

AVIATION SPECIAL REPORT

# Technology for tracking lost planes

CANBERRA, AUSTRALIA

Value of satellite data, and its limitations, seen in search for Malaysia jet

BY CHRISTINE NEGRONI

Two hours after Malaysia Airlines Flight 370 disappeared on a flight from Kuala Lumpur to Beijing on March 8, the Boeing 777 experienced a total loss of power, according to a recently released report from the Australian Transport Safety Bureau. The significance of this is not explained in the report because it is part of the Malaysian investigation, and Malaysian officials have declined to comment on it. But it is another strange detail from the data collected by Inmarsat, the London-based satellite technology company.

In the absence of hard evidence, the satellite data have provided most of the clues so far for investigators trying to pin down the plane's likely whereabouts, somewhere in the south Indian Ocean.

The fate of Flight 370 is uniquely puzzling, said Olivier Ferré, who works with the French air accident bureau, who oversaw the investigation into another airliner crash into the Indian Ocean in 2009, Air France Flight 447, which vanished into the Atlantic in 2009.

"So far," Mr. Ferré said, the Malaysian Airlines disappearance "is a crash with no airplane, no bodies, no crash site."

So far, it is "a crash with no airplane, no bodies, no crash site, no physical evidence. It is a virtual crash until a piece of wreckage is found."

no physical evidence. It is a virtual crash until a piece of wreckage is found."

The hunt for Flight 370 has shifted five several times—a frustrating but unavoidable process, said Martin Dolan, chief commissioner of the Australian safety bureau, who said the searchers had had to investigate signals mistakenly thought to be coming from the plane's "black box" locator beacon.

The most recent area focus, announced June 26, has been derived from complex computer modeling and probability studies within the framework of the Inmarsat data.

The satellite information has been used almost from the start of the search, when it showed that the plane had not gone down in the South China Sea, a surprise even to the engineers at Inmarsat. "I saw the first analysis and I said, 'Are



Ground control

The control room at Inmarsat's headquarters in London. The loss of Air France Flight 447 prompted Inmarsat to embed more time information in its satellite communications, which allowed it to calculate the route of the Malaysia Airlines Flight 370 when it went missing.

you sure?" recalled Roy Pinto, the company's chief operating officer, in an interview.

Since then it has become clear that the data could be exploited in increasingly sophisticated ways, leading to a progressive redefinition and refinement of the search areas. "If there was an airplane moment," Mr. Pinto said, it was when the engineers realized that timing information contained in electronic "handshakes" exchanged between the plane and a satellite over the Equator could be used in a simple way to define possible flight paths.

After the Air France accident it took six days to find the first floating debris and two years to locate the airplane's flight data and cockpit voice recorders. The search was assisted by information transmitted from the plane via Inmarsat satellites. But the delay in finding the wreckage prompted Inmarsat to modify its satellite network to include information about the time taken for a message to circulate from the ground to the satellite and the airplane and back again.

When the Malaysian jetliner went missing, this embedded time information and changes in the wavelength of the electronic signals, or pings, it emitted allowed the company to calculate the plane's route south after crossing the Malay peninsula.

"The timing told you it was getting further away from the satellite—and the frequency changes told you a little bit more about where it was in relation to the north-south position of the satellite," said Chris McLaughlin, a senior vice president at the company.

Still, as the plane's disappearance shows, data that are now routinely and automatically transmitted by airliners are not sufficiently comprehensive to

identify their precise location when they are out of radar and radio range.

On any given day, that includes planes transmitting "the North Atlantic, the Pacific and over the remote areas in Africa and Russia," said Kevin Hatt, safety director at the International Air Transport Association, the airline trade group.

The industry is looking at jiggling back on satellite-based location reporting that already is used by some airlines for one-route weather forecasting and air traffic control. Proposals include increasing how often that location information is sent and assigning certain parameters to an airplane's communication system so that unusual events would prompt automatic transmissions of location and other information.

Using satellites is sensitive, however, and airlines restrict the amount of satellite time they buy to control their costs.

"A one-size solution will not fit all," Mr. Hatt said. "Not all flights operate in a radar environment while others are operating every day in radar. Not all are equipped the same." He added that I.A.T.A. was working with a United Nations agency, the International Civil Aviation Organization, on aircraft tracking and would present options to airlines to "fill the gap" in global coverage by the end of the year.

The I.C.A.O., with a broader agenda, is also reviewing ways that airlines could send flight data to the ground, an approach that could someday replace their onboard black box recorders.

