

**Small Sat Virginia Initiative Proposal
for the
Virginia Joint Commission on Technology and Science
Nanosatellite Technology Subcommittee**

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Background

This proposal is submitted by the Virginia Space Grant Consortium (VSGC) in response to the general charge of the JCOTS Nanosatellite Technology Subcommittee:

*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 looking for possible federal partnerships, identifying any impediments to the creation of a consortium, and looking at other incentives that might foster the creation and sustainability of a consortium.*

At the November 2014 Subcommittee meeting, VSGC proposed that it lead a Small Sat initiative for the state in collaboration with VSGC members and other university, industry and federal partners. VSGC was encouraged to bring a preliminary proposal for consideration by the Subcommittee at its June 2015 meeting. The Consortium was asked to provide a more detailed proposal for the September 16, 2015 Subcommittee meeting. This proposed approach builds upon the work of the VSGC Small Sat Working Group initiated in 2011 and extensively expands that effort to embrace 29 partnering NASA, industry and organizations. It also uses the term, "Small Sat" instead of "nanosatellite" to encompass the broader range of small satellite classes (up to 1100 lbs.).

Small Sat Virginia Initiative



This proposal requests funding from the Commonwealth of Virginia to seed and to provide a core level of funding for sustainability for a Small Sat Virginia Initiative. The Initiative would leverage funding from other sources to build and grow the program.

The mission of Small Sat Virginia is to grow a Small Sat Aerospace Cluster in the Commonwealth to foster economic development.

Goals:

- **Leverage State Small Sat interests and capabilities to maximize Virginia engagement in the multibillion dollar and growing Small Sat sector for economic development, technology development and demonstration, scientific advancement, workforce development, STEM education, and enhanced utilization of state aerospace resources and capabilities.**
- **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.**

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 **much needed** workforce pipeline to aerospace companies. Small Sat projects contribute to research infrastructure at Virginia institutions of higher education.

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.
- Foster networking among university, industry and NASA partners.
- In partnership with the Mid-Atlantic Regional Spaceport and NASA Wallops Flight Facility, create opportunities for university as well as industry-led Small Sat launch opportunities/capabilities.
- 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 the STEM workforce pipeline.

The Initiative creates opportunities for synergy within Virginia's Aerospace Sector (annual economic output of \$12.1B) and an economic engine for growth for Virginia Small Sat capabilities. The global market for Small Sats is currently projected at about \$41.6 billion with the United States currently commanding about 43% of the market. The market is expected to grow at least 17% over the next five years. By synergizing existing small sat capabilities within the Commonwealth through Small Sat Virginia, the Commonwealth is poised to better capitalize on the emerging Small Sat business opportunities. These capabilities include:

- NASA Langley can provide 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 can provide engineering and mission planning support services as well as participation in other NASA Launch opportunities.
- The Mid-Atlantic Regional Spaceport can seek opportunities to provide increased launch services for small sat payloads.
- Ground Tracking Stations at Virginia Tech and Old Dominion University and potentially at Hampton University (in development).
- Space@VT at Virginia Tech offers end-to-end expertise and facilities to design, build, test, and fly CubeSats, other Small Satellites, and space payloads.
- The University of Virginia (UVA) offers research and education in space science and technology, including undergraduate flight projects.

- Old Dominion University (ODU) offers 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 electronics, digital controls, and solar power systems.
- College of William & Mary can provide support for mission science, detector development, signal, algorithm and computational analysis, and engineering design support in its Innovation & Design Studio, prototyping spaces, and student machine shops, including systems integration in high bay assembly areas.
- Hampton University offers extensive expertise and experience in atmospheric science research and satellite payloads. Expertise includes atmospheric remote sensing of Earth and planets, atmospheric dynamical modeling, solid planet dynamics and satellite geodesy. Facilities include a LIDAR laboratory, satellite data center and image processing lab.
- There are many Virginia companies with a wide range of capabilities and interests in the Small Sat enterprise. Virginia is fortunate to have companies such as Orbital ATK and IntelSat General with Small Sat capabilities including launch, payload and mission support services, and a range of other companies with interests ranging from Small Sat component manufacturing, sensor development, and reconnaissance to earth resources monitoring and deployer capabilities. Fourteen companies have already signed on as partners to the initiative as noted.

Letters of commitment and support from 26 participants are provided in Section III. As the Initiative becomes a reality, the number of interested companies is expected to increase significantly.

Organizational Structure

- **Leadership** -- Small Sat Virginia will be led by Virginia Space Grant Consortium, which will draw on its extensive experience in managing statewide aerospace initiatives. The project will be overseen by the VSGC Director, Mary Sandy, whose time will be contributed by the VSGC, and staffed by a full-time Program Manager with Small Sat industry experience and a half-time Administrative Assistant.
- **Advisory Committee** -- An Advisory Committee will be comprised of the VSGC Director and VSGC Program Manager, representatives from Universities with current active CubeSat projects plus representatives from MARS, NASA Langley, NASA Wallops Flight Facility, corporate partners, and the Technology, Transportation, Education and Commerce Secretariats. All partners to this initiative have committed to having a representative who will serve on the Initiative's Advisory Committee.

- **Participants:**

Universities: University of Virginia, Virginia Tech, Old Dominion University, William and Mary, Hampton University and other Virginia Universities with Small Sat Interests. (Potentially VCU, GMU and JMU)

Organizations: Virginia Space Grant Consortium, Virginia Commercial Space Flight Authority/Mid-Atlantic Regional Space Port (MARS), NASA Langley Research Center and 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.

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, and VPT. Note: 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; and the New Worlds Institute, a visionary organization focuses on opening up the Space Frontier. VSGC also anticipates working with the Student Spaceflight Experiments Program, which offers flight opportunities for precollege student teams, and potentially Kentucky Space, which offers a microgravity research lab on the International Space Station. Other collaborators are expected to emerge over time.

Meetings: The 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.

Why Virginia should invest in the Small Sat Virginia Initiative

The Virginia Space Grant Consortium commissioned a study by the Virginia Tech Office of Economic Development to assess the economic impact of the proposed \$4 million Commonwealth investment in the Small Sat Virginia Initiative. The study results are provided in Section IV of this proposal.

The study describes the magnitude of the global satellite industry (\$208 billion in 2014) and the explosive growth of its small satellite component (at least 20% of the market and growing). It also sets forth the resulting potential to contribute to growth in numerous related industry sectors, such as satellite TV, satellite radio, broadband, mobile satellite and aviation, as well as the development of space-based solutions to issues on Earth using low cost Small Sat technology for communication, earth imaging, earth resource monitoring and reconnaissance. The Small Sat market is projected to grow at 17% over the over the next five years. The study very conservatively projects a return to the Commonwealth of \$13.5 to \$16.2 million and at least 57 to 89 new jobs for a three-year, \$12 million Commonwealth investment. It notes that cluster development literature and regional case examples suggest nurturing a Small Sat cluster in which significant assets and an already high concentration of industries exist, like those found for Small Sat in Virginia. In this case, state investment makes sound economic sense. The study also points to the strong return on investment to other states like Kentucky and Kansas and to investments by foreign countries such as France and Morocco for similar kinds of growing technology sectors.

Descriptions of Small Sat Virginia Non-University Partners and Collaborators (as of September 15, 2015)

Virginia Space Grant Consortium

Established in 1989, the Virginia Space Grant Consortium is a coalition of Virginia universities, NASA Langley Research Center, NASA Wallops Flight Facility, state agencies and other Virginia organizations committed to aerospace, STEM and high tech education, workforce development, and research. Part of NASA's National Space Grant College and Fellowship program, VSGC's award-winning programs have significantly impacted aerospace, STEM and high tech education, workforce development, and research in the Commonwealth. Programs include university-led space flight initiatives, statewide industry and national federal internship programs, more than \$6 million in scholarships and fellowships to Virginia students, STEM student enrichment programs and faculty professional development institutes and workshops. In recent years, each seed dollar invested by NASA's Space Grant program has resulted in about \$8 in leveraged funding. VSGC has worked with more than 500 non-member partners and has demonstrated success in leading coalitions of partners in statewide and national initiatives.

Aerojet Rocketdyne

Aerojet Rocketdyne is an innovative company delivering solutions that create value for its customers in the aerospace and defense markets. The company is a world-recognized aerospace and defense leader that provides propulsion and energetics to space, missile defense and strategic systems, tactical systems, and armaments areas in support of domestic and

international markets. Aerojet has facilities in Orange and Gainesville, Va., and offices in Washington, DC.

American Astronautical Society (AAS)

Formed in 1954 and headquartered in Reston, Va., the American Astronautical Society (AAS) is an independent scientific and technical society of aerospace professionals and organizations in the United States dedicated to the advancement of space science and exploration. AAS supports NASA's Vision for Space Exploration and is a member of the Coalition for Space Exploration and the Space Exploration Alliance. AAS also focuses on strengthening the global space program through cooperation with international space organizations. AAS members include: engineers, scientists, administrators, institutions and corporations working in support of the nation's space activities, as well as military space specialists, physicians, lawyers, educators, historians, journalists, artists and other professionals. AAS runs national meetings, symposia and publications.

American Institute of Aeronautics and Astronautics (AIAA)

The American Institute of Aeronautics and Astronautics (AIAA), located in Reston, Va., has more than 30,000 individual members from 88 countries, and 95 corporate members. AIAA is the world's largest technical society dedicated to the global aerospace profession. Created in 1963 by the merger of the two great aerospace societies of the day, the American Rocket Society (founded in 1930 as the American Interplanetary Society), and the Institute of the Aerospace Sciences (established in 1933 as the Institute of the Aeronautical Sciences), AIAA carries forth a proud tradition of more than 80 years of aerospace leadership. AIAA's purpose to ignite and celebrate aerospace ingenuity and collaboration, and its importance to our way of life; to provide a lifelong link to the aerospace community; and to serve as a champion for its achievements.

Cubic Aerospace

Cubic Aerospace is a Limited Liability Corporation founded in 2013, and headquartered in Reston, Va. Cubic's owner, John Bevilacqua, spent over 10 years at Orbital ATK (formerly Orbital Sciences), and led their analog/power electronics design department for nearly three years.

Cubic currently offers services in the design, manufacture, test, and operation of space power systems and avionics. In addition to providing these services to both government and commercial customers, Cubic is developing innovative transient protection devices through a Small Business Innovative Research (SBIR) grant. Cubic recognizes the growing market for Small Sat components and engineering services, and is actively pursuing Small Sat business development through projects with commercial customers and proposals to government agencies.

Deep Space Industries

Deep Space Industries (DSI) is an asteroid mining company, changing the economics of the space industry by providing the technical resources, capabilities, and system integration required to prospect for harvest, process, manufacture, and market in-space resources. These resources, found on easily accessible near-Earth asteroids, will provide unlimited energy and supplies for a growing space economy. Asteroids will be mined to secure water, propellant, and building materials to serve growing space markets. From extending the profitability of commercial satellites to providing life support and power to new private-sector orbiting research stations, DSI is enabling the settlement of the final frontier.

DSI is already generating revenue from commercial contracts as well as government and university research projects. Examples include designing and manufacturing a constellation of small satellites for communication and computing applications, and NASA partnerships for testing emerging space technologies. Patents have been filed on asteroid-processing technologies as well as innovative Cubesat-compatible propulsion, communications, power, and operations technologies. The company is innovating nano-sat, robotic, and mining technology. As a bi-product of its bold goals to mine the sky, it has also developed innovative technologies with applications much closer to home. The company is adjacent to NASA Ames Research Center in Moffett Field, Calif.

