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NEW SPACE OPERATIONS IN THE INTERNET OF THINGS ERA - ANYWHERE, ANYTIME, ANYTHING!

Abstract

The vision of the Internet of Things (IoT) has evolved. Multiple technologies converged due to improvements in micro systems, wirelesse communications, sensoring and breakthroughs in software development, and all of them are enabling the Internet of Things.

Networks of smart devices are implemented into people's houses and at work. The results of permanent environmental and social monitoring are already taking influences into the daily lifes. The experiences of using smart networks can also be applied on space operations. This paper describes the adaptions on basis of a flexible and agile space segment like small satellites with respect to the ground segment. It is shown in particular with a focus of the Distributed Ground Station Network (DGSN) for tracking of and communication with small satellites and cubesats. The DGSN uses a grid of ground stations with a multitude of internet connected nodes. It is based on software defined radio (SDR) to provide not only flexibility in servicing several satellites in several fequency bands, but also to be able to be used in sensoring the environmental natural and artifical electro-magnetic transmissions in the spectrum.

For achieving this, the approach of combining a well known space operation ground system together with a global deployment of small and cheap ground station design uncovers the need of adopting new strategies and techniques. The paper shows aspects such as the reliability of such a network, what the level of trust amoung all peers can be, the current regulations of the International Telecommunications Union and possible cybersecurity challenges of a wide and open grid.

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 2013-2015 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 IoT behaviour are studied. The results and further derivates will be presented in this paper.