ADS-B

Learning the Ins and Outs

Pilots Face Decision on When to Implement

STORY BY DAVE HIGDON

The first day of January 2020. That's the date aircraft flying much of the airspace must employ automatic dependent surveillance-broadcast Out per a Federal Aviation Administration rule finalized in May 2010.

That's the FAA's deadline, but what's your deadline for adapting your aircraft to ADS-B?

You could, of course, for myriad reasons, wait until Dec. 31, 2019, the drop-dead end-of-the-transition period.

By then, goes one perspective, choices will be broader; prices might be lower; expertise higher – and you'll have held on to those bucks until the system will no longer let you into Class A, B and C airspace, and other layers, on that old transponder – even unadorned Mode S units.

Maybe the doubters and naysayers will have diminished. Or, you could shoot for 2013.

By then, the ground network of support stations completes nationwide coverage from, predominantly, 500 feet above-ground-level and higher.

That's the countering perspective to the wait-until-the-bitter-end thinking.

Or, you could bite the proverbial bullet as soon as you find a system that meets the standards of both federal regulatory requirements and your budget.

Already, according to FAA information, the ADS-B-system covers more than half the country from 1,800 feet MSL, higher at higher field elevations, but lower over the Gulf of Mexico and within 20 miles of those stations.

The remaining part of the continent not covered continues to shrink at a steady pace, as the FAA continues to add service areas and tying in the 300-odd stations already constructed – out of about 800 planned for service by 2018.

By then, few pieces of acreage will lack ground-level coverage.

Then, the decision with a real potential payoff for the aircraft owner and pilot: whether to go for the whole system, ADS-B Out and ADS-B In.

According to the FAA, two free ADS-B services became universally available on Aug. 29, 2008. So, opting in early with both Out and In gets you more use of these two services via the hardware supporting ADS-B In.

Few aircraft owners would say they are thrilled at the prospect of spending money, and many owners feel they're being forced to invest where they otherwise might not.

However, many of those same owners have shared a bit of eagerness to find the affordable system and just do it – that is, they are ready to move on to ADS-B, and move all-in. And, the reason is those two services, which, strangely, the FAA has yet to include in rulemaking or otherwise promulgate standards.

But, the agency offers them, promotes them, and they're a pretty good deal at many levels – particularly if you're flying without some of general aviation's greatest assets: near-live airborne weather information and images and airborne traffic-advisory system.

If you're flying an aircraft equipped like most, you likely have a GPS of some type – portable to panel-mounted – but lack a new one with wide-area augmentation system functionality. You may lack a GPS and a multifunction display, an anti-collision system or on-board Doppler weather radar.

As popular and available as these hazard-avoidance technologies are, they still aren't in most aircraft – particularly older aircraft whose owners are contemplating adding glass to their panels.

ADS-B fit into a transition that embraces these new technologies – among the most-coveted in flying.

No, they won't transform your pilot skills, but they can transform your situational awareness. And, a WAAS GPS – but one way to satisfy the need for an ADS-B navigation-data source – also can expand your capabilities.

Conforming to requirements informs controllers with needed information. This goes hand-in-hand with in-cockpit traffic and weather – without additional hardware or subscription fees.

The ground network continues to grow toward full ground-network coverage by 2013; the FAA is shooting for full operability far earlier than 2020 – but allowing the added time to assure itself of a smooth transition.

So, remember: ADS-B Out is mandatory – in just a little more than eight years.

You can wait and see; fit the update into a panel makeover or other upgrade.

But, if you're already lacking weather and traffic – or would like more or better – consider going all in and adopting ADS-B In at some point, as well.

Once you do, you'll gain benefits from the system and not merely contribute Out benefits to the FAA and, in the process, enhance your hazard-awareness several levels.

And here's a tip worth remembering: When the time comes, replace a failed Mode A/C transponder with a modern Mode S model capable – or upgradeable – to deliver ADS-B Out. You'll satisfy the regulatory requirement at a competitive price.

The Basics

Here is a quick refresher on ADS-B – what it is, what it does, equipment needed, why the FAA wants the system and how pilots can benefit from components of the system, individually and as a whole.

Let's start by revisiting the basics of this technology. Automatic dependent surveillance-broadcast. The name itself nicely describes what's happening.

ADS-B Out automatically broadcasts a package of data from the aircraft, data which FAA air traffic service controllers depend on to maintain aircraft surveillance.

The data an aircraft broadcasts includes highly accurate position information supplied by a navigation source – either a performance-qualified RNAV or inertial-nav source or the most-popular method which this article focuses on, WAAS GPS – connected to the aircraft's ADS-B Out transmitter; the GPS data package also includes speed and direction of flight. The aircraft's altitude source must be the same as the altitude source of the encoder, and it is important that the aircraft's ADS-B system and tansponder/encoder system report the same altitude.

