



***DARPA*Tech**

2002 Symposium

Transforming
Fantasy



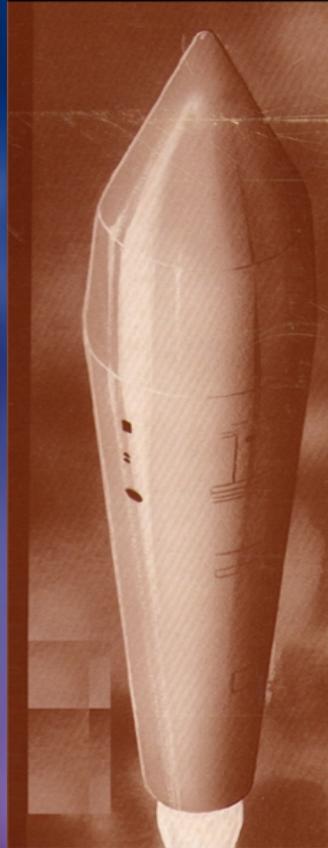
Larry E. Corey
Program Manager



Advanced RF Sensors



Cold War



High-tech
Countable

Today



Low-tech
Innumerable

Proliferated Air Threats



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

Proliferated Air Threats



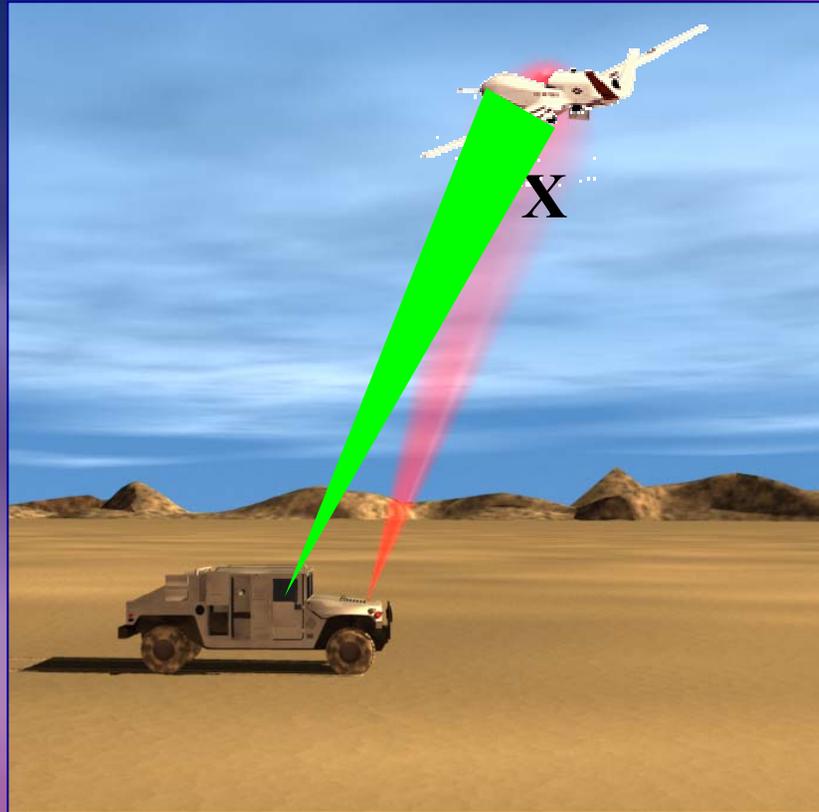
Solution: multiple inexpensive seekers

Electronic Countermeasures (ECM)



