INTERNATIONAL CIVIL AVIATION ORGANIZATION
ASIA AND PACIFIC OFFICE

REPORT OF

AUTOMATIC DEPENDENT SURVEILLANCE – BROADCAST (ADS-B) SEMINAR AND THE EIGHTH MEETING OF ADS-B STUDY AND IMPLEMENTATION TASK FORCE (ADS-B SITF/8)

Ha Noi, Viet Nam, 18 – 22 May 2009

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- Review and update FASID Table CNS 4A – Surveillance Systems and CNS 4B – ATS Automation Systems;
- Divide into working groups as follows and subsequently report conclusions to Plenary;
    - Regulatory authorities working group
    - South East Asia working group
    - Bay of Bengal and South Asia working group
    - Pacific working group
- Develop a sample document for the regional harmonized requirements for ADS-B Out avionics equipage.

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1. INTRODUCTION

1.1 The Automatic Dependent Surveillance – Broadcast (ADS-B) Seminar and the Eighth Meeting of ADS-B Study and Implementation Task Force (ADS-B SITF/8) were held in Ha Noi, Viet Nam from 18 to 22 May 2009. The Seminar and the Meeting were hosted by the Civil Aviation Administration of Viet Nam (CAAV) and Viet Nam Air Navigation Services Corporation (VANSCORP).

1.2 The meeting was opened by Mr. Lai Xuan Thanh, Deputy Director General of Civil Aviation Authority of Viet Nam. He extended warm welcome to all the participants to Ha Noi for the ADS-B Seminar and ADS-B Study and Implementation Task Force Meeting. Mr. Thanh emphasized the importance of regional cooperation for implementation of advanced technologies like ADS-B which will increase the capacity of air navigation surveillance. He also mentioned the cost effectiveness for sharing ADS-B data. He highlighted the importance of the Seminar for exchanging information and experience on knowledge on the new technology to promote planning and timely implementation of ADS-B. He hoped that the meeting will progress tasks assigned to ADS-BSITF by the APANPIRG and 45th DGCA Conference. Mr.Thanh expressed their pleasure in hosting the meeting and thanked VANSCORP and other sponsors for their support in organizing the events. He wished participants to enjoy their stay in Ha Noi.

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 CAAV and VANSCORP for hosting the meeting in Ha Noi and for the excellent arrangements made. He informed the meeting that performance based approach has been adopted by APANPIRG and regional Performance Base Navigation plan has been updated and will be presented for consideration by APANPIRG. He highlighted the tasks completed by the Task Force and outlined the objective of the Eighth Meeting. He emphasized the important role of the Task Force and Seminars in exchanging ADS-B related information. He thanked all the contributors and experts for supporting the Seminar.

1.4 While thanking CAAV and VANSCORP for hosting the ADS-B Seminar and the Task Force meeting and for the wonderful arrangements made for the events, Mr. Greg Dunstone, Chairman of the Task Force, highlighted the development of ADS-B in the region and other regions since the last meeting. He noted the need to continue the work of the Task Force and also emphasized the need to follow the discussions with actions on the ground to deliver real benefits to the Industry. He encouraged participants for fruitful discussions and wished the meeting a success in its deliberations.

2. ATTENDANCE

2.1 The Seminar was attended by 91 participants and the Meeting was attended by 60 participants from Australia, Cambodia, China, Hong Kong China, Macao China, Fiji, France, India, Indonesia, Malaysia, Pakistan, the Philippines, Republic of Korea, Singapore, Thailand, USA, Viet Nam, CANSO, IATA, IFALPA, SITA and 6 representatives from 6 industrial groups. 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/8. The objective of the Seminar was to provide information to the participants on ADS-B planning and implementation. The Seminar was presented 19 presentations covering a comprehensive list of topics on the ADS-B as follows:

- Basic ADS-B Concept Introduction
- APANPIRG and ADS-B SITF activities
- Multilateration Introduction
- ATC Automation and ADS-B
- Airframe Manufacturers Plan
- Avionics products
- Regulators and air space users
- Ground stations and ADS-B service providers
- ANSP deployment and plans

3.2 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 data processing system using 1090 ES link was provided by Comsoft GmbH 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 was the Secretary.

5. ORGANIZATION, WORKING ARRANGEMENTS AND LANGUAGE

5.1 The Seminar and the Meeting met as a single body except on 21 May 2009, when the three ad hoc working groups met to progress proposals for sub-regional implementation plans.

5.2 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/19 on ADS-B SITF/7 and SEA ADS-B WG/3 meetings.

Agenda Item 3: Review progress made by ADS-B related ICAO Panels and Outcome of 45th DGCA Conference on ADS-B

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

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

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

Agenda Item 7: Development of Asia/Pacific Regional ADS-B implementation plan and sub-regional based ADS-B implementation plan.

- Review report of the fourth meeting of South East Asia Sub-Regional ADS-B Implementation Working Group;
- Review and update FASID Table CNS 4A – Surveillance Systems and CNS 4B – ATS Automation Systems;
- Divide into working groups as follows and subsequently report conclusions to Plenary:
    - Regulatory authorities Working Group
    - South East Asia Working Group
    - Bay of Bengal and South Asia Working Group
    - Pacific Working Group
- Develop a sample document for the regional harmonized requirements for ADS-B Out avionics equipage.

Agenda Item 8: Any other business

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Agenda Item 2: Review the outcome of the APANPIRG/19 on ADS-B SITF/7 and SEA ADS-B WG/3 meetings

Outcome of APANPIRG/19 on ADS-B

2.1 The meeting noted that the APANPIRG/19 reviewed the work accomplished by the Seventh Meeting of the ADS-B Study and Implementation Task Force and the Third Meeting of the SEA ADS-B Working Group. The report of the Seventh Meeting of ADS-B Task Force was also reviewed by CNS/MET SG/12 held in Bangkok from 21 to 25 July 2008 and ATM/AIS/SAR SG/18 in June 2008.

2.2 Actions taken by APANPIRG on the report of ADS-B SITF and the working group were as follows:

- Under Conclusion 19/34, following Guidance Materials on the implementation of ADS-B Out Services were adopted:
  - Reporting Probability of ADS-B update as shown in Appendix M to the APANPIRG/19 Report;
  - Reporting ADS-B Avionics fitment as shown in Appendix N; and
  - the performance criteria for multi-sensor fusion as shown in the Appendix O.
- Under Conclusion 19/35, guidelines for the development of ADS-B implementation plan was adopted.
- Under Conclusion 19/36, the sample Agreement for ADS-B Data Sharing and the Cost Apportionment framework was adopted as regional guidance material.

2.3 The meeting noted that all the regional planning documents and guidance material adopted by APANPIRG/19 were posted on the ICAO APAC website: http://www.bangkok.icao.int/edocs

2.4 The meeting reconfirmed the significance of Conclusion 19/37 regarding the revised mandate for the regional ADS-B. States intending to implement ADS-B based surveillance service were urged to publish mandate as soon as possible and no later than 2010 with the implementation target date after mid 2012.

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Agenda Item 3: Review progress made by ADS-B related ICAO Panels and Outcome of 45th DGCA Conference on ADS-B

Outcome of DGCA/45

3.1 The meeting reviewed the ADS-B related outcome of 45th Directors General of Civil Aviation (DGCA/45) Conference held in Malaysia in November 2008.

3.2. DGCA/45 Conference recognized that in the current period of global financial turbulence, any initiative to enhance operational efficiency with the objective of achieving cost-saving would be welcomed by operators including ADS-B to improve airspace capacity and efficiency. The Conference requested State authorities, airline operators and ANSPs to adopt a collaborative approach to improve the operating environment and to foster and sustain the continued growth of the industry.

3.3 With respect to implementation of ADS-B in the Region, the Conference developed the following Action Item:

ACTION ITEM 45/3

Recognizing the benefits that can be derived from implementation of ADS-B, the Conference invited the ICAO APANPIRG ADS-B Study and Implementation Task Force (ADS-B SITF) to develop guidance material for harmonized regulations of ADS-B systems on aircraft.

3.4 Recognizing that harmonized regulations is a global issue and ICAO technical provision focuses on signal in the air, the meeting supported the Action Item formulated by the 45th DGCA Conference and reconfirmed the need for the Task Force to take follow-up action to contribute towards development of the required guidance material.

Update of ICAO Panels on ADS-B Related issues

Aeronautical Surveillance Panel (ASP)

3.5 The meeting noted that the Aeronautical Surveillance Panel (ASP) has developed SARPs material and supporting technical specifications for the new version of extended squitter messages (named as Version 1) in support of ADS-B. Technical details and Mode S extended squitter register definitions that were shown in an Appendix to Annex 10, Volume III, have been relocated to a new technical manual (Doc 9871 AN/464 - Technical Provisions for Mode S Services and Extended Squitter), First Edition of which was published in 2008.

3.6 The first meeting of the Working Group of the Whole of the ASP (ASP-WGW/1) was held in Montreal from 8 to 12 December 2008. The meeting formulated eleven recommendations including amendments to Annex 10 — Aeronautical Telecommunications, Volume IV — Surveillance and Collision Avoidance Systems, Technical Provisions for Mode S Services and Extended Squitter (Doc 9871) and Doc 8071, Manual on Testing of Radio Navigation Aids and Volume III — Testing of Surveillance Radar Systems relating to secondary surveillance radar (SSR) and/or automatic dependent surveillance — broadcast (ADS-B) using 1 090 MHz extended squitter.

3.7 The meeting supported publishing of new Aeronautical Surveillance Manual (Doc xxxx) which will consolidate all the valid parts of Manual of the Secondary Surveillance Radar (SSR) Systems (Doc 9684) and the Manual on Mode S Specific Services (Doc 9688) with new guidance material on emerging surveillance techniques. The meeting also finalized draft SARPs for multilateration (MLAT) systems used for air traffic surveillance and recommended that they be incorporated in Annex 10, Volume IV, as a new chapter. The draft MLAT SARPs contain functional requirements and emphasize on the protection of the 1 030/1 090 MHz RF environment. The respective guidance material on MLAT systems will also be incorporated in the new Aeronautical Surveillance Manual (Doc xxxx). The meeting agreed to postpone the finalization of the draft

Required Surveillance Performance (RSP) and to place the draft guidance material on RSP into the Aeronautical Surveillance Manual (Doc xxxx).

Radio frequency (RF) pollution problem associated with 1 030/1 030 MHz

3.8 The meeting concluded that the RF environment would be sustainable and capable of accommodating the foreseen traffic growth and the introduction of new systems and services beyond the year 2020 only if certain measures could be taken. It was also agreed that monitoring activities and relevant simulation and studies would still be needed to ensure the continued sustainability of the environment. The meeting recommended disseminating the material containing the necessary measures to protect the RF environment to the States and international organizations.

Separation and Airspace Safety Panel (SASP)

3.9 The meeting noted that the fourteenth meeting of the Working Group of the Whole of the Separation and Airspace Safety Panel (SASP) was held in at the ICAO Regional Office in Paris, France from 13 to 24 October, 2008. The work of SASP has been progressed by several project teams including Project Team 13 dealing with ADS-B and MLAT. The outcome of the Project Team 13 considered by the Working Group of the Whole of SASP is summarized as follows:

- The main focus for the team had been the final review of the comparative assessment circular and PANS-ATM amendment proposal that made provision for MLAT in Chapter 8 of the PANS-ATM. As a result of this work, the team considered that the work on developing the documentation for 3NM and 5NM ADS-B and MLAT separation was essentially complete and that these documents would now be processed through the Secretary.

- A significant issue noted by the team is regarding limitations in the ability of ADS-B to transmit individual emergency codes. Further work in developing required amendment proposals in this regard will be undertaken at the next meeting.

3.10 With respect to implementation of 3 NM separation using ADS-B and MLAT, the meeting was informed that Australian regulator would not take action until the associated ICAO provision developed by SASP is applicable.

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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 for the Task Force assigned by APANPIRG.

4.2 The TOR was considered appropriate and the meeting did not propose any changes to the TOR.

4.3 The meeting reviewed and updated the Subject/Tasks List and formulated the following draft Decision.

Draft Decision 8/1 - 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.

Performance Framework Form (PFF)

4.4 The meeting reviewed the Performance Framework Form for the Implementation of ADS-B in Asia and Pacific Regions presented by the Secretariat. The Form was prepared in line with the recent guidance provided by ICAO headquarters. The form provides information on various tasks to be completed for implementation based on Terms of Reference adopted by APANPIRG and also provides information on the implementation schedule. The meeting also noted two related Conclusion adopted by APANPIRG/19.

4.5 The meeting made editorial changes to the proposed PFF and agreed to a proposal from CANSO to include the DGCA Conference Action Item 45/3 into the task list of the Task Force and in the Performance Framework Form. Accordingly, the meeting formulated following Draft Decision recommending the adoption of this PFF.

Draft Decision 8/2 - Implementation of the ADS-B Air to Ground Surveillance in Asia/Pacific Region – PFF

That, the Performance Framework Form (PFF) for the 'Implementation of the ADS-B Air to Ground Surveillance' provided in **Appendix B** to the Report be adopted.

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

5.1 Under this agenda item, the meeting discussed Tasks List to be undertaken by the members of the Task Force.

5.2 It was recognized that some of the tasks approved were found to be more complicated than they were estimated to be, such as guidance on legal liability issues for ADS-B data sharing.

5.3 USA provided brief introduction to several useful documents available for study and validation of using ADS-B including the following:

- MIT Lincoln Labs analysis of mixed ADS-B and Radar environment;

- MITRE Technical report: Automatic Dependent Surveillance –Broadcast Surveillance Requirements to Support Air Traffic Control Separation Standard – August 2005;

- Preliminary Analysis Report Evaluation of Multilateration and PRM systems at St Louis airport 2005;

- Final Report on Operational Evaluation of 5 Nautical Mile ADS-B to Radar Separation Services in Alaska 2006;

- MIT Lincoln Labs Initial GoMex Simulation Results 2007;

- Asynchronous Reception Effects on ADS-B Derived Separation Errors Compared with MSSR Baseline – S.R. Jones April 25, 2007.

5.4 The meeting considered it essential to develop common understanding for the regulators to publish equipage requirement for ADS-B OUT based service. This would get all the regulators concerned to work in the same path. The meeting strongly recommended that a regulators workshop on ADS-B OUT equipage requirement is organized before the end of 2009. Australia and USA offered to support the Workshop through coordinating and providing experts for the Workshop. Accordingly, the meeting formulated the following draft Conclusion:

Draft Conclusion 8/3 – Workshop on ADS-B OUT equipage requirement

That, ICAO be invited to organize a workshop on ADS-B OUT equipage requirement by the end of 2009 with assistance from Australia and USA.

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

CNS/ATM Implementation Planning Matrix

6.1 The meeting reviewed and updated the ADS-B aspect of CNS/ATM Implementation Planning Matrix presented by the Secretariat based on the outcome of ATNICG/4 meeting held in early May 2009. It was noted that the matrix was regularly updated by CNS/MET Sub-group of APANPIRG and the Task Force meetings with respect to specific elements of CNS/ATM systems. The Matrix lists status of implementation of major CNS/ATM elements in 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 C** to this report.

New Caledonia

6.2 France provided an update on the ADS-B implementation plan in New Caledonia. Three ground stations will be installed at the existing VHF sites by March 2009. Technical demonstration is scheduled from July to October 2009 and technical testing during October to December 2009. Operational testing will start from end of 2009 and complete mid 2010. The plan is divided into two phases.

6.3 It was also informed that AFTN circuit between New Caledonia and Fiji will be upgraded in early 2010. The circuit will be via Australia and shared by several air navigation services.

It was advised that the same link could be used to carry ADS-B data.

6.4 France also informed the meeting about modernization plan in French Polynesia including Eurocat-X installed in March 2008 at FAA'A and radar installed at Mont Marau in November 2008. Estimated operational use of Eurocat-X system will commence in August 2009.

SA Aware in Australia

6.5 The meeting noted explanation and/reason why that CASA Regulations currently in place require that, from mid 2012, all aircraft transmitting ADS-B must use GNSS TSO145/6 equivalent position sources. This requirement is primarily for the reason that the TSO 145/6 GPS receiver includes FDE and SA Aware capabilities.

6.6 Australia presented 3 related papers (IP/5, IP/6 and IP/10) which provided analysis of received ADS-B data. Papers previously presented by Australia showed a significant difference in performance between GPS receivers with and without Selective Availability (SA).

6.6.1 These papers examined ADS-B data in March, April, May 2008 and showed that the difference (SA aware or not) is not as large as previously thought with respect to AVAILABILITY, because earlier studies had not removed avionics faults unrelated to GPS satellite geometry issues.

6.6.2 IP/5 catalogues ADS-B outages not related to GPS satellite geometry which included:

- No GPS for whole flight leg (probably on data from "one side" of aircraft)
- No GPS for part of flight leg
- Intermittent GPS connection

6.6.3 IP/6 examined ADS-B NUC values for various GPS MMR and transponders. The major finding is that one transponder product is reporting lower NUC values than specified and this software error has been rectified.

6.7 IP/10 then re-examined the overall statistics, the paper focuses on the ADS-B outages involving GPS satellite geometry and the impact of SA Aware avionics. Availability of SA ON avionics is no longer a significant concern however the reliability of SA ON avionics is now the main concern

6.8 After removing the impacts of the issues identified in IP/5 & IP/6 the following conclusions were drawn.

When considering the outages caused by GPS constellation issues:

a) From an availability point of view – assuming NUC>4 is the requirement:

- SA aware receivers deliver exceptionally good performance.
- SA ON receivers delivered an availability of 99.97% once ADS-B outages not related to GPS geometry are discarded. This rises to 99.993% if one transponder type is not included.

From a continuity (reliability) point of view

- SA aware receivers deliver very good performance.
- SA ON receivers deliver a somewhat poor MTBF for GPS constellation geometry related failures of only 1,005 flight hours.

6.9 It is clear that SA aware avionics delivers better results however, SA ON avionics availability (due to GPS geometry) is better than previously estimated. At the same time, some concern remains regarding the reliability and continuity of the GPS function for SA ON avionics. Australia expressed concern about the ongoing use of SA ON avionics and encouraged adoption of SA aware avionics to support ADS-B.

6.10 Australia encouraged other states to perform similar analysis to further confirm or refute the Australian findings with respect to SA ON avionics ADS-B service reliability.

China

6.11 China presented to the meeting the results of the Trial & Evaluation Project conducted in South Western part of China to support ADS-B implementation. Several issues including analysis of the invalid data were identified. The meeting was informed that CAAC and ATMB installed an ADS-B ground station in Chengdu in April 2007 to monitor random target of aircraft that are equipped with ADS-B equipment in the area. Two flight tests were conducted. ADS-B data were collected against radar data. The first flight test was conducted in December 2008. Airbus 319 aircraft was used flying from Chengdu to Jiuzhai for the test. The second flight test took place at MianYang airport in Feb, 2009. A Citation aircraft equipped with RTK equipment was used for data collection to validate accuracy, error and other parameters. The meeting discussed and analyzed some issues resulting from the ADS-B evaluation tests including velocity and heading evaluation, low updates rate, etc. It was noted that RU6, a component of the ADS-B receiver used for the tests was found faulty which is being fixed by the manufacturer. The meeting commended the information provided by China as sharing data and issue from real flight testing were considered very useful which would bring benefits.

ADS-B Filter for Data Sharing

6.12 IP/4 presented by Australia stated that Australia had decided to develop a flexible PC based ADS-B Filter to manage and control the exchange of ADS-B data between Australia and its neighbors. It is called Foreign ADS-B Filter (FAF). The development of FAF is expected to be completed in 2009. The functional requirement and system requirement are provided in the **Appendix D** to this report for consideration by other States who wish to share ADS-B derived data.

6.13 Regarding location of the filter, the meeting felt the FAF could be installed at either site or at both sites which should be specified in the data sharing agreement. The reliability and redundancy of FAF should also be taken into account when PC based system is used.

Australian Wide Area Multilateration (WAM)

6.14 In addition to a presentation made at the ADS-B Seminar, Australia provided an information paper to the meeting which describes their experience gained and lesson learnt in deploying Wide Area Multilateration in Tasmania, Australia. The project started in May 2006 and the Site Acceptance testing commenced in May 2008. A number of flight tests have been conducted as part of Site Acceptance testing. Final flight test and conclusion of SAT is expected in MID 2009.

ADS-B data sharing between Malaysia and Indonesia

6.15 Malaysia informed the meeting that Indonesia has offered to share its ADS-B data from Banda Aceh ground station with Malaysia during the recent South-East Asia sub-regional ADS-B implementation working group meeting held in February 2009. The meeting noted the expected coverage diagram for the Banda Aceh ADS-B ground station which extended well into the Kuala Lumpur ATCC area of responsibility (AOR) within the Bay of Bengal. The ADS-B data from Banda Aceh station is expected to enhance Malaysia surveillance capability within its AOR in the Bay of Bengal Area. The meeting was further informed that the current Kuala Lumpur ATCC ADS-C/Radar integrated workstation for oceanic (Bay of Bengal) Sector is capable of processing and integrating ADS-B data.

6.16 The meeting noted that DCA Malaysia has communicated with DGCA Indonesia requesting for a technical discussion regarding the proposed ADS-B data sharing. Indonesia confirmed that the ADS-B ground station has been installed with data format ASTERIX 21 version .23. Indonesia is ready to further discuss with Malaysia for the data sharing.

6.17 It was encouraging to note the initiatives being taken by Malaysia and Indonesia for ADS-B data sharing in the Bay of Bengal area. CANSO expressed growing interest in ADS-B data sharing and possibility of regional ADS-B collaboration over the Bay of Bengal. Port Blair was cited as a possible location where ADS-B implementation would be beneficial for flights over non-radar airspace. States concerned were encouraged to consider sharing VHF communication capability where they are applicable.

Pakistan

6.18 Pakistan informed the meeting that the Pakistan Civil Aviation Authority (PCAA) is considering different options to enhance its airspace management with the prime objective to provide efficient and safe air traffic services to all air traffic operating within and transiting through Pakistan air space. Most of the Pakistan air space currently is already under radar surveillance, some gaps in the west, northern mountain regions and some portion in the south and southwest airspace need to be brought under positive visibility/surveillance. PCAA considers ADS-B, a potential option to fill up the gaps in radar surveillance and also considers using ADS-B to provide partial back up to the existing radar.

6.19 One ADS-B station was installed at Karachi ACC on trial basis for a period of one year. PCCA hired consultancy from ICAO TCB to assist in planning/designing future surveillance strategy for Pakistan airspace. In the light of TCB report/trial data analysis, risk mitigation, cost effectiveness and as per requirement, PCAA will proceed further in achieving the prime objective.

