

ICAO has proposed new 15-minute and one-minute aircraft-tracking initiatives in response to several high profile incidents in recent years. The proposed tracking requirements and the technology and services required to implement them are considered here. Many aircraft are already equipped to meet the new standards.

Flight tracking initiatives & systems

Several high-profile incidents have highlighted shortcomings in existing flight tracking capabilities. Following the disappearance of Malaysia Airlines flight MH370 in 2014, an International Civil Aviation Organization (ICAO) Working Group developed a draft concept of operations for a Global Aeronautical Distress & Safety System (GADSS).

The adoption of ICAO's GADSS was recommended at a high-level safety conference in February 2015.

This article identifies the main GADSS components, including proposals for specific tracking intervals for standard, or abnormal and distress flight situations. The potential timeframes in which these tracking initiatives will be implemented, the technology and services required to implement them, and the necessary on-board equipment are also discussed.

Current tracking standards

The surveillance systems required to provide air traffic control (ATC) with constant aircraft position data, are generally already in place for high-density airspace over land.

Surveillance systems may not, however, be available in oceanic airspace, or over more remote regions, such as the poles or regions of Africa.

In remote and oceanic regions aircraft use a combination of either an inertial navigation system (INS) or a global navigation satellite system (GNSS) to establish aircraft position, and either voice and datalink communications to send position reports at certain intervals.

"The frequency of position reports by pilots or aircraft to ATC in remote and oceanic airspace varies, depending on the density of the airspace and the procedures in place," explains Henk Hof, chairman of the ICAO ad-hoc working group for

flight tracking at Eurocontrol.

"On the North Atlantic tracks, position reports are made to ATC at every latitude- and longitude-based waypoint the aircraft flies over, or after 45 minutes have passed since the last position report was made, depending on which comes sooner," he adds. "Position reports are also made on the North Atlantic whenever an aircraft wishes to change its speed or altitude, or if its estimated time of arrival at an inbound waypoint changes by plus or minus three minutes from the previous reported estimate. In other remote airspace the interval could be up to one hour."

GADSS

The GADSS will have three main system components: aircraft tracking, autonomous distress tracking, and retrieval of flight data.

The whole system will be enabled by an information repository service and system-wide information management (SWIM) to ensure that, in the event of an abnormal or distress flight situation developing, information can be passed among stakeholders, including: the aircraft operator; air navigation service providers (ANSPs); and search and rescue (SAR) agencies.

The concept of operations for the GADSS is still being finalised.

Flight tracking

The flight tracking initiatives proposed as part of the GADSS call for flight-tracking functionality to activate, and remain available, from take-off to landing. They will apply to aircraft with a maximum take-off weight (MTOW) in excess of 27,000kg (37,479lbs) and with more than 19 seats.

"Operators must ensure that aircraft are constantly tracked, but will not have

to provide a tracking service in airspace where normal ATC surveillance systems are available," explains Hof.

Operators will, however, need to ensure they have tracking systems in place to cover airspace where ATC surveillance is unavailable. This is most likely in remote and oceanic airspace.

In cases where the tracking solution is provided by the operator, the airline will need to monitor the position data it receives. It is not yet clear if operators will also need to receive and monitor ATC data in airspace where their aircraft are tracked by ATC surveillance systems.

Some airlines already track aircraft to an extent, through their flight operations departments, although this is not consistent around the globe. "US airlines have a requirement for dispatchers to flight follow, but this does not specify any tracking metrics such as the frequency of reporting," explains Tim Ryan, director of GLOBALink programmes and services management at Rockwell Collins.

"Requirements for non-US carriers will vary across nation states, but in general there are no flight following requirements," adds Ryan.

Airlines may, therefore, be required to make operational adjustments, as well as upgrades to hardware, software or services to comply with tracking requirements.

ICAO proposed two initial flight-tracking objectives following a high-level safety conference in February 2015.

The first calls for a standard tracking interval for normal flight operations that would provide aircraft position reports at least every 15 minutes. ICAO expects that this standard will be applied from late 2016.

The second objective requires the capability to reduce the position update interval to once every minute in the event of an abnormal event being detected.

An abnormal event is defined as one

ICAO has proposed new flight tracking procedures. These call for 15-minute tracking intervals in normal flight conditions, and a 1 minute interval if an abnormal event is detected.

that requires immediate crew action and involves an increased risk to a flight.

The one-minute tracking requirement does not specify how an abnormal event should be detected, but stipulates that there should be capability to manually reduce the tracking interval to once-per-minute when an abnormal event arises.

The one-minute tracking interval is designed to provide search and rescue agencies with a more manageable search radius in the event of a crash or aircraft disappearance. ICAO has suggested that the current aim is to make the one-minute tracking capability applicable by 2021.

The 15-minute and one-minute tracking proposals would include the requirement for each position report to contain the aircraft's identification and its 4-dimensional (4D) position information. A 4D position report includes the aircraft's latitude, longitude, altitude and the precise time it was at each position.

