

**ADS - B (Automatic Dependent Surveillance Broadcast)**  
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ADS-B is the talk of the town nowadays. What do I need? Will the 2020 mandate stick? Who needs it? What changes are coming? And of course...the 'Biggie'...What does it cost?

My experience on this subject, which goes back to the infancy of a project which started out as the "Capstone Program", tells me that the biggest hurdle (aside from cost) has been the lack of understanding of how an aircraft owner gets from here to there on equipage. There are plenty of articles telling you what ADS-B is and how it works so I won't deal heavily with this issue in this article. The purpose of this article is to get down to the 'Brass Tacks' of ADS-B. My hope is that I can apply the K.I.S.S. method to provide a basic understanding of what is needed and the pros/cons to your choices. These choices will include portable/uncertified equipment and certified equipment.

## Minimum Requirements:

### 1. Certified WAAS GPS Receiver

There are not, and most likely will never be, any ADS-B solutions, certified or uncertified that will meet the ADS-B Mandate without a Certified WAAS GPS Receiver for a Type Certificated Aircraft. Exceptions have been made to accommodate the non-certificated aircraft market provided the uncertified equipment meets certain performance characteristics. Your options range from a Panel Mounted WAAS GPS Receiver, to an independent Remote Mounted WAAS GPS Receiver (a.k.a. 'a black box), or a WAAS GPS Receiver that is built in as part of the ADS-B solution (UAT or Transponder).

### 2. ADS-B Solution

You have the choice of an ADS-B UAT or a Mode S Transponder with Extended Squitter (ES). *Note: UAT may be used at any flight level, however, if you intend on flying above 18,000 Ft., out of the country where Mode S is required, OR using the aircraft for Part 135 operations, you must have a MODE S w/ES Transponder whether or not you have an ADS-B UAT.*

## ADS-B Out vs. ADS-B IN:

ADS-B Out is the ability to transmit a properly formatted ADS-B message from the aircraft to ground stations and to other ADS-B In equipped aircraft. ADS-B IN is the ability of an aircraft to receive information transmitted from ADS-B ground stations and/or from other aircraft. ADS-B IN is not mandated by the ADS-B Out rule. If an operator chooses to voluntarily equip an aircraft with ADS-B IN capability, a compatible display is also necessary to see the information. Refer to AC20-165A information on ADS-B OUT and AC20-172A information on ADS-B IN installation and certification. A compatible display can be anything from an iPad to a panel mounted display.

The merits of ADS-B are pretty simple. Assuming the mandate, every aircraft flying within Class B Airspace will need to be, at a minimum, ADS-B Out compliant. The tendency of an owner with an ADS-B OUT only aircraft is to feel that they financed a project for the benefit of everyone else (oh...and to comply with a government mandate). The part of this mindset that gets lost in the equation is that it is just as important for others to see you as it is for you to see other aircraft.

