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U-2 Spy Plane Crashes FAA Computer

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On April 30, 2014, the air-traffic control computers at the busy Los Angeles, California, Air Route Traffic Control Center (ARTCC) suddenly went down, paralyzing air traffic across the U.S. Southwest. After some denials, the U.S. Federal Aviation Administration (FAA) finally admitted that a U-2 spy plane operating within the area at high altitude caused a software problem that took down the computers. It took almost an hour to restore the computers to service and several hours to clear up backlogged traffic.

The U-2 Dragon Lady

The U-2, nicknamed the "Dragon Lady," is a single-seat airplane that can fly above 70,000 feet for high-altitude reconnaissance. Conceived in the early 1950s as a surveillance aircraft that could evade detection by the Soviet Union, it went into operation in 1955. The U.S. believed that the limit of the Soviet Union's radar was 65,000 feet, so flights at 70,000 feet and above would go undetected.

U.S. Air Force file photo

Unfortunately for the U.S., the Soviet's improved their radar and could track U-2 flights. Using a surface-to-air missile, they shot down a U-2 in 1960 that was flying a CIA mission. Pilot Gary Powers was captured; and much of the plane was recovered, giving the Soviet's a great deal of information about the U.S. capability for high-altitude surveillance, including detailed high-resolution photos taken by Powers. This was a major embarrassment for President Eisenhower, who had assured Nikita Khrushchev that the U.S. was not conducting spy mission flights over the Soviet Union.

After 60 years of service, the U-2 is still being used by NASA for civilian purposes and by the U.S. Air Force. The plane saw service in both the Afghanistan and Iraqi wars.

It is believed that the Air Force is planning on decommissioning the U-2's, perhaps replacing them with unmanned drones such as the Global Hawk.

The ERAM System

The U.S. air-traffic control system is old. It is built on the radar and radio technologies of the 1950s; and it is becoming increasingly difficult for it to handle today's air traffic, which is expected to double or triple over the next one to two decades. It is written in obsolete languages, it is difficult to upgrade, and hardware and software crashes are becoming increasingly common.

So what is the FAA doing about this? Its answer is NextGen – the next generation air-traffic control system. NextGen is a transformation of the entire U.S. national air transportation system. It replaces legacy ground-based navigation (radar, navigation aids) and ground/air voice communication with GPS positioning and digital communication.

An important component of NextGen is a system called En Route Automation Modernization (ERAM). ERAM is tasked with specifically keeping planes from colliding with each other, whether they be large commercial airliners or small general aviation aircraft.

Unfortunately, ERAM's deployment has been plagued with development problems, software bugs, cost overruns, and schedule slips. The (now) USD $2.4 billion system, whose development started in 2002, was supposed to have been installed in the twenty ARTCC facilities in the U.S. by 2010. A 2012 audit report by the U.S. Department of Transportation's Office of Inspector General found numerous examples of software problems and determined that the project was well behind schedule and way over budget. It blamed poor contract and project management for the bulk of the problems.

ERAM is now partially installed in sixteen of the twenty ARTCC facilities, but it is not fully operational in any of them. Its newly scheduled full deployment is August, 2014; but this date is unlikely to be met.

Nevertheless, controllers say that ERAM is a vast improvement over past systems and is needed to safely handle the growing air traffic in the U.S. airspace.

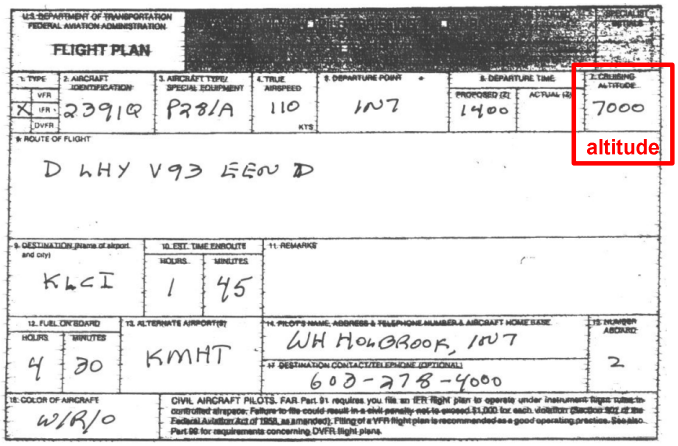
It is the ERAM system that was taken down by the U-2's flight in Los Angeles' ARTCC air space.

