



**WORKING PAPER**

**MULTIDISCIPLINARY MEETING REGARDING GLOBAL TRACKING**

**Montréal, 12 to 13 May 2014**

**Agenda Item 3: Explore the potential for strengthening ICAO provisions**

**AIRCRAFT TRACKING – DIFFERENT ISSUES AT STAKE**

(Presented by the European Union)

**SUMMARY**

This working paper aims to discuss various possibilities on the permanent tracking of aircraft by satellite or other means of communication, especially for flights in airspaces without any coverage by ATM ground surveillance means, in particular over oceans. It also addresses the timely localisation of an aircraft after an accident and the localisation of aircraft wreckage under water.

**Action:** Action by the meeting is contained in paragraph 5.

**1. OBJECTIVES**

1.1 The core issue is to address public expectations that the aviation system can cope with situations such as the disappearance of flights including AF447 and MH370. For the general public, it has become unthinkable that a flight can simply disappear; an aircraft should be permanently tracked, even beyond radar coverage and in case of an accident, it should be immediately located. This issue had already come to the fore in the aftermath of the AF447 case, and much thinking has gone into it on the basis of which action can be taken.

1.2 The core task is to convince stakeholders that it is crucial for both safety and security reasons to be able to generate an alert immediately after the loss of a commercial air transport aircraft and to determine quickly the aircraft location wherever the event occurred and whatever its survivability and then to agree on the most appropriate and cost-effective means. In case of an accident, air traffic control (ATC) must be aware of a problem in the first place so that they can alert the responsible authorities, whilst search and rescue (SAR) teams must be informed as soon as possible and have a precise location to assist potential survivors. Safety investigators need to access the necessary pieces of evidence (wreckage) and data (flight recorders) to determine the circumstances and causes of the accident. In addition, the relevant stakeholders (such as regulators, manufacturers, operators) must be informed to take mitigating measures, where necessary.

1.3 More generally, the issue can also be linked to existing and future plans to upload (more) flight and health data in real time from aircraft in flight; today this practice varies considerably from one airline to another.

1.4 The issue of permanently locating aircraft has resurfaced after the disappearance of flight MH370. Without prejudice to the accident causes, this accident highlighted a number of vulnerabilities, in particular regarding the possible intentional disconnection of airborne ATM systems. The fact that a number of other airplane losses are related to deliberate actions by pilots leads to include this issue in aircraft tracking, in particular by alerting someone on the ground of the development of an unusual situation. Knowing as soon as possible the development of unusual situations, such as the deliberate disconnection of flight recorders or tracking systems, should help to improve our understanding of them and in turn to prevent loss of data as a result of a crash. It should enable to quickly distinguish intentional events from related accidents.

1.5 To address the issues raised by flights AF447 and MH370, the following high level objectives are proposed. They include survivability, safety investigation and accident prevention as well as intentional disconnection. The following table summarises these objectives with their related issues and provides associated criteria.

Aspect	Issue	Example high level objective and associated criteria
<b>Survivability</b>	<p>When an aircraft is lost in an area not covered by ATM ground surveillance, search and rescue means are not timely alerted and they do not have accurate location information, making it impossible to save any life.</p> <p>The performance of current models of fixed ELT has proved to be ineffective in a number of cases.</p>	<p>The competent SAR entities should be alerted and get a location of the end of the flight, in a timely manner and wherever the aircraft is lost<sup>1</sup>.</p> <p>This alert should work for all potentially survivable accidents (e.g. robust to normal power loss, and to partial destruction of the airframe).</p>
<b>Safety investigation and accident prevention</b>	<p>The aircraft wreckage and the flight recorders cannot be found, and the causes of accident remain unknown. The victims' relatives have no information and effective corrective actions by regulators and the industry cannot be taken.</p>	<p>Means should be provided to locate the aircraft wreckage and the flight recorders, wherever they rest over land or under water and within a few days. This means should also work in non-survivable accident conditions.</p>
<b>Security (intentional disconnection)</b>	<p>An aircraft can go missing in areas without primary radar surveillance by simply disabling communication systems and the transponder.</p>	<p>An indication of actual aircraft trajectory should be made available to competent authorities when requested, and there should be no means to intentionally disable it.</p>

<sup>1</sup> EASA Opinion 01/2014 specifies that the point of impact must be determined with 6 NM accuracy and within 3 hours of the accident time.

