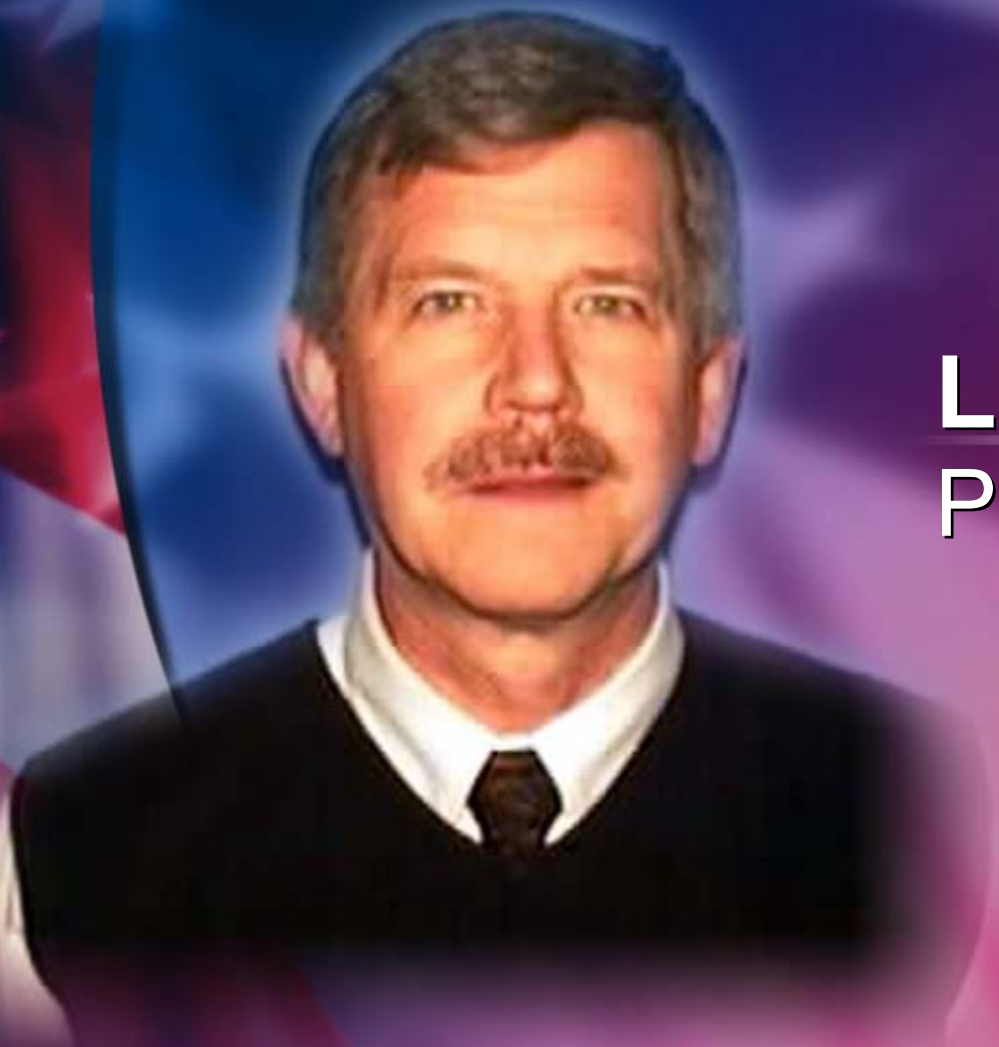
DARPA

DARPATech

2002 Symposium

Transforming Fantasy



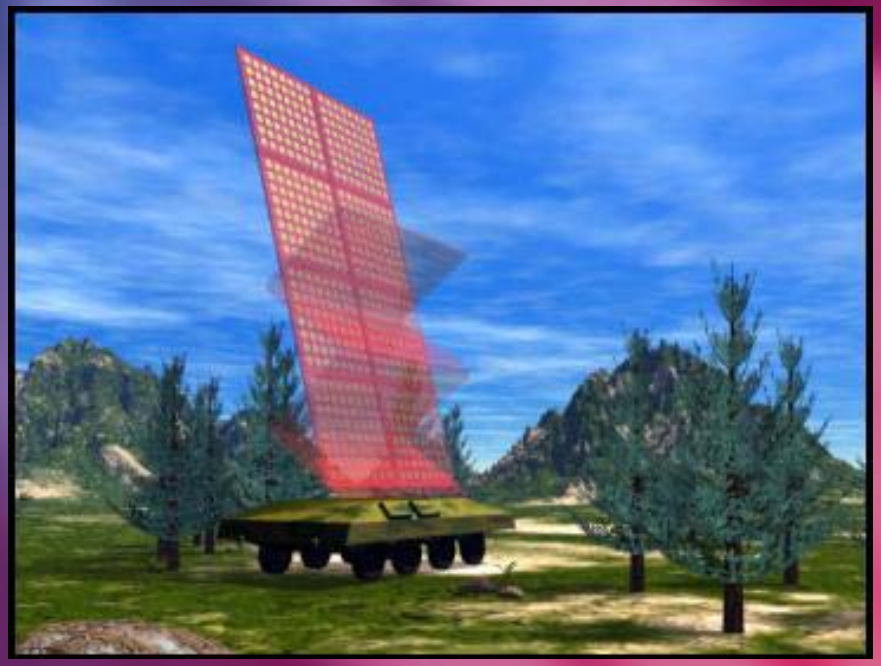
DARPA

Larry E. Corey

Program Manager

Transforming Fantasy

Advanced RF Sensors



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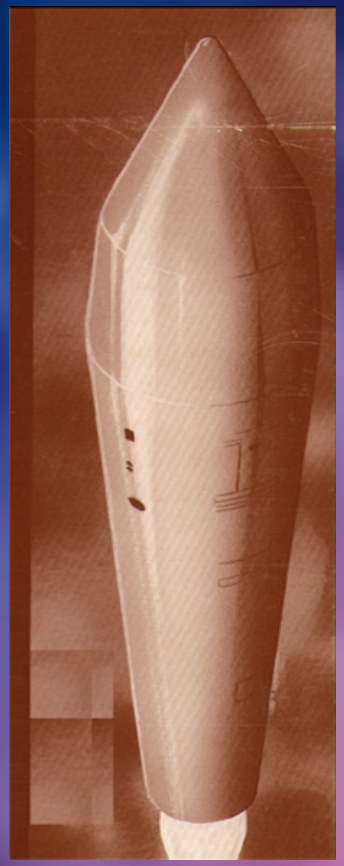
Cold War



High-tech
Countable

Today

Low-tech
Innumerable

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Proliferated Air Threats

