



**CECOM Research Development and
Engineering Center (CERDEC)
Space & Terrestrial Communications
Directorate**



Army Communications Science & Technology for the Objective Force

*Armaments for the Army Transformation
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Communications & Networking Development Philosophy

Adopt Commercial off the shelf Technology

Adopt

Commercial Example

- Personal Communications Services (PCS)

Adapt Commercial Technology When It Cannot Be Directly Inserted

Adapt

• PCS

- ✓ Add Security
- ✓ Downsize Base Station

Develop Technology in Concert With Other Services and Agencies for Unique Areas And Partnerships, Alliances, Teaming

Develop

• PCS

- ✓ Universal Handset

Need to Differentiate Technology vs Product

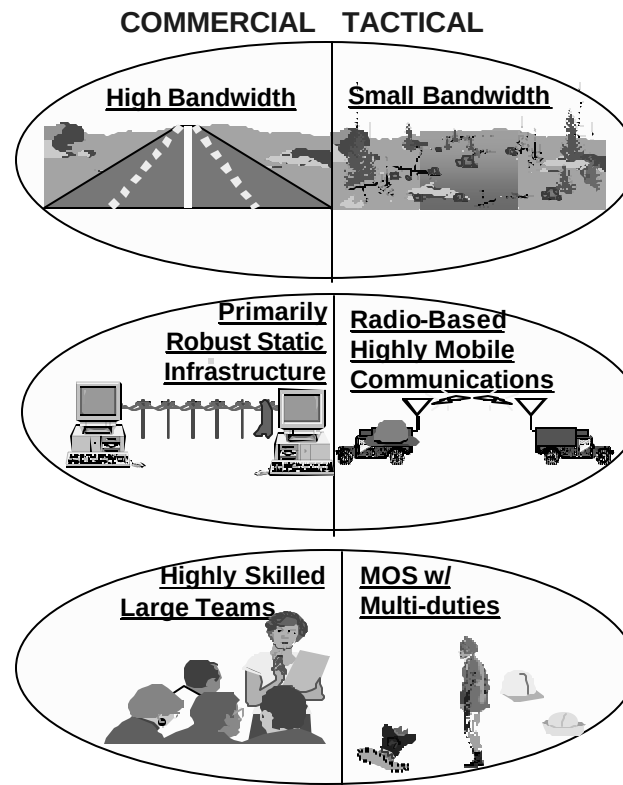
CECOM Bottom Line: THE SOLDIER



Commercial versus Military Communications Challenges

Commercial

- Mobile Subscriber, Fixed Infrastructure
- Pre-configured Networks
- Tall, Fixed Antenna Towers
- Fiberoptic Internodal Connections
- Greater Frequency Spectrum Availability
- Fixed Frequency Assignments
- Protection: None -> Privacy (single level)
- Interference Rejection is Somewhat Important
- Low probability of Detection (LPD) is not an issue



Military

- Mobile Subscriber - Mobile Infrastructure
- Ad Hoc, Self Organizing Networks
- Small, Easily Erectable Masts; Low Profile OTM Antennas
- Mobile, Wireless, Internodal Connections
- Restricted Frequency Assignments; Geographically Impacted
- Protection: None -> Top Secret/SI (Multiple, Simultaneous Levels)
- Interference Rejection and Antijam are Critical
- Low Probability of Detection (LPD) is Critical