ICAO cannot mandate the proposed standard and abnormal flight-tracking intervals. It will issue standards and recommended practices (SARPs) relating to the proposed tracking intervals. It is then up to local and national regulatory authorities to enforce the proposals, but it is widely expected that they will accept the proposals.

Other GADSS requirements

Other longer-term GADSS requirements include proposals for an autonomous distress tracking (ADT) system, and for retrieval of flight data, both of which are to be implemented in 2021.

The ADT will operate independently from standard aircraft-tracking systems. ADT will automatically broadcast 4D position reports or distress signals, based on certain triggers such as unusual altitude or speed data, or the failure of standard tracking systems. The ADT will be capable of operating independently from aircraft power systems if necessary.

The proposal for the retrieval of flight data will require crash-protected, automatically deployable flight recorders, fitted with emergency locator transmitters (ELTs). Recorders such as the flight data recorder (FDR) and cockpit voice recorder (CVR) would have to be attached to the exterior of the aircraft and automatically deployed in the event of a crash, whether it is a mid-air



collision, or impact with the ground or water.

Flight tracking solutions

Existing and future solutions that can or will satisfy ICAO's near-term GADSS initiatives are identified here. On-board technical solutions are considered first, followed by some main service providers.

Only those systems required to satisfy the 15-minute and one-minute tracking standards are discussed.

The 15-minute and one-minute tracking proposals are performance-based initiatives, so airlines do not have to adopt one particular solution to satisfy the tracking requirements. There are a number of available and planned technologies that could be used to meet the new tracking standards. Airlines are free to select the systems that are most suitable for their operation.

Current technology that would satisfy the proposed 15-minute and once-per-minute tracking standards can be split between ATC surveillance systems and other flight-tracking solutions.

ATC Surveillance

The main ATC surveillance systems available are: secondary surveillance radar (SSR) and automatic dependent surveillance broadcast (ADS-B) over land; and automatic dependent surveillance-contract (ADS-C) in remote and oceanic regions.

Airlines will not be obligated to provide additional independent tracking services where these ATC surveillance systems are available, but for the surveillance systems to work, aircraft will require appropriate on-board equipment.

SSR & ADS-B

SSR requires aircraft to be fitted with appropriate transponders. Most if not all commercial aircraft will already be suitably equipped.

Automatic dependent surveillance broadcast (ADS-B) is the latest system to be developed for ATC surveillance in high-density airspace. There are two main functions of this technology: ADS-B OUT and ADS-B IN.

ADS-B IN allows an aircraft to receive data from the ground and other ADS-B equipped aircraft. ADS-B OUT broadcasts position data. Aircraft equipped with ADS-B IN can also receive the ADS-B OUT position reports from others.

ADS-B OUT position data contain a number of parameters including the date and time, aircraft registration, flight number, airline code, latitude, longitude, altitude, speed and vertical speed.

Aircraft require an on-board position source, such as a GNSS or INS, and an extended squitter transponder for ADS-B functionality. Some aircraft are fitted with dual mode transponders that satisfy SSR and ADS-B requirements. Others require separate transponders for each function.

ADS-B-capable aircraft identify their own position via the onboard position source. They then constantly broadcast position reports via transponders.

ADS-B can provide a more accurate live surveillance picture than primary and secondary radar due to its precise GPS position reports. ADS-B was initially developed to help reduce aircraft separation and increase airspace capacity. It will eventually replace SSR as the primary means of ATC surveillance.

Aireon estimates that over 90% of



aircraft operating across the North Atlantic are equipped with ADS-B. By 2020 mandated ADS-B capability will be in place in many parts of the world, including North America and Europe.

SSR and ADS-B surveillance systems have limited range. They only provide coverage within 200-250nm of land-based receivers. The only ATC surveillance system currently available in remote and oceanic airspace is ADS-C.

ADS-C

ADS-C sends automated aircraft identification and 4D position reports to ATC and acts as an ATC surveillance tool. Unlike ADS-B, ADS-C does not continuously broadcast position. ADS-C transmissions are based on time intervals or events. The contract is between an ATC end-system and the aircraft. The air navigation service provider (ANSP) determines the parameters and frequency of reporting. ADS-C has replaced position by voice over HF radio over long distances, in remote areas.

“An ADS-C contract is an agreement between the ground facility and the aircraft, consisting of a request (uplink) and an acknowledgement (downlink),” explains Ryan. “Once a contract has been established, position reports will be sent to the ground facility until the specified contract conditions are met or the contract is cancelled.”

Ryan explains that there are three types of ADS-C position reports: current, periodic and event.

“Current position reports are also known as on-demand contracts. This type of contract produces a single, immediate position report on request,” says Ryan.

“Periodic contracts produce multiple

position reports at set time intervals.”

