Nanosatellite Program – A Challenge to AMSAT for Collaboration to Use the Amateur Bands

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Abstract

A program is being funded by the AFSOR and DARPA to provide $100k each for ten universities to build ten nanosatellites (1kg –10kg). They will also provide the launch on the space shuttle on the SHELS launch platform in December of 2000. Teaming of universities, industries and other organizations is highly encouraged. This program provides an exceptional opportunity of OSCAR groups nation wide to support universities in this effort and show them how to do it the low-cost, innovate and faster "AMSAT" way. These nanosatellites could have transponder payloads for use by the amateur community as well as many other experiments that would be useful for future amatuer satellites.

Introduction and Motivation

The Space Systems Development Laboratory at Stanford University is one of a few universities in the United States that has an active university support program for students to build microsatellites and operate them in space. There have been many students and faculty that have interest in such activity, but due to perceived difficulty establishing such program these programs never been too successful.

During the Micro-Nanotechnology for Micro-Nanosatellites Workshop sponsored by the Air Force Office of Space Research (AFOSR) and the Defense Advanced Research Project Agency (DARPA) at Albuquerque, New Mexico on April 21, 1998, there was a call from the organizers of the conference to find ways to do more space experiments with smaller satellites at a lower cost. There was a challenge given to the workshop sponsors that they should consider funding a university nanosatellite development program and provide launches for these satellites.

The AFOSR and DARPA responded to this challenge and at the meeting established the Nanosatellite Program that would provide funding of $100,000 each to ten universities starting in October 1998 to build ten nanosatellites for launch at the end of the year 2000. As seen below, the nanosatellite is defined as weighting 10 Kg or less.

Program Definition

The following is a broad area announcement of this program published in June 1998.

Special Topic: University Nanosatellite Program
Points of Contact:
Howard Schlossberg, AFRL/AFOSR, (202) 767-4902
Joe Mitola, DARPA/STO, (703) 243-9830
Maurice Martin, AFRL/VSS (NRC), (505) 853-4118
Dr. Bill Clapp, AFRL/VSD, (801) 626-7272

This topic is only open to U.S. colleges/universities or consortia of universities. AFOSR and the Defense Advanced Research Projects Agency (DARPA) are jointly funding up to 10 research projects centered on the design and demonstration of nanosatellites. (Satellites sized 1 - 10 kg). These grants of $50k/year over two years will be awarded for universities to design, assemble, and conduct on-orbit experiments for these satellites. AFOSR and DARPA encourage universities to pursue creative low-cost space experiments to explore the military usefulness of nanosatellites. Experiments in formation flying, enhanced communications, miniaturized sensors, attitude control, maneuvering, docking, power collection, deorbit at end of life, or other on-orbit demonstrations of advanced space technology are of particular interest. Universities are encouraged to secure additional funding, hardware, and use of facilities from industry or government agencies and to identify the dollar value of these resources in the proposal.

Universities interested in payload development only are encouraged to team with universities who will be proposing satellite fabrication. Consortia of universities may submit proposals for multiple satellites but must have at least as many universities as the number of satellites proposed. Proposals should address the specific satellite research issues to be addressed and the anticipated satellite capabilities, and provide a plan for completing the project. A single university may submit multiple proposals and depending on the teaming arrangements may be part of more than one award. The proposal should provide specifics related to mission objectives, research issues to be addressed, estimated size and weight, experience in space research hardware fabrication, partners, key personnel, and a student management plan. Proposals should be less than 10 single-sided pages, be submitted by 30 Sept 98.

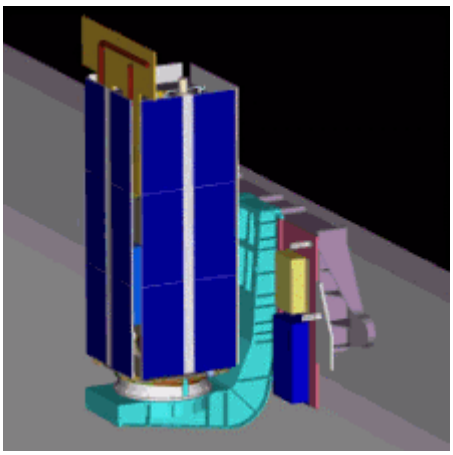
It is highly desirable that a large number of the research projects result in launch-ready nanosatellites. The satellites should be ready for launch not later than Sept 2000. Universities may arrange their own launches or may design to an AFRL-funded DoD or NASA shuttle launch on or after Dec 2000. Satellite dimensions must accommodate ten satellites and the deployment structure fitting within a shuttle hitchhiker payload volume of 54" x 42.5" x 24." Example satellite envelopes are 20" x 19" x 7.5" or 25" x 12" x 10.5", but other dimensions will be accommodated to the extent possible. Satellites should comply with shuttle design restrictions and withstand launch environments of both the shuttle and standard small launch vehicles. The operational life of the satellites may be any length of time greater than 1 month, but a design life of at least 4 months is highly encouraged. AFRL will supply the deployment structure and separation systems, payload integration, and assist with other system level concerns such as securing frequency clearances, clarifying launch environments, etc.

