X-37B Orbital Test Vehicle Fact Sheet

Updated June 1, 2017

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Summary

The X-37B OTV is a technology demonstrator and experimental vehicle which is likely to be used for flight testing new reusable space launch vehicle (SLV) technologies (such as guidance and thermal protection) and on-orbit testing of new sensor technologies and satellite hardware primarily for space-based remote sensing. While it does have some capability for orbital inspection, repair, and retrieval, it is unlikely to perform these functions given its limited payload bay and altitude range. It has near zero feasibility as an orbital weapons system for attacking targets on the ground.

Background

- X-37B is an experimental re-usable spaceplane, similar to the Shuttle but much smaller, completely robotic, and using more advanced technologies.[1]
- X-37B is designed to be launched into space on top of a large rocket, stay on orbit for months to years, and then re-enter and land on a runway.
- X-37B has thrusters for on-orbit maneuvering and de-orbit, but no engines for powered flight in the air—it is a glider in the atmosphere.
- X-37B started life as a NASA program in 1999, but transferred to DARPA in 2004. DARPA transferred it to the USAF in 2006 after more budget issues.[1]
- Total program costs and budget line are classified.

Image credit: U.S. Air Force

- Although no official orbital parameters have ever been given, hobbyist tracking indicates the X-37B typically operates at an inclination of 38-43.5 degrees and an altitude of 285 to 400 km (180 to 250 mi), which is far lower altitude and inclination than most operational spacecraft.[2]
- Flight operations of the X-37B are overseen by the U.S. Air Force's 3rd Space Experimentation Squadron, located at Schriever Air Force Base, Colorado.[3]

X-37B Orbital Flight History

Launch Date	Launch Location	Landing Date	Landing Location	Time on Orbit
April 22, 2010	Cape Canaveral, FL	December 3, 2010	Vandenberg Air Force Base, CA	224 days
March 5, 2011	Cape Canaveral, FL	June 16, 2012	Vandenberg Air Force Base, CA	469 days
December 11, 2012	Cape Canaveral, FL	October 17, 2014	Vandenberg Air Force Base, CA	675 days
May 20, 2015	Cape Canaveral, FL	May 7, 2017	Kennedy Space Center, FL	718 days

Debate Over Mission and Rationale for the X-37B Program

Official objectives of the X-37B program include "space experimentation, risk reduction and concept of operations development for reusable space vehicle technologies." [1] However, none of the potential missions posited by the US military appear to justify the program's existence, especially on a cost basis, and this has led to speculation about what the "real" mission may be. The following section discuss the feasibility, advantages, and drawbacks of five of the most cited potential missions for the X-37B.

1. X-37B as an on-orbit sensor platform and technology test bed (Feasibility: high)

Concept

- X-37B payload bay could contain various sensors used for intelligence collection of the Earth from space, potentially including radar, optical, infrared, and signals/electronic intelligence (SIGINT/ELINT) suites to flight-test and evaluate new sensors and hardware.
- Could also be done in response to crises/warfighter needs for Operationally Responsive Space (ORS).
- USAF: "What it offers that we have seldom had is the ability to bring back payloads and experiments to examine how well the experiments performed on-orbit," said Gary Payton, the undersecretary of the Air Force for space programs. "That's one new thing for us." [4]

Advantages

- Ability to flight test and return experimental sensors and satellite hardware would be of significant benefit to the US military.
- This is a mission that has been done in the past using the Shuttle and could help to reduce risks in deploying new technologies. [5]
- Ability to re-configure the payload bay contents for various sensor packages would make it much more flexible than having to procure multiple satellites.
- The combination of chemical and ion propulsion could make the X-37B more maneuverable in orbit than many ORS satellites or existing satellites, allowing for more flexible ground coverage.