CECOM Bottom Line: THE SOLDIER

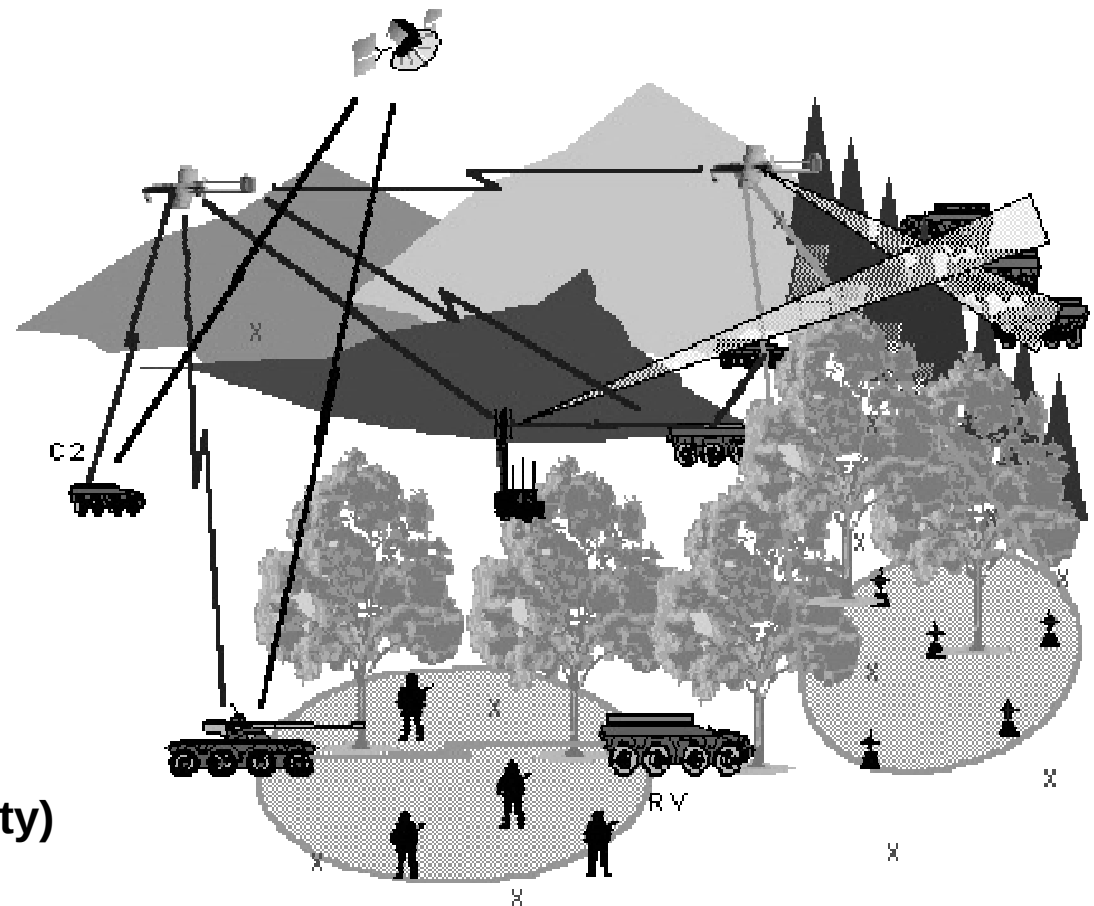


Communications Technology Challenges



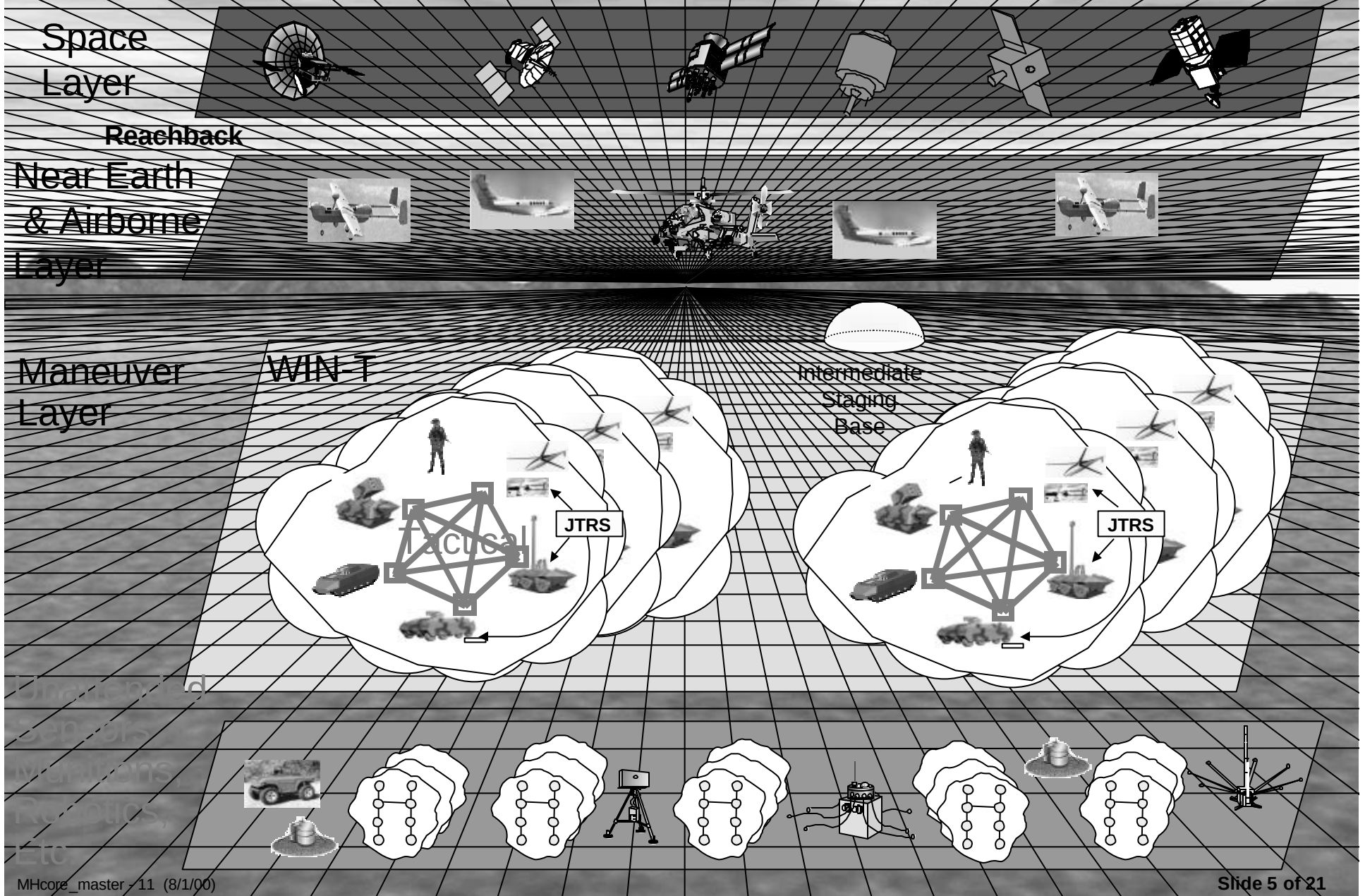
Objective Force demands an assured, mobile, networked infrastructure that works in diverse complex terrain

