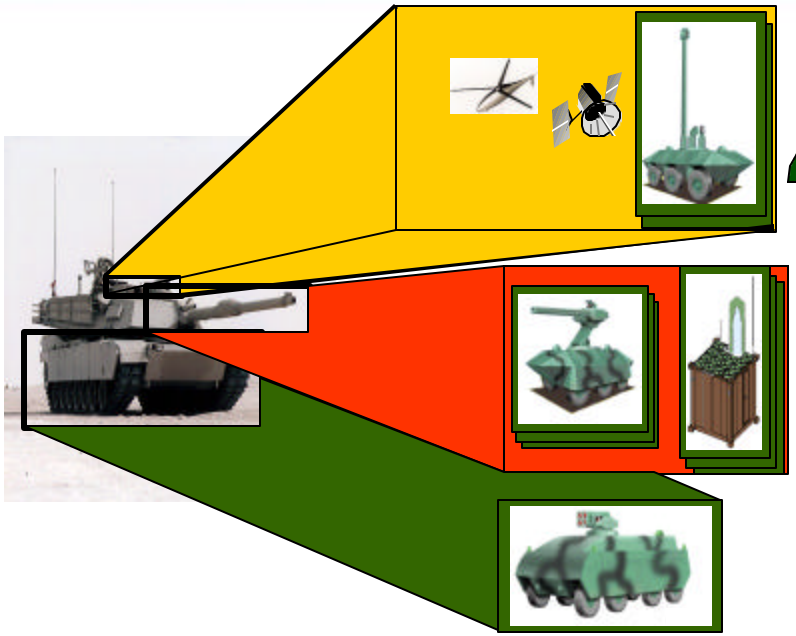
Red overmatch sets the conditions of battle

FCS
- **Multi-mission**
- **Rapidly deployed**
- **Light logistically**
- **Variable lethality**

Allows U.S. to set conditions on the battlefield

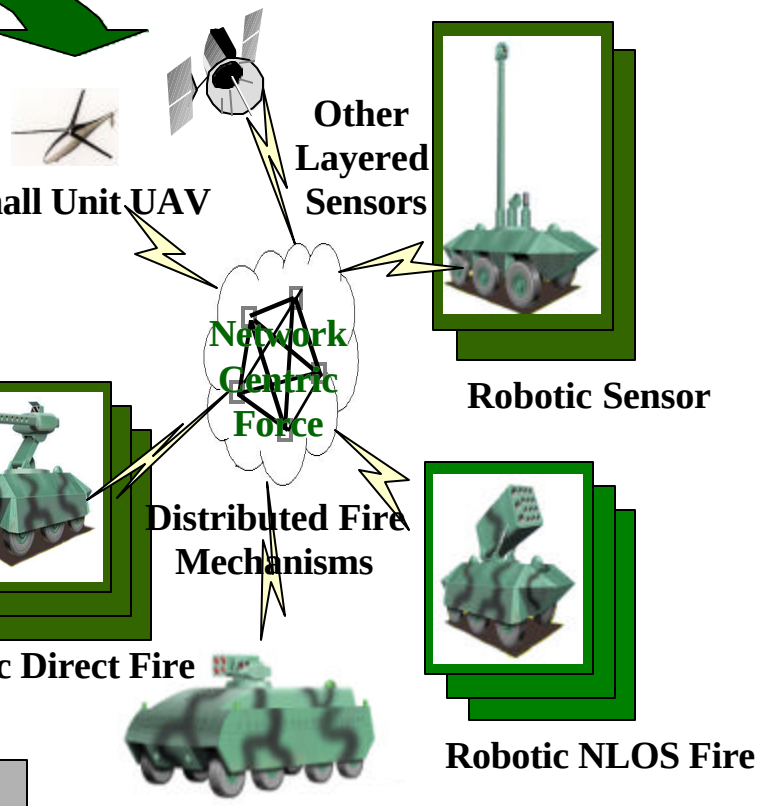
Technical Approach

Network Centric Distributed Platforms



From This...

To This...



Exploit Battlefield Non-Linearities using Technology to Reduce the Size of Platforms and the Force