Gas Plume Imaging, A Subsidiary of Global Atmospheric Technology Science

Gas Plume Imaging (GPI), LLC is a company providing air quality monitoring services using networks of revolutionary sensors for Oil and Natural Gas and related industries. GPI brings major advances in gas detection technology by offering complete low-cost solutions (fixed, ground mobile or airborne for pipeline monitoring) based on sensitive next-generation remote sensing instruments that deliver superior measurements for real-time identification of leaks as well as analyzing, quantifying, and mapping fugitive emissions (either toxic, combustible, or explosive gases).

GPI, LLC (Boulder, Colo.) was founded in January 2014 by Larry Gordley (Newport News, Va.) and David Fritts (Colorado) of GATS Inc., leading experts in atmospheric remote sensing with a successful history of relevant projects for NASA, NSF, and other U.S. government agencies. GPI, LLC was formed to commercialize specific gas detection technologies, based on the intellectual property that GATS Inc. has developed and improved over the past 30 years.

Global Atmospheric Technology Science

Global Atmospheric Technologies and Sciences (GATS) is an innovative aerospace company focusing on remote sensing and atmospheric science. GATS provides instrument development, flight operations, retrieval algorithms, and data processing/management systems for NASA

research missions and other remote sensing programs. At its main office in Newport News, Va., GATS houses the Satellite Payload Operations Center and Scientific Computing Facility, from which it operates and processes science data from multiple satellite instruments.

IntelSat General Corporation

Located in McLean, Va., Intelsat General Corporation (IGC) provides a wide range of customized, secure, end-to-end communications solutions for commercial, government, and military customers. These solutions allow IGC's customers to expand their communications flexibly, reliably and globally, earning IGC a reputation as a trusted and innovative industry leader. IGC is an indirect, wholly owned subsidiary of Intelsat S.A, the world's largest and most experienced provider of fixed and mobile satellite services for many of the world's leading media and network companies, ISPs and government agencies. IGC's administrative offices and the majority of its employees are located in the United States as is the Satellite Operations Center used to command and control the spacecraft. IGC provides far more than just satellite bandwidth. It also crafts unique solutions derived from its unmatched technical know-how and global reach. Its fleet of approximately 50 satellites and 36,000+ miles of terrestrial fiber optic cable with strategically located teleports and PoPs worldwide allow its customers to meet all of their communications needs, from routine to mission-critical.

Mid-Atlantic Regional Spaceport/Virginia Commercial Space Flight Authority

The Virginia Commercial Space Flight Authority (VCSFA) was created in 1995, with the mission of promoting commercial space activity, economic development and aerospace research within the Commonwealth of Virginia. VCSFA began its lease at Wallops Island in 1997, and continually expanded the Mid-Atlantic Regional Spaceport (MARS) facilities to its present-day state, with two launch facilities (one mid-class and one small-class launch facility), as well as access to support infrastructure facilities through agreements with NASA, such as vehicle and payload processing integration facilities, support instrumentation, and emergency facilities. MARS is licensed by FAA for orbital launches. Building upon a 55-year legacy of experience gained during over 16,000 rockets launched from NASA Wallops Flight Facility, MARS provides the best alternative for responsive, cost effective, reliable mission capable access to space.

Moog

Located in Blacksburg, Va., Moog is a company focused on solving difficult engineering problems for motion control, air moving, electronics and fiber optic applications. It provides innovative design and manufacturing for both standard and custom products. It is the market leader in slip rings, fractional horsepower brushless DC motors and fiber optic products. Moog's portfolio of products supports the aerospace, defense, marine, medical, commercial and industrial markets. Every day, its employees dedicate their time and energy to delivering outstanding products and tackling the tough problems. Moog's unique corporate culture

promotes trust, mutual respect and an atmosphere where great ideas drive incredible, intricate, high-tech designs with demanding requirements.

NAL Research

NAL Research, based in Manassas, Va., has been developing and manufacturing satellite transceivers since 1997, for the US DoD, foreign MoDs (Ministry of Defense), federal agencies, law enforcement bureaus, commercial sectors, and universities. These products are being used worldwide by thousands of organizations in operations including asset tracking, search and rescue, remote sensing, and command/control of both ground and airborne platforms. Its devices are critical parts of many DoD's and federal agencies' Intelligent, Surveillance and Reconnaissance (ISR) systems. Its products are also critical parts of many commercial tracking systems. NAL Research had supported many universities and federally funded research and development centers (FFRDCs) on various small satellite programs including the University of Virginia, Texas A&M University, The MITRE Corporation, The Aerospace Corporation, and NASA, just to name a few.

Nanoracks, LLC

NanoRacks, LLC located in Webster, Texas was formed in 2009, to provide commercial hardware and services for the U.S. National Laboratory onboard the International Space Station via a Space Act Agreement with NASA. The company has grown into the Operating System for Space Utilization by having the tools, the hardware, and the services to allow other companies, organizations, and governments to realize their own space plans. To date, over 200 payloads have been deployed by the Company on the International Space Station and its customer base includes the European Space Agency (ESA) the German Space Agency (DLR,) the American space agency (NASA,) US Government Agencies, Planet Labs, Urthecast, Space Florida, NCSSE, Virgin Galactic, pharmaceutical drug companies, and organizations in Vietnam, UK, Romania, and Israel. Its customer base has propelled NanoRacks into a leadership position in understanding the emerging commercial market for low-Earth orbit utilization.

NASA Langley Research Center

Founded in 1917, as our nation's first civilian aeronautical research lab, NASA Langley Research Center is NASA's original field center. Today, NASA Langley is a research, science, technology, and development center that provides game-changing innovations to enable NASA's significant contributions to the nation. With a workforce of around 3600 people, pretty evenly mixed between civil servants and contractors, and an annual operating budget of about \$840 million, NASA Langley conducts ground-breaking research, and develops and demonstrates critical technologies that address national priorities in aeronautic applications,

space exploration and Earth sciences. Langley has a strong interest in Small Sat technologies particularly as they apply to Earth sciences research and technology demonstration.

NASA Wallops Flight Facility

NASA's Wallops Flight Facility is the agency's premier location for conducting research using suborbital vehicles: aircraft, scientific balloons, and sounding rockets. In addition, Wallops manages all aspects of Goddard Space Flight Center's SmallSat program. Furthermore, Wallops is a leader in the development, integration, testing, and operations of numerous small orbital projects including, among others, the Cosmic Ray Energetics and Mass (CREAM) instrument, Launch Vehicle Services for NASA's Lunar Atmosphere and Dust Environment Explorer (LADEE) mission, and full program management of the former Get Away Special (GAS) and Shuttle Attached Payloads Program. Wallops' partnership with the Commonwealth's Mid-Atlantic Regional Spaceport expands the facility's capabilities in supporting the launch of orbital vehicles.

Since its beginnings in 1945, as a facility for conducting high-speed research on aerodynamic designs, Wallops has launched more than 16,000 rockets carrying aircraft models, space and earth science experiments, technology development payloads, and satellites. Today, Wallops builds on its legacy serving as NASA's only launch range providing range safety, surveillance, vehicle tracking and communications, command systems, meteorological services, optical systems, a range control center, payload processing, and launch vehicle integration facilities. One of only four locations inside the United States for launching payloads into orbit, Wallops is a vital national asset providing assured access to space. The facility's estimated economic impact across the United States is \$808 million generating more than 5,700 jobs.

National Institute of Aerospace

The National Institute of Aerospace (NIA) is a non-profit research and graduate education institute located in Hampton, Va., that was created to conduct leading-edge aerospace and atmospheric research, develop new technologies for the nation, and help inspire the next generation of scientists and engineers. Since 2002, NIA has served as a partner with NASA Langley Research Center to further the agency's national missions in aeronautics, space exploration and science. NIA conducts a unique graduate program offered at NIA and NASA Langley by its member universities. NIA's research, education and outreach programs involve more than 200 people on projects sponsored by NASA, the Federal Aviation Administration, the Department of Defense, the National Science Foundation, and the commercial aerospace industry.

New Worlds Institute

The Members and Associates of the Austin-based New Worlds Institute are individuals from around the globe dedicated to harnessing the ideas and expertise to open the space frontier in our lifetime. The New Worlds Institute conducts international symposia and sponsors the building and testing of flagship technologies, systems, and ideas that will help those operating in the space frontier to survive and thrive.

OmniEarth

OmniEarth based in Arlington, Va. offers a variety of geospatial solutions and information services that provide decision makers with the data they need to make informed decisions. OmniEarth specializes in image processing, data fusion, big data and predictive analytics, answering the questions most pertinent to industry, government, and consumers.

Orbital ATK

As a global leader in aerospace and defense technologies, Orbital ATK designs, builds and delivers space, defense, and aviation-related systems to customers around the world both as a prime contractor and as a merchant supplier. The main products include launch vehicles and related propulsion systems; satellites and associated components and services; composite aerospace structures; tactical missiles, subsystems and defense electronics; and precision weapons, armament systems and ammunition. Headquartered in Dulles, Va., Orbital ATK employs more than 12,000 people in 20 states across the U.S. and several international locations. Orbital ATK comprises three operating groups: Flight Systems Group, Defense Systems Group and Space Systems Group. They are the major builders of satellites and related subsystems to include over 225 space systems and more than 800 space components delivered or in production and are the leading operator of small research rockets and high-altitude scientific balloons with about 30 missions conducted per year. Orbital ATK provides the commercial resupply missions to the International Space Station which are launched from the Mid-Atlantic Region Spaceport at Wallops Island, Va.

Planetary Systems Corporation

Planetary Systems Corporation (PSC), located in Silver Spring, Md., is a dynamic, small aerospace company founded in 1998 with the goal of providing high-quality, affordable mechanical systems to the aerospace industry. PSC is a major provider of advanced separation systems for use on spacecraft.

Schafer Corporation

Created in 1972, Schafer Corporation based in Arlington, Va. began as a specialist in challenging and advanced technology development for government and industry, focusing on directed energy and electro-optics. Schafer also provides innovative engineering and technology to the military, intelligence, DHS, NASA, new commercial space companies and other industries. Schafer is engaged in complex, high-level missions and programs, guiding efforts such as development, modeling, simulation, communication, and technology management.

Science and Technology Corporation

Established at Hampton, Va., in 1979, Science and Technology Corporation (STC) is an innovative, award-winning, minority-owned small business that has been providing high-value science, technology, and support services to the US Government for over 30 years — principally to NASA, NOAA, DOD, and USCG. Now with 11 principal locations — including international — and a staff of around 300, STC is strongly positioned and committed to providing in-depth research, development, engineering, support, and management services, leveraging its core competencies in the domains of 1) Small Satellites; 2) Atmospheric Sciences; 3) Remote Sensing; 4) Scientific Data Processing; 5) Aerospace Modeling and Simulation; 6) Electromagnetic Systems Research; 7) Range Test and Evaluation; 8) Chemical-Biological Defense; 9) Chemical-Demilitarization; 10) Arctic and Antarctic area Marine Transportation; 11) Ship Structures Performance Monitoring; and 12) Program Support.

SpaceQuest

SpaceQuest, Ltd., located in Fairfax, Va., is a leading developer of advanced satellite technology for government, university and commercial use since 1994, specializing in the design, development, testing, and manufacture of spacecraft as well as space and ground components for operation with low-Earth orbiting satellites. Through innovative designs and the latest electronic technology, SpaceQuest is building microsatellites and satellite components faster and more cost effectively than ever before. SpaceQuest built and launched 18 satellites on nine launch campaigns in the last 20 years. Its microsatellite bus has flown 15 times for academic, commercial, and government customers. SpaceQuest became a pioneer in commercial space-based AIS data collection with the launch of its first AIS satellite in 2007.