- Self-Organizing Networks
- High data rates
- Greater ranges/dispersion
- Real-time delivery
- Low-probability of detection
- Jam resistance
- Propagation effects
 - Terrain blockage
 - Foliage penetration
 - Urban “canyons”
- Context based routing (priority)
- Network Protection



CECOM Bottom Line: THE SOLDIER

Objective Force / FCS Network Grids



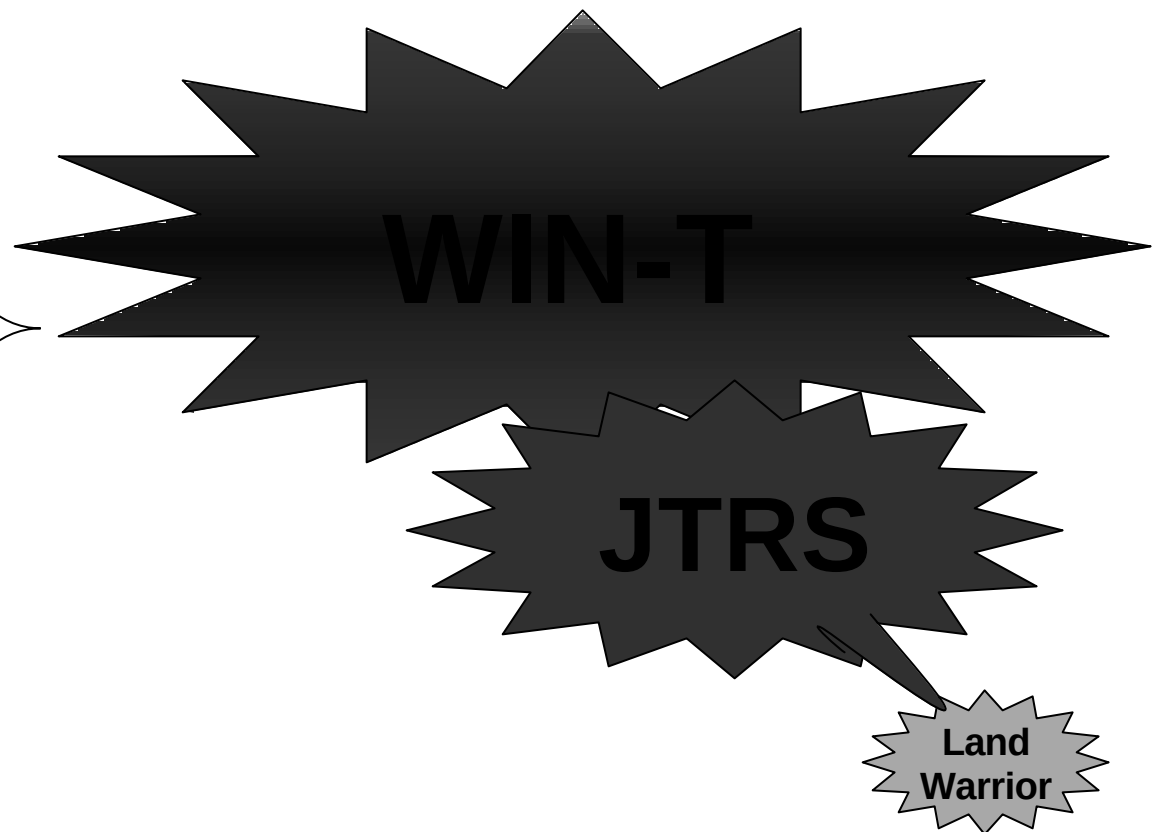


Major Communication Thrusts



- Secure On-the-Move Networking
- Reachback/Range Extension (SATCOM & UAV)
- Unattended Sensors Networking
- Secure Personal Communications
- Antennas
- Information Protection/Information Assurance
- Networked Fires

