SPACE SYSTEMS SYMPOSIUM (D1)
Training, Achievements, and Lessons Learned in Space Systems (5)

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LESSONS LEARNED AFTER ONE YEAR IN SPACE FOR THE AAUSAT3 SATELLITE

Abstract

The AAUSAT3 satellite is a 1U cubesat, which has been developed by students at Aalborg University, Denmark in collaboration with the Danish Maritime Authority. The satellite was launched into a polar DD-SSO orbit of 800 km altitude on February 25th 2013 on a mission to monitor ships from space using their AIS broadcast signals as an indication of position.

The satellite was developed as a purely decentralized system consisting of 8 components, Electronic Power Supply, Communications, AIS receiver 1 (HW based), AIS receiver 2 (SDR based), ADCS1 (detumbling), ADCS2 (pointing), Flight planner and Logging, interconnected through a CAN bus running the Cubesat Space Protocol. In the absence of an Onboard Computer, each subsystem has been developed as a completely autonomous subsystem, thus reducing interdependencies between subsystems.

As this was the first cubesat satellite ever to try and detect AIS messages from space the SDR radio was developed with ease of software updating in mind. This means, that methods were put in place to do raw spectrum sampling at the AIS frequencies as well as downloading of these. On the basis of these downloaded spectrum samples improved algorithms were developed and uploaded to the satellite, which has increased its detection rate to more than 10000 transmissions/hour. The software loading system has been released open source and the fault tolerant design is described in details.

AAUSAT3 was the first CubeSat from Aalborg University to use a CCSDS inspired spacelink protocol, and presented results show a significant enhancement in the communication reliability. After successfully deploying two ground stations for AAUSAT3, the satellite modem and transceiver unit has been open sourced for radio amateurs and similar who want to receive AAUSAT3 transmissions.

AAUSAT3 did perform full payload test with successful AIS reception on both AIS1 and AIS2 during its very first orbits. Also, full two way communication was established on the very first pass above Aalborg.

The AIS2 SDR receiver has proven very effective compared to AIS1, the traditional GMSK receiver, and the linux based software update system was used four times to test and compare individual algorithms.

After more than one year in space, a number of design flaws and important lessons learned have been identified and is presented on this paper. The mission of AAUSAT3 is not only to receive AIS but also to educate similarly minded students. These valuable lessons have all been the basis for the development of AAUSAT4.