Publication of Duncan Aviation

STRAIGHT TALK ABOUT ADS-B

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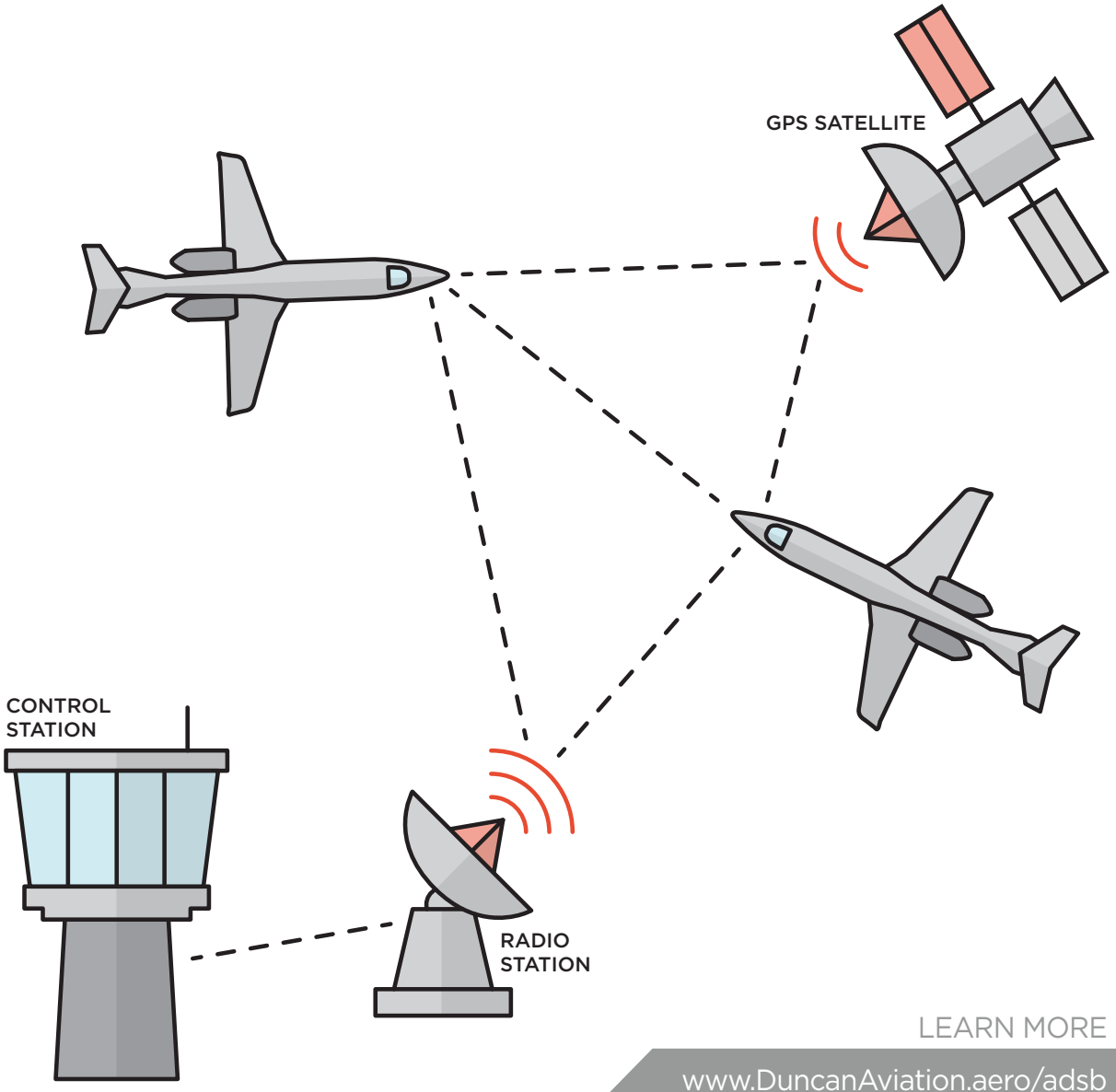

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EDITORS' NOTES

Thank you for reading our ADS-B (Automatic Dependent Surveillance-Broadcast) publication. We feel that the time is right to make this updated information available. We have spent countless hours researching all aspects of ADS-B, including deadlines and available equipment, and we feel that we lead the industry with our knowledge and capabilities. We have developed several programs for not only ADS-B, but also for the other NextGen (Next Generation) technologies. For instances, we've included updated information regarding TCAS (Traffic Alert and Collision Avoidance System) II 7.1 software in a section near the end of this publication.

This guide is intended as a learning tool, and we hope it answers all of your questions regarding ADS-B Out. We also hope that we can inspire more questions and discussion surrounding the NextGen technologies. Please take the time to send us a note with a question or comment by clicking the send us a message link on our Straight Talk website: *www.DuncanAviation.aero/straighttalk/adsb*

At Duncan Aviation, we're on the cutting-edge of avionics technology, and it's no different with ADS-B. We understand the regulations, trust our OEM partners, and know the equipment that is currently available. Additionally, over the past decade, we have talked with hundreds of our customers and manufacturers so we can provide the most useful and comprehensive information available with regard to ADS-B and the other NextGen mandates. Our focus in this publication is primarily on Part 25 aircraft, and the information here is current as of of January 2018.

Duncan Aviation acknowledges the help and support of the FAA ADS-B Groups, the FAA Engineering and Safety Groups, the Aircraft Electronics Association and the avionics manufacturers who are working on the products to make your flying safer, easier and more affordable. Remember that the best-equipped aircraft will be the best-served by the world's air traffic systems.

