ADS-B and Next-Gen Avionics

What is ADS-B?

ADS-B is a replacement for (or supplement to) traditional radar based surveillance of aircraft. ADS-B is a major change in surveillance philosophy – instead of using ground based radar to interrogate aircraft and determine their positions, each aircraft will use GPS to find its own position and then automatically report it.

Why would we want ADS-B?

There are three benefits driving the transition to ADS-B. Firstly, the GPS positions that are reported by ADS-B are more accurate than the current radar positions and are more consistent. This means that in the IFR environment closer spacing can be used than at present, and this provides much-needed capacity improvements in congested airspace. Secondly, ADS-B surveillance is easier and less expensive to deploy than ground radar. This means that airspace which previously had no radar and only procedural separation services can now have the benefits of ATC services. And finally, because ADS-B is a broadcast service that can be received by other aircraft as well as ATC on the ground, ADS-B offers the option for an aircraft to have accurate and inexpensive traffic awareness of other nearby aircraft.

Will I need ADS-B?

Almost certainly. The benefits of ADS-B only become available if substantially all the aircraft participate. Closer spacing is only available if all the aircraft have improved position reporting. If radar is not deployed, ATC can only see ADS-B equipped aircraft. Without an ADS-B output, an aircraft would be invisible to the traffic receiver on another aircraft. For airspace where ADS-B has been deployed as the primary separation mechanism it is likely that having ADS-B equipment will be an entry requirement.

A very important point is that for all these benefits to work, an aircraft only needs ADS-B “Out”. That is, the aircraft must report position information to ATC and to other aircraft. There is no requirement for ADS-B “In” – that will always be an optional feature.

When will I need ADS-B?

That depends on the airspace you want to fly in. Widespread mandates for ADS-B are forecast between now and 2020. In the short term however, there is not much airspace where ADS-B is required, especially for GA aircraft. Over the next 10 years additional airspace will be designated for carriage of ADS-B, but it is difficult to forecast when this will start to impact on GA operators. Nevertheless, the expected lifetime of the avionics being installed today spans into the ADS-B deployment period, and it is worth taking into account future capabilities when buying equipment now.

What equipment do I need?

To support ADS-B “Out”, the aircraft must have a GPS receiver as the position source, and a datalink transmitter to actually send the ADS-B data.

The datalink transmitter that most aircraft will use is a Mode S transponder, using a feature called “Extended Squitter”. The Mode S transponder with Extended Squitter

is the international standard for ADS-B output. Specific to US airspace – and not approved elsewhere – is the UAT datalink transmitter as an alternative to the Mode S transponder. UAT transmitters may only be used on GA aircraft flying at lower altitudes in the USA.
The GPS receiver used must be an IFR certified receiver. It is expected that for future Next Gen operations in the USA this receiver also needs to be WAAS capable, because the high precision positioning has been factored into the separation planning. In the rest of the world, WAAS has not been mandated.

Should I use UAT or Mode S?

If you are flying outside the USA, there is no choice – the only approved solution is Mode S. That is also true for large aircraft and high altitude aircraft in the USA – you must use Mode S. If however you are flying a GA aircraft in the US, you may instead elect to use a UAT solution.
A UAT solution will almost certainly be more expensive than a Mode S based solution, because the Mode S ADS-B solution is built into many existing ATC transponders, whereas the UAT solution is a separate datalink radio. That raises the obvious question – why would anyone use UAT? The key difference between the two solutions is that UAT has spare uplink bandwidth, whereas Mode S Extended Squitter only has the capacity for ADS-B position reporting. That means that a UAT radio can receive additional data streams, in addition to the traffic information. The FAA is providing a weather reporting function using the spare datalink bandwidth of the UAT radio, and the FAA is hoping that this "added value" feature will encourage GA operators to install ADS-B equipment sooner that they otherwise might.

What about ADS-B In?

An aircraft with ADS-B "In" would be able to hear position reports from all the other nearby aircraft – independently of ATC. Such a facility would drive what is called a "Cockpit Display of Traffic Information", or CDTI. In practice this kind of display is often integrated with a Multi-Function Display or moving map GPS display.
To support ADS-B "In" obviously requires a datalink receiver, in addition to the datalink transmitter that is providing the ADS-B "Out" function. Most UAT based ADS-B solutions will include a datalink receiver as well as a transmitter – as already mentioned the key advantage of the UAT system is the ability to uplink other information, so there's a limited opportunity for a transmit-only UAT system. Mode S transponder based solutions today do NOT include the datalink receiver. Instead, the Mode S based ADS-B receivers are generally packaged as a separate system. At the high end, these are usually integrated with TCAS systems. For GA aircraft a separate ADS-B receiver is used.

What is antenna diversity?

A key benefit of ADS-B is that an aircraft with an ADS-B receiver can detect other nearby aircraft, and that needs to work for aircraft both above and below, and in any relative position. Large transport aircraft with TCAS already use more than one antenna for their TCAS and transponder systems, in order to ensure that there are no radio blind spots caused by the wings or fuselage. Having more than one antenna is called diversity, and the FAA has proposed that the principle of antenna diversity should be applied to all ADS-B installations.

Other international regulators are not convinced, and diversity is still a hot topic for discussion in the industry, because a dual antenna installation can cost more than twice the price of a single antenna installation. In small GA aircraft the transmission pattern of a typical transponder antenna, although far from uniform, shows significant radiation above the aircraft as well as below, even when the antenna is on the aircraft belly. We at Trig are therefore not convinced that the marginal improvement in system resilience from installing antenna diversity is worth the considerable extra cost, but obviously we will follow the regulatory lead.

What does it cost?

All the current Trig Mode S transponders – TT21, TT22 and TT31 – are also ADS-B "Out" certified. There is NO extra cost to the Trig transponder for the ADS-B capability.

The problem is the GPS receiver. Since the GPS needs to be an IFR certified receiver, it is by far the most expensive part of the solution.