AMSTE Overview

Presentation to 7th International Artillery & Indirect Fire Symposium

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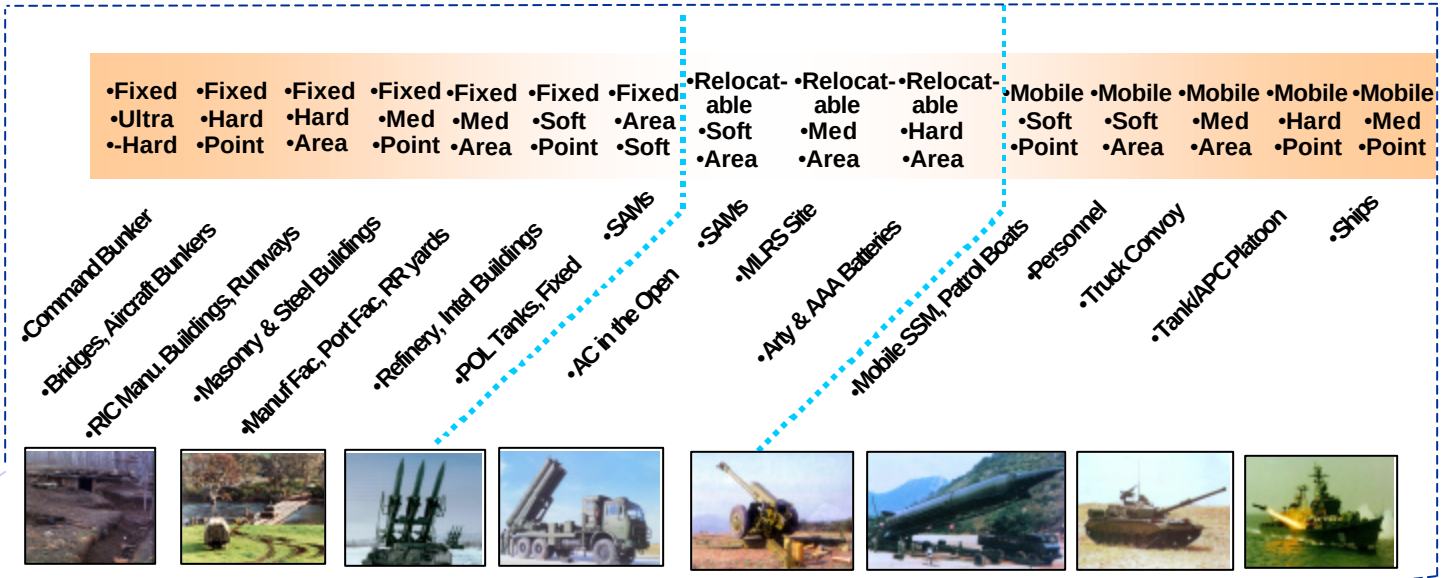
Dave DeVore
Devorda@northropgrumman.com
(321)726-7489

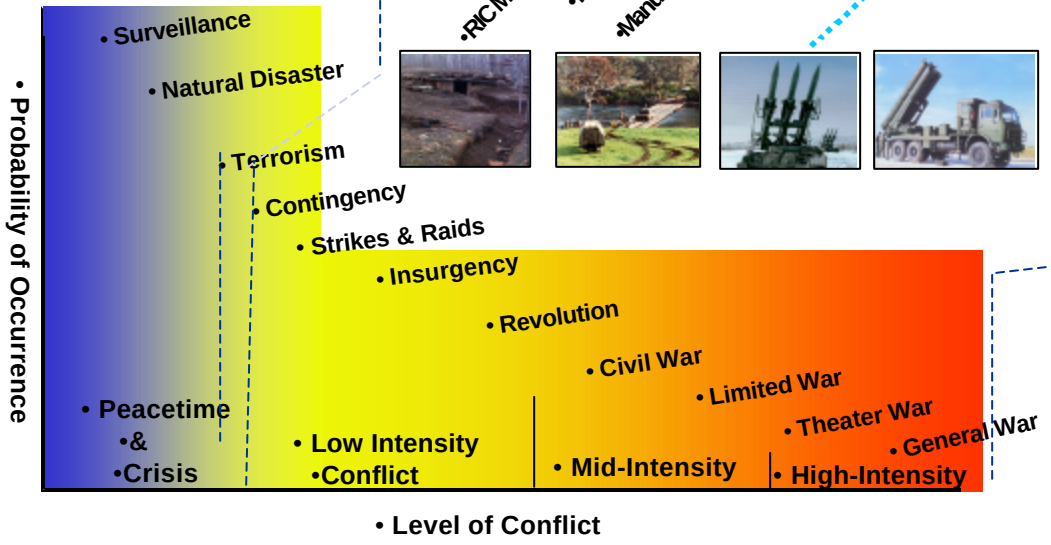
Overview

- DARPA's Affordable Moving Surface Target Engagement Program
  - Requirements and Objectives
  - Concept of Employment
- Program Structure
  - Initial Test Results
  - Direction
- Summary

Challenge: Spectrum of Conflict Drives Need for Ability to Engage Moving Targets

- **A high percentage of the target is mobile or relocatable**

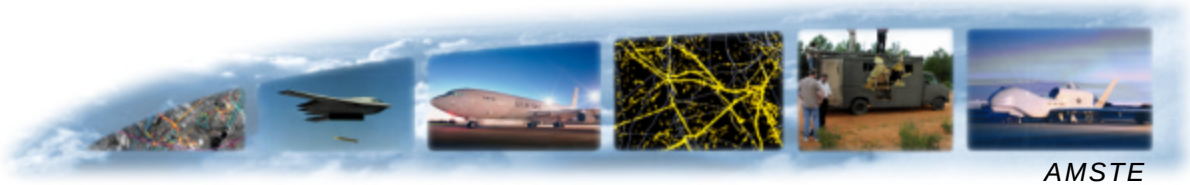




- *AGS missions and tasking span targets across the full spectrum of conflict*
- *Precision engagement is increasingly focused on Time Critical Targets*

