ADSB Aircraft Tracking

2023-09-13

Have you ever wondered about that aircraft flying over your head? Perhaps you are already aware that most aircraft are required to transmit location data. Anyone can easily receive that publicly available broadcast data. Maybe you already receive that data and are feeding it to one or more of the flight trackers. This article will help explain the fascinating hobby of aircraft tracking and will help you set up a receiving system or tell you why it is desirable to send the data to other flight trackers.

Most aircraft worldwide are required to transmit data using a system known as ADS-B meaning Automatic Dependent Surveillance-Broadcast. ADS-B is a surveillance technology in which an aircraft determines its position using satellite navigation or other sensors and periodically broadcasts the position, enabling the aircraft to be tracked. The information can be received by air traffic control ground stations as a replacement for secondary surveillance radar, as no interrogation signal is needed from the ground. It can also be transmitted and received point-to-point by other aircraft or ground-based receivers. ADS-B is "automatic" in that it requires no pilot or external input. It is "dependent" in that it depends on data from the aircraft's navigation system. ADS-B currently transmits data on 1090 MHz in a well-defined format. Particularly in the United States, 978 MHz is also used. Generally, all aircraft excluding many military flights will transmit ADS-B. Reception at a ground station near the aircraft is fairly easy. Sometimes, an aircraft does not transmit position information. In that case, a technique called multilateration or MLAT can derive position by using four or more receivers and a technology called Time Difference of Arrival. See https://www.multilateration.info/surveillance/multilateration.html .

Building a receiving system is straightforward, requiring only an antenna, a software-defined radio receiver, a processor like an old laptop or a Raspberry Pi, and some readily available open-source software. See below for more details. To feed the received data to a flight tracking service requires an internet connection. You can see the current near real-time worldwide flight information at https://globe.airplanes.live/ . The real power of this technology, besides the clear advantages for air traffic control, is almost real-time visibility of almost all aircraft. For the hobbyist or enthusiast, a very modest effort will often make a huge difference in the quality of the tracking information. In many areas, large gaps exist in the feeder coverage, and more feeders are always valuable, particularly for MLAT.

Most flight tracker services are for-profit commercial enterprises. They aggregate the data provided usually by volunteers and use that data to make a profit. The exception is airplanes.live. That tracker is community-driven and is operated by a dedicated group of self-described “gentlemen nerds.” The tracking data is actually free and is available on at least one flight tracker (airplanes.live) without any restrictions. Often the commercial flight trackers will offer a super platinum premium all-access membership to verified feeders, basically giving access to the same data which is freely available at airplanes.live .

You can find out more about airplanes.live at https://airplanes.live/ . Several gurus and enthusiasts are behind this growing flight tracker. They are all around the world, as are the feeders. In order to ensure that the flight tracker remains fully open and accessible, the airplanes.live operators have implemented

legal measures to ensure that the site cannot be sold out from under the volunteer feeders and that the tracking information remains publicly accessible.

As mentioned above, building a feeder is a fairly straightforward exercise that would be a very good group or club project. The system consists of only an antenna, a software defined radio receiver, a processor like an old laptop or a Raspberry Pi, and some readily available open-source software. The cost of a Pi-based feeder system can be as low as $60 to $350, though use of some available components like an old laptop or computer running Ubuntu will reduce the cost at the expense of increased power consumption. Bear in mind that this article is intended to be an introduction rather than a fully verified step-by-step implementation recipe. Read on for an overview as well as some links to expert advice.

1. Antenna. The frequency of interest is 1090 MHz, and the signals will come from anywhere. Thus, an omnidirectional antenna with some gain is very desirable. An adequate outdoor antenna is at https://www.ebay.ca/itm/334811187263 . In practice, though, height is considerably more important than antenna gain. Many feeders place an antenna in a house attic with good results, but mounting on an outdoor tower is better. Still, as a starter, a short lower gain antenna like https://www.nooelec.com/store/sdr/sdr-addons/1090mhz-ads-b-antenna-5dbi-sma.html is perfectly fine when mounted indoors, perhaps in a window. Cabling should be 50 ohm low-loss (at 1090 MHz) cable like LMR-200, observing the appropriate connectors and gender and site-dependent length. A cable like https://www.amazon.ca/dp/B07S8V44VK is suitable. For outdoor installation, lightning protection like https://www.amazon.ca/Lightning-Arrestor-N-Female-Protects-Antennas/dp/B07JY6TD2T is crucial.
2. Software Defined Radio. For a feeder, many SDRs exist, some good and some not so good. Generally, they are implemented as USB plug-in dongles like https://www.nooelec.com/store/nesdr-smartee-sdr.html. Ideally, look for an SDR that is in a metal case for good heat dissipation, has a low-noise amplifier in the front end, and has a 1090 MHz band-pass filter. A source for an ideal SDR is being developed by airplanes.live. In the meantime, particularly in areas of high ambient RF noise, adding a filter and low noise amplifier between the above SDR and the antenna will work. Such a device is at https://www.ebay.ca/itm/266260156842.
3. Processor. Many feeders use a Raspberry Pi or equivalent, though current availability is problematic but improving. A complete starter kit is at https://www.pishop.ca/product/raspberry-pi-4b-starter-kit-pro/. Almost any older laptop or desktop will work very well. The processing load from a feeder is very small. The processor will also require an internet port, with Wi-Fi being a simple implementation. The network usage is also quite small, though definitely dependent on the number of aircraft signals received by the feeder.
4. Software. The operating system of choice is a Linux variant like Raspbian or Debian or Ubuntu. For airplanes.live, the actual ADSB software is open source and easy to implement. The steps below will install and activate the needed software:
    a. Start with fresh up-to-date Raspberry Pi OS Lite installation, or for a laptop, a Linux variant like Ubuntu.

b. Next install the software that controls the SDR, namely readsb and tar1090 packages by following the explanation at https://github.com/wiedehopf/adsb-scripts/wiki/Automatic-installation-for-readsb .
c. To control and optimize your installation, graphs1090 is extremely useful. https://github.com/wiedehopf/graphs1090.
d. Finally, send the aircraft tracking data to the airplanes.live flight tracking service. https://github.com/airplanes-live/feed.

If you are already a feeder to one of the commercial tracking services, you can easily also feed to airplanes.live. In place of all the instructions above, simply do the airplanes.live software installation described in paragraph 4, step d.

The aircraft tracking system at airplanes.live has a very active and friendly user community, particularly since it is built and maintained by gentlemen nerds. The best way to get support with a feeder is on the airplanes.live Discord server at https://discord.gg/jfVRF2XRwF or by an email to help@airplanes.live . Anyone is encouraged to set up a new feeder, or to add airplanes.live to an existing feeder. Currently, almost 1,200 feeders to airplanes.live exist worldwide, and you can easily become one of them!