NASA SBIR 2019 Phase I Solicitation

S3.05 Terrestrial Balloons and Planetary Aerial Vehicles

Lead Center: GSFC

Participating Center(s): GSFC, JPL

Technology Area: TA5 Communication and Navigation

Satellite Communications for Terrestrial Balloons

NASA's Scientific Balloons provide practical and cost-effective platforms for conducting discovery science, development and testing for future space instruments, as well as training opportunities for future scientists and engineers. Balloons can reach altitudes above 36 kilometers, with suspended masses up to 3600 kilograms, and can stay afloat for several weeks. Currently, the Balloon Program is on the verge of introducing an advanced balloon system that will enable 100-day missions at mid-latitudes and thus resemble the performance of a small spacecraft at a fraction of the cost. In support of this development, NASA is seeking cost efficient innovative technologies that can provide high bitrates satellite communications for supporting current and future science needs during long duration missions.

Improved and innovative downlink bitrates using satellite relay communications from balloon payloads are needed. Long duration balloon flights currently utilize satellite communication systems to relay science and operations data from the balloon to ground based control centers. The current maximum downlink bit rate is 150 kilobits per second operating continuously during the balloon flight. Future requirements are for bit rates of 1 megabit per second or more. Improvements in bit rate performance, reduction in size and mass of existing systems, or reductions in cost of high bit rate systems are needed. TDRSS and Iridium satellite communications are currently used for balloon payload applications. A commercial S-band TDRSS transceiver and mechanically steered 18 dBi gain antenna provide 150 kbps continuous downlink. TDRSS K-band transceivers are available but are currently cost prohibitive. Open Port Iridium service is also currently being used.

The expected Technology Readiness Level (TRL) range at completion of the project is 1-3.

Planetary Aerial Vehicles for Titan

Innovations in materials, structures, and systems concepts have enabled aerial vehicles to play an expanding role in NASA's future Solar System Exploration Program. Aerial vehicles are expected to carry scientific payloads at Titan that will perform in-situ investigations of its atmosphere, surface and interior. Titan features extreme environments that significantly impact the design of aerial vehicles.

NASA is interested in conducting long term monitoring of the Titan atmosphere and planetary surface using aerial vehicles at altitudes ranging from the surface up to 20 km. Concepts for Lighter-than-Air (e.g., balloons, airships) and Heavier-than-Air (e.g., fixed wing, rotary wing) vehicles are encouraged. The aerial platforms should be

capable of operation in Titan's atmosphere and interaction with the surface is strongly desired. Surface interaction may involve sample collection from surfaces that may contain frozen water ice, organic dunes or hydrocarbon lakes. Concepts that do not have surface interaction and focus on continuous flight are acceptable for consideration. The proposal may assume that a radioisotope thermoelectric generator could be part of the system architecture for providing basic power to the vehicle. The proposal should describe how the vehicle concept would be deployed into the atmosphere or from the surface and operated for its mission. Concepts for any of the following capabilities of aerial vehicle are encouraged:

- Technology demonstration with science payload less than 5 kg.
- Pathfinder mission with science payload less than 30 kg.
- Flagship mission with science payload up to 60 kg.

Small companies can play a major role in planetary aerial vehicles. We expect that a small company with innovative technologies may put together a mission concept that would later be desirable for NASA/JPL to pick up as a mission proposal partner for New Frontiers or Discovery. In our call we state that we are looking for several mission classes from Technology Demonstration (like the Mars helicopter) to a Flagship mission. It is expected that a Phase I effort will consist of a system-level design and a proof-of-concept experiment on one or more key components.

The expected Technology Readiness Level (TRL) range at completion of the project is 2-3.

References:

- Mars Helicopter Website: https://www.jpl.nasa.gov/news/news.php?feature=7121
- Satellite Communications for Balloons: https://sites.wff.nasa.gov/code820/