As always, we strive to improve ourselves and our knowledge. Feel free to contact our avionics experts with any of your ADS-B concerns, questions or challenges. See page 21 for names and contact information or visit our website: *www.DuncanAviation.aero*.

NEXTGEN INITIATIVE

For the past several years, Duncan Aviation has written articles, posted blogs and held seminars about the FAA's initiative for the future of national airspace management and control called Next Generation Air Transportation System, or NextGen. We've found that nearly everyone has heard about the NextGen initiatives, but questions remain about how the FAA's mandates affect individual owner/operators. The concept evolved from initiatives started during President Bill Clinton's administration to update and transform the ATC (Air Traffic Control) system from a ground-based, radar network to an aircraft- and satellite-based system. Equipment would also transition from the World War II-era analog radio systems to contemporary digital systems. A large part of this system is called ADS-B.

You've probably heard the terms NextGen and ADS-B more often in the last few years because the vision is quickly becoming a reality. The FAA is working with industry organizations and manufacturers to implement the plan, which it believes will increase the safety and efficiency of airspace in the United States by providing more complete and reliable traffic and weather data to pilots and controllers. Consequently, the aircraft best-served will be those that are the earliest and best-equipped.

The goal of the NextGen initiative is to make air transportation safer and more reliable while increasing the capacity of our airspace and reducing aviation's environmental impact. Projections indicate that air traffic will increase by 20% over the next decade. The systems being implemented now and in the mid-term are needed to accommodate the increasing demands on our national airspace system. In addition, the FAA is working with its global counterparts to ensure that NextGen is forward-compatible with similar initiatives worldwide, such as Europe's Single European Sky ATM (Air Traffic Management) Research (SESAR).

With the increased traffic, very light jets, UAVs (Unmanned Aerial Vehicles), and commercial space flight in our near future, there is an immediate need to upgrade the national airspace system.

The following are other technologies related to NextGen that are being developed and tested. Duncan Aviation will continue to track them as they are further developed. Expect to hear more about them in the future.

- **GBAS (Ground Based Augmentation System)**—Eventually intended to be operational at every Category 1 airport in the country, GBAS is a precision WAAS (Wide Area Augmentation System) approach that will provide navigational guidance all of the way to the runway surface—even at non-ILS (Instrument Landing System) airports.

- **MLAT (Multilateration)**—This is a transponder-based tracking system that relies on multiple ground-based receivers that calculate an aircraft's position by measuring the TDOA (Time Difference of Arrival) of the transponder signal at three or more fixed receiver locations. This system does not rely on embedded GPS (Global Positioning System) data or a RBS (Radar Beacon System) and is meant to supplement mountainous areas below 10,000 feet that are not covered by ADS-B signals.

- **ASDE-X (Airport Surface Detection Equipment–Model X)**—This technology, which employs radar, multilateration and satellite data, lets ATC monitor ground vehicles and aircraft at an airport (as well as those aircraft approaching) to detect potential conflicts on the runways, taxiways and ramps. It is in use at 35 US airports.

- **FANS-1/A (Future Air Navigation System 1/A)**—Integrating data communication with Flight Management Systems (FMS) is a NextGen component designed to reduce verbal communication among pilots and between pilots and ATC. Pilots don't always speak the language of the country into which they're flying, and accents often hinder clear communication. FANS is designed to ease communication problems that result from language barriers and to automate communication among ATC and airborne and surface traffic. This avionics-based system opens a digital data link between a pilot and ATC for clearance and position reporting. Also referred to as ADS-C (Automatic Dependent Surveillance-Contract), FANS 1/A is for all of the NATs (North Atlantic Tracks).

The FAA will need cooperation from all participants in aviation to achieve its NextGen goals. Aircraft that are equipped for ADS-B In and Out, RVSM (Reduced Vertical Separation Minimum), WAAS-LPV (Wide Area Augmentation System with Localizer Performance and Vertical Guidance), RNP (Required Navigational Performance) and FANS-

1/A (Future Air Navigation System 1/A) will have access to shorter, more direct flight routes and easier access to runways and terminals at airports, which saves pilots and passengers time and money.

THE ROOTS OF ADS-B

CALCULATING AN AIRCRAFT'S POSITION FOR ATC

Before the widespread use of radar for ATC in the 1950s, an aircraft's position was calculated by the crew and relayed to controllers by radio. As radar technology matured, it gave controllers a picture of the airspace around them. Initially known as PSR (Primary Surveillance Radar), it only showed aircraft as dots on a screen.

With the addition of Mode C transponders, ATCs could assign a four-digit code to the dots on their screens, allowing them to identify each dot as a particular aircraft. This is known as SSR (Secondary Surveillance Radar).

Adding Mode S transponders gave each dot an aircraft-specific identifier tied to the aircraft's registration number, as well as its altitude.

All of the technology to this point was to locate the aircraft from the point of the controller, who could then manage the traffic. This approach worked well for areas guided by ATC but did nothing for the vast areas without radar. As the skies became more congested, a system for real-time traffic awareness for both pilots and controllers alike became a necessity.

After RVSM airspace improvements were implemented in the late 1990s, it became clear that reducing separation vertically would not solve the problems caused by increasingly congested skies. The way to put more traffic into even less airspace is to reduce that separation laterally as well. In 1998, the FAA released its first plan for ADS-B performance standards in DO-242. The first transponder- specific directive (DO-260) was released, and it established the baselines for the surveillance technology (Mode-S 1090MHz ES [Extended Squitter]) that is expected to replace radar. Subsequent versions DO-242A, DO-260A and DO- 260B made changes and further explained the standard.

