ADS-B

It's Not Tomorrow's System Anymore

BY DAVE HIGDON

By now, you've heard the news. Aircraft operating in airspace currently requiring Mode C or Mode S transponders must equip with ADS-B Out by Jan. 1, 2020, in the United States; a notice of proposed rulemaking in Europe proposes the requirement by 2015.

The FAA's landmark rulemaking reached the public in final form in May.

The rulemaking culminates nearly two decades of development that included more than a decade of live field tests, several years of debate, an NPRM accompanied by a lengthy comment period, a long period of discussion and dissection of the comments, and the work finalizing the rule published in May.

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larly now, with the FAA's final rule hitting the streets.

The rule's revelation elevated our knowledge of both the agency's plans and regulatory wants; it also heightened confusion and deepened doubts about the value of the technology — at least its value to the users asked to collectively spend billions to comply.

In a testament to the avionics industry and its recognition of the pending changes, a variety of approved solutions already existed and held the requisite TSOs when the rule hit print — TSOs many expected to remain relevant.

Unless those previously TSO'd items win approval under the new orders, they will no longer be legal on Jan. 1, 2020, thanks to new TSOs released in early December.

One other item to weigh when considering a solution: The FAA decided to retain current transponder requirements for back-up purposes — further fueling confusion, dismay and frustration.

Expect customers' questions to run the gamut. With so many years, so much time involved, a wealth of rumors and a stack of new names and acronyms to translate and explain, many prospective clients and customers understandably will be confused and confounded before walking in the door or calling.

But at some point in the next nine years, every aircraft owner who wants to enjoy its benefits must arrive at an answer about how to comply.

Starting at the Beginning

What exactly is automatic dependent surveillance–broadcast? Its name pretty much sums up the idea concisely.

An ADS-B aircraft system automatically broadcasts a package of GPS-generated information upon which the FAA's ATC surveillance system is dependent for displaying on-screen any given aircraft and corresponding information.

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The components required include a TSO'd WAAS/GPS source and one of two devices to broadcast the data the GPS generates.

To automatically meet the FAA's dependence on aircraft-broadcast data, an onboard ADS-B Out system takes WAAS/GPS-generated position, vector, altitude and velocity data, packages it into a digital form and broadcasts that information at an

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update rate of about once per second or more.

Ground stations receive those data packets, route the information to ATC communications and computer systems, and then process the information to display on controllers' workstations.

ADS-B Out does its job automatically, with no outside influence, dozens of times per minute.

In contrast, radar surveillance of the Mode A, Mode C and Mode S variety depends on ground-based secondary-surveillance radar bursts to "interrogate" an onboard transponder, and then must broadcast a reply with its "squawk," which includes an altitude code in the case of Mode C, and with Mode S, altitude and other information from a stand-alone encoder or an encoding altimeter.

Calculating position, flight direction and speed, then translating the altitude squawk, falls to high-power, highly complex computers that, once they do their work, generate an image on controllers' screens, with a tag that includes other information.

Radar is more accurate today than ever — for radar — but the system and its compounded flaws and errors remain too inaccurate for the FAA to allow IFR aircraft within five miles of each other when IMC.

ADS-B, however, provides position accuracy to within a few hundred feet, even better altitude accuracy, and velocity accuracy far better than what radar calculates — and ADS-B does it faster and more often, thanks to the self-generated, automatic nature of the data broadcast. This accuracy ability provides the basis for reducing spacing and tightening up other standards — the main efficiency gains the FAA and airlines covet.

Why ADS-B?

After years of development and field tests, the FAA selected ADS-B as the foundation technology to underpin the Next Generation Air Traffic Management System, commonly known as NextGen.

ADS-B Out does a hugely better job tracking aircraft and informing controllers on their displays — far better than radar does today.

Before reaching the rule-issuance point, the agency worked with two constituencies to deploy developmental ADS-B for more than a decade of field tests in Alaska's harsh environment and the Ohio River Valley, a high-traffic region.

