INTERNATIONAL CIVIL AVIATION ORGANIZATION
ASIA AND PACIFIC OFFICE

REPORT OF

ADS-B SEMINAR AND THE SEVENTH MEETING OF AUTOMATIC DEPENDENT SURVEILLANCE – BROADCAST (ADS-B) STUDY AND IMPLEMENTATION TASK FORCE (ADS-B SITF/7)

Chengdu, China, 7 - 11 April 2008

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SUMMARY ON AGENDA ITEMS

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ATTACHMENTS

1. Introduction

1.1 The ADS-B Seminar and the Seventh Meeting of Automatic Dependent Surveillance – Broadcast (ADS-B) Study and Implementation Task Force (ADS-B SITF/7) were held in Chengdu, China from 7 to 11 April 2008. The Seminar and the Meeting were hosted by the Air traffic Management Bureau (ATMB) of the Civil Aviation Administration of China (CAAC).

1.2 The meeting was opened by Ms. Lu Xiaoping, Deputy Director General of ATMB. In her opening remarks, she extended welcome to all the participants to Chengdu in this beautiful spring season to exchange views on technical developments of ADS-B and systematic implementation of the technology in the Asia and Pacific Regions. Ms. Lu emphasized the sound cost benefits and outstanding performance of the technology and highlighted ADS-B related trials and projects undertaken in China. CAAC has planned to employ ADS-B technology in the west part of China. Through these activities, CAAC hopes to strengthen the co-ordination and co-operation among the Civil Aviation Authorities in the region to facilitate the ADS-B implementation. On behalf of Mr. Zhang Jianqing, the Deputy Director General of Flight Standard Department of CAAC and Mr. Gao Yi, Director General of Southwest Regional ATMB who also attended the opening ceremony, Ms. Lu expressed their pleasure in hosting the meeting and wished the meeting full success in its deliberations.

1.3 On behalf of Mr. Mokhtar A. Awan, Regional Director, ICAO Asia and Pacific Office, Mr. Li Peng, Regional Officer CNS of the ICAO Regional Office expressed gratitude and appreciation to the ATMB for hosting the meeting in Chengdu and for the excellent arrangement made for the meeting. He highlighted the tasks completed by the Task Force and outlined the objective of the Seventh Meeting. He stated that global aviation has experienced a significant growth for both passengers and cargo and Asia and Pacific Regions in particular have shown the world's highest growth rate. He emphasized the important role of the Task Force and Seminars in exchanging ADS-B related information. He thanked all contributors and experts for supporting the Seminar.

1.4 In his opening remarks, Mr. Greg Dunstone, Chairman of the Task Force, highlighted the importance of improving surveillance and enhancing the ATC capabilities in meeting the needs of rapid air traffic growth. He recalled history of ADS-B Task Force and highlighted the developments of ADS-B in the region since the last meeting. He noted the need to continue the work of the Task Force but also the important need to follow the discussions with action on the ground to deliver real benefits to the Industry. He indicated his desire to see in particular some States actually operationally using shared ADS-B data across an FIR boundary within a year.

2. Attendance

2.1 The Seminar was attended by 140 participants and the Meeting was attended by 74 participants from Australia, China, Hong Kong China, Macao China, Fiji, France, Indonesia, Japan, Malaysia, Maldives, New Caledonia, Pakistan, the Philippines, Republic of Korea, Singapore, Sri Lanka, Thailand, USA, Viet Nam, Austro Control, CANSO, IATA, SITA and representatives from 7 industries. List of participants is at **Attachment 1.**

3. ADS-B Seminar

3.1 The ADS-B Seminar was organized in conjunction with the ADS-B SITF/7. The objective of the Seminar was to provide information to the participants on ADS-B planning and implementation. The Seminar was presented with 21 presentations covering a comprehensive list of topics on the ADS-B as follows:

- Basic ADS-B Concept Introduction
- APANPIRG and ADS-B SITF activities
- Introduction to Multilateration
- ATC Automation and ADS-B
- Airframe Manufacturers Plan
- Avionics products
- Ground stations and ADS-B service providers
- States and ANSP projects and deployment plans

3.2 During the Seminar, a number of speakers from various States and Industries provided valuable information on various aspects of ADS-B. The ADS-B Seminar was well received by all the participants.

3.3 A demonstration on ADS-B processing system using 1090 ES link was provided by the Aeronautical Data Communication Corp. China (ADCC) during the Seminar.

4. Officers and Secretariat

4.1 Mr. Greg Dunstone, Surveillance Program Leader of Airservices Australia chaired the Seminar and the Meeting. Mr. Li Peng, Regional Officer CNS, ICAO Asia and Pacific Office acted as Secretary.

5. Organization, working arrangements and language

5.1 The Seminar and the Meeting met as a single body except on 10 April 2008, when the four ad hoc working groups met to progress proposals for sub-regional implementation plans. The working language was English inclusive of all documentation and this Report. List of Working Papers and Information Papers presented at the Seminar and the Meeting is at **Attachment 2.**

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Agenda Item 1: Adoption of Agenda

1.1 The agenda adopted by the meeting was as follows:

Agenda Item 1: Adoption of Agenda

Agenda Item 2: Review the outcome of the APANPIRG/18 on ADS-B SITF/6

Agenda Item 3: Review progress made by ADS-B related ICAO Panels

Agenda Item 4: Review the Terms of Reference and Subject/Tasks List

Agenda Item 5: Report and updates by the lead member of the Task Force on Tasks assigned

Agenda Item 6: Development of Asia/Pacific Regional ADS-B implementation plan and sub-regional based ADS-B implementation plan

- Review report of the first and second meeting of South East Asia Sub-regional ADS-B Implementation Working Group;
- Identify sub-regional area (FIR) where there is a positive cost/benefit for Near-term implementation of ADS-B OUT and;
- Develop sample document for implementation of requirements for ADS-B Out avionics equipage in accordance with APANPIRG/18 C 18/35

Agenda Item 7: Review States' activities and interregional issues on trials and implementation of ADS-B

Agenda Item 8: Identify applicable multilateration applications in the Asia and Pacific Regions

Agenda Item 9: Examine the feasibility of using ADS-B derived data for height monitoring

Agenda Item 10: Discuss issues observed during the trial and implementation of ADS-B including review of items from ADS-B Problem report database

Agenda Item 11: Any other business

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Agenda Item 2: Review the outcome of the APANPIRG/18 on ADS-B SITF/6

Outcome of APANPIRG/18 on ADS-B

2.1 It was noted that the APANPIRG/18 held from 3 to 7 September 2006 in Bangkok reviewed the work accomplished by the Sixth Meeting of the ADS-B Study and Implementation Task Force and discussed issues on the ADS-B implementation. The report of the Sixth Meeting of ADS-B Task Force was also reviewed by CNS/MET SG/11 held in Bangkok from 16 to 20 July 2007 and ATM/AIS/SAR SG/17 from 2 to 6 July 2007.

2.2 The actions taken by APANPIRG on the report of ADS-B SITF were highlighted as follows:

- Under Conclusion 18/32, the guidance material on comparison of various surveillance technologies was adopted;
- Under Conclusion 18/33, the 3rd Edition of ADS-B Implementation and Operations Guidance Document (AIGD) was adopted;
- Under Conclusion 18/34, the Guidelines on performance parameters for using ADS-B managed services were adopted;
- Adopted Conclusion 18/35 regarding "Mandate Regional ADS-B Out implementation" which defines some relevant ADS-B avionics standards to be used from now till at least 2020. It encourages States to establish mandatory requirement for ADS-B equipage in appropriate airspace with a target date of 2010.
- Under Conclusion 18/36, the Concept of Use Multilateration was adopted; and
- Under Conclusion 18/37, the Surveillance Strategy for Asia/Pacific Region was adopted.

2.3 The APANPIRG/18 also adopted a decision for the establishment of a sub-regional ADS-B Implementation Working Group as proposed by Indonesia, Malaysia, Singapore and Thailand to develop the terms of cooperation and an implementation plan for near-term ADS-B applications in the South East Asia Region.

2.4 Under this agenda item, the meeting also reviewed the surveillance strategy for Asia and Pacific Regions developed by the CNS/MET Sub-group and adopted by APANPIRG/18. The meeting noted that the strategy was considered as living document which is regularly updated based on the developments.

2.4.1 The meeting discussed whether the ADS-B In should be proposed to be included into the surveillance strategy. As a result of discussion, ADS-B In was not considered mature enough to be included in the strategy at this stage. The main reasons highlighted were as follows:

- very low equipage and no excitement for ADS-B In till 2015;
- lack of regulatory requirements;
- lack of equipage standard; and
- no procedure and separation standard have been developed.

2.4.2 It was also clarified that in the USA, the NPRM has not considered mandating ADS-B In. Its equipage is subject to individual airline on volunteer basis.

2.4.3 In view of the foregoing, the meeting did not identify the need to make proposal for changes in the strategy.

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Agenda Item 3: Review progress made by ADS-B related ICAO Panels

Update of ICAO Panels on ADS-B Related issues

3.1 The meeting noted that the effective date of amendments to PANS-ATM as proposed by the First Meeting of the OPLINK Panel including ADS-B based separation etc., was on 22 November 2007. As to the work of SAS Panel on ADS-B, the work to support 5 NM separations with ADS-B had been completed and has been published as Circular 311 and posted on the ICAO-NET. The meeting also noted that the OPLINKP was suspended after its first panel meeting which was held in 2005. It is being re-activated to deal with new tasks assigned by ANC and it will be involved in developing guidance material on ADS-B.

3.2 The Aeronautical Surveillance Panel (ASP) has developed SARPs and supporting technical specifications for a new version of extended squitter messages (named as Version 1) in support of ADS-B which has improved elaboration of navigation and surveillance accuracy. The new and amended SARPs are a part of Amendment 82 to Annex 10.

3.2.1 Amendment 82 to Annex 10 which became applicable on 22 November 2007, introduce UAT (for ADS-B) and a new set of 1 090 MHz extended squitter messages (called Version 1, based on DO 260A) that enables air-ground as well as air-air applications of ADS-B.

3.2.2 Technical details and Mode S/extended squitter register definitions that were shown in an Appendix of Annex 10, Volume III, has been relocated to a new technical manual (Doc 9871 - Technical Provisions for Mode S Services and Extended Squitter) that has been scheduled for publication in 2008. Similarly, technical details for UAT are to be published in the form of a manual (Doc 9861 - UAT Manual).

3.3 The meeting noted that the ASP is developing the following materials for finalization at the first meeting of ASP which is scheduled for 24 to 28 November 2008:

a) draft high-level SARPs for multilateration systems (MLAT);

b) new provisions on required surveillance performance (RSP) and airborne surveillance applications (relating to use of ADS-B reports onboard aircraft);

c) report on RF pollution study relating to 1030/1090 MHz in light of increased traffic and new systems (e.g. MLAT);

d) consolidation of guidance material on surveillance in a new aeronautical surveillance manual; and

e) update to existing ICAO provisions on surveillance and collision avoidance systems in light of operational experience.

3.3.1 The meeting was informed that ASP WG and SWG meeting, hosted by Aerothai, will be held in Bangkok from 14 to 23 May 2008 to finalize SARPs and guidance material for presentation to ASP/1.

Proposal for amendment to PANS-ATM

3.4 Australia presented a paper to propose amendment to “ADS” reference in PANS ATM Doc 4444, Appendix 2 Flight Planning and Surveillance Equipment

3.4.1 The meeting noted that the Amendment 5 includes operational procedures and phraseology for the use of ADS-B. The document includes ADS-B as one of a number of possible surveillance technologies that may be used.

3.4.2 The November 2007 Edition of PANS ATM Doc 4444, Appendix 2 Flight Plan, defines the letter "D" to indicate "ADS capability" in Item 10 under 'Surveillance Equipment'. In Australia, where ADS-B is in operational use, Airservices Australia has received requests from aircraft operators to use "D" to indicate ADS-B capability in flight notifications because Doc 4444 does not directly specify its use for ADS-C only. In order to avoid confusion, it is recommended that the ADS equipment definition of "D" be changed to "ADS-C capability" as Asia Pacific ADS-B Implementation Guide recommends the use of "RMK/ADSB" to indicate ADS-B.

3.4.3 IATA fully supported the proposal and expressed concerns that Field Item 18 of FPL is almost full and efforts should be made to reduce the overcrowding of Field Item 18.

3.4.4 It was informed that longer time would be required if such amendment is recommended by APANPIRG for consideration by Panels. Secretariat was requested to coordinate with ICAO Headquarters with respect to the proposed change.

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Agenda Item 4: Review the Terms of Reference and Subject/Tasks List

4.1 Under this agenda item, the meeting reviewed the revised TOR as adopted by APANPIRG/18 and discussed Subject and Tasks to be undertaken by the Task Force.

4.2 The TOR was considered appropriate and the meeting did not propose any changes to the TOR. The meeting considered the need to continue its efforts in developing the sub-regional ADS-B implementation plan and project. It was agreed that the issues which emerged during the trial and implementation stages should also be appropriately addressed by the Task Force. The exchange of information and experiences gained during the trial and implementation of ADS-B should be further encouraged.

4.3 The meeting updated the Subject/Tasks List and formulated the following draft Decision for consideration by CNS/MET Sub-group and APANPIRG.

Draft Decision 7/1 - Subject/Tasks List of ADS-B Study and Implementation Task Force

That, the Subject/Tasks List for ADS-B Study and Implementation Task Force provided in **Appendix A** to the Report be adopted.

4.4 In response to Task No. 2, States and International organizations at the meeting provided information on their general approach on the ADS-B data sharing (real time operational data sharing for the delivery of ADS-B based serviced) as follows:

- Australia: supports the surveillance data sharing between neighbouring FIRs of States;

- China: in order to improve the harmonization of implementation of ADS-B, China supports ADS-B Data sharing;

- Hong Kong China: keeps open view on sharing surveillance data in order to meet ICAO requirements;

- Macao China: supports data sharing expressed by China and Hong Kong China;

- Indonesia: supports data sharing for the flight safety and efficiency and working together with neighbouring FIRs;

- Japan has not decided to employ ADS-B in Japan. JCAB would consider user's benefit and support data sharing;

- Malaysia supports in principle the idea for data sharing but need to look into the concrete plan for the data sharing;

- France: plans to deploy ADS-B in New Caledonia and looking forward to share the derived ADS-B data with neighbouring FIRs;

- Pakistan: considering to deploy ADS-B to fill the gap between coverage of radar in the upper south and west area;

- Fiji: fully supports ADS-B data sharing;

- the Philippines agree with the idea of data sharing in light of the seamless surveillance coverage amongst adjacent FIRs. Nevertheless, contract is subject to detailed provisions in the bilateral agreement with states with whom data is shared with;

- Republic of Korea: installed 2 sets of ADS-B ground station at Incheon Intl' airport and estimated them to be operational from 1 June 2008. Data from the ground stations are processed in the Phase II SMR fusion processor (STREAMS). ADS-B data are also used to support the Surface Conflict Alert;

- Singapore: supports the data sharing for civil aviation applications;

- Sri Lanka: has not made a decision yet about data sharing;

- Thailand: supports data sharing in principle but looking for concrete proposal;

- USA: fully encourages data sharing with our southern and northern boundary FIRs. Potential sharing ADS-B surveillance date with Fiji;

- Viet Nam: supports the data sharing for civil aviation applications;

- CANSO: fully supports seamless ATM service to our customers; and

- IATA: fully supports data sharing to provide enhanced ATM service to the operators.

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Agenda Item 5: Report and updates by the lead member of the Task Force on Tasks assigned

5. Under this agenda item, the meeting discussed the subject and tasks to be undertaken by the Task Force.

Guidance Material on Reporting ADS-B Probability of Update

5.1 The meeting considered a proposal by Australia to standardize the way for the States to report ADS-B probability of detection in response to Subject/Task List 9. It was noted that radars rotate at a fixed rate and that typically the air traffic controller is presented with new surveillance data at a rate identical or similar to the rotation rate of the radar, e.g: in the terminal area the screen refresh rate is usually about 5 seconds.

5.2 Probability of detection (Pd) is often used as a performance measure of a radar. It is a measure of the likelihood that a target will be detected. There is an underlying assumption in this definition that this probability applies to a single antenna rotation or controller screen update. Since ADS-B does not have a rotating antenna and typically a message is updated every 1 second and is then usually presented to the controller at the same rate as radar so that the controller perception of speed for radar and ADS-B tracks is the same.

5.3 This means that it is difficult to compare radar and ADS-B. A means was proposed to measure Pd which is applicable to both radar and ADS-B by measuring the screen updates presented to the controller and dividing by the number of possible screen updates e.g: in 100 screen updates, ADS-B or radar positional data is presented to the controller 90 times and hence the Pd = 90%.

5.4 If the ADS-B is to be used for an enroute only function, the selected period could be 5, 10 or 12 seconds.

Draft Conclusion 7/2 – Guidance Material on Reporting Probability of ADS-B update

That, The Guidance Material on Reporting Probability of ADS-B update as shown in **Appendix B** be adopted for use by States in the Asia and Pacific Regions.

Guidance Material on Reporting ADS-B Avionics fitment

5.5 The meeting considered a proposal by Australia to standardise the way for the States to report ADS-B equipage in response to Subject/Task List 10. The key features of the proposal were that the States should only consider aircraft equipped if they were capable of broadcasting ADS-B positional data with associated integrity indicators suitable to meeting the requirements of 5 nautical mile separation services. In addition the meeting agreed to a recommendation that States report equipage by numbers of airframes as well as by numbers of flights.

5.6 The meeting discussed the possibility of requesting IATA to provide a report of percentage of fleet ADS-B equipage by airlines – but it was decided that this would be too difficult to define at this stage.

5.7 The meeting discussed the possibility of requesting details of each airframe’s ADS-B certification, but this was advised to be too difficult at this stage and would be re-assessed in 1 year.

5.8 In view of the foregoing considerations, the meeting formulated the following Draft Conclusion for adoption of the ADS-B Avionics fitment reporting mechanism.

