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FACE OFF

Two years after the disappearance of MH370, two rival satellite companies are vying to convince airlines and aviation authorities that each has the best plan to keep airliners from vanishing.

Warren Ferster spoke to the architects of each idea.



In a satellite factory near Phoenix, engineers and technicians from Orbital ATK are assembling the final components of the first in a constellation of satellites that will collect position and identification broadcasts from airliners flying hundreds of kilometers below. Those signals, called ADS-B for automatic dependent surveillance-broadcast, were originally meant to be received only by other aircraft and ground towers. But the signals also radiate off into space, which is where a company called Aireon, based in McLean, Virginia, plans to gather them with electronics and antennas on each of the 72 planned Iridium Next satellites.

Aireon's plan isn't the only option for tracking planes when they're cruising over oceans or mountain ranges far from radio towers. London-based Inmarsat says it can meet most of the tracking needs right now by receiving position transmissions directly from the aircraft via its fleet of geosynchronous satellites above the equator.

over airliner tracking



Adobe

Air traffic control can't track airliners wherever they are in the world. Two satellite industry rivals are touting competing options for fixing the blind spots.

It's been a contentious time for these rivals, and for more than the usual reasons of profit, losses and balance sheets. At stake is how best to reduce the risk of more cases like that of Malaysia Airlines flight 370, which vanished two years ago this month with 239 aboard. Playing out in the months ahead will be a race of sorts. Aireon's payloads must arrive in orbit safely and on time to start tracking aircraft in early 2018. Inmarsat has a window to make its case to the airlines and aviation authorities that they should embrace its alternative approach in part because of the potential it creates for receiving a flood of data from airliners, perhaps including cockpit audio.

Wakeup call

The disappearance of the Malaysia Airlines Boeing 777 was reminiscent in one respect of the Air France crash off Brazil in 2009. Investigators searched frantically for the wreckage of that

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Airbus A330 at the bottom of the Atlantic Ocean before finding it in May 2011, 23 months after the crash. The two tragedies spurred an international outcry for a system that would, at minimum, enable civil aviation authorities to more closely track aircraft flying over oceans and other remote areas.

One result was the International Telecommunication Union decision in November to permit satellites, not just airliners, to transmit in the frequency reserved for ADS-B. The decision was good news for Aireon, because it meant that the Iridium Next spacecraft will be able to bounce ADS-B signals from satellite to satellite and into the company's ground network without risk of interference from other transmissions. Before the decision, Aireon did not have primary spectrum allocation and risked compromise of its service. It was an unusually swift decision for the 193-nation telecommunication union, the U.N.-affiliated bandwidth regulatory authority known for lengthy deliberative cycles that culminate every three to four years at World Radiocommunication Conferences, month-long conclaves in Geneva.

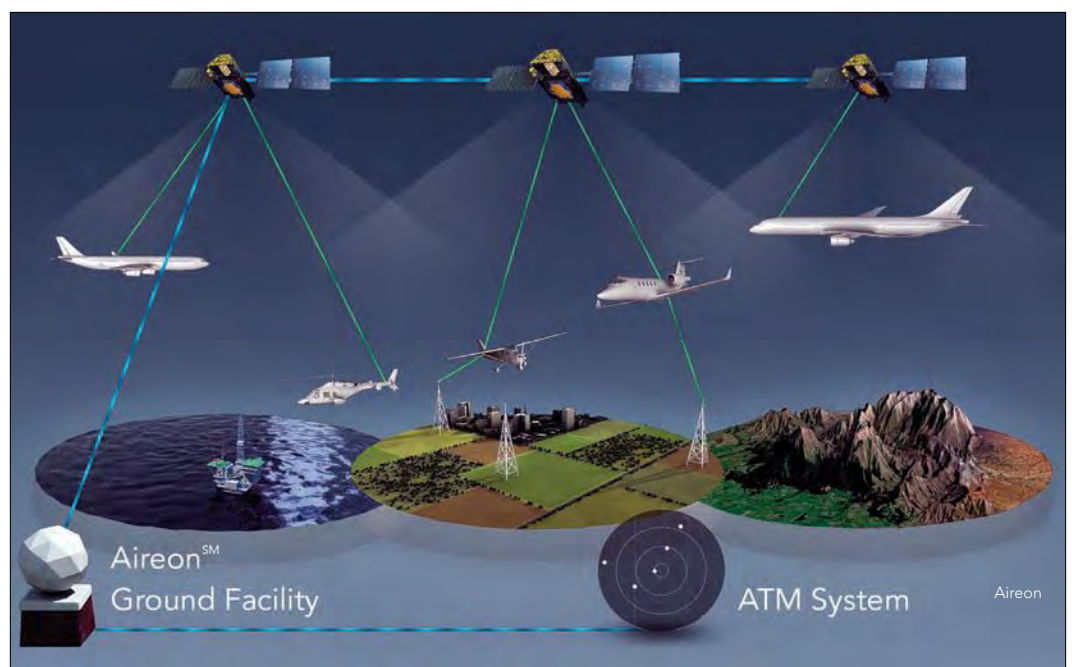
"It was huge," says Nancy Graham, who helped get that regulatory ball rolling before leaving her position a year ago as director of the Air Navigation Bureau of the U.N.'s International Civil Aviation Organiza-

tion. She is now president of Graham International, her consulting firm based in San Antonio. ICAO had urged the ITU to take up the ADS-B-via-satellite matter in response to the MH370 disappearance, and it was placed on the WRC-15 agenda despite opposition from Inmarsat and other geosynchronous satellite operators who cautioned against a rush to embrace satellite-delivered ADS-B.

