



NASA SBIR 2011 Phase I Solicitation

O1.01 Antenna Technology

Lead Center: GRC

Participating Center(s): GSFC, JPL, JSC, LaRC

NASA seeks advanced antenna systems and technologies to enable communications for future space operations, space science, Earth science and solar system exploration missions. These areas, in priority order, are:

Novel Materials for Next Generation Antennas

NASA is interested in exploiting novel materials approaches for next generation antennas. For example, "smart" materials such as shape memory polymers or ionic polymer metal composites to permit active shape control or beam correction are of interest. Artificial electromagnetic media for phase velocity control and impedance tuning to improve the efficiency and bandwidth of electrically small antennas is of interest. Emerging novel technologies such as ferroelectrics, multiferroics and spintronics concepts leading to new antenna designs are desirable.

Smart, Reconfigurable Antennas

Smart antennas, reconfigurable in frequency, polarization and radiation pattern, are of interest for space and planetary exploration missions. In particular, antenna designs and proof-of-concepts leading to the reduction of the number of antennas needed to meet the communication requirements associated with rovers, pressurized surface vehicles, habitats, etc., are highly desired. In addition to the aforementioned reconfigurability requirements, specific antenna features include multi-beam operation to support connectivity to different communication nodes on planetary surfaces, or in support of communication links for satellite relays around planetary orbits. Innovative receiver front-ends or technologies that allow for the DSP to move closer to the antenna terminal furthering the impact of the aforementioned, revolutionary "game-changing" antenna technology concepts are highly desirable.

Ground-based Uplink Antenna Array Designs

NASA is considering arrays of ground-based antennas to increase capacity and system flexibility, to reduce reliance on large antennas and high operating costs, and eliminate single point of failure of large antennas. A large number of smaller antennas arrayed together results in a scalable, evolvable system, which enables a flexible schedule and support for more simultaneous missions. A significant challenge is the implementation of an array for transmitting (uplinking), which may or may not use the same antennas that are used for receiving. Arraying concepts that can enable technology standardization across each NASA network (i.e., DSN, NEN, and SN), within

the framework of the newly envisioned NASA integrated network architecture, at Ka-band frequencies and above, are highly desired.

Phased Array Antennas

High performance phased array antennas, i.e., with efficiencies at least 3X that of state-of-practice MMIC-based phased arrays, are needed for high-data rate communication at Ka-Band frequencies and above as well as for remote sensing applications. Communications applications include: planetary exploration, landers, probes, rovers, extravehicular activities (EVA), suborbital vehicles, sounding rockets, balloons, unmanned aerial vehicles (UAV's), TDRSS communication, and expendable launch vehicles (ELV's). Also of interest are multi-band phased array antennas (e.g., X- and Ka-band) and RF/optical shared aperture dual use antennas, which can dynamically reconfigure active elements in order to operate in either band as required to maximize flexibility, efficiency and minimize the mass of hardware delivered to space. Phased array antennas for space-based range applications to accommodate dynamic maneuvers are also of interest. The arrays are required to be aerodynamic or conformal in shape for sounding rockets, UAV's, and expendable platforms and must be able to withstand the launch environment. Potential remote sensing applications include: radiometers, passive radar interferometer platforms, and synthetic aperture radar (SAR) platforms for planetary science.

Large Aperture Deployable Antennas

Large aperture deployable antennas with surface root-mean-square (rms) quality better than $\lambda/40$ at Ka-Band frequencies and above, are desired. In addition, these antennas should significantly reduce stowage volume (packaging efficiencies as high as 50:1), provide high deployment reliability, and significantly reduced mass density (i.e., 2). These large Gossamer-like antennas are required to provide high-capacity communication links with low fabrication costs from deep space (Mars and beyond). Concepts addressing antenna adaptive beam correction with pointing control are also of interest.

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: Research to identify and evaluate candidate telecommunications technology applications to demonstrate the technical feasibility and show a path towards a hardware/software demonstration. Bench or lab-level demonstrations are desirable.

Phase II Deliverables: Emphasis should be placed on developing and demonstrating the technology under simulated flight conditions. The proposal shall outline a path showing how the technology could be developed into space-worthy systems. The contract should deliver a demonstration unit for functional and environmental testing at the completion of the Phase II contract.