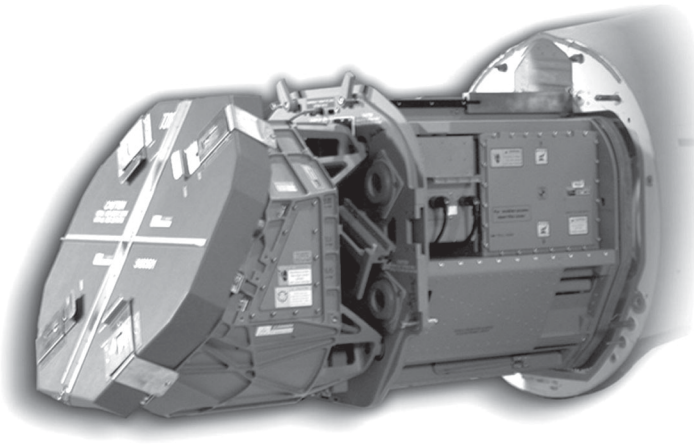
Advanced Electronically Scanned Array (AESA) Radar

SUMMARY

- The Advanced Electronically Scanned Array (AESA) radar is demonstrating as good as, or better than, predicted mapping and target detection performance against ground targets.
- Initial performance against airborne targets is encouraging.
- Software delivery is behind schedule, but the program office and Raytheon (the contractor) are addressing the problem. Enough time is available to recover the schedule.
- The Test and Evaluation Master Plan, approved in September 2004, is adequate.



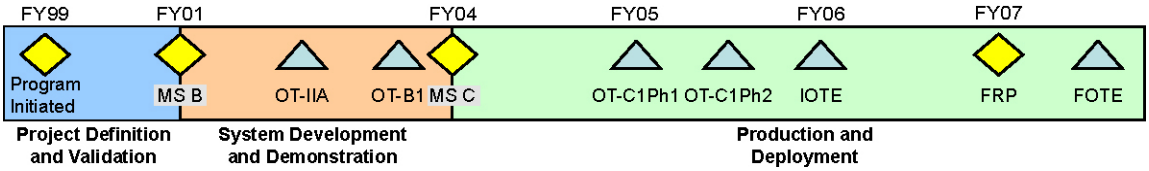
The APG-79 AESA radar system is an upgrade to the F/A-18 E/F Super Hornet and replaces the APG-73 mechanically scanned array radar.

SYSTEM DESCRIPTION AND MISSION

The APG-79 AESA radar system is an upgrade to the F/A-18 E/F Super Hornet and replaces the APG-73 mechanically scanned array radar. The radar employs a fixed antenna array composed of hundreds of transmit and receive modules. Each transmit and receive module has its own low noise amplifier that separately amplifies the transmitted radio frequency waveforms. The sum of the transmitted energy from the transmit and receive modules is significantly greater than that of the APG-73 radar, and the failure of a single module only slightly reduces system performance while the radar system continues to function. Thus, system reliability should be much better than a mechanically scanned antenna system such as the APG-73.

The main advantages the APG-79 radar will provide are increased detection range; increased survivability through reduction of own radar cross-section and a decrease in emissions; simultaneous use of air-to-air and air-to-ground modes; and correction of deficiencies in electronic attack and electronic protection performance of the APG-73. Radar beam steering algorithms in the aircraft mission computers enable both the rapid repositioning of the radar main-beam, called beam agility, and the interleaving of operational modes such as air-to-air and air-to-ground. The mission computers also allow the simultaneous performance of tasks such as tracking multiple targets while providing data-link guidance to missiles in flight. The radar also uses an optical fiber channel in lieu of a traditional electronic bus and employs both ADA and C programming languages for data processing and signal processing, respectively. The prime contractor for the radar is Raytheon Radar Systems, El Segundo, California.

TEST AND EVALUATION ACTIVITY



The Navy will conduct operational testing of the APG-79 radar in five phases: OT-IIA, OT-B1, OT-C1 Phase 1 and Phase 2, and OT-C2 (Operational Evaluation). OT-IIA and OT-B1 are complete. The test strategy includes the operational test community through continuous DT assist flights, and relies heavily on the use of modeling and simulation in the early phases of testing. In keeping with this strategy, much of the early operational assessment focused on validating

the data used to feed the performance models and simulations, since little radar functionality was available for the early operational test phases.

In February 2003, the Navy conducted the OT-IIA operational assessment at the Raytheon Radar Systems Integration Lab. No actual flight-test occurred and only the real beam map mode of the radar was available for this assessment. In the fall of 2003, the Navy's operational test squadron, VX-9, conducted OT-B1 with the first Engineering and Manufacturing Development radar installed in an F/A-18F. Test crews made several synthetic aperture radar (SAR) maps and evaluated the hardware and the cooling system. In early 2004, the Navy installed a second APG-79 radar in a second F/A-18F and used it for developmental flight-testing. A third aircraft with APG-79 became available in September 2004.

The Navy began OT-C1 Phase 1 in October 2004. Several SAR imaging modes were available as well as some, albeit very limited, air-to-air functionality. OT-C1 Phase 2, scheduled for the spring of 2005, should demonstrate a more robust air-to-air capability.

TEST AND EVALUATION ASSESSMENT

During OT-IIA, Navy test personnel made a map of nearby Catalina Island using the real beam map mode on the land-based radar at Raytheon's Radar System Integration Lab facility. Test crews assessed the quality of the map and the accuracy of coordinates as excellent. In addition, Raytheon presented extensive laboratory data to support their claims of the radar model's predictions of performance.

During OT-B1 flight-testing, the operational test aircrew made several SAR maps. Although immature signal processing did not allow the level of detail in the maps expected in operational deployment, the aircrew assessed the basic resolution as excellent.

Developmental testing is advancing. Many of the radar's operational modes are available much earlier than expected. However, a large number of software anomalies are keeping the software coding workload high and the program is about three months behind schedule. Most of the delay is due to system "lock-ups" caused by poor understanding of the hardware and the complex system architecture. However, the development timeline has sufficient buffer to absorb this delay, the program office and contractor are addressing the issue, and DOT&E expects progress will accelerate in the next six months. Another source of concern is the inability to use the high-resolution "SAR-4 mode" maps for target identification (e.g. distinguish aircraft type on a tarmac, or identify an individual building from others in close proximity in a complex target environment). In its current form, SAR-4 takes significantly longer to collect and, in most cases, it does not offer enough of a noticeable improvement over SAR-3 to be worth the time trade-off in the cockpit. This issue remains a future source of risk. Initial radar detection ranges of airborne targets are consistent with the modeling and simulation predictions computed by Raytheon and significantly lower the development risk in this area.

To date, there is little data on the suitability aspects (reliability, maintainability, and availability) of the radar, and the program continues to use models based on previous systems to predict this performance while collecting sufficient data.