Draft Conclusion 7/3 - Guidance material on ADS-B Avionics Fitment Reporting

That, Guidance Material on Reporting ADS-B Avionics fitment as shown in **Appendix C** to this report be adopted.

Security Related Issues

5.9 The meeting considered a paper on draft Guidance material prepared by Australia and France regarding issues of ADS-B security in response to Subject/Task List 12.

5.9.1 It was noted that that ADS-B technologies are currently “open systems” and the openness is an essential component of successful use of ADS-B for air-air surveillance.

5.9.2 It was also noted that ADS-B transmission from commercial aircraft is a “fact of life” today. Many commercial aircraft are already equipped with ADS-B and have been transmitting data for some time.

5.9.3 Further, it was noted that there has been considerable alarmist publicity regarding ADS-B security. To a large extent, this publicity has not considered the nature and complexity of ATC. Careful assessment of security policies in use today for ADS-B and other technologies can provide a more balanced view.

5.9.4 The meeting recalled the following considerations on ADS-B security (AN-Conf/11-WP/6) discussed at the 11th Air Navigation Conference. Namely:

"There are practical limits that must be recognized due to technological, political, and fiscal reasons. Not all solutions will be technical that is, come from a box. Some of the solutions may be procedural, legal, technical or a combination of all. In short, States will need to consider the likelihood and severity of interference by conducting appropriate hazard and safety assessments as a means of developing mitigation strategies."

5.9.5 The meeting reviewed a list of ADS-B vulnerabilities categorised into threats to Confidentiality, Integrity and Availability. As result of discussion, the meeting developed following recommendations:

- While ADS-B is recognized as a key enabling technology for aviation with potential safety benefits, it is recommended that States made aware of possible ADS-B security specific issues;

- It is recommended that States note that much of the discussion of ADS-B issues in the Press has not considered the complete picture regarding the ATC use of surveillance data;

- For current ADS-B technology implementation, security risk assessment studies should be made in coordination with appropriate national organisations and ANSPs to address appropriate mitigation applicable in each operational environment, in accordance with ATM interoperability requirements; and

- Future development of ADS-B technology, as planned in the SESAR master plan for example, should address security issues. Studies should be made to identify potential encryption and authentication techniques, taking into consideration the operational need of air to ground and air to air surveillance applications. Distribution of encryption keys to a large number of ADS-B receivers is likely to be problematic and solutions in the near and medium term are not considered likely to be deployed worldwide.

5.9.6 The meeting discussed and agreed that the security threats had to be kept in perspective and that today's systems like VHF communication, CPDLC/ADS-C and Navaids are also subject to similar threats. In addition the balance aviation security and safety benefits from ADS-B had to be weighed against risks. Suitable mitigators were required against the risks depending on the likelihood and consequence of the identified risks.

5.9.7 It was noted that legislation and enforcement of legislation was an important part of reducing risks for all these technologies including VHF radio. For example, one State noted that prosecutions took place for "spoofing" of VHF communications. Another State noted that no instances of intentional GPS interference had been detected over many years of operational use.

5.9.8 It was recognized that radar was subject to false tracks such as reflections and that controllers are well trained to use other information to detect false tracks.

5.9.9 The meeting considered that the working paper was a useful document to aid consideration of ADS-B security issues. The meeting agreed to convert the paper into a Guidance Document which is available on request to the ICAO Office Bangkok. Accordingly, the meeting formulated the following draft Conclusion.

Draft Conclusion 7/4 – Guidance Material on ADS-B Security

That, the Guidance Material on Security issues associated with ADS-B as shown in the **Appendix C2 (not posted**) be adopted.

Multisensor fusion processing

5.10 The meeting reviewed and endorsed a draft Guidance material prepared by Australia on performance criteria and issues to be considered when introducing ADS-B into an Air Traffic Control multi-sensor fusion processor in response to Subject/Task List 11.

5.10.1 It was noted that modern air traffic control systems use multi-sensor fusion processes to improve the quality of surveillance track data provided to air traffic controllers. This is the latest step in a series of evolutionary improvements to ATC surveillance systems.

Draft Conclusion 7/5 – Multi-sensor fusion issues and Performance

That, the Guidance Material on the performance criteria for multi-sensor fusion as shown in the **Appendix D** to the report be adopted for consideration by States when integrating ADS-B into an Air Traffic Control multi-sensor fusion processes.

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Agenda Item 6: Development of Asia/Pacific Regional ADS-B implementation plan and sub-regional based ADS-B implementation plan

Review report of the first and second meeting of South East Asia Sub-Regional ADS-B Implementation Working Group

6.1 The meeting reviewed the outcome of SEA Sub-regional ADS-B Implementation Working Group meetings. The group was established in accordance with APANPIRG/18 Conclusion 18/38. The first Working Group meeting was held on 15 and 16 November 2007 in Singapore. The meeting was attended by 21 participants from Australia, Indonesia, Malaysia, the Philippines, Singapore, Thailand, Viet Nam, CANSO, IATA and ICAO, and 14 representatives from 7 industries. The full report of the meeting is available at http://www.icao.or.th/meetings/2007/seaadsb_wg1rpt.pdf. The second Working Group meeting was held from 27 to 29 February 2008 in Bali, Indonesia. The meeting was attended by 25 participants from Australia, Indonesia, Malaysia, the Philippines, Singapore, Thailand, Viet Nam, IATA, ICAO, 9 representatives from 4 industries and 25 observers from Indonesia. The full report of the meeting is available at:
http://www.bangkok.icao.int/meetings/2008/sea_adsb_wg2rpt.pdf.

6.2 The working group agreed on the terms of co-operation and progressed on following agreed tasks:

- developed the cost apportionment framework for ADS-B Ground Stations and ADS-B Surveillance Data Sharing;
- agreed guidelines to be used for the development of implementation plan;
- developed a sample agreement for ADS-B Data Sharing;
- agreed a ADS-B implementation study project to be undertaken by IATA for the sub-region; and
- worked out an initial sub-regional ADS-B implementation plan to be further enhanced at subsequent meetings. Some surveillance gaps were identified in the plan and two possible additional sites were proposed to cover a gap in the South China Sea. States concerned were requested to consider the feasibility of installing ADS-B stations at these sites. Viet Nam offered two additional ADS-B sites viz Song Tu Tay Island (11°25'N, 114°21'E) and Truong Sa Island (8°38'N, 111°55'E) at the second meeting to cover the ADS-B coverage gap in the South China Sea. The Philippines also identified a possible site to fill the gap, but it is a private airport operated by RIO TUBA Nickel Mining Corporation (8°31'N, 117°24'E). Thus they have to evaluate and study further. These issues will be further discussed at the next meeting of the Working Group to be held in Kuala Lumpur, Malaysia in June 2008.

6.3 The meeting appreciated the efforts and progress made by the SEA ADS-B WG. CANSO highly commended the group for the result achieved and IATA expressed its full support to the work being carried out by the group.

6.4 Considering that the general guidelines developed by the group would be useful for other States in developing similar sub-regional or national implementation plan, the meeting endorse the following draft Conclusion for consideration by CNS/MET Sub-group of APANPIRG.

Draft Conclusion 7/6 - Guidelines for the development of Implementation Plan

That, States be advised to use the following guidelines for the development of implementation plan:

(a) minimize capital and operating costs of ADS-B data facilities;

(b) give priority to provide coverage over major traffic flows;

(c) provide ADS-B coverage in areas within 150nm from FIR boundaries;

(d) suitable sites with power, shelter, access routes and data communication links shall be preferred; and

(e) overlapping of ADS-B coverage is preferred.

6.5 The meeting was of the view that the sample agreement for ADS-B Data Sharing and cost apportionment developed by the working group should be endorsed as regional guidance material for use by States in the region. Accordingly, the meeting formulated the following draft Conclusion.

Draft Conclusion 7/7 – Sample Agreement for ADS-B Data Sharing

That, the sample Agreement for ADS-B Data Sharing and the cost apportionment framework provided in the **Appendices E and F** be adopted as regional guidance material.

Identify sub-regional area (FIR) where there is a positive cost/benefit for Near-term implementation of ADS-B OUT

6.6 To progress the development of sub-regional implementation of ADS-B in the region, four ad hoc working groups were established during the meeting to further develop proposals for sub-regional implementation plans for North Asia, South Asia, South East Asia and Pacific Regions. Each group reported the results of their discussions to the Task Force. The outcome of the discussions has been briefly recorded in the **Appendix G** to this report.

6.6.1 IATA provided an information paper (IP/16) on the initial study and analysis of ADS-B project in North Asia in response to a task assigned to them. The proposal includes a minimum of 8 ADS-B ground stations and significant data communications infrastructure to improve surveillance and ATM service covering three major ATS routes in the Sub-region. This proposal was further discussed at the North Asia Working Group during the meeting. The result of discussion on the proposal is reflected in the outcome of the discussions in the **Appendix G.**

Follow-up action to APANPIRG/18 C18/35

6.7 The secretariat informed the meeting that as a follow-up action to the Conclusion 18/35 of Eighteenth meeting of APANPIRG, a State Letter was issued on 2 April 2008. The meeting noted the information and reviewed the letter. In order to avoid confusion, it was suggested to amend few words contained in the letter. The Secretariat agreed to the proposal and initiated a revised letter based on the suggestion and the conclusion adopted by APANPIRG/18.

6.7.1 The meeting identified the need to develop a sample document for implementation of requirements for ADS-B Out avionics equipage including the positional data source. This was suggested to be included in the list of Subject/Task of the Task Force.

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Agenda Item 7: Review States' activities and interregional issues on trials and implementation of ADS-B

7.1 Under this agenda item, several information papers were presented to the meeting.

Australia

7.2 Australia provided an updates of Australian ADS-B related activities in the last 12 months as follows:

- 11 ADS-B sites are operational including Thursday Island which is available for data sharing;
- a total of 28 ground stations are expected to become operational throughout 2008/9;
- additional 20 stations have been delivered in June 2007 for installation at enroute radar site and other sites;
- 5 NM Separation service has been introduced;
- rules have been published requiring all aircraft to only broadcast ADS-B according to the standards;
- Joint Consultation paper (JCP) has been published proposing an ADS-B mandate in Australia by 2012. JCP also proposed a subsidy to support general aviation equipage. Further, the JCP proposes the transition to satellite navigation and the removal of many NDBs and VORs.

7.2.1 It was informed that the following interim services were provided:

- identification & altitude verification (full position reporting not required);
- the use of ADS-B position and altitude information in the application of procedural separation standards between ADS-B tracks and all other tracks;
- flight following for ADS-B equipped aircraft provided upon request;
- ADS-B short term conflict warnings with respect to other ADS-B equipped aircraft;
- ADS-B-based route and altitude conformance monitoring;
- Radar-like assistance to ADS-B equipped aircraft in emergencies; and
- Traffic advisory services between ADS-B equipped aircraft.

7.2.2 Airservices Australia has adopted a "neighbourhood programme" whereby Australia will support initiatives by our neighbours to improve ATM safety and capability. The Australian ground station at Thursday Island is operational with coverage provided into Indonesia and PNG. It is available for data sharing with Indonesia and PNG.

7.2.3 The meeting noted the number of aircraft transmitting ADS-B in Australia. A graphical report on Avionics Equipage rates for year 2007/2008 was provided to the meeting. The number of detected airframes transmitting good NUC (by State of Registry) and the percentage of Flights (per segment of operation) made by airframes approved by CASA for ADS-B service were noted.

7.2.4 Of particular note was the fact that Australia expects that in April 2008, more than 50% of all scheduled international flights will be conducted by airframes to which the regulator has approved the delivery of ADS-B services.

China

7.3 China informed the meeting of the Trial & Evaluation project for ADS-B being conducted by the General Administration of Civil Aviation of China.

7.3.1 An introduction on the TIS-B Experiment System and implementation plan at Shuangliu Airport was presented to the meeting. The receiving equipment for the TIS-B uplink data is mounted on mobile vehicles as aircraft substitute. ADS-B receiving equipment is also fixed on mobile vehicles with a display to monitor TIS-B report. The experiment system would provide support for ADS-B system smooth transition at Shuangliu Airport.

7.3.2 The meeting was further informed about an ADS implementation project for the ATS Route between Chengdu and Lhasa. The objective of the project is to enhance the procedure control with ADS-B surveillance on Chengdu ATS route in order to provide effective, reliable and continuous control. Four ADS-B ground stations will be co-located with VHF stations at Lhasa Kanbala, Linzhi Airport, Cahgndu Damala and Kangding Airport. The meeting noted the outlines of construction periods and schedule of project.

7.3.3 China provided information of the verification project of ADS-B system in Civil Aviation Flight University of China (CAFUC). The objective of the project is to test and verify the operational performance, accuracy and serviceability of ADS-B system. The result of test will provide reference and theoretical proof for further development and implementation of ADS-B in China.

7.3.4 The ADS-B's feature and its construction process at Civil Aviation Flight University of China (CAFUC) was noted. It was stated that ADS-B is not only able to enhance flight safety but also facilitate the traffic flow. Up to date, CAFUC has installed ADS-B airborne equipment on 7 types of aircraft, approximately total 160 aircraft, 5 ADS-B ground stations and connecting telecommunication network. Additional two ground stations are being installed.

New Caledonia

7.4 During the seminar France presented the New Caledonia ADS-B operational implementation programme.

France provided an update on the status of ADS-B implementation in New Caledonia as follows:

a) implementation decision taken mid 2007;
b) 2 ground stations will be installed before the end of the year 2008;
c) 1 more ground station will be installed by march 2009;
d) The ADS-B controller position display will be available in the 2 ATC sites of Tontouta airport and Magenta airport by mid 2009; and
e) the 3 ground stations will be operational in the 3rd quarter of 2009.

Republic of Korea

7.5 Republic of Korea provided updates on ADS-B related activities in Korea. Incheon international Airport has installed an X-Band SMR and two sets of ADSB ground station which are going to be operational from 1 June 2008. Data link 1090 ES (Extended Squitter) is used for the ADS-B system and Data format applied is ASTERIX Cat 21 edition 0.23 as adopted by APANPIRG in November 2003. ADSB messages from ADSB Ground Station to the Phase II SMR Fusion Processor (STREAMS) and Automated Radar Terminal System (ARTS) are transmitted via dual fiber optic cables. ADSB data is also used to support the Surface Conflict Alert (SCA) function for moving aircraft and vehicles on the ground, and ensure safe and smooth movement of ground traffic. For monitoring the vehicles moving in the airport, 35 ADS-B vehicle transmitters are installed In addition 15 portable ADS-B transmitters are available for additional use. ADS-B would contribute to the safe operation of aircraft and the smooth handling of increasing air traffic demand in the Incheon international Airport.

Pakistan

7.6 Pakistan informed the meeting that most of Pakistan air space already is under radar surveillance. Some gaps in the west and northern mountain regions need to be brought under positive visibility/surveillance. CAA Pakistan considers ADS-B a potential option to fill up the gaps in radar surveillance. CAA Pakistan is planning a comprehensive study also involving the domestic operators/carriers as presently almost none of the Pakistan registered aircraft is ADSB equipped. CAAP is in contact with potential supplier and may set up single ADS-B station on trial basis by end of 2008 or early 2009. Further progress shall be subject to the trial data analysis, risk mitigation, response from the operator and cost effects etc.

Fiji

7.7 Fiji provided updates on the status of ADS-B implementation in Fiji. It was stated that as Fiji does not have any surveillance system, it was proven from a business case that ADS-B is the cheaper to implement as opposed to radars. The consequence for a mishap in the Fiji airspace will be disastrous to the Fiji economy and it is therefore prudent that a move towards an early ADS-B implementation be strongly supported. The CAA of the Fiji Islands (CAAFI) has mandated the ANSP (Airports Fiji Limited) to implement a surveillance system as soon as possible for the domestic airspace preferably by 2010. The Airports Fiji Limited awaits the award of the contract for supply install and commission of the following components of the ADS-B project:

- ATM system upgrade and or replacement;
- ADS-B ground system;
- Provision of ADS-B avionics for Fiji –registered aircrafts; and
- Airspace Restructure.

It was informed that it was envisaged that the above components will be commissioned by end of 2009. It was further clarified that the domestic airlines are required to be compliant with target date of 2010 and for international airlines the target date would be 2012.

CNS/ATM Implementation Planning Matrix

7.8 The meeting also reviewed and updated the ADS-B aspect of CNS/ATM Implementation Planning Matrix presented by the Secretariat. It was noted that the matrix was regularly updated by CNS/MET Sub-group of APANPIRG and the Task Force meetings with respective to specific elements of CNS/ATM systems. The Matrix lists status of implementation of major CNS/ATM elements within the Region. The Matrix is used as a planning tool for monitoring the progress of implementation. The Matrix updated by the meeting is provided in **Appendix H** to this report.

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Agenda Item 8: Identify applicable multilateration applications in the Asia and Pacific Regions

8.1 Under this agenda item, the meeting noted with interest, information presented by Malaysia on the Multilateration (MLAT) which had been introduced at Kuala Lumpur International Airport (KLIA) to supplement the Surface Movement Radar (SMR) and to minimize the limitations of SMR.

8.1.1 MLAT system was needed to provide complete coverage of the runways, taxiways/taxi lanes and aprons and also an airspace coverage of up to 25 NM. Therefore the system employed was required to be able to track targets from gates/bays until departure to a range of 25 NM. The system design comprises of 22 remote ground sites with sensors comprising:

i) 20 receivers;
ii) 7 transmitters; and
iii) 2 reference transponders

8.1.2 The sensors are capable of receiving Mode A, C, S and ADS-B data. The system also includes 2 off-site sensors mounted on cell-phone remote sites towards the east and west of the airport to provide improved airspace coverage. The sites are located at a distance of 20 Kilometres from the airfield. Data from these sites is relayed via a dedicated microwave link. The sites within the airfield are connected via redundant fiber optic link to the Main Control Tower. As MLAT is a new technology, it was observed during implementation that multi-path effects occurred during ground surveillance. This is now being addressed with the installation of eight (8) additional sensors. The system is expected to become fully operational in May 2008.

