Transforming Defense

"The Path Not Taken … yet"

- ***The Role of Defense in National Security***
- ***The Management of Defense***
- ***The Force***

OSD, Office of Force Transformation

Maintain a Broad and Sustained Military Advantage …
by Continuous Adaptation to a Changing Environment

Transforming Defense

… The Emerging Way of War

The New Rules

- Fight first for *information superiority*
- *Speed* of command
- Access to information: *shared awareness*
- *Dispersed forces:* noncontiguous operations
- *Demassification*
- Elimination of *process lines*
  (e.g. - fusion of ops, intel & logistics or organize, deploy, employ & sustain)
- Elimination of *structural lines*
  (e.g. - Joint ops at the small unit level)
- *Self-synchronization*
- *Alter* initial conditions at *higher rates of change*
- *Compression* of levels of war

Network-Centric Warfare

High Rates of Change
Closely Coupled Events
Lock In / Out
Speed of Command
Self Synchronization

What's Valued

Networking
Sensing
Envelope Management
Speed / Endurance
Numbers
Risk Tolerance
Staying Power

The Emerging American Military:

- More expeditionary … lighter, more lethal
- More networked … more interoperability at the JTF level
- Leveraged increasingly persistent ISR … UAVs, SOF, JSTARS
- Tighter sensor-shooter timelines … sensing, C2, fly-out
- Valued Information Superiority … information operations

More Expeditionary

… lighter, more lethal

Operation Desert Storm		Operation Iraqi Freedom
• Extensive Buildup Phase	→	• Shortened Buildup Phase
• Multiple Armored Divisions and Organic Artillery – Responsive and available for all-weather operations	→	• Fewer Tanks and Organic Artillery – Responsive, all-weather airpower used in combined arms effort
• Extensive Air Campaign Prior to Ground Campaign	→	• Simultaneous / Integrated Air and Ground Campaign
• Large Iron Mountain Logistics Tail to Support Large Force – No enroute asset visibility	→	• Logistics More Transparent, But Extended and … – Still not integrated into operations
• Sequential Operations in Contiguous Battlespace	→	• Simultaneous Operations in Non-Contiguous Battlespace

Transforming Defense

… Maintain a Broad & Sustained Military Advantage

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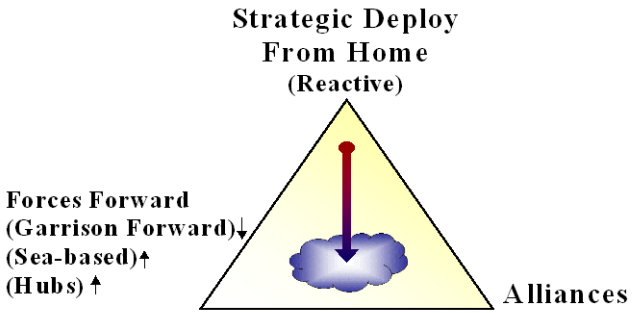
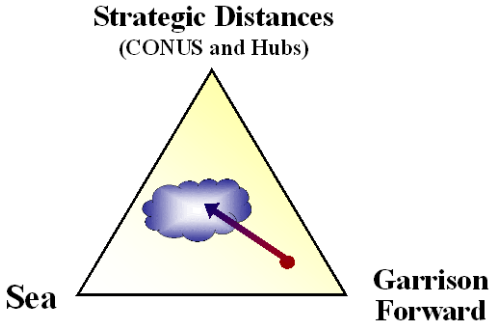
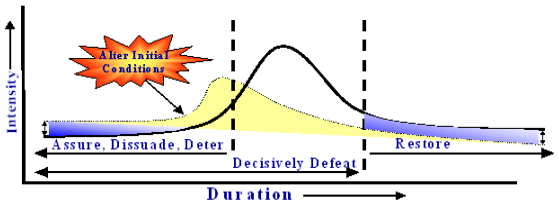
- Deter forward – the new deterrence
  - Alter initial conditions at increased rates of change
  - The Nation's new 1 - 2 punch …
    - Operational maneuver from strategic distance
    - Operational maneuver from the sea
- Assured access for the Combatant Commander
  - Deny enemies sanctuary by providing persistent surveillance, tracking and rapid engagement
  - Protect critical bases of operations and defeat CBRNE weapons and their means of delivery
  - Project and sustain U.S. forces in distant anti-access or area-denial environments







Transforming Defense

…Corporate Strategy

Type I: Continuous small steps

Sustaining

Evolutionary changes

Stay on the local maximum

Type II: Many medium jumps

Explore and expand the local region

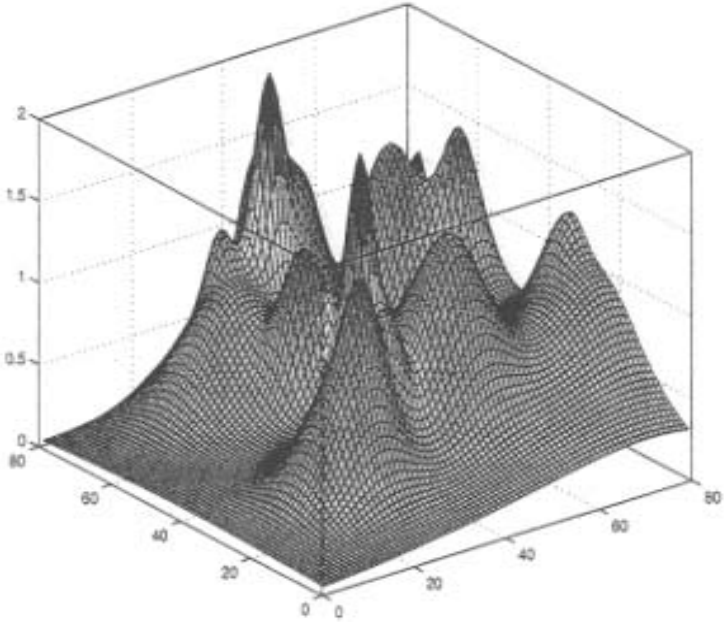
New doctrine / organization / systems

Type III: A few big bets

Could change DoD

Change the world

Create a new game with new rules



Office of Force Transformation S&T Initiatives

- Advanced Intrmodal Mobility (AIM)
- Sense and Respond Logistics (SRL)
- Tactical Micro-Satellites (TMS)
- Re-Directed Energy (RDE)
- Ultra-Large Airlifter (ULA)
- Distributed Adaptive Sensor & Effector Network

Transforming Defense

… by Continuous Adaptation to a Changing Environment

Co-evolve and catalyze concept/ technology pairings …

- Explore the region of unarticulated needs and non-consensual change
- Work the intersection of prototyping and operational experimentation
- Expand the capabilities base …
  - To field adaptive systems
  - That create effects
  - And generate military advantage

Create tipping points to *make things happen* …

- Tactical Microsats and Network-Centric Collaborative Targeting
  - Adding a responsive space component to horizontally integrated battlespace ISR
- Re-Directed Energy
  - The killer app for High Energy Lasers
- Sense and Respond Logistics
  - Demand-focused adaptive support for the Joint Force

Advanced Intermodal Mobility (AIM)

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Advanced Intermodal Mobility (AIM)

Military Need:

- Distributed networked forces capable of littoral operations using high modular transfer and transaction rates across the theater of operations
- In-stride sustainment of battalion and brigade sized operational forces maneuvering from the sea

Objective:

- This project develops, produces and experiments with distributed networked forces capable of littoral operations
- Creation of inter-modal logistics, experimenting with new forms of lifting bodies (ULA, ATT) that demonstrate the capacity for modular chassis and common logistical interfaces
- For sea going vessels develop experimental articles that provide a high-speed (60-70 knots), high-payload fraction (30-50%), and shallow drafted capability (5-15 ft) for increased depth of mobility

Advanced Intermodal Mobility (AIM)

- ***Key elements:*** Carbon/Kevlar composites, hydrodynamic hull forms, rapid reconfigurability, inter-modal logistics, 100 kt vessel by end of the decade, multitude of scalar invariant air-lifting bodies, modular chassis and logistical interfaces linked to Sense and Respond networks