The technology is based on an accurate GPS-derived position that sends real-time information from a properly modified Mode S Transponder for re-broadcast to ATC.

Prior to these more recent technology changes, the FAA launched the TCAS (Traffic Alert and Collision Avoidance System) in 1981 to give pilots a view of the aircraft around them. TCAS II was released in 2000, and it changed the language used to resolve vertical conflicts.

TCAS II was better than anything used in the past, but it has some significant limitations. An aircraft intruding into another's airspace must be equipped with at least Mode C transponders, but the system does not work to its full potential unless both aircraft have TCAS. The TCAS computer must process advisories based on position reports and must calculate velocities. It also only separates aircraft vertically and does not provide any lateral guidance. ADS-B In will be the next program upgrade for TCAS II.

We have added information about TCAS software version upgrades to this publication in the last section, named TCAS II Version 7.1.

WHAT IS ADS-B?

ADS-B is an aircraft and satellite-based transmission system. ADS-B components can be broken into two primary functions: ADS-B Out and ADS-B In. An aircraft equipped with ADS-B Out sends WAAS/GPS-derived position and velocity data from the aircraft systems through an ADS-B-modified Mode S Transponder or a UAT (Universal Access Transceiver) to other aircraft, ground vehicles and ground stations to control and coordinate air traffic.

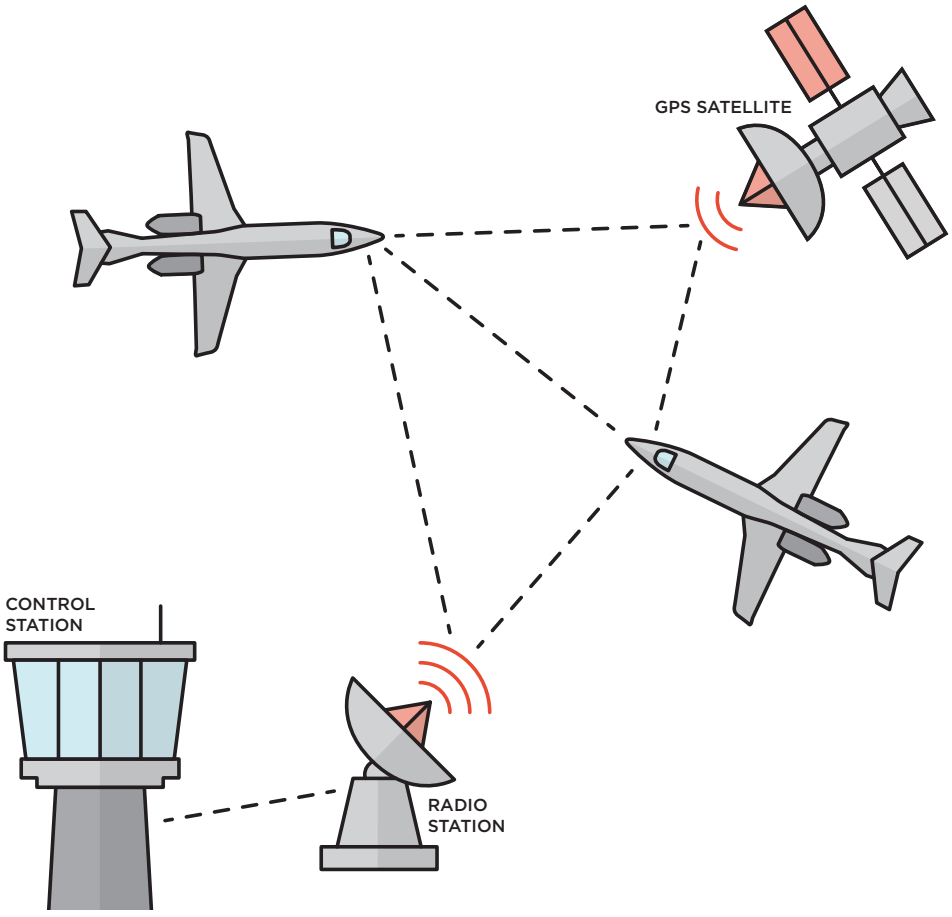
ADS-B Out instruments transmit aircraft information to ATC ground stations and to aircraft equipped with ADS-B In-capable devices. Hyper-accurate WAAS/GPS position data is automatically broadcast from all ADS-B Out-equipped aircraft to ATC ground stations and ADS-B In-equipped aircraft. The FAA has mandated that aircraft flying in the airspace that now requires Mode-C transponders to be equipped with ADS-B Out-capable devices by January 1, 2020.

ADS-B In-capable aircraft receive information from other aircraft transmitting ADS-B Out data and the ATC ground infrastructure. ADS-B In will remain optional for most aircraft.

HOW ADS-B WORKS

The first step in the on-board ADS-B system is the GPS-generated position system. The only position information that is accurate enough to meet the ADS-B specification is a WAAS/GPS system, which can either be a part of an existing FMS, another WAAS/GPS navigator, or a stand-alone WAAS/GPS sensor specifically employed for use by the ADS-B system. Aircraft equipped with either a 1090 MHz ES transponder or a 978 MHz UAT gathers that WAAS/GPS information and aircraft-specific parameters from on-board sensors, such as the IRS (Inertial Reference System), AHRS (Attitude and Heading Reference System) and ADS (Air Data Systems). The transponder or UAT processes the information and transmits it.

