Virginia Space Grant Consortium

Small Sat Virginia Initiative

For JCOTS Nanosatellite Advisory Committee
Mary Sandy, Director
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Small Sats Are Changing Space Business

Considered a disruptive technology.
Strong commercial interest in Small Sats.
• Shortened development times
• Months to a few years from concept to orbit
• Low cost access to space
• Cheaper launch costs – can often serve as ballast for rockets (shared launch costs benefit launch provide as well)
• More timely technology development and scientific gains (don’t lose technology improvements lost in long design and development cycles for large spacecraft; can capitalize on latest scientific understandings)
Commercial off the shelf components allow plug and play
Allows for higher risk tolerance
Small Sats can be used for missions that larger satellites can’t perform, such as setting up a constellation of communication nodes or conducting in-orbit inspection of larger satellites.
Permits smaller distributed platforms/constellations with more expansive coverage (Like QB-50)
2014

SpaceWorks’ 2014 Projection estimated between 140 and 143 nano/microsatellites across all sectors would launch globally in 2014; 158 nano/microsatellites were actually launched. This represented an increase of nearly 72% compared to 2013.

2015+

In 2014, 107 commercial nano/microsatellites (1-50 kg) launched and thousands of commercial small satellites (101-500 kg) are planned for launch over the next fifteen years. Recent multi-million and multi-billion dollar investments in various ventures confirm the commercial sector’s continued interest in the nano/microsatellite and small satellite industries.
Launch Opportunities Are Growing

**Key Small Sat Virginia goal** -- Capitalize on Virginia launch capabilities through MARS and NASA Wallops and to work with Virginia companies for launch services as appropriate.

Interorbital Systems, a Californian company, recently carried out a successful suborbital test flight of a small rocket (pictured right) designed to carry a 145kg payload. The company has presold berths for dozens of CubeSats at $13,000-38,000 per unit, as well as its own TubeSat format, which it offers to academia as kit and launch for $8,000.
Launch Opportunities Are Growing

• WASHINGTON, June 12, 2015 /PRNewswire-USNewswire/ -- NASA's Launch Services Program has issued a Request for Proposal (RFP) for new commercial Venture Class Launch Services (VCLS) for small satellites, often called CubeSats or nanosatellites, and experiments on science missions using a class of rockets smaller than any currently available to the agency.

• NASA will test an air-launched system in 2016 with Generation Orbit, an Atlanta company. It uses a Gulfstream G-IV executive jet to carry aloft a rocket which it fires off to put 45-50kg payloads into low-Earth orbit.

• NASA is also working with Virgin Galactic, a private space venture led by Richard Branson. Virgin Galactic has developed its LauncherOne, another air-launched rocket. It can be flown to a higher altitude and carry payloads up to 225kg.

• NASA launch opportunities for university payloads through Elana program as well as support for student payload development through the Undergraduate Student Instrument Program. NSF also has a small sat support program for universities.
Small Sat Projections

DARPA, the Pentagon’s R&D arm, has been working on a number of Small Sat technologies designed to reduce their weight and improve reliability and performance.

NASA, DOD, and National Security Agencies are all investing in small sat technologies and applications.

In the next five years or so some 1,000 nanosats, as small satellites of 1-10kg are called, are expected to be launched. (Technology Quarterly, June 2014)
Small Sat Projections

• Global small sat market currently estimated at about $41.6 billion and growing significantly.
• Drawing significant commercial investments.
  – OneWeb – a constellation of 648 small satellites for global Internet coverage (Richard Branson/Virginia Galactic and others)
  – Space X (Elon Musk) is creating “advanced microsatellites “that will orbit the earth in large clusters.
Nanosatellites Advisory Committee

Looking at next steps for the Commonwealth with respect to Nanosatellites

General charge -- to study the establishment of a Consortium of Space Science Education that would consist of universities, companies and other organizations in the field. The Consortium would advance research and development related to nanosatellite and cube satellites. Will look for possible federal partnerships, identify any impediments to the creation of a consortium and look at other incentives that might foster the creation and sustainability of a consortium.
Taking Virginia to Orbit by growing a small satellite cluster in the Commonwealth which will spur economic development.
Small Sat Virginia Partners
Organizational Participants

- Virginia Space Grant Consortium
- Virginia Commercial Space Flight Authority/Mid-Atlantic Regional Space Port (MARS)
- NASA Langley Research Center
- NASA Wallops Flight Facility
- National Institute of Aerospace.
- The American Institute of Aeronautics and Astronautics and the American Astronautical Society have also indicated their strong interest and support.
Industry Participants

Companies:

