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ASSESSMENT OF AUXILIARY SPACE-BASED ELEMENTS FOR THE GALILEO 2ND GENERATION SYSTEM

Abstract

With the Galileo global navigation satellite system, the European Union and the European Space Agency are creating a high-precision positioning system for all world-wide users. Aiming to reach Full Operational Capability in 2019, the deployment of Galileo satellites is progressing steadily with 6 additional in-orbit satellites planned for 2016. Meanwhile, investigations into a next-generation successor system for the post-2020 timeframe, aptly named Galileo 2nd Generation (or G2G), have already been initiated.

The overarching goals of the G2G system are to increase payload performance and to enhance cost effectiveness. For this purpose, the on-station mass is required to increase, which can be accomplished by equipping the satellites with electrical propulsion and performing a low-thrust transfer from a LEO injection orbit to their MEO operational orbits.

The baseline G2G system is planned to consist of 24 operational in-orbit satellites, which are equally divided over 3 orbital planes. All spacecraft in the baseline constellation will operate in a MEO orbit at 23,222 km and 56 inclination.

In addition, the possibility of adding auxiliary space-based elements into the navigation system has been examined as part of the investigations into G2G. The primary purpose of these elements is to improve the navigation performance in the European region, with emphasis on the northern latitudes and to provide satellite-based augmentation services (SBAS) to the baseline G2G system. In particular for the auxiliary space-based elements, other orbit types than MEO are also under consideration, e.g. inclined geo-synchronous and highly elliptical orbits.

In this paper, the possible auxiliary space-based elements will be analyzed. First of all, the different options will be identified and shortly described. A high-level assessment of their impact on the system navigation performance will be presented, e.g. impacts on dilution of precision and visibility characteristics. Furthermore, technical impacts on the payload, among others EIRP and Doppler shift, and mission analysis considerations, such as transfer and de-orbit Delta-V requirements, will be discussed.

All relevant parameters will be summarized in a complete overview resulting in a high-level comprehensible trade-off. As a final note, a possible implementation for the auxiliary space-based element making use of OHB's Electra platform will be presented.