

# MONITORING AIRCRAFT EMERGENCIES IN NEAR REAL TIME

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**AeroMechanical Services and Iridium offer aviation industry a global solution to monitor aircraft emergencies in near real time**

**Summary:** AeroMechanical Services Ltd. (AMS), a leading provider of data and voice communications services for the aviation industry with its Automated Flight Information Reporting System (afirs<sup>™</sup>), and Iridium, operator of the world's largest commercial satellite network, have demonstrated the ability to capture and continuously stream inflight position and performance data from an aircraft's flight data recorder (FDR).

Using an operating mode of afirs known as FlyhtStream<sup>™</sup>, the solution combines onboard smart electronics technology, a satellite constellation with fully global reach, including over the Poles, and secure, Internet-based data delivery to end users. If something abnormal occurs during an aircraft's flight, the system triggers an alert and begins streaming operating performance data via Iridium to designated recipients, including airline executives and ground support crews, aircraft and engine manufacturers, air traffic control, and search and rescue.

FlyhtStream represents a quantum leap for the aviation industry in terms of improving aircraft tracking and in-flight emergency communications. For the first time, the system offers to the aviation community a tool that can be used to analyze, diagnose and resolve in-flight problems as they occur, holding out the promise of actually preventing crashes and loss of life, as well as facilitating better operating decisions during non-crisis situations.

The system has been proven during in-flight trials over the Atlantic Ocean and other areas globally, and afirs already is being utilized by more than 30 passenger-service airlines and business aviation customers as an economical solution to monitor in-flight aircraft performance from anywhere in the world.

## **A long-standing industry problem**

On June 1, 2009, Air France Flight 447 crashed into the Atlantic Ocean en route to Paris from Rio de Janeiro. All 228 passengers and crew perished and most of the aircraft disappeared. Officials investigating the Airbus A330-200 disaster have never found the jetliner's FDRs in the deep ocean waters. Limited messages received from the aircraft during the emergency via conventional communications systems did not provide enough information for ground assistance, nor did they clarify the cause of the emergency. As a result, investigators do not know what caused the jetliner to crash.

The loss of Air France 447 drove home the need to improve in-flight tracking and air traffic management of aircraft flying transoceanic routes and over remote land areas.

Much of the aviation community's attention has focused on FDRs ("black boxes"), which are mandatory equipment on airliners. While state-of-the-art FDRs accumulate a detailed record of hundreds of in-flight operating parameters, they are not designed to provide "live" information during flight. Their primary function is to provide a historical record

of an aircraft's flight, equipping investigators with enough after-the-fact information, for example, to determine the probable cause of a crash. In the event the black boxes can't be recovered after a crash, they are of no use at all.

### **The AMS solution**

The AMS afirs-over-Iridium solution, that incorporates the FlyhtStream data-streaming function, does not attempt to replace black box technology. Rather, it enhances and leverages FDR capabilities to give airline operators valuable situational awareness of inflight operations and flight path. In addition to giving ground crews, airframe and engine manufacturers, and others the ability to troubleshoot emergencies, the technology also provides raw FDR data in the event that the black box is not recovered after a crash.

Under its marketing brand FLHYT, AMS introduced its current-generation afirs product to the commercial aviation market in 2004. It is known as the afirs 220, a programmable, smart electronic device that monitors, records and processes data and manages real time communications over Iridium.

The FlyhtStream function that is available within afirs can be pre-programmed to automatically trigger an alert and begin streaming data over Iridium if an abnormal operating condition is detected, such as loss of cabin pressure, a rapid change in altitude, an engine failure, excessive "g" loads, etc. In addition, the data-streaming capability, including continuous transmission of an aircraft's GPS coordinates, can be triggered remotely by a ground crew or by the pilot of an airplane experiencing an emergency situation.

FlyhtStream is but one of the unique features built into the afirs 220. Coupled with Iridium's global satellite network, the system's "enabler," afirs seamlessly integrates routine aircraft performance data, GPS tracking, and two-way voice and text-messaging communications between aircraft pilots and ground support crews or air traffic controllers during flights.

