National Aeronautics and Space Administration

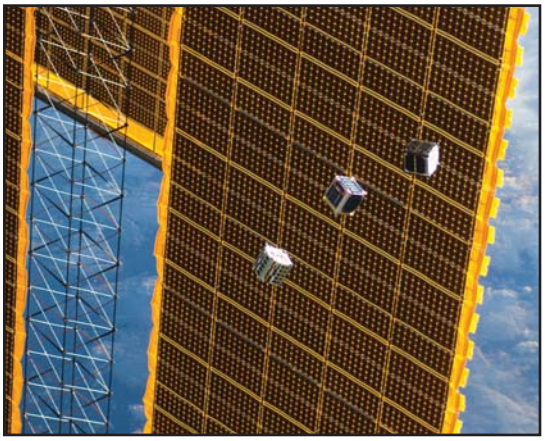
TechEdSat Nano-Satellite Series

Technologies for Passive Reentry, Future Sample Return and Mars Missions

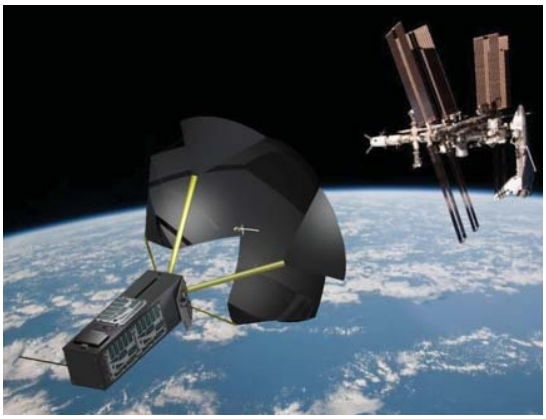
NASAfacts

TechEdSat-3p is the second generation in the TechEdSat-X series. The TechEdSat Series uses the CubeSat standards established by the California Polytechnic State University (Cal Poly), San Luis Obispo. With typical blocks being constructed from 1-unit (1U = 10x10x10 cm) increments, the TechEdSat-3p has a 3U volume with a 30 cm length. The project uniquely pairs advanced university students with NASA researchers in a rapid design-to-flight experience lasting 1-2 semesters. The TechEdSat Nano-Satellite Series provides a rapid platform for testing technologies for future NASA Earth and planetary missions, as well as providing students with an early exposure to flight hardware development and management.

TechEdSat-1 (a 1U), the first in the series, successfully demonstrated the use of an AAC (Angstrom Aerospace Corporation USA) Power Board to power the satellite, and the radiation-tolerant nanoRTU (nano-Remote Terminal Unit) to control a StenSat radio that provided basic housekeeping and space environmental data. It was part of the first group of CubeSats to be deployed from the International Space Station (ISS) on October 4, 2012 - and functioned 7 months until it re-entered Earth's atmosphere.



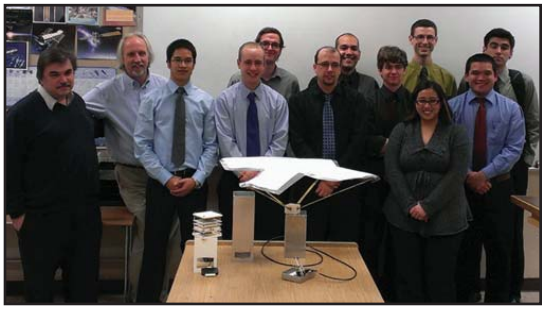
Photograph of TechEdSat-1 (far left) after jettison from ISS



Rendering of TechEdSat-3p post-jettison from the ISS

TechEdSat-3p will be the first 3U CubeSat deployed from the ISS. It will demonstrate two new technologies. The first is a passive deorbiting system that uses a uniquely designed drag device (Exo-Brake) to perform a rapid de-orbit and re-entry. The second will demonstrate the use of an Iridium modem combined with a GPS receiver to communicate accurate positional and de-orbit information. Eventually, these will be combined to provide controlled sample return capability from the ISS or other orbiting platforms.