The final type of ADS-C reports are event-related. “An event report is triggered by a specific condition or event that matches conditions in the contract request,” says Ryan. “This might include a change in altitude or deviation from the expected track.”

Ryan cautions that there are a limited number of events that can be monitored to trigger event reporting.

“ADS-C allows an ANSP to set up one event contract and one periodic contract, which would then operate independently of each other.”

Aircraft equipped with ADS-C can already meet the proposed 15-minute and one-minute tracking standards. Periodic 4D position reports can be established at 15-minute or one-minute intervals. In addition, event contracts with specific triggers can be used to identify developing abnormal situations, before requesting increased reporting intervals to meet the one-minute requirement.

ADS-C is a function of the Future Air Navigation System (FANS) avionics solution, developed in the 1980s to allow more optimal routings for long-haul flights over remote and oceanic regions. It provides a navigation function and ATC surveillance via ADS-C. FANS also provides controller pilot data link communications (CPDLC) capability to support ATC communications.

FANS is commonly referred to as FANS-1/-A. FANS-1 is the Boeing standard and FANS-A is the Airbus standard. A new level of FANS has also been developed for use over land, featuring ADS-B rather than ADS-C. It is referred to as FANS-2 or FANS-B, depending on aircraft manufacturer.

For FANS-1/-A, and therefore ADS-C

In high-density airspace over land a number of ATC surveillance systems already monitor live aircraft positions. These systems include SSR and ADS-B. There is also a system for remote and oceanic airspace called ADS-C.

capability, aircraft need to be equipped with a position source that interfaces with the aircraft’s flight management system (FMS). In most modern aircraft the primary position source will be some form of GNSS, although an INS might also be used. ADS-C position reports are sent as Aircraft Communication And Reporting System (ACARS) messages, so an ACARS router will also be required.

There are a number of different classifications for flightdeck communications. Only certain air-to-ground communication systems can be used for each category.

Air traffic services (ATS) messages are those sent between an aircraft and ATC. They are considered to be safety-related and can only be sent via approved communications systems.

Aircraft Operational Communications (AOC) and Airline Administrative Communications (AAC) are those sent between the aircraft and airline back-office departments for operational or administrative purposes. They do not necessarily need to be sent by safety-approved communication systems. A wider range of connectivity systems can be used for them.

ADS-C transmissions are classified as ATS messages, so they must be sent over safety-approved communication pipes.

In remote and oceanic airspace the ADS-C ACARS messages are sent to ATC via Inmarsat Classic Aero or Iridium satcom, or via high-frequency data link (HF DL). The appropriate equipment for these communication channels will also be required, and will already be installed on many long-haul aircraft.

The Inmarsat Classic Aero and Iridium satcom systems both use the L-band radio spectrum.

Inmarsat ‘Classic Aero’ provides a data transmission rate of up to 10.5 kilobits per second (Kbps) and provides almost global coverage. The only gaps in its coverage are those polar areas further than about 82 degrees North and South. The Inmarsat ‘Classic Aero’ system became the standard Satcom option for safety-related communications from 1995.

The Iridium constellation is positioned in low-Earth orbit. It provides 100% global coverage and was approved for safety-related communications in 2011. The Iridium system has a data transmission rate of 2.4Kbps.



The hardware required for the Inmarsat Classic Aero and Iridium satcom systems includes a satcom radio, antenna and a duplexer low-noise amplifier (DLNA).

Like the Iridium satcom network, HFDDL provides 100% global coverage. Rockwell Collins is the only HFDDL service provider. It has 15 digital HF stations positioned around the globe.

Aircraft will require an HFDDL radio to send ADS-C position reports over HFDDL.

ADS-C messages are sent to ATC ground stations via the Rockwell Collins or SITA OnAir networks. ADS-C messages can, therefore, also be passed directly to airlines via Rockwell Collins or SITA OnAir. “ADS-C messages are encoded, so carriers would need the ability to decode them before they can use the information,” says Ryan.

Many long-haul aircraft are already equipped with FANS-1/A, and, therefore, with ADS-C capability. There are FANS-1/A mandates in place for the North Atlantic, so in order for aircraft to operate across the North Atlantic without restrictions, they must be FANS-1/A-equipped.

Other tracking solutions

There are a number of other on-board technologies available for flight-tracking.

ACARS position reports

ACARS was introduced in the 1970s to provide text-based communication from aircraft to airline operations and line maintenance departments, and may include a position reporting function.

Rockwell Collins and SITA OnAir

provide ground-based networks to receive and process ACARS messages sent from aircraft. Airlines need a contract with a provider to send ACARS messages.

ACARS position reports can be sent at pre-determined intervals, including every 15 minutes or one minute if needed. This can be configured by the airline, and set up by the pilot, or from the ground via an uplink.

