United States SPACE FORCE
University Partnership Program

Information Webinar

Dec 14, 2021

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Agenda

- Opening Remarks – Dr. Joel Mozer
- S&T Needs
- Program Components
- Program Objectives
- Near-term Planned UPP Activities
- Q&A (via Chat)

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SPACE FORCE MISSION AND S&T NEEDS

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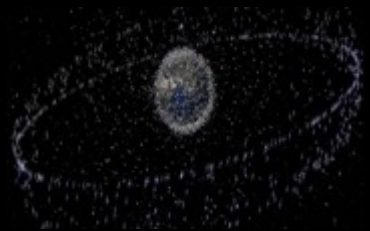
MISSIONS & DISCIPLINES

The U.S. Space Force must ORGANIZE, TRAIN and EQUIP forces for three assigned missions:

- **Protect the interests of the United States in space**
- **Deter aggression *IN*, *FROM*, and *TO* space**
- **Conduct Space Operations**

Space Electromagnetic Warfare



Orbital Warfare

Space Battle Management

Space Access & Sustainment

Military Intelligence

Cyber Operations

Engineering & Acquisitions

The Rise of Great Power Competition

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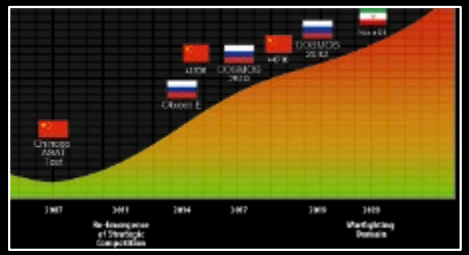
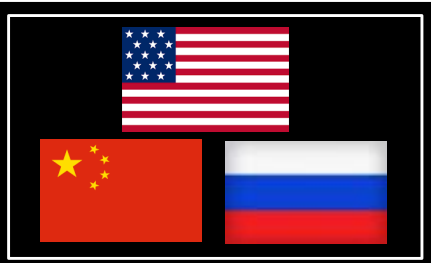
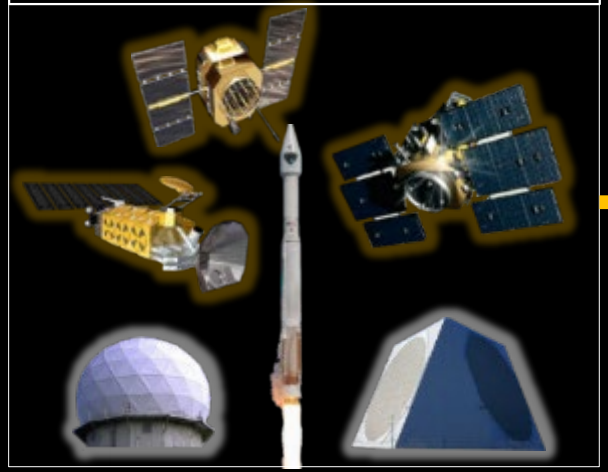
GREAT POWER COMPETITION





SPACE CAPABILITY



NATIONAL POWER

- Military
- Informational
- Diplomatic
- Financial
- Intelligence
- Economic
- Law
- Development

Space Power is Foundational to All Facets of American National Power

Space Environment Over Time

Build Up Of Domain Congestion

Golden Age of Space!

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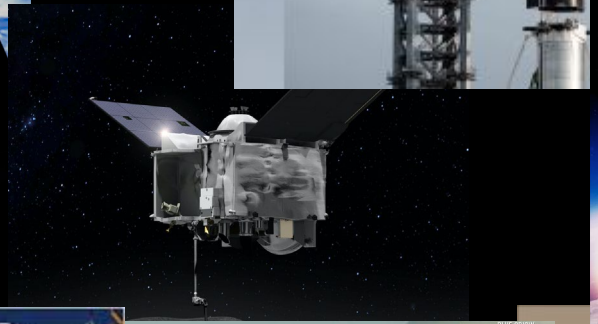