8.1.3 It was noted that MLAT data is considered as one of the many inputs into the ATC system. As the inputs are independent of each other, failure of any one input does not degrade the ATC services provided. It was clarified that the system has function to include the ADS-B data input.

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Agenda Item 9: Examine the feasibility of using ADS-B derived data for height monitoring

9.1 In response to a new task assigned by APANPIRG/18 to examine the use of ADS-B for height monitoring (Task No. 13), the meeting considered a working paper presented by Australia.

9.1.1 The meeting noted that the Regional Monitoring Agencies (RMA) established by ICAO are responsible for height monitoring for each region. These agencies capture and assess aircraft flights which are monitored for height-keeping performance. This data is available to State Regulators for the RVSM approval process. RMAs conduct the initial and ongoing monitoring of flights to ensure the safety objectives of RVSM are continually met. It is currently accomplished using either ground based Height Monitoring Units (HMU) or GPS Monitoring Units (GMU).

- HMUs record all aircraft as they pass through the height sensor. These systems are based on multilateration surveillance; and

- A GMU is temporarily installed in the aircraft cockpit during monitoring flights with post-processing of the GPS data employed to increase the accuracy of the measured height.

9.1.2 A HMU is not available in the Asia and Pacific Regions to provide initial or ongoing monitoring of aircraft height-keeping performance. A GMU is used to record the initial monitoring of flight for operators that don't have access to the overseas based HMUs. A need exists to establish a HMU in the region to monitor the ongoing performance of aircraft during RVSM operations. Operators have indicated that their preference is for ground based monitoring systems due to the logistics and inconvenience of fitting a GMU in the cockpit.

9.2 The meeting reviewed the analysis of the alternative solution of using ADS-B for monitoring RVSM operation presented in the paper. The meeting concluded that ADS-B reports both Mode C barometric altitude and GNSS Geometric height thus it is a suitable candidate for providing data for RVSM height monitoring. However, a number of limitations on the quality and accuracy of the available data exist.

9.3 Although IATA and some States expressed support for the feasibility of using ADS-B data for RVSM height monitoring the meeting expressed concerns regarding the limited resources and expertise on the subject of RVSM within the group. Some experts from Industry indicated that they would further investigate how ADS-B derived data could be processed and used for height monitoring.

9.4 The Task Force recommends the use of ADS-B data as one of the possible methods for RVSM height monitoring but the consideration and implementation of the use of this option needs to be further developed by the RVSM Task Force and RASMAG. The result of the study is provided in **Appendix I**

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Agenda Item 10: Discuss issues observed during the trial and implementation of ADS-B including review of items from ADS-B Problem report database

The significance of GPS Selective Availability for ADS-B

10.1 The meeting considered a paper presented by Australia which showed significantly improved ADS-B availability when GNSS avionics was used which took advantage of the fact that "Selective Availability" was turned off.

10.1.1 Australia has studied 160 million ADS-B data samples from aircraft which are approved to receive ADS-B services in Australia. Aircraft which are aware of the SA status and utilise the SA off situation to produce integrity data produced higher integrity figures and result in better ADS-B performance. The better performance of SA aware avionics was also reported by Eurocontrol.

10.1.2 The meeting noted that SA aware avionics is preferred, it performs better and provides protection against "bad" constellation geometry and thus forward fitment of ADS-B should include SA aware capability in GNSS receivers.

10.1.3 The meeting was informed that some avionics vendors offer software upgrades to allow existing GNSS receivers take advantage of SA off.

10.1.4 The meeting also noted that that the Australian Civil Aviation Orders and associated Advisory Circular require the GPS performance delivered by SA aware avionics in support of ADS-B post 2012 in Australia.

Causes of loss of ADS-B availability to ATC

10.2 The meeting considered a working paper which discussed the causes of loss of ADS-B service to a number of aircraft in Australia over a 3 month period. It was noted that these were in 3 categories:

a) A high percentage of NUC=0 (for a long duration such as a whole sector) believed to be related to GNSS or transponder faults and corrected/exposed when the pilot selected the alternate transponder of sequential flight legs. More work is required to better understand the nature of these failure modes.

b) A loss of ADS-B service due to loss of adequate GPS geometry resulting in a low NUC value reported.

It was noted that there were 283 of these outages in September 2007 but only 38 or 39 in each of October & November 2007. An outage in this context is the loss of ADS-B services to a single aircraft. The average period of loss of service was 6 minutes. The large number of outages in September is thought to be due to satellite outages and system changes that occurred in the GPS control system at that time.

It was further noted that in the 3 month period there was only a single outage of 5.5 minutes for avionics which were SA aware. It was noted that the performance of SA aware receivers provides protection to some extent from satellite geometry problems and satellite outages.

c) A number of ADS-B outages with NUC=0 (for short durations) for which the cause is not yet known.

Relationship of HFOM to HPL

10.3 The meeting was informed of a study conducted by Australia which examined 12 million samples from a GNSS receiver installed on a building in Canberra. The study found that HPL varied between 0.014 nautical miles to 1.237 nautical miles. The study also examined the empirical relationship between HFOM and HPL. It found that at any given time HFOM ranged from 1.3% to 43% of HPL.

10.3.1 It was noted that if HPL of 0.5 Nm is acceptable then this empirical data suggests that HFOM would be less than 0.25 NM i.e. the 95% error for the positional data is less than 0.25 Nm. This study adds some weight to the decision by some states to offer services based on NUC alone (DO 260) when the NUC value is determined by HPL alone. Whilst the HFOM value can be determined directly from DO 260A avionics it is unavailable from DO 260 avionics. However, it was noted that the study only relates to a single avionics product and it would be useful to know if the same relationship were found for other GPS receivers such as those that assume SA ON.

10.4 The meeting discussed the issue of different GPS performance being experience in different regions of the world. There was agreement that analysis of ADS-B loss of service due low NUC values would be useful in other geographical areas.

Performance Based Navigation

10.5.1 The meeting noted the current status of ICAO PBN implementation programme presented by the Chairman of PBN Task Force of APANPIRG. It was informed that the PBN Task Force established by APANPIRG held its first meeting in January and second meeting in early April 2008. The reports of the meetings are available on the regional ICAO web site at http://www.bangkok.icao.int/. The next meeting will be held in Bangkok on 14-17 July, 2008 and will include a one day seminar on PBN concept. Activities and planned outcomes from the regional task force include completion of the first regional implementation plan by APANPIRG/19 in September, 2008 and state implementation plans by 2009.

10.5.2 It was further noted that like ADS-B, PBN is one of the elements of the transition to a satellite-based ATM structure as detailed in both the global and regional ATM plans. While the basic concepts are in place, a significant amount of implementation work is required to ensure the safe and coordinated adoption of these technologies. Material presented at the PBN Task Force meetings has shown the benefits of combining PBN and ADS-B implementation programs in allowing simultaneous upgrades of both the navigation and surveillance systems to satellite-based technologies.

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Agenda Item 11: Any other business

Note of appreciation

11.1 The meeting expressed its appreciation and gratitude to the Air Traffic Management Bureau, CAAC for hosting the ADS-B Seminar and the meeting, the excellent support provided and for all activities organized during the meeting.

Time and Venue of Next Meeting

11.2 The third meeting of SEA ADS-B Working Group was scheduled to be held at early July 2008 in Kuala Lumpur, Malaysia and timing for the next meeting of ADS-B Study and Implementation Task Force is scheduled to be held in April or May 2009. Since no offer for hosting the next meeting was received during meeting, the members of the Task Force will be informed well in advance of venue of the meetings after consultation with the concerned.

11.3 SEA ADS-B Working Group reports to ADS-B Task Force, but for expediency reasons, the meeting agreed that the outcomes of the next meeting be reported to the twelfth meeting of CNS/MET SG of APANPIRG.

Use of ADS-B in North Asia Area

11.4 As follow-up to IP16 presented by IATA to the meeting, a two-prong approach to resolve ATM issues in the north Asia area including DPR. Korean and Russian Far East airspaces was proposed:

a) That a technical mission be sent to DPR. Korea to ascertain the ATM/Communications infrastructure to support the polar 1, 2, and 3 routes. Possibility and capability of DPR. Korea to implement ADS-B Out surveillance and data sharing with adjacent States are to be explored; and

b) That relevant States adjacent to DPR. Korea including China, Republic of Korea, Russia and Japan evaluate the possibility of installing ADS-B ground stations at appropriate locations or the use of radar coverage to assist DPR. Korea in air traffic management for the affected Polar 1, 2 and 3 routes. States should report back to the ADS-B SITF/8 meeting on the status of this evaluation.

11.5 IATA further stated that it was particularly encouraged by the progress of the South East Asia group which was beginning to turn words into action. IATA noted its appreciation of the Vietnamese initiatives in the South China Sea. This has huge potential for benefits to operators using L642 and M771 routes. IATA encourages Vietnam to continue to push forward with these plans.

11.6 IATA also acknowledged the leadership and focus of Australia in pushing for ADS-B deployment in the region, but IATA had more recently sensed a slow down in the Australian domestic program which was of great concern. The Australian UAP is late and there are no results yet available from the Joint Consultation Paper which proposed an ADS-B mandate in 2012. IATA is keen for this JCP to succeed.

Discussions on the future of the ADS-B Task Force

11.7 The meeting further reviewed the TOR of the Task Force and discussed the future of the ADS-B Task Force. States and international organizations at the meeting made the following comments:

- ADS-B implementation is now at a critical phase as States shift from study & talk to action/implementation;

- Continuation of the Task Force will contribute to solving ADS-B problems of implementation. Since implementation is just starting in most States, this is now a critical time to have the Task Force available. It was agreed by many participants that the study phase is nearing completion and concentration of the Task Force should focus on implementation coordination. Some participants expressed the view that study is never complete;

- Exchange of information is essential and necessary at the initial implementation stage. Until implementations are mature (at least one ground station being used in States) the forum of the Task Force will remain very useful;

- The issue of integration of multilateration has not yet been adequately addressed by the Task Force;

- The Task Force meeting once a year is a small and effective investment by States for the value that is derived from the meeting;

- The host State derives significant benefit through the education opportunity of the Seminar;

- The Task Force builds confidence for States to move forward with ADS-B and multilateration;

- More work is required on the legalities of ADS-B data sharing especially issues of liability; and

- The Task Force must now focus on implementation, transition and data sharing issues.

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UPDATED ADS-B SUBJECT/TASKS LIST

No.	Subject/Tasks List	Associated with Strategic Objective	Associated GPI	Deliverables	Target Date	Action to be taken and led by
1	Conduct study and present a paper on a study for the use of ADS-B technology in airspace in the North Asia.	D. Efficiency	GPI01/02/05/06/07/09/ 14/16/17/21/22	Report of study for the use of ADS-B in North Asia area	Completed (04/2008)	IATA
2	Report Organizational Policy on ADS-B data sharing with neighbors.	A. Safety D. Efficiency	GPI01/02/05/06/07/09/ 10/11/14/16/17/21/22	Status report	Completed (04/2008)	All Members
3	Each State report on the number of airframes fitted and transmitting with good NUC/NIC.	D. Efficiency	GPI01/05/06/09/14/16/ 17/21/22	Report on statistics conducted	10/2008	All Members with Ground Stations
4	Develop draft comparison of surveillance technologies document including required site and network architecture, expected surveillance coverage, cost of system.	D. Efficiency	GPI01/02/05/06/07/09/ 14/16/17/21/22	A regional guidance material for implemetation	Completed (4/2007)	Greg Dunstone
5	Develop draft update to AIGD to incorporate multilateration.	D. Efficiency	GPI01/05/06/09/ 14/16/17/21/22	The second amendment to the AIGD	Completed (4/2007)	Nick King, Chainan Chaisompong & Howard Anderson Anderson)
6	Provide a paper with an update on available equipment standards: (ARINC, Eurocae, RTCA, ICAO, TSO)	D. Efficiency	GPI01/05/06/09/ 14/16/17/21/22	An information document for implementation	10/2008	USA- seek updates from Home
7	Develop a table detailing readiness of Airspace users & ATS providers	D. Efficiency	GPI01/05/06/09/ 14/16/17/21/22	Report of a survey conducted	Completed (4/2007)	Singapore

No.	Subject/Tasks List	Associated with Strategic Objective	Associated GPI	Deliverables	Target Date	Action to be taken and led by
8	Provide details of potential areas (FIRs) that where there is a positive cost/benefit for near term implementation of ADS-B Out	D. Efficiency	GPI01/05/06/09/ 14/16/17/21/22	Report of result of studies	Completed (4/2008)	All -Corner meetings
9	Develop a paper on how Probability of detection should be reported for ADS-B so that it can be compared to radar probability of detection	D. Efficiency	GPI01/05/06/09/ 14/16/17/21/22	Guidance material for implementation	Completed (4/2008)	
10	Develop guidelines on how ADS-B equipage should be reported in future, especially the definition of "equipped".	D. Efficiency	GPI01/05/06/09/ 14/16/17/21/22	Guidelines for implementation	Completed (4/2008)	Greg Dunstone
11	Develope outline of the performance criteria and identify issues to be considered when introducing ADS-B into an Air Traffic Control multi-sensor fusion process	D. Efficiency	GPI01/05/06/09/ 14/16/17/21/22	Guidance material for implementation	Completed (4/2008)	Rick Castaldo, Greg Dunstone Michel G. Procoudine
12	Deveop brief guidance paper on security issues associated with ADS-B	D. Efficiency	GPI01/05/06/09/ 14/16/17/21/22	Guidance material for implementation	Completed (4/2008)	Patrick Souchu, Greg Dunstone, Mike Gahan
13	Exam the feasibiity of the use of ADS-B for height monitoring	A. Safety	GPI01/05/06/09/ 14/16/17/21/22	Result of feasibility study - Advice on ADS-B capability to RVSM Groups.	Completed the advice materaila 4/2008	TBD
14	Guidance material on how to build safety case for delivery of separation services	Safety	GPI01/05/06/09/ 14/16/17/21/22	Guidance material for implementation	Apr-09	Australia
15	Guidance material on display of ADS_B tracks on displays	D. Efficiency	GPI01/05/06/09/ 14/16/17/21/22	Guidelines for implementation	Apr-09	Australia
16	Sample mandate material defining ADS-B avionics including the positional data source	A. Safety	GPI01/05/06/09/ 14/16/17/21/22	Guidance material for implementation	Apr-09	Australia
17	Guidance on legal liability issues for ADS-B data sharing	A.Safety	GPI01/05/06/09/ 14/16/17/21/22	Guidance material for implementation	Apr-09	U.S.A.

No.	Subject/Tasks List	Associated with Strategic Objective	Associated GPI	Deliverables	Target Date	Action to be taken and led by
18	Develop and impliment regional collaboration project for ADS-B Out operational use including data sharing in SEA and report on implementation progress	D. Efficiency	GPI01/05/06/09/ 14/16/17/21/22	Develop and implment sub-regional ADS-B collaboration project.	Jul-08/ Dec-10	SEA WG
19	Develop and impliment regional collaboration project for ADS-B out operational use including data sharing in South Pacific and report on implementation progress	D. Efficiency	GPI01/05/06/09/ 14/16/17/21/22	Develop and implment sub-regional ADS-B collaboration project.	Apr-09/ Dec-11	South Pacific States
20	Develop common compliance procedures for regulatory surveillance of ADS-B avionics installations and operation.	D. Efficiency	GPI01/05/06/09/ 14/16/17/21/22	Sample document	Apr-09	Australia
21	Study application of ADS-B and multilat for precision runway monitoring	D. Efficiency	GPI01/05/06/09/ 14/16/17/21/22	Guidance material for implementation	Apr-10	All Members
22	Perform data collection and data analyis of ADS-B messages to examine GPS performance in different geographic areas	D. Efficiency	GPI01/05/06/09/ 14/16/17/21/22	Report of data collected and analyzied	Apr-09	All Members

GUIDANCE MATERIAL ON REPORTING ADS-B PROBABILITY OF UPDATE

1. Background

1.1 Radars rotate at a fixed rate. Typically the air traffic controller is presented with new surveillance data at a rate identical or similar to the rotation rate of the radar, e.g. in the terminal area the screen refresh rate is usually about 5 seconds.

1.2 Probability of detection (Pd) is often used as a performance measure of a radar. It is a measure of the likelihood that a target will be detected. There is an underlying assumption in this definition that this probability applies to a single antenna rotation or controller screen update. This could be called probability of update.

1.3 ADS-B does not have a rotating antenna and typically a message is presented to the ATC centre every 1 second. It is then usually presented to the controller at the same rate as radar so that the controller perception of speed for radar and ADS-B tracks is the same. Normally this implies that multiple ADS-B “detections” are received during the display update cycle.

1.4 To compare the detection probability of radar and an ADS-B receiver system one must consider the operational use of the facility. For ADS-B to have the equivalent (or better) performance as radar, it must have equivalent probability of providing an update to the controller as radar over the same period.

1.5 If a radar system provides an update every 5 seconds, then to compare the radar probability of detection, one must consider the probability of ADS-B detecting and displaying the aircraft in the 5 second period. If one wishes to compare to an en-route radar rotating at 5 RPM, then one must consider the probability of ADS-B detecting and displaying the aircraft in the 12 second period.

2. Radar PD calculation

2.1 The achieved radar Pd is calculated by examining, for a particular coverage area, the achieved detections and dividing by the number of attempts at detection : ie the number of antenna revolutions or number of screen updates, e.g. in 100 antenna rotations 90 detections are presented to the controller and hence the Pd = 90%

3. ADS-B Probability of update calculation

3.1 An equivalent Probability of Update for ADS-B would be calculated by examining, for a particular coverage area, the detections presented to the controller and dividing by the number of possible screen updates Eg: in 100 screen updates, ADS-B positional data is presented to the controller 90 times and hence the Probability of update = 90%

3.2 If there is a desire to measure Probability of Update of ADS-B to be used for a terminal area function, without consideration of a display system, it is recommended that a period of 5 seconds is used. Divide the observation period into 5 second intervals and measure the probability as

$$\frac{\text{the number of 5 second intervals that contain valid useable positional data}}{\text{the number of 5 second intervals}}$$

3.3 If the ADS-B is to be used for an en-route only function, the selected period could be 5, 10 or 12 seconds.

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GUIDANCE MATERIAL ON REPORTING ADS-B AVIONICS FITMENT

1 Purpose

1.1 States often discuss the percentage of flights or percentage of a fleet that is equipped with ADS-B. Whilst safety benefits can be delivered in environments with low equipage rates, the delivery of efficiency benefits to airspace users requires a high percentage of fitment.