Approved for Public Release, Distribution Unlimited

System Technology Options

Future Combat Systems

Draw From the Fullest Range of Technology Options

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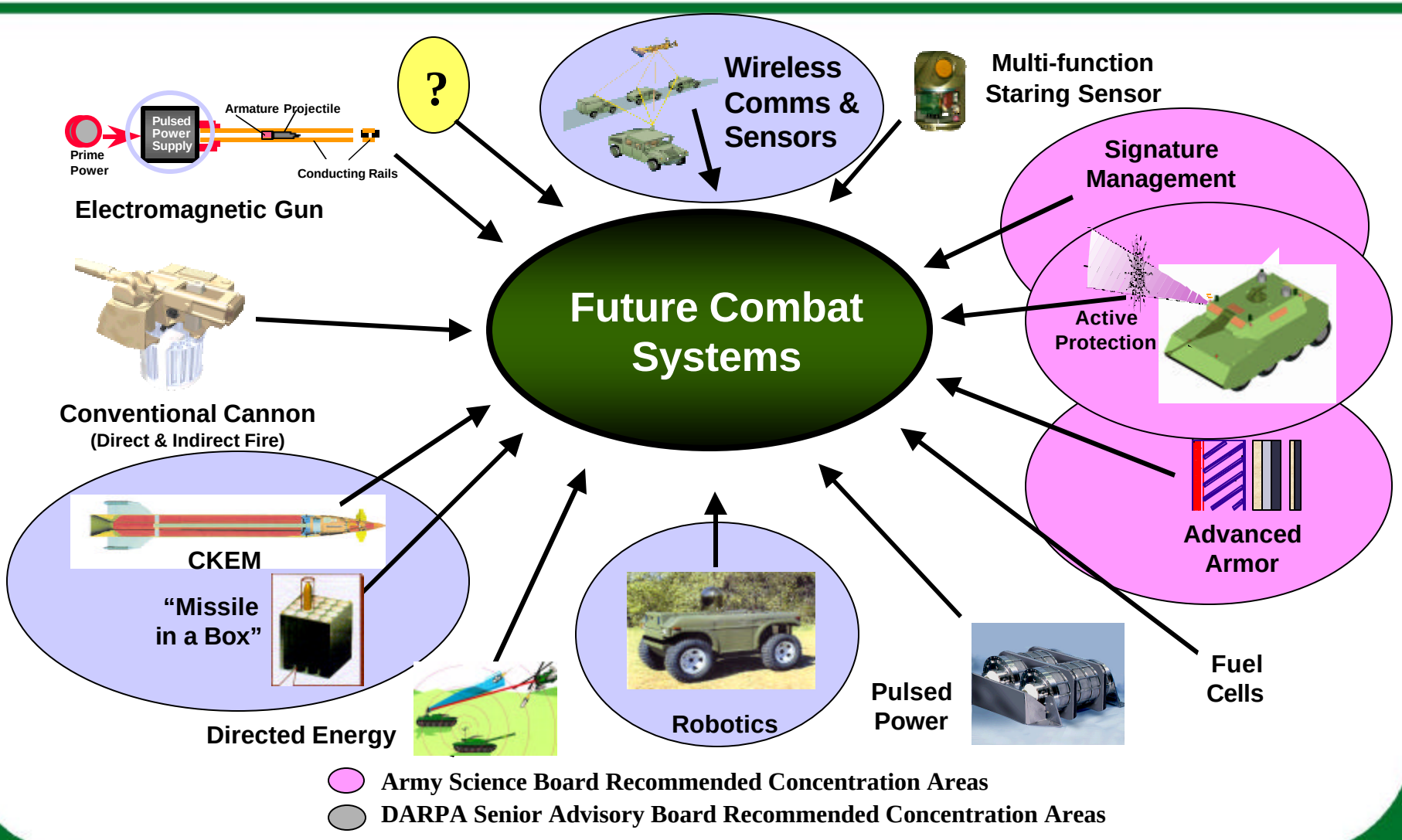

FCS Survivability Baseline

- **FCS Concept Survivability**
  - Smaller functional platforms
    - Harder to see
    - Harder to be targeted
    - Enhanced signature management
  - Distribution of mission functions between platforms
    - Enhanced mission survivability
    - Maximize advantages of terrain features
  - Networked assets
    - Task sharing and mutual protection
    - Remote threat engagement
  - Enhanced situational awareness
    - Inter-platform mutual protection
  - Application of unmanned systems
    - Remove the soldier from harms way

