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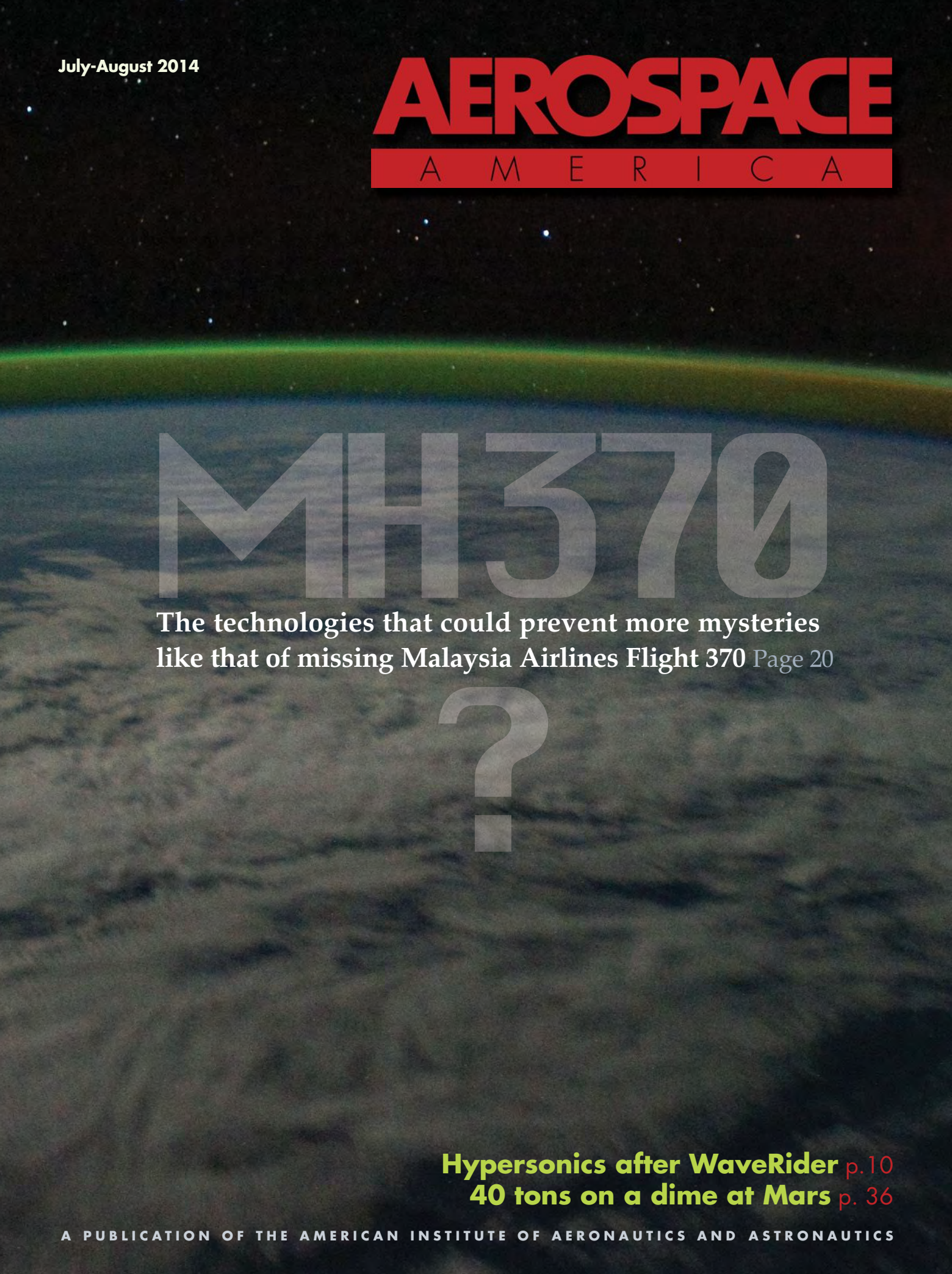

MH370

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Learning fast from MH370

The international aviation community wants to put an airliner-tracking system in place to prevent more mysteries like that of Malaysia Airlines Flight 370. And it wants to do so quickly.* Natalia Mironova *and* Philip Butterworth-Hayes *examine the options.