The Philippines

6.20 The Civil Aviation Authority of the Philippines (CAAP) installed a new Mode S SSR capable of processing ADS-B reports based on 1090ES. This enables the monitoring of ADS-B equipped aircraft in the 100NM radius from the radar station. The ADS-B function of the radar will be used to observe and evaluate population of aircrafts equipped with ADS-B within the Manila TMA.

6.21 The CAAP has planned to install two stand alone ADS-B stations in Manila and Puerto Princesa by 2012. The stations will be used as additional test and evaluation stations. These stations will likewise be used as a probable radar cone of silence and gap filler. The CAAP also intends to include the ADS-B function in all other Mode S SSR stations that will be installed in 2012.

6.22 CANSO commended the Philippines on the planned installation of ADS-B station at Puerto Princesa by 2012 as it would provide benefits similar to that envisaged in the South China Sea cost benefit study.

Viet Nam

6.23 Viet Nam provided an information paper on the current status of their radar coverage, other surveillance systems and its ADS-B implementation plan. Viet Nam has been participating in South East Asia's program on ADS-B installation and has committed to share ADS-B data with its neighboring States. Viet Nam also considers to share VHF communication capabilities with neighboring FIR when ADS-B control is applied. Viet Nam had preliminary discussion with Thales on upgrading ATM system in Ho Chi Minh AACC to process ADS-B data and sharing of ADS-B data with Singapore.

ADS-B Roadmap Hong Kong, China

6.24 It was informed that Hong Kong, China will:

a) Mandate ADS-B carriage, by end 2013, for aircraft flying over L642/M771;

b) Mandate ADS-B carriage, by end 2014, for all aircraft flying within the Hong Kong FIR; and

c) Mandate ADS-B carriage, after 2015 (TBC), for low flying aircraft, including general aviation aircraft and helicopters.

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Agenda Item 7: Development of Asia/Pacific Regional ADS-B implementation plan and sub-regional based ADS-B implementation plan.

FASID Tables on Surveillance Systems

7.1 The meeting reviewed and updated Tables CNS 4A and 4B of the Asia and Pacific Regions Air Navigation Plan, Volume II, FASID, Doc 9673. Table CNS 4 was renamed as Table CNS 4A – Surveillance Systems in 2006 and Table CNS 4B - ATS Automation Systems was renamed from the Table ATS 3. The FASID Table CNS 4A specifies the requirements for Surveillance Systems implemented and those to be implemented. Table CNS-4B specifies the requirements for ATC automation systems in the Asia and Pacific Regions. Table CNS 4A was updated in early 2006 and the Table 4B has not been updated since year 2000,

7.2 The Tables were updated based on the information provided from States therefore, the meeting agreed to formulate the following draft conclusion.

Draft Conclusion 8/4 – Table CNS 4A and Table CNS 4B

That, the FASID Table CNS 4A and Table CNS 4B be replaced with Updated Tables provided in **Appendix E** and **Appendix F** to the Report in accordance with the established procedure.

Outcome of SEA WG/4 Meeting

7.3 The meeting reviewed the outcome of the fourth meeting of the Southeast Asia ADS-B Working group meeting presented by the moderator of the working group. The SEA ADS-B WG/4 meeting, hosted by Airservices Australia was held in Melbourne on 9-10 February 2009. The outcome of the meeting was highlighted as follows:

- Recognizing that the area of interest to the working group for sharing ADS-B surveillance data also covers most part of South China Sea area, the working group agreed to invite other States that have interest to participate in the future meetings of the working group. The meeting agreed that Brunei Darussalam become a member of the working group. The Secretariat was requested to invite China and Hong Kong China for the next meeting of the working group;

- Australia, Brunei Darussalam, Indonesia, Malaysia, Singapore, Thailand and Viet Nam provided updates on their ADS-B related activities including their trial, plan and implementation status;

- Australia shared the information on their development of ADS-B Filter for data sharing;

- CANSO provided progress report of SEA ADS-B study project undertaken by CANSO and IATA with assistance from FAA and CAAS. The meeting requested IATA/CANSO to consider several other factors in preparation of the business cases and

- The meeting agreed to expedite ADS-B implementation in South China Sea:

i) Complete installation of ADS-B stations at Natuna and Matak Islands, Singapore and Con Son Island by 2010;

ii) sharing of ADS-B data and DCPC capability between DGCA Indonesia, CAAS and VANSCORP to facilitate application of radar-like separation standards;

iii) commence ADS-B operational trials in 2010 along air routes L642 and M771; and

iv) The earliest operational trial will be conducted approximately at the end of 2010 depending on new ATC automation system capabilities in the states. It was envisaged that an ADS-B mandate for some flight levels could come into effect in 2013.

7.4 Regarding harmonization of the rule for equipage requirement, the SEA ADS-B WG meeting considered some alternatives for Asia Pacific including:

- adoption of the proposed Australian rule but noted that this was not accepted in USA, Europe nor Canada;
- adoption of AMC20-24 but noting that this does not include a requirement for SA awareness nor Fault Detection & Exclusion (FDE);
- adoption of the proposed Australian rule including acceptance of AMC20-24 as one means of gaining approval of an aircraft ADS-B equipment configuration and;
- to require SA awareness or not.

7.5 The meeting reviewed the follow up action taken by members of the working group. Representative from Singapore airlines presented airline's view on the operational approval for the ADS-B OUT. The presentation is provided in the Addendum to the WP07. The meeting noted with appreciation the analysis and view expressed in the presentation.

7.6 CANSO presented the cost benefit study for the initial phase of ADS-B implementation in the South China Sea area. The study was undertaken jointly with IATA with assistance from CANSO members, in particular the FAA which is helping in the analysis, and CAAS which is helping with the collection of operational and technical data. The meeting appreciated the study conducted by CANSO. The meeting noted the positive business case of the project and possibility of greater benefits if ADSB were implemented over a wider area regionally. CANSO and IATA were requested to assist in an extension of the South China Sea project cost benefit study to include the Philippines. Singapore and USA agreed to provide the necessary support assuming that the Philippines was willing to provide the appropriate data.

7.7 With respect to whether CBA study could expand to the Bay of Bengal area, India was of the view that following the example provided, each ANSP would be able to carry out cost benefit study by themselves.

Guidelines for Development of ADS-B Implementation plan

7.8 Viet Nam presented a paper proposing additional guidelines for the meeting to consider for addition to "Guidelines for development of ADS-B Implementation plan by States adopted by APANPIRG/19 meeting under Conclusion 19/35. The meeting endorsed the proposal and agreed to add "or area" in the proposed new sub-graph "g". Accordingly, the meeting formulated the following draft Conclusion.

Draft Conclusion 8/5 - Revised Guidelines for Development of ADS-B Implementation Plan by States

That, the revised guidelines provided in **Appendix G** to this reported be adopted.

Sample Agreement for data sharing

7.9 Singapore and Indonesia proposed draft amendment to the sample agreement adopted as regional guidance material for the States who will make use of ADS-B data sharing to formulate their own bi-lateral agreements. Amendment is proposed to change the wordings of certain clauses that may not be precise enough to reflect the actual intent. There is also a need to amend the sample agreement to include the provision of VHF voice communication services by one State for the other.

7.10 The proposed amendment to the sample agreement is provided in **Appendix H** to this Report. Members of the Task Force were requested to provide feedback at the next Task Force meeting (ADS-B SITF/9) based on the experience gained by States.

ADS-B Data Sharing Project Australia and Indonesia

7.11 Based on the initial discussion at the SEA ADS-B WG/4 meeting, Airservices Australia and Indonesia have agreed to further progress the project and the funding has been allocated by each party for phase 1A only. Australia and Indonesia hope that data sharing will be operational in the 2nd Quarter 2010. This phase will use single data communications infrastructure to support situational awareness and safety nets. It is proposed to use an existing satellite data communications link between Australia and Indonesia. The phase 1A will include: Data sharing from existing ADS-B sites

- Thursday Island (installed)
- Gove (to be installed in 2009)
- Merauke (installed)
- Saumlaki (installed)

Australian ADS-B aircraft mandate

7.12 Australia informed the meeting that in March 2009, the Civil Aviation Safety Authority (CASA) issued legislation for an ADS-B aircraft equipment mandate for aircraft flight in the upper airspace (at and above FL290) of Australian territorial airspace, with a compliance date on and from 12 December 2013. This is the first aircraft mandate for ADS-B carriage to be issued in Australia. It is applicable to Australian aircraft and also to foreign registered aircraft when operating in Australia. A copy of the text of the mandate is provided in the Attachment to the IP/3 which is provided in the **Appendix I** to this report and is also available on the following CASA webpage: http://www.casa.gov.au/newrules/airspace/jcp/nfrm_jcp_annexb.pdf

7.13 The meeting also noted that Australia remains committed to the use of ADS-B technology despite the decision to no longer proceed with the cross-industry funding proposals

Options for states to establish harmonized Aircraft ADS-B avionics mandates

7.14 CASA, Australia provided a paper that outlines some possible options for regulatory authorities of ICAO APAC States to consider in the establishment and compliance timing for an aircraft ADS-B avionics mandate for flights in non-radar enroute airspace. The options are based on those standards and processes that have, or are presently being, established by several ICAO member States.

AMC20-24

7.15 The meeting noted the considerations of third meeting of South East Asia ADS-B WG in July 2008 on AMC20-24 published on 25 April 2008 by the European Aviation Safety Agency (EASA) which defines acceptable means of compliance for the airworthiness and operational approval of the “Enhanced Air Traffic Services in Non-Radar Areas using ADS-B Surveillance” The working group meeting agreed that AMC20-24 with proposed changes serves as baseline document for further consideration. The AMC20-24 with proposed changes by SEA ADS-B WG is provided in the **Appendix J** to this Report.

ADS-B OUT Equipage Standards - IATA

7.16 The meeting noted the proposal for ADS-B OUT Equipage Standards proposed by IATA for the APAC Region. It was stated that both the Australian approval method and AMC 20-24 are suitable standards for Asia Pacific. EASA AMC20-24 is better recognized as a global benchmark detailing an acceptable means of compliance for operation in non-radar areas. AMC 20-24 should eventually be adopted as the equipage standard for Asia and Pacific. Forward fit aircraft should comply from commencement of operations while retrofit aircraft must comply by 2013.

7.17 Regarding need for Boeing and Airbus (and other manufacturers) to be engaged at highest levels to support early certification and modification issues, the meeting was of the view that IATA is in a better position to follow up with Boeing and Airbus. IATA may contact manufacturers for their support and participation of the ADS-B task force meeting. IATA expressed need for input from Boeing and Airbus.

7.18 Regarding approval process for ADS-B OUT, it should be no different for any other avionics equipment. The contracting States shall recognize as valid an air operator certificate issued by another Contracting State. Australia informed the meeting that a possible way is to endorse the list of CASA approved aircraft that can be provided by CASA on request.

Development of Regulations for ADS-B equipage

7.19 The meeting noted that a number of States are finalizing Regulations for ADS-B avionics approval and use, including specifying airspace in which ADS-B carriage is required. A summary including status in Australia, Canada, EASA and USA was provided by Australia which, describes the current state of development of these regulations (IP/20)

7.20 The meeting had a lengthy discussion on the development of harmonized rule for equipage requirement for the avionics mandating in the APAC Region. The difficulties and concerns expressed at the meeting included the following:

- Options for the standard for NRA surveillance service;
- Lack of experts within the Task Force from regulatory authorities responsible for avionics approval;
- The standard or requirements for the avionics are kept improving;
- Lack of global harmonized requirements or standard; and
- Cost for certification, upgrading/retrofit and opportunity cost

7.21 It was recalled that use of DO260 or DO260A standards in ADS-B OUT avionics have been considered acceptable for the purpose of application of 5 nm separation standards in “non radar airspace” in Asia Pacific Regions. APANPIRG has already agreed that DO260 is acceptable until 2020.

7.22 The meeting noted that currently there are only two acceptable means of operational approval for ADS-B OUT operations:

a) Australian CASA method of approval by equipage qualification;
b) AMC 20 –24 certification

7.23 It was also noted that it has not been possible to obtain AMC20-24 certification for some aircraft that have received Australian ADS-B OUT operational approval. For these aircraft, IATA has indicated that the airframer OEMs requires an upgrade to a different version of the product before certification and this can add a significant cost to airlines.

7.24 The meeting was apprised of the advantages of GPS SA aware and FDE functionalities in aircraft equipage namely:

- FDE: Protection against loss of service due to a faulty ranging signal from a single satellite;
- SA awareness: Significantly increased ADS-B service reliability/continuity & availability.

7.24.1 Some avionics vendors have service bulletin upgrades to existing (TSO129 GPS Receiver) to make them SA Aware. Other vendors do not have such upgrades.

7.24.2 The meeting noted that AMC2024 does not require GPS SA aware, nor does it require FDE functionality. SA aware functionality is available on some Boeing & Airbus aircraft and FDE is available on almost all such aircraft.

7.25 The meeting was advised of some concerns regarding the frequency and impact of unexpected ADS-B service loss when providing 5NM separation services particularly during vectoring.

7.26 The meeting was also advised of the published Australian mandate which will take effect in December 2013. Additionally, Australia requires SA Aware functionality taking effect in June 2012. Australia clarified that the aircraft equipment fitment mandate in 2013 is not intended to remove DO260 equipped aircraft from ADS-B OUT approval. It was informed that Australia (CASA) will issue appropriate documents to clarify this.

7.27 The meeting was briefed on the expected longer-term performance requirements that are likely to require SA aware avionics and will require transponders meeting DO260B standard in 2020 by US FAA and EASA Europe. The previous decision of APANPIRG to allow use of DO260 until at least 2020 was also noted. Details of equipage requirements are yet to be defined by the FAA and EASA rulemaking process. In view of the foregoing, the meeting felt that equipage requirements for ADS-B OUT service need to be globally harmonized by 2020. USA agreed to prepare a paper in this regard for consideration by CNS/MET Sub-group in July 2009.

7.27.1 The meeting recognised that the APAC Region needs a transition strategy, in particular, methods of approval for operational use in the period prior 2020.

7.27.2 The meeting agreed that the Australian approval method and AMC20-24 are suitable standards for APAC Region. The ADS-B Task Force will continue to monitor the publication of ADS-B equipage standards within and outside the region for possible adoption.

7.28 However, it was also recognized that some aircraft configurations are currently unable to obtain AMC 20-24 certification without upgrade despite being in compliance with the current Australian standard. In the interim, these aircraft can and should be authorized to operate ADS-B in the APAC Region. CASA Australia has indicated that they will be able to share aircraft approval data with other States to assist in this initiative.

7.29 At the same time, the benefits of SA aware avionics and FDE were recognised and it is recommended that new aircraft should be fitted with these capabilities. Therefore, States are recommended to identify these capabilities as forward fit requirements as soon as reasonable. As a result of discussion, the meeting formulated following two draft Conclusions.

Draft Conclusion 8/6 - Regional ADS-B Equipage Requirement

That, States be urged to issue ADS-B authorizations for the interim period 2010-2020 (or until requirements can be harmonized globally) in NRA airspace based on:

- AMC20-24 certification or
- Approval by CASA Australia or

- The requirements of the CASA Civil Aviation Order 20.18 Amendment (No. 1) 2009 and Advisory Circular AC21-45

Draft Conclusion 8/7 – Forward Fitment Requirements for SA Aware and FDE functionality

That, States be recommended to adopt forward fitment requirements which include SA aware and FDE functionality as soon as reasonable.

Sub-regional ADS-B implementation projects

7.30 In order to further progress or identify new ADS-B implementation projects at sub-regional level, the three ad hoc working groups were established during the meeting to further develop proposals for sub-regional implementation plans for South East Asia, Bay of Bengal and South Asia and Pacific each group reported the results of its discussions to the Task Force. The outcome of the discussions has been recorded in the **Appendix K** to this report.

7.31 The regulatory authorities Working Group did mot meet as planned due to lack of representatives from regulatory authorities responsible for avionics approval.

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Agenda Item 8: Any other business

Introduction to VANSCORP

8.1 Brief Introduction to VANSCORP was presented to the meeting. VANSCORP is established based on the Viet Nam Air Traffic Management' (VATM). VANSCORP, a corporation under the management of Ministry of Transport, is a unique provider for air navigation services in Viet Nam.

Note of appreciation

8.2 The meeting expressed its appreciation and gratitude to the Civil Aviation Authority of Viet Nam and VANSCORP for hosting the ADS-B Seminar and the meeting, for the excellent support provided, and for all activities including a culture tour organized during the meeting.

Time and Venue of Next Meeting

8.3 The fifth meeting of SEA ADS-B Working Group is scheduled in November - December 2009 or early 2010 in Indonesia and the next meeting of ADS-B Study and Implementation Task Force is scheduled in April or May 2010. 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 the exact date and venue of the meetings after consultation with the concerned.

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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	10/2009	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 implementation	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
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	10/2009	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
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

No.	Subject/Tasks List	Associated with Strategic Objective	Associated GPI	Deliverables	Target Date	Action to be taken and led by
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	Develop 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 material (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-10	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-10	Australia
16	Sample mandate material defining ADS-B avionics including the positional data source including task by 45th DGCA Conference.	A. Safety	GPI01/05/06/09/ 14/16/17/21/22	Guidance material for implementation	Apr-10	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-10	U.S.A.
18	Develop and implement 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	Sub-regional ADS-B collaboration project has been .	Jul-08/ Dec-10	SEA WG

No.	Subject/Tasks List	Associated with Strategic Objective	Associated GPI	Deliverables	Target Date	Action to be taken and led by
19	Develop and implement 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 implement 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	Completed (5/2009)	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 - continous	Apr-10	All Members
23	Provide feedback to the proposed amendment to sample service agreement for datasharing	D. Efficiency	GPI01/05/06/09/ 14/16/17/21/22	Comments	April-10	All Members
24	Develop and implement regional collaboration project for ADS-B out operational use including data sharing in Bay of Bengal area and report on implementation progress	D. Efficiency	GPI01/05/06/09/ 14/16/17/21/22	Develop and implement sub-regional ADS-B	Apr-09/ Dec-11	Bay of Bengal States
25	Working Paper for CNS/MET/SG/13 on the need for global harmonized equipage requirements for ADS-B surveillance service in NRA	D. Efficiency	GPI01/05/06/09/ 14/16/17/21/22	Working Paper	June-09	member from USA
26	Provide feedback to the proposed amendment and template for datasharing based on experience gained by Indonesia and Signapore (Appendix H to the report)	D. Efficiency	GPI01/05/06/09/ 14/16/17/21/22	Comments	April-10	All Members

ASIA/PACIFIC REGION

PERFORMANCE FRAMEWORK FORM

(REGIONAL)

REGIONAL PERFORMANCE OBJECTIVE — APAC – CNS 3 Implementation of the ADS-B Air to Ground Surveillance	
Expected Outcome	
Improved situational awareness and surface surveillance	
Benefits	
Environment **Efficiency** **Safety**	• reductions in fuel consumption and subsequent lower gas emissions • increased flexibility and flow of traffic operations • ultimately, when performing *radar-like* control, potential redesign of airspace taking into account the application of reduced separation minima, integrate use of aircraft navigation and surveillance capability • introduction of surveillance in a non-radar environment • support to search and rescue operations

Strategy
Medium term (2011 - 2015)
Short term (2010)

ATM OC COMPONENTS	TASKS	TIME FRAME START-END	RESPONSIBILITY	STATUS	REMARKS
AOM *(Airspace Organisation and Management)* **CM** *(Conflict Management)* **AUO** *(Airspace Users Operations* **ATMSDM** ***(ATM Service Delivery Management)***	• Compare currently available technologies with respect to concept of operations, relative costing, technical and operational performance and maturity of alternative technology/solutions (primary, secondary radar including Mode-S, ADS-B, multilateration, ADS-C)	2009	ADS-B Study and Implementation Task Force (ADS-B SITF)	In progress	Regional Guidance material on comparison of technologies issued

• Develop an implementation plan for near term ADS-B applications in the Asia Pacific Region including implementation target dates taking into account: • available equipment standards; readiness of airspace users and ATS providers; • identifying sub-regional areas (FIRs) where there is a positive cost/benefit outcome expected for near-term implementation of ADS-B OUT; • developing a standardised and systematic task-list approach to ADS-B OUT implementation; and • holding educational seminars and provide guidance material to educate States and airspace users on what is required to implement ADS-B OUT.	2009-10	ADS-B Study and Implementation Task Force	In progress	The FASID Table CNS 4A and 4B – surveillance and ATM automation being updated; ADS-B Seminar conducted annually; potential sub-regions for using ADS-B identified; Requirement for avionics specification for the near term application are being developed based on AMC2024 and Australian CASA document .
• Develop Guidance Material to support harmonized regulation of ADS-B systems required on board the aircraft.	2010	ADS-B Study and Implementation Task Force	To be started	Forty Fifth DGCA Conference, through its Action Item 45/3 invited ICAO APANPIRG ADS-B Study and Implementation Task Force (ADS-B SITF) to develop the guidance material
• Study and identify applicable multilateration applications in the Asia and Pacific Region considering: • Concept of use/operation; • Required site and network architecture; • Expected surveillance coverage; • Cost of system; • Recommended separation minimums; and • If multilateration can be successfully integrated into an ADS-B OUT system for air traffic control	2011	ADS-B Study and Implementation Task Force	In progress	Concept of using multlateration has been developed; Some states have plan in place to introduce multilateration in particular & integrate it with A-SMGCS and Terminal area and Enroute surveillance application
• Coordinate ADS-B implementation plan and concept of operations with other ICAO regions where ADS-B implementation is going on and with relevant external bodies such as EUROCONTROL, EUROCAE, RTCA and Industry	2013	ADS-B Study and Implementation Task Force	In progress	Updated information on ADS-B in Europe and North American Regions is provided to Task Force Meeting annually; Some Industry representatives provide input at ADS-B Seminar and meetings

	• Develop **Terms of Co-operation** for SEA which will include: • establishing model documents for possible use by States when o Agreeing to share ADS-B data, and DCPC (such as VHF radio voice communication) capability between adjoining States for various ADS-B applications (including a sample letter of agreement); or o Establishing ADS-B avionics fitment mandates • identifying optimum coverage for ADS-B ground stations and associated VHF radio voice communication in the sub-regional FIR boundary areas.	2011	South East Asia (SEA) Sub Regional ADS-B Implementation working Group	In progress	Terms of co-operation developed; sample agreement of data sharing developed; Some location for ADS-B ground stations identified. CBA for SEA project being progressed; Implementation plan being developed.
	Develop an **implementation plan** for near term ADS-B application in SEA which will deliver efficient airspace and increased safety on a regional basis that includes: • schedule and priority dates to bring into effect ADS-B based services taking into account; o Timing of any equipage mandates. o Timing of any ATC automation upgrades to support ADS-B. o Timing of commissioning of any ADS-B data sharing and associated VHF radio voice communication facilities. • consideration of major traffic flows				Major traffic flow from Australia to Singapore through Indonesia and L642 and M771 in SEA being considered.
linkage to GPIs	GSI-12 Use of Technology to Enhance Safety; GPI/9 Situational Awareness; GPI/5: RNAV and RNP, GPI/7: dynamic and flexible ATS route management, GPI/17: data link applications and GPI/22: Communication Infrastructure;				
References	Report of AN CONF/11; Global ATM Operational Concept (Doc9854); Global Air Navigation Plan (Doc9750); Technical Provisions for Mode S Services and Extended Squitter (Deco9871) APANPIRG/16/17/19 report on ADS-B ADS-B related regional guidance materials adopted by APANPIRG				