Transforming Defense

…diversity and high options

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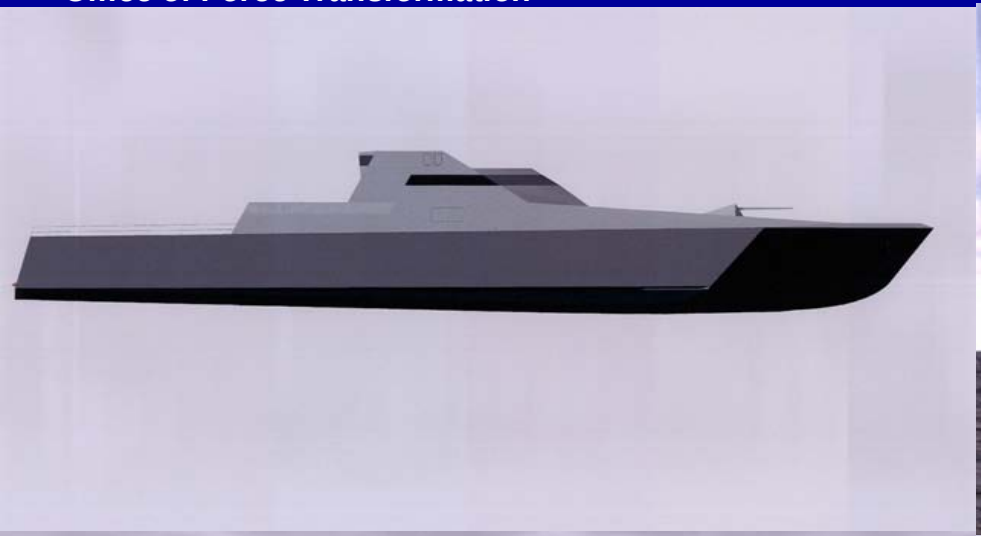

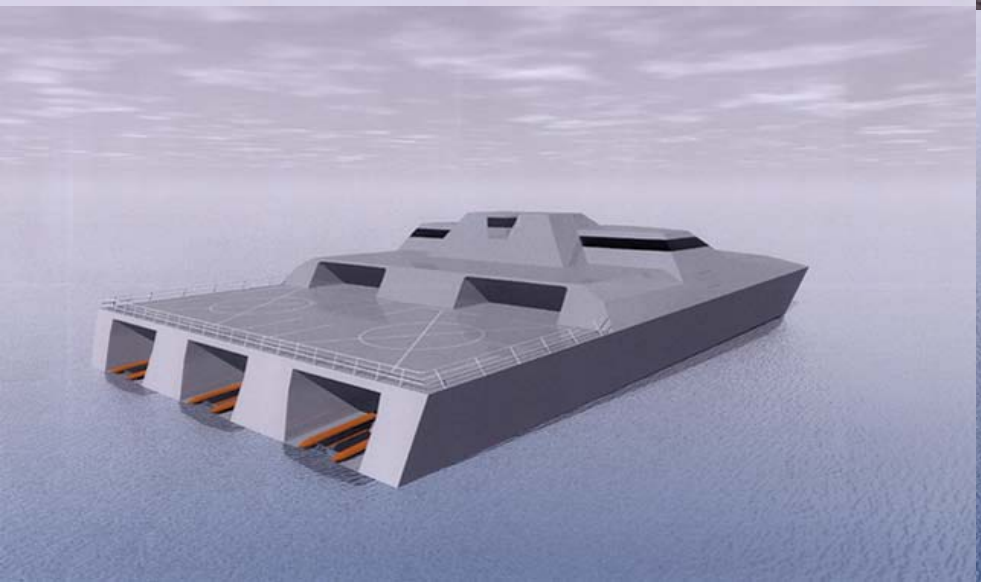

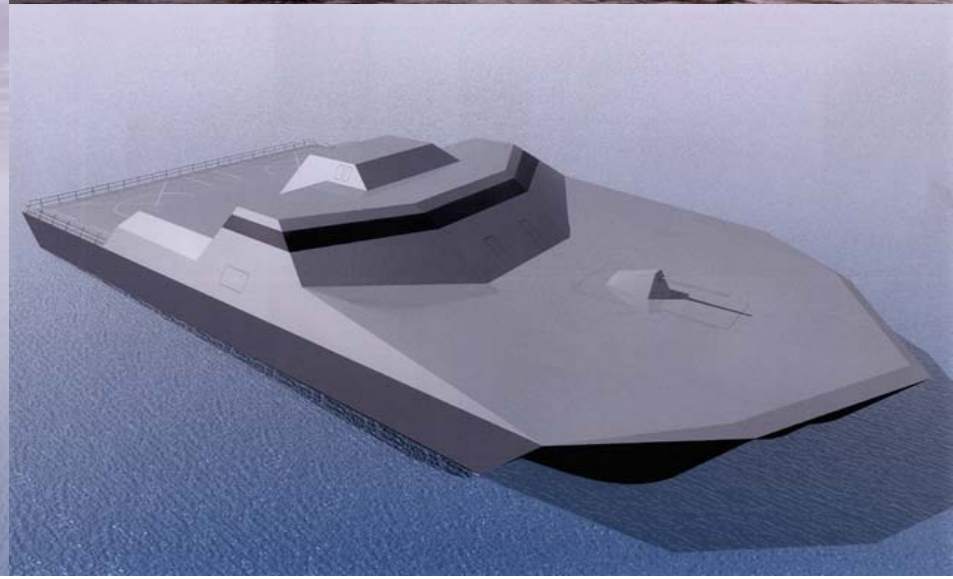

Transforming Defense

…diversity and high options

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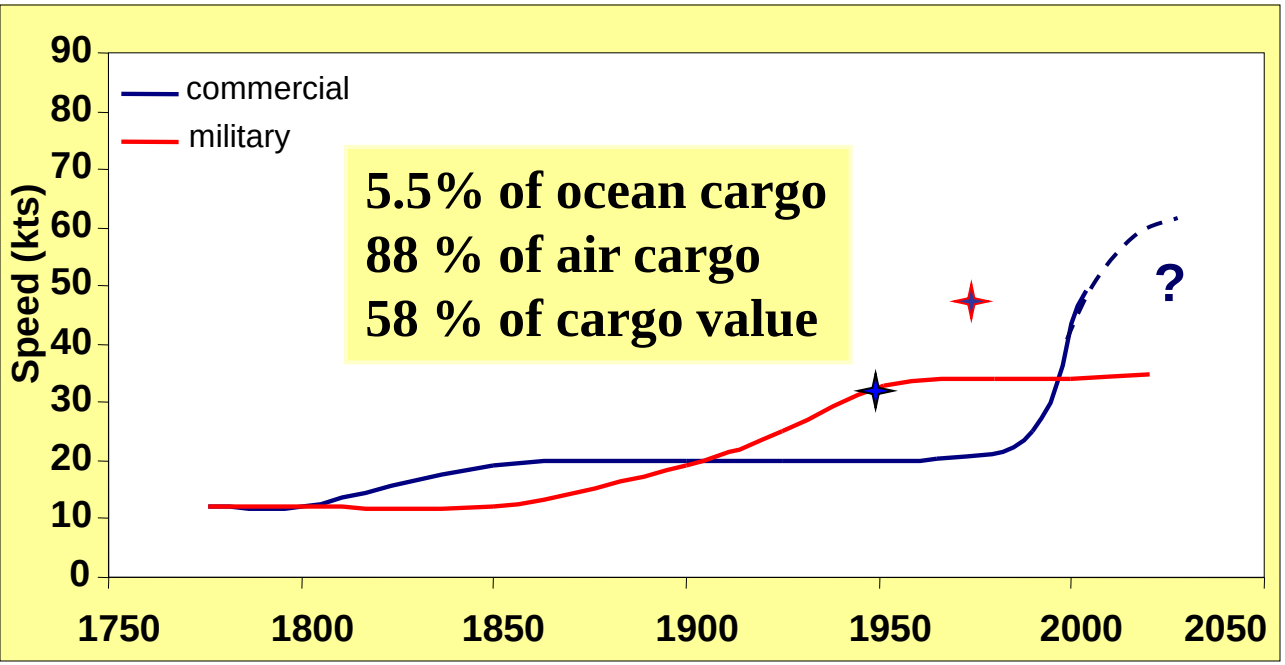
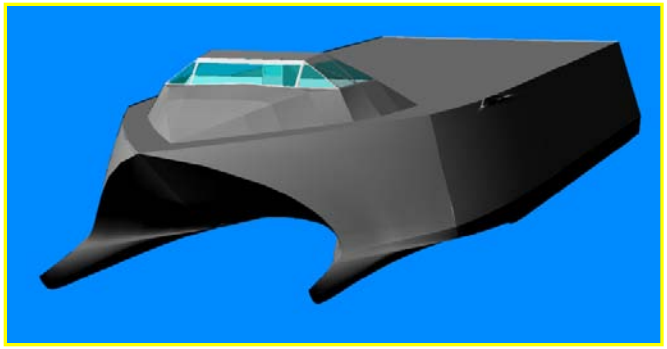
Effects of mass without massing forces

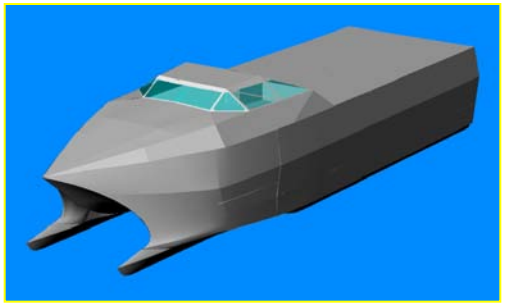
…payload fraction matters – numbers count