1.2 A common method of reporting equipage rate is desirable. It has been noted that States currently use different criteria for reporting.

2 Acceptable Avionics

2.1 For ADS-B to be useful it is necessary that the avionics are transmitting "good" positional data integrity values. Therefore before an aircraft can be considered equipped it must be able to generate appropriate NUC (or NIC) values.

2.2 It may not be possible for all States reporting ADS-B detections to know definitively whether the transmitted integrity value from each detected airframe is generated correctly. In some cases this determination can only be made in consultation with the aircraft operator and avionics and/or airframe manufacturer. It is not proposed that all States undertake this determination.

2.3 Therefore, it is proposed that States report on the number of airframes reporting NUC or NIC acceptable for delivery of separation services, i.e. NUC>4. They may also report on the number of aircraft transmitting NIC or NUC indicating that ADS-B data cannot by used for separation services. No determination about the source or acceptability of NUC or NIC needs to be made in the reporting.

3 Reporting by Flight or Airframe

It is useful to report the number of ADS-B airframes detected as well as the number of ADS-B equipped flights.

3.1 By airframe reporting

Each ADS-B capable airframe is identified by its 24 bit address. Therefore it is relatively easy to maintain tables of individual airframes that have been detected transmitting acceptable ADS-B position and integrity data.

This report will include all aircraft that have been detected, regardless of whether they operated with and without a flight plan.

It is useful to understand the equipage rate for both foreign aircraft and local registered aircraft. Hence it is proposed that these are reported separately.

- Local [aircraft] – registered in the reporting State.
- Foreign [aircraft] – registered in any State other than the reporting State.

Splitting local aircraft into above and below 5700Kg also gives some indication of the type of aircraft equipped.

It would also be useful to indicate in the report the number of aircraft on the local aircraft register so that a percentage of equipage can be reported as well as the raw number of airframes detected.

This report may not be indicative of the impact of ADS-B because some equipped aircraft may operate very infrequently, others may operate many sectors a day and some may be either rare or frequent users of the State's airspace.

3.2 By Flight reporting

It may be possible for States to determine which individual flights are ADS-B equipped by using:

- Flight plan indicators
- Registration numbers of equipped aircraft matched to flight plans
- Date/ time and ADS-B transmitted flight ID matched to flight plans

From an air traffic management perspective, reporting by flight is more useful than reporting by airframe, because it gives an indication of the potential to provide services to airspace users. This report is more indicative of the impact of ADS-B because some equipped aircraft may operate very infrequently and others may operate many sectors a day.

This report will only include flights that have been operated with a flight plan.

If reporting by flight, assuming that flight plan data is available, it would be useful to categorise the flights into a number of categories. The following are proposed:

- International Scheduled flights
- Domestic Scheduled flights
- Domestic flights

where

- Domestic means a flight departing from and arriving in the reporting State (operation entirely within the reporting State).
- International means a flight departing from OR arriving in the reporting State (operation only partly within the reporting State).

4 Reporting forms and charts are shown in the Appendices

APPENDIX A

Report for year: …………

Percentage of flight planned **FLIGHTS** (per segment of operation) made by airframes with good integrity data for ADS-B service

	Scheduled International flights	**Unscheduled International flights**	**Scheduled Domestic flights**	**Unscheduled Domestic flights**
January				
February				
March				
April				
May				
June				
July				
August				
Sept				
October				
November				
December				

Number of ADS-B Equipped **AIRFRAMES** detected

	Foreign registered airframes	**Local registered airframes**
January		
February		
March		
April		
May		
June		
July		
August		
Sept		
October		
November		
December		

Percentage of ADS-B Equipped Local Airframes detected (based on local aircraft register for each month)

	Percentage of local registrations (>5700 MTOW)	**Percentage of local registrations (< 5700 MTOW)**
January		
February		
March		
April		
May		
June		
July		
August		
Sept		
October		
November		
December		

APPENDIX B: SAMPLE REPORTING GRAPHS

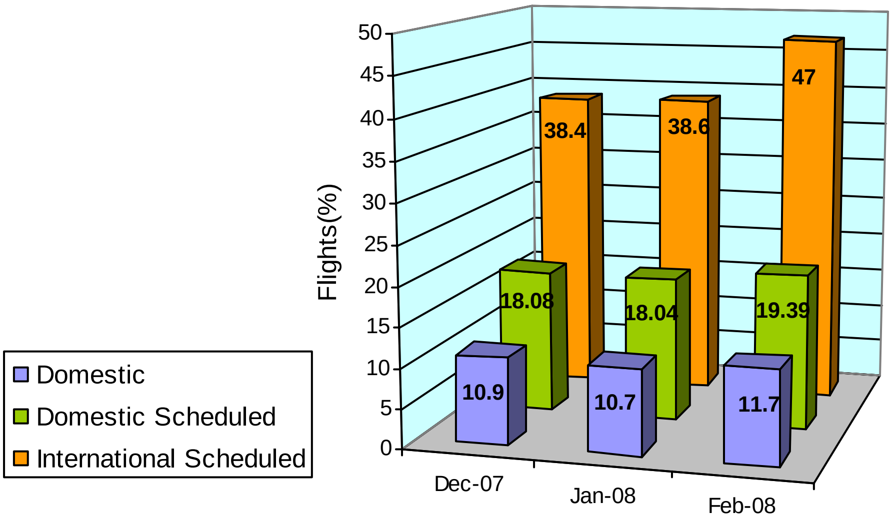

Figure 1 ADS-B **Flights** Detected since December 2007

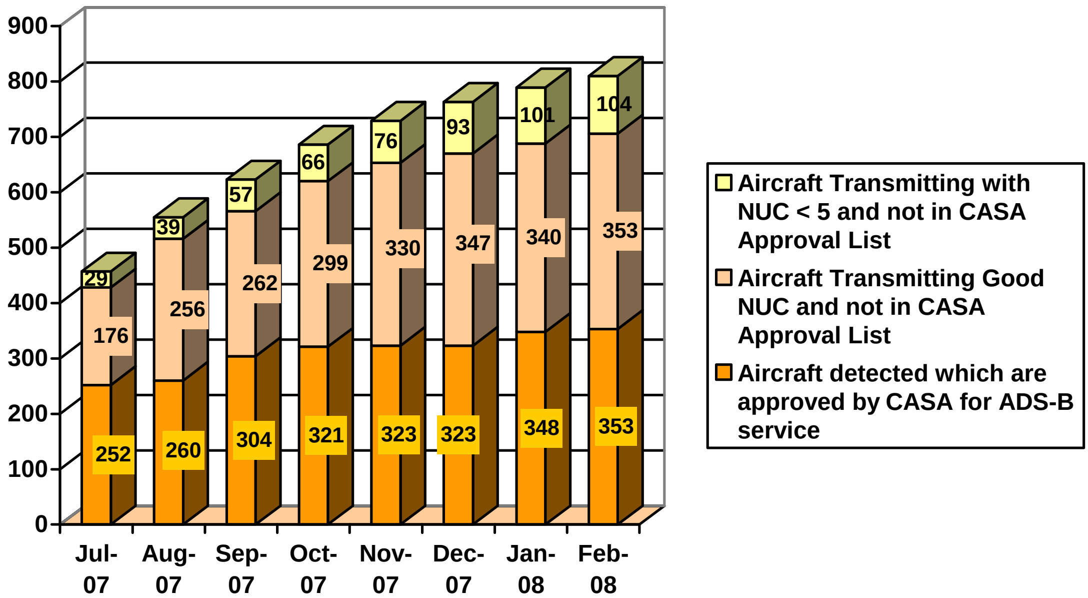

Figure 2 ADS-B **Airframes** Detected since July 2007

GUIDANCE MATERIAL ON ISSUES TO BE CONSIDERED IN ATC MULTI-SENSOR FUSION PROCESSING INCLUDING THE INTEGRATION OF ADS-B DATA

1 Introduction

Modern air traffic control systems use multi-sensor fusion processes to improve the quality of surveillance track data provided to air traffic controllers. This is the latest step in a series of evolutionary improvements to ATC surveillance systems, each offering performance benefits over previous systems.

The original surveillance systems presentations were limited to only displaying a single radar per controller's screen.

Radar mosaic displays provided the first advance on single radar displays. The coverage presented to a controller was divided into "sort boxes", and data from one radar could be displayed in some areas ("boxes"), and data from other radars displayed in other areas, each radar selected for best detection in a given area. Mosaic display systems are generally limited to displaying data from a single "preferred" radar per "sort box".

Multi-radar fusion processing provides an advance on mosaic processing by fusing the detections of multiple radars in areas of overlapping coverage, improving the probability of detection and the tracking of manoeuvring aircraft. Multi-radar fusion processing is a well established process, but is usually limited to integrating the outputs from similar radars that have overlapping coverage.

Multi-sensor fusion provides a further advance on multi-radar fusion by integrating data from a multiplicity of sensors to form a single track for each aircraft. A multi-sensor fusion processor may form a surveillance track using inputs from any or all of the following sensors:

- Primary radars
- Mode A/C SSRs using sliding window processing
- Mode A/C SSRs using monopulse processing
- Mode S SSRs
- Mode S SSRs with DAPS (downlinks of aircraft parameters)
- Wide Area Multilateration systems
- ADS-B receivers

Each of these sensors has different attributes, and a well designed multi-sensor fusion processor will take advantage of the strengths of each sensor, and use these to compensate where possible for the weaknesses of other sensors. It is important to note that some of the measures taken to mitigate the weaknesses of traditional radar sensors should not be applied to data from newer data sources (such as ADS-B) if those weaknesses are no longer a characteristic of the new data. Rather, the processing of each type of data in a multi-sensor fusion algorithm should be adapted to make best use of the actual performance of each of the data sources. Factors to be considered include accuracy, update rates, integrity (probability of false data), and amount of data provided (ie in addition to position, other aircraft information such as aircraft address, flight ID, vertical and horizontal velocities, bank angle, on ground or not, cleared flight level entered into the aircraft FMS, etc may be provided by some sensors, and these items should be used where they can improve performance).

2. Characteristics of Different Sensors

A high level summary of some of the key characteristics of the different sensor types listed above is provided at Attachment 1. The following figures provide examples of accuracy and update characteristics from different sources, and the impact they can have on multi-sensor fusion tracking.

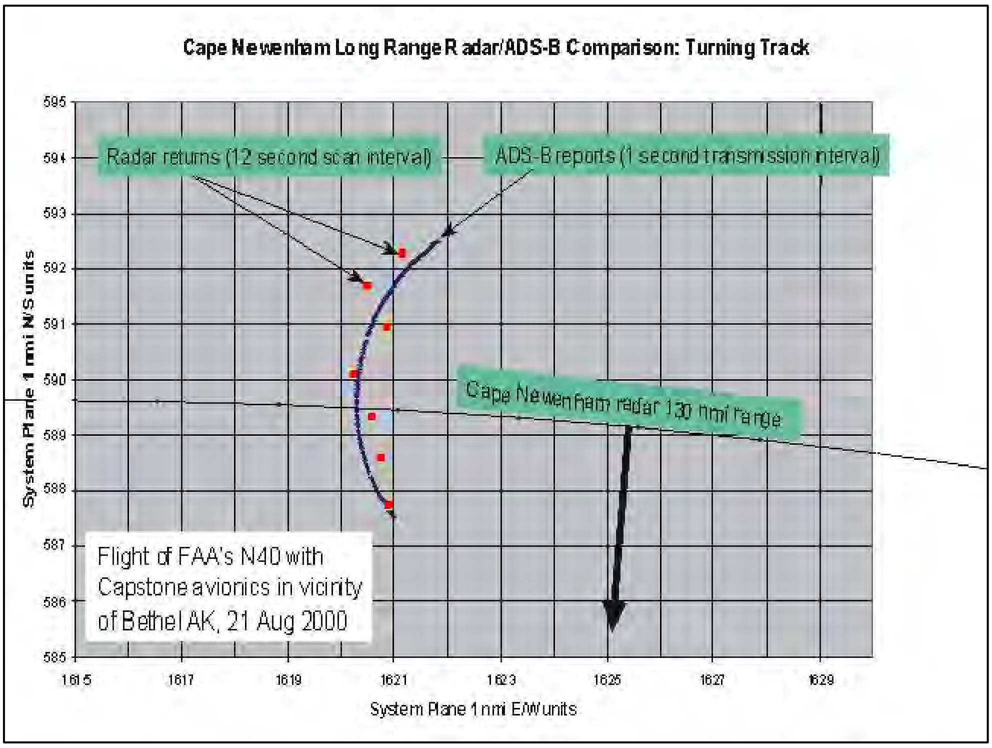

Figure 1 – Alaska: ADS-B and Radar position reports *(FAA)*

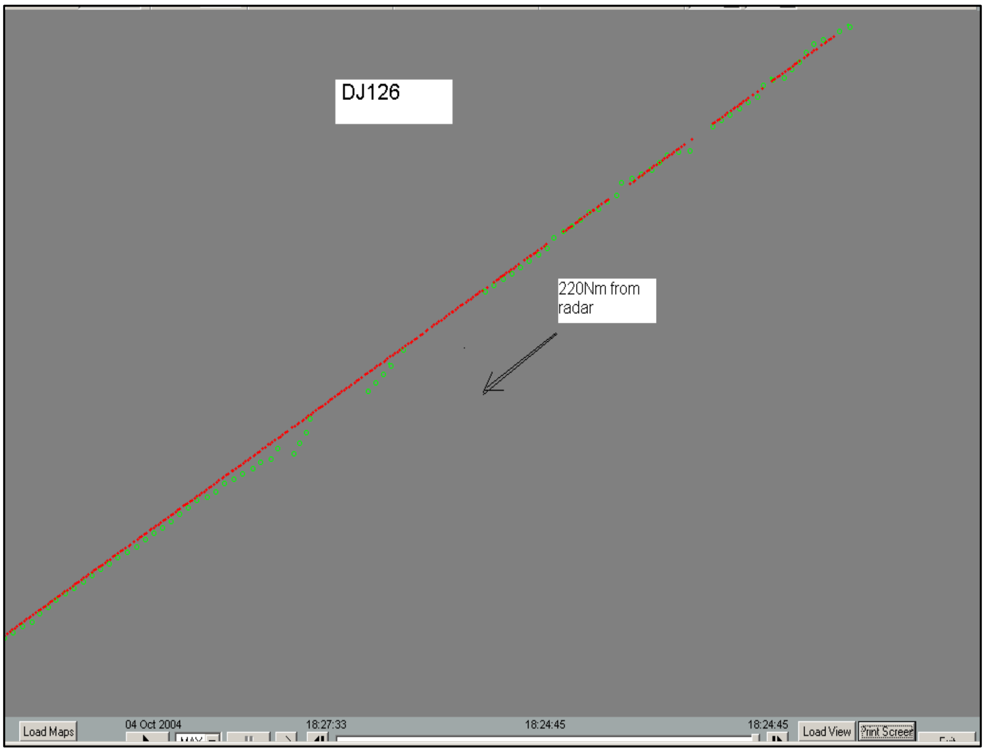

Figure 2 – Australia: ADS-B (red) and Monopulse SSR (green) *(Airservices Australia)*

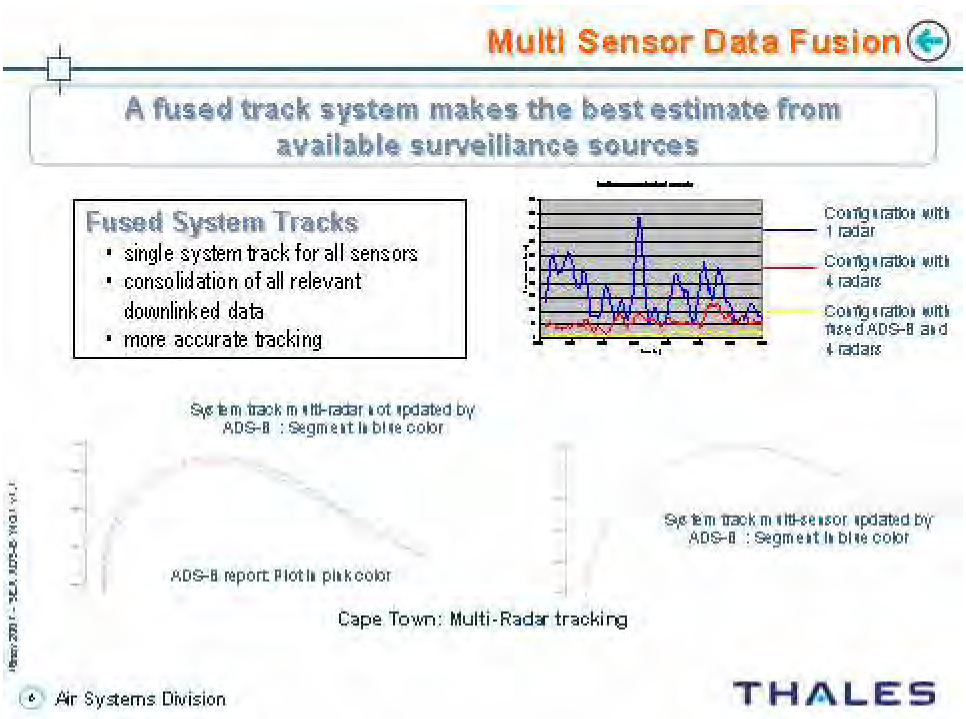

Figure 3 – Analysis of Multisensor Data Fusion with ADS-B *(Thales ATM)*

Figures 1 and 2 provide examples where the position accuracy of ADS-B is clearly much better than that of the radars at the radar ranges indicated. In addition, the update rate of the ADS-B data is much higher (once per second compared to once every 5 or 12 seconds). Both of these factors contribute to improved performance. Radar measurements that exhibit high position noise must be damped to mitigate against false couplings with position reports from other aircraft, and to achieve moderate stability of velocity vectors. While this damping improves tracking for straight line flights, the penalty of damping is overshoot position errors during manoeuvres. The improved accuracy of ADS-B data means there is little if any need for damping. Furthermore, for a given level of damping the overshoot errors tend to increase as the square of the time between updates, and so the higher update rate of ADS-B data significantly reduces the impact of any small amounts of damping that may be applied to this data. In Figure 3 the red line on the graph also shows the improvement from fusion of data from four overlapping radars, which the effect of increasing the average update rate for radar data, but the yellow line shows that the integration of ADS-B data further reduces position errors by a significant amount.