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.	16 ADS-B sites are operational. A total of 28 UAP ground stations are expected to become operational throughout 2009. Additional 20 stations have been delivered in 2007 for installation at enroute radar sit and other sites. 5 NM Separation service has been introduced. NFRM on the carriage and use of ADS-B avionics has been issued.	FANS 1/A ADS-C 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**			
						WAM installed in Tasmania commissioning expected 2009. Provides radar like WAM data and ADS-B data. ASMGCS with multilateration being installed at Melbourne, Sydney, Brisbane and Perth. Operational between 2009 -2010. Mulitlateration based precision runway monitor to be commissioned in 2010.		
BANGLADESH	BIS Router and AMHS planned for 2011.	AIDC between Dhaka and CTG, Dhaka and Sylhet planned for 2011		Not yet planned	Not yet planned	Not yet planned	Not yet planned	

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**			
BHUTAN	ATN BIS Router and UA service 2008.			Procedures developed for NPA.				
BRUNEI DARUSSALAM	ATN BIS Router planned for Sept 2008 and AMHS planned for 2008-2011							
CAMBODIA	BIS Router and AMHS planned for 2007	Planned 2009	Planned 2009	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 Router and AMHS deplyoyed in 2008. - Tripartite BBIS trial completed with Bangkok and Hong Kong, China in Jan. 2003. - ATN/AMHS trial with Hong Kong using XOT over internet conducted in 2006. Further trials planned in 2009 - ATN/AMHS test with Macau is ongoing. - AMHS/ATN trial with Kuwait is to be delayed.	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. Shanghai ACC and Japan to be implemented. TBD With Korea to be delayed	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.	A ADS-B trial has been conducted in 2006. 5 UAT ADS-B sites are operational and used for flight training of CAFUC. Another ADS-B of 1090ES trial has been conducted since2007.	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 and AMHS technical trial 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 connection conducted in September, 2006 - ATN/AMHS trials with Philippines planned for end 2009. -Further ATN/AMHS technical trials with China planned for late 2009. -Operational system to be available 2009. -ATN/AMHS interoperability trials with Macau, China planned during May-August 2009 and operational test during Sept-Oct 2009.	AFTN-based AIDC with Sanya put into operational use in Feb 2007. AIDC with Guangzhou planned for late 2009.	FANS 1/A based CPDLC 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. 6-month operational trial commenced in Feb. 2009	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 put into operational use in April 2009. Data collection/ analysis on aircraft ADS-B equipage in Hong Kong airspace conducted on quarterly basis. ADS-B trial using a dedicated ADS-B system was conducted in Apr 2007. Planning on further trial is in progress.	FANS 1/A trials for ADS-C conducted.	AFTN-based AIDC with Sanya put into operational use in Feb 2007. Ready to conduct trials on AFTN-based AIDC with Zhanjiang/ Guangzhou, China.

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 trials with Thailand, Japan planned for 2010.							
MACAO, CHINA	ATN AMHS interoperability with China started 25 March with planned duration of 2 months Interoperability ATN & AMHS tests with Hong Kong planned during May-Aug 2009 to be followed with operational test in Sept-Oct 2009							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	ATN BIS Router and AMHS implementation by 4th quarter 2010.	AFTN based AIDC implemented between Nadi, Brisbane, Auckland and Oakland.	Implemented and integrated with ATM systems to support FANS1/A equipped aircraft.	Implemented	Implemented	ADS-B implementation in 2009/2010.	FANS 1/A ADS-C implemented.	
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 Physical installation over. SAT in May 2008, coordinating with China, Thailand and Singapore for conduct of test.	AFTN Based AIDC Coordniatin g with Bngladesh and Pakistan and, we are ready	FANS-1 implemented at Kolkata, Chennai, Mumbai and Delhi.		SBAS - Technical developments in 2007. - Implementation planed for 2009.	Trial completed in 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 2009. Trial with Singapore planned.	Brisbane and Makassar in planned in June 2009.	FANS-1/A. CPDLC in Ujung Pandang FIRs already trial start from 2008 and will be implemented in 2009.	Procedure to be completed in 2006 for NPA.		22 ADS-B ground stations have been installed in 2009. Upgrading ATC automation at Makasar for ADS-B application capabilities in 2009.	FANS 1/A ADS-C trial planned at Jakarta and Ujung Pandang ACC in 2009.	MATSC new version with capability for ADS-B and Mode-S will be operated in 2009.
JAPAN	ATN BBIS already implemented. AMHS implemented between Japan and USA in 2005 and between Japan and Hong Kong, China, ROK, Singapore, Australia planned for 2009-2011. Connection test between Taibei 2008 – ongoing	AIDC based. AFTN procedure implemented with Oakland and Anchorage. Planned between Incheon ACC and Fukuoka ATMC 2009. Between Fukoka,ATMC and Taibei ACC 2012	FANS1/A system Implemented in Fukuoka FIR	NPA implemented at 4 aerodromes.	SBAS Operational In 2007	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 completed planned for implementation with Bangkok in 2009.	AIDC with Bangkok planned for 2010	FANS-1/A Planned for Bay of Bengal and South China Sea areas. Equipment is under test operation. Bay of Bengal this year		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 2011	AFTN AIDC planned with Bangkok ACC in 2011.	Planned for Bay of Bengal and South China Sea areas in 2006.	NPA at KLIA implemented.		Implementation of ADS-B proposed in 2008-2010.	FANS 1/A ADS-C planned for Bay of Bengal and South China Sea areas in 2006.	
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.				

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**			
MICRONESIA FEDERATED STATES OF								
Chuuk				Implemented				
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 ACC 2009 Tontouta APP 2009		
NEW ZEALAND	BIS Router and AMHS implementation planned for 2011.	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.	*MLAT being implemented in Auckland (Surface Movement) and Queenstown
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 was installed at ACC Karachi and evaluation is in progress.	Planned for 2005-2010	Existing Radar system being upgraded.
PAPUA NEW GUINEA				Implemented at certain aerodromes.	Implemented.			

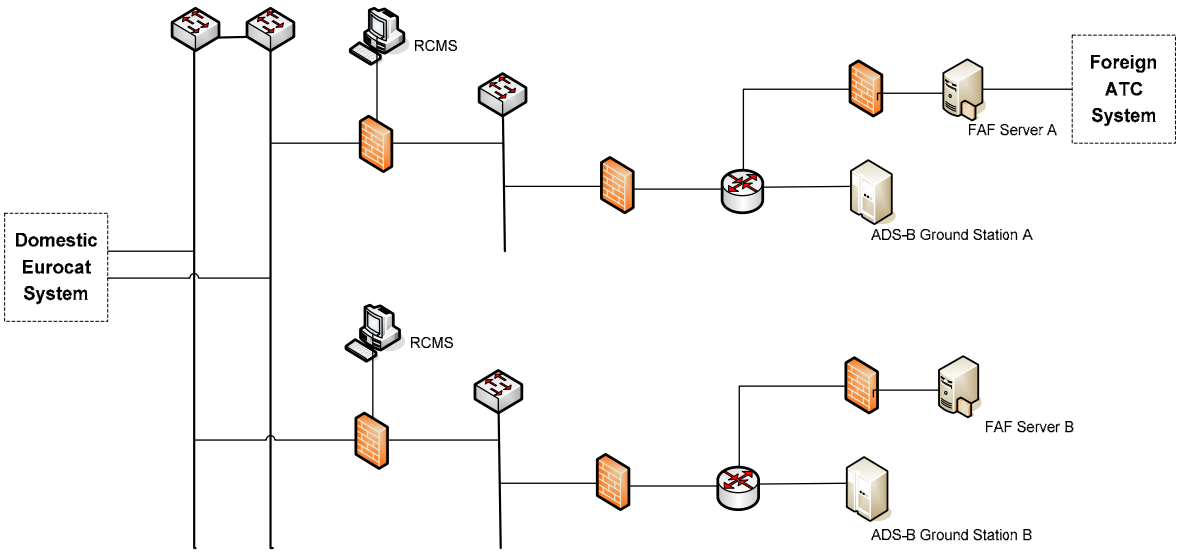
CNS/ATM Implementation Planning Matrix								
State/ Organization	**ATN G/G Boundary Intermediate System (BIS) Router/AMHS**	**AIDC**	**CPDLC**	**GNSS**		**ADS-B/ Multilateration**	**ADS-C**	**Remarks**
				RNAV (GNSS)	**En-route**			
PHILIPPINES	ATN G/G BIS Router/AMHS implemented in 2006 AMHS trials with Singapore by end 2008 and Hong Kong planned in 2009.	Planned for 2011.	CPDLC Planned for 2011.			Included in CNS/ATM Project and scheduled for implementation in 2011.	FANS 1/A ADS-C planned for 2011.	
REPUBLIC OF KOREA	ATN BIS Router/AMHS planned for 2005-2010.	AFTN based AIDC planned for 2009 between Incheon ACC and Fukuoka ATMC	PDC & D-ATIS implemented 2003.	NPA procedure developed at Incheon International Airport in 2008.		ADS-B trials planned for 2008-2009 at Incheon International Airport.	Trial for FANS 1/A ADS-C implemented since 2003.	
SINGAPORE	AMHS implemented. ATN BIS Router trial with Malaysia commenced in 2007 and with Indonesia in 2009. ATN/AMHS trial planned with Australia, India, Thailand, UK and Philippines	ATN based AIDC to be implemented in 2010.	Implemented since 1997. Integrated in the ATC system in 1999.	NPA Procedure implemented in 2005. RNAV (SID/STAR) implemented in 2006.	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.		PDLC in trial operation since November 2000.			ADS-B Trials planned for 2010 and implementation in 2011.	FANS 1 /A ADS-C trial since November 2000.	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 AMHS Atlanta Sept 2009 to serve CAR/SAM,/ North Atlantic/Europe	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. ATN/AMHS trial in 2010 and operation in 2012	AFTN based AIDC implemented in 20069 Trial for ATN based AIDC planned in 2010.	CPDLC operational trial conducted in early 2007.	RNAV	For en-route TBD.	TBD	FANS 1/A ADS-C operational trial conducted for oceanic area of Ho Chi Minh FIR since March 2002.	

FOREIGN ADS-B FILTER

1.1 The FAF is to be installed between the domestic ADS-B network and foreign ADS-B networks as shown below :



1.2 The FAF provides the following functions :

- Acts as a filter to ensure that only data agreed to be shared is passed between FIRs. Filter behaviour is defined in offline tables. It may also perform geographical filtering eg: remove data from areas that are sensitive or restrict sharing to within 200Nm of the boundary etc.

- Performs security and validity checks on network information and ADS-B data to satisfy the requirements of the two different FIRs/ ANSPs. Data is rejected if mandatory fields are not present or data does not meet expectations.

- Acts as a gateway between domestic and foreign ATC systems by performing network address translation and data format adaptation according to the characteristics of the two systems to make sure little change is needed to the core ATC systems or networks.

    - For example, Australian Asterix Cat21 data includes two extra fields beyond that defined in the standard. These extra fields will be stripped to allow transmission in the Asia Pacific standard (Asterix Cat21 version 0.23) to any adjacent FIR.

- Performs functions normally performed by the Australian ADS-B ground stations, which may not necessarily be performed by a foreign FIR. Eg: 24 bit code filtering.

- Allows adaptation to changes in data sharing agreements without incurring costs of changes to the ATC automation system.

- Provides logging and integrates with a SNMP based Remote Monitoring and Control System to support alerts to users.

4 BENEFITS

4.1 Short Term

In general, it provides the technical platform to support flexibility in cross FIR boundary data sharing:

- Adapts external ADS-B data flows to the ADS-B network used in Australia.
- Easily integrated into the Eurocat system or other ATC systems
- Allows for flexibility to cope with changes to data sharing agreements – tailored for each adjacent FIR
- Allows filtering of sensitive categories of aircraft, airspace etc.

4.2 Strategic

- FAF supports data sharing – and data sharing enhances surveillance cross-boundary ATC safety & efficiency.

ANNEX A: FUNCTIONAL REQUIREMENT SUMMARY

Capacity
FAF is able to support 100 ADS-B sites and 10 ATC systems at the same time.

Data Formats
- Eurocat Asterix Category 21 supported
- Monitoring message (SNMP) supported

Update Rate
- Decided by the agreement bilaterally between two parties

Latency
- A data throughput delay less than 100 mS

Network
- Supports connection between foreign and domestic ADS-B data communication networks based on a mutually-agreed basis between ANSPs of adjoining member States/ ADS-B data service providers.
- Supports multicast (preferred) and point-point TCP/IP for the interface.
- FAF appears to the network as a “pseudo” ADS-B ground station(s)

Safety
- Firewall
- Valid user register information
- Network parameters filter before connection
- Data content filter after connection

Maintenance
- Exception display on screen
- Remote access to log files
- Monitoring service from RCMS
- Offline Configuration to tailor system for remote sites & networks
- Document for technical and operational support

Further improvements
Further development or changes shall be decided by the agreement or contract between two parties.

ANNEX B : SYSTEM REQUIREMENT

Hardware Minimum Requirement

- Pentium IV 2.4GHz/800MHz FSB
- 256MB 333MHz DDR SDRAM memory
- 40GB Hard Drive

Operating System
The operating system shall be Mandrake 10.2 Linux (Mandriva 2005), kernel version 2.6.11-6.

Interface Specification

- Physical Layer
  Physically the interface shall comply with the IEEE 802.3 ethernet 100BaseTX (preferred) or 10BaseT terminated onto an RJ-45 patch port.
- Network Layer
  The network layer is implemented using the Internet Protocol (IP) and the network shall support Internet Control Message Protocol (ICMP) level 0, 1 and 2.
- Transport Layer
  In the transport layer, the protocols UDP and TCP are available. The application use the transport protocols al follows:
  UDP: Asterix and SNMP messages.
  TCP: Telnet sessions or File transfers FTP (Eg. for Software upload).

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TABLE CNS-4 – SURVEILLANCE SYSTEMS

Explanation of the Table

Column

1	Name of country and location of the facility or FIR
2	Air Traffic Services Unit served by the facility
3	PSR – Primary Surveillance Radar
4	Coverage of Primary Surveillance Radar in nautical miles
5	SSR – Secondary Surveillance Radar and Modes implemented will be indicated within Brackets, namely Mode A, C & S
6	Coverage of Secondary Surveillance Radar and/or ADS-B in nautical miles
7	ADS-B Automatic Dependent Surveillance Broadcast
8	ADS-C Automatic Dependent Surveillance Contract
9	SMR – Surface Movement Radar
10	A-SMGCS – Advanced Surface Movement Guidance and Control System
11	PAR – Precision Approach Radar
12	Remarks

Note:

The following codes are used in columns 3, 5, 7, 8, 9, 10, 11 and 12

I - required and implemented
for column 5, I - stands for implementation using conventional SSR while
MI - stands for implementation using Monopulse SSR
X - required but not implemented status not determined
N - required but not implemented
A - existing facility provided to supplement or substitute the requirement
F - future Plan
< - year planned commissioning year to be used as appropriate in conjunction with ‘F’ & ‘N’
> - year planned decommissioning year to be used as appropriate in conjunction with ‘A’ & ‘I’

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TABLE CNS 4 - SURVEILLANCE SYSTEMS

Country/Location	ATS Units Served	PSR	Coverage of PSR (NM)	SSR(A/C/S)	Coverage of SSR/ADS-B (NM)	ADS-B	ADS-C	SMR	A-SMGCS	PAR	Remarks
1	2	3	4	5	6	7	8	9	10	11	12
AUSTRALIA											
Hans Tableland	Cairns ~~ACC~~ TUC ~~Cairns APP~~ ~~Cairns TWR~~ Brisbane EC			MI(A/C)>14 MI (ACS) F<14	250	250 F<10					
Redden Creek	CairnsACC Cairns APP Cairns TWR	I	50	MI(A/C)>08 MF(A/C/S)F<10	250	250F<12					
Tabletop	Brisbane ACC			MI(A/C)>14 MI(ACS)F<14	250	250 F<10					
Swampy Ridge	Brisbane ACC			MI(A/C)>14 MI(ACS)F<14	250	250 F<10					
Mount Alma	Brisbane ACC			MI(A/C)>14 MI(ACS)F<14	250	250 F<10					
Mount Hardgrave	Brisbane ACC Coolangatta APP Coolangatta TWR			MI(A/C)>14 MI(ACS)F<14	250	250 F<10					
Brisbane Airport	Brisbane APP Brisbane TWR	I	50	MI(A/C)>08 MF(A/C/S)<10	250	250 F<12					
Mount Sommerville	Coolangatta APP Coolangatta TWR	I	50	MI(A/C/S	250	250 F<12					
Round Mountain	Brisbane ACC Sydney APP			MI(A/C)>14 MI(ACS)F<14	250	250 F<10					
Mount Boyce	Melbourne ACC Sydney APP Brisbane ACC Melbourne ACC			MI(A/C)>14 MI(ACS)F<14	250	250 F<10					
Sydney Airport	Sydney APP Sydney TWR	I	50	MI(A/C)>08 MF(A/C/S)<10	250	250F<12		I			

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TABLE CNS 4 - SURVEILLANCE SYSTEMS

Country/Location	ATS Units Served	PSR	Coverage of PSR (NM)	SSR(A/C/S)	Coverage of SSR/ADS-B (NM)	ADS-B	ADS-C	SMR	A-SMGCS	PAR	Remarks
1	2	3	4	5	6	7	8	9	10	11	12
Mount Majura	Canberra APP Canberra TWR	I	50	MI(A/C)>08 MF(A/C/S)F<10	250	250F<12					in Melbourne
Mount Bobbara	Melbourne ACC (in Melbourne) Canberra APP Canberra TWR			MI(A/C)>14 MI(ACS)F<14	250	250 F<10					
Mount Macedon	Melbourne ACC Melbourne APP Melbourne TWR			MI(A/C)>14 MI(ACS)F<14	250	250 F<10					
Gellibrand Hill	Melbourne ACC Melbourne APP Melbourne TWR	I	50	MI(A/C/S)	250	250F<12					
Summertown	Adelaide ACC Adelaide APP Adelaide TWR Melbourne ACC			MI(A/C)>14 MI(ACS)F<14	250	250 F<10					
Adelaide Airport	Adelaide ACC Adelaide APP Adelaide TWR	I	50	MI(A/C)>08 MF(A/C/S)F<10	250	250 F<12					
Kalamunda	Perth ACC Perth APP Perth TWR			MI(A/C)>14 MI(ACS)F<14	250	250 F<10					
Perth Airport	Perth ACC Perth APP Perth TWR	I	50	MI(A/C)>08 MF(A/C/S)F<10	250	250F<12					
Darwin (military ATC facility)	Brisbane ACC			MI(A/C)	160						SSR data only
Tindal (military ATC facility)	Brisbane ACC			MI(A/C)	250						SSR data only

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TABLE CNS 4 - SURVEILLANCE SYSTEMS

Country/Location	ATS Units Served	PSR	Coverage of PSR (NM)	SSR(A/C/S)	Coverage of SSR/ADS-B (NM)	ADS-B	ADS-C	SMR	A-SMGCS	PAR	Remarks
1	2	3	4	5	6	7	8	9	10	11	12
Oakey (military ATC facility)	Brisbane ACC			MI(A/C)	250						SSR data only
East sale (military ATC facility)	Melbourne ACC			MI(A/C)	250						SSR data only
Darwin	Brisbane ACC			MI(A/C)>14 MI(ACS) F<14	250	250 F<10					
Bundaberg	Brisbane ACC				250	I					
Balgo Hill	Brisbane ACC				250	FF<2009					
Caiguna	Melbourne ACC				250	I					
Doongan	Brisbane ACC				250	FF<2009					
Esperance	Melbourne ACC				250	I					
Jackson	Brisbane ACC				250	FF<2009					
Thursday Island	Brisbane ACC				250	I					
Ayers Rock AP	Melbourne ACC				250	FF<2009					
Birdsville	Melbourne ACC				250	FF<2009					
Broken Hill	Melbourne ACC				250	I					
Mornington Island	Brisbane ACC				250	FF<2009					
West Gap (Alice Springs)	Brisbane ACC				250	I					
Warburton	Melbourne ACC				250	FF<2009					
Broome	Brisbane ACC				250	FF<2009					
Leonora	Brisbane ACC				250	I					
Longreach	Brisbane ACC				250	I					
Telfer	Brisbane ACC				250	I					
Meekatharra	Brisbane ACC				250	I					
~~Mount Barrow~~	~~Melbourne ACC~~				~~250~~	~~F<2006~~					

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TABLE CNS 4 - SURVEILLANCE SYSTEMS

Country/Location	ATS Units Served	PSR	Coverage of PSR (NM)	SSR(A/C/S)	Coverage of SSR/ADS-B (NM)	ADS-B	ADS-C	SMR	A-SMGCS	PAR	Remarks
1	2	3	4	5	6	7	8	9	10	11	12
Mount Isa (DCA Hill)	Brisbane ACC				250	FF<2009					
Newman	Brisbane ACC				250	I					
Oodnadatta	Brisbane ACC				250	FF<2009					
Tennant Creek	Brisbane ACC				250	I					
Karratha	Brisbane ACC				250	I					
Billabong	Melbourne ACC				250	I					
Gove	Melbourne ACC				250	FF<2009					
~~Mount Oxley~~	~~Melbourne ACC~~				~~250~~	~~F<2006~~					
~~Mount Rumney~~	~~Melbourne ACC~~				~~250~~	~~F<2006~~					~~Near Hobart in Tasmania~~
Bourke	Melbourne ACC				250	I					
Nullabor	Melbourne ACC				250	FF<2009					
Woomera	Melbourne ACC				250	I					
TAS WAM Multilat	Melbourne ACC				100	FF<2009					MLAT F<2010
Sydney Airport	Sydney TCU				40	F<2010				I	MLAT F<2010
BANGLADESH Dhaka	Dhaka APP			I(A/C)	200						
BHUTAN											
BRUNEI DARUSALAM Brunei Airport	Brunei APP	I	80	I(A/C)	250						
CAMBODIA				I(A/C)	250						VDPP 2011, VDSV 2010
CHINA Beijing-1	Beijing TWR Beijing APP			MI(A/C)	200						Mode S when required

