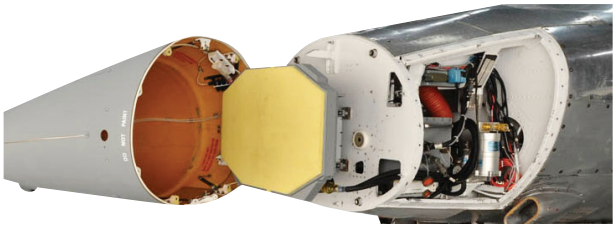
JEAN-JACQUES DELISLE | Technical Editor

# AESAs Boost Multi-Role Capabilities for Warfighters, UAVs, and Wi-Fi

**Advanced electronic-warfare technologies and techniques have taken hold of AESA solutions to create applications ranging from electronic attack to UAVs and data links.**

**BOTH IN THE** United States and across the globe, active electronically scanned array (AESA) radar is being increasingly recognized and adopted for its key features. For example, AESA technology provides the simultaneous detection, identification, and tracking of multiple air and surface targets. Compared to mechanically scanned arrays, it features up to 10× increased operational availability. In addition, its higher resolution leads to increased standoff range. Now, modular techniques and low-cost retrofit modules are beginning to surface for AESA technology. As a result, they are considered more viable for legacy warfighters while offering more application scalability *(Fig. 1)*.



**1. Several companies have developed retrofit AESAs to replace mechanically scanned arrays. In doing so, they have raised the relevance of legacy aircraft.** *(Courtesy of Northrop Grumman)*

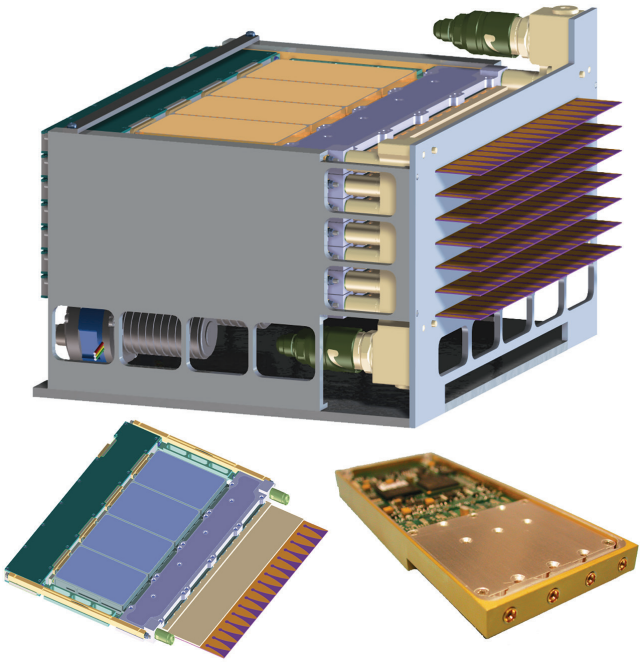
These cost-cutting and modular techniques also are prompting reviews of AESA technology for land, naval, and even commercial applications. For earlier generations of warfighters, passive phased-array radar brought a huge advance in electronic-warfare (EW) capability by allowing the radar to be steered with mechanical motors. To eliminate the need for such adjustments, AESAs rely on beamforming and beam-steering technologies. The ability of these arrays to handle multi-role capabilities also has been enhanced due to the emergence of solid-state technologies, such as gallium-nitride (GaN) and software-defined-radio (SDR) architectures.

Thanks to the advancement of wideband, solid-state electronics such as GaN power amplifiers (PAs), several fourth- and fifth-generation warfighters are now being equipped with AESAs. These retrofits are converting warfighters from a wide range of countries into multi-role-capable airframes—a major upgrade. In addition, these systems promise to provide increased mechanical reliability and lower maintenance costs, thereby decreasing the cost over time and downtime of warfighters. Generally, these devices are designed for a variety of aircraft and platforms as drop-in modules—a feature that brings repair and servicing closer to the field.

