

About the implications and prospects of on-orbit servicing

By Nikolaos Kessidis, March 6, 2012

Telecommunication, TV broadcasting and weather forecasting satellite systems stationed in the geostationary earth orbit have a high commercial and strategic value as they represent the majority of active satellites. It will soon be essential to have adequate possibilities of remote intervention to service and repair satellites in order to safeguard not only those huge capital investments but also the usability of the orbit itself.

In all probability, satellites are the only complex technological systems without a routine maintenance, repair and upgrade program. In its contemporary understanding, maintenance or upgrade typically means launching a new satellite to replace an older one. Therefore the design lifetimes for satellites are made longer which increases manufacturing cost significantly.

The most risky phase for a space mission is the launching process itself, potentially affecting hardware integrity and function. The result may be unintended mechanical interferences and/or deployment failures. Understandably enough the accessibility is limited or even impossible after launch, causing even small failures to lead to serious repercussions.

Specially manufactured satellites will have to do the work since the physical, technical and economic constraints of such a mission make servicing by astronauts impossible. Today, robotic servicing appears to be technically feasible and provides a set of capabilities, which range from satellite inspection to physical upgrade of components. In order to reach the vision of on-orbit servicing, it would be necessary to develop a new value proposition for satellite architectures enabling them to receive much more services in future. In particular investing in key enabling technologies such as improved systems for rendezvous / docking / refueling, modular and self-reconfigurable architectures and advanced tools and end-effectors. This will allow implementing the on-orbit servicing through refueling, repairing, and refurbishment, which automatically will derive more economic value through extended use.

Satellites are often called expensive pieces of hardware sustaining their high value even after some critical resource has been expended or some critical technology has become obsolete. Additional value could be derived if a servicing craft would be able to repair or replace a broken critical component or move the satellite into another orbit. Such a spacecraft would raise the hope of opening up new scientific perspectives to reach beyond today's observatories. It could also provide refueling services to spacecraft's that are to move to remote destinations and to manage the orbital debris, an area of growing concern in the geostationary earth orbit.

Satellite servicing looks particularly promising of altering current paradigms of satellite construction, operation and maintenance, all critical components that will be required to meet the upcoming challenges in space exploration.