ACARS position reports generally include latitude, longitude, time, aircraft identification and flight number. The time can sometimes be omitted, leading to a reliance on the timestamp of the ACARS message. Rockwell Collins notes that altitude is not generally included in ACARS position reports. If altitude is not included, ACARS position reports alone cannot be used to satisfy the 4D requirements of the 15-minute and one-minute tracking proposals.

It is still possible to send full 4D data in ACARS position reports, although the cost involved could vary considerably.

To send ACARS position reports aircraft must be equipped with on-board equipment to generate and process ACARS messages and the communication and connectivity systems necessary to send the position reports to the ground.

To create and process ACARS messages aircraft require appropriate routers. These tend to be called communications management units (CMUs) on Boeing aircraft and air traffic services units (ATSUs) on Airbus types. There are similar units for aircraft produced by other manufacturers. These routers collect relevant data from avionics units before generating and sending ACARS messages by the most cost-effective communication channel available.

The 15- and 1-minute tracking proposals will require airlines to ensure that someone is tracking their aircraft at these intervals. Operators will not be required to provide additional, independent tracking systems where ATC surveillance is available.

In many cases the appropriate ACARS router functions will be provided as standard fit on the production line.

Various retrofit options are available for aircraft that do not have ACARS capability, including Spectralux’s Dlink+ line replaceable unit (LRU) that combines the functions of a display, CMU and VDR in one LRU.

Aircraft will also require an on-board position source, such as a GNSS or INS, to generate ACARS position reports.

ACARS position reports are classed as AOC messages. In most cases they are likely to be sent via ATS-approved connectivity systems. In remote and oceanic airspace they are most likely to be sent via the Inmarsat Classic Aero or Iridium satcom pipes, or over HFDDL.

Aircraft need appropriate equipment for these communication channels.

ACARS position reports could also be sent in high density airspace over land. In this instance they would most likely be sent using very-high-frequency (VHF) radio or VHF digital radio (VDR). Aircraft would have to be equipped with the necessary VHF or VDR radio equipment in order to facilitate this.

HFDDL performance and frequency data

HFDDL can be used to transmit ACARS messages in remote and oceanic areas. This is included as part of Rockwell Collins’ datalink service.

The HFDDL network also regularly transmits other data between aircraft and high-frequency ground stations (HFGSS) as part of system diagnostic checks. These include frequency and performance data packets. “These are autonomous back-channel messages that include positional data and the time of day that the data packet was formed,” explains Ryan.

Latitude and longitude, and a message time stamp are provided, but the data packets do not currently include altitude data, so HFDDL performance data could not be used in isolation to meet the proposed tracking standards, since it will not satisfy the 4D position requirement.

“A new software load is being considered, adding altitude data to these HFDDL performance packets,” adds Ryan.

The HFGSSs currently request frequency and performance data every 10 minutes. Position data are stored within the HFGS, and also sent to a central

Rockwell Collins server in real-time.

To receive position data from HFDL performance packets, aircraft will need a GNSS or INS and an HFDL radio. If the altitude data were added to the HFDL performance packets they could meet the 15-minute tracking requirement.

HFDL can handle one-minute position reporting for distressed aircraft via ACARS position reports or ADS-C, but it would be more difficult for the HFDL frequency and performance data to include one-minute reporting.

FLYHT - AFIRS

Canadian company FLYHT Aerospace Solutions Ltd (FLYHT) provides flight-tracking capability as part of its Automated Flight Information Reporting System (AFIRS™) solution.

AFIRS can collect data from aircraft avionics and transmit it to the ground. It can also stream data from flight data recorders (FDRs), and provide voice and text messaging capability.

AFIRS is capable of providing aircraft identification and a live stream of 4D position reports in high-density, or remote and oceanic airspace, and can, therefore, meet ICAO's 15-minute and once-per minute tracking standards.

"AFIRS sends data to a ground-based server in short burst data (SBD) format

via the Iridium satcom pipe," explains Matt Bradley, president of FLYHT.

To send aircraft position reports using AFIRS, an aircraft needs to be equipped with the AFIRS 228 Iridium satcom unit. This is an all-in-one unit that features integrated GPS and Iridium satcom functions. Separate navigation aids and communication systems are not required. The AFIRS 228 unit can be retrofitted to any commercial airliner. It is also used as a line fit solution by a major aircraft manufacturer. About 30 airlines are already using AFIRS for flight-tracking.

In development

New technologies that could be used for flight-tracking purposes will become available in the next few years, able to track aircraft in high-density, and remote and oceanic airspace.

Aireon - Space-based ADS-B

Aireon is a joint venture between satellite communication provider Iridium and a number of ANSPs from around the world, including NAV Canada, ENAV, the Irish Aviation Authority and Navair.

It is developing a space-based ADS-B system. Unlike current terrestrial ADS-B services, Aireon's solution will provide 100% global coverage.

"The primary function of the space-based ADS-B system will be to provide air traffic surveillance data to ANSPs, although airlines will also be able to use it as a tracking tool," explains Cyriel Kronenburg, vice president of sales and marketing at Aireon. "The system will be able to track ADS-B equipped aircraft in real-time anywhere in the world."