VPT

VPT Inc., headquartered in the Virginia Tech Corporate Research Center (VTCRC) located in Blacksburg, is one of the world's leading designer and manufacturer of high reliability, DC-DC power converters focused on military, commercial aerospace, satellite, and high-end industrial applications. VPT space products are presently flying on GPS satellites, NASA and international missions to Mercury, Venus, Mars, the Moon, Pluto, and the International Space

Station. Other applications include the F-35 Fighter, Predator Drone, the PAC-3 Missile, and Boeing 787 and 777 aircraft. VPT has 55 employees in Virginia, 10 in Seattle, Wash., nine in Boston, Mass., and 150 in Taiwan. In addition, VPT has a strategic partnership with PPI-Time Zero in Waynesboro, Va., for the manufacture of certain product lines. VPT was founded in 1993 by Dr. Dan Sable and Dr. Fred Lee as a spin-off of the Virginia Tech Center for Power Electronic Systems (CPES). In 2009, VPT was acquired by Heico Corporation (NYSE: HEI) based in Miami, Fla. and presently operates as an independent subsidiary of their Electronic Technologies Group (ETG). VPT has several hundred customers that include all of the leading aerospace firms such as Orbital Sciences, Lockheed Martin, Raytheon, BAE, Boeing, Harris, Hamilton Sunstrand, and L3 Communications.

Budget Overview

A detailed budget is provided in Section II. The following chart offers an overview.

Budget request is \$4 million dollars per year.

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

Estimated Contributed Costs – \$800K

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**

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).

Commonwealth funding would be set aside to support Small Satellite activities over a wide range of opportunities:

- Launch opportunities that can be created through the Mid Atlantic Regional Spaceport (MARS) and NASA Wallops Flight Facility.
- Securing International Space Station (ISS) launch and flight opportunities.
- Securing flight opportunities through other venues.
- Matching as needed for NSF, NASA and DOD-funded Small Sat flight opportunities as well as commercial venues.
- Continued collaboration with NASA Langley and NASA Wallops for flight programs and mission support.
- Small Sat university payloads of varying sizes.
- Fostering pipelining activities with K-12 projects and with graduate and undergraduate students providing K-12 mentoring and outreach.
- Supporting and facilitating partnerships for industry Small Sats.
- Exploring synergistic opportunities like the current VSGC QB-50 collaboration between the VSGC and French partners.
- Workshops/professional development/cross training opportunities for faculty and students across institutions.
- Matching funding for federal awards that provide flight opportunities only or funding limited to development. This would support efforts already deemed worthy by federal agencies based on a competitive process.
- Internships for university students with NASA, DOD and industry.

The VSGC conservatively estimates contributed costs of \$800,000 per year from partnering organizations and other sources. VSGC will contribute \$28K in cash each year to student projects and the Director's time which is estimated at about \$22k per year.

Opportunity announcements and funding opportunities will be widely distributed to interested parties with a competitive selection process. It is anticipated that a large portion of funding for payload projects would be allocated through a streamlined RFP process with varying amounts available through different types and levels of awards as delineated in the detailed budget. A portion of the funds would be set aside for emerging opportunities and be allocated on a case-by-case basis. Some funding would be used for smaller requests, such as precollege initiatives or to fund a component of a Small Sat project. VSGC has a state budget line item under the State Council of Higher Education for Virginia.

Proposed Budget for Small Sat Virginia Initiative

	Year 1		Year 2		Year 3	
	State	VSGC/ Partners	State	VSGC/ Partners	State	VSGC/ Partners
Year 1	500,000					
Year 2			500,000		500,000	
Year 3						500,000
TOTAL	500,000	0	500,000	0	500,000	500,000

I. LAUNCH PROCUREMENT

- A. Build Launch Capabilities at Wallops Island, Virginia through Partnerships with NASA and MARS Build Launch Capabilities for Mid-Atlantic Regional Spaceport and NASA Wallops Flight Facility.
 - 1. Investigate rocket and deployer options for services; engineering design, integration and testing for deployers with launcher. Travel; contracting with launch providers for services; establishing MOU for services, planning for deployer and integration to launch vehicles. Engagement with potential launch providers, establishing MOU for services, planning for deployer and integration to launch vehicles. Purchase commercial, off-the-shelf deployer options and test and integrate those for available rockets. Deployer costs of \$50K for a 3u flight and \$70K for a 6u flight are included in the total dollar value shown.
 - 2. Offer at least two launch opportunities per year for a total of 6u mass per launch for Virginia University/NASA or Federal/DoD/Industry Payloads. Can sell unused deployer space to non-Virginia or commercial entities. Could potentially be in place by year two. Goal is to have at least two launches per year of 6u's each. This can be any combination of u's totaling 6 u.
- B. Procure launch options as needed and ride sharing if available from non-Virginia launches. Commercial launch costs are estimated at \$90K per 1 u/1.33 kilogram. Nanoracks launch costs to deploy from the International Space Station are \$90K per u. Funding for other launch costs, including FAA and potentially NOAA licensing (about \$8K for each). Project at least 2 launches per year - one on the International Space Station and one on a commercial provider with one at 1u and one at 3u.

II. PAYLOAD DEVELOPMENT - NOTE EXPECTED TIME FRAME FOR PROJECTS FROM FUNDING TO COMPLETION IS 18 - 24 MONTHS

- A. Costs are estimated for payloads at Virginia Universities with NASA and industry collaboration. Smaller projects at precollege institutions will be encouraged.

	State	Contributed
Two projects awarded per year at \$400,000 (3u) with two year cycle to complete award.	800,000	
One large 6u collaboration awarded per year with two year cycle to complete award.	1,000,000	
5 projects per year at \$100,000 - 1 to 2 u with two year cycle to complete award.	500,000	
Funding for supplementary costs for projects needing only elements of support. (such as travel, student support, materials, etc.)	100,000	
Anticipated contributions: VSGC - \$28,000 and \$600,000 from other sources.		628,000

III. INTERNSHIPS FOR UNIVERSITY STUDENTS TO WORK WITH NASA, OTHER FEDERAL AGENCIES AND INDUSTRY ON SMALL SAT VIRGINIA PROJECTS

- A. 20 Summer Internships at \$6,000
- B. 20 Academic Semester Internships at \$9,000

IV. ADMINISTRATION

- A. Virginia Space Grant Consortium

	State	Contributed
Director/contributed time		22,038
Small Sat Virginia Program Manager	1 FTE	160,000
Administrative Assistant	.5 FTE	30,000
Travel and other Administrative Costs		35,000
- B. Old Dominion University Research Foundation Indirect Costs

TOTAL COSTS

Year 1	225,000	22,038	230,700	22,699	236,571	23,380
Year 2	305,000		305,000		305,000	
Year 3						23,380
TOTAL	\$4,000,000	\$800,038	\$4,005,700	\$800,699	\$4,011,571	\$801,380

Proposed Budget for Small Sat Virginia Initiative

Typical Costs for University Payloads:

Typical costs for \$100,000 project:

Materials /Purchased Services	58,000
Travel	12,000
Student Support	30,000

Typical Costs for \$250K project:

Student Support	78,000
Systems Engineering	30,000
Equipment and expendable parts	100,000
Purchased Services	30,000
Travel	12,000

Typical Costs for \$1M Project:

Graduate Student labor (2) per year	260,000
Undergraduate wages (8) per year	192,000
Faculty summer salary (2 years)	60,000
Equipment and expendable parts	300,000
Purchased Services	30,000
Systems Engineer	30,000
Travel	28,000
Other	100,000



September 10, 2015

A handwritten signature in cursive script that reads "Mary Sandy".

Mary Sandy
Director
Virginia Space Grant Consortium
600 Butler Farm Road, Suite 2200
Hampton, VA 23666

Dear Ms. Sandy,

Aerojet Rocketdyne supports the Small Sat Virginia initiative as proposed by the Virginia Space Grant Consortium. Our company is a provider of propulsion for both small satellites and their launch vehicles. As a company with a hundred year legacy, educating the next generation of employees is extremely important to us.

Aerojet Rocketdyne's commitment to Science, Technology, Engineering and Mathematics (STEM) education is a top priority each year. The company has a rich heritage supporting local schools, after-school enrichment programs such as robotics and rocketry teams, and science centers in promoting STEM literacy. We are very proud of our partnerships with Project Lead the Way, FIRST, VEX and BEST Robotics, the Challenger Center for Space Science Education and Science Buddies among other organizations dedicated to STEM education and developing our future workforce. We would like to add the Small Sat Virginia initiative to that distinguished list.

Engaging university students through the Small Sat Virginia initiative will provide them with invaluable hands-on experience. It sometimes can be difficult to hire students straight from college because they have not had very much hands-on experience. By working with small satellites, students will have the opportunity to work on the entire process of a spacecraft development rather than just a single development phase. This program will provide students with the experience needed for future employment opportunities after they complete their degrees.

I applaud the efforts of the Commonwealth of Virginia to put this program in place. If I can be of further assistance, please do not hesitate to contact me.

Regards,

A handwritten signature in cursive script that reads "John D. Schumacher".

John D. Schumacher
Vice President for Washington Operations

Aerojet Rocketdyne is greatly appreciative of your continuing efforts to sustain and grow the Commonwealth's next generation of space experts and explorers!



September 11, 2015

Mary Sandy, Director
Virginia Space Grant Consortium
600 Butler Farm Road
Hampton, VA 23666

Dear Ms. Sandy:

I'm writing to confirm the support of the American Astronautical Society (AAS) for the Small Sat Virginia Initiative as proposed by the Virginia Space Grant Consortium (VSGC). As stated in a recent report on the benefits of small satellite missions, Small Sats play a key and compelling role in space-based scientific and engineering programs. They afford undergraduate and graduate students opportunities to participate in and experience the complex and organic nature of science, from proposal to development, to analysis, to publication. For businesses, Small Sats reduce both development time and costs, and greatly reduce the time to obtain results.

The Small Sat Virginia Initiative recognizes the tremendous growth and investment in Small Sats and numerous related technologies within the aerospace industry. It takes advantage of the Commonwealth's relationship with Mid-Atlantic Regional Spaceport, and NASA Wallops Flight Facility and will maximize Virginia's engagement in Small Sat initiatives for economic and technology development, workforce development, STEM education, and utilization of state aerospace resources and capabilities.

The VSGC has an outstanding reputation for coordinating and developing aerospace-related and high technology educational and research efforts throughout the Commonwealth. The AAS will gladly work with you by providing outreach to the space community at large and encourage involvement by other Virginia-based space organizations and educational institutions.

Sincerely,

A handwritten signature in black ink that reads 'JR Kirkpatrick'.

James R. Kirkpatrick
Executive Director



Shaping the Future of Aerospace

Executive Director

1801 Alexander Bell Drive, Suite 500, Reston, VA 20191-4344
703.264.7500 • 800.639.2422 (toll free) • 703.264.7551 (fax)

www.aiaa.org

10 September 2015

Mary Sandy, Director
Virginia Space Grant Consortium
600 Butler Farm Road
Hampton, VA 23666

Re: Small Sat Virginia Initiative

Dear Ms. Sandy:

On behalf of the more than 30,000 individual members and 95 corporate members of the American Institute of Aeronautics and Astronautics (AIAA), I welcome the Virginia Space Grant Consortium's (VSGC) efforts to establish and promote the Small Sat Virginia Initiative.