Even at the time of the Air France accident, sending flight data based on some triggering event was possible, said Viraf Kapadia, chief executive of Star Navigation, a flight monitoring service based in Toronto, who said he had suggested it to the crash investigators.

"Everyone talked about it," he said, but then "suddenly everyone went to sleep, I.A.T.A. and I.C.A.O." He added, "People were worried about cost."

Officials at both aviation organizations say that it takes time to make broad changes in a complex industry. But they concede that cost concerns have been a consideration.

"Much of the technology already exists" to enable global tracking of airplanes in flight, the I.A.T.A. director general, Tony Tyler, said in an interview. One issue is, of course, the cost of doing this. It would be wrong to think this is not an important consideration."

In the absence of physical evidence, electronic data has proven its value in Malaysia, Mr. Kapadia said. "There's an absolute revolution going on," he said, calling the Malaysia flight "a pivotal turning point." Yet, for all the high-tech guidance, investigators still have not found the plane, a reminder of the limits of current applications of the technology.

# Airlines listen more closely to want fliers who want

SERVICE FROM PAGE 1

after devoting huge financial and engineering resources to their billboard programs, the Boeing 787 Dreamliner and the Airbus A350.

W. James McNerney Jr., chairman and chief executive of Boeing, said in May that it would not attempt any new "monocohort" planes, vowing to stay away from groundbreaking designs in favor of a more "evolutionary" approach for the next decade. "Most of us have gotten religion," he said at a conference of Wall Street analysts.

At Airbus, a similar refrain can be heard. After spending over \$25 billion on research and development in recent years to build the A350 and to match Boeing's 787 with its own carbon-composite plane, the A350, Airbus is also signaling a retreat from groundbreaking designs.

At Airbus, a similar refrain can be heard. After spending over \$25 billion on research and development in recent years to build the A350 and to match Boeing's 787 with its own carbon-composite plane, the A350, Airbus is also signaling a retreat from groundbreaking designs.

This new approach signals a convergence with airline customers who are looking for more efficiency with current technology. Some engineering work on wings and pylons is needed to support the new engines, which are larger and have bigger fan blades, but substantial airframe changes are not required.

These new engines promise fuel savings of 15 percent compared with current technology. Some engineering work on wings and pylons is needed to support the new engines, which are larger and have bigger fan blades, but substantial airframe changes are not required.

Airbus has already taken more than 2,600 orders for its re-engineered A320 Neo, and the first planes could be delivered at the end of next year. Boeing has also announced a re-engineered version of its 737, the 737 Max, and has already received 2,300 orders for it from 47 airlines.

With this approach, plane makers now are "leveraging the past," said Richard L. Abouaf, an aviation industry consultant at the Teal Group in Fairfax, Va.

"There is a convergence of interest since the airlines are more focused on their bottom line," he said. "This means being just as selective as the manufacturer in where to put their cash."

The same trend is now coming to the widely traded Boeing 787 Dreamliner, which has outlined plans to update its flagship long-distance airplane, the 787, with new engines and a better-performing wing

But even as carriers invest in their cabin amenities, airline executives remain mindful of the unpredictable nature of their business—the turmoil of the past decade has taught them a lesson on the benefits of caution.

# Shifting threats spur sales of fighter planes

Budget constraints put focus on equipping older jets with new technology

BY DANIEL SOLON

On Bastille Day in Paris 100 years ago, spectators at the Grand Military Parade imagined the scale of destruction that was about to be unleashed on much of Europe, including the first use of military air power.

Since then, control of airspace has become a basic strategic doctrine. But which airspace, and how to control it in a period of game-changing developments in weapons, sensors and cyber-systems, are questions as challenging as at any time in the past century.

While geopolitical threats are shifting fast, most military budgets are still locked down by post-recession austerity policies. But even though governments may want to cut military spending, defense needs are pushing the other way.

Russian and Chinese expansionism, real or perceived, has revived the specter of Cold War confrontations in Eastern Europe and East Asia. Meanwhile, in the Middle East, boundaries drawn after World War I are disintegrating, with a risk of sectarian and regional power plays potentially affecting governments from Central Asia to the Arabian Peninsula and the Sahara.

Richard Abouaf, an analyst at the Teal Group in Fairfax, Va., said he expected this week's French government International Airshow to see makers of tried-and-trusted fourth-generation fighter planes pulling out all the stops to sell in the Middle Eastern market. The term "fourth generation" is applied to planes such as the Eurofighter Typhoon, the American F-15 or the French Rafale, originally designed in the 1970s and upgraded since then to incorporate some modern stealth and electronic warfare technologies.

