PATHFINDER
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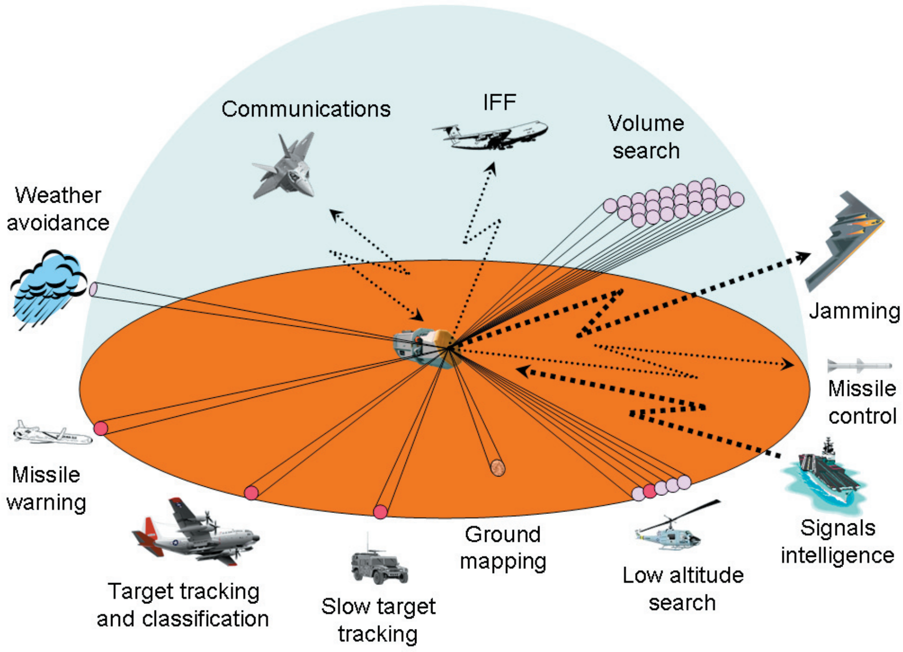
ACTIVE ELECTRONICALLY SCANNED ARRAY RADARS PART 2: THE SIGNIFICANCE OF AESA RADAR TECHNOLOGY

In the first part of this series, we discussed how AESA radars work; this part will look at the significance of this technology in the airborne environment.

To demonstrate the versatility of AESA radars, consider the problems associated with detecting and defeating a low-level, high-speed cruise missile against a cluttered, noisy, background. Before we start, we need to explore the problem of detecting cruise missiles with radar. A radar with a high pulse repetition frequency (PRF) provides unambiguous, nose-on speed resolution and good clutter rejection, while a radar with medium PRF provides good low-speed resolution but suffers from low detection range, and a low PRF radar provides unambiguous target ranges but suffers from poor clutter rejection. Therefore, to detect a low level, high-speed cruise missile in clutter, using mechanically scanned radars, would require either three different radars or a single radar capable of sweeping at high, medium and low PRF–a time consuming process with a mechanically scanned antenna. With an AESA radar, however, different parts of the radar antenna can be assigned to perform these different scans almost simultaneously, allowing the missile not only to be detected but tracked as well. Then, by linking the radar with the on-board electronic warfare system, an electronic attack (such as jamming, spoofing or directed energy) can be mounted against the missile–through the radar–at greater ranges than would be possible using a typical fighter aircraft's onboard electronic warfare system alone.

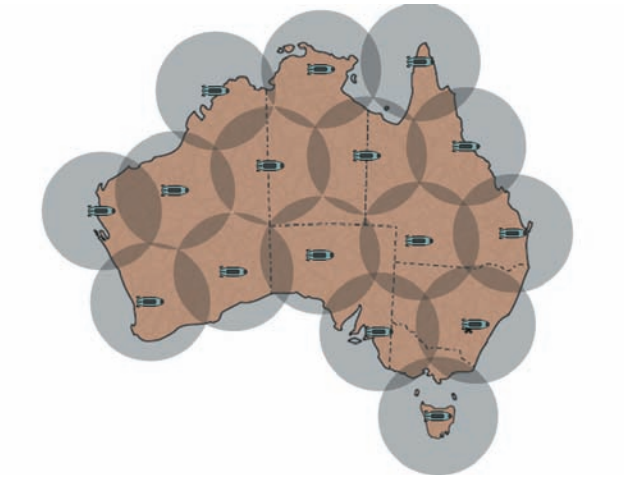
Predominately because of their cost, the main airborne use of AESA technology at the moment is in fighter aircraft, specifically the F/A-18E/F, F-22 and F-35. As the current crop of fighters, such as the F-15, F-16 and F-18A/B, undergo mid-life upgrade programmes their radars will be replaced with AESA technology. AESA radars will also be fitted to the new crop of Airborne Early Warning and Control aircraft, where the true impact of being able to rapidly switch radar modes has yet to be fully determined, and will then trickle down to maritime patrol aircraft and eventually military transport aircraft.