As the world's largest aerospace professional society, AIAA recognizes the growing interest in small satellites and their potential for enabling new technologies. Small satellites are currently being flown by NASA, the Department of Defense, and numerous aerospace companies and universities around the world. There are many benefits associated with satellites of this scale, such as development cost and time, launch cost, and the potential for mass production when compared to conventional satellites. Their small size and weight also makes them ideal for many specialized applications that are unsuitable for larger satellites. More important is their value to students who become actively involved in the designing, testing, launching, and monitoring of small satellites, which ultimately offers our next generation of scientists and engineers hands-on experience in an emerging industry and burgeoning market that has grown sixfold over the last five years.

The aerospace sector in the Commonwealth of Virginia supports over 28,000 jobs and generates an economic impact of approximately \$7.6 billion. Virginia is home to over 250 aerospace firms, two NASA facilities, a commercial spaceport, and numerous universities offering outstanding engineering, science, technology and mathematics education and research. The Small Sat Virginia Initiative will create synergy among these unique assets and help the Commonwealth capitalize on the growing small satellite market, maintaining Virginia's leadership in the aerospace sector.

It is my hope that the Virginia General Assembly accepts this proposal as submitted and provides the funding required to advance the Small Sat Virginia Initiative. AIAA would be happy to participate in the Initiative and have a representative on the Initiative's Advisory Committee. Should you have any questions or wish to discuss our interests further please do not hesitate to contact our Manager of Public Policy and Government Relations, Steve Sidorek, at 703.264.7541 or steves@aiaa.org.

Sincerely,

A handwritten signature in black ink, appearing to read 'Sandra H. Magnus'. The signature is fluid and cursive, written over a light blue horizontal line.

Sandra H. Magnus
Executive Director

American Institute of Aeronautics and Astronautics

Background and Support for the Small Sat Virginia Initiative

About Cubic Aerospace:

Cubic Aerospace is a Limited Liability Corporation founded in 2013 and headquartered in Reston, VA. Cubic includes two full-time employees and up to three additional temporary employees based on project specific needs. Cubic's owner, John Bevilacqua, spent over 10 years at Orbital ATK (formerly Orbital Sciences), and led their analog/power electronics design department for over 2.5 years.

Cubic currently offers services in the design, manufacture, test, and operation of space power systems and avionics. In addition to providing these services to both government and commercial customers, Cubic is developing innovative transient protection devices through a Small Business Innovative Research (SBIR) grant. Cubic recognizes the growing market for Small Sat components and engineering services, and is actively pursuing Small Sat business development through projects with commercial customers and proposals to government agencies.

How Cubic can support goals of the Small Sat Virginia Initiative:

Cubic is a young business which has attracted a significant and quickly growing workload in recent months. With plans to move into a new, larger Virginia office and to hire two more full-time employees in the coming months, Cubic is poised to become a significant future presence in the Virginia aerospace sector. The growth potential and agility offered by our small size and experience in both commercial aerospace and university Small Sat projects puts Cubic in a strong position to adapt to the changing satellite market. Cubic is in a unique position to implement forward thinking approaches to building our business, which will concurrently further the goals of the Virginia Small Sat Initiative (i.e. economic and workforce development, university engagement, and leveraging the unique opportunities present in Virginia).

University research groups have inherently high workforce turnover rates and, therefore, often lack some of the institutional knowledge in satellite hardware engineering, fabrication, testing, and integration that is needed to efficiently and successfully complete their innovative Small Sat projects. With Virginia Small Sat Initiative support, Cubic could collaborate with Small Sat teams at Virginia universities to identify the enabling Small Sat technologies needed for their missions. This type of relationship would allow university researchers to focus on innovation and development in their respective areas of expertise, and would provide Cubic with support to develop new products for the growing Small Sat component market.

Ways the Small Sat Virginia Initiative could help Cubic:

- 1) R&D funding to develop Small Sat components would provide Cubic with valuable IP and products to sell.
- 2) Connections to other Virginia aerospace businesses would foster valuable collaboration and opportunities for business development.
- 3) Launches through MARS could provide flight heritage, which is key to selling satellite components, even in the Small Sat market.
- 4) Relationships with Virginia university professors and students would allow us to more effectively recruit new employees and partner on projects (e.g. through NASA/DOD STTR programs).

September 11th, 2015

Mary Sandy, Director
Virginia Space Grant Consortium
600 Butler Farm Road
Hampton, VA 23666

Dear Ms. Sandy:

Deep Space Industries is pleased to provide this letter of support for the Small Sat Virginia Initiative as proposed by the Virginia Space Grant Consortium (VSGC).

Deep Space Industries is a leading commercial space company pioneering science, exploration and prospecting in deep space with a particular focus on asteroids and their associated resource potential. Our method for reaching asteroids is advanced small satellites. The company is built on a strong foundation of heritage from large and small space programs stretching back over 2 decades, while being firmly committed to a more modern approach to space, based on public-private business models and leverage of recent advances in micro and nano-class space technologies. We are intimately familiar with the emerging wave of micro and nano-class missions and the potential game-changing role they are set to play in the next decade of space exploration.

As you know, we have several years of experience with mission concepts for affordable deep space exploration missions as well as a successful commercial operation selling spacecraft busses through our Agile Nanosat Platform. We are always looking for partners to help commercialize our innovative IP involving CubeSat-compatible subsystems, and place a strong emphasis on helping build small businesses in this sector. We are also in strong need of qualified partners and collaborators for the Mothership mission, the first commercial mission to an asteroid utilizing a carrier craft that will protect smaller nanosats on long, deep space journeys and then act as the communications hub for relaying information back to Earth.

We believe this initiative to be an enabling development that would be of commercial value to a number of groups preparing missions, ourselves included, and we are excited by the VSGC's proposal to increase the Commonwealth's capability and expertise in the growing small satellite industry. Per our ongoing discussions, the synergy and complementarity between our respective near-term mission goals remains exciting and opportunities for collaboration abound.

We strongly support the Initiative and furthermore would like to have a representative on the Initiative's Advisory Committee when this endeavor succeeds. We look forward to a long, prosperous partnership with the Small Sat Virginia Initiative and are appreciative of the opportunity to help build a thriving small sat economy in the region.

Sincerely,



Daniel Faber
CEO

VIRGINIA SMALL SAT INITIATIVE,
Mary Sandy, Director
Virginia Space Grant Consortium
600 Butler Farm Road
Hampton, VA 23666
msandy@odu.edu
757 766-5210 (office) or 757 218-4496 (mobile)

Letter of support for the Small Sat Virginia Initiative

Dear Ms. Sandy,

The present is to confirm Gas Plume Imaging LLC (GPI) intent to participate in the Virginia Small Sat Initiative and to have a representative on the Initiative's Advisory Committee.

Through its patented remote sensing technologies, namely the *Pupil Imaging Gas Correlation (PIGC™)* and the *Digital Array Gas Radiometer (DAGR™)*, representing a paradigm shift in the gas detection market, GPI can bring revolutionary instruments that would advance research and development related to nanosatellite and cube satellites.

Specific GPI interest is through direct collaboration on small sat missions and projects, providing algorithms and data processing support services, advising on atmospheric science, as well as for providing internships and student implication. We strongly believe that help from undergraduate or graduate students can bring fresh and dynamic work force personnel, gaining experience through the realization of those space missions, and at the same time opening jobs directly into our company.

The Small Sat Virginia Initiative would be benefitting our company though workforce development, opening tangible potential new business opportunities, and getting potential funding for collaborative projects. We also view this collaboration opening a growing global technology sector for the Virginia State by synergizing with unique Virginia assets and capabilities (e.g. NASA, university programs, launch opportunities through Mid-Atlantic Regional Spaceport and NASA Wallops).

Yours sincerely,



Richard L. Lachance, Ph.D.
CMO and V.P. Eng.

Skype: Richard.L.Lachance

(418) 953-9411

RLlachance@GasPlumeImaging.com



GATS, Inc.

11864 Canon Blvd., Suite 101
Newport News, VA 23606
(757) 873-5920
Fax (757) 873-5924

September 1, 2015

Mary Sandy, Director
Virginia Space Grant Consortium
600 Butler Farm Road
Hampton, VA 23666

Re: Virginia Small Sat Initiative

Dear Ms. Sandy,

I am writing to express my company's support and appreciation for your Virginia Space Grant Consortium initiative. My company, GATS, headquartered in Newport News, VA in City Center, has been supporting and conceiving satellite missions for nearly 30 years. We currently operate two orbiting instruments and are now involved in several projects that are using our sensor designs for small satellite applications. These include an international collaboration with LASP in Colorado, NCU in Taiwan and NTU in Singapore, a second collaboration with Virginia Tech, the Naval Research Laboratory and NASA Ames Research center, a study grant from Defense Canada, and a major mission proposal with Dr. Bernath of ODU, to name a few. We have several other concepts that would be ideal for small satellite applications for finding fugitive gas leaks and measuring temperature fields in the upper atmosphere for advancing long term weather prediction. We also have technology initiatives to enhance these programs and are in partnership with Brandywine Photonics of Pennsylvania and their suppliers for building our instruments.

We are now specializing in small sensors with potentially huge impact in gas monitoring and weather information. With a little help from the state, these initiatives could be kept right here in Virginia as opposed to seeking collaborations around the country and world. Virginia has a great university system, and bright students that would fit ideally into our small satellite ventures. In fact, the consortium that includes LASP of Colorado is made possible only because of students subsidized by University of Colorado, NCU and NTU. With the MARS launch facility, great universities like VT, ODU (where GATS contributes yearly to a scholarship program), W&M, GMU and others, there is no reason why our initiatives couldn't stay in Virginia. But Virginia is simply not taking advantage of its technical assets when it comes to small satellite opportunities, which are anticipated to grow exponentially for decades.

Although the potential for jobs and revenue is substantial for some of our sensors that augment weather and gas monitoring systems, an even bigger benefit of small sat programs is the ideas and technology that spin off of these initiatives. For instance, we are about to introduce a mini methane monitor that is a direct result of satellite technology we developed with NASA Langley in the 80's, but can only now be miniaturized due to new detector technology. These types of

enhancement ideas and products only occur if young minds are funded to work on them. GATS has current technologies that could benefit tremendously from a student workforce if we had the funding to pay them. With initiatives such as yours, the new Tech Center near Jefferson Labs, Research Parks like recently developed in Blacksburg and others, a little state help could go a long ways.

I commend your effort to help fix that deficiency, and am eager to participate in whatever way helps, including serving on boards and advisory committees. So in closing I want to wish you the best of luck and assure you we will help in whatever way we can.

Best Regards,

A handwritten signature in cursive script that reads "Larry Gordley".

