ADS-B AVIATION TECHNOLOGY

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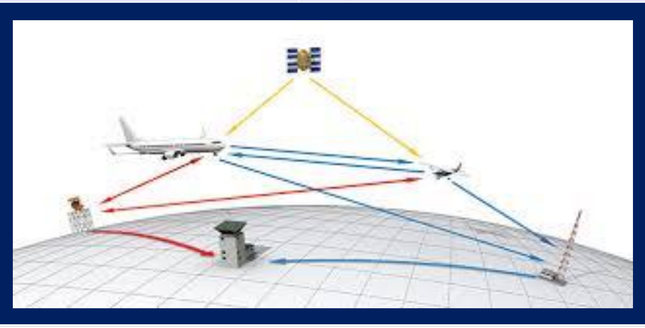
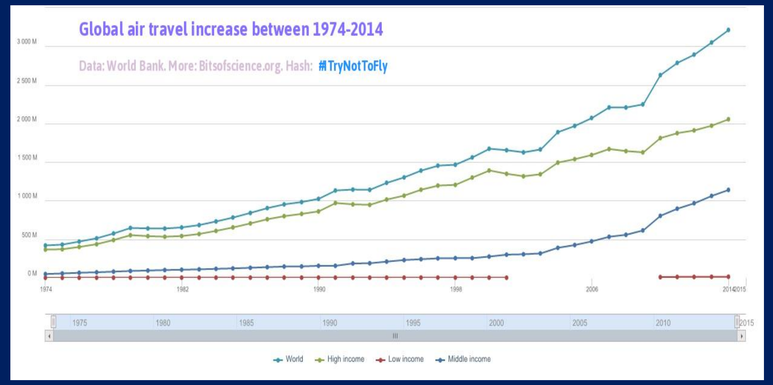
TECHNOLOGY BEHIND ADS-B

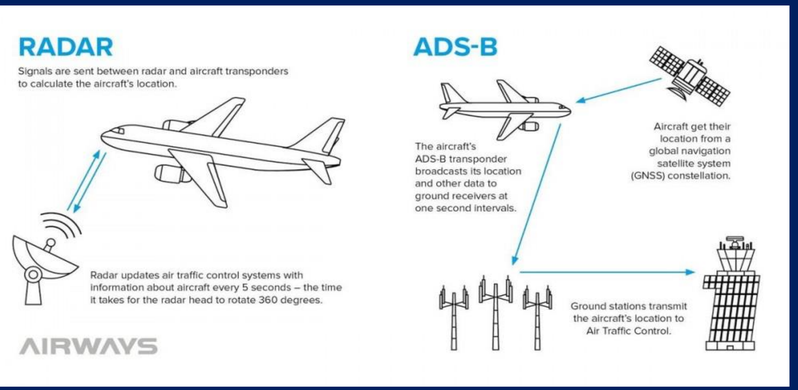
GPS is the foundation of ADS-B. 27 different satellites orbit in 6 different paths making sure that there are at least 4 satellites available anywhere on Earth. Ground stations monitor the satellites and communicate with them through large antennas so the satellites know precisely where they are on the Earth's surface and in relation to each other. The GPS in a car or phone draws from the satellites around it in order to find it's precise location. Similarly, ADS-B communicates with the satellites (as seen in the figure below) in order to calculate parameters like speed, altitude, location, direction, etc. Unlike in a car where only the it's position is seen, ADS-B allows planes to communicate with each other (also shown in the figure below), provided the plane is fitted with both ADS-B In and ADS-B Out.

ADS-B Out	ADS-B In
1/1/2020, ADS-B will be required in all active aircraft. Satellites from the global positioning system send data to aircraft enabled with ADS-B Out. It updates per second and shares the aircraft's speed, direction, flight path, altitude, location, and many other conditions.	While not mandated by law, installation of ADS-B In is recommended. It receives all ADS-B Out signals from other aircraft, giving pilots complete spatial awareness. ADS-B In also contains weather tracking technology, helping pilots navigate storms.



RADAR	ADS-B
Aircraft send radio waves to ATC	Satellites send data to aircraft
Data is decoded to direct air traffic	Data is sent to ATC and other aircraft
Little and imprecise data	Abundant and precise data
Cannot send data from aircraft to aircraft	Speed, direction, heading flight path, altitude, location, etc.
Updated every few seconds	Updated every second
Cannot track weather	ADS-B In can track weather
Inefficient flight paths from imprecise data	Efficient flight paths minimize delays, flight time, and fuel use
Cannot track over oceans	Can track over oceans





MALAYSIAN FLIGHT 370

The disappearance of Malaysian Flight 370 demonstrates the limitations of previous aviation tracking and the vast advancements of current technologies including ADS-B. In the actions leading to Flight 370's disappearance critical technological issues arose, including the effortless disabling of internal transmissions of important aircraft performance information, the geographic limitations of radar transoceanic tracking and the sparse use of satellite-based tracking.

The Malaysian Flight 370 triggered a multinational search, resulting in mislead searches across 46,000 square miles of the Indian Ocean, approximately $150 million in costs, over four years of labor and no conclusive results for the family members of the victims. If more advanced tracking technology had been available sooner, the relief and resources by the US and supporting national governments could have been conserved. The greatest mystery in modern aviation may never be solved, but ADS-B has been developed to avoid similar tragedies.

INTERNATIONAL CREDENTIALS

There are many countries that are currently adopting ADS-B technology which has influenced other countries to follow suit. By January 1, 2020 aircraft will be required to have the Version 2 ADS-B Out system, which can be either a 1090 ES ADS-B system or a UAT Automatic Dependent Surveillance - Broadcast system. In areas outside the United States, proposals to begin implementing the ADS-B technology have spread across the globe. The image on the left below shows the projected coverage for ADS-B in 2020. The image on the right below displays where on-ground stations would be located in the US. This widespread adoption of ADS-B is caused by new regional and global aviation initiatives, such as the Single European Sky and Next Gen, which promote increased aviation safety and sustainability.

SUSTAINABILITY & THE ENVIRONMENT

The large payout to buy and install ADS-B is justified by the technology's ability to save money, time, and fuel. With radar, aircraft flying over the ocean had to be 80 to 100 nautical miles apart. ADS-B reduces that distance to only 15 to 30 nautical miles. This allows for more efficient flight paths at a higher volume, saving flight time, fuel costs, while maximizing the amount of ongoing flights. Lower fuel emissions decrease CO_2 emissions per flight. ADS-B In's weather tracking ability saves 86 gallons of fuel per transoceanic flight. ADS-B has reduced flight time over the Gulf of Mexico by 7-11 minutes and increased maximum flight volume from 75 to 85 flights per hour. A projected $70 million dollars is to be saved by 2035 due to the implementation of ADS-B in the Gulf of Mexico alone. ADS-B has also been installed into different on-ground systems that allow all airport vehicles to be monitored which will reduce flight delays caused on the ground.