

NAVSTAR Global Positioning System (GPS)

Executive Summary

- The Air Force launched the eighth and final NAVSTAR GPS Block IIR-M (Modernized) satellite in August 2009 and the first Block IIF (follow-on) satellite in May 2010. However, prototype Military-code (M-code) capable Military GPS User Equipment (MGUE) will not be available to conduct basic developmental testing of Block IIR-M and IIF unique capabilities until 2015.
- During integrated developmental and operational testing of the Architecture Evolution Plan (AEP) version 5.5.d, the Air Force discovered problems with some military GPS receivers.
- The GPS Integrated Test Team (ITT) successfully drafted an Enterprise-level Test and Evaluation Master Plan (TEMP).

System

- The NAVSTAR GPS is an Air Force-managed, joint Service precision navigation and timing space program used for DoD and non-DoD operations.
- The NAVSTAR GPS consists of three operational segments:
 - Space Segment - The NAVSTAR GPS spacecraft constellation consists of a minimum of 24 operational satellites in semi-synchronous orbit.
 - Control Segment - The control segment consists of primary and backup GPS master control stations, operational system control antennas, a pre-launch compatibility station, and geographically dispersed operational monitoring stations.
 - AEP 5.5.4 is the current version of the control system supporting Blocks II/IIA, IIR/IIR-M, and IIF.
 - Next Generation GPS Operational Control Segment (OCX) replaces AEP 5.5.4 and will support the current GPS constellation and the follow on Block III satellites.
 - User Segment - There are many versions of NAVSTAR GPS mission receivers hosted on a multitude of operational systems and combat platforms.
- The system is being modernized with an M-code enhanced capability to better meet the needs of operational users. Future GPS updates will improve service in signal interference/jamming environments; enhance military and civil signal integrity; and provide time-critical constellation status.



- The Air Force Space Command has launched three blocks of NAVSTAR GPS satellites and has two blocks of spacecraft in development:
 - Block I (1982-1992)
 - Block II/IIA (1990-1997)
 - Block IIR/IIR-M (Modernized) (1997 – present)
 - Block IIF development (May 2010 – present)
 - Block III development (replacement spacecraft)

Mission

- Combatant Commanders, U.S. military forces, allied nations, and various civilian agencies use the NAVSTAR GPS system to provide highly accurate, real-time, all-weather, passive, common reference grid positional data, and time information to operational users worldwide.
- Commanders use NAVSTAR GPS to provide force enhancement for combat operations and military forces in the field on a daily basis throughout a wide variety of global strategic, operational, and tactical missions.

Major Contractors

- Block IIR/IIR-M and Block III: Lockheed Martin Space Systems – Sunnyvale, California
- Block IIF: The Boeing Company, Integrated Defense Systems – Seal Beach, California
- OCX: Raytheon Company, Intelligence and Information Systems – Garland, Texas

Activity

- The Air Force launched the first NAVSTAR GPS Block IIF satellite in May 2010. It has completed operational testing and was declared operational in September 2010.
- The Air Force synchronized schedules across the GPS Enterprise to deliver the following in 2015: 24 M-code

capable satellites on orbit, a control segment designed to be capable of operationally commanding modernized capabilities, and the first handheld user equipment designed to be M-code capable.

AIR FORCE PROGRAMS

- During integrated developmental and operational testing of AEP version 5.5.d (2QFY10) the Air Force discovered problems with some military GPS receivers.
- GPS AEP Version 5.5.4 underwent testing in August and September of 2010. As directed by the OSD, the ITT developed a draft TEMP for the GPS Enterprise. The GPS Enterprise TEMP includes testing for Blocks IIF and III of the satellites, the AEP upgrade to the current Operational Control Segment, OCX, Selective Availability Anti-Spoof Module (SAASM) capable User Equipment, and M-code capable MGUE.
- The Joint Requirements Oversight Council released a Joint Capabilities Document in place of an Initial Capabilities Document for MGUE.

Assessment

- The test planning in 2010, for all segments of GPS (space, control, and user), continued the improvement displayed in 2009. Problems discovered with military GPS receivers during AEP testing have prompted the GPS Wing to obtain an extensive suite of test equipment, including a large number of receivers and test cases, to exercise user equipment prior to any future changes to the GPS. Testing against current threats has been included across the test program, from modeling and simulation, through developmental, and into operational testing.
- The amount of detail in the Enterprise-level TEMP differs between the User and Space and Control segments as the three segments are at different levels of maturity. These variations will hinder the development of the overall test strategy by placing limits on test planning and test scenario development.
- Based upon current progress, the SAASM mission-planning tool may not be available for the Multi-Service Operational Test and Evaluation (MOT&E) in FY11. Without this tool, there will be significant limitations on the operational realism of the MOT&E.
- Information assurance has been included in test planning during 2010. This is an improvement because previous information assurance testing through external interfaces has been significantly constrained. However, the scope of information assurance testing remains undetermined at this time.

- The results of AEP 5.5.4 testing demonstrated that further development will be needed to complete all functions associated with SAASM, Over the Air Re-keying, and Contingency Recovery.

Recommendations

- Status of Previous Recommendations. The Air Force has three previous recommendations that have not been satisfactorily addressed.
 1. The Air Force should assure comprehensive and realistic information assurance testing is conducted of all external interfaces that support GPS operations and performance.
 2. The SAASM program should synchronize the development of the Mission Planning System with the three segments of GPS to provide end-to-end SAASM and modernized capabilities for OT&E.
 3. The program should test new and legacy NAVSTAR GPS receivers as soon as possible to assure that as much capability as possible is consistently provided to operational users.
- FY10 Recommendations.
 1. Planning should continue to focus on end to-end testing of the space and control segments with GPS receivers (including ground equipment). Testing should assure GPS receivers are capable of receiving and processing the new modernized signals and are hosted on representative platforms (i.e., ships, aircraft, land, and space vehicles) in realistic operational environments.
 2. The synchronization of the development of the Space, Control, and User segments has improved but should continue to be watched because delays in any segment will delay operational testing of all segments.