Problem: Jamming

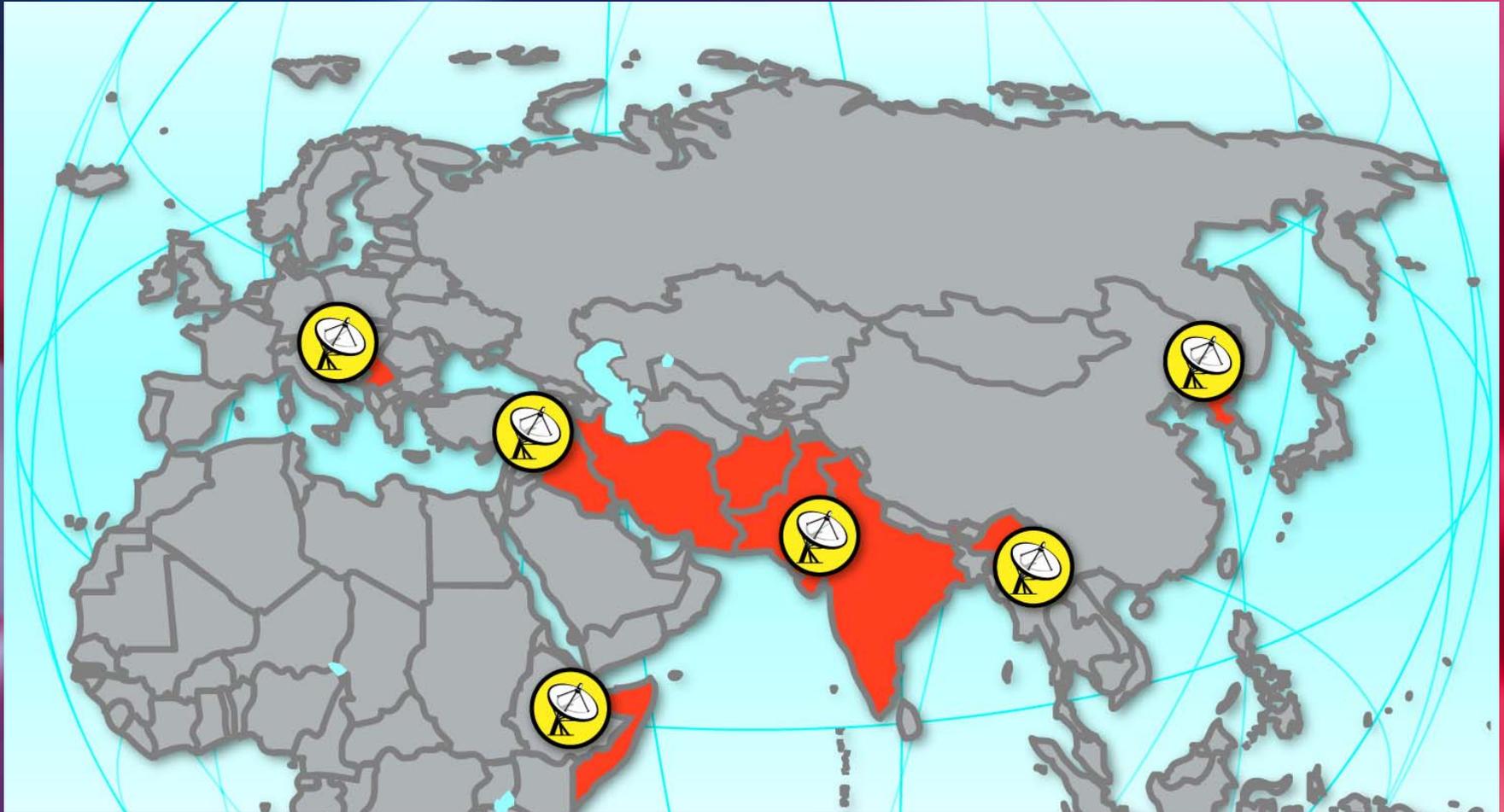
Electronic Countermeasures (ECM)



