U.S. Co-orbital Anti-satellite Testing

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Summary

The United States does not have a publicly-acknowledged co-orbital anti-satellite (ASAT) capability or program to develop such a capability. However, the United States does possess the technological capability to develop a co-orbital capability in a short period of time if it chooses to do so. The United States has conducted one co-orbital intercept test in 1986 with the Delta 180 experiment as part of the Strategic Missile Defense Initiative. Since then, the United States has conducted multiple tests of technologies for close approach and rendezvous in both low Earth orbit (LEO) and geosynchronous Earth orbit (GEO, along with testing of tracking and targeting technologies that could lead to a future co-orbital ASAT capability.

Co-orbital ASAT Programs

Co-orbital ASATs place an interceptor into orbit, which then maneuvers to alter its orbit to a trajectory that brings it close to a target. Co-orbital ASATS could maneuver to approach immediately after being placed into orbit or after remaining dormant for an extended period of time. They can try to damage or destroy their target by direct collision at hyper velocities, releasing a cloud of fragments that will collide with the target, using a robotic arm to damage or remove parts of a target satellite, or using electronic warfare or directed energy weapons at close range. Regardless of the technique used, co-orbital ASATs require onboard guidance, navigation, and control systems to identify and track a targeted space object and fine-tune its trajectory for proper interception. Although the United States has never had an officially recognized co-orbital ASAT program, it did test and develop many of the underlying technologies as part of its missile defense programs during the Cold War. Most notably, several of the technologies for space-based midcourse ballistic missile intercept developed as part of the Strategic Defense Initiative (SDI) during the 1980s could have been used to intercept satellites as well.

Delta 180 Experiment

The United States conducted a successful co-orbital intercept as part of the Delta 180 experiment under the Strategic Missile Defense Initiative (SDIO). The goal of the Delta 180 experiment was to better understand tracking, guidance, and control for a space intercept of an accelerating target.[1] The experiment involved modifying the second stage of a Delta 2 (D2) rocket to carry a sophisticated tracking system that included radar, ultraviolet, visible, and infrared sensors. The payload consisted of a McDonnell Douglas Payload Assist System (PAS) platform combined with the warhead and seeker from a Phoenix air-to-air missile and Delta 2 rocket motors.

The Delta 180 experiment was launched from the Cape Canaveral Air Force Station on September 5, 1986. Two pieces, the D2 target and the PAS interceptor, were placed into a 220-km circular orbit. The PAS maneuvered to a separation distance of 200 km, and 90 minutes after launch, the D2 observed the launch of an Aries rocket from White Sands Missile Range. At 205 minutes after launch, the D2 and PAS both ignited their engines on an intercept course, colliding at a combined speed of nearly 3 km/s.[2] Sixteen pieces of orbital debris from the collision were cataloged with apogees as high as 2,300 km. However, the low altitude of the intercept resulted in all pieces reentering the atmosphere within two months.

Current Status

While the United States has not had a fully structured co-orbital ASAT program, it has tested and developed many of the underlying technologies. These include multiple successful military robotic rendezvous and proximity operations (RPO), between satellites in both LEO and GEO, of sophisticated space situational awareness (SSA) capabilities for identifying, tracking, and targeting space objects. Examples of RPO missions include the 1990 Prowler satellite that maneuvered around the GEO region to inspect Russian satellites,[4] the 2006 XSS-11 satellite that conducted RPO and inspections of LEO space objects,[5] and the current GEO Space Situational Awareness Program (GSSAP) satellites that are conducting inspections and surveillance in the GEO region.[6]

Summary of Known or Suspected US Co-orbital-ASAT Tests in Space

Date	Interceptor	Launch Site	Target	Orbit Altitude	Debris Created[7]	Result
9/5/1986	Delta 180 Payload Adapter System	Cape Canaveral Air Force Station	Delta 2 R/B	220	16	Successful intercept of thrusting object in 220-km circular orbit

Endnotes

1. John Dassoulas and Michael D. Griffin, "The Creation of the Delta 180 Program and Its Follow-ons," Johns Hopkins APL Technical Digest, vol. 11, Numbers 1 and 2 (1990): p.86, https://www.jhuapl.edu/Content/techdigest/pdf/V11-N1-2/11-01-Dassoulas.pdf.
2. "VSE (Delta-180, DM-43)," Gunter's Space Page, accessed March 22, 2018, https://space.skyrocket.de/doc_sdat/vse.htm.
3. Dassoulas and Griffin.
4. Ted Molczan, "Unknown GEO Object 2000-653A / 90007 Identified as Prowler," January 21, 2011, https://satobs.org/seesat_ref/STS_38/Unknown_GEO_Object_2000-653A_-_90007_Identified_as_Prowler.pdf
5. "XSS-11 Micro Satellite," Fact Sheet: Air Force Research Laboratory, Space Vehicles Directorate, current as of September 2011, accessed March 22, 2018, p.1, http://www.kirtland.af.mil/Portals/52/documents/AFD-111103-035.pdf?ver=2016-06-28-110256-797.
6. Stephen Clark, "Air Force General Reveals New Space Surveillance Program," SpaceFlight Now, February 25, 2014, http://spaceflightnow.com/news/n1402/25gssap/
7. Data compiled from the public catalog maintained by the U.S. military at https://Space-Track.org