Part of the mystery of MH370 is that it was equipped with another form of automatic dependent surveillance, called ADS-C, which has been in use since the 1990s. When ADS-C is enabled and functioning, it establishes a satellite link to send data to an air navigation authority under a contract that spells out the kind of information to send and how often. This system was installed but not operating when the jetliner went astray. Were the satellite link operational, authorities might have had a fairly good idea of where the doomed aircraft went.

Inmarsat

Inmarsat's strategy is centered on ADS-C, even though the FAA has mandated that aircraft flying in U.S. airspace must transmit identity and position data by 2020 via ADS-B. Europe's air traffic control authority has issued a similar mandate with a 2017



Starting in 2018, the Virginia-company Aireon plans to track aircraft from space using antennas on the Iridium Next satellites scheduled for launch this year and next. The Aireon payloads will collect identity and position broadcasts from airliners.

effective date, while ADS-B is already in use in Canada and Australia.

But ADS-C remains useful. Until Aireon begins its service, ADS-B information can only enter an air-traffic-control network when the plane is within range of a radio tower. That means aircraft flying through remote regions still rely on ADS-C. These transmissions can be received and relayed by Inmarsat's geosynchronous satellites or Iridium's current constellation, except for planes flying at high latitudes where geosynchronous satellites can't reach. In those cases Iridium is the only option because its satellites cross from pole to pole in low Earth orbit.

Mary McMillan, vice president of aviation safety and operational services at Inmarsat, acknowledged that aircraft flying north of 84 degrees north latitude are beyond the reach of Inmarsat services. But she noted that of the four main polar routes used by commercial airliners, only one falls into that category, numbering fewer than 20 flights per day that are out of Inmarsat's reach for a brief period.

Inmarsat touts the fact that ADS-C service is available today aboard more than 90 percent of commercial airliners flying transoceanic routes. ADS-C piggybacks today on a service called ACARS, for Aircraft Communications Addressing and Reporting System, which packages the GPS-derived position-location data before transmitting it via satellite. The primary function of ACARS is to periodically forward aircraft performance information to the airlines that use it to schedule maintenance procedures.

McMillan says Inmarsat is rolling out a new service dubbed Swiftbroadband-Safety that dramatically improves on the current ADS-C service, known as Classic Aero, by sending large data packages via Internet Protocol. The shift to IP opens the possibility of transmitting all sorts of information in real time, possibly including cockpit data and audio that are today recorded in an aircraft's black boxes and recovered after a crash.

McMillan, who during a 30-year career as an airline pilot witnessed the transition from inertial guidance systems to GPS, characterized the emerging services as a major breakthrough.

"It's actually like going from a rotary dial phone to an iPhone — that's where we are," she says. Swiftbroadband-Safety "retains all

Automatic dependent surveillance-broadcast sites like this one in Western Australia receive position and identification broadcasts from airliners and route them to air traffic controllers. Soon, ADS-B broadcasts might be relayed by satellites, too.



of the functionality of Classic Aero but it also is going to enable a whole new class of functionality and capabilities that when I started flying I could only dream about."

A tall hurdle stands in the way, and it has little to do with technology. The problem is that ADS-B and ADS-C are safety-of-life services that operate in protected spectrum, which is "extraordinarily limited," Graham notes. If it weren't for that, relaying black box data in near real time is "absolutely" feasible today, she says.

ITU and ICAO have not yet decided whether sufficient spectrum is available for transmitting voice and other data from thousands of airliners in protected frequencies.

McMillan concedes that the bandwidth question is an unknown. "I think there's going to be a lot of work in the industry to determine what is a safety service and what is not."

There also are other questions centered on costs and how those would be divvied up.



In the control tower at Melbourne Airport, a controller from Airservices Australia tests an Inmarsat satellite service that can track planes over the ocean. The service relays position and identification information transmitted by airliners in the Automatic Dependent Surveillance-Contract format.

Airservices Australia

Counting on Russia, Ukraine and SpaceX

Aireon sees big advantages to those who will embrace its service. Don Thoma, Aireon's chief executive, says Iridium Next is tailor-made for delivering ADS-B data to those who need it. The Iridium Next satellites are equipped with crosslink antennas to pass transmissions from one satellite to the next for speedy data delivery. They are also backed up by a network of teleports on the ground.

"Aireon is riding on top of the Iridium network and has been designed from day one to provide an air traffic control safety-surveillance capability," Thoma says.

In addition to preventing disappearances, aircraft on transoceanic flights would be able to fly in closer proximity without risk of colliding. Search and rescue authorities could be alerted more quickly if something goes wrong. Economy is the other main benefit: Aireon is expected to enable airlines to fly more fuel-efficient routes over the oceans, thereby saving money.