Solution: Rapid reconfiguration for new frequency



Shifting worldwide threat geography



Problem: The volatile world requires transportable sensors

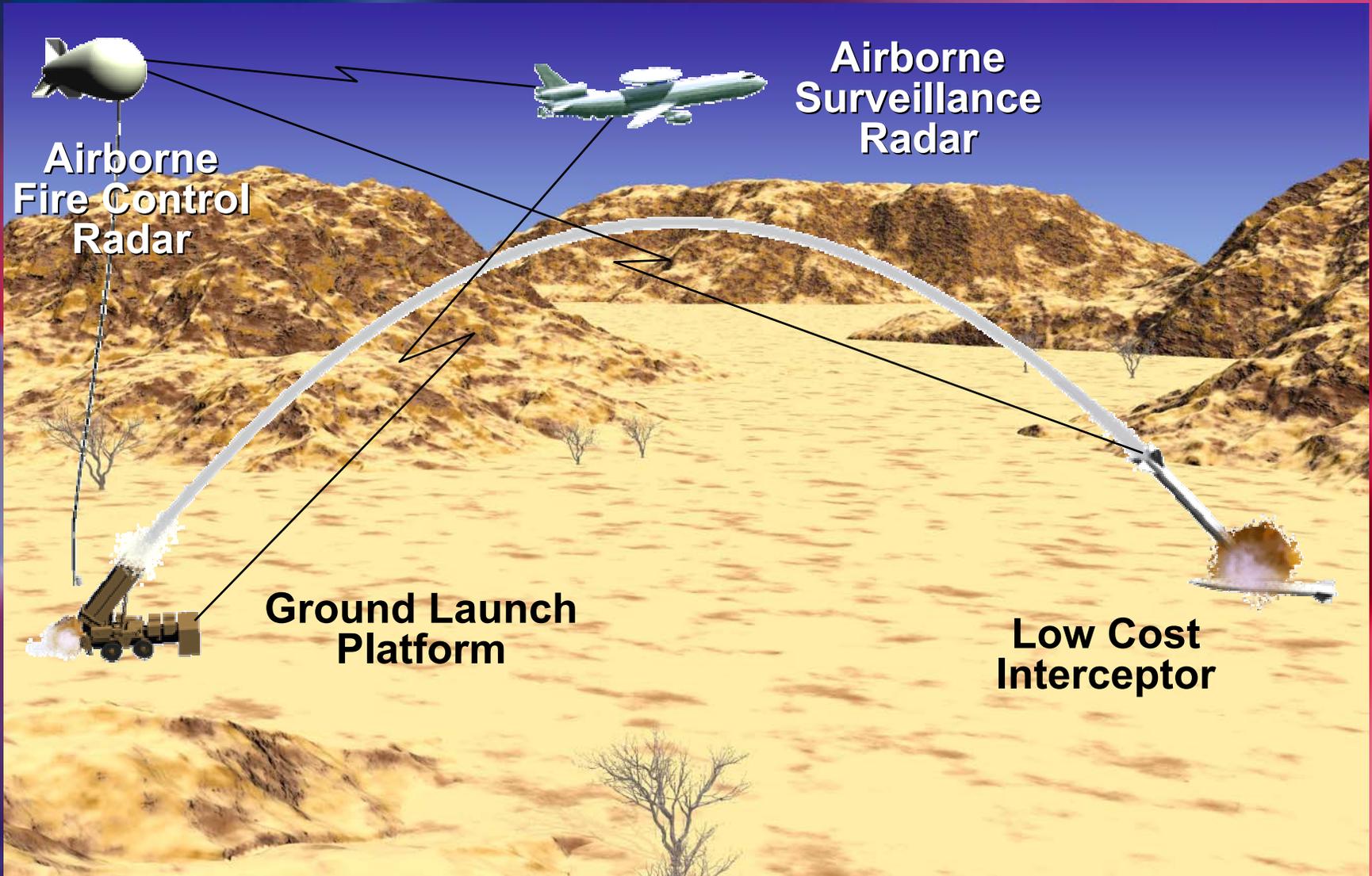


Shifting worldwide threat geography



Solution: Inexpensive, transportable radar

Low Cost Cruise Missile Defense (LCCMD)