Finally, the aircraft's ADS-B Out system updates the data broadcast hundreds of times per minute.

Receiving these data broadcasts are ground repeater stations connected to controllers via ground-communications computer processors; those stations already number more than 300, with about 800 total planned.

So, how does this all differ from today's ATC surveillance technologies?

Today, when a surveillance radar beam sweeps – or "pings" – an aircraft transponder, the transponder "replies" by broadcasting one of 4,009 discrete four-digit codes, along with altitude data derived by an encoder attached to the transponder. The computers take the transponder "squawks" and process them into targets on controllers' screens showing the aircraft's code, its position, altitude and a flight vector.

Flying the en route system, the computers update position reports every couple of minutes; radar in terminal areas updates the screen image several times a minute.

And, the data lacks anything approaching the precision of the ADS-B Out.

Not only is the data updated multiple times a second,

Continued on following page...

Continued from page 61

the GPS-provided data broadcast incorporates information corrected by the wide-area augmentation system, and WAAS delivers position accuracy of less than 50 feet laterally, under 15 feet vertically and within a fraction of a knot.

ADS-B Out versus ADS-B In

Two related technologies share a system – that's ADS-B Out and ADS-B In.

Where ADS-B In comes into play – and holds appeal to many – is a pair of "free" (excise-taxpayer funded) services which require additional equipment beyond that required to meet the mandate for ADS-B Out.

The repeater aspect of the ground stations involves re-broadcasting the two products: the traffic information service-broadcast (TIS-B) and the flight information service-broadcast (FIS-B). TIS-B sends out data with individual aircraft position reports for both ADS-B and non-ADS-B aircraft using data fed from the ATS system. FIS-B broadcasts weather and flight-information products, including Doppler weather radar images and other graphic weather products, plus sundry text products – NOTAMs, METARs, SigMets and more.

The FAA approved two systems for satisfying the requirement for ADS-B Out, one with an altitude restriction, the other with a service constraint.

ADS-B Out Equipment Requirements:

WAAS GPS or other performance-compliant navigator – stand-alone (blind), integral to a single-box ADS-B system or a panel-mounted navigator.

ADS-B Out Transmitter, either a 978 MHz ADS-B stand-alone transmitter or UAT; or 1090ES Unit, stand-alone or an ADS-B Capable Mode S Transponder and an antenna.

ADS-B In Equipment Requirements:

(in addition to Out hardware)

978 MHz ADS-B Receiver or 978 UAT to receive the Out signals of other aircraft, as well as FIS-B and TIS-B data; or 1090ES also able to receive TIS-B and a display screen of some type to show FIS-B and TIS-B images and text; can be stand-alone, MFD or the screen of a GPS navigator.

The one without an altitude restraint is 1090 MHz Extended Squitter – essentially an enhanced Mode S unit. 1090ES not only has no altitude restriction, it's also the standard internationally endorsed and is being used exclusively in Australia and several parts of Europe. The comparable systems in both Europe and Australia are compatible with our ADS-B equipment; that means what works here will work there.

The 1090ES solution also works to receive TIS-B broadcasts from the network of ADS-B ground stations; it does not, however, receive the companion FIS-B signals.

The altitude-constrained solution is the 978 MHz Universal Access Transceiver, or 978UAT.

Considered a more-robust, more-flexible solution, a 978UAT works to satisfy the ADS-B Out regulatory requirement, and it also provides ADS-B In, receiving both TIS-B and FIS-B. And, FIS-B is the weather service.

A 978UAT or 978 MHz ADS-B transmitter satisfies the Out requirement – up to 18,000 feet. Flying above 18,000 MSL? Get 1090ES for your Out solution.

In fact, another approach to getting TIS-B combines the 1090ES ADS-B Out solution, which gets TIS-B, with a separate 978 MHz ADS-B receiver to get the FIS-B.

Completing an 'All-In' ADS-B System

Satisfying the ADS-B Out requirement is actually pretty simple. The system needs the WAAS-enabled, approved GPS navigator linked to an ADS-B Out broadcast box, be it the 1090ES type or a 978 MHz Transmitter, or 978UAT.

That's it: a GPS nav source coupled to a broadcast unit. The GPS can be a blind unit working only for the ADS-B, or it can be a panel-mounted navigation source unit that (a) meets the applicable technical standards order and (b) can be linked to whatever Out broadcast box you chose.

That satisfies the FAA requirement.