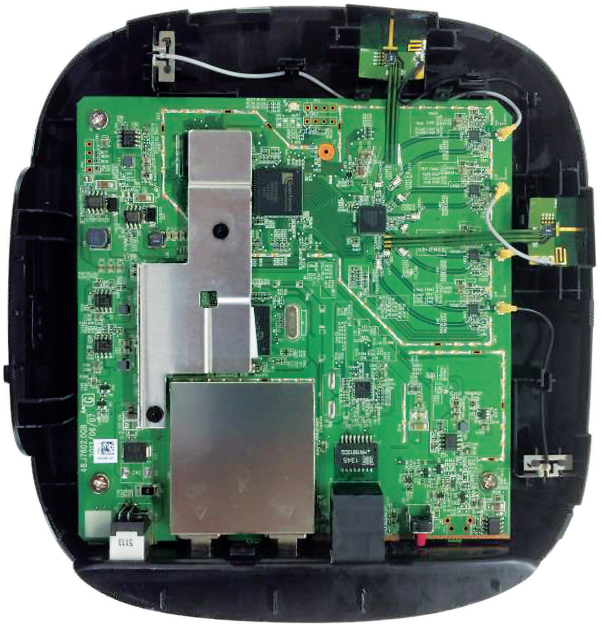
**2. Using a modular approach to AESA construction can increase the scalability of a technology while easing integration into older platforms and technologies.** *(Courtesy of API Technologies)*

## LOW-COST AESA TECHNOLOGY

As AESAs further their reach into retrofit applications, companies like BAE, Northrop Grumman, Raytheon, and others are increasing the lifetime of aging warfighter platforms. Prompting these retrofits are two factors: the decrease in available funding for the num-



3. Many new AESAs are capable of multi-role applications ranging from anti-surface and anti-submarine to surveillance and tactical air-support roles. *(Courtesy of Thales)*



4. Active-steering antenna technology is beginning to be embraced for commercial technologies, such as enhancing Wi-Fi data rates, by eliminating dead zones and tracking high-demand devices. *(Courtesy of Ethertronics)*

ber of warfighters that are being demanded and the lower cost of AESA technology after the initial development and deployment. The investment in AESA also has been reduced as a result of advancing field-programmable gate arrays (FPGAs) and SDR techniques *(Fig. 2)*.

The latest AESA technologies also offer a dramatically reduced weight and size profile, which allows the radar to provide operational cost savings via payload reduction. These systems are small enough to be mounted on many unmanned-aerial-vehicle (UAV) platforms *(Fig. 3)*. As a result of such enhancements, UAV warfighters are being planned by the U.S. Navy. There also is the possibility of making viable autonomy drop-in kits for helicopters and land vehicles. More potential applications will undoubtedly emerge, given AESA's ability to operate as a traditional EW antenna while providing software control and programmability *(Fig. 4)*. In fact, these devices can operate as long-range data links as well as high-resolution radar-imaging devices. They also operate over many different radar bands.

## MODULAR AESA PLATFORMS

In addition to ease of integration, scalable design has become one of the primary focus factors for recent AESA developments. As a result, a number of organizations are developing module-based AESA platforms constructed from a combination of multiple building blocks. This common-module approach increases the manufacturability of an AESA platform while lowering its cost and complexity barriers of entry. It also brings AESA technology closer to infiltrating satcom, data-link, weather, and air-traffic-control applications.

With the contract for phase one of the Arrays on Commercial Timescales (ACT) program, for example, the DARPA Microsystems Technology Office is attempting to merge enhanced AESA development with the commercial infrastructure. The project focuses on AESA platforms based on a digital common module. That module is reusable, highly integrated, and uses commercial CMOS IC technology. The current vision of the common module is a commercial system-on-a-chip (SoC) with integrated, high-speed digital-to-analog and analog-to-digital converters (DACs and ADCs). It is capable of direction sampling and RF signal creation well into the K-band (18 to 27 GHz). Nonlinear digital-signal-processing (DSP) algorithms may enable the dynamic range needed to implement such a system.

AESA technology will continue to advance. For example, recent European investment has led to the development of metamaterial enhancements to AESA radars. These enhancements reduce the cost and size of RF feeding networks, thereby minimizing the coupling between the radiating elements while mitigating the parasitic back/side-lobe radiation from edging effects. On the home front, Raytheon developed a pod-based AESA radar jammer for the Navy that is essentially a high-powered SDR with networking capability.

As EW continues to dominate the arms race, AESA technologies will benefit from innovations that could trickle back to telecommunications and satcom technologies. mw