INTERNATIONAL CIVIL AVIATION ORGANIZATION
ASIA AND PACIFIC OFFICE

REPORT

OF ADS-B SEMINAR AND THIRTEENTH MEETING OF AUTOMATIC DEPENDENT SURVEILLANCE – BROADCAST (ADS-B) STUDY AND IMPLEMENTATION TASK FORCE (ADS-B SITF/13)

22 – 25 April 2014
Hong Kong, China

The views expressed in this Report should be taken as those of the Meeting and not the Organization.

Approved by the Meeting
And published by the ICAO Asia and Pacific Office, Bangkok

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SUMMARY OF DISCUSSIONS

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1. Introduction

1.1 The ADS-B Seminar and Thirteenth Meeting of Automatic Dependent Surveillance – Broadcast (ADS-B) Study and Implementation Task Force (ADS-B SITF/13) were held in Hong Kong, China from 22 to 25 April 2014. The Seminar and the Meeting were hosted by Civil Aviation Department of Hong Kong, China.

1.2 Mr. Richard Wu, Chief Electronics Engineer extended a warm welcome to all participants. In his opening speech, he mentioned that this was the first meeting after ADS-B equipage mandates for some airspace had been implemented by some Administrations in the APAC Region. The Task Force was expected to address new, challenging issues observed recently in a timely manner. He offered all participants to enjoy the comfortable meeting facilities prepared for the events.

1.3 In his opening remarks Mr. Greg Dunstone, Chairman of the Task Force, highlighted the achievements of Task Force and milestones of ADS-B implementation in the Region.

1.4 Mr. Li Peng conveyed a warm welcome from the ICAO Regional Director to all participants and expressed sincere appreciation to the CAD, Hong Kong China for hosting the Seminar and the meeting.

2. Attendance

2.1 The Seminar was attended by 157 participants and the Meeting was attended by 91 participants from Australia, Bangladesh, Canada, Hong Kong China, Macao China, French Polynesia, India, Indonesia, Japan, Malaysia, Maldives, New Zealand, Nepal, Pakistan, Philippines, Republic of Korea, Singapore, Thailand, USA, and Viet Nam, CANSO, IATA, IFALPA and representatives from industries. A list of participants is at **Attachment 1.**

3. ADS-B Seminar

3.1 An ADS-B Seminar was organized in conjunction with the ADS-B SITF/13. This information and experience sharing sessions focused on mandating carriage/operational use of ADS-B from regulators; airframe and avionics manufacturers; air space users' perspective; system/equipment suppliers, and Air Navigation Service Providers. The Seminar received 15 comprehensive presentations as shown in the Attachment 2. A number of questions were discussed and some clarifications were given by the speakers. The presentations were well received and appreciated by the participants.

4. Officers and Secretariat

4.1 Mr. Greg Dunstone, Surveillance Program Lead of Airservices Australia facilitated the Seminar and Mr. Greg Dunstone, Chairman of the Task Force chaired the Meeting. Mr. Li Peng, Regional Officer CNS and Mr. Shane Sumner, Regional Officer ATM, ICAO Asia and Pacific Regional Office, acted as Secretaries.

5. Organization, working arrangements and language

5.1 The meeting met as a single body for the Seminar and the meeting except for third day of the meeting on which four ad hoc working groups (South East Asia, East Asia, Bay of Bengal and Regulatory Group) were established to coordinate proposals and actions for sub-regional implementation plans. The working language was English inclusive of all documentation and this Report. The meeting considered 25 working papers, 22 information papers. A List of Papers presented at the meeting and Seminar is at **Attachment 2.**

Agenda Item 1: Adoption of the Agenda

1.1 The agenda items adopted by the meeting was as follows:

Agenda Item 1: Adoption of agenda

Agenda Item 2: Review the outcomes of the APANPIRG/24, ADS-B SITF/12, SEA/BOB ADS-B WG/9 Meetings, and Sub-group Chairpersons' Meetings on Regional Priorities and Targets on ASBU B0-ASUR

- Approval of 7030 regarding disabling non-compliant ADS-B – issues
- Review any lessons learnt from initial ADS-B mandates

Agenda Item 3: Formulate and follow-up response from ADS-B SITF to AN/Conf-12 Recommendations

Agenda Item 4: Review Subject/Tasks List and action items including:

- Amendment to AIGD
- Blacklist discussion
- Exemption processing
- Commissioning checklist
- ADS-B performance monitoring
- ADS-B anomaly reports tracking database

Agenda Item 5: Review States' activities and interregional issues on trials and implementation of ADS-B and multilateration

- Report on progress of ADS-B mandates that became active in 2013, observations, problems encountered and safety concerns from ANSP, regulator and operator perspectives
- ADS-B Flight planning and reviewing issues
- ADS-B state of registry / ADS-B approval issues
- ADS-B fitment rate issues for Business jet aircraft
- ADS-B Out Forward-Fit for newly registered aircraft in APAC by 2017

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

- Near-term implementation plan in Bay of Bengal
- Update on near-term implementation plan in South China Sea
- Identification of potential projects in eastern part of South China Sea area

Divide into working groups as follows and subsequently report conclusions to the Plenary

- *South East Asia working group*
- *Bay of Bengal and South Asia working group;*
- *Pacific working group etc.*

Agenda Item 7: Any other business

Agenda Item 2: Review the outcomes of the APANPIRG/24, ADS-B SITF/12, SEA/BOB ADS-B WG/9 Meetings, and Sub-group Chairpersons' Meetings on Regional Priorities and Targets on ASBU B0-ASUR

APANPIRG/24 on ADS-B (WP/2)

2.1 The meeting reviewed the outcome of APANPIRG/24 on ADS-B. The relevant report of APANPIRG/24 on matters relating to ADS-B was provided in the Attachment to WP/02. The follow-up actions taken by the Secretariat and States on the Conclusions of APANPIRG/24 were noted by the meeting.

2.1.1 It was also noted that APANPIRG/24 appreciated the efforts and progress made by the ADS-B SITF and SEA/BOB ADS-B WG and thanked DCA Myanmar and Airports Authority of India for hosting the Eighth Meeting of the SEA/BOB implementation Working Group and Twelfth Meeting of the ADS-B Study and Implementation Task Force.

Action on Report of SEA/BOB ADS-B WG/9 (WP/3)

2.2 The meeting reviewed the report of Ninth Meeting of South East Asia and Bay of Bengal Sub-regional ADS-B Implementation Working Group (SEA/BOB ADS-B WG/9), held at ICAO Regional Sub-office in November 2013. The report of the Working Group is available on the ICAO APAC website: http://www.icao.int/APAC/Meetings/Pages/2013-SEABOB-ADSB-WG9.aspx

2.2.1 The meeting noted the Actions Items agreed by the Working Group and the follow-up actions taken by the members of the Task Force. The meeting reviewed the recommended actions on the follow-ups to the Air Navigation AN Conf/12 and decided not endorse the draft Conclusion proposed by the Working Group regarding the regional ADS-B OUT forward fit mandate commencing from December 2017. Instead, States were encouraged to consider cost effectiveness of publishing forward fit and retrofit mandates when planning their transition to ADS-B, and early promulgate their mandates and transition plan for forward fit and retrofit of ADS-B avionics for aircraft in their airspace.

2.2.2 States were also urged to consider developing their national plan for their surveillance capabilities according to the guidance provided in Edition 4 of Global Air Navigation Plan endorsed by the Assembly in September 2013.

2.2.3 The SEA/BOB ADS-B WG/9 meeting noted that Mode S radars are being deployed by a number of States in the Region, however function of Mode S radar with DAPS for ATM automation system has not been fully utilized.

ADS-B Collaboration Initiatives

2.3 At ADS-B WG/9, CANSO highlighted the importance of close collaboration in ADS-B implementation and the need to maintain the momentum of on-going ADS-B initiatives over the South China Sea and Bay of Bengal. Many States in the Asia/Pacific Region had implemented or planned to implement ADS-B, but there was a need for greater collaboration among neighbors to harmonize implementation plans. While ADS-B could bridge surveillance gaps and support future ATM concepts, close cooperation was the key to unlocking its full potential. The initial phase of ADS-B implementation over the South China Sea involving Indonesia, Singapore and Viet Nam was a great example of what can be achieved.

2.3.1 The possibility of ADS-B collaboration between India, Maldives and Sri Lanka had also been proposed, but no meeting between the parties had taken place. CANSO encouraged States concerned in the Bay of Bengal and eastern part of South China Sea to progress ADS-B data sharing in order to achieve more fruitful result of ADS-B Implementation.

GPS Avionics Failure

2.4 Australia provided information at WG meeting discussing the ADS-B impact of GPS avionics failure in Boeing aircraft. The ADS-B architecture of Boeing aircraft included 2 GPS receivers.

2.4.1 Prior to deployment of RTCA-DO260B avionics there was no annunciation to the flight crew of ADS-B failure, and no indication if the transponder failed to receive GPS positional data.

2.4.2 In the event of failure of one GPS unit in Airbus aircraft the other GPS provided information to both transponders. In future Airbus was expected to adopt architecture similar to Boeing to reduce latency.

2.4.3 In the Boeing aircraft configuration the failure of one GPS would result in no ADS-B data being received by ATC if the corresponding transponder was selected as the operational transponder.

2.4.4 In mitigation it would be desirable that Boeing procedures required selection of the transponder on the alternate side if failure of a GPS unit was known by the crew.

2.4.5 As a further mitigation, ATC procedures could be developed, requiring ATC to request that the flight crew selected the alternate transponder when an ADS-B anomaly was detected. Australia had been using this procedure for some years, as detailed in the National ATS Procedures Manual (NAPM):

9-50-3
ADS-B position symbol not displayed

When ADS-B transmissions from a known ADS-B equipped aircraft are not being received within ADS-B coverage:

a) inform aircraft that ADS-B transmissions are not being received;

b) request pilot change to second transponder if possible; and

c) submit an Event Report.

Australia AIP defined the phraseology SELECT SECONDARY TRANSPONDER

2.4.6 The procedure provided a recovery in cases of failed GPS, and had been successful in recovery from various other ADS-B anomalies.

2.4.7 Hong Kong China advised that Boeing did not include the effect of GPS failure on ADS-B output in its MEL, and that this information should be included. Boeing indicated that more information will be provided regarding GPS failure on ADS-B output in the MEL.

Systematic Performance Monitoring of ADS-B Equipped Aircraft

2.5 Hong Kong China recapped to the meeting that during the ADS-B SITF/12, a working paper was presented regarding a systematic algorithm based on an independent surveillance source and flight plan information to monitor and analyse avionics performance of ADS-B equipped aircraft. Moreover, APANPIRG/24 requested the ICAO Secretariat to seek the possibility of establishing a centralized database for sharing the monitoring results at the ICAO Regional Sub-office.

2.5.1 The analysis compared radar and flight plan information with ADS-B reported position, and examined the Navigation Uncertainty Category (NUC) and Flight Identification (FLTID) included in ADS-B reports, concluding that (a) ADS-B reported position deviation of greater than 1NM, (b) NUC of less than 4, and (c) FLTID mismatches against the ATS flight plan were examined if they were present in more than 5% of total reports by the aircraft. The system generated a list of aircraft meeting any of these criteria, including date/time of occurrence, ICAO Aircraft Address, a screen capture of radar and ADS-B tracks, graphical representation of NUC value changes and ADS-B/Radar track deviation. The monitoring and analysis of more than 350,000 ADS-B movements by more than 4,000 ADS-B equipped aircraft identified 3 major categories of problems:

- Category 1: ADS-B position report with good integrity (NUC 4 or greater), but position data bad when compared with radar;
- Category 2: FLTID not matching with Aircraft Identification in the flight plan; and
- Category 3: ADS-B position report with no integrity (NUC always 0)

The analysis results were provided in *Appendix B* to the Report of SEA/BOB WG/9 meeting Report.

2.5.2 Hong Kong China emphasized the safety implications to ATC for Category 1 problem, and recommended that monitoring results for Category 1 aircraft should be shared with other States capable of performing ADS-B monitoring and analysis to verify the findings, and that once verified a list should be promulgated on a central database for sharing with all parties. Concerned States and operators should then take remedial action, with ANSPs considering "blacklisting" affected aircraft from their ground systems before the problems were rectified.

2.5.3 Category 2 problems were observed for 15,598 (4.4%) ADS-B flights. Category 2 problem would trigger misleading conflict alert to ATC with cluttered screens - two target labels with different IDs (one for radar and another for ADS-B) being displayed to ATC, Hong Kong China recommended that these results should also be promulgated to concerned CAAs to follow up airworthiness issue with operators in question urging them for early rectification. Category 3 problems were observed for 16,612 (4.6%) ADS-B flights. It is recommended that concerned operators should initiate prompt action for rectification, otherwise they will be treated as non-equipped and requested to fly outside ADS-B airspace.

2.5.4 IATA requested that the Secretariat assist in seeking references in ICAO documentation or reports (from Assembly or AN Conf. etc.) to confirm whether "most capable, best served" or "better equipped, best served" was the most appropriate and widely agreed phrase to indicate better service outcomes on the basis of aircraft equipage/capability, and to encourage operators to equip accordingly.

2.5.5. With respect to Action Item 1 of SEA/BOB WG/9 meeting regarding development of Guidance Material on ADS-B equipage requirements for remotely piloted aircraft (RPA). The meeting considered that earlier awareness of the work of other ICAO groups on the subject would be required at this stage. Guidance may be required on the appropriateness of specifying Mode S and ADS-B on RPA that may not operate in the controlled surveillance airspace.

Outcome of the SG Chairpersons meeting on regional priorities ANRF (WP/05)

2.6 The meeting reviewed the outcome of the Chairpersons of APANPIRG Sub-groups. The meeting noted the seven highest priority regional targets agreed by the Chairpersons as shown in the Appendix A to the working paper and the Priorities for the Seamless ATM Plan elements as described in Appendix B to the paper.

2.6.1 The meeting also reviewed the initial Air Navigation Report Form (ANRF) - Safety and Efficiency of Surface Operations for regional performance objective - ASBU B0-SURF and ASBU B0-ASUR (Initial capability for ground surveillance). While noting the forms are in the initial draft stage, the meeting was of the opinion that the metric or performance indicator for ASBU B0-ASUR should have a more detailed service delivery focus. More appropriate performance indicator would be the percentage of the airspace volume is covered using ADS-B, MLAT or radar. The ANRF on B0-SURF and B0-ASUR is provided in **Appendix A** to this report for further consideration by CNS SG.

Amendment to SUPPS Doc.7030 (IP/09)

2.7 The meeting noted the information on approval of amendment to SUPPs Doc.7030 to include the procedure on requirement for disabling non-compliant ADS-B. The PfA was approved by the President on behalf of Council on 4 December 2013 and States were notified of the approval on 11 December 2013.

2.7.1 While noting the lengthy procedure on amendment to SUPPs required, the meeting observed that the similar PfA to Doc 7030 was processed in NAT region immediately after the PfA was approved by the President of the Council.

Agenda Item 3: Formulate and follow-up response from ADS-B SITF to AN/Conf-12 Recommendations

Follow-Up Work on Recommendations of AN-Conf/12 (WP/04)

3.1. The meeting was provided with an update of a review undertaken by a small working group (SWG) established by ADS-B SITF/12 and comprising Australia, Hong Kong China and Singapore, tasked to make recommendations for practical ADS-B related initiatives in response to outcomes of the 12th Air Navigation Conference, as directed by *APANPIRG Conclusion 24/4 - Follow-up to AN-Conf/12 and Recommendations by States and International Organizations* and *Decision 24/5- Follow-up to AN-Conf/12 Recommendations by APANPIRG***.**

3.1.1 Having reviewed the AN-Conf/12 recommendations, the SWG proposed that the ADS-B SITF respond to and take action on 16 of the 56 recommendations. The meeting reviewed and amended some draft responses developed by SWG, and formulated the following draft Conclusion:

Draft Conclusion 13/1 - Recommendations in Response to AN-andConf/12 Recommendations

That, the response to ADS-B related recommendations arising from AN-Conf/12, as provided in **Appendix B** to this report be adopted as guidance for consideration by States.

Agenda Item 4: Review Subject/Tasks List and action items including:

TOR and Subject/Tasks (WP/15)

4.1 The meeting reviewed the Terms of Reference of the ADS-B SITF and did not identify the need to revise the ToR which was considered still appropriate for the time being. However, the meeting identified the need to reflect correct name of APANPIRG Sub-groups in the note of ToR as shown in **Appendix C.**

4.1.1 The meeting reviewed and updated Subject/Tasks list of the Task Force which is provided in **Appendix D** to this Report.

4.1.2 In order to update status of Task No. 7/36, a survey was conducted during the meeting on the readiness of ADS-B ground stations that had been upgraded to be capable receiving ADS-B D0260B compliant ADS-B data. The result of the survey is provided in **Appendix E** to this report.

ADS-B implementation Status and APANPIRG Conclusions on ADS-B (WP/16)

4.2 The meeting reviewed information on ADS-B status in the APAC Region as presented by the Secretariat. The information was prepared with strong support provided by IATA and CANSO. States were urged to provide further updates to ensure that the data captured is current and accurate. The information updated during the meeting is provided in **Appendix F** to this Report.

4.2.1 The meeting also noted the relevant Conclusion and Decisions adopted by APANIRG in the last decade which is consolidated in **Appendix G** to this Report.

Proposed Amendment to AIGD (WP/17)

4.3. In accordance with its Terms of Reference, ADS-B SITF was tasked to develop guidance material to assist States and airspace users in the Asia/Pacific Region in implementing ADS-B. Australia, Hong Kong China and Singapore proposed amendment to the ADS-B Implementation and Guidance Document (AIGD) to incorporate guidance for monitoring and analysis of the performance of ADS-B avionics.

4.3.1 The 9th meeting of the South East Asia/Bay of Bengal ADS-B Working Group (SEA/BOB ADS-B/WG/9) recommended that States intending to mandate ADS-B equipage should commence early monitoring, analysis and follow up work before the mandate to allow sufficient time for airline operators to rectify problems, and for States to collect/analyze the data and conduct safety assessments, leading to deployment of ADS-B for operational use.

4.3.2 The proposed amendment to AIGD is provided at **Appendix H**, with changes tracked. It was proposed to add a new Appendix 2 into the AIGD as shown in the **Appendix H2** to provide guidance materials on performance monitoring and analysis of ADS-B equipped aircraft, based on the experience gained by relevant States/Administration including Australia, Singapore and Hong Kong China.

4.3.3 There are other proposed amendment to AIGD, including guidance materials on synergy between ADS-B and GNSS, revised ATC phraseology and clarification on the flight planning requirements etc.

4.3.4 It was foreseeable that increasing number of States worldwide would start to formulate plans to implement ADS-B in order to meet their operational needs and implement relevant Aviation System Block Upgrades (ASBUs). It was recommended that the AIGD should be promulgated to States in other Regions as guidance materials for experience and knowledge sharing on ADS-B implementation in order to reap early operational benefits and save efforts. The Secretariat informed the meeting that the AIGD had been already forwarded to other ICAO Regional Office for their reference and agreed to seek assistance from ICAO Headquarters to make the AIGD available to States in other Regions to achieve better synergy in ADS-B implementation.

4.3.5 In view of foregoing, the meeting developed the following Draft Conclusion:

Draft Conclusion 13/2 - Revised ADS-B Implementation and Operational Guidance Document.

That, the revised ADS-B Implementation and Operational Guidance Document (AIGD) provided in **Appendix H** (including **H2**) to this report be adopted.