The AMSTE Motivation

- Significant materiel and technology investment has enabled US Forces to hold fixed and stationary targets at risk
- AMSTE will extend US battlefield dominance to moving threats
  - Extend our capabilities to permit all weather engagement of vehicles on the move
  - Deny opponents the sanctuary of movement
  - Destroy enemy's ability to attack, regroup, hide or inflict damage
  - Threat targets have used movement to avoid/hide from US reconnaissance and surveillance sensors
    - Operation Allied Force
    - Operation Desert Storm
  - Time-critical targets move prior to or just after launch
  - Mobile SAMs use movement to avoid targeting
    - Increases SAM location uncertainty
    - Aircrew offensive capability restricted



AMSTE Applies to Wide Range of Time Critical Threats

Hard and Soft Targets with Area, Unitary, Armour Penetrating Weapons

Naval Threats

SSN-X-26: Mach 2.5, 65 to 160 nmi, Sea Skimmer

C-301: Mach 2.0, 50 to 100 nmi, Sea Skimmer

C-101: Mach 2.0, 25 mi, Sea Skimmer

Command & Control

Air-Air Threats

SA-10/HQ-10

SA-12/HQ-18

Ground -Ground Threats

SCUD TELS

Tanks

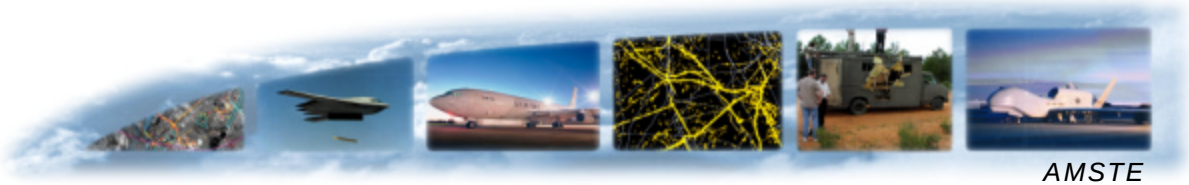
Artillery

Source: www.FAS.org

AMSTE Objectives

- The AMSTE program will develop and demonstrate a netted system-of-systems approach for:
  - Networked targeting of moving threats using:
    - Multi-platform fused GMTI
    - Precision fire control tracking
    - Long term track maintenance
    - From tactically significant standoff ranges
    - Against moving and move-stop targets
    - Using guided weapons
    - In adverse weather
    - To deliver <10m CEP

Deny Adversaries the Sanctuary of Maneuver



Customer Objectives

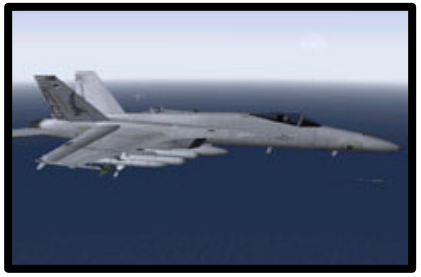
- Successful engagement of maneuvering surface targets (Land and Sea) using low cost affordable weapons
- Maintain track continuity from nomination through engagement sorting targets from non-target vehicles (>20 mins)
- Solution must be transition-able to services and solve the overall battle management challenge

DARPA Funded Effort With AFRL (Rome) As Technical Agent

AMSTE Addresses the "Kill Chain" from Target Nomination through Engagement

FIND, FIX

- Search
- Detection
- Cueing
- Handover
- Combat ID



TARGET, TRACK

- Track Association
- Gridlocking
- Georegistration
- Track Maintenance

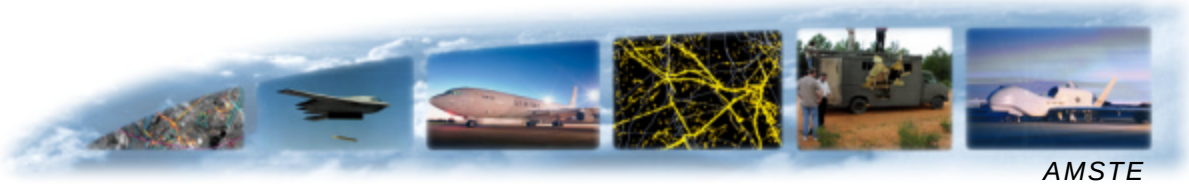
ENGAGE

- Weapon Assignment
- Precision Track
- In Flight Update
- Continuous Footprint Update
- Terminal Maneuver

ASSESS

- Kill Assessment

AMSTE Focus



AMSTE Focus

Target *moving* surface threats from long range and rapidly *engage* with precision, standoff weapons

Key AMSTE Characteristics:

All-Weather Engagement:	Requires use of multilaterated, georegistered GMTI sensors
Targeting Focused:	Requires ability to maintain threat track from nomination through engagement
Precision Engagement:	Requires ability to provide fire control updates to weapons in flight

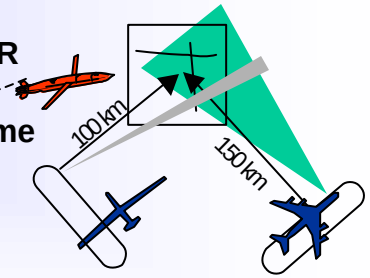
AMSTE technologies support a seamless moving target engagement from

Nomination Track Maintenance Engagement

Open System of System Architecture Accounts for Wide Mix of Configurations

(1) ISR Sensors Only

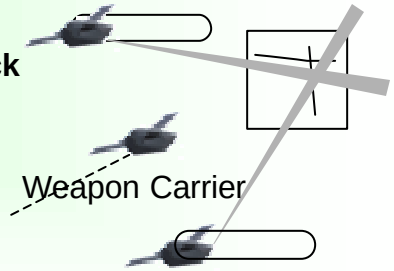
Concept: Use multiple MTI/SAR standoff platforms to provide track maintenance and endgame targeting solution



Variants:
- Single ISR, Two ISR
- Artillery, Naval Fire support, airborne weapon
- Command guided w/ or w/o seeker on weapon

(2) Attack Sensors Only

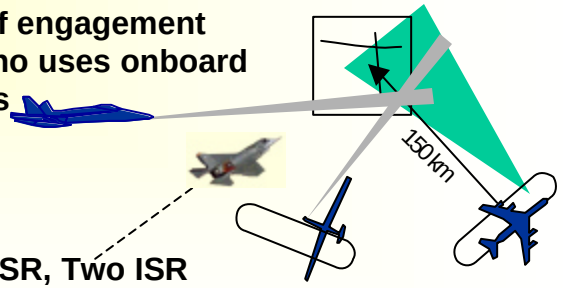
Concept: Use multiple attack aircraft to respond to nomination cues without interactive ISR support



