

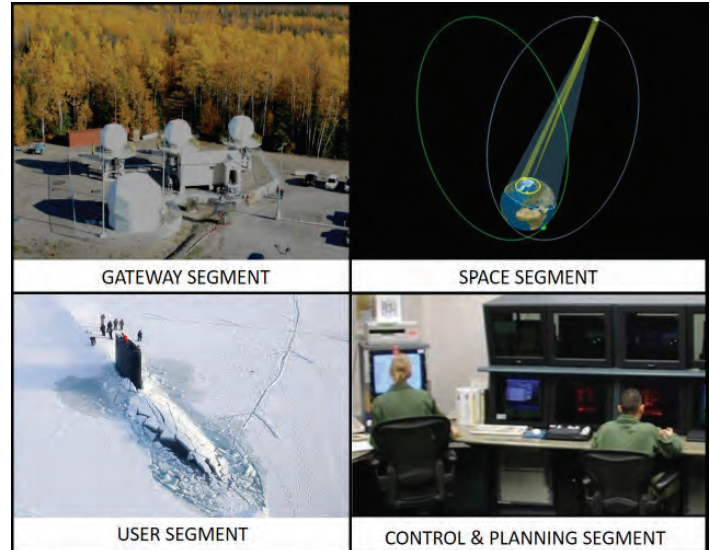
Enhanced Polar System (EPS)

Executive Summary

- The Enhanced Polar System (EPS) system is not deployed and is still being tested to resolve configuration problems prior to operational test and deployment.
- The EPS Program's Lead Developmental Tester Organization (LDTO) conducted Integrated Test #1 (IT-1) in January through February 2018 that identified problems with end-to-end system integration, operational procedures, and operator training.
- The EPS Program Office conducted a series of risk reduction and integrated test events to prove they resolved the integration problems prior to MOT&E. These developmental and integrated test events demonstrated improvements to the communication planning process, a better understanding of the end-to-end architecture, and clarified operator roles and responsibilities in resolving system problems. The Program Office subsequently resolved problems with voice communications, but problems in consistently establishing and maintaining specific end-to-end data communications remain.
- The EPS Integrated Test (IT) #4 resulted in the Navy Broadcast Control Authority (BCA) unable to transmit and receive data broadcast and data teletype messages to deployed submarines on a consistent basis.
- The Air Force Test and Evaluation Center (AFOTEC) has executed two phases of a planned three-phase MOT&E. AFOTEC collected data from the operationally realistic integrated testing and the Navy's 2018 Ice Exercise (ICEX), per the DOT&E-approved test plan. AFOTEC planned a dedicated MOT&E period from July 16 through September 14, 2018, but the Air Force postponed this phase of the MOT&E pending resolution of system-of-system integration problems and the Program Executive Officer certifying the EPS ready for operational test. The EPS MOT&E is tentatively scheduled for 2QFY2019.

System

- EPS is designed to provide secure, jam-resistant satellite communications in the North Polar Region using a subset of the Advanced Extremely High Frequency eXtended Data Rate waveform.
- EPS consists of four segments:
 - The Payload Segment consists of two payloads hosted on satellites placed in highly elliptical orbits. The EPS payloads will provide polar communications coverage for 24 hours per day.
 - The Control and Planning Segment (CAPS) is the primary means for monitoring and controlling the payloads via a ground connection to a Tracking and Commanding terminal in the polar region. The Tracking and Commanding terminal will provide radio frequency connectivity between the payload and CAPS.



- The Gateway Segment consists of a single gateway site with three collocated gateway terminals that will provide connectivity radio frequency connectivity between the payload and the gateway ground equipment. The Gateway Segment is also designed to provide ground connectivity between north polar and mid-latitude users through the DOD Teleport System.
- The EPS Terminal Segment consists of user terminals that are Multiband Terminal platform variants. The Navy Multiband Terminals can be deployed on ships and submarines, as well as at specific fixed ground locations. Additional terminals are currently unfunded but may be developed in the future and deployed on aircraft and ground-transportable, mobile, and fixed terrestrial platforms.

Mission

Combatant Commanders will use EPS to provide secure, jam-resistant tactical satellite communications required to support peacetime, contingency, and wartime operations at high north latitudes with command and control centers located elsewhere.

Major Contractors

- Northrop Grumman Aerospace Systems – Redondo Beach, California
- Northrop Grumman Mission Systems – Redondo Beach, California

