International Civil Aviation Organization

THE NINTH MEETING OF AUTOMATIC DEPENDENT SURVEILLANCE – BROADCAST (ADS-B) STUDY AND IMPLEMENTATION TASK FORCE (ADS-B SITF/9)

Jakarta, Indonesia, 18 -19 August 2010

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

GPS TIME TAGGING ISSUE

(Presented by Australia)

SUMMARY

States need to be careful that ADS-B Ground stations correctly time tag ADS-B data during the first 14 minutes after "switch on".

1. Background

1.1 GPS time currently differs from Coordinated Universal Time (UTC) by 15 seconds due to UTC "leap seconds". GPS time was set to match Coordinated Universal Time (UTC) in 1980, but has since diverged.

Wikipedia *http://en.wikipedia.org/wiki/Leap_second* states :

A leap second is a positive or negative one-second adjustment to the Coordinated Universal Time (UTC) time scale that keeps it close to mean solar time. UTC, which is used as the basis for official time-of-day radio broadcasts for civil time, is maintained using extremely precise atomic clocks. To keep the UTC time scale close to mean solar time, UTC is occasionally corrected by an intercalary adjustment, or "leap", of one second..

2. GPS Receivers and UTC

2.1 To output UTC, a GPS receiver must have access to the offset between UTC and GPS time. This offset is transmitted in the GPS navigation message. Some receivers store this offset in non-volatile memory, so that the offset (which changes infrequently ~ 1/ year) is immediately available when the GPS receiver restarts.

2.2 However, at start up, some GPS receivers erroneously output GPS time (as if it were UTC) until a new offset is received in a GPS navigation message. It can be 14 minutes before such a message is received. If these GPS receivers are used for ADS-B time tagging, before the offset arrives false position reports can be shown to ATC.

"Switch-on" can occur as a result of planned maintenance activity, power failure or other events.

3. Possible mitigations

3.1 A number of protections can limit the impact of this issue as follows :

a) Operational procedures that do not put the ADS-B ground station back into service until 15 minutes after switch on; and

b) ATC system functionality that tests the reasonableness of the time tag. If the time tag is say more than 5 seconds old, or more than 0.5 second ahead of current time, then the data could be discarded.

4. ADS-B Time tagging

4.1 GPS time tagging is used in both radar and particularly in ADS-B. The time of applicability of the data is often used to allow extrapolation of ADS-B data to the time of display. An error in time tagging can therefore result in a positional error being displayed to ATC. For an aircraft at 300 knots, a 15 second error will result in a positional error of 1.25 nautical miles.

5. Other ATC uses of GPS time

5.1 Of course the same issue could impact ATC centres, radars, multilat and other systems that use or generate time tags.

6. Recommendation

6.1 States are encouraged to check that their ADS-B systems do not suffer from this time tagging problem.

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