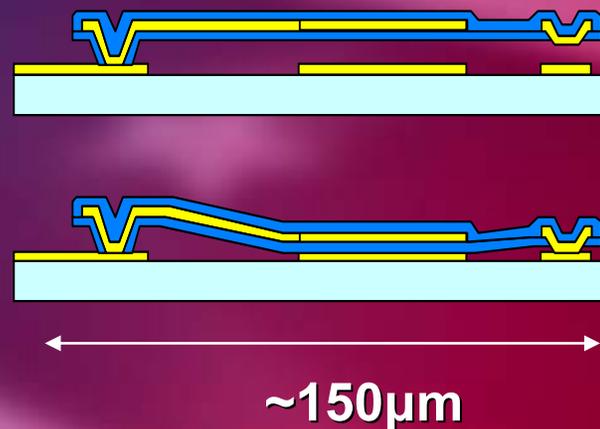
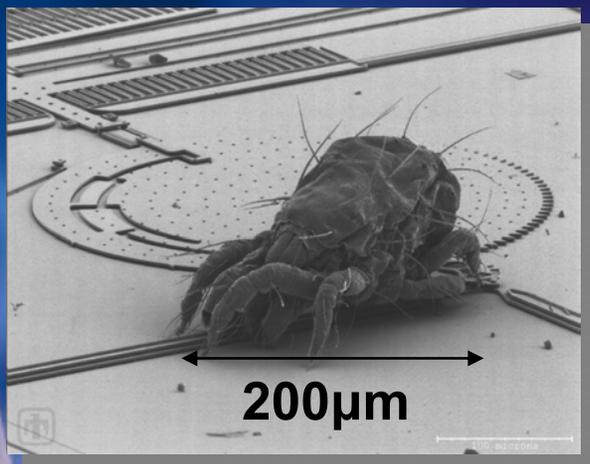
MEMS Electronically Scanned Array (ESA) Seeker



MEMS ESA Antenna

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

MEMS: Micro Electromechanical Systems

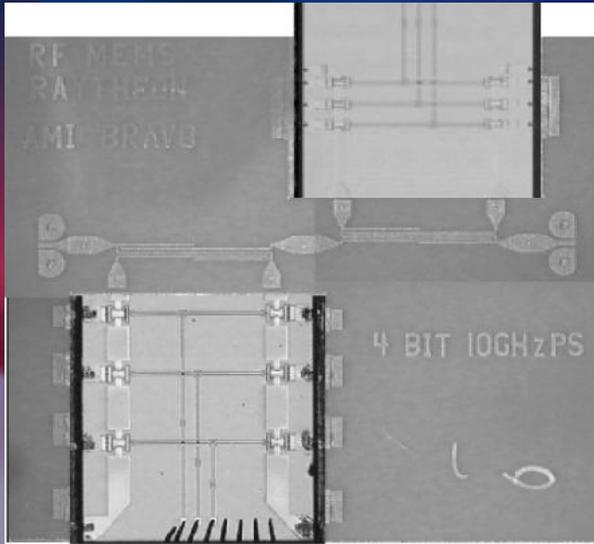


- ▶ Complex, tiny mechanical structures can be fabricated using IC approach

- ▶ RF switches can be used for phase shifters, reconfigurable antennas

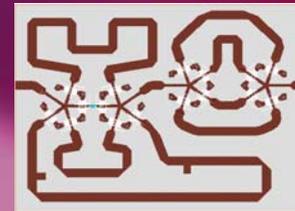
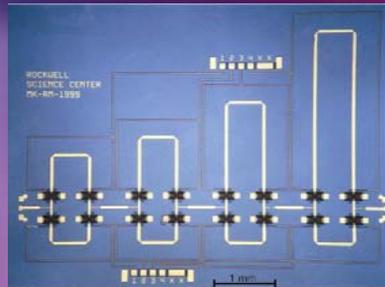
Small, lightweight, low-loss, linear