Problem: multiple inexpensive air threat assets overwhelm expensive (Patriot-like) defenses

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Proliferated Air Threats

Solution: multiple inexpensive seekers

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Electronic Countermeasures (ECM)

Problem: Jamming

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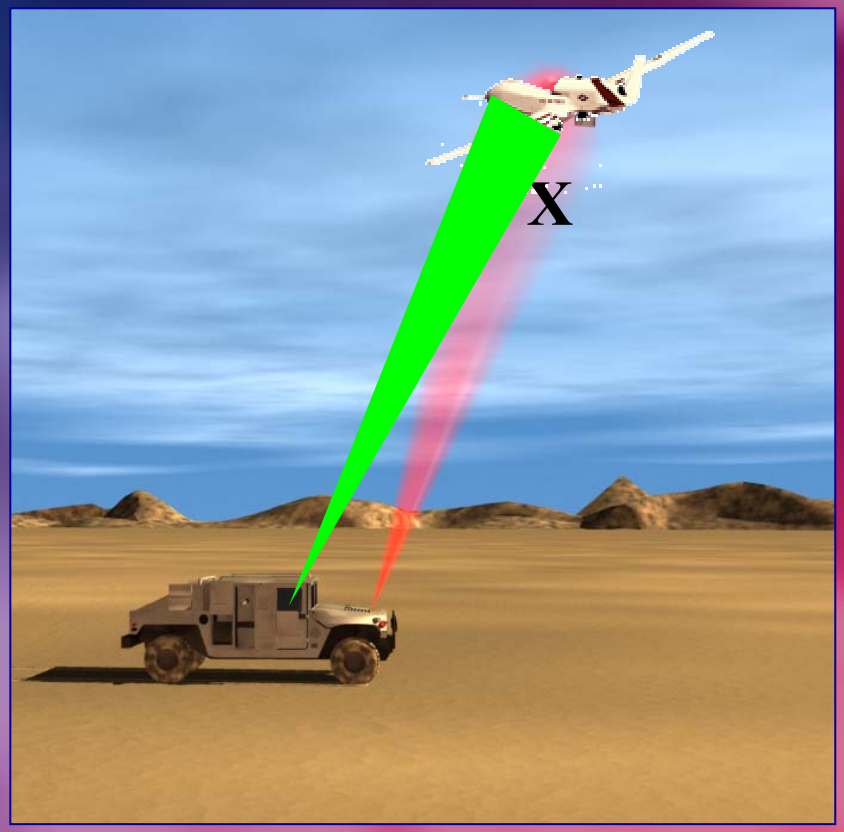
Electronic Countermeasures (ECM)