Aireon's space-based ADS-B solution could be used to satisfy ICAO's 15-minute and one-minute tracking proposals, since it will transmit aircraft identification and 4D position information in real time.

Aireon's system will relay ADS-B OUT signals broadcast by aircraft transponders, to an Aireon ground station, via satellites equipped with ADS-B transceivers. The ground station will then stream the live position data to ANSPs and tracking customers.

The second-generation Iridium NEXT constellation of Thales-built satellites will host Aireon's ADS-B receivers, built by Harris. "We are essentially renting space for our ADS-B payloads on the Iridium NEXT satellites," explains Kronenburg. "This means Aireon does not have to invest in its own satellite constellation, which would have been prohibitively expensive.

"Aireon's transmissions are entirely separate from the other communication

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channels using the satellites,” continues Kronenburg. “Our transmissions use a separate receiver.”

The Iridium NEXT constellation will consist of 66 satellites in low earth orbit. These are expected to launch in 2015-2017 and will provide global coverage. Aireon currently expects its full ADS-B service to be available in 2018.

Aireon will be the only provider to relay ADS-B signals via the Iridium NEXT constellation.

Aircraft that are already equipped for terrestrial ADS-B will not require any additional equipment to make use of Aireon’s space-based service. They will need an ADS-B capable transponder and a GNSS. Some aircraft may use an INS.

UTAS - ADM flight tracking

UTC Aerospace Systems (UTAS) has developed a flight-tracking capability as part of its Aircraft Data Management (ADM) solution. UTAS’s ADM solutions include an aircraft interface device (AID), tablet interface module (TIM™) and SmartDisplay® electronic flight bag (EFB) computing systems.

The AID can be installed as a standalone device to allow Flight Operational Quality Assurance (FOQA) datalogging, and/or flight tracking capability. This is achieved via a software add-on that is hosted by the AID. The AID will use the software to download aircraft position and aircraft condition monitoring system (ACMS) data, and monitor aircraft health by analysing specific parameters defined by the airline.

The UTAS flight-tracking system will send data to the ground in ACARS message format over VHF, VDR, HFDL, Inmarsat Classic or Iridium Satcom pipes.

“The tracking interval will be configurable by UTAS and be based on customer requirements,” explains Joseph Kuruvilla, manager of sales aftermarket systems EMEA, global customer management at UTAS.

The system will provide aircraft identification and 4D tracking data. “4D position information will be taken from the aircraft navigation system,” explains Kuruvilla.

On modern aircraft this is normally a GNSS, but some older aircraft may still use an INS. Aircraft with the UTAS flight tracking solution will be able to satisfy the 15-minute and one-minute tracking intervals proposed by ICAO. The precise tracking interval can be configured through the software as appropriate.

The minimum equipment required for an aircraft to use the UTAS flight-tracking function is an AID with the appropriate software add-on, an ACARS router, a GNSS or INS, and relevant VHF, HFDL or satcom communication equipment.

UTAS expects the flight-tracking function of its ADM solution to be available in late 2015.

Inmarsat SwiftBroadband safety

Inmarsat’s SwiftBroadband (SB) satcom service was introduced in 2007. Unlike the first-generation Inmarsat Classic Aero and Iridium satcom pipes, SB sends data in an Internet Protocol (IP) format. It is an L-band system with a data transfer rate of up to 432Kbps.

Inmarsat is working to get SB approved for safety-related communications, including FANS, and therefore, ADS-C.

Inmarsat’s SB safety service will also

Some third party service providers offer an on-board hardware and/or software solution, a ground-based server and a back office portal or interface for flight tracking purposes. FLYHT’s AFIRS solution offers flight tracking capability as part of a broader product offering.

include an integral aircraft position reporting and tracking function that will provide 4D position information.

The SB safety service is available now for airlines wishing to trial the system. Full commercial SB Safety services will be available by the end of 2015 or in early 2016.

Third-party service providers

Airlines will need to use third-party service providers where they wish, or are obligated, to track their aircraft.

It is unclear if operators will also need access to position reports where aircraft are under ATC surveillance.

Some airlines may prefer to independently track their aircraft at all times for operational reasons. This may also be a more favourable approach than switching between ATC surveillance and independent tracking methods as the aircraft moves between different airspace.