RF MEMS Improvement Program



80 mm²

4-bit Phase Shifters



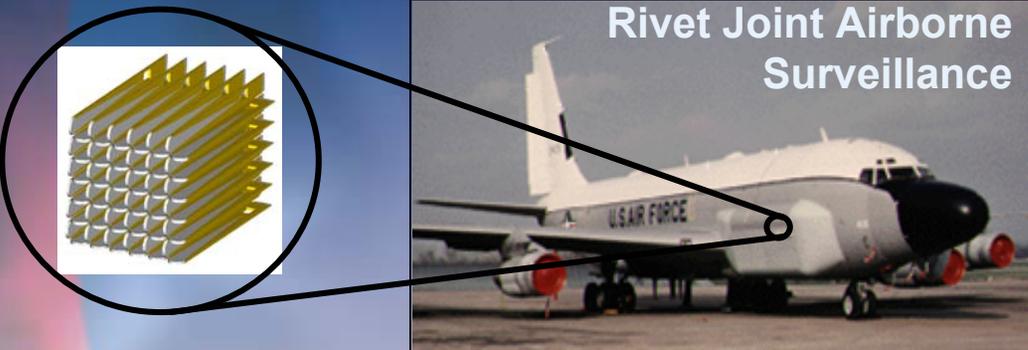
6 mm²

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

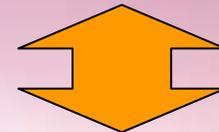
Reconfigurable Aperture Program (RECAP)



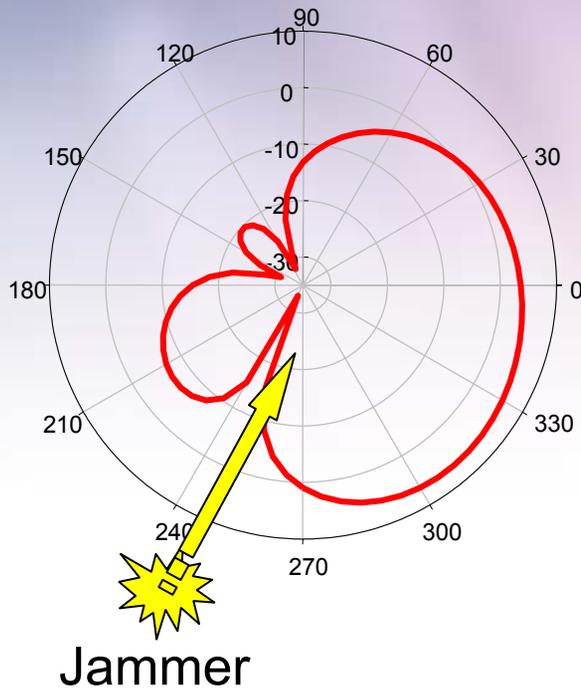
RECAP



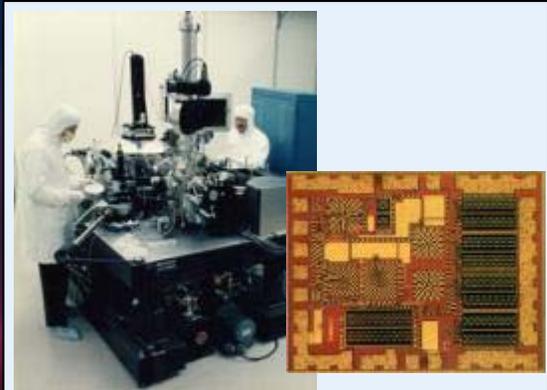
8" Spiral on RECAP's Varactor-Tuned AMC



8" Spiral with Conventional Groundplane



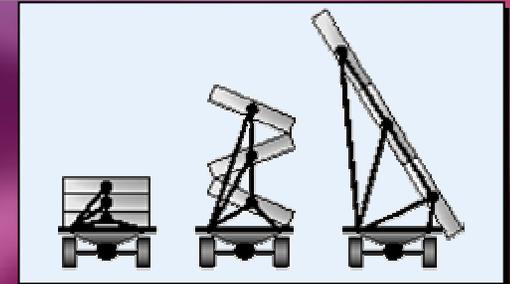
Lightfoot: Transportable, Large, Low-Power-Density Radar Antennas



