Technology

Look, Ma - No Radar! Tomorrow's Air Traffic Control

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For almost 70 years, radar and air traffic control (ATC) have been like peanut butter and jelly or ham and swiss: a combination so obvious, so symbiotic, that separating the two is inconceivable.

Except that the FAA has conceived -- and is implementing -- an ATC system that doesn't use radar at all.

Radar has lots of problems. Sites are expensive; coverage is line-of-sight to the horizon. Then you need another radar, and more computers to interpret and massage the basic signal. Radar signals suffer from signal loss due to mountains and precipitation.

Present-day ATC radars call for transponders in aircraft in order to fly within certain airspace. These transponders are relatively simple boxes that when tickled with a radar beam return a four-digit code and the aircraft's altitude -- what pilots call "Mode C."

We can do better

GPS makes a whole new approach to air traffic control possible -- the notion of networking GPS units together into one large network.

What if each airborne GPS receiver could report its location and altitude, unasked, every second? Then controllers on the ground would know exactly where every airplane was, more often and accurately than they could by relying on a radar sweep every six or 12 seconds.

Let's not stop there. What if other aircraft could read each other's locations, opening the way to a new generation of independent collision avoidance equipment? Even without controllers to call traffic or any human intervention, every aircraft so equipped would have the means to avoid a collision.

Take it one last step. How about equipping each airborne unit with a datalink receiver to receive traffic and weather information and other data such as airspace restrictions without having to talk on the radio?

Enter ADS-B

In 2005, the FAA proposed just such a system, and hung a long, complicated name on it – Automatic Dependent Surveillance – Broadcast, or ADS-B.

The name begins to makes sense if you parse it out:

- **Automatic** -- There's no need for pilots to do anything to use ADS-B. There's less need to speak with controllers, no need for controllers to assign transponder "squawk" codes.
- **Dependent** -- As in dependent on an accurate, Wide Area Augmentation System-capable GPS, or a flight management system such as an inertial navigation system, to calculate position and speed.
- **Surveillance** -- In the world of aviation electronics there are three functional categories: communications, navigation and surveillance. Like radar, ADS-B is classified as a surveillance tool.
- **Broadcast** -- Airborne ADS-B devices, called Universal Access Transceivers (UATs), not only receive information but broadcast their own data to other aircraft within about 150 miles and to ATC. This data includes registration number ("N number" in the U.S.), airspeed, altitude, direction, projected track, and attitude. UATs would replace transponders but are pricey: At present a UAT costs $8,000, plus another $3,000 for a multi-function display. The price is expected to fall with advancing technology and broad implementation.

ADS-B has been tested successfully in one of the world's harshest aviation environments -- Alaska. The seven-year Capstone program proved that ADS-B could track both weather and traffic when bundled with a GPS receiver and a moving map.

The ADS-B system offers radar-quality aircraft separation services, possible decreases in travel time and better air traffic and aircraft fleet management. All could save airlines and travelers time and money, and reduce pollution, too.

In parts of the world lacking ATC service, such as remote parts of China, Australia, South America and Africa, ADS-B is the solution.

It also makes a better emergency locator than radar. With ADS-B, each aircraft's position will be recorded every second. This feature has already saved a life in Alaska's Capstone test.

Can ADS-B co-exist with radar?

In the long term, no. The cost to maintain both would be astronomical and redundant. The cost to maintain the aging radar network is about $150 million a year, and it would cost about $2.5 billion to upgrade to ADS-B capabilities.

By contrast, the entire ADS-B system, including ground-based transceivers at about $200,000 each, is being built for about $1.8 billon, and will cost about $30 million a year to operate and maintain.

For this we will get coverage from high altitude right down to the ground, and ADS-B can be used for on-airport surveillance as well.

As for when ADS-B will be introduced throughout the United States, implementation has already begun. It is now available along the east coast from Florida to New Jersey. In August 2007 FAA awarded ITT Corporation a $1.8 billion contract to build and maintain the ADS-B infrastructure nationally. Uniquely, ITT will own and operate the system, and will be paid to supply ADS-B data to the FAA. The full system will be online by 2020.

Too many eggs in the GPS basket?

ADS-B is subject to a single point of failure: the GPS system itself. Such a failure could deprive pilots of all electronic navigation and cripple air traffic control if no alternative is available. Operating on one frequency, GPS is vulnerable to accidental or intentional interference.

Today, aircraft operated under instrument flight rules using GPS must still have an alternative form of navigation available, because GPS is subject to occasional localized outages. ADS-B will require some form of as-yet unspecified redundancy.

ADS-B is the core component of the FAA's future air transport and traffic management system, the Next Generation Air Transportation System (fortunately, the FAA has adopted the abbreviated and much catchier name "NextGen" for the system). Offering huge benefits in efficiency and safety, ADS-B will become the centerpiece of the U.S. National Airspace System over the next 13 years.

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