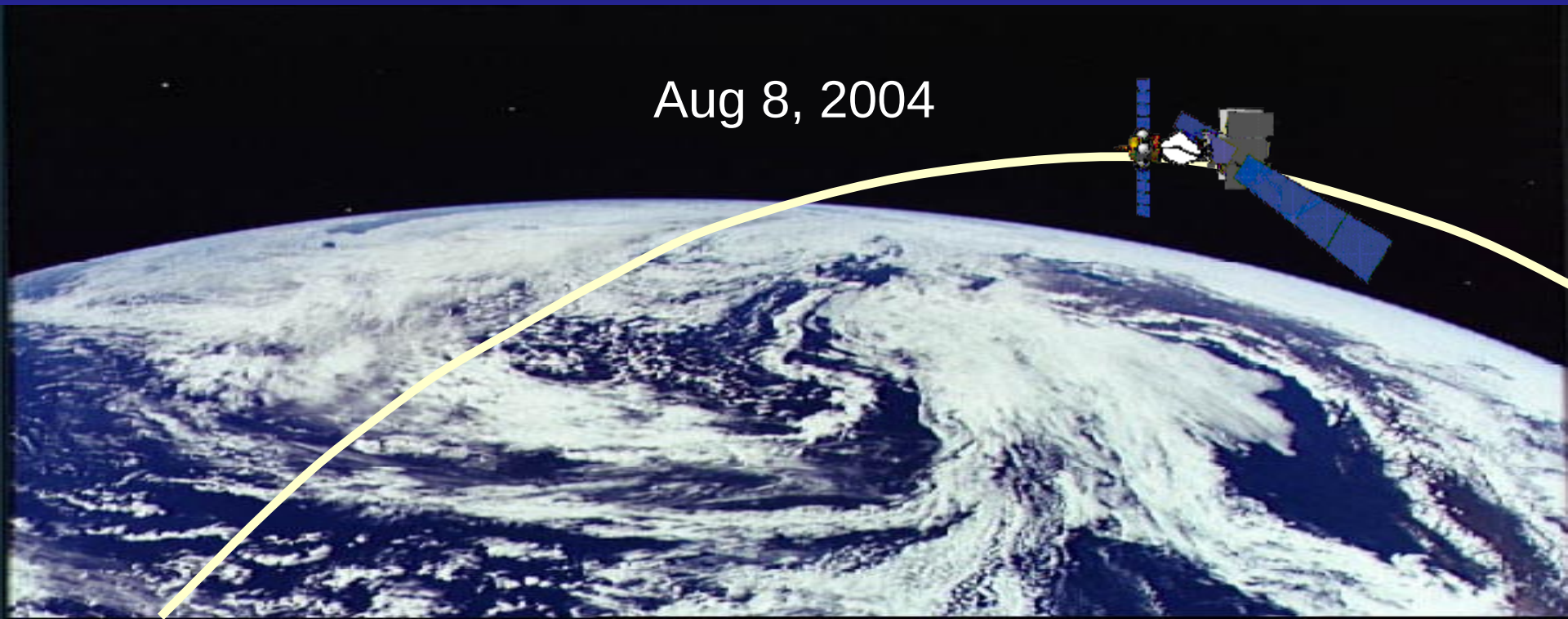
DARPA In Space

Dr. Gordon Roesler
DARPA Virtual Space Office
(571) 218-4398
groesler@darpa.mil



The DARPA Space Mandate Today

"…the Defense Advanced Research Projects Agency and the Military Departments' science and technology laboratories [shall] undertake research and demonstration of innovative space technologies and systems for dedicated military missions."

