MASTER OSCILLATOR POWER AMPLIFIER ARCHITECTURE

Description

The NASA Goddard Space Flight Center's (GSFC) Laser and Electro-Optics Branch is currently seeking an industry partner to assist with laser amplifier development for the Laser Communications Relay Demonstration (LCRD) program.
GSFC is pursuing a master oscillator power amplifier (MOPA) architecture as the laser transmitter for the LCRD. Available matured technologies with a high technology readiness level (TRL) that can be applied for the laser power amplifier stages (TRL > 4) is required. The power amplifier stage shall be used in two different communication modems for the LCRD. The two different modems are based on differential phase shift keying (DPSK) and pulse position modulation (PPM) formats. A short description of the LCRD program can be found in a recently released public announcement at website http://www.nasa.gov/mission_pages/tdm/lcrd/index.html .
GSFC seeks specific capability information on erbium doped fiber amplifier (EDFA) technologies for space applications. This will be used in a capability assessment to assist with preparing possible future NASA-industry partnership opportunities. Initial emphasis will be on a short-term demonstration effort on power scaling. However, the information will also be assessed for a possible longer-term partnership. The goal of this RFI is to ensure that the best and widest possible sets of capabilities are considered for immediate applications for the LCRD mission.
Interested organizations are invited to submit a description of their EDFA efforts for space applications with technical and resource/facility capabilities relevant to our LCRD mission. This submittal should be sent to the NASA point of contact listed below. It should also describe the organization's experience and past performance in the areas of airborne and space-based fiber laser and amplifier development. GSFC is particularly interested in companies that have existing breadboard or hardware that can be readily used for demonstrating the performance that are close to the above requirements.
The fiber amplifier module of interests shall accept input from a Government-furnished equipment (GFE) master oscillator (MO) via a single mode PM fiber with nominal input average power of ~ 0 dBm (and minimum of -10 dBm). The fiber amplifier module shall consist of an optical isolator to protect the MO, pump diodes, active fiber gain medium, WDM combiners, monitor taps with calibrated monitor photodiodes to monitor the module health and performance, and output isolator.

Specific information in the following areas is required:

1. Information on previously developed prototypes, breadboards, brass-boards, engineering models or flight EDFAs, which operate in the wavelength band from 1530 – 1570 nm for space applications that meet or exceed the performance requirements given in Table I.

2. Outline steps necessary to demonstrate the performance of the amplifier design per Table 1 on an Engineering Design Unit (EDU) by 9/2012. The EDU shall meet all performance requirements under laboratory conditions but not necessarily the environmental requirements for space based operation.

3. Outline subsequent steps necessary to upgrade existing breadboards, or the EDU to Engineering Test Units (ETUs) by 12/2013. Nominally an ETU is a stepping-stone

toward flight, and should be designed to have a flight-like configuration, but is not built to fully qualified standards.

4. Outline subsequent steps necessary for achieving TRL 6 (fully space qualified) on the fiber amplifier module and delivering one flight and one flight spare modules for the DPSK modem and one flight and one flight spare modules for the PPM modem by 12/2015.

5. Also include any approaches that would meet the requirements of both modulation formats with a single amplifier design. For this approach, the deliverables would be for two flight and one flight space modules.

6. Information on previous experience with fiber based optical and laser components (e.g. pump laser diodes, damage testing of optical coatings and fiber media, fiber splices integrity, space radiation induced darkening, etc.) and environmental testing and qualification (e.g. vibration, long-term reliability, temperature cycling, accelerated life-tests, vacuum) of airborne and/or space-based EDFA.

7. Information on facilities capability that could potentially be applied to manufacturing the space-qualified EDFA for the LCRD mission.

8. Any published results and/or technical reports on the above (or other relevant) topics, to be included as appendices.

Format of Capability Statements & Questions: (Capability Statements include Items 1 – 4 below.)

1. Executive Summary – This should not exceed two pages and may address any major items that the organization wishes to highlight and should include the following: name and address of firm, size of business, average annual revenue for past three (3) years and number of employees; ownership; business size standard, such as, large, small, small disadvantaged, 8(a), HUBZone, Service Disabled Veteran Owned Small Business (SD-VOSB), Veteran Owned Small Business (VOSB) and/or Women-Owned; number of years in business; affiliate information; parent company, joint venture partners, potential teaming partners, prime contractor (if potential sub) or subcontractors (if potential prime); list of customers covering the past five (5) years (highlight the relevant work performed, contract numbers, contract type, dollar value of each procurement; and point of contact – address and phone number).