Future Space Capabilities

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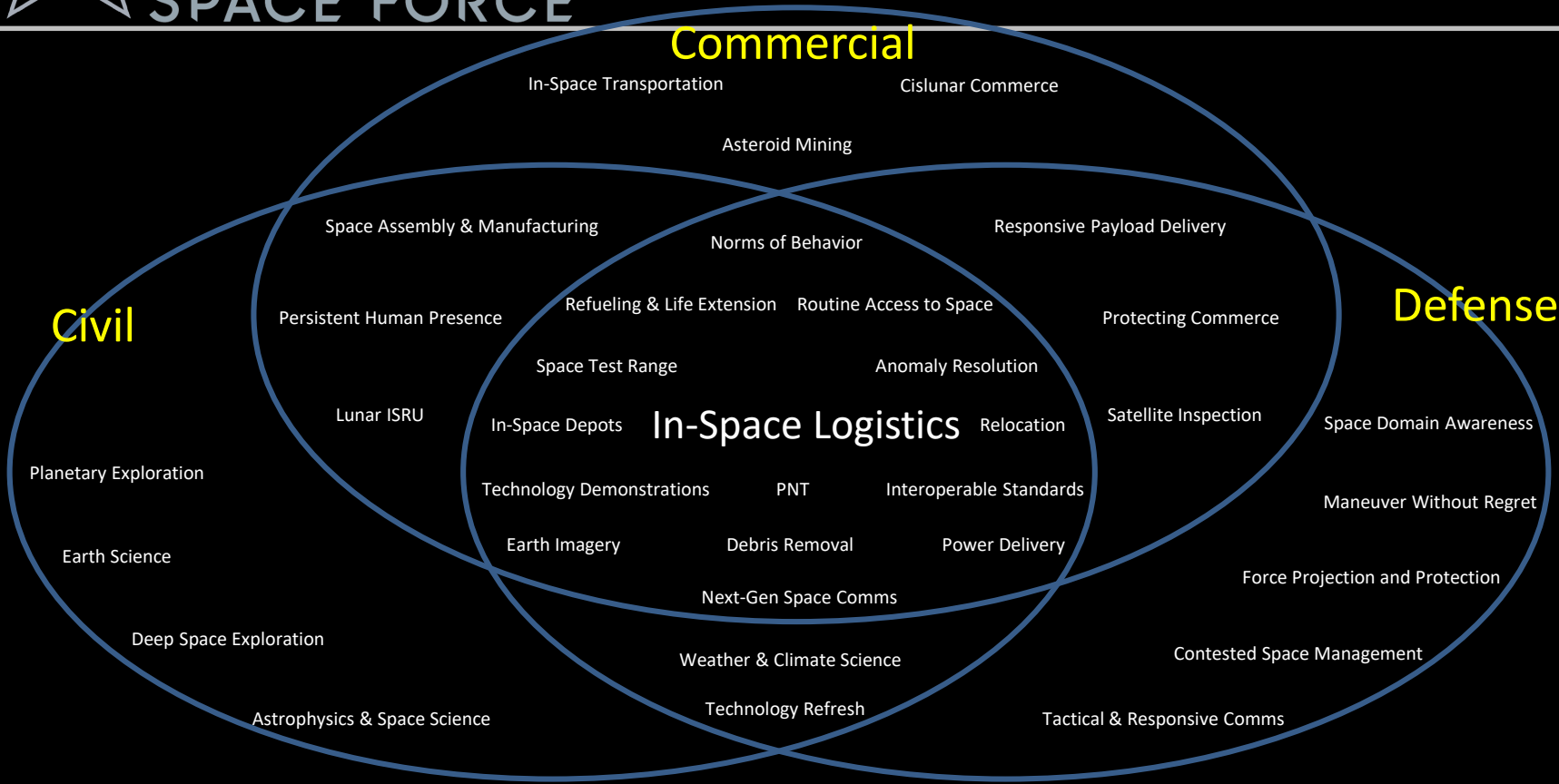