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TABLE CNS 4 - SURVEILLANCE SYSTEMS

Country/Location	ATS Units Served	PSR	Coverage of PSR (NM)	SSR(A/C/S)	Coverage of SSR/ADS-B (NM)	ADS-B	ADS-C	SMR	A-SMGCS	PAR	Remarks
1	2	3	4	5	6	7	8	9	10	11	12
Beijing-2	Beijing ACC Beijing TWR Beijing APP Beijing ACC	I	60	MI(A/C)	200						
Beijing-3	Beijing TWR Beijing APP Beijing ACC	I	200	MI(A/C)	250						
Tianjin	Tianjin TWR			MI(A/C)	200						
Shijiazhuang	Shijiazhuang TWR Beijing ACC			MI(A/C)	200						
Taiyuan	Taiyuan TWR Taiyuan ACC	I	60	MI(A/C)	200						
Hohhot	Hohhot TWR, ACC			MI(A/C)	200						
Manbanshan	Hohhot ACC			MI(A/C)	200						
Sunite	Hohhot ACC			MI(A/C)	200						
Guangzhou-1	Guangzhou TWR Guangzhou APP Guangzhou ACC	I	60	MI(A/C)	200						
Guangzhou-2	Guangzhou TWR Guangzhou APP Guangzhou ACC	I	60	MI(A/C)	200						
Guangzhou-3	Guangzhou TWR Guangzhou APP Guangzhou ACC			MI(A/C)	200						
Shenzhen	Shenzhen TWR Guangzhou APP Guangzhou ACC	I	60	MI(A/C)	200						
Shaoguan	Guangzhou ACC			MI(A/C)	200						
Zhuhai	Zhuhai TWR Zhuhai APP Zhuhai ACC	I	60	MI(A/C)	200						
Sanya	Sanya TWR Sanya APP	I	150	MI(A/C)	250						

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TABLE CNS 4 - SURVEILLANCE SYSTEMS

Country/Location	ATS Units Served	PSR	Coverage of PSR (NM)	SSR(A/C/S)	Coverage of SSR/ADS-B (NM)	ADS-B	ADS-C	SMR	A-SMGCS	PAR	Remarks
1	2	3	4	5	6	7	8	9	10	11	12
	Sanya ACC										
Sanya-2	Sanya TWR,APP,ACC			MI(A/C)	250						
Haikou	Haikou TWR Haikou ACC	I	60	MI(A/C)	200						
Changsha	Changsha TWR Changsha ACC	I	60	MI(A/C)	200						
Changsha-2	Changsha TWR, ACC			MI(A/C)	200						
Enshi	Enshi TWR Wuhan ACC			MI(A/C)	200						
Wuhan	Wuhan TWR Wuhan ACC	I	60	MI(A/C)	200						
Wuhan-2	Wuhan TWR , ACC			MI(A/C)	200						
Zhengzhou-1	Zhengzhou TWR Zhengzhou ACC	I	60	I(A/C)	200						
Zhengzhou-2	Zhengzhou TWR Zhengzhou ACC	I	60	MI(A/C)	200						
Zhoukou	Zhengzhou ACC			MI(A/C)	200						
Guilin -1	Guilin TWR Guilin ACC			I(A/C)	200						
Guilin - 2	Guilin TWR Guilin ACC	I	60	MI(A/C)	200						
Nanning	Nanning TWR Nanning ACC			MI(A/C)	200						
Zhanjiang	Zhanjiang TWR Zhanjiang ACC			I (A/C)	200						
Shantou	Shantou TWR Shantou ACC	I	60	MI(A/C)	200						
Jieyang	Shantou TWR Shantou ACC			MI(A/C)	200						

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Country/Location	ATS Units Served	PSR	Coverage of PSR (NM)	SSR(A/C/S)	Coverage of SSR/ADS-B (NM)	ADS-B	ADS-C	SMR	A-SMGCS	PAR	Remarks
1	2	3	4	5	6	7	8	9	10	11	12
Kunming	Kunming TWR Kunming ACC	I	60	I(A/C)	200		I				
Chengdu	Chengdu TWR Chengdu ACC	I	60	I(A/C)	200		I				
Guiyang - 1	Guiyang TWR Guiyang ACC			I(A/C)	200						
Guiyang - 2	Guiyang TWR Guiyang ACC	I	60	MI(A/C)	200						
Chongqing	Chongqing TWR Chongqing ACC	I	60	MI(A/C)	200						
Shanghai-1	Shanghai TWR Shanghai APP Shanghai ACC	I	60	MI(A/C)	200						
Shanghai-2	Shanghai TWR Shanghai APP Shanghai ACC	I	60	I(A/C)	200						
Jinan	Jinan TWR, ACC			MI(A/C)	200						
Jinan-2	Jinan TWR, ACC			MI(A/C)	200						
Qingdao	Qingdao TWR Qingdao ACC			MI(A/C)	200						
Hefei	Hefei TWR Hefei ACC	I	60	MI(A/C)	200						
Nanjing	Nanjing TWR Nanjing ACC	I	60	MI(A/C)	200						
Lianyungang	Lianyungang TWR Lianyungang ACC			MI(A/C)	200						
Xuzhou	Xuzhou TWR			MI(A/C)	200						
Hangzhou	Hangzhou TWR Hangzhou ACC	I	60	MI(A/C)	200						
Nanchang	Nanchang TWR Nanchang ACC	I	60	I(A/C)	200						

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1	2	3	4	5	6	7	8	9	10	11	12
Nanchang-2	Nanchang TWR, ACC			I(A/C)	200						
Ganzhou	Nanchang ACC			MI(A/C)	200						
Shangrao	Nanchang ACC			MI(A/C)	200						
Fuzhou	Fuzhou TWR Fuzhou ACC	I	60	MI(A/C)	200						
Wenzhou	Wenzou TWR			MI(A/C)	200						
Xiamen	Xiamen TWR Xiamen ACC	I	60	MI(A/C)	200						
Xiamen	Xiamen TWR, ACC			MI(A/C)	200						
Shenyang	Shenyang TWR Shenyang ACC	I	60	MI(A/C)	200						
Shenyang-2	Shenyang TWR Shenyang ACC	I	60	MI(A/C)	200						
Dalian	Dalian TWR Dalian ACC	I	60	I(A/C)	200						
Dalian-2	Dalian TWR, ACC			MI(A/C)	200						
Harbin	Harbin TWR Harbin ACC	I	60	MI(A/C)	200						
Xi'an	Xi'an TWR Xi'an ACC	F<2000	60	I(A/C)	200						
Lanzhou	Lanzhou TWR Lanzhou ACC			MI(A/C)	200		I				
Urumqi	Urumqi TWR Urumqi ACC	I	60	MI(A/C)	200		I				
HONG KONG, CHINA											
Beacon Hill	Hong Kong ACC Hong Kong APP Hong Kong TWR			MI(A/C)	250	F<2008					
Mount Parker	Hong Kong ACC Hong Kong APP	I	200	MI(A/C)	250						

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Country/Location	ATS Units Served	PSR	Coverage of PSR (NM)	SSR(A/C/S)	Coverage of SSR/ADS-B (NM)	ADS-B	ADS-C	SMR	A-SMGCS	PAR	Remarks
1	2	3	4	5	6	7	8	9	10	11	12
	Hong Kong TWR										
Tai Mo Shan	Hong Kong ACC Hong Kong APP Hong Kong TWR	I	140	MI(A/C)	250						
Sha Chau	Hong Kong APP Hong Kong TWR	I	80	MI(A/C)	250						
Hong Kong Int'l Airport	Hong Kong APP Hong Kong ACC Hong Kong TWR					F<2008		I	I		PRM I in 2000
MACAO, CHINA Macao	Macao TWR			MI(A/C)	200			F<2010			
COOK ISLANDS											
DPR KOREA **Pyongyang**	Pyongyang ACC Pyongyang APP Pyongyang TWR	I	60	MI(A/C) MI(A/C)	200 200					I	
FIJI											
	Naid ACC Nadi APP					F<2010 F<2010	I				
FRENCH POLYNESIA	Tahiti ACC Tahiti APP			N<2008(A/C) N<2008(A/C)	250	TBD	I				
INDIA											
Ahmadabad		I	60	MI	256						
Trivandrum		I	60	MI	256						
Hyderabad		I	60	MI	256						
Guwahati		I	60	MI	256						
Kolkata		I	60	MI	256		I				
Chennai		I	60	MI	256		I				
Delhi		I	60/220	MI	256		I				RSR=220NM

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Country/Location	ATS Units Served	PSR	Coverage of PSR (NM)	SSR(A/C/S)	Coverage of SSR/ADS-B (NM)	ADS-B	ADS-C	SMR	A-SMGCS	PAR	Remarks
1	2	3	4	5	6	7	8	9	10	11	12
Mumbai		I	60/220	MI	256		I	F			"
Mangalore				MI	256						
Berhampur				MI	256						
Varanasi				MI	256						
Nagpur				MI	256						
INDONESIA											
Banda Aceh	Medan ACC			I(A/C)	240	I 2008					
	Jakarta ACC			MI (A/C)	240						
Medan	Medan APP	I	90	~~MI(A/C)~~	~~240~~	I <2008					
	~~Medan ACC~~										
	Jakarta ACC			MI(A/C)	240						Pre-operation, ADS-B not integrated to ATC system
Natuna	Jakarta ACC			I(A/C)	240						
Tanjung Pinang	Tanjung Pinang APP	~~I~~	~~90~~	I(A/C)	240	I<2008					
	Jakarta ACC	I	90								
Pontianak	Pontianak APP	~~I~~	~~90~~	~~I(A/C)~~	~~240~~	I<2008					
	Jakarta ACC	I	90	I(A/C)	240						
Pekanbaru	Pekanbaru APP	~~I~~	~~90~~								
	Medan ACC	I	90	I(A/C)	240	I<2008					
	Jakarta ACC										
Palembang	Palembang APP	I	90	MI(A/C)	240	I 2008					
	Jakarta ACC			~~MI(A/C)~~	~~240~~						
Jakarta/Cengkareng	Jakarta APP	I	90	I(A/C)	240	I 2008			F 2010		ADS-C Trial
	Jakarta ACC			MI(A/C)	240						
	Jakarta FIR					F<2007	X				ADS-B Trial
Jakarta/Halim	Jakarta ACC			~~I(A/C)~~	~~240~~	F<2007					
Semarang	Ujung Pandang ACC			I(A/C)	240	I<2009					
	Jarkata ACC										
Banjarmasin	Banjarmasin APP			MI (A/C)	240	I<2009					

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1	2	3	4	5	6	7	8	9	10	11	12
	Ujung Pandang ACC			~~I(A/C)~~	~~240~~						
Balikpapan	Balikpapan APP	I	90	MI(A/C)	240	I<2009					
	Ujung Pandang ACC			~~MI(A/C)~~	~~240~~						
Yogyakarta	Yogyakarta APP	I	90								
	Ujung Pandang ACC			MI(A/C)	240						
	Jakarta ACC										
Surabaya	Surabaya APP	I	90								
	Ujung Pandang ACC			MI(A/C)	240	I<2009			F 2011		
	Jakarta ACC										
Bali	Bali APP	~~I~~	~~90~~	~~MI(A/C)~~	~~240~~	I<2009			F 2011		
	Ujung Pandang ACC	I	90	MI(A/C)	240						
Waingapu	Ujung Pandang ACC			I(A/C)	240	I<2008					
Ujung Pandang	Ujung Pandang APP	I	90	I(A/C)	240	I<2008			F 2011		ADS-C Trial
	Ujung Pandang ACC			I(A/C)	240						
	Ujung Pandang FIR					F<2007	X				ADS-B Trial
Manado	Ujung Pandang ACC			I(A/C)	240	I<2010					
Ambon	Ujung Pandang ACC			I(A/C)	240	I<2008					
Kendari	Ujung Pandang ACC			I(A/C)	240	I<2010					
Biak	Biak APP			I(A/C)	~~200~~	I<2010					
	Ujung Pandang ACC				240						
Jayapura	~~Jayapura~~ APP	~~F<~~2009		~~F<2009~~	~~F(S)<2009~~ 240						
	~~Jayapura~~ ACC										
Kupang	~~Kupang~~ APP	~~F<2009~~		~~F<2009~~	~~F(S)<2009~~	I<2010					
	~~kupang~~ ACC										
~~Toli-Toli~~	~~Toli-Toli ACC~~			~~F<2009~~	~~F(S)<2009~~						
Tarakan	~~Tarakan~~ ACC	F<2010		~~F<2009~~	~~F(S)<2009~~	I<2009					
Batam	~~Batam~~ APP			~~F<2009~~	F(S)<2009	I<2009					
	~~Batam~~ ACC				F(S)<2009						
Sorong	~~Sorong~~ ACC			~~F<2009~~	F(S)<2009	I<2008					

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1	2	3	4	5	6	7	8	9	10	11	12
JAPAN											
Narita Airport	Narita TWR					F<2009		I			
Haneda Airport	Haneda TWR							I			
Nagoya Airport	Nagoya TWR							I			
Osaka Airport	Osaka TWR							I			
Kansai Airport	Kansai TWR							I			
Naha Airport	Naha TWR							I			
	Naha APP	I	60	I(A/C)	60						
Hakodate Airport	Hakodate APP	I	60	I(A/C)	60						
Sendai Airport	Sendai APP	I	60	I(A/C)	60						
Narita Airport - 1	Narita APP	I	60	I(A/C)	60						
Narita Airport - 2	Narita APP	I	60	I(A/C)	60						
Handeda Airport - 1	Tokyo APP	I	60	I(A/C)	60						
Handeda Airport - 2	Tokyo APP	I	60	I(A/C)	60						
Niigata Airport	Niigata APP	I	60	I(A/C)	60						
Nagoya Airport - 1	Nagoya APP	I	60	I(A/C)	60						
Nagoya Airport - 2	Nagoya APP	I	60	I(A/C)	60						
Chubu Airport - 1	Chubu APP	I	80	I(A/C)	80						
Chubu Airport - 2	Chubu APP	I	80	I(A/C)	80						
Osaka Airport - 1	Osaka APP	I	80	I(A/C)	80						
Osaka Airport - 2	Osaka APP	I	80	I(A/C)	80						
Kansai Airport - 1	Kansai APP	I	80	I(A/C)	80						
Kansai Airport - 2	Kansai APP	I	80	I(A/C)	80						
Hiroshima Airport	Hiroshima APP	I	60	I(A/C)	60						

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1	2	3	4	5	6	7	8	9	10	11	12
Takamatsu Airport	Takamatsu APP	I	60	I(A/C)	60						
Kouchi Airport	Kouchi APP	I	60	I(A/C)	60						
Fukuoka Airport - 1	Fukuoka APP	I	60	I(A/C)	60						
Fukuoka Airport - 2	Fukuoka APP	I	60	I(A/C)	60						
Nagasaki Airport	Nagasaki APP	I	60	I(A/C)	60						
Oita Airport	Oita APP	I	60	I(A/C)	60						
Kumamoto Airport	Kumamoto APP	I	60	I(A/C)	60						
Miyazaki Airprot	Miyazaki APP	I	60	I(A/C)	60						
Kagoshima Airport - 1	Kagoshima APP	I	60	I(A/C)	60						
Kagoshima Airport - 2	Kagoshima APP	I	60	I(A/C)	60						
Naha Airport	Naha APP	I	60	I(A/C)	60						
Shimojishima Airport	Shimojishima APP	I	60	I(A/C)	60						
Kushiro	Sapporo ACC		200	I(A/C)	200						
Yokotsudake	Sapporo ACC	I	200	MI(A/C)	200						
Hachinohe	Sapporo ACC	I	200	I(A/C)	200						
Jobonzan	Sapporo ACC Tokyo ACC	I	200	I(A/C)	200						
Oginojo	Sapporo ACC Tokyo ACC	I	200	MI(A/C)	250						
Yamada	Tokyo ACC	I	200	I(A/C)	200						
Hakone	Tokyo ACC	I	200	I(A/C)	200						
Mikawa	Tokyo ACC	I	200	I(A/C)	200						
Mikuniyama	Tokyo ACC	I	200	I(A/C)	200						
Hirata	Tokyo ACC	I	200	I(A/C)	200						

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1	2	3	4	5	6	7	8	9	10	11	12
	Fukuoka ACC										
Imanoyama	Tokyo ACC Fukuoka ACC	I	200	I(A/C) MI(A/C)	200 F(250)						
Kaseda	Fukuoka ACC Naha ACC	I	200	I(A/C)	200						
Sangunzan	Fukuoka ACC	I	200	I(A/C)	200						
Amami	Fukuoka ACC Naha ACC	I	200	I(A/C) MI(A/C)	200 F(250)						
Miyakojima	Naha ACC	I	200	I(A/C)	200						
Yaedake	Naha ACC	I	200	I(A/C) MI(A/C)	200 F(250)						
Iwaki	Tokyo ACC			MI(A/C)	250						
Hachijo	Tokyo ACC			MI(A/C)	250						
Fukue	Fukuoka ACC			MI(A/C)	250						
Nihonkai	TBD			MI(A/C)	F(250)						
KIRIBATI											
LAO PDR											
Vientiane	Vientiane APP	I	80								
Vientiane	Vientiane ACC			MI(A/C)	250						
Savannakhet	Vientiane ACC			MI(A/C)	250						
Xieng Kuang	Vientiane ACC			MI(A/C/S)	250	F<2015					
MALAYSIA											
Langkawi	Langkawi APP Kuala Lumpur ACC	I	60	MI (A/C)	200						
Subang	Lumpur APP Kuala Lumpur ACC	I	60	MI (A/C)	200		F<2007				
Genting Highlands	Kuala Lumpur ACC			MI(A/C)	200						

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1	2	3	4	5	6	7	8	9	10	11	12
Kulala Lumpur (KLIA)	Lumpur APP Kuala Lumpur ACC	I	60	MI(A/C)	200			I			
Johor	Johor Bharu APP Kuala Lumpur ACC	I	60	MI (S)	200						
Kota Bharu	Kota Bharu APP Kuala Lumpur ACC	I I	60 60	MI (S)	200						
Kota Kinabalu	K. Kinabalu APP K. Kinabalu ACC	I	60	MI(A/C)	200						
Kuching	Kuching APP K. Kinabalu ACC	I	60	MI(A/C)	200						
Miri	Miri APP K. Kinabalu ACC Kuching ACC	I	60	MI (A/C)	200						
MALDIVES											
MARSHALL ISLANDS											
MICRONESIA (FEDERATED STATE OF)											
MONGOLIA	Ulaanbaatar ACC Ulaanbaatar APP					<2008 <2008	I I				
MYANMAR Yangon	Yangon APP Yangon ACC			MI(A/C)	200						
Mandalay	Mandalay APP	I	60	MI(A/C)	200						
NAURU											
NEPAL Kathmandu	Kathmandu APP	I	60	I (A/C)	200						
NEW CALEDONIA											

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1	2	3	4	5	6	7	8	9	10	11	12
	Tontouta ACC Tontouta APP					TBD TBD					
NEW ZEALAND											
Auckland	Chrischurch ACC	I	80								
Auckland OCA	Auckland ACC						I				
Auckland TWR	Auckland TWR							F<2009			
Ballance	Chrischurch ACC			I	250						
Cass Peak	Chrischurch ACC			I/A/C/S	250						
Chrischurch	Chrischurch ACC	I	80								MDS Trial 2-8/06
Hawkins Hill	Chrischurch ACC	I	80	I	250						
Mount Robertson	Chrischurch ACC			I	250						
Queenstown	Chrischurch ACC Queenstown TWR										Wide Area MDS planned for Queenstown in 2007
Ruao Tewhenua	Auckland ACC Chrischurch ACC			I	250						
Teweraiti	Chrischurch ACC			I	250						
PAKISTAN											
Karachi Airport	Karachi ACC Karachi APP Karachi TWR	I	98	MI(A/C)	200						
Pasni	Karachi ACC			MI(A/C)	200						
Lak Pass	Karachi ACC Lahore ACC			MI(A/C)	200						
Rojhan	Karachi ACC Lahore ACC			MI(A/C)	200						
Lahore Airport	Lahore ACC Lahore APP	I	98	MI(A/C)	200						

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1	2	3	4	5	6	7	8	9	10	11	12
	Lahore TWR										
Islamabad Airport	Lahore ACC Islamabad APP Islamabad TWR	I	98	MI(A/C)	200						
PAPUA NEW GUINEA											
Jacksons airport	Jacksons APP Moresby ACC	I	60	I(A/C)	200						
PHILIPPINES											
Manila	Manila APP	I F<2012	60	I(A/C) M(A/C/S) F<2012	90						
Tagaytay	Manila ACC	~~X~~	~~250~~	MI(A/C/S)	250						
Clark	Clark APP	I	70	MI(A/C)	70						
Mactan	Mactan APP	I F<2012	70	I(A/C)	70						
Kalibo	Kalibo/Caticlan APP	F<2012		M(A/C/S) F<2012							
Bacolod	Bacolod APP	F<2012		M(A/C/S) F<2012							
Davao	Davao APP	F<2012		M(A/C/S) F<2012							
Subic ~~Bay~~	Subic APP	I	70	I(A/C)	70						
Laoag	Manila ACC Manila ATM Center			MI(A/C) M(A/C/S) F<2012	250 250						
Aparri	Manila ATM Center			M(A/C/S) F<2012							
Mount Majic	Manila ACC Manila ATM Center			MI(A/C) M(A/C/S) F<2012	250						
Palawan RCAG	Manila ATM Center			M(A/C/S) F<2012							

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1	2	3	4	5	6	7	8	9	10	11	12
Zamboanga	Manila ATM Center			M(A/C/S) F<2012							
Manila ATM Center	Manila ATM Center					F<2012					
Puerto Princesa	Manila ATM Center					F<2012					
REPUBLIC OF KOREA											
Jeju	Jeju TWR							I			
	Jeju APP	I	60	I(A/C)	200						
Cheongju	CheongjuTWR										
Incheon-1	Incheon TWR					F<2008		I	I		
	Seoul APP, ACC	I	60	MI(A/C)	200						
Incheon-2	Incheon TWR										
	Seoul APP, ACC	I	60	MI(A/C)	200						
Yangyang	Yangyang TWR										
Gimhae	Gimhae TWR							I			
	Gimhae APP	I	60	I(A/C)	200						
Daegu	Daegu APP	I	60	MI(A/C)	200						
Cheongju	Jungwon APP	I	60	MI(A/C)	200						
Gimpo	Gimpo TWR							I	F<2006		
	Gimpo APP, ACC	I	60	MI(A/C)	200			I			
SINGAPORE											
Singapore	Singapore ACC	I	220	MI(A/C)	250	F<2010	I				
	Singapore APP	I	70	MI(A/C)	200						
	Singapore TWR					F<2010		I			
	Singapore APP	I	70	MI(A/C)	200						
SOLOMON ISLANDS											
SRI LANKA											
Bandaranaike Airport	Colombo APP	I	90								
Mount Piduruthalagala	Colombo ACC			MI(A/C)	200	F<2010	I				ADS-C trial