3 Issues to be considered in ATC multi-sensor fusion processing

Many different approaches are possible in the design of multi-sensor fusion surveillance systems suitable for air traffic control. The following paragraphs describe some of the issues to be considered when designing such a system, and the performance that can be expected from ADS-B in these areas.

3.1 Filtering of anomalous data

All of the sensor types listed above have the potential to generate anomalous reports, and the processing system needs to have the capability to filter out this data. Often this is undertaken in a two step process, with a first pre-processing filter at the sensor processing level, and a second filtering at the multi-sensor processing level.

Primary radars detect many objects which are not aircraft, such as road vehicles, weather cells, ground clutter and birds. If the radar is a combined primary and SSR system, then those primary radar detections that correlate in position with an SSR report can be given added credence in a sensor pre-processing filtering process. At this level some form of scan to scan surveillance processing or track formation is carried out, to filter out reports that do not show a scan to scan position movement consistent with aircraft performance parameters. However, even after pre-processing at the sensor, primary radars will output reports that are not from aircraft.

SSR systems require a transponder on each aircraft, and therefore do not generate the sort of anomalous reports that can occur with primary radars. However, SSR systems generate other forms of anomalous reports, such as those caused by reflections, mutual interference (garbling) and poor signal to noise ratios. SSR signals may be reflected off structures such as hangars and terminal buildings to create erroneous reports with incorrect azimuth and range. Some form of surveillance processing at the sensor is normally applied to try to filter out SSR reflection plots, but this is not always totally successful. Garbling occurs when the signals from two or more aircraft interfere with each other in the receiver. Garbling can cause loss of detection, corrupted Mode A (identity) and Mode C (pressure altitude) data, and azimuth shifts. SSR Mode A/C systems that use monopulse signal processing are less prone to losses of detection and azimuth shifts when replies from two aircraft partially overlap in azimuth. Weak signals (usually at longer ranges) can also lead to corrupted Mode A and C data, where receiver noise can corrupt the data detection process. Data from a Mode A/C SSR system does not have any form of error checking, making corrupted data difficult to detect.

SSR Mode S was developed to overcome the SSR garbling problem. Each aircraft is allocated a unique 24 bit address, which is used to selectively interrogate that aircraft. Only the aircraft with the specified address reply, eliminating garbling. False plots due to reflections are largely eliminated also, because on acquisition the Mode S ground station has to work out which replies are the correct ones, and thereafter it will only schedule selective interrogations on that azimuth, and not on the false reflective path azimuths. Incorrect decoding of data by a receiver is still possible when signal to noise ratios are poor, but SSR Mode S data includes a rigorous error detection and correction check sum generated in the aircraft that not detects virtually all errors, but also allows many to be corrected. In general the amount of anomalous data from SSR Mode S sensors is much reduced compared to previous SSR systems. SSR Mode S also allows an aircraft to downlink a number of aircraft parameters (referred to as DAPS), and this data can be used to improve the multi-sensor processing.

A Wide Area Multilateration (WAM) system requires transmissions from an aircraft to be received at a number of geographically dispersed receiving sites. The position accuracy of WAM reports is highly dependent on the geometry of the receiving sites relative to the position of the aircraft (meaning that accuracy for an aircraft in one position may be quite different to that for an aircraft in another position). It is important that the accuracy of WAM data is known to any multi-sensor fusion process. Wide Area Multilateration can operate by processing squitter signals from SSR Mode transponders (including Mode S Extended Squitter ADS-B signals), or by processing reply signals generated from any transponders in response to interrogations from other sources (TCAS on other aircraft, or ground based interrogators). In general, when processing signals from Mode A/C transponders a WAM system can suffer from garbling similar to SSR, but when processing signals from Mode S transponders the improvements in data integrity of SSR Mode S are obtained.

ADS-B data uses the SSR Mode S error detecting and correcting communication protocols to ensure that the data received from an aircraft has not been corrupted. Occasional garbling of ADS-B signals can occur if signals from two aircraft arrive at a receiver at the same time, but this is infrequent due to the pseudo random timing of ADS-B transmissions. It may result in the loss of one report, but is extremely unlikely to create an erroneous report. Given the high rate of transmissions, a new report is likely within a second, making the occasional loss of a report much less significant to the multi-sensor fusion process than the loss of a report from any of the radar sensors. Position determination is carried out by the aircraft avionics system, and the accuracy and integrity of this position determination is included in the data transmitted by the aircraft (parameters such as NUC for equipment certified to DO260, and NIC, NAC and SIL for equipment certified to DO260A). **It is critically important that this aircraft generated position accuracy and integrity information is taken into account when integrating ADS-B data into an ATC multi-sensor processing system.** For example, reports with low NUC values (such as 0,1,2 or 3) will often be discarded as inadequate to support an ATC application. For an airport surface surveillance separation application the threshold is likely to be set much higher whereas for an airport surface surveillance advisory service it may be less stringent. There is a possibility that faulty position determining equipment on an aircraft could generate anomalous position reports but mark these as high accuracy and integrity, although the probability of this occurring is considered extremely low. To detect and eliminate these spurious reports, some form of basic surveillance processing is recommended, such as a ‘reasonableness check’ on distance traveled between subsequent reports. For example, it is not ‘reasonable’ for an aircraft to appear to have travelled 25 miles in the half or one second interval between two ADS-B messages.

3.2 Integrating Data from Different Sensors in the Multi- Sensor Fusion Process

The multi-sensor fusion process needs to be adapted to make best use of the performance characteristics of each of the contributing sensor systems.

Mapping to common datum, the process which converts the various sensor reports to a common datum. Uncertainties can be created in conversion of radar data (based on slant range measurements) to a geographic reference without accurate altitude information. Consideration of processing requirements when there is poor altitude data needs to be considered.

Correlation, the process of deciding which sensor reports are updates to the track of a given aircraft, is a critical part of the fusion process. ADS-B, SSR Mode S and some WAM reports will include the unique 24 bit aircraft address of the aircraft, and this provides a very high confidence indicator that should be used for correlating new reports with an existing multi-sensor track. These reports may also include the aircraft Flight Identification, which is also a good indicator. For SSR Mode A/C systems, the Mode A code is a reasonable measure for correlation, but as explained above it is subject to corruption in garbling situations, and cannot be used with the same confidence as an aircraft address. (Label swaps in garbling situations are not unknown in Mode A/C multi-radar fusion systems). The position data in a report is also a factor in correlating a new report with an existing fused track – the change in position since the last update should be within the bounds of an airplanes' aerodynamics. For correlating primary radar only reports, position correlation is the only measure that can be used.

Position Estimation in a multi-sensor fusion process should to take full advantage of the characteristics of each contributing sensor system – items such as position accuracy, resolution, integrity and update rates differ from sensor to sensor, and the contribution that each makes to the multi-sensor fusion process should be weighted accordingly. **Update rate** is particularly important in tracking the position of a manoeuvring aircraft, and ADS-B and WAM, with typically an update every second, can provide large performance benefits over the typical five, ten or twelve second updates provided by radars. **Position accuracy and integrity** of the data from each sensor type should also influence the weighting given in estimating the multi-sensor track position (and position noise) at each update. For ADS-B the NUC (or DO260A equivalent) should be taken into account in some way – for example, discarding reports with NUC below some threshold, and then perhaps assigning higher weights to higher NUC value reports. High NUC value reports are likely to be the most accurate of all sensors.

The accuracy of WAM position reports are dependent on the geometry of the ground receivers and the aircraft, and it is important that the multi-sensor fusion process is provided with information on WAM position accuracy – for example, all reports are better than a specified accuracy threshold (other reports having been discarded in pre-processing), or each report is accompanied by a "Figure of Merit" based on the geometry of the received signals.
For all types of radar sensors, the accuracy is likely to be constant in range from the sensor, but will decrease in azimuth with increasing range. Less weight should be given in the position estimation process to the azimuth component of radar reports as range increases. It is also necessary to protect against biases in the data from different sensor types.

Bias: ADS-B data is all based on WGS-84 latitude and longitude, and for all values of NUC likely to be used operationally, will be derived from GNSS. ADS-B bias can be assumed to be zero. WAM bias should also be low, but is dependent on the accuracy of survey of ground sites and the time tagging of receptions. Radar bias is mainly a factor of how accurately the north mark encoding of antenna position has been aligned on each radars, combined with the accuracy of survey of the sites. These are both manual processes, and significant errors are not unknown.

Velocity and Acceleration Estimation is important for a number of purposes, including presentation to the controller, safety net functions (such as STCA) and for predicting the multi-sensor track position as part of the correlation process for deciding which new reports should be correlated with which multi-sensor tracks. There are several ways of estimating velocity and acceleration. The traditional approach in multi-radar fusion processes was to look backwards at the last few position reports and calculate a direction, speed and sometimes an indication of whether the aircraft appeared to be turning or travelling straight. This use of historical data works moderately well in constant speed straight flight with accurate position data, but always lags when the aircraft accelerates (including in turns). If the position data is noisy and needs to be damped, this lag increases. The lag can be reduced by more frequent position updates. New sensors offer other ways of determining velocity and acceleration. For example, SSR Mode S with DAPS includes the capability to extract from an aircraft FMS parameters such as ground speed and bank angle, while each ADS-B report includes a velocity value that has been calculated by the position determining equipment (GPS) on board the aircraft. These sources can provide data that is superior to that estimated from an analysis of the historical position reports from the aircraft, and should be used to improve the multi-sensor fusion velocity and acceleration estimation process.

Collection, validation and reporting of downlink data is also to be considered. Downlink data includes barometric altitude, geometric altitude, selected flight level, Flight ID, 4 digit octal code etc. Rules and processes are required to treat these appropriately from each data source. In some cases it may be appropriate to cross check this data with the track trajectory Eg: velocity vector. In other cases the downlinked data may actually support the tracking itself.

4 Performance Requirements

There are no publicly available performance specifications for multisensor fusion processing systems. However an example specification for multiradar tracking is Eurocontrol Standard Document for Radar Surveillance in Enroute Airspace and Major Terminal Areas SUR.ET1.ST01.1000-STD-01-01. This is available on the Eurocontrol Web site.

The performance requirements of a multisensor fusion process will typically include the following:

a) for defined aircraft manoeuvres and defined sensor performance (eg defined radar systematic and random errors):

- Accuracy in straight line flight including position error, speed error, and heading error; and
- Accuracy in manoeuvres of defined characteristics (.5 g , 2 g turns etc)

b) Track initiation delay;
c) False track probability;
d) Track continuity;
e) Tracker processing capability taking into account the relevant sensors, reporting rates and sensor overlap;
f) Anomaly rates such as split tracks, track swap rate, ghost track rate; and
g) Latency – defined as appropriate with the system track display methodology.

ATTACHMENT 1

Some Typical Performance Characteristics of Surveillance Sensor Systems

Performance Characteristic	Primary Radar (PSR)	SSR Mode A/C sliding window	SSR Mode A/C monopulse	SSR Mode S	SSR Mode S withs DAPs	Wide Area Multilateration	ADS-B
Position Accuracy	Decreases with range	Decreases with range	Better than PSR and sliding window SSR – decreases with range	Similar to monopulse SSR	Similar to monopulse SSR	Depends on Rx geometry – can vary from better than radar to worse than radar	GPS – reported by avionics (NUC /NIC, NAC, SIL).
Position updating rate (typical)	5 to 12 seconds	5 to 12 seconds	5 to 12 seconds	5 to 12 seconds	5 to 12 seconds	1 second	1 second
Anomalous position reports	Yes (weather, road vehicles etc)	Yes (multipath reflections)	Yes (multipath reflections	Low probability	Low probability	Low probability	Low probability (NUC/NIC, NAC, SIL protection)
24 bit Airframe Address	No	No	No	Yes (if Mode S avionics)	Yes (if Mode S avionics)	Yes (if Mode S avionics)	Yes
Flight Identification	No	No	No	Yes (if Mode S avionics)	Yes (if Mode S avionics)	Yes (if Mode S avionics)	Yes
Identity code (Mode A)	No	Yes	Yes	Yes	Yes	Yes	No
Altitude (LSB)	No	Yes (100’)	Yes (100’)	Yes (25’ if Mode S avionics))	Yes (25’ if Mode S avionics))	Yes (25’ if Mode S avionics))	Yes (25’)
Susceptibility to garbling	Not applicable	High	Moderate	Eliminated	Eliminated	Low	Low
Data error check/correct	Not applicable	No	No	Yes	Yes	Yes (if Mode S avionics)	Yes
Velocity	No	No	No	No	Yes (DAPS)	No	Yes (GPS)

Proposed Sample ADS-B Data Sharing Agreement

INTERNATIONAL CIVIL AVIATION ORGANISATION
ASIA AND PACIFIC OFFICE

SAMPLE AGREEMENT FOR THE SHARED USE OF ADS-B DATA

Edition	**:**	**1.0**
Edition Date	**:**	**2008**
Status	**:**	**Draft**

SOUTH EAST ASIA SUB-REGIONAL AUTOMATIC DEPENDENT SURVEILLANCE-BROADCAST (ADS-B) IMPLEMENTATION WORKING GROUP

Proposed Sample ADS-B Data Sharing Agreement

DOCUMENT CHANGE RECORD

The following table records the complete history of the successive editions of the present document.

EDITION	DATE	REASON FOR CHANGE	SECTIONS PAGES AFFECTED
1.0	February 2008		

Proposed Sample ADS-B Data Sharing Agreement

TABLE OF CONTENTS

Proposed Sample ADS-B Data Sharing Agreement

Proposed Sample ADS-B Data Sharing Agreement

1. FOREWORD

1.1 The present document concerns the guidelines for the drafting of agreements for the shared use of ADS-B data.

1.2 This document is related to the SEA ADS-B WG.

1.3 These guidelines were constituted from:
the Guidelines for an Agreement for the shared use of radar sensor data used by Eurocontrol.

1.4 Notes containing extra information on the use of the proposed contract text are printed in light face, the status being indicated by the prefix **NOTE.**

1.5 The original version of this document is in the English language.

Proposed Sample ADS-B Data Sharing Agreement

2. SCOPE

2.1 This document constitutes the SEA ADS-B WG guideline concerning the drafting of an agreement for the shared use of ADS-B data between ATS Organisations in the SEA ADS-B WG and the provision of ADS-B data by service providers. This document contains the proposed text for a bilateral sharing agreement for ADS-B data. The changes required to make it a multilateral sharing agreement for ADS-B data are put in as suggestions.

2.2 The agreement consists of the proposed text for twelve numbered articles and nine annexes, named Annex A up to Annex I. These annexes contain information which is likely to change from time to time. Deviations from the proposed text in the agreement as well as in the annexes, can be necessary due to legal, organisational or technical reasons. Examples of such changes are:

- The starting date could be set to the date the radar data has been delivered for the first time;
- The notice period to end the contract could be chosen differently;
- When installation at the providers' premises requires, i.e. additional staff, the cost could be charged to the user.

The clauses enclosed in brackets ([]) should be replaced by the information described in these clauses.

Proposed Sample ADS-B Data Sharing Agreement
3. REFERENCE DOCUMENTS The following documents and standards contain provision which, through reference in this text, constitute provisions of the document. At the time of publication of this document the editions indicated for the referenced documents were valid. Revisions of the referenced documents shall not form part of the provisions of this document until they are formally reviewed and incorporated into this document. In case of conflict between this document and the contents of these other referenced documents, this document shall take precedence. 1 [To list the relevant documents]

Proposed Sample ADS-B Data Sharing Agreement

4. ABBREVIATIONS AND ACRONYMS

For the purposes of these guidelines the following are used:

ADS-B Automatic Dependent Surveillance - Broadcast

ASTERIX All Purpose Structured Eurocontrol Radar Information Exchange

Proposed Sample ADS-B Data Sharing Agreement

5. PROPOSED TEXT FOR THE AGREEMENT

The [name of the State's responsible Organisation or name of the (privatised) ATC Organisation] represented by [function],

hereinafter called "the *Provider*",

And

The [name of the State's responsible Organisation or name of the (privatised) ATC Organisation] represented by [function],

hereinafter called "the *User*";

Suggestion: If there are more than one Provider or more than one User, the above lines are to be repeated for each Provider or User.

In case the Providers are also Users (e.g. each party supplies information from an Automatic Dependent Surveillance – Broadcast (ADS-B) to the other party), one can replace the words Provider and User with the names of the Organisations and indicate in Annex A who is Provider and who is User for each source of the ADS-B data.

- Having regard to the South East Asia Sub-regional Automatic Dependent Surveillance – Broadcast (ADS-B) Implementation Working Group (SEA ADS-B WG) objectives, including the optimisation of the provision and use of the ADS-B surveillance function through the installation of new facilities or the sharing of ADS-B data;
- With a view to the establishment of the categories of services through the airspace of the regions specified in Annex A and I;

Proposed Sample ADS-B Data Sharing Agreement

NOTE- More reasoning and motivations for the contract can be inserted here

- Have agreed as follows:

ARTICLE 1 - Objective of the Agreement

1 The objective of this Agreement is to improve safety and operations efficiency of civil air traffic by enhancing ADS-B coverage and ADS-B data availability in the Flight Information Regions for which the *User* is responsible and the areas within 150Nm from the boundaries of these Flight Information Regions.