## 2. BACKGROUND

2.1 After the AF447 accident, the French safety investigation authority (BEA) convened a 'Flight Data Recovery Working Group' and afterwards a 'Triggered Transmission of Flight Data Working Group'. The latter group was composed of more than 150 members from many countries, representing a wide range of participants, including investigation bodies (BEA, NTSB, AAIB, TSBC, ATSB, ASC, MAK), regulatory authorities (such as ICAO, EASA, FAA, DGAC), airframe manufacturers (Airbus, Boeing), service providers, equipment and satellite manufacturers (Astrium/Star Navigation, Inmarsat, Iridium, FLYHT, DRS, etc.), and international associations (IATA, COSPAS-SARSAT). In March 2011, this group concluded that it was technically feasible to significantly reduce the search area for wreckage by:

- triggering transmission of appropriate data via satellite communication prior to impact; and/or
- automatically activating emergency locator transmitters (ELTs) prior to impact; and/or
- automatic reporting of aircraft position at regular time intervals.

2.2 At the ICAO 12th Air Navigation Conference (November 2012) a European Working Paper on oceanic positioning and tracking, and flight data triggered transmission (WP/55) was presented, drafted in cooperation between the SESAR-JU and France, asking ICAO to evaluate, as a matter of urgency, the necessary changes in the field of transmission of flight data.

2.3 ICAO flight recorder panel (FLIRECP) proposed that all aeroplanes of a MCTOM of over 27 000 kg for which the individual certificate of airworthiness is issued after 1 January 2020, have a means to establish the position of an accident within 6 NM accuracy. The means of compliance were:

- a) ELTs integrated in a deployable recorder or activated in flight upon automatic detection of an emergency;
- b) regular and automatic transmission of aircraft position;
- c) triggered transmission of aircraft position upon automatic detection of an emergency.

2.4 It was considered that any transmission of position through various systems, like satellite communications or HF data link, could be also acceptable means of compliance. To be effective, a regular transmission should be made every minute in order to comply with the proposed 6 NM accuracy requirement. The FLIRECP proposed to progressively implement these requirements for large aeroplanes performing long-range over-water flights or performing flights over designated land area. ICAO ANC agreed with the principle of 6 NM accuracy, however they identified some issues with the proposal of the FLIRECP (integration with Standards on ELT and state of maturity of technological options) therefore they deferred back the FLIRECP proposals in 2012, and again in 2013.

2.5 In a recent amendment to Annex 6 to the Chicago Convention applicable since November 2012, ICAO adopted Standards to extend the transmission time of flight recorder underwater locator beacons (ULBs) to 90 days (from 30 days) for large aeroplanes and to have the airframe of large aeroplanes fitted with ULBs emitting at a lower frequency and having a much greater detection range. In both cases, it should be done not later than 1 January 2018. The implementation of these two measures is expected to address the objective of safety investigation and accident prevention.

2.6 In response to safety recommendations and the new Standards in ICAO Annex 6, EASA has proposed, in Notice of Proposed Amendment (NPA) 2013-26, changes to the requirements for flight

recorders and to mandate a long-range<sup>2</sup> ULB for certain aircraft in order to improve the possibility to locate a missing aircraft. This NPA also introduced the means to locate the accident within 6 NM accuracy as an alternative to the long-range ULB, since if this means was in place, the underwater search area would be small enough and extending the transmission time of flight recorders ULBs to 90 days would be sufficient. EASA Opinion 01/2014, which is the final proposal of EASA to the European legislator after reviewing the comments on NPA 2013/26, was published on 6 May 2014.