Performance of ADS-B Stations and Avionics in Singapore FIR (WP/24)

4.4 Singapore shared with the meeting the performance monitoring that Singapore is conducting. It was mentioned that the probability of detection for 1s update rate is checked to detect drops in sensor performance and the probability of detection for 10s update rate is checked to ensure that ICAO requirement is met.

4.4.1. Singapore further shared that when the low NUC values of the ADS-B reports is found, airlines will be contacted, where possible, to be informed of the issue, so that the issue could be checked during servicing and maintenance.

4.4.2. New Zealand asked whether a list of airline contacts could be provided to ANSPs to facilitate such reporting. IATA responded that IATA can provide a generic contact list, but the contact person may not be directly handling ADS-B related issues. For non-Asia/Pacific airlines, IATA could assist with establishing point of contact for specific airlines.

4.4.3. The Chair stressed the importance of correct allocation of ICAO Aircraft Address (24 bit code), and States were urged to inform aircraft operators immediately errors were detected due to the criticality of this information in various surveillance and ACAS applications.

Flight Plan Association with ADS-B Surveillance Information (WP/25)

4.5 The USA presented a proposed approach for associating surveillance track data with flight plan information in ATC automation systems.

4.5.1 Each individual flight plan had a distinct Mode 3/A code that was generated for that flight. On initial contact with ATC (usually during the clearance delivery process), each aircraft was provided with their Mode 3/A code.

4.5.2 Radar systems in the USA continued to provide radar data in a Common Digitizer (CD) format. The data fields in this format were limited, so the primary identification information for an aircraft was the Mode 3/A Code included in the CD report. The ATC automation systems used the Mode 3/A Code to automatically associate an aircraft's surveillance track with the applicable flight plan data without the need for manual controller intervention. The CD format did not include a field for the 24-bit ICAO Address or the Flight ID. Therefore, the Mode 3/A Code was historically the only means for associating flight plans with radar surveillance tracks in the U.S.

4.5.3 In some instances, multiple aircraft had been operating on the same Mode 3/A Code, which could cause incorrect flight plan association. Additional problems occurred when more than one flight plan was filed for a given aircraft, creating an ambiguity in associating the surveillance track with the flight plan that required resolution during the initial clearance delivery process, negatively affecting operational efficiency.

4.5.4 USA had deployed ADS-B surveillance throughout the National Airspace System. Surveillance based on ADS-B information provided the Mode 3/A Code, along with Flight ID and 24-bit ICAO Address to identify the aircraft. Therefore, flight plan association could be enhanced for targets equipped with ADS-B.

4.5.5 The ICAO flight plan (FPL) provided a means for operators to enter the hexadecimal form of their ICAO Aircraft Address in the flight plan, using the CODE/ indicator. Since the Aircraft Address could be used for flight plan association, aircraft operators needed to ensure that the ICAO Address, if included in the FPL was entered correctly. Experience indicated that operators often made errors when providing Aircraft Address in the flight plan; therefore, use of only the Aircraft Address for flight plan association was not recommended.

4.5.6 As a result of ADS-B and other modernization initiatives, ATC automation systems would have direct access to Flight ID and Aircraft Address to support flight plan association. Since these identifiers were unique to each aircraft, the limitations associated with assignment of Mode 3/A Codes were mitigated.

4.5.7 In 2012, the USA's En Route Automation Modernization (ERAM) ATC automation system implemented flight plan association based on Mode 3/A Code, Flight ID, and ICAO Aircraft Address. If any of these parameters were available in the surveillance track, the ERAM system would make a flight plan association. However, if any of the parameters did not match the flight plan information, the association was dropped. The frequency of occurrence of dropped flight plan associations increased dramatically with this approach, primarily due to incorrect Flight ID and/or ICAO Address, either in the aircraft's avionics or in the aircraft's filed flight plan. As a result, a priority scheme was identified:

a) Matching Mode 3/A Code;
b) Matching Flight ID (if Mode 3/A Code not present or invalid); and
c) ICAO Aircraft Address, if Mode 3/A Code or Flight ID could not be matched.

4.5.8 When a flight plan association was made, no checks were initiated for the lower priority association method(s). If a mismatch of Flight ID was detected, ATC was notified through an alert in the aircraft's displayed data block.

4.5.9 This process was viewed as a robust methodology for surveillance track – flight plan association and identifying Flight ID entry errors.

4.5.10 The meeting was reminded that it was important that States develop a robust mechanism to ensure Flight ID was correctly input by crews. This could include training, education, incident reporting, or whatever other process was necessary to ensure compliance.

Centralized Database for ADS-B Avionics Performance Monitoring (WP/20)

4.6 Since December 2013, when ADS-B mandates for some major traffic flows in certain airspace over the South China Sea had become effective, monitoring and analysis of avionics performance of ADS-B equipped aircraft had become a significant task for concerned States/Administrations. Problems detected/observed by performance monitoring could have safety implications, which required timely promulgation and rectification.

4.6.1 APANPIRG/24 requested and ICAO agreed to support establishing a centralized database to be hosted by the ICAO Regional Sub-office (RSO) for sharing the monitoring results in order to enhance safety for the Region.

4.6.2 The ADS-B Avionics Problem Reporting Database (APRD) was proposed to be established for the Region and hosted centrally by the ICAO RSO. The proposed database structure is provided at **Appendix I** (focus Table 1b**)** to this report.

4.6.3 The APRD would be posted on a secure web-site accessible to States and Administrations, who would nominate a single point of contact for registration with the ICAO RSO. Points of contact would be notified each time the APRD was updated. The site would be administered by the ICAO RSO, and each registered State or Administration would be granted read-only, password protected access rights. A few States and/or Administrations with capabilities to monitor and analyze ADS-B avionics performance would also be accorded Administrator access rights.

4.6.4 States and Administrations were encouraged to establish a mechanism within their ANSP and regulatory authority to perform monitoring and analysis of ADS-B equipped aircraft. Guidance in establishing such mechanisms was provided in the ADS-B Implementation and Operations Guidance Document (AIGD), available on the ICAO Asia/Pacific Regional Office Website at http://www.icao.int/APAC/Documents/edocs/cns/ADSB_AIGD6.pdf.

4.6.5 It was noted by the meeting that the inputting of problems may become an issue, as experience with the reporting of FANS 1/A problems to the Central Reporting Agency (CRA) set up for that purpose showed that it was difficult to generate enthusiasm for this reporting among States.

4.6.6 IATA stated that the identification of operators and individual aircraft in a database that was accessible to a broad range of people was a concern. For example, while problems reported to the FANS 1/A CRA was de-identified the proposed APRD was not. There were concerns about being listed in an accessible database that was being interrogated by ANSPs and States, potentially with a view to "blacklisting: identified airframes.

4.6.7 The meeting discussed about a procedure that may be applied for restricted access to the database. After some further discussion, the meeting agreed that a de-identified database of known generic problems would be maintained (Table 1b).

Synergy between ADS-B and GNSS/PBN (WP/21)

4.7 Australia had recognized that for a large part of the aircraft fleet, fitment of ADS-B would require fitment of GNSS equipment to the aircraft at the same time.

4.7.1 Planning for Australia's transition to satellite based Navigation and Surveillance was well coordinated. For example:

- The one regulation requires both GNSS (for navigation) and ADS-B (for surveillance) to be fitted at approximately the same time;
- Regulations require all IFR aircraft to have appropriate GNSS equipment installed by February 2016, allowing Australia to decommission 50% of the existing NDB and VOR systems, whilst retaining the other 50% as a robust backup;
- The same regulation requires ADS-B to be installed in IFR aircraft on the same date for IFR operations in Western Australia, and in February 2017 for IFR operations throughout Australia; and
- New aircraft registered in Australia after Feb 2014, must already be equipped with ADS-B and GNSS.

4.7.2 The development of Industry plans in Australia recognized the synergy and consultation on both GNSS & ADS-B was conducted (and remained conducted) in close co-ordination between surveillance and navigation aspects. It was also recognized that there was significant efficiency & lower costs for an operator to have GNSS equipment and ADS-B equipment fitted at the same time under the one visit to the hangar.

4.7.3 At the SEA/BOB WG/9 meeting held in Nov. 2013 the synergy between PBN and ADS-B implementation using GNSS was discussed. The meeting agreed that a brief guidance material may be developed for consideration by CNS SG for inclusion into the regional PBN implementation plan. Australia agreed to prepare a draft for presentation to ADS-B SITF/13.

4.7.4 The guidance material on the synergy between ADS-B and GNSS/PBN technology was reviewed by the meeting. The meeting agreed that the additional guidance material will be included in the AIGD.

ADS-B Data RVSM Safety Monitoring (IP/05)

4.8 In following up Task list 9 (His No 39) of ADS-B SITF/12 meeting, Australia shared their experience in using ADS-B data for performing safety monitoring including RVSM aircraft height keeping. It was introduced that the Australian Airspace Monitoring Agency (AAMA) operated by Airservices Australia on behalf of ICAO, is one of 5 Asia/Pacific Regional Monitoring Agencies. The AAMA has led the world in the development and implementation of aircraft height-keeping monitoring and determination of Altimetry System Error (ASE) using ADS-B.

4.8.1 The principle used is to use the ADS-B geometric altitude (GPS derived) and environment pressure data to validate the Barometric based Flight level, which is also transmitted in ADS-B messages. In undertaking this activity, the AAMA has developed means by which to determine the geoid height reference of the aircraft. This is the height assumption of the GNSS system as Height Above Mean Sea Level (HAMSL) or Height Above Ellipsoid (HAE). The difference between HAE and HAMSL varies over the Earth's surface by +/- 200 ft and data analysed by the AAMA has determined there is significant variance across aircraft and aircraft fleets in relation to the reference used.

4.8.2 To date, the AAMA has monitored over 2800 individual airframes representing more than 122 operators and in excess of 4 billion separate data points, each of which has an associated ASE calculation. The data resulted in excess of 200 million minutes of monitoring output.

4.8.3 Using ADS-B for height monitoring has overcome numerous technical hurdles including: determining the geoid height reference; correcting data for bias due to ionosphere-induced errors in GNSS signals, position and time of day; developing statistical methods for small-data samples; and, the ability to efficiently analyse very large data sets (approximately 120 GB of data per month).

Research Plan RVSM performance monitoring (IP/11)

4.9. Japan also informed the meeting about their research plan regarding the viability of aircraft height keeping performance monitoring using ADS-B data. States are required to monitor the aircraft height-keeping performance in airspace where Reduced Vertical Separation Minimum (RVSM) is applied. The results of analysis were used to assess the viability of using ADS-B data as a means of height keeping performance monitoring. The outline of the research plan including consideration of characteristics of error sources and some issues for height monitoring was introduced.

Update on TPR901 Problem (IP/06)

4.10 Australia updated the meeting that Rockwell Collins had successfully introduced a Service Bulletin that solves the problem in Boeing aircraft. However, as reported at previous meetings, Australia had observed the problem with a number of Airbus aircraft. Rockwell has advised that a solution will not be available in the near future because of their commitment to DO260B development. The TPR901 transponder is used in a large number of commercial airliners.

4.10.1 Subsequent investigation by Rockwell Collins has found that the particular transponder, common to all of the aircraft where the position jumps had been observed, had an issue when crossing ±180 degrees longitude. On some crossings (1 out of 10) errors are introduced into the position longitude before encoding. These errors are not self-correcting and can only be removed by a power reset of the transponder.

4.10.2 Airbus has prepared a procedure to support power down before flight. However, there is no complete workaround available for flights that operate across 180 degrees longitude directly to destination without replacing the transponder. Airbus advised that a new TPR901 transponder compliant with DO260B will be available in 2014. This new transponder will not exhibit the problem.

Performance monitor by India (IP/12)

4.11 India informed the meeting about their efforts undertaken by India to monitor and identify ADS-B equipped aircrafts flying in Indian FIRs emitting position information non-conforming to the associated position integrity levels, using in-house developed software. Therefore primarily this effort is to identify those ADS-B equipped aircrafts supplying bad position reports with integrity levels greater than 4. The in-house developed software compares the ADS-B equipped aircrafts position reports with that of the local RADAR, taken as reference, to determine the amount of deviation from the reference position reports.

4.11.1 It is found in the analysis carried out at various airports installed with ADS-B ground sensors that the maximum deviation of the ADS-B position reports from reference RADAR was less than 0.5 NM in more than 95% of the position reports.

Performance of Current ADS-B Version 2 Systems (IP/18)

4.12 USA provided initial analyses of observed ADS-B Version 2 quality parameters in comparison to the requirements of the U.S. ADS-B Out rule.

4.12.1 It was informed that FAA was analyzing both the current performance of U.S. secondary surveillance systems used for ATC and current ADS-B Version 2 avionics performance, to derive operationally realistic benchmarks for the availability of the ADS-B quality parameters required by 14 CFR 91.227.

4.12.2 The FAA gathers and records the performance of ADS-B emitters that are detected by the current operational ADS-B radio stations in the U.S. via the Surveillance and Broadcast System Monitor. The information paper quoted the data collected for a two-month period during June 1 – August 31, 2013.

4.12.3 The data provided in a Table form demonstrated that, NIC>6 is the most challenging parameter to achieve with high availability using GPS position sources that were designed and certified prior to GPS Selective Availability being disabled (SA-unaware or “SA-on” receivers). The UPS aircraft have such a large range of NIC>6 availability since this fleet uses both SA-aware and SA-unaware GPS MMRs, both across the fleet and even both MMR models on a single aircraft. The US Airways fleet performance is thought to be reasonably representative of typical SA-aware MMR performance, even though only one manufacturer’s MMR model is the source of the data shown. The average NIC>6 performance of aircraft equipped with an Satellite-Based Augmentation System (SBAS) appears roughly equivalent to the average NIC>6 performance of aircraft equipped with SA-aware MMRs, even though the U.S. SBAS service, the Wide-Area Augmentation System (WAAS) had no notable service outages during this period.

4.12.4 Based on this data, for the current GPS satellite constellation, it appears that ADS-B systems using SA-aware GPS receivers will generate average NIC>6 operational availability values that are roughly equivalent to ADS-B systems using SBAS receivers.

Agenda Item 5: Review States' activities and interregional issues on trials and implementation of ADS-B and multilateration

ADS-B Implementation – ATC Phraseologies (WP/07)

5.1 IATA provided information on issues identified with ATC phraseologies which cannot be complied with by flight crew with existing aircraft equipage on board.

5.1.2 With the implementation of several ADS-B mandates in the end of 2013, relevant ATC procedures were promulgated by States in their AIP SUPPs. Issues were identified with ATC using the following ATC phraseologies that require review:

- TRANSMIT ADS-B IDENT
- STOP ADS-B TRANSMISSION
- RE-ENTER ADS-B AIRCRAFT IDENTIFICATION

5.1.3 ADS-B transmission was an integral component of the aircraft transponder, which had no controls or switches to permit the pilot to interact with ADS-B functions independently from SSR functions. ADS-B OUT was automatically activated when the transponder was switched on.

5.1.4 Compliance with an instruction to STOP ADS-B TRANSMISSION required the pilot to turn off the transponder. As a result, the phraseologies had created confusion and unnecessary R/T congestion.
IATA recommended that ATC in each State ceased:

a) using the phrase TRANSMIT ADS-B IDENT;

b) using any phrase to request termination of ADS-B transmission or operation; and

c) using the phrase RE_ENTER ADS_B AIRCRAFT IDENTIFICATION

5.1.5 Considering the lengthy process of proposing an amendment to PANS/ATM, the meeting agreed that an additional paragraph addressing the concerns on phrases to be included in the AIGD.

The Use of Flight Plan Data to Support ATM and the Effect of Variable Application of Flight Planning Requirements (WP/08)

5.2 Australia provided information on flight planning of ADS-B capability, the variable application of ICAO flight plan (FPL) requirements, the ATM system adaptation implemented in Australia to support ADS-B operations, and the effect of inconsistent application of flight planning methodology across aircraft operators.

5.2.1 Amendment 1 to the 15th Edition of ICAO Doc 4444 (PANS/ATM), effective in November 2012, introduced new, more detailed flight planning requirements improving the description aircraft capabilities in Items 10 and 18 of the ICAO FPL. Descriptors for surveillance equipment capabilities were provided for in Item 10b of the FPL. Descriptors for ADS-B capability were provided in both the "SSR Mode S" and "ADS-B" ranges of descriptors. The purpose of the ADS-B descriptors was to allow ATC to plan operations with an expectation that the aircraft will or will not be transmitting ADS-B as indicated in the FPL, before the aircraft was detected.

5.2.2 Examination of Flight Plan data indicated that serviceable ADS-B capability was not consistently indicated, perhaps due to a lack of clarity and understanding of the ICAO FPL requirements.

5.2.3 PANS/ATM Appendices 2 and 3 for use in FPL included two options for indicating an extended squitter (ADS-B) capability:

- E Transponder — Mode S, including aircraft identification, pressure-altitude and extended squitter (ADS-B) Capability

- L Transponder — Mode S, including aircraft identification, pressure-altitude, extended squitter (ADS-B) and enhanced surveillance capability

ADS-B descriptors in the flight plan include six options for ADS-B capability:

- B1 ADS-B with dedicated 1 090 MHz ADS-B "out" capability
- B2 ADS-B with dedicated 1 090 MHz ADS-B "out" and "in" capability
- U1 ADS-B "out" capability using UAT
- U2 ADS-B "out" and "in" capability using UAT
- V1 ADS-B "out" capability using VDL Mode
- V2 ADS-B "out" and "in" capability using VDL Mode 4

ICAO Doc 7030 *Regional Supplementary Procedures* for the North Atlantic (NAT) Region specified flight planning requirements for ADS-B:

- *NAT 2.1.15.1 All ADS-B approved aircraft intending to operate in the NAT Region shall insert either the B1 or B2 descriptor as appropriate in Item 10b of the flight plan;*

- While The SSR Mode S descriptors "E" and "L" provided for extended squitter (ADS-B) capability, in some cases it there may not be suitable GNSS / ADS-B input. Planning "E" or "L" could be based only on the extended squitter capability of the transponder, without regard for actual ADS-B compliance/capability of the aircraft;

- The ADS-B descriptors U1, U2, V1 and V2 were clear;

- B1 and B2 included the term "dedicated", which could suggest an ADS-B transmitter which was separate from the Mode S transponder. Depending on interpretation, B1 or B2 could be planned, depending on interpretation, to indicate ADS-B capability, regardless of the transmitter hardware (being either the Mode S transponder or a discrete unit), or only where the ADS-B transmitter was separate from the Mode S transponder;

- There was no value in ATC knowing whether or not the ADS-B capability was in a discrete unit or not. ATC was only interested in whether the aircraft as a whole was transmitting useable ADS-B data;

- The majority of ADS-B equipped flight plans received by Australia indicated both the SSR Mode S capability, and the associated ADS-B capability, e.g. EB1, LB1, LB2. Some ADS-B equipped flights we observed to be planning "E" or "L", but without "B1" or B2";

- There were significant issues faced by other regions that required DO260B for operational purposes. Currently there were no means in the flight plan to distinguish between DO260 and DO260B. It was likely that Europe/USA would require a designator to indicate DO260B compliance. For example:

  - B1/B2 : DO260 (or DO260A)
  - B3/B4 : DO260B

- European organizations had discussed additions to Item 18 SUR/ to achieve this as an interim measure until the ICAO FPL could be revised again. European organizations had also identified potential redundancy between L (and E) and the B1/B2 designators.

