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Author: Ms. Federica Rinaldi
University Mediterranea of Reggio Calabria, Italy, federica.rinaldi@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
Prof. Antonella Molinaro
University Mediterranea of Reggio Calabria, Italy, antonella.molinaro@unirc.it
Prof. Giuseppe Araniti
University Mediterranea of Reggio Calabria, Italy, araniti@unirc.it

PAGING IOT DEVICES IN 5G-ENABLED NON-TERRESTRIAL NETWORKS

Abstract

The fifth-generation (5G) technology gives a strong focus to space communications that allow to achieve true widespread connectivity, even where the terrestrial coverage is limited or absent (i.e., onboard moving platforms, in remote and rural areas). Non-Terrestrial Networks (NTN) are characterized by wide area coverage and clear Line-of-Sight (LoS) and represent an effective solution to ensure any kind of service anywhere and anytime. For this reason, NTNs will play a key role also in forthcoming sixth-generation (6G) network.

In recent years, the need to interconnect a myriad of devices led to a new paradigm known as the Internet of Space Things (IoST) that spreads the concept of the Internet of Things (IoT) to space communications. In this context, constellations of nanosatellites, which are characterized by small payload size, low costs for realization and scalability guarantees, are seen as a revolutionary means to achieve the global interconnection of resource-constrained IoT devices on the ground. In wide-area sensor networks, IoT devices usually wake up to communicate their status update to a data aggregator, either when the IoT device's buffer is full or when the difference between two consecutive sensor measurements hits a threshold. In NTN with low-orbit satellites, different satellites of the same constellation may act as data aggregators from sensors when they pass over them, therefore the device-originated activity must be aligned with the ground-to-satellite link availability pattern. However, remote sensing becomes challenging whenever it is required to access current observations at the earliest possible, as in many on-demand tracking applications. In such a situation, the network must page target devices to wake them up outside their regular activity pattern to send collected data. This requires the transmission of a chain of messages from the application server to the group of IoT devices in the area of interest, possibly via several satellites connected through inter-satellite links. Furthermore, the activity status of IoT devices is driven by short connected and long idle periods, which allow them to operate on a battery for several years. As a consequence, IoT devices may not be immediately available for paging. In this paper, we focus on the performance of the paging procedure required to wake up resource-constrained IoT devices located in a given area of interest. We also propose a solution for on-demand remote sensing, whose aim is to gather devices' status updates as soon as possible. The proposed solution is validated by simulation.