Advanced Extremely High Frequency (AEHF) Satellite Communications System

Executive Summary

- The Air Force Operational Test and Evaluation Center (AFOTEC) conducted an Operational Utility Evaluation (OUE) to support fielding of the initial release of the Advanced Extremely High Frequency (AEHF) Mission Control Segment (MCS). The testing confirmed that the new AEHF MCS was capable of operating and sustaining the existing Milstar constellation.
- AEHF Space Vehicle-1 (SV-1), launched in August 2010, suffered a maneuver anomaly while trying to achieve geosynchronous orbit during the initial boost phase. This will, at a minimum, delay AEHF SV-1 reaching the planned orbital position and could delay testing.

System

- The AEHF system represents the third generation of Extremely High Frequency Satellite Communications capability protected from nuclear effects and jamming activities.
- The AEHF system will follow the Milstar program as the protected backbone of the DoD's integrated military satellite communications architecture. The AEHF is expected to increase system throughput capacity by a factor of ten.
- The overall AEHF system has three segments:
  - Space segment - The space segment comprises an integrated constellation of Milstar and AEHF satellites.
  - Mission Control segment - The control segment includes fixed and mobile telemetry, tracking, and commanding sites; fixed and transportable communication planning elements; and the common user interface with the Space Ground-Link Subsystem and the Unified S-Band capability.
  - Terminal (or User) segment - The terminal segment includes ground-fixed, ground-mobile, man-portable, transportable, airborne, submarine, and shipboard configurations.
- The first AEHF satellite is intended to have the capabilities of a Milstar II satellite at launch, but the software will be upgraded to full AEHF capability after the launch of the second satellite, which will be launched as a fully-capable AEHF satellite. This upgraded capability will dramatically increase the available bandwidth to the deployed users.
- The operational AEHF constellation is defined as four interconnected satellites per the AEHF Operational Requirements Document, dated October 2, 2000. The Defense Acquisition Executive authorized fabrication and assembly of the first four satellites and development of the Control and User segments. The Defense Acquisition Executive also directed the Air Force to plan for the acquisition of satellite vehicles five and six. The exact number of satellites in the AEHF constellation is yet to be determined.

Mission

Combatant Commanders and operational forces worldwide will use the AEHF system to provide secure, responsive, and survivable space-based, strategic, and tactical military communications.

Major Contractor

Lockheed Martin Space Systems – Sunnyvale, California

Activity

- AFOTEC conducted an OUE to support fielding of the initial release of the AEHF MCS. The testing confirmed that the new AEHF MCS was capable of operating and sustaining the existing Milstar constellation prior to launch of the first AEHF satellite.
- AFOTEC cancelled a program to develop a jamming simulator and is now exploring an alternate means of testing anti-jamming capability.
- AFOTEC initiated a program with Arnold Engineering Development Center to develop a scintillation test capability.

Scintillation is a fluctuation in radio wave propagation that can result from atmospheric effects or as a result of a nuclear detonation.

- The program office conducted High Altitude Electromagnetic Pulse (HEMP) certification testing on the three transportable Interim Command and Control (IC2) vehicles.
- AEHF SV-1, launched on August 14, 2010, suffered a maneuver anomaly while trying to achieve geosynchronous orbit during the initial boost phase. This will, at a minimum, delay AEHF SV-1 reaching the planned orbital position and could delay testing.
- Due to the SV-1 maneuver anomaly, AFOTEC and the program manager will be updating the Test and Evaluation Master Plan to incorporate a revised test strategy once the future acquisition and operational deployment strategies for the program are understood.

Assessment

- The combined contractor and government test team continues to identify and fix problems prior to entry into operational testing. Software problems that were observed during testing last year have been corrected. Problems identified early in the integrated testing process led to two emergency software drops that corrected critical deficiencies.
- The operational testers have made limited progress since last year in developing a modeling and simulation strategy to assess nulling antenna performance in order to supplement operational testing. AFOTEC is studying how to best simulate a threat jammer, but details of that testing have not been finalized and the threat jammer capability is only partially funded. Testing of the anti-jam capability must be conducted in support of IOT&E.
- IC2 HEMP test results indicate that additional filters are required to meet HEMP certification. The program manager is adding the necessary filters to the low power amplifiers of two of the vehicles and plans additional testing this year.
- The OUE was adequate to support the initial fielding of the MCS to operate and sustain the existing Milstar constellation. The AEHF MCS is capable in its backward-compatible mode of operating and sustaining the Milstar constellation. The MCS successfully provided mission planning at deployed locations, resource monitoring at the satellite communications (SATCOM) support centers, and satellite command and control.
- Testing identified suitability deficiencies with the fixed mission control element (MCE), the transportable MCE, and the AEHF Satellite Mission Control Subsystem (ASMCS). Both MCEs experienced multiple failures for an average mean time between critical mission failures of 113 hours for the fixed MCE and 138 hours for the transportable MCE, both below the requirement of 221 hours. The transportable mission control element and the ASMCS both exceeded the one hour mean repair time requirement with measured repair times of 1.83 hours and 3.43 hours, respectively.

Recommendations

- Status of Previous Recommendations. The Air Force has made satisfactory progress on two of the three FY09 recommendations, but has not provided a strategy to operationally test the anti-jam capability.
- FY10 Recommendations. In addition to addressing the remaining FY09 recommendation, the Air Force should:
  1. Track and test reliability growth of the MCS.