Variants
- Two, Three, or Four ship (1 ship is weapon carrier)
- Command guided w/ or w/o seeker on weapon

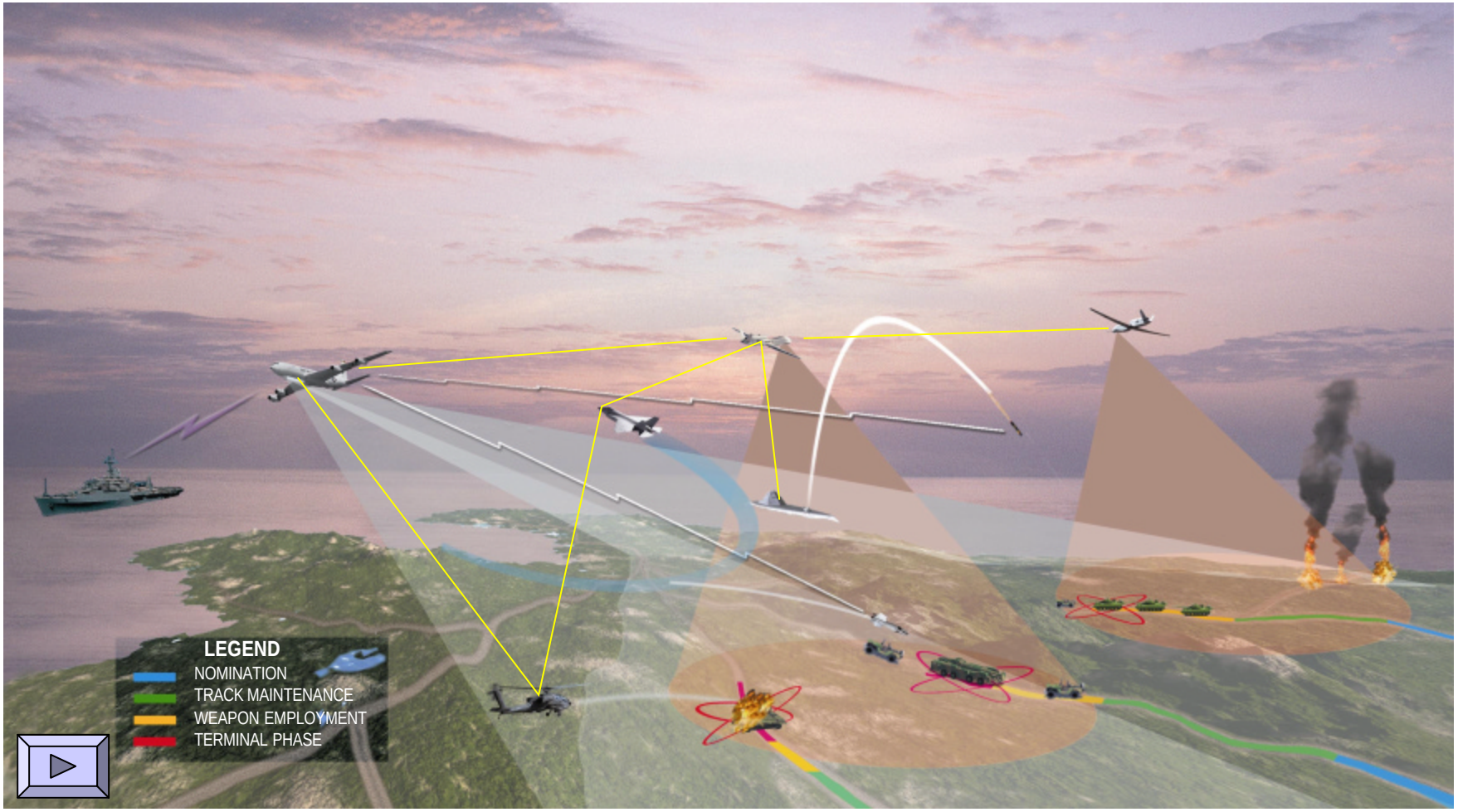
(3) ISR Augmented with Attack Sensor

Concept: Use ISR(s) for track maintenance, handoff engagement control to attacker who uses onboard sensors plus receives measurements for endgame tracking



Variants:
- Two Ship with One ISR, Two ISR
- Active vs. Passive attack platform sensor
- Command guided and/or seeker on weapon

AMSTE Concept



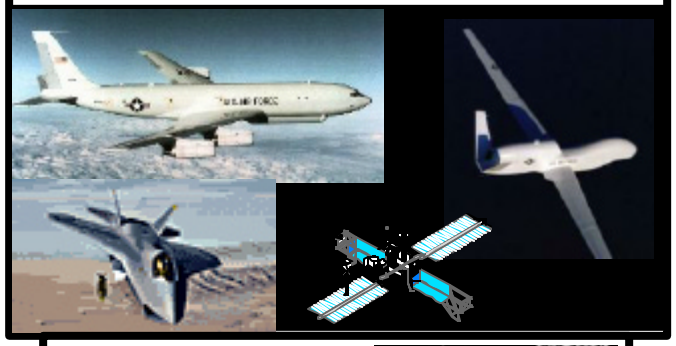
AMSTE II Concept of Employment

- Receive cue to high value target
- Locate and track high value, mobile targets in real-time and all weather primarily using surveillance radar assets
- Maintain track on high value targets during approval/weapon-target pairing cycle
- Position/task second radar to illuminate target and form highly accurate bi-lateration track
- Assign guided weapon to target
- Continuously pass target location, velocity, and time data to the weapon until it impacts target

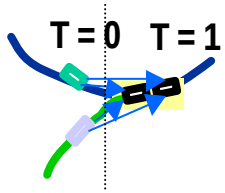
Target *Moving* Surface Threats from Long Range and Rapidly *Engage* with Precision, Standoff Weapons