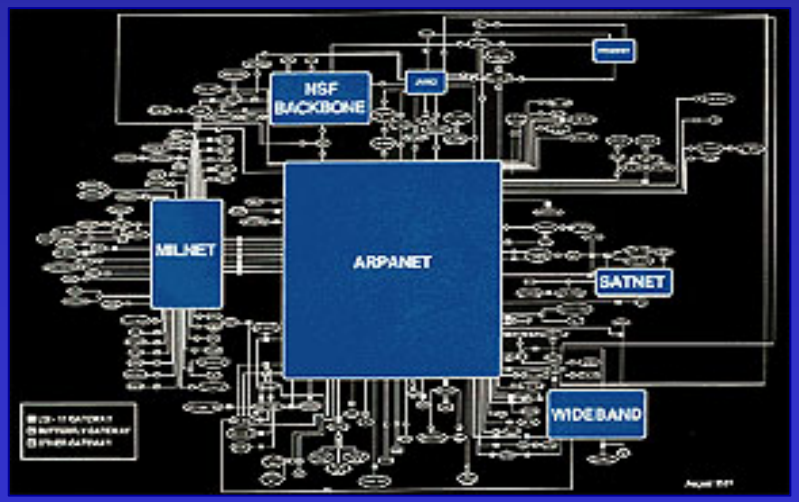
--SecDef Memorandum October 18, 2001

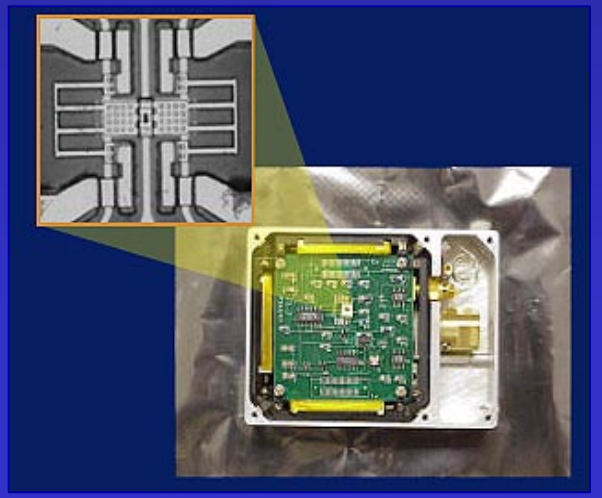
The DARPA Approach

Radical Innovations
- High Risk/High Payoff

Early Evaluation and Feedback

Go/No-Go Milestones
- Milestone Decisions Based on Performance Metrics





DoD Space Technology Goals

The Department of Defense should focus its space technology investment strategy on:

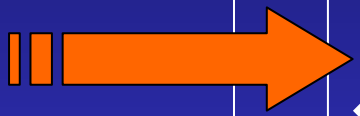
- ✓ **Reducing the cost of launch and space systems** by emphasizing miniaturization and new ways of doing business
- ✓ Developing new sensors that can **detect and track smaller, moving and concealed targets** under all environmental conditions
- ✓ Promoting **on-orbit data processing and artificial intelligence** to reduce human operator costs and the burden of high data volume on the communication infrastructure
- ✓ Developing **advanced launcher and propulsion technology** to reduce the cost of getting to and maneuvering on orbit
- ✓ Developing **on-orbit servicing** equipment that can extend space system life expectancy and make it possible to upgrade system capabilities on orbit
- ✓ Developing **advanced surveillance and defensive and offensive technologies** needed for space control and information operations
- ✓ Developing advanced command and control, guidance and pointing, power generation, materials and optics technologies needed for **power projection from space**

Source: Report of the Commission to Assess United States National Security Space Management and Organization, January 11, 2001

DARPA is working to transform space through technology

Today's Technology Breakthrough Areas

- Computing
- Materials
- Photonics
- Robotics
- Communications
- MEMS
- Nanotechnology
- Mathematics



Examples of enabled capabilities

- On-orbit assembly of large space structure
- Spacecraft repositioning, rescue, retirement or relocation
- Migration of space capabilities onto microsatellite-scale buses
- Establishment of large geosynchronous sensor bases
- Lunar materials exploitation
- Defensive space systems

We want to "upload" breakthroughs into space

DARPA Space Goals

Design payload concepts that will lead to **TOTALLY NEW SPACE CAPABILITIES** for DoD applications:

- assembly
- capable microsats
- repositioning
- servicing
- huge apertures
- others

Doing things in space that have NEVER BEEN DONE BEFORE

Why On-Orbit Assembly of Large Complex Systems?