300-foot x 300 MT Payload



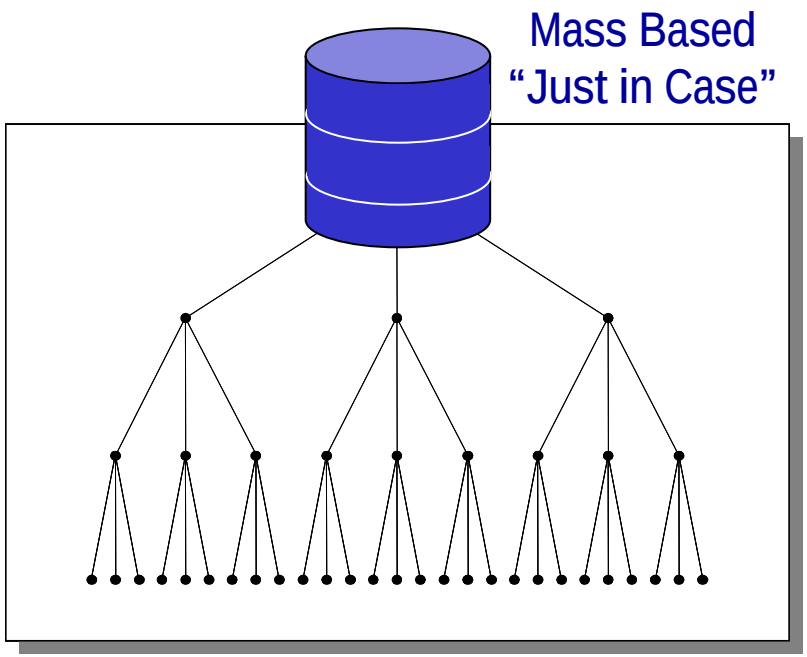
165- foot 165 MT Payload



110 – foot 50 MT Payload

640-foot 5000 MT Payload

Can Current Logistics Practices Support Operational Requirements in a Non-Contiguous Battlespace?



Chain

Too brittle, simple pattern, simple control, scaled

'business end' most poorly connected, hard to reconfigure or change flow

- **Classic logistics is not agile enough for distributed adaptive operations**
  - Has no ability to reconfigure the logistics network relationships, inventory or distribution strategy
  - Entails long buildup times, longer resupply cycles and large inventories
  - Operates best with "massing of forces"
- **Classic logistics involves an unstable combination of push and pull signals**
  - Supply pull signals beyond the first level are inventory fills
  - Rear suppliers don't see combat unit demand and can be whipsawed
- **Classic logistics is vulnerable**
  - Results in asset concentration in stockpiles towards rear
  - Relies on a linear battlefield and secure logistics area
  - Exhibits predictable network structure
- **Classic logistics is inflexible**
  - Typically combat units can only draw on the supply in their chain, not the total battlefield stocks or stocks of other services

Approaches to Logistics

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Mass-Based

- **More is better**
- **Mountains of stuff measured in days of supply**
- **Uses massive inventory to hedge against uncertainty in demand and supply**
- **Mass begets mass and slows everything down**

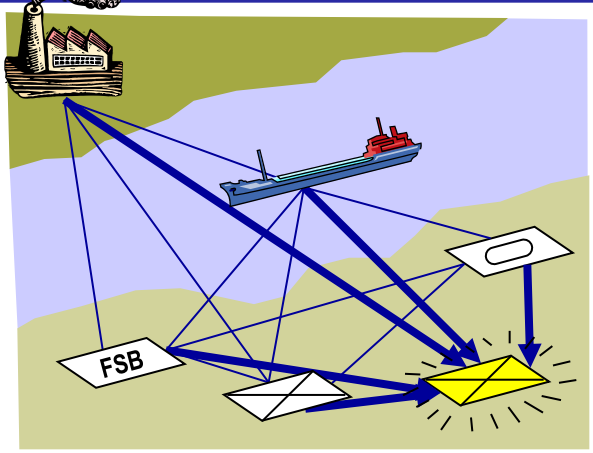
Prime Metric: Days of supply

Just-in-Time

- **On-time is better**
- **Inventory is reduced to a minimum and kept moving**
- **Uses precise demand prediction and static optimization to purge uncertainty**
- **Works great … except when it doesn't**

Prime Metric: Flow Time

Sense and Respond



- **Agile is better**
- **Inventory is dynamically positioned throughout**
- **Uses transportation flexibility and robust IT to handle uncertainty**
- **Initial S&R models look promising**

Prime Metric: Speed & Quality of Effects

Attributes of a Sense & Respond Logistics Network

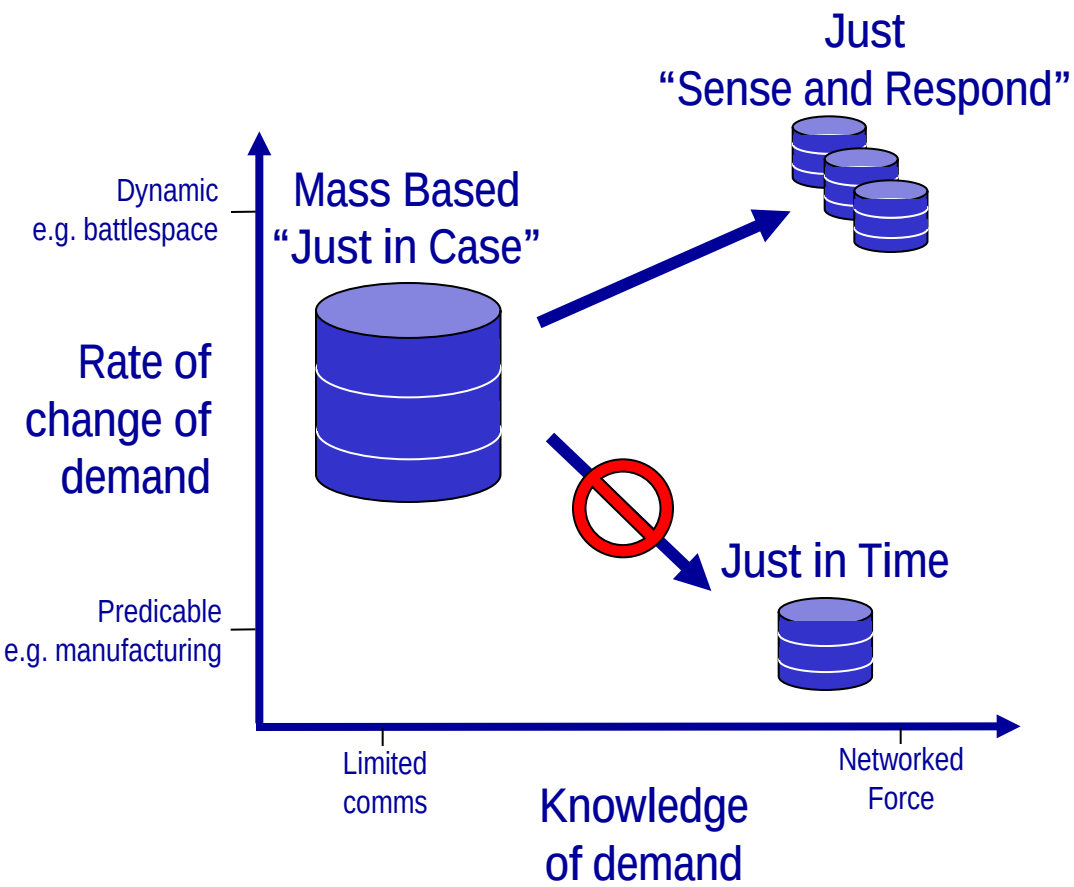
When compared with classic logistics, S&R networks will enable commanders to better *create and exploit* operational advantage

- Greater logistics agility which enables greater operational agility
  - S&R supply networks can support combat units with the same degree of quality
  - S&R supply networks can increase options available to the operational commander
- Greater logistics network survivability
  - S&R supply networks can withstand greater ranges of failures of communications and security nodes
- Better support for the full range of military operations
  - S&R supply networks can support non-combat missions with a higher degree of quality, e.g., Peacekeeping, Foreign Consequence Management, NEO, etc.
  - S&R supply networks can support constructed forces and task-specific force packages with a greater degree of confidence and quality