The Alaska tests demonstrated both the technical capabilities of the contributing technologies and their viability working as a surveillance tool with capabilities unavailable from radar — and in an environment that limited use of even the best radar.

Accident rates declined — steeply: about 40 percent.

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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 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 United States 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 United States out to 12 nautical miles, at and above 3,000 feet MSL.

Current transponder requirements are not changed or affected by the ADS-B rule. ❑

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In the Ohio River Valley, work with UPS demonstrated the ability of ADS-B to monitor and improve the efficiency of high-volume aircraft movements, flow control and traffic management in the high-pressure environment of a large package express and in the freight airline's largest hub in Louisville, Ky. — a hub originally sandwiched between two other high-volume overnight package carrier's hubs, one in Memphis, Tenn., the other in Indianapolis, Ind.

The fuel-saving implications alone for special approach procedures now in use represent millions annually.

So, ADS-B goes beyond merely duplicating radar.

It's this range of features that underpin the key appeal of ADS-B.

Delight in the Details

Using WAAS/GPS yields position, altitude and velocity information many times more accurate than what even today's best radar can provide. The lateral accuracy level required by the final rule is 0.05 nautical miles.

Velocity accuracy can be off by no more than 33 feet per second. The updates — 60 to 100 times per minute — are multiple times faster than the three to six rotations per minute of en route and terminal radar systems.

Combine the high level of accuracy of ADS-B's GPS-generated position and speed data with the rapid updates, and the result is an ability to confidently space aircraft closer together.

Airspace management and traffic surveillance with radar has long suffered with coverage gaps, some because of terrain, some because of lack of radar dishes in remote areas.

By 2013, ADS-B, with more than 790 ground stations placed and linked through four data-control stations, promises to eliminate coverage gaps and reduce low-altitude limitations with more than 95 percent of the contiguous Unites States receiving coverage.

Coverage already is nearly total starting at 1,800 feet MSL — higher in higher elevations, lower over the Gulf of Mexico, where near gulf-wide ADS-B coverage went active in February.

Beyond Surveillance

The pitch to the general aviation population largely consists of what ADS-B offers the pilot in the cockpit, working as a delivery conduit for the flight information system–broadcast and traffic information service–broadcast.

Available to aircraft that also equip with ADS-B In, TIS-B and FIS-B are broadcast from all those ground stations showing traffic — ADS-B and transponder-only aircraft alike — and weather (both graphic and text products), plus TFRs and special-use airspace.

The FAA allowed U.S. aircraft owners two options for satisfying the ADS-B Out rule: 1090 extended squitter (1090ES) and the 978 MHz universal access transceiver (978 UAT).

The 1090ES option basically is expanded use of the data squitter currently carried on 1090 MHz Mode S transponder signals with the ADS-B data packaged in a longer data pulse — the "extended" squitter.

The 978 UAT option uses a segment of the radio frequency spectrum specially reserved for it: the 978 MHz spectrum.

Where You Need ADS-B per the European Commission

Still pending final issuance — expected before year's end — the European Commission published an NPRM last year that proposes mandating 1090ES ADS-B Out after Feb. 5, 2015, but only for aircraft over 12,500 lbs or with the ability to achieve cruise speeds greater than 250 knots. Europe chose 1090ES because it is compatible with the current Mode S elementary surveillance and enhanced surveillance mandates. ❑

As the use of "transceiver" implies, this 978 UAT is a two-way solution meeting the ADS-B Out broadcast requirement, while also receiving ADS-B Out signals from other sources — the "in" aspect of ADS-B In.

The 978 UAT Out broadcast carries all the same information sent by the extended squitter of 1090ES, while the ADS-B In product comes from the output of ADS-B ground stations, their translation of signals from 1090ES-equipped aircraft and direct transmission of other 978 UAT-equipped aircraft, plus from FIS-B and TIS-B data packages.

FAA requires 1090ES for flying at or above FL180, while allowing it as one of your options for flying below and up to 17,999 msl — yet another change from the proposal.