At power, Mr. Abouaf said, "is becoming less about platforms and more



Stealth warfare

Lockheed Martin has proposed the SR-72, a pilotless spy plane that could fly at Mach 6. But the plane won't be ready before 2030, and in the meantime, countries are rethinking how to control their airspace.

about systems, and systems of systems. The importance of an airplane is being dwarfed by the value and importance of its interior technologies and by the value of all the sensors, data links and connections that make it much more effective."

An example of that trend is the Gripen E fighter program by Saab of Sweden, which incorporates increasingly advanced electronics and sensors. Brazil signed a deal in December to buy 36 Gripen, and Saab is prospecting for more customers in Asia.

In India, meanwhile, Laurent Fabius, the French foreign minister, and William Hague, the British foreign secretary, have been jostling this month to sell either Rafales or Typhoons to the new government of Prime Minister Narendra Modi.

In Asia, however, Mr. Abouaf said, what China's neighbors perceive as its

increasing assertiveness has placed a premium on stealth technology and interoperability with American forces. That, he said, spells "F-35" to him.

The highly stealthy "fifth generation" Lockheed Martin F-35 was described by Prime Minister Tony Abbott of Australia in April as "the most advanced fighter in production anywhere in the world."

Whether Farnborough will provide a platform for more orders, however, is uncertain. Already long delayed and far over budget, the F-35 program suffered further embarrassment this month when an engine fire during testing led the United States military to ground its entire fleet, raising a question mark over the plane's ability to even turn up at the British air show.

As governments gear up to meet near-term threats, they also look

ahead into a disturbingly different future, where geopolitical disruptions are matched by dramatic technological changes in cyberwarfare, drones and hypersonic flight, among other areas.

At least some of those developments could reasonably be projected to surface in time horizon, though many others remain locked in secrecy.

Even more futuristic projects include the X-51 "Waverider," a program of Boeing's Phantom Works division. In a flight a year ago, the X-51, an unmanned hypersonic ramjet that surfs on its own shock waves, reached Mach 5, five times the speed of sound. Technology from the experimental program could be used in a hypersonic missile planned for service in the mid-2020s, to be launched from B-2 bombers or F-35 fighters.

Another futuristic project is Lockheed Martin's SR-71 Blackbird reconnaissance plane, which could fly faster than a speeding missile, at Mach 6, or twice the speed of the long-retired SR-71 Blackbird reconnaissance plane.

Named the SR-72, a demonstration model could be ready by 2018, with prototype testing in 2020 and an operational version in service by 2030.

The cost, said Alexander Ashbourne, a military analyst based in London, would be around \$300 million per plane, "which only the United States could afford."

design. For Boeing, the new plane, the 777X, is a far cheaper choice than building new planes from scratch.

At the same time, the 777X, which is not expected to be delivered until 2020, is projected to be 12 percent more fuel-efficient than rivals, thanks to an all-new composite wing—derived from the wing developed for the 787 Dreamliner—and new turbofan engines from GE Aviation.

Airbus is also expected to announce that it will refit a more efficient engine on one of its best-selling planes, the A320, a medium-range jetliner, according to analysts. That option might cost around \$2 billion, the analysts say, which is a far cry from the cost of developing a completely new plane.

Airbus may have little choice. While the A320 has been a best seller, the European plane maker does not have anything to compete with Boeing's 737-800 in the 200- to 300-seat medium-size market, according to analysts.

Both aircraft manufacturers also face considerable pressure to raise their production rates to meet the projected growth in traffic and the anticipated loading of the market with new airplanes in service in the next two decades.

Much of the growth in demand will continue to come from the three big carriers in the Persian Gulf—Emirates, Etihad and Qatar Airways—which have taken a central role in the global aviation market and are increasingly critical to the manufacturing industry. These carriers now account for about half of all wide-body orders on the plane makers' books.

Recently, some analysts have speculated that the formidable growth of the Middle East carriers might be slowing after Emirates canceled an order for 70 A350 airplanes from Airbus, a sign perhaps that the airline, based in Dubai, had overestimated demand. Emirates, however, still expects to carry 70 million passengers by 2020, up from 45 million today. The reality could simply be that the A350 is just too small for Emirates as the carrier concentrates its fleet on Boeing 777s and Airbus A380s.

"This decision has nothing to do with demand," the airline's top financial executive, Nigel Hopkins, said recently at an analysts' conference in London. "We are very comfortable with our growth predictions."

PHOTO TOP BY AP/WIDEWORLD; BOTTOM BY AP/WIDEWORLD