- Aerojet Rocketdyne
- Cubic Aerospace
- Deep Space Industries
- Gas Plume Imaging
- Global Atmospheric Technologies and Sciences (GATS)
- InTelSat General
- Moog
- NAL Research
- OmniEarth
- Orbital ATK
- Schafer Corporation,
- Science and Technology Corporation
- SpaceQuest
- VPT

Others have expressed interest and companies will continue to be added.
Collaborators

• Small Sat Virginia will work with organizations external to the Commonwealth who can advance the goals and interests of Small Sat Virginia in ways that benefit the Commonwealth.
• Collaborators who have provided letters of support include: Nanoracks, which provides launch and flight opportunities aboard the International Space Station
• New Worlds Institute, a visionary organization focuses on opening up the Space Frontier.
• Also anticipate working with the Student Spaceflight Experiments Program, which offers flight opportunities for precollege student teams, and potentially Kentucky Space, which offers a research lab on the International Space Station.
• Other collaborators are expected to emerge over time.
VSGC as Small Sat Virginia Lead

• Established Virginia aerospace coalition for education, workforce development and research.
• 26 years’ experience in development and leading statewide programs
• Strong history of partnership and coalition building – more than 500 nonmember partners
• Outstanding leveraging of resources -- $10.45/1 in 2014 for each Space Grant core dollar
• Small Sat Work Group since 2011 with numerous small sat projects
VSGC Flight Programs Heritage

- Cubesats
- Sounding rocket missions
- Microgravity experiments
- Space Station experiments
- Research balloon payloads
- Airborne experiments
- Design projects
52 Consortia:
Every state + D.C. and Puerto Rico

987+ Affiliates:
652 higher education
87 industry
83 governmental (state/local/federal)
76 museum/science centers
89 other local partners

Public/Private Partnerships

Established by Congress in 1987:
Public Law 100 - 147

Virginia Space Grant began in 1989
VSGC Member Institutions

College of William and Mary
Hampton University
Old Dominion University
University of Virginia
Virginia Polytechnic Institute and State University
NASA Langley Research Center
NASA Goddard Space Flight Center’s Wallops Flight Facility
State Council of Higher Education for Virginia
Virginia Community College System
Virginia Department of Education
MathScience Innovation Center
Science Museum of Virginia
Virginia Air and Space Center
Center for Innovative Technology

VSGC has worked with more than 500 program partners
Organizational Structure – Advisory Committee

• VSGC Director and VSGC Program Manager
• University Representatives engaged in Small Sat activity
• MARS
• NASA Langley

• NASA Wallops
• Industry Representatives
• Representatives from Technology, Transportation, Education and Commerce Secretariats.
Organizational Elements

- Advisory Committee will meet at least twice annually and more frequently as needed.
- Participant meetings will be held at least quarterly with both in-person and WebEx options.
- Virtual meetings will be held as needed between formal meetings.
- Establishment of committees as needed for proposal review, proposal development, etc.
Mission

To grow a Small Sat Aerospace Cluster in the Commonwealth to foster economic development.
Goals

Leveraging state capabilities, maximize Virginia engagement in Small Sat initiatives for
✓ economic development
✓ technology development and demonstration
✓ scientific advancement
✓ workforce development / STEM education
✓ enhanced utilization of state aerospace resources and capabilities.
Goals

• Make Virginia the “go to” state for Small Sat business, mission and launch support.

• Grow Virginia businesses through engagement in the Small Sat Virginia Initiative.

• Foster a strong workforce pipeline for the Virginia aerospace sector and build university research capabilities through university involvement in small sat initiatives in partnership with NASA, DOD, and industry, as well as fostering precollege engagement.
Objectives

• Foster the development of university Small Sat initiatives at individual institutions and across institutions.

• Support instrument development and science objectives best achieved with Small Sat payloads.

• Engage university, industry and NASA partners.

• In partnership with the Mid-Atlantic Regional Spaceport and NASA Wallops, create opportunities for university as well as industry-led Small Sat launch opportunities/capabilities.
Objectives

• Pursue opportunities for university-led Small Sat launches with NASA, NSF, DOD and other organizations as appropriate.

• Provide mentoring, professional development and cross training for faculty and students at Virginia universities, colleges and community colleges who wish to undertake Small Sat programs.

• Grow research capabilities and funding at Virginia universities.

• Foster interest in flight projects at precollege institutions to contribute to STEM workforce pipeline.
Workforce Development

- Workforce development is a key product for Small Sat Virginia.
- University Small Sat programs provide students with invaluable experience in real space missions providing a workforce pipeline to aerospace companies.
- Students learn the parameters and challenges of the space environment.
- Small Sat projects contribute to research infrastructure at Virginia institutions of higher education.
Virginia’s Aerospace Assets for Small Sats

- NASA Langley -- design, development, and environmental test and qualification expertise for cubesat payloads and cubesat and small sat flight systems, as well as participation in other NASA Launch Opportunities.