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Activity

- EPS is not deployed and is still being tested to resolve integration problems prior to operational test and deployment.
- The EPS Program Office's LDTO and AFOTEC conducted IT-1 from January 8 through February 23, 2018, using the BCA Pacific at Pearl Harbor, Hawaii, to communicate with a submarine in Groton, Connecticut, and a Navy destroyer in Everett, Washington.
- The Air Force planned and conducted, with Army Red Teams, extended, operationally realistic cyber-threat testing from January 8 through February 16, 2018, and resumed testing from July 14 – 30, 2018. An Air Force Red Team conducted further testing on August 6 – 17, 2018. The Air Force and Army conducted all testing in accordance with the DOT&E-approved cyber test plan.
- The EPS Program Office, AFOTEC, and Massachusetts Institute of Technology/Lincoln Laboratory tested the jam-resistant capabilities of EPS from February 20 – 23, 2018, in Clear, Alaska.
- The EPS Program Office participated in the Navy biennial ICEX conducted from March 7 – 18, 2018. During the ICEX, two submarines conducted polar operations. The Navy designated 2 days during the exercise for EPS testing.
- The EPS Program Office conducted a series of increasingly complex risk reduction events from March 30 through May 11, 2018, at Commander, Task Force-69 (CTF-69), U.S. 6th Fleet, and operational submarines to validate end-to-end polar communications. The EPS Program Office's LDTO conducted IT-2 from June 4 – 15, 2018, at CTF-69 and at the Naval Undersea Warfare Lab. The purpose of IT-2 was to evaluate EPS end-to-end (CTF-69 to Submarine) communication capabilities and to verify fix actions of problems discovered in IT-1 using the Undersea Warfare Lab, acting as a submarine surrogate.
- AFOTEC executed two phases of the planned three-phase MOT&E. AFOTEC collected data from the operationally realistic integrated testing and the Navy's 2 ICEX, per the DOT&E-approved test plan. AFOTEC planned a dedicated MOT&E period from July 16 through September 14, 2018, but the Air Force postponed the dedicated MOT&E pending resolution of system-of-system integration problems and the Program Executive Officer certifying the EPS ready for operational test. The EPS MOT&E is tentatively scheduled for 2QFY19.
- The EPS Program Office's LDTO conducted IT-3 from August 9 – 17, 2018, at Commander, Submarine Force Atlantic and on a submarine based in Norfolk, Virginia, to test end-to-end communication capabilities to support submarine polar operations. The LDTO also tested surface ship communications between an Everett, Washington-based Navy destroyer and NCTAMS Pacific in Hawaii.
- The program manager conducted a developmental test followed by LDTO IT-4 from September 10 – 28, 2018, to demonstrate the end-to-end submarine data communications performance.

Assessment

- The EPS Program Office, AFOTEC, and Army and Air Force Red Teams executed 9 and a half weeks of cyber-testing to more closely represent a persistent cyber threat and conduct more extensive testing than has been typically planned for programs in the past. Problems with system performance, challenges with gaining authority to connect to the system, system misconfigurations, and changes in schedules resulted in a partially completed cyber test. AFOTEC is scheduling additional Red Team testing to occur during the dedicated MOT&E period. The Program Office and AFOTEC have placed a significant focus on the cybersecurity assessment. However, additional work remains to ensure that the system provides secure communications in a cyber-contested environment.
- The IT-1 identified problems with end-to-end system integration, operational procedures, and operator training. The communication planning process required more fidelity on equipment configurations than was anticipated. The EPS operators had difficulty resolving problems when they occurred, and a lack of understanding the complete end-to-end architecture led to poor communications performance for both submarines and surface ships.
- The anti-jam test results confirmed that EPS has modulation modes on all beam coverage areas that allow communications through threat-representative jamming.
- During ICEX, the Navy was not able to consistently pass voice messages from the Arctic-deployed submarines to the Pacific BCA in Hawaii. The Navy was unable to successfully transmit and receive data messages. The Navy operators experienced configuration problems, and a general lack of knowledge about the EPS system architecture and troubleshooting procedures hampered problem resolution. The current Navy Polar Concept of Operations (CONOPS) does not discuss EPS operations and the Navy needs to update the CONOPS to include EPS. The lack of CONOPS inhibited a shared understanding of how EPS supports Navy submarine and surface combatant polar operations.
- The EPS Program Office risk reduction testing demonstrated voice communications consistent with the current satellite system but problems in consistently establishing and maintaining specific end-to-end data communications remained. The risk reduction testing also resulted in improvements to the communication planning process, a better understanding of the end-to-end architecture, and of operator roles and responsibilities in resolving problems. The testing also fostered increased efforts by the Navy to integrate EPS into the Navy communications architecture.
- The EPS IT-2 event demonstrated improved performance in communications planning and user ability to log on to the EPS payloads. However, the Navy BCA was unable to send data broadcast and teletype messages to deployed submarines on a consistent basis.
- During EPS IT-3 the Navy BCA was unable to send data teletype messages to deployed submarines. The BCA

was able to transmit broadcast messages intermittently but could not consistently maintain this capability. The short availability of the submarine to conduct testing truncated efforts at troubleshooting and finding the root-cause of the inconsistency. The NCTAMS and the Navy destroyer were also unable to communicate consistently over EPS during the test event.

- The EPS IT-4 resulted in the Navy BCA unable to transmit and receive data broadcast and data teletype messages to deployed submarines on a consistent basis.

Recommendations

- The Air Force should:
 1. Continue to work with the Navy to integrate EPS into the Navy communications architecture prior to MOT&E.

2. Work with the Navy to formalize EPS end-user training aboard U.S. Navy vessels.
 3. Address findings from the cybersecurity assessments to ensure that EPS can fulfill its mission in a cyber-contested environment.
- The Navy should develop and publish an updated Polar CONOPS based upon the EPS.

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