2. Main body & appendices. The main body of the response should not exceed 10 pages in length and shall address the topics stated earlier. There is no page limit on appendices.
3. Questions for responders. As part of its assessment, GSFC may contact respondents to this RFI if clarification or further information is needed. However, the Government is under no obligation to have discussions with any or all respondents, or to make any award as a result of the RFI. No solicitation exists; therefore, do not request a copy of the solicitation. If a solicitation is released it will be synopsized in FedBizOpps and on the NASA Acquisition Internet Service. It is the potential offeror's responsibility to monitor these sites for the release of any synopsis or solicitation.

4. Rough-order-of-magnitude (ROM) cost estimates – Companies are encouraged to provide ROM costs for milestones and deliverables as discussed in above.

5. Use of information – This RFI is issued solely for information and planning purposes and does not constitute a solicitation. Any information obtained as a result of this RFI is intended to be used by the Government on a non-attribution basis to assist in planning for development for the LCRD mission. Responses to this notice are not offers and cannot be accepted by the Government to form a binding contract. Information will be kept as proprietary if so marked. At this time, NASA is exploring the possibility of a future acquisition as a result of this RFI.

Submission Process:

1. Capability Statements shall be submitted to the Technical Point of Contact (POC) listed below. Statements should be submitted electronically via email to the address listed below. A pdf format is preferred.

2. Submission Deadline: The Government reserves the right to consider a small business or 8(a) set-aside business based on responses hereto. All responses shall be submitted to Mr. DeAndre Rawlings via email no later than February 06, 2012. Please reference 2012FLA in any response.

3. Questions may be poised to the Procurement POC or the Technical POC listed below. Questions and answers will be posted as an addendum to this RFI.

4. Points of Contact:

Primary Procurement POC:
DeAndre Rawlings, Contract Specialist
NASA Goddard Space Flight Center Phone: (301) 286-0206
Email: deandre.r.rawlings@nasa.gov

Secondary Procurement POC:
Mozetta Edwards, Contracting Officer
NASA Goddard Space Flight Center Phone: (301) 286-8480
Email: mozetta.a.edwards@nasa.gov

Technical POC:
Dr. Anthony Yu
NASA Goddard Space Flight Center Laser
Email: anthony.w.yu@nasa.gov

Table 1 – Nominal (planning) specifications for fiber amplifiers

Parameters	EDU	ETU and Spaceborne Operation	Comments
Wavelength Band	C+L band 1530–1570 nm		
Output Average Power	1 Watt average power (2.5 Gbps DPSK) 1 Watt average power (16-ary 670 Mbps PPM; 16 W peak Power)		This is the end-of-life output power. Anticipated mission life ~ 3 years.
Input Average Power from Master Oscillator	> -10 dBm		MO to be provided as GFE
Overall Efficiency	> 5%	> 7%	Wall plug efficiency
Polarization Maintaining	Yes, output PER > 18 dB		With 20 dB input PER
Optical Linewidth	< 100 kHz for DPSK		Input Linewidth of < 100 kHz
Noise Figure	< 3.5 dB		At lowest input power of -10 dBm
Optical Isolation	>35 dB on Input >35 dB on Output		
Output Energy Flatness vs Time	< 1% per hour; <1% in 1 min; <8% in 8 hours		
Output Power Stability	N/A	< 1% in 20 min; < 3% in 8 hours	Closed loop after warm-up
Orbit Altitude	N/A	Geosynchronous Orbit (~40,000 km)	
Radiation Dosage	N/A	TBD	
Reliability EOL	$R_g = 0.9$	$R_s = 0.99$	TBR
Temperature Ranges			
Operate in Spec	10 to 25°C		
Operate (not required in Spec)	N/A	5 to 30°C	
Non-Operate (no damage)	N/A	-10 to 50°C	
Maximum Temperature Rate of Change	± 4°C per hour		