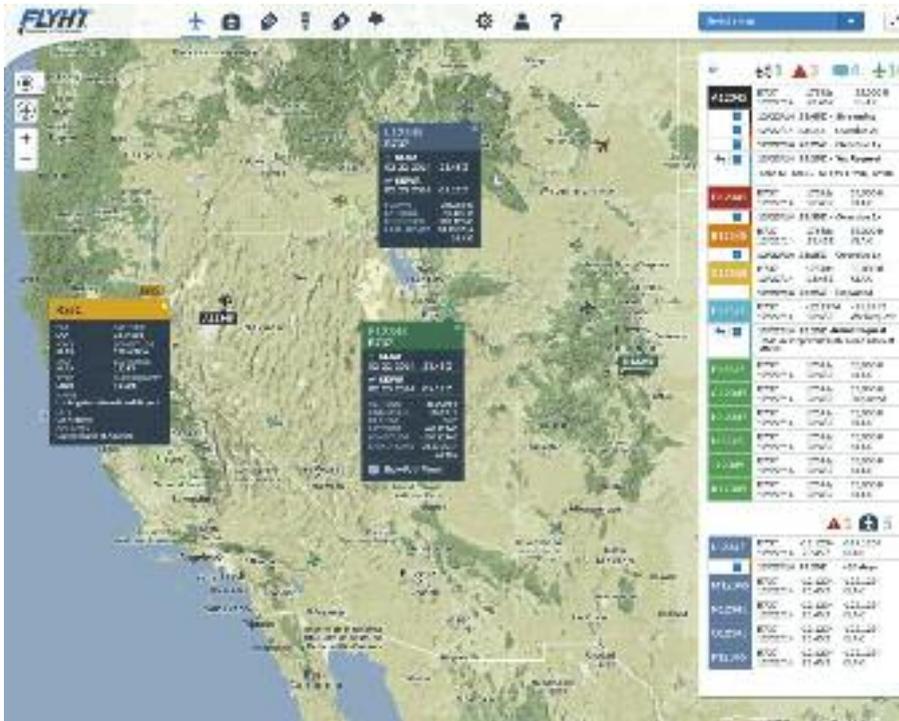
A number of third-party solutions have been developed, providing aircraft position reports from take-off to landing.

Several elements are required to have access to flight-tracking data, including on-board hardware and software with flight tracking functionality, communication pipes for air-to-ground data transmissions, a ground-based communication network, and a back-office portal or user interface on which the data can be presented and analysed.

Some third-party flight-tracking service providers offer air-to-ground communications pipes, a ground-based communications network and a back-office portal or user interface. These providers collate flight-tracking data from multiple third-party hardware and software solutions, including ATC surveillance systems. Examples include Rockwell Collins and SITA OnAir.

Other service providers offer a single technological hardware and/or software solution for flight-tracking, along with some form of ground-based server and a back-office user interface or portal. These providers do not offer air-to-ground communications pipes or ground-based communications networks. Examples include FLYHT, and UTAS.

Some airlines may decide to create in-house user interfaces for flight-tracking. They will, however, still require raw data feeds from service providers.



It has been suggested that operators might come to agreements with ANSPs to provide ATC surveillance data.

Some of the main third-party flight-tracking service providers and their products are examined here.

Rockwell Collins – ARINC MultiLinkSM flight tracking service

Rockwell Collins has a long history of providing air-to-ground voice and data services through its ARINC brand, which it purchased in 2013.

Its GLOBALink product includes a ground-based network for receiving and distributing voice and ACARS data messages from aircraft. It also provides VHF, VDL M2 and HFDL air-to-ground communication pipes. Rockwell Collins is the only provider of HFDL services.

The GLOBALink ground network is also capable of receiving and distributing voice and ACARS messages sent over third-party satcom pipes.

“ARINC first started providing flight-tracking services in the mid-1990s,” explains Ryan. These services included providing situational displays of aircraft based on ACARS position reports.

Rockwell Collins has now developed its ARINC MultiLinkSM flight tracking service, in response to ICAO’s 15-minute and one-minute flight-tracking proposals.

The ARINC MultiLink flight-tracking service is a ground-based software application that will pull aircraft positional data from many sources before presenting the combined information in a situational display tool. These sources could include ADS-C, ACARS and ADS-B position reports, digitised radar data from ANSPs, and HFDL performance and frequency data.

ARINC MultiLink will be the only flight-tracking service to harness position information within HFDL performance and frequency data; Rockwell Collins is the only provider of HFDL services.

ARINC MultiLink has been designed to incorporate data from other sources.

“If the flight-tracking proposals are going to be met, the solutions need to be affordable to airlines,” explains Ryan.

“The primary objective of ARINC MultiLink is to make efficient use of the data that airlines are already generating.

“ARINC MultiLink will pull various data feeds into a common location, extract the required position information, and harmonise the various data into a common format before providing it to the aircraft operator,” continues Ryan.

“The system will use all the available data, all of the time, providing a richer view of aircraft status,” adds Ryan. “The use of multiple data feeds could allow ARINC MultiLink to differentiate between a serious problem with an aircraft and a malfunction with an individual system, and alert the operator accordingly. For example, if ADS-C transmissions are interrupted, but other data feeds continued, this may suggest a problem with the FANS system. A failure of multiple data feeds might indicate a more serious issue with the aircraft.”