SRLC Attributes Present in Operation Iraqi Freedom

	Attribute	Present in OIF
Supply from:	Any unit, any Service	✓
Transport From:	Any source in theater	✗
Supply Push From:	Analysis of SoM; real-time unit status; demand signals	✓
Logistics Staff:	Operators who collaborate closely with Ops staff in production and support of SoMs	✓
IT Requirements:	Extensive cross-Service, electronic order, asset and inventory visibility, decision support tools	✓
Focus:	Operational availability of warfighter (satisfy demand, provide continuous sustainment)	✗
Metrics:	Readiness to execute when needed	✓
Supported Strategy:	Adaptive, dispersed, network-centric, asymmetric threat, joint, on-the-fly force reconfiguration, continuous operations	✓
Battlespace:	Non-contiguous, no ISBs / FSBs, no RSOI	✗
Organizations	Functional, capability-based, joint, fleeting, no established infrastructure	✗
Supply and Assets Belong To:	Theater commander, for use by any unit to give greatest operational benefit	✗

S&R Reduces Logistics Bulk and Supports Demand Dynamics



- S&R exploits advanced communication and IT capabilities, scale-free distribution network design and transportation flexibility to:
  - Dynamically evolve the logistics network structure with the operation
  - Increasing supply options by making more effective use of battlefield stocks
  - Increase operational agility
- S&R is NCW for logistics

The Advance to Baghdad

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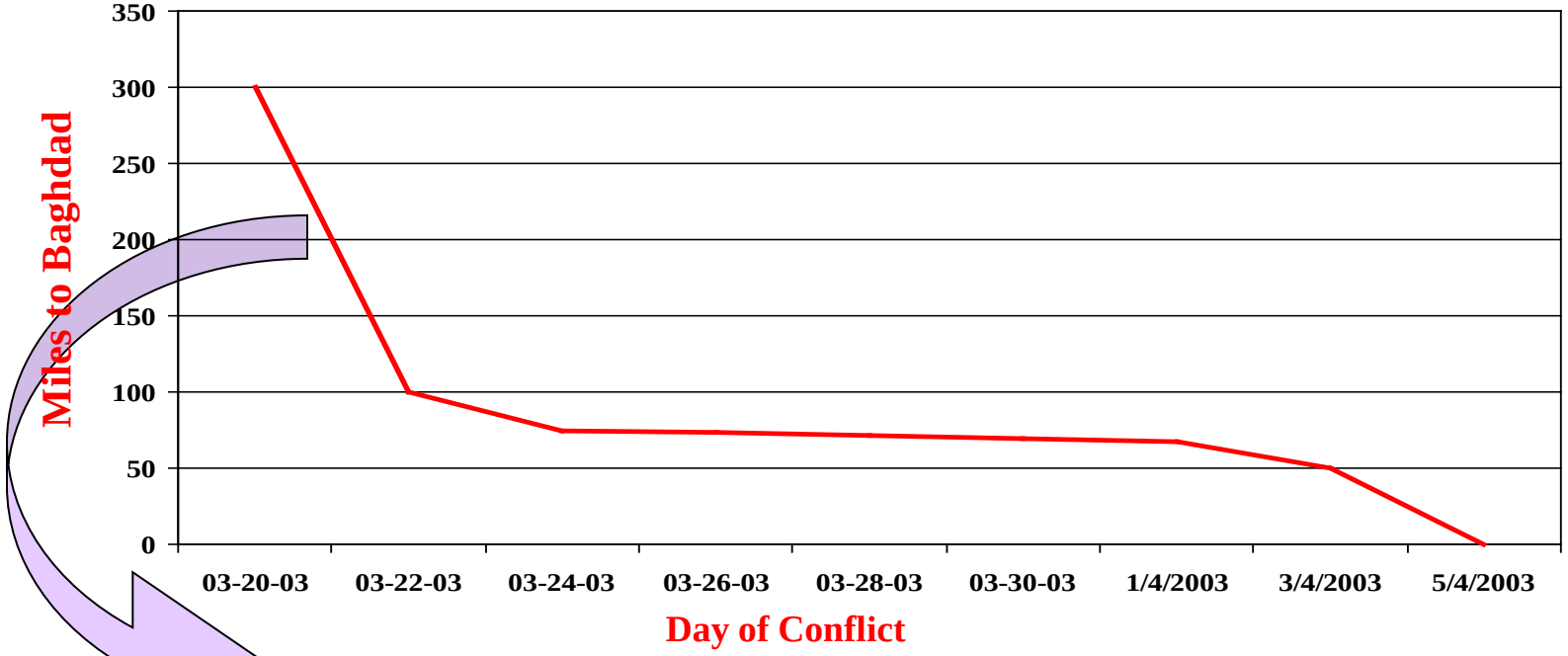

1. Rate of Advance outruns logistics Communications

2. Logisticians shift to “push” system – use models, SitReps, to “sense” supply needs

3. Tactical Units shift to cross supply to fill gaps

Sense & Respond Logistics

- **Attributes of a "Sense & Respond" system**
  - Rapidly adapts and responds to evolving operational demands
  - Exploits advantage from decentralization and self-synchronization
  - Dynamically adapts to perturbations in security environment
- **Explore through experimentation, potential S&R contributions to**
  - Projecting and sustaining joint forces in anti-access environments
  - Co-evolving C2 doctrine and information systems that support distributed, semi-autonomous decision-making ("fly by wire") on the non-contiguous battlespace
  - Developing new methods of sense-making and control
  - Recognizing and exploiting operational advantage

Underpins joint distributed, adaptive warfighting

S&R Experimental Concept/Technology Pairing

- Prototype S&R Logistics decision support system for Naval forces
  - Rapidly generate initial S&R logistics support plans
    - Adjust as maneuver forces are redirected
  - Provide user interfaces to allow user confirmation and override
    - Include interfaces to appropriate legacy COTS and GOTS
    - Reliable enough to operate in a maritime environment
- Demonstrated in simulation and in Sea Viking 04
  - Compare to traditional logistics
    - Using specific use cases
    - Using standard models
    - Using after-action reports
  - Define the dynamic adaptive logistics network using S&R algorithms
  - As a leave behind, provide an imbedded S&R simulation capability
- Further development of the prototype will continue at I-MEF G9

TacSats and NCCT

… Adding a responsive space component to horizontally integrated battlespace ISR

Tactical Micro-satellites …

… have "UAV-like" payload integration cycle times

… use new lower cost responsive launch vehicles

… will task and disseminate data via SIPRNET, augmented with direct downlink (DDL) for direct access by the forces

NCCT …

… is an Air Force/CENTCOM ACTD that uses principles of network centric operations to address time-critical targets

… will demonstrate machine-to-machine cross-cueing and collaboration functionality to support battle space decision makers

… will be a joint capability to fuse theater-wide ISR

What Network-Centric Collaborative Targeting does …

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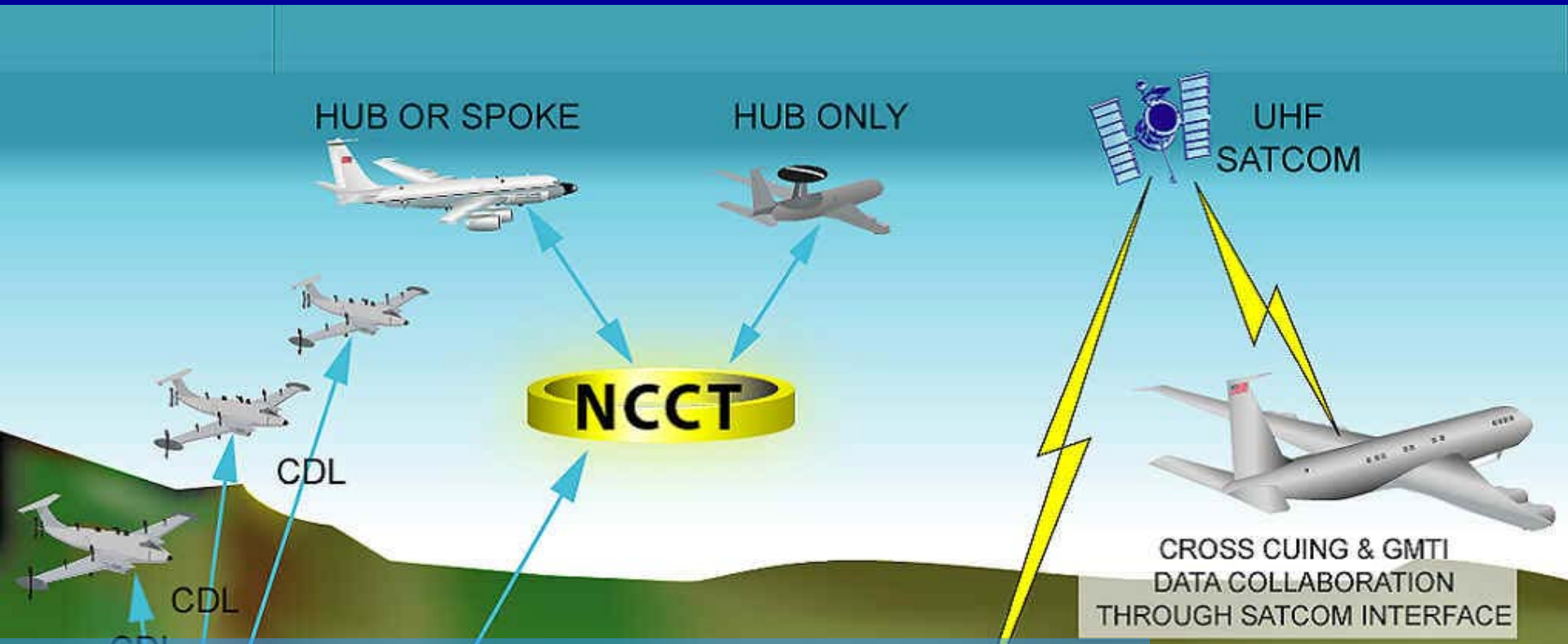

- **Horizontally integrates multiple ISR assets**
  - **Provides machine-to-machine interaction of multi-INT sensors**
  - **Creates actionable information on time sensitive targets**
- **Multi-INT with Imagery, Ground Moving Target Indicator and Signals Intelligence**

But What's Missing?