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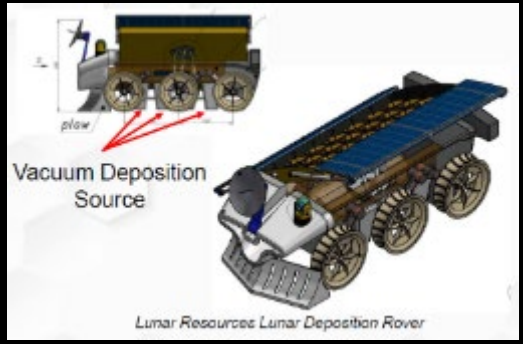
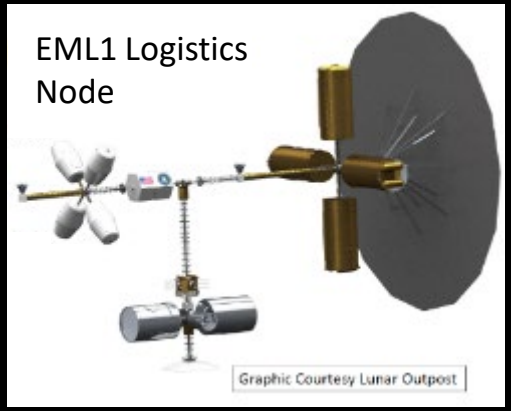
S&T Challenges

- Improving freedom of action in, from, and to the space domain
- Improving the survivability and resilience of space systems and architectures
- Digital engineering and model-based systems engineering
- Increasing responsible AI, ML, and autonomy
- Improving space access, mobility, and logistics
- Enhancement and integration of existing services from and through an expanded space domain



Credit: Lunar Resources, Inc.



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UNIVERSITY PARTNERSHIP PROGRAM AND UNIVERSITY CONSORTIUM

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University Partnerships

- The University Partnership Program (UPP) is a joint USSF collaboration effort with a select number of academic research institutions focused on the advancement in research for development of future space capabilities and workforce to ensure technical dominance in space operations
- UPP leverages / supports the nation's top universities possessing
  - High academic standards
  - Nationally-ranked STEM degree programs
  - World-renowned space-related research programs
  - Established Reserve Officer Training Corps (ROTC) programs

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Objectives

- Establish opportunities for world-class research, advanced academic degree, and workforce leadership development
- Identify and pursue research areas of mutual interest with UPP member universities, individually and collectively
- Foster continuous collaboration among UPP university partners, and among universities, government, and industry
- Establish scholarship, internship, and mentorship opportunities for university students and cadets
- Develop and sustain a STEM pipeline with world class space S&T workforce of the future

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Current UPP Partners

FY21/FY22 Formal Agreements

FY21:

- Georgia Institute of Technology
- Massachusetts Institute of Technology
- North Carolina Agricultural and Technical State University
- Purdue University
- University of North Dakota
- University of Colorado System
  - -UC Boulder
  - -UC Colorado Springs
- University of Texas System
  - -University of Texas- El Paso
  - -University of Taxes- Austin

FY22:

- Howard University
- University of Southern California
- University of Puerto Rico

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University Consortium

- A well-designed and managed consortium of universities performing space S&T is a key piece of the USSF's University Partnership Program (UPP)
- The UC provides a rich ecosystem for USSF to partner with universities to identify, pursue, and sustain research areas of mutual interest to develop and test space related capabilities
- USSF will use novel contractual mechanisms to create a consortium (e.g., Partnership with Industry and Academia) - similar to Space Enterprise Consortium for Universities

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University Consortium for National Space Research: Tasks