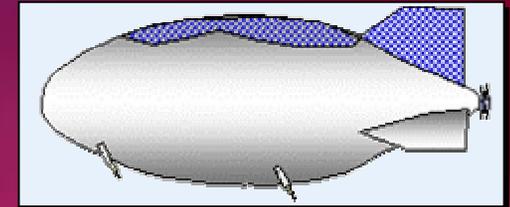
RF Components Leveraged
Off Commercial
Technology Base



Large Lightweight
Antenna Structures Leveraged
off Space Technologies



Ground-Based Platform

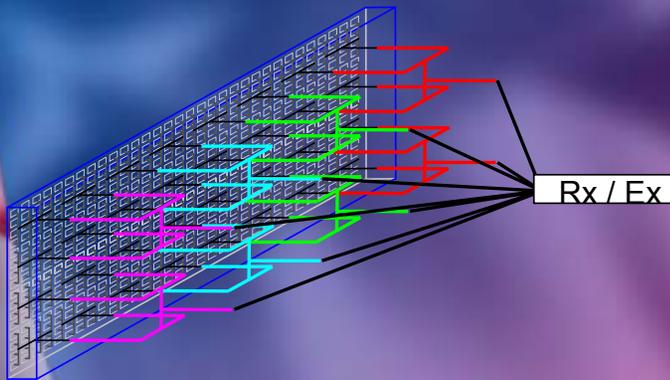


Airborne Platform

- ▶ **Meet the radar PA and PA² 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