This information is processed in real-time and sent to ATC and can be published online for flight-tracking purposes. Ground stations receive



these signals and rebroadcast them for other aircraft to see, effectively merging the 1090 and 978 MHz systems. The rebroadcast traffic service is referred to as Traffic Information Services-Broadcast (TIS-B). Other aircraft can directly receive these signals if both aircraft are equipped to do so. ATC uses the aircraft-based information to tighten the lateral separation at altitude and tighten the lateral and vertical separation when the aircraft is ascending or descending through airspace.

Another service, called FIS-B (Flight Information Services-Broadcast) provides the flight crew with weather in graphic and text formats along with other information, such as ATIS (Air Travel Information Service) and NOTAMS (Notes to Airmen). This service will typically use the 978 MHz UAT format because it has a larger bandwidth. FIS-B will not require a subscription for use, giving flight crews more information than they have previously had using subscription-based products like satellite weather.

For older aircraft, a multi-function display can be used as a CDTI (Cockpit Display of Traffic Information) to replace a radar display. This will merge the existing radar with FIS-B, TIS-B, terrain and TCAS data. Newer avionics suites will fully integrate this information into the EFIS (Electronic Flight Instrument System) display.

ADS-C CONFUSION

Not to be confused with ADS-B, ADS-C is Automatic Dependent Surveillance-Contract, and it has to do with FANS datalink. For more information on ADS-C, please refer to our FANS 1/A Straight Talk book on our website: *www.DuncanAviation.aero/straighttalk/fans*.

ADS-B EVOLUTION

The concept of ADS-B goes back to an FAA-sponsored study in 1973. The standards to make the concepts a reality were proposed in the early 1990s and have been revised many times. International standards have been developed by the ICAO (International Civil Aviation Organization).

Ground stations were installed in Alaska, Arizona, and on the east coast to fully test the system. Eleven ground stations were deployed and activated in 2008, and Florida was the first state to be officially set up by the FAA for ADS-B. Full infrastructure deployment is now complete in the United States, Hudson Bay, and the Gulf of Mexico with an FAA mandate for all aircraft to be equipped by 2020.

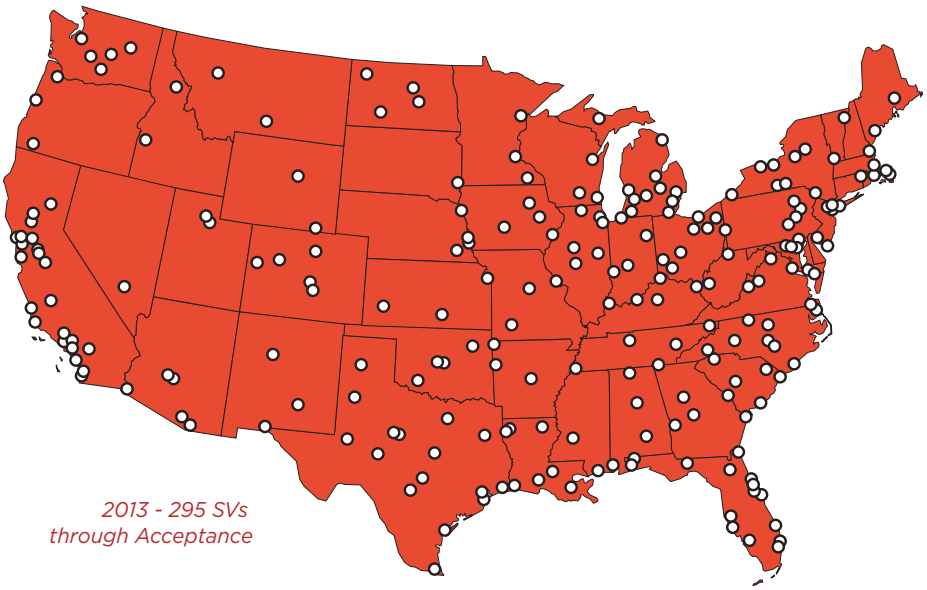
The OEM specification for 1090ES Transponders is DO-260 and, as mentioned, it has been revised twice; DO-260B is the current revision. In spite of the revisions, several regions that implemented the ADS-B specifications stipulated in the earlier versions of DO-260 have largely retained the earlier revisions as their implementation specification. For example, the Hudson Bay, Australia, Singapore, Indonesia, and Hong Kong retained the specification for DO-260A. Europe and the United States intend to meet the mandate specification for DO-260B.

DO-260B has been adopted as the future worldwide standard. The high-level differences are as follows:

- **DO-260**—Initial specification, which later was determined to have latency and accuracy measurements outside of the parameters expected.

- **DO-260A**—First specification revision developed to add accuracy to DO-260. This usually incorporates modified WAAS/GPS receivers. This version was installed and tested by the airlines, and the results were still outside the range of latency desired for domestic United States. Other failsafe functions were also desired.

- **DO-260B**—Incorporates WAAS/GPS accuracies from DO-260A and improved latency, which also adds position forecasting developed from position and velocity to predict aircraft position. This adds additional cockpit failure annunciators.



2013 - 295 SVs through Acceptance

INTERNATIONAL IMPLEMENTATION

Internationally, Canada, China, Sweden and the UAE (United Arab Emirates) all currently have ground stations in place with varying coverage and services. Australia was the first country with full ADS-B coverage. In addition to the NextGen standards in the United States, ADS-B will be the backbone for SESAR being developed for Eurocontrol. NextGen and SESAR are parallel sets of standards with complete interoperability, which provides seamless transitions for aircraft traveling between the United States and Europe.