- An understanding of each aircraft's ADS-B capability was important for the Air Traffic Controllers' traffic management and planning. :

- The variability of flight planning understanding among operators, pilots and ANSPs undermined the reliability of information presented to the air traffic controller. There were no known current or anticipated operational uses for the declaration of 1090 MHz Extended Squitter capability in the flight plan beyond declaration of ADS-B capability.

- It was recommended that ICAO Doc. 4444 (PANS/ATM) Appendix 2 (A2-7) and Appendix 3 (A3-13) be amended as follows:

  - E Transponder — Mode S, including aircraft identification, pressure-altitude and ~~extended squitter (~~ADS-B out~~)~~ Capability

  - L Transponder — Mode S, including aircraft identification, pressure-altitude, ~~extended squitter (~~ADS-B out~~)~~ and enhanced surveillance capability

  - B1 ADS-B ~~with dedicated 1 090 MHz ADS-B~~ "out" capability using 1 090MHz extended squitter.

  - B2 ADS-B ~~with dedicated 1 090 MHz ADS-B~~ "out" and "in" capability using 1 090MHz extended squitter.

- In this recommendation there was duplication of indication of ADS-B carriage for aircraft where the Mode S transponder was the transmission device.

- This recommendation would be unlikely to require significant changes to ATM systems; the descriptors were unchanged but their interpretation was clarified. Some adaptation changes could be required where ANSPs were currently using the descriptors as triggers for system processing such as controller HMI indications.

- Changes to flight planning systems would be required in cases where the text associated with each descriptor was provided for pilot reference, and to individual States' AIP where ICAO DOC 4444 flight planning requirements were repeated.

- Some concerns on possible duplication were expressed regarding the proposed change on interpretation on code E and L. The meeting finally agreed to include the regional interpretation into the AIGD, and agreed to the following Draft Conclusion:

Draft Conclusion 13/3 – Flight Plan Item 10 ADS-B Indicators

That, ICAO be invited to consider to amend relevant contents in Doc. 4444 PANS/ATM Appendix 2 (A2-7) and Appendix 3 (A3-13) as shown below:

- E Transponder — Mode S, including aircraft identification, pressure-altitude and ~~extended squitter (~~ADS-B out~~)~~ capability
- L Transponder — Mode S, including aircraft identification, pressure-altitude, ~~extended squitter (~~ADS-B out~~)~~ and enhanced surveillance capability
- B1 ADS-B ~~with dedicated 1 090 MHz ADS-B~~ "out" capability using 1 090MHz extended squitter.
- B2 ADS-B ~~with dedicated 1 090 MHz ADS-B~~ "out" and "in" capability using 1 090MHz extended squitter.

Air Traffic Service Provision and Regulator Roles in ADS-B (WP/09)

5.3 Australia proposed a method for ADS-B service provision without requiring the involvement of the ANSP in certification issues.

5.3.1 Item 10b of the flight plan indicated surveillance equipment and capabilities. ICAO Doc 4444 (PANS/ATM) stated that capabilities comprised the following elements:

a) presence of relevant serviceable equipment on board the aircraft;

b) equipment and capabilities commensurate with flight crew qualifications; and

c) where applicable, authorization from the appropriate authority

5.3.2 In the SSR environment, the Air Traffic Control system continued to present the radar information, whether or not the SSR indicators were in the flight plan. The ANSP did not have the responsibility to check compliance, or the qualifications of the crew, or if certification of state of registry existed for the transponder. The ANSP assumed that the SSR equipment and altitude encoder was installed correctly, certified, maintained correctly, and that the pilot was capable of operating the equipment. SSR transmissions would not be made by aircraft unless the equipment was compliant with the standards. The same was true for ADS-B.

5.3.3 ADS-B data should not be transmitted unless the transmissions were compliant with the standards. This was endorsed by APANPIRG and reflected in Doc 7030 Regional Supplementary Procedures - MID/ASIA, Chapter 5 – Surveillance, Section 5.5.

5.3.4 As illustrated in **Figure 1**, The ANSP should also assume that if ADS-B was transmitted, the avionics is compliant. If the avionics was not compliant it should have been disabled as required in ICAO Doc 7030 Regional Supplementary Procedures - MID/ASIA, Chapter 5 – Surveillance, Section 5.5. The ANSP should assume that the crew was trained.

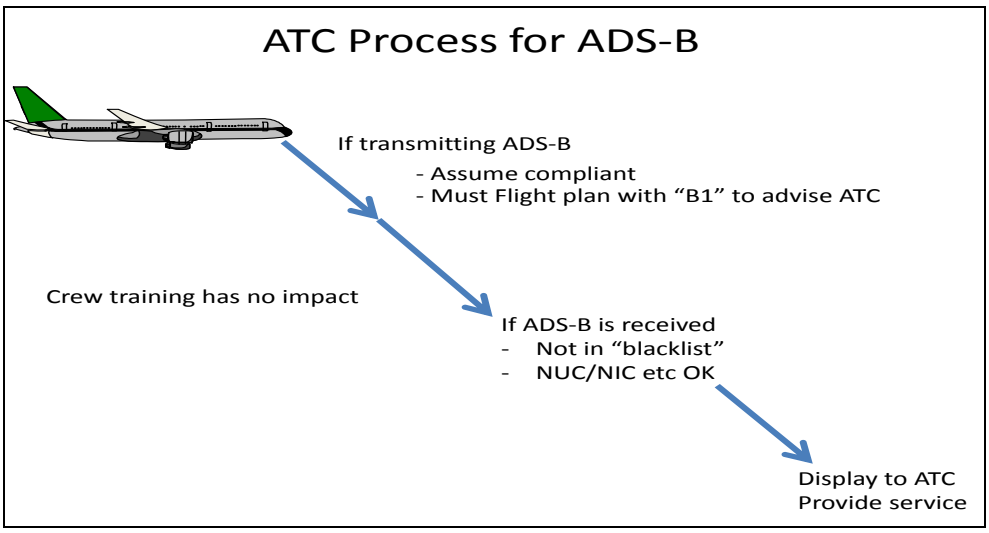

Figure 1: ATC Process for ADS-B

5.3.5 The absence of capability indicators in the FPL was sometimes used to indicate that crew training or State of registry approval did not exist. In all known operational implementations, received ADS-B data (with appropriate quality factors) was displayed to ATC whether or not the flight plan included ADS-B indicators.

5.3.6 It was not appropriate to discard ADS-B data based on the flight plan contents because flight plan indicators were sometimes wrong. There would be negative operational impact from removing the presence of an aircraft from display to ATC based on a single flight plan indicator.

ADS-B data should be used if:

a) the quality indicators (NUC/NIC etc) were acceptable; and

b) the aircraft was not in a "blacklist" of airframes not compliant with the regulations.

5.3.7 The regulator had the role of monitoring and enforcing the standards. It was entirely appropriate that the regulator used appropriate methods to confirm that the regulations were followed. These could include *inter alia* documentation checks, ramp checks, personnel licensing etc. Figure 2 illustrates Regulatory processes relating to ADS-B compliance.

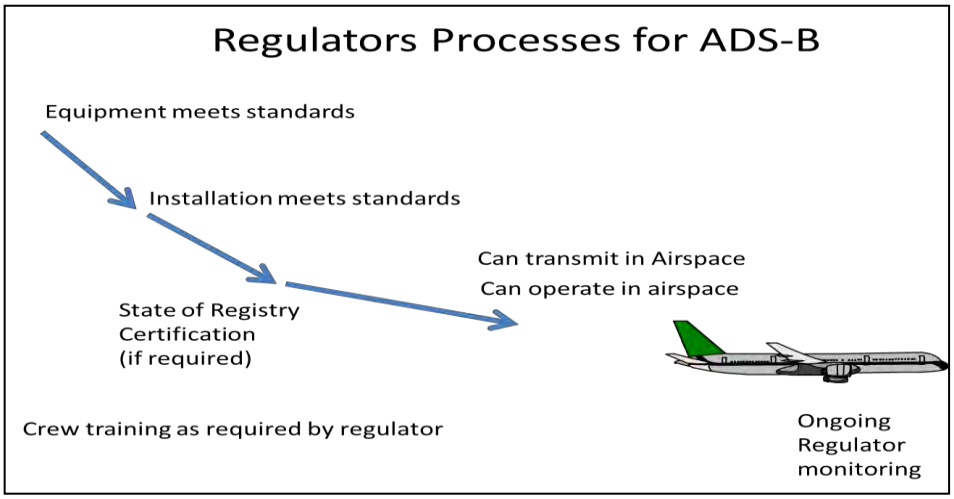

Figure 2: Regulatory Process for ADS-B

5.3.8 Regulators needed to be able to enforce requirements that non-compliant transmissions were to be disabled. In most cases, the regulator would be informed of detected non-compliance by the ANSP.

5.3.9 The operational specification process, whilst perhaps useful in the initial deployment of ADS-B, was seen as being a hindrance to maximizing operational use of ADS-B.

5.3.10 In discussions at SEA/BOB ADS-B WG/9 it was agreed that States in APAC Region did not require an "operational specification" (ops spec) to specify certification of non- equipment aspects such as crew training, maintenance etc. These issues were covered under the existing requirements (if any) for the GPS and transponder equipment. The operational approval requirements for ADS-B were considered to bring too little change to warrant an ops spec.

5.3.11 The requirement for aircraft operators to have an operational approval from their State arose from APANPIRG Conclusion 21/39, which was made in 2010.

5.3.12 Australia subsequently examined the performance of ADS-B data transmitted by aircraft that were not approved by their State of Registry, and found that in nearly all cases the data was as good as approved data. Those aircraft that were not transmitting compliant ADS-B were clearly detected by the ANSP mainly because of low or zero integrity (NUCp/NIC), or large track-jumps.

5.3.13 Australia consequently decided that the requirement for operational and technical approval from State of Registry was more of a hindrance than a help to both safety & efficiency.

5.3.14 It was noted that a number of Asia Pacific States required State of Registry operational approvals for the introduction of ADS-B airspace in December 2013, possibly to conform with the APANPIRG Conclusion/template.

5.3.15 Waiting for a State of registry operational approval process disqualified many fully compliant aircraft/crews from the advantages of ADS-B based ATC surveillance and its safety and efficiency benefits. Australia suggested that States reconsider the necessity for operational and technical approvals of aircraft by the State of Registry.

5.3.16 Australia recommended that States and ANSPs should reconsider any current requirements for "operational approval" for aircraft operators, and remove any such reference to a requirement for an "operational approval" or "operational specification" from State regulations and AIP.

5.3.17 New Zealand and USA supported the proposal to remove the requirement for operational approvals, and Canada advised that they also did not require operational approval. Other States stated that they would have difficulty in supporting ADS-B operations without an operational approval process. The meeting discussed the varying regulatory and legislative circumstances that may exist among Asia/Pacific States, and the evolutionary nature of each State's development of ADS-B regulations.

5.3.18 In view of the foregoing and in order to provide flexibility to those States until experience greater was gained, the following Draft Conclusion was developed by the meeting:

Draft Conclusion 13/4 - Regulations for Compliance of ADS-B Transmissions

That,

States be urged to implement regulations to give effect to Regional Supplementary Procedure Serial APAC-S12/10 – MID/Asia 5-3 to ensure that all aircraft transmitting ADS-B are compliant with the standards;

States in the Asia and Pacific Regions may choose to require or not require an Operations Specification or Operations Approval for ADS-B OUT.

ADS-B Operational Approval for Operations Outside of U.S. Domestic Airspace (WP/06)

5.4 USA provided information on how the FAA issued State of Registry operational approval for U.S.-registered aircraft to comply with ADS-B mandates of other States and discussing the burden to the aircraft operator and approving regulator of requiring "State of Registry" operational approval.

5.4.1 The Federal Aviation Administration (FAA) had created an operations authorization for U.S. Registered aircraft to comply with early ADS-B directives by Australia and Canada. The authorization, designated OpSpec/MSpec/LOA A353 was applicable to U. S. commercial and private aircraft conducting ADS-B operations outside U.S. designated airspace.

5.4.2 The process took three months on average from delivery of the application until HQ approved to issue the authorization. In earlier years this process was adequate as the FAA received less than ten applications per year. However, several ANSPs in the Asia/Pacific region had ADS-B mandates effective in December 2013 requiring operational approval by the State of registry. The number of applications had increased dramatically. Thus far in 2014 FAA had reviewed 93 applications, with a further 53 in the queue.

5.4.3 FAA had therefore decided to amend the process, and implement a new authorization; OpSpec/MSpec/LOA A153, with a reduced amount of documentation required from the operator and removal of the HQ review.

5.4.4 FAA believed that ADS-B operations should not require State of Registry operational approval. There were multiple air navigation service providers that safely managed ADS-B airspace without requiring State of Registry approval. The FAA's position was that State of Registry approval did not add value, but FAA would continue to use the new process to meet the requirements of other States while reducing the burden on the operator and decreasing the time period required for processing.

Implementation Status in China (WP/03)

5.5 China provided updates on the status of their ADS-B implementation at the SEA/BOB WG/9 meeting. Eight ADS-B ground stations had been installed by the end of 2012. The national ADS-B ground station deployment roadmap was going to be issued shortly. According to the draft plan, more than 200 ADS-B ground stations will be constructed nationwide as the first phase.

5.5.1 An ADS-B ground station had been put into trial operation in the area of Sanya FIR since 2008. Additional three ADS-B ground stations were being constructed in the area. In July 2009, Sanya ATC Centre integrated ADS-B signal into their ATM automation system which is able to display ADS-B data alone or show the integrated data derived from both radar and ADS-B. In order to support implementation of ADS-B based surveillance service for the major ATS routes L642 and M771, China had issued a NOTAM on ADS-B trial operation.

5.5.2 Currently in Sanya FIR an ADS-B signal alone won't be used for ATC separation services. It was further informed that current radar coverage was large enough to cover Sanya FIR.

Status in Viet Nam (WP/03)

5.6 Viet Nam informed at SEA/BOB WG/9 meeting of the status of their two phased ADS-B Implementation plan and ADS-B mandate for eight oceanic ATS routes including M771, L642, L625, N892, M765, M768, N500 and L628 at and above FL290.

5.6.1 The phase one for redundant coverage for oceanic airspace of Ho Chi Minh FIR had been completed by March 2013. The phase two for whole lower and upper airspace of Ha Noi and Ho Chi Minh FIR will be completed by 2016. The mandate for ADS-B equipage was published through an AIC dated 20 June 2013. According to the AIC, aircraft must carry a serviceable and compliant ADS-B OUT transmitting equipment from 12 December 2013 and aircraft operator were also requested to have relevant ADS-B operational approval issued from the State of aircraft registry.

Status in Malaysia (WP/03)

5.7 The SEA/BOB WG/9 meeting noted the ADS-B implementation plan presented by Malaysia. The plan include installation of two ADS-B ground stations in KL FIR; surveillance data sharing with neighboring country and the requirement for fitment of on-board equipment. The location of ADS-B stations will be at Pulau Langkawi and Genting Highland.

French Polynesia (IP/02)

5.8 France informed the meeting that domestic airspace surveillance of French Polynesia currently is provided through a Secondary Radar located on the main Island Tahiti. This radar covers only the part of the controlled area which is most frequently used. The radar implemented in 2009 has an expected life of 15 years. The ADS-B project has been launched to improve safety, surveillance, and efficiency.

5.8.1 The meeting noted the locations of 9 ADS-B receivers to be installed which will enable air traffic surveillance on the domestic network.

ADS-B Development and Implementation Plan in ROK (IP/03)

5.9 Republic of Korea updated the meeting of their ADS-B Development and Implementation Plan.

5..9.1 R&D project has been progressed in terms of ADS-B development and operational test. The objective of the deployment plan of the Korean government was to efficiently manage increased air traffic and reinforce the surveillance of low-altitude aircrafts and enhance situational awareness.

5.9.2 The MOLIT has been working on ADS-B system development since 2010 which includes 1090ES ground station (GS), UAT GS, UAT airborne equipage, UAT ground-vehicle equipage, ADS-B/TIS-B/FIS-B server, the monitoring system and ADS-B Validation System tool.

5.9.3 The government also set an Aviation Safety Network deployment program for light aircraft surveillance. A main purpose of the program is to detect light aircraft location and provide pilot with necessary alert message and information in case the aircraft enters a hazardous area.

Light Aircraft Surveillance Equipment (LASE IP/04)

5.10 USA provided information on LASE. The presentation introduced the purpose and capabilities of LASE performance requirement and exemptions.

ATC Surveillance Activities in Australia (IP/07)

5.11 Australia updated the meeting, about their ATC surveillance activities including following information on WAM, A-SMGCS and ADS-B:

- WAM in Tasmania (TASWAM) has been operational since early 2010
- WAM in Sydney (SYDWAM) is operational in the terminal area supporting a 3NM separation standard and for Parallel Runway Monitor (PRM) application
- Currently there are no plans to deploy further WAM systems; however the WAM system in Tasmania will soon be upgraded with Higher Power Interrogators to improve detection of aircraft (particularly at higher flight levels) within the multilateration volume
- The planned software upgrade to support DO-260B has been delayed in Sydney WAM. ADS-B coverage from WAM in Sydney has been restricted to minimise any impact from incorrect processing of DO-260B targets. Surveillance services are still being provided by radar/WAM coverage

A-SMGCS

- Operational in Melbourne since December 2009, Sydney since May 2010 and Brisbane since January 2014. In Melbourne, the ground display is integrated into the tower automation system and operates as a “fused display” with the associated terminal area radar
- Perth system still being tested with commissioning planned for mid this year

ADS-B

- 33 ADS-B sites are currently operational plus ADS-B is received from operational WAM systems
- A new project is planning to install 14 new ADS-B ground stations from 2014 to 2016 and improve the resilience of the digital communications network that transports the data from the remote ground stations to the ATC centres.
- Recent installations include Point Lookout and Mt Hardgrave which are close to radar sites on the East Coast to provide additional coverage to the East to support Oceanic ATC operations while also providing overlapping surveillance coverage to that provided by the existing radar
- Consideration is being given to upgrading the Terminal Control Unit, Automation System to display and process ADS-B at Melbourne and Perth.

Activation of ADS-B Mandates and ADS-B Equipage Rate

5.12 The meeting was informed that Australia successfully transitioned to mandatory ADS-B use at and above FL290 from 12 December 2013. In addition, forward fit of ADS-B is now required for new registrations in Australia

5.12.1 From 6th February 2014 all newly registered Australia aircraft that require a transponder must be fitted with Mode S and in addition those that fly IFR must also be fitted with ADS-B Out. This marks the start of a transition away from Mode A/C transponders to Mode S and ADS-B.

UAP ADS-B Mandate in Australia (IP/08)

5.13 While recalling the preparation work for UAP mandate in the last 5 years, Australia inform the meeting of their future mandate dates and requirements for Australian registered aircraft are shown below.

6 February 2014 - All IFR aircraft first registered on or after 6 February 2014

4 February 2016 - All IFR aircraft operating in Class A, B, C, or E airspace within 500NM north and east of Perth

2 February 2017 - All IFR aircraft first registered before 6 February 2016.

Surveillance Activities in Japan (IP/10)

5.14 Japan informed the meeting of their surveillance activities in Japan with regard to implementation of new systems, such as data fusion system, en-route WAM system and ADS-B. The surveillance activities were conducted based on the CARATS roadmap which indicates future CNS/ATM implementation plans in Japan.