The team demonstrated for the first time, the Iridium Short-Burst Data modem as a new nano-satellite communication option with a successful flight on April 21, 2013 for 24 hours. This new communication paradigm may be described as a 'Tracking and Data Relay Satellite (TDRS) for NanoSats' in that orbiting assets replace ground stations for rapid data retrieval and uplink capability.



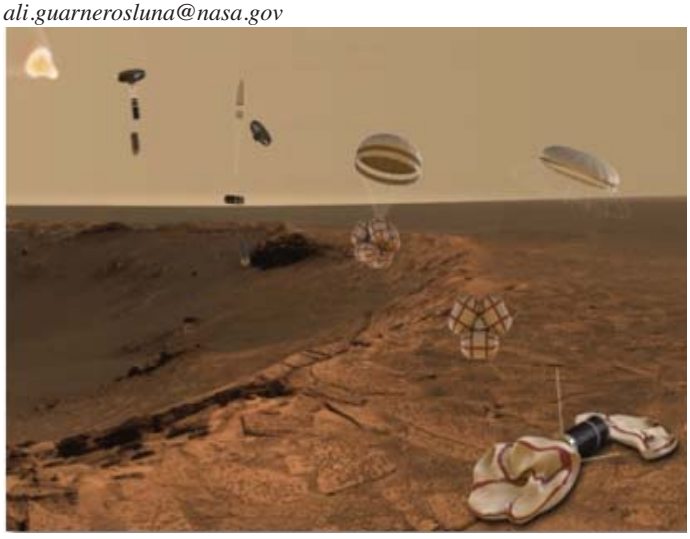
Photograph of TechEdSat-3p and San Jose State University Team

The TechEdSat-3p project is a technology demonstration mission led by Principal Investigator Marcus Murbach of NASA Ames Research Center (ARC). Students from the San José State University and the University of Idaho undertook this as their senior design project. Throughout the academic year, the students from both universities collaborated through video conferencing. The students utilized their nearby resources to complete the low-cost and quick turnaround project within 6 months. During the final phase of the project, the students from the University of Idaho came to ARC for the summer to aid in the completion, integration, and testing of TechEdSat-3p.

The satellite's structure, avionics, and payload, were custom designed by the TechEdSat-3p team to utilize the 3U volume most efficiently and provide ample space for the deorbiter. The CubeSat's hardware was mostly off the shelf components available to anyone in order to make it easily reproducible for future flight variations.

TechEdSat-3p was launched to the ISS on August 3, 2013 in KOUNOTORI4 (HTV4, a Japanese cargo transfer vehicle to the ISS), and later this year will be deployed from the Japanese Aerospace Exploration Agency's (JAXA) Japanese Experiment Module (JEM) Small Satellite Orbital Deployer (J-SSOD). For future work in the TechEdSat-X series, TechEdSat-4 will be very similar to the TechEdSat-3p design. It will further develop the passive deorbiting system by adding drag-modulation for accurate de-orbit and eventual re-entry control. The overarching goals of the TechEdSat-X series are to a) develop the requisite technologies for on-demand sample return capability from the ISS, and b) perform re-entry test flights and hardware validation for future nano-satellite missions to the Martian surface. Based on nanosat technology, these missions are proposed for the 2016-2020 timeframe. This may open up tremendous education and research opportunities as an extension of the 'TechEdSat-X' series.

ISS Small Payload Quick Return (SPQR) Concept



Mars Companion Mission, NanoSat-Sized Surface Lander (Atromos concept)

Contributors:

The TechEdSat-3p mission is supported by the NASA ARC Engineering Directorate (Dr. D. Korsmeyer), the NASA Engineering and Safety Center (Mr. N. Kunz), the Safety and Mission Assurance Directorate (Mr. M. Liu) and the Ames Center Chief Technologist Office's Center Innovation Fund (Dr. H. Partridge).

For more information about Ames, visit:
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