- NASA Wallops -- engineering and mission planning support services as well as participation in other NASA Launch opportunities.

- Mid-Atlantic Regional Spaceport (MARS) potential for launch services.
University Aerospace Assets for Small Sats

- Space@VT -- end-to-end expertise and facilities to design, build, test, and fly cubesats, other Small Satellites, and space payloads.

- UVa -- Research and education in space science and technology, including undergraduate flight projects.

- ODU -- expertise in both mechanical and electrical engineering aspects of small satellite systems, as well as systems integration. Specific strength areas include orbital mechanics (navigation, formation flying, orbital rendezvous), thermal physics and hypersonic flow for entry/descent, communications systems and electronic.

- Ground Tracking Stations at Virginia Tech and Old Dominion University and potentially at Hampton University (in development).

- The College of William and Mary – support for mission science, detector development, signal, algorithm and computational analysis, and engineering design.

- Hampton University – offers extensive expertise and experience in atmospheric science research and satellite payloads.
Virginia’s Aerospace Industry

Virginia is fortunate to have a wealth of companies engaged in the Small Sat enterprise. Many have already joined the Initiative. Strong interest on the part of industry.

Aerospace firms - 267 with 438 locations

Direct economic output of Virginia’s Aerospace Industry of 7.4 billion plus $4.7 billion in support of additional economic activity in Virginia.

Fourteen companies are currently partners, but many Virginia companies are expected to have an interest.
# Aerospace in Virginia

## Major Employers
- AERIAL Machine & Tool
- Aerojet
- Alcoa Howmet
- Aurora Flight Science
- BAE Systems
- Boeing
- Cobham North America
- Dynamic Aviation Group
- EADS North America
- Euro Composites
- General Dynamics
- Goodyear Tire & Rubber
- Kollmorgen
- L-3 Communications
- Lockheed Martin
- Measurement Specialties
- Moog
- Northrop Grumman
- Orbital ATK
- Raytheon
- Rockwell Collins
- Rolls-Royce N. A.
- RTI International Metals
- The Aerospace Corp.
- Triumph Aerospace

## Military and Federal
- The Pentagon
- Central Intelligence Agency
- Dept. of Homeland Security
- Fort Belvoir
- Fort Lee
- Fort Myer
- Fort Pickett
- Joint Base Langley-Eustis
- Marine Corps Base Quantico
- Missile Defense Agency
- National Ground Intelligence Center
- National Reconnaissance Office
- Naval Air Station Oceana
- Naval Surface Warfare Center, Dahlgren
- Navy Commander Operational Test and Evaluation Force
- Norfolk Naval Base
- Office of Naval Research
- Space and Naval Warfare Systems Command

## Research and Development
- Commonwealth Center for Advanced Manufacturing
- Commonwealth Center for Aerospace Propulsion Systems
- Defense Advanced Research Projects Agency
- NASA Langley Research Center
- National Center for Coatings Application, Research & Education
- National Center for Hypersonic Combined Cycle Propulsion
- National Institute of Aerospace
- Virginia Modeling, Analysis, and Simulation Center
- Virginia Space Grant Consortium

## Education
### University
- Virginia Tech
- University of Virginia
- Old Dominion University
- Virginia Commonwealth University
- Liberty University
- Hampton University
- Averitt University

### Community College
- Blue Ridge Community College
- John Tyler Community College
- Thomas Nelson Community College

### High School
- Aviation Academy of Newport News
- Public Schools

## Airports
- Washington Dulles International Airport
- Ronald Reagan Washington National Airport
- Charlottesville-Albemarle County Airport
- Lynchburg Regional Airport
- Newport News-Williamsburg International Airport
- Norfolk International Airport
- Richmond International Airport
- Roanoke Regional Airport
- Shenandoah Valley Regional Airport
- 57 general aviation airports
**Budget request is $4 million dollars per year.**

- Core/base funding from Commonwealth. Leverage State funding through partnerships with federal, industry and other organizations.

**Internships - $150K**
- For Virginia university students with industry and federal labs.

**Program Administration - $225K:**
- Full time staff lead at VSGC plus half time administrative support, travel; **ODURF**

**Indirect Costs - $305K**

**Estimated Contributed Costs – $800K**

**Funding for Launch Opportunities – $920,000**
- MARS and NASA Wallops opportunities
- Funding pool to support other launches as needed.

**Small Sat Payload Projects - $2.4 million**
- Plus any funding the Initiative is able to leverage from other sources (NSF, NASA, DoD, Industry, VSGC).
Economic Impacts
Small Sat Virginia

- Virginia Tech Office of Economic Development retained to do economic impact analysis, including state of the satellite and small satellite industry national and globally.
Contact

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