5.14.1 Main characteristics for the design of WAM systems are as follows;

i) The systems are basically compliant with the European technical standards ED-142.

ii) The systems basically have duplicated coverage with SSRs. Currently mainland of Japan is double or triple coverage by SSRs. JCAB has planned to remove some of SSR sites by introducing the WAM system.

iii) The systems are capable of decoding ADS-B data with all versions (i.e. Ver.0, Ver.1, and Ver.2).

iv) The systems basically secure n-1 redundancy for the constellation of receiver sites. This means the system is possible to provide the same services (ex. performance and coverage) even if one receiver site suspended.

v) The systems have an interrogation function in some of the receiver sites to achieve high data update rate with 8 seconds. In addition, the interrogation function is also used as Mode-S DAPs (Downlink Aircraft Parameters) acquisition function in future.

India ADS-B project Updates (IP/13)

5.15 India updated the meeting on use of ADS-B information both for Enroute and Terminal Airspace. ADS-B is being used as complementary to Radar surveillance where radars are available. ADS-B information is also used for Non-Radar based Air Traffic Surveillance Services both in Enroute and Terminal Airspace. India has installed 21 ADS-B ground receivers, across the mainland and Port Blair.

5.15.1 The ground receiver equipment certification by the regulator has been completed at Cochin, Lucknow, Jaipur, Varanasi and Trivandrum. The other ground receivers are expected **to be** certified in near term. The integration of data from these ADS-B ground receivers into the ATS Surveillance systems and the fusion of tracks are in progress. The ADS-B surveillance sensor data from the 21 ground receivers, depending on the requirement to service an airspace volume, is/are integrated into the ATS Surveillance systems of Chennai, Kolkata, Mumbai, Delhi, Ahmadabad, Nagpur, Guwahati, Trivandrum, Varanasi, Mangalore, Cochin, Amritsar, Lucknow, Jaipur, Patna, Agartala, Bhubaneswar, Calicut, Coimbatore, and Trichy ATC Centers.

5.15.2 India expressed at SEA/BOB ADS-B WG/9 meeting their willingness to share ADS-B data with Myanmar, Maldives, Sri Lanka, Malaysia and Indonesia. The Airports Authority of India (AAI) had commenced the process of acquiring approval from the Government and Regulatory agencies for ADS-B data sharing with neighbors. In the recently concluded ATS coordination meeting of the Bay of Bengal Arabian Sea Indian Ocean Region India and Myanmar reviewed the status of implementation of ADS-B in the respective States.

Maldives (IP/14, WP/03)

5.16 The meeting was informed that Maldives Airports Company Limited (MACL) had completed installation and commissioning of 4 ADS-B ground stations in November 2012. Two stations were installed at Male' Ibrahim Nasir International Airport (INIA), one station is at the North in Kulhudhuffushi Island and another one is at South in Fuah Mulah Island. ADS-B data have already been integrated into SELEX SI ATM automation system. With these ADS-B ground stations, it now covers approximately 95% airspace of the FIR at and above FL290. Monitoring and collection of ADS-B data was carried out. Maldives has plans to share ADS-B data with its adjacent FIRs.

5.16.1 The meeting was also informed that the two large seaplane fleets in Maldives had equipped with ADS-B for their operational control purpose. The majority of the operation is concentrated within 80 nautical miles from Male TMA. ADS-B sensor installed at Male' enables to get data of seaplane movements from sea level to 6000ft up to 80NM. All the seaplanes operating equipped with ADS-B IN/OUT avionics

5.16.2 Maldives has a plan to commence ADS-B operations at and above flight level 290 by the end of 2016. Maldives is also willing to share ADS-B data with adjacent FIRs.

ADS-B related Activities in USA (IP/15)

5.17 USA provided a summary of activities and status of ADS-B implementation in USA including following aspects:

- Outcome of RTCA Special Committee 186;
- Regulatory Activities;
- Technical Standard Order (TSO)-C195a;
- Surveillance and Broadcast Services Program;
- Service Delivery Approach and Implementation Status;
- FAA ADS-B Development Strategy;
- Air Traffic Control Separation Services;

- Pilot Advisory Services;
- Pilot Applications;
- Oceanic In-Trail Procedures (ITP) [ICAO ASBU B0-OPFL];
- Interval Management (IM) [ICAO ASBU B0-RSEQ and B1-ASEP];
- Traffic Situation Awareness with Alerts;
- ADS-B on Airport Surface Vehicles;
- Using ADS-B to Enhance ATC Separation Services;
- Avionics Upgrades to ADS-B Version 2 Avionics;
- TCAS/ACAS-X Program [ICAO ASBU B2-ACAS]

The various website links to the rule making in USA were also provided to the meeting for reference.

Implementation Planning in Bangladesh (IP/16)

5.18 Bangladesh informed the meeting that Bangladesh has taken a Public Private Partnership (PPP) project that includes the installation of ADS-B ground stations throughout the country as back up to the present and proposed new radar systems and as a means of filling the gap in radar coverage over the Bay of Bengal area. Bangladesh is willing to share ADS-B data and VHF RCAG communications with neighboring States to enhance the safety and surveillance capability in the Sub-region.

5.18.1 It was noted that the near term ADS-B implementation plan includes installation of ADS-B ground stations at the following 4 (four) locations:

- Hazrat Shahjalal International Airport, Dhaka as a supplement to radar systems;
- Cox's Bazar Airport to provide surveillance coverage over the Bay of Bengal
- Barisal Airport to provide low level coverage for traffic to/from Kolkata, India.
- Saidpur Airport: To provide low level coverage for Flying Schools in the northwest.

5.18.2 The PPP project also includes an MLAT system at Hazrat Shahjalal International Airport, Dhaka to provide surface movement control and supplemental TMA coverage. The ADS-B ground stations, MLAT and Radar systems will be integrated with the new ATM Automation system to be installed at Dhaka. The PPP project was expected to be completed by December 2016.

ADS-B Version 2 Installation in USA (IP/17)

5.19 The meeting noted that **a**s of March 01, 2014, number of ADS-B Version 2 aircraft identified (not including vehicles, FAA test aircraft and U.S. military aircraft) was as follows:

2493 total DO-260B (1090MHz) Aircraft
1201 total DO-282B (UAT) Aircraft
123 dual 260B and 282B

5.19.1 As result of performance compliance monitoring, some known System Installation Issues are highlighted as follows:

- Non-compliant GPS or GPS not compatible with ADS-B transmitter
- Improper software versions
- Mode 3/A mismatch (transponder / UAT)
- Improper entry of 24-bit ICAO addresses
- Improper entry of ADS-B installation data

– Flight ID Data Entry
– A380 doesn't transmit Geometric Altitude
– Issues primarily found in General Aviation

Some corrective Actions being taken including:

- **AIR in conjunction with SBS and AFS will be working to educate the public on ADS-B**
- Seminars/briefings at trade & industry events
- Coordination of related articles in trade & industry publications

- **ADS-B Avionics Installation Guidance page on FAASTeam Maintenance Hangar website:** http://www.faasafety.gov/

- **Investigate compliance issues**
- Operators and installers contacted by AFS
- Manufacturers contacted by AIR

Safety assessment and operational approval for the use of ADS-B in Canadian Airspace (IP/20)

5.20 NAV CANADA provided information sharing their experience on the development and recent changes in the regulatory requirements under which NAV CANADA operates in the provision of separation services associated with ADS-B Out. The changes resulted in the removal of the requirement for NAV CANADA to check if their airspace users hold an ADS-B Operations Specification prior to providing ADS-B Out separation services.

5.20.1 NAV CANADA is regulated under Canadian Aviation Regulations (CARs), developed and enforced by th the Canadian Civil Aviation Authority, Transport Canada.

5.20.2 The CARs reference Instrument Flight Rules (IFR) separation using radar; there is no CARs reference to other surveillance sources for IFR application. Therefore, in order to utilize alternate means to provide surveillance separation, NAV CANADA required an exemption to the existing CARs.

5.20.3 Over a three year period leading up to operational use of ADS-B Out for surveillance separation in January 2009, NAV CANADA developed a detailed Safety Management Plan. This plan included a Hazard Identification and Risk Analysis (HIRA). The HIRA process identified potential risks as determined from the product of severity and probability of occurrence, and recommended mitigations to bring the risks to a level as low as reasonably practical (ALARP).

5.20.4 As a result of recent modifications to the HIRA document, as of December 31st, 2013, Transport Canada issued a revised exemption to CAR to NAV CANADA. This revision allows NAV CANADA to utilize ADS-B as a surveillance source for separation as low as five nautical miles regardless of the receipient holding an ADS-B Operations Specification. This change has allowed NAV CANADA to expand services to all aircraft that provide ADS-B Out message meeting the required performance level. This increased the participation percentages from approximately 55% to 90% of the traffic volume, offering significant opportunities for increased efficiencies in trajectory management.

5.20.5 The meeting appreciated the detailed information on the experience of NAV CANADA provided in the paper.

Space based ADS-B Surveillance Service (IP/19)

5.21 An overview of NAV CANADA's plans for introduction of space-based ADS-B surveillance services was provided to the meeting. It was recommended That States to support worldwide value extraction from space-based ADS-B surveillance. The paper referred to the IP/1 presented at the Air Traffic Management Operations Panel (ATMOPSP) Send Working Group of the Whole Meeting (WG/WHL/2) held in Montreal, Canada – 31 March to 4 April 2014. The attached ATMOPSP Information Paper provides the detailed development proposed by NAV CANADA to extract value from ADS-B Out signals received by the Iridium Next constellation through the hosted payload sponsored by Aireon. The Concept of Operations at Attachment One to the Information Paper, developed in collaboration with NAV CANADA's customers, identifies the phased implementation in the evolution of the surveillance services and the associated Air Traffic Management (ATM) changes delivering quantifiable benefits. It was stated in the attached Information

5.21.1 The meeting appreciated the opportunities offered to States/Administrations in the APAC Region to receive additional information through a workshop on space-based ADS-B supported by NAV CANADA. The Secretariat agreed to explore appropriate opportunity including time and venue for a regional workshop on space based ADS-B.

Business Jet Aircraft Fitment Issues

5.21.2 Under this Agenda Item, the meeting also discussed about ADS-B fitment rate issue for Business jet aircraft. It was advised that a number of States/Administrations had received a letter from IBAC asking for suspension or withdrawal of the ADS-B mandates in the specified routes segments of the concerned State/Administrations' airspace.

5.21.3 The meeting noted that:

- The South China Sea project had received considerable publicity over many years. Most stakeholders (eg. IATA) had become involved and supported the project and the mandates;

- APANIRG has supported the project & mandates through adoption of Conclusions including the latest one Conclusion 22/8;

- Airframe OEM organisations such as Gulfstream have provided avionics and issued bulletins about the Australian and South China Sea mandates well before the effective date;

- Relevant States had published AIP/AIC documents years in advance of the effective date giving due period of time to compliance with the requirement and had received no objection from any organisations until after the effective date. The time for objections would have been in the formative stages of the project, not after implementation;

- IBAC affiliated organisations (eg the Australian ABAA) were well aware of the Australian and South China Sea activities;

- The FAA published material referring the mandates well before they became effective;

- CANSO has supported the mandates and the activities had been well publicised in the industry;

- The Airlines and travelling public obtain safety & efficiency benefit as a result of ADS-B fitment and as a result of the homogeneous (ADS-B only) nature of the airspace;

- The requirement for State of Registry approval is in accordance with APANPIRG conclusion 21/39. It should be further noted that individual states may or may not choose to require State of Registry approvals;

- Due consideration should be also given to provide priority for access to the mandating airspace for aircraft with operative ADS-B as equipment over those aircraft not operating ADS-B equipment.

5.21.4 As a result of discussion, it is concluded that IBAC should have been well aware of the project and had numerous opportunities to attend or object during the past years. It is inappropriate to object after the mandate comes into effect.

5.21.5 Based on the directive of APANPIRG and deliberations at ADS-B Study and Implementation Task Force, a common position was developed among the Administrations concerned with respect to the response to the request from IBAC. The meeting also requested Secretariat to invite IBAC to participate future meeting of the Task Force.

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

Requirement for ICAO Aircraft Address in Flight Planning and Associated Issues (WP/10)

6.1 Australia provided information discussing issues on the inclusion of ICAO Aircraft Address in flight planning and proposing that this data item was not required for flight planning.

6.1.2 The ICAO Aircraft Address was a unique identifier allocated by individual States under ICAO Annex 10 Vol. 3 Chapter 9 *Aircraft Addressing System*. It was configured in the aircraft's transponder/s and was not accessible or configurable by the pilot. It served largely to support technical functions such as Mode S Selective Interrogation, ADS-B processing by ground stations, FANS 1/A logon correlation, data items in ASTERIX format messages to identify unique targets, etc. It could also be used as a unique identifier to support track fusion from multiple data sources as could occur in a multi-sensor tracking system.

6.1.3 Appendix 2 of ICAO Doc. 4444 (PANS/ATM) stated that CODE/ (where the Aircraft Address was expressed as hexadecimal characters) could be included in the FPL Item 18 as optional data. Some States had mandated the flight planning of CODE/, typically with the implementation of ADS-B services. The AIP of other States either reflected the availability of CODE/ as an optional entry in FPL Item 18, or made no mention of it at all.

6.1.4 Where the Aircraft Address was included in the FPL many ATM systems would then use it as one possible means of associating a surveillance track or FANS 1/A logon request with a FPL. Other means included Flight ID, SSR Mode 3/A code or (for ADS-C) the aircraft registration.

6.1.5 A mismatch between the Aircraft Address configured in the transponder and the CODE/ indicated in the FPL could cause issues in the ATM system such as warnings to ATC of the mismatch, or coupling of a surveillance system track to an incorrect flight plan, or failure to couple at all.

6.1.6 Where CODE/ was flight planned and aircraft were subsequently reallocated after flight plan submission, it would be necessary to update the filed FPL with the new aircraft address via a modification message (CHG). This was often not correctly done. During Australia's ADS-B trials of the use of CODE/ in flight planning for a medium sized operator of turbo-prop aircraft the relatively frequent number of aircraft changes, without corresponding FPL amendments, triggered numerous cases of incorrect couplings based on CODE/, in these cases via Mode S SSR.

6.1.7 A significant number of aircraft had incorrectly configured transponders, with an Aircraft Address not consistent with the allocation by the Civil Aviation Safety Authority.

6.1.8 Australia recommended that, where Flight ID and/or Mode 3/A SSR code were available as a means of associating a surveillance track to a flight plan in the ATM system, these should be the primary means of achieving such an association, and the flight planning of CODE should not be mandatory, but considered as a fallback methodology only for particular cases where Flight ID was not available to support coupling.

6.1.9 Noting the above information, the meeting after discussion, agreed that it was the prerogative of the individual State to determine the track association criteria and flight planning requirements that best suited its operational environment and traffic mix, rather than being stipulated at regional level.

Progress on Possible Project: Papua New Guinea (PNG), & Australia & Indonesia (WP13)

6.2 At ADS-B SITF/10 and SITF/11 it was proposed that an ADS-B data sharing project be included in the ATM system modernization planning activities in PNG. A PNG-Australia data sharing project was now close to commencing.

6.2.1 Both Australia and Indonesia had ADS-B programs, and both had deployed ground stations and commenced sharing data across the FIR boundary. The use of shared ADS-B data between Indonesia and Australia increased situational awareness and supported safety nets. It reduced numbers of coordination incidents at the FIR boundary, and provided earlier detection of ATC and pilot errors, and technical and operational analysis of data to increase support and confidence in data sharing in preparation for future radar-like separation at the FIR boundary.

6.2.2 PNG was implementing an ATM system modernization program including plans to deploy 7 duplicated ADS-B ground stations and ADS-B data sharing filter capabilities. Regulatory requirements for aircraft to equip with ADS-B avionics were also being developed, but an implementation date had not yet been established.

6.2.3 ADS-B surveillance was planned to be utilized above FL245 across the Port Moresby FIR and also in specific higher traffic areas between Port Moresby, Mount Hagen, Madang and Nadzab.

Surveillance on Low Flying Aircraft Using ADS-B (WP/14)

6.3 Hong Kong China provided information highlighting the ADS-B ground station system in Hong Kong for provision of surveillance on both en-route and low-level aircraft including general aviation (GA) and helicopters equipped with ADS-B. Flight trials confirmed the system provided good surveillance coverage, enhancing surveillance capabilities and situational awareness for ATC and pilots, and facilitating Search and Rescue (SAR) operations and subsequent accident/incident investigations.

6.3.1 Flight trials were conducted by Hong Kong Civil Aviation Department in cooperation with the Government Flying Service (GFS), using their helicopter equipped with an on-board ADS-B test transponder. During the trials the aircraft maintained low altitude (e.g. 500 FT AMSL) as far as practicable, and descended for landing at selected locations. ADS-B and SSR data were recorded and compared. Target drops were observed in SSR data for aircraft flying at low altitude, but there were almost no ADS-B target drops.

6.3.2 Based on the satisfactory results of the flight trials, CAD would continue to work with GFS to equip their newly delivered fixed-wing aircraft and helicopters with ADS-B as a pilot scheme. With consideration of the cost-benefits, availability of avionics products and technical installation issues, CAD had kicked off discussion with local industry to explore the way forward in equipage of other locally registered GA aircraft and helicopters

6.3.3 Republic of Korea expressed appreciation to Hong Kong China for sharing such useful information with other States as Korea was conducting a study to work out a solution for the low flying GA aircraft. Regarding proposed GM to be developed, Hong Kong China agreed to prepare the GM for consideration by next meeting. The GM would include consideration of design and selection of locations for low level GA type traffic, etc.

Separation Minima, Airspace Capacity and ADS-B Mandates (WP/11)

6.4 The Secretariat presented information on operational capacity, efficiency and safety improvements enabled by ADS-B surveillance, the Regional expectation of implementation of these capacity and efficiency benefits, and on a Draft Conclusion developed for consideration by APANPIRG, through the ATM Sub-Group, intended to provide guidance to States on appropriate steps to be taken when planning and implementing mandates for aircraft ADS-B equipage.

6.4.1 The extension of ATS surveillance coverage as a result of ADS-B implementation provided the opportunity for significant improvements in airspace capacity while simultaneously reducing ATC workload and task complexity. Applicable separation standards were defined in PANS/ATM, and referenced in the Asia/Pacific Seamless ATM Plan which also defined categories of airspace in which surveillance-based separation standards should be applied.

6.4.2 Significant airspace capacity and efficiency improvements were achieved through the implementation or extension of ATS surveillance services, *where accompanied by implementation of surveillance based separation standards*.

6.4.3 ICAO Doc 4444 – *Procedures for Air Navigation Services/Air Traffic Management (PANS/ATM)* specified horizontal separation minima based on ATS surveillance systems of 5.0NM, or 3.0 NM when radar capabilities at a given location so permit.

6.4.4 It was noted that surveillance-based separation minima of 5NM and 3NM had been in wide use globally for several decades, including in a number of Asia/Pacific States, in many cases using early generations of primary and/or secondary radar systems and ATC displays which had long since been retired. The implementation of these separation minima provided a quantum leap in airspace capacity and efficiency, improved opportunity for flight at optimal, fuel-efficient flight levels, and reduced ATC workload and task complexity.

6.4.5 The introduction of advanced ATM automation systems had further improved ATC capacity, where supported by appropriate separation standards.

6.4.6 Overly-conservative separation minimums such as 20, 30, 50 and 80 NM were both applied and planned within surveillance coverage in some critical areas of Asia/Pacific airspace, thus failing to fully utilize current and planned surveillance and ATM system capability, and restricting airspace capacity.

6.4.7 The Asia/Pacific Seamless ATM Plan specified Preferred ATM Service Levels (PASL) in two Phases. PASL Phase I, with expected implementation by 12 November 2015, included the expectation that all ATC units should authorize the use of the horizontal separation minima stated in ICAO Doc 4444 (PANS ATM), or as close to the separation minima as practicable.

