STATEMENT OF OBJECTIVES

Space Strategic Technology Institute (SSTI): In-Space Operations (ISO)

A. Overview

The United States Space Force (USSF) is establishing Space Strategic Technology Institutes (SSTIs) to address space science and technology (S&T) challenges through a network of partnered universities. The USSF goal is for the SSTIs to facilitate joint applied research and focus it on transformational space domain technology breakthroughs and developments that lead to the advancement of capabilities that can be transitioned and integrated into current and future USSF and U.S. Government space capabilities. It is highly desired for the research to lead to testbeds, high fidelity modeling and simulations, demonstrations, and prototypes. The research is expected to transition technology to higher technology readiness levels throughout the period of performance and out years will be awarded based on an evaluation of this ability.

The In-Space Operations (ISO) SSTI will comprise a team of at least three research institutions (including lead university). The team of universities in ISO SSTI are encouraged to collaborate with other universities and industry to address space research, development, and demonstration needs.

USSF plans to make the full award to the lead research institution submitting the proposal. This research institution will manage the research of any ISO subtopics, such as those described in section C. The lead institution is responsible for evenly distributing funds to team member institutions via subawards. It is also permissible for team member institutions to issue further subawards.

B. Statement of Objectives

The objective of this call is to establish USSF SSTI(s) to perform research in the challenge area of ISO. The past decades have seen increasing world-wide access to and utilization from Low Earth Orbit (LEO) to Geostationary Earth Orbit (GEO) for multiple purposes including commercial applications such communications, infrastructure applications such as position, timing, and navigation, civil applications such as Earth science and crewed space stations, and military and intelligence applications. There is also expanding activity in beyond GEO, cislunar, and interplanetary realms as nation states and commercial industry expand both human and robotic exploration and the search for in situ resources.

The university teams proposing to the SSTI- ISO will propose research that is aligned with their team's unique research strengths. This section provides descriptions of example technologies that are related to ISO. These examples are not exhaustive and are intended to be non-prescriptive. The intent is to provide broad focus area examples that will help the proposers to understand typical S&T challenges and needs for the SSTI.

Each team is encouraged to include future technology vectors and horizon scanning on emerging and forward leaning technologies through a systematic assessment of potential future threats and technology surprises.

A minimum of three collaborators (from academia and/or industry) are encouraged for each effort under the SSTI-ISO. It is also recommended that the collaboration includes a multidisciplinary approach, not only across technical disciplines, but also including non-technical aspects and approaches to the problems.

In future years the research may include additional partner universities, and the Air Force Research Laboratory (AFRL), the Defense Advanced Research Projects Agency (DARPA), or other DoD or U.S. Government agencies and laboratories, as well as industry and international partners. The government laboratories have a deep understanding of the technology needs, end-user's requirements, and potential applications of the research outcomes. Please also refer the White House published In-Space Servicing, Assembly, and Manufacturing National Strategy document released April 2022.

C. Description of Technical Area

The SSTI ISO will focus on technologies needed to improve space access, mobility, and logistics. Specific technology areas of interest may include, but not limited to:

- Technologies that expand capabilities in space (LEO, MEO, GEO, HEO, xGEO, lunar)
    - In-space servicing, assembly and re-fueling in contested environment
        - Spacecraft fueling ports and fuel systems to enable normalized, rapid, autonomous fueling and re-fueling on orbit
        - Fuel tanks and integrated fuel delivery and transport system from the ground to space and in space to enable a distributed and mobile space fuel supply eliminate launching ballast or mass simulants on rockets.
        - Space asset technologies improving the ability to re-fuel in all orbits.
    - Tactically responsive launch/operations
    - Cyber security and data trust specific to ISO
    - Space based robotic systems enabling a range of ISO capabilities.
        - Research to enable a space-based robotic servicer, in-orbit repair or upgrade, and space tug
        - Research on robotic assembly to construct a 1000+ m sq object in GEO or beyond.
        - Research on robotics and autonomy to demonstrate the use of logistical systems to transport, collect or remove debris larger than a cubic meter to reduce debris potential impacts on military space systems.
        - An GEO or above normalized, autonomous fuel depot with accompanying robotic servicer.

    - Command & control, human-machine teaming, AI, satellite swarms.
    - Rendezvous and proximity operations (RPO).
    - Logistics infrastructure to support In-Space Operations (ISO).
    - New space-lift technologies for rapid, flexible, and affordable deployment of space assets
    - Space-based manufacturing
    - Technologies which enable a satellite or other object to be more easily re-manufactured or re-used in space.
    - Additive and other advanced manufacturing techniques
    - Servicing and repair
    - Refueling for maneuver without regret
    - On-orbit depots
    - In-situ resource harvesting and utilization
    - Space debris removal
    - Autonomous robotic systems
    - Standards for satellite servicing and debris mitigation
    - Materiel storage and mobility in and through space predictive maintenance
    - Accurate, timely, networked, and interoperable modeling and simulations supporting ISO architectures and capabilities
- Optimization and scheduling algorithms for refueling to enabling increase in speed of refueling operations over currently planned missions.
- Launch of a large space asset into LEO and final repositioning to operational orbit by robotic tug or servicer.
- Research on standardized buses and payloads that allow for rapid and flexible modification or replacement of bus subsystems or payloads on the ground and in space.
- Research spacecraft bus/payload with all major wear components in replaceable locations and the robotic replacement or upgrade of a flight computer.
- Research to demonstrate the ability to repurpose old and non-operating assets to create a space aperture.
- Research to demonstrate and mature re-manufacturing and re-use of existing and future anthropogenic objects in space.
- Research on utilization of in-situ materials for manufacturing or extraction of propellant.
- Novel Validation and Verification techniques to establish safety and reliability of servicing interfaces

Interested offerors may propose additional technologies related to the technical areas listed above, that bolster R&D innovation, increase the maturity and market readiness of DoD relevant technologies to prepare them for transfer and commercialization that support DoD needs.