Technology hindered, helped search for Flight 370

March 28 2014, by Scott Mayerowitz

In this Monday, March 24, 2014, file photo, a ground controller guides a Royal Australian Air Force AP-3C Orion to rest after sunset upon its return from a search for the missing Malaysia Airlines Flight 370, over the Indian Ocean, at the Royal Australian Air Force Base Pearce in Perth, Australia. The disappearance of Malaysia Airlines Flight 370 has presented two tales of modern technology. The public has been surprised to learn of the limitations of tracking and communications devices, which contributed to the plane vanishing for more than two weeks. But the advanced capabilities of some technologies, particularly satellites, have provided hope that the mystery won't go unsolved. (AP Photo/Jason Reed, Pool, File)

The disappearance of Malaysia Airlines Flight 370 has presented two tales of modern technology. The limitations of tracking and communications devices allowed the plane to vanish from sight for nearly three weeks. But satellites' advanced capabilities have provided hope that the mystery won't go unsolved.

In this day and age of constant connection, the public has been surprised to learn that radar and satellites aren't actually all-seeing, cellphone locations aren't always traceable and key data about the plane is only recorded, not transmitted in real time to the ground. And onboard tracking systems can be disabled manually—one theory holds that someone in the cockpit intentionally diverted the plane and disguised their actions.

"Technology can track a flight, but assuming malice was involved, it wouldn't change the outcome of this disaster. Only better human intelligence and screening can do that," said Richard Aboulafia, an aviation consultant with the Teal Group.

Still, the mystery of Flight 370 would have been even more perplexing if it wasn't for some of these technologies. The little information we have today about where the plane might have crashed came from satellites.

"If it weren't for the technologies, nobody would have had a clue where to look," said Scott Hamilton, managing director of aviation consultancy Leeham Co.

Here is a look at how old and new technologies have aided or hindered the search effort.

TRANSPONDERS

These cockpit devices send signals to radar stations on the ground with

details about the plane's flight number, heading, speed and altitude. The transponder also can be used to send predetermined messages to air traffic controllers. For instance, if a plane's transponder squawks out a code of "7500" it means there has been a hijacking. A squawk of "7600" refers to a radio failure and "7700" means an emergency.

Flight 370 took off from Kuala Lumpur, Malaysia at 12:40 a.m. local time on March 8, heading to Beijing. Then at 1:20 a.m., the transponder stopped transmitting. The Boeing 777-200ER with 239 passengers and crew aboard kept flying for several hours but no further signals were ever received from the transponder.

It's rare for a commercial pilot to intentionally turn off a transponder during flight, but occasionally there is a legitimate reason, such as a malfunction, electrical short or fire. Pilots would want to shut it down rather than risk a fire spreading.

RADAR

Radar was developed just before the start of World War II. The word radar is actually an acronym: radio (use the R and the A) detection and ranging.

An antenna on the ground sends out electromagnetic waves. They reflect, or backscatter, from the surface of an aircraft and almost instantly return to the radar station. Since these radio waves travel at a known, set speed—the speed of light—the radar system is able to calculate how far away a plane is from the antenna.

But radar's only able to track planes within 200 to 250 miles, depending on the age of the technology and the weather. Station locations are selected to allow for a slight overlap so planes in high-traffic areas are never out of reach.

In the case of the Malaysia Airlines jet, military radar picked up a signal at 2:14 a.m. of a plane flying in the opposite direction of Flight 370's original path. The radar signal was infrequent and there was no transponder data, making it harder to track.

In this March 20, 2014 file photo provided by the Australia Defence Department, Royal Australian Air Force Loadmasters Sgt. Adam Roberts, left, and Flight Sgt. John Mancey, launch a Self Locating Data Marker Buoy from a C-130J Hercules aircraft in the southern Indian Ocean as part of the Australian Defence Force's assistance to the search for Malaysia Airlines flight MH370. The disappearance of the airplane has presented two tales of modern technology. The public has been surprised to learn of the limitations of tracking and communications devices, which contributed to the plane vanishing for more than two weeks. But the advanced capabilities of some technologies, particularly satellites, have provided hope that the mystery won't go unsolved. (AP Photo/Australian Defence Department, Justin Brown, File)

Normally, when planes leave areas of radar coverage, pilots use high-frequency radios or satellite text communications to update air traffic controllers of their position at routine intervals.

