International Civil Aviation Organization

AUTOMATIC DEPENDENT SURVEILLANCE – BROADCAST SEMINAR AND ELEVENTH MEETING OF AUTOMATIC DEPENDENT SURVEILLANCE – BROADCAST (ADS-B) STUDY AND IMPLEMENTATION TASK FORCE (ADS-B SITF/11)

Jeju, Republic of Korea, 24-27 April 2012

Agenda Item 6: Review States' activities and interregional issues on trials and implementation of ADS-B and multilateration

ADS-B AVIONICS ISSUES EXPERIENCED

(Presented by Australia)

SUMMARY

This paper provides details about ADS-B avionics issues experienced by the Australian ANSP and makes recommendations for reporting these deficiencies

1. Background

1.1 Whilst almost all ADS-B avionics operates correctly a few issues have been encountered by a number of states.

1.2 This paper catalogues the issues experienced by the Australian ANSP.

2. Feedback is necessary for correction

2.1 For problems to be rectified it is critical that the appropriate "feedback" networks exist.

2.2 It is highly desirable that those discovering problems study then, capture data and analyse them and find the root cause.

2.3 They must also convey the information to those that can initiate change including:

- Regulators – to initiate any appropriate regulatory action or enforcement
- aircraft operators – to allow airline avionics specialists to examine the causes and as customers of the avionics companies ensure that corrective action takes place

- avionics companies – to give them the technical evidence and knowledge about the problem

Incentives must be created to ensure that appropriate parties act on the information received including

- Regulations that require deficiencies to be rectified
- Regulatory enforcement
- Consequences to the conduct of operations with incorrectly operating equipment

Eg no access to airspace requiring the equipment

2.4 If ANSP reports an ADS-B problem, they should provide adequate detail about the nature of the problem to the regulator, the operator and the relevant avionics companies. As an industry we will not make the technology work unless we are diligent in this endeavour.

2.5 The solution to these problems is the careful cataloguing of the problems and working at them one by one.

2.6 In WP/10 at ADS-B SITF Bangkok meeting in 2004 the Task Force decided to establish a database of identified problems. Australia is the custodian of the database but has not received any reports from states. Australia is willing to continue to catalogue the issues as agreed in 2004.

3. Operation with deficiencies

3.1 All technologies and avionics systems have problems. For example there are numerous problems associated with Mode A/C and Mode S transponders that exist today. The Industry continues to work hard to identify and correct them, but at the same time we continue to use transponders for ATC. The correction process is slow, but can be speeded up by earlier and more thorough reporting.

3.2 A catalogue of ADS-B deficiencies currently managed in the Australian environment is provided in Attachment A. Only a small number of problem types have been identified and in general, few aircraft exhibit these problems.

3.3 It must be noted that aircraft transmitting poor positional data with NUC=0 or NIC=0 are not considered a problem. The data they are transmitting declares that the data does not have integrity. This situation exists with many aircraft when the GNSS receiver is not connected to the transponder. This data is typically not used by ATC.

3.4 There are two major mechanism for managing identified problems:

a) Regulations which require non approved avionics to disable ADS-B transmission (or transmit “no integrity”). In Australia, CASA published regulations regarding this issue in 2007. After subsequent revision in 2009 to exclude NUC=0 airframes, the regulations currently state :

More recently APANPIRG has agreed that a similar rule will be applied as a regional procedure in Asia Pacific.

b) Filtering out and discarding data from any airframes that do not comply with the regulations and advising the regulator of the non compliance.

4. Black list/ White list filtering

4.1 Currently Australia's filtering uses a "white list" filtering system whereby only "approved" aircraft have ADS-B data presented to ATC.

4.2 Airservices is working on a safety case, to abandon the use of the aircraft by aircraft "white list' filtering system. Once abandoned, the ATC system will present all aircraft ADS-B transmissions with adequate quality, other than known (blacklisted) aircraft having faulty transmissions, to ATC. As for transponders, the ATC system will assume that all transmitting aircraft have ADS-B equipment that operates correctly in accordance with the regulations. Exceptions will then be managed in the same way that problems are managed for SSR transponders.

5. Recommendation

5.1 It is recommended that

A) The meeting note that:

- A small number of ADS-B avionics problems have been identified in Australia.
- Mechanisms exists to allow management of these aircraft
- Solutions exist for most identified problems (usually transponder software revisions)

B) States:

- report identified ADS-B problems to their regulator, the airline and the avionics vendor With all appropriate details.
- report identified ADS-B problems to Australia for entry in the ADS-B Task Force deficiency database.