Solution: Rapid reconfiguration for new frequency

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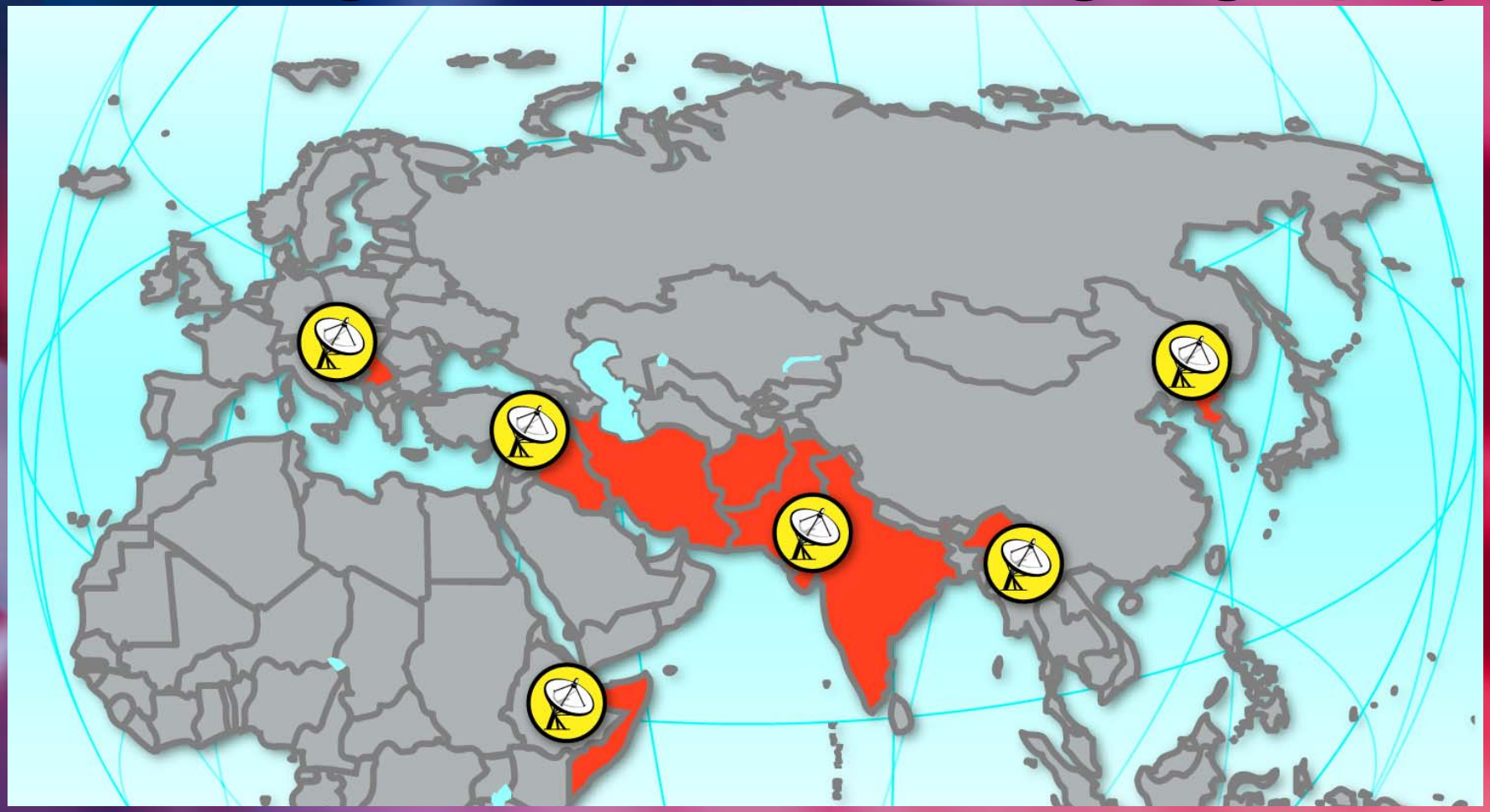
Shifting worldwide threat geography



Problem: The volatile world requires transportable sensors

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Shifting worldwide threat geography

