



Rockwell Collins ARINC MultiLinkSM
flight tracking service

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Background

Each time a highly publicized event involving a commercial airline occurs, the aviation community begins to clamor for automated transponders to track aircraft position. Three recent events include the crash of Air France Flight 447 on June 1, 2009, the disappearance of Malaysia Airlines Flight 370 on March 8, 2014, and the most recent crash involving Indonesia AirAsia Flight QZ8501 on Dec. 28, 2014.

In May 2014, the International Civil Aviation Organization (ICAO) convened a Multidisciplinary Meeting Regarding Global Flight Tracking for the purpose of discussing issues surrounding aircraft tracking and accident location. This meeting “forged consensus among its Member States and the international air transport industry sector on the near-term priority to track airline flights, no matter their global location or destination.”¹ As a result, ICAO formed a task

force to “examine available options for tracking commercial aircraft, considering implementation, time, complexity and cost efficiency to achieve worldwide coverage.”² ICAO is also involved in “developing a flight tracking concept of operations covering how the new tracking data gets shared, with whom and under what circumstances.”

In June 2014, the International Air Transport Association (IATA) indicated that it had launched an initiative to closely examine global flight tracking – the Aircraft Tracking Task Force (ATTF)³. The IATA described the purpose of the ATTF – “to identify the best near term options and develop performance based recommendations for global flight tracking.” The ATTF is expected to report on recommendations sometime in March 2015.

Discussion

After the Air France Flight 447 accident, the French Bureau d’Enquêtes et d’Analyses (BEA) convened a working group that examined accident data involving 44 transport category aircraft. From this data, the BEA concluded that in 95 percent of the cases, the aircraft’s impact point could have been resolved to within 6 nautical miles (NM) had the aircraft been reporting its position once every minute. While AF447 was configured to transmit Aircraft Communications Addressing and Reporting System (ACARS) position reports every 10 minutes, it still took authorities nearly two years to locate the black boxes⁴.

More than three-quarters of the Earth’s surface lacks some form of ground-based radar, which points to a need for a more sophisticated and robust aircraft tracking system. This new tracking solution must be capable of providing positional data to within 1 NM of accuracy and reporting these data with a much higher update rate. *Bloomberg Businessweek* is reporting that the IATA-led task force is preparing to issue a nonbinding recommendation for its

members to achieve this level of accuracy with an update rate of 15 minutes.⁵ The National Transportation Safety Board (NTSB) is encouraging a voluntary implementation of a one-minute update rate recommended by the BEA study.

While these initiatives by IATA, ICAO, BEA, NTSB and others may provide future opportunities for enhanced tracking, Rockwell Collins has been actively involved in developing ground-based aircraft tracking capabilities for over 20 years. We view the challenges associated with worldwide aircraft tracking as requiring multiple data sources to address. If tracking is dependent on a single data source or a single piece of equipment, the likelihood that tracking could be disrupted is quite high.

The company’s ARINC GLOBALinkSM WebASDSM and the ARINC Hermes SkyViewTM are two platforms currently capable of rendering graphical tracking information from the sophisticated data, merging algorithms generated by the Rockwell Collins ARINC MultiLinkSM flight tracking service.

Concept of Operations for Aircraft Tracking

The concept of operations for aircraft tracking builds on the premise that multiple data sources are required in order to provide adequate assurance that an aircraft can be tracked worldwide and that the service can sustain the loss of one or more data feeds and still be able to provide reasonably accurate positional data. It can be shown that the statistical probability of tracking an aircraft and the accuracy of its position are greatly enhanced with the use of multiple data sources.

ARINC MultiLink is able to merge multiple sources of aircraft positional data. These feeds include, but are not limited to:

- ▶ FANS ADS-C position reports
- ▶ ACARS position reports
- ▶ Air Navigation Service Provider (ANSP) digitized radar data
- ▶ HFDL performance and frequency data
- ▶ ADS-B position reports

Rockwell Collins has developed tools that can help an airline see the kinds of data that are already being generated in both passive and active applications. With these tools, we are able to help the carrier devise the best solution to fill the gaps in its tracking profile and be the most cost effective for the airline.

FANS ADS-C Position Reports

Future Air Navigation System (FANS) Automatic Dependent Surveillance (ADS) is a method of surveillance that depends on automatic downlink reports from an aircraft's avionics whenever specific events occur or specific time intervals are reached. ADS reports do not require an independent surveillance source (e.g., a radar antenna) to operate. This type of position reporting is the most capable and flexible of all the various data sources.