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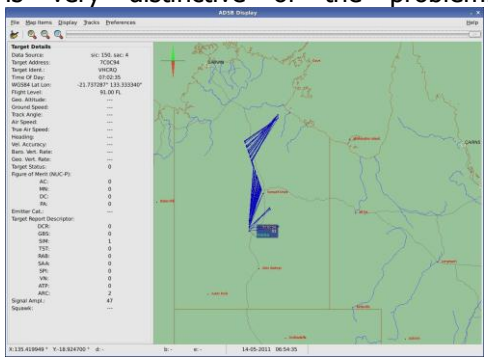
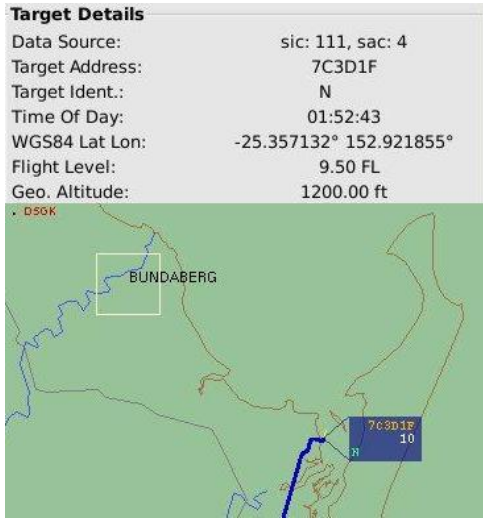
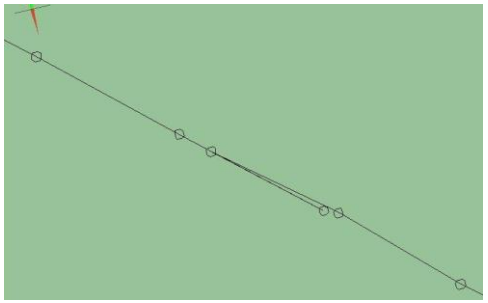
Attachment A : Table of Known ADS-B Avionics issues

Reference	"Problem"	Cause	Presentation to ATC if allowed to display	Comments
1.	Track Jumping problem with TPR901 	Software issue with TPR901 transponder only affecting Boeing aircraft. Does not occur in all aircraft with this transponder.	Will present as a few wild/large positional jumps. Nearly all reports are tagged as low quality (NUC=0) and are discarded, however, some occasional non zero reports get through. Problem is very "obvious". Could result in incorrect longitudinal position of Flight Data Record track. Can trigger RAM alerts.	Problem identified and fix has been rolled out in fleets known to have been affected. Rockwell Collins released Service Bulletin TPR-901-34-503 on March 1, 2011 to correct this anomaly. This component service bulletin changes the part number to 822-1338-005. The fix has been proven to work. Airlines operating to Australia have been corrected. If a new case is discovered, an entry needs to be made to the black list until rectification has been effected.
2.	Rockwell Collins TDR94 Old version. The pattern of erroneous positional data is very distinctive of the problem. 	Old software typically before version -108. The design was completed before the ADS-B standards were established and the message definitions are different to the current DO260. Rockwell has recommended that ADS-B be disabled on these models.	Will present as a few wild positional jumps. Nearly all reports are tagged as low quality (NUC=0) and are discarded, however, some occasional non zero reports get through. Also causes incorrect altitude reports. Problem is very "obvious".	Problem well known. Particularly affects Gulfstream aircraft which unfortunately leave the factory with ADS-B enabled from this transponder model. Rockwell has issued a service bulletin recommending that ADS-B be disabled for aircraft with this transponder software. See Service Information Letter 1-05 July 19, 2005. It is easy to disable the transmission. If a new case is discovered, an entry needs to be made to the black list until rectification has been effected.