Solution: Inexpensive, transportable radar

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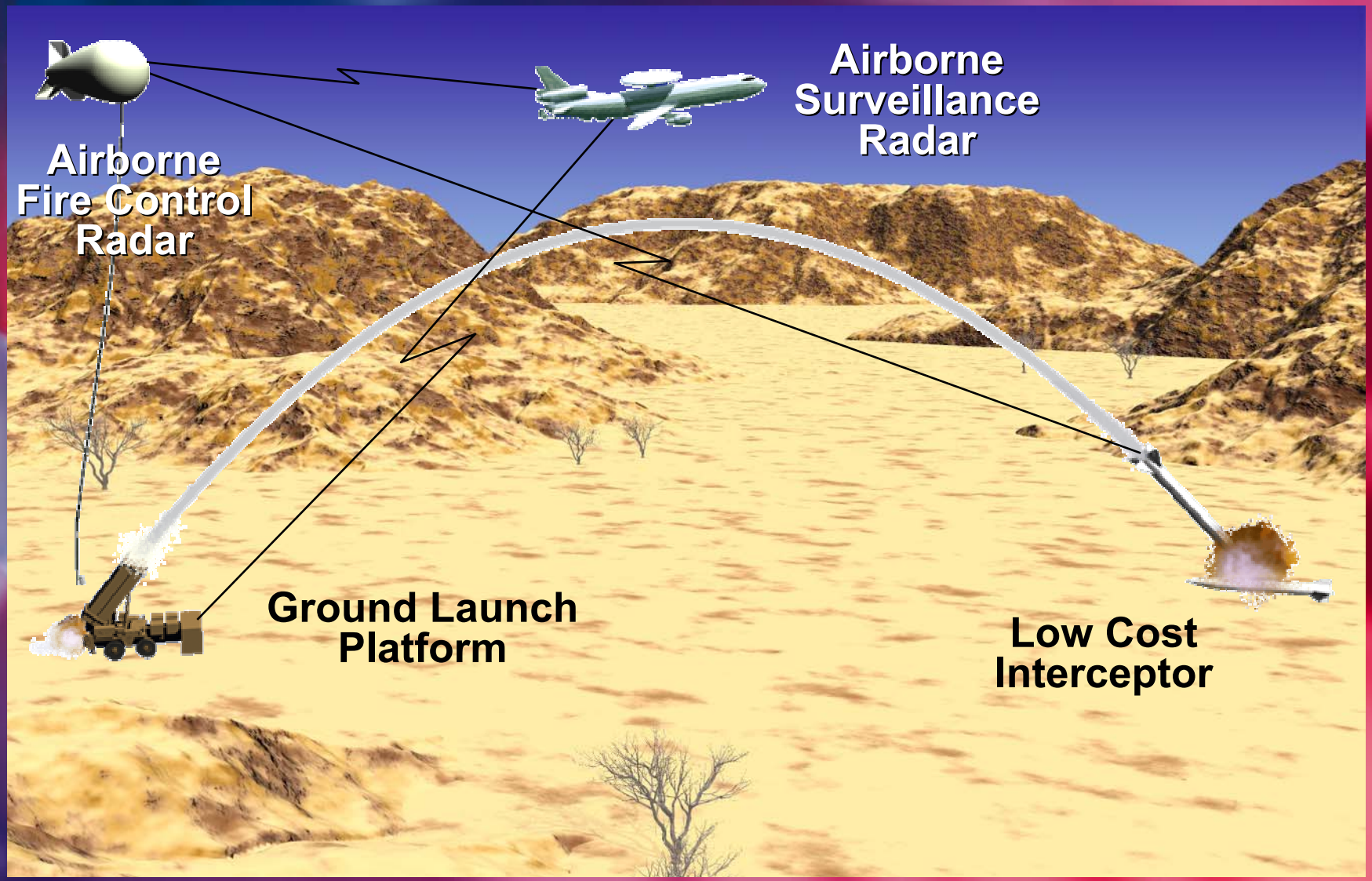
Low Cost Cruise Missile Defense (LCCMD)



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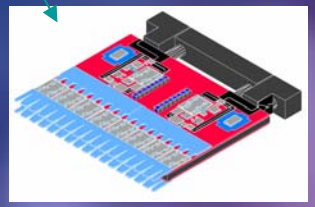
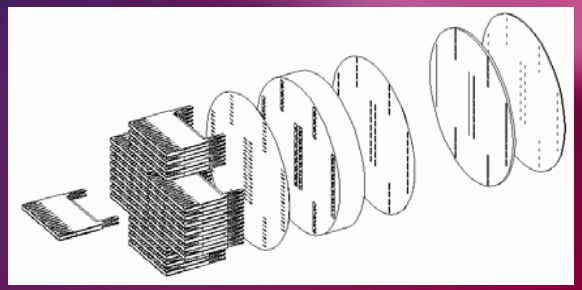
MEMS Electronically Scanned Array (ESA) Seeker

Phase Shifter



Antenna Slat



Antenna

MEMS ESA Antenna

- Ka-band (35-GHz) Active Radar Seeker
- Electronically Scanned Array with 768 antenna elements

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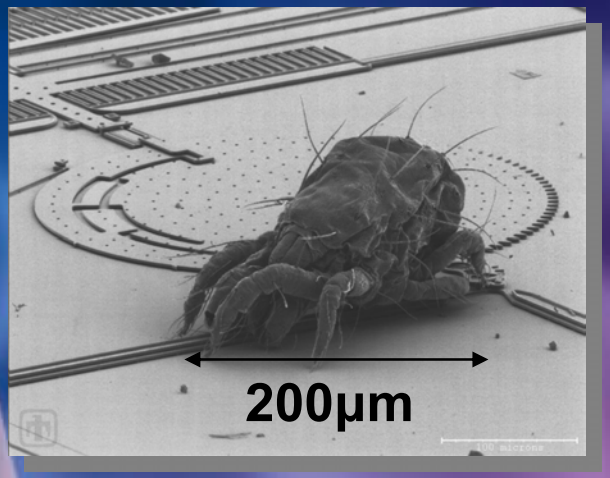
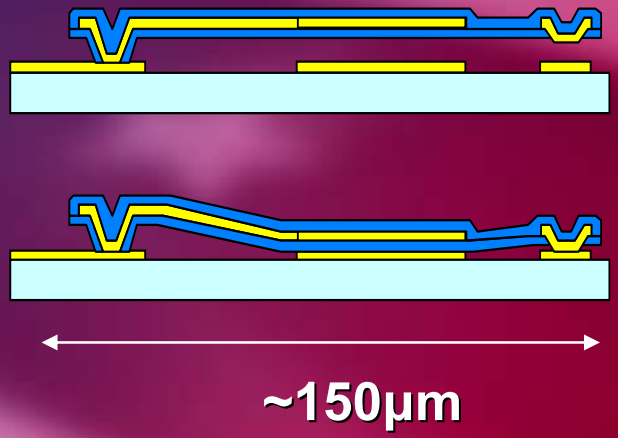
MEMS: Micro Electromechanical Systems