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1	2	3	4	5	6	7	8	9	10	11	12
THAILAND											
Bangkok	Bangkok APP Bangkok ACC Bangkok TWR	I	80	~~I(A/C)~~ MI(A/C)	~~250~~ 250	F<2010					
Bangkok/ Suvarnabhumi AP	Bangkok APP Bangkok ACC Bangkok/SVB TWR	I	80	MI(A/C/S)	250			I	I		A-SMGCSLevel2
Chiang Mai	Chiang Mai APP Bangkok ACC	I>2010	60	MI(A/C)>2010 F(A/C/S)<2010	250 250						
Ubon Rachathani	Bangkok ACC			MI(A/C)>2009 F(A/C/S)<2009	250 250						
Surat Thani	Bangkok ACC Hat Yai APP Phuket APP			MI(A/C)>2009 F(A/C/S)<2009	250 250						
Hat Yai	Hat Yai APP Bangkok ACC	I>2010	60	F(A/C/S)<2010	250						
Phuket	Phuket APP	I>2009	60	F(A/C/S)<2009	250						
~~Bangkok~~	~~Bangkok TWR~~										
Phitsanulok	Phitsanulok APP	I	60								
Hua Hin	Hua Hin APP	I	60								
U Taphao (Military Installation)	U Taphao			I(A/C)	200						
TONGA						F<2010					
UNITED STATES											
Alaska	ACC					2003	I<2006				
Hilo, Hawaii	ACC APP TWR	I	60	I(A/C)	200						
Honolulu, Hawaii	ACC APP TWR	I	60	I(S)							

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1	2	3	4	5	6	7	8	9	10	11	12
Kahului, Hawaii	APP TWR	I	60	I(A/C)							
Kokee, Hawaii	ACC	I	200								
Lihue, Hawaii	APP TWR	I	60	I(A/C)							
Mount Kaala, Hawaii	ACC	I	200	I(A/C)							
Pahoa, Hawaii	ACC			I(A/C)							
Kunianiau, Hawaii	ACC			I(A/C)							
Guam	ACC	I	200	I(A/C)							
Mount Santa Rosa, Guam	APP TWR	I	60	I(A/C)							
Mount Santa Rosa, Guam	ACC	I									
Kona, Hawaii	ACC			F(A/C)	200						
Mount Kaala, Hawaii	ACC	F	250								
Mount Santa Rosa, Guam	ACC	F<2000	250	F(S)<2000	250						
VANUATU											
VIET NAM											
Hanoi/Noibai	Hanoi ACC ~~Hanoi ACC~~ Noibai APP Noibai TWR	I	80	MI(A/C) MI (A/C)	200 250	F<2013		F<2011	F<2011		
Danang/Sontra	Ho Chi Minh ACC Danang APP ~~Ho Chi Minh~~ Honoi ACC	I I	80 80	MI (A/C)	250		~~F<2006~~				
Qui Nhon	Ho Chi Minh ACC Danang APP Hanoi ACC			MI (A/C)	250						
Ca Mau	Ho Chi Minh ACC			MI (A/C)	250						
Nghe An/Vinh	Hanoi ACC			MI (A/C)	250						

Appendix E to the Report

TABLE CNS 4 - SURVEILLANCE SYSTEMS

Country/Location	ATS Units Served	PSR	Coverage of PSR (NM)	SSR(A/C/S)	Coverage of SSR/ADS-B (NM)	ADS-B	ADS-C	SMR	A-SMGCS	PAR	Remarks
1	2	3	4	5	6	7	8	9	10	11	12
Tansan Nhat	Tansan Nhat APP Ho Chi Minh ACC Tansan Nhat TWR	I F	80	MI (A/C)	250	F<2011	I (2006)	 F<2012	 F<2012		 F<2010

Table CNS 4B

ATS AUTOMATION SYSTEMS

EXPLANATION OF THE TABLE

Column

1 Name of State/Territory and location of ATS automation systems within the State

2 Air traffic services unit served by the ATS automation systems

AACC — Area approach control centre
ACC — Area control
APP — Approach control
EC — En-route centre
FIS — Flight information service
SMC — Surface movement control
TCU — Terminal control unit
TMA — Terminal control area
TWR — Tower control

3 Surveillance sensor linked to the ATS automation systems. Four-letter FIR identifier, enclosed in parenthesis, shown for surveillance sensors outside the FIR.

4 Radar data processing system

5 Flight data processing system

6 Minimum safe altitude warning system

7 Automatic dependent surveillance

ADS B — Automatic dependent surveillance broadcast
ADS C — Automatic dependent surveillance contract

8 Controller-pilot data link communications

9 ATS interfacility data link communications

10 Processing area of the radar data processing system in nautical miles

11 Number of ATS positions

12 Remarks

Note.— The following codes are used in columns 4 to 11:

I —Required and implemented

X — Required but implementation status not determined

N — Required but not implemented

A — Existing facility provided to supplement or substitute the requirement

F — Future plan
< Year — Planned commissioning year, to be used as appropriate in conjunction with “F” and “N”
> Year — Planned decommissioning year, to be used as appropriate in conjunction with “A” and “I

State/Territory Location	ATS unit served	Data source	RDP	FDP	MSAW	ADS	CPDLC	AIDC	Processing area (NM)	Operator positions	Remarks
1	2	3	4	5	6	7	8	9	10	11	12
AUSTRALIA											
~~Adelaide~~	~~AACCTCU TWR~~	~~Adelaide PSR/SSR Summertown SSR~~	~~2>1998~~						~~Maximum~~	~~12 5~~	
Adelaide	TCU TWR	Adelaide PSR/SSR Summertown SSR	~~2<1998~~ I	~~<1998~~ I	I	**	**	F<2011	Maximum 2600x3000	5	** Available – not used
~~Brisbane~~	~~AACC TWR~~	~~Brisbane PSR/SSR Darwin SSR Tindal SSR Mt. Alma SSR Mt Boyce SSR Mt. Hardgrave SSR Mt. Somerville SSR Oakey SSR Sydney PSR/SSR Tabletop Mt. SSR The Round Mountain SSR~~	~~2>1998~~						~~4x512x512~~	~~22~~	
Brisbane	~~ACC~~ EC	Brisbane PSR/SSR Darwin SSR Tindal SSR Mt. Alma SSR Mt. Boyce SSR Mt. Hardgrave SSR Mt. Somerville SSR Oakey SSR Sydney PSR/SSR Tabletop Mt. SSR The Round Mountain SSR	I	I	I	~~2<1998~~	~~2<1998~~	~~2<1998~~	Maximum 2600x3000 2600x3000	47	
Brisbane	Brisbane and Coolangatta TMAs TWR	Brisbane PSR/SSR Mt. Boyce SSR Mt. Hardgrave SSR Mt. Somerville SSR Oakey SSR	~~2<1998~~ I	~~I~~ I	I	**	**	F<2011	Maximum 2600x3000	8	
~~Cairns~~	~~AACC TWR~~	~~Hanns Tableland SSR Redden Creek PSR/SSR~~	~~2>1998~~						~~1024x1024~~		
Cairns	TCU TWR	Hanns Tableland SSR Redden Creek PSR/SSR	~~2<1998~~ I	~~<1998~~ I	I	**	**	F<2011	Maximum 2600x3000	~~4~~ 5	
~~Coolangatta~~	~~AACC TWR~~	~~Redden Creek PSR/SSR~~	~~2>1998~~						~~1024x1024~~	6	
~~Melbourne~~	~~Melbourne and Canberra AACC TWRs~~	~~Brisbane PSR/SSR Darwin SSR Tindal SSR Mt. Alma SSR Mt Boyce SSR Mt. Hardgrave SSR Mt. Somerville SSR Oakey SSR Sydney PSR/SSR Tabletop Mt. SSR~~	~~2>1998~~						~~1024x1024~~	24	

State/Territory Location	ATS unit served	Data source	RDP	FDP	MSAW	ADS	CPDLC	AIDC	Processing area (NM)	Operator positions	Remarks
1	2	3	4	5	6	7	8	9	10	11	12
		~~The Round Mountain SSR~~									
Melbourne	~~ACC~~ EC	Brisbane PSR/SSR Darwin SSR Tindal SSR Mt. Alma SSR Mt Boyce SSR Mt. Hardgrave SSR Mt. Somerville SSR Oakey SSR Sydney PSR/SSR Tabletop Mt. SSR The Round Mountain SSR	I	I	I	~~2<1998~~	~~2<1998~~	~~2<1998~~	Maximum 2600x3000	45	
Melbourne	Melbourne and Canberra TMAs TWRs	Gellibrand Hill PSR/SSR Adelaide SSR East Sale SSR Mt. Bobbara SSR Mt. Boyce SSR Mt. Macedon SSR Mt Majura SSR Sydney SSR Summer town SSR	~~2<1998~~ I	I	I	**	**	F<2011	Maximum 2600x3000	10	
~~Perth~~	~~AACC TWR~~	~~Perth PSR/SSR~~ ~~Kalmunda SSR~~	~~2>1999~~						~~1024x1024~~	~~13~~	
Perth	TCU TWR	Perth PSR/SSR Kalmunda SSR	~~2<1999~~ I	I	I	**	**	F<2011	Maximum 2600x3000	~~6~~ I	
~~Sydney~~	~~AACC TWR~~	~~Sydney PSR/SSR~~ ~~Mt. Boyce SSR~~ ~~Mt. Bobbara~~	~~2>1999~~						~~512x512~~	~~13~~	
Sydney	TCU TWR	Sydney PSR/SSR Mt. Boyce SSR Mt. Bobbara	~~2<1999~~ I	~~<1999~~ I	I	**	**	F<2011	Maximum 2600x3000	6	
Sydney	TWR	Sydney surface movement radar	~~2~~ I						Aerodrome precincts	5	
Sydney	TCU	Parallel approach runway monitor	I						Sydney 34L & R and 16L & R approaches	2	
BANGLADESH											
BHUTAN											
BRUNEI DARUSSALAM											
Berakas			<1997	<1997					512x512		
Brunei	APP		2						150x150		
CAMBODIA											

State/Territory Location	ATS unit served	Data source	RDP	FDP	MSAW	ADS	CPDLC	AIDC	Processing area (NM)	Operator positions	Remarks
1	2	3	4	5	6	7	8	9	10	11	12
CHINA											
Beijing	APP ACC		2						~~Radius 200~~ 1024x1024		
Changchun	APP		2						1024x1024		
Changsha	APP		2						1024x1024		
Chengdu	APP ACC		2						~~Radius 200~~ 1024x1024		
Chongqing	APP ACC		2						1024x1024		
Dalian	APP ACC		2						~~Radius 200~~ 1024x1024		
Fuzhou	APP ACC		2						1024x1024		
Guangzhou	APP ACC		2						~~Radius 200~~ 1024x1024		
Guilin	APP ACC		2						1024x1024		
Guiyang	APP ACC		2						~~Radius 200~~ 1024x1024		
Haikou	APP		2						1024x1024		
Hangzhou	APP ACC		2						1024x1024		
Harbin	APP ACC		2						512x512		
Hefei	APP ACC		2						1024x1024		
Hohhot	APP ACC		2						1024x1024		
Jinan	APP ACC		2						1024x1024		
Kunming	APP ACC		2						~~Radius 200~~ 1024x1024		
Lanzhou	APP ACC		2						1024x1024		
Lianyungang	APP		2						512x512		
Nanchang	APP ACC		2						~~Radius 200~~ 1024x1024		
Nanjing	APP ACC		2						512x512		
Qingdao	APP ACC		2						1024x1024		

State/Territory Location	ATS unit served	Data source	RDP	FDP	MSAW	ADS	CPDLC	AIDC	Processing area (NM)	Operator positions	Remarks
1	2	3	4	5	6	7	8	9	10	11	12
Sanya	APP ACC		2						512x512		
Shanghai	APP ACC		2						~~Radius 200~~ 1024x1024		
Shantou	APP ACC		2						1024x1024		
Shenzhen	Shenzen APP ACC Guangzhou APP ACC		2						~~Radius 200~~ 1024x1024		
Shenyang	APP ACC		2						1024x1024		
Shijiazhuang	APP		2						1024x1024		
Tianjin	APP		2						1024x1024		
Taiyuan	APP ACC		2						1024x1024		
Urumqi	APP ACC		2						1024x1024		
Wenzhou	APP ACC		2						512x512		
Wuhan	APP ACC		2						~~Radius 200~~ 1024x1024		
Xi'an	APP ACC		2						~~Radius 200~~ 1024x1024		
Xiamen	APP ACC		2						1024x1024		
Zhanjiang	APP		2						1024x1024		
Zhengzhou	APP ACC		2						~~Radius 200~~ 1024x1024		
Zhuhai	APP		2						1024x1024		
COOK IS.											
DEMOCRATIC PEOPLE'S REPUBLIC OF KOREA											
	APP ACC		1						Radius 200	6	
FIJI											
Nadi	ACC			I		ADSC-I ADSB-F<2010	I	I	250		

State/Territory Location	ATS unit served	Data source	RDP	FDP	MSAW	ADS	CPDLC	AIDC	Processing area (NM)	Operator positions	Remarks
1	2	3	4	5	6	7	8	9	10	11	12
FRENCH POLYNESIA (France)											
Tahiti	TWR APP ACC			2							
Tahiti	ACC					ADS-C <1998					
GUAM (United States)											
Anderson	ACC		2						200x200		
HONG KONG, China											
Hong Kong	APP ACC TWR		2	2	2000				250x250		
Hong Kong	ACC					ADS-C <TBA					
INDIA											
Chennai				2		I	I				
Delhi					I						
Kolkata						I	I				
Mumbai					I						
INDONESIA											
Bali	Bali ACC APP	N<2003	2						1024x1024	4	
Jakarta	Jakarta ACC APP Soekamo-Hatta TWR Jakarta FIC	1	2	2	1	1	1	N<2002	2048x2048	40	SSR (Banda Aceh/ Medan/Pekanbaru/ Tanjung Pinang/ Benjarmasin/ Yogyakarta/ Surabaya) Cengkareng MSSR will be connected to RDP F<2000
Medan	Medan ACC	F<2003	2								
Ujung Pandang	Ujung Pandang ACC APP	N<2003	2					N<2003	4036x4036	20	SSR(Balikpupen, Banjanhasin, Maiden, Surabaya, Bali, Waingapu, Kendar, Biak)
JAPAN											
Chubu	APP		2	2					70x70		
Fukuoka	APP		2	2					70x70		
Fukuoka	ACC		2	2					500x800		

State/Territory Location	ATS unit served	Data source	RDP	FDP	MSAW	ADS	CPDLC	AIDC	Processing area (NM)	Operator positions	Remarks
1	2	3	4	5	6	7	8	9	10	11	12
Haneda	Tokyo APP		2	2					70x70		
Narita	APP		2	2					70x70		
Okinawa	Naha APP		2	2					360x700		
Osaka	APP		2	2					80x80		
Sapporo	ACC		2	2					500x700		
Tokyo	ACC		2	2					500x875		
KIRIBATI											
LAO PEOPLE'S DEMOCRATIC REPUBLIC											
MACAO, China											
Colanne	Macao TWR		2	~~2<1997~~ 2<2010					500x500	3	
MALAYSIA											
Kinabalu	ACC APP TWR		I	I	I				20 000x20 000	3	
Kuching	APP ACC TWR		I	I	I				20 000x20 000	3	
Langkawi	APP		I	I	I				20 000x20 000	1	
Subang	Kuala Lumpur ACC APP TWR		I	I	I	F<2002	F<2002		20 000x20 000	11	
MALDIVES											
MARSHALL IS.											
MICRONESIA (FEDERATED STATES OF)											
MONGOLIA											
MYANMAR											
Yangon	APP ACC		2<1997						440x440		

State/Territory Location	ATS unit served	Data source	RDP	FDP	MSAW	ADS	CPDLC	AIDC	Processing area (NM)	Operator positions	Remarks
1	2	3	4	5	6	7	8	9	10	11	12
NAURU											
NEPAL											
Kathmandu	APP		2<1997			ADS-C <2000					
NEW ZEALAND											
Auckland	Auckland ACC TWR		I	I	<2003	ADS-C I	I	I	5500x2500		
Christchurch	Christchurch ACC TWR Wellington TWR		I	I	<2003				1024x1024		
PAPUA NEW GUINEA											
Port Moresby	ACC		2	2<1999		ADS-C <2000			200 Radius		
PHILIPPINES											
Laoag	Manila ACC		2	2		ADS-C <TBA			1024x1024		
Mactan	APP		2			ADS-C <TBA			200x200		
Manila	APP		2			ADS-C <TBA			200x200		
Mt. Majic	Manila ACC		2			ADS-C <TBA			1024x1024		
Subic	APP		2			ADS-C <TBA			200x200		
Tagaytay	Manila APP		2			ADS-C <TBA			1024x1024		
REPUBLIC OF KOREA											
Daegu or Incheon	ACC	8 PSRs/SSRs	3 <2001	3 <2001					Radius 200	6	
Gimhae	APP		2	2	1 (low altitude alert)				60x60	3	
Incheon	APP	2 PSRs/SSRs in Incheon 1 PSR/SSR in Gimpo	2	2	1				60x60	8	
Jeju	APP	PSR/SSR	2	2	1 (low altitude alert)				60x60	3	
SINGAPORE											
Singapore	~~ACC~~ AACC		1	1	1	1	1	<2010	1024x1024		

State/Territory Location	ATS unit served	Data source	RDP	FDP	MSAW	ADS	CPDLC	AIDC	Processing area (NM)	Operator positions	Remarks
1	2	3	4	5	6	7	8	9	10	11	12
	~~APP~~ AACC TWR										
SOLOMON IS.											
SRI LANKA											
Colombo	ACC		2	2<TBA		ADS-C & B TBA			200 Radius		
THAILAND											
Bangkok	APP ACC		2	2		ADS-B <1996			1024x1024		
Chiang Mai	Chang Mai APP Bangkok ACC		2						1024x1024		
Phuket	APP		2						1024x1024		
Hatyai	APP		2						1024x1024		
TONGA											
UNITED STATES											
Hilo	APP TWR		2						60x60		
Honolulu	ACC		2	2					500x500		
Honolulu	APP TWR		2						60x60		
VANUATU											
VIET NAM											
Ho Chi Minh	ACC		2	2	2	2	2		1024x1024	16	
Hanoi	ACC		2	2	2				1024x1024	8	

PROPOSED MODIFICATION TO GUIDELINES FOR THE DEVELOPMENT OF ADS-B IMPLEMENTATION PLAN

That, States be advised to use the following guidelines for the development of ADS-B implementation plan.

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

b) give priority to provide ADS-B coverage over major traffic flows and *those airspaces currently not covered by radar. ADS-B should have overlapping area with existing radar coverage.*

c) provide ADS-B coverage in areas within 150 NM 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.

f) Integrate ADS-B data with the ATM automation system wherever possible taking advantage of synergies with other means of surveillance (such as radar, ADS-C, flight plan tracks) ;

g) Mandate ADS-B OUT equipage on the aircraft operating in the airspaces, at the flight levels or area where currently no radar surveillance is available and where ADS-B based services are offered (served with ADS-B ground stations).

h) Expand the "mandate" to aircraft operating in other airspace when the ANSP is able to provide ADS-B based services in the airspace.

i) ADS-B Implementation is more effective when it is implemented regionally both on the ground and on the aircraft.

j) When considering the benefits of ADS-B Implementation, it is necessary to consider the total benefits to all stakeholders (airline operators, passengers, efficiency of the ATM network, and society etc) and not only the benefit derived for airlines operators and air navigation services providers.

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DGCA INDONESIA'S AND CAAS' EXPERIENCE IN ADOPTING THE SAMPLE AGREEMENT FOR ADS-B DATA SHARING

Proposed new template	Existing template
Article 1 – Definitions This is a new section to define the various terms used in the agreement.	Not in existing template.
Article 2 – Objective of the Parties We propose to split up the original article into two separate articles with one stating the objective and the other stating the provision. We also include the provision of VHF voice communication services (VHF services) as part of the objective.	**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 The ADS-B data to be provided are specified in Annex B, H and I.
Article 3 – Provision of ADS-B Data and Other Necessary Services We would amend the clause to include the provision of VHF services.	
Article 4 – Limitations on Use and Communication of ADS-B Data In the original template, either party is only allowed to use the information for civil Air Traffic Services only. We propose to add a provision stating that any other usage is subjected to the provider's approval.	**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.

Proposed new template	Existing template
Article 5 – Installation of Required Equipment and Private Circuits We propose amending the template to list down the equipment that is required instead relying on the term 'required equipment'. This also allows a party to install equipment at the other party's premises, if required. We also propose that the parties be responsible for getting the equipment to work, rather than just to 'arrange'.	**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 be carried out in conjunction with the Provider and the User. 4 The provision of the present article shall also apply in the event of modifications to the equipment or private circuits.
Article 6 – Maintenance The old template states that maintenance of the equipment will be done by the available staff at the respective premises where the equipment is installed. We propose to remove the term 'available staff'. The Providers and the Users will employ more staff if deemed necessary to maintain the equipment to the required standards. The amended clauses will allow the Providers to charge a fee to the users for the maintenance services provided by him.	**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.

Proposed new template	Existing template
Article 7 – Modifications We include VHF and other services as part of the possible proposed changes by the Users. The amended clauses will address the costs of modification to be born by each party.	**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 8 – Cost We include VHF as part of the article.	**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.
Article 9 – Continuity of Provision of ADS-B Data and DCPC Services Instead of just maintaining to the standard that is normally applied to other equipment, we include the desired performance standards such as those of the tier 1 services, so that there is no misunderstanding between the parties.	**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 new template	Existing template
Article 10 – Liability This would be agreed among the parties of the agreement.	**Article 8 – Liability** [The requirements on this Article should be agreed bilaterally between States]
Article 11 – Force Majeure This is to state the expectations of the parties in case of a force majeure. This would be agreed among the parties of the agreement.	**Article 9 – Legal Aspect / Settlement of Dispute** [The requirements on this Article should be agreed bilaterally between States]
Article 12 – Settlement of Dispute This is to state the manners in which disputes are to be settled. This would be agreed among the parties of the agreement.	
Article 13 – Correspondence Not much foreseen changes, except that more forms of correspondence may be included.	**Article 10 – Correspondence** 1 Correspondence to be applied in the framework of this Agreement is specified in Annex E.