The minimum equipment requirements for the mandatory ADS-B Out capability will be a compatible form of GPS WAAS receiver and a Mode S transponder or data link radio (called a UAT), and an altitude encoder. All aircraft that need to operate in Class A airspace and most foreign airspace will require the Mode S transponder. Piston aircraft that operate below 18,000 feet in the United States can use the UAT; however, Europe has opted for Mode S (ES) only.

ADS-B In will require the above-mentioned equipment, as well as a display, such as a multi-function or multi-hazard display, or an Electronic Flight Bag.

WHAT ABOUT INTERNATIONAL REQUIREMENTS?

The FAA is working with the ICAO, CANSO (Civil Air Navigation Service Organization) and foreign governments to develop standards for equipment on aircraft that engage in international travel. These standards require a Mode S 1090 MHz ES transponder and are already mandated in parts of Europe. The specific guidance from SESAR of the European Commission approved the Surveillance and SPI-IR (Performance Interoperability Implementing Rule) identifying surveillance system performance and ground and airborne interoperability requirements for ADS-B in Europe.

As of Feb. 2015, EuroControl/EASA has required new aircraft (forward-fit) to comply with DO-260B by 2016. The FAA and EuroControl/EASA will require all aircraft to be in compliance with DO-260B (ADS-B) by 2020.

EASA/ICAO has also mandated TCAS II version 7.1 software, which is discussed in more detail in the last section of this publication.

THE BENEFITS OF ADS-B

- Gives ADS-B-equipped aircraft priority over non-equipped aircraft, including more flexible and continuous routing
- Alleviates the requirement for position reports from ADS-B- equipped aircraft
- Increases situational awareness, which reduces runway incursions
- Communicates real-time traffic in the cockpit at an effective range of more than 100 miles
- Uses both lateral and vertical guidance; transmits position and velocity data automatically for greater precision
- Allows surveillance in remote areas that are not currently picked up on radar
- Reduces aircraft separation, making departure and arrival times more predictable, so ATC can plan farther in advance
- Reduces the cost of the infrastructure needed to operate air space in the United States
- Enhances aviation safety
- Scales and adapts for use in general aviation and in ground vehicles. Provides affordable, effective surveillance of all air and ground traffic, including on taxiways and runways

With ADS-B, both pilots and controllers will see radar-like images with highly accurate traffic data from satellites. The images update in real-time and don't degrade with distance or terrain. Pilots with access to this information will have improved situational awareness so they're able to fly closer to other aircraft while maintaining safe distances, and they'll need less assistance from ATC.

Because ATC has a better picture of the traffic they are managing, they're able to eliminate wasted space between aircraft. This, in turn, increases aircraft capacity in the air and decreases the need for holding patterns. It will also allow the use of CDA (Continuous Descent Approach), which calls for an aircraft to descend at idle thrust from cruising altitude to landing. CDA procedures aim to reduce fuel burn and emissions. ADS-B, combined with the increased position precision of GPS RNP procedures, will save operators time and money by shortening their time in the air.

ADS-B was designed to be much less expensive to set up and maintain than the infrastructure currently in use, so our nation's

air system can increase capacity and safety while staying on a budget. It also allows for full United States coverage as ground stations can be located in remote locations such as the Alaskan outback or on offshore oil rigs in the Gulf and Hudson Bay.

The gains in safety, capacity and efficiency that result from a satellite-based system will enable the FAA to meet predicted air traffic growth. And because ADS-B is a flexible and expandable platform, it can change and grow as needed.

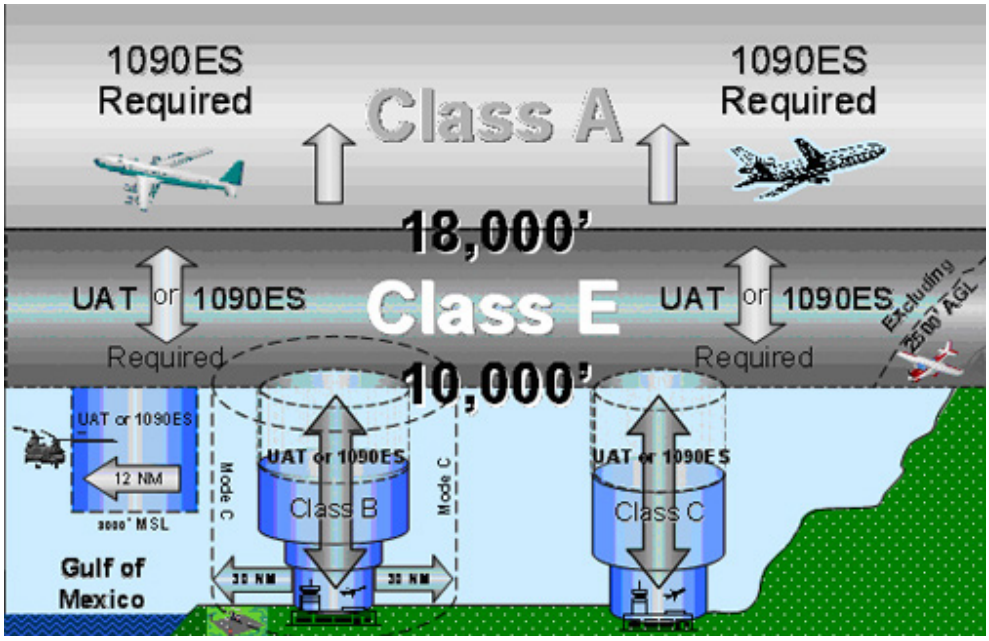
ADS-B FAA MANDATE

The FAA began implementing NextGen timelines in 2009 starting with ADS-B. The ADS-B ground-station infrastructure was fully operational by the end of 2014. The FAA has mandated that aircraft flying in United States airspace above 10,000 feet must be equipped with ADS-B Out by January 1, 2020.