- Complex, tiny mechanical structures can be fabricated using IC approach
- RF switches can be used for phase shifters, reconfigurable antennas

Small, lightweight, low-loss, linear

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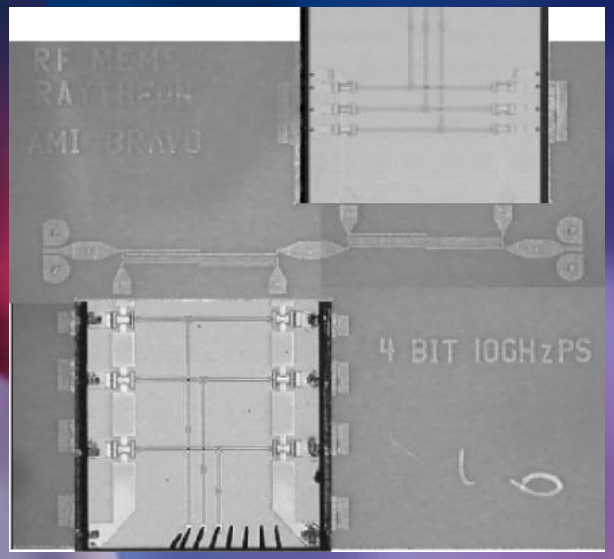
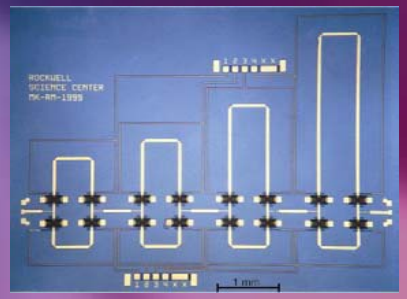
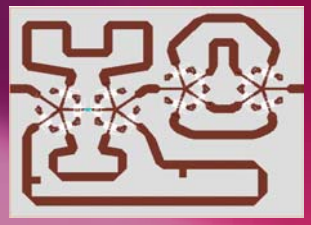
RF MEMS Improvement Program



80 mm^2

4-bit Phase Shifters





6 mm^2

- Goal: continue evolution, enhance reliability of RF MEMS while lowering loss, cost

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Reconfigurable Aperture Program (RECAP)

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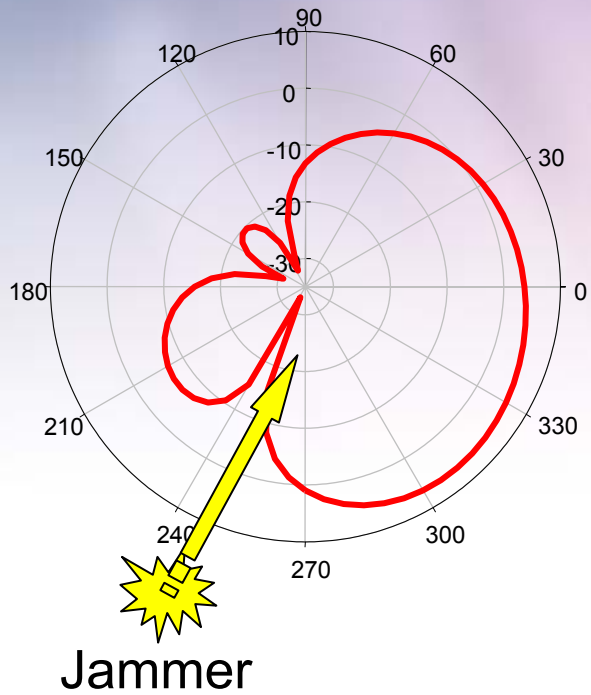
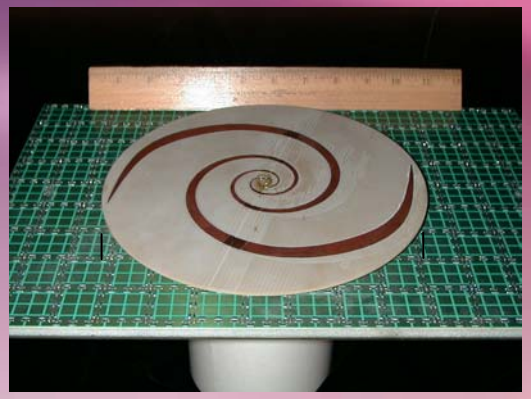
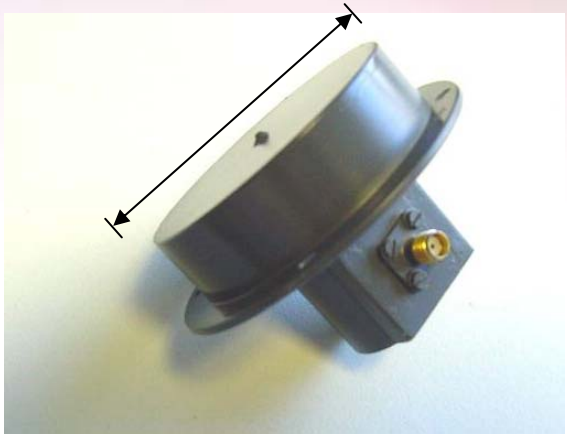
RECAP



