

NAVSTAR Global Positioning System (GPS)

SUMMARY

- The NAVSTAR Global Positioning System (GPS) test planning process continues through Air Force Operational Test and Evaluation Center working groups.
- The Block II/IIA and IIR satellites are continuing to successfully perform their navigation and timing mission for worldwide operational users.
- The Block IIR-M pre-launch satellite system tests will begin in April 2005 and the first Block IIR-M spacecraft launch is expected in mid 2005.

SYSTEM DESCRIPTION AND MISSION

NAVSTAR GPS is an Air Force-managed joint Service program that provides highly accurate, real-time, all weather, passive, common-reference grid position and time information to military and civilian users worldwide. It consists of three segments: space, control, and user equipment. The control segment consists of a master control station, four ground antennas, a pre-launch compatibility station, and six geographically dispersed monitoring stations. The monitoring stations monitor satellite downlink signals and upload corrections to diminish errors broadcast to users. The user segment consists of numerous types of GPS receivers that use satellite downlink signals to determine position, velocity, and precise time. These receivers are hosted on a multitude of platforms.



The Air Force plans the first Block IIR-M satellite launch for early 2005.

The space segment consists of a nominal 24-satellite constellation in semi-synchronous orbit. The Air Force Space Command has launched three blocks of NAVSTAR GPS satellites:

- Block I satellites (Developmental) – 11 satellites launched from 1982 through 1992. Satellite 7 experienced launch failure and was not usable.
- Block II/IIA – 9 Block II satellites launched between 1986 and 1990 and 19 Block IIA versions launched between 1990 and 1997. Improvements included radiation-hardened electronics, greatly increased navigation message data storage capacity, and selective availability and anti-spoof modes for more signal security.
- Block IIR – 9 satellites launched between 1997 and June 2004, with the first experiencing a launch failure. Block IIR satellites gained inter-satellite ranging capabilities, increased satellite autonomy and radiation hardness, and more launch responsiveness. There are nine additional Block IIR launches planned, with as many as eight of those being the modernized or Block IIR-M version.

Future NAVSTAR GPS satellite blocks include:

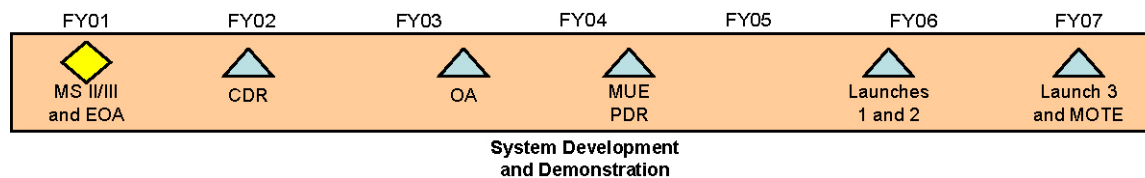
- Block IIR-M – The Air Force plans the first Block IIR-M satellite launch for early 2005. The IIR-M capabilities include developmental military use-only M-code on the L1 and L2 signals and a civil code on the L2 signal.
- Block IIF – Also under development, with the first launch planned for mid-FY06. The Block IIF satellites are functionally equivalent to the IIR/IIR-M satellites and pave the way towards operational M-code after IOT&E in 2010. Block IIF will also add a new separate signal for civilian use, designated L5. This variant will also have increased, adjustable signal power.

AIR FORCE PROGRAMS

The Air Force Operational Test and Evaluation Center conducted an operational assessment of the first Block IIR satellite in late 1997. Although the IIR satellite met all navigation and timing requirements, the report detailed a significant problem with the improved cross-link capabilities. The system program office has incorporated an interim fix for the problem on the second and third IIR satellites, and they are applying a more robust resolution to the remaining Block IIR/IIR-M satellite family.

Active user equipment programs include continuing Miniaturized Airborne GPS Receiver 2000 platform installations in FY03 and beyond; Defense Advanced GPS Receiver deliveries beginning in FY03; and M-code receiver deliveries beginning in FY10. All receivers produced after FY02 are to have the Selective Availability Anti-Spoofing module capability installed.

TEST AND EVALUATION ACTIVITY



FY04 activity included continued test planning meetings and combined developmental/operational testing of GPS Modernization backward compatibility with legacy user equipment. Future testing includes a series of combined developmental/operational testing events and operational assessments in support of the development and fielding of the new operational control system, the launch of the first IIR-M and IIF satellites, and M-code fielding. The next round of IOT&E will occur when 24 operational Block IIR-M and Block IIF satellites are on-orbit and M-code capable control segment software Version 6 is declared operational. IOT&E will be a system-wide test of the space and control segments and legacy and modernized (M-code capable) user equipment and is scheduled to take place in FY11.

TEST AND EVALUATION ASSESSMENT

Control segment software development continues to be a moderate to high-risk area with an ambitious schedule. The Test and Evaluation Master Plan and associated test planning documents are undergoing revision by the GPS test community to accommodate the introduction of variable satellite signal power settings and increases in signal strength. DOT&E believes that fielding the new operational control system and M-code availability warrant not just combined developmental/operational testing, but dedicated operational test events.

DOT&E continues to advocate the testing of new and legacy GPS receivers as early in the program as possible. These receivers must be integrated into representative platforms (e.g., ships, aircraft, and land vehicles) and tested in operational environments. Development of M-code-capable user equipment lags behind the development of the space and control segments, and this may induce delays in testing the Block IIR-M and IIF systems, along with the attendant M-code and civil signal user capabilities. Before that time, testing of backward compatibility will use legacy receivers and initial M-code testing will use prototype receivers.