



# Space COI Annual Update: 2018 Strategic Overview

**Dr. Jaime A. Stearns  
Dr. Thomas W. Cooley  
Space Vehicles Directorate  
Air Force Research Laboratory**



# Space COI Annual Update - Overview



## COI Description

–The goal of the Space COI is to 1) Facilitate collaboration and leveraging of complementary investments of the space S&T efforts across the community in support of the intent of the nation's Space interests; and 2.) Identify gaps, establish and maintain a set of S&T roadmaps to guide Space Community research program investments, perform portfolio assessments, and provide future resource recommendations to leadership

## COI Purpose

–The Space S&T COI is a forum for sharing new ideas, technical directions and technology opportunities, jointly planning programs, measuring technical progress, and exchanging advances in space S&T

## Portfolio Focus

–DoD S&T investments in space-unique technologies that are essential to maintain and advance existing U.S. conventional and asymmetric military advantages enabled by space systems at the strategic, operational, and tactical levels

Technology Sub-Area 1

### **Satellite Communications**

Technology Sub-Area 2

### **Missile Warning, Missile Defense, Kill Assessment and Attack Assessment**

Technology Sub-Area 3

### **Positioning, Navigation and Timing**

Technology Sub-Area 4

### **Intelligence, Surveillance and Reconnaissance**

Technology Sub-Area 5

### **Space Control and Space Situational Awareness**

Technology Sub-Area 6

### **Space Access**

Technology Sub-Area 7

### **Space and Terrestrial Environmental Monitoring**

Technology Sub-Area 8

### **Command and Control; and Satellite Operations**

Technology Sub-Area 9

### **Space Enablers**

Technology Sub-Area 10

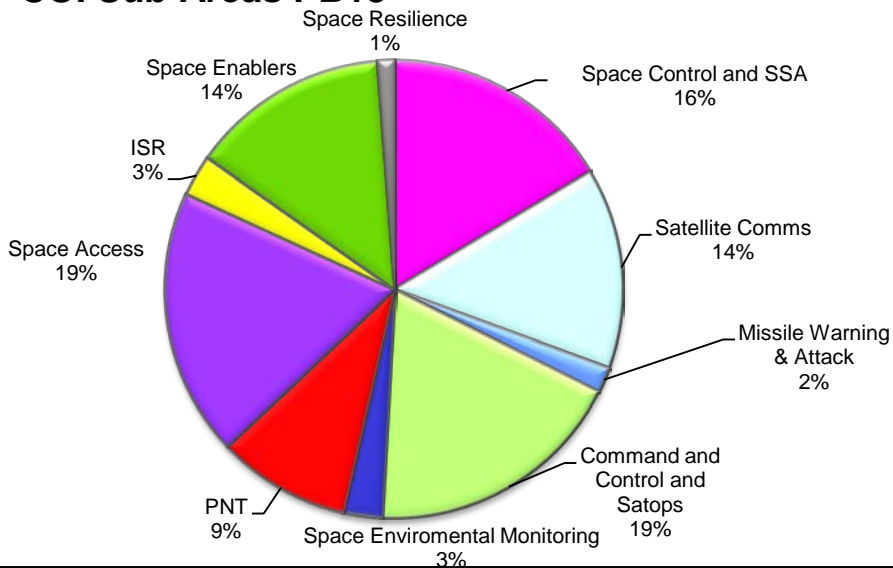
### **Space Resilience**



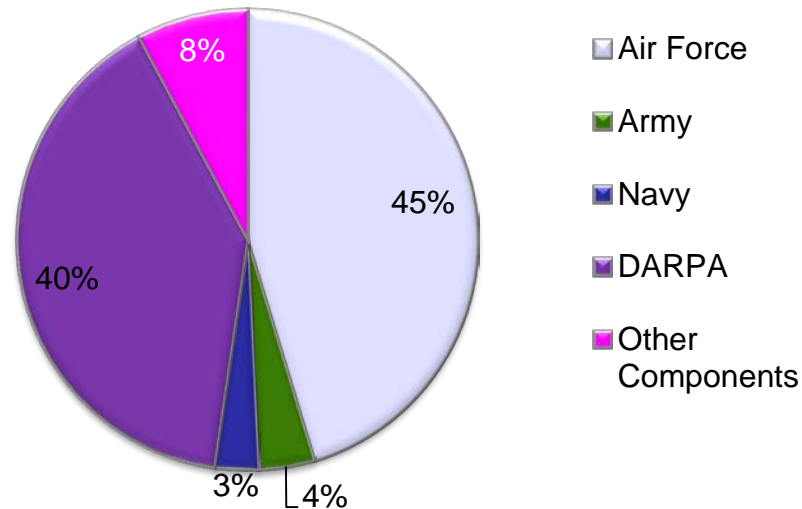
# Space S&T COI Investment and Performers



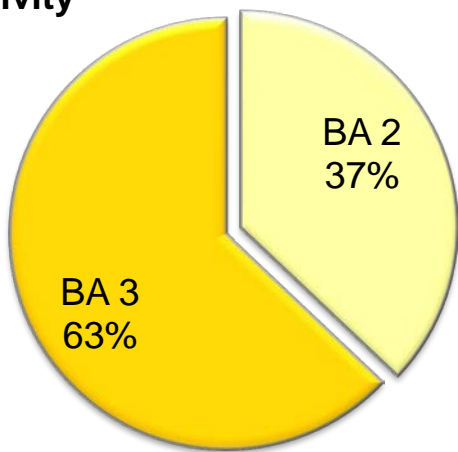