6.4.8 CANSO stated that it was important that capacity enhancements were realized as soon as possible, and commented that the benefits of coverage that may be inferred by coverage diagrams presented in ICAO and DGCA Conference reports may not in fact exist without the implementation of data exchange or other initiatives. Some coverage charts and diagrams may create a wrong impression among decision makers.

6.4.9 IATA urged States to consider and address the issues impeding the region from implementing the separation standards that would improve airspace capacity and efficiency by providing ATC with the tools to deliver optimal services.

6.4.10 The combined 4th Meeting of the South Asia/Indian Ocean ATM Coordination Group and 21st Meeting of the South East Asia ATS Coordination Groups (SAIOCG/4 & SEACG/2, Hong Kong, China, 24 to 28 February 2014) had noted that the imposition of an ADS-B mandate should be the final step in any ADS-B implementation process, and agreed to the following Draft Conclusion for consideration by the ATM Sub-Group and APANPIRG:

Draft Conclusion SAIOACG4/SEACG21-1: ADS-B Airspace Mandates

That, States considering airspace mandates for aircraft Automatic Dependent Surveillance-Broadcast (ADS-B) equipage are urged to ensure that the effective date of any such mandate is determined after consideration of the following:

a) appropriate consultation with affected airspace users;

b) the area of airspace requiring carriage and operation of ADS-B to be coordinated with affected Air Traffic Control (ATC) units, including those adjacent to the ADS-B airspace;

c) conduct of a safety case, which includes, inter alia, a human factors review and the integration of the ADS-B data with the ATC workstation;

d) pilot and ATC training for the provision of ADS-B surveillance-based separation;

e) the ability to provide an enhanced service delivery; and

f) promulgation of the ADS-B airspace with appropriate notice, and in accordance with the provisions of Annex 15.

The above Draft Conclusion was supported and endorsed by the meeting.

ADS-B Data Sharing Between India and Myanmar (WP/18)

6.5 The meeting was provided with an update by India of the status of ADS-B data sharing between India and Myanmar, which had been agreed in principle between the States. Initial discussions initiated at ADS-B SITF/11 in April 2012 were further progressed at the ADS-B focus group meeting facilitated by CANSO in July 2012.

6.5.1 ADS-B SITF/12 (April 2013) had agreed to Draft Conclusion 12/2, adopting milestones for data sharing between India and Myanmar, who had earlier agreed in principle to share data from the Agartala, Port Blair, Sittwe and Coco Island sites.

6.5.2 The Port Blair and Agartala ADS-B ground station receivers were installed and regulatory approval was expected by end of May 2014. The installation at Sittwe had also been completed, but Coco Island's was delayed till end of 2014 due to bad weather and logistics issues. The proposed data sharing agreement, based on the ICAO Asia/Pacific ADS-B Data Sharing Agreement Template, had been submitted to the Ministry of Civil Aviation, which was actively coordinating for inter-ministerial clearances which were expected by end of June 2014. The date for signing the data sharing agreement may be realistically expected in 2nd half of 2014 after approval from the Ministry of Civil Aviation.

Implementation updates from Singapore (WP/22)

6.6 Singapore presented an update on the implementation of ADS-B within the Singapore FIR. On 6 November 2013, Singapore issued AIP Supplement 243/13 advising that from 12 December 2013, aircraft operating on ATS routes L642, M771, N891, M753, L644 and N892, at or above FL290 must carry a serviceable ADS-B and operational approval as a follow-up to the original AIC published in December 2010 on ADS-B implementation. Prior to implementation, Singapore noted an ADS-B equipage rate of 70%, but after implementation this had jumped to above 90%. The implementation of ADS-B airspace within the Singapore FIR had been successful. However a few issues were discovered pertaining mostly to flight planning errors. The issue of phraseology for ADS-B operations that could cause confusion for flight crew and ATC is also highlighted with recommendations to the taskforce for review.

Sub-regional ADS-B Implementation Plan Updates (WP/23)

6.7 On behalf of Indonesia, the Philippines and Viet Nam, Singapore presented updates on the progress of the collaborative efforts of the States for South China Sea project. Singapore received ADS-B data from the Indonesian islands of Matak and Natuna while Indonesia had also received ADS-B data from Singapore. Singapore also received ADS-B data from Vietnamese island of Con Son. As for the communications, VHF radios from Con Son is operational; while the VHF radios from Matak and Natuna were installed and expected to be operational within 2014. The Philippines and Singapore also agreed in-principle on ADS-B data sharing. The Philippines is securing a site in Quezon Palawan for the installation of ADS-B and VHF.

6.7.1 In response to a query, the Philippines clarified that as part of CNS/ATM project resumed recently, only one ADS-B ground station will be installed in Manila in 2016. The ADS-B station at Quezon Palawan being discussed between Singapore and the Philippines will not be integrated into the new ATM system. It was further informed that the interim ATS system to be made available at Manila by end of 2014 will be capable to process ADS-B data. In this connected, the Secretariat was requested to follow up with CAAP for appropriate arrangement to utilize the ADS-B data that will be available from Quenzon Palawan station at least for technical evaluation.

Agenda Item 7: Any other Business

Regional Supplementary Procedures Amendment to Support ADS-B Mandates (WP12)

7.1 The Secretariat presented a Proposal for Amendment (PfA) to Regional Supplementary Procedures (ICAO Doc 7030) to support State mandates for ADS-B equipage for aircraft operating outside territorial airspace but within the area of responsibility of the State.

The following Conclusion concerning ADS-B mandates had been adopted by APANPIRG:

C 22/8 ADS-B Airspace Mandate

That, States intending to implement ADS-B based surveillance services may designate portions of airspace within their area of responsibility:
a) mandate the carriage and use of ADS-B equipment; or
b) provide priority for access to such airspace for aircraft with operative ADS-B as equipment over those aircraft not operating ADS-B equipment.

7.1.1 A Proposal for Amendment (PfA) to Regional Supplementary Procedures had been drafted by the ICAO Asia/Pacific Regional Office (Serial No. APAC-S 14/09 – MID/ASIA/PAC). The PfA included amendments relating to mandates for ADS-B, ADS-C, ACAS II and Mode S SSR transponders, to provide a framework for the establishment of performance-based airspace by enabling States to promulgate airspace mandates over the High Seas. The PfA was intended to encourage a regional approach to the establishment of such mandates, where it was appropriate to do so. The proposal recognized that unlike the cases of Europe, the North Atlantic or North America it was not practical for the Asia/Pacific Region to establish Sub-Regional or Region-wide simultaneous mandates.

7.1.2 The proposed amendment was in accordance with the concept of Seamless ATM and performance-based approaches, the Aviation System Block Upgrade (ASBU) initiative and Global Air Traffic Management Operational Concept (ICAO Doc 9854).

7.1.3 The ADS-B-related sections of the PfA are provided at **Appendix J**. The PfA would be presented for agreement by the Second Meeting of the Air Traffic Management Sub-Group of APANPIRG (ATM/SG/2) in August 2014, and subsequent endorsement by APANPIRG/25.

7.1.4 The meeting was informed that the PfA would be coordinated with the APANPIRG Chair, and processed through ATM Sub-Group and APANPIRG for formal presentation to the Council of ICAO after APANPIRG endorsement. Parallel coordination would be conducted with ICAO HQ to ensure the document was ready for processing by APANPIRG/25 (September 2014)

7.1.5 The meeting made a number of comments which are annotated in the attached draft PfA. The meeting supported the PfA in principle to be reviewed and adopted by APANPIRG in a form of Conclusion, subject to further amendment by relevant group of APANPIRG.

Security Issues of ADS-B Operations (WP/19)

7.2 India presented security aspects of ADS-B protocols. The provisions of the Aviation Security Manual (Doc 8973) had urged to make provisions for protection of critical information and computer systems against cyber-attacks and interference. Further, in the recently issued Air Traffic Management Security Manual (Doc 9985), emphasis had been placed on the protection of ATM systems against cyber attacks.

7.2.1 Due to the high dependence of ADS-B on data links to carry surveillance data the possibility of attacks needed to be deliberated.

7.2.2 As there were no cryptographic mechanisms implemented in the ADS-B protocol, messages could be trivially injected, modified or deleted by an attacker with control of the wireless channel.

7.2.3 Passive attacks involved the recording and misuse of unencrypted ADS-B messages to obtain unique identifiers of aircraft as well as accurate position trajectories. There were several methods of obtaining messages, including commercially available ADS-B receivers, internet services providing digitized live ADS-B data to the public, and Mode S and ADS-B-capable open source equipment. The movement of VIP aircraft in particular was highly undesirable from the national security aspect.

7.2.4 Active attacks could result in severe threats to air traffic safety, and could be based on message injection, message deletion and message modification. Injection of ADS-B messges from non-existent or *ghost* aircraft could be broadcast on ADS-B channels, potentially flooding the ANSP and leading to undesired decisions by ATC or denial of service due to excessive ghost targets in the surveillance system.

7.2.5 The Asia/Pacific Region ADS-B Implementation Guidance Document (AIGD) recognized the security issues associated with ADS-B, and stated that the nature and complexity of the ATC system as a whole needed to be considered when contemplating security issues. Recommendations had been made for the States to handle the ADS-B security issues in coordination with the appropriate national organizations and ANSPs.

7.2.6 In this connection, the meeting recalled that the issue was discussed and addressed a number of years ago. As a result, a guidance material was developed and adopted by APANPIRG which is available under ICAO Portal site. The nature of ADS-B not same as Radar with respect to security concerns was recognized.

Review of outcome of South East Asia (SEA) and Bay of Bengal (BOB) Sub-regional Projects

7.3 The meeting reviewed and further updated the Sub-regional ADS-B implementation projects as presented by the Ad Hoc working groups (South East Asia, Bay of Bengal, East Asia and Regulatory Group). The outcome of discussions by Ad Hoc working groups is provided in **Appendix K** to this Report which could serve as a basis for further development of the sub-regional implementation plans at its next meeting. A readiness checklist updated by the SEA/BOB WG/9 meeting is provided in **Appendix L** to the Report.

Date and Venue for the Next Meeting

7.4 The meeting discussed whether there was a need to hold further meetings to progress implementation of ADS-B in the Region. The exchange of ideas, and experience gained during the planning and implementation period was considered invaluable. The next ADS-B Task Force meeting was scheduled for April or May 2015. Australia would consider hosting the meeting subject to approval by the Administration concerned. The SEA/BOB ADS-B WG/10 meeting was scheduled for October or November 2014. The Secretariat would further coordinate with member States of the Task Force and Working Group for these meetings. The member States would be informed of the exact dates and venues in due course.

7.5 The meeting also discussed the life time of the Task Force, which had met 13 times in the past 11 years. A number of guidance materials had been developed and then adopted by APANPIRG to assist States in the planning and implementation of ADS-B. The Task Force would further discuss outstanding issues/tasks at its next meeting and, depending on the scale of work involved, any uncompleted tasks may be addressed by other contributory bodies of APANPIRG after the next meeting. This issue would be included as an agenda item for the next meeting of the Task Force, for further discussion.

Note of appreciation

7.6 The meeting expressed its appreciation and gratitude to the Civil Aviation Department of Hong Kong China for hosting the ADS-B Seminar, the excellent arrangements made for the meeting and for all activities organized during the meeting including a visit to the new ATM facilities.

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AIR NAVIGATION REPORT FORM

HOW TO USE - EXPLANATORY NOTES

1. **Air Navigation Report Form (ANRF):** This form provides a standardized approach to implementation monitoring and performance measurement of Aviation System Block Upgrades (ASBU) Modules. The Planning and Implementation Regional Groups (PIRGs) and States could use this report format for their planning, implementation and monitoring framework for ASBU Modules. Also, other reporting formats that provide more details may be used but should contain as a minimum the elements described below. The Reporting and monitoring results will be analyzed by ICAO and aviation partners and then utilized in developing the Annual Global Air Navigation Report. The Global Air Navigation Report conclusions will serve as the basis for future policy adjustments aiding safety practicality, affordability and global harmonization, amongst other concerns.

2. Regional/National Performance objective: In the ASBU methodology, the performance objective will be the title of the ASBU module itself. Furthermore, indicate alongside corresponding Performance Improvement area (PIA). Consequently, for ASBU Block 0, a total of 18 ANRFs will need to be developed that reflects respective 18 Modules.

3. Impact on Main Key Performance Areas: Key to the achievement of a globally interoperable ATM system is a clear statement of the expectations/benefits to the ATM community. The expectations/benefits are referred to eleven Key Performance Areas (KPAs) and are interrelated and cannot be considered in isolation since all are necessary for the achievement of the objectives established for the system as a whole. It should be noted that while safety is the highest priority, the eleven KPAs shown below are in alphabetical order as they would appear in English. They are access/equity; capacity; cost effectiveness; efficiency; environment; flexibility; global interoperability; participation of ATM community; predictability; safety; and security. However, out of these eleven KPAs, for the present, only five have been selected for reporting through ANRF, which are Access & Equity, Capacity, Efficiency, Environment and Safety. The KPAs applicable to respective ASBU module are to be identified by marking Y (Yes) or N (No).

4. **Implementation Progress:** This section indicates status of progress in the implementation of different elements of the ASBU Module for both air and ground segments.

5. **Elements related to ASBU module:** Under this section list elements that are needed to implement the respective ASBU Module. Furthermore, should there be elements that are not reflected in the ASBU Module (example: In ASBU B0-A CDM, Aerodrome certification and data link applications D-VOLMET, D-ATIS, D-FIS are not included; Similarly in ASBU B0-AIM, note that WGS-84 and eTOD are not included) but at the same time if they are closely linked to the module, ANRF should specify those elements. As a part of guidance to PIRGs/States, the FASID (Volume II) of every Regional ANP will have the complete list of all 18 Modules of ASBU Block 0 along with corresponding elements, equipage required on the ground and in the air as well as metrics specific to both implementation and benefits.

6. **Implementation Status (Ground/Air):** Planned implementation date (moth/year) and the current status/responsibility for each element are to be reported in this section. Please provide as much details as possible and should cover both avionics and ground systems. If necessary, use additional pages.

7. **Implementation Roadblocks/Issues**: Any problems/issues that are foreseen for the implementation of elements of the Module are to be reported in this section. The purpose of the section is to identify in advance any issues that will delay the implementation and if so, corrective action is to be initiated by the concerned person/entity. The four areas, under which implementation issues, if any, for the ASBU Module to be identified, are as follows:

   - Ground System Implementation:
   - Avionics Implementation:
   - Procedures Availability:
   - Operational Approvals:

   Should be there no issues to be resolved for the implementation of ASBU Module, indicate as "NIL".

8. **Performance Monitoring and Measurement:** Performance monitoring and measurement is done through the collection of data for the supporting metrics. In other words, metrics are quantitative measure of system performance – how well the system is functioning. The metrics fulfil three functions. They form a basis for assessing and monitoring the provision of ATM services, they define what ATM services user value and they can provide common criteria for cost benefit analysis for air navigation systems development. The Metrics are of two types:

   A. Implementation Indicators/supporting metrics: This indicator supported by the data collected for the metric reflects the status of implementation of elements of the Module. For example- Percentage of international aerodromes with CDO implemented. This indicator requires data for the metric "number of international aerodromes with CDO".

   B. Benefit Metrics: This Metric allows to asses benefits accrued as a result of implementation of the module. The benefits or expectations, also known as Key Performance Areas (KPAs), are interrelated and cannot be considered in isolation since all are necessary for the achievement of the objectives established for the system as a whole. It should be noted that while safety is the highest priority, the eleven KPAs shown below are in alphabetical order as they would appear in English. They are access/equity; capacity; cost effectiveness; efficiency; environment; flexibility; global interoperability; participation of ATM community; predictability; safety; and security. However, out of these eleven KPAs, for the present, only five have been selected for reporting through ANRF, which are Access & Equity, Capacity, Efficiency, Environment and Safety. It is not necessary that every module contributes to all of the five KPAs. Consequently, a limited number of metrics per type of KPA, serving to measure the module(s)' implementation benefits, without trying to apportion these benefits between module, have been identified at the end of this table. This approach would facilitate States in collecting data for the chosen metrics.

9. On the basis of examples of Performance Indicators/supporting Metrics detailed in this document, PIRGs/States to reflect under this section the appropriate metrics that represents the monitoring of respective ASBU Module both in terms of implementation as well as benefits to five KPAs.

The impact on KPAs could be extended to more than five KPAs mentioned above if maturity of the system allows and the process is available within the State to collect the data.

AIR NAVIGATION REPORT FORM (ANRF)
APAC Regional Planning for ASBU Modules

REGIONAL/NATIONAL PERFORMANCE OBJECTIVE – B0-SURF:
Safety and Efficiency of Surface Operations (A-SMGCS Level 1-2)

Performance Improvement Area 1:
Airport Operations

ASBU B0-SURF: Impact on Main Key Performance Areas (KPA)

	Access & Equity	Capacity	Efficiency	Environment	Safety
Applicable	Y	Y	Y	Y	Y

ASBU B0-SURF: Planning Targets and Implementation Progress

Elements	Targets and Implementation Progress (Ground and Air)
1. Surveillance system for ground surface movement(PSR,SSR, ADS-B or Multilateration (Aircraft vehicles)	November 2015 (Seamless ATM Phase I): All high density international aerodromes (100,000 scheduled movements per annum or more) should have provided electronic surface movement guidance and control.
2. Visual aids for navigation	November 2015 (Seamless ATM Phase I) All high density international aerodromes (100,000 scheduled movements per annum or more) should have implemented visual aid components of an SMGCS (makings, lights and signs).
3. Wildlife strike hazard reduction	November 2015- (Seamless ATM Phase I)All high density international aerodromes (100,000 scheduled movements per annum or more) should have completed wildlife hazard assessment and implemented mitigation measures

ASBU B0-SURF: Implementation Challenges

Elements	Implementation Area			
	Ground system Implementation	**Avionics Implementation**	**Procedures Availability**	**Operational Approvals**
Surveillance system for ground surface movement(PSR,SSR, ADS-B or Multilateration (aircraft vehicles)	A-SMGCS system integrating sensors. Vehicles properly equipped (cooperative transponder systems)	Nil	Nil	Nil
Visual aids for navigation	nil	Nil	nil	Lack of calibration capacity
Wildlife strike hazard reduction	nil	Nil	Lack of national procedures for recording and reporting wildlife strikes	Conflict with nation environment regulations

ASBU B0-SURF: Performance Monitoring and Measurement (Implementation)	
Elements	**Performance Indicators/Supporting Metrics**
Surveillance system for ground surface movement(PSR,SSR, ADS-B or Multilateration (aircraft vehicles)	Percentage of high density international aerodromes with electronic surface movement guidance and control in accordance with the Seamless ATM Plan Phase 1.
10. Visual aids for navigation	Percentage of international aerodromes complying with visual aid requirements as per Annex 14, Volume I
11. Wild life strike hazard reduction	Percentage of reduction of wildlife incursions

ASBU B0-SURF: Performance Monitoring and Measurement (Benefits)	
Key Performance Areas	**Performance Metrics**
Access & Equity	Improves portions of the Manoeuving area obscured from view of the control tower for vehicles and aircraft. Ensures equity in ATC handling of surface traffic regardless of the traffic's position on the international aerodrome
Capacity	Sustained level of aerodrome capacity during periods of reduced visibility
Efficiency	Reduced taxi times through diminished requirements for intermediate holdings based on reliance on visual surveillance only. Reduced fuel burn
Environment	Reduced emissions due to reduced fuel burn
Safety	Reduced runway incursions. Improved response to unsafe situations. Improved situational awareness leading to reduced ATC workload

AIR NAVIGATION REPORT FORM (ANRF)

APAC Regional planning for ASBU Modules

2. REGIONAL PERFORMANCE OBJECTIVE – ASBU B0-ASUR: Initial capability for ground surveillance **Performance Improvement Area 1: En-route and Terminal Operations**					
3. ASBU B0-ASUR: Impact on Main Key Performance Areas					
	Access & Equity	**Capacity**	**Efficiency**	**Environment**	**Safety**
Applicable	Y	Y	Y	Y	Y

4. ASBU B0-ASUR: Planning Targets and Implementation Progress	
5. Elements	**6. Targets and implementation progress (Ground and Air)**
Item 180- ATS surveillance of Regional Seamless ATM Plan	November 2015 (Seamless ATM Plan Phase 1): All Category S upper controlled airspace and Category T airspace supporting high density aerodromes should be designated as non-exclusive or exclusive as appropriate ADS-B airspace requiring operation of ADS-B
	November 2018 (Seamless ATM Plan Phase 2): All Category S upper controlled airspace and Category T airspace should be designated as non-exclusive or exclusive as appropriate ADS-B airspace requiring operation of ADS-B using 1090ES with DO-260/260A and 260B capability. In areas where ADS-B based separation service is provided, the mandatory carriage of ADS-B OUT using 1090ES with DO260/260A and 260B should be prescribed
Item 270- ATS surveillance with data integrated	November 2015 (Seamless ATM Plan Phase 1): ADS-B or MLAT or radar surveillance systems should be used to provide coverage of all Category S-capable airspace as far as practicable, with data integrated into operational ATC aircraft situation displays

7. ASBU B0-ASUR: Implementation Challenges				
Elements	**Implementation Area**			
	Ground System Implementation	**Avionics Implementation**	**Procedures Availability**	**Operational Approvals**
Item 180- ATS surveillance	Long transition time to ADS-B systems for SSR equipped providers Misuse of ADS-B messages of insufficient integrity Sharing of data surveillance	Ratio of fleet ADS-B equipped and approved, particularly in general aviation, and ageing commercial fleet Faulty/ageing avionics	NIL	Dependent on States' development of approval standards.