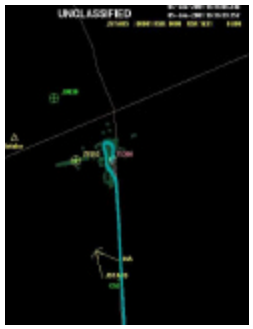
AMSTE Key Technologies

All Weather Precision Sensors

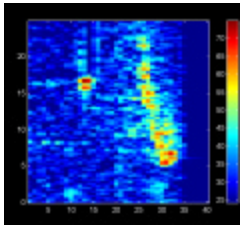


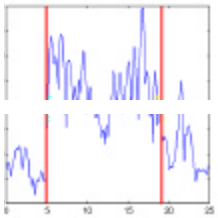
Precision Tracking



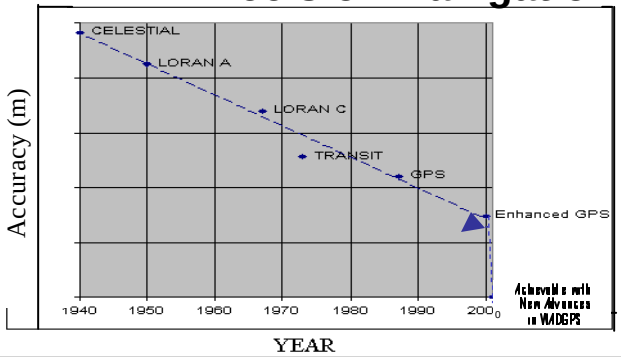


LTTM



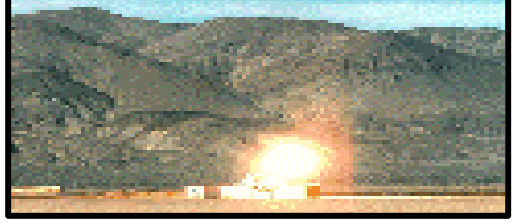


Precision Navigation



Precision Weapons

Enhanced Battle Mgmt



AMSTE is Targeted to Use Variety of Weapons

JDAM
GBU-32

- Warhead: Mk 84 2000 lb
- Range: 10-18 nm
- Current Inventory: Over 11,000 JDAM Tailkits Produced
- Unit Cost Unmodified: ~$30k

OWL
On-Target Weapon,
Long-Range

- Near-zero CEP Without a Seeker
- Precision Geolocation in Any Weather
- Range: 80 Nm
- Unit Cost Approximately: $100k
- None Currently In Inventory

Maverick
AGM-65D/G

- Warhead: 57 kg HE Shaped Charge or 136 kg Blast Frag.
- Range: 13 nm
- Unit Cost Unmodified: $122k
- Inventory: ~40k in 1999

JSOW
AGM-154A

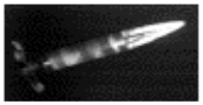
- Warhead: BLU-97/B Area Munition
- Range: 12 nm Unpowered, > 120 nm Powered
- Unit Cost Unmodified: $250k
- Current Inventory: ~11k

LASM
SM-4
Land Attack
Standard Missile

- Warhead: Mk 125
- Range: 90 nm
- Unit Cost Unmodified: < $300k
- None Currently In Inventory

MAAWLR
Miniature Autonomous Attack
Weapon – Long Range

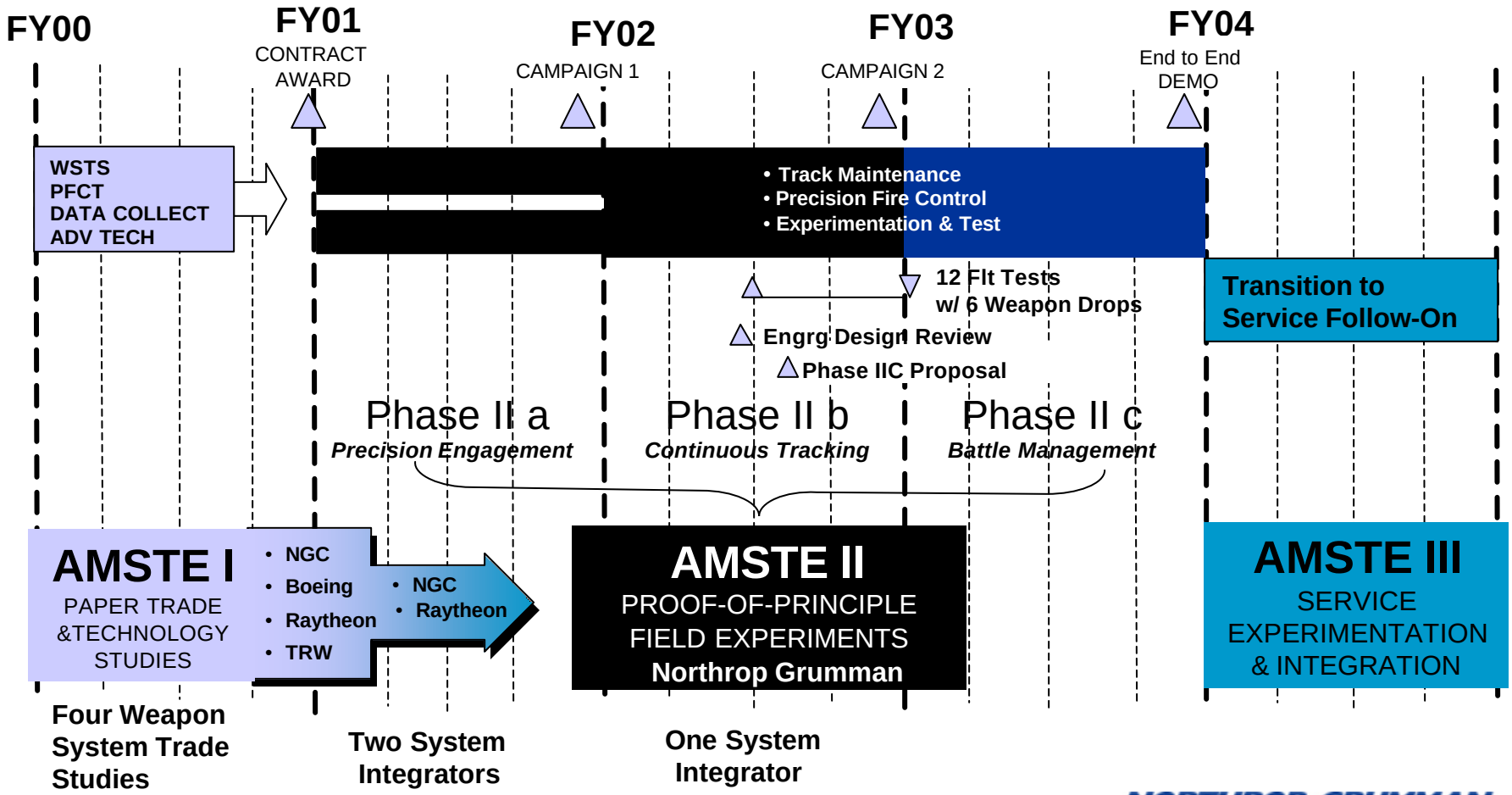
- Warhead: BAT Multi-Mode Warhead
- Range: > 100 nm
- Current Inventory: None
- Unit Cost Unmodified: < $150k w/BAT Seeker, ~$80k w/o Seeker