## COI Sub-Areas PB18



## Component Investment



## Budget Activity



## Intramural vs. Extramural split:

- Army - 6.2 47/53; 6.3 38/62
- Navy - 6.2 60/40; 6.3 40/60
- Air Force - 6.2 48/52; 6.3 20/80

## Major Performers:

- Aerojet-Rocketdyne, APL, BAE Systems, Ball Aerospace, Boeing, Dynetics, Honeywell, Lockheed Martin, MIT-LL, Northrop Grumman, NRL, Orbital/ATK, Raytheon, Sandia National Laboratory, Teledyne Brown



# 1) Overview of Space COI Portfolio Changes



- **Membership**

- New Space S&T COI Chair – Thomas Cooley, AFRL
- Representatives from Air Force (AFRL), Army (SMDC), Navy (ONR and NRL), MDA, NRO, and DARPA

- **Investment Influences**

- AFSPC Space Enterprise Vision (SEV) adjusting acquisition focus toward resilience and technologies that support resilience
- Increases in space budget have not reached Space S&T Community
- NSDC (National Space Defence Center) causing new strain on S&T budget to meet STRATCOM Joint Urgent Emerging Need (JEON). Focus BMC2.
- Growing demands spur creative collaboration but increase program risk

- **Roadmaps Stable**

- “New Space” commercial enterprises providing new opportunities



## 2) Space COI Activity In-Year



- **Major Accomplishments and Areas of Cross-Service Collaboration**

- Awarded ARAP for Defense Optical Channel Program (DOC-P)
  - The \$45 million award will fund a three-year project titled, "Joint Service Laboratories Capabilities in Quantum Sciences and Engineering," which necessitates cross-coordination between the ARL, NRL and AFRL

- **External Engagements**

- Conducted Space IR&D Technology Interchange Meetings (Dec 2017)
  - COI technology representatives from the Air Force, Army, and Navy
  - 14 industry partners presenting 76 technology topics related to Space COI

- **Planned Activity**

- Continue Cross-Service collaboration to updated and refine specific Space COI Technology Roadmaps (Space COI Meeting Feb. 20-23, 2018)
- Support the OSD Space COI Review by EXCOM (May 2018)



