

Space Traffic Management and Resilient Space Environment 2022

In-orbit servicing, manufacturing and recycling

Title

Removing barriers for transitioning into the new space infrastructure paradigm.

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Abstract

In the next decade large-antenna satellites assembled in space will provide citizens with a wide range of services, and scientific satellites will allow us to see further into deep space than ever before. Payloads will be exchanged on reconfigurable satellites. Efforts to reduce space debris mean that the majority of satellites are serviced or de-orbited in space. Advanced and standardised space robotics will be used for autonomous manufacturing and assembly of large structures in LEO and lunar orbit. The same robotic technologies and autonomous industrial processes will be used for producing resources in space. All of this will come along an advanced space infrastructure to manage safely those thousands of space assets. New services of the space ecosystem architecture will be required like Position, Navigation & Timing (GPS-like system could provide PNT services to spacecraft operating in cislunar space), Logistics and Manufacturing (Space vehicles for manufacturing or transfer of products), Space Domain Awareness (Space vehicles configured with sensors to identify, track, catalogue, and inspect objects in space), Power (Energy sources e.g. chemical, solar, and nuclear, to power spacecraft in Earth orbit and cislunar orbit) and Deep-space communications (Extensive network of sensors and tailored communications services to deal with the complexity of space travel). To achieve this a paradigm shift change away from “static space” and towards “flexible, dynamic and sustainable space” shall occur. Advancing technologies in the field of robotics, automation, and standard interfaces is a necessary step to develop a new space ecosystem paradigm where flexible, modular spacecraft designs and large space infrastructure become the norm. Specialized satellites and other high-value assets will significantly benefit from cost-effective In-Space Manufacturing and Assembly (ISMA) solutions. Emerging industries can build on proven ISMA technologies to deliver new scalable products and services to Earth, enable sustainable products and activities in LEO, lunar orbit and on the surface of the Moon. On that way to the new space infrastructure high barriers will have to be overcome. The new space market suffers uncertainties on its orientation like what the first applications will be, either on relocation or maintenance and later manufacturing. The Technical Readiness for cost-effective In-Orbit Operations is not as high as it should be. Methods for verification of systems produced in space must be established. Standardization is required to accommodate in-space servicing and ISMA, and is seen as a key driver to be able to reduce costs and make the space business attractive.