To date, the Federal Aviation Administration (FAA), the European Aviation Safety Agency, the Civil Aviation Administration of China and Transport Canada have deemed afirs 220 as airworthy on more than 25 aircraft types and models. Some of the aircraft covered include the Airbus A320 family, the classic and next-generation Boeing 737, Boeing 757s, Boeing 767s, DC-10s, Bombardier regional jets and Dash-8 Turboprops, and Hawker Beechcraft business jets.

Since being introduced to the market, the afirs 220 system has delivered significant cost savings and operational efficiency improvements to aviation operators across AMS' business segments. Currently, more than 30 AMS aviation customers globally are using afirs, with flight operations in the Americas, Europe, Africa, the Middle East, China, South Asia, the Caribbean and even the Antarctic. Customers include scheduled and charter airlines, regional and commuter airlines, cargo operators, special mission operators, such as the UN Food Program, business aviation and the military.

Aviation customers report that afirs-over-Iridium gives them complete visibility over their fleet, regardless of where an aircraft is flying. Typically, afirs is programmed to transmit routine data messages every five minutes to aviation customers, reporting such information as an airplane's precise location and operating condition. Pricing is attractive because customers are billed based on actual use during a flight.

### **A look at how afirs works**

The afirs 220 is compact and lightweight at 8.7 pounds. The device is installed in the avionics bay and is connected to aircraft sensors through data buses, similar to the way office computers are connected to local area networks. Other on-board equipment consists of a small cockpit indicator panel and several configurations of Iridium satellite phones for use by aircraft pilots or cabin crews. A low-drag dual-element antenna, about the size of a deck of cards, is mounted on top of the fuselage of an aircraft, providing

both the connection to Iridium's satellite network and the reception of GPS time and position data.

Essentially, the afirs 220 "eavesdrops" on aircraft sensor data passing through the buses. The smart device is programmed to capture, record and analyze pre-selected criteria, including engine performance, excess vibration and other system deviations that typically signal the need for maintenance, and such routine readings as altitude, heading and speed. Data deemed to be high priority is compressed and transmitted via Iridium's satellite network to users on the ground. Lower-priority data is saved to a data-storage card that can be downloaded as needed after an aircraft lands.

Information transmitted from the afirs 220 is routed seamlessly over Iridium to an AMS application called UpTime, a web-based server that processes the data into messages and forwards them to customers via the Internet. UpTime is the primary interface between afirs and end users. Featuring sophisticated software programs and aircraft databases, UpTime automatically collects, generates and delivers standard aircraft performance reports, as well as customized reports prescribed by individual customers.

Using Iridium's fully meshed, cross-linked satellite network, the afirs system is able to transmit data from aircraft to end user in seconds. Data passes from satellite to satellite, touching ground at Iridium's operations control center in Tempe, Ariz., and is then routed to AMS' UpTime web server. The near real-time speed of data throughput is a critical component of FlyhtStream's value proposition for use in emergency data-streaming situations.

In addition to low-latency data transmission, Iridium provides afirs users with truly global coverage, a significant and unique capability among mobile satellite communications providers. Iridium's 66 low-earth orbiting satellites circle above Earth on polar orbits, intersecting over the North and South poles. Iridium's constellation offers the only reliable and continuous two-way communications link with aircraft flying over the Polar Regions, transoceanic routes and remote land areas.

With a long-term commitment to its aviation, and other, industry customers, Iridium is in the process of designing and building its next-generation satellite constellation, Iridium NEXT. The company anticipates launches for Iridium NEXT to begin in 2015 with full replacement of the current constellation planned for 2017. The new constellation will maintain the company's existing network architecture of 66 cross-linked satellites covering the globe. Iridium NEXT will not only meet the rapidly expanding demand for truly global mobile communications in the skies, it will also substantially enhance and extend Iridium mobile communications services, delivering higher data speeds; powerful new services and devices; advantages of IP technology; and backward compatibility with current devices and applications. Iridium announced the execution of a fixed-price contract with Thales Alenia Space for the design and construction of satellites for the Iridium NEXT constellation. In addition, Coface, the French export credit agency, has issued, for the account of the French State, a "Promise of Guarantee" which commits to cover 95 percent of the \$1.8 billion credit facility for the project.