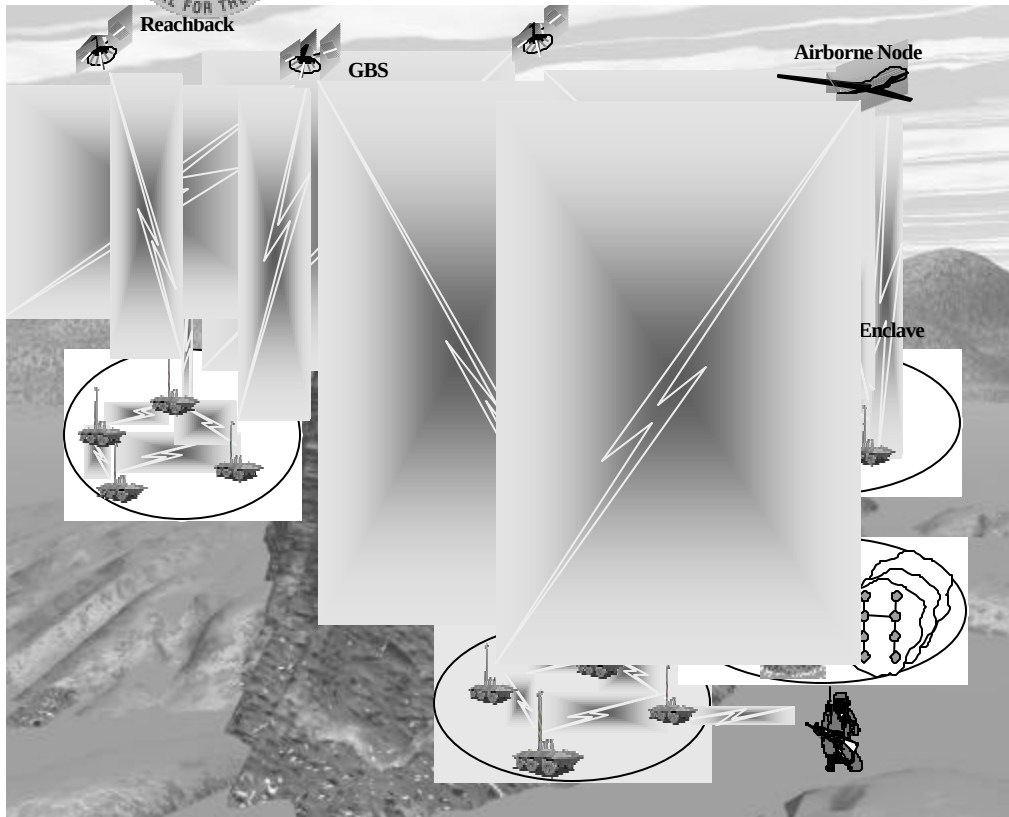
Programmed Objective Force Comms Systems



CECOM Bottom Line: THE SOLDIER



On-the-Move Networking - Mobile Infrastructure



- **Collaboration:**

- DARPA, Commercial, Other Services, Industry IR&D

- **Challenge:**

- Provide an assured, wireless, network that works in diverse, complex terrain

- **Barriers:**

- **Days** to preplan & configure network
- Limited bandwidth for assured network access, services, & speed of delivery
- Complex, dynamic, network mgmt
- Continuous coverage



- **Solutions:**

- **Minutes** to configure network via self-organizing Ad Hoc protocols
- Efficient bandwidth utilization via adaptive algorithms
- Simplified automated net ops using intelligent distributed agents
- UAV Communications payloads

Warfighter Payoff: Increased Responsiveness, Deployability, Agility and Versatility



MOSAIC

- Multiple Contracts Awarded
- Modular demo in 02
 - 6-10 vehicle & lab platforms
- Integrated demo in 04
 - Relevant environment with Agile Commander ATD

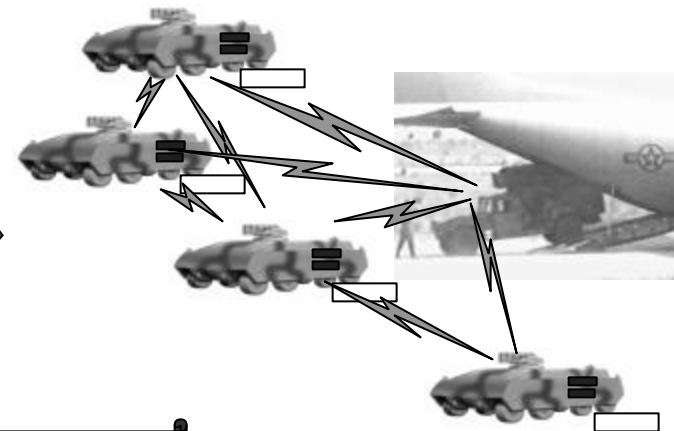
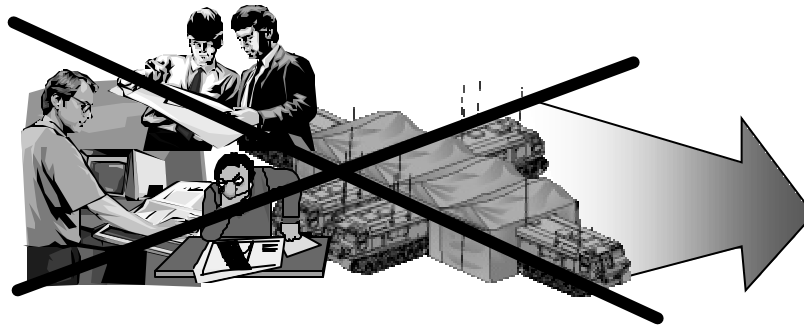
Breadboard Test -TRL 5