Aircraft owners may opt for a stand-alone ADS-B In solution to work alongside 1090ES if they want or need the ADS-B Out option.

For operators lacking a traffic alert system and/or in-cockpit weather data-link, TIS-B and FIS-B largely would obviate the need to pay for the acquisition and installation of separate systems — and altogether eliminate any subscription requirements for a data-link weather service.

ADS-B In does require a cockpit display, but options here already are broad and deep.

Interestingly, the FAA only recently formed a group to study rules and equipment standards for ADS-B In; the committee isn't due to make its recommendations until 2012.

This still leaves many small-plane operators questioning whether or not the change to ADS-B provides them any benefits worthy of the investment.

Knowing the Deadline and Rationale

In truth, what we know least about is who will offer exactly what equipment and for how much. We had some ideas of sources, costs and capabilities through ADS-B solutions already offered

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under prior TSOs — the approval standards superseded by the updated documents published in December.

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

Cost remains another unknown — unless you consider prices of existing gear to be an accurate forecaster of future costs. Only when accurate estimates of actual costs emerge, can pilots and aircraft owners weigh any benefits, which means continuing questions about paying for the mandate.

A Sample Equipment Guide

Many major avionics makers already offer ADS-B solutions of various flavors, many of them approved under older TSOs.

Here's a sampling of those products, which can help you when you start asking your field or regional representatives about them and future ADS-B product plans.

UAT Options

• FreeFlight Systems' RANGR 978 MHz line has three pieces of equipment: FDL-978TRX, a full-function UAT with Out/In; FDL-978TX, ADS-B Out only; and FDL-978RX, a stand-alone ADS-B In receiver. The two ADS-B Out boxes require WAAS/GPS input from a TSO'd navigator or stand-alone blind WAAS/GPS. The company said it plans to TSO the RANGR line.

For more information, visit www.freeflightsystems.com.

• Garmin International offers its GDL90, now five years in production and the first to meet the original TSO 154. It employs its own integral WAAS/GPS sensor, which can be used to work with other devices.

For more information, visit www.garmin.com.

• NavWorx's ADS600-B is a stand-alone UAT solution with its own integral WAAS/GPS. NavWorx also offers the ADS600 as a stand-alone ADS-B In solution and the PADS600 portable, battery-powered ADS-B In receiver, which can play on handheld GPS and other displays.

For more information, visit www.navworx.com.

1090ES Options

• Becker Avionics offers the BXP6403 Mode S transponder, a drop-in replacement for the Bendix/King KT 76A and one of several solutions Becker is pursuing.

For more information, visit www.beckerusa.com.

• Garmin's GTX330 ES and GTX33 ES won TSO approvals more than two years ago and are designed to work with a wide range of WAAS/GPS navigators, while continuing to offer ancillary features the company gave these models prior to their upgrade for ADS-B service.

For more information, visit www.garmin.com.

• Honeywell's KT 73 Mode S transponders with the Bendix/King label are upgradeable, if already in the field, or available new with the ADS-B Out function installed.

For more information, visit https://commerce.honeywell.com.

• Rockwell Collins's TDR94D is a Mode S transponder employed as part of a collision-avoidance system and upgradeable to fulfill the Out requirements as a 1090ES solution.

For more information, visit www.rockwellcollins.com.

• Trig Avionics offers two solutions: the TT21 and TT22, both compact Mode S/1090ES solutions that also carry their own integral altitude encoder. They differ in altitude range and speed capabilities, as well as output power. Trig's TT31 was the first European transponder approved for ADS-B Out — and it also is a drop-in replacement for the Bendix/King KT 76 and KT 78 transponders.

For more information, visit www.trig-avionics.com.

In a related, partial solution to the ADS-B In dilemma, Avidyne is developing — and taking advance orders for — an upgrade to its TAS600 series traffic advisory systems that adds ADS-B In functionality to the traffic-alert sensors.

For more information, visit www.avidyne.com. ❑

If you have comments or questions about this article, send e-mails to avionicsnews@aea.net.