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FIELD TESTING OF TRACKING SATELLITE SIGNALS USING LOW COST RADIO EQUIPMENT AS AN EVALUATION FOR THE DISTRIBUTED GROUND STATION NETWORK

Abstract

The Distributed Ground Station Network (DGSN) is a proposed global network of small ground stations for automatic tracking of satellites. With a minimum of five ground stations receiving a satellite's beacon signal, the position of the signal's origin can be determined using precise GNSS (GPS, Galileo) reception times and communicating over the internet or other networks. In other words, a "reverse GPS" system. The project is designed to be a low budget, citizen science project. The cost of individual ground stations hardware should be no more than 100 Euros. DGSN mission goal is to provide an open tracking and communication service to satellite operators who needs a global, permanent and free access to their satellite's position, telemetry and payload data. The tracking is especially important during, and a few weeks after, a launch of several satellites from one rocket before other TLE-sources are updated. The focus lies on small and CubeSats due to their uncertain "take what you got" orbit of the launch provider.

In collaboration with the original project by AerospaceResearch.net conducted at the University of Stuttgart, the DGSN Trondheim Student Project at the Norwegian University of Science and Technology (NTNU) has made use of off-the-shelf, low cost hardware to set up a ground station for receiving and analysing satellite signals in the UHF and VHF band. Using a simple, but broadband (50 MHz to 2 GHz), DVB-T radio receiver as a software-defined radio platform, the focus of our project has been in demonstrating receiving actual signals from satellites. Previous tests have focused on trilateration of signals from stationary sources such as radio towers, but it is imperative that receiving signals from the satellites themselves using simple antennas is possible. In light of this, it was necessary to calculate the theoretical possibility of receiving satellite signals using simple wide searching antennas. Furthermore, creating software for processing and interpreting the signals, and putting our calculations to the test by conducting real world experiments with the receivers.

In this paper, we discuss mission drivers for a globally distributed ground station network and the citizen science limitations on budgets and COTS technologies of such a single ground station design. The

emphasis on the link budget and the process of finding a suitable antenna which can receive the desired signals, mainly from CubeSat projects. At NTNU, the base station is set up in co-operation with the the NUTS CubeSat.