8” Spiral on RECAP’s Varactor-Tuned AMC



8” Spiral with Conventional Groundplane



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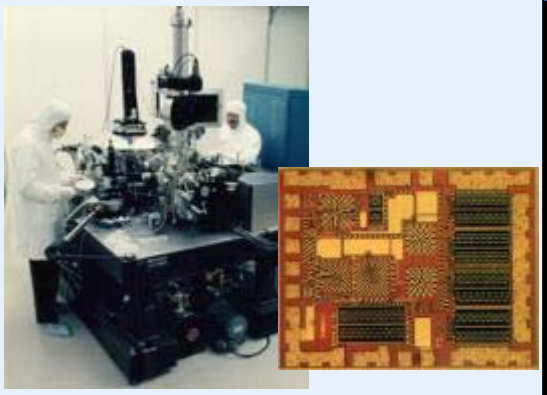
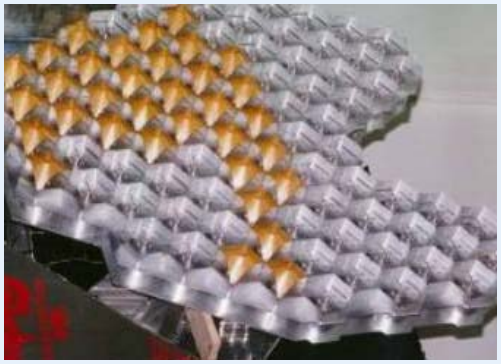
Lightfoot: Transportable,Large, Low-Power-Density Radar Antennas



RF Components Leveraged Off Commercial Technology Base

+



Large Lightweight Antenna Structures Leveraged off Space Technologies

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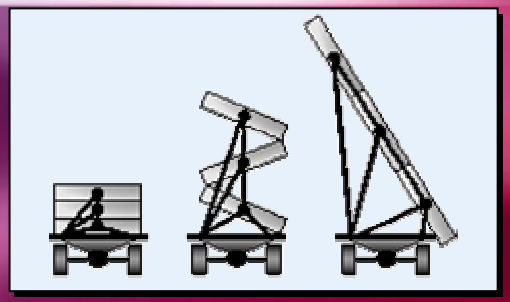
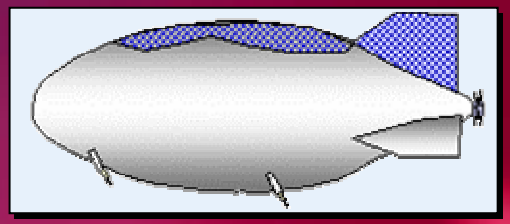


Ground-Based Platform



Airborne Platform

- **Meet the radar PA and PA^2 requirements with low power and large apertures:**
  - Decreases the amount of equipment needed to support the radar
  - Improves radar performance
  - Requires the development of antenna technologies and new radar platforms

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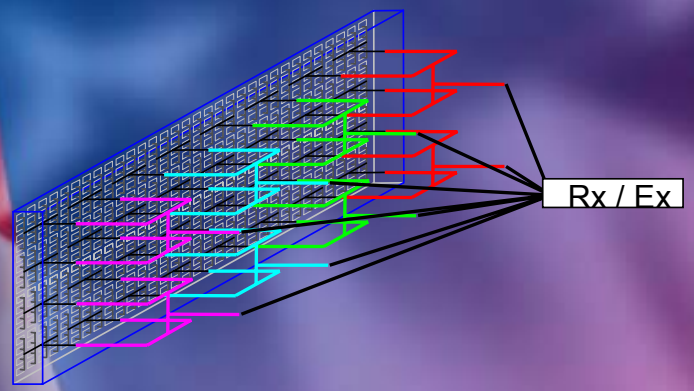
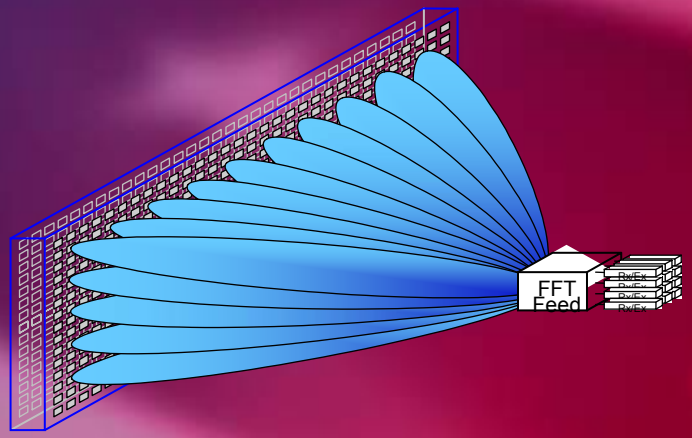
Beamforming