FANS ADS is also known as ADS-C (Automatic Dependent Surveillance-Contract). An ADS-C is an agreement between the ground facility and the aircraft, consisting of a Request (uplink) and an Acknowledgement (downlink). Once a contract has been established, the aircraft will send position reports to the ground facility until either the conditions specified in the request are met or the contract is explicitly canceled.

In addition to ADS position reports established between the aircraft and ANSPs, the Rockwell Collins ARINC OpCenterSM FANS Manager is able to provide dispatchers with an interface through which they can handshake with the aircraft avionics and request the delivery of position

reports at a specified interval in time or upon a specific event. This can also be set up to automatically activate ADS-C based on specific triggers unique to a carrier. The ARINC OpCenter FANS Manager enables a customer to establish or cancel any of the three types of FANS reports:

- ▶ Current position report – Also known as an on-demand contract, this contract produces a single, immediate position report.
- ▶ Periodic position report – This type of ADS contract produces multiple reports at a set time interval.
- ▶ Event position report – An event report is generated whenever a specific condition/event occurs, which matches a condition in the contract request, such as an altitude change or waypoint change.

Any time a FANS ADS-C position report is received by the ARINC OpCenter FANS Manager, the message is decoded and forwarded for display on the target situational display. Each type of position report contains standard positional data (i.e., current latitude, longitude, altitude and time), along with other information pertinent to the type of report selected.

ACARS Position Reports

For those aircraft that are data-link equipped, the carrier has the option of generating position reports over ACARS. ACARS position reports generally include latitude, longitude, time, aircraft ID and flight ID. However, the system can be customized, and airlines frequently add other information to these reports (i.e., departure airport,

destination airport, estimated time of arrival, fuel on board, etc.). Rockwell Collins has amassed a library containing over 140 different position report formats. Airlines may contact Rockwell Collins for help in selecting a format or to integrate their format into our library.

ANSP Digitized Radar Data

Most ANSPs have some form of radar coverage. Some of those ANSPs digitize that data and provide it to service providers to distribute to airlines. The timing, sequencing and overall accuracy of the data received from the various Air Route Traffic Control Centers (ARTCCs) can make merging these data a challenge. Data are currently

available in the United States and United Kingdom airspace. The acquisition of Aircraft Situation Display to Industry-like (ASDI) data from other global sources is underway. EUROCONTROL provides a pseudo-radar product that implements similar techniques.

HFDL Performance and Frequency Data⁶

Each High Frequency Ground Station (HFGS) provides primary data-link coverage over a radius of 3,000 NM. Overlapping primary coverage areas are enhanced by the characteristics of HF radio signals, which support extra-long-range communications beyond the primary coverage areas. Using this multi-hop propagation characteristic of HF Data Link (HFDL), data communication is possible worldwide.

Frequency and performance diagnostic information is regularly transmitted between the aircraft and the HFGS. The HFGS controls the frequency at which the diagnostic data packets are transmitted. With each logon to the HFGS, the airborne HF radio will transmit a frequency diagnostic

data packet. Performance data packets are also transmitted to the HFGS if there is data space in an ACARS message or in response to polling by the HFGS. Both performance and frequency data packets contain the aircraft position data and time of day that packet was formed.

Currently, HFGSs are set to poll aircraft every 10 minutes during periods of inactivity. During over-water operations, this may be one of the few data sources available for positional data. The aircraft position data contained within the HFDL data packets are stored both within the HFGS and also sent real-time to a central server.

ADS-B Position Reports

Automatic Dependent Surveillance-Broadcast (ADS-B) is a surveillance technology for tracking aircraft. The aircraft determines its own position via satellite navigation and periodically broadcasts position reports. The information can be received by air traffic control ground stations as a replacement for secondary radar. The system relies on two avionics components – a high-integrity GPS navigation source and an ADS-B data-link unit. There are several types of certified ADS-B data links, but the most common ones operate at 1,090 MHz, essentially a modified Mode S transponder.