Larry Gordley
CEO, GATS
(Global Atmospheric Technologies and Sciences)
11864 Canon Blvd, Suite 101
Newport News, VA 23606

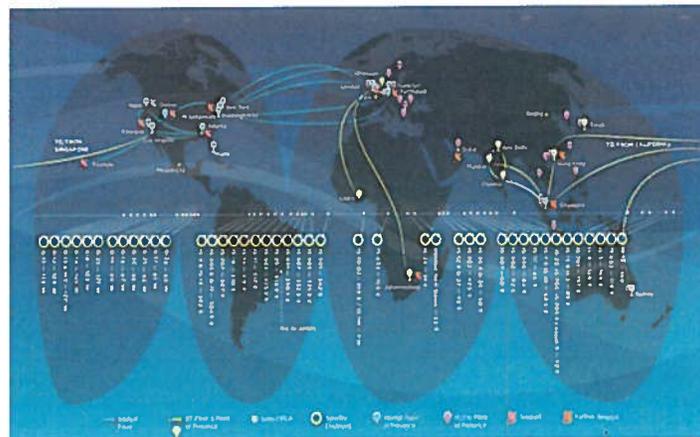
18 August 2015

Mary Sandy
Director
Virginia Space Grant Consortium
600 Butler Farm Road, Suite 2200
Hampton, VA 23666
757-766-5210 (phone)
757-766-5205 (fax)
www.vsgc.odu.edu

Dear Ms. Sandy,

In response to your request for information regarding the interest of IntelSat to serve as a Virginia Space Grant Consortium organization participant, IntelSat General Corporation (IGC) is pleased to provide this Letter of Interest (LOI) to contribute to the Virginia Space Grant Consortium by leveraging IntelSat's position within the space community. As you may know IntelSat is the largest owner operator of geostationary stationary satellites vast miles of terrestrial fibre to ensure global connectivity. We understand that this letter may be included in your proposal supporting the Small Sat Virginia Initiative for the JCOTS Nanosatellite Advisory Committee.

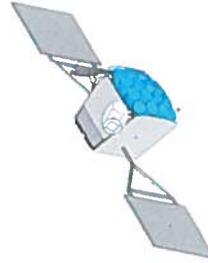
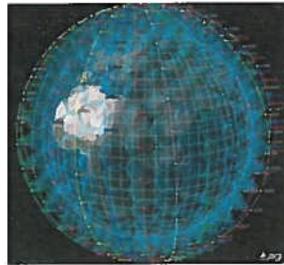
In particular IGC has a IP/MPLS high-speed global network creating one platform connecting satellites, teleports, fiber & Points of Presence. This global infrastructure when combined with IntelSat's launch tempo, space operations and engineering excellence can provide a core to the Small Sat Virginia Initiative.



IntelSat's Satellite and Ground Network

Furthermore, IntelSat is an early investor into the OneWeb constellation. The system will provide: a) 18 planes of 36 Spacecraft (a total of 648 Smallsats) b) 16 beams per Spacecraft c) Coverage optimized above 20°N/S latitudes d) Global Gateway Access Network and provide capacity to over 11 million users with thru-put performance of >6 Tbps globally and with then 30 ms round trip latency. IntelSat leveraging its OneWeb investment ensures multiple launch opportunities, provides a measure of assured access to space and risk reduction for the Small Sat Virginia Initiative.

OneWeb Constellation and Deployed Smallsat Configuration



With participation, the Concept of Operations (CONOPS) along with assured access to space, Intelsat can provide the systems, interfaces, and operations necessary to achieve mission success supporting the Small Sat Virginia Initiative.

Intelsat envisions gaining valuable knowledge from the Consortium. The training of Intelsat's team, along with the Consortium, will yield a core knowledgebase to propel Virginia into the forefront on smallsats. The development of a capable work force at Virginia's universities, knowledgeable of space and its implications will provide a continuous feed of new talent into Intelsat thus creating, not only new jobs but also maintaining the existing workforce to perpetuate Intelsat into future endeavors.

Intelsat is committed to support of the Small Sat Virginia Initiative. The Consortium support fits well within Intelsat's strategy. Intelsat General is standing by for notification by support of the Small Sat Virginia Initiative and to participate as an access-to-space provider. This letter serves as an indication of Intelsat's interest in supporting the support of the Small Sat Virginia Initiative proposal and program.

Please contact me at your earliest convenience for further elaboration as you may require.

Sincerely,

Gerry Jansson

Gerry Jansson
Director, Space Segment Development
Intelsat General Corporation
Gerry.jansson@intelsatgeneral.com
+1 202.957.0146



August 26, 2015

Mary Sandy
Director
Virginia Space Grant Consortium
600 Butler Farm Road
Hampton, VA 23666

Dear Ms. Sandy,

We are writing in support of the Small Sat Virginia Initiative as proposed by the Virginia Space Grant Consortium (VSGC).

Our company is interested in participating in the initiative and to have representation on the Initiatives Advisory Committee. As the second largest employer in the New River Valley behind Virginia Tech we represent over 1100 Virginia employees. We already have a successful relationship as part of the Virginia Economic Development Partnership (VEDP). Our belief is there is an opportunity to leverage the knowledge and experience from our involvement with VEDP to VSGC.

Our company specializes in solving motion, power and data transmission challenges in harsh environments including space. Our product line includes slip rings, motors, resolvers, actuators, air moving, fiber optic, and sonar products. Since 1953 we have been doing business in the Commonwealth designing and manufacturing both custom and standard products. We currently enjoy a growing share of the space products market and have been supplying parts in orbit since the beginning of the space age. We see the small sat and cube sat market as an important growth market and believe it will see an exponential rise in the near term. Our parent company, Moog Inc., has a separate group dedicated to space systems giving us a broad overview of the "playing field". We believe our penetration into most major space companies gives us a unique knowledge set regarding the future of space related activity. This contribution along with our knowledge of space hardware and the special skills required of our employees, for the space industry, makes us a valuable team member.

The VSGC will benefit our organization by driving business activity in the Commonwealth. A saying we frequently use is "a rising tide lifts all boats." It is our position driving small sat business will grow our business along with many other Virginia companies. It will help us understand market trends and position ourselves to capture business. It will allow networking opportunities to look at joint ventures and research activities with both businesses and Universities. Being located in Blacksburg we already enjoy a relationship with Virginia Tech



which can be strengthened through this consortium. The small sat market drives a unique set of challenges as it requires small, efficient products, cost effectiveness, and performing in a special environment. These challenges can only be met through successful R&D to produce new cutting edge technology. This requires collaboration with other organizations such as Universities and demands additional employees with the unique technical skills to design and produce new types of space hardware.

Moog's position is this is an important effort to growing business in the Commonwealth. Not only will it benefit the aerospace sector but in our case it helps support supplemental businesses. These include businesses we currently collaborate with like local machine shops and test facilities, such as Aerospace Testing in Roanoke and E-Labs in Fredricksburg. The small sat market represents probably the largest area for future business in the space field. It is important for VA businesses to be out in front of this effort to position themselves to capture opportunities for the commonwealth. Moog's belief is the VSGC will be an important resource to drive business opportunities and we are excited to be part of the team.

Sincerely,

Phil Prosser
Business Development Manager
Moog Components Group
Blacksburg, VA
(540) 239-2921
pprosser@moog.com



9385 Discovery Boulevard Suite 300, Manassas VA 20109

10 September 2015

Ms. Mary Sandy, Director
Virginia Space Grant Consortium
600 Butler Farm Road
Hampton, VA 23666

Dear Ms. Sandy,

This letter is to confirm NAL Research's strong support of the Virginia Small Satellite Initiative as proposed by the Virginia Space Grant Consortium. I recognize the incredible value of the Small Satellite Initiative for economic development, technology development and demonstration, scientific advancement, workforce development, and especially STEM education. Our company is committed to support the Initiative in the development of satellite subscriber/user devices.

NAL Research has been developing and manufacturing satellite transceivers since 1997 for the US DoD, foreign MoDs (Ministry of Defence), federal agencies, law-enforcement bureaus, commercial sectors and universities. These products are being used worldwide by thousands of organizations in operations including asset tracking, search and rescue, remote sensing and command/control of both ground and airborne platforms. Our devices are critical parts of many DoD's and federal agencies' Intelligent, Surveillance and Reconnaissance (ISR) systems. Our products are also critical parts of many commercial tracking systems. NAL Research had supported many universities and federally funded research and development centers (FFRDCs) on various small satellite programs including the University of Virginia, Texas A&M University, The MITRE Corporation, The Aerospace Corporation, NASA, just to name a few.

Please do not hesitate to contact me if you need to further discuss our collaboration.

Sincerely,

A handwritten signature in black ink that reads "Ngoc Hoang". The signature is written in a cursive, flowing style.

Ngoc Hoang, CEO and Founder
Email: nth@nalresearch.com
Phone: 703-392-1136 x204



Attn: Mary Sandy
Virginia Space Grant Consortium
600 Butler Farm Road, Suite 2200
Hampton, VA 23666

Dear Ms. Sandy,

NanoRacks is more than willing to support the creation of the Small Sat Virginia Initiative as proposed by the Virginia Space Grant Consortium (VSGC).

NanoRacks has unique and extensive experience deploying over 80 commercial and government CubeSats from the International Space Station and expects to soon demonstrate deploying CubeSats from ISS visiting vehicles.

Based on that experience, NanoRacks can assist in guiding consortium members on the general aspects and workflows involved in the launch and deployment phases of CubeSat projects.

As a growth commercial space business, NanoRacks sees benefits from efforts that increase both the number of potential customers and also from projects that provide a broader pool of future experts and customers.

NanoRacks today works with a number of Virginia based organizations, including OrbATK, who no doubt would also benefit from such outcomes from the Small Sat Virginia Initiative.

Regards,

A handwritten signature in black ink, appearing to read "Jeff Manber".

Jeffrey Manber
Chief Executive Officer

National Aeronautics and
Space Administration

Langley Research Center
Hampton, Virginia 23681-0001



August 28, 2015

Reply to Attn of: The Office of the Director

Ms. Mary Sandy
Director, Virginia Space Grant Consortium
600 Butler Farm Road
Hampton, Virginia 23666

Ref: VSGC Small Sat Virginia Initiative Proposal

Dear Ms. Sandy:

We are aware that Virginia Space Grant Consortium (VSGC) is requesting funding from the Commonwealth of Virginia for a Small Sat Virginia Initiative. As you know, NASA Langley engages in substantial atmospheric science research that deploys research capability on satellites, including Small Sats and Cubesats.

In that regard, NASA Langley has the ability to engage with VSGC and university and industry partners that may become involved in the Small Sat Virginia Initiative, when NASA or potential partners have unique resources or capabilities that can be used in furtherance of aeronautics, space, earth science, and related technology. NASA typically partners on a non-reimbursable basis (no exchange of funds) when there is a mutually beneficial activity identified that will further the Agency's missions. NASA also partners on a reimbursable basis (NASA's costs are reimbursed) when NASA has unique goods, services and facilities not being fully utilized to accomplish mission needs which it can make available to others on a noninterference basis consistent with the Agency's missions. NASA can also make its inventions available to companies via licenses that can enable new and innovative use of technologies for commercial purposes involving Small Sat Initiatives, thereby enabling economic growth and transfer of benefits of the inventions to the public.

In the event that VSGC receives funding for the initiative, NASA Langley commits to consider opportunities to partner on research that leverages Virginia's engagement in the Small Sat Initiative and opportunities to make available NASA resources that may have applications useful to the initiative and NASA. Such future NASA Langley commitments are dependent upon the availability of personnel, facilities and NASA resources, including appropriated funds, required to provide the support as well as the successful negotiation of a Space Act or other Agreements with NASA Langley.

I wish you well in your preparation of the proposal and all of us here at Langley Research Center are looking forward to considering various opportunities to work with VSGC and Small Sat Virginia Initiative partners in the event your proposal is accepted for award.

Sincerely,

A handwritten signature in black ink, appearing to read "David E. Bowles", with a horizontal line extending to the right.

