Fact Sheet

Defense Advanced Research Projects Agency

"Providing technological innovation for national security for almost 50 years."

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ORBITAL EXPRESS

The Defense Advanced Research Projects Agency (DARPA) Orbital Express program will validate the technical feasibility of robotic, autonomous on-orbit refueling and reconfiguration of satellites during a three-month mission slated to begin with a launch in March 2007.

The program is deploying two satellites: a surrogate next generation serviceable satellite (NextSat) and a prototype servicing satellite (ASTRO). During an extended series of operations, this pair of satellites will rendezvous and dock multiple times. ASTRO will refuel NextSat, transferring hydrazine propellant into NextSat's fuel tank via a non-proprietary interface. ASTRO will also insert a battery module aboard NextSat.

The technologies developed by the DARPA Orbital Express program will support a broad range of future U.S. national security and commercial space programs. A successful demonstration will open up new possibilities for future space system design and operations. Orbital Express technologies can be used in the future to reduce spacecraft fuel constraints and upgrade obsolete technologies on satellites configured for replacement of modular components.

Military Significance

On-orbit satellite refueling will provide the U.S. with the flexibility to maneuver its satellites and optimize their time over ground targets, avoid debris and other spacecraft, change orbits to counter denial and deception activities on the ground, and, more generally, provide tactical agility for a wide range of emerging missions. The ability to replace or upgrade electronic components on deployed spacecraft will support more rapid deployment of new technologies to satellites, without fielding new vehicles. Satellites can be upgraded with technologies that become available after launch, or components that fail prematurely can be replaced.

Demonstration Mission

Orbital Express will demonstrate the technical feasibility of on-orbit servicing, show the utility of on-orbit servicing to upgrade and/or refuel space assets on station, and establish a non-proprietary satellite-to-satellite interface standard that can be used across the space industry. The Orbital Express program will be the first demonstration of fully autonomous rendezvous; soft capture and autonomous station-keeping; and on-orbit refueling and component replacement. Once deployed in a circular, 492-kilometer, low earth orbit, the two

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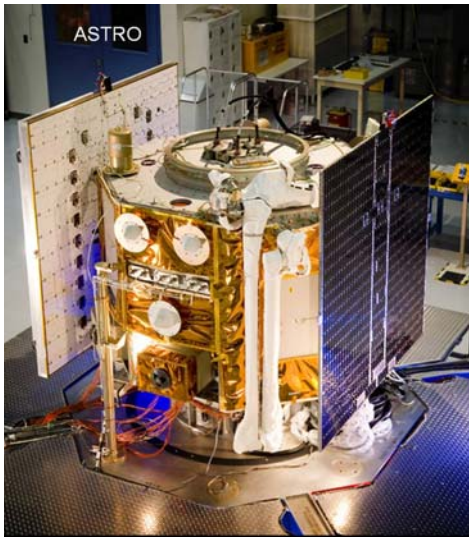
space vehicles will be controlled from the Air Force's Research Development Test and Evaluation Support Center, Kirtland AFB, N.M. Over the next 90 days, a series of experiments will be conducted that demonstrate the ability to conduct autonomous servicing operations. The on-orbit demonstration will include the following activities:



- Transfer of hydrazine monopropellant between ASTRO and NextSat.
- Use of ASTRO's robotic arm to detach and reattach a flight computer from a bay onboard ASTRO.
- Use of the arm to detach a battery from its bay on ASTRO and transfer it to a similar bay onboard NextSat.
- Use of ASTRO's arm to couple to a NextSat grappling fixture and "berth" the spacecraft, allowing a separate capture mechanism to perform final docking.
- Multiple rendezvous and capture scenarios with a number of different sensors, at ranges up to seven kilometers (4.4 miles).
    - "Soft" (low momentum transfer) docking with a special, three-fingered capture mechanism.
    - Use the robotic arm to grapple and pull NextSat into the capture system envelope.
    - Use of an infrared camera, multiple optical cameras, a laser rangefinder, and NASA's Advanced Video Guidance System, which uses retroreflector targets on NextSat and a laser on ASTRO to estimate a client spacecraft's attitude and facilitate docking.

Background

Boeing is the prime integrator for the Orbital Express program and builder of the ASTRO spacecraft. Ball Aerospace constructed NextSat. Other team members include Boeing Advanced Network and Space Systems; NASA; Northrop Grumman Space Technology; MacDonald, Dettwiler and Associates Ltd.; the Charles Stark Draper Laboratory Inc.; and Starsys Research.

Orbital Express began as a three-contractor spacecraft-servicing study in 2000. In 2002, DARPA selected Boeing Phantom Works as the prime contractor for the follow-on design, development, and space demonstration of technologies for autonomous on-orbit refueling and reconfiguration of satellites. The program held its Critical Design Review in 2003, and completed the ASTRO servicing spacecraft and NextSat client satellite in 2005. Boeing conducted system testing of the two spacecraft throughout the following year, and, in September 2006, shipped the two satellites to Astrotech, Titusville, Fla., for payload processing.

General Characteristics

Primary Mission: Space Technology Experimentation/Test
Prime Contractor: Boeing Phantom Works
ASTRO Height: 70 in.
ASTRO Width: 69 in. (solar array span - 220 in.)
ASTRO Weight: 2,100 lbs. (unfueled)
ASTRO Propellant Weight: 300 lbs.
NextSat Height: 40 in.
NextSat Width: 39 in. (solar array span - 83 in.)
NextSat Weight: 500 lbs.
Total OE Launch Weight (NextSat and fully fueled ASTRO): 2,900 lbs.
Launch Vehicle: Lockheed-Martin Atlas V 401, with Single-Engine Centaur upper stage

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