Paper ID: 6982
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SPACE EDUCATION AND OUTREACH SYMPOSIUM (E1)
NEW WORLDS - INNOVATIVE SPACE EDUCATION AND OUTREACH (4)

Author: Dr. Ghulam JAFFER
Graz University of Technology (TU Graz), Pakistan, g.jaffer@yahoo.com

Dr. Andrew Klesh
National Aeronautics and Space Administration (NASA), Jet Propulsion Laboratory, United States, andrew.t.klesh@jpl.nasa.gov
Mr. Ronnie Nader
Ecuadorian Civilian Space Agency (EXA), Ecuador, rnader@exa.ec
Prof. Otto Koudelka
Graz University of Technology (TU Graz), Austria, koudelka@tugraz.at

USING A VIRTUAL GROUND STATION AS A TOOL FOR SUPPORTING HIGHER EDUCATION

Abstract

Students in higher education scientific and technological research want to communicate with the ISS, download live satellite images, and receive telemetry, housekeeping and science data from nanosatellites and larger spacecrafts. To meet this need, the Ecuadorian Space Agency (EXA) has recently provided the civilian world with an internet to orbit gateway (HERMES-A / MINOTAUR Space Flight Control Center) available for public use. This gateway virtually connects participating clients from around the world to a remote satellite ground station (GS), providing a broad community for multinational cooperation. The goal of the GS is to lower financial and engineering barriers that hinder access to science and telemetry data from orbit.

The basic design of the virtual GS on the user side is based on free software suites. Using these and other software tools, along with amateur radio equipment and a home-built antenna, the ground station is able to provide access to orbit for a multitude of users without each having to go through the costly setup. In this paper, we present the design and implementation of the virtual GS in a higher education setting. We also discuss the basic architecture of the single existing system and the benefits of a proposed distributed system. Details of the software tools and their applicability to tracking, monitoring and processing are also provided as used by students performing ground station operations.

As the GS was built with the CubeSat community in mind, we provide metrics of traceability of several CubeSats and Nanosatellites as well as details on the successful download and translation of housekeeping and telemetry. The TUGraz, EXA and Michigan team as well as other members located in Japan have participated in various mission operations and have investigated real-time satellite data download and image acquisition. Students at these institutions undergo training with on-orbit satellites in preparation for their own use with future Nanosats after a successful launch.

Finally, we present results obtained by simultaneously downloading data and voice on four continents: North America (Michigan), South America (Ecuador), Europe (Austria) and Asia (Japan). This demonstration serves to illustrate the cooperative efforts and ability of the virtual GS in the tracking of satellites and education of students. The satellites tracked include HO-68, ITUpSAT1, UWE-2, BEESAT, SwissCube, SO-67, CO-57, 58, 65, 66, RS22, RS30, AO51 and COMPASS1.