Dexterous robotic assembly of large imaging system

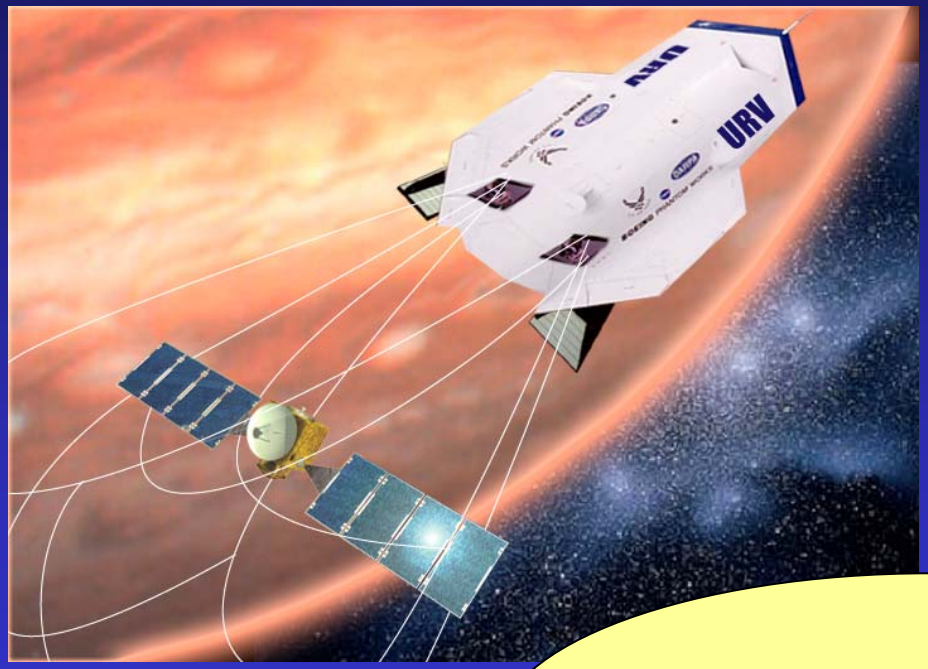
DoD Interests

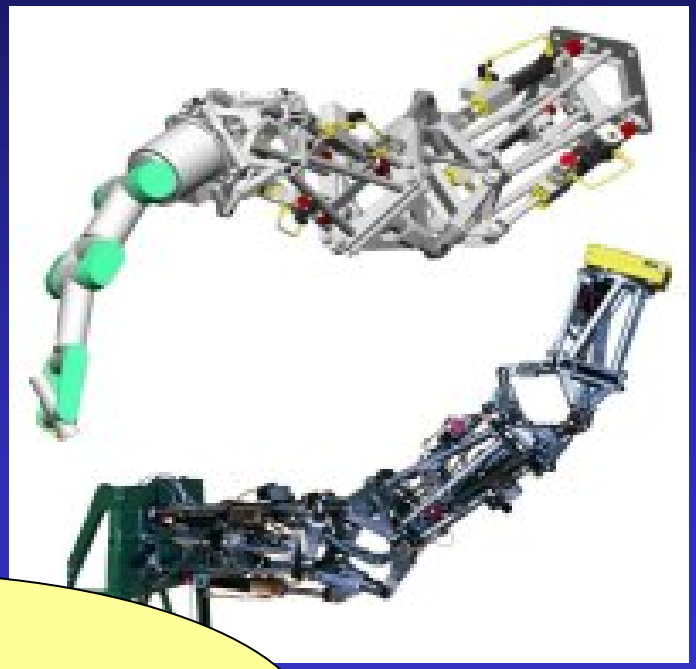
- Persistent ISR
- High Bandwidth
- Mobile users

Why Dexterous Mechanical Systems on Orbit?

