



International Civil Aviation Organization

**THE FOURTH MEETING OF ADS-B STUDY AND
IMPLEMENTATION TASK FORCE (ADS-B SITF/4)**

Nadi, Fiji, 26-28 October 2005

Agenda Item 13: Discuss issues observed during the trial and implementation of ADS-B

SITE MONITOR PROCESSING

(Prepared and Presented by Greg Dunstone, Airservices Australia)

SUMMARY

This describes the role of ADS-B Site Monitors in the Australian ADS-B Upper Airspace Project

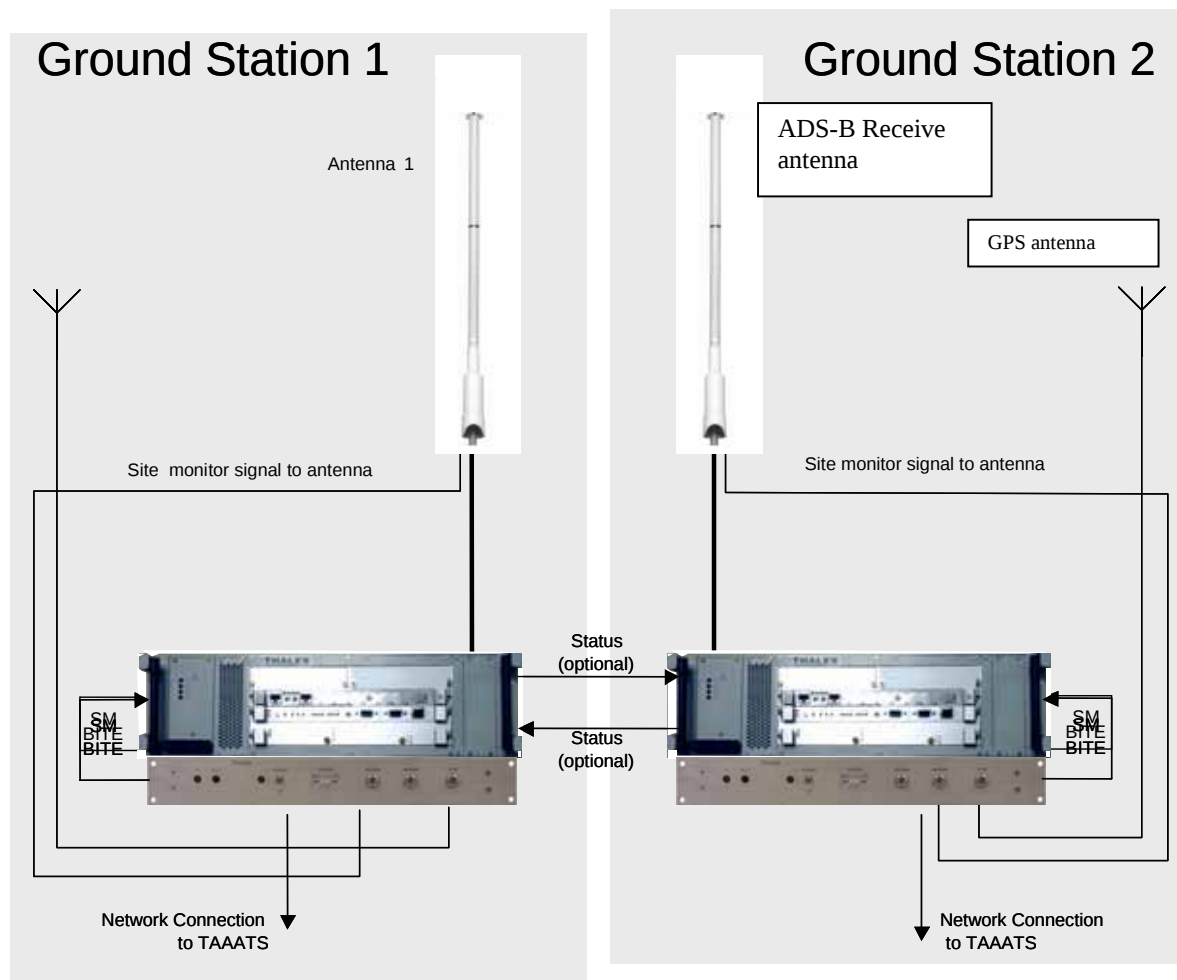
1. BACKGROUND

1.1 ADS-B site monitors are an integral part of the Australian ADS-B Upper Airspace Project. They provide a number of roles as described below.

2. DESCRIPTION OF SITE MONITOR SYSTEM

2.1 The site monitor deployed at UAP sites comprises separate equipment which generates ADS-B messages. It only generates an “identity” message with FlightID=“THALES”. This signal is transmitted and connected to the ADS-B receiver’s antenna via a “coupling port”.

2.2 At a typical ADS-B site there are two ADS-B ground stations, both operating and transmitting messages to the ATC centre. Each ground station has a site monitor, i.e. there are two site monitors per site.



2.3 When the ADS-B ground station receives this identity message, it reads additional information from an in-built high performance GPS engine to allow it to generate an “Asterix” target report which is sent to the TAAATS system. The Asterix message includes:

- GPS position
- Geometric altitude (GPS altitude)
- A “FOM” value derived from the GPS engine HPL value

2.4 The ground station GPS engine is capable of calculation of HPL¹. It is also able to perform Fault Detection and Exclusion (FDE). Furthermore, it is able to be managed by remote control using the ADS-B ground station Remote Control and Monitoring System (RCMS).