Excalibur
XM982

- Warhead: DPICM, SADARM, Unitary
- Range: 31 nm
- Current Inventory: None
- Unit Cost Unmodified:

AMSTE Program Schedule & Milestones



NORTHROP GRUMMAN
Integrated Systems

AMSTE Initial Test Results

- Non Maneuvering Vehicle
- Constant Speed
- Engaged from Standoff with maneuvering PDAM (JDAM Wpn)
- Objective: 10 mtr CEP
- Goal: 3 mtr CEP
- Result: Direct Hit

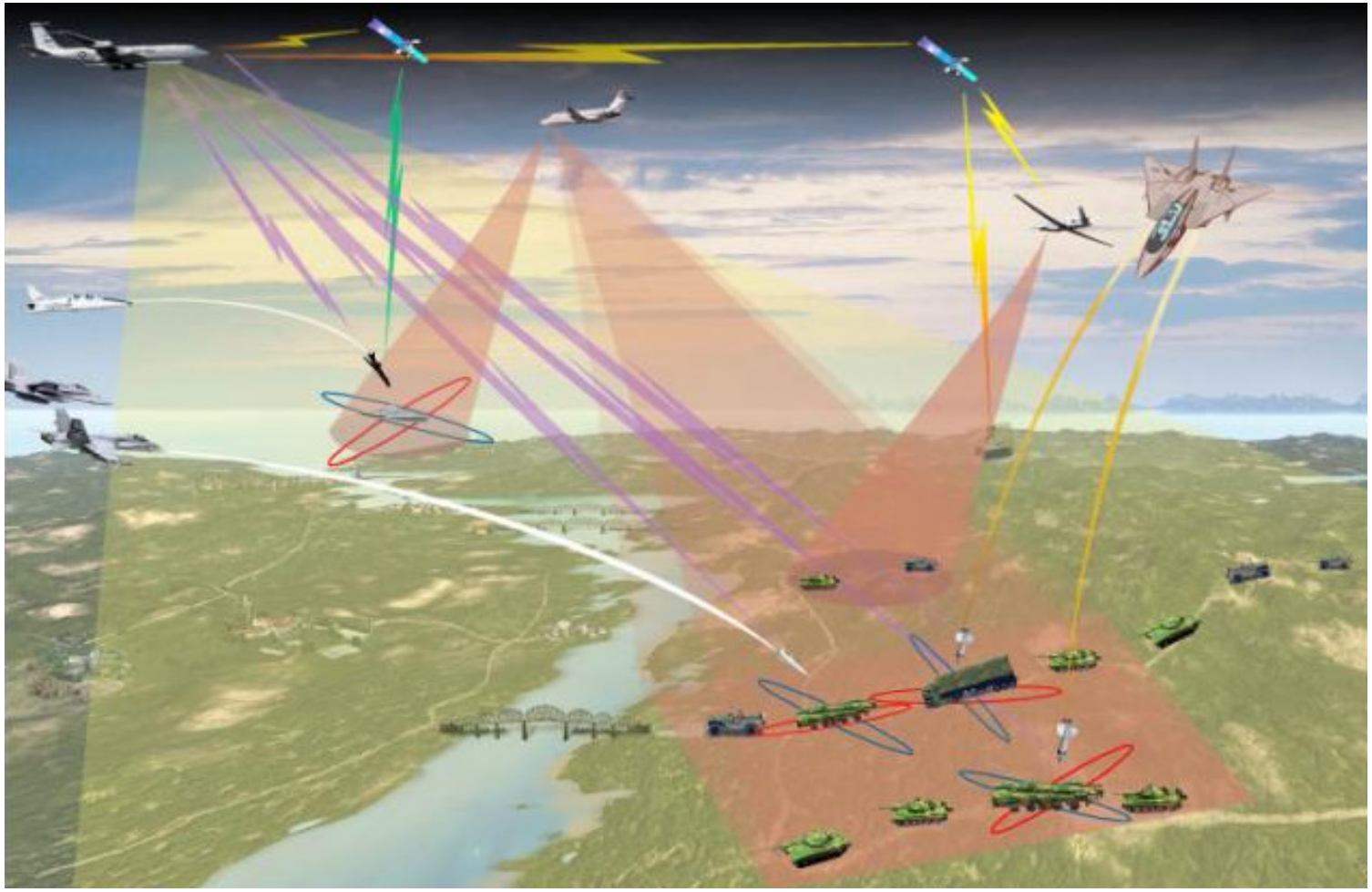
Phase I Lessons Learned

- AMSTE is a systems approach that requires
  - Effective transitions through the kill chain
  - Coordination and availability of GMTI and other modes
  - Tight response timeline
- Performance limitations are reduced as more netted sensors are able to contribute to engagement
- Maintaining track may be the most difficult technical challenge
- Required endgame accuracies appear feasible with netted sensors
- AMSTE can be implemented with data link modification to existing weapons

Progression of Experimental Challenges

Challenge Conditions	FY01	FY02	FY03
Accuracy:	10 m CEP →		
Target Behavior	Benign	Evasive	Unscripted
Terrain Type	Flat	Hilly	Hilly
Track Maintenance:	1 - 5 min	20 min	As Required
# of Vehicles	Few	Many	Many
Complexity	Ghosting	Not Separable with Kinematics	Unscripted
Automation:	PE	TM to PE	End to End