DoD Interest

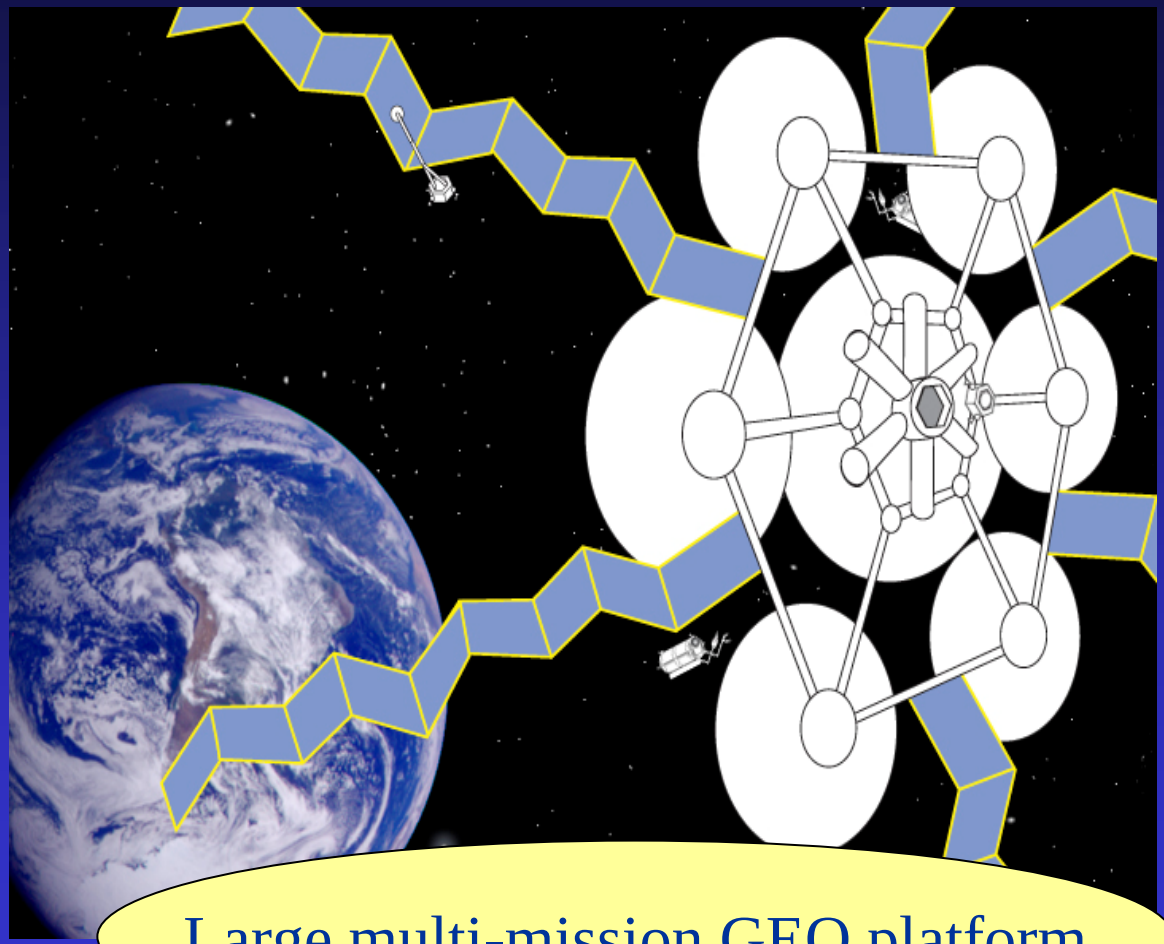
- Reducing Cost
- Extending life
- New way of doing business





Robotic repositioning of serviceable spacecraft

WHY Large Platforms in GEO?