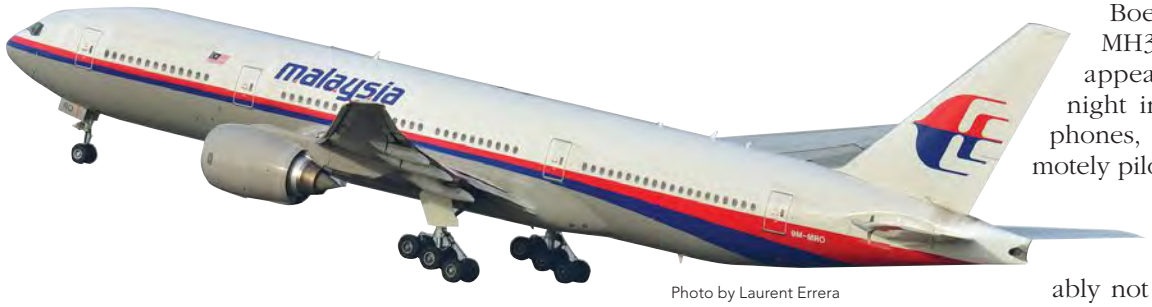


Photo by Laurent Errera

The International Civil Aviation

Organization reacted to the disappearance of Malaysia Airlines Flight 370 by calling experts from more than 30 countries to a meeting in Montreal in May. As things stand, the world's airlines and air traffic controllers have no system in place to track planes as they cross the world's vast ocean and desert regions. For the normally restrained ICAO, the meeting's official announcement amounted to a bureaucratic scream about the need to fix that problem. ICAO said the goal was "to try and increase current momentum on deliberations over the specific aircraft and satellite-based capabilities needed to permit global implementation of worldwide flight tracking."

Pundits and airline passengers were shocked in March to learn that a Boeing 777 like Flight MH370 could simply disappear into the black of night in this age of satellite phones, in-flight Wi-Fi and remotely piloted aircraft. But those who gathered in Montreal were probably not surprised. Today, the passengers and crews of airliners are virtually on their own once they move beyond the approximately 290-statute-mile range of shore radars and radio towers. Before

MH370 vanished, the desire for better surveillance had been driven mostly by the allure of cutting fuel costs by allowing planes to fly closer together and spend less time in holding patterns.

The world is about to learn whether the mystery of Flight 370 will be enough to prompt the airlines and the world's air navigation service providers — meaning the FAA and equivalent organizations around the globe — to finally resolve the technical, financial and policy challenges posed by global airliner tracking. Whatever technology is chosen, the goal would be to plug the radar "dead zones" that could, in theory, put other jets at risk.

What's clear is that the aviation industry has a fresh determination: "I hope we learn more from Flight 370 than let's have longer-life batteries," says Allan McArtor, chairman and CEO of Airbus Group, formerly EADS North America, referring to calls for longer lasting black boxes.

Time is of the essence. Coming out of the May meeting, ICAO set up a new Aircraft Tracking Task Force to identify and assess the options. An ambitious deadline of October 14 was set for a final report.

The choice

One camp would like to adapt the existing Aircraft Communications Addressing and Reporting System to relay position data over geosynchronous satellites and ground gateways. Airlines use ACARS mainly to receive intermittent performance reports from planes in flight so maintenance work on engines or electrical systems can be done once the planes land. It is used less often to relay navigation data. The maintenance data arrives at airline operations centers via radio links when the planes are over land or via Iridium and Inmarsat satellites when they are over the oceans. As the world now knows, the satellite carrying ACARS data kept shaking hands hourly with MH370 via an Inmarsat geosynchronous satellite, although no data was sent.