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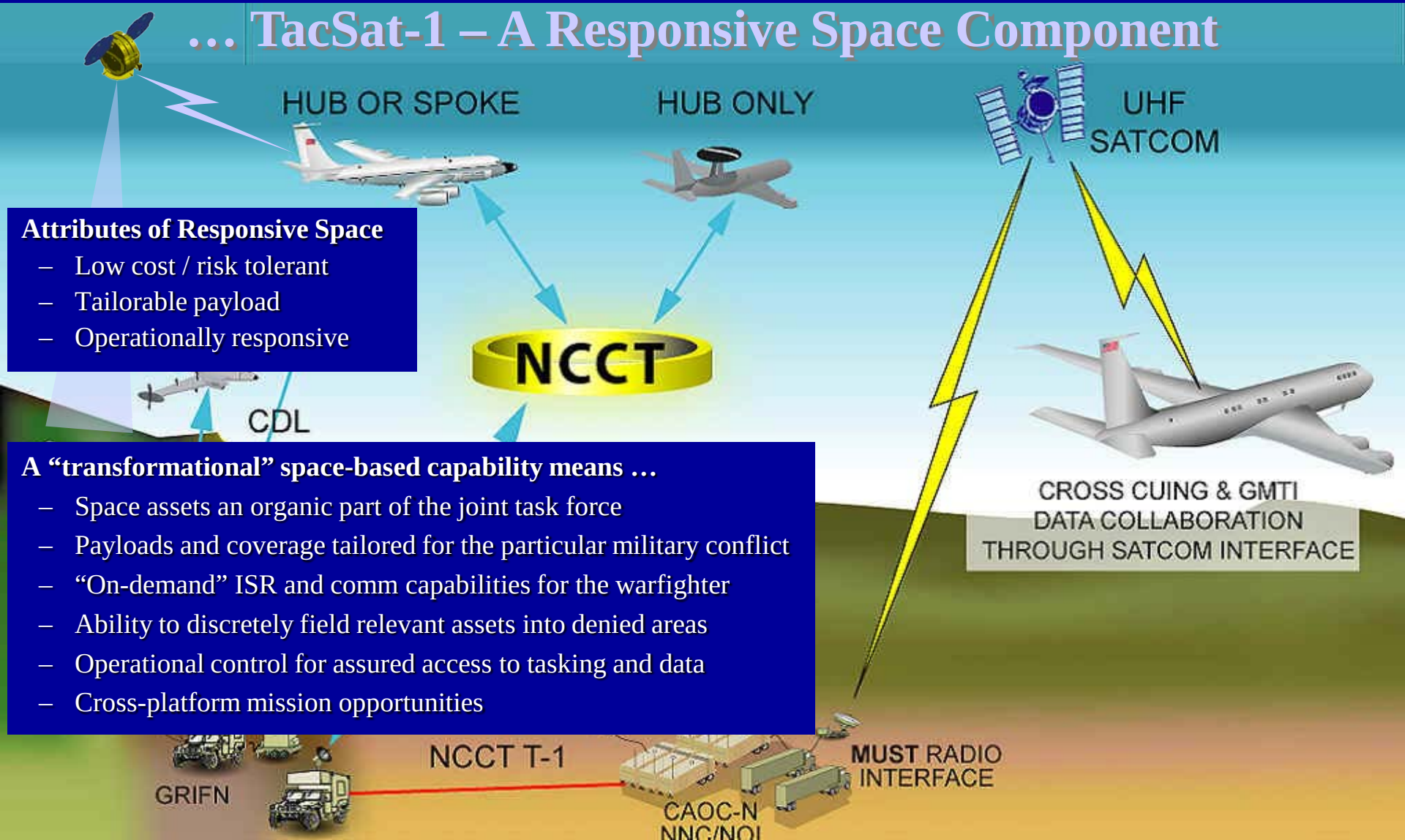
… TacSat-1 – A Responsive Space Component



Attributes of Responsive Space

- Low cost / risk tolerant
- Tailorable payload
- Operationally responsive

A "transformational" space-based capability means …

- Space assets an organic part of the joint task force
- Payloads and coverage tailored for the particular military conflict
- "On-demand" ISR and comm capabilities for the warfighter
- Ability to discretely field relevant assets into denied areas
- Operational control for assured access to tasking and data
- Cross-platform mission opportunities

Microsat Attributes

- Designed for responsiveness *and* affordability
  - Nominal 1 year on-orbit life
  - Low-cost components, buses and integration
- On-demand inventory developed with:
  - Standard satellite buses
  - Modular satellite payload components
  - Compatible government/commercial booster modules
- Specific payloads and launchers rapidly assembled, on an as needed basis, by a cadre of trained space personnel
- Cheapest available launch locations used
- Minimum number of relevant payloads launched into tailored orbits, to optimize coverage of a given area

Microsat Concept of Operations

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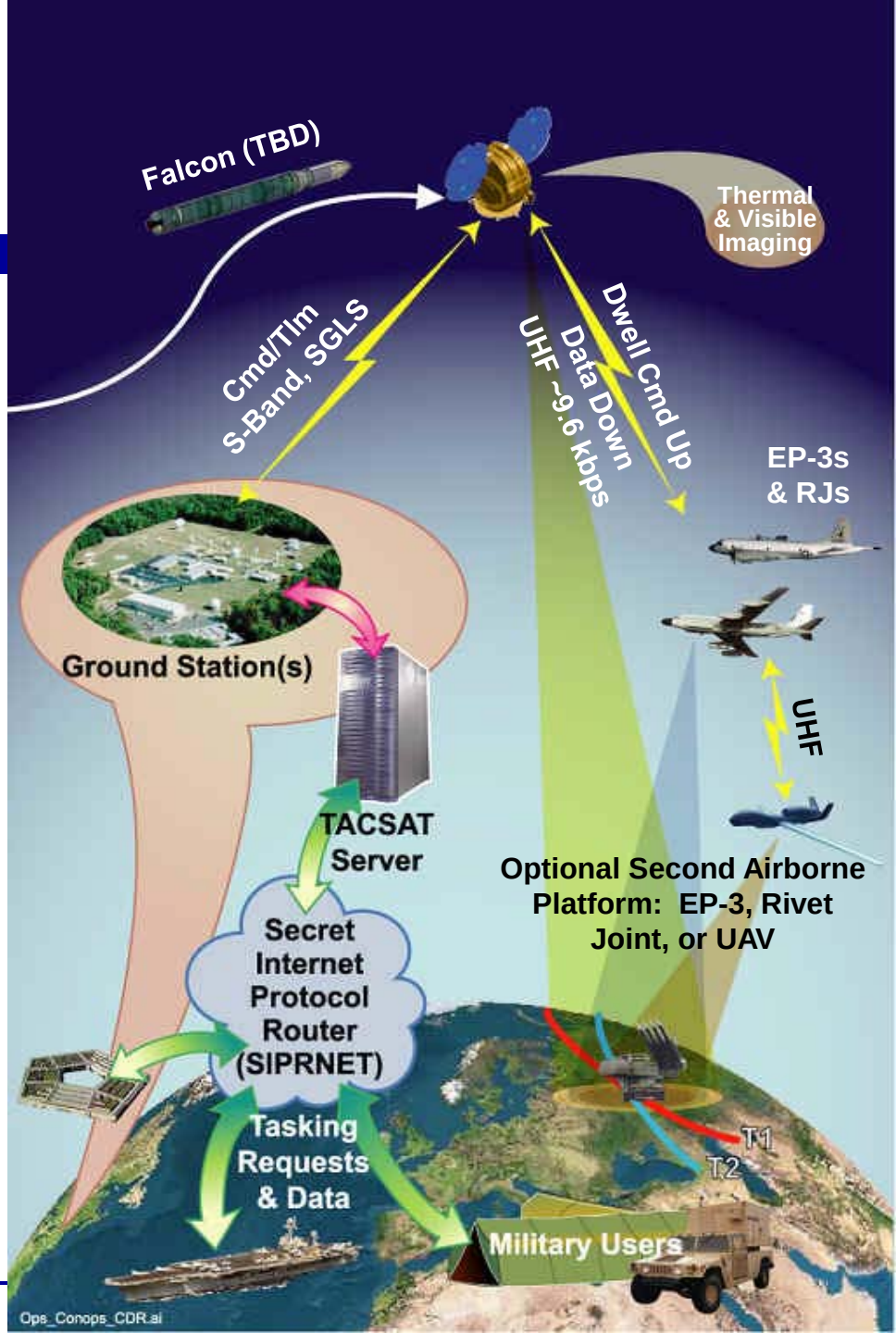
- Operational tasking, area of interest and DDL location uploaded prior to launch, with in-theater cross-platform collaboration
- Satellites automatically configure and maneuver to orbit / constellation based upon area of interest
- Geolocation-based tasking using GPS
- Pre-launch tasking, automation and direct downlink assure mission success
- Mission value enhanced via ability to task and disseminate data over the SIPRNET