Now, if you want to benefit from the free stuff, weather, traffic and the ability to directly "see" other ADS-B Out aircraft directly – you need ADS-B In capability; that can be either a 978UAT or 978 MHz ADS-B stand-alone receiver.

Finally, you also need a display of some type to see the traffic and weather products.

An aircraft operator already equipped with some form of traffic-alert or collision-avoidance system may not feel compelled to embrace ADS-B In; ditto for the operator or owner already equipped to receive satellite weather from one of the subscription-based services.

But, for the thousands of aircraft lacking both – or lacking only a traffic-alert system beyond Mk.II EyeBall traffic detection – embracing both Out and In may hold interest.

The total-system costs of Out and In solutions – even for aircraft lacking a display – are less than any of the

stand-alone traffic sensors, which also need a display; adding In to your ADS-B package also is competitive with adding a dedicated satellite receiver.

So, no weather-equipment charge or monthly subscription fees, a consideration that may be particularly attractive to pilots using a portable device to receive satellite weather datalink services.

Now, these products – the traffic and weather – may be used only for advisory needs, the FAA points out, since there are system lags, and the weather images take several minutes to update and get broadcast.

Think of those animated Doppler-radar sequences that glue us to the tube when waiting out weather; the individual images that make up those animations are each equivalent to the images delivered via FIS-B.

There just aren't any handsome, lovely, smiling weather people to tell us how badly we're stuck.

GPS' WAAS Advantage: More and Better Approaches

Here's the element that gets surprisingly little attention in the pro-con, wait-don't-wait-wait-a-little conversation: the value of the WAAS GPS as a position-data solution.

Sadly, the only thing rarer than an anyone-can-afford-one airplane is a wide selection of panel-mounted, approved WAAS GPS navigators. Many exist as elements of integrated avionics systems compared to stand-alone panel units.

No question – more are coming.

If there's a component of the ADS-B system with hands-down, no-question immediate use potential, it's the WAAS GPS navigator.

Here's why: since throwing the switch on the wide-area augmentation system, the FAA has been developing new instrument approaches at an amazing rate, approaching 3,000 new localizer performance with vertical guidance approaches, better known as LPV.

LPV approaches closely mimic the gold-standard ILS approach, with one huge difference: no ground-based ILS hardware. Instead, the GPS receiver itself generates its own localizer and glideslope paths based on the approach created and programmed into the navigator.

LPV approaches can provide minima down to 200 feet and a half mile if the airport equips itself with appropriate lighting and marking; 300-foot ceilings and a half-mile require less ground infrastructure.

And, for many of the other new WAAS GPS-based approaches, little to nothing at all is required aside from runway lights, end marker lights or such.

These approaches improve on or replace non-precision approaches based on everything from NDBs to VORs and DMEs – and, in many cases, improve on existing GPS non-precision approaches, if they can't go full boat to an LPV approach.

More and more, airports unable to qualify or afford an ILS can get ILS-like approaches to both runway ends for about 1/30th the ILS cost; that's about 3.3 percent of the ILS – and without the electric bills and maintenance costs of the ILS.

Start Shopping

Selections in ADS-B hardware are available that either meet the Out mandate alone or meets the Out mandate and provides the In connection, as well. One solution integrates its own WAAS GPS navigators.

The key piece of approval required to meet the Out mandate is one of these two TSOs: TSO–166b for 1090ES and TSO 154c for 978 UAT.

Looking, however, at the options available under the prior TSOs – 166a and 154b, both which were proposed final standards – should inform us of who we can expect to offer solutions based on the newest documents.

Cost remains another unpredictable element and one dependent on what the aircraft needs and what the owner wants.

For example, the existence of a TSO-approved WAAS GPS – such as Garmin's GNS 430W and 530W, or its GTN 650 and GTN 750 – satisfy the WAAS GPS need.

Other solutions exist and more are in the works; they will impact the total costs depending on their installed costs. ❑

Where You Need ADS-B, per the FAA:

The ADS-B rule, like current transponder operating requirements, requires operators to have ADS-B Out avionics installed and operating by 2020, in order to fly their aircraft in the busiest airspace, as described below:

- *Class A, B and C airspace.*
- *All airspace at and above 10,000 feet MSL (mean sea level) over the 48 contiguous U.S. and the District of Columbia.*
- *Within 30 nautical miles of airports listed in 14 CFR §91.225, from the surface up to 10,000 feet MSL.*

Class E airspace over the Gulf of Mexico from the coastline of the U.S. out to 12 nautical miles, at and above 3,000 feet MSL.

You should note that current transponder requirements are not changed or affected by the ADS-B rule.