David E. Bowles
Director

National Aeronautics and Space Administration
Goddard Space Flight Center
Wallops Flight Facility
Wallops Island, VA 23337-5099



Reply to Attn of:

800

Mary Sandy, Director
Virginia Space Grant Consortium
600 Butler Farm Road
Hampton, VA 23666

Subject: Letter of Support for Small Spacecraft Virginia Initiative

Dear Ms. Sandy:

NASA Goddard Space Flight Center (GSFC)/Wallops Flight Facility (WFF) is excited to be a NASA Partner for the Small Satellite Virginia Initiative that is being proposed by the Virginia Space Grant Consortium (VSGC). NASA Wallops has a long standing partnership with the VSGC and we look forward to continuing this partnership on this new, and exciting initiative.

NASA Wallops Flight Facility (WFF) accepts the responsibilities as described in the initiative and intends to carry out all tasks identified for WFF. In addition, Mr. Thomas Johnson will serve on the Initiative's Advisory Council.

The Wallops Flight Facility is part of the Goddard Space Flight Center (GSFC), which is one of the largest scientific and engineering organizations in the world. GSFC has launched nearly 300 space based missions since 1959 and Goddard has an unprecedented success rate, with only one spacecraft failure since 1974. WFF has been supporting SmallSats for over 7 years and we are NASA's only facility that can fully support a SmallSat mission from initial concept through on-orbit mission operations. This support also includes launch support from Wallops Island, where the first launch of a SmallSat took place. WFF has the capability to launch SmallSats on Antares or Minotaur and there are numerous new small launch vehicles being developed that could launch from Wallops.

We look forward to the opportunity to partner with the VSGC and to educate the next generation of space systems engineers through this effort.

Respectfully,

A handwritten signature in black ink, appearing to read "Thomas Johnson".

Thomas Johnson
GSFC/WFF Small Satellite Manager



Dr. Douglas O. Stanley
President & Executive Director

August 30, 2015

Dear Mary:

The National Institute of Aerospace (NIA) is excited to support the Small Sat Virginia Initiative that you are proposing and that we discussed. We would be pleased to provide a member on the Advisory Committee of this important initiative and to assist in any way we can. We have greatly valued previous successful collaborations with your Virginia Space Grant Consortium (VSGC), such as the award-winning NASA Langley LARSS Internship Program.

As you know, NIA is an independent 501(c)(3) non-profit research, graduate education and outreach institute functioning as a strategic partner with NASA Langley Research Center (LaRC), other Government laboratories, universities, and industry. Our member universities include Virginia universities such as: Hampton University, University of Virginia, Virginia Tech, Old Dominion University and the College of William & Mary. We can assist in assembling collaborative research and development teams across our member university students and faculty as well as our 50-person research staff. We also have established a small satellite research lab on site that could be a valuable resource.

We also have been hosting the Mid-Atlantic Regional Small Satellite Community Workshops at NIA in collaboration with NASA and VSGC. We believe that the Small Sat Virginia Initiative will build on this and other regional efforts to allow Virginia to capture small satellite missions and attract companies to create a critical mass of workforce in this cutting edge and rapidly growing field.

Should you need any further information, please let us know.

Sincerely,

A handwritten signature in black ink, appearing to read "D. Stanley".

Dr. Douglas O. Stanley
President & Executive Director
National Institute of Aerospace



Mary Sandy, Director
Virginia Space Grant Consortium
600 Butler Farm Road
Hampton, VA 23666

Dear Ms. Sandy,

I am sending you this note in strong support of the Small Sat Virginia Initiative as proposed by the Virginia Space Grant Consortium (VSGC).

As one of the people who helped start the revolution now underway in the opening of space to citizens, signed up the first Citizen to fly in space, leased the Russian space station as a commercial facility, helped begin the XPrize and several other initiatives, I am truly excited to see Virginia taking such a bold step – at exactly the right moment in time.

Within the next 2-5 years we will see a dramatic increase in space activities – especially in the realm of the private sector. New projects, new companies and new space launch systems now in the works are about to come on line. This means a greatly increased availability for rides into space – especially in the nano/cube/small sat arena, which are easily manifested as secondary and piggyback payloads. What it also means is that as this industry and new government programs come on line there will be a large increase in demand for an educated workforce, and the aligned service industries and providers to support what can only be described as a space renaissance.

Years ago I advised Accomack County on what we used to call the NewSpace industry, and so have a fondness for Virginia. I am Chair of two companies engaged in space, one of which is developing smallsats right now. In this note I speak as myself and as the Founder of a not for profit organization dedicated to the opening of space. My experience is great and my understanding is perhaps from different angles than that of some in the more traditional areas of space – and more towards what is coming. In any case I offer my services and support in any way I can to help Virginia succeed, including as an Adviser, should it be needed. Our organization also stands ready to do whatever we can to assist this important effort.

UP!

Rick Tumlinson
Founder



OLD DOMINION
UNIVERSITY

Mechanical and Aerospace Engineering Department

Frank Batten College of Engineering and Technology
1300 E.V. Williams Engineering and Computational Sciences Building, Norfolk, VA 23529
Phone: 757/683-3720 • Fax: 757/683-3200 • <http://eng.odu.edu/mae>

Mrs. Mary Sandy
Director
Virginia Space Grant Consortium
600 Butler Farm Road, Suite 2200
Hampton, VA 23666
Dear Mary:

As Old Dominion University's representative to the Advisory Council of the Virginia Space Grant Consortium, I am pleased to write this letter in support of the Small Sat Virginia Initiative as proposed by the Virginia Space Grant Consortium (VSGC). We have enjoyed a long and productive relationship with VSGC over the past 25 years, having participated in student projects ranging from multi-institutional high-altitude balloon research through numerous sounding rocket flight experiments and data collection from orbiting satellites. VSGC has fostered collaborative efforts on behalf of the Commonwealth of Virginia that are precisely the kinds of activities that can make the Small Sat Virginia Initiative succeed.

While it will be up to President Broderick or his designee to appoint a representative to serve as our point of contact on the Small Sat Virginia Initiative, I would be happy to do it.

Old Dominion University serves as host to the Mid Atlantic Regional Spaceport and in addition to fiscal and administrative support, we provide expertise and students to enable it to operate efficiently and cost effectively. Our colleges of engineering and science both have faculty expertise that can support a range of scientific and space systems engineering support. We expect to be able to help the spaceport identify low-cost launch opportunities that can facilitate small satellite flights, particularly as they promote educational, research and economic development activities within the Commonwealth. We expect that our Entrepreneurial Center will be able to help identify and support commercial, small satellite initiatives that can help those businesses evolve and grow within the Commonwealth.

Presently, only four states have launch facilities that provide access to useful Earth orbits, and in many respects the Mid Atlantic Regional Spaceport can provide the most agile and least expensive access to that orbital domain. From an economic perspective, Virginia has an opportunity to attract and sustain a significant share of the small satellite delivery and satellite support businesses that are expected to grow rapidly. As we continue to miniaturize virtually every element of satellite hardware, the small satellite segment of the industry

Sincerely,

Dr. Robert L. Ash, Professor

I D E A F U S I O N

Old Dominion University is an equal opportunity, affirmative action institution



251 18th Street South Suite 650 Arlington VA 22202

Date: September 14, 2015

Attention: Mary Sandy, Director Virginia Space Grant Consortium
600 Butler Farm Road, Suite 2200
Hampton, VA 23666
757-766-5210

Dear Ms. Sandy

OmniEarth is pleased to provide a Letter of Interest (LOI) to contribute as a business and commercial partner to the Virginia Space Grant Consortium's (VSGC's) support of the Small Sat Virginia Initiative. As a company comprised of aerospace professionals, in particular with extensive experience in the nanosatellite and small satellite industry, OmniEarth believes that such a focused effort would 1) be valuable in fostering the next generation of Virginia space scientists, engineers, and other skilled professionals as well as 2) providing coordinated and positive infrastructure to continue the growth of the small satellite industry in Virginia.

At OmniEarth, we recognize that future economic decisions and activities will be based on quantifiable, verifiable global data. Much of that data will originate as observations from space-based platforms. Thus, those that most economically reach and observe from Earth's space will be best poised to address the market. Part of that process will be judicious use of current and future nanosatellite and small satellite technologies and transportation to space. In particular, use of nanosatellite CubeSat technologies and orbit insertion as secondary payloads will continue to revolutionize the industry.

OmniEarth will be both a producer and user of the global data sources. We recognize that Earth is a vibrant and interactive system and that modern global business requires a quantitative approach. OmniEarth is an emerging company focused on changing the way the Earth is understood. We provide enhanced decision making tools for subscribers in the agriculture, forestry, energy, civil and military markets. We will continue to help our customers better understand, manage, and predict the work around them by providing them with advanced geoanalytics derived from the space borne data. We will also collaborate with industry leaders to establish next generation nanosatellite and small satellite constellations to make global observations. We will ultimately deliver analytics-ready, multispectral imagery from everywhere on Earth every day, enabling subscribers to see, analyze and react to change in near real time. The centerpiece of the company's strategy is a constellation of observatories that, when complete, will image every spot on earth every day.

We encourage VSGC's leadership in creating an environment that will inspire the next generation of aerospace professionals and entrepreneurs to work in the Virginia. We expect that through the Small Sat Virginia Initiative, VSGC will be able to leverage the experience and capabilities of Virginia's aerospace companies, research laboratories, universities, and government institutions to foster grants and awards for internships as well as establish small satellite business initiatives and attractive tax incentives for small aerospace business growth in Virginia. We are excited to contribute and be a part of this opportunity. In addition, if requested I would welcome an opportunity to serve as an Advisor to VSGC.

Sincerely,

Chad S. Fish, CTO
435-757-8794, chad.fish@omniearth.net



September 10, 2015

Ms. Mary Sandy, Director
Virginia Space Grant Consortium
600 Butler Farm Road
Hampton, VA 23666

Dear Ms. Sandy:

Orbital ATK is pleased to provide this letter of interest in support of the *Small Sat Virginia* initiative being proposed by the Virginia Space Grant Consortium. Orbital ATK is in a unique position in the Commonwealth as the only commercial company that designs, manufactures, launches, and operates satellites within the state. We are also a leader in this arena, having built 82 small satellites in the past thirty years.

As a high technology company, Orbital ATK relies on not just continuous innovation, but a pipeline of qualified and highly capable young professionals. A program, such as *Small Sat Virginia*, that encourages students to pursue careers in aerospace through the use of mentorship, internship opportunities, and scholarship funding will help us attract and retain top talent right here in the Commonwealth. We applaud the broad range of the initiative's objectives such as the support of scientific instrument development, mentorship students and faculty at both the college and precollege level, and the fostering of cooperation between state, federal, and commercial entities. Orbital ATK shares many of the goals of the *Small Sat Virginia* initiative and stands ready to further investigate areas in which we can collaborate with the top caliber universities and our government partners across the Commonwealth. We will also provide an appropriate individual to serve on the *Small Sat Virginia* advisory council, if requested.

We look forward to the start of the *Small Sat Virginia* initiative and to helping shape Virginia's space workforce of tomorrow.

Sincerely,

A handwritten signature in blue ink, appearing to read "Tom Wilson". The signature is fluid and cursive, written over a light blue horizontal line.