AFOSR and DARPA are interested in proposals from university coalitions to design, fabricate and prepare for launch sets of three nanosatellites capable of demonstrating formation flying, on-orbit local area communication networks, and other distributed satellite capability. It is desired

that the satellites have hardware that permits 1) accurate relative position determination, 2) thrust capability for precise orbital insertion for formation flying (minimal thrust expected after insertion), 3) local communications with at least one satellite having ground link capability, and 4) on-board memory for storing both uplinked commands and experiment data for downlink. Universities are encouraged to find low-cost and innovative ways of implementing the above functions or may propose alternate means of maintaining formation such as tethers or something other than active attitude and orbit control. Proposals need only address a level of on-orbit collaboration deemed feasible and may identify specific hardware to be provided by the government. Universities are not limited to the ideas presented, and may request assistance from AFRL, AFOSR, and DARPA in developing and implementing operational concepts of interest to DoD. These three satellites may have additional technology payloads as size, weight, and power allow.
To facilitate teaming among universities and with government space laboratories and industry, AFRL is sponsoring a web site at www.vs.afrl.af.mil/nanosats/ with university points of contact and general information regarding individual programs. This site will also contain information of general interest regarding launch environments, ideas for experiments, free hardware, technical interchange meetings, etc. Additions or corrections to the website may be emailed to martinr@plk.af.mil.

Launch Opportunity

One of the suggested launch environments, and separation system may be the Shuttle Hitchhiker Experiment Launch System (SHELS) launch platform. The SHELS system shown in Figure 1 is a non-canister ejection system for deployable payloads up to 400 lbs. that mounts to Orbiter sidewalk on shelf system. It provides deployment velocities of 1.5 ft/sec to 3.0 ft/sec (adjustable). The tip-off rate is less than 3 deg/sec and provides more volume to payload than traditional hitchhiker ejection system. The total volume allowed is 54" x 42.5" x 24" (approximate).



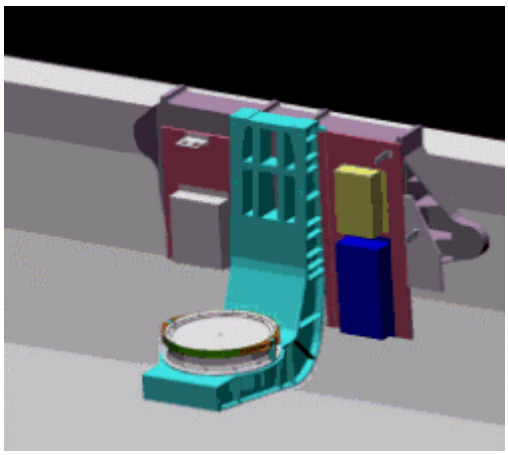


Figure 1 SHELS Launch Platform on NASA Space Shuttle

It has a simple marmon band and pyrotechnic bolt cutter interface. The four primary components are the umbilical capability (optional), ejection system, support shelf including thermal shroud, Multipurpose Interface Box (MIB).

This launch system would allow stacking 10 nanosatellites of dimensions 20" x 19" x 7.5" or 25" x 12" x 10.5". After launch from the shuttle, the carrier below would eject the nanosats.

A Challenge to AMSAT-NA for Collaboration

The challenge to AMSAT-NA is to aggressively contact possible universities that could participate in this program and with the help of AMSAT members that have expertise in designing and building microsatellites submit a proposal to be part of the nanosatellite program.

This would generate some modest funds of $100,000 to start their program and generate a lot of future AMSAT members and expertise to build new OSCAR satellite. There have been several attempts by AMSAT members in the past to form teams to build microsatellites but without the direct help of AMSAT have not been successful. The consuming efforts by most members on the P3D did not allow AMSAT to support these programs until now. With the efforts on P3D now coming to a conclusion, AMSAT-NA can generate some excitement by increasing their capability to build micro and nanosatellites at modest costs.

What can AMSAT members think of to do with one or two or more nanosatellites that would really stimulate the amateur/OSCAR community? Building AMSAT support groups for universities now to be part of the team can provide support that will make university winners in this program. This proposal is ten pages long. It is needs to be submitted by September 30, 1998 and selected universities will be allowed to charge expenses back to October 1, 998 even though the award will likely occur in November or December 1998.

Summary

The Nanosatellite Program for universities provides funding and a launch for ten nanosatellites. The AMSAT-NA community should be part of this program in supporting universities and helping build the next generation of OSCAR satellite builders and operators.

With AMSAT's help, universities that may not have been capable of participating in this program can now become competitive winners. Building micro/nanosatellites is an exciting and educational experience as many veteran OSCAR builders can testify. How about helping the communities experience this excitement and support your favorite university?

The Program at Stanford University is a direct result of the help AMSAT provided in the project with Weber State University in 1988-1990 in building the current OSCAR microsatellites. We thank you for that help and now challenge you to do the same for other universities.