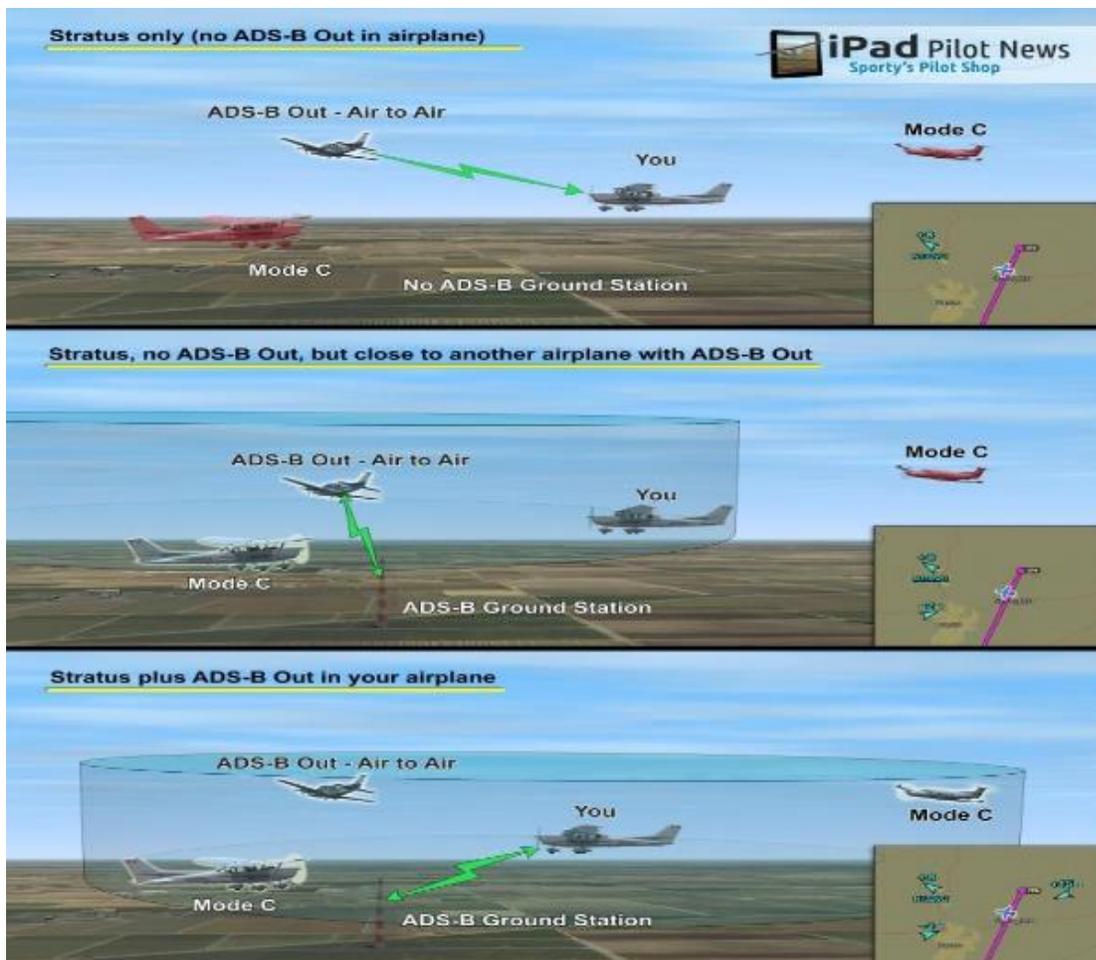
I will concede that the merits of ADS-B IN outweigh the merits of ADS-B Out. The frugal side of me dictates that financing a mandate without reaping the total benefit of those funds spent seems like a shame. The merits of FIS-B Weather, whether through panel-mount or portable means, are pretty self-evident. FIS-B weather, either as a no-cost back-up to subscription based datalink weather for IFR pilots or as a sole source of weather for the VFR pilot who could never justify the costs of subscription based datalink weather is an added bonus. TIS-B traffic, either as a blend to existing TAS/TCAS traffic systems or as a sole means of traffic, can only enhance a pilot's awareness of what is around them. Given the availability of lower cost portable solutions, once certified ADS-B Out equipped, every pilot has the opportunity in one configuration or another, to have something to show for the 'pain of progress'.

## Portable Solutions:

So where do the Portable ADS-B solutions come into play? **Bottom line is this... The purpose of the Portable Type solutions are to provide a means of using/displaying up to three (3) types of data (FIS-B Weather, ADS-B Air-to-Air traffic, BUT beware....understand what you are buying.**

### Points on the Subject:

1. To date, Portable solutions will ONLY provide you with two out of the three (FIS-B Weather and ADS-B Air-to-Air Traffic.) UNLESS your aircraft is otherwise certified ADS-B equipped. Why? See "How it Works" later in this article.
2. Air-to-Air Traffic will ONLY be available IF you are in contact with a Mode S w/ES Transponder or UAT ADS-B Out equipped aircraft.
3. Some portable systems reference traffic targets to GPS Altitude rather than Pressure Altitude. The industry standard for TIS-A, TIS-B, TAS, and TCAS is to reference target aircraft to pressure altitude. If your choice in a portable solution uses GPS altitude, this can translate into the altitude of your target aircraft being as much as 700ft. off. Future upgrades may resolve this issue. Caution: If your portable solution uses a built in sensor to determine pressure altitude, use of this device in a pressurized aircraft simply won't work.