Conventional Technology



- Waveguides and wires feed every element
- Heavy
- Not stowable

Lightfoot Challenge



- Space feed RF and control signals
- Optical beamforming
- Digital beamforming

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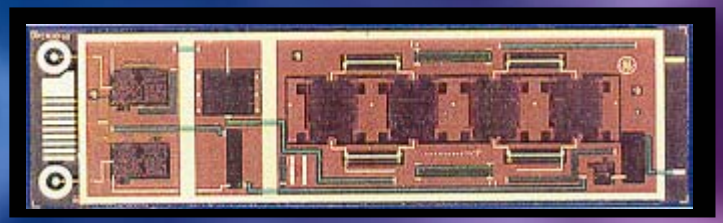
T/R Chips

Conventional Technology



- 35 W peak output
- Cost = $1,000
- Separate components

Lightfoot Challenge

- 1 W peak output
- Cost = $10-$25
- Single integrated T/R chip

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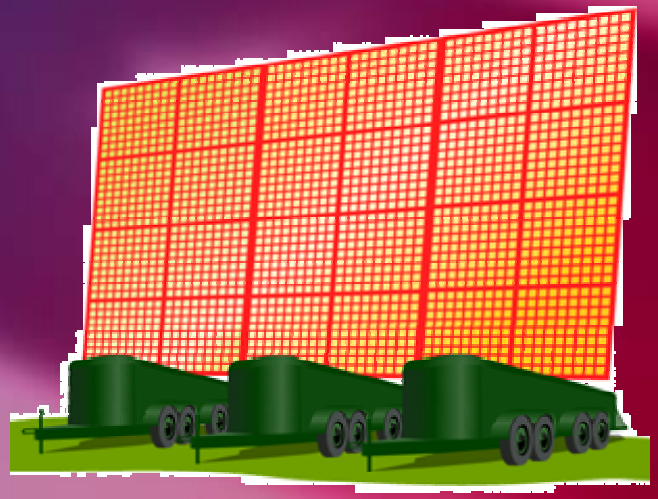
Lightweight Antenna Structures

Conventional Technology

- Ground-based: heavy, non-folding
- Space-based: good technology base for lightweight folding antennas

Lightfoot Challenge



- Lightweight, foldable for repetitive stowing and deployment

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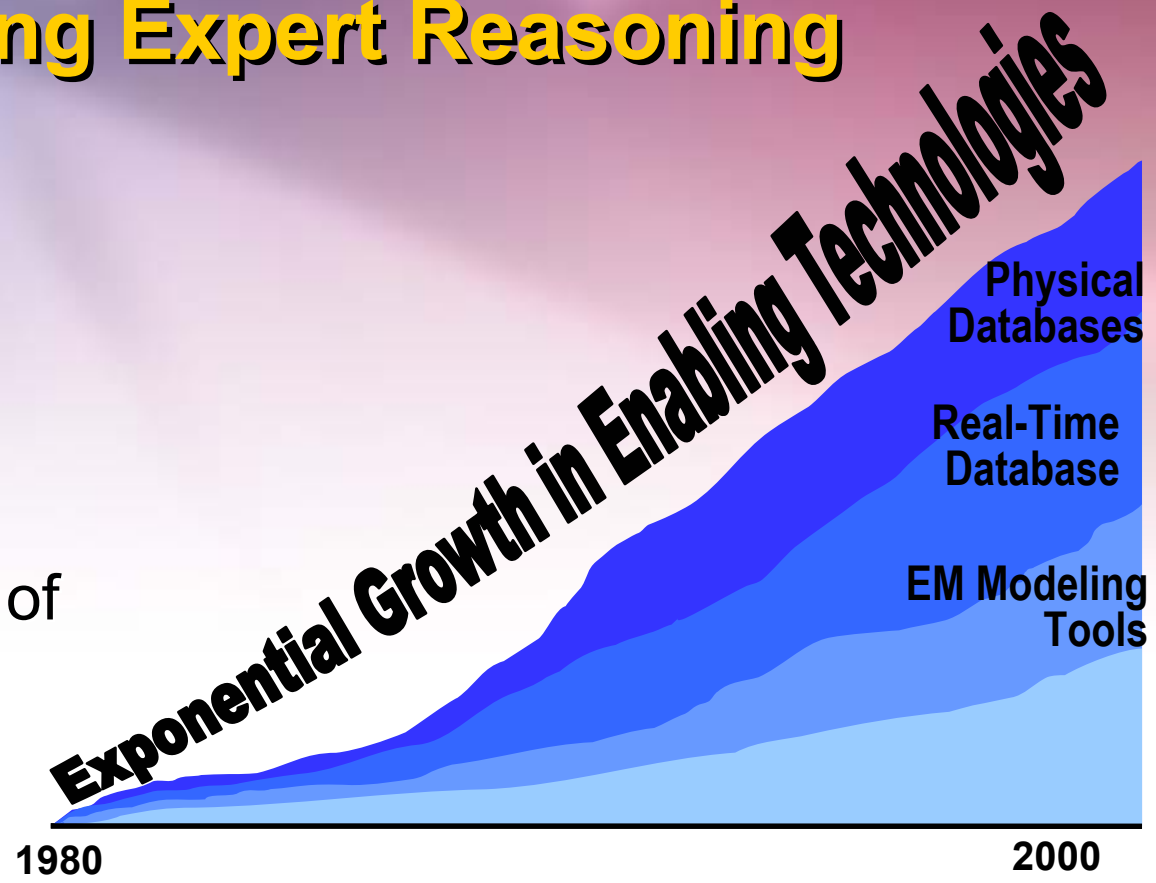
Knowledge Aided Sensor Signal Processing Expert Reasoning

