



NASA SBIR 2009 Phase I Solicitation

01.07 Long Range Space RF Telecommunications

Lead Center: JPL

Participating Center(s): ARC, GRC, GSFC

Solicitation Summary

This solicitation seeks to develop innovative long-range RF telecommunications technologies supporting the needs of space missions.

Purpose (based on NASA needs) and current state-of-the-art

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 about 2 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%.

Specifications and Requirements

- 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 large linear phase modulation (above 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%) 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 techniques and/or wide band-gap semiconductor devices at X-band (8.4 GHz) and Ka-band (26 GHz, 32 GHz and 38 GHz);

-
- Epitaxial GaN films with threading dislocations less than 106 per cm² for use in space qualified wide band-gap semiconductor devices at X- and Ka-band;
 - 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);
 - SSPAs, modulators and MMICs for 26 GHz Ka-band (lunar communication);
 - Improved integrated non-linear amplifier/modulator designs that reduce crest-factor impacts and significantly enhance the efficiency of high peak-to-average power ratio waveforms, such as 802.11 and 802.16;
 - TWTAs operating at millimeter wave frequencies (e.g. W-Band) and at data rates of 10 Gbps or higher;
 - Ultra low-noise amplifiers (MMICs or hybrid) for RF front-ends (
 - MEMS-based RF switches and photonic control devices needed for use in reconfigurable antennas, phase shifters, amplifiers, oscillators, and in-flight reconfigurable filters. Frequencies of interest include VHF, UHF, L-, S-, X-, Ka-, V-band (60 GHz) and W-band (94 GHz). Of particular interest is Ka-band from 25.5 - 27 GHz and 31.5 - 34 GHz.

Phase 1 Deliverables

Feasibility study, including simulations and measurements, proving the proposed approach to develop a given product. Verification matrix of measurements to be performed at the end of Phase 2, along with specific quantitative pass-fail ranges for each quantity listed.

Phase 2 Deliverables

Working engineering model of proposed product, along with full report of on development and measurements, including populated verification matrix from Phase 1.