2.7 Properly addressing the issue of intentional disconnection and informing the competent authorities of the position of a missing aircraft upon request, will require new technological elements on board, or evolution of existing technologies. One possible cost effective mean of compliance, as detailed in the working paper entitled 'Aircraft Tracking and Localisation Options', is the new return link service (RLS). This RLS link, exploited by COSPAS-SARSAT, would allow the SAR Master Control Center (MCC) to activate at distance the ELT, which would then automatically report aircraft position. Provisions should be made so that these ELTs can only be de-activated by the MCC, but not by aircrew.

### 3. DISCUSSION

3.1 This working paper is complemented by another working paper (Global Tracking 2014-WP/6) that presents a number of options for aircraft tracking and localisation, including the aforementioned means of compliance, by considering a number of points: 1) the robustness of the on-board systems to technical issues or intentional disconnections; 2) Coverage over remote areas; 3) Conditions/frequency of transmissions to ensure a timely alert; 4) Geographical accuracy and 5) Multiple providers/costs.

3.2 This second working paper contains a table that summarizes the previous options, their pros and cons with a ballpark quantitative assessment of their associated costs and possible time for implementation. This table highlights the high-level objectives that should be met for each option.

3.3 The above-mentioned options will need to be carefully studied as well as their limitations.

### 4. CONCLUSIONS

4.1 AF447 and MH370 cannot be considered as isolated cases. There is a growing number of long-range aircraft that fly over oceans to connect distant continents. It is important to improve the ability to quickly locate (missing) aircraft for saving potential survivors and preventing effectively future accidents.

4.2 It is recommended to follow an approach that addresses the needs of all relevant stakeholders (search and rescue specialists, accident investigators; air traffic controllers; flight safety/airworthiness/maintenance services) rather than letting them develop separate and incomplete solutions, in particular where their technological needs are rather similar.

4.3 It is also important to take into account the current means already in place for search and rescue (COSPAS-SARSAT infrastructure and current ELT requirements) and for locating the wreckage

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<sup>2</sup> Current ULBs attached to flight recorders use 37.5 KHz, which provides a limited range of between 2 to 3 km. A lower frequency beacon/device (8.8 KHz) would enable the signal to be picked up at distances up to 30 km. Military assets (vessels, submarines, subsea warfare aircraft) are all fitted to detect low frequencies (in the audible spectrum), which is not the case for 37.5 KHz that requires specific hydrophones (only available in a very limited number).

and the flight recorders under water (in particular, the new ULD requirements proposed by NPA 2013-26). ULB Standards contained in ICAO Annex 6 and transposed in European rules by EASA Opinion 01/2014). The future solutions should complement what is already working today in a consistent and cost-effective manner.

4.4 Near real-time transmission of aircraft position could be achieved in the longer term upon automatic detection of an emergency or the use of deployable flight recorders, and in the medium term by automatic transmission of aircraft position at regular intervals. Such regular and automatic transmission of aircraft position could facilitate SAR and the safety investigation (if it is made robust to accident conditions and to intentional disconnections) and it could improve air traffic control coverage over remote areas leading to improved routing.

4.5 Several technological options exist. However, any standards imposed on the industry will to the extent possible need to be technologically neutral and avoid dependency on monopoly providers. Hence, performance-based requirements based on high-level objectives should be preferred.

4.6 Decisions will need to be taken on issues such as what constitutes an adequate surveillance of the aircraft position; what should be the availability of the signal that indicates the position of an aircraft; under what conditions an alert should be triggered; how the continuity (non-interruptability) and reliability of the system should be ensured; how should interoperability of different technical solutions should be ensured.

## 5. ACTION BY THE MEETING

5.1 The meeting is invited to:

- a) endorse the proposed high-level objectives introduced in this working paper;
- b) note the availability of a number of options to address the issue of aircraft tracking, as well their respective advantages and disadvantages;
- c) evaluate the necessary changes in the field of transmission of flight data and develop performance based amendments to the appropriate ICAO Standards within a short timeline; and
- d) ensure that the changes take into account existing provisions and on-going development to avoid costly duplication of efforts.

— END —