Future Combat Systems

Enhanced Survivability Through Shared Functions & Networking

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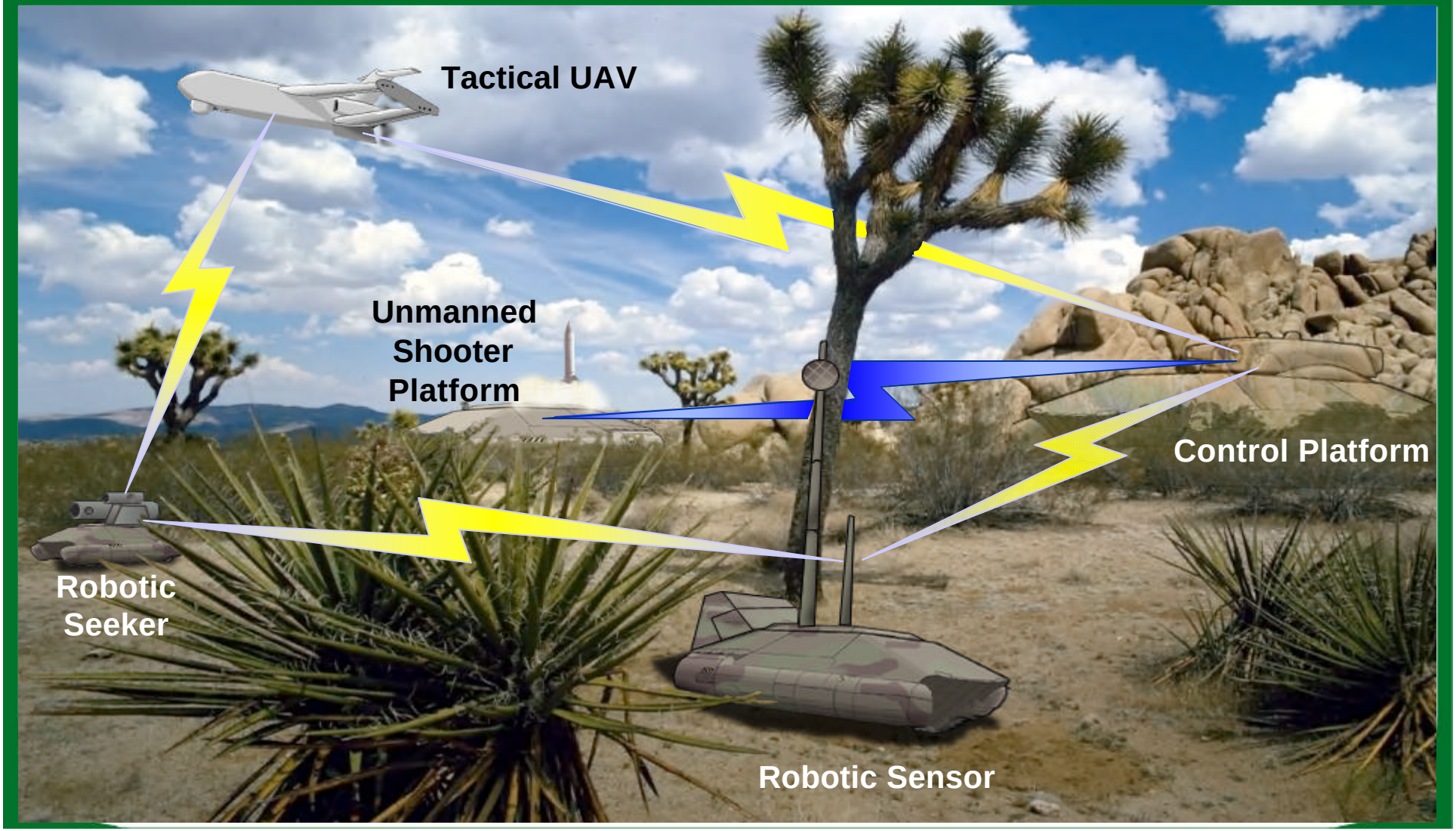
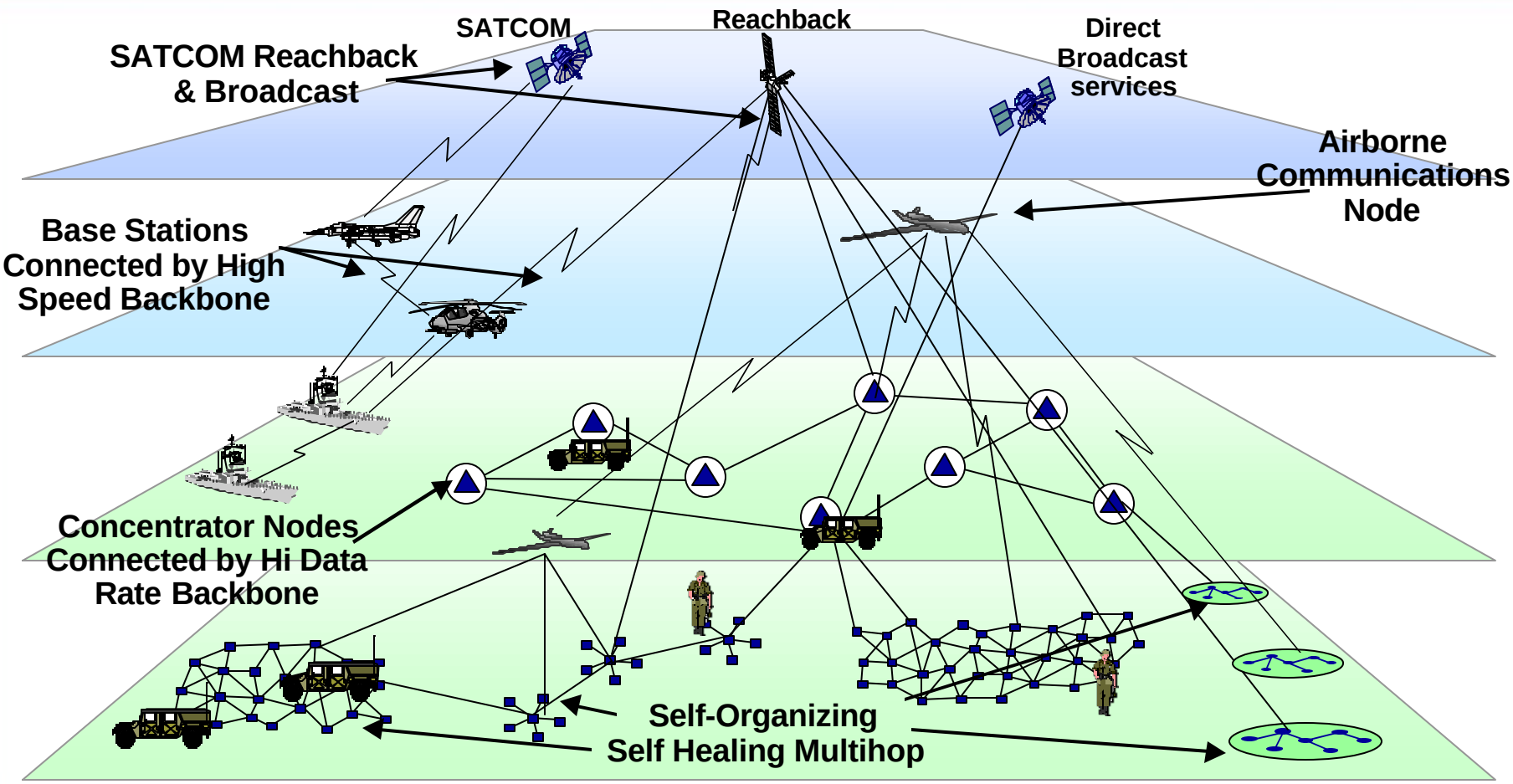