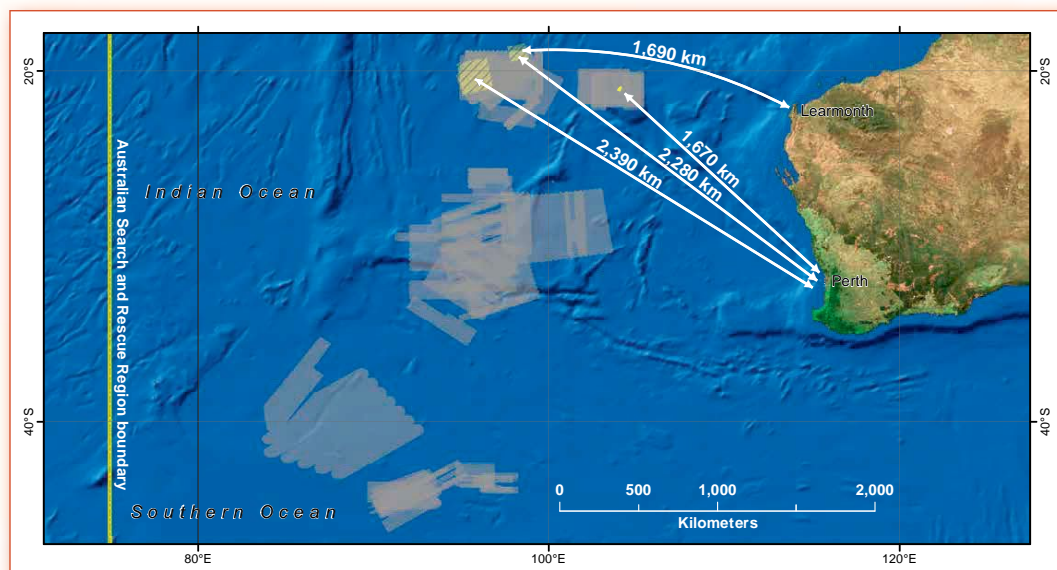
Aerion has its share of challenges, too, however. The advertised availability date of early 2018 assumes Iridium Next deployment goes off without a hitch, always a big if in the space industry. Plans call for the first two satellites to be launched aboard a Russian-Ukrainian Dnepr rocket and then undergo four months of on-orbit testing before the rest are launched in batches of 10 aboard Falcon 9 rockets from SpaceX. Iridium announced in October that the Dnepr launch would be delayed from December to April 2016 due to satellite component issues.

Iridium says that even with that delay, it's on track to complete the network by the end of 2017 and start operations in 2018. A Falcon 9 failure, though, like the one in June on a resupply mission to the International Space Station, would likely ground the Falcon 9 fleet for several months, throwing off Iridium's timetable.

How often should planes report?

A criticism of ADS-C centers on the fact that its position and identity reports are intermittent, whereas ADS-B is a nearly continuous broadcast. McMillan of Inmarsat says ADS-C

When Malaysia Airlines Flight 370 disappeared in March 2014, searchers initially looked for the jetliner in the Gulf of Thailand and the South China Sea. But the hunt gradually shifted to the southern Indian Ocean, with Australia leading the efforts. Brown areas on the map show waters searched between March 18 and April 10 of that year. Areas in yellow with hash marks indicate planned searches on April 11.



Australian Maritime Safety Authority

transmits position reports once every 14 minutes on average, which is based on the time it would take an aircraft to wander into another's boxed-off space under the current separation standards. Graham, the former Air Navigation Bureau chief, notes that ADS-C providers could negotiate more frequent position reports with their customers.

Still, Aireon executives see the reporting issue as a key differentiator. Today, search and rescue operations might not begin until 42 to 45 minutes after an aircraft has gotten into trouble, says Cyriel Kronenburg, Aireon vice president of aviation services. "So draw a circle of 45 minutes of 500 mile-per-hour flight and that gives you a huge area to work with," Kronenburg, says.

Aireon calculates that ADS-B signals can be delivered to controllers in eight seconds and a search could be initiated 24 seconds after the signal from an airliner is lost.

McMillan, in addition to pointing out that ADS-C transmission rates are negotiable, notes that ADS-C is a two-way service, whereas ADS-B is a one-way broad-

cast. Two-way communications are needed for many of the FAA's proposed NextGen navigations applications, she says.

A new role for smartphones?

Another question is whether it might somehow be possible to tap the transoceanic broadband satellite connections that might soon become the norm for smartphone-equipped passengers who are willing to pay for the connectivity.

After all, lost smartphones can be located. Why not do the equivalent with an airliner?

The situation is not that easy, however. Unlike satellite-delivered ADS-B or ADS-C, the new broadband satellites do not operate in the protected safety-of-life spectrum. That would appear to rule them out as official surveillance tools for air traffic control authorities, at least for the foreseeable future. Until something else comes along, the choice appears to be between Aireon and Inmarsat, or perhaps even some combination of the two. ▲

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