Interactive Presentations (IP)
Topic 7 - Interactive Presentations (7)

Author: Prof. Giuseppe Araniti
University Mediterranea of Reggio Calabria, Italy, araniti@unirc.it

Mr. Giacomo Genovese
University Mediterranea of Reggio Calabria, Italy, giacomo.genovese@unirc.it
Prof. Antonio Iera
University of Calabria, Italy, antonio.iera@dimes.unical.it
Prof. Antonella Molinaro
University Mediterranea of Reggio Calabria, Italy, antonella.molinaro@unirc.it
Dr. Sara Pizzi
University Mediterranea of Reggio Calabria, Italy, sara.pizzi@unirc.it
Ms. Olga Vikhrova
University Mediterranea of Reggio Calabria, Italy, olga.vikhrova@unirc.it

SDN-SAT: A SOFTWARE DEFINED NANOSATELLITE PLATFORM FOR CUBESATS INCLUSION IN THE INTERNET OF THINGS

Abstract

One of the most significant novelties that is emerging in the field of satellite communications is a new class of miniaturized satellites known as CubeSats. Originally envisioned for university education and research purposes, CubeSats have more recently attracted commercial solution providers as a means for conducting space activity and enabling multiple services, including Earth remote sensing, weather forecasting, space situational awareness, space science. The increasing interest in CubeSats is mainly due to their ability to enable widespread connectivity at a low cost. Furthermore, since they can be equipped with multiple small technology payloads, ranging from optical to thermal sensors, CubeSat can be considered as "sensors of the physical world in the sky" and are legitimated to become fully-fledged components of the Internet of Things (IoT). Any investigation concerning the inclusion of CubeSat constellations in next-generation networks must consider the virtualization paradigm, which will pervade the architecture of the forthcoming fifth-generation (5G) communication system. Tangible examples of this process are Software Defined Networking (SDN) and Network Function Virtualization (NFV) paradigms, which together constitute the virtualization engine of the 5G architecture. The device virtualization concept, by means of the instantiation and management of a digital counterpart (or twin) of the physical device, can be efficiently exploited in the satellite environment to reduce the computational load of CubeSats, and to optimize and simplify the use of different payloads installed and/or integrated within a nanosatellite platform. Furthermore, virtualization enables the development of new services with additional capabilities, such as offering aggregated and correlated data among different payloads belonging to one or more nanosatellites. In the light of this, we propose to apply softwarization and virtualization paradigms, widely used in the terrestrial networks, to nanosatellites, which, as other IoT objects, can expose the collected data and make them accessible through standardized application programming interfaces (APIs) and IoT communication protocols. In particular, a Virtual Object (VO) associated as a digital twin to a CubeSat can migrate from ground station (GS) to GS during the CubeSat revolution in its orbits and allow continuous interaction with the nanosatellite. The VO model is implemented by using the Open Mobile Alliance (OMA) Lightweight Machine to Machine (LwM2M) standard, widely used in IoT environments for resource-constrained devices. Some use cases for the integrated use of CubeSats in multi-tenant plat-

forms and effective service orchestration will be discussed, and early results will demonstrate the feasibility of the proposed approach.