Airlines have several options for accessing ARINC MultiLink tracking data, including streaming data feed. This will involve pulling streaming data from Rockwell Collins servers and using it within their own situational displays or other applications. Data can also be integrated in Rockwell Collins’ WebASD and Skyview situational displays that are part of the ARINC OpCenter and Hermes flight operations systems.

The 15- and 1-minute tracking proposals require each position report to include an aircraft’s identification and 4D position information. The 4D position includes latitude, longitude, altitude and the exact time at the position.

Depending on available data feeds, ARINC MultiLink could be used to meet proposed tracking intervals, and could allow airlines to adjust the frequency at which position reports are received.

ARINC MultiLink users can receive ADS-C position reports at specific time intervals or after specific events. Airlines can set automatic triggers for an ADS-C position report, such as a variation in course or altitude. ADS-C position messages are decoded and forwarded to the WebASD situational display.

A future development of ARINC MultiLink will provide the capability to compare position data with a flight plan, allowing the system to alert operators when aircraft stray from their tracks.

ARINC MultiLink will be available in September 2015. The pricing structure for the service is yet to be confirmed.

SITA OnAir AIRCOM FlightTracker

SITA OnAir has years of experience in air-to-ground communications. Like Rockwell Collins, it provides voice and data communication services and has a ground network to receive and distribute voice or data messages over VHF, VDL M2, and third-party satcom pipes.

SITA OnAir has developed a ground-based software solution called AIRCOM FlightTracker. “AIRCOM FlightTracker was developed to provide a quick solution to airlines to improve tracking using technologies that are already in place on today’s aircraft,” explains Paul Gibson, portfolio director of AIRCOM at SITA OnAir. “It is a low-cost solution for airlines to meet and exceed the ICAO recommendation without need to install additional equipment on their aircraft.”

“AIRCOM FlightTracker collates multiple aircraft position tracking sources including ADS-B, ATC radar, ACARS and ADS-C,” continues Gibson. “It can automatically request position data from aircraft to fill gaps in terrestrial coverage to give complete global coverage, even for oceanic routes.”

“AIRCOM FlightTracker can compare the tracking data with an airline’s flight plans, and automatically generates alerts when unexpected conditions occur,” adds Gibson. “The airline can configure the rules that cause alerts to be created, such as a failure to transmit a position report when expected, and can also configure the FlightTracker

to specify the maximum required time interval between position reports.”

The AIRCOM FlightTracker could be used to meet proposed 15-minute and one-minute tracking intervals, depending on the data feeds available. It will decode ADS-C data for airlines to analyse.

SITA OnAir's AIRCOM FlightTracker, a software add-on for the AIRCOM FlightMessenger system, plots each aircraft's position on a Google Maps display. AIRCOM FlightMessenger provides SITA OnAir's ACARS messaging service. It is used by about half of the global ACARS-equipped fleet.

AIRCOM FlightTracker is installed at the airline or in the SITA ATI Cloud.

Four airlines have already signed up to AIRCOM FlightTracker, which is due to enter service with Malaysia Airlines in 2015. There was no information available about the pricing strategy for the AIRCOM FlightTracker.

SITA OnAir will make position reporting information from AIRCOM FlightTracker available free to SITA member customers in an emergency.

Aireon

Aireon will make its space-based ADS-B signals available to ATC providers. It will also make the data available to airliners for flight-tracking

purposes through a secure raw data feed, a basic visual tracking application, or third-party tools.

This should be available in 2018 and the pricing structure for airline access to Aireon's space-based ADS-B data is likely to be based on a monthly subscription.

Aireon also plans to provide a free emergency tracking service to authorised organisations in critical situations, such as loss of contact with an aircraft.

UTAS

Data from UTAS's flight-tracking system will be sent from the aircraft to a cloud-based server on the ground. This server could be hosted by UTAS or within an airline's own IT infrastructure. UTAS will provide a situational display tool for airline's using its hosted data.

It is unclear if aircraft position data from UTAS's system will be available to third-party flight tracking service providers. “The availability of the data will be determined by the customer because they own it, and it comes from its aircraft,” explains Kuruvilla. “UTAS provides the system to enable the functionality.”

“The system will have a distress monitoring capability that automatically increases data acquisition and position transmission rates when an incident or

abnormal event is detected,” adds Kuruvilla. “Algorithms hosted on the UTAS Aircraft Interface Device (AID) will detect the abnormal or distress situations and trigger the appropriate response.”

Kuruvilla points out that the flight tracking function can be an add-on to UTAS's other ADM solutions or a stand-alone feature.

UTAS's pricing model for flight tracking will depend on the functionality required by the airline. The service is expected to be available in late 2015.

FLYHT

Data transmitted by FLYHT's AFIRS is sent to a ground-based server known as UpTime™. This stores the data and transfers it in real time to the operator.

FLYHT provides a user interface called FLYHTFollow that can be used to track aircraft positions and alerts. AFIRS tracking data can be made available to third-party tracking solutions if required.