2 For this purpose, the *Provider* shall provide its ADS-B data to the *User* with effect from [date] and in accordance with the implementation schedule in Annex G.

3 he ADS-B data to be provided are specified in Annex B, H and I.

Proposed Sample ADS-B Data Sharing Agreement

ARTICLE 2 - Limitations

1 The *User* shall use the ADS-B data provided only to ensure the safe, proper and continuous operation of civil Air Traffic Services or activities in support of his Air Traffic Services and for technical demonstration, evaluation and test purposes related to his operational tasks, unless otherwise specified in Annex A.

2 The *User* shall not communicate to any party not specified in this Agreement in any matter of form whatsoever any information supplied pursuant to this Agreement. The said information shall not be used for any purpose other than those specified in paragraph 1 hereof, without the prior written consent of the *Provider*.

[NOTE : To include a definition: Air Traffic Services shall mean Civil Air Traffic Services.]

ARTICLE 3 - Installation

1 The *Provider* and the User shall install all required equipment at their respective premises.

2 Both the *Provider* and the *User* shall arrange for the provision, installation and commissioning of private circuits and other associated equipment as specified in Annex B and F, required for the transmission of the ADS-B data from the *Provider* to the *User*.

3 Initial testing of the equipment and private circuits for the provision of the ADS-B data shall be carried out in conjunction with the *Provider* and the *User*.

The provision of the present article shall also apply in the event of modifications to the equipment or private circuits.

Proposed Sample ADS-B Data Sharing Agreement

ARTICLE 4 - Maintenance

1 Unless otherwise specified in Annex C, the routine maintenance, repair and replacement service for the equipment and the private circuits installed for the provision of ADS-B data under this Agreement shall be executed by technical staff available at the *Provider's* and at the *User's* premises.

2 Unless otherwise specified in Annex D, the routine maintenance, repair and replacement at the Provider's premises referred to in paragraph 1 hereof shall be carried out free of charge by the Provider to the standards of maintenance commonly adopted by the Provider.

3 The routine maintenance, repair and replacement at the User's premises shall be done by and at the expense of the *User* to the standard of maintenance commonly adopted by the *User*.

ARTICLE 5 - Modifications

1 Both the *Provider* and the *User* shall implement any modification in the equipment and the private circuits for the provision of ADS-B data at their respective premises due to any decision of the *Provider*. The modification shall be carried out in accordance with Article 3.

2 The *User* may propose technical modifications of the specifications for the provision of ADS-B data to the *Provider*. The *Provider* shall decide on the implementation of it.

3 The modifications to be implemented shall be specified by the *Provider* in writing to the *User* not less than six months before the date the modification shall be implemented.

ARTICLE 6 - Cost

1 The cost apportionment for the use of ADS-B data as specified in Annex A, B and I shall be in accordance with Annex D.

Proposed Sample ADS-B Data Sharing Agreement

ARTICLE 7 - Integrity

1 The *Provider* shall take all reasonable steps, in accordance with the standards commonly adopted by him, to monitor and maintain the quality and continuity of the provision of ADS-B data of the facilities specified in Annex B and F.

2 Where this is reasonably practicable the *Provider* shall give the *User* such notice in respect to any planned periodic break in service as soon as such information is available and a minimum of 24 hours notice in case of any other planned break in service.

3 The *Provider* shall report immediately or at the earliest reasonable opportunity any failure in the provision of the ADS-B data or any abnormality of ADS-B data provided, to the *User's* technical supervisor centre.

4 The *User* shall, in accordance with the standards commonly adopted by him, monitor the ADS-B data received from the *Provider* and report immediately or at the earliest reasonable opportunity any failure in the reception or any abnormality of the ADS-B data, to the *Provider's* technical supervisor centre.

Proposed Sample ADS-B Data Sharing Agreement
ARTICLE 8 - Liability [*The requirements on this Article should be agreed bilaterally between States]*
ARTICLE 9a - Legal Aspects
ARTICLE 9b - Settlement of Dispute

Proposed Sample ADS-B Data Sharing Agreement

ARTICLE 10 - Correspondence

1 Correspondence to be applied in the framework of this Agreement is specified in Annex E.

ARTICLE 11 - Annexes

1 Annex A, B, C, D, E, F, G, H and I are attachments to this Agreement. The *Provider* and *User*, in mutual consent and formal acceptance, are allowed to amend and up-date, as circumstances deem necessary, the contents of the Annexes, in so far as the amendments are not in contradiction to or out of scope with the text in this Agreement.

ARTICLE 12 - Duration

1 The present Agreement shall enter into force on the day on which it is signed by the last of the contracting Parties, for a period of [duration to be decided by the Parties].

2 Thereafter, that period shall be automatically prolonged unless any of the contracting Parties has, by giving written notice at least [duration to be decided by the Parties] before the expiry of the contract period or the termination date of prolonged period, terminated the Agreement.

3 The Agreement can early terminate in the event the provision of ADS-B data as specified in Annex A hereof is to be permanently withdrawn from service. The *Provider* shall give to the *User* not less than [duration to be decided by Parties] notice in writing in advance thereof.

4 The Agreement can early terminate on request of the *User* in the event of modifications to be implemented. The *User* shall give to the *Provider* not less than [duration to be decided by Parties] notice in writing in advance thereof.

Proposed Sample ADS-B Data Sharing Agreement

In witness whereof, the undersigned having been duly authorized, sign the present Agreement.

Done at [place] on [date] in the English language in [number] originals.

NOTE-If the Agreement is in more than one language the following text can be used to replace the previous paragraph.

Done at [place] on [date] in the English, [other language(s)] languages in [number] originals. In the event of any inconsistency, the text in the [language] language will prevail.

For [State's Organization/name of the (privatized) ATC Organisation, Provider] :
[name]
[function]

For [State's Organization/name of the (privatized) ATC Organisation, *User*] :
[name]
[function]

ANNEX A. PARTIES

A.1 In the Framework of this Agreement the providers and users are :

Provider 1 :
Provider 2:
User 1:
User 2:

(NB: In a many cases, each ANSP is likely to be both a Provider and user. Ie ANSP sends & receives ADS-B data))

. Having regard to Article 2 : Limitations,

the *Provider* authorises the *User* to communicate the provided ADS-B ground station data to the

Proposed Sample ADS-B Data Sharing Agreement
following parties : . insert the name of the 3rd parties (if any) USER 1 : - List of 3rd parties (if any) USER 2 : - List of 3rd parties (if any)
A.2 For this purpose, the *User* to this Agreement shall arrange for (an) identical ADS-B ground station Sharing Agreement(s) acting as *Provider*, with the specified parties. **NOTES -** *Whenever the user wants to supply the ADS-B ground station data or a processed version thereof to a third party, the name of the third party has to be added to the list in this annex. The sharing agreement made between the user and the third party must be approved by the Provider in writing. The Provider decides whether it is necessary to update this agreement between Provider and user(s).* *The User could become a Provider of data to another specified party*
ANNEX B. INTERFACE SPECIFICATION **B.1** This Annex describes the Interface Specification, needed for the interfacing between the *Provider* and the *User* to share ADS-B ground station data.
B.2 ADS-B Data sharing interface **B.2.1 Data Elements** ADS-B messages shall comprise the data elements defined in Eurocontrol Asterix Category 21 version 0.23.

Proposed Sample ADS-B Data Sharing Agreement
[NOTE : To include a definition: Asterix Category 21 shall mean Eurocontrol Asterix Catergory 21 Version 0.23.] ADS-B Data received from each aircraft from each ADS-B ground station shall be transmited at a rate of <Rate to be agreed between *User* & *Provider*> The Asterix Category 21 version 0.23 standard allows packaging of multiple ADS-B records into a single data block, or alternatively to place a single ADS-B record per data block. Record packaging shall be performed to the extent possible to minimise communication bandwidth requirements without delaying transmission of any given record.
B.2.2 Message Description The message format shall be in accord with the Asia Pacific ADS-B data interface sharing standard : Namely Asterix Cat 21 version 0.23.
<Not required>
B.2.4 Communication Protocol NOTE : The communication protocol should be decided by the Parties. Relevant aspects of the communication protocol should be specified in this Annex such as ; • name of the communication protocol including version of the protocol; • options used of the protocol, if any; • parameter setting; • addressing issue; • link speed; etc {eg *The network layer is to be implemented using the Internet Protocol (IP). The network shall support Internet Group Management Protocol (IGMP) level 0, 1 and 2 as defined in RFC3300.* *Note: IGMP level 1 supports transmission of Multicast datagrams, level 2 supports transmission and reception of multicast datagrams, while level 0 corresponds to IP unicast.*

Proposed Sample ADS-B Data Sharing Agreement
For Asterix messages, the Network Layer shall use the Internet Protocol (IP) for the delivery of packets using MULTICAST broadcast techniques. A multicast addressing scheme, as agreed, shall be used. }
B.2.5 Physical Aspects Add appropriate details as available. Eg DDS circuit using service from <Company> Eg: Satellite datalink service using <Company> and Modems…
ANNEX C. MAINTENANCE **C.1** The maintenance, repair and replacement service for equipment installed at the *Provider*'s and the *User*'s premises shall include the following activities during normal working hours: . routine maintenance, repair and replacement service for the equipment installed at the *Provider*'s and the *User*'s premises; . support by staff for testing the equipment and modifications. **C.2** During as well as outside normal working hours, the maintenance service at their premises shall be carried out by the *Provider* and the *User* in accordance with the standards of maintenance commonly adopted by the *Provider* and the *User*. **C.3** The *User* shall collect and replace any faulty equipment or spare part, subject of this Agreement, at the *Provider*'s and the *User*'s premises. The *User* shall procure at its own expense the following maintenance and repair support service contracts: . [equipment] with [maintenance and repair support agency] .... [equipment] with [maintenance and repair support agency]

Proposed Sample ADS-B Data Sharing Agreement

The *Provider* shall procure at its own expense the following maintenance and repair support service contracts:

. [equipment] with [maintenance and repair support agency]

<In some cases it may be appropriate for the Provider to procure or provide the maintenance of equipment located at the Provider premises>

C.4 For routine co-ordination and report the following technical supervisor centres shall be responsible:

At the *Provider*'s premises : [telephone and fax number]
At the *User*'s premises : [telephone and fax number]

ANNEX D. COST

<the details of cost issues will be agreed bi-laterally>

D.1 General
Costs borne by parties will based on a mutually-agreed basis between ANSPs of adjoining member States and/or ADS-B data service providers.

Costs considered include equipment costs, installation costs, maintenance costs, line or equipment lease costs, costs of performance reporting and costs of related services.

Cost apportionment is based upon the user-pays principle, elaborated as follows:

(a) If an ADS-B ground station serves solely (or significantly) the need of the Provider, as far as possible the cost of installation and maintenance should be borne by the Provider.

Proposed Sample ADS-B Data Sharing Agreement

(b) If an ADS-B ground station provides surveillance data to the *Provider* as well as the *User*, the Provider may, if it desires to do so, work out the cost apportionment with the User. Cost apportionment should be on a mutually-agreed basis between the User & Provider, and could cover three cost components: (i) installation of the ADS-B ground station; (ii) maintenance of the ADS-B ground station; and (iii) costs of sharing of ADS-B surveillance data.

(c) If it is necessary for an ADS-B ground station to be installed to serve solely (or significantly) the need of the *User*, the cost of installation and maintenance should, as far as possible be borne by the *User*.

D.2 Data Cost

The cost for providing ADS-B ground station data itself, as agreed between *provider*(s) and *User*(s) should be specified here. When the data is supplied free of charge it should be mentioned here too.

D.3 Installation Cost

The cost of installing communication circuits and the equipment for the provision of ADS-B ground station data as agreed between *provider*(s) and *User*(s) should be specified here.

D.4 Maintenance Cost

The routine maintenance, repair and replacement service for the equipment installed for the provision of ADS-B ground station data as agreed between *provider*(s) and *User*(s) should be specified here..

D.5 Periodical Cost

Periodic cost of rental of private circuits, private circuit line checks, service contracts or any other periodic rent or fee as agreed between *provider*(s) and *User*(s) should be specified here.

The use at the *Provider*'s premises and the *User*'s premises of any installation space and the use of the power supply as agreed between *provider*(s) and *User*(s) should be specified here.

D.6 System technical and operational support Cost

The cost of any technical or operational support provided by one party to the other to establish an operational and sustainable *Provider* ADS-B system as agreed between *provider*(s) and *User*(s) should be specified here.

Proposed Sample ADS-B Data Sharing Agreement

D.7 Termination costs
The pre-agreed cost of termination of the *Provider* ADS-B system as agreed between *provider*(s) and *User*(s) should be specified here..

D.8 Modification costs
If the *User* require and *Provider* may agree to modify the service. In such cases, the costs of any modification shall be negotiated in good faith taking into account the principles of cost sharing as described above,.

ANNEX E. CORRESPONDENCE
All correspondence in connection with this agreement shall be mail as follows:

[*Provider* State's Organisation or name of ATC Organisation, mail address, email address, telephone and fax number]

[*User* State's Organisation or name of ATC Organisation, mail address, email address,
telephone and fax number]

ANNEX F. EQUIPMENT PROVIDED BY ONE PARTY to the OTHER.

(only required if necessary – which is unlikely)

ANNEX G. IMPLEMENTATION SCHEDULE

Define Milestones :

FIR1 to FIR2
a) Inter FIR datalink installed for testing :<Dates>
b) Completion of data link testing :<Dates>
c) Ground station installation : <Dates>

Proposed Sample ADS-B Data Sharing Agreement

d) Availability of ADS-B data for testing :<Dates>
e) Use of ADS-B data for situational awareness by ATC :<Date>
f) Use of ADS-B data for delivery of separation services: :<Date>

FIR2 to FIR1

g) Inter FIR datalink installed for testing :<Dates>
h) Completion of data link testing :<Dates>
i) Ground station installation : <Dates>
j) Availability of ADS-B data for testing :<Dates>
k) Use of ADS-B data for situational awareness by ATC :<Date>
l) Use of ADS-B data for delivery of separation services: :<Date>

ANNEX H. FUNCTIONAL PERFORMANCE REQUIREMENT

Capacity: The *Provider* ADS-B system shall be able to support no less than <to be agreed between Parties> aircraft from every site at one time.

Accuracy: Accuracy is provided by the airborne avionics and no accuracy requirement is imposed on the *Provider* ground system.

Update Rate: The *Provider* ADS-B system shall provide positional and information updates at a rate of <To be agreed> times per second.

The *Provider* ADS-B system may collect received ADS-B messages between updates and then transmit a composite message to the ATC centre using the most up to date positional data. This allows collection of velocity and positional data into a single Asterix package and lowers the processing load of the ATC system. When data is received from an aircraft, the *Provider* ADS-B system track data is updated.

Network latency: The ADS-B network shall deliver reports to the User interface within 2 seconds of their output from the ADS-B ground station for 95% of the time. (Tier 1)

Network latency: The ADS-B network shall deliver reports to the User interface within 15 seconds of

Proposed Sample ADS-B Data Sharing Agreement

their output from the ADS-B ground station for 95% of the time. (Tier 2)

The *Provider* ADS-B system shall provide a MTBF (loss of ADS-B Service) to the User interface exceeding 50,000 hours. (Tier 1)

This requirement will typically require
= the communications infrastructure to be completely duplicated without a single point of failure.
= Two ADS-B ground stations shall be installed at each site. There shall be no common point single point of failure . Each ground station shall provide ADS-B data to the ATC centre.

The *Provider* ADS-B system shall provide a MTBF (loss of ADS-B Service) to the User interface exceeding 400 hours. (Tier 2)

Availability : The service shall be provided with a service availability from each ground station site of better than 99.9%. In calculation of availability, planned outages shall be included. (Tier 1)

Availability : The service shall be provided with a service availability from each ground station site of better than 95%. In calculation of availability, planned outages shall be included. (Tier 2)

Integrity
Integrity of ADS-B data is critical to system safety. The ADS-B ground station, the data communication system, and any processing before the interface shall not introduce errors (compared to the received ADS-B messages) more frequent than 1 in every million messages ($1* 10^{-6}$).

The provided service shall not deliver any received data to the interface which has not satisfied ADS-B downlink message cyclic redundancy checks (CRC)

Ground Station Receiver & Processing functionality requirements

The *Provider* ADS-B system shall be based upon Mode S extended squitter technology.

The *Provider* ADS-B system shall receive and decode all Mode S DF17, DF18 and DF19 messages

Proposed Sample ADS-B Data Sharing Agreement

defined in the RTCA standards DO-260 and DO-260A.

The *Provider* ADS-B system shall receive and decode Mode S DF17, DF18 and DF19 messages using the Lincoln Laboratory error detection and decoding techniques specified in RTCA DO-260 or demonstrate equivalent performance using other techniques

The *Provider* ADS-B system shall be configurable to transmit or not to the interface

- Messages for aircraft indicating they are "on ground"
- Messages resulting from aircraft equipped with DO260 compliant avionics
- Messages resulting from aircraft equipped with DO260A compliant avionics

The *Provider* ADS-B system shall be designed so that when DO260A messages are received, the *Provider* ADS-B system must calculate a Asterix FOM field. The FOM value for each combination of NIC, NAC and SIL shall be configurable and agreed

Site Monitor

The concept of the ADS-B Site Monitor is to independently test the end to end functional performance of the ADS-B System. The position, geometric altitude, FOM value, other asterix data and presence of the site monitor is tested by the ATC automation system

Site monitor Asterix messages including GPS determined position and GPS geometric altitude from each ADS-B ground station shall be transmitted to the interfaces to provide an independent system integrity verification function.

The FOM value that is transmitted to the ATC centre shall be based upon the HPL value of the GPS receiver

A failure of the site monitor shall not adversely affect the operation of the *Provider* ADS-B system equipment.