- Connect, communicate and collaborate
  - Communicate USSF vision and problem sets to Universities
  - Connect Universities to DoD space S&T funding opportunities and assist in navigating the process.
  - Connect universities with government and industry stakeholders to solve USSF problems
  - Promote collaborative partnerships for universities with each other, govt labs and industry
- Provide infrastructure to accelerate innovation and transition
  - Compete and manage application-driven basic/applied research projects within the Consortium
  - Create and manage tools to foster innovation & transition through physical and virtual collaboration spaces
  - Support University limited distro / classified access and infrastructure
  - Develop / provide guidance on navigating international/foreign involvement
- Foster space workforce development
  - Create and track a pipeline for space professionals
  - Connect Consortium Universities to Space Grant Consortium and other existing internships and opportunities
  - Create programming to grow a diverse and inclusive space workforce
- Provide a management backbone for the Consortium
  - Market the Consortium and recruit 100+ participating Universities
  - Create governance and marketing for connection and support programs and S&T opportunities

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University Consortium for National Space Research

- Purpose of the Consortium:
  - Connect Universities to DoD space research opportunities and transition opportunities to USSF
  - Communicate USSF problem focus areas to space consortium members and better communicate university innovation to the USSF and rest of government
  - Foster collaboration between space consortium universities and between the universities and government and industry

- Key Component of University Partnership Program (UPP)
  - UPP institutions can (and should) be a part of the consortium
  - Consortium schools should partner with other UPP schools for workforce development and recruiting

"Consortium of institutions of higher education to lead foundational research in areas that the Chief determines to be critical to the mission of the Space Force"

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OPPORTUNITIES IN R&D AND WORKFORCE DEVELOPMENT

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Current Research Areas and University Partnerships (via AFOSR)

- Space-Access Propulsion Sub-CTC
  - Chemical Kinetics/Turbulent Combustion
  - Combustion Dynamics
  - Rotating Detonation Rocket Engines
- In-Space Propulsion Sub-CTC
  - Electrosprays
  - Chemical
  - Electric Propulsion and Dynamical Systems
- Strategic Propulsion Sub-CTC
- Space Logistics & Resources
- Adv Space Power
- Rad hard microelectronics
- Automation and Robotics
- Combat Cloud
  - Spectrum-Efficient LPD Communication
  - Carrier Aggregation in Satellite Communications
  - Network Time Synchronization / Satcom Resource Allocation
  - Network/fountain/erasure coding
  - Active Queue Management in Transport Control Protocol Networks
  - Virtual Channel Bonding in Satcom/High Performance HAIPE-based Satcom Networking
  - Digital Beamforming
  - LPI waveforms for CDO env application
  - Cyber-secure content-centric network
  - Advanced waveforms, network science

- Theater Delivery/Integration for PNT:
- Astrodynamics
  - Low-SNR multi-target tracking
- Multi-phenomenology Characterization
  - DARPA ARTIMIS - next-gen Vis/SWIR/LWIR spectral survey instrument
  - Doppler velocimetry
  - Deployment of telescope to South Pole Station
  - Spectral characterization using HiVis spectrograph
- Quantum Optical Research:
  - Synchronization and entanglement swapping
  - Research on Entangled Photons
  - Earth to Space Quantum Channels
  - Detection probabilities theories of the CSO mission
  - Weather modeling and prediction
  - Astrodynamics/orbital mechanics
  - AO, wave-optics modeling, and theory
- Space Domain Awareness
  - Vertical external cavity surface emitting laser (VECSEL)
  - Pyramid wavefront sensor (WFS)
  - Diamond Raman laser for sodium beacon
  - Non-linear Curvature Wavefront Sensor algorithms to sense low order modes in photon starved environments
  - Three-sided pyramid wavefront sensor

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Current Opportunities for University Partnerships (via AFRL)

- University Consortium Funding Opportunity
  - Connecting 7 teams from different universities, two year research efforts
- Hyperspace Challenge for Universities
  - Connecting 11 teams from different universities to Space Force needs (2 from the UPP schools)
- Space University Research Initiative (SURI)
  - Total of 44 Participants (9 UPP schools) submitted proposals under two topics:
    - Space Domain Awareness & Space Logistics
- AFRL Space Scholars (~140 university student participants) https://afrlscholars.usra.edu/scholarsprogram/
- University Nanosat Program (dozens of teams at institutions across the country)
- Multiple AFOSR space related Grants
- SBIR/STTR Program https://spacewerx.us/space-prime/
- Education Partnership Agreements
  - Supports staff and data exchange with access to facilities and equipment
- University Cooperative Agreements (a few funded agreements for space)