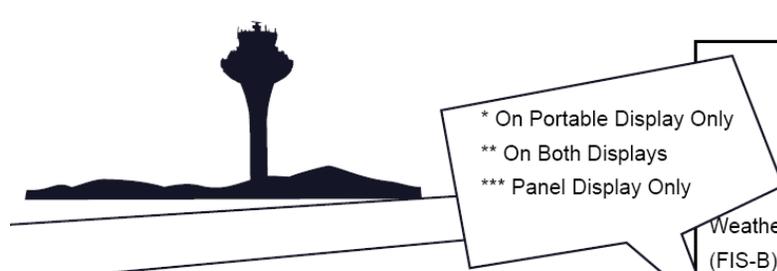
The illustration specifies a Stratus portable system. From a principle of operation, this is consistent with other portable systems such as the Garmin GDL39. It is important to remember that though each system operates under the same basic premise, there are other operational differences to consider for your application. Do your homework and be satisfied!

The key to understanding the illustrations is to notice the shaded "Hockey Puck" or as I like to call it "The Cylinder of Surveillance". What is it? This shaded area is the shield of data that is sent to an ADS-B Out equipped aircraft from a Ground Station. Note: You don't ever actually "See" the Cylinder; only the traffic within it.

How does it work? In order to provide data, the Ground Station needs to be "Pinged" to identify who you are and it needs to know WHERE you are. The 'Ping' is generated by the ADS-B Out equipment and the 'Where' is determined by your WAAS GPS (hence the need for the WAAS GPS). Your GPS provides position data to your ADS-B Equipment and your ADS-B equipment then sends your position to the ADS-B Ground Station as it 'Pings' the station. The Ground Station in turn, knowing where you are and what aircraft are around you, will transmit a TIS-B Cylinder of Surveillance to your ADS-B In equipment placing your aircraft right smack in the middle of the cylinder. If equipped with a complete ADS-B UAT System with display and/or an additional portable ADS-B system, your Cylinder of Surveillance will be displayed accordingly on the display. *Note: This is the data that is only partially supplied or MISSING completely when equipped with ONLY a Portable type system (not ADS-B OUT compliant).*

Another key note in this discussion is to recognize that installing a new 'ES' transponder (or upgrading an existing Mode S transponder to 'ES'), combined with a WAAS GPS, does NOT give you a Cylinder of Surveillance, it only gives you the SAME TIS-A traffic that would have been achieved from a non-ES Mode S transponder and that is assuming that you are within range of one of the remaining terminal radars that support TIS-A Broadcast. However, combining this upgrade with a portable ADS-B system WILL provide you with a Cylinder of Surveillance as displayed on your portable display. An exception to the is the Garmin GTX345 series Transponders which are not just ADS-B OUT compliant but also have a complete dual-band ADS-B receiver built in. See Chart Below.

For the purpose of simplifying the following chart, let's define "Cylinder of Surveillance" (Abbreviated COS) - It is defined as the area 15nm radius and +/-3500 ft. surrounding your aircraft (or other ADS-B aircraft) which contains traffic data.



**What will you see?**

		Weather (FIS-B)	ADS-B Target	ADS-B Target with Target COS (Assuming contact with Gnd Station)	TIS-A Traffic	Your COS (Assuming contact with Gnd Station)
<b>Option 1</b>	Portable ADS-B System (Only)	Yes	Yes	Yes	No	No
<b>Option 2</b>	Extended Squitter Mode S Transponder w/WAAS GPS(ADS-B Certified)	No	No	No	Yes	No
<b>Option 3</b>	ADS-B UAT w/WAAS GPS + Display (ADS-B Certified)	Yes	Yes	Yes	No	Yes
	Option #1 with Option #2	*Yes	*Yes	*Yes	***Yes	*Yes
	Option #1 with Option #3	**Yes	**Yes	*Yes	No	**Yes

## What do you NEED and who NEEDS it?

Here's a quick breakdown (Note: This is the 'quick' answer, reference FAA guidance for specifics):

- If you are flying above 18,000 Ft., operating under Part 135, or plan to fly in a country requiring it, you will need a Mode S Transponder with Extended Squitter (ES).
- If flying within Class 'B' Airspace after ADS-B mandate, you will need a Certified ADS-B Out w/Certified WAAS GPS for a TC'd aircraft.

