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OPERATION AND ROBOTIC ASSEMBLY OF A FUTURE MODULAR IN-ORBIT DATA CENTER INFRASTRUCTURE

Abstract

A continuously increasing need for processing power can be observed over the past years and is expected to continue on an even steeper curve in the future. Most prominent drivers for this development are e.g. the rapidly growing application of AI in everyday use-cases, the need to process and analyze increasing amounts of data (big-data use-cases) generated and used by various systems with increasing number due to the general digitization of processes and systems on a global scale. Not only this development requires the provision of enormous amounts of energy with correspondingly increasing demand in the future. With the UN's NetZero goals, to which the EU has also committed itself, this poses major challenges in meeting existing and future needs. With evolving technology the installation of large infrastructures in space becomes more and more feasible, allowing the utilization of advantages in space, such as e.g. solar energy. The overall goal of the ASCEND EU project is to conceive a data center in-orbit (i.e. the Space Data Center (SDC)) that is able to ensure future data processing and storage needs while at the same time reducing its environmental footprint that will help Europe become a carbon neutral continent by 2050. Within this paper a concept analysis for a modular SDC is presented, relying on a robotic assembly and maintenance approach. A general overview of top-level requirements and the envisioned data center system and modules is given, providing a concept overview and scope of the solution. The SDC is broken down into a small number of identical modules, which help to unify the assembly process as well as the needed logistics for ramping-up and scaling of the system to reach several hundreds of mega watt processing power in orbit. Along these general assumptions and constraints a concept of operations and operational concept analysis has been performed and is presented in this paper. A focus is given 1st on the mission phases for SDC implementation, operation and evolution and 2nd in more detail on the robotic based on-orbit assembly and maintenance concept of the SDC, including the outline and needs of

a feasible robotic sub-system. As a result a concrete concept to implement and operate a SDC is outlined, including aspects for ramp-up and maintenance to reach up to 1 GW processing power in orbit by 2050, while significantly reducing the environmental footprint.