SATELLITE TRACKING

Some jets use satellites to regularly send maintenance data back to headquarters. Malaysia Airlines did not opt to subscribe to this service from Boeing. The jet's disappearance has many calling for airlines to live stream information from planes' voice and data recorders. However, transmitting data by satellite from all 80,000 daily flights worldwide wouldn't be cheap—it costs $7 to $13 a minute for each plane. And it's not like airlines are flush with extra cash. On average, they made $4.13 in profit per passenger last year and $2.05 in 2012.

Other satellite transmissions from the plane, however, helped searchers ultimately narrow in on the plane's final location in a remote part of the Indian Ocean.

The plane automatically sent a brief signal—a "ping"—every hour to a satellite belonging to Inmarsat, a British company, even after other communication systems shut down. The pings indicated that the jet kept flying for seven hours after its last radar contact.

Inmarsat was able to calculate two long arcs indicating where the plane might have flown. It refined that analysis by factoring in the jet's speed relative to the satellite. The company gauged how the frequency was received and transmitted—the so-called Doppler effect is similar to the way the sound of a passing car changes as it approaches and passes by a fixed point.

This Burst Frequency Offset method had never been used before. Its validity was confirmed by applying the analysis to six other Boeing 777

flights—whose positions were known— on the same day, flying in various directions.

That new information led to an announcement Monday night by Malaysian Prime Minister Najib Razak that the plane ended its flight in a remote part of the Indian Ocean.

SATELLITE IMAGES

Private satellites and those of several governments have spotted what were initially believed to be parts of the plane in the southern Indian Ocean, about 1,550 miles southwest of Perth, Australia. But the search area was moved 680 miles to the northeast on Friday, as Australian officials said a new analysis of radar data suggests the plane had flown faster and therefore ran out of fuel more quickly than had been previously estimated.

That means searchers have concluded that the hundreds of floating objects detected over the last week by satellite weren't from the plane after all. Any images picked up by satellites might be the best tool in ultimately finding the remains of the plane.

CELLPHONES

Many people initially asked why cellphone GPS data couldn't be used to help find the missing plane. Several relatives of passengers said they were getting phones to ring, even if they remained unanswered. Smartphones can help pinpoint a person's location but only if they are near a cellular tower allowing the phone to transmit data. If a plane is 7 miles up in the air or flying over the ocean, the phone won't be able to connect with towers on land. As for why the phones kept ringing, that's sometimes what happens when a network can't locate a phone.

In this Thursday, March 27, 2014, file photo, Sgt. Matthew Falanga, an airborne electronics analyst, observes a radar image aboard a Royal Australian Air Force AP-3C Orion aircraft during a search operation of the missing Malaysian Airlines Flight 370 over the southern Indian Ocean. The disappearance of the airplane has presented two tales of modern technology. The public has been surprised to learn of the limitations of tracking and communications devices, which contributed to the plane vanishing for more than two weeks. But the advanced capabilities of some technologies, particularly satellites, have provided hope that the mystery won't go unsolved. (AP Photo/Michael Martina, Pool, File)

SEARCH PLANES

Several planes are searching for the plane in an area that' an eight-hour round-trip flight from their Australian base. That leaves only enough fuel a two-hour search of the target area. Among the planes searching are a

Lockheed P-3 Orion and a C-130 Hercules.

The flight crews use a radar system and infrared, long-range and high resolution cameras—plus their own eyesight—to search the ocean. They also films everything so they can review what they've seen after they return to base.

But the searches have been hampered by dangerously high winds and churning seas.

BUOYS

A C-130 Hercules military transport plane has been dropping 3-foot long buoys with GPS into the water to help get a better understand of the ocean currents in the search area. While not perfect, the idea is to get clues about where crash debris might float over time to further refine the search.

BLACK BOXES

There are two so-called black boxes, which are actually orange. One records conversations and noises in the cockpit. The other saves key flight data such as speed and altitude.

The boxes are designed to withstand strong impacts and large fires. They also come with a device that pings to help searchers find it underwater, though the deeper the box, the more difficult it is to hear those pings. The U.S. Navy has sent a Towed Pinger Locator to the Indian Ocean. It can hear the black box pinger down to a depth of about 20,000 feet.

The black box battery is required to last at least 30 days, but information can be retrieved for years. It took 23 months to find the black boxes from an Air France crash in 2009. All of the data was recovered.

In the case of Flight 370, there's a problem. The cockpit voice recorders only save the last two hours of conversations. The plane flew for nearly seven hours after the transponder stopped emitting a signal. So, any cockpit conversation or noises from when the plane initially went off course were likely recorded over.