### **Proving out FlyhtStream**

To demonstrate the reliability and effectiveness of FlyhtStream-over-Iridium, AMS has worked with two airlines to test the technology on transatlantic and terrestrial passenger service flights.

One of the trials, launched in fall 2009 and concluded during the second quarter of 2010, evaluated the data-streaming capability of an afirs 220 device outfitted on two Airbus A320s and a Boeing 757. Another ongoing trial is using a Boeing 767. Both the Airbus and Boeing aircraft models are considered "data rich," meaning their data buses collect enough information from FDRs to fully describe the airplanes' performance and status during flight.

In both trials, the aim was to use the FlyhtStream function to transmit as much of the

FDR data as possible over Iridium while the aircraft were flying. Of particular interest was to demonstrate that Iridium's bandwidth was sufficient to handle the volume of data flowing from the FDR data file to the ground. The criteria for success was to demonstrate that FlyhtStream-over-Iridium had the ability to transmit enough in-flight data to be of value to airline operators, airframe and engine manufacturers, and government agencies that conduct airplane accident investigations.

Results from the trials clearly revealed the feasibility and power of using FlyhtStream-over-Iridium to monitor in-flight performance and position in near real time. With UpTime software tools, AMS staff involved in the testing was able to use data streamed investigation board to determine what was happening to the aircraft.

The afirs 220 uses an Iridium transceiver capable of transmitting data at a rate of 2,400 kilobits per second. The trials showed that, due to AMS' ability to compress data passing through the smart box, the Iridium network had more than enough bandwidth to handle the load. During testing, the system was able to continuously stream data representing hundreds of aircraft performance parameters.

Underscoring the significance of the FlyhtStream trials, the Bureau d'Enquetes et d'Analyses (BEA), the French government board that investigates airplane accidents, invited AMS to join a working group that was formed in response to the Air France 447 tragedy. Since then, AMS has worked with the BEA group to further demonstrate and extend FlyhtStream's capabilities. For example, to confirm the accuracy of the datastreaming trigger system, AMS programmed the triggers identified by the BEA working group into an afirs 220 unit being used in the trials. Those triggers were run against an on-ground FDR database that AMS maintains to confirm the unit was not falsely triggering and that all triggering events did in fact launch the FlyhtStream mode.

In addition to its collaboration with the BEA, AMS was invited to join a consortium of airlines, aircraft manufacturers, data service providers and air traffic control entities involved in the OPTIMI project, an initiative launched by the European Commission to improve in-flight tracking and air traffic management. OPTIMI, an acronym for Oceanic Position Tracking Improvement Management Initiative, is evaluating existing technology that could be deployed to improve air safety. AMS is sharing information on its datastreaming trials with the Critical Event Detection and Reporting (CEDAR) consortium that is carrying out the OPTIMI members, including Air France, Air Europa, Airbus, five Air Navigation Service Providers, a Communications Service Provider and AMS.

**Conclusion:** AMS has proven that its afirs FlyhtStream-over-Iridium mode is capable of continuously streaming in-flight data from an aircraft's FDR to the ground in near real time. FlyhtStream is a unique capability developed as part of the afirs 220, an on-board smart avionics device produced by AMS. The afirs 220 has been certified as airworthy and currently is being deployed by more than 30 customers on revenue-producing transoceanic, terrestrial, and polar passenger and cargo flights.

At this point, attention is turning to developing a formal set of procedures that can be used to standardize the use of FlyhtStream. That process will involve aviation regulators, aircraft and equipment manufacturers, and airlines and industry technologists.

AMS has met the regulatory requirements to install and operate the FlyhtStream application on commercial aircraft. Aircraft crashes are rare, but often result in the tragic loss of life when they do occur. It is our hope that FlyhtStream will be used to help prevent aircraft crashes, not merely record them.

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