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SYSTEMS ARCHITECTURE STUDY FOR FUTURE SPACEBORNE INTERNET OF THINGS CONNECTIVITY

Abstract

Over the last decade, the world has observed an increasing need of global connectivity from single mobile users to moving transport vehicles and fixed facilities. Such a need comes from a large number of users coming online from the emerging regions of the world, as well as the increased degree of connectivity of people, and devices around the world. As demand is increasing, and is expected to increase in the future, additional developments will be required on the infrastructure side to provide enhanced connectivity services. Satellite constellation projects are being proposed to enable global connectivity, both in narrowband and broadband. Internet of Things (IoT) is a particular use case of interest for narrow band connectivity services from space.

In this paper we extend the study that was originally presented at the IAC 2020, which proposed a systems architecture analysis framework for IoT connectivity via nanosatellite constellations in Low Earth Orbit. We explore the tradespace of feasible system architectures and benchmark them against foreseen market requirements in order to identify the effects of key architectural decisions having the greatest effect on system performance and lifecycle cost.

We extended our framework by proposing updated connectivity demand distribution maps, considering population density and population growth data for fixed and mobile users such as airplanes, ships, trains and cars traffic data. We consider an extended set of architectural options, including hosted payloads and small satellites as well as an increased number of variables for LEO constellation cases. Connectivity cases are also extended by adding mobile calls and constant data traffic. This work is focused on deeper investigation of market elasticity and market characterization in order to derive solid insights on architectural decisions for staged deployment of a constellation.

We demonstrate how higher granularity on market elasticity brings to useful information for informing the phased deployment of satellite constellations for IoT connectivity. In particular, we show how the proposed demand following approach, informed by modeling, maximizes expected value of the constellation throughout its lifecycle.