There is another camp, and this camp would like to take advantage of the fact that airliners are starting to be equipped to

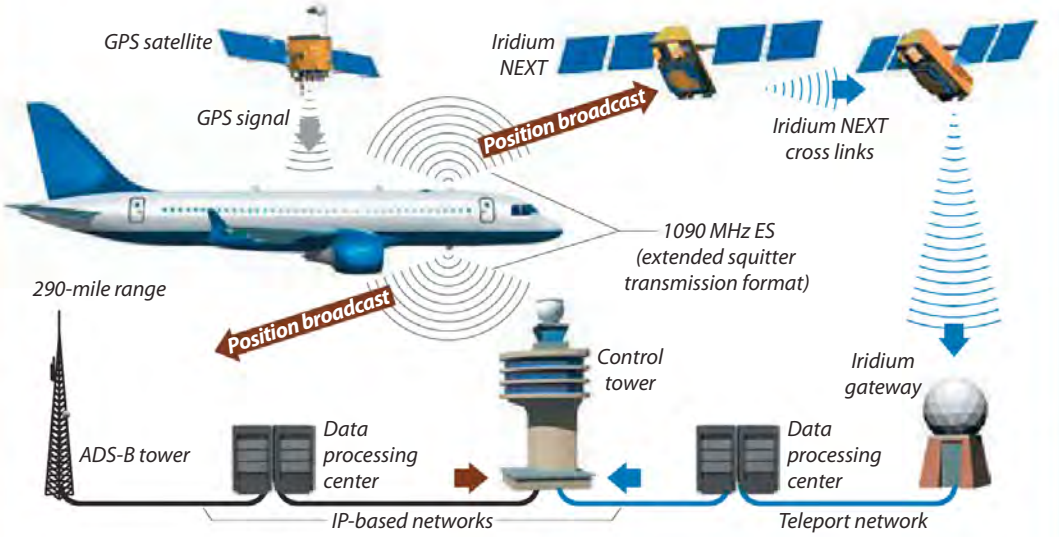
Boeing

Tamper proof? Fire concerns are making authorities hesitant to deny the crew the ability to turn off GPS broadcasts. Shown here is an artist's rendering of the cockpit of Boeing's new 737 MAX family of aircraft.

by Natalia Mironova and Philip Butterworth-Hayes

EXPANDED SURVEILLANCE

Airlines are equipping planes to broadcast GPS locations to controllers via automatic dependent surveillance-broadcast, ADS-B, services. These signals are meant for ground towers, but they also radiate to space, where new Iridium satellites would listen for them and track planes when they are out of range of towers.



Sources: FAA, Iridium, Exelis

Illustrations by John Bretschneider

broadcast GPS coordinates via new automatic dependent surveillance-broadcast, or ADS-B, transponders, as required by the FAA under its NextGen air traffic control modernization initiative. These transponders broadcast GPS signals through antennas positioned on the roofs and bellies of planes so the plane doesn't lose connectivity with receiving towers when it banks. The signals are meant for those ground towers, but they also radiate into space. That's where satellite operator Iridium and the multinational venture called Aireon come in. Even before MH370 disappeared, Aireon executives were laying plans to listen in on ADS-B signals with antennas aboard Iridium's forthcoming next-generation low-Earth-orbit satellites.

The task force is saying only that it wants to examine timely solutions. "The [task force] is focused on identifying near-term options for global tracking of aircraft. One of the primary activities of [the task force] will be to assess the products and services that exist today to see how they may be used to implement global flight tracking. Because the industry has committed to an extremely aggressive timeline to develop recommendations, it is imperative to limit the scope of the assessment," says Perry Flint, spokesman for the Americas for IATA, the International Air Transportation Association, which represents the interests of the world's airlines and leads the new task force.

Which options or option would constitute near-term solutions? That's unclear at this point. Flint says it will be up to the task force to identify those options.

Going global

The main alternative to the ACARS-Inmarsat proposal comes from Aireon, the joint venture between Iridium Communications, Inc., and Nav Canada, the not-for-profit company that owns and operates Canada's air navigation system. Aireon payloads will be installed on 66 Iridium NEXT satellites, which Iridium plans to begin launching next year, with the tracking service expected to start in 2017. Aireon is banking that its timetable will mesh well with installation of the ADS-B technology on airliners. Each aircraft's avionics compartment (usually located below the pilots) must be fitted with a transponder box the size of a microwave oven that sends out the plane's GPS location data every 10 to 15 seconds to a ground-based data center, which processes the information and distributes it to the airlines and air traffic control. The FAA is already rolling out ADS-B in U.S. airspace as part of the NextGen initiative, and it will be mandatory for all aircraft flying into the U.S. by 2020.