As with the current transponder operating requirements, the ADS-B rule 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
- For 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

On May 27, 2010, the FAA published new rules contained in 14 CFR §92.225 and §91.227 mandating airspace and avionics performance requirements after January 1, 2020. Advisory Circular AC 20-165A issued in November 2012 provides guidance for the installation and airworthiness approval of ADS-B Out systems in aircraft. The mandated avionics perform the ADS-B Out function, which transmits precise location and other information about the aircraft to ground stations and other aircraft equipped with ADS-B. The rule does not mandate ADS-B In avionics, which enable other services available with ADS-B. Aircraft



Graphic Source: www.faa.gov

outfitted with ADS-B In avionics can take advantage of broadcast services of data, like graphical and text-based weather, traffic advisories, and other aeronautical information, in the flight deck. The ADS-B rule mandates ADS-B Out avionics performance when operating within designated affected airspace, giving aircraft owners approximately seven years to equip their aircraft. 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.

It is important to note that the ADS-B rule did not change or affect current transponder or RVSM maintenance requirements.

Although a TCAS II (Traffic Alert and Collision Avoidance System) is not an integral component in the ADS-B systems on-board aircraft, the two systems are closely linked. Created to reduce the possibility of mid-air collisions, TCAS involves communication among all aircraft equipped with an appropriate transponder. Each TCAS-equipped aircraft interrogates all other similarly equipped aircraft in a determined range about their position (via the 1030 MHz radio frequency), and all other aircraft reply to those interrogations (via 1090 MHz).

If a TCAS II system is installed in an aircraft that will eventually be outfitted with ADS-B equipment, the TCAS system will send

a message to the ADS-B equipment telling the ADS-B system that the TCAS II system is installed and operational.

All major TCAS manufacturers offer an upgrade to TCAS version 7.1, which makes two important safety enhancements. Version 7.1 changes the current TCAS II audio warning from "Adjust Vertical Speed, Adjust" to "Level Off, Level Off." It also corrects missed and late TCAS reversals. TCAS reversals were introduced in TCAS version 7.0 to adapt to changing situations where the original sense had clearly become the wrong thing to do; for instance, when one of the pilots decides not to follow the Resolution Advisory (RA) or is instructed by ATC to perform a particular maneuver. 7.1 introduces improvements to the current reversal logic to address late issuance of reversal RAs and potential failures to initiate reversal RAs.

TCAS version 7.1 also makes four other minor enhancements to the system:

- Corrects an issue when an aircraft is descending through 1,000-feet AGL (Above Ground Level)
- Modifies the Datalink Capability Report (the TCAS status report sent by the TCAS processor to the Mode S transponder) to tell the systems that the TCAS processor is Hybrid Surveillance-capable
- Allows for the transmission of the TCAS processor part number and software level
- Corrects TCAS multi-aircraft logic issues that reduces the risk of close-encounters of multiple aircraft in RVSM airspace

The enhancements introduced in TCAS version 7.1 proved to be significant enough to warrant mandates by both ICAO and the EASA. According to the ICAO, all new-production aircraft had to have been upgraded to TCAS version 7.1 by January 1, 2014, and all retrofit aircraft by January 1, 2017.* EASA required upgrades for forward-fit aircraft by March 1, 2012, and retrofit aircraft by December 1, 2015.

**ICAO countries can be exempted from this mandate. Each country must submit a new or alternative date of compliance to ICAO by Jan 1, 2017.*

ADS-B FAQS

HOW WILL THE UPGRADE PATH DIFFER IF THE AIRCRAFT DOES OR DOES NOT HAVE ELEMENTARY OR ENHANCED SURVEILLANCE? WILL I NEED TO HAVE BOTH?

ELS (Elementary Surveillance) and EHS (Enhanced Surveillance) are required for aircraft flying in European airspace but not in United States airspace. ADS-B improves ELS and EHS functions with more precise aircraft information. While ELS and EHS functions are not required as a part of ADS-B, they will most likely be a by-product of it. If an aircraft already has ELS and EHS, it will be much easier to evaluate what an aircraft needs to be ADS-B-compliant.

DOES MY TRANSPONDER MEET THE REQUIREMENTS FOR ADS-B?

FAA TSOs (Technical Service Orders) describe the equipment specifications approved for ADS-B operations. The ADS-B rule states that avionics must meet the standards of either TSO-C166b (for 1090 MHz ES link equipment) or TSO-C154c (for 978 MHz UAT link equipment). TSO-C166b is required in Class A airspace, and either link can be used in all other airspace.

HOW MUCH WILL IT COST TO UPGRADE TO ADS-B OUT? HOW MUCH FOR FULL ADS-B?

Costs for the equipment and certification paths differ based on an aircraft's current avionics configuration. It will cost more to retrofit an aircraft that is currently equipped with all analog devices than one equipped with mostly digital devices. Call one of our knowledgeable avionics representatives for more information.

IS TCAS VERSION 7.1 MANDATED IN THE UNITED STATES?

Not at this time. The FAA strongly supports TCAS version 7.1 and issued this statement: The latest version of software for TCAS II is version 7.1. To ensure compatibility with international standards, the FAA encourages the installation of this software as soon as practical. This statement has stirred thoughts among the avionics manufacturing community that version 7.1 may be mandated in the US.