7. ASBU B0-ASUR: Implementation Challenges				
Elements	**Implementation Area**			
	Ground System Implementation	**Avionics Implementation**	**Procedures Availability**	**Operational Approvals**
Item 270- ATS surveillance with data integrated	Lack of any automation functionality. Quality control of integration of data into ATM automation systems.	NIL	NIL	NIL

8. ASBU B0-ASUR Performance Monitoring and Measurement 8A. ASBU B0-ASUR: Implementation Monitoring	
Elements	Performance Indicators/Supporting Metrics
Item 180- ATS surveillance	Indicator: Percentage of FIRs with ATS surveillance using ADS-B or SSR or MLAT where ATS surveillance is possible (Percent of airspace is provided with ATS surveillance service using ADS-B or SSR or MLAT) Supporting metric: Number of FIRs with ATS surveillance using ADS-B or SSR or MLAT where ATS surveillance is possible
Item 270- ATS surveillance with data integrated	Indicator: Percentage of ACCs with ATS Surveillance using ADS-B, MLAT or radar where ATS surveillance is possible and having data integrated into the ATC system situation display Supporting metric: Number of ACCs with ATS Surveillance using ADS-B, MLAT or radar where ATS surveillance is possible and having data integrated into the ATC system situation display

8. ASBU B0-ASUR. Performance Monitoring and Measurement 8 B. ASBU B0-ASUR: Performance Monitoring	
Key Performance Areas	**Metrics (if not indicate qualitative Benefits)**
Access & Equity	Improved airspace capacity, separation standards and ATC situational awareness permit better opportunity for access to airspace by all users.
Capacity	Benefits: Typical surveillance-based horizontal separation minima are 3 NM or 5 NM enabling a significant increase in airspace capacity compared to procedural minima.
Efficiency	Benefits: Optimized air traffic flow sequencing and runway throughput rates enabled by typical surveillance separation minima. Reduced ATC workload with implementation of surveillance separation minima and significantly reduced radiotelephony traffic required for managing identified aircraft.
Environment	Benefits: Reduced carbon emissions resulting from increased airspace capacity and efficiency, which lead to greater opportunity for flight at optimal flight levels and reduction in airborne holding.

8. ASBU B0-ASUR. Performance Monitoring and Measurement 8 B. ASBU B0-ASUR: Performance Monitoring	
Key Performance Areas	**Metrics (if not indicate qualitative Benefits)**
Safety	Benefits: Less likelihood of airspace and ATC overload due to increased airspace capacity and reduced controller workload. Reduced likelihood of breakdown-of-separation incidents. Support for search and rescue alerting response.

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Recommendations Adopted by AN-CONF/12	Proposed Response/Actions by ADS-B SITF
Recommendation 1/2 – Implementation That ICAO: a) through its regional offices, **provide guidance and practical assistance to States** and regions and sub-regions when they decide to implement individual blocks or modules of the aviation system block upgrades; b) establish a group and improved mechanism for interregional cooperation to ensure harmonization of air traffic management; and c) **assist States and regions in training and capacity-building towards implementation** of the relevant modules of the aviation system block upgrades.	APANPIRG has already, and will continue, to provide guidance and practical assistance to States in our region regarding planning and implementation of ASBU modules related to ADS-B OUT and ADS-B IN including B0-SURF, B0-ASUR, B0-OPFL, B0-ASEP and B0-SNET etc. Since 2002, APANPIRG has established the "ADS-B Study & Implementation Task Force" (ADS-B SITF) which has been providing comprehensive guidance materials for ADS-B and numerous seminars and workshops on ADS-B before each meeting. APANPIRG has already proposed early implementation of ADS-B OUT technology and will continue to do so. This has been reflected in the Asia/Pacific Regional Surveillance Strategy document. B0-ASUR on "Initial Capability For Ground Surveillance" and B0-SNET on "Increased Effectiveness of Ground Based Safety Nets", which are dependent on ADS-B OUT technology, are amongst the highest priority ASBU implementation in the Asia Pacific region.
Recommendation 1/7 – Automatic dependent surveillance — broadcast That States: a) recognize the effective use of automatic dependent surveillance — broadcast (ADS-B) and associated communication technologies in bridging surveillance gaps and its role in supporting future trajectory-based air traffic management operating concepts, noting that the full potential of ADS-B has yet to be fully realized; and	APANPIRG has already proposed early implementation of ADS-B OUT technology, and will continue to do so. APANPIRG has encouraged ADS-B data sharing among States. Conclusions have been adopted under APANPIRG to urge States to share their ADS-B data and DCPC facilities. ADS-B data sharing is already operational in the region and further deployments are being planned. Besides, APANPIRG has also encouraged harmonized ADS-

Recommendations Adopted by AN-CONF/12	Proposed Response/Actions by ADS-B SITF
b) recognize that cooperation between States is key towards improving flight efficiency and enhancing safety involving the use of automatic dependent surveillance — broadcast technology; That ICAO: c) urge States to share automatic dependent surveillance — broadcast (ADS-B) data to enhance safety, increase efficiency and achieve seamless surveillance and to work closely together to harmonize their ADS-B plans to optimize benefits.	B implementation among States. Templates for harmonized ADS-B implementation, promulgation of harmonized ADS-B avionics equipage requirements, and guidelines for airworthiness and operational approval, have been developed and published. The dates of ADS-B mandates in many sub-regions were also aligned to take effect from 12 December 2013. APANPIRG has developed and published guidance materials on ADS-B data sharing and harmonized ADS-B implementation, and will continue to promote it at each APANPIRG and its contributory bodies' meetings.
Recommendation 1/9 – Space-based automatic dependent surveillance — broadcast That ICAO: a) support the inclusion in the Global Air Navigation Plan, development and adoption of space-based automatic dependent surveillance — broadcast surveillance as a surveillance enabler; b) develop Standards and Recommended Practices and guidance material to support space-based automatic dependent surveillance — broadcast as appropriate; and c) facilitate needed interactions among stakeholders, if necessary, to support this technology.	APANPIRG noted the development of space-based ADS-B. APANPIRG suggests that the highest cost benefit for this technology will be in the NAT region. The technology may also be cost effective in oceanic regions where installation of ground surveillance equipment/systems are technically infeasible. In this case, the cost benefit from reduced separation standards competes against FANS ADS-C and with ADS-B IN technology. We also note that the cost to ANSPs and the applicable lateral separations are not yet clear and that the technology is, as yet, unproven.

Recommendations Adopted by AN-CONF/12	Proposed Response/Actions by ADS-B SITF
	However, APANPIRG sees enormous potential for space-based ADS-B across the oceans of the region. The strategy being adopted by the region is to keep an eye on its development until there is clarity about technical success and about the cost of the services before committing to this technology. The Asia/Pacific Seamless ATM Plan has identified space-based ADS-B as one of the key areas that should be researched for future development, in order to continue pursuance of seamless ATM beyond ASBU Block 0 implementations and global interoperability.
Recommendation 1/11 – Automation roadmap That ICAO: a) develop a global roadmap for the evolution of ground air traffic management automation systems in line with aviation system block upgrade implementation; and b) develop performance-based system requirements for air traffic management automation systems so that: 1) where necessary these systems are interoperable across States and regions; and 2) the function and operation of these systems will result in consistent and predictable air traffic management system performance across States and regions.	APANPIRG should encourage States to ensure that all newly deployed air traffic management automation systems should support all applicable ICAO adopted surveillance technologies such as ADS-B / MLAT and Mode S DAPS (Mode S Enhanced Surveillance), and that when appropriate, existing air traffic management automation systems will be upgraded to have such capabilities. Besides, capabilities to allow ADS-B data sharing should be included. Depending on whether there will be operational benefits to States and the region, APANPIRG could consider to promulgate a time line of expected ADS-B / MLAT / Mode S DAPS capabilities in their air traffic management automation systems by say November 2018 (in line with the "Preferred ATM Service Levels" PASL Phase II in Asia/Pacific Seamless ATM Plan).

Recommendations Adopted by AN-CONF/12	Proposed Response/Actions by ADS-B SITF
	Guidance materials regarding appropriate ADS-B / MLAT / Mode S DAPS functionalities are available in the published guidance documents including guidance on sharing of ADS-B data. However, guidance materials for ADS-B implementation in complex radar airspaces are yet to be developed. ADS-B SITF to consider enhancing guidance materials for implementation of Mode S DAPS, as well as ADS-B implementation in radar airspace if needed.
Recommendation 1/12 – Development of the aeronautical frequency spectrum resource 1) That States and stakeholders: a) recognize that a prerequisite for the deployment of systems and technologies is the availability of adequate and appropriate radio spectrum to support aeronautical safety services; b) work together to deliver efficient aeronautical frequency management and "best practices" to demonstrate the effectiveness and relevance of the industry in spectrum management; 2) demonstrate efficient use of the spectrum allocated through efficient frequency management and use of best practises;	With the deployment of ADS-B consideration should be given to the decommissioning of radars to reduce frequency spectrum utilization. The sharing of DCPC facilities to support ADS-B operations could also lead to decommissioning of certain HF stations and thus releasing the associated HF frequencies. High ADS-B fitment rates may lead to the removal of primary radars in some states. The Regional Surveillance Strategy has encouraged States to reduce dependence on primary radars for area surveillance.

Recommendations Adopted by AN-CONF/12	Proposed Response/Actions by ADS-B SITF
Recommendation 2/2 – Development of ICAO provisions for remotely operated air traffic services That ICAO provide: a) updates on additional guidelines for surveillance and air and ground communications systems; b) requirements for the use of sensors and display technologies to replace visual observation to air traffic in the provision of air traffic services; and	Due to the high Mode-S and ADS-B fitment and usage in the APAC region, trials of remotely operated ATS may be practical within the region earlier than other regions. APAC states should be encouraged to support these activities.
Recommendation 4/1 –Efficient management of airspace and improved flow performance through collaborative decision-making That States: h) accelerate the implementation of collaborative decision-making processes in the provision of services at the regional level, being guided by the principles set forth in the *Manual on Collaborative Air Traffic Flow Management* (Doc 9971) and the *Manual on Flight and Flow – Information for a Collaborative Environment* (Doc 9965); i) according to their operational needs, implement the aviation system block upgrade modules relating to network operations included in Block 0.	CDM in some environments may be improved by separate organisations having a common view of the traffic. ADS-B data sharing between organisations may support better CDM.

Recommendations Adopted by AN-CONF/12	Proposed Response/Actions by ADS-B SITF
Recommendation 4/2 – ICAO aviation system block upgrades relating to ground surveillance using automatic dependent surveillance – broadcast/multilateration, air traffic situational awareness, interval management and airborne separation. That the Conference: a) endorse the aviation system block upgrade modules relating to **interval management** included in Block 1 and recommend that ICAO use them as the basis of its work programme on the subject; b) agree in principle to the aviation system block upgrade modules relating to airborne separation included in Block 2 as the strategic direction for this subject; That States: h) according to their operational needs, to implement the aviation system block upgrade modules relating to ground surveillance, improved air traffic situational awareness and improved access to optimum flight levels included in Block 0.	APANPIRG supports and prioritizes deployment of ASBU B0-ASUR (Initial Capability for Ground Surveillance) using ADS-B OUT technology. Initially, this serves the needs of ground surveillance but will place the region in a good position for ADS-B IN applications listed in Block 0, 1 and 2. States could consider the cost effectiveness of using forward fit mandates (requiring new airframes to be equipped) when planning the transition to ADS-B. APANPIRG could consider to enhance safety & efficiency in the region by supporting further deployment of ADS-B IN capabilities available in Block 0, including : - B0-ASEP Air Traffic Situational Awareness (ATSA) - B0-OPFL Improved Access to Optimum Flight Levels Through Climb/Descent Procedures Using ADS-B (ITP)
Recommendation 4/3 – ICAO aviation system block upgrades relating to airborne collision avoidance systems and ground-based safety nets That the Conference: a) endorse the aviation system block upgrade module relating to ground-based safety nets included in Block 1 and recommend that ICAO use it as the basis of its work programme on the subject;	Depending on whether there will be operational benefits for States and the region, APANPIRG could further improve safety in the region by encouraging States in the region to implement: B0-SNET Increased Effectiveness of Ground Based Safety Nets States in the region could agree, based on ALARP principles, to replace / upgrade their ATC systems to include :

Recommendations Adopted by AN-CONF/12	Proposed Response/Actions by ADS-B SITF
b) agree in principle to the aviation system block upgrade module relating to airborne collision avoidance systems included in Block 2, as the basis of the strategic direction for this subject; g) incorporate the new generation of airborne collision avoidance system (ACAS X) into its work programme; That States: i) according to their operational needs, to implement the aviation system block upgrade modules relating to airborne collision avoidance systems and ground based safety nets included in Block 0.	- Short-term conflict alert (STCA) using data from available surveillance sensors such as Radar, WAM and ADS-B - Area proximity warning (APW) - Minimum safe altitude warning (MSAW) - Route adherence monitoring (RAM) - Cleared level adherence monitoring (CLAM) - Selected level mismatch (using Mode C, Mode S and ADS-B data) The Asia/Pacific Seamless ATM Plan has set target date for implementation of the ground-based safety nets by PASL Phase II (expected implementation by November 2018). This could be done at the same time as upgrading the ATC system to support ADS-B. This recommendation supports ACAS-X which uses ADS-B to improve ACAS performance. An ADS-B fitment mandate across the APAC region would improve the effectiveness of these ACAS-X capabilities.
Recommendation 4/5 – Civil/military coordination/cooperation and sharing of airspace That States: a) planning and implementation regional groups, and ICAO to analyse the benefits that could be achieved through improved civil/military cooperation and sharing of the airspace serving international traffic flows and express the results of this analysis in terms of:	APAC could consider encouraging the sharing of ADS-B data between civilian and military authorities, including those from neighbouring States, to support a common view of the airspace. Engagement of the military in ADS-B could lead to improved co-ordination and increased airspace sharing. Use of ADS-B data provided by the civilian authority could fill surveillance gaps in the military system (at least as far as civilian traffic is concerned).

Recommendations Adopted by AN-CONF/12	Proposed Response/Actions by ADS-B SITF
1) capacity increases and reduction in routine delays as measured by traffic volumes on major traffic flows; 2) document fuel savings and emission reductions through the use of the fuel savings estimation tools; and 3) other additional benefits;.	Guidance materials on advice to military authorities regarding ADS-B data sharing has been developed and published.
Recommendation 4/6 – ICAO aviation system block upgrades relating to integration of remotely piloted aircraft into non-segregated airspace That the Conference: a) endorse the aviation system block upgrade module relating to remotely piloted aircraft included in Block 1 and recommend that ICAO use it as the basis of its work programme on the subject; b) agree in principle to the aviation system block upgrade modules relating to remotely piloted aircraft included in Blocks 2 and 3 as the strategic direction for this subject;	According to ICAO Annex 2 – Rules of the Air, "remotely piloted aircraft" is defined as "an unmanned aircraft which is piloted from a remote pilot station". When operated above 400ft, beyond visual line of sight, "remotely piloted aircraft" should be operated under the IFR and be equipped with the appropriate surveillance technology for the class of airspace. The APANPIRG publication of such a rule could avoid the costs of an expensive retrofit in the future. The time is right for ADS-B SITF to deliberate such a strategic move.
Recommendation 6/1 – Regional performance framework – planning methodologies and tools That States and PIRGs: a) finalize the alignment of regional air navigation plans with the Fourth Edition of the *Global Air Navigation Plan* (Doc 9750, GANP) by May 2014;	APANPIRG should focus on implementing ASBU Block 0 Modules according to States' operational needs. ADS-B related ASBU Block 0 modules are ready for deployment including :

Recommendations Adopted by AN-CONF/12	Proposed Response/Actions by ADS-B SITF
b) focus on implementing aviation system block upgrade Block 0 Modules according to their operational needs, recognizing that these modules are ready for deployment; c) use the electronic regional air navigation plans as the primary tool to assist in the implementation of the agreed regional planning framework for air navigation services and facilities; d) involve regulatory and industry personnel during all stages of planning and implementation of aviation system block upgrade modules; e) develop action plans to address the identified impediments to air traffic management modernization as part of aviation system block upgrade planning and implementation activities;	- B0-ASUR (Initial capability for ground surveillance) using ADS-B/MLAT - B0-SNET Increased Effectiveness of Ground Based Safety Nets - B0-ASEP Air Traffic Situational Awareness (ATSA) - B0-OPFL Improved Access to Optimum Flight Levels Through Climb/Descent Procedures Using ADS-B (ITP) The Asia/Pacific Seamless ATM Plan has set the priorities and timeline in implementing the above modules.
Recommendation 6/2 – Guidelines on service priority That: a) ICAO develop an appropriate set of operational and economic incentive principles to allow early benefits of new technologies and procedures, as described in the aviation system block upgrade modules, to support operational improvements, while maximizing safety, capacity and overall system efficiency; and b) States and international organizations contribute to this work.	APANPIRG could obtain some quick wins by promulgating a view that aircraft equipped with ADS-B have service priority over those that don't (i.e. better equipped, better served). This will increase the business case for equipage. The above has already been reflected in the ADS-B mandate published by States (e.g. non-ADS-B equipped aircraft is required to fly outside the ADS-B airspace)

Recommendations Adopted by AN-CONF/12	Proposed Response/Actions by ADS-B SITF
Recommendation 6/6 – Use of multiple constellations That States, when defining their air navigation strategic plans and introducing new operations: a) take advantage of the improved robustness and availability made possible by the existence of multiple global navigation satellite system constellations and associated augmentation systems; b) publish information specifying the global navigation satellite system elements that are approved for use in their airspace; c) adopt a performance-based approach with regard to the use of global navigation satellite system (GNSS), and avoid prohibiting the use of GNSS elements that are compliant with applicable ICAO Standards and Recommended Practices; d) carefully consider and assess if mandates for equipage or use of any particular global navigation satellite system core constellation or augmentation system are necessary or appropriate;	ADS-B robustness would be improved if multiple constellations could be used. APANPIRG could consider to request states to ensure that future ADS-B and GNSS mandates do not rely on a single constellation. When aviation standard multi constellation GNSS equipment/systems become available, ADS-B SITF could then develop guidance materials for use of multiple constellations to support ADS-B in APAC region
Recommendation 6/10 – Rationalization of terrestrial navigation aids That, in planning for the implementation of performance-based navigation, States should: a) assess the opportunity for realizing economic benefits by reducing the number of navigation aids through the implementation of performance-based navigation;	APANPIRG could consider to: a) publish a list of the approvals available to operators in different States. Eg: GNSS NPA approvals without requiring a conventional alternate. This could encourage other states to increase the useability of GNSS systems

Recommendations Adopted by AN-CONF/12	Proposed Response/Actions by ADS-B SITF
b) ensure that an adequate terrestrial navigation and air traffic management infrastructure remains available to mitigate the potential loss of global navigation satellite system service in their airspace; and c) align performance-based navigation implementation plans with navigation aid replacement cycles, where feasible, to maximize cost savings by avoiding unnecessary infrastructure investment.	b) APANPIRG could promote the synergy between ADS-B and GNSS equipage. ADS-B requires a high performance GNSS system. The business case of ADS-B and GNSS combined is better than for either alone. ADS-B SITF considered to develop guidance materials on this subject.
Recommendation 6/12 – Prioritization and categorization of block upgrade modules That States and PIRGs: a) continue to take a coordinated approach among air traffic management stakeholders to encourage effective investment into airborne equipment and ground facilities;	APAC States could agree to give higher service priority to ADS-B equipped aircraft than those that do not equip (i.e. better service, better served). States are encouraged to take a coordinated approach to implement ADS-B/WAM to bridge the existing surveillance gaps so as to apply end to end radar liked separation along major air routes. This can improve the business case for operators to equip. The above has already been reflected in the ADS-B mandate published by States (e.g. non-ADS-B equipped aircraft is required to fly outside the ADS-B airspace)

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**THE REVISED TERMS OF REFERENCE OF
ADS-B STUDY AND IMPLEMENTATION TASK FORCE**

- 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);

- 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 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 IN & OUT.

