International Civil Aviation Organization

TWELFTH MEETING OF THE SOUTH EAST ASIA AND BAY OF BENGAL SUB-REGIONAL ADS-B IMPLEMENTAITON WORKING GROUP (SEA/BOB ADS-B WG/12)

Guangzhou, China, 08 – 10 November 2016

Agenda Item 3: **Review implementation and co-ordination activities and sub-regional implementation plans**

3.3) Updates by other States

BOEING 787 ADS-B DEFICIENCY UPDATE

(Presented by Australia, Singapore, Hong Kong China, and United States, with contribution from Boeing and Rockwell Collins)

SUMMARY

This paper provides an update on an ADS-B problem experienced with Boeing 787 aircraft and detail of rectification plans.

1. Introduction

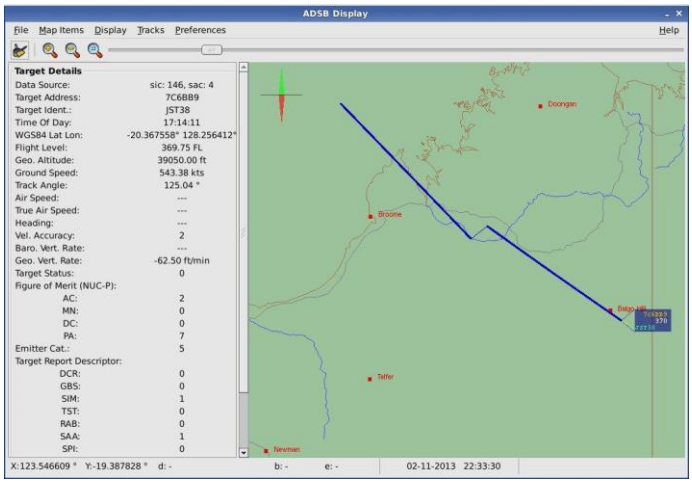
1.1 This paper describes the current status of an ADS-B deficiency that afflicts Boeing 787 aircraft, and the plans for rectification of the operational fleet.

1.2 This paper is a status update that follows from the paper presented at the ADS-B SITF/15 in Bangkok, Thailand (April 2016) as IP/05 and at Sub-Regional ADS-B Implementing Working Group (SEA/BOB ADS-B WG/11 Nov 2015) as WP/09.

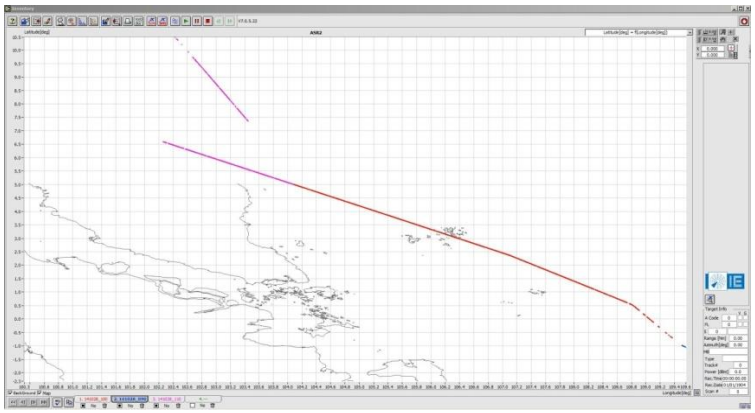
2. History

2.1 On 29th October 2014, an Australian registered B787 aircraft was observed by ATC to be transmitting inaccurate ADS-B positional data whilst declaring the data as high integrity.

2.2 In this case, following a heading change at a planned waypoint, the reported ADS-B data appeared to be extrapolated in a straight line with constant velocity along the previous heading until it auto-corrected. The correction was observed as a “jump” shown below. The aircraft is flying from the north-west towards the south-east.



2.3 Airservices subsequently became aware of similar incidents, both for this particular aircraft, and for other B787 aircraft operating internationally including Singapore, USA, Canada and Europe. Data was collected from a number of Asia Pacific ANSPs supporting the investigation. Another correction was observed as a "jump" shown below. The aircraft is flying from the south-east towards the north-west.