Proposed Sample ADS-B Data Sharing Agreement
ANNEX I. COVERAGE or GROUND STATION DETAILS • The category of service and coverage of each source of ADS-B data provided; • Which party is the provider for each source Describe either the coverage volume or ground station supporting the shared service: Eg: Coverage volume: Above FL180 within the geographical region defined in the attached diagram.> Or Within line of sight coverage from ADS-B ground station at <lat-Long>

COST APPORTIONMENT FRAMEWORK FOR ADS-B GROUND STATIONS AND ADS-B SURVEILLANCE DATA SHARING

The following provide the guidelines on the formulation of cost apportion framework between States.

(a) If an ADS-B ground station serves solely (or significantly) the need of the owner ANSP, as far as possible the cost of installation and maintenance should be borne by the owner ANSP.

(b) If an ADS-B ground station provides surveillance data to the owner ANSP as well as the adjacent ANSPs, the owner ANSP may, if it desires to do so, work out the cost apportionment with the adjacent ANSPs. Cost apportionment should be on a mutually-agreed basis between the ANSPs, and could cover three cost components:

(i) installation of the ADS-B ground station;

(ii) maintenance of the ADS-B ground station; and

(iii) sharing of ADS-B surveillance data.

(c) If it is necessary for an ADS-B ground station to be installed in one Member State which serves solely (or significantly) the needs of an adjacent ANSP (the user ANS P), the cost of installation and maintenance of the ADS-B ground station should as far as possible be borne by the user ANSP.

(d) The tier of service level should also be considered when formulating the actual cost apportion.

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REPORT OF THE AD HOC SUB REGIONAL GROUPS

1. Report of the South Asia Group

At the previous meeting, this group included:

- India
- Maldives
- Nepal
- Pakistan
- Sri Lanka

However at this meeting only Sri Lanka and Pakistan attended. Pakistan joined the North Asia group because it included neighbouring China. The neighbours of Sri Lanka remained. The status in Sri Lanka is as follows:

Sri Lanka: At present, Sri Lanka has 2 MSSR stations which cover an area of 200 NM radius circle and ADS-C to cover the eastern oceanic sector of the FIR. Sri Lanka has planned to conduct ADS-B trials in 2010 and implement in 2011 as a backup facility to existing radar.

2. Report of the South East Asia Group

The discussion focused on the need of data-sharing among the States over the next 5 years. The first phase is up till 2011, the second phase is up till 2013.

The subgroup identified 5 possible projects as follows.

Project 1 - Indonesia will share the ADS-B data from the following sites with Australia in phase 1:

- Waingapu
- Kupang
- Saumlaki
- Merauke

Project 2 – Indonesia, Malaysia, Singapore, The Philippines and Vietnam will share ADS-B data. The following stations will be installed in Phase 1:

- Singapore
- Natuna
- Con Son
- Song Tu Tay Island
- Truong Sa Island

The meeting noted that the ADS-B Station at Con Son Island will provide a surveillance coverage overlapping with that of Singapore. This will provide continuous surveillance coverage for the eastern part of South China Sea.

The other three stations will cover the existing surveillance gaps at South China Sea.

Following this meeting, Singapore will discuss with Vietnam and Indonesia for Bi-lateral data sharing agreements. The States will update the status at the next Working Group Meeting.

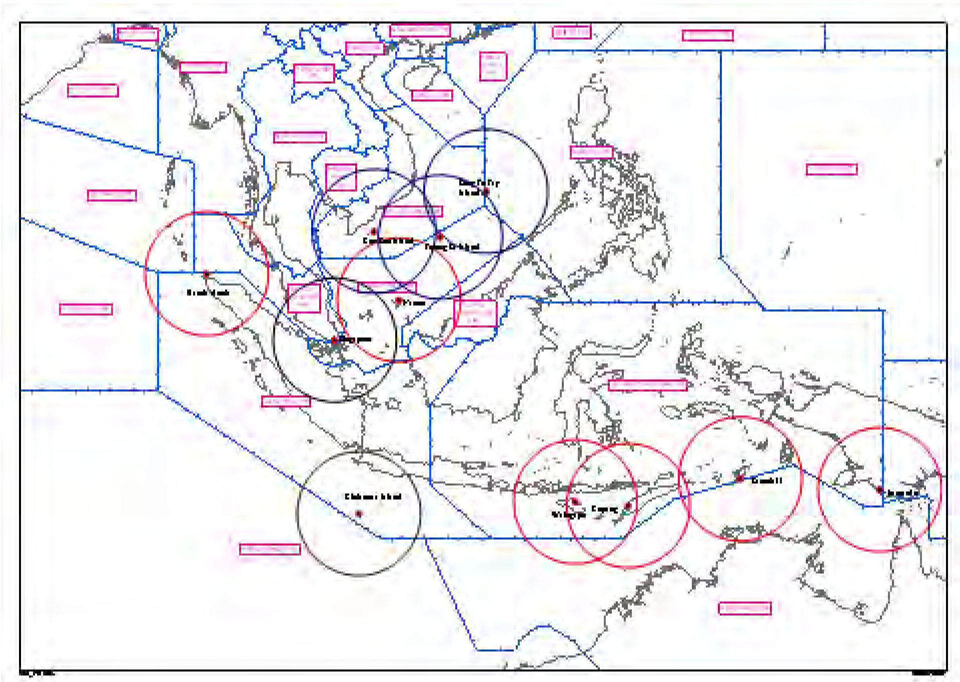
The Philippines and Malaysia will discuss with Vietnam at later stage when their ATC systems are ready for ADS-B.

Project 3 - Indonesia will share data from Aceh with Malaysia in Phase 2 subject to the setting up of a ground station at Port Blair after Malaysia has discussed with India.

Project 4 - Australia will share data from Christmas with Indonesia, target to be implemented in phase 2.

Project 5 - Vietnam and Thailand looking into data sharing together with Laos and Cambodia. However the meeting noted that Laos and Cambodia are not currently participating in the task force and working group meeting. It is suggested that Malaysia who is hosting the next working group meeting invite these countries as well as Brunei for the next working group meeting to explore other possibilities of collaboration.

The South East Asia proposals are also shown in the following diagram:



3. <u>Report of the North Asia group</u>

Countries included in the North Asia Group are as follows:-

China
Hong Kong, China
Macao, China
Japan
Pakistan
Republic of Korea
Thailand
Viet Nam
IATA

The main discussions are as below:

(1) Status report of ADS-B related matters of each participated States:

China: China has installed two 1090ES ground stations in Chengdu and Jiu Zhai Gou respectively, and the ADS-B trial has been started successfully and will be completed by end 2008. Trials conducted at the CAFUC and on the Chengdu/Lhasa route are progressing well. China will continue the conduction of ADS-B related trials in future. China is deploying multilateration for ground surveillance at Beijing Capital Airport before August 2008

Hong Kong, China: Hong Kong, China has been conducting ADS-B trials and quarterly survey which started in 2004 using the A-SMGCS system. Further trials using a dedicated ADS-B trial system successfully completed in 2007.

Macao, China: It is planned that the ADS-B out surveillance service will be available by 2010.

Japan: Japan has no plan to introduce ADS-B service as most of their airspace is covered by radar. The surface movement detection trial using a MLAT system at the Tokyo International Airport and Narita International Airport is being conducted. ENRI plans to conduct ADS-B monitoring activities from 2009.

Republic of Korea: Full radar coverage has been achieved. The ADS-B system for ground surveillance installed at Incheon Airport will be put into operational use since 1 June 2008.

Thailand: Progress status as before with no update.

Viet Nam: Most of the airspace, except in South China Sea, is covered by radars. For ADS-B trials, there will be 2 projects. One project will involve changing of ADS-C to ADS-B where applicable by 2011. Another project will provide surface movement detection trial at Tan Son Nhat Airport by 2010.

Pakistan: One ADS-B trial system will be installed at Karachi Airport for 1 year and would continue to conduct trials as appropriate.

(2) North Asia Cooperation as proposed by IATA

As follow-up to IP 16 presented by IATA to the Task Force, a two-prong approach to resolve ATM issues in the North Korean (DPRK) and Russian Far East airspaces is proposed:

a) That a technical mission be sent to North Korea (DPRK) to ascertain the ATM/Communications infrastructure to support the Russia 1, 2, and 3 routes. Capability of North Korea (DPRK) to implement ADS-B OUT surveillance and data sharing with adjacent States are to be explored,

b) That relevant States adjacent to North Korea (DPRK) (China, South Korea (ROK), Russia, and Japan) to evaluate the possibility of installing ADS-B ground stations near the border with North Korea (DPRK) or the use of radar coverage to assist North Korea (DPRK) in traffic management for the affected Russia 1, 2, and 3 routes. States should report back to the ADS-B SITF 8 on the status of this evaluation.

c) Japan proposed that it would be appropriate for a representative grouping of these States be formed to progress ADS-B implementation and ATM enhancement for the region to benefit flights in the region

Reference:

Airspace - Flight between North America, Russian Far East to Incheon/China and beyond. Flights between Japan and Europe also transit the airspace;
Russia 1 (SESUR – Gangwon (KAE));
Russia 2 (TEKUK – Gangwon); and
Russia 3 (Muraveyka (BG) – TELOD - Gangwon)

3. Report of the Pacific Island Group

Countries included in the Pacific Island Group are as follows:-

New Caledonia (France)
Fiji
Australia

3.1 Implementation plans

Fiji: implementation begins in 2008 and full system commissioning is expected in 2009. At least 6 Ground stations will be installed. Contact will be taken with regional island states in the NADI FIR to install additional ground stations.

New Caledonia: 2 ground stations will be installed at the end of 2008. A third Ground station will be installed in 2009 and initial operational capability is planned by end 2009.

Tahiti new ATM system (TIARE) has ADS-B capability. Some ground station will be installed later.

A ground station in Vanuatu would be beneficial to enhance surveillance coverage of Vanuatu, New Caledonia ACCs and Nadi FIR.

Information should be obtained regarding Papua New Guinea, Solomon Islands, Samoa, Tonga, Kiribati, Cook Islands, Nauru, Tarawa, Norfolk Island.

Hawaii, Guam and a few other areas are part of the FAA ADS-B program that is being addressed by the NPRM.

3.2 Data sharing

New Caledonia and Fiji propose to enter into an agreement for data sharing. Fiji, Australia, New Zealand and the USA are encouraged to enter into agreement for data sharing.

Cost sharing of communication links is to be defined through bilateral agreement.

3.3 Aircraft equipage

Initially Coordination on the list of well equipped and certified ADS-B aircraft flying in the region is necessary. A white list of aircraft can be shared between ANSP in the region.

Aircraft equipage also needs to be encouraged through all possible means such as Aeronautical Information or coordination with IATA and individual airlines. Fiji is also including locally registered aircraft fitment in the proposed ADS-B implementation contract.

Coordination between States and aircraft operators should start early in order to define a regional aircraft fitment mandate.

3.4 Regional coordination

Consider forming a Pacific ADS-B sub group to coordinate ADS-B implementation in this area. This group could meet locally. Fiji could consider hosting a first subgroup meeting by last quarter of 2008.

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CNS/ATM Implementation Planning Matrix								
State/ Organization	**ATN G/G Boundary Intermediate System (BIS) Router/AMHS**	**AIDC**	**CPDLC**	**GNSS**		**ADS-B/ Multilateration**	**ADS-C**	**Remarks**
				RNAV (GNSS)	**En-route**			
AUSTRALIA	ATN tests were conducted. BIS Router and Backbone BIS Router and AMHS implemented	AFTN based AIDC Implemented between Brisbane and Melbourne, Auckland, Nadi and Auckland. AIDC is also in use between Melbourne and Mauritius.	Implemented and integrated with ATM systems to support FANS1/A equipped aircraft.	Implemented.	Implemented.	11 ADS-B sites are operational including Thursday Island. A total of 28 ground stations are expected to become operational throughout 2008/9. Additional 20 stations delivered in June 2007 for installation at enroute radar site and other sites. 5NM Separation service has been introduced. JCP issued proposing an ADS-B mandate by 2012.	FANS 1/A ADS-C implemented.	
BANGLADESH	BIS Router and AMHS planned for 2007.							
BHUTAN	ATN BIS Router and UA service 2008.			Procedures developed for NPA.				

CNS/ATM Implementation Planning Matrix								
State/ Organization	**ATN G/G Boundary Intermediate System (BIS) Router/AMHS**	**AIDC**	**CPDLC**	**GNSS**		**ADS-B/ Multilateration**	**ADS-C**	**Remarks**
				RNAV (GNSS)	**En-route**			
BRUNEI DARUSSALAM	ATN BIS Router planned for Sept 2008 and AMHS planned for 2008-2011							
CAMBODIA	BIS Router and AMHS planned for 2007			Procedure developed for NPA				

CNS/ATM Implementation Planning Matrix								
State/ Organization	**ATN G/G Boundary Intermediate System (BIS) Router/AMHS**	**AIDC**	**CPDLC**	**GNSS**		**ADS-B/ Multilateration**	**ADS-C**	**Remarks**
				RNAV (GNSS)	**En-route**			
CHINA	ATN BIS Router AMHS will be implemented from 2006. - Tripartite BBIS trial completed with Bangkok and Hong Kong, China in Jan. 2003. - ATN trial with Hong Kong, China conducted 2003/2004. - AMHS with Hong Kong, China planned to conduct in 2006. - AMHS/ATN trial with Macau is under planning. - AMHS/ATN trial with Kuwait is under planning.	AIDC between some of ACCs within China has been implemented. AIDC between several other ACCs are being implemented. Operational trial on the AFTN based AIDC between Sanya and Hong Kong commenced on Aug. 2006 and put into operational use in Feb 2007.	Implemented to support certain AIS Rout. - L888 route, polar routes and Chengdu-Lhasa route. - Trial on HF data link conducted for use in western China.	RNAV (GNSS) implemented in certain airports. - Beijing, Guangzhou, Tianjin and Lhasa airports.	Implemented in certain airspace. - L888, Y1 and Y2 routes.	ADS-B trial conducted in 2006. 5 UAT ADS-B sites are operational and used for flight training of CAFUC. Another ADS-B of 1090ES trial will be commenced in 2008.	FANS 1/A ADS-C implemented to support certain routes. - L888 route polar routes and Chengdu-Lhasa route.	

CNS/ATM Implementation Planning Matrix								
State/ Organization	**ATN G/G Boundary Intermediate System (BIS) Router/AMHS**	**AIDC**	**CPDLC**	**GNSS**		**ADS-B/ Multilateration**	**ADS-C**	**Remarks**
				RNAV (GNSS)	**En-route**			
HONG KONG, CHINA	ATN/AMHS technical trials with Japan conducted in 2003. 64 Kbps ATN Link with Bangkok put into operational use in June 2004. ATN/AMHS technical trials with Beijing, China using VPN over Internet conducted in Sept. 2006. Further ATN/AMHS technical trials with Thailand and China planned for 2009. ATN/AMHS trials with Philippines planned for 2009.	AFTN-based AIDC with Sanya put into operational in Feb. 2007. Ready to conduct trials on AFTN-based AIDC with Zhanjiang/ Guangzhou, China	FAN 1/A based CDPLC conducted. VDL Mode-2 technical trial conducted. D-ATIS D-VOLMET and PDC implemented.	RNAV (GNSS) departure procedures implemented in July 2005. Flight check for RNAV NPA Procedures was conducted in Apr. 2008. Operational trial is planned for mid 2008.	Implemented in certain airspace.	A-SMGCS trial using ADS-B/ Multilateration technology on the prime airport surveillance area completed in 2006. A larger-scale A-SMGCS covering the whole Hong Kong International Airport will be ready for operational trial planned for mid 2008. Data collection/analysis on aircraft ADS-B equipage in Hong Kong airspace conducted on quarterly basis.	FAN 1/A trials for ADS-C conducted.	

CNS/ATM Implementation Planning Matrix								
State/ Organization	**ATN G/G Boundary Intermediate System (BIS) Router/AMHS**	**AIDC**	**CPDLC**	**GNSS**		**ADS-B/ Multilateration**	**ADS-C**	**Remarks**
				RNAV (GNSS)	**En-route**			
	ATN/AMHS technical trials with Macao, China planned for 2009.					ADS-B trial using a dedicated ADS-B system was conducted in Apr. 2007. Planning on further trial is in progress.		
MACAO, CHINA	ATN BIS router and AMHS planned for 2008. Trial with China and Hong Kong, China in planning stage.					"A-SMGCS" being planned with ADS-B as option for consideration.		ATZ within Hong Kong and Guangzhou FIRs. In ATZ full VHF coverage exist. Radar coverage for monitoring purposes.
COOK ISLANDS								
DEMOCRATIC PEOPLE'S REPUBLIC OF KOREA								

CNS/ATM Implementation Planning Matrix								
State/ Organization	**ATN G/G Boundary Intermediate System (BIS) Router/AMHS**	**AIDC**	**CPDLC**	**GNSS**		**ADS-B/ Multilateration**	**ADS-C**	**Remarks**
				RNAV (GNSS)	**En-route**			
FIJI	AMHS in-house trials completed in 2006. AMHS trials completed in 2007. ATN BIS Router and AMHS plans to be implemented in 2008.	AFTN based AIDC with Brisbane and Auckland operational in 2005. AFTN based AIDC implement with Oakland	FANS-1 implemented	NPA procedures for (S) completed in Dec. 2002.	Implemented as (S).	ADS-B implementation in 2008/2009. Estimate 10 Ground Stations	ADS-C implemented in oceanic airspace using EUROCAT 2000 X.	
FRANCE (French Polynesia Tahiti)		Implementation of limited message sets with adjacent centres under discussion.	FANS-1. Implemented since 1996.				FANS 1/A ADS-C implemented since March 1999.	
INDIA	ATN BBIS router and AMHS planned for implementation at Mumbai in March 2008.	AFTN Based AIDC 1. between Mumbai and Karachi 2007 2. between Kolkata and Dhaka 2008	FANS-1 implemented at Kolkata, Chennai, Mumbai and Delhi.		SBAS - Technical developments in 2007. - Implementation planed for 2009.	Trial planned for 2006. ASMGCS Implemented at IGI Airport New Delhi.	FANS 1/A ADS-C implemented at Kolkata, Chennai, Delhi and Mumbai.	

