TECHNOLOGY POLICY BRIEF

APRIL 2014

NANOSATS & CUBESATS

Background & Description

"Small satellites," satellites weighing less than 100 lbs., have become important tools for space development, with the microsatellite segment of the satellite launch industry in particular growing rapidly in recent years. Specifically "nanosatellite," or "nanosat," development has shown a dramatic increase. Nanosats are typically defined as artificial satellites with a wet mass between 2.2 and 22.0 lbs. Advances in technology have allowed for lower costs in manufacturing, miniaturization of componentry, and increased overall utility. Such features also make nanosatellites very attractive and cost-effective tools for space education, especially for schools which have only recently started space development programs.

Nanosatellites and nanosatellite constellations (multiple satellites working together in or out of formation) are increasingly capable of performing missions that previously required much larger and much heavier equipment. Nanosat technology is now much more accessible and customizable. In this regard, significant commercial application for such technology may exist.

Launching satellites and nanosats affordably, reliably, and on schedule remains one of the major challenges for the use of small spacecraft. A trend has developed towards the utilization of dedicated small launch vehicles and other non-traditional methods for launching satellites. Coupled recently with increased capital supporting private spaceflight initiatives, opportunities have developed involving a variety of small payload Nanosatellite Launch Vehicles.

CubeSats are a subclass of nanosatellites and, due to certain common design characteristics, form a cost-effective and independent means of getting a payload into orbit. The majority of CubeSats carry only one or two scientific instruments and typically utilize commercial off-the-shelf components. The first CubeSats were launched in 2003 on a Russian Eurokot and an estimated 75 CubeSats were in earth's orbit by August of 2012. Their uses typically include taking pictures and measurements from space, sending radio communications, performing atmospheric research, conducting biology experiments, and testing platforms for future technology.

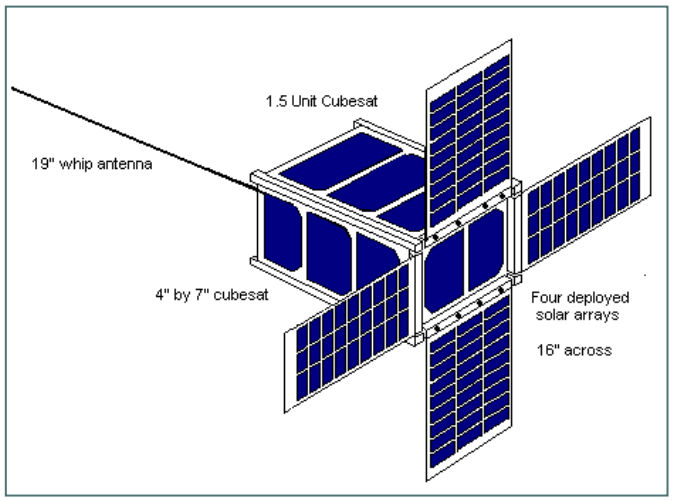
CubeSat design specifications derive from a set of standards developed and published by California Polytechnic State University and Stanford University in 1999 with the goal of helping universities worldwide perform space science exploration. The cube-shaped

For more information, contact:

Aaron Campbell
Staff Attorney,
Joint Commission on Technology and Science

804.786.3591 ext. 224
acampbell@dls.virginia.gov

satellites are approximately four inches long, have a volume of about one quart, and weigh about three pounds. Most often they measure 10x10x10 centimeters and are scalable along only one axis. CubeSats are usually powered entirely by solar panels that surround their exterior.



Significance & Deployment

The uniformity and small size of CubeSats allows them to be launched at a fraction of the costs typically associated with launching larger traditional satellites and they can be deployed using a common system.

Often CubeSats are launched and deployed through a mechanism mounted to a launch vehicle called a Poly-PicoSatellite Orbital Deployer (P-POD). Several research institutions, including NASA, as well as private companies offer launch opportunities of several cubes in a cluster. NASA's CubeSat Launch Initiative (CSLI) provides opportunities for small satellite payloads to fly on rockets planned for upcoming launches. The CubeSats are flown as auxiliary payloads on previously planned missions.

Currently, a CubeSat can be launched on a privately funded mission for less than $100,000. Startup companies such as NanoSatisfi, which offers temporary access and control of CubeSats for a weekly fee, are entering the industry and have the ability to provide real-time data access to small businesses and individuals. As their on-board technology improves, so too will the value of the data derived from CubeSats.

Recent Developments

On November 19, 2013 eleven CubeSats from NASA's ELaNa Education Launch of Nanosatellites program launched from the Mid-Atlantic Regional Spaceport at Wallops Island. Among these CubeSats was the TJ3Sat, built by the students of Thomas Jefferson High School for Science and Technology in Alexandria, Virginia. The TJ3Sat is the first satellite made by high-schoolers to go into space. According to the Thomas Jefferson High School website, "TJ3Sat's primary mission is to provide educational resources to other K-12 education institutions to foster interest in aerospace through the successful design and flight of a CubeSat." Currently the position of the TJ3Sat can be tracked in real-time through an online portal linked to the program's homepage.

Recently, the U.S. National Science Foundation announced that it expects to award a maximum of two discretionary grants totaling approximately $900,000 to fund and support the development, construction, launch, and operation of CubeSats based science missions for geospace and atmospheric research. In addition, the upcoming launch of the SpaceX-4 commercial resupply mission to the international space station, currently scheduled for August 2014, will enhance the space station's satellite deployment capabilities with the delivery of Cyclops. This tool, also known as the Space Station Integrated Kinetic Launcher for Orbital Payload Systems (SSIKLOPS), will provide yet another means to release CubeSats and other nanosatellites from the orbiting outpost.