If ADS-B is going to be turned into a tracking solution, it "needs a global roll-out...not just in the U.S.," cautions McArtor of Airbus.

Aireon hopes to make ADS-B a global system by fixing its one disadvantage: The stations and towers that receive ADS-B broadcasts and relay them to controllers are all on land, which limits coverage to when planes are over land or within a few hundred miles.

ADS-B has not been fully rolled out aboard planes, but advocates note that the towers and networking equipment are in place and that aviation authorities beyond the FAA are beginning to mandate it — although not yet the satellite version. "Europe

has a similar thing in place. And more and more countries are moving to that model," says Ed Sayadian, vice president of air traffic management at Exelis, which built and is maintaining the ground system for the FAA's portion of ADS-B and will also build and maintain the data management and distribution system for Aireon. According to Sayadian, the transition to satellite-based ADS-B would be seamless for aircraft already equipped with ADS-B transmitters because of the omni-directional nature of the antennas.

Even so, the FAA hasn't signed on to be part of Aireon just yet. Onboard so far are Nav Canada, the Irish Aviation Authority, the Italian Company for Air Navigation Services — known by the Italian acronym ENAV — and Naviair, which provides aviation infrastructure in Denmark, Greenland and the Faroe Islands.

Wayne Plucker, an aviation industry expert with global consulting firm Frost & Sullivan, says the "heavyweights" like the FAA and Eurocontrol will have to adopt Aireon for it to become a global standard for flight tracking, and he says he is not convinced everyone is onboard yet. "There is still a lot of talking going on about data-sharing," he says. "No one wants a terrorist to use tracking information for ill use," he adds.

On top of that, making sure smaller and less financially stable nations can afford to participate will be key to making Aireon truly global. Aireon President and CEO Don Thoma tells Aerospace America that's an issue Aireon's partners have already thought through: "To take advantage of Aireon's service there are no additional service charges that they already incur from ANSPs (air navigation service providers) and we expect those additional fees will be based on a net savings to the airlines, as the cost of the Aireon service will be less than the value of fuel saved," he explains by email.

The case for existing technology

The ACARS proponents say they have an edge, because while ADS-B transponders are being installed in some planes, ACARS is already aboard many more. ACARS data link service providers SITA of Geneva and ARINC of Annapolis, Md., have been using Inmarsat and Iridium satellites to complement the VHF and HF radio communications used over land.

The primary role of ACARS has been maintenance messages, but even now airlines sometimes use it to transmit position information. In this model known as ADS-C (the C standing for contract), the airplane's position message is automatically broadcast to a requesting air navigation service provider as part of an international initiative called FANS for Future Air Navigation System, using ACARS as the communications medium. A plane entering an authority's airspace establishes a real-time communications "contract" after it's requested by air traffic control. The contract spells out how often position information will be transmitted. This is different from ADS-B, in which airliner positions are broadcast almost continuously for anyone with the right equipment to receive them.

Inmarsat wants the airlines to make greater use of ADS-C, and following the loss of MH370, the company has offered to provide this position reporting data for free. As Inmarsat aviation vice president David Coiley explains: "What we're trying to do is stimulate the routine use of that capability globally other than the way that it's currently used for flight-tracking. What we would like to see is more ANSPs take this up."

Inmarsat-compatible communications antennas are already on 90 percent of the world's widebody, long-haul airliners, Coiley says. "There is no additional expenditure required or hardware, and the solution facility and the flight-tracking capability already exist on the aircraft. So it's an immediate hit, an immediate improvement we are trying to stimulate to encourage the broader adoption of ADS-C positional reporting," he adds.

SITA, the ACARS communication provider, has an idea for how to expand ADS-C smoothly. Prompted by the Montreal meeting, the company announced in June that it will offer what it called an enhanced data sharing capability to complement Inmarsat's proposal. The SITA AIRCOM Server Flight Tracker service would allow an airline's flight dispatchers to access ADS-C data currently only available to air navigation service providers.