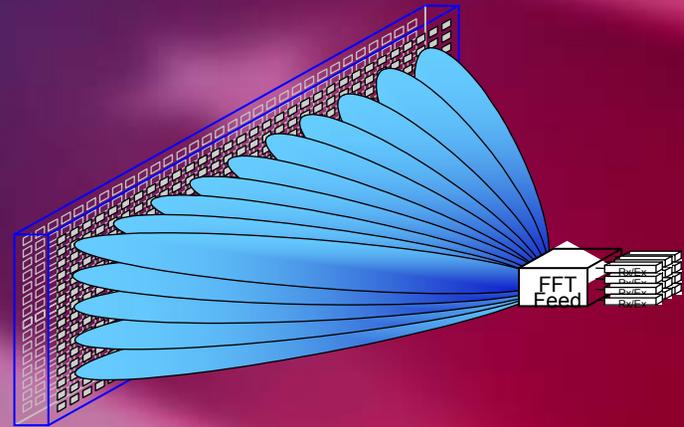
Beamforming

Conventional Technology



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

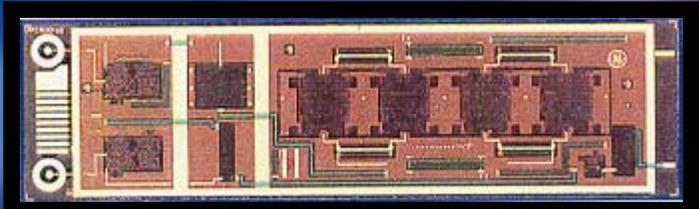
Lightfoot Challenge



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

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

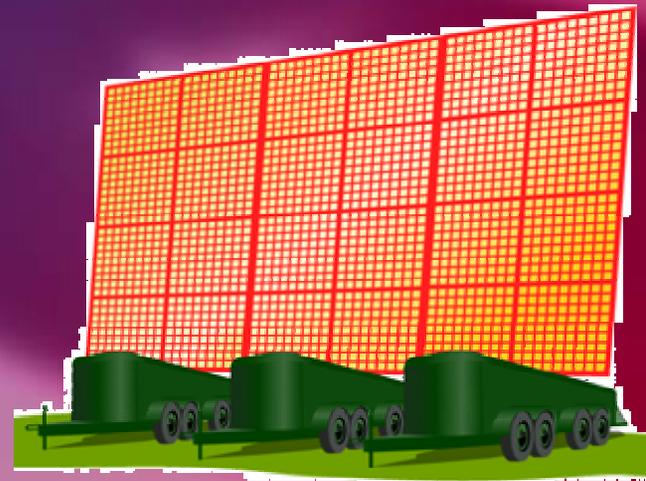
Lightweight Antenna Structures

Conventional Technology



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

Lightfoot Challenge



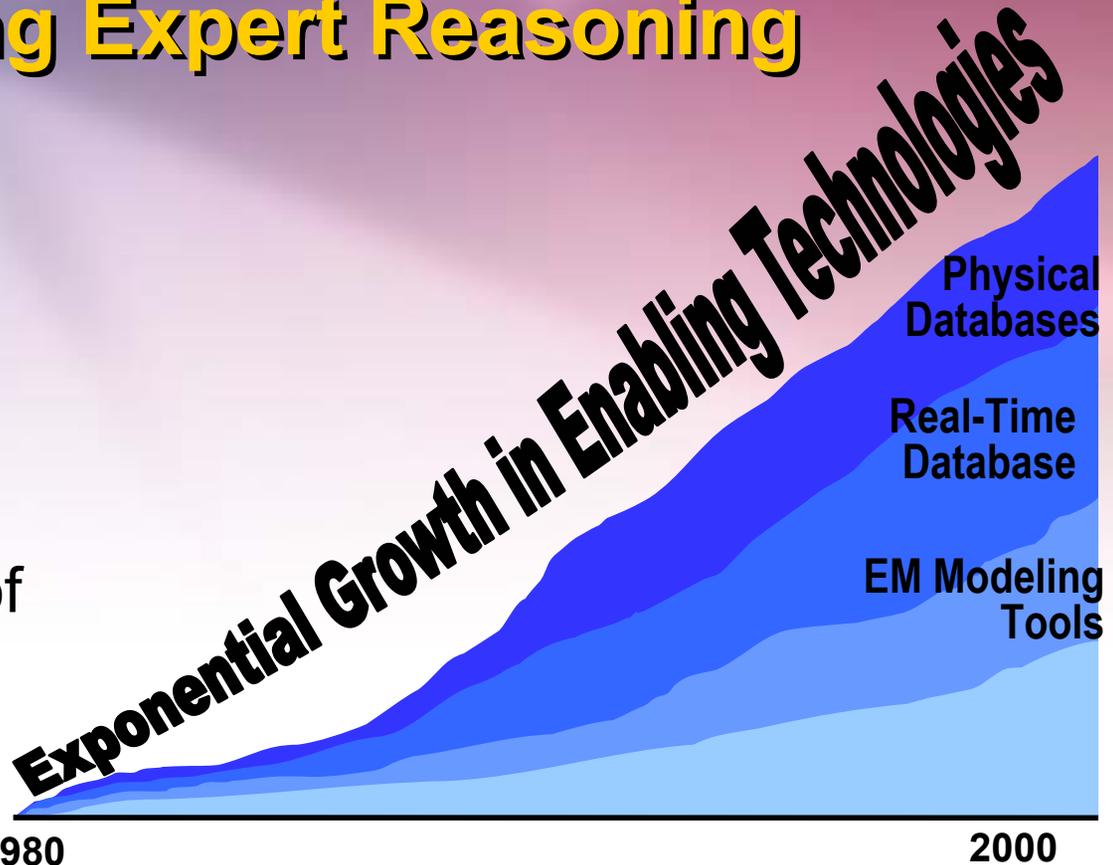
- ▶ Lightweight, foldable for repetitive stowing and deployment