Proposed new template	Existing template
Article 14 – Annexes Some editorial changes to make the article clearer. We proposed that Annex F be changed to list the equipment, facilities and services to be provided by each party.	**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. Annex A – Parties Annex B – Interface Specifications Annex C – Maintenance Annex D – Cost Annex E – Correspondence Annex F – Equipment Provided By One Party to the Other Annex G – Implementation Schedule Annex H – Functional Performance Requirement Annex I – Coverage or Ground Station Details
Article 15 – Duration We propose to include a renewal period in the event of automatic renewal. Other changes would mainly be editorial.	**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 new template	Existing template
Article 16 – Final Provision We propose to include an article stating that nothing in the agreement shall prejudice the primary obligation of the parties whether under statute or otherwise, to ensure the safe, proper and continuous provision of civil air traffic services. It will also include other legal clauses agreed among the parties.	**Article 9 – Legal Aspect / Settlement of Dispute** [The requirements on this Article should be agreed bilaterally between States]

Civil Aviation Order 20.18 Amendment (No. 1) 2009

Subsection 9B

9B Directions relating to carriage and use of automatic dependent surveillance – broadcast equipment

9B.1 This subsection applies to aircraft engaged in private, aerial work, charter or regular public transport operations.

9B.2 In this subsection and Appendix XI:

ADS-B means automatic dependent surveillance – broadcast.

ADS-B test flight means a flight to prove ADS-B transmitting equipment that is newly installed on the aircraft undertaking the flight.

aircraft address means a unique combination of 24 bits assigned to an aircraft by CASA or by a relevant RAAO for the purpose of air to ground communications, navigation and surveillance.

approved equipment configuration means an equipment configuration that:

(a) meets the conditions for approval set out in Appendix XI; or

(b) is approved in writing by CASA.

Note Equipment configurations approved by CASA are published in Appendix D of Advisory Circular 21-45.

ATSO means Australian Technical Standard Order of CASA.

EASA means the European Aviation Safety Agency.

ETSO means European Technical Standard Order of the EASA.

FAA means the Federal Aviation Administration of the United States.

FL 290 means flight level 290.

Note Flight level 290 is defined in subregulation 2 (1) of CAR 1988.

RAAO means a recreational aviation administration organisation that is recognised by CASA.

TSO means Technical Standard Order of the FAA.

9B.3 If an aircraft carries ADS-B transmitting equipment for operational use in Australian territory, the equipment must comply with an approved equipment configuration.

9B.4 If an aircraft carries ADS-B transmitting equipment for operational use in Australian territory, the equipment must transmit:

(a) a flight identification that corresponds exactly to the aircraft identification mentioned on the flight notification filed with air traffic control (***ATC***) for the flight; or

(b) if no flight notification is filed for the flight — a flight identification that is:

(i) for an aircraft registered on the Australian Civil Aircraft Register and operating wholly within Australian territory — the aircraft's registration mark; or

(ii) for an Australian aircraft registered by a RAAO — in accordance with the organisation's operations manual; or

(c) another flight identification directed or approved by ATC.

9B.5 If an aircraft carries ADS-B transmitting equipment that complies with an approved equipment configuration, the equipment must be operated continuously during the flight in all airspace at all altitudes unless the pilot is directed or approved otherwise by ATC.

9B.6 If an aircraft carries ADS-B transmitting equipment which does not comply with an approved equipment configuration, the equipment must be deactivated before the aircraft flies in Australian territory.

9B.7 However, the equipment need not be deactivated as mentioned in paragraph 9B.6 if the aircraft is undertaking an ADS-B test flight in VMC in airspace below FL 290.

9B.8 On and after 12 December 2013, if an aircraft operates at or above FL 290, it must carry serviceable ADS-B transmitting equipment that complies with an approved equipment configuration.

Note On and after 12 December 2013, an aircraft must carry and continuously operate compliant ADS-B transmitting equipment in accordance with paragraph 9B.8.

Apart from this, there is no obligation to carry compliant ADS-B transmitting equipment.

However, including the effect of subsection 9B.5 above, if compliant ADS-B transmitting equipment is in fact carried, whether voluntarily or in accordance with the obligation under 9B.8, it must be operated continuously in all airspace, at all altitudes.

9B.9 Paragraph 9B.8 does not apply to an aircraft if the aircraft owner, operator or pilot has written authorisation from CASA for the operation of the aircraft without the equipment.

Appendix XI

Approved equipment configuration — conditions for approval

1 An equipment configuration is approved only if it meets all of the conditions set out in this Appendix.

2 It is a condition of approval that the ADS-B transmitting equipment must be of a type that is:

(a) authorised:

(i) by the FAA in accordance with TSO-C166 as in force on 20 September 2004 or a later version as in force from time to time; or

(ii) by CASA in accordance with ATSO-C1004 as in force on 2 October 2003 or a later version as in force from time to time; or

(iii) by CASA in accordance with ATSO-C1005 as in force on 22 December 2004 or a later version as in force from time to time; or

(b) otherwise authorised by CASA for this purpose.

3 It is a condition of approval that, on and after 28 June 2012, the geographical position transmitted by the ADS-B transmitting equipment must be determined by:

(a) a GNSS receiver of a type that is authorised by the FAA in accordance with TSO-C145a or TSO-C146a as in force on 19 September 2002 or a later version as in force from time to time; or

(b) another system authorised by CASA for this purpose.

4 It is a condition of approval that the pressure altitude transmitted by the ADS-B transmitting equipment must be determined by:

(a) a barometric encoder of a type that is authorised by :

(i) the FAA in accordance with TSO-C88a as in force on 18 August 1983 or a later version as in force from time to time; or

(ii) the EASA in accordance with ETSO-C88a as in force on 24 October 2003 or a later version as in force from time to time; or

(b) another system authorised by CASA for this purpose.

5 It is a condition of approval that, unless otherwise approved in writing by CASA, the ADS-B transmitting equipment must:

(a) allow the pilot to activate and deactivate it during flight; and

(b) transmit the current aircraft address.

Note The requirement in paragraph 5 (a) is met if the ADS-B transmitting equipment has a cockpit control that enables the pilot to turn the ADS-B transmissions on and off.

AMC 20-24
Certification Considerations for the Enhanced ATS in Non-Radar Areas using ADS-B Surveillance (ADS-B-NRA) Application via 1090 MHZ Extended Squitter.

1 PREAMBLE

1.1 The scope of this Acceptable Means of Compliance (AMC) is the airworthiness and operational approval of the "Enhanced Air Traffic Services in Non-Radar Areas using ADS-B Surveillance" (ADS-B-NRA) application.

1.2 Operational benefits of the ADS-B-NRA application include the enhancement of the Air Traffic Control Service in current non-radar airspace. ADS-B-NRA would provide controllers with improved situational awareness of aircraft positions, and in consequence appropriate separation minima could be applied depending on the environment and the approval of the competent authority. Current non-radar airspace is controlled using procedural methods which demand large separations. ADS-B-NRA separation minima would be smaller than that used in current non-radar airspace. Alerting Services in non-radar airspace will be enhanced by more accurate information on the latest position of aircraft.

Hence, it is expected that in areas where radar coverage is not feasible or not economically justified this application will provide benefits to capacity, efficiency and safety in a way similar to what would be achieved by use of SSR radar.

1.3 The European CASCADE programme is the mechanism for co-ordination of the European implementation of ADS-B (ADS-B-NRA and other ADS-B based ground and airborne surveillance applications). One of the programme's aims is to ensure harmonisation and efficiency of implementation.

1.4 CASCADE uses the globally interoperable 1090 MHz Extended Squitter (ES) data link technology, compliant with ICAO SARPS in Annex 10 and in line with the recommendations of the Conference ICAO ANC-11.

1.5 In parallel, the FAA Airservices Australia and Nav Canada plan to deploy ADS-B using the same data link technology. It is assumed that aircraft will be interoperable with all implementation programmes using the EUROCAE/RTCA ADS-B-NRA standard (ED-126, DO-303).

1.6 The meaning of abbreviations may be found in Appendix 1.

2 PURPOSE

2.1 This AMC is for operators seeking to operate in airspace classifications A to E where ADS-B-NRA services have been implemented by the Air Navigation Service Provider. It provides the basis for approval of aircraft systems and identifies operational considerations.

It may also assist other stakeholders by alerting them to aircraft requirements, operator procedures and related assumptions. These other stakeholders could include airspace planners, air traffic service providers, ATS system manufacturers, surveillance data processing system manufacturers, communication service providers, aircraft and avionics equipment manufacturers and ATS regulatory authorities.

2.2 Acceptable Means of Compliance (AMC) illustrate a means, but not the only means, by which a requirement contained in an EASA airworthiness code or an implementing rule of the Basic Regulation, can be met.

An applicant correctly implementing this AMC in its entirety is assured of acceptance of compliance with the airworthiness considerations prior to use of the automatic dependent surveillance broadcast equipment. The operational considerations in this AMC are consistent with the operational considerations in the position paper 039 revision 8, that is endorsed by the JAA Operations Sectorial Team (OST). An Operator that, in conjunction with the airworthiness considerations, has correctly implemented this AMC

should be ensured of acceptance of compliance with the operations rules applicable in JAA Member States.

3 SCOPE

3.1 This AMC is applicable to the various ATS services contained in the ADS-B-NRA application, including separation services. This AMC fulfils the ADS-B-NRA Safety, Performance Requirements and Interoperability Requirements as established in EUROCAE ED-126[1], using the methodology described in EUROCAE document ED-78A[2].

AMC requirements are driven by the ED-126 requirements for a 5NM separation service (applicable to both en-route and TMA airspace).

Note: the actual choice of ADS-B-NRA ATC service provision, including of the applicable separation minima, is at the discretion of the implementing Air Traffic Service Provider, and should be based on local safety cases.

3.2 The AMC addresses the 1090 MHz Extended Squitter (ES) data link technology as the ADS-B transmit technology.[3]

4 REFERENCE DOCUMENTS

4.1 Related Regulatory Requirements

- CS/FAR 25.1301, 25.1307, 25.1309, 25.1322, 25.1431, 25.1581, or equivalent requirements of CS 23, 27 and 29, if applicable.
- EU-OPS 1.230, 1.420, 1.845, 1.865, 1040, 1.1045 and 1.1060, as amended, or, if applicable, equivalent requirements of JAR-OPS 3.
- National operating regulations.

4.2 Related EASA/JAA TGL/NPA/AMC (and FAA TSO) Material

- ETSO-2C112b: Minimum Operational Performance Specification for SSR Mode S Transponders (adopts ED-73B)
- ETSO-129A (TSO-129/TSO-129A): Airborne Supplemental Navigation Equipment Using the Global Positioning System (GPS)
- ETSO-145/ETSO-146 (TSO-145/TSO-146; TSO-145A/TSO-146A): Airborne Navigation Sensors Using the Global Positioning System (GPS) Augmented by the Wide Area Augmentation System (WAAS)
- AMC 20-13 Certification of Mode S Transponder Systems for Enhanced Surveillance
- JAA Temporary Guidance leaflet (TGL) 13, Revision 1: Certification of Mode S Transponder Systems for Elementary Surveillance

4.3 Related FAA Advisory Circular Material

- FAA AC20-138A: Airworthiness Approval of Global Navigation Satellite System (GNSS) Equipment

4.4 Related EUROCAE/RTCA Standards

- ED-126 (DO-303): Safety, Performance and Interoperability Requirements Document for ADS-B-NRA Application (December 2006)

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[1] ED-126: "Safety, Performance and Interoperability Requirements Document for ADS-B-NRA" Application

[2] ED-78A: Guidelines for approval of the provision and use of Air Traffic Services supported by Data communications

[3] Other, requirements compliant, ADS-B transmit systems (e.g. VDL Mode 4) are expected to be covered through separate regulatory material, as appropriate.

- ED78A (DO-264): Guidelines for Approval of the Provision and Use of Air Traffic Services Supported by data communications;
- ED-102 (DO-260): MOPS for 1090MHz for ADS-B
- DO-260A: MOPS for 1090MHz for ADS-B
- ED-73B (DO-181C): Minimum Operational Performance Specification for Secondary Surveillance Radar Mode S Transponders
- ED-26: MPS for airborne altitude measurements and coding systems

4.5 Related ICAO Standards and Manuals

- PANS-ATM, Doc 4444, Amendment 4: Procedures for Air Navigation Services – Air Traffic Management
- Annex 10 (Volume III & IV): Aeronautical Telecommunications

5 ASSUMPTIONS

Applicants should note that this AMC is based on the following assumptions.

5.1 Air Traffic Service Provider (ATSP)

ATSP implements the ADS-B-NRA application compliant with relevant requirements of the safety, performance and interoperability requirements of EUROCAE standard ED-126. Deviations from, or supplements to the established standards are assessed by the ATSP. Deviations that potentially impact the airborne domain should be assessed in coordination with relevant stakeholders as per ED78A.

Section 8 of this document, “Airworthiness Considerations”, lists permissible deviations from the target requirements related to the use of existing aircraft installations in support of initial implementations[4]. These deviations are currently considered operationally acceptable under the assumption that ground mitigation means as discussed in the following subsections, are implemented, at the descretion of the ATSP.

5.1.1 Consistency of position quality indicators with associated position information at time of transmission

In cases where position quality indicators are not consistent with actual position quality (e.g., due to uncompensated latency in position transmissions), the implementing ATSP might:

- treat the higher quality indicator encodings as an advised lower one (e.g. NUC=7 may be treated as NUC=5) or,
- consider, for separation purpose, a quality indicator more stringent than the one stated in ED-126 (e.g. NUC =5 rather than NUC=4).

5.1.2 Encoding of NUC Quality Indicator (DO-260 compliant transponders)

In order to mitigate the encoding of the NUC quality indicator based on accuracy quality information (HFOM) in the case of the unavailability of the GPS RAIM function (i.e. unavailability of HPL information), the implementing ATSP may, for instance, rely on the analysis of the frequency and duration of the unavailability of the RAIM function (as part of the local safety assessment).

5.1.3 Transmission of generic emergency indicator only

In order to mitigate the transmission of only the generic emergency indicator (and not also the discrete codes selected by the flight crew), It is assumed that appropriate operational procedures have been established by the implementing ATSP and that pilots and controllers have been trained in their use.

[4] Refer to sections 8.3.3, 8.3.5 and 8.8.2.

5.1.4 Communications Service Provider (CSP)

In case of CSPs providing (part of) the ground surveillance data communication services (operation of ADS-B ground stations and/or surveillance data networks), the CSP is committed to provide communication services to ATSPs with the expected Quality of Service as defined in a specific Service Level Agreement.

The Service Level Agreement is bilaterally agreed between the CSP and an ATSP. The terms of reference of the Service Level Agreement are consistent with the performance requirements of the ED-126 document.

5.2 Aeronautical Information Service

Each State publishes in its AIP/NOTAM, or equivalent notification, information related to the surveillance provisions, schedule, relevant procedures and confirmation of compliance with ED-126.

6 SYSTEM DESCRIPTION

The basic concept of ADS-B involves the broadcasting of surveillance information from aircraft via a data link.

To support the ADS-B-NRA application, the overall ADS-B avionics system (in the following referred to as "**ADS-B System**") would need to provide the following functions:

- Adequate surveillance data provision capability;
- ADS-B message processing (encoding and generation);
- ADS-B message transmission (1090 MHz ES airborne surveillance data-link);

Whereas the latter two functions are incorporated in the 1090 MHz ES ADS-B transmit system, the surveillance data provision is realised through various on-board surveillance data sources (e.g. horizontal position source, barometric altimetry, ATC transponder control panel).

The horizontal position accuracy and integrity requirements of the ADS-B-NRA application are associated with quality indicators which form part of the air-to-ground ADS-B message exchange. The interconnecting avionics architecture is part of the ADS-B System.

7 FUNCTIONAL CRITERIA

Note: ICAO and EUROCAE/RTCA interoperability references, including aspects of range and resolution of the various data items listed hereafter, for both ED-102/DO-260 and DO-260A equipment-based ADS-B transmit systems, are presented in Appendix 4.

7.1 In line with ED-126 (section 4), the ADS-B System needs to meet the following surveillance data transmission requirements, as a minimum:

- A unique ICAO 24 bit aircraft address (contained within each ADS-B message transmission);
- Horizontal Position (latitude and longitude);
- Horizontal Position Quality Indicator(s) (position integrity for both ED-102/DO-260 and DO-260A based ADS-B transmit systems, as well as accuracy for DO-260A based ADS-B transmit systems);
- Barometric Altitude;
- Aircraft Identification;
- Special Position Identification (SPI);
- Emergency Status and Emergency Indicator;

- Version Number (in aircraft operational status message, if avionics are DO-260A compliant).

7.2 In line with ED-126 (section 4), it is recommended that the ADS-B System meets the following optional surveillance data transmission requirement:

- Ground Velocity.

8 AIRWORTHINESS CONSIDERATIONS

8.1 Airworthiness Certification Objectives

For the purposes of the ADS-B-NRA application, the ADS-B System installed in the aircraft needs to be designed to deliver data that satisfy the airborne domain requirements in line with ED-126 Section 3.4, (Appendix 3 provides a summary for information purposes).

8.2 ADS-B System

8.2.1 The (overall) ADS-B System integrity level with respect to the processing of horizontal position data and horizontal position quality indicators, covering the processing (and data exchange) chain from horizontal position data source(s) to ADS-B transmit data string encoding) needs to be 10^{-5}/fh (refer also to Table 1 in Appendix 3).

Note 1: this integrity level is required to adequately protect against the corruption of horizontal position data and horizontal position quality indicators when applying separation.

Note 2: These performance figures have been set for the "ADS-B out" function, to be used in ADS-B NRA operations as laid down by the Operational Safety Assessment in Annex C of ED 126.

Note 3: Compliance with these performance figures do not constitute per se a demonstration that the safety objectives of ADS-B NRA operations allocated to avionics are achieved.

Note 4: Also refer to § 3.1.

8.2.2 The (overall) ADS-B System continuity level needs to be $2*10^{-4}$/fh (refer also to Table 1 in Appendix 3).

Note 1: These performance figures have been set for the "ADS-B out" function, to be used in ADS-B NRA operations as laid down by the Operational Safety Assessment in Annex C of ED 126;

Note 2: Compliance with these performance figures do not constitute per se a demonstration that the safety objectives of ADS-B NRA operations allocated to avionics are achieved;

Note 3: Also refer to § 3.1.

8.2.3 The latency of the horizontal position data, including any uncompensated latency, introduced by the (overall) ADS-B System does not exceed 1.5 second in 95% and 3 seconds in 99.9% of all ADS-B message transmission cases (refer also to Table 1 in Appendix 3).

8.3 ADS-B Transmit System

8.3.1 Compliance with the air-ground interoperability requirements, as specified in ED-126 and presented in Section 7.1 and Appendix 4, needs to be demonstrated.

8.3.2. For 1090 MHz Extended Squitter ADS-B transmit systems, this should be demonstrated by the relevant tests documented in:

- ED-73B/ETSO-2C112b (or DO-181C);

- ED-102, as a minimum, or an equivalent standard which is acceptable to the Agency (e.g. DO-260 or DO-260A).

8.3.3 ADS-B transmit systems need to transmit horizontal position quality indicators consistent with the associated position information at the time of transmission.

For the expression of the position accuracy quality, the related indicator should therefore reflect:

- The quality (in terms of both integrity and accuracy) of the position measurement itself; and
- Any (uncompensated) latency incurring prior to transmission.

Note: guidance on the quality indicators is provided in Appendix 4.

The applicant needs to demonstrate the correctness of consistent quality indicator encodings in line with (minimum) position source quality and any (uncompensated) maximum latency as expressed in 8.2.3.

Permissible deviation for initial implementations:

For initial implementations, some aircraft installations may not take into account any (uncompensated) latency in the encoding of the position accuracy quality indicator as applicable at the time of transmission. Hence, such installations might transmit horizontal position quality indicators that are consistent with the associated position information only for lower quality indicator encodings[5] (e.g. NUC=5 or NAC=5) but not higher ones (e.g. NUC=7 or NAC=7). Such deviation from the above target requirement need to be listed in the Aircraft Flight Manual (refer to Section 9.3).

8.3.4 The value of the horizontal position quality indicators need to be based on the integrity information for the encoding of the ED-102/DO-260 related NUC and the DO-260A related NIC quality indicator, as related to the horizontal position sources.

In addition, the encoding of the DO-260A NAC quality indicator needs to be based on the accuracy information of the horizontal position sources.

8.3.5 In case of ED-102/DO-260 based ADS-B transmit systems, the NUC Quality Indicator value need to be encoded based on the integrity containment radius[6] only.

Permissible deviation for initial implementations:

For initial implementations, some GNSS position source based aircraft installations may encode the NUC Quality Indicator on accuracy quality information (HFOM) under rare satellite constellation circumstances leading to the temporary unavailability of the integrity monitoring (RAIM) function (i.e. unavailability of integrity containment radius calculation). Such deviation from the above target requirement need to be listed in the Aircraft Flight Manual (refer to Section 9.3).

8.3.6 If the ADS-B transmit system does not have a means to determine an appropriate integrity containment radius and a valid position is reported, then the Quality Indicator (i.e. NUC or NIC) need to be encoded to indicate that the integrity containment radius is unknown (i.e. NUC/NIC should be set to 'zero').

8.3.7 Transmitter antenna installation needs to comply with guidance for installation of ATC transponders to ensure satisfactory functioning. (Also refer to ED-73B)

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[5] This is a consequence of the definition of the quality indicator encoding describing an interval of values between a lower and an upper bound (refer also to Appendix 4.2). For instance, a NUC=5 encoding expresses an upper bound of position accuracy quality indication of 0.3NM whilst a NUC=7 encoding expresses an upper bound of 0.05NM. Therefore, in case of e.g. the actual GNSS position source performance, a NUC=5 encoding provides sufficient margin to also correctly express the effects of on-board uncompensated latency whilst this is not the case for a NUC=7 encoding any more.

[6] I.e. GNSS conformant HPL/HIL information.

8.3.8 If more than one ADS-B transmit system is installed, simultaneous operation of both transmit systems needs to be prevented.

8.4 Horizontal Position Data Sources

8.4.1 The requirements on horizontal position data sources are based on the ED-126 safety and performance assessments.

8.4.2 Components of horizontal position data sources external to the aircraft ADS-B system (such as the GNSS space segment) fall outside these airworthiness considerations. Such external components are assumed to operate in accordance with their specified nominal performance[7].