But ACARs has its own limitations as a flight tracking service. The service relies on geosynchronous satellites whose positions over the equator limit how far north or south they can reach, and so some regions are uncovered. There is the problem of reliability and security — a new back-up and system monitoring network will be needed to ensure the space-based and ground-based systems are operating to the required standards.

Airliner surveillance: Iridium's Aireon venture plans to use the forthcoming Iridium NEXT satellites to gather up position broadcasts.

Aireon

Tamper proof?

Besides the logistics of data sharing and affordability issues, one topic keeps coming up in discussions about onboard tracking devices — all of them can be turned off by the pilot. The Flight 370 mystery has been punctuated by speculation that someone — the flight crew or perhaps terrorists — intentionally switched off or disabled the communications equipment that would transmit position data.

So far, no one has proposed a device that would be locked away in a tamper-proof box with its own wiring and power source, similar to the way airliner black boxes operate. The main reason for that is the pilot's need to be able to turn off avionics or anything else electrical in case of fire, be it with an off switch or a circuit breaker. It's a safety issue, according to the pilots. The International Federation of Air Line Pilots' Associations "supports the concept of global tracking of aircraft; however, as with any issue related to aviation, there needs to be a safety and cost benefit analysis for procedures and/or equipage proposals," says Valerie McLeod, a spokeswoman for the federation. "IFALPA is not in favor of simply making aircraft communications equipment 'tamper proof' — the ability to turn off electrical equipment in the aircraft in the event of a malfunction or electrical fire is essential."

One solution could be to place the flight tracking device in a part of the aircraft that cannot be accessed by the flight crew — such as in the tail behind the rear pressure bulkhead. "But then you would need to re-consider aircraft certification issues," says David Gleave, an aviation accident investigator based in the U.K. Today, long-haul aircraft must be ready to fly on battery power alone for 30 minutes. Adding a flight tracking device would increase the load on the batteries, and this could mean that many aircraft would not be able to operate for the required 30 minutes.

Inmarsat is exploring a potential solution to the "off switch problem" independently of the free flight-tracking service the company is offering. The one piece of equipment that stays on even if the avionics are turned off is the aircraft's antenna, which sends hourly signals to the satellite with the airplane's unique code to ensure continuous connectivity. This is known as "handshaking." It provided the only clues about MH370's possible flight path after other communications were lost.

Handshaking, however, is not a great tool for flight tracking — the updates happen only once an hour and the signal doesn't include any position data, so the direction of flight had to be calculated from the angle between the aircraft and the satellite. Coiley says Inmarsat is working to fix that. "What Inmarsat is evaluating at the moment is enhancing the handshake capability — the signaling capability in our network to actually include positional report data. It is currently possible for us to enhance the handshake to include position data," he says.

Policy questions

Whether the international community will embrace Aireon or sign on to Inmarsat's proposal depends on how a host of institutional challenges are resolved. Agreement would be needed about which class of aircraft must be covered. Should the smallest type of aircraft be required to engage in the global flight tracking service? If an airline's aircraft is never out of radar range, is it really necessary to re-equip with a satcom transmission system? Where does the information go? Directly to the nearest air navigation service provider, or to a ground station that would automatically distribute the information to the relevant en-route, approach or airport centers? Who would be responsible for tracking the aircraft's location against the flight plan, and alerting first the crew then the appropriate security and safety organizations in case the aircraft did not return to its agreed flight plan? How fast should the data update rate be? What sort of timescale should be considered for implementation?

This is the work that ICAO is currently undertaking after Montreal, separately from the airliner tracking task force. The data-sharing is likely to be based on the current system, in which the communications service providers (ARINC and SITA) distribute aeronautical telecommunications data to different clients, but use the same core system.

Not all governments are waiting for those questions to be sorted. In early May India's civil aviation regulator instructed Indian airlines to track all aircraft in real time using onboard ACARS or ADS-B. It ordered flight crews to report aircraft coordinates, speed and altitude every 15 minutes while flying over areas not covered by radar.

One thing experts agree on is that making airliner tracking global will require innovation and compromise. As Frost & Sullivan's Plucker says, "It's a study in international conundrums. There is not a good answer at this point." Or at least not an easy one.