

TO: Aerospace Community

FROM: NASA Ames Research Center (ARC)

SUBJECT: Request for Information: Design, Assembly, Test and Manufacture of Pico- or NanoSatellites

PLEASE NOTE: This is a request for information only and does not constitute a commitment, implied or otherwise, that NASA Ames will take procurement action in this matter. Further, neither NASA Ames nor the Government will be responsible for any cost incurred in furnishing this information. NASA is issuing this Request for Information to gain a better understanding of industry capabilities and to assess the current state of the technology. Responses to this RFI are to be submitted by Monday, August 15, 2011.

RFI Description and Requirements

NASA Ames Research Center invites you to submit a response to this inquiry, which will support preliminary activities associated with the development of a mission concept to demonstrate the development, launch and operation of a large swarm of pico- or nanosatellites. Multiple, advanced civil and commercial space mission concepts seek to leverage the advantages of small spacecraft deployed in massive numbers for a variety of applications, ranging from Low Earth Orbit (LEO) communications networks and multipoint space physics observations in the near-term, to third-generation geosynchronous (GEO) communications satellites, structure-less arrays for radio frequency (RF) and microwave sounding of the Earth's surface, and structure-less arrays for astronomical observations in infrared (IR), visible, and ultraviolet (UV) light in the far-term. Recent advances in pico- and nanosatellite bus design and testing using industrial grade consumer electronics promise to make the deployment of tens, hundreds, and potentially even thousands of small satellites affordable. By incorporating off-the-shelf, power efficient processors, memory, radios, accelerometers, rate gyros, magnetometers, GPS, batteries, power management, and cameras, industrial grade commercial systems provide a possible solution for extremely low cost spacecraft. This mission, named SwarmSat, will demonstrate the complementary technologies of large satellite swarms comprised of consumer electronics-based pico- or nanosatellites.

The SwarmSat project is a candidate mission being studied for the Edison Small Satellite Demonstration Missions Program funded by NASA's Office of the Chief Technologist (OCT). SwarmSat is being planned as a 3 year mission. If a project start date of October 1, 2011 is assumed, then the final launch for the potential SwarmSat mission should occur no later than September 30, 2014.

Conceptual designs of satellite subsystems and payloads that meet the mission goals are being developed at NASA Ames. This RFI will focus on the industrial design, development, assembly, integration, testing and mass production of pico- or nanosatellites based on existing commercial technologies for SwarmSat. The project goals for SwarmSat are to assist in:

- Determining the utility of large swarms or constellations of small spacecraft
- Lowering the unit cost of future small spacecraft
- Enabling the creation of new spacecraft applications

The primary mission objective for SwarmSat is to demonstrate the development, launch and operation of a large swarm of picosatellites or nanosatellites. There is a minimum target of 70 pico-/nanosatellites and a nominal target of 100+ pico-/nanosatellites to be assembled, integrated, launched and operated in LEO.

Baseline Concept for SwarmSat

NASA Ames has developed a very inexpensive baseline concept design to meet the mission objectives of SwarmSat. Approximate cost of assembly for this baseline design is less than \$4K per unit. Figure 1 below illustrates the final assembly of the baseline design. The reference design is based on a commercial, PC/104 format single board computer and the CubeSat standard specification. The specifications for this baseline design are as follows:

Current hardware:

- 500 MHz Geode Processor w/ 256 MB SDRAM
- PC/104 external single card Watchdog (Arduino-based)
- PC/104 external single card 2 Mpixel camera, magnetometer
- PC/104 External single card UHF transponder
- Mass: ~1400g
- Battery Bank 12x18650 3.7V cells, 2800 mAh
- Body mounted solar arrays (ATJ cells on FR4 substrate)
- 2 to 4 S/UHF/L band patch or tape antennas integrated with solar arrays
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- PC/104 external single card solar array and battery charge controller
- Extruded aluminum frame
- PC/104 external single card payload electronics
- Target volume (10 cm x 10 cm x 15 cm) (CubeSat 1.5U)

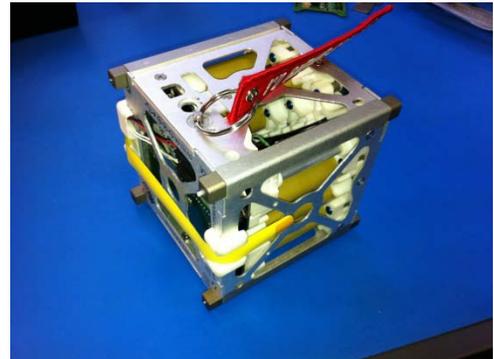


Fig 1. Assembly of Baseline Design

Guidelines for RFI Response

The specific objective of this RFI is to request information related to any of the technical challenges described below. In addition, please describe your company or organization's capabilities, skills, experiences and facilities that will enable you to develop and succeed in delivering solutions to the technical challenges presented below.