ADS-B positional data contain the following data elements:

- › Data/time
- › Aircraft registration
- › Flight ID
- › Airline agency code
- › Latitude and longitude
- › Altitude
- › Speed
- › Vertical speed

Value Proposition

Benefits of ARINC MultiLink include:

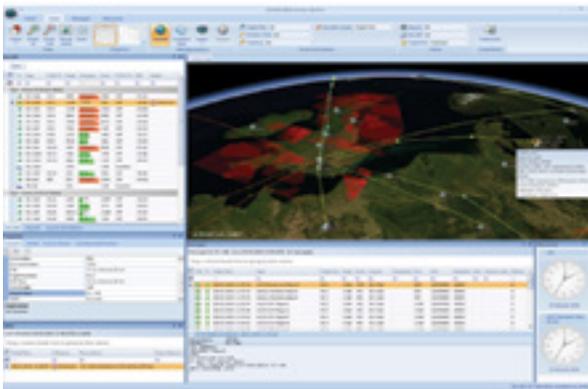
- › Each airline is currently providing positional data through both passive and active reporting mechanisms. Because some of this data is specific for air traffic control or system diagnostics purposes, it is never made available to the carrier for flight tracking. ARINC MultiLink pulls this data together, merging and validating all data elements.
- › HFDL positional data are included in the merged positional data and are available worldwide for HFDL-equipped aircraft.
- › Each carrier has the ability to selectively augment the fidelity and accuracy of the data feed by generating additional data from the aircraft – selected aircraft

and/or selected geographic regions. Rockwell Collins has developed specialized tools to help the customer manage data charges and get the best value from the service.

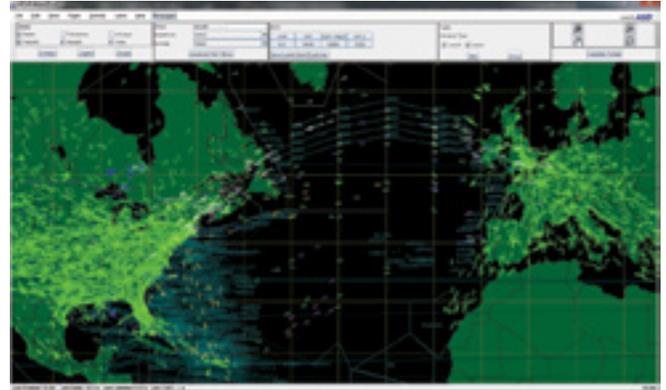
- › ARINC MultiLink is capable of providing positional data at a higher frequency than is currently available today. The service has been designed with the flexibility to report data in accordance with any future ICAO/IATA recommendations.
- › Flight track deviation reporting is possible when the carrier is subscribed to the OpCenter FANS Manager.

Service Offering

ARINC MultiLink will be provided to customers in two forms: (1) as a streaming data feed, or (2) as an integrated feed within Rockwell Collins' ARINC OpCenter/WebASD and Hermes SkyView situational displays. The service includes initial and ongoing consultations to ensure that the carrier is receiving the most economical flight tracking solution.



ARINC Hermes SkyView



ARINC GLOBALink WebASD

Notes:

¹ ICAO (2014). *ICAO Delivers Agreement Between States, Industry Groups on Global Airline Flight Tracking Capability*. Retrieved Feb. 15, 2015, from <http://www.icao.int/Newsroom/Pages/ICAO-delivers-agreement-on-global-airline-flight-tracking-capability.aspx>

² Turner, Aimee (2014). *Performance approach planned for future global flight tracking*. Retrieved Feb. 22, 2015, from <http://www.airtrafficmanagement.net/2014/05/performance-approach-planned-for-global-flight-tracking/>

³ IATA (2014). *Aircraft Tracking Task Force Frequently Asked Questions*. Retrieved Feb. 15, 2015, from <https://www.iata.org/pressroom/Documents/aircraft-tracking-task-force-faqs.pdf>

⁴ ICAO (2014). *Aircraft Tracking – working paper presented by France at the ICAO Multidisciplinary Meeting Regarding Global Tracking in Montreal, Canada, May 12-13, 2014*. Global Tracking 2014-WP/8 9/5/14, <http://www.icao.int/Meetings/GTM/Documents/WP.08.France.Aircraft%20tracking.pdf>.

⁵ Bachman, J., Rothman, A., & Bennett, S. (2015). "Why Passenger Planes Can Still Vanish," *Bloomberg Businessweek*, (4410), 32-34.

⁶ John Patterson, Ph.D.; *Leveraging HF Data Link for the Industry*. May 2, 2014.

Building trust every day.

Rockwell Collins delivers smart communication and aviation electronic solutions to customers worldwide. Backed by a global network of service and support, we stand committed to putting technology and practical innovation to work for you whenever and wherever you need us. In this way, working together, we build trust. Every day.

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