# COI Success:



## Defense Optical Channel Program (DOC-P)

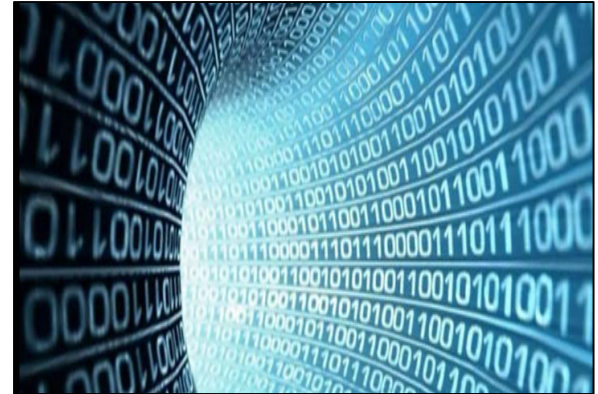
- In Apr 2017, the ASD/R&E ARAP program awarded a three-year, \$45M grant to the DOC-P proposal
  - DOC-P was submitted through the Space S&T Col, including AFRL Space Vehicles, NRL, SPAWAR, SMDC, and ARL
- Goal: Establish a DoD leadership cadre that applies advances in lasercom and optical channel technology, addressing challenges in militarily relevant environments
- DOC-P will incorporate civil, academic, commercial & international entities
- Effort focuses on three tasks addressing specific defense needs:
  - 1) Laser Comm with Channel Adaptive Techniques: Assured comm with anti-jamming and LPI / LPD capabilities
  - 2) Optical Time Transfer: Free-space optical spread-spectrum comm and time transfer with miniaturized frequency combs, producing 100,000-fold increased precision over GPS
  - 3) Quantum Comm: Demo of prototype integrated classical/quantum free-space channel in daylight, with compact space-based, airborne, and ground terminals



# Scientific Successes

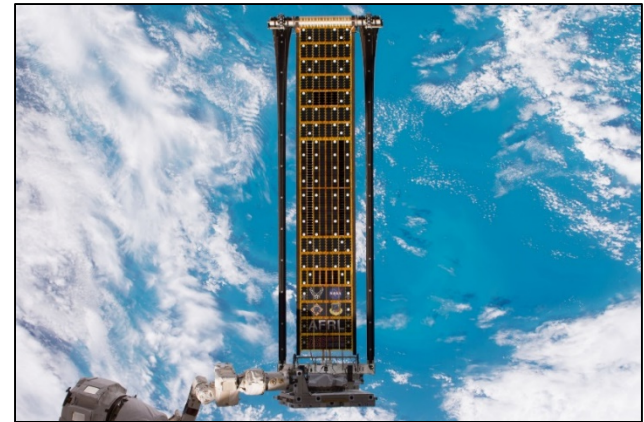
## Fallen Angel

- Space system cybersecurity experiment conducted across the ANGELS system architecture at its end-of-life
- Evaluated the efficacy of experimental defensive cyber operations tools and techniques



## Roll-Out Solar Array (ROSA)

- ROSA flight experiment on the International Space Station (ISS) achieved 100% of its science objectives
- ROSA is a tensioned blanket solar array that unfurls using two high strain composite booms, a revolutionary low-cost approach to space deployable mechanisms that was invented in-house at AFRL.
- ROSA reduces solar array mass by 20%, volume by 400%





# Major Milestones

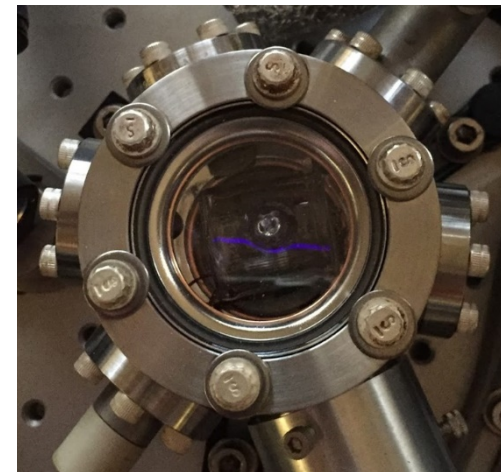
## Compact Environmental Anomaly Sensor

- Energetic Charged Particle sensor for rapid environmental anomaly attribution
- Manifested on first operational system (Weather System Follow-on – Microwave, 2022)
- Sensor design will transition to industry to meet SecAF-mandated placement of environmental sensors on every spacecraft



