The key operating characteristics for a Spaceport focus are interoperability, ease of use, flexibility, safety/environmental protection, and multiple concurrent operations. The long-term vision is to have "airport-like" spaceport operations. Therefore, the development of effective spaceport technologies is of primary importance to NASA. These technologies will need to support both the existing and future vehicles and programs.

**Space-Based Telemetry**

NASA is seeking to reduce or eliminate the need for redundant range assets and deployed down-range assets that are currently used to provide for Line-of-Sight (LOS) Tracking Telemetry and Control (TT&C) with sub-orbital platforms and orbit-insertion launch vehicles.

There are varying applications for space-based transceivers, each necessitating a different set of requirements. The desired focus is very low size, weight, and power (SWaP), tactical grade, highly reliable, and easily reconfigurable transceivers capable of establishing and maintaining unbroken satellite communication links for telemetry and/or control. This technology will serve applications, which include low-cost sub-orbital missions, secondary communications systems for orbit insertion vehicles, low cost and size orbital payloads (typically LEO), and flight test articles. Durations will range from minutes to several weeks and the ability to operate on highly dynamic platforms is critical. High data rate links are highly desired, thus the use of NASA's TDRSS is emphasized, although other commercial satellite systems, which can provide nearly global and high data rate links can also be explored. Factors to address include:

- Advancements in software based radios and encoding techniques,
- Use of the latest semiconductor technologies (GaN or other),
- Advanced heat dissipation techniques,
- Immunity to corona breakdown,
- Ease of data interfacing.
RF power output requirements range from a few watts to as high as 100 W. Special consideration should be given to transceiver capability vs. packaging that would allow for customizable configurations depending on the target application.

Range Weather

NASA seeks innovative technologies to remotely measure electric fields aloft to reduce the threat of destruction of a launch vehicle by rocket triggered lightning. Potential candidate technologies include new algorithms to take advantage of existing dual-polarized Doppler five-cm weather radar capability, or entirely new technologies for the remote sensing of electric fields. The ability to economically measure the incremental ballistic wind velocities along the predicted trajectory of launch vehicles at remote and evolving launch ranges at altitude up to 100 kft via fixed and mobile LIDAR approaches is also highly desirable.

The above technologies are considered to be highly desirable for NASA's objectives and critical for the realization of true Spaceports.

For all above technologies, research should be conducted to demonstrate technical feasibility during Phase I and show a path toward Phase II hardware and software demonstration and delivering a demonstration unit or software package for NASA testing at the completion of the Phase II contract.

Phase I Deliverables: A final report containing optimal design for the technology concept including feasibility of concept, detailed path towards Phase II hardware and software demonstration, and detailed results of Phase I analysis, modeling, prototyping, and testing.

Phase II Deliverables: A working proof-of-concept demonstrated and delivered to NASA for testing and verification with a TRL of 4 to 6.