

SPACE SYSTEMS SYMPOSIUM (D1)  
Innovative and Visionary Space Systems Concepts (1)

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IN-ORBIT SERVICING AND DE-ORBITING CONCEPTS AND A GERMAN DEMONSTRATION  
MISSION

**Abstract**

The number of in-orbit satellites increases rapidly, such many of them will reach their end-of-lifetime in the near future. Extending the lifetime will require In-Orbit Servicing. But some of the decommissioned satellites may require safe disposal onto a graveyard orbit or a safe and controlled re-entry into the earth atmosphere depending on the initial orbit of the satellite. In-Orbit Servicing includes servicing and safe disposal of decommissioned satellites on LEO or GEO.

In-Orbit Servicing is not only dedicated to refuelling communication satellites, which could extend mission lifetime, but could be also used to maintain and repair satellites. Maintenance and repair will include fastening of thermal blankets, exchange of boxes and batteries that are out of operational time, re-fuelling or repair of blocked mechanisms or similar things.

Applying In-Orbit Servicing would reduce the number of satellites getting lost in-orbit and imposing dangerous situations for neighbouring satellites creating additional space debris as a result of a collision or in case of any uncontrolled re-entry into earth atmosphere. As a matter of fact, each nation that has entered the international treaty for using the space, will be made responsible for any issue effecting, for example, human life on earth. In-Orbit servicing will be an important matter not only for extending satellite services, but also for insurance issues, if in-orbit service will include controlled de-orbiting of uncontrolled satellites or space debris.

In-Orbit Servicing of Satellites is including the capability of a Servicer Satellite to identify the target, to approach and finally dock the target, that may be at an uncontrolled attitude. A Robot Arm may than be used to maintain and repair certain components of the targeted satellite and/ or connect to a pressure-line for refuelling. These servicing activities require standardisation of components and interfaces, ports, to allow for Servicer Satellite Operations. Servicer Satellite Operations have to be planned, controlled and tracked from the dedicated mission control centre giving the Servicer Satellite a certain on-board autonomy to conduct the servicing mission.

The paper will describe the possible mission architectures for required in-orbit servicing operations. It will provide some required design standardisation measures required for future satellite design to allow in-orbit servicing. The results of the DEOS Mission Study will be used as an example to demonstrate a feasible approach for an In-Orbit Servicing Mission Architecture.