## Advances in Propulsion Systems

- Successfully completed the full-scale fuel kick pump test campaign as part of the Hydrocarbon Boost Technology Demonstrator (HBTD) program
- Provides key insights for future engines that use the oxygen-rich staged combustion (ORSC) engine cycle.



## Next Generation Atomic Clock Development

- Secured funding and slot on GPS III Space Vehicle 10 for two versions of advanced atomic frequency standard

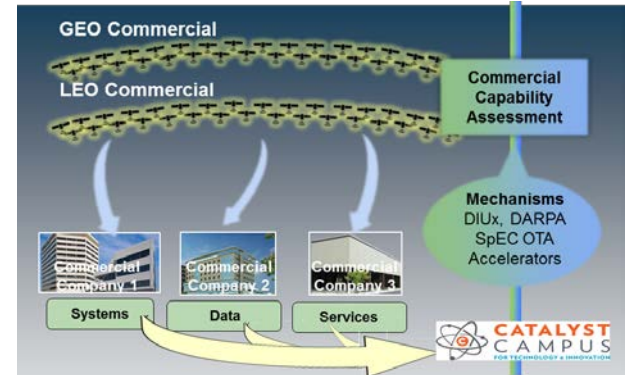




# New Partnerships

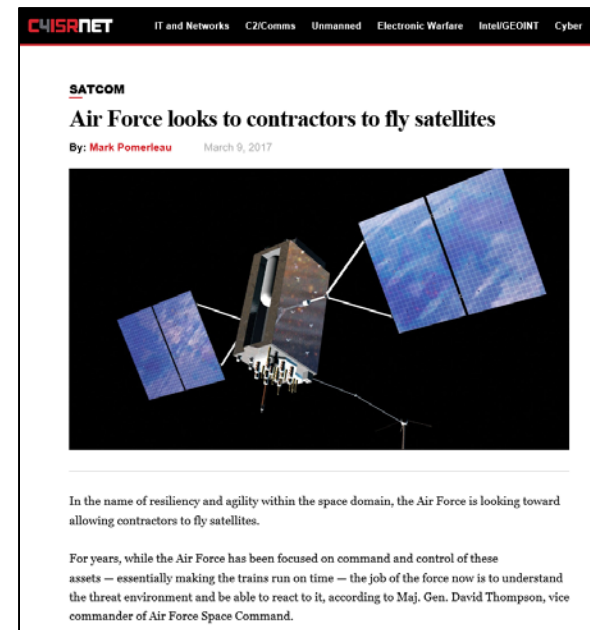
## Demonstrating New Business Models

- Space Accelerator adapts speed of venture capital to military acquisition of SSA and Weather capability
- Kicked off Commercial Augmentation of Mission Operations, bringing commercial Space Situational Awareness to DoD missions



## Commercial Tasking of AF Satellites

- Successfully demo'd the use of commercial ground antennas to augment the Air Force Satellite Control Network (AFSCN)
- Contractor interface allowed AFSCN users to connect to commercial antennas without having to modify existing AFSCN control systems
- Significant R&D towards resilient space communication





# 3) Opportunities for Industry



- **Budget constraints drive teaming**
  - Critical need for partnerships to meet current challenges in space
  - Providing industry and academic innovation to Space Warfighting Construct
- **Commercial and International investments are accelerating**
  - New models for timely agile engagement with commercial and international partners underway with OTA, DIUX, and multi-lateral partnerships



# DISCUSSION