On the Use of Mega Constellation Services in Space [Invited Speech]

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***Abstract*—This paper introduces a framework for incorporating Low-Earth Orbit (LEO) platforms into Non-Terrestrial Networks (NTNs) within the evolving 6G communication ecosystem. Our approach utilizes the Mega-Constellation Services in Space (MCSS) concept, harnessing the extensive coverage and high capacity of LEO mega-constellations—originally designed for terrestrial applications—to support platforms operating in lower LEO orbits. The findings demonstrate that this solution effectively addresses the challenges posed by intermittent and time-restricted satellite communication links, which current Ground Station Networks and Data Relay Systems have yet to fully overcome.**

Our contributions include three main aspects: (i) a comprehensive MCSS evaluation framework using Monte Carlo simulations to analyze space user connectivity and distribution; (ii) an innovative Space User Terminal (SUT) tailored for MCSS, featuring diverse configurations and leveraging 5G New Radio Adaptive Coding and Modulation; (iii) in-depth results showcasing MCSS's significant performance enhancements compared to existing Ground Station Networks and Data Relay Systems, highlighting its potential for future 6G NTNs. The proposed space terminal integrates a multi-system, multi-orbit, and software-defined design capable of managing daily data flows at the Terabit scale with latency on the order of minutes. This compact and energy-efficient solution paves the way for seamless integration of LEO platforms as nodes within the space internet infrastructure [1].

***Index Terms*—6G, Non-Terrestrial Networks, Mega Constellations, Low-Earth Orbit Satellites**

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