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MULTIFUNCTIONAL SPACE TRAFFIC MANAGEMENT ARCHITECTURE FOR SAFETY AND CONTROL OF SATELLITE CONSTELLATIONS

Abstract

Expanding applications of LEO satellites and constellations is dramatically increasing the population of large and small spacecraft in already congested orbits between 600 km and 1200 km altitude. Projections indicate there will be an additional 10,000+ new satellites in this region of space within a few years. The exacerbation of the congestion will surely create increase conjunctions among active satellites and debris objects. These new and additional space activities will radically change space operations, require new sensor systems and necessitate changes in the way space traffic management (STM) is conducted. For example, there are multiple constellations, each with thousands of satellites, being proposed to provide global broadband Internet services. A common feature of these constellations is that they will fly at already-congested altitudes, posing a serious risk to other satellites residing either nearby or passing through such altitudes. In addition, the disposal of satellites at end-of-mission life pose potential risks to other satellites at other altitudes. New, space-based precision sensor systems will allow a needed expansion of the object tracking catalog to include dangerous objects that have previously been ignored. As a result, satellite operators will have to deal with increasing numbers of both collisions and conjunction alerts. Any STM system will have to deal with a very high level of traffic-related activity. Any resolution to this situation must include a STM program built on technology-based policies and regulations. The associated architecture must include satellite-satellite and satellite-debris separation techniques and related additional equipment for every new spacecraft. Several new technologies and systems will be needed. This paper delves into the technologies, systems and operational approaches that will be required in order to keep space permanently safe and accessible.