¹ The GPS engine is a Thales/Ashtech DG16. This is a 16-channel receiver with 12 GPS L1 code and carrier channels, 2 SBAS channels and 2 300 KHz DGPS beacon channels and an embedded beacon receiver to provide sub-meter differential positioning — the 2 SBAS channels can be configured as 2 additional GPS channels offering a total of 14 GPS channels. The SBAS capability is not enabled in this implementation.

2.5 The TAAATS Eurocat ATC system receives Asterix messages for the site monitors from all ADS-B ground stations. A site monitor message is discarded if the FOM value (derived from HPL) is below a <parameter> value

2.6 The ATC system then monitors the “site monitors” for each site. An alert is presented to controllers whenever:

- A site monitor message has not been received for a <parameter> period of time.
- The received site monitor positional data is outside a small window of the preset geographical position
- The received site monitor GPS altitude data is outside a small window of the preset GNSS altitude position

2.7 The system remote monitoring and control system (RCMS) receives additional information directly from the ground station as follows:

- Routine GPS status reports every <parameter> seconds
- Additional data is collected whenever the GPS engine encounters any of the following
 - HPL value exceeds <parameter>
 - Satellite ranging error detected & corrected
 - Satellite ranging error, correction not possible
 - Satellite ranging error detection not available (lack of satellites or poor geometry)
 - Other satellite error detected

The additional data is logged every <parameter> seconds and includes:

- Number of satellites used in HPL computation
- Satellites being tracked
- HPL value
- Pairs of excluded satellites
- An indication of the GPS problem encountered

3. ADS-B ANTENNA AND RF RECEPTION CHECK

3.1 The site monitor transmits an identity message. The ADS-B ground station checks that the received signal strength is within a defined threshold. If the antenna is damaged or if RF components have degraded, the received signal would diminish and an RCMS error will be raised.

3.2 This gives a level of confidence that the RF reception path has not been degraded.

4. CHECK END-END PROCESSING FUNCTION

4.1 If the signal is not present, no site monitor message is sent to Eurocat and controllers are alerted. In fact if any element between RF transmission and Eurocat fails to operate correctly an alert will be generated.

4.2 This gives confidence that the complete processing chain is working – even in the absence of ADS-B equipped aircraft within coverage of the ground station.

5. POSITION MONITORING

5.1 The performance of the GPS constellation is monitored by the ADS-B ground stations. If the GPS reported position exceeds a threshold from expectation an alert is raised.

5.2 This function also confirms that the GPS altitude (geometric altitude) is within a defined band. If the received value is outside the band an alert is raised.

5.3 These capabilities give an indication as to the ADS-B performance of aircraft near to the ADS-B ground station which are tracking the same GPS satellites. It is indicative of expected ADS-B performance rather than absolute.

6. CHECK GPS SATELLITE SYSTEM IS NORMAL

6.1 The GPS engine RCMS monitoring provides alerts when any malfunctioning GPS satellite is detected. This includes the case when inadequate satellites are available to calculate HPL or perform RAIM.

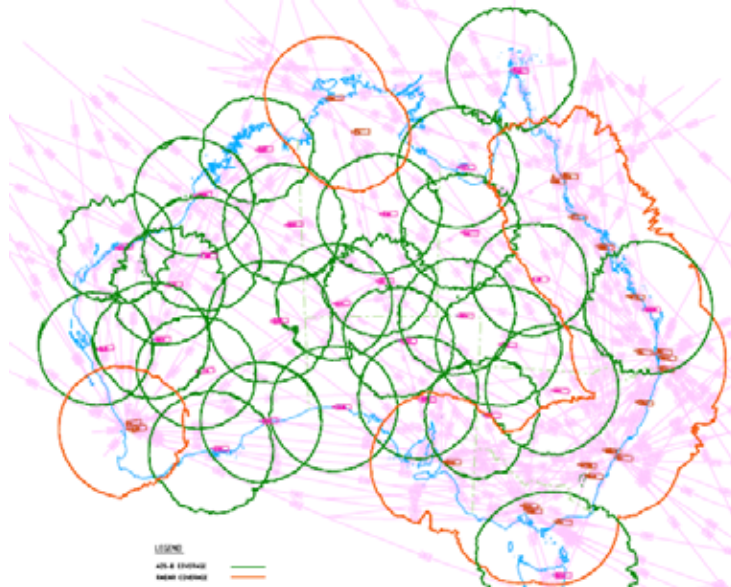
Eg: If there are not sufficient satellites visible to any site monitor to enable it to generate HPL, that will be indicated to the RCMS as a warning.

7. SATELLITE EXCLUSION MONITORING

7.1 If an individual satellite outputs false ranging information, ADS-B site monitor GPS engines will detect the fault using their FDE logic.

Due to the enormous geographical spread of the UAP ADS-B ground stations, this provides the ability to detect ranging errors in a large number of satellites at any one time.

Assuming a 5 degree mask angle, and a geographical spread of ground stations of 37 degrees longitude and 27 degrees latitude, visibility of almost 50% of the GPS satellites is achieved!



Two site monitors are installed at every ground station site

If any aircraft are transmitting NUC based on HFOM and are hence not protected against faulty ranging signals, it is highly likely that a site monitor will be providing a level of alerting/ protection.

8. SATELLITE PERFORMANCE LOGGING

8.1 In the event of satellite system problems, post event investigation will be supported by the logging information stored in the RCMS systems.