Tom Wilson
Vice President Strategy & BD
Space Systems Group
Orbital ATK, Inc.
45101 Warp Drive
Dulles, VA 20166
tom.wilson@orbitalatk.com
Tel: 1-703-406-5651



10 September 2015

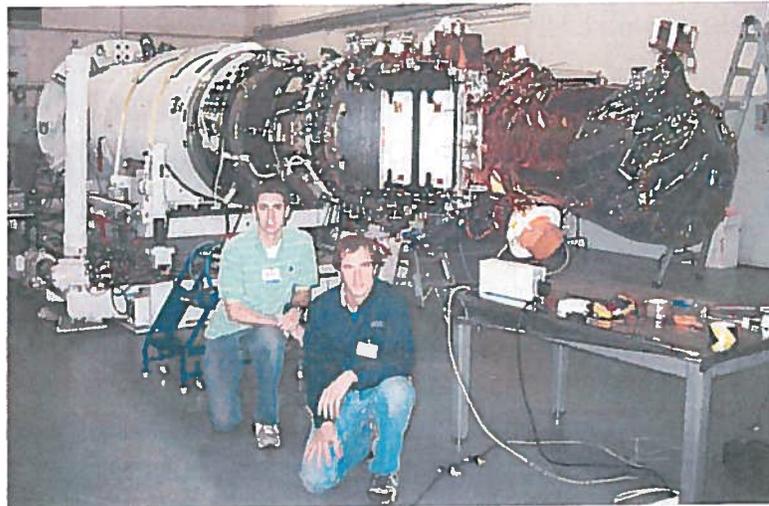
Mary Sandy, Director
Virginia Space Grant Consortium
600 Butler Farm Road
Hampton, VA 23666

Dear Mary,

I am writing this letter in support of the Virginia Small Satellite Initiative as proposed by the Virginia Space Grant Consortium. PSC designs spacecraft mechanisms for use by the Department of Defense, NASA and many commercial domestic and international space companies. PSC works closely with several Virginia organization including Orbital Sciences and SpaceQuest.

Our products have been launched from Wallops Island on several occasions

Figure 1 PSC engineers after integration of the Tacsat-2 spacecraft at Wallops Island



Though we are a Maryland company, we have relied on excellent student interns and graduates of universities in Virginia over our 17 year existence. Two of our employees Mr. Ryan Williams and Mr. Huston Manning are graduates of Virginia Tech.

As such we continue to look forward to the excellent preparation these students have which, in part, comes from the good work of the Virginia Space Grant Consortium.

Sincerely,

A handwritten signature in black ink, appearing to read "Walter Holemans".

Walter Holemans, Chief Engineer and Owner, PSC



One Team • Your Vision • Our Mission

August 25, 2015

Ms. Mary Sandy
Virginia Space Grant Consortium
600 Butler Farm Road, Suite 2253
Hampton, VA 23666

Dear Ms. Sandy,

The Schafer Corporation is delighted to endorse the Virginia Space Grant Consortium's (VSGC) Small Sat Virginia Initiative. While we have not had prior collaboration with the VSGC, we have been actively involved in space systems and technology since the company's founding in 1972. Headquartered in Arlington, Virginia, Schafer is a mid-sized technology services company. We have designed space systems, developed proof of concept space system products, and performed space payload integration.

As a company, Schafer is focused on advanced technology and engineering with specialized expertise in directed energy and electro-optics. Schafer's space heritage has primarily been in support of the Department of Defense laboratories and the Missile Defense Agency. More recently, however, we have expanded our support to NASA and several commercial space activities. As one example of Schafer's space capabilities, we are currently developing a very high bandwidth communications capability using laser technology for use in space. This capability is targeted for both government and commercial space application and will be hosted on the cube sat architecture with potential demonstration on the Space Station.

We see tremendous opportunity in the development of small satellites and flexible launch platforms. This is clearly what we believe is the primary direction for future space efforts. The Small Sat Virginia Initiative will foster increased space technology and economic opportunities for Virginia-based companies and universities. The Small Sat Virginia Initiative will also permit the Commonwealth to take advantage of the significant investments that both NASA and the DoD have made with Virginia-based companies and universities. This initiative can facilitate expanded benefits of these investments through a variety of collaborative efforts in conjunction with Small Sat Virginia. The end result will be that Virginia can quickly become one of the major space business and technology hubs for the Nation.

Schafer has a number of nationally recognized experts in space and space systems. We would be willing to offer their support to VSGC's efforts to help initiate and guide the formation of the Small Sat Virginia Initiative. In particular, James Faist, Schafer Vice President for Military Aerospace, and Mark Fisher, Schafer Vice President for Civil Aerospace, would be available to serve as advisors to the Initiative. Jim and Mark have extensive experience in DoD and NASA space programs and are viewed as thought leaders in their fields. Their resumes are attached. As appropriate, Schafer would also be willing to host interns connected with the Small Sat Initiative.

Schafer is very pleased to have the opportunity to support the Small Sat Virginia Initiative. We see this Initiative as good for Virginia and for Schafer Corporation. Please don't hesitate to contact me or our CEO, Dr. Michael Griffin if you would like to discuss Schafer or our support for the Small Sat Virginia Initiative.

Sincerely,



John M. Gilligan
President and Chief Operating Officer



SCIENCE and TECHNOLOGY CORP.

21 Enterprise Parkway, Suite 150, Hampton, Virginia 23666-6413 USA
Telephone: (757) 766-5800 Fax: (757) 865-1294
www.stcnet.com

August 24, 2015

Mary Sandy, Director
Virginia Space Grant Consortium
600 Butler Farm Road
Hampton, VA 23666
Phone: 757/766-5210
FAX: 757/766-5205
www.vsgc.odu.edu

Mary,

STC strongly supports the “Small Sat Virginia Initiative”, and applauds you and VSGC for taking the lead in proposing it to JCOTS for State funding.

Whereas, the Small Satellite concepts and systems, including the Cubesat (4”x4”x4”), and the Pocketsat (2”x2”x2”), were pioneered by the US (e.g., ‘Cubesats’ by Professors Bob Twiggs, formerly at Stanford University-CA and now at Morehead State University-KY, and Jordi Puig-Suari, at CalPoly, St Louis Obispo-CA; and ‘Pocketsats’ by Bob Twiggs in order to reach down to the Kindergarten students), however, due to the adverse impacts of stringent US ITAR restrictions, the foreign competitors took over the lead in the business of small-sats, much to the frustration and detriment of US small-sat businesses. So, the timing of the “Small Sat Virginia Initiative” could not have come at a better time, now that the ITAR restrictions for university Satellites have been somewhat relaxed. On business side, the state funding (in large amounts) is essential to jump-start the business aspects of the small-sats in to full gear, and to make up for the lost time of a few years. On the educational side, small-sats and space are the challenging new frontiers, and hence a big draw for attracting the next generation of scientists, technicians, engineers and mathematicians, and because of their small size and weight, they are equally attractive to both men and women to get in to the field. Imagination is the only limit.

STC is an innovative advanced-technology, minority-owned mature small business, and an award-winning contract-services provider, headquartered in Hampton-VA since 1979, with its staff at 10-US and 1-European locations, to provide superior quality support to contracts from different centers of the Government (e.g., NASA, NOAA, and DOD), US Industry (e.g., Jacobs, Tempus Global Data, Lockheed-Martin, etc.), and International Organizations (e.g., WMO, WCRP, ESA, etc.), and, in addition, is an internally-funded R&D entrepreneur: See www.stcnet.com .

STC is, perhaps, the first small-business in Virginia to be the sponsor, with its own funding and/or in-kind support, of the following STEM- & Entrepreneurship-encouraging and Economic-development-prone initiatives:

- (1) The development of a Joint STC-UMBC flight-ready nano-satellite, QubeScout-S1

- (2"x2"x5", 700gram, to test a sun-sensor for attitude control), that was built by 6-7 undergraduate students in 3 months), and successfully launched (on Nov 21, 2013) to a 616-km orbit from aboard a Dneper rocket (at a cost of less than \$100,000, including launch): See <http://stcnet.com/innovations/>, <http://www.stcnet.com/newsletter/Spring2014.pdf>;
- (2) The publishing of the first scholarly, peer-reviewed, international online Journal of Small Satellites (JoSS, www.jossonline.com), managed by Hampton-VA-based Managing Editors, and US-based Editors-in-Chiefs and over 15 (including international) Technical Area Editors (TAEs), now in its 4th successful year of publication by the Hampton-based small, scholarly, publishing house, A. Deepak Publishing (ADP, estab. 1981, www.deepakpublishing.com), that is offered free of charge to encourage STEM programs and foster potential and budding entrepreneurs;
 - (3) The development of a 2- to 3-week short-course /workshop (TRS125) to "Design, Build, Launch, and Telemetry of Small Sats" (with Instructor: Prof. Bob Twiggs, the pioneer of the Cube-Sat and the Pocket-Sat), offered by the STC-Affiliated, 501c3, Not-for-Profit, Taksha Institute, headquartered in Hampton since 1976: See <http://www.taksha.org/course/TRS125> ;
 - (4) The STC co-sponsorship and support of the Ames Fruit-Fly Experiment (AFex) in a cube-sat aboard the ISS (International Space Station), involving the study of the Oxidative-Stress Effects on the human neurological behavior (such as, Parkinson's disease) by studying the oxidative stress effects on the flying pattern behavior of fruit-flies (drosophila) born in microgravity environment: See <http://nanoracks.com/wp-content/uploads/Release-01-ASGSR-fruit-fly-student-experiment.pdf> ;
 - (5) The STC co-sponsorship of Taksha-organized "1st International Symposium on Small Satellites for Arctic and Maritime Operations and Research" (ISSAMOR I, 2012, Washington DC): See announcement Flyer at <http://www.taksha.org/course/GMA950/> ;
 - (6) The STC co-sponsorship of the planned Taksha-organized "1st International Workshop on Small-Sats for All Ages, 2016" (with Prof. Bob Twiggs as co-convener) to encourage STEM Education, Workforce Development, and Business Entrepreneurship (now in progress);
 - (7) The STC co-sponsorship of the Taksha-organized International Workshops on several new applications of current interest pertaining to National Security, Space Debris, Space Policy, Space Travel, and Space Colonization (in different planning stages).

If you need further information or clarification, please contact me directly at my cell (757-272-3066) or email at a.deepak@stcnet.com.

With best regards,

Adarsh

Adarsh Deepak, PhD
Founder, President & CEO,

Science and Technology Corp. (STC), www.stcnet.com
Publisher, A. Deepak Publishing (ADP), www.deepakpublishing.com
Journal of Small Satellites (JoSS), www.jossonline.com
Chairman, Taksha Institute (TI),
(A 501c3 Not-for-Profit since 1976),
www.Taksha.org
T: 757-272-3066 mobile
T: 757-766-5800 main office
E: a.deepak@stcnet.com



3554 Chain Bridge Road, Suite 103
Fairfax, Virginia 22030
Tel: (703) 273-7010
Fax: (703) 273-7011

26 August 2015

Mary Sandy, Director
Virginia Space Grant Consortium
600 Butler Farm Road
Hampton, VA 23666

Dear Mary,

I am writing this letter in support of the Virginia Small Satellite Initiative as proposed by the Virginia Space Grant Consortium. SpaceQuest has been a pioneer in the design, development, launch and operation of microsatellites since 2000. We have self-funded the manufacture and launch of 12 satellites, and provided hundreds of custom satellite components for international universities, space agencies, defense departments and aerospace companies. SpaceQuest has considerable experience with the integration and launch of small satellites, having completed ten launch campaigns during the past 15 years.

The era of "New Space" activities created by the development of low-cost satellite components and driven by venture capital investments, especially in Silicon Valley, has opened up opportunities for expanding the space industry in Virginia. Recent announcements and programs to manufacture and deploy thousands of small satellites will revolutionize the industrial base for satellite components. Bringing some of these production contracts to Virginia will create long term employment opportunities.