CNS/ATM Implementation Planning Matrix								
State/ Organization	**ATN G/G Boundary Intermediate System (BIS) Router/AMHS**	**AIDC**	**CPDLC**	**GNSS**		**ADS-B/ Multilateration**	**ADS-C**	**Remarks**
				RNAV (GNSS)	**En-route**			
INDONESIA	ATN BIS Router and AMHS planned for trial in 2008.	AFTN based AIDC planned for implementation between Brisbane and Jakarta in 2010. Brisbane and Makassar in 2008.	FANS-1/A. CPDLC in East Indonesia, (Ujung Pandang FIR) planned for 2008.	NPA Procedure completed at 33 airports.	Implemented	5 ADS-B ground stations installed in 2007. Upgrading ATC automation at Makasar for ADS-B application capabilities in 2008. By end of 2008, 14 ADS-B ground stations will be installed.	FANS 1/A ADS-C in East Indonesia (Ujung Pandang ACC) planned in 2008.	
JAPAN	ATN BBIS already implemented. AMHS implemented between Japan and USA in 2005 and between Japan and other States planned for 2010.	AIDC based. AFTN procedure implemented with Oakland and Anchorage. Planned with Incheon in 2008.	FANS1/A system Implemented in Fukuoka FIR	NPA implemented at -8 aerodromes.	Implemented	Amendment work to be radio law regulations for using ADS-B out (1090 MHz ES) is under way.	FANS 1/A. ADS-C implemented in Fukuoka FIR	
KIRIBATI								

CNS/ATM Implementation Planning Matrix								
State/ Organization	**ATN G/G Boundary Intermediate System (BIS) Router/AMHS**	**AIDC**	**CPDLC**	**GNSS**		**ADS-B/ Multilateration**	**ADS-C**	**Remarks**
				RNAV (GNSS)	**En-route**			
LAO PDR	ATN BIS Router and AMHS planned for implementation with Bangkok in 2006.	AIDC with Bangkok planned for 2008	FANS-1/A Planned for Bay of Bengal and South China Sea areas. Equipment is under test operation.		Implemented.		FANS-1/A. ADS-C planned for Bay of Bengal and South China Sea areas. Equipment under test operation.	
MALAYSIA	ATN BIS Router completed 2007. AMHS planned in 2009	AFTN AIDC planned with Bangkok ACC in 2010.	Planned for Bay of Bengal area in 2008.	NPA at KLIA implemented.	Implemented only for Oceanic	Implementation of ADS-B proposed in 2008-2015.	FANS 1/A ADS-C planned for Bay of Bengal area in 2008.	
MALDIVES	ATN BIS Router/AMHS planned for implementation in the 2008.	Planned for 2008.	FANS1/A installed Trials planned in last quarter of 2007		Trials planned for 2005-2008. Implementation in late 2008.	Trials planned for 2007-2008. Implementation in late 2008.		
MARSHALL ISLANDS				NPA implemented at Majuro Atoll.				
MICRONESIA FEDERATED STATES OF								
Chuuk				Implemented				

CNS/ATM Implementation Planning Matrix								
State/ Organization	**ATN G/G Boundary Intermediate System (BIS) Router/AMHS**	**AIDC**	**CPDLC**	**GNSS**		**ADS-B/ Multilateration**	**ADS-C**	**Remarks**
				RNAV (GNSS)	**En-route**			
Kosrae				Implemented				
Pohnpei				Implemented				
Yap				Implemented				
MONGOLIA	ATN BIS Router and AMHS planned for 2005 and 2006. Trial with Bangkok conducted		Function available. Regular trials are conducted.	GPS procedures are being developed and implemented at 10 airports.	Implemented.	ADS-B trial in progress implementation planned for 2006.	FANS 1/A ADS-C implemented since August 1998.	
MYANMAR	Trial for ATN BIS Router with Thailand planned for 2006. Test with China planned for 2006.		Implemented since August 1998				Implemented since August 1998	
NAURU								
NEPAL	BIS Router and AMHS planned for 2010.	AFTN/AMHS based AIDC between KTM-CAL, KTM-BAN, KTM-LHASA planned for 2010.		GPS departure and approach has been developed for 8 airports and planned for implementation in 2008.	will be implemented as required.	ADS-B feasibility study planned for 2007		

CNS/ATM Implementation Planning Matrix								
State/ Organization	**ATN G/G Boundary Intermediate System (BIS) Router/AMHS**	**AIDC**	**CPDLC**	**GNSS**		**ADS-B/ Multilateration**	**ADS-C**	**Remarks**
				RNAV (GNSS)	**En-route**			
NEW CALEDONIA						Tontouta APP,ACC 2009 Magenta APP 2009		ADS-B only
NEW ZEALAND	BIS Router and AMHS implementation planned for 2008.	AFTN based AIDC implemented between New Zealand, Australia, Fiji, Tahiti, Chile and USA.	FANS-1/A. Implemented	Implemented.	will be implemented as required.	Domestic trial was conducted in 2005. Use will be re-evaluated in 2008. Trial of Area MLAT conducted in 2006. ADS-B planned as an element of MLAT at specific sites for domestic use.	FANS 1/A Implemented.	
PAKISTAN	Implementation of ATN considered for Phase II (2005-2010).	Implemented between Karachi and Lahore ACCs	Implementation planned from 2005-2010.	Arrival and departure NPA procedure are being developed.	Planned for 2005-2010.	Feasibility study for using ADS-B is in hand. One station planned for 2009 to establish confidence.	Planned for 2005-2010	Existing Radar system being upgraded.
PAPUA NEW GUINEA				Implemented at certain aerodromes.	Implemented.			

CNS/ATM Implementation Planning Matrix								
State/ Organization	**ATN G/G Boundary Intermediate System (BIS) Router/AMHS**	**AIDC**	**CPDLC**	**GNSS**		**ADS-B/ Multilateration**	**ADS-C**	**Remarks**
				RNAV (GNSS)	**En-route**			
PHILIPPINES	ATN G/G BIS Router/AMHS implemented in 2006 AMHS trials with Singapore and Hong Kong planned in 2007.	Planned for 2012.	CPDLC Planned for 2012.			Included in CNS/ATM Project and scheduled for implementation in 2012.	FANS 1/A ADS-C planned for 2012.	
REPUBLIC OF KOREA	ATN BIS Router/AMHS planned for 2005-2010.	AFTN based AIDC planned for 2008 between Incheon ACC and Fukuoka ATMC	PDC & D-ATIS implemented 2003.	NPA planned for 2008 at Incheon International Airport		Install the ADS-B ground station for G to G surveillance on June 2008.	Trial for FANS 1/A ADS-C implemented since 2003.	
SINGAPORE	ATN BBIS Router trial with Hong Kong conducted between April and June 2003. Planned for ATN and AMHS implementation in 2006.	ATN based AIDC to be implemented in 2010	Implemented since 1997. Integrated in the ATC system in 1999.	NPA procedure developed. RNAV (SID/STAR) in 2005	Implemented.	Trial commenced in 2006. Operational in 2010. 2007 for ASMGCS	FANS 1/A ADS-C implemented since 1997. Integrated with ATC system in 1999.	

CNS/ATM Implementation Planning Matrix								
State/ Organization	**ATN G/G Boundary Intermediate System (BIS) Router/AMHS**	**AIDC**	**CPDLC**	**GNSS**		**ADS-B/ Multilateration**	**ADS-C**	**Remarks**
				RNAV (GNSS)	**En-route**			
SRI LANKA	ATN BIS Router Planned for 2009. AMHS planned along with BIS in 2009.		CPDLC in operation since 2007.			ADS-B Trials planned for 2010 and implementation in 2011.	FANS 1 /A ADS-C in operation since 2007.	GPS based domestic route structure being developed.
THAILAND	BBIS/BIS Routers already implemented. Target date for AMHS in 2008.	AFTN based AIDC planned for 2010.	FANS-1/A Implemented .		Implemented.	Multilateration implemented in 2006 at Suvarnbhumi Intl. Airport. 22 ADS-B ground Stations will be implemented in 2008	FANS 1/A ADS-C Implemented.	
TONGA	AMHS planned for 2008.			NPA planned for 2007.		Trial planned for 2010		CPDLC and ADS-C is not considered for lower airspace
United States	AMHS implemented	AFTN based AIDC implemented	FANS-1/A based CPDLC implemented	Implemented	Implemented	Implemented	Implemented	
VANUATU								

CNS/ATM Implementation Planning Matrix								
State/ Organization	**ATN G/G Boundary Intermediate System (BIS) Router/AMHS**	**AIDC**	**CPDLC**	**GNSS**		**ADS-B/ Multilateration**	**ADS-C**	**Remarks**
				RNAV (GNSS)	**En-route**			
VIET NAM	BIS Routers planned for 2009.	AFTN based AIDC planned in 2009 Trial for ATN based AIDC planned in 2010.	CPDLC operational conducted since April 2008.	RNAV	For en-route TBD.	MLAT trial conducted in TSN airport since end 2010. ADS-B in HCM FIR 2011.	FANS 1/A ADS-B operation conducted for oceanic area of ACM FIR since April 2008.	

INITIAL RESULT OF STUDY ON RVSM MONITORING USING ADS-B

Currently the RVSM Height Monitoring Measurements is using HMU or GMU

The purpose of RVSM height monitoring is to determine the following parameters for each aircraft:

- Assigned Altitude Deviation (AAD) – the difference between the Cleared Flight Level and the current Flight Level of the aircraft;

- Altimeter System Error (ASE) – this is the error in the altitude determined by the altimeter;

- Total Vertical Error (TVE) – this is the combination of AAD and ASE. This represents the difference between the Cleared Flight Level (CFL) and the actual measured height.

Providing that the TVE for each aircraft meets the Global Height-keeping Specification, outlined in ICAO Document 9574, the Target Level of Safety for RVSM operations can be assumed to be met.

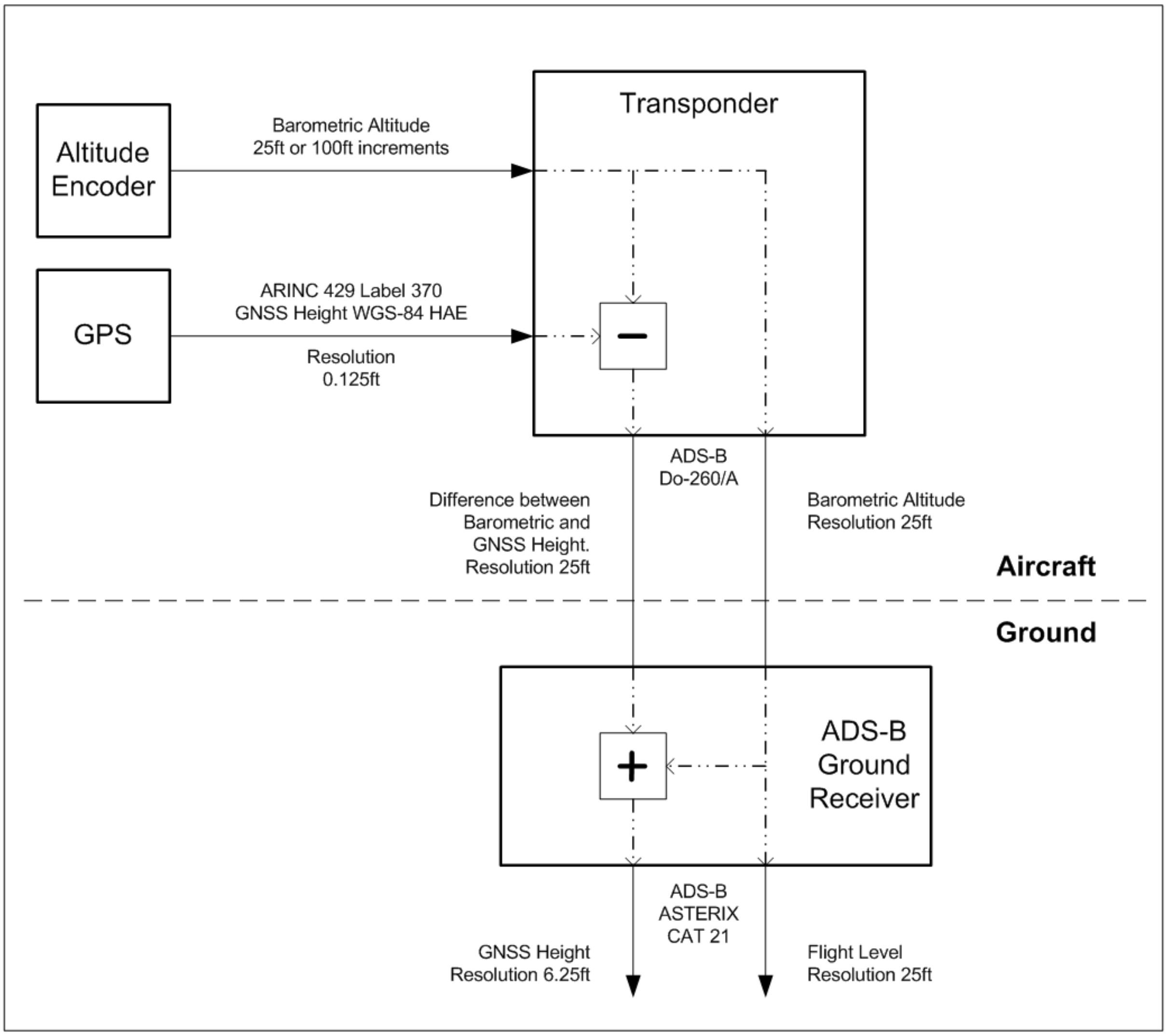
To determine the TVE for each aircraft, the monitoring unit must measure the height of the aircraft and compare this to the barometric altitude of the CFL. The CFL must be converted to a height above ground (or a common reference height) using the known atmospheric conditions at the time.

The ASE performance of the aircraft can also be monitored by comparing the reported barometric altitude to the CFL and taking this difference away from the overall TVE. Analysis of ASE monitoring in Europe has suggested that altimeter errors exist and can increase over time.

ADS-B for RVSM Height Monitoring

ADS-B reports both Mode C barometric altitude and GNSS Geometric height and **so is a suitable candidate for providing data for RVSM height monitoring**.

The following diagram shows the way in which the required height and altitude measurements are made available to the ADS-B system.



As can be seen above a number of limitations on the quality and accuracy of the available data exist. Further investigation into the use of ADS-B for RVSM monitoring has found the following:

- Not all aircraft approved for RVSM are ADS-B equipped, although this will change as ADS-B equipage rates continue to increase;

- The barometric altitude is encoded in either 100ft or 25ft increments by the altitude encoder. The transponder then transmits this value via SSR Mode C or Mode S (radar or ADS-B). Mode C can only transmit values quantised to 100ft increments. Mode S uses 25ft increments. Accuracy is reduced during this quantisation;

- GNSS Height provided by the GPS is quantised by the GPS to provide the value to the transponder. The difference between this value and the barometric altitude is calculated by the transponder and encoded in the ADS-B messages. This process further quantises the value. The accuracy of the GNSS height value recovered by the ground processing equipment is reduced due to this quantisation;

- As per RTCA DO-260 and DO-260A, the GNSS height value is reported by ADS-B as a difference from the barometric altitude. The preferred value for this calculation is GNSS Height Above Ellipsoid (HAE). However GNSS altitude above Mean Sea

Level (MSL) may be used if the airborne position is reported using Format Type Codes 11 through 18. This corresponds to a DO-260 NUC of 0 to 7. In this case there is no indication of which value is used, although it will be consistent for the particular aircraft; and

- ADS-B does not provide any information on the current atmospheric pressure/temperature conditions at the time the GNSS height measurement was taken. Atmospheric data is required to convert the CFL into a corresponding height for comparison to the GNSS height.

The Mode C altitude reported by the aircraft can be used to determine the likely CFL based on proximity to available Flight Levels.

Previous Work

A number of papers have been presented to the Separation and Airspace Safety Panel (SASP) describing algorithms for using ADS-B like data for monitoring of ASE. Without deployed ground infrastructure many of the algorithms presented have had little validation in the field.

Current Work on ADS-B RVSM Monitoring in Australia

Australia has a large ADS-B ground infrastructure from which to collect data. Initial samples of this data have been analysed using the algorithms previously presented to SASP. One such technique is the comparison of GNSS heights between closely spaced aircraft to cancel the affects of atmospheric pressure variations with time on pressure altitude conversions. By comparing a single aircraft to a number of others an indication of the ASE can be determined. A paper was presented to SASP in November 2007 describing this work.

Initial use of ADS-B data applying these techniques has produced large error values and a large spread in the errors observed. It is suspected that the limitations previously mentioned, particularly the quantisation introduced by the aircraft avionics, is contributing to the spread of errors observed. Alternative techniques for describing the aircraft trajectory are currently being explored.

Conclusion

Although ADS-B does provide a measurement of aircraft pressure altitude and GNSS height, a number of limitations have been identified with this data. Further work is required to determine whether ADS-B can be used successfully for RVSM Monitoring.

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ADS-B SEMINAR AND THE SEVENTH MEETING OF ADS-B STUDY AND IMPLEMENTATION TASK FORCE (ADS-B SITF/7)

Chengdu, People's Republic of China
7 -11 April 2008

Attachment 1 to the Report

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THE SEVENTH MEETING OF AUTOMATIC DEPENDENT SURVEILLANCE - BROADCAST (ADS-B) STUDY AND IMPLEMENTATION TASK FORCE (ADS-B SITF/7)

Chengdu, People's Republic of China, 9 – 11 April 2008

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WP/5	9	ADS-B and RVSM Monitoring	D. Nixon, Airservices, Australia
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