

IAF SPACE COMMUNICATIONS AND NAVIGATION SYMPOSIUM (B2)
Interactive Presentations - IAF SPACE COMMUNICATIONS AND NAVIGATION SYMPOSIUM (IP)

Author: Mr. Sawyer Rempel
University of Manitoba, Canada, sawyer.rempel@umsats.ca

Mr. Sanjay Abraham
University of Manitoba, Canada, sanjay.alex@gmail.com

Mr. Kevin Dick
University of Manitoba, Canada, kevin.dick@umsats.ca

Mr. Emerich Kovacs III
University of Manitoba, Canada, emerich.kovacs@umsats.ca

Mr. Joseph Howarth
University of Manitoba, Canada, joseph.howarth@umsats.ca

Dr. Dustin Isleifson
University of Manitoba, Canada, Dustin.Isleifson@umanitoba.ca

DESIGN OF A FULL DUPLEX CUBESAT COMMUNICATIONS SYSTEM FOR AMATEUR RADIO
OPERATION

Abstract

The University of Manitoba Space Applications and Technologies Society (UMSATS) is currently underway on their fifth iteration of CubeSat design, TSAT5. Designed according to the Canadian Satellite Design Competition guidelines, the CubeSat is based around an educational outreach earth observation payload mission dubbed 'selfiesat'. The premise of the mission gives amateur radio operators the ability to initiate an image capture and receive an immediate data transmission during a single pass.

To succeed in the mission objective, a robust and reliable data transmission system is required to facilitate communication between users and the satellite. This paper outlines the design and development of a CubeSat communication system suitable for image downlinking within the amateur radio spectrum.

The unit in development by the UMSATS team integrates both a VHF and UHF radio allowing for dual band, full duplex operation. Designed to operate within the amateur frequency allocations, the system uses the AX.25 amateur packet radio protocol, a popular protocol among the ham radio community. The communications system has three primary operational modes: data downlink, command uplink, and beacon. The UHF band is dedicated to data downlink and is responsible for transmission of mission critical payload and telemetry data to ground operators. The VHF serves a dual purpose acting as both an uplink channel for incoming ground commands it also incorporates an APRS beacon.

The inclusion of an automatic packet radio system (APRS) enables regularly scheduled transmission of data frames which can easily be interpreted by amateur operators. Its onboard FPGA enables the system to directly access critical health data off the system bus for transmission to operators without prompting. This secondary downlink mode will aid ground crew in maintaining up to date tracking and bus health data, while also maximizing potential for involvement from the amateur community.

A system with capabilities such as these brings features to the table unprecedented in existing commercial units while providing versatility for future design iterations enables them with advanced communication capabilities.