NASA SBIR 2010 Phase I Solicitation

O1.05 Long Range Space RF Telecommunications

Lead Center: JPL

Participating Center(s): ARC, GRC, GSFC

This solicitation seeks to develop innovative long-range RF telecommunications technologies supporting the needs of space missions. The ultimate objective is to maximize aggregate mission data return per unit mass, unit volume, unit cost and unit power consumed by the spacecraft telecommunications subsystem.

In the future, spacecraft with increasingly capable instruments producing large quantities of data will be visiting the moon and the planets. To support the communication needs of these missions and maximize the data return to Earth, innovative long-range telecommunications technologies that maximize power efficiency, transmitted power density and data rate, while minimizing size, mass and power are required.

The current state-of-the-art in long-range RF space telecommunications is 6 Mbps from Mars using microwave communications systems (X-Band and Ka-Band) with output power levels in the low tens of Watts and DC-to-RF efficiencies in the range of 10-25%.

This solicitation seeks proposals in the following areas:

- Ultra-small, light-weight, low-cost, low-power, modular deep-space transceivers, transponders and components, incorporating MMICs and Bi-CMOS circuits;
- MMIC modulators with drivers to provide a wide range of linear phase modulation (greater than 2.5 rad), high-data rate (10 - 200 Mbps) BPSK/QPSK modulation at X-band (8.4 GHz), and Ka-band (26 GHz, 32 GHz and 38 GHz);
- High-efficiency (> 60%), low mass Solid-State Power Amplifiers (SSPAs), of both medium output power (10 W-50 W) and high-output power (150 W-1 KW), using power combining and/or wide band-gap semiconductors at X-band (8.4 GHz) and Ka-band (26 GHz, 32 GHz and 38 GHz);
- Utilization of nano-materials and/or other novel materials and techniques for improving the power efficiency or reducing the cost of reliable vacuum electronics amplifier components (e.g., TWTAs and Klystrons);
- Ultra low-noise amplifiers (MMICs or hybrid) for RF front-ends (< 50 K noise temperature);
- MEMS-based integrated RF subsystems that reduce the size and mass of space transceivers and transponders. Frequencies of interest include UHF, X- and Ka-Band. Of particular interest is Ka-band from 25.5 - 27 GHz and 31.5 - 34 GHz;
- Ultra low mass, high gain, high efficiency spacecraft antennas using advanced light materials and structures.
- Novel, hybrid spacecraft antenna designs that can act as efficient reflectors/concentrators of both RF (X- and Ka-Band) and optical (1550 nm) electromagnetic waves.
For all above technologies, research should be conducted to demonstrate technical feasibility during Phase I and show a path towards Phase II hardware/software demonstration with delivery a demonstration unit or software package for NASA testing at the completion of the Phase II contract.

Phase I Deliverables: Feasibility study, including simulations and measurements, proving the proposed approach to develop a given product (TRL 3-4). Verification matrix of measurements to be performed at the end of Phase II, along with specific quantitative pass-fail ranges for each quantity listed.

Phase II Deliverables: Working engineering model of proposed product, along with full report of development and measurements, including populated verification matrix from Phase II (TRL 5-6). Opportunities and plans should also be identified and summarized for potential commercialization.