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A MODULAR SYSTEM DESIGN AND ANALYSIS APPROACH FOR SIZING COMMERCIAL  
POST-ISS LEO INFRASTRUCTURES

**Abstract**

Sooner or later the International Space Station (ISS) will be out of operation. Currently, several institutions are investigating the need, challenges and opportunities of a future, post-ISS infrastructure in Low Earth Orbit (LEO), especially for commercial utilization. In 2015, the German Aerospace Center (DLR) initiated a study which included an extensive stakeholder analysis, focusing mainly on scientific applications, and the corresponding design of a lean LEO infrastructure, called the 'Orbital Hub'. In 2019, the European Space Agency (ESA) co-funded several studies considering rather the commercial utilization of such post-ISS infrastructures. Therefore, Airbus Defense and Space, Space Applications Services, Kayser Italia, Sierra Nevada Corporation and DLR joint forces to analyze a future human presence in a future LEO ecosystem until 2050. The study covered the analysis of financial viability and sustainability. The work is based on a market assessments and variations of key market data, taking into account the utilization by private but also institutional sectors. The activities were divided into four major consecutive tasks, a market analysis, a technical concept design, a cost analysis and a subsequent business analysis. These tasks were continuously subjected to a risk and benefit analysis and eventually converged into an implementation planning for short-, medium and long-term scenarios. The present paper focusses on the technical part, describing how the sizing of future LEO infrastructures beyond ISS could be effectively performed following a modular system design and analysis approach. This approach makes use of the technical building blocks and cost elements identified in the Orbital Hub study, the market analysis data gathered during this activity and the resulting top-level requirements. The comparison of several use cases showed that the commercially most interesting LEO platform is not only driven by

high-revenue promising market areas but also low-resource demanding applications. The current baseline concept design and its recommended build-up scenario from 2025 until 2050 are described. A thorough market analysis is a continuous effort and forecasts will very likely change over time. Thus, there is a need for rapidly responding to future scenarios, to support decision making during the build-up and operational period of a modular post-ISS infrastructure. The presented design approach and related tool support the reaction of market changes and quickly provides the required input to the business analysis in a simple but efficient manner.