FCS Survivability

Don't be Detected

- **Typical Enabling Technologies**
  - Advanced materials
  - Advanced communications and sensors
  - Digitization
  - Hybrid power and energy
- **Sample Supporting Programs**
  - Small Unit Operations (SUO)
  - Combat Hybrid Power Systems (CHPS)
- **Challenges**
  - Network survivability
  - Platform design and packaging
  - Enhanced situational awareness
  - Maximum implementation of effective passive solutions
  - Electromagnetic and thermal signature management

Vision: A Survivable, Mobile, Adaptive, Ad Hoc Tactical Network



SUO SAS and GloMo Programs Provide the Foundation

Combat Hybrid Power Systems (CHPS)

Supports platform size reduction and silent operations

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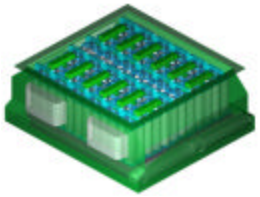
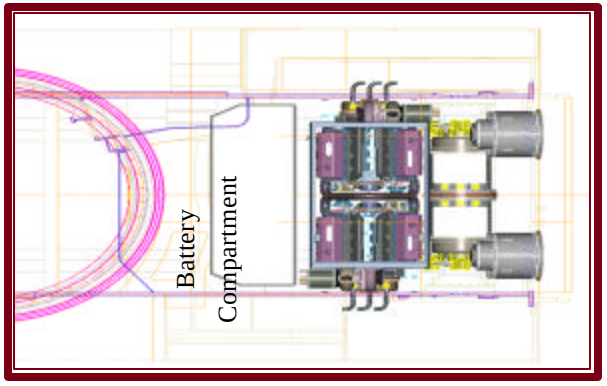
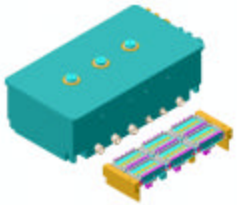


Energy /Power Storage
Li-Ion Battery/Flywheel

High Power Density
Prime Mover

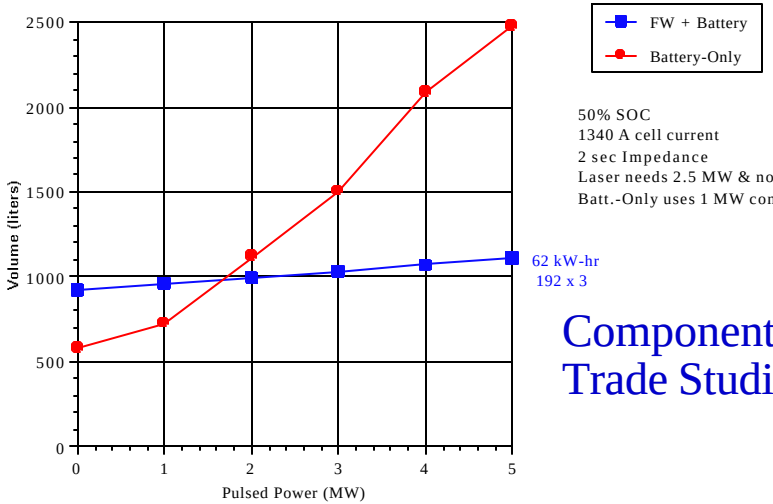
Evaluation of system architectures
using real hardware & validated models





Compact Power
Conversion -
SiC & hiT Si

IMPROVED SiC
ENERGY STORAGE SYSTEM VOLUME
CHPS Battery



50% SOC
1340 A cell current
2 sec Impedance
Laser needs 2.5 MW & no conv.
Batt.-Only uses 1 MW converter