Artist's rendition of how the X-37B will deploy on orbit, including the solar panels used for electrical power. Image credit: Boeing

Drawbacks

- Prompt response is hindered by its currently reliance on an EELV booster for launch and the associated processing timelines and launch pad availability requirements.
- Not very cost effective given the estimated average cost of close to $100 million per EELV launch (based on the Atlas V version 501 configuration used for the April 20, 2010 launch). [6]

2. X-37B as a deployment platform for ORS satellites (Feasibility: medium)

Concept

- X-37B could be launched into orbit and deploy multiple small satellites on a very timely basis to support time sensitive warfighter needs.
- USAF: "We could have an X-37 sitting at Vandenberg or at the Cape, and on comparatively short notice, depending on warfighter requirements, we could put a specific payload into the payload bay, launch it up on an Atlas or Delta, and then have it stay in orbit, do the job for the combatant commander, and come back home," Payton said. "And then the next flight, we could have a different payload inside, maybe even for a different combatant commander." [4]

Advantages

- Flexibility in payload configuration, as you don't need to integrate each new satellite to the booster. The satellites get

integrated to the X-37B, which then gets integrated to the booster.

- Deployment could be done in a semi-stealthy manner, potentially avoiding or delaying tracking.

Drawbacks

- Not very timely as it is still are dependent on the time required to generate and setup a large rocket.
- The costs for a single rocket to launch an X-37B is far more than the entire ORS budget, which historically has been in the single-digit millions.[7]
- The payload bay for the X-37B can only carry a couple of small satellites, giving very little "bang for the buck" compared to using dedicated smallsat launch vehicles.
- Deployment could be done out of sight of amateur community, but very unlikely to be able to conceal from military space situational awareness capabilities.

3. X-37B as an on-orbit servicing vehicle (Feasibility: low)

Concept

- X-37 could be used to rendezvous with malfunctioning satellites and repair or refuel them, or in some cases capture and return them to Earth for a post-mortem analysis.

Advantages

- Could help the US military solve the problem of figuring out what went wrong when a satellites dies.
- Return of hardware from space could help with research into effects of space weather, debris, and micrometeoroids.

Drawbacks

- Other programs such as NASA's RESTORE-L, DARPA's RSGS are also working on on-orbit servicing capabilities,[8] and are likely more cost-effective.

Image credit: Boeing

4. X-37B as an on-orbit inspection or ASAT platform (Feasibility: low)

Concept

- X-37 could be used to rendezvous and inspect satellites, either friendly or adversary, and potentially grab and de-orbit satellites.

Advantages

- Historical and current on-orbit inspection satellites (such as XSS-11, MiTEx, and GSSAP) have a fixed set of sensors, X-37 sensor package could be upgraded or modified as needed on a per-mission basis.[9]
- Existing satellites can only access satellites close to their existing inclination and do not have the potential to capture and return.
- Could provide the capability to disable adversary satellites on-orbit without creating a large amount of debris.

Drawbacks

- Other platforms such as XSS-11 and MiTEx already have this capability and can stay on orbit for much longer.
- X-37B is much larger than the XSS-11 or MiTEx, which increases the chances that an adversary would detect an unauthorized rendezvous.
- The X-37B cargo bay is much smaller than many operational satellites, and most of that space is likely to be filled by the required robotic arm and other gear.

- To date, the X-37B has operated at altitudes below any other operational satellites.

5. X-37B as a Conventional Prompt Global Strike (CPGS) weapon or delivery system (Feasibility: zero)

Concept

- X-37B could be launched in response to a pending crisis and remain on orbit for a length of time to respond to high value/ very time sensitive targets.
- X-37B could either drop "rods from god" out of its payload bay or re-enter and become a weapon itself.

Advantages

- Would eliminate political issues over using ballistic missiles launched from the ground for CPGS missions.

Drawbacks

- Hyperkinetic weapons dropped from bay would need to be equipped with thrusters capable of performing a huge de-orbit burn, very difficult given small bay size. [10]
- X-37B itself re-enters like the space shuttle landing at an estimated 200 mph (321 kph)[11], which means it travels in the atmosphere much slower than an RV on a ballistic arc or a hyperkinetic weapon. Thus it would need to carry conventional explosives to do any significant damage.
- X-37B after re-entry would be a slow moving, not-very-maneuverable glide bomb, easy prey for any air defense system along its path to the target.
- Having only a few X-37Bs would not provide very timely coverage of potential ground targets.[12]

Endnotes

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