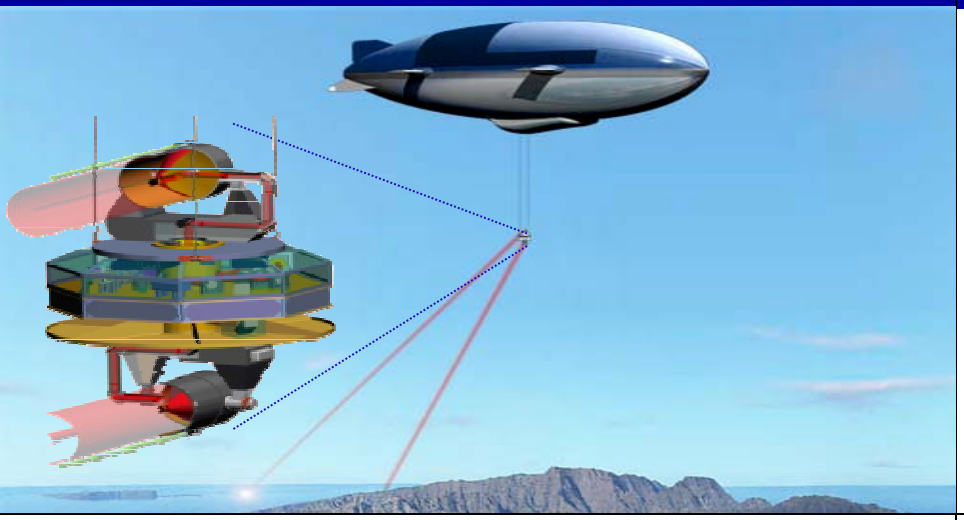
“TacSat-1” Objectives

1. Provide a micro-satellite which ...
   - Experiments with new space capabilities at low cost
   - Reduces TacSat total system employment risk
   - Provides an operationally relevant capability
2. Demonstrate responsive launch
   - Launch within a year -- 9 months start to launch
   - Develop a near term path for rapidly launching tactical space capabilities
   - Influence launch vehicle interface design to support tactical micro-satellite capabilities
3. Provide direct tasking control and data dissemination methods to JTF commanders
   - Specific real-time application
   - Broad SIPRNET applications
4. Develop team and processes necessary for rapid response space capability

Re-Directed Energy

- **Military Need:** Over horizon active defense, communication and sensing
  - Re-direct laser energy to over-the-horizon objectives, e.g. cruise missile, ballistic missile, aircraft & ground targets or to operational nodes within optical communications footprint for image relay without optical to electronic conversion
- **Objective:** Redirection of laser energy beyond line-of-sight via airborne relay
  - Build a specific demonstration system for the High Altitude Airship ACTD to create a technical means to provide non-straight line optical propagation geometries
  - The **FY05** rapid experimentation will determine the viability of applying these concepts to military missions
    - Prepare functional surrogate to support experimentation involving accurately redirecting laser / optical energy onboard a persistent airborne platform
  - In **FY06** the system will be upgraded to utilize power levels supporting operational effects and conducting concept driven operational experimentation
    - High-risk component and subsystem experiments will be performed and real-time Joint force connectivity will be included
    - Goal is to place a functional surrogate aboard prospective High Altitude Airship ACTD

Aerospace Relay Mirror System (ARMS)



Program Description

- Demonstration and validation of 1/2 scale high energy laser (HEL) relay system
- Strongly enhances operational utility of emerging, transformational HEL weapons
- Leaves behind flight demonstration and test system

Transformational Benefits

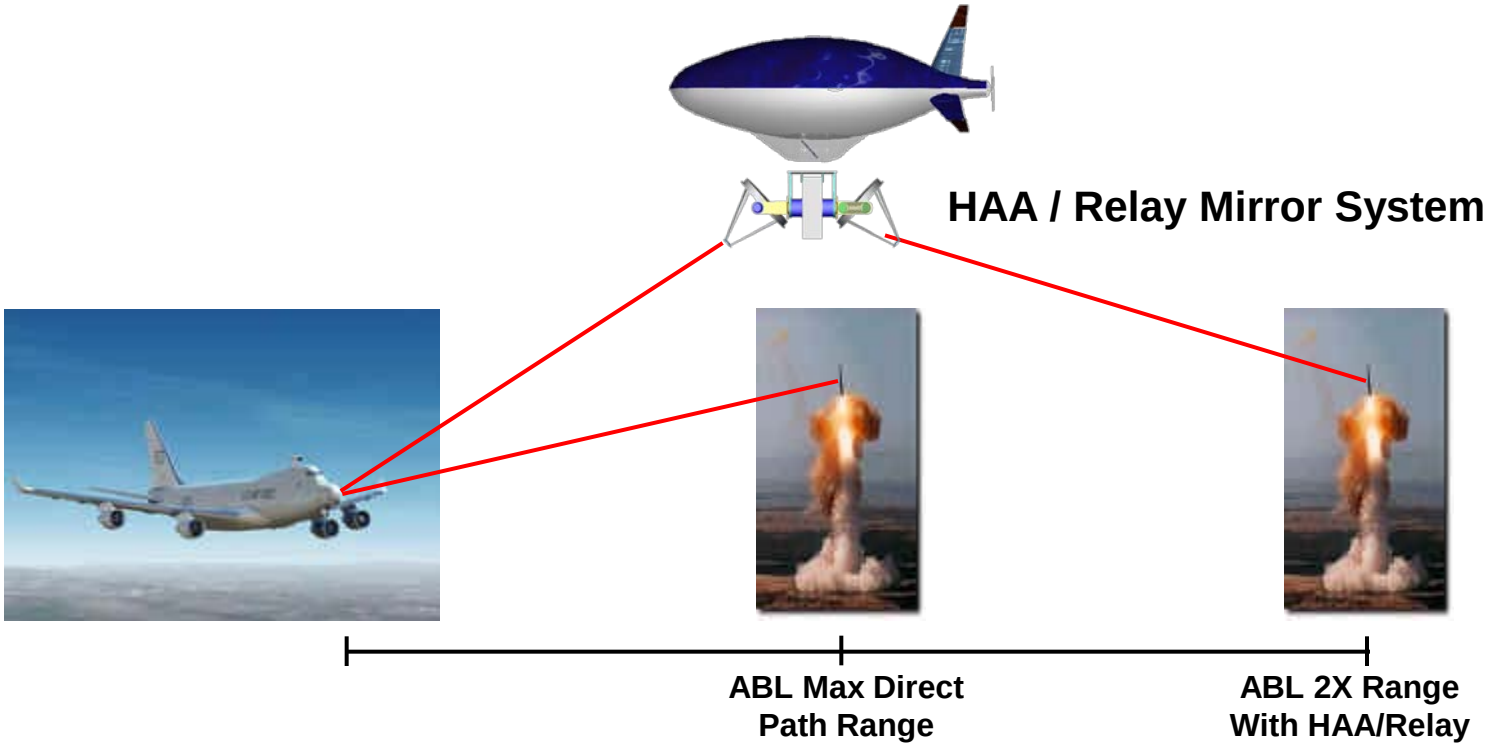
- Extends range of engagement, field of regard for high precision, speed of light laser weapons
- Complements and extends utility of an emerging class of laser sources, ground, sea and air based
- Provides highly capable electro optical platform for multiple defense and offense applications
  - Ballistic missile boost phase to Homeland defense against low altitude air threats
- Persistent theater intelligence gatherer, disseminator