Component
Trade Studies

	62	62	104	145	207	249	kW-hr (Battery-Only)
192 x	3	3	5	7	10	12	Number of cells

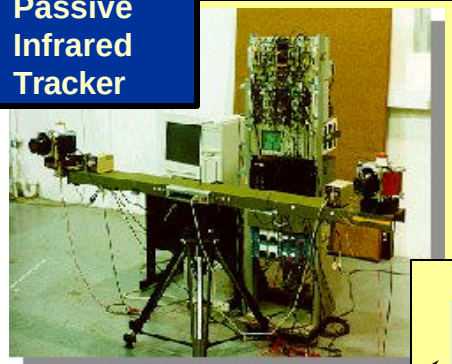
FCS Survivability

Don't be Hit

- **Typical Enabling Technologies**
  - Signal jamming
  - Decoys and deception
  - Active protection
  - Advanced sensors
- **Sample Supporting Programs**
  - Army Active Protection Systems (APS)
- **Challenges**
  - Threat detection
  - Response Time
  - Threat neutralization alternatives and tactics
  - Minimizing collateral damage
  - Signature management
  - Network "Cooperative Engagement"

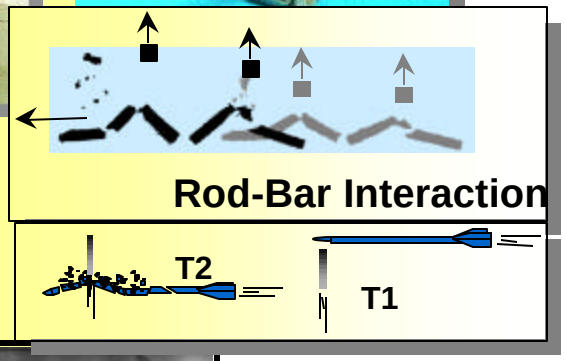
Kinetic Energy Active Protection

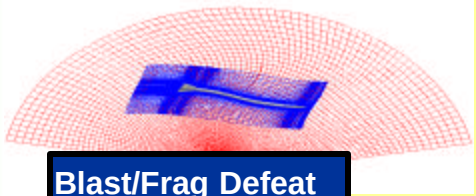
Passive Infrared Tracker



Electromagnetic Launcher and Pulse Forming Network

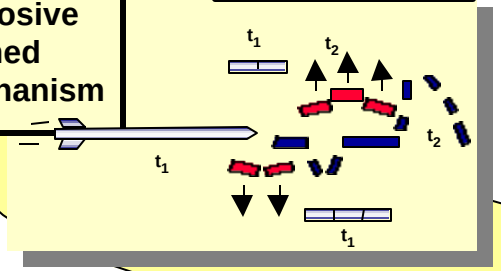
SEDD Escan Patch Antenna



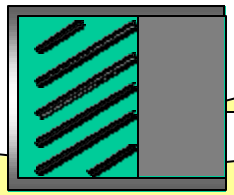


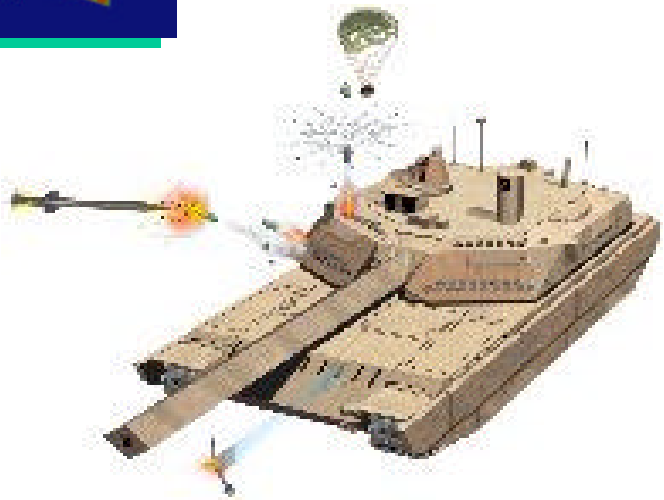
Blast/Frag Defeat Mechanism

High Explosive Launched Defeat Mechanism



Basal Armor





Critical Technologies:

- ***Cueing***
- ***Tracking***
- ***Fire control***
- ***Counter-munitions***
- ***Base armor***

