NASA SBIR 2009 Phase I Solicitation

O4.05 Space-Based Range Technologies

Lead Center: GSFC

Participating Center(s): AFRC, GRC

The vision of Space-Based Range architecture is to assure public safety, reduce the costs of launch operations, enable multiple simultaneous launch operations, decrease response time, and improve geographic and temporal flexibility. This sub-topic seeks 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. In order to achieve this, specific advancements are needed in TT&C.

Position, Attitude, and Inertial Metrics

Realization of a Space-Based Range requires the development of highly accurate and stable integrated metric tracking and inertial measurement units. The focus is on technologies that enable and advance development of low Size, Weight, and Power (SWaP), tactical grade, integrated metric tracking units that provide highly accurate and stable positioning, attitude, and inertial measurements on high dynamic platforms.

Factors to address include:

- Easy coupling of IMUs, gyros, accelerometers, and/or attitude determining GPS receivers that will provide very high frequency integrated metric solutions;
- The ability to reliably function on spin-stabilized rockets (up to 7 rps), during sudden jerk and acceleration maneuvers, and in high vibration environments is critical;
- Advancements in MEMs-based IMUs and accelerometers, algorithm techniques and Kalman filtering, phased-based attitude determination, single aperture systems, quick Time to First Fix and reacquisition.

Space-Based Telemetry

There are varying applications for space-based transceivers, each necessitating a different set of requirements. The desired focus is very low 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 coding techniques;
- Use of the latest semiconductor technologies (GaN or other);
- Advanced heat dissipation techniques (to allow small packaging and long duration operating times);
- 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. That is, a modular or stacking design with a common bus architecture should be considered where the RF and digital sections are separated. This could allow for a base digital and DC power design that will support multiple RF slices (such as a low, medium, or high power slice). Also, to satisfy missions who require unidirectional communications, a modular design could allow for separate transmitter and receiver modules/slices.

Phase 1 Deliverables

A final report containing optimal design for the technology concept including feasibility of concept, a detailed path towards Phase 2 hardware and/or software demonstration. The report shall also provide options for potential Phase 2 funding from other government agencies (OGA).

Phase 2 Deliverables

A working proof-of-concept demonstrated and delivered to NASA for testing and verification.