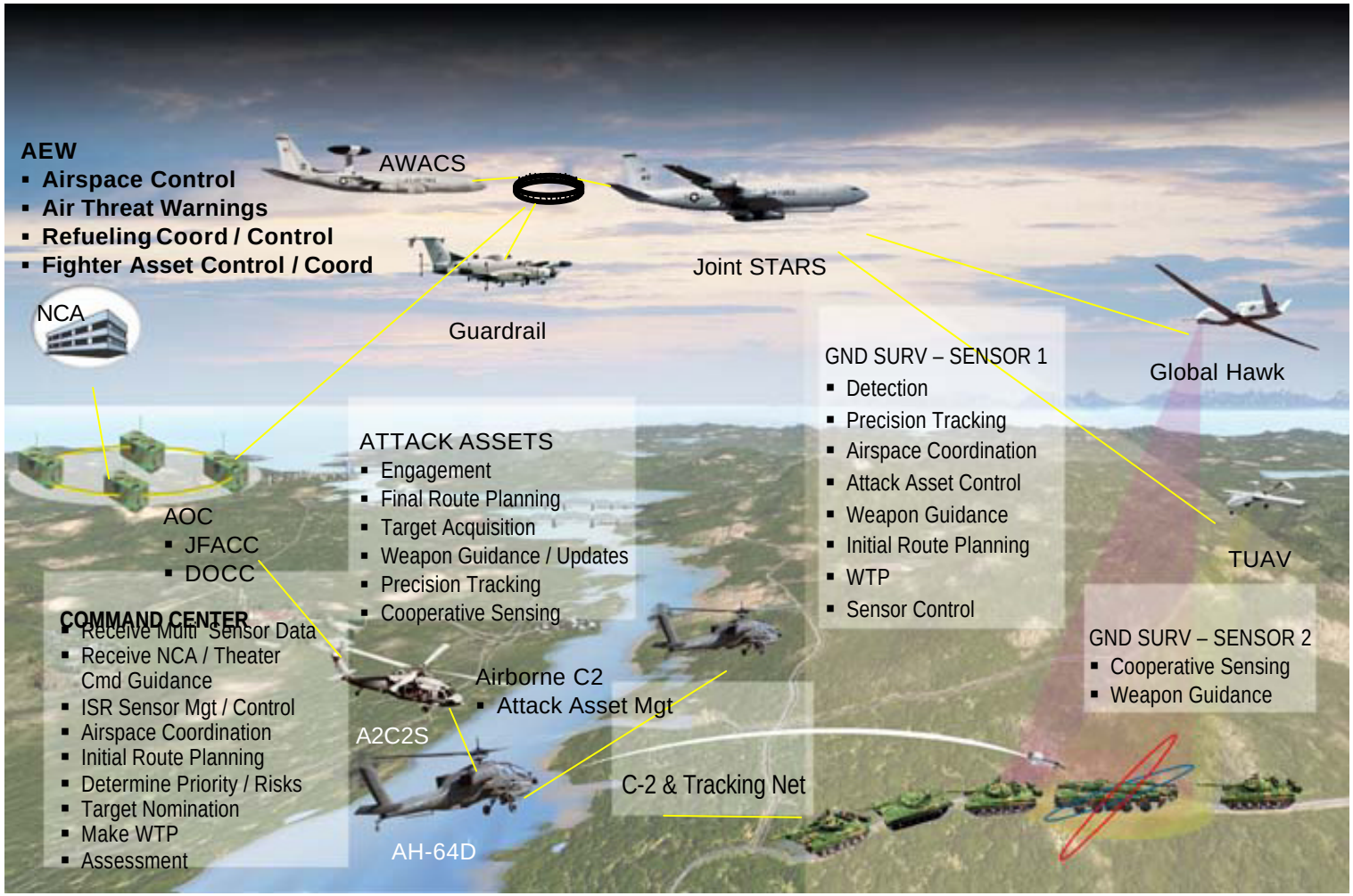
FY02 Experiments



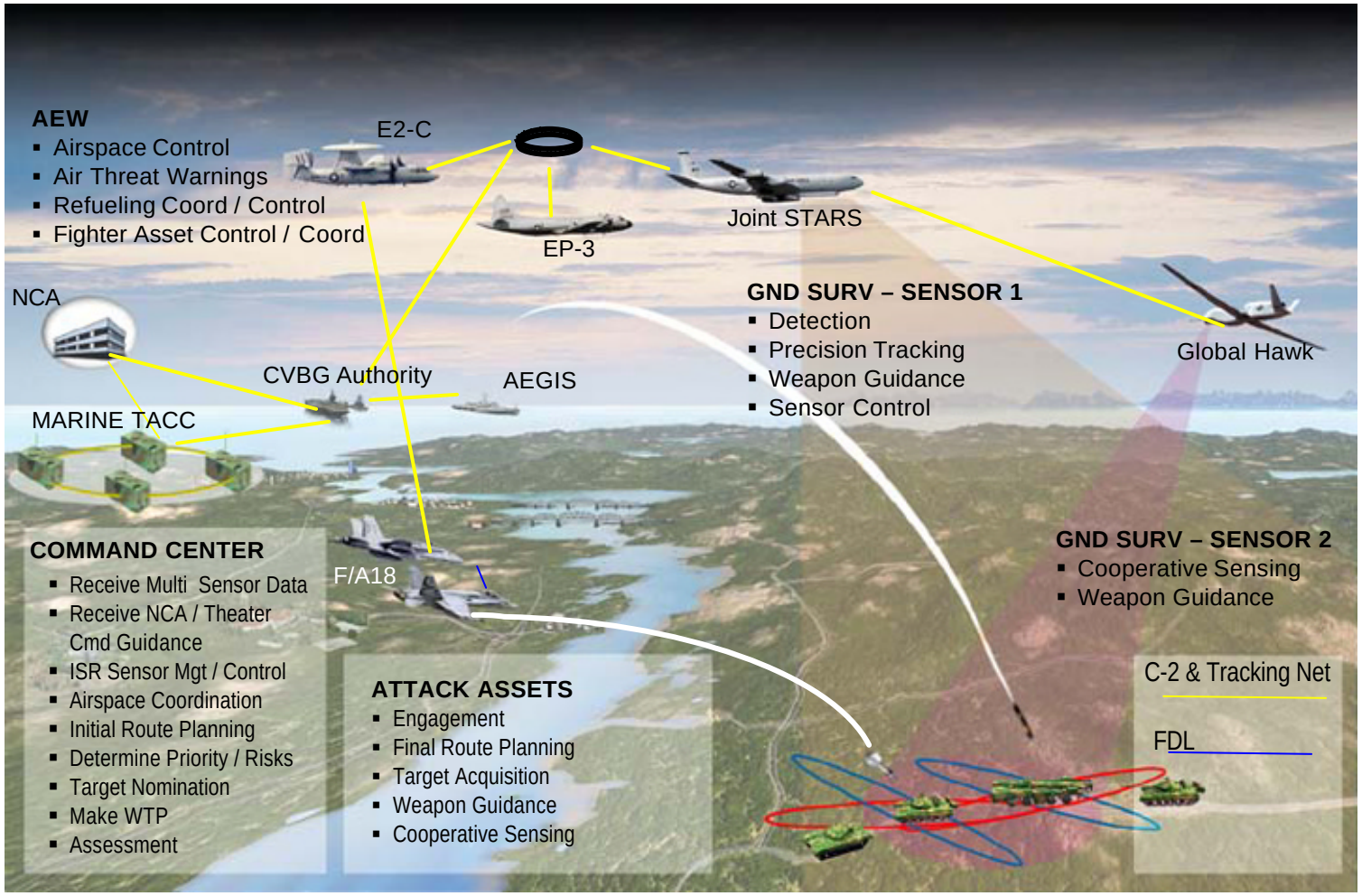
Application to the Warfighter

AMSTE enables Warfighters within a joint architecture, to conduct all weather, near simultaneous, precision engagements from stand-off ranges of multiple, dynamically moving surface targets, while