Knowledge Aided Sensor Signal Processing Expert Reasoning

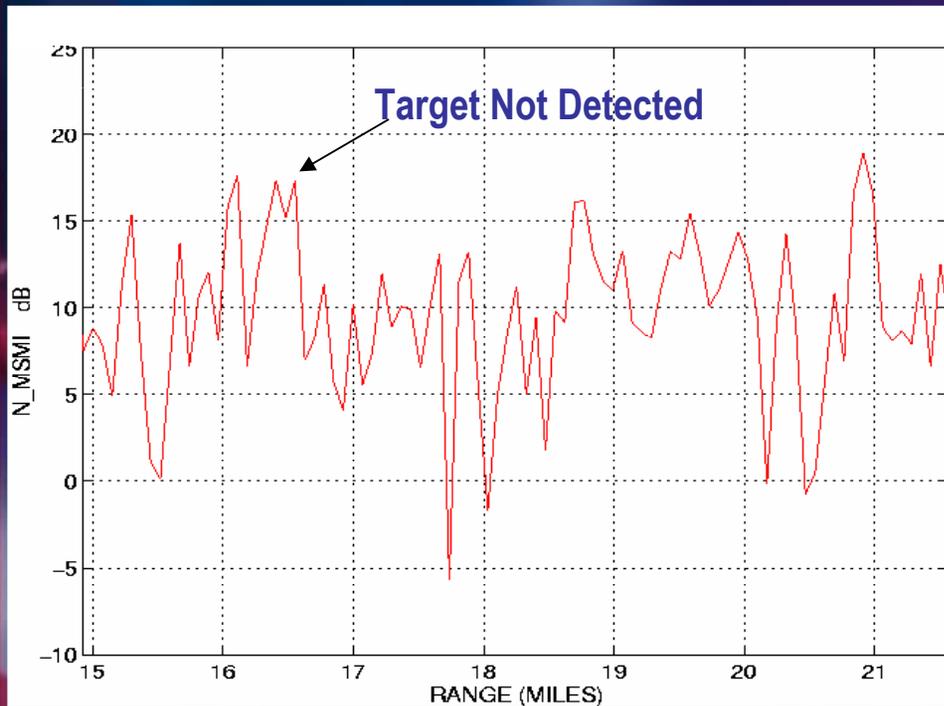


Exploit our knowledge of the real world to better analyze sensor data

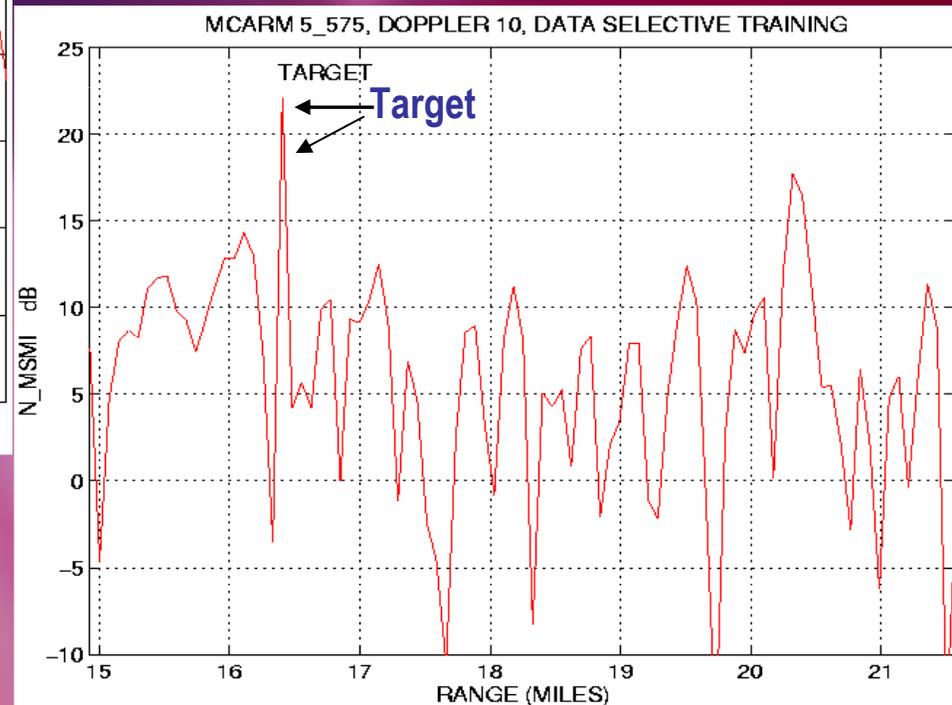


KASSPER

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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