Large multi-mission GEO platform

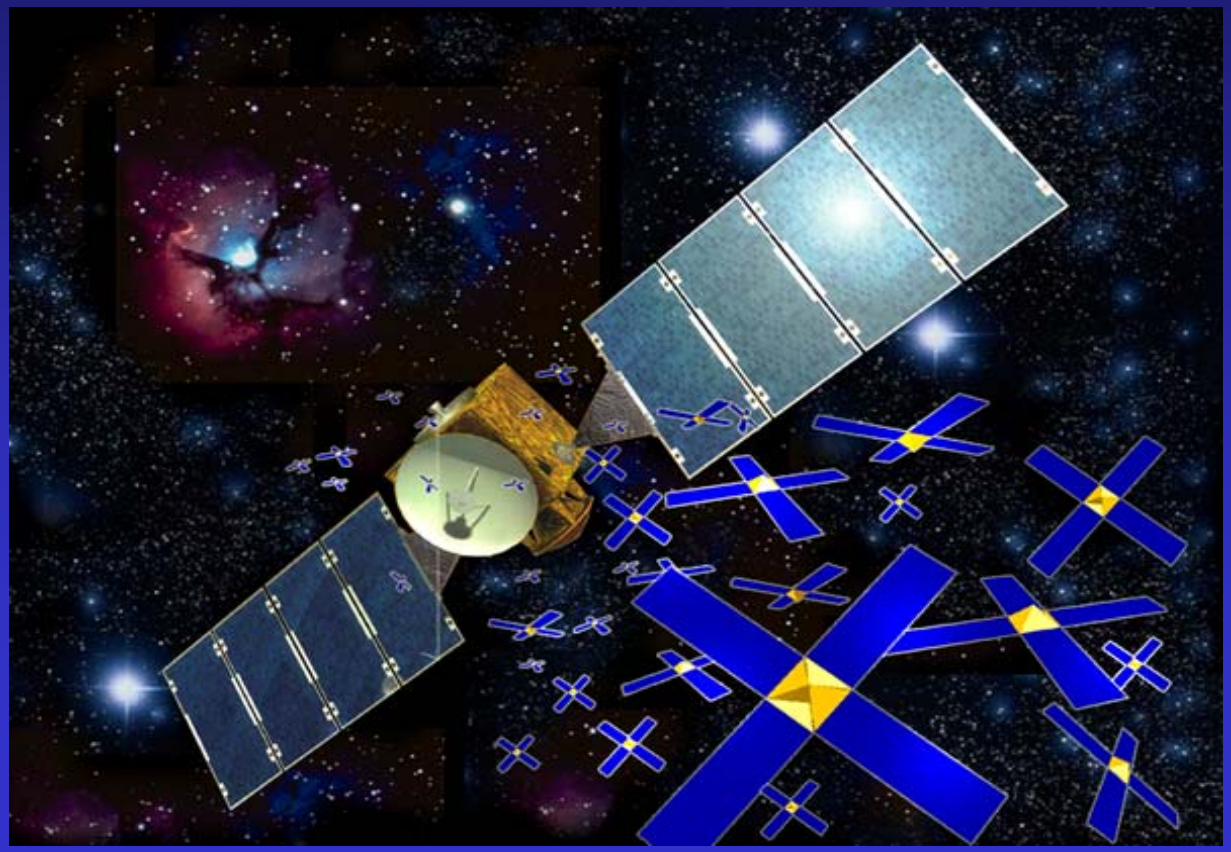
DoD Interests

- Long dwell information collection
- Very high capacity communications
- Service to mobile users

WHY New Roles for Microsatellites?

DoD Interest

- **Enhanced survivability of critical space capacities by utilization of distributed microsat capabilities**
- **Exploitation of low-cost, small payload launcher capabilities**



DARPA Nanosat SBIRs

- Self-regulating thermal radiator
- Miniature star sensor
- Standardized C&DH box
- Steerable Ka-band array
- Attitude sensor suite
- Solar cell/ultracapacitor
- Modular S-Band Radio
- C&DH subsystem module
- Miniature reaction wheels
- H_2O_2/hydrocarbon propulsion
- DC/DC Converter module
- Autonomous Field Emission Cathodes for Electrically Propelled Nanosats
- Self deployment mechanism

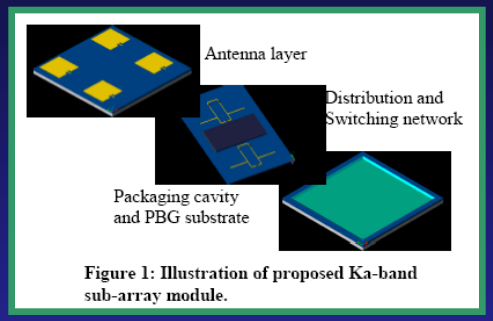


Figure 1: Illustration of proposed Ka-band sub-array module.

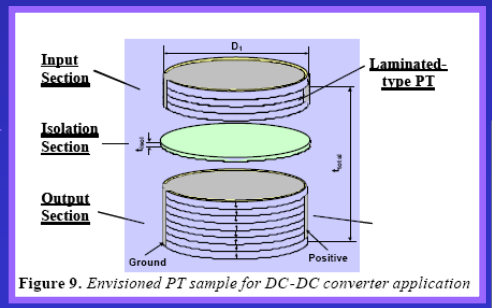


Figure 9. *Envisioned PT sample for DC-DC converter application*

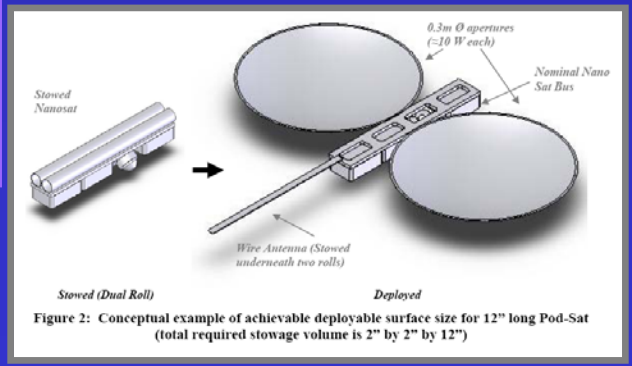


Figure 2: Conceptual example of achievable deployable surface size for 12" long Pod-Sat (total required stowage volume is 2" by 2" by 12")

Spacecraft for Universal Modification of Orbits (SUMO)

Smallsats—Critical Assets

- Engage students
  - Workforce demographics looming
- Space qualification
  - Help reduce access costs
- New missions
  - Responsive capabilities