Nevertheless, failures of the external data source components are required to be detected through on-board monitoring (as expressed in section 8.4.3).

8.4.3 Any eligible horizontal position data source needs to meet the following minimum requirements (refer also to Table 2 in Appendix 3):

- Correct encoding of quality indicator information in line with the actual performance of the selected horizontal position data source(s), i.e. in relation to position integrity containment bound (ED-102/DO-260 and DO-260A ADS-B transmit systems) and position accuracy (DO-260A ADS-B transmit systems);
- Position source failure probability: 10^{-4} per hour[8];
- Position integrity alert failure probability, commensurate with the performance characteristics of GNSS integrity monitoring[9]: 10^{-3} (per position source failure event);
- Position integrity time to alert: 10 seconds.

8.4.4 If available and valid, integrity containment radius information should be provided to the ADS-B transmit system from the position data source, or equivalent, on the same interface as and together with each positional data.

8.4.5 If the integrity containment radius is not provided by the horizontal position data source, the ADS-B transmit system may use other means to establish an appropriate integrity containment radius[10], provided a requirements compliant integrity alert mechanism is available.

8.4.6 Use of GNSS Systems as Primary Position Data Source

8.4.6.1 GNSS is considered as primary horizontal position data source for the provision of an acceptable accuracy and integrity performance in support of the ATC separation services contained within the ADS-B-NRA application.

The ED-126 safety and performance assessments are based on the specified performance and characteristics of GNSS systems, including receiver autonomous integrity monitoring. Therefore, for GNSS systems as specified in section 8.4.6.2, a safety and performance demonstration is not required.

8.4.6.2 If GNSS is used as a positional source, the GNSS system should be either compatible with:

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[7] For GNSS based systems, this includes satellite constellation aspects.

[8] For GNSS based position sources, the failure occurs outside the aircraft system and is therefore expressed as per ATSU-hour. Proof of compliance of alternative solely aircraft based sources should take this into account and might have to express the requirement as 10^{-5} per flight hour (i.e. for the en-route environment).

[9] As realised through receiver autonomous integrity monitoring (RAIM), including its characteristics of increasingly less likely to fail for position errors beyond the horizontal protection limit. Within ED-126, the position source failure is modelled as a bias error that equals the integrity containment radius.

[10] E.g. HPL/HIL based upon known RAIM protection threshold.

- ETSO C-129A, TSO C-129 or TSO C-129A; or
- ETSO C-145/C-146 or TSO C-145A/C-146A,

capable of delivering position data with a periodic interval of at least 1.2 s [11].

8.4.6.3 For GNSS systems compatible with (E)TSO C-129 (any revision), it is highly desired that the system incorporates Fault Detection and Exclusion capability as defined in AC 20-138A, Appendix 1, "GPS as a Primary Means of Navigation for Oceanic/Remote Operations".

8.4.7 Use of Alternative Compliant Position Data Sources

As the ED-126 safety and performance assessments are based on the performance and characteristics of GNSS systems, for alternative position sources a dedicated safety and performance assessment is required to demonstrate compliance with the ED-126 requirements.

8.4.8 Use of Temporary Back-up Position Data Sources

Back-up position data sources not complying with the requirements referred to in section 8.4.3 may prove very useful in enhancing the continuity of ADS-B surveillance provision during temporary outages of the primary (or equivalent alternative) position data sources.

Any such back-up position data source needs to report its accuracy and integrity performance to the ADS-B transmit system, in a format compliant with ED-102/DO-260 or DO-260A, as appropriate.

8.5 Barometric Altitude Data Sources

8.5.1 Pressure altitude provided to the ADS-B transmit system needs to be in accordance with existing requirements for ATC transponders.

8.5.2 The digitizer code selected needs to correspond to within plus or minus 38.1 m (125 ft), on a 95% probability basis, with the pressure-altitude information (referenced to the standard pressure setting of 1013.25 hectopascals), used on board the aircraft to adhere to the assigned flight profile. (ICAO Annex 10, Vol IV, 3.1.1.7.12.2.4. See also EUROCAE ED-26).

The performance of the encoders and of the sensors needs to be independent from the pressure setting selected.

8.5.3 The transponder should indicate correctly the altitude resolution (quantisation) used, i.e. 25ft (from an appropriate source, default resolution) or 100ft (Gillham's coded source, permissible alternative resolution).

The conversion of Gillham's coded data to another format before inputting to the transponder is not permitted unless failure detection[12] can be provided and the resolution (quantisation) is set in the transmitted data to indicate 100ft.

8.5.4 In case more stringent barometric altimetry requirements are applicable in line with e.g. airspace requirements (e.g. RVSM) or other function requirements (e.g. ACAS II), then these requirements and their related regulation take precedence.

[11] ETSO C-145/C146 provides additional capabilities compared with ETSO C129A such as: processing of GPS without Selective Availability, processing of SBAS signals when available and Fault Detection Exclusion as a basic function. Therefore ETSO C145/146 usually provides higher quality integrity values than ETSO C-129A equipment.

[12] For instance, this need can be satisfied by means of dual independent altitude corrected sensors together with an altitude data comparator (which may be incorporated and enabled in the ADS-B transmit system).

8.6 Aircraft Identification

8.6.1 Identification needs to be provided to the ADS-B transmit system so that the information is identical to the filed ICAO flight plan. This information may be provided from:

- A flight management system; or
- A pilot control panel; or
- For aircraft, which always operate with the same flight identification (e.g. using registration as the flight identification) it may be programmed into equipment at installation.

8.6.2 In case no ICAO flight plan is filed, the Aircraft Registration needs to be provided to the ADS-B transmit system.

8.7 Special Position Identification (SPI)

For ATC transponder-based ADS-B transmit systems, the SPI capability needs to be provided. The SPI capability should be integrated into the transponder functionality and should be controlled from the transponder control panel.

8.8 Emergency Status/Emergency Indicator

8.8.1 When an emergency status (i.e. discrete emergency code) has been selected by the flight crew, the emergency indicator needs to be set by the ADS-B transmit system.

8.8.2 For ATC transponder-based ADS-B transmit systems, the discrete emergency code declaration capability should be integrated into the transponder functionality and should be controlled from the transponder control panel.

Permissible deviation for initial implementations:

For initial implementations, instead of the required transmission of the discrete emergency codes 7500, 7600 and 7700 when selected by the flight crew, the transmission of only the generic emergency indicator can satisfy this requirement. Such deviation from the above target requirement needs to be listed in the Aircraft Flight Manual (refer to Section 9.3).

8.9 Airworthiness Considerations regarding Optional Provisions

8.9.1 Ground Velocity (OPTIONAL)

Ground velocity, e.g. from an approved GNSS receiver, in the form of East/West and North/South Velocity (including a velocity quality indicator) is recommended to be provided.

8.9.2 Special Position Identification (SPI) (OPTIONAL)

For non-ATC transponder-based ADS-B transmit systems (i.e. installations based on dedicated ADS-B transmitters), a discrete input or a control panel should be provided to trigger the SPI indication.

8.9.3 Emergency Status/Emergency Indicator (OPTIONAL)

For non-ATC transponder-based ADS-B transmit systems (i.e. installations based on dedicated ADS-B transmitters), a discrete input or a control panel should be provided to indicate the emergency status (discrete emergency code).

8.9.4 Flight Deck Control Capabilities (OPTIONAL)

8.9.4.1 Means should be provided to the flight crew to modify the Aircraft Identification information when airborne.

8.9.4.2 Means should be provided to the flight crew to disable the ADS-B function on instruction from ATC without disabling the operation of the ATC transponder function.

Note: It is recommended to implement an independent ADS-B disabling function. For future ADS B application such flight deck capability may become mandatory. It should be recalled that disabling the operation of the transponder will disable also the ACAS function.

8.9.4.3 Means should be provided to the flight crew to disable the transmission of the barometric altitude.

9 COMPLIANCE WITH THIS AMC

9.1 Airworthiness

9.1.1 When showing compliance with this AMC, the following points should be noted:

a) The applicant will need to submit, to the Agency, a certification plan and a compliance statement that shows how the criteria of this AMC have been satisfied, together with evidence resulting from the activities described in the following paragraphs.

b) Compliance with the airworthiness requirements (e.g. CS-25) for intended function and safety may be demonstrated by equipment qualification, safety analysis of the interface between the ADS-B equipment and data sources, structural analyses of new antenna installations, equipment cooling verification, evidence of a human to machine interface, suitable for ADS-B-NRA.

c) The safety analysis of the interface between the ADS-B transmit system and its data sources should show no unwanted interaction under normal or fault conditions.

d) The functionality for ADS-B-NRA application may be demonstrated by testing that verifies nominal system operation, the aircraft derived surveillance data contained in the ADS-B messages, and the functioning of system monitoring tools/fault detectors (if any).

9.1.2 The functionality for ADS-B-NRA application may be further demonstrated by ground testing, using ramp test equipment where appropriate, that verifies nominal system operation, the aircraft derived surveillance data contained in the ADS-B messages, and the functioning of system monitoring tools/fault detectors (if any).

Note: this limited testing assumes that the air-ground surveillance systems have been shown to satisfactorily perform their intended functions in the flight environment in accordance with applicable requirements.

To minimise the certification effort for follow-on installations, the applicant may claim credit, from the Agency, for applicable certification and test data obtained from equivalent aircraft installations.

9.2 Performance

Where compliance with a performance requirement cannot readily be demonstrated by a test, then the performance may be verified by an alternative method such as analysis, including statistical analysis of measurements under operational conditions.

9.3 Aircraft Flight Manual

9.3.1 The Aircraft Flight Manual (AFM) or the Pilot's Operating Handbook (POH), whichever is applicable, needs to provide at least a statement of compliance that the ADS-B System complies with this AMC20-24 and if deviations are applicable. Deviations, including those stated in this document[13], as appropriate may be included or referred to.

9.4 Existing installations

9.4.1 The applicant will need to submit, to the Agency, a compliance statement, which shows how the criteria of this AMC have been satisfied for existing installations. Compliance may be supported by design review and inspection of the installed system to

[13] Refer to sections 8.3.3, 8.3.5 and 8.8.2.

confirm the availability of required features, functionality and acceptable human-machine interface.

9.4.2 Where this design review finds items of non-compliance, the applicant may offer mitigation that demonstrates an equivalent level of safety and performance. Items presented by the applicant which impact safety, performance and interoperability requirements allocation will need to be coordinated in accordance with ED-78A.

10 OPERATIONAL CONSIDERATIONS

10.1 General

10.1.1 The installation should be certified according to airworthiness considerations in section 8 prior to operational approval.

10.1.2 The assumptions in section 5, concerning Air Traffic and Communications Services Providers, and Aeronautical Information Services, should have been satisfied.

10.1.3 A unique ICAO 24 bit aircraft address should be assigned by the responsible authority to each airframe.

10.2 Operational Safety Aspects

10.2.1 In all cases, flight crews should comply with the surveillance provisions, schedules and relevant procedures contained in the Aeronautical Information Publications (AIP) published by the appropriate authorities.

10.2.2 Direct controller-pilot VHF voice communications should be available at all times.

10.2.3 If flight crew receive equipment indications showing that position being broadcast by the ADS-B system is in error (e.g. GPS anomaly), they should inform the ATSP, as appropriate, using any published contingency procedures.

10.2.4 When there is not an independent Flight Deck Control selection between the ADS-B function (ADS-B on/off) and the ATC transponder function, the crew must be fully aware that disabling the ADS B function will also lead to disable the ACAS function.

10.3 Operations Manual and Training

10.3.1 Operations Manual

10.3.1.1 The Operations Manual should include a system description, operational and contingency procedures and training elements for use of the ADS-B-NRA application.

10.3.1.2 The Operations Manual, preferably section B, should contain the operational aspects described in this guidance material.

10.3.1.3 Operators operating under the provisions of ICAO Annex 6 Part II “International General Aviation – Aeroplanes” are not required to have an operations manual.

However, in order to use ADS-B applications, the operator should develop similar training and operational procedures to the ones described in this guidance material. This material may need to be approved by the State of Registry of the operator in accordance with national practice and sight of this approval may be required by the ADS-B navigation service provider.

10.3.2 Flight Crew Training

10.3.2.1 Aircraft operators should ensure that flight crew are thoroughly familiar with all relevant aspects of ADS-B applications.

10.3.2.2 Flight crew training should address the:

a) General understanding of ADS-B-NRA operating procedures;

b) Specific ADS-B associated phraseology;

c) General understanding of the ADS-B technique and technology;

d) Characteristics and limitations of the flight deck human-machine interface, including an overview of ADS-B environment and system descriptions;

e) Need to use the ICAO defined format for entry of the Aircraft Identification or Aircraft Registration marking as applicable to the flight;

Note 1: ICAO Document 8168-OPS/611 Volume I (Procedures for Air Navigation Services) requires that flight crew of aircraft equipped with Mode "S" having an aircraft identification feature should set the aircraft identification into the transponder. This setting is required to correspond to the aircraft identification that has been specified at Item 7 of the ICAO flight plan and consists of no more than seven characters. If the aircraft identification consists of less than seven characters, no zeros, dashes or spaces should be added. If no flight plan has been filed, the setting needs to be the same as the aircraft's registration, again, up to a maximum of seven characters.

Note 2: The shortened format commonly used by airlines (a format used by International Airlines Transport Association (IATA)) is not compatible with ICAO provisions for the flight planning and ATC services used by ATC ground systems.

f) Operational procedures regarding the transmission of solely the generic emergency flag in cases when the flight crew actually selected a discrete emergency code (if implemented, refer to section 8.8) and SPI;

g) Indication of ADS-B transmit capability within the ICAO flight plan but only when the aircraft is certified according to this AMC;

h) Handling of data source errors (e.g. discrepancies between navigation data sources) (refer to 10.2.3);

i) Incident reporting procedures;

j) Crew Resources Management and associated human factors issues.

10.4 Incident reporting

Significant incidents associated with ATC surveillance information transmitted by the ADS-B data link that affects or could affect the safe operation of the aircraft will need to be reported in accordance with EU-OPS 1.420 (or national regulations, as applicable).

10.5 Minimum Equipment List

The MEL will need to be revised to indicate the possibility of despatch of aircraft with the ADS-B system unserviceable or partially unserviceable.

11 MAINTENANCE

11.1 Maintenance tests should include a periodic verification check of aircraft derived data including the ICAO 24 bit aircraft address using suitable ramp test equipment. The check of the 24 bit aircraft address should be made also in the event of a change of state of registration of the aircraft.

11.2 Maintenance tests should check the correct functioning of system fault detectors (if any).

11.3 Maintenance tests at ADS-B transmit system level for encoding altitude sensors with Gillham's code output should be based on the transition points defined in EUROCAE ED-26, Table 13.

11.4 Periodicity for the check of the ADS-B transmitter should be established.

12 AVAILABILITY OF DOCUMENTS

EASA documents are available from http://www.easa.europa.eu.

JAA documents are available from the JAA publisher Information Handling Services (IHS). Information on prices, where and how to order is available on both the JAA web site www.jaa.nl and the IHS web site www.avdataworks.com.

ICAO documents may be purchased from Document Sales Unit, International Civil Aviation Organisation, 999 University Street, Montreal, Quebec, Canada H3C 5H7, (Fax: 1 514 954 6769, e-mail: sales_unit@icao.org) or through national agencies.

EUROCAE documents may be purchased from EUROCAE, 102 rue Etienne Dolet, 92240 MALAKOFF, France, (Fax: 33 1 46556265). Web site: www.eurocae.org.

RTCA documents may be purchased from RTCA, Incorporated, 1828 L Street, Northwest, Suite 820, Washington, D.C. 20036-4001 U.S.A. Web site: www.rtca.org.

EUROCONTROL documents may be requested from EUROCONTROL, Documentation Centre, GS4, Rue de la Fusee, 96, B-1130 Brussels, Belgium; (Fax: 32 2 729 9109 or web site www.eurocontrol.int).

FAA documents may be obtained from Department of Transportation, Subsequent Distribution Office SVC-121.23, Ardmore East Business Centre, 3341 Q 75th Avenue, Landover, MD 20785, USA.

Australia CASA documents are available from http://www.casa.gov.au/.

Appendix 1.1: Common Terms

Reference should be made to EUROCAE document ED-126 for the definitions of terms.

Appendix 1.2: Abbreviations

ADS-B	Automatic Dependent Surveillance- Broadcast
ADS-B-NRA	Enhanced ATS in Non-Radar Areas using ADS-B Surveillance
AFM	Aircraft Flight Manual
ANC	Air Navigation Commission (ICAO)
ATSP	Air Traffic Service Provider
ATC	Air Traffic Control
ATS	Air Traffic Services
ATSU	Air Traffic Service Unit
ATM	Air Traffic Management
CASCADE	Co-operative ATS through Surveillance and Communication Applications Deployed in ECAC
EUROCONTROL	European Organisation for the Safety of Air Navigation
FAA	Federal Aviation Administration
GNSS	Global Navigation Satellite System
HPL	Horizontal Protection Limit
HIL	Horizontal Integrity Limit
ICAO	International Civil Aviation Organisation
INTEROP	Interoperability Requirements
MEL	Minimum Equipment List
NIC	Navigation Integrity Category
NACp	Navigation Accuracy Category
NUC	Navigation Uncertainty Category
POH	Pilots Operating Handbook
RFG	Requirement Focus Group
SIL	Surveillance Integrity Level
SPI	Special Position Identifier
SPR	Safety and Performance Requirements
SSR	Secondary Surveillance Radar
OSED	Operational Services and Environment Definition
Rc	Horizontal Position Integrity Containment Radius
TMA	Terminal Manoeuvring Area

Appendix 2.1: Summary of core ADS-B-NRA Operational Assumptions

- The ADS-B-NRA application assumes implementation of the procedures contained in the PANS-ATM ADS-B amendment. Fallback procedures from the radar environment apply to ADS-B-NRA when necessary. For example, ATC could apply alternate procedural separation (e.g., a vertical standard) during degraded modes.
- En route traffic density is assumed to be the same as in the current environment in which single radar coverage would enable the provision of a 5NM separation service for en route regions. This corresponds to low or medium density.
- Direct Controller-Pilot Communication (VHF) is assumed to be available at all times.
- It is assumed that the ADS-B coverage is known to the Controller in the controlled airspace.

Appendix 2.2: Summary of core ADS-B-NRA Ground Domain Assumptions

- Controller operating procedures are assumed to be unaffected by the selection of an ADS-B data link, i.e., the ADS-B data link is assumed to be transparent to the controller.
- Air Traffic Controllers are assumed to follow existing procedures for coordination and transfer of aircraft. This applies to coordinating appropriate information with downstream units and complying with local agreements established between ATC units regarding separation standards to be established prior to entry into a bordering ATC unit.
- Appropriate ATS authorities are assumed to provide controllers with adequate contingency procedures in the event of ADS-B failures or degradation.
- It is assumed that there is a monitoring capability in the ADS-B Receive Subsystem that monitors the health and operation of the equipment and sends alerts and status messages to the Air Traffic Processing Subsystem.

Appendix 3: Summary of ADS-B-NRA Airborne Safety and Performance Requirements

Parameter	Requirement
Horizontal Position and Horizontal Position Quality Indicator(s)	10^{-5}/fh
ADS-B System Continuity	$2*10^{-4}$/fh
Horizontal Position Latency[1]	1.5 sec/95%

Table 1: Overall Minimum Airborne ADS-B System[2] Requirements

Parameter	Requirement
Horizontal Position Source	
• Accuracy (95%)	• 5 NM Sep: 926 m
• Integrity	
• Containment Radius (Rc)	• 5 NM Sep: Rc=2 NM
• Source Failure Probability	10^{-4}/h[3]
• Alert Failure Probability	10^{-3} (per position source failure event)
• Time to Alert	• 5 NM Sep: 10 sec

Table 2: Minimum Horizontal Position Source Requirements

Note: *for DO-260 based ADS-B transmit systems, the related encoding of the horizontal position quality indicator through the Navigation Uncertainty Category (NUC) effectively leads to a containment radius requirement of 1NM for a 5 NM separation service.*

Note: *accuracy and integrity containment radius requirements are expressed here as guidance to related horizontal position source regulation (refer to section 8.4).*

Note: *the containment bound requirements reflect the outcomes of both the collision risk assessment (CAP) and time-to-alert assessment.*

Note: *the accuracy and integrity containment radius requirements have to be met by the horizontal position source, taking into account the effects of on-board latency (if not compensated for).*

An uncompensated latency of 1.5 seconds translates into a dilution in the order of 450 metres (assuming an aircraft speed of 600 knots in en-route airspace). This value of 450 metres has to be added to the actual performance of the horizontal position source(s), the sum of which has to be within the required bounds.

The GNSS equipment specified in 8.4.6 meets the overall accuracy and integrity requirements, including the effects of an uncompensated latency of maximum 1.5 second accumulated up to the time of transmission.

[1] Uncompensated delay measured from to the time of validity of position measurement until ADS-B transmission (i.e. at RF level).
[2] As defined in section 6.
[3] For GNSS based functions, expressed as an assumption of GNSS performance.

Parameter	Requirement
Barometric Altitude	• Accuracy: as per the installed sensors (refer to section 8.5.2) • Maximum Latency: 1 sec (as for SSR)
Aircraft Identification, SPI, Emergency Status	As for SSR [AMC20-13].

Table 3: Other Minimum ADS-B Surveillance Data Requirements

Parameter	Loss	Corruption	Note
Barometric Altitude	Minor	Minor	As for SSR [AMC20-13].
Aircraft Identification	Minor	Minor	As for SSR.[AMC20-13]

Table 4: Failure Condition Categories

Appendix 4.1: Summary of ADS-B-NRA Air-to-ground Interoperability Requirements

The minimum set of parameters that **should** be provided to support the ADS-B-NRA application are summarised in the following table extracted from ED-126:[1]

Parameter		BDS register	Version 0		Version 1
			ICAO Annex 10 Amendment 79, VOL III, App to chap 5	DO-260/ED-102	DO-260A
Aircraft identification		0.8	§2.3.4	§2.2.3.2.5	§2.2.3.2.5
SPI [2]		0.5	§2.3.2.6	§2.2.3.2.3.2	§2.2.3.2.3.2
Emergency indicator		0.5	§2.3.2.6	§2.2.3.2.3.2	§2.2.3.2.3.2
Barometric altitude		0.5	§2.3.2.4	§2.2.3.2.3.4	§2.2.3.2.3.4
Quality indicator (NUC/NIC)		0.5	§2.3.1	§2.2.3.2.3.1	§2.2.3.2.3.1
Airborne Position	Latitude	0.5	§2.3.2.3	§2.2.3.2.3.7	§2.2.3.2.3.7
	Longitude	0.5	§2.3.2.3	§2.2.3.2.3.8	§2.2.3.2.3.8
Emergency status [3] [4]		6.1	Table 2-97	§2.2.3.2.7.9	§2.2.3.2.7.8
Quality indicator (NACp)		6.5	No definition	No definition	§2.2.3.2.7.2.7
Quality indicator (SIL)		6.5	No definition	No definition	§2.2.3.2.3.1.1
Version Indicator[5]		6.5	No definition	No definition	§A.1.4.10.5

Table 5: Mandatory ADS-B-NRA Parameters

[1] The notion of version "0" and "1" differentiates between DO-260/ED-102 and DO-260A transponders.
[2] If provided by flight deck controls.
[3] If provided by flight deck controls.
[4] For special conditions under which the non-transmission of selected discrete emergency codes is allowed, refer to Section 8.8.2.
[5] Only for D0-260A based ADS-B transmit systems.