- Lab test environment
 - Limited dynamics
 - Simulation for scalability
- Demonstrates Technical approach
- Identifies Integration/Interface issues



TRL 6

- 15-20 nodes, vehicle & fixed with Surrogate UAV
- Integrated with other STOs



CECOM Bottom Line: THE SOLDIER



On-the-Move Tactical SATCOM Technology



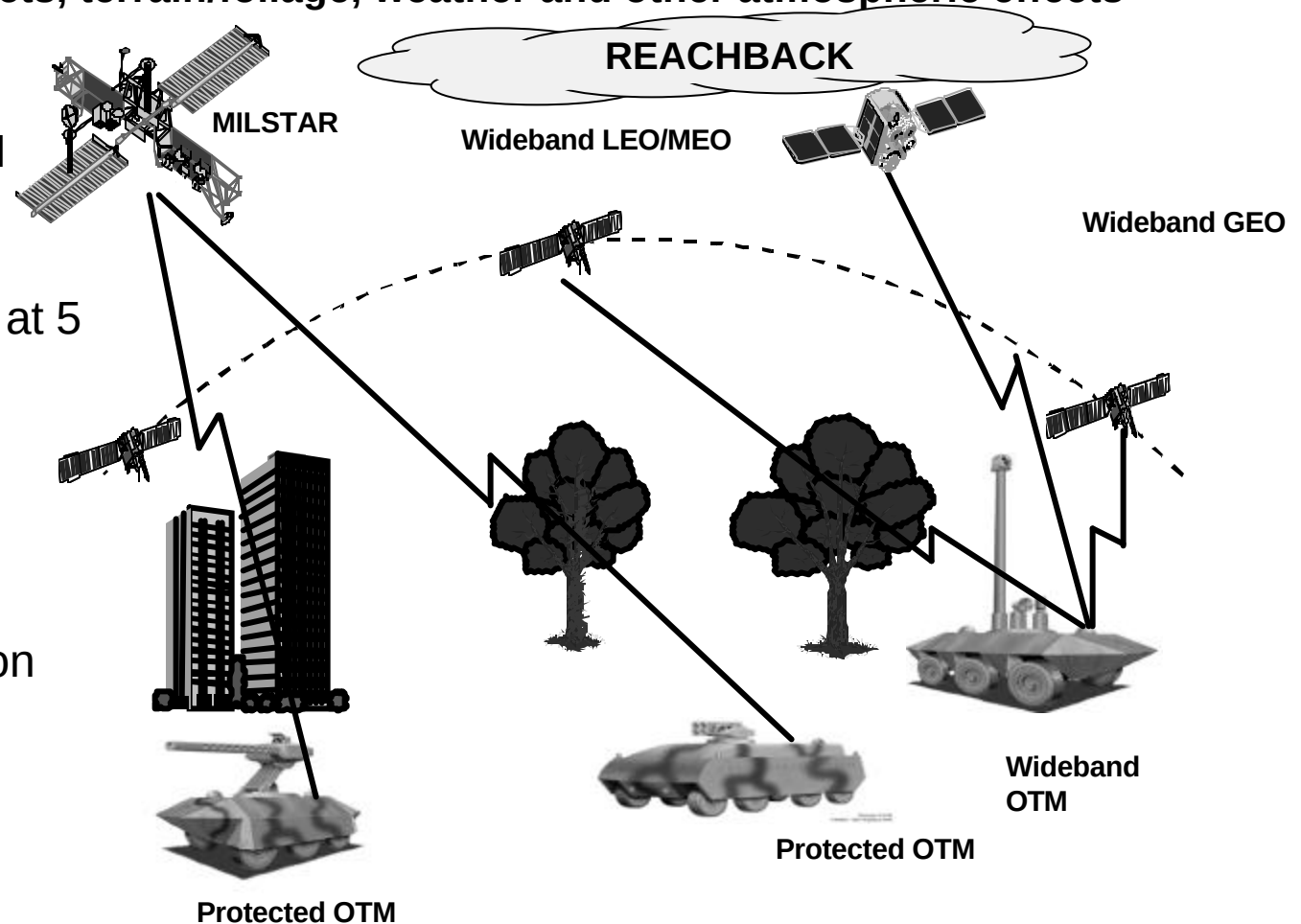
Objective: Enable on-the-move SATCOM for military and emerging commercial satellites which recovers quickly from signal blockages due to man made objects, terrain/foliage, weather and other atmospheric effects