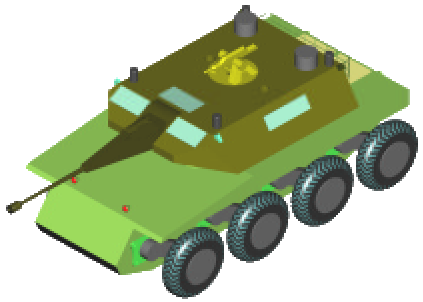
FCS Survivability

Don't be Penetrated

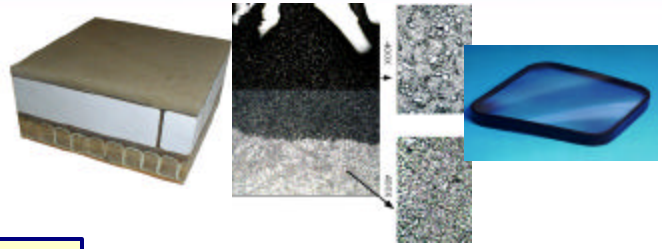
GVSS328-13

- **Typical Enabling Technologies**
  - Advanced passive materials
  - Advanced energetic materials
  - Electromagnetics
- **Sample Supporting Programs**
  - Army lightweight passive armor programs
  - Army integrated armor/structure programs
- **Challenges**
  - Defining threat boundary for armor protection
  - Addressing solutions for growth potential
  - Network survivability
  - Minimizing collateral damage
  - Electromagnetic signature management

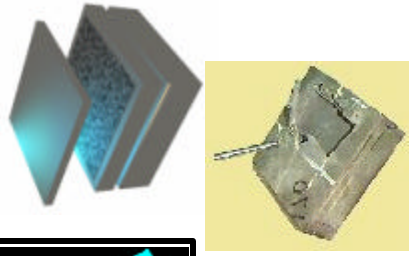
Lightweight Passive Armor



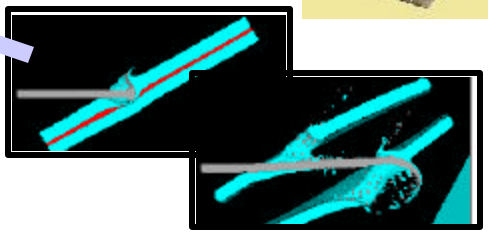
Advanced Materials and Composites



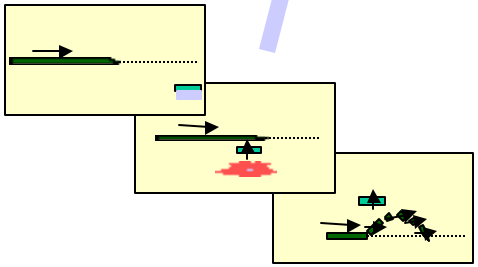
Ceramics / Interface Defeat



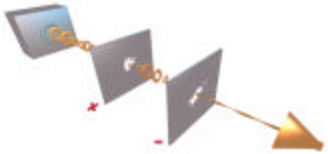
Explosive / Energetic Armor



Momentum Transfer Armor



EM Armor



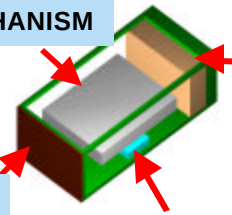
Smart Armor

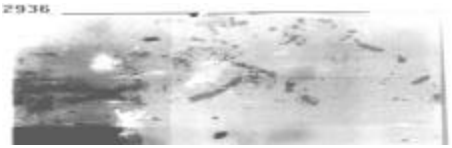
KILL MECHANISM

INTEGRATD BASE ARMOR/STRUCTURE

SENSOR

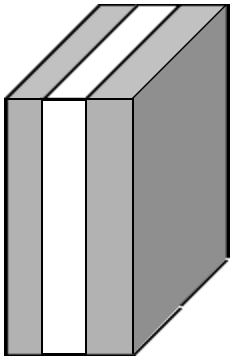
LOGIC / CONTROLLER PROCESSOR



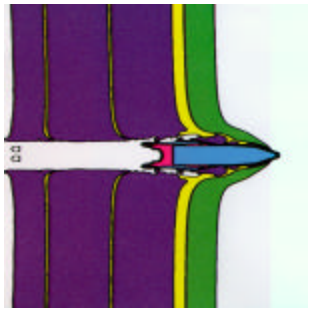


Integrated Armor/Structure Systems for Light Weight Vehicles

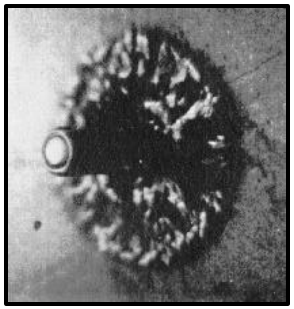
Integrating defeat mechanisms and structural technologies to establish performance bounds