AESA Functions

As the technology matures and costs reduce, AESA technology will find its way into the civil sector where its multi-mode features will provide a significant safety benefit. Traditionally, the only function that radar performed in civil aircraft was weather detection. By introducing AESA technology, civil aircraft will not only have an improved weather radar, they will also have improved airborne collision avoidance (through the AESA radar's air-to-air modes) as well as improved ground avoidance (through its air-to-ground modes reducing the probability of controlled flight into terrain). In addition, taxing aircraft will be able to monitor other taxing aircraft, thereby reducing the probability of a runway incursion or a taxing incident.

AESA radars are also capable of performing highly specialised radar functions such as Synthetic Aperture Radar (SAR)–detecting small stationary objects and producing a picture-like image–and Ground Moving Target Indictor (GMTI)–detecting moving surface targets.



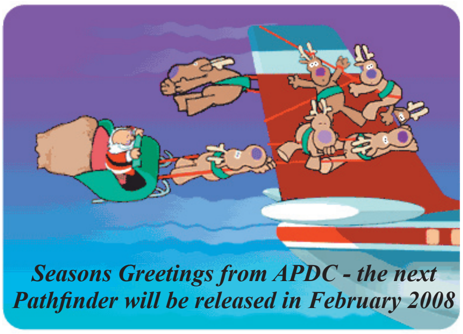
Surface coverage of airship mounted AESA radars at 60,000 feet

Besides being a radar, AESA radars can be a broad-band noise and reactive jammer, not quite as good as a dedicated jamming platform but much better than having to fit a dedicated jamming pod on an aircraft with the associated weight and performance penalties. They can also act as a directed-energy weapon, again not as powerful as a dedicated system, but an AESA radar can focus its energy on a target for longer (because it can also track it) and thereby overcome the lack of peak power by increasing dwell time on the target to burn electronic circuits. Surprisingly, an AESA radar can also act as a high speed data link by attaching a modem, generating data transmission speeds of approximately 548 Mbps and data receive rates of up to 1 Gbps. These data rates are significantly better than the 1 Mbps of the current military standard airborne data link (Link 16).

Future development of AESA technology, besides reducing size, cost, weight and improving efficiency, include very large apertures (about 6 million TR modules mounted on a 6,000 m^2 antenna). An antenna of this size might need to be carried on an airship rather than an aircraft, but would allow very small objects, perhaps even humans, to be detected over very large ranges–ideal for border security. Other avenues under development include conformal arrays, where the TR modules are mounted on the skin of an airborne platform, or, even better, the TR modules are part of the platform's structure. Such arrangements would allow airborne vehicles to have spherical radar coverage. With spherical radar coverage and approximately 16 airships at 60,000 feet, all modes of transport within continental Australia–air, land, sea and space–could be monitored. Such a system would provide real time border security, air traffic control, ballistic missile detection, cruise missile detection, road and rail traffic monitoring and national weather radar.

For a given size and weight, AESA radar technology provides significantly more capability than competing approaches, due to more power, lower losses and increased flexibility. Further, the AESA design provides inherently superior countermeasure resistance, enhanced range resolution, and more flexibility to support non-traditional radar modes such as jamming and ESM. In addition, AESA technology supports high reliability/low maintenance designs with associated lower life-cycle costs. These advantages are so compelling that it is unlikely that any military organisation will procure any other sort of radar by choice.

- *In civil use, AESA technology will provide significant safety enhancement*
- *Future development may include airship-mounted radars able to monitor all modes of transport within Australia*
- *The advantages of AESA radars are so compelling that it is unlikely that any military organisation will procure any other sort of radar by choice.*



Seasons Greetings from APDC - the next Pathfinder will be released in February 2008

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