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TIME-SYNCHRONIZATION IMPACT ON THE PERFORMANCE OF THE DISTRIBUTED GROUND STATION NETWORK SERVICE FOR TRACKING CUBESATS AND FURTHER SIGNAL SOURCES

Abstract

CubeSats and small satellites are revolutionizing the current space business by its applications and sheer numbers. The increased interest in launching them are creating new challenges with respect to the orbital knowledge of these new space assets. The Distributed Ground Station Network (DGSN) is a novel network concept of small ground-stations and connected via the internet for performing autonomous tracking of the satellites' beacon signals. By correlating the received signal with the precise, GNSS synchronized reception times of at least five ground stations, it allows the positioning of the signal's origin. Thus a global and continous tracking of small satellites becomes possible.

This paper describes the various impacts on the performance on the Distributed Ground Station Network caused by time-synchronization. During the field testing of the DGSN, the availability and the quality of the GNSS time-source varied and caused inaccuracies in the positioning of the tracked CubeSats and further signals. Different compenstation strategies were created to handle these effects. Furthermore different locations and grid-constellations are analysed for making the DGSN as flexible as possible. Besides tracking cubesats, the system will be used during the REXUS2018 sounding-rocket re-entry experiment and providing track and also payload data reception with this supporting ground segment in Kiruna, Sweden. Due to the usage of Software Defined Radio (SDR) hardware, DGSN can also be used for other signal tracking. For all these application at remote locations without adequate Internet infrastructure, the global GNSS time source is essential and pose challenges to the system.

The DGSN was started as part of the Small Satellite Design studies at the Institute of Space Systems (IRS) at the University of Stuttgart in 2012. It took part in the Google and ESA Summer of Code campaigns in 2013-2017 as well as the NASA Space Applications Challenge, where the open-source nature of the network was developed to include and foster the community in being involved right from the start. The DGSN is now a doctoral dissertation research at the Institute for Photogrammetry (IFP) at the University of Stuttgart. DGSN is currently in field testing of the prototype ground stations during which the challenges and opportunities of the Internet-of-Things behaviour are studied. The results and further derivates will be presented in this paper.