Material Development



Modeling and Analysis

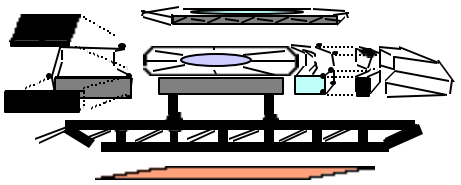


Experimental Validation

Develop max protection possible for fixed areal density

Armor/structure integration & optimization

Develop minimum weight armor/structure for given protection requirement



FCS Survivability

Don't be Killed

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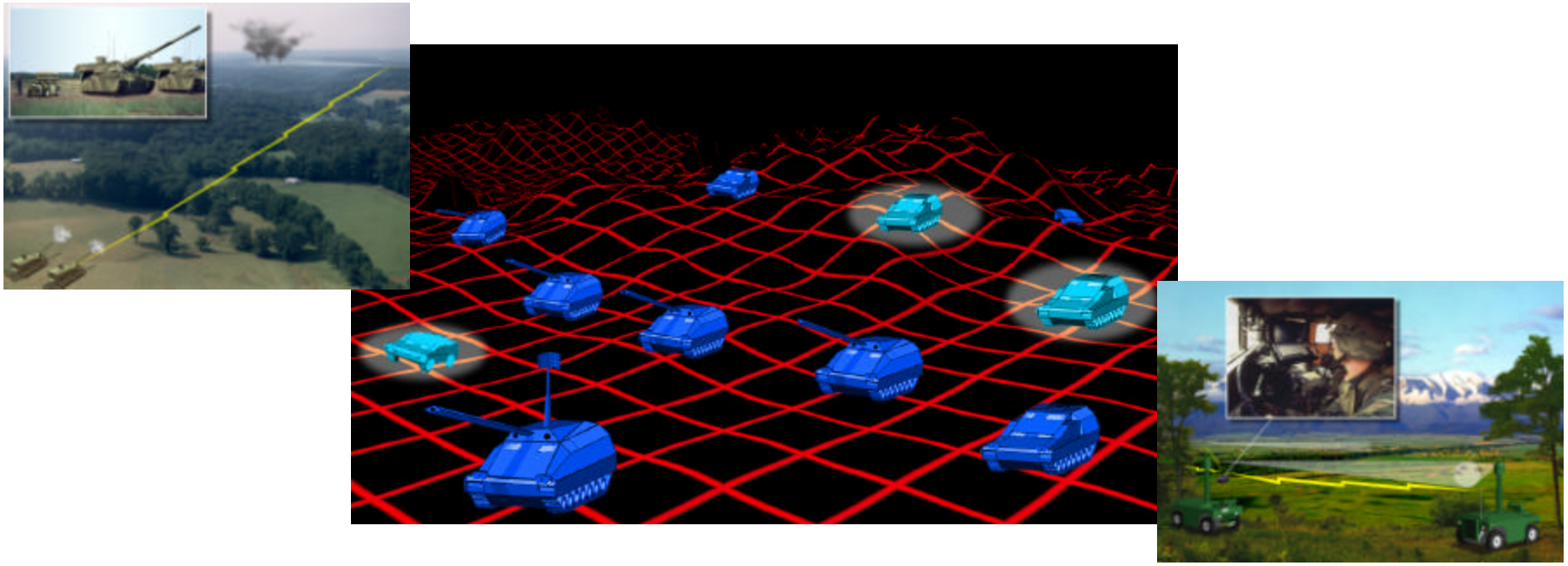
- **Typical Enabling Technologies**
  - Robotics/Autonomy
  - High energy absorption materials
  - Internal platform design/fire suppression
  - Spall suppression
- **Sample Supporting Programs**
  - Demo III
  - Joint Robotics Program
- **Challenges**
  - Internal platform design optimization
  - Providing effective spall protection
  - Effective blast and fire protection
  - Prevention of 2nd round hit
  - Mission continuation with remaining system assets

A Vision of Future Land Combat

Robotics Technology Contributing to Manned & Unmanned Systems

GVSS328-17

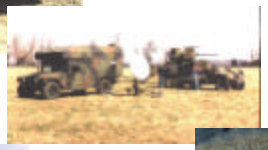


Mobile robotic systems and robotics technology in the air and on the ground, are essential: for situational awareness, for fire support, for logistics, for communications, and as aids to reduce the severe physical and mental overburden of future combat

DOD Interagency Collaboration in Robotics

Agency	Technical Focus
DOC	• Real time sensory interactive control • Computing architecture • Retrotraverse navigation • Architecture standards • Standardized vehicle actuation
NASA	• Stereo machine vision • Obstacle detection • Active gaze control • CMU planner integration • Terrain classification • Terrain adaptive velocity
DOE	• Low data rate video compression for mobility • Advanced manipulator • Tactical unmanned vehicle prototypes • Tasking & Control
DOT	• Baseline advanced highway system experimentation • Autonomous road following
DOJ	• Contingency support