I highly endorse the Commonwealth's leadership in fostering an environment that inspires young aerospace engineers and entrepreneurs to work in Virginia. In addition to providing grants, awards, and prizes to small satellite initiatives, establishing attractive tax incentives for small aerospace businesses in the Commonwealth will help motivate our brightest aerospace students to seek employment in Virginia rather than migrating to the West Coast. Sponsoring competitive scholarships for interns to work on small satellite projects can give them the experience and motivation to seek employment opportunities available in Virginia. Networking the capabilities, assets and experience of Virginia Universities, Research Laboratories, NASA Agencies, Launch Facilities, and Aerospace Companies to promote the funding and execution of new small satellite programs would demonstrate Virginia's commitment to becoming the national leader in space.

My personal experience with space programs dates back to the early days of the Apollo program. As a US Air Force Officer I worked on the Lunar Module Guidance System, the GPS satellite program, the High-Energy Space-Based Laser Program at DARPA, and the Strategic Defense Architecture. As the founder and owner of SpaceQuest, I led the development and launch of numerous small satellite programs, including three expandable space station modules for Bigelow Aerospace Corporation. If requested, I would welcome the opportunity to participate as an Advisor to the Virginia Space Grant Consortium.

Sincerely,

A handwritten signature in blue ink that reads "Dino Lorenzini".

Dr. Dino A. Lorenzini
Chairman and CEO

MECHANICAL AND AEROSPACE ENGINEERING

Christopher Goyne, Ph.D.
Associate Professor of Mechanical and Aerospace Engineering
Director, Aerospace Research Laboratory

August 27, 2015

Mary Sandy, Director
Virginia Space Grant Consortium
600 Butler Farm Road
Hampton, VA 23666

RE: Letter of Support for Small Sat Virginia Initiative as proposed by the Virginia Space Grant Consortium (VSGC)

Dear Ms. Sandy,

I am writing to provide my strongest recommendation that JCOTS advocate for Commonwealth of Virginia funding for the Small Sat Virginia Initiative as proposed by the Virginia Space Grant Consortium (VSGC). As detailed in the proposal, the University of Virginia would participate in the Initiative as a key member. This would build on the many activities in aerospace research and education that the University of Virginia currently conducts in partnership with VSGC. The University of Virginia is willing to participate in the Initiative and provide a representative on an eventual advisory committee. The University of Virginia would engage with the Initiative by building on existing strengths in space science research and engineering. This would include research and education at both the graduate and undergraduate levels. We would collaborate on small sat missions and projects and would seek engagement with industry, government and other university partners. We are also interested in incorporating the activities of the Initiative into our educational curricula as the activity would be an excellent educational resource. It is anticipated that we would build on Initiative support to seek out additional federal and industrial research funding to expand on the scope of our engagement and collaboration.

The proposed funding for the Small Sat Virginia Initiative represents a significant return on investment for the Commonwealth of Virginia. It is expected that the Initiative will be a catalyst that will lead to economic opportunities for sector growth in the field of satellite and space technology. In addition, the opportunities for undergraduate and graduate students to work on meaningful projects, side-by-side with industry and government experts, will provide a pool of talented engineers and scientists that will be available to service this expanding sector.

Sincerely,



Prof. Christopher Goyne



VIRGINIA COMMERCIAL SPACE FLIGHT AUTHORITY

August 18, 2015

Mary Sandy, Director
Virginia Space Grant Consortium
600 Butler Farm Road
Hampton, VA 23666

Dear Mary,

The Virginia Commercial Space Flight Authority (VCSFA), or "Virginia Space," supports the Small Sat Virginia Initiative as proposed by the Virginia Space Grant Consortium (VSGC). Virginia Space can play a key role in making this Initiative a success through its existing relationship with NASA, liaison to the Commonwealth and universities, extensive network within the commercial/ government space industry, and most directly through launch operations at the Mid-Atlantic Regional Spaceport (MARS) within the NASA Wallops Flight Facility.

Virginia Space offers a full range of launch services at MARS to support the hosting of Small Sat/ ride-share payloads, including: Pad OA, a state of the art, cryogenic launch facility for liquid fuel rockets; and Pad OB, a cost competitive mission adaptable pad for solid rocket fuel rockets; expertise in flight hardware ground processing; personnel on the ground to assist researchers; and a robust workforce of engineers and technicians including many locally educated.

The Small Sat Virginia Initiative would benefit Virginia Space through launch opportunities at MARS, which would in turn benefit the Commonwealth and the Virginia Aerospace sector. Accordingly, Virginia Space is willing to participate in the Initiative and to have a representative on the Initiative's Advisory Committee. Additionally, Virginia Space is willing to continue providing advice and networking opportunities to maximize impact for the Initiative.

Sincerely,

A handwritten signature in blue ink that reads "Dale K. Nash". The signature is fluid and cursive.

Dale K. Nash
Executive Director, VCSFA



VirginiaTech

College of Engineering

Space@VT, Bradley School of Electrical and Computer Engineering
Professor Gregory D. Earle
1901 Innovation Drive, Suite 1000
Blacksburg, Virginia 24060
540/231-2294 Fax: 540/231-3362
E-mail: earle@vt.edu

17 August 2015

Mary Sandy, Director
Virginia Space Grant Consortium
600 Butler Farm Road, Suite 200
Hampton, VA 23666

Dear Mary,

I am pleased to write this letter of support for the Small Sat Virginia Initiative that your office is preparing, in partnership with Virginia Tech and other state universities. As a long-time partner in the Virginia Space Grant Consortium, Virginia Tech has developed infrastructure and capabilities that will undoubtedly help to ensure the success of the project. The Space@VT group has twin goals – first, as a state university we strive to produce graduates from our degree programs who can directly benefit both large and small space-related industries within the state. Our second goal is to perform outstanding science investigations and technology demonstration missions through our spaceflight programs. We have so far been successful in both of these objectives, as evidenced by our collective publication record in top-tier science and engineering journals, and by the demand for graduates from our program. As you know, many of our graduates have gone on to successful careers at large companies with a strong presence in northern Virginia, such as Orbital Sciences and Northrop-Grumman. In addition, some recent graduates from the Space@VT group are now working at smaller companies in Virginia such as Cubic Aerospace, where they continue to collaborate with us on a variety of project opportunities.

As you know, the Space@VT group here at Virginia Tech is an internationally recognized leader in the small satellite and sounding rocket arenas. We have a long history of collaboration with various NASA partners, including the Wallops Space Flight Facility and NASA-Langley. As evidence of this, our LAICE satellite project will be deployed from the space station next year, we are midway through a sounding rocket development project with NASA-Wallops, we are providing ground-station support for the European QB-50 project, and we are actively submitting proposals for a handful of new projects in the current funding cycle.

Going forward, the Space@VT group fully intends to participate as members of the advisory committee for the new program you propose, and we foresee continued collaboration as part of the VSGC core complement of space-related universities in the state. I invite you to keep us informed as this exciting new opportunity develops, and I look forward to working with you in the future.

Sincerely,

Gregory D. Earle, Professor
Electrical and Computer Engineering
Virginia Polytechnic Institute and State University

Invent the Future

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY
An equal opportunity, affirmative action institution



VirginiaTech[®]
College of Engineering

Dr. Jonathan Black

Associate Professor of Aerospace Engineering
Associate Director of Research for Aerospace Systems, Hume Center
Northrop Grumman Senior Faculty Fellow in C4ISR
Faculty Affiliate, Center for Space Science and Engineering Research (Space@VT)
215 Randolph Hall 0203
460 W. Old Turner St.
Blacksburg, Virginia 24061

15 August 2015

Mary Sandy, Director
Virginia Space Grant Consortium
600 Butler Farm Road, Suite 200
Hampton, VA 23666

Ms. Sandy,

Please accept this letter of support for the Small Sat Virginia Initiative as proposed by the Virginia Space Grant Consortium (VSGC). I am pleased to participate in the Initiative and to serve as a representative on the Initiative's Advisory Committee. My preparedness for participated in this activity includes being a US Citizen; experience with small satellite spaceflight missions, Space Shuttle and International Space Station experiments, and hosted payloads; and active published research in autonomous space vehicles, linear and nonlinear control theory, advanced sensing technologies, space systems engineering, and novel orbit analysis for a wide variety of civil, military, and intelligence applications.

I started as an Associate Professor of Aerospace Engineering at Virginia Tech (VT) in August of 2014, where I am a member of the Center for Space Science and Engineering Research ([Space@VT](#)), the Associate Director of Research for Aerospace Systems of the [Ted and Karyn Hume Center for National Security and Technology](#), and have recently been appointed the Northrop Grumman Senior Faculty Fellow. Prior to joining VT, I served as a faculty member in the Aeronautics and Astronautics department at the Air Force Institute of Technology (AFIT), Wright-Patterson Air Force Base, Ohio. There I was the founding Director of the [Center for Space Research and Assurance](#). As Director, I focused the center's efforts on cutting-edge space technology development and scientific space experiments; managed and executed the annual \$2 million center research portfolio; supervised a diverse group of 20 consisting of research faculty, program managers, laboratory and administrative staff, graduate students, and summer interns; briefed senior Department of Defense and Intelligence Community leadership advising national space policy and strategy; and cultivated research and educational relationships inside and outside AFIT. I also served as PI or Co-PI on five spaceflight experiments.

The Small Sat Virginia Initiative will substantially benefit VT though educational workforce development meeting the business needs of local Virginia companies, potential new business opportunities, potential funding for collaborative projects, participating in a growing global technology sector, networking to build new business opportunities, synergizing of unique Virginia assets and capabilities (NASA, university programs, launch opportunities through Mid-Atlantic Regional Spaceport and NASA Wallops), and by leveraging strong DOD interest in small satellites. The economic impact of spaceflight missions in growing Virginia-based businesses and creating jobs will be substantial. Several private companies are proposing constellations of dozens of satellites, and that will continue to grow. The proposed initiative will well-position the Commonwealth to help lead the nation in this growth.

Thank you, and please contact me at jonathan.black@vt.edu, 540-231-0037 for any additional information.

Respectfully,

Jonathan T. Black, PhD

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A HEICO Company

1971 Kraft Dr. Suite 1000, Blacksburg, VA 24060

8/24/2015

Dr. Dan Sable
CEO, VPT Inc.
1971 Kraft Dr. Suite 1000
Blacksburg, VA 24060

Mary Sandy, Director
Virginia Space Grant Consortium
600 Butler Farm Road
Hampton, VA 23666

Mary;

The purpose of this letter is to provide our support to the Small Sat Virginia Initiative as proposed by the Virginia Space Grant Consortium (VSGC). VPT Inc., headquartered in Blacksburg, VA, is a major provider of DC-DC power converters for space applications. VPT products are presently flying on GPS satellites, NASA and international missions to Mercury, Venus, Mars, the Moon, Pluto, and the International Space Station. VPT was the first contributor to Virginia Tech's Space @ VT initiative and has contributed over \$60K to their research group over the last several years. VPT has also provided Space @ VT with expertise and flight hardware for their space missions. VPT is willing to actively participate in the initiative and have a representative on the Initiative's Advisory Committee.

Most recently, VPT customers have expressed strong interest in power converters for small satellite missions. VPT has provided hardware for a number of universities in the US and internationally designing small satellites. VPT is paying close attention to the initiatives of several companies looking to provide global, broadband services through small satellites in a Low Earth Orbit (LEO). This has the potential to revolutionize the industry and bring great benefits to companies located in Virginia, like VPT that design and manufacture space hardware.

Please do not hesitate to contact me with any questions at sable@vptpower.com or (540) 443-7568.

Sincerely,

A handwritten signature in black ink that reads 'Dan Sable'.

Dr. Dan Sable, PE
CEO, VPT Inc.