“AFIRS can manually and automatically alter the frequency of position reports in three main ways,” explains Bradley. “First, the interval can be adjusted by the user manually using a ground interface. Second it can be programmed to automatically increase or decrease, depending on the geographic area in which the aircraft is flying. This is

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known as ‘geofencing’. Finally, on-board logic can be programmed to increase the frequency of position reports in the event of abnormal activity. This might include an unexpected deviation in course or altitude, or unusual pitch or roll activity.”

AFIRS can compare an aircraft’s actual position to the flight plan in the FMS and alert the operator if there is a deviation.

“It is not enough to know that an aircraft has deviated from the flight plan,” says Bradley. “The operator needs to know why.”

“AFIRS can programme on-board algorithms so that an aircraft has the ability to identify when it is in trouble and send an alert,” continues Bradley. “Due to AFIRS’ ability to access FDR data, the on-board logic can be programmed to monitor more detailed parameters than just a deviation from the flight plan. These might include pitch, roll and yaw parameters, for example.

“When the system detects a defined abnormal or distress event it can begin streaming FDR data automatically,” adds Bradley. “This service is known as FLYHTStream™. It is possible to send enough FDR data over the Iridium pipe in one minute to identify key parameters associated with a distress event.”

There is a charge for the AFIRS box and a flat fee per aircraft per month for the tracking and alerting service. FLYHT will provide free emergency tracking.

“Airlines can buy the FLYHTFollow tracking solution without buying AFIRS, but they will lose some key functionality enabled by AFIRS,” adds Bradley.

Airline cost considerations

ICAO’s focus on implementing

performance-based flight-tracking requirements should limit the extent to which airlines need to re-equip aircraft, cushioning the potential cost impact.

Many aircraft are already equipped with hardware and software systems that capable of satisfying the 15-minute and once-per-minute tracking initiatives.

In high-density airspace, most aircraft are already covered by ATC surveillance systems including SSR or ADS-B.

In remote and oceanic airspace many long-haul aircraft are already equipped with FANS-1/-A, and, therefore, ADS-C capability. FANS-1/-A is already required for long-haul aircraft to operate certain routes and further mandates are in place to extend these requirements.

Narrowbody and regional aircraft may be less prepared for the tracking requirements when operating in remote or oceanic airspace. They are, however, less likely to operate in such airspace.

In addition, any aircraft operating within some of the world’s busiest airspace will be subject to mandates relating to next-generation ATC systems, such as the Single European Sky (SES) scheme in Europe, and NextGen in the US. Implementation of ADS-B-OUT capability will be mandatory in these regions by 2018 and 2020 respectively, so many narrowbody and regional aircraft will need to be suitably equipped. They will subsequently be able to use their ADS-B functionality for tracking in remote and oceanic regions when Aireon’s space-based ADS-B solution is available in 2018.

Some operators may prefer flight-tracking solutions that are independent from ATC surveillance systems such as ACARS, FLYHT’s AFIRS, or UTAS’s ADM. As flight-tracking can be only one

Some third party flight tracking service providers gather data from multiple hardware and software solutions, including ATC surveillance systems. Rockwell Collins ARINC MultiLink system can collate these multiple sources into a single user interface.

element of a broader capability range with these solutions, operators may prefer the synergies this provides.

Operators will also need to account for the fees charged by third-party service providers for the provision of tracking data. They also need to consider the costs incurred by the various air-to-ground communication pipes. Air-to-ground data costs can vary significantly.

Future solutions

The flight-tracking solutions discussed so far are capable of providing aircraft position data, as long as the appropriate systems are functioning correctly.

InFlight Labs is developing a system called Smart ELT that can be activated by an anomaly in key avionics, or remotely by ATC via Iridium satcom. When activated, Smart ELT sends an emergency signal to search and rescue satellites (SARSAT), as well as GPS position data to ATC every 20 seconds to help locate a distressed aircraft. InFlight Labs Smart Avionics Systems include Smart ACARS, Smart ADS-B, Smart ELT, Smart FDR and Smart Transponder. They are additions for existing avionics systems that monitor the power or data to those systems through all phases of flight.

“The focal point of InFlight Labs’ offering will be the Smart ELT,” explains Joseph Beganich, spokesman at InFlight Labs. “The Smart ELT is activated automatically if a data parameter is breached in any key avionics or a power interruption is detected by the Smart Avionics functions. Smart ELT then automatically sends a distress signal to SARSAT and ATC concurrently.

“All key avionics can be switched off during flight,” claims Beganich. “The tamper-proof Smart Avionics System with Smart ELT products will police existing avionics,” continues Beganich. “Now if an aircraft system fails or is turned-off intentionally, an aircraft can still be tracked anywhere in the world. Pilots will still be able switch off various systems but ATC will know about it, regardless of the circumstances.”

InFlight Labs expects to begin testing its solution in six to nine months. **AC**

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