### Costs:

Unfortunately, given the diversity of the airframes, condition of these airframes, avionics configurations, and the constant changes within the avionics industry any attempt on my part to capture a 'one-size fits all cost associated with these requirements would be irresponsible on my part. Again, the intent of this article is to provide a better understanding of what your options are so that you, as the aircraft owner, are in a better position to know what you need and/or want. This knowledge then empowers you to determine your costs through a trusted Avionics Shop.

However, 2016 and 2017 have seen some changes that have simplified many choices. Two things have occurred:

1. January 2017 has seen several manufacturers end their promotional pricing which in the end, increases the cost for these options.
2. The year 2016 has seen the introduction of Transponder solutions that INCLUDE a built in GPS. The significance of these products is important to note. Why? Because when one compares the typical costs to install a remote mounted UAT for compliance to the cost of replacing a Transponder for compliance, you will find that though the option of Transponder replacement most likely will be more money, the amount more is generally less than \$1,000. So there is an argument to me made from a long term cost benefit perspective to go with the Transponder replacement rather than the less expensive UAT option. If you go with the UAT option for compliance and at some time in the future you end up having to replace your transponder, you will end up spending far more than a \$1,000 for this replacement. Not only that, but you end up with an extra antenna on the aircraft, multiple boxes, and more weight (though not really significant). Bottom line is that going the Transponder route, in most cases, provides a cleaner end game. And should the day come when another country such a Canada or Mexico decides that a Mode S Transponder is required for entry, going with the Transponder option for compliance today prevents a need for change in the future.

### Future Changes:

It is hard to predict the future. There are two questions that I am often asked concerning the future.

1. Will the 2020 date get pushed back?
2. Will the prices drop?

The only way I know to answer the first question is to say that it wouldn't be the first time that the FAA has pushed back a proposed date. It has also been speculated that if all aircraft, which will need ADS-B Out, were to schedule this work with their Avionics shop as of 1/1/2014, there would not be enough shops and manpower to perform all the upgrades by 2020. If this is true, what will happen? Considering that this rule will have been in effect for 13 years, it is hard to determine which side of the fence this will fall. To answer the price question, there are multiple manufacturers but the products that have been promised have pretty much already reached the market and I have not heard any rumors regarding anything new since so this leads me to believe that there is no major impactful solution on the horizon. History tells us that technology and competition typically causes a drop in equipment price but I am not so sure that will be the case here. Why? Supply and demand could be a factor and the fact that to date, certification can only be accomplished via an STC with a Flight Manual Supplement (FMS) or a Field Approval. There is an exception for non-TC'd aircraft. This raises another question - If manufacturer 'A' is the WAAS GPS source and manufacturer 'B' is the ADS-B Out source, which of the two manufacturers will provide the STC and FMS? In this

case, if manufacturer 'A' decides to change their software to accommodate their own ADS-B solution what will happen? This is further compounded when discussing display of ADS-B In.

These may all seem like reasons to wait to upgrade so let me close with this. If you can make a commitment to a manufacturer's approach to ADS-B and upgrade sooner rather than later, you are done thus can avoid the speculations and the anticipated lead times. It may also better assure easier sell of the aircraft in the future. There is also talk of financing assistance for those who may be less than capable of upgrading freely. As we move forward, all other things being equal, it makes sense to upgrade sooner rather than later. The labor costs have the potential to rise - especially if avionics shops get backed up trying to meet the demand. So it comes down to this...If you spend the money now, you could reap the benefits of ADS-B immediately. If you chose to not spend it at all (maybe you are planning on selling the aircraft in 5-6 years), then expect it to cost you something on the 'back-end'. Given the costs of ADS-B, buyers of your aircraft will most likely not buy without a sale price reduction of the aircraft to offset the costs of compliance. In this case, you in effect, will have spent the money and have never had the opportunity to experience what ADS-B has to offer.