3.	Litton GPS with proper RAIM processing	Litton GNSSU (GPS) Mark 1 design problem. (Does not apply to Litton Mark II). GPS does not output correct messages to transponder.	Perceived GPS integrity changes seemingly randomly. With the GPS satellite constellation working properly, the position data is good. However the reported integrity is inconsistent and hence the data is sometimes/often discarded by the ATC system. The effected is perceived extremely poor "coverage". The data is not properly "protected" against erroneous satellite ranging signals – although this cannot be "seen" by ATC unless there is a rare satellite problem.	This GPS is installed in some older, typically Airbus, fleets. Data appears "Correct" but integrity value can vary. Performance under "bad" satellite conditions is a problem. Correction involves replacing the GNSSU (GPS) which is expensive. If a new case is discovered, an entry needs to be made to the black list until rectification has been effected.
4.	SIL programming error for DO260A avionics	Installers of ADS-B avionics using the newer DO260A standard mis-program "SIL". a) This problem appears for DO260A transponders, with SIL incorrectly set to 0 or 1 (instead of 2 or 3) b) As the aircraft enters coverage, the ADS-B ground station correctly assumes DO260 until it receives the version number. c) The transmitted NIC (DO260A) is interpreted as a good NUC (DO260) value, because no SIL message has yet been received. The data is presented to ATC.	First report of detection appears good (and is good) , all subsequent reports not displayed because the data quality is perceived as "bad" by the ATC system. Operational effect is effectively no ADS-B data. Hence no risk.	Would NOT be included in a "black list".

		D) When the SIL is received, the ground station realises it is DO260A, and examines the SIL. Since the SIL does not meet requirements, the reported FOM is set to zero and removed from the ATC display. IMPACT: Good data not provided to ATC		
5.	Garmin "N" Flight ID problem 	Installers of Garmin transponder incorrectly set "Callsign"/Flight ID. This is caused by poor human factors and design that assumes that GA aircraft are US registered.	Flight ID appears as "N". Inhibits proper coupling.	Can be corrected by installer manipulation of front panel. Does not warrant "black list" activity.
6.	Flight ID corruption issue 1 – trailing "U" Flight ID's received : GT615 ,GT615U ,NEB033 ,NEB033U ,QF7550 ,QF7550U ,QF7583 ,QF7583U ,QF7585 ,QF7585 ,QF7585U ,QF7594 ,QFA7521 ,QFA7531,QFA7531 ,QFA7531U,QFA7532 ,QFA7532U,QFA7532W,QFA7550 ,QFA7552 ,QFA7581	TPR901 software problem interfacing with Flight ID source. Results in constantly changing Flight ID with some reports having an extra "U" character.	Flight ID changes during flight inhibits proper coupling or causes decoupling.	Affects mainly B747 aircraft. Boeing SB is available for Rockwell transponders and B744 aircraft [Rockwell Collins have SB 503 which upgrades faulty -003 transponder to -005 standard] If a new case is discovered, an entry needs to be made to the black list until rectification has been effected.

7.	Flight ID corruption issue 2	ACSS software problem results in constantly changing Flight ID. Applies to ACSS XS950 transponder Pn 7517800-110006 and Honeywell FMC (pn 4052508-952). ACSS fix was available in Sept 2007.	Flight ID changes during flight inhibits proper coupling or causes decoupling.	Software upgrade available. If a new case is discovered, an entry needs to be made to the black list until rectification has been effected.
8.	No Flight ID transmitted	Various causes	Flight ID not available. Inhibits proper coupling.	Aircraft could "fail to couple with Flight Data Record. Not strictly misleading – but could cause controller distraction.
9.	ACSS Transponder 10005/6 without Mod A reports NUC based on HFOM.		Appears good in all respects until there is a satellite constellation problem. (not normally detectable by ground systems).	Not approved and hence not compliant with CASA regulations. If known could be added to black list. Configuration is not permitted by regulation.

10.	Occasional small position jump backwards 	For some older Airbus aircraft, an occasional report may exhibit a small "jump back" of less than 0.1 nm Root cause not known	Not detectable in ATC due to extrapolation, use of latest data and screen ranges used.	ATC ground system processing can eliminate these.
11.	Older ACSS transponders report integrity too conservatively	Design error reports integrity one value worse than reality	In poor GPS geometry cases the ATC system could discard the data when the data is in fact useable. Will be perceived as loss of ADS-B data.	Can be treated in the same manner as a loss of transponder capability.
12.	Intermittent wiring GPS-transponder	ADS-B transmissions switch intermittently between INS position and GPS position.	Normally the integrity data goes to zero when INS is broadcast, but sometimes during transition between INS and GPS, an INS position or two can be broadcast with "good" NUC value. Disturbing small positional jump.	If a new case is discovered, an entry needs to be made to the black list until rectification has been effected.
13.	Wrong 24 bit code	Installation error	No direct ATC impact unless a rare duplicate is detected.	This is not a direct ADS-B problem, but relates to a Mode S transponder issue that can put TCAS at risk. Cannot be fixed by black list entry. Needs to be passed to regulator for resolution.