HOW MUCH WILL IT COST TO UPGRADE TCAS TO TCAS VERSION 7.1?

OEMs have not yet calculated the costs for upgrading software and equipment. Please call one of our avionics professionals for specific pricing information for your TCAS system.

ARE CERTIFICATION COSTS A PART OF THE UPGRADE?

Yes. The certification path will be via STC (Standard Type Certificate). The original STC for the TCAS installation in your aircraft will need to be amended for the upgrade to 7.1. You will need to contact the STC holder to determine their timeline for the amendment and the cost to purchase the amended STC. Several manufacturers have upgraded their Approved Model List (AML) STCs to accommodate version 7.1.

HOW LONG WILL MY PLANE BE DOWN FOR AN ADS-B INSTALLATION?

Downtime for an ADS-B retrofit will vary, depending on the difficulty of the interface. Analog aircraft will require more downtime, while digital will require less. Downtime for a digital aircraft will most likely be one week. Some analog aircraft will also fall into this time frame, although will likely take slightly longer.

IS THERE ANY BENEFIT TO OUTFITTING MY AIRCRAFT NOW WITH ADS-B EQUIPMENT AS OPPOSED TO WAITING UNTIL CLOSER TO THE DEADLINE?

Yes. There are many benefits to upgrading your equipment now. As the deadline approaches for your non-ADS-B- compliant aircraft, equipment prices and downtimes will increase simply because demand will be so great. As we get closer to the 2020 deadline and more owners/ operators attempt to get their aircraft into the relatively few FAA-approved shops that are able to procure and install certified ADS-B equipment, those shops will face increasing trouble with scheduling, not to mention the certification delays due to heavy demand.

AS AN OWNER/OPERATOR, WHAT CAN I DO NOW TO BE COMPLIANT IN 2020?

Certified equipment is available, and Duncan Aviation is in the process of developing STCs covering various airframes. Call one of our knowledgeable avionics representatives for airframe specific information.

WHAT KIND OF CERTIFICATION PATH WILL BE NEEDED?

As with any new TSO or product that is required by the FAA, there becomes an issue in getting it certified as airworthy on your aircraft. That is where the modification center or avionics service center you choose becomes extremely important—even when the new units or SBs (Service Bulletins) are completed and meet the new TSO established by the FAA. The new units and SBs do not constitute or grant approval for certification into a particular aircraft.

At the time of publication, the FAA indicated that all new installations will need to be performed through an STC that amends the Type Certificate (TC) of the aircraft. This process increases costs and downtime for operators. Many of the larger modification centers will perform this function on behalf of owners and vendors.

WHAT ROLE DO OEMS PLAY?

Some of the vendors playing a key role in this mandate have indicated they have a path in getting their equipment certified. Duncan Aviation has partnered with several OEMs to provide certified equipment to comply with the ADS-B mandates. Call our knowledgeable avionics reps for more information.

KEY TERMS

978 MHz UAT (Universal Access Transceiver)—A data link that supports ADS-B, as well as TIS-B (Traffic Information Service-Broadcast) and FIS-B for use in airspace below 18,000 feet.

1090 MHz ES—A data link that uses 1090 MHZ Extended Squitter that supports ADS-B but does not support FIS-B, intended for use in air carrier, business and other high performance aircraft. This link is capable of using an existing Mode S transponder with specific modifications.

ADS-B (Automatic Dependent Surveillance-Broadcast)—A cooperative system that transmits digital information regarding the identity, velocity and position of the aircraft to ATC.

ASDE-X (Airport Surface Detection Equipment, Model X)—A multifaceted surveillance technology that lets air traffic controllers track aircraft and other vehicles on the ground.

CDA (Continuous Descent Approach)—Known as Optimized Profile Descent (OPD) in the United States, CDA is a procedure governing aircraft approaches and landings, and it is designed to reduce fuel use and noise.

CDTI (Cockpit Display of Traffic Information)—A stand- alone or integrated display that provides detailed information about other aircraft, specifically spacing intervals.

FIS-B (Flight Information Services-Broadcast)—A data broadcasting service that sends graphic-based weather data and Temporary Flight Restrictions (TFRs) to an ADS-B-equipped aircraft, regardless of whether it uses a 1090 MHz ES or 978 MHz UAT.

GPS (Global Positioning System)—A satellite-based navigation system that tracks aircraft terminal to terminal (taxiing, takeoff, in flight, approach and landing).

Ground Based Augmentation System (GBAS)—A system that supports and augments GPS data with regard to the proximity of an aircraft to an airport.

PSR (Primary Surveillance Radar)—A ground-based radar system that determines an aircraft's position by transmitting a signal, which then bounces off the aircraft and reflects back to the radar. PSR does not determine the altitude or identity of an aircraft.

SBAS (Satellite Based Augmentation System)—A system that supports wide-area or regional augmentation using geostationary satellites. The information helps increase position accuracy.

SSR (Secondary Surveillance Radar)—A ground- based radar system that interrogates an aircraft's transponder(s) in order to establish the aircraft's range and bearing. Mode A/C transponders also identify the aircraft and provide altitude information.

Squitter—Broadcasts from aircraft that are periodically transmitted by on-board transponders. Squawks are in response to interrogations from ATC, but squitter transmissions take place without an interrogation.

TCAS (Traffic Alert and Collision Avoidance System) II, version 7.1—Independent of ground-based ATC, TCAS is a warning system that alerts aircraft to the threat of a mid-air collision. Version 7.1 is an upgrade to the system that changes the verbal warnings and gives pilots specific procedures to avoid a collision.