Major Milestones

- 20 years of relay systems tech/ops utility assessment
  - Strategic Defense Initiative Organization (1984)
  - Spaced-based Laser IFX AAS Study (1998)
  - Internal Research & Development (1999)
  - AF Aerospace Relay Mirror System (2002)
- Program Milestones
  - ARMS System PDR – May 03
  - System CDR – Oct 03
  - Complete Lab Tests – Feb 05
  - Complete Low Altitude Field Tests – Jun 05
  - HAA Payload Integration -- Jan 06

Relay Mirror Systems on HAAs

… Creating Multi-Mission Capabilities for HELs



An HAA / relay mirror system can *more than double* ABL range

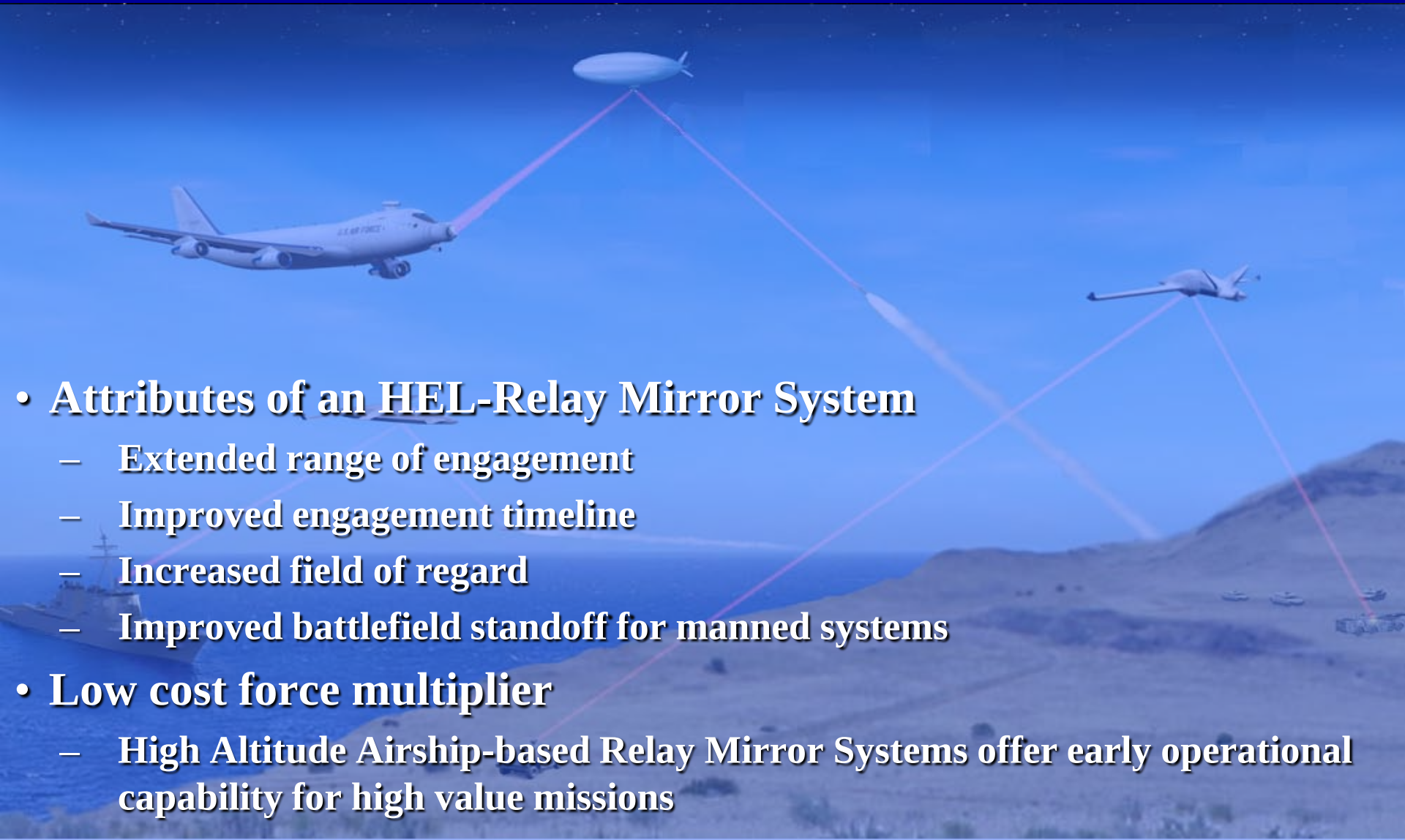
High Energy Laser Systems

… Weapons Applications in the Near-Term

- **Attributes of HEL**
  - Speed of light
  - High precision offers low collateral damage
  - Tunable damage effects
  - Cost effective munitions ($/engagement)
  - Concurrent sensing capabilities
  - Deep magazine potential
- **Challenges**
  - Line of sight limits field of regard
  - Atmospheric losses over long propagation lengths
  - Clouds and obscurants limit field of engagement

Relay Mirror Systems

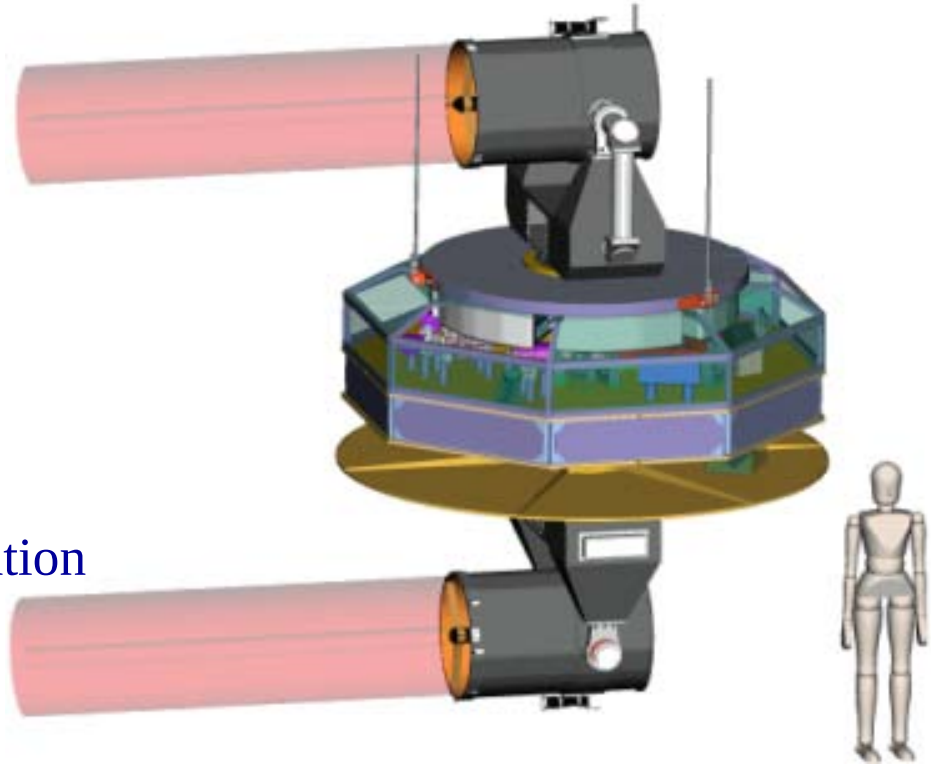
…The Killer Apps for HELs



- **Attributes of an HEL-Relay Mirror System**
  - Extended range of engagement
  - Improved engagement timeline
  - Increased field of regard
  - Improved battlefield standoff for manned systems
- **Low cost force multiplier**
  - High Altitude Airship-based Relay Mirror Systems offer early operational capability for high value missions

Aerospace Relay Mirror System

- ARMS is a subscale prototype of HEL relay mirror systems
- Risk reduction test-bed for relay system development
  - Dual line-of-sight pointing
  - Energy capture and transfer
  - Payload integration
  - Airship/Relay Mirror System integration
- Testbed for future relay system technologies and missions
  - ABL performance enhancement
  - Midcourse discrimination
  - Precision strike of time critical targets
  - Target Designation and Targeting
  - ISR



ARMS Program Objectives

- **Design a functional payload within budget ($19.5M), with a growth path to high altitude and scaled high power operations**
  - Demonstrate performance of Dual-Line-of-Sight and Energy Capture
  - Actively track boosting missiles with relayed ground illuminator
  - Passively track sunlit satellites
  - Actively track augmented satellites with relayed ground illuminator
- **Current Approach**
  - Incorporate light weight gimbals, structure, etc. to maximum extent possible
  - Use advanced components as budget allows
  - If necessary, select low cost, surrogate components for functional demo
- **Traceability (unfunded)**
  - Integrate and operate an Airship-Based Relay System
  - Demonstrate utility and performance of Relay Systems against objective missions
  - Develop skills needed to build and operate Objective System