limiting collateral damage using affordable munitions

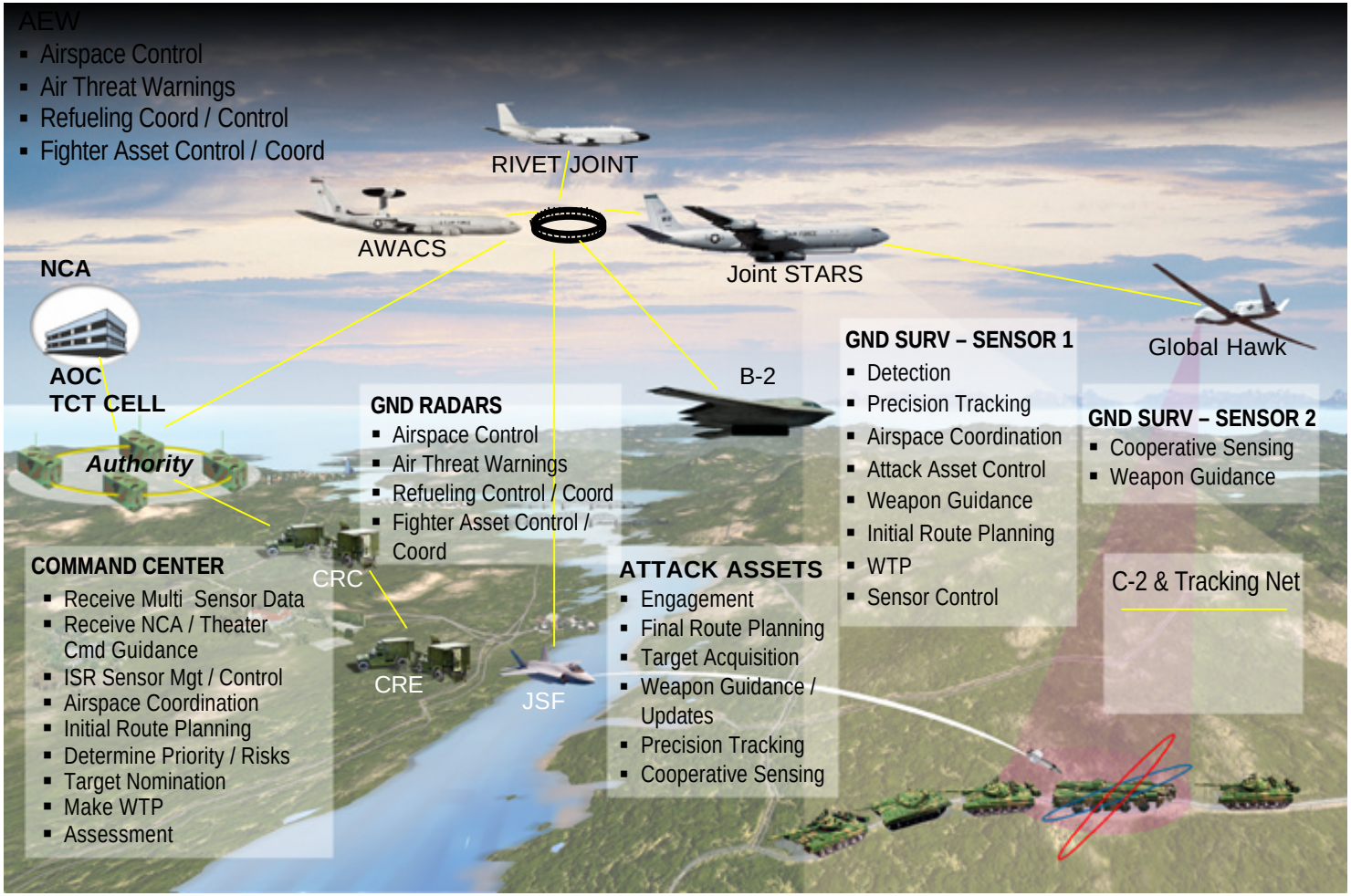
AMSTE Nominal Architecture



AMSTE Nominal Architecture



AMSTE Nominal Architecture



AMSTE Contributions to FCS

FCS Requirements:

- Network centric
  - Know precisely, in real-time, location of all friendly and enemy forces