Applications:

- **Scouts:** MILSTAR OTM comms at 9.6 kbps
- **C2 Node to C2 Node:** Wideband OTM comms at 5 Mbps Rx, 256 kbps Tx

Major efforts:

- Blockage mitigation (voice & data)
- Rapid Satellite acquisition and reacquisition
- Turbo Codes
- Integration
- OTM Assessment

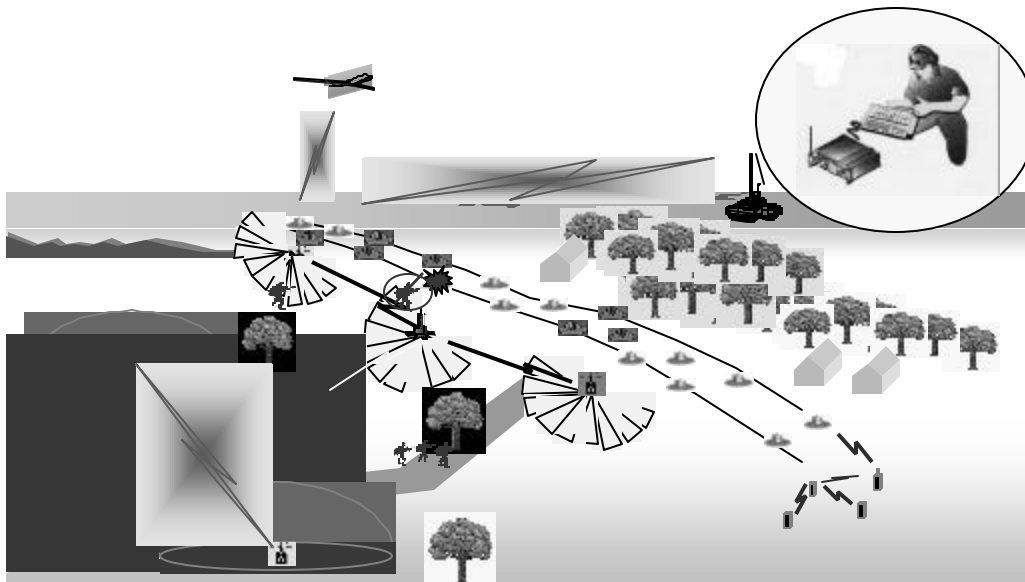


CECOM Bottom Line: THE SOLDIER



Networked Sensors for the Objective Force Communications

Objective: Develop a robust secure jam resistant, stealthy communications network for unattended devices



Pacing Technologies:

- Low-power, small efficient fast signal correlators
- Jam-resistant, LPI/LPD waveforms
- Energy-efficient networking protocols and channel access

Warfighter Payoffs:

- Enhanced Survivability
- Improved Situational Awareness --- quicker reaction, broader coverage, better identification

A Secure, Stealthy, Robust, Power Efficient Miniature Radio and Network



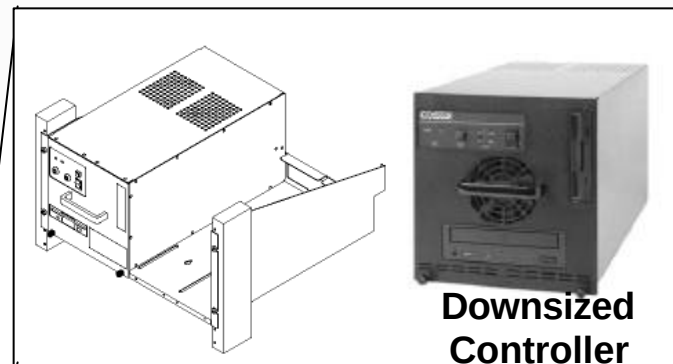
Terrestrial PCS (Example)



