Virtual radar on the radar

New technology on trial in Queensland could give general aviation pilots an IT revolution in their cockpit. Nick King reports.

OPPOSITE DIRECTION traffic is ABC, 12 o'clock at eight miles, maintaining 4500ft": It's information pilots would normally get only from an air traffic controller and a radar system. Even TCAS (traffic alert and collision avoidance system) does not give that sort of detail, but in the not-too-distant future, pilots flying outside radar coverage will be able to access such information through the aircraft's avionics.

Automatic dependent surveillance – broadcast (ADS-B) is a new datalink technology undergoing an operational trial in airspace around Bundaberg, Queensland. Airservices Australia has installed a single ground station and is equipping about 15 aircraft with ADS-B avionics to provide "radar-like" ATC services below radar coverage. Sometimes referred to as "virtual radar", ADS-B shows promise as a low-cost alternative to secondary surveillance radar (SSR) in many ATC applications while also introducing a new airborne surveillance capability to the cockpit.

In ADS-B, the aircraft transmits its 3-dimensional position, identity and other parameters at half-second intervals. The broadcast is automatic and needs no pilot input in flight. The position and altitude are derived from (dependent on) the aircraft's navigation equipment and altitude encoder. As with SSR transponder replies, the aircraft transmissions can be received by ground stations and used to plot aircraft positions on a screen display. This is the focus of the current trial in Queensland.

Automatic dependent surveillance is not a new concept. It is used every day in oceanic operations around the world. Most new Airbus and Boeing aircraft can be fitted with ADS-Contract (ADS-C) avionics, known as "FANS-1/A". This equipment works in much the same way as the ADS-B system, except that reports are typically spaced at 20 minute intervals and the information is "addressed" to the ATC centre. FANS-1/A has removed much of the reliance on pilot position reports outside VHF coverage and delivered significant efficiencies in oceanic operations. However, unlike ADS-B, the relatively long intervals between ADS-C reports make FANS-1/A unsuitable for ATC vectoring and other highly tactical applications.

ADS-B avionics are relatively light and compact, making them suitable for installation in aircraft ranging from ultralights to heavy jets. The most basic level of aircraft equipment would be a transmit-only installation, sometimes called "ADS-B Out", that would operate in a similar way to an SSR transponder. The International Civil Aviation Organization (ICAO) believes ADS-B could also be used to broadcast the location of temporary obstacles, airport vehicles and parachutists with "ADS-B Out" emitters.

Because ADS-B transmissions are broadcast, they can also be received by other aircraft for input into a cockpit display of traffic information (CDTI). The CDTI and the associated receiver constitute an "ADS-B In" capability, which offers pilots a birds-eye view of the traffic situation, much like that presented to a radar controller. "ADS-B In" can operate independently of ground stations, so CDTI surveillance will continue even if the aircraft is outside or below ATC surveillance coverage.

ADS-B offers benefits in safety, efficiency and economy, such as:

- radar-like ATC surveillance improving flow management and providing automated alerts, in contrast to current surveillance based on voice position reporting
- application of radar-like ATC separation minima, which will make more efficient use of existing capacity
- radar-like SMC surveillance at more aerodromes to improve runway incursion monitoring and reduce congestion on taxiways and aprons
- introduction of an air–air surveillance capability that can improve pilot situational awareness
- improvements in controller–pilot communication and workload through shared situational awareness
- better position reporting infrastructure for SAR and company flight–following applications.

The Bundaberg ground station is contained in a small shed beside a Queensland Rail communications tower. Conceivably, self-contained solar-powered ADS-B ground stations could be located almost anywhere, such as on existing masts or buildings, with the required line of sight recep-

tion. This contrasts with radar sites that require large amounts of power, backup generators, heavy vehicle access and which, because of radiation issues, are subject to considerable environmental limitations. The maintenance costs of an ADS-B ground station also compare favourably with the rotating machinery of radar.

ADS-B is relatively cheap and the potential benefits seem attractive, but how likely is its deployment in Australia?

ADS-B could be a reality in the next few years. As a first step, Airservices has proposed the deployment of 20 ground sites to provide radar-like coverage across continental Australia. These 20 sites would offer almost continuous coverage above FL300, as well as very useful lower-level coverage around centres like Broome, Alice Springs and the Western Australian goldfields. The 20 sites could become operational by 2005.

Additionally, most of Airservices' existing radars will reach the end of their service life in 2008, and one of the options being considered is the replacement of the en route SSR network with ADS-B. The savings to Airservices achieved by replacing SSR with ADS-B ground stations could be used to subsidise the costs of aircraft equipage.

One of the issues surrounding ADS-B has been the choice of datalink. Until recently, there has been considerable uncertainty over which, if any, datalink will become the global standard for ADS-B. Two datalinks, VDL Mode 4 and Mode S Extended Squitter, have technical standards produced by ICAO, while a third link, known as UAT, is used in the Alaskan "Capstone" program. Interoperability of systems is a major concern in strategic planning, so Australia was cautious about deploying ADS-B until a globally-accepted standard emerged.

During 2002 and 2003, various manufacturers, service providers and regulators around the world indicated a preference for the Mode S datalink. The US Federal Aviation Administration and Eurocontrol have now chosen it as the globally interoperable link and there has also been support for Mode S from many states in the Asia–Pacific region. The choice of Mode S means that many air transport aircraft fitted with Mode S transponders will already be carrying the necessary hardware for "ADS-B Out".

The Bundaberg trial uses the Mode S datalink and aircraft equipment consists of a GA-style (IFR certified) GPS to supply the navigation data and a GA-style Mode S transponder to send the reports. Airservices Australia has also been investigating other technology options for light aircraft. Costs and power supply are prime concerns and it now seems likely that a low-demand Mode A/C Transponder with "ADS-B Out" capability could be produced relatively cheaply.

As an alternative to a fully certified CDTI, it also seems possible that handheld "ADS-B In" displays based on personal organisers could be used in much the same way that hand-held GPS is now used in VFR operations. Even with these low-cost options, Airservices recognises that costs will be a factor in widespread equipage and a number of subsidy scenarios are currently being considered.

It's still early days for ADS-B but the technology looks set to become an important surveillance tool for Australia.

See www.airservicesaustralia.com/adsb for more details on the Bundaberg trial.

Nick King is a flying operations inspector in CASA's airspace, air traffic and aerodrome standards branch.