State of Play

ON-ORBIT SERVICING, ASSEMBLY, AND MANUFACTURING (OSAM)

April 2, 2021

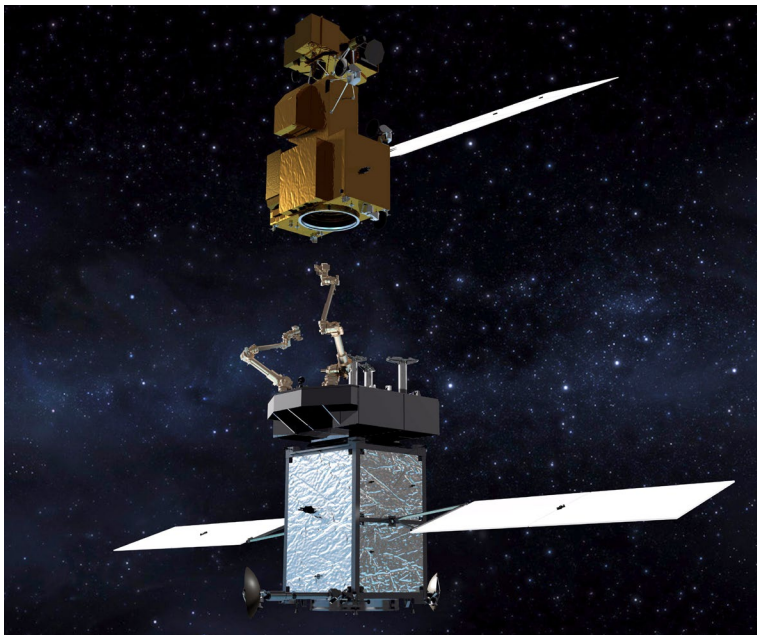
Overview

Due to shrinking technology and falling prices, on-orbit servicing, assembly, and manufacturing (OSAM) is an area of emerging technology and growth in the space domain. In general, this domain refers to the use of refuelers and space tugs for on-orbit maneuvering and refueling. Many companies are participating in the trade space of these exciting missions. Below is a snapshot of some of the key trends in OSAM in the U.S. and European marketplace.

Key Technologies and Developments

U.S. Government

From the U.S. government side, the Defense Innovation Unit (DIU) has current Orbital Outpost and Multi-Orbit Logistics Vehicle (m-OLV) programs. The Air Force Research Laboratory (AFRL) is researching technologies related to refueling small spacecraft. The Air Force Space and Missile Systems Center (SMC) has on going and recent work studying refueling for future National Security Space (NSS) satellites. The United States has created a National OSAM Initiative, which would include elements and capabilities important to the Department of Defense (DOD), and civil and intelligence community agencies. Several "whole of government" topics are being discussed currently, including standards developments, technology development, and prototyping, emphasizing the need to begin preparing satellites currently in or entering the development cycle for servicing in the future through the addition of high-level requirements language and the development of interface standards.



Artist's concept of the Restore-L servicer extends its robotic arm to grasp and refuel a client satellite on orbit. Image Credit: NASA

U.S. Industry

For large and government contractors, Northrop Grumman is currently in the lead with its Mission Extension Vehicle 1 (MEV-1), which, in 2020, successfully docked with client satellite Intelsat 901 in the geosynchronous graveyard (about 300 kilometers above the geosynchronous orbit). Two months later, the MEV-1 had returned the satellite back to its operational orbit, where MEV-1's own propulsion systems will provide Intelsat 901 five more years of operational life. OSAM-1 (formally, Restore-L) is scheduled for launch in 2024, using a commercial satellite bus provided by Maxar, and will rendezvous with the Landsat 7 spacecraft, refuel it, and then perform an in-space robotic assembly of an antenna and a boom. OSAM-2, formerly known as Archinaut 1, is a spacecraft under development by Made In Space to build and deploy a solar array in space.

For small companies, key players include Motiv, a company that makes robotic arms for JPL; Altius, a company focused on satellite-servicing systems and, along with OrbitFab, propellant transfer; and Astroscale, a company that targets autonomous orbital debris removal. A recent trend is acquisition of smaller companies by special purpose acquisition companies (SPACs).

Within the past year, Altius was acquired by Voyager Space Holdings, and Made-in-Space was acquired by Redwire Inc. Since being founded in 2019, Voyager has acquired three other space companies (The Launch Co., NanoRacks, and Pioneer Astronautics), and Redwire has rolled up six other space companies since 2020 (Adcole Space, Deep Space Systems, Deployable Space Systems, LoadPath, Oakman Aerospace, and Roccor).

Select International Initiatives

There is a great deal of interest and funding for in-space satellite manufacturing in Europe, responding to U.S. advances in the domain. Airbus Defense and Space in Bremen, Germany, is developing a "Satellite Factory in Space," which will lead a seven-company consortium in a two-year Phase A/B1 study for the PerAspera In-Orbit Demonstration (PERIOD) project, supported by $3.6 million in funding from the European Commission under the Horizon 2020 research program. PERIOD will demonstrate the value of in-space servicing, manufacturing, and assembly. It is intended to help Europe develop capabilities and industrial infrastructure to be positioned strongly in the in-orbit servicing and manufacturing market.

Future Outlook

In the coming years, we expect to see many new entrants in the OSAM field. We are likely to see commercial refueling demonstrated within 3 to 5 years and become more common thereafter. On-orbit repair and component swaps are probably 5 to 10 years away. Robot arms are already sufficient for much of this, but lower cost and higher dexterity versions are in development and will make missions more commercially viable. It will also take some time and a shift in thinking for traditional spacecraft manufacturers and operators to become comfortable with the idea of servicing. SMC is assessing interface standards for servicing future spacecraft, and commercial industry is likely to follow that lead. The ability to have spacecraft serviced on-orbit and structures produced in space will eventually affect the design of spacecraft themselves and the launch vehicles that place them into space. Ultimately, the reliability of in-space servicing and manufacturing is likely to increase demand for launches of assembly and building materials, followed by a need to access materials already in space — thereby eliminating the time and cost of launching out of Earth's gravity well. In the more distant future, in-space servicing and manufacturing is likely to drive demand for in-space material extraction and refinement to support servicing and construction of space systems orbiting Earth and in the cislunar domain and beyond.

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