**Commercial
Basestation
Controller**



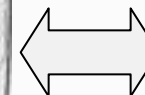
**Bridge Switch
Node**



**Downsized
Controller**



**Downsized
Basestation**





Universal Handset Technology

Mobile Satellite System

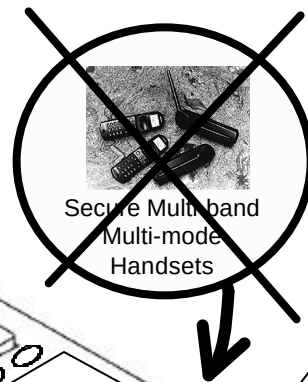
Bluetooth Air Interface

One-Touch Internet Access

Full motion video

MDR/LDR data and extended display ports

Type I - Type IV Security

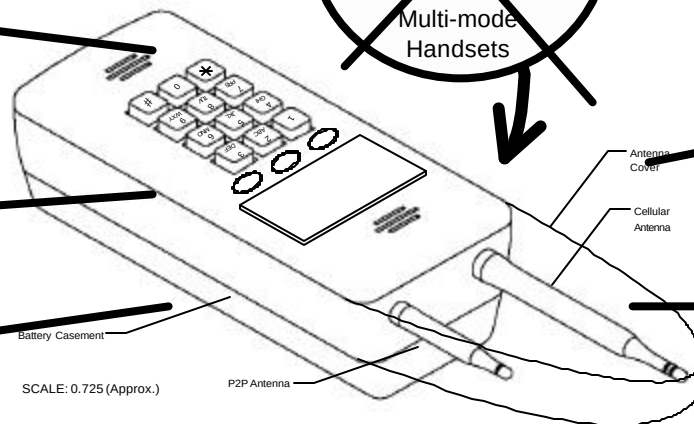


Terrestrial/ACN Cellular (Multi-band 800/900/1900) and SUO-SAS (200-800)

Netted mode and Group Services

Peer-to-peer w/ ad hoc networking - SUO-SAS

Super sensitive, rapid acquisition P/Y code GPS



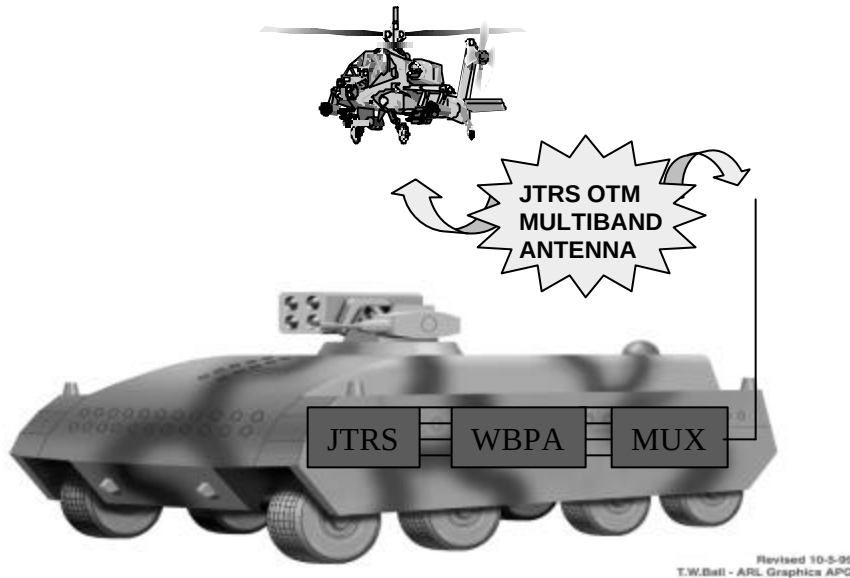
Plus: standard cell phone features such as hands-free operation, voice recognition, and button memory dialing

CECOM Bottom Line: THE SOLDIER



Tactical Antenna Technologies

JTRS Multiband On-The-Move (OTM) Antenna



- JTRS Critical Component
- Tactical OTM LOS Scenarios
— Ground, Airborne
- 30 - 450 MHz
- 400-2000 MHz
- High Power Capability

Technologies

- Dual mode VHF/UHF Dipole/Monopole
- Distributed Reactive Tuning
- Multielement Radiating Structures
- Coaxial & slotted traps
- Genetic algorithm optimization
- Taped resistive loading
- Lumped circuit loading
- Distributed LRC Networks

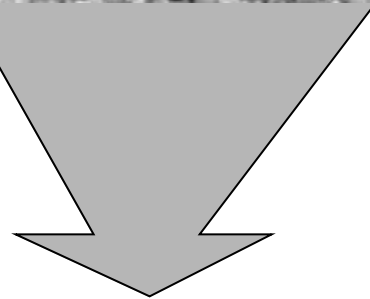
CECOM Bottom Line: THE SOLDIER



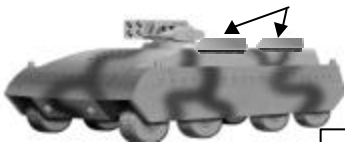
Ferroelectric Phased Array (Wideband OTM)



TODAY (Static)



RCV / XMT ARRAYS



TOMORROW (Mobile)

- **Challenge**

- Enable OTM non line-of-sight communications via UAV and SATCOM

- **Barriers**

- Supporting multiple beams simultaneously
- Very expensive construction methods
- Size and complexity
- Off road tracking stability

- **Solutions**

- Revolutionary low profile, wideband, cost effective antennas using Ferroelectric materials
- Sophisticated tracking algorithms
- Micro Electro Mechanical Systems (MEMS) integrated with interferometric GPS