TIS-B (Traffic Information Services-Broadcast)—A component of ADS-B that lets ADS-B-equipped aircraft receive free

traffic information. TIS-B also reports on the locations of non-ADS-B-equipped aircraft that radar tracks.

WAAS (Wide Area Augmentation System)—A system developed to augment Global Positioning Systems (GPS), with the goal of improving its accuracy, integrity and availability. Intended to correct GPS signal errors, WAAS collects data from ground stations and satellites, allowing aircraft to rely on GPS for all phases of flight, from takeoff through Category I precision approaches.

WAM (Wide Area Multilateration)—Multilateration is the method of determining a target's position from the TDOA (Time Difference of Arrival) of transponder replies at spatially separate receivers. With Wide Area Multilateration, aircraft can be tracked lower to the ground and can be spaced more closely, which prevents weather-related delays.

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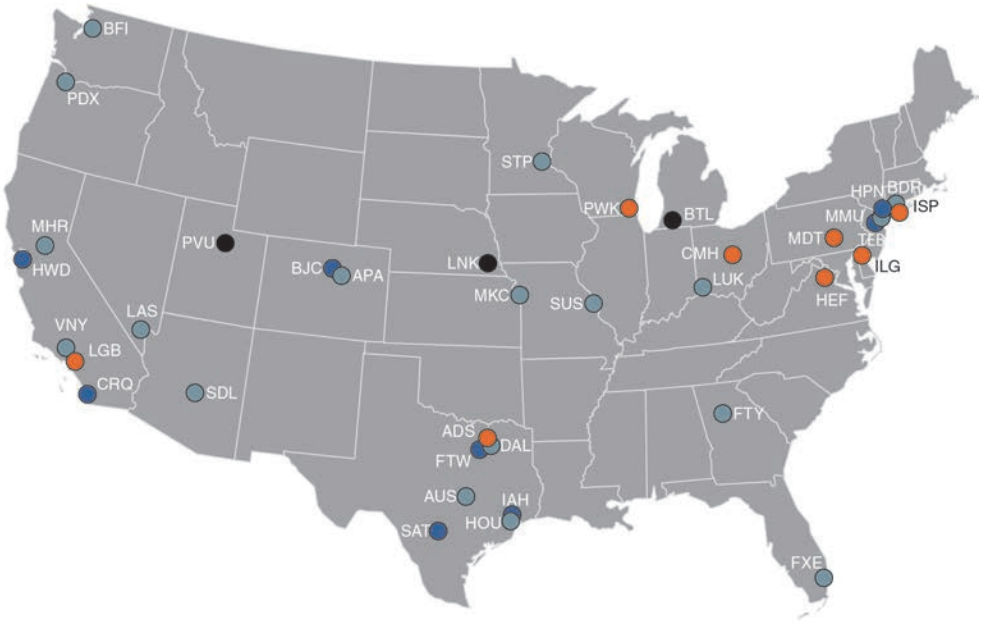
DUNCAN AVIATION LOCATIONS



FULL SERVICE LOCATIONS

BTL	Battle Creek, Michigan	269.969.8400
LNK	Lincoln, Nebraska	402.475.2611
PVU	Provo, Utah	877.771.2788

ENGINE RAPID RESPONSE TEAM DISPATCH LOCATIONS

ADS	Addison, Texas	469.853.5789
FTY	Atlanta, Georgia	404.227.9766
PWK	Chicago, Illinois	877.522.0111
CMH	Columbus, Ohio	302.332.8391
APA	Denver, Colorado	303.649.1790
FXE	Ft. Lauderdale, Florida	954.771.6007
MDT	Harrisburg, Pennsylvania	302.332.8391
LGB	Long Beach, California	470.226.7790
ISP	Long Island, New York	470.226.7790
HEF	Manassas, Virginia	302.332.8391
ILG	New Castle, Delaware	302.332.8391
PDX	Portland, Oregon	503.287.7777
SDL	Scottsdale, Arizona	480.922.3575
BFI	Seattle, Washington	206.764.3962

AVIONICS SATELLITES

FTY	Atlanta, Georgia	404.227.9766
AUS	Austin, Texas	512.530.7050
BDR	Bridgeport, Connecticut	203.386.0111
SUS	Chesterfield, Missouri	636.536.7090
LUK	Cincinnati, Ohio	513.873.7523
DAL	Dallas, Texas	214.352.3468
APA	Denver, Colorado	303.649.1790
FXE	Ft. Lauderdale, Florida	954.771.6007
HOU	Houston, Texas	713.644.0352
MKC	Kansas City, Missouri	816.421.1836
LAS	Las Vegas, Nevada	702.262.6142
PDX	Portland, Oregon	503.287.7777
MHR	Sacramento, California	916.231.0943
SDL	Scottsdale, Arizona	480.922.3575
BFI	Seattle, Washington	206.764.3962
STP	St. Paul, Minnesota	651.209.8430
TEB	Teterboro, New Jersey	201.288.1550
VNY	Van Nuys, California	818.902.9961

AVIONICS WORK AWAYS

BJC	Broomfield, Colorado	303.410.7053
FTW	Ft. Worth, Texas	817.740.9266
HWD	Hayward, California	510.780.1640
IAH	Houston, Texas	281.821.2689
MMU	Morristown, New Jersey	973.326.1110
SAT	San Antonio, Texas	210.267.9644
CRQ	San Diego, California	818.298.7489
HPN	White Plains, New York	914.686.8294