1. Design for Manufacturability

The SwarmSat design must be optimized for manufacturability. The reference SwarmSat was designed to meet performance requirements and not necessarily manufacturability. Designs for manufacturability will ultimately be required to facilitate mass production of the flight units while minimizing cost and schedule. The current mission objectives require manufacture of 70 to 100 spacecraft to be ready for launch by September 2014. Future demands may require manufacture of thousands of SwarmSats for numerous future applications. It is critical to the success of this project to develop a design that can be easily manufactured at a fraction of the cost of current pico- and nanosatellites.

In your response to this RFI, provide references or describe your experience with adapting a baseline nanosat or picosat design that was optimized for manufacturability while minimizing cost and schedule, or describe your company's capabilities to potentially develop such a design.

2. Assembly and Manufacture of SwarmSats

Describe your company's capabilities to assemble and manufacture 100 SwarmSats. Describe the tools, equipment, and personnel you would propose for assembly and manufacture. Discuss relevant procurement issues, including procurement scheduling, component manufacturing, parts screening, and any planned outsourcing. Include a ROM estimate of total cost and expected schedule to manufacture up to 100 SwarmSats.

3. Safety and Environmental Testing

The SwarmSats will be required to undergo a tailored set of spaceflight qualification and verification tests, including environmental tests and functional tests, optimized for cost and schedule vs. risk. It is envisioned that much of the required functional testing can be embedded into an assembly line or process, and that statistics-based sample and lot testing can be used to estimate the reliability of the process, and the SwarmSats, as a whole. Describe your company's standard system "designs for testability" (i.e. built-in testpoints/ATE) and describe your methods for embedding testing processes into the steps of assembly and manufacture. Describe your company's qualification, acceptance and verification test optimization for cost, schedule and risk.

Additional Information

NASA intends to use the results of its market research to aid in the development of requirements and acquisition strategy. The objectives of this RFI are: to provide industry with preliminary information regarding this potential acquisition, solicit information about potential sources and rough order of magnitude (ROM) cost/schedule estimates, and to notify industry of the Government's intent to potentially conduct site visits or hold informational meetings with industry to better assess current capabilities.

This preliminary information is being made available for planning purposes only, subject to FAR Provision 52.215-3, entitled "Request for Information or Solicitation for Planning Purposes." It does not constitute a Request for Proposal, and it is not to be construed as a commitment by the Government to enter into a contract, nor will the Government pay for the information submitted in response to this request. Although all comments received will be carefully reviewed and considered for inclusion in a later action, the initiators of this request make no commitment to include any particular recommendations.

Interested parties may submit questions by email to the identified POC. Pertinent information from questions and answers about this RFI will be shared with all interested parties, without disclosing the identity of the source of the question.

Written responses shall:

- 1) Not exceed 25 pages;
- 2) Use an Arial or Times New Roman font text with a size not smaller than 11 point;
- 3) Address all areas listed to the extent possible;
- 4) Figures, exhibits, and diagrams should be readable and are not included in the page limit;
and
- 5) Provide a Point of Contact to address questions from NASA.

Electronic responses, in either Microsoft Office or Adobe (PDF) format, are preferred.

Responses must also include the following information:

1) Company name, address, point of contact, phone number, fax, e-mail, and website (if applicable), 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 significant, relevant customers covering the past five years (briefly describe relevant work performed, contract numbers, point of contact phone number, fax, email, contract type, dollar value of each procurement).

2) Indicate whether your company is a Large business, Small business, Small Disadvantaged Business, 8(a) set-aside small business, HUBZone small business, Woman-owned small business, Veteran-owned small business, HBCU/MI, Service-Disabled Veteran-owned small business for relevant NAICS codes.

Questions about this RFI shall be submitted by email only to the Contract Specialist, Marianne.Shelley@nasa.gov.

All information received in response to this RFI that is marked Proprietary will be handled and protected accordingly. To the extent necessary, NASA will likely provide Proprietary information to its support service contractors who are under an obligation to keep third-party Proprietary information in confidence. By submitting a response to this RFI, the responder is

deemed to have consented to the release of Proprietary information to such NASA support service contractors. Responses to the RFI will not be returned.

Responses to this RFI are requested by 12 PM Pacific Time, on **Monday, August 15, 2011** and shall be submitted by email only to Marianne.Shelley@nasa.gov.

No solicitation exists; therefore, please do not request a copy of a solicitation. If a solicitation is released it will be synopsisized in FedBizOpps and on the NASA Acquisition Internet Service. It is the responder's responsibility to monitor these sites for the release of any solicitation or synopsis. Information about major upcoming ARC procurement actions is available at <http://ec.msfc.nasa.gov/cgi-bin/eis/admin/admin.cgi?center=ARC>