Ultra-Large Airlifter (ULA)

Military Need:

- The ability to insert capabilities into decisive points in time and space, change the initial conditions and create asymmetric advantages for our forces
  - A "missing piece" to address limitations to current force deployment
  - Move operationally ready units/capabilities from origin to destination around the clock and bypass bottlenecks or choke points

Objective:

- Encourage development of a new vertical delivery capability for US military
- Bring government and private sector stakeholders together to accelerate creation of a broad sector of new commercial assets that provide a complimentary deployment capability to existing assets

Ultra-Large Airlifter (ULA): New term for platforms that are either pure airship or a hybrid air vehicle with a combination of ligher-than-air (LTA) and heavier-than-air (HTA) characteristics

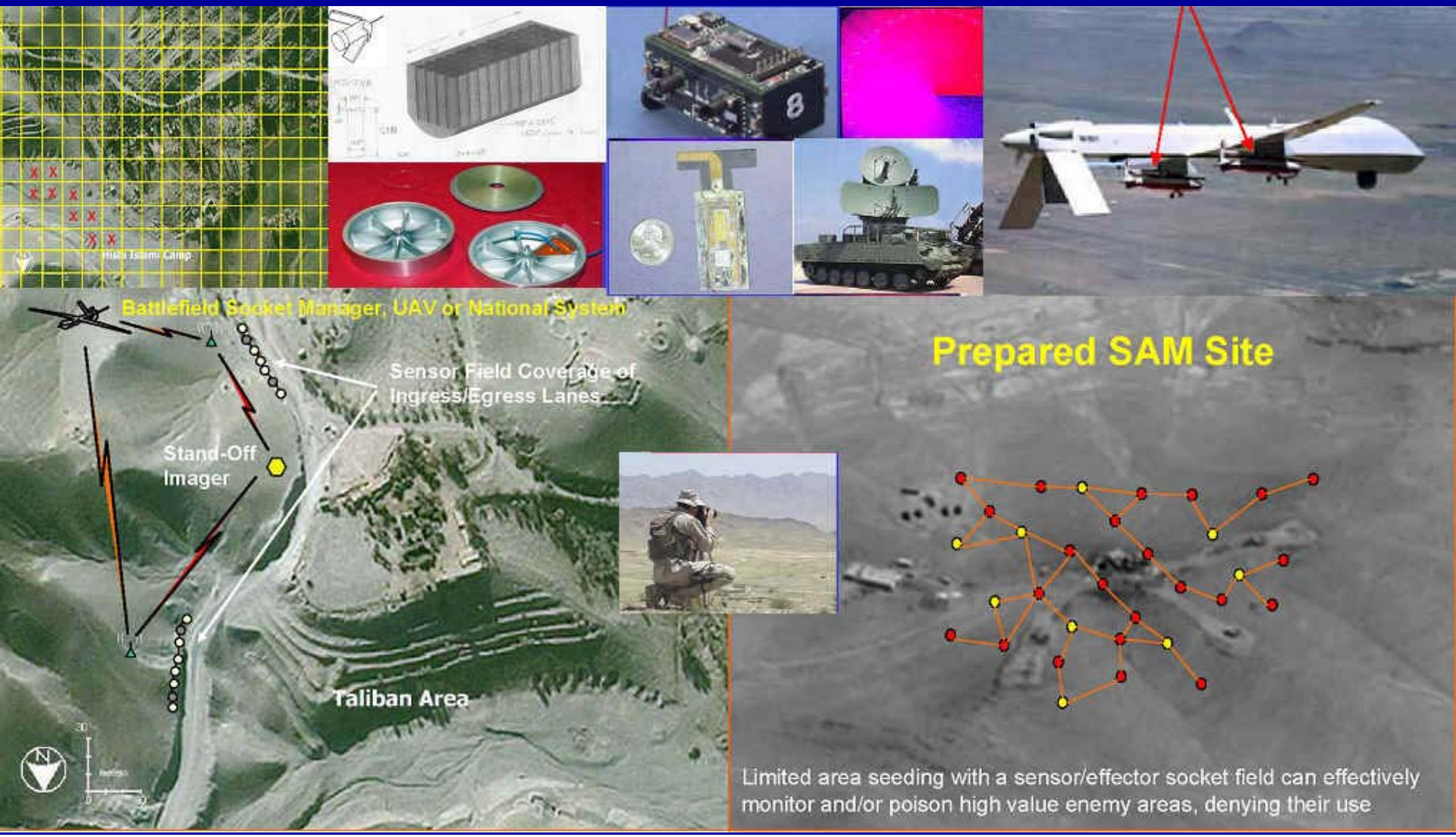
- **Cargo:** payload and volume greater than conventional aircraft by 100s of tons
- **Range:** capability measured in thousands of miles
- **Speed:** substantially greater than surface ships
- **Infrastructure:** does not require significant infrastructure for operations

ULA Development

- Field a capability that reaches across DoD / Interagency / Private Sector to include State Governments as well as other countries
  - LTA systems support the spectrum of DoD goals for future force
    - In early 1960s, DoD got out of LTA for mission, resource and force structure reasons
    - In the early 2000s, DoD will return to LTA because innovative development approaches will allow us to support new missions and new capabilities
  - Creates a contextual change in military and commercial transportation using an untapped potential: lighter-than-air technology
- As a commercial asset, ULAs have the potential to facilitate humanitarian efforts, open up new markets currently limited by lack of infrastructure and improve economic conditions thus reducing the likelihood of regional instability
- Commercial usage essential to broaden the capabilities base and mitigate risk
  - Non-traditional development paths create a broader customer base
  - Diverse Markets - Diverse Designs - Diverse Mission Capabilities
  - Now working to Identify Value Networks and multiple means of development

Distributed Adaptive Sensor & Effector Network

Office of Force Transformation



Distributed Adaptive Sensor & Effector Network

Military Need: Enable correlation and coordination of a multitude of sensors and effectors for Joint and coalition operational missions.

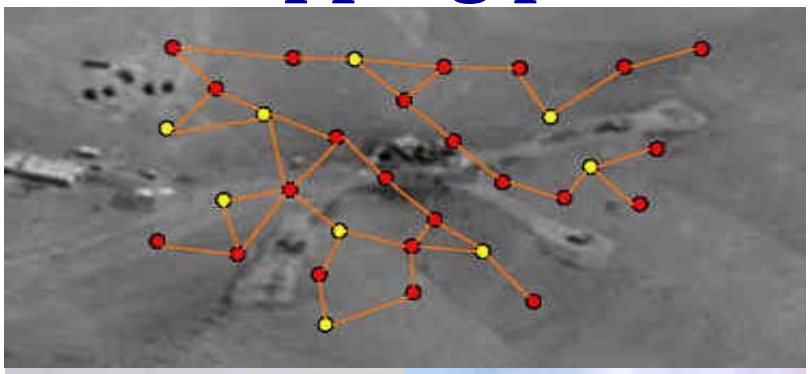
Objective: Develop, produce and experiment with distributed networks, sensors, and effectors composed of tactically adaptable modular devices that are deployed using a standardized payload ("sockets")

- The "sockets" approach delivers a new operational responsive capability for coordinating the efforts of geographically dispersed forces operating in complex environments
  - Explore the correlation of wide area sensors to large numbers of proximate sensors in order to achieve collective effects with operational forces, alter initial conditions and effect deterrence on an adversary
- The initial effort will develop experimental articles ("sockets") that provide mobility, sensing, computation and communication for operational experimentation to explore collective behavior and non-linear algorithms
- Subsequent emphasis will be to develop experimental articles to form a chassis for exploring operational ramifications of candidate sensors and sensor surrogates and will develop distributed "effector" systems to deny an adversary tactical capabilities or alter adversaries operations in a desired way
  - Collective assets will be explored in consonance with Joint Force and Component Operational Experimentation
  - Focus will be on adaptation and application of mission-specific advanced technologies to rapidly develop and field netted sensor, communications, effector capabilities and concept/tech pairing to achieve operational advantage

More to Follow …

… in areas of interest, not *yet* at a tipping point:

- Distributed Adaptive Sensor & Effector Network



- Ultra-Large Airlifter (ULA)

- Advanced Intra-theater Mobility (AIM)

"A Future Worth Creating"

Concept of Innovation

Unarticulated Needs

Demonstration

Emerging Needs

Consensual Change

Innovation

Force Transformation

Non-Consensual Change

Joint / Service Experimentation

Exercise

Emerging Means & Methods

Test & Evaluation

Articulated Needs

Innovation = Creativity x Implementation