Demo I



Mustang

Demo I

Demo II

Demo III

TMAP - Late 80's

SARGE

TMR

FCS Survivability -

An Added Dimension

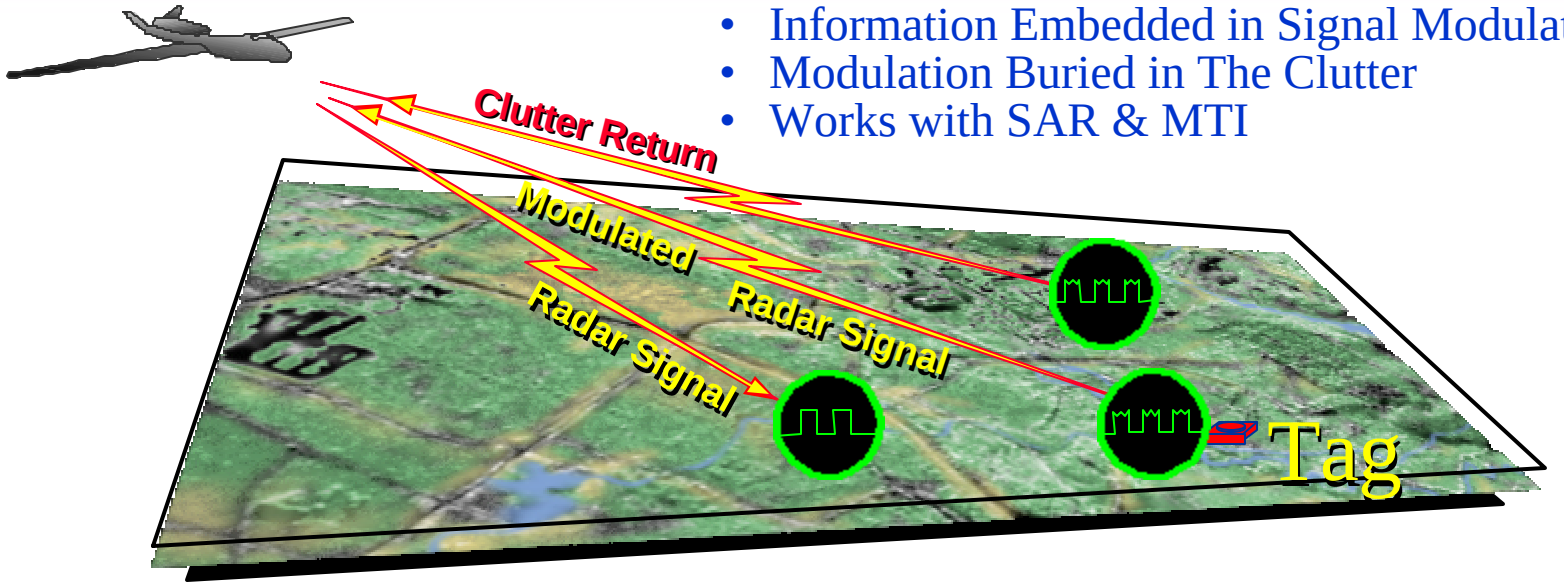
Don't be There!

GVSS328-19

- **Typical Enabling Technologies**
  - Tagging
  - Advanced UAV's
  - Remote Fires
- **Sample Supporting Programs**
  - RF Tags
  - A-160
  - Advanced Fire Support System(AFSS)
- **Challenges**
  - Identify and track targets
  - Provide robust and secure communications and networks to empower decision options
  - Overcome time latency problems
  - Identify action protocols and rules of engagement

Digital RF Tags Program System Concept

- Information Embedded in Signal Modulation
- Modulation Buried in The Clutter
- Works with SAR & MTI



SAR Image

Tag Image

A160 Unmanned Helicopter System Concept

GVSS328-21

- **Advanced Rotorcraft Technology**
  - Low Disk Loading for Efficient Low Power Loiter
  - Low Rotor Tip Speed
  - Hingeless, “Rigid” Rotor

- **Unmanned Helicopter for Surveillance, Ground Support**
  - 30-48 Hours Endurance
  - EO/IR Search/Designator and SAR/MTI Radar Payloads
  - Reduced acoustic signature
  - Significant Increase in Hover and Cruise Altitude
- **Supply of Land and Sea Forces**
  - 500-1000 nautical mile Range with Cargo Payload
- **Deployable to long ranges from Land and Ship Bases**
  - 2000-3000 nautical mile Range with Surveillance Payload

Advanced Fire Support System

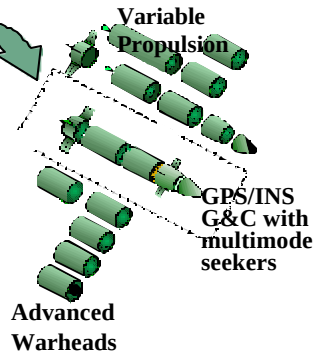
GVSS328-22

New Military Capability

- Immediate firepower
- 5x-10x kills per ton vs current ordnance
- Large zone of influence
- Multimode seekers
- In-flight targeting
- Duration weapon

Family of Missiles

- Modular design

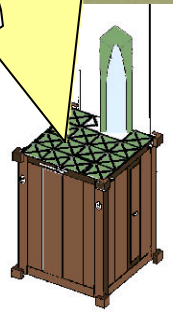


Designed for Deployability

- Logistic efficiency through containerization
- No platform or crew required

Low Cost

- Reduced personnel and vehicles
  - LCC reduced > 50%
- CAIV design process
- Commonality of components and assembly



Modular Vertical Launch

- Self locating / orienting
- Unmanned operation
- Not platform specific
- Can be vehicle appliqué

Summary

- FCS survivability demands a balanced solution
- Distributed systems are more survivable and harder to detect
- Distributed systems enhance the survivability of manned platforms
- Electromagnetic and thermal signatures must be reduced
- Survivability of Networks will be as important as the survivability of our guns and weapons platforms