- 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.

- 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.

Note: *The Task Force, while undertaking the tasks, should take into account of the work being undertaken by SAS, AS Panels with a view to avoid any duplication.*

The Task Force should report to the APANPIRG, through the CNS~~/MET~~ Sub-group and provide briefing to the ATM~~/AIS/SAR~~ Sub-group.

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UPDATED ADS-B SUBJECT/TASKS LIST FOR THE TASK FORCE

Serial No.	His No.	Subject/Tasks List	Associated with Strategic Objective	Deliverables	Target Date	Status and Action to be taken and led by
1	18	Develop and implement regional collaboration project for ADS-B Out operational use including data sharing in South East Asia and report on implementation progress.	Capacity & Efficiency	Sub-regional ADS-B collaboration project has been developed.	May-15	SEA/BOB WG - On going
2	19	Develop and implement regional collaboration project for ADS-B out operational use including data sharing in South Pacific and report on implementation progress.	Capacity & Efficiency	Develop and implement sub-regional ADS-B collaboration project.	May-15	South Pacific States On-going
3	21	Study application of ADS-B and mutilate for precision runway monitoring.	Capacity & Efficiency	Guidance material for implementation	May-15	All Members On-going
4	22	Perform data collection and data analysis of ADS-B messages to examine GPS performance in different geographic areas.	Capacity & Efficiency	Report of data collected and analyzed - continuous	May-15	All Members On-going
5	23	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.	Capacity & Efficiency	Develop and implement sub-regional ADS-B collaboration project.	May-15	Bay of Bengal States
6	30	To exam existing air-ground communication and surveillance capability in the boarder area between China and Myanmar and identify the need and possibility for sharing ADS-B data from potential ADS-B ground station at Lashio.	Capacity & Efficiency	Report status and position	May-15	China and Myanmar On-going
7	36	States to advise when their ground stations can be upgraded to receive ADS-B DO260B compliant ADS-B data. A survey was conducted during ADS-B SITF/13 (Appendix E), further updates will be done at next ADS-B SITF/14 Meeting.	Capacity & Efficiency	Report status at the Task Force meetings	May-15	All Members
~~8~~	~~38~~	~~Bring attention of States concerned to the integrity requirement as specified in the ICAO Document (Circular 326) and the risk that ADS-B data without integrity (such as NUC=0) should not be used to support either separation or situation awareness.~~	~~Capacity & Efficiency~~	~~Through SUPPs amendment~~	~~July-13~~	~~Regional Office Completed PfA~~

Serial No.	His No.	Subject/Tasks List	Associated with Strategic Objective	Deliverables	Target Date	Status and Action to be taken and led by
~~9~~	~~39~~	~~Report experience in using ADS-B data for performing safety monitoring including RVSM aircraft height keeping performance monitoring~~	~~Capacity & Efficiency~~	~~Working papers~~	~~April-14~~	~~Australia and USA~~ ~~Completed~~
8	40	Investigate appropriateness of specifying Mode S and ADS-B on RPA that may not operate in the controlled surveillance airspace	Capacity & Efficiency	Available Information on the subject	May-15	ICAO RO
9	41	Amend AIGD to include i) Included guidance materials on monitoring and analysis of ADS-B equipped aircraft; ii) Include guidane aterials on synergy between GNSS and ADS-B; iii) Revised ATC Phraseology; iv) Include flight planning clarification;	Capacity & Efficiency	Approved by APANPIRG	Sep. 2014	Hong Kong, China, Australia and Singapore
10	42	Recommendations on respoonse to AN Conf/12 Recommendations relevant to ADS-B	Capacity & Efficiency	Reviewed by APANPIRG	Sep. 2014	Hong Kong, China, Australia and Singapore
11	43	APAC ADS-B implementation status Initial survey was provivded at ADS-B SITF/13 (Appendix F). Further updates and confirmation are required	Capacity & Efficiency	A table form showing the regional whole picuture	May-15	ICAO RO, IATA, CANSO and all administratons
12	44	General ADS-B Avionics Problem Reporting Database (APRD)	Safety and Efficienty	Specification and database	Specificaiton part completed May-15	Hong Kong, China & ICAO RSO
13	45	Reprot on RVSM height monitoring using ADS-B	Safety and Efficienty	Working papers and Report	May-15	All Members On-going
14	46	Provide list of contact points of IATA member airlines responsbile taking action on report of abnormal performance of ADS-B OUT avioncs	Safety and Efficienty	A table of contact points	May-15	IATA

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ADS-B SITF TASK 7/36 – States to advise when their ground stations can be upgraded to receive ADS-B D0260B compliant ADS-B data					
State or Administration	**No. of ADS-B Ground Stations Installed**	**D0260B Compliant?**			
		Yes (all)	**Yes (some)**	**No**	**If *some* or *No*, planned date of full D0260B capability**
Australia	33	☐	☒	☐	Sydney WAM (SYDWAM) site yet to be upgraded
Bangladesh	Nil	☐	☐	☐	
Hong Kong, China	9	☒	☐	☐	
Macao, China	Nil	☐	☐	☐	
India	21	☒	☐	☐	
Indonesia	31	☐	☐	☒	To be discussed
Japan	Nil	☐	☐	☐	
Malaysia		☐	☐	☐	
Maldives	4	☐	☒	☐	Not yet determined.
Myanmar		☐	☐	☐	

ADS-B SITF TASK 7/36 – States to advise when their ground stations can be upgraded to receive ADS-B D0260B compliant ADS-B data					
State or Administration	**No. of ADS-B Ground Stations Installed**	**D0260B Compliant?**			
		Yes (all)	**Yes (some)**	**No**	**If *some* or *No*, planned date of full D0260B capability**
Nepal	Nil	☐	☐	☐	
New Zealand	22	☐	☐	☒	December 2014
Philippines	Nil	☐	☐	☐	
Pakistan	1	☐	☐	☐	Test basis. Will discuss outcomes from ADS-B SITF Meeting.
Republic of Korea	2	☐	☐	☒	2017
Singapore	1	☒	☐	☐	
Thailand	1	☐	☐	☒	
USA	634	☒	☐	☐	
Viet Nam	3	☒	☐	☐	

ADS-B IMPLEMENTATION STATUS IN THE APAC REGION

State/ Administration	ADS-B Ground Infrastructure and ATC System readiness or Implementation plan	Date of issue/effectiveness date of equipage mandate	Mandated Airspace and/or ATS-routes	Intended separation criteria to be applied	Remarks
AFGHANISTAN	ADS-B & Multi Lateration system installed.				subject to safety assessment
AUSTRALIA	A total of 31 ADS-B stations and 28 WAM stations are currently used. ATC system readiness since 2004. ADS-B data sharing with Indonesia operational since 2/2011. ASMGCS using multilateration is operational in Brisbane, Sydney & Melbourne. It is being installed in Perth. Additional 15 ADS-B stations from 2014-2016. OneSKY replacing current ATM system is estimated for full operational around 2020.	2009/effective date of mandating in UAP 12/12/2013. A forward fit ADS-B mandate also applies from 2/2014 for all IFR aircraft at all flight levels. An ADS-B for all IFR aircraft applies from 2/2017.	at/above FL290 UAP from 12/2013 for domestic & foreign aircraft. Mandates for additional flight level are considered for 2015 & 2017. WAM is operating in Tasmania since 2010 delivery 5 Nm separation service. WAM is also operating in Sydney for 3 Nm separation service in TMA and for precision runway monitoring function.	5 NM 3 NM SYDWAN	

State/ Administration	ADS-B Ground Infrastructure and ATC System readiness or Implementation plan	Date of issue/effectiveness date of equipage mandate	Mandated Airspace and/or ATS-routes	Intended separation criteria to be applied	Remarks
BANGLADESH	Bangladesh has a plan to commission four ADS-B ground stations to be installed at Dhaka, Cox's Bazar, Saidpur and Barisal Airports by 2016. ADS-B data will be integrated with new ATS system at Dhaka.				
CAMBODIA	3 ADS-B ground stations have been installed in Cambodia since 2011 and able to provide full surveillance coverage for Phnom Penh FIR.				
CHINA	5 UAT ADS-B sites are used for flight training of CAFUC. 8 ADS-B stations installed by end of 2012. 200 ADS-B stations nationwide will deployed as 1st phase. 1 ADS-B station operational in Sanya FIR since 2008. Sanya ATC system ready since July 2009 to support L642	NOTAM issued on ADS-B trial operation			ADS-B signal alone won't be used for ATC separation

State/ Administration	ADS-B Ground Infrastructure and ATC System readiness or Implementation plan	Date of issue/effectiveness date of equipage mandate	Mandated Airspace and/or ATS-routes	Intended separation criteria to be applied	Remarks
	and M771. Chengdu-Jiuzhai project finished in 2008 with 2 ADS-B stations and additional site is planned to enhance the surveillance coverage. Chengdu - Lhasa route surveillance project completed with 5 ADS-B stations using 1090ES since 2010. Trials planned from May 2011. 1 ADS-B site installed in Sanya FIR since 2008. 3 additional ground stations planned, Trial planned for Jun, 2011.				
HONG KONG CHINA	A larger-scale A-SMGCS covering the whole Hong Kong International Airport put into operational use in April 2009.	AIP supplement issued on 29 Oct.2013/12 Dec. 2013 as effective date.	L642/M771 ATS routes.	To be determined.	ADS-B signals being fed to ATC controllers under an operational trial programme. ATS automation system to be ready in 2015

State/ Administration	ADS-B Ground Infrastructure and ATC System readiness or Implementation plan	Date of issue/effectiveness date of equipage mandate	Mandated Airspace and/or ATS-routes	Intended separation criteria to be applied	Remarks
	Data collection/ analysis on aircraft ADS-B equipage in Hong Kong airspace conducted on quarterly basis since 2004. ADS-B trial using a dedicated ADS-B system completed in 2007. ADS-B out operations over PBN routes L642 and M771 at or above FL 290 within HK FIR are planned in December 2013 and within HK FIR at or above FL 290 in December 2014. ADS-B ground station infrastructure completed in 2013. ADS-B trial using ADS-B signal provided by Mainland China to cover southern part of Hong Kong FIR commenced in 2010.				ADS-B planned to be put into operational use 6 months after new ATM System in operation
MACAO, CHINA	Mode S MSSR coverage available for monitoring purposes.				

State/ Administration	ADS-B Ground Infrastructure and ATC System readiness or Implementation plan	Date of issue/effectiveness date of equipage mandate	Mandated Airspace and/or ATS-routes	Intended separation criteria to be applied	Remarks
DEMOCRATIC PEOPLE'S REPUBLIC OF KOREA	ADS-B has been used as back-up surveillance of SSR since 2008.				
FIJI ISLANDS	ADS- B /multilateration ground stations installed. Situations awareness service will be provided in 2013.				
FRANCE *(French Polynesia)*	Project launched to install 9 ADS-B stations. 2 stations to be installed in 2014; 3 in 2015 and 4 will be installed in 2016.			5 NM for airspace under coverage.	
INDIA	ASMGCS (SMR + Multilat) is operational at Delhi, Mumbai, Chennai, Kolkata, Bangalore and Hyderabad Airports. ASMGCS is also being installed at 05 more international airports. ADS-B Ground Stations installed at 14 locations in phase one across continental and Oceanic airspace at Port Blair. 07 more ADS-B	AIP supplement issued on 17th April 2014 with effective date of implementation from 29th May 2014.			ADS-B in India to provide redundancy for radar and filling the surveillance gaps. Currently study the integrity of ADS-B data and evaluating in both Non-radar and radar environment for ATC purposes.

State/ Administration	ADS-B Ground Infrastructure and ATC System readiness or Implementation plan	Date of issue/effectiveness date of equipage mandate	Mandated Airspace and/or ATS-routes	Intended separation criteria to be applied	Remarks
	Ground stations in phase two in 2014. ATS systems at 12 ACCs are capable of processing ADS-B data and provide the information on Display. Wide area Multilateration pilot project is being planned in Kolkata TMA to augment the surveillance coverage.				
INDONESIA	30 Ground Station successfully installed. Since 2009, ATC Automation in MATSC has capabilities to support ADS-B application. ADS-B Task Force team established to develop planning and action concerning ADS-B Implementation within Indonesia FIR ADS-B data sharing with Australia and Singapore.				ADS-B Task Force Team is considering a mandate in 2016

State/ Administration	ADS-B Ground Infrastructure and ATC System readiness or Implementation plan	Date of issue/effectiveness date of equipage mandate	Mandated Airspace and/or ATS-routes	Intended separation criteria to be applied	Remarks
JAPAN	Multilateration Systems for surface monitoring have been implemented at seven airports and are being implemented at another one airport. PRM (WAM) is planned to be implemented at Narita Airport. (Operation will start in 2014). Basic design of en-route WAM system completed in FY2013. Plans to start manufacture in FY2014 and estimated operational in FY2018. Plan to evaluate accuracy of ADS-B information and has intension to introduce ADS-B to the oceanic direction.				
MALAYSIA	Malaysia planned to start mandate ADS-B requirement in KL FIR in 2018 and full implementation of ADS-B service at	Plan to issue mandate with target effective date end of 2018.			

State/ Administration	ADS-B Ground Infrastructure and ATC System readiness or Implementation plan	Date of issue/effectiveness date of equipage mandate	Mandated Airspace and/or ATS-routes	Intended separation criteria to be applied	Remarks
	specific routes/exclusive airspace by end of 2020. Plan to install two ADS-B stations at Pulau Langkawi and Genting Highland by 2016. Data sharing with neighbouring by mid. 2017.				
MALDIVES	4 ADS-B stations installed in Nov. 2012 (2 at Male' Ibrahim Nasir Intl Airport, 1 at Kulhudhuffushi Island in the North and 1 at Fuah Mulah Island in the South to cover 95% of the FIR at/above FL290. Maldives' ADS-B is integrated with the ATM system (in November 2013), and under observation prior to commencing trials. Maldives has plan to share ADS-B data with its adjacent FIRs.				Seaplane in Maldives equipped with ADS-B for AOC purpose. These seaplanes have ADS-B IN functions as well.

State/ Administration	ADS-B Ground Infrastructure and ATC System readiness or Implementation plan	Date of issue/effectiveness date of equipage mandate	Mandated Airspace and/or ATS-routes	Intended separation criteria to be applied	Remarks
MONGOLIA	Five ADS-B ground stations for combination with SSR will be implemented first quarter of 2013. Full coverage for surveillance gaps will be implemented by 2015-2016.				
MYANMAR	ADS-B ground stations to be installed at Sittwe, Co Co Island by end of 2014 as 1st phase Yango , Lashio and Myeik - 2015 as 2nd phase; Kengteng, Myitkyina in 2016. Completion of integration to Euro Cat. C. in 2014. Agreed to share ADS-B data with India, agreement on sharing being negotiated.				Supplement radar and fill the gaps to improve safety and efficiency. ADS-C/CPDLC integrated in Yangon ACC since 2010.
NEPAL	ADS-B feasibility study conducted in 2007.				