**Material
Breakthrough!**

High Availability, Wideband, OTM, Beyond Line-of-Sight



Program Concept Chart Tactical Information Assurance Technology

(CER-01)

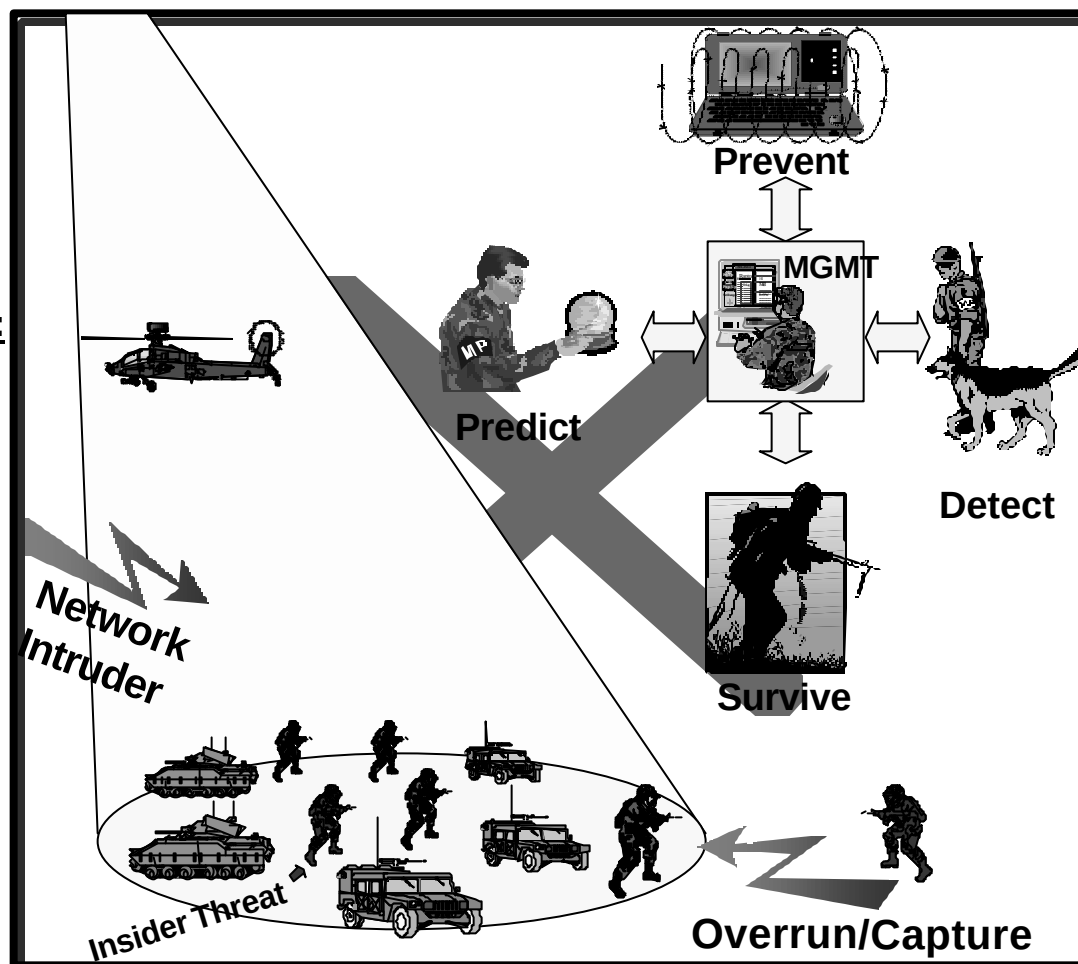


Objective: Adapt and Develop Critical Information Assurance Components to Insure Network Availability Despite Increasing Threats

Total
Program
\$24.3M

Pacing Technologies:

- Advanced Network Access Control
- Next Generation Intrusion Detection
- Synchronized Security Management
- Tactical Public Key Infrastructure
- Mobile Code Authentication



OPM
\$120M

Warfighter Payoffs:

- Increased Warfighter Confidence to Prosecute Battle
- Reduced Vulnerabilities In Objective Force Networks
- Limit Compromise in Overrun Situation
- Effective Security Management to Avoid Personnel Increase

CECOM Bottom Line: THE SOLDIER



Networked Fires

Objective

Provide high speed networked communications to enable standoff precision high volume/rate of fire engagements

Priority/Precedence
Protocols for
Fire Missions

Current:

- Program Concept in Development

In-flight updates via
network enables
munition retasking

No dedicated
data links

Networking of
unattended sensors
and robots to inflight
munitions and
missiles

Speed of
Service

Multi-role Armament System

BLOS & NLOS Engagement

Networked Maneuver G2 and
Fire Support

Detection and image data to FCS from Sensors

**CECOM/
AMCOM/
ARDEC**

Enable One Shot One Kill

It's a Network Centric World!



Right info...

Right time...

Right warfighter.