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Internships and Scholarship Opportunities

- Program objective is provide a consistent pipeline of talent via scholarship, internship, and mentorship opportunities for university students
- UPP builds on existing AFROTC, the Air Force Office of Scientific Research, the Air Force Research Laboratory, and other initiatives to advance Space Force and partner university interests.
- Program development will focus on integrating UPP with various Internship and Scholarship opportunities:
  - Premier College Intern Program (PCIP)
  - USSF Scholars Program
  - Science, Technology, Math, and Research for Transformation (SMART) Scholarship Program
  - Pathways Program
  - John S. McCain Strategic Defense Fellowship
  - AFRL Scholars Program
  - AFRL Scholars Professionals
  - University Research Engagement Program
  - AFOSR Internship Program
  - AFOSR Faculty Program
  - AFRL/AFOSR Summer Internship Program

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PLANNED ACTIVITIES

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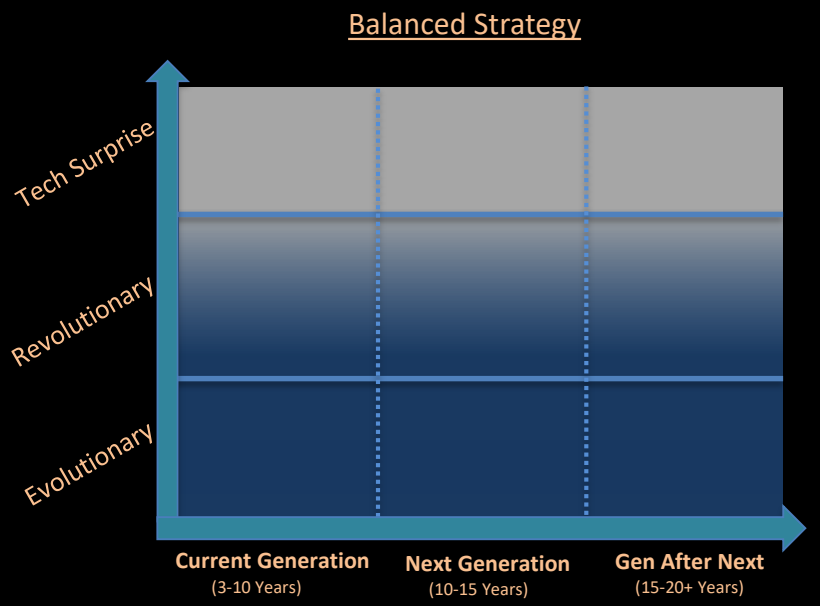
Near-Term Objectives

- Identify overlapping research of mutual interest that align with Space S&T-priorities
- Explore overlapping topics of interest among UPP members
- Identify PhD candidates
- Identify research & thesis/dissertation topics
- Leverage current programs
  - DoD acquisition programs
  - Explore tech transfer opportunities
- Investments focused on S&T priorities
- Research Outlook with a balanced approach



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UPP Workshops and Webinars

- Individual short webinars on each of 6 S&T challenges
  - Sessions 1-6: Detailed overview of each S&T priority and group assignment
  - Session 7: Out brief on list of research topics that support S&T challenges
- Regional workshops, each with 50 participants from 3-4 UPP members
  - Five-hour workshop
  - Each workshop with specific theme
  - Group breakouts
    - Each group breakout based on mutual interest in S&T priority
    - Mapping of S&T into research topics
    - Group Facilitators from AFRL, AFOSR, USSF, Other govt organizations