Trajectory provided by CAAS Singapore

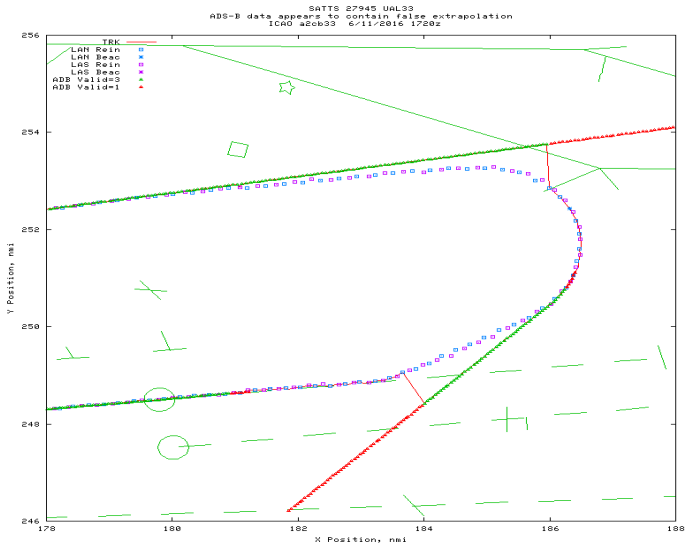
2.4 Boeing identified that the root cause was associated with the Surveillance processor within the B787 Integrated Surveillance System (ISS) which computes and assembles the ADS-B message, relating to the way in which latitude and longitude data were packaged for delivery to the transponder function. When the latitude and longitude information was split across different data packets, the transponder function did not process the position data, and instead commenced extrapolating the position at constant heading and velocity – until the position data was again contained within a single message packet.

2.5 In late 2015, Boeing and Rockwell Collins finalized development of the DO-260B upgrade for the B787 fleet. As well as correcting the original extrapolation issue, and supporting DO-260B, the upgrade provided other reliability benefits for the avionics. The 787 Type Certification has been amended to include the software upgrade - Service Bulletin (SB) B787-81205-SB340005-00. The upgraded ADS-B Out function is compliant with FAA AC 20-165A, EASA CS-ACNS Subpart D (Surveillance) and TSO-C166b.

2.6 The majority of B787 operators have since applied the Service Bulletin.

3. Recent Developments

3.1 In June 2016, the FAA reported 2 instances of similar incorrect ADS-B position extrapolation errors; 1 x United Airlines B787 at Los Angeles (shown below), and 1 x Aeromexico B787 at Tijuana, despite having been upgraded to the latest software version (DO-260B).



Trajectory provided by FAA

3.2 The extrapolation errors were investigated by Boeing and Rockwell Collins. It was quickly determined that the original cause – splitting of data packets for position as transmitted to the transponder (and fixed in the above Service Bulletin) was not at fault, but that another fault mode was responsible.

3.3 The fault mode was subsequently identified as occurring when the internal timing between different elements of the Integrated Surveillance System became synchronized, resulting in data packets (for both GNSS position and also for altitude), not being distributed to the transponder. The potential for "stale" altitude data also impacts TCAS system logic.

3.4 No other ANSP has reported this position extrapolation error occurring in service, other than the incidents uncovered by FAA described, plus an additional event detected by FAA in August 2016 (on departure from San Francisco). All events detected by FAA have occurred on different aircraft. Additionally, there have been 3 ATC reports of misleading pressure altitude reported (in over 2.8 million flight hours).

4. Current status

4.1 Rockwell Collins declared a TSO non-compliance due to the erroneous position extrapolation and the erroneous altitude that can potentially be reported by the transponder. Until a software fix was implemented, this caused a "stop shipment" of ISS units from Rockwell Collins to Boeing.

4.2 Software changes to elements of the Integrated Surveillance System (ISS) have been identified to fix the root cause and include:

4.2.1 Reducing the rate of data exchange – this change is complete and addressed the TSO non-compliance so the "stop shipment" could be lifted. This change is included on currently shipped ISS units from Rockwell Collins.

4.2.2 Adding defensive code to prevent extrapolation/coasting exceeding 3 seconds

4.3 Rockwell Collins are progressing towards TSO certification of the complete software enhancements (expected during November 2016). Boeing will perform a change to the B787 Type Certificate for incorporation of the upgraded ISS.

4.4 It may be expected that the upgrade will be available for deployment to the in-service B787 fleet in April 2017 via Service Bulletin after the first 787 production line delivery.

4.5 The first aircraft off the production line with the fully upgraded software is expected to be delivered in April 2017.

4.6 To the authors' knowledge, no states have implemented any "exclusions" or "blacklists" in response to this more recent issue.

5. Action by the Meeting

5.1 The meeting is invited to

a) note the latest manifestations of erroneous position extrapolation, and actions undertaken by Boeing and Rockwell Collins to solve the problem;

b) note that the avionics software upgrades will still take some months for release and to be deployed across the B787 fleet; and

c) discuss any relevant matters as appropriate.

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