The minimum set of parameters that **should** be provided to support the ADS-B-NRA application are summarised in the following table extracted from ED-126:

Parameter	BDS register	Version 0		Version 1
		ICAO Annex 10 Amendment 79, VOL III, App to chap 5	DO-260/ED-102	DO-260A
Airborne Ground Velocity	0.9	§2.3.5	§2.2.3.2.6	§2.2.3.2.6

Table 6: Optional ADS-B-NRA Parameters

Appendix 4.2: Guidance on Encoding of Positional Quality Indicators

In order to be able to check the compliance of the actually transmitted ADS-B data with the required quality on the recipient side, ADS-B message transmissions contain “Quality Indicators”. These are expressed for ED-102/DO-260 and DO-260A compliant ADS-B transmit systems as follows:

- ED-102/DO-260: Navigation Uncertainty Category (NUC), a combined expression of (accuracy and) integrity requirements through a single parameter;
- DO-260A: Navigation Accuracy Category (NACp) to express the position accuracy (as a 95 percentile), Navigation Integrity Category (NIC) to express the integrity containment radius and Surveillance Integrity Level (SIL) to specify the probability of the true position lying outside that containment radius without alerting.

Minimum acceptable NUC and NIC/NACp values in support of 5 NM ADS-B-NRA separation services, based on the requirements summarised in Table 2 of Appendix 4, are as follows in line with the “NIC/NACp to NUC” conversion table below.

NUC values (encoding based on HPL, with the accuracy requirements met by GNSS systems by design and in line with the related NACp values in below conversion table):

- 5 NM separation: NUC = 4;

The corresponding NIC/NACp values are as follows.

- 5 NM separation: NIC = 4, NACp = 5,

The SIL value is established to SIL≥2 in line with the combination of the position source failure and position integrity alert failure requirements, as summarised in Table 2 of Appendix 4.

Note 1: In case the SIL value is not output by the position data sources, it is recommended that the ADS-B transmit system provides for the static setting of SIL as part of the installation procedure and as demonstrated for the applicable position data source configuration.

Note 2: ED-126 provides, based on its reference collision risk analysis only, arguments for an equally appropriate encoding of a SIL=2 as a matter of expressing the system integrity as well. As for the presentation of the values presented in this document, it is at the discretion of the ATSP to decide upon the appropriate threshold values required in support of the separation services in its airspace.

NUC (max Rc NM)		NIC (max Rc NM)		NACp (95% bound)	
9	(0.003)	**11**	(0.004)	**11**	(3 m)
8	(0.01)	**10**	(0.013)	**10**	(10 m)
	-	**9**	(0.04)	**9**	(30 m)
7	(0.1)	**8**	(0.1)	**8**	(0.05 NM)
6	(0.2)	**7**	(0.2)	**7**	(0.1 NM)
5	(0.5)	**6**	(0.6)	**6**	(0.3 NM)
4	(1.0)	**5**	(1.0)	**5**	(0.5 NM)
3	(2.0)	**4**	(2.0)	**4**	(1 NM)
	-	**3**	(4.0)	**3**	(2 NM)
	-	**2**	(8.0)	**2**	(4 NM)
2	(10)	**1**	(20)	**1**	(10 NM)
1	(20)	**1**	(20)	**1**	(10 NM)
0	(no integrity)	**0**	(> 20)	**0**	(unknown)

Table 7: NUC conversion to NIC and NACp

ADS-B APPROVED MEANS OF COMPLIANCE IN ASIA PACIFIC

(ADS-B SEA WG/3)

ADS-B out certification shall comply with EASA AMC20-24 with the following exceptions:

1. At para 8.4.6.3 revise from

   For GNSS systems compatible with (E) TSO C-129 (any revision), it is highly desired that the system incorporates Fault Detection and Exclusion capability as defined in AC20-138A, Appendix 1, "GPS as a Primary Means of Navigation for Oceanic/Remote Operations".

   to

   For GNSS systems compatible with (E)TSO C-129 (any revision), **it is required** that the system incorporates Fault Detection and Exclusion capability as defined in AC20-138A, Appendix 1, "GPS as a Primary Means of Navigation for Oceanic/Remote Operations".

2. Add a new paragraph 8.4.9

   For GNSS systems operating in environments where the ANSP requires ADS-B data with (NUC>4 for DO260) or (SIL=2, NIC>5 for DO260A) and an operational availability above 99.95%, the GNSS system shall not assume that Selective Availability (SA) is ON.

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Report of the Bay of Bengal/South Asia Group

1 The members of the Group are:

a) India
b) Malaysia
c) Pakistan
d) Singapore
e) Thailand
f) CANSO
g) IATA
h) SITA

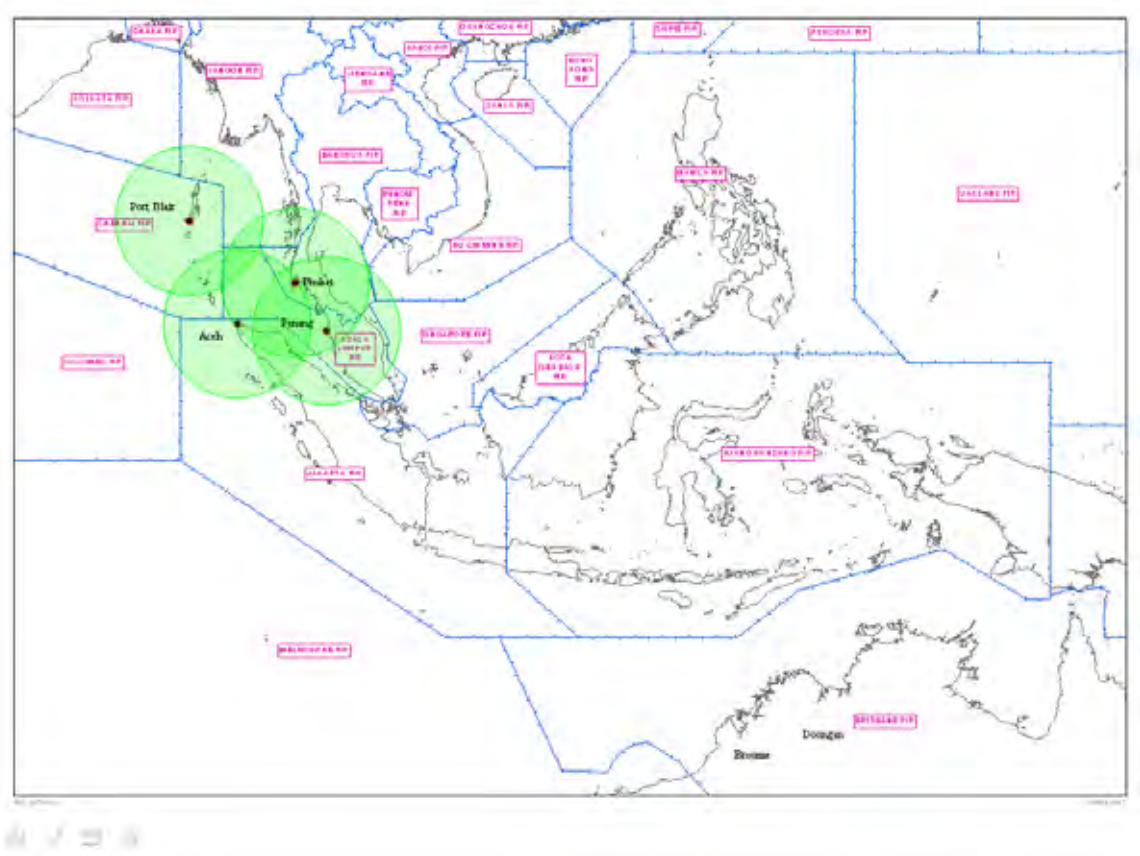
2 India informed that ADS-C services are provided in Chennai and Calcutta FIRs . In view of the next generation of alternate surveillance technology currently available (ADS-B) and the continual benefits the technology offers, it is strongly recommended that India should carry out a study and install ADS-B stations at appropriate locations in the Bay of Bengal area to provide full and seamless radar-like coverage to enhance safety and improve efficiency for air traffic services.

3 India expressed concern that without the participation of Myanmar in the regional ADS-B implementation plan, there will be pockets of airspace without surveillance.

4 It is recommended that the installation of ADS –B ground station at Port Blair as an initial phase will considerably lead to enhanced safety and increased efficiency at intersection points between parallel and crossing ATS routes.

5 Pakistan informed the Group that there are plans to replace the current radar facilities with a new ATM system. ADS-B ground stations will be established in the areas not covered by radar and these ADS-B ground stations will also be the back-up for the new ATM system.

6 Malaysia informed the Group that the major portion of the Bay of Bengal area within the Kuala Lumpur FIR is covered by the Langkawi radar.



Report of the South East Asia Group:

The South East Asia Group focused on the near term implementation of the following projects that were identified in the last task force meeting.

Project 1 – ADS-B Data Sharing Between Indonesia And Australia

Indonesia and Australia will share data from the following stations:

Phase 1a (by 2010)

- Saumlaki ADS-B (Indonesia) (Installed)
- Merauke ADS-B (Indonesia) (Installed)
- Thursday Island ADS-B (Australia) (Installed)
- Gove ADS-B (Australia) (to be installed by Sep 2009)

Data sharing agreement would be signed by Sep 2009.

Phase 1b (Tentatively after 2012)

- Kintamani - Bali (Indonesia) (Installed)
- Waingapu ADS-B (Indonesia) (Installed)
- Kupang ADS-B (Indonesia) (Installed)
- Darwin ADS-B (Australia)
- Doongan ADS-B (Australia) (Installed by end 2009)
- Broome ADS-B (Australia) (Installed)

Project 2 – ADS-B Data Sharing In South China Sea

Under the near term implementation plan, Indonesia, Singapore and Vietnam would share the ADS-B data from the following stations:

- Singapore ADS-B (Singapore provide data to Indonesia) (Install by Oct 2009)
- Natuna ADS-B (Indonesia provide data to Singapore) (Installed)
- Matak ADS-B (Indonesia provide data to Singapore) (Installed)
- Con Son ADS-B (Vietnam provide data to Singapore) (Installed by 2010)

Indonesia and Vietnam agreed to consider Singapore's request to provide VHF radio communication services (DCPC) from the following stations to Singapore. This is to enable implementation of radar-like separations in the non-radar areas within the Singapore FIR. In reply to Vietnam's query, Singapore confirmed the need for VHF radio communication services from Con Son to serve a new sector adjacent Ho Chi Minh FIR.

- Natuna VHF (Indonesia install for Singapore) (Installed by Nov 2010)
- Matak VHF (Indonesia install for Singapore) (Installed by Nov 2010)
- Con Son VHF (Vietnam install for Singapore) (Installed by 2010)

ADS-B Data sharing and DCPC services agreement between Singapore and Indonesia would be signed by Sep 2009.
ADS-B Data sharing and DCPC services agreement between Singapore and Vietnam would be signed by Mar 2010.

States are urged to explore the possibility of covering the remaining surveillance gaps in the South China Sea as discussed in previous SEA ADS-B WG meetings for implementation in future. The group also encourages The Philippines to install an ADS-B station in its southern part of Palawan to provide surveillance coverage beyond its FIR and to share the ADS-B data from the station with the neighbouring states to enhance safety.

Project 3 – ADS-B data sharing between Indonesia and Malaysia

Indonesia would share the ADS-B data from Aceh with Malaysia. The station is already installed.
Malaysia and Indonesia will discuss the technical requirements and the data sharing agreement.

Project 4 – ADS-B data sharing between Cambodia, Thailand and Vietnam

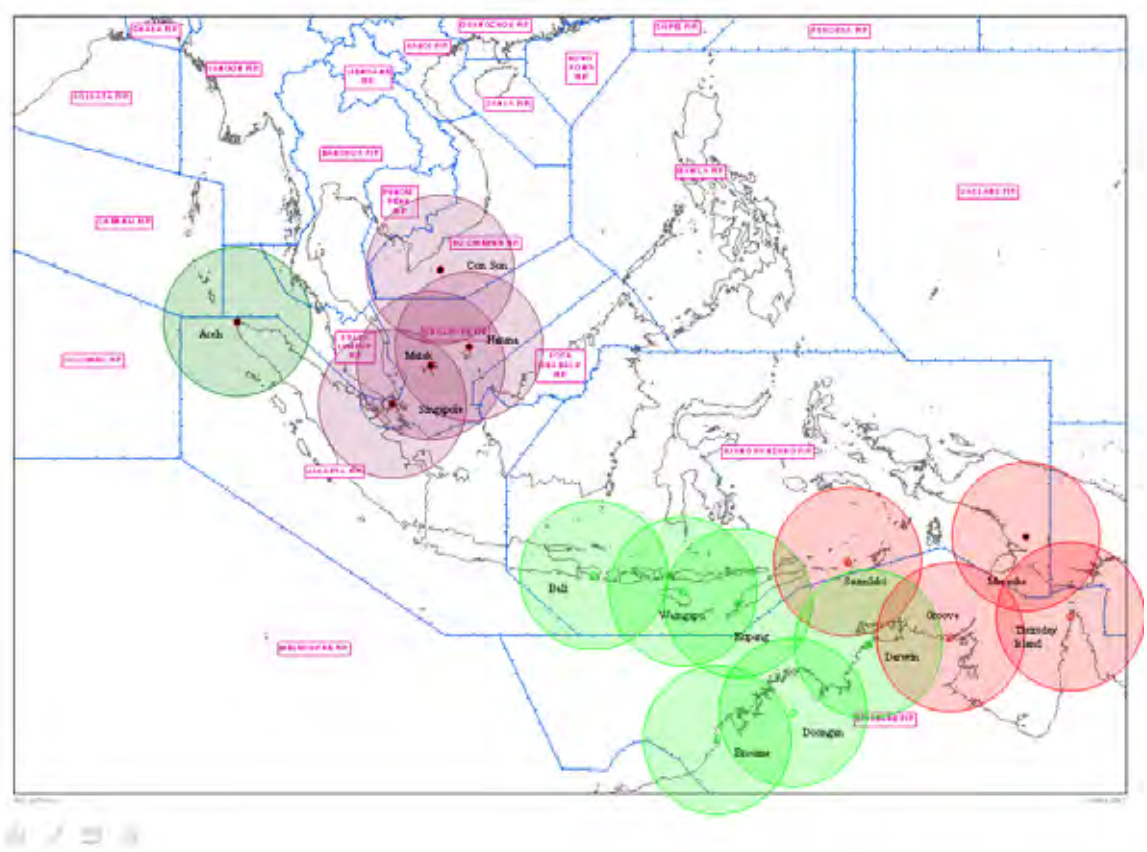
Cambodia requested ADS-B data sharing from Thailand and Vietnam

In principle, Vietnam is willing to share ADS-B data with Cambodia. The area of Vietnam's FIR near Cambodia is already covered by radar. Hence Vietnam requested Cambodia to initial meeting to discuss with Vietnam, its need of ADS-B data.

Thailand said that currently, it does not have any ADS-B station that covers Cambodia. It invited Cambodia to initiate its discussion on data sharing between Thailand and Cambodia.

Others

China and Hong Kong China indicated their interest to join the SEA WG as the ADS-B implementation in South East Asia such as L642 and M771 will involve them.


Con Son
Natuna
Melak
Singapore
Dili
Weipapa
Bajawa
Darwin
Groote
Elcho
Nhulunbuy
Island
Broome
Derby

Report of the Pacific Group:

Table 1: Pacific ADS-B Implementation

State	ATC Airspace	ADS-B Applications	ADS-B Ground Infrastructure	Registered Aircraft	Data Sharing	Comment
Fiji	Nadi FIR – oceanic and low altitude domestic	Initially ATC situational awareness, ATC surveillance services planned 2013, possible ADS-B ITP (air-air) in the future	8 ADS-B and 4 MLAT ground stations installed with new ATM system (2010)	8 international ~35 domestic	New Caledonia	Older domestic aircraft. No equipage – need ADS-B and GPS. Smaller airlines/operators only want to invest in avionics once.
New Caledonia	Below NADI FIR – FL245 and below, low altitude domestic ATC	Initially ATC situational awareness, future maybe ATC separation	3 ground stations with standalone ATC display (2009)	12 commercial plus several GA (e.g., helicopters)	Fiji and Australia	Avionics certification for older aircraft may be issue
US (Guam)	Below Oakland FIR, low altitude Guam ATC	ATC surveillance services, FIS-B/TIS-B/ADS-R uplink	3 ground stations installed to Guam CERAP ATM system (2012)	?		
Australia	Brisbane FIR oceanic	ATC surveillance services/situational awareness, ITP (air-air)	Lord Howe Island, Norfolk Island, multiple domestic sites	?	New Caledonia, New Zealand?	
New Zealand	Auckland FIR oceanic	ATC surveillance services/situational awareness, ITP? (air-air)	ADS-B/WAM at two terminal locations	?	Australia?	

State	ATC Airspace	ADS-B Applications	ADS-B Ground Infrastructure	Registered Aircraft	Data Sharing	Comment
Multiple South Pacific States	low altitude mainly below Auckland FIR	No known plans – possible situational awareness	No known plans	?	?	

Considerations for data sharing:

If sharing data for ATC surveillance services – ground station and communication lines may need to be installed at ATC surveillance services level (e.g., 99.999)

May need to share air-ground voice data in addition to ADS-B data (e.g., New Caledonia to Fiji). May need new voice frequency.

Recommendations:

Need world/region wide regulator standard on avionics approval/certification prior to operational ATC services (i.e., 2013 for Fiji) – or aircraft will not know what to equip with and manufacturers to build to. Consideration is needed for larger international and smaller domestic aircraft/operators.

Urgent need to get regulators involved now to ensure we are all working from the same page.

Need for Pacific area ADS-B information exchange – e.g., Fiji, New Caledonia, Australia share ADS-B implementation plans with smaller ANSPs and educate smaller ANSPs on ADS-B. Smaller ANSPs may install ADS-B for situational awareness only, share data to enroute FIR, provide site for ground station installation)

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ADS-B SEMINAR AND THE EIGHTH MEETING OF ADS-B STUDY AND IMPLEMENTATION TASK FORCE (ADS-B SITF/8)

Hanoi, Viet Nam
18 – 22 May 2009

ATTACHMENT 1 TO THE REPORT

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ATTACHMENT 2

International Civil Aviation Organization

THE EIGHTH MEETING OF AUTOMATIC DEPENDENT SURVEILLANCE – BROADCAST (ADS-B) STUDY AND IMPLEMENTATION TASK FORCE (ADS-B SITF/8)

Hanoi, Viet Nam, 20 – 22 May 2009

LIST OF INFORMATION AND WORKING PAPERS

IP/No.	Agenda Item	Title	Presented by
IP/1	-	Meeting bulletin	Secretariat
IP/2	3	Update of ADS-B related ICAO Panels	Secretariat
IP/3	7	Australian ADS-B Aircraft Equipage Mandate for Flight in the Upper Airspace	Australia
IP/4	6	ADS-B Filter for Data Sharing	Australia
IP/5	6	ADS=B Outages: Not GPS Constellation related	Australia
IP/6	6	ADS-B Performance: Transponder and MMR Products	Australia
IP/7	6	UAP Update	Australia
IP/8	7	ADS-B Decisions by Australia	Australia
IP/9	6	Trial & Evaluation Project in China	China
IP/10	6	Further Analysis of ADS-B NUC Data	Australia
IP/11	6	Australian Wide Area Multilateration (WAM) Experience & Lessons	Australia
IP/12	7	Australian Consideration on SA Aware Avionics for ADS-B	Australia
IP/13	6	ADS-B Data Sharing between Malaysia and Indonesia	Malaysia
IP/14	7	Outcome of SEA ADS-B WG/3 on AMC 20-24	Secretariat

IP/ No.	Agenda Item	Title	Presented by
IP/15	7	ADS-B Implementation Plan in New Caledonia	France
IP/16	6	ADS-B Implementation Plan in Viet Nam	Viet Nam
IP/17	6	The ADS-B Functionality in the new Enroute SSR Mode S Radar	Philippines
IP/19	6	Pakistan ADS-B Programme Update	Pakistan
IP/20	7	Summary of Development of ADS-B Regulations	Australia
WP/ No.	**Agenda Item**	**Title**	**Presented by**
WP/1	-	Provisional agenda	Secretariat
WP/2	2	Outcome of APANPIRG/19 on ADS-B	Secretariat
WP/3	3	Action Items of the 45th DGCA Conference	Secretariat
WP/4	4	Review Terms of Reference and Task List of ADS-B Study and Implementation Task Force	Secretariat
WP/5	4	Performance Based Approached and Measurement	Secretariat
WP/6	7	Possible Options for States to Establish Harmonized Aircraft ADS-B Avionics Mandates in Non-radar Airspace in the Asia/Pacific Region	Australia
WP/7	7	Update on the Progress of the South-East Asia Sub-regional ADS-B Implementation Working Group (SEA ADS-B WG/4)	Australia
WP/8	6	Review CNS/ATM Implementation Planning Matrix	Secretariat
WP/9	7	Review FASID Tables on Surveillance Systems	Secretariat
WP/10	7	Proposed Additional Guidelines for the Development of ADS-B Implementation Plan by States in the Region	Viet Nam
WP/11	7	Cost Benefit Study of the Initial Phase of ADS-B Implementation over the South China Sea	CANSO and IATA
WP/11 (a)	*7*	*Economic Analysis of an Initial Implementation of ADS-B in the South China Sea May 2009*	*CANSO*

ATTACHMENT 2

WP/ No.	Agenda Item	Title	Presented by
WP/12	7	ADS-B Aircraft Equipage Strategy	IATA
WP/13	7	ADS-B Data Sharing Project Australia – Indonesia	Australia & Indonesia
WP/14	7	Experience in Adopting the Sample Agreement	Indonesia & Singapore

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