University Research of Mutual Interest that Support USSF S&T Priorities

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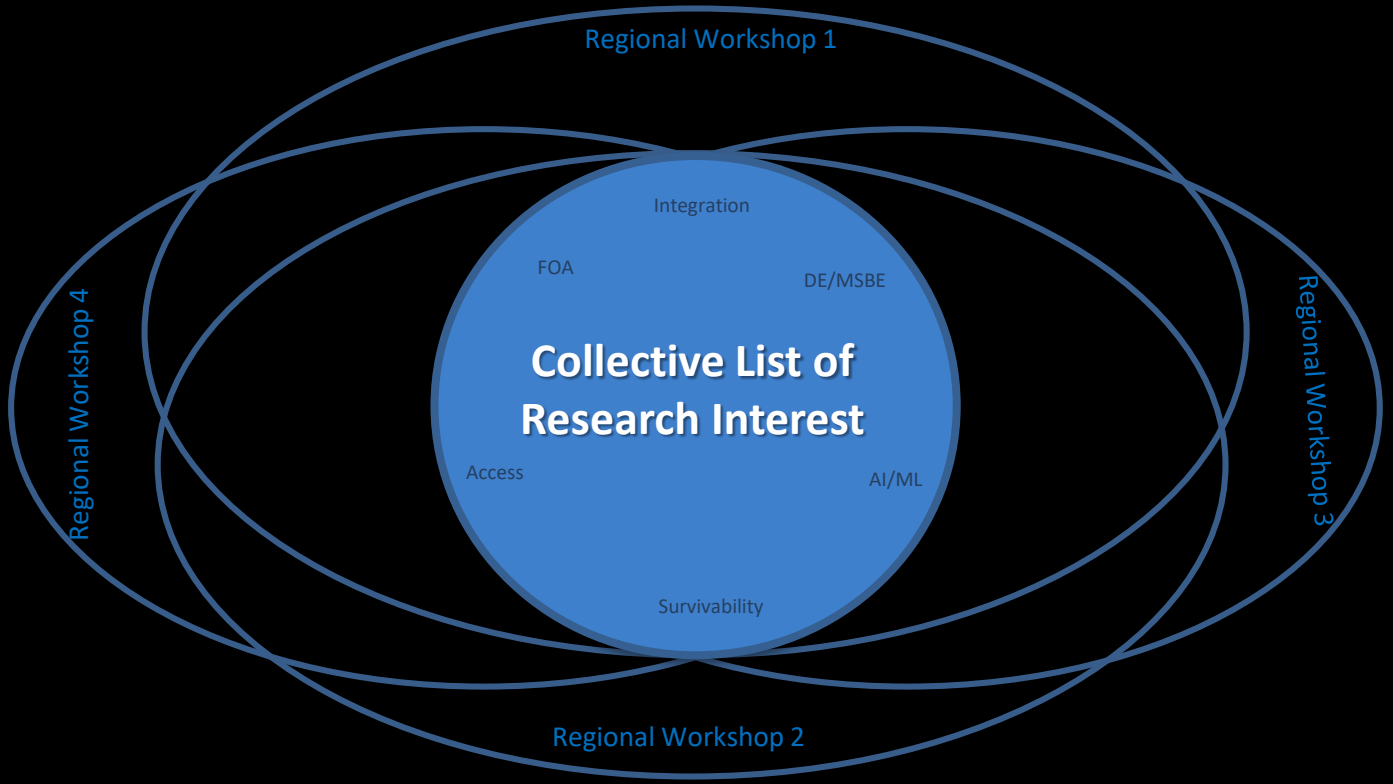
UPP Workshop
Outcome



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UPP Workshop Outcome

UPP Member	FoA	Survivability	DE/MBSE	AI/ML	Access	Integration
1	X			X		X
2					X	
3		X				X
4	X				X	
5				X		
6		X			X	X
7	X					
8		X				X
9			X			
10		X				
11	X		X	X		
12		X				
13					X	X

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UPP Workshop
Outcome

UPP Member	FoA	Survivability	DE/MBSE	AI/ML	Access	Integration
1	X			X		X
2					X	
3		X				X
4	X				X	
5				X		
6		X			X	X
7	X					
8		X				X
9			X			
10		X				
11	X		X	X		
12		X				
13					X	X

Research area of mutual interest, individually and collectively (synergetic approach)