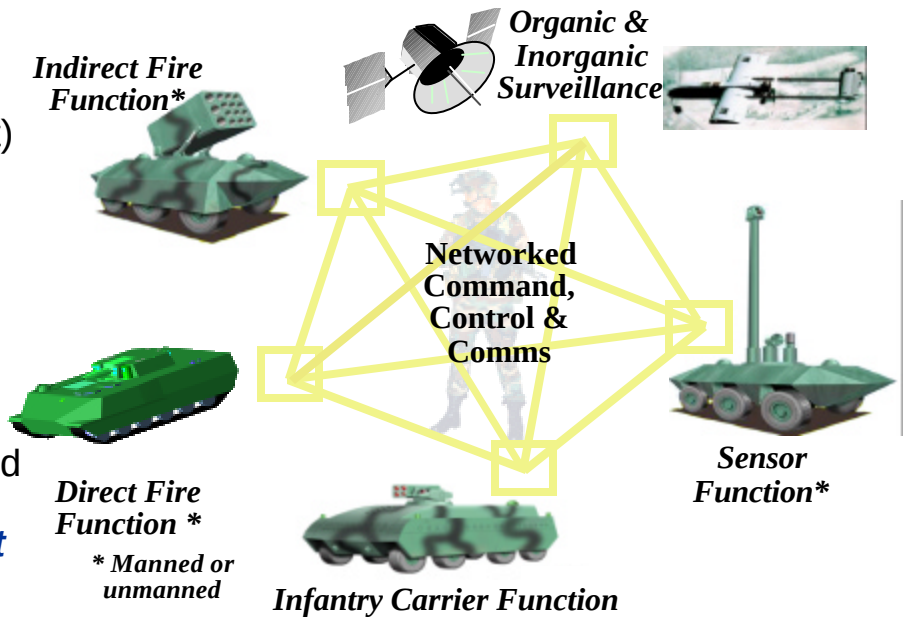
  AMSTE tracking, targeting, & C2 enhancements can provide

- Robotics integrated into force
  - Amplify capability of manned elements
  - Multi-functional (RSTA, armed, sustainment)
- Increased reliance on extended range engagement
  - Organic plus strategic and tactical support

  AMSTE Supports long range ISR and precision fires, can use organic systems

- Capable of air-mobile operations
  - Commercial and minimum DoD strategic and tactical lift

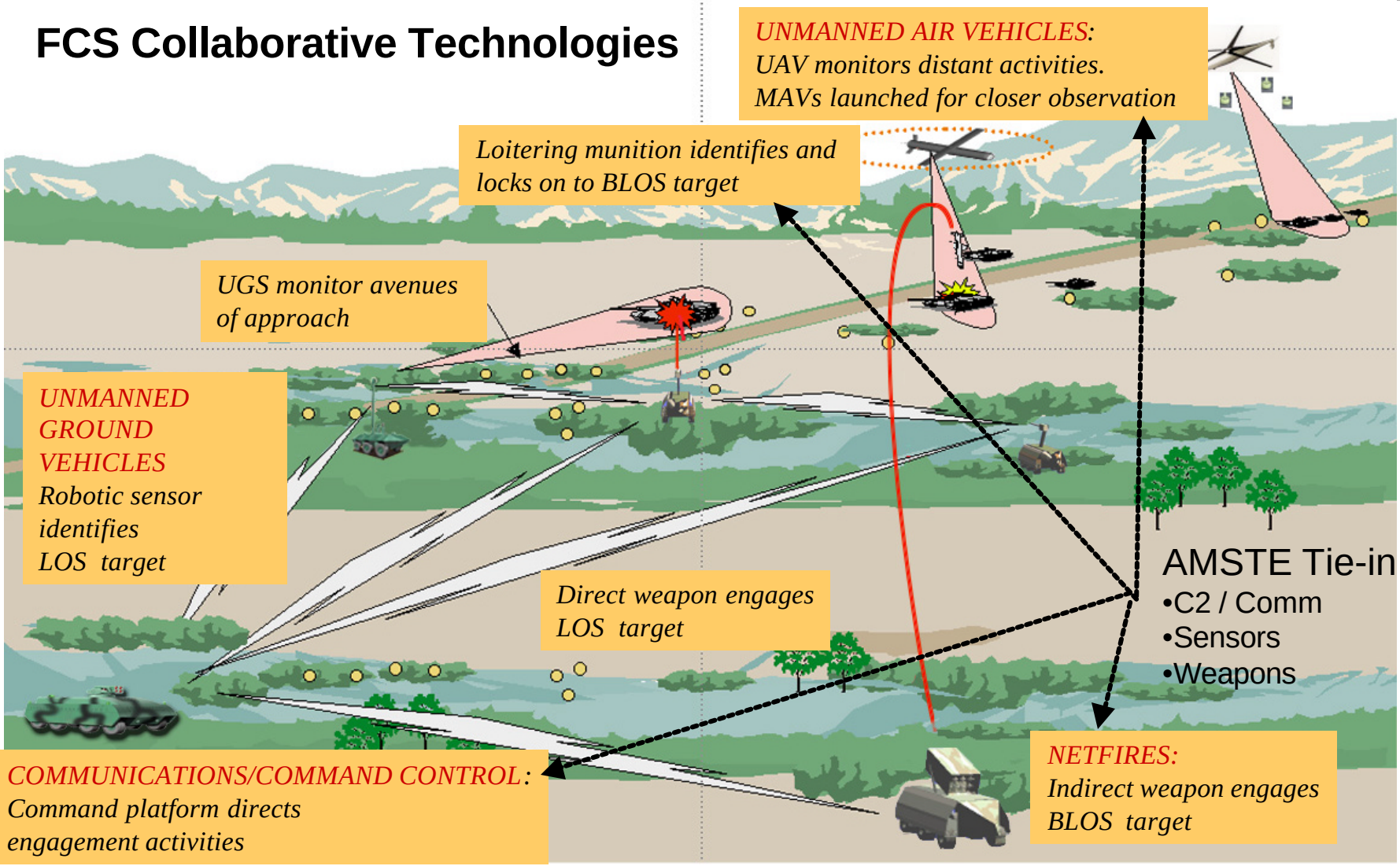
  AMSTE precision targeting and engagement requires less force structure



AMSTE brings reduced logistics footprint, affordable, all weather, stand-off, precision engagement of movers to FCS

Source: FCS Industry Day, 9 Nov 01

FCS Collaborative Technologies



Source: FCS Industry Day, 9 Nov 01

Summary

- Experimentally proving movers with increasing complexity of motion can be precisely engaged
- Developing an Architecture and Algorithms that support Long Term Track Maintenance
- Accounting for Battle Management implications to reduce decision timelines
- AMSTE brings unprecedented capability to warfighter
  - All weather, affordable, precision engagement from stand-off ranges
  - Denies adversary sanctuary of movement to avoid destruction
- Applicable to Army systems