Exploit our knowledge of the real world to better analyze sensor data



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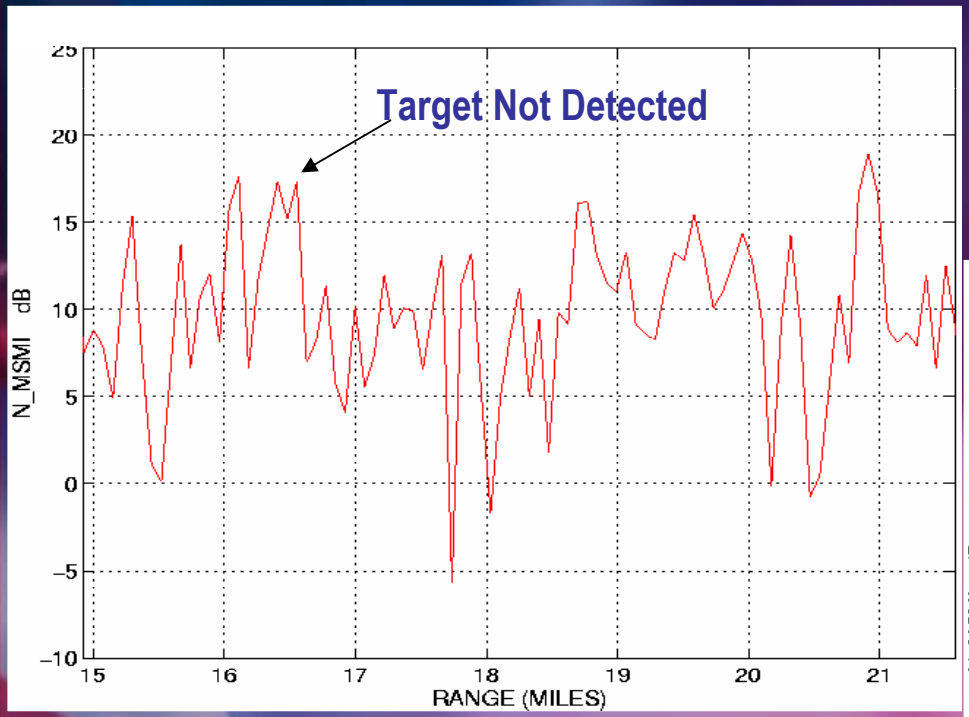
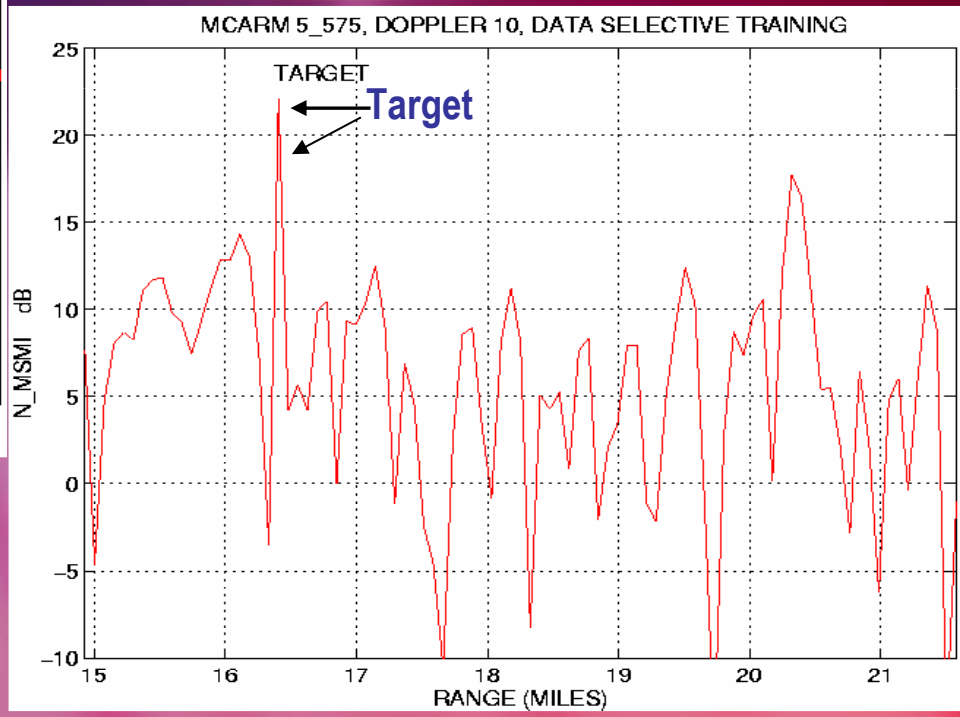
KASSPER

Providing environmental details to the processor aids in target detection





Complex environments impede the target detection of purely statistics-based processing

http://www.darpa.mil/baa/prda0107ifkpa.htm

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Advanced RF Sensors

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