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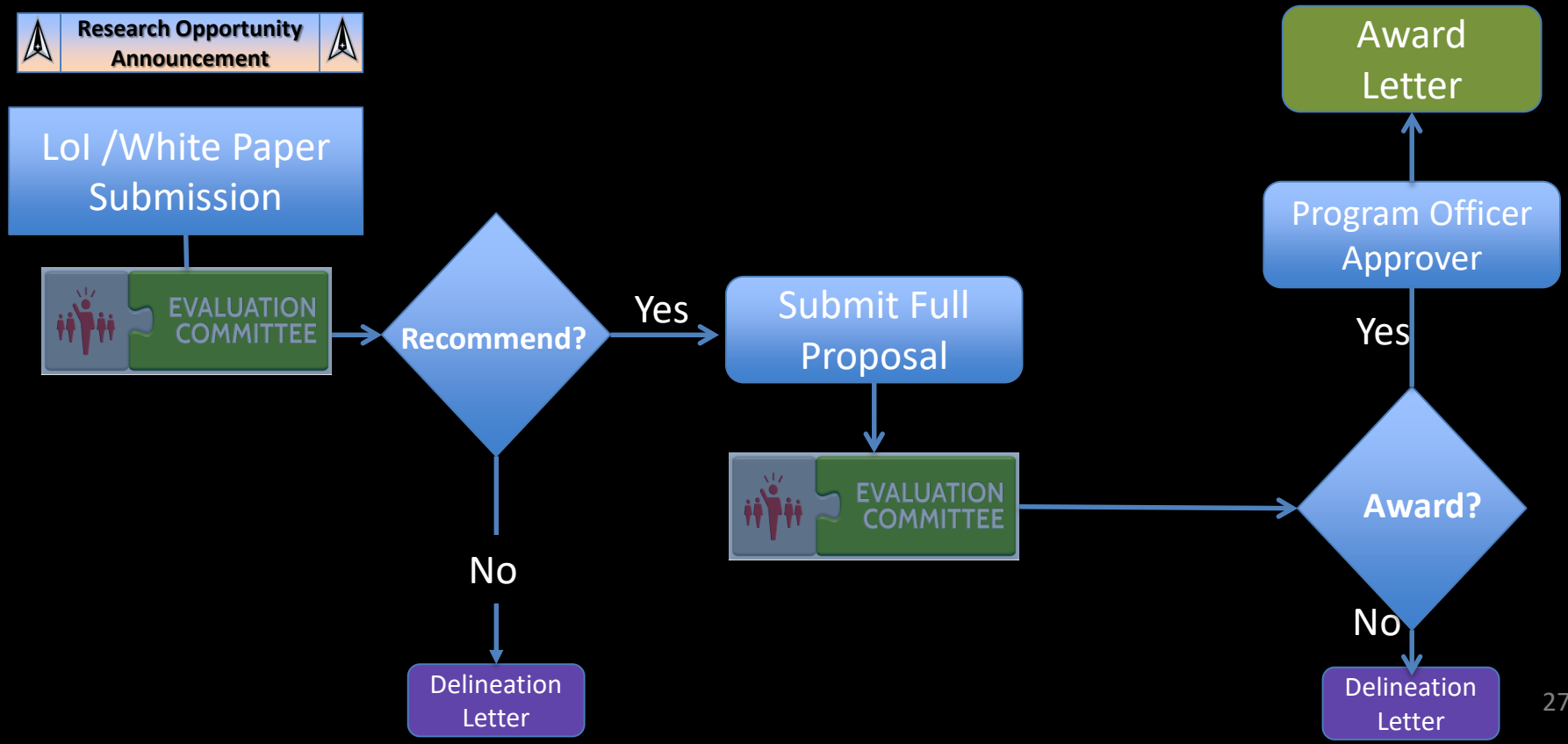
Research Opportunties Process



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Q&A

(RESPONSES TO QUESTIONS IN THE CHAT)

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SEMPER SUPRA

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BACKUP