The U-2's Flight into the LA ARTCC Air Space

On Wednesday, April 30, 2014, the Air Force filed an FAA flight plan for a U-2 flight within the Los Angeles ARTCC area. Flight plans are required for any operations within controlled air space in the U.S., and this flight plan was like any other. (Outside of controlled air space, in good weather, planes – especially small general aviation airplanes – can fly VFR without a flight plan. VFR, or Visual Flight Rules, requires that the pilot be responsible for avoiding collisions. There is no air-traffic controller monitoring his flight).

There were two differences in the U-2 flight plan from a normal flight plan. One difference was that it specified a very complex route, flying in and out of the ARTCC area several times. Most flight plans are for simple point-to-point routes, flying to a destination airport or from a departure airport within the ARTCC, or for a straight path through the ARTCC air space.

The other difference was that apparently the flight plan did not include an altitude. To compensate for this, an air-traffic controller entered an arbitrary altitude of 60,000 feet, typical for a U-2 flight and miles above any other air traffic.



The Software Bug

About 2:30 in the afternoon of April 30th, the Los Angeles ERAM system began to have problems. It would shut down and restart repeatedly. Its backup system, which tried to take over ERAM functions when the

primary system failed, behaved in the same way. It took a few days, but finally the FAA admitted that the problem was caused by the U-2 flight.

For whatever reason, the Los Angeles ERAM system apparently became confused about the altitude at which the U-2 was flying. One conjecture is that the plane's transponder, which sends information about the plane's position, including its altitude, to the ARTCC system was faulty and was sending erroneous altitude information. Furthermore, it may not have been flying at the arbitrary altitude of 60,000 feet that was manually entered by the controller.

Not knowing the altitude of the U-2 flight, the ERAM system had to analyze the routes of every flight in its area as compared to the flight path of the U-2 and to redirect those flights so that they would not collide with the U-2 (even though the U-2 was, in fact, miles above all of the other flights). This was a level of activity not envisioned in the design of the ERAM; and it evidently ran out of memory, causing it to shut down and restart. When the backup system tried to take over, it suffered the same consequences.

It took FAA specialists almost an hour to reconfigure the ERAM to allow it to resume its normal functions. In the meantime, hundreds of flights were cancelled or delayed. Over a period of time, the FAA issued several explanatory statements:

> "FAA technical specialists resolved the specific issue that triggered the problem on Wednesday, and the FAA has put in place mitigation measures as engineers complete development of software changes. The FAA will fully analyze the event to resolve any underlying issues that contributed to the incident and prevent a reoccurrence."
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> "The computer system interpreted the flight as a more typical low-altitude operation and began processing it for a route below 10,000 feet."
>
> "The extensive number of routings that would have been required to de-conflict the aircraft with lower-altitude flights used a large amount of available memory and interrupted the computer's other flight-processing functions."
>
> "The FAA … has enabled facilities that use the computer system to significantly increase the amount of flight-processing memory available. The FAA is confident these steps will prevent a reoccurrence of this specific problem and other potential similar issues going forward."

The Impact on Air Traffic

The impact of the outage in such busy airspace was wide-spread. Hundreds of flights around the country were canceled, delayed, or rerouted. Flights originating within the Los Angeles ARTCC were grounded, as were any other flights destined for airports within the ARTCC. All in all, fifty flights were cancelled and almost 500 flights were rerouted or delayed. Major airports within the ARTCC that were affected included Los Angles, San Diego, and Las Vegas.

During the outage, air-traffic controllers had to use slips of paper and telephones to relay information about planes to other controllers and to other air-traffic control centers. A major cause of disruption is that when air traffic control has to revert to a compromised mode of operation, the minimum separation between airplanes is increased from one mile to five miles. Furthermore, even though planes are identified on the controllers' display screens by four-digit codes transmitted by the planes' transponders, aircraft must periodically report their positions as they pass over designated reporting points to eliminate any confusion. They may be directed to hold at these points until the air space in front of them can be cleared. These procedures greatly reduce the achievable flow of air traffic through the controlled air space.

Summary

The failure of the Los Angeles ARTCC due to a U-2 overflight was caused by a software error in the ERAM system. Developed by Lockheed (the company that also developed the U-2), software bugs such as this are an indication of inadequate testing of the software during its development. This conclusion is supported by the facts set forth in the Inspector General's report described earlier. Software bugs are a leading factor in the multiyear schedule slip of the ERAM system.

This incident also raises the ugly specter of hackers gaining access to the U.S. air-traffic control system. If a faulty flight plan could cause this much havoc, what else would it take to bring an ARTCC system down? Experts say that such a hack would be extremely complex and highly unlikely. However, the FAA is planning to set up a center in Maryland for sharing information on detected and possible threats.

Acknowledgements

In addition to the references cited above, material for this article was taken from the following sources:

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