State/ Administration	ADS-B Ground Infrastructure and ATC System readiness or Implementation plan	Date of issue/effectiveness date of equipage mandate	Mandated Airspace and/or ATS-routes	Intended separation criteria to be applied	Remarks
NEW CALEDONIA	Three ADS-B ground stations commissioned in 2010 to cover international traffic at La tontouta airport serving Tontouta ACC & APP. It is used for Situation awareness and SAR.				
NEW ZEALAND	MLAT being used in Queenstown area (WAM) and Auckland (airport surface movements). ADS-B data available from all MLAT & SSR sites.				
PAKISTAN	Feasibility study for using ADS-B is in hand. One station was installed at ACC Karachi and evaluation is in progress.				
PAPUA NEW GUINEA	Legislation mandating ADS-B and guidelines for aircraft equipage and operational approval to be issued by 31/12/2011 with target mandatory date by mid-2015 and plans to provide ADS-B service above FL245				

State/ Administration	ADS-B Ground Infrastructure and ATC System readiness or Implementation plan	Date of issue/effectiveness date of equipage mandate	Mandated Airspace and/or ATS-routes	Intended separation criteria to be applied	Remarks
	within Port Moresby FIR and also in specific higher traffic areas domestically.				
PHILIPPINES	One (1) ADS-B ground station in Manila ATM Center will be available in 2016.				
REPUBLIC OF KOREA	ADS-B implemented 2008 for SMC in Incheon International Airport. ROK is developing ADS-B system since 2010 through R&D group. The testbed at Gimpor Airport supporting both 1090ES and UAT, undergoing operational testing (2013-16). At Incheon Intl Airport, promotion of surface surveillance (2014-17) In 2nd phase from 2015 to 2016, ADS-B ground stations will supplement to the radar in the terminal area and fill up the gap between radar coverage. The last phase from 2017 to				

State/ Administration	ADS-B Ground Infrastructure and ATC System readiness or Implementation plan	Date of issue/effectiveness date of equipage mandate	Mandated Airspace and/or ATS-routes	Intended separation criteria to be applied	Remarks
	2020, ADS-B will be deployed for entire Incheon FIR.				
SINGAPORE	The airport MLAT system was installed in 2007 and "far-range" ADS-B sensor was installed in 2009. ATC system has been processing ADS-B data since 2013.	AIC was issued on 28 December 2010/effective from 12 December 2013. AIP supplement published in Nov 2013 to remind operators of ADS-B exclusive airspace implementation.	L642 and M771. At and above FL290. Also affect the following ATS routes N891, M753, L644 & N892	40nm on ATS routes L642, L644, M753, M771, N891 and N892 30nm planned for 26th June 2014 on ATS routes L642, M753, M771 and N892; 20nm panned for end 2015	Safety case was completed end of November. 2013.
SRI LANKA	ADS-B Trials planned for 2012 and implementation in 2013. The ADS-B station was planned at Pidurutalagala.				
THAILAND	Multilateration implemented in 2006 at Suvarnbhumi Int'l. Airport. An ADS-B Ground Station has been installed in Bangkok as test unit. ADS-B is planned to be part of future surveillance infrastructure. New ATM System to be in operational in 2015 will be				

State/ Administration	ADS-B Ground Infrastructure and ATC System readiness or Implementation plan	Date of issue/effectiveness date of equipage mandate	Mandated Airspace and/or ATS-routes	Intended separation criteria to be applied	Remarks
	capable of processing ADS-B data.				
TONGA	Trial planned for 2017				
UNITED STATES	As of 31 March 2014, 634 radio sites had been installed; these sites cover the "baseline" set of Service Volumes planned by the FAA in 2007. Since 2007, FAA has planned and funded activities to activate additional Service Volumes that will constitute an additional 29 radio sites. Approximately 100 of the 230 U.S. air traffic control facilities are using ADS-B for ATC separation; all facilities are planned to be using ADS-B by 2019.	The U.S. ADS-B Out rule (14 CFR 91.225 and 14 CFR 91.227) was issued in May 2010 and specifies that the ADS-B Out mandate is effective on 1 January 2020.	Class A, B, and C airspace, plus Class E airspace above 10,000 ft MSL. See 14 CFR 91.225 for details.	The U.S. is using both terminal and en route (5nm) separation criteria, depending on the specific airspace and available surveillance information. Terminal separation includes the following separation criteria: - 3nm - 2.5nm - independent parallel approach operations down to 4300 ft centreline separation - dependent parallel approach operations down to 2500 ft centreline separation (currently 1.5 nm diagonal distance).	

State/ Administration	ADS-B Ground Infrastructure and ATC System readiness or Implementation plan	Date of issue/effectiveness date of equipage mandate	Mandated Airspace and/or ATS-routes	Intended separation criteria to be applied	Remarks
VIET NAM	Two phases ADS-B implementation plan adopted. Phase 1 implemented in March 2013. Phase 2 for whole lower and upper airspace of Ha Noi and Ho Chi Minh FIR to be completed by 2016.	AIC issued on 20 June 2013/ADS-B mandating effective from 12 December 2013 in Ho Chi Minh FIR.	M771, L642, L625, N892, M765, M768, N500 and L628 At/above FL290.		Operators required to have operational approval from State of aircraft registry.

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APANPIRG Conclusions/Decisions on ADS-B

Conclusion/ Decision No --- Strategic Objective*	Title of Conclusion/Decision	Text of Conclusion/Decision
D 24/1 **A & C**	**Regional Priorities and Targets for Air Navigation**	That APANPIRG a) establish, consistent with Recommendations 6/1 and 6/12 of the AN-Conf/12, priorities and targets for air navigation by May 2014; b) utilize specific interface groups, where required, for addressing the harmonization of air navigation plans in adjacent areas of APANPIRG; and c) coordinate with APAC-RASG to ensure consistency of action and avoid overlap.
C 24/2 **A & C**	**Establishing Regional Priorities and Targets**	That, following the PIRG- RASG Global Coordination meeting held in March 2013 APANPIRG/24 invited the Chairpersons of ATM, RASMAG, CNS, and MET sub groups to establish regional priorities and targets for the APAC Region in alignment with the GANP and APAC Seamless ATM Plan by December 2013 in order to facilitate submission to ICAO by May 2014
C 24/4 **A & C**	**Follow-up to AN-Conf/12 Recommendations by States and International Organizations**	That, the States and International Organizations, on the basis of analysis contained in the Appendix A to Report on Agenda Item 2, takes follow-up action as appropriate on the applicable recommendations of the AN-Conf/12
C 24/23 **A & C**	**Asia/Pacific SAR Contact List**	That, States should be urged to provide contact details of SAR managers or senior SAR staff who may respond in a timely manner to aeronautical non-emergency and administrative SAR matters to the Asia/Pacific Regional Office, for incorporation into an Asia/Pacific SAR Contact List.
C 24/42 **A & C**	**Timeframe for Data-sharing in the Bay of Bengal Sub-region**	That, States concerned be urged to consider the timeframe established for data-sharing in the Bay of Bengal Sub-region as provided in Appendix H to the Report on Agenda Item 3.4.

Conclusion/ Decision No --- Strategic Objective*	Title of Conclusion/Decision	Text of Conclusion/Decision
C 24/43 **A & C**	**Processing altitude information in ADS-B Message**	That, States/Administrations implementing ADS-B based surveillance services be urged to be fully aware of the safety implications and difference between geometric and barometric altitude. Geometric altitude information shall not be displayed on ATC displays used for the provision of air traffic services. States may choose to use geometric altitude in ATM systems for other purposes.
C 24/44 **A & C**	**Amendment to ADS-B Implementation and Operation Guidance Document (AIGD)**	That, the revised AIGD provided in Appendix I to the Report on Agenda Item 3.4 be adopted.
C 24/45 **A & C**	**Exchange ADS-B performance monitoring result**	That, States be encouraged to exchange findings/result of their ADS-B performance monitoring including experience gained in conducting the required performance monitoring.
C 24/46 **A & C**	**Need for adequate Logistics and Spares Support for ADS-B service**	That, States consider making maintenance arrangements including requirements for spares pool and/or maintenance contract for all ADS-B system acquisitions and existing systems already in operation if these arrangements do not yet exist.
C 24/47 **A & C**	**Surveillance Strategy for the Asia/Pacific Region**	That, the revised surveillance strategy for the Asia/Pacific Region provided in Appendix J to the Report on Agenda Item 3.4 be adopted.
D 23/30	**Revised Terms of Reference and Subject/Tasks List of ADS-B Study and Implementation Task Force**	That, the revised Terms of Reference and updated Subject/Tasks List of ADS-B Study and Implementation Task Force provided in **Appendices F** and **Appendix G** to the Report on agenda item 3.4 be adopted.

Conclusion/ Decision No --- Strategic Objective*	Title of Conclusion/Decision	Text of Conclusion/Decision
C 23/31	**Guidance Materials on ASTERIX Category 21 Messages & Advice to Military Authorities regarding Sharing of ADS-B Data**	That, the following ADS-B implementation guidance materials be adopted: a) generation, processing and sharing of ASTERIX Category 21 ADS-B Messages provided in **Appendix H** to the Report on agenda item 3.4; and b) advice to military authorities regarding sharing of ADS-B data provided in **Appendix I** to the Report on agenda item 3.4.
C 23/32	**Amendment to ADS-B Implementation Guidance Document (AIGD)**	That, the AIGD be amended to include a sample template on harmonization framework for ADS-B implementation as provided in **Appendix J** to the Report on agenda item 3.4.
C 23/33	**Database of Blacklist Airframe broadcasting misleading ADS-B Data**	That, a) Australia be requested to establish and maintain a Database of Blacklist airframe broadcasting misleading ADS-B data for sharing with other Administrations in the Asia/Pacific Region; and b) States implementing ADS-B based surveillance service be encouraged to provide the identified occurrences of airframe broadcasting misleading data to Australia for entry into the ADS-B Blacklist Database.
C 23/34	**Sharing of ADS-B data to support ATC operations and safety monitoring**	That, States be urged to provide ADS-B data for sharing to support ATC operations and safety monitoring.
C 23/35	**Surveillance Strategy for the Asia/Pacific Region**	That, the revised surveillance strategy for the Asia/Pacific Region provided in the **Appendix K** to the Report on agenda item 3.4 be adopted.

Conclusion/ Decision No --- Strategic Objective*	Title of Conclusion/Decision	Text of Conclusion/Decision
C 22/8 **A &C**	**ADS-B Airspace Mandate**	That, States intending to implement ADS-B based surveillance services may designate portions of airspace within their area of responsibility: a) mandate the carriage and use of ADS-B equipment; or b) provide priority for access to such airspace for aircraft with operative ADS-B as equipment over those aircraft not operating ADS-B equipment.
C 22/31 **A &C**	**Development of Guidance Material on ADS-B**	That, the following regional guidance materials on ADS-B implementation be adopted and published on the APAC Website. a) Guidance Material on Building a safety case for the delivery of an ADS-B separation service provided in **Appendix J** to the report on Agenda Item 3.4 ; b) the revised Sample Agreement for Data Sharing contained in **Appendix K**; c) Amendments to the ADS-B Implementation Guidance Document (AIGD) as shown in the **Appendix L** consequential to amendment to the Flight Plan and **Appendix M** on the reliability and availability for ADS-B ground system.
C 22/32 **A &C**	**Coordination for VHF for sharing Voice Communication Capability**	That, a) States be urged to support provision of VHF radio voice air/ground communication infrastructure for use by adjacent States; and b) States sharing ADS-B data and providing VHF Voice air-ground communication infrastructure to adjacent States should co-ordinate with ICAO Regional Office and their national Telecommunication Regulatory Authority for assignment of specific VHF radio frequencies to be used by the adjacent States.

Conclusion/ Decision No --- Strategic Objective*	Title of Conclusion/Decision	Text of Conclusion/Decision
C 22/33 **A &C**	**Support DO260B Compliant Avionics**	That, States providing ADS-B based surveillance services be urged to upgrade their ADS-B ground stations in time (2012-2015) to receive DO260B standard transmissions in addition to those aircraft transmitting ADS-B data compliant with DO260 and DO260A.
D 22/34 **A &C**	**Name and Terms of Cooperation of ADS-B Implementation WG**	That, Recognizing the need to expedite ADS-B implementation and surveillance data sharing in the Bay of Bengal area, the South East Asia Sub-regional ADS-B Implementation Working Group be renamed as "South East Asia and Bay of Bengal Sub-regional ADS-B Implementation Working Group". Revised Terms of Cooperation and work programme based on the existing one for the SEA Sub-regional ADS-B Implementation Working Group be further developed by the new Working Group.
C 22/35 **A &C**	**Expedite ADS-B implementation project in South China Sea area**	That, States concerned with ADS-B implementation in the South China Sea area be urged to expedite required actions and coordination to achieve the implementation.
C 22/36 **A &C**	Amendment to Regional Supplementary Procedures on ADS-B	That, the Regional Supplementary Procedure Doc7030 MID/ASIA Chapter 5 be amended in accordance with the established procedure to include regional requirements on ADS-B as provided in the Appendix N to the report on Agenda Item 3.4.
C 21/38	**Guidance Material on Processing and Display of ADS-B Tracks on Air Traffic Controller Positions**	That, the Processing and Display of ADS-B Tracks on Air Traffic Controller positions provided in Appendix O to the Report on Agenda Item 3.4 be adopted.

Conclusion/ Decision No --- Strategic Objective*	Title of Conclusion/Decision	Text of Conclusion/Decision
C 21/39	**Template for promulgation of ADS-B Avionics Equipage Requirements**	That, based on APANPIRG Conclusion 20/54, States intending to implement ADS-B based surveillance service for a defined airspace and having not published regulations be urged to promulgate mandating rule for ADS-B Avionics Equipage Requirements as soon as possible using the following template: *On and after dd/mm/yyyy, if an aircraft operates on airways (insert routes)……..at or above FLXXX……..(or in defined airspace boundaries …….. at or above FLXXX):* *a) the aircraft must carry serviceable ADS-B transmitting equipment that has been certificated as meeting EASA AMC 20-24, or meets the equipment configuration standards in Appendix XI of Civil Aviation Order 20.18 of the Civil Aviation Safety Authority of Australia; and* *b) the aircraft operator must have the relevant operational approval from the State of Registry.*
C 21/40	**Guidelines for Airworthiness and Operational Approval for ADS-B Avionics Equipage**	That, States be advised to use the guidelines provided in Appendix P to the Report on Agenda Item 3.4 for Airworthiness and Operational Approval for ADS-B Out Avionics Equipage.

Conclusion/ Decision No --- Strategic Objective*	Title of Conclusion/Decision	Text of Conclusion/Decision
C 21/42	**Rule on Misleading ADS-B Transmissions**	That, States where ADS-B may be used, even voluntarily, promulgate rule for ADS-B Avionics Equipage Requirements consider publishing additional provisions for misleading ADS-B transmission as follows: *After <insert earliest date that ADS-B may be used for any relevant operational purpose> if an aircraft carries ADS-B transmitting equipment which does not comply with* *a) EASA AMC 20-24, or* *b) the equipment configuration standards in Appendix XI of Civil Aviation Order 20.18 of the Civil Aviation Safety Authority of Australia.* *the aircraft must not fly unless the equipment is:* *(a) deactivated; or* *(b) set to transmit only a value of zero for the NUCp or NIC. Note:* *1. It is considered equivalent to deactivation if NUCp or NIC is set to continually transmit only a value of zero.* *2. Regulators should take appropriate action to ensure that such regulations are complied with.* *3. ATC systems should discard ADS-B data when NUC or NIC=0*
D 20/47	**Guidance material for flight inspection/validation of ADS-B ground stations**	That, ADS-B SITF be tasked to study the need for developing guidance material for flight inspection/validation of ADS-B ground stations.

Conclusion/ Decision No --- Strategic Objective*	Title of Conclusion/Decision	Text of Conclusion/Decision
C 20/52	**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 Q** and **Appendix R** to the Report on Agenda Item 3.4 in accordance with the established procedure.
C 20/53	**Revised Guidelines for Development of ADS-B Implementation Plan by States**	That, the revised guidelines for Development of ADS-B Implementation Plan by States provided in **Appendix S** to the Report on Agenda Item 3.4 be adopted.
C 20/54	**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 Non-Radar Areas (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 *Note: States that have not yet published regulations should implement necessary regulations that recognize that any one of the above requirements is acceptable and not specify an individual requirement.*
C 20/55	**Forward Fitment Requirements for SA Aware and FDE functionality**	That, ICAO recommends States concerned to adopt forward fitment requirements which include SA aware and FDE functionality as soon as reasonable.

Conclusion/ Decision No --- Strategic Objective*	Title of Conclusion/Decision	Text of Conclusion/Decision
19/37	**Revised Mandate Regional ADS-8 OUT Implementation**	States intending to implement ADS-B based surveillance service. Be urged to a) determine ADS-B OUT equipage mandates based upon the ability to provide ADS-B OUT separation services: b) expedite the implementation of ADS-B OUT in accordance with the Regional Air Navigation Plan and the provision of separation service based on ADS-B OUT; c) publish their equipage mandates as soon as possible. with a target publication date of no later than 2010 so that operators can plan ahead their forward purchasing and retrofit. d) choose a date after mid-2012 on 11h1ch the ADS-B out equipage mandate will become effective in airspace served b) ADS- B ground stations 11ith sufficient transition period to enable fleet equipage. *Note. The implementation would require aircraft equipped with avionics compliant with either* 1) version *0 as as specified in An11t I0. l'olume IIChapter 1. Paragraph 3 1.1.8.6* *(up to and mc/uding , lmendment 8lto Annex 10) and Chapter 1 of/he TecJmtcal PrOI'tsions for .\lode S Services and blended Squi/ler (/CAO Doc 98-1) (Equivalent to D0160) to be used till atleast1020 or* 2) Version 1 ES as specified in Chapter 3 of the Technical Provisions for ModeS Services and Extended Squttter (1CAO Doc 9871) (Equi\alent to D0260A)

Conclusion/ Decision No --- Strategic Objective*	Title of Conclusion/Decision	Text of Conclusion/Decision
18/32	**The guidance material on comparison of various surveillance technologies**	That, the guidance material on comparison of various surveillance technologies (GMST) provided in the Appendix H to the Report on Agenda Item 3.3 be adopted.
18/33	**The Second Amendment to the AIGD**	That, the ADS-B Implementation and Operations Guidance Document (AIGD) be amended as shown in the Appendix I to the Report on Agenda Item 3.3.
18/34	**Guidelines on performance parameters for using ADS-B managed service**	That, States consider the performance parameters contained in Appendix J to the Report on the Agenda Item 3.3 as service performance guidelines while finalizing acquisition of an ADS-B managed service agreement with a service provider
18/35	**Mandate Regional ADS-B Out implementation**	That, States planning to deliver ADS-B based ATS services, implement requirements for ADS-B Out avionics equipage for aircraft operating in their airspace with a target date of 2010 Note: The implementation would require aircraft equipped with avionics compliant with either a) Version 0 ES as specified in Annex 10, Volume IV, Chapter 3, Paragraph 3.1.2.8.6 (up to and including Amendment 82 to Annex 10) and Chapter 2 of draft Technical Provisions for Mode S Services and Extended Squitter (ICAO Doc 9871) (Equivalent to DO260) to be used till at least 2020. or b) Version 1 ES as specified in Chapter 3 of draft Technical Provisions for Mode S Services and Extended Squitter (ICAO Doc 9871) (Equivalent to DO260A)

Conclusion/ Decision No --- Strategic Objective*	Title of Conclusion/Decision	Text of Conclusion/Decision
18/36	**Concept of Use for Multilateration**	That, the Concept of Use of Multilateration provided in Appendix K to the Report on Agenda Item 3.3 be adopted as Version 1 for use as regional guidance material.
18/37	**Establishment of a sub-regional ADS-B implementation Working Group in the South-East Asia area (SEA ADS-B WG)**	That, a South-East Asia Sub-regional ADS-B Implementation Working Group be established by the end 2007 to develop the terms of cooperation and an implementation plan for near-term ADS-B applications in the sub-region.
17/49	**Use of ADS-B 1 090 MHz Extended Squitter for automatic air-reporting**	That, ICAO be invited to develop the necessary SARPs and guidance material to facilitate the implementation of ADS-B 1 090 MHz extended squitter for automatic air-reporting.
16/55	**Amendment to the Regional Plan for the CNS/ATM System to include ADS-B**	That the ASIA/PAC Regional Plan for the New CNS/ATM System be amended to include ADS-B element for the surveillance systems as indicated in the Appendix C to the Report on Agenda Item 3.
15/25	**Airlines plan for the deployment of ADS-B**	That, IATA be requested to conduct a survey of its member airlines' plan for the deployment of ADS-B in the Asia/Pacific region and provide result to the ADS-B Task Force Working Group to be held on 14-15 October 2004.
15/26	**Exchange of ADS-B surveillance data with neighbours**	That, States be encouraged to share ADS-B surveillance data with neighbouring States and to develop mechanisms to achieve this as ADS-B ground infrastructure requirements are being identified during the design phase.

Conclusion/ Decision No --- Strategic Objective*	Title of Conclusion/Decision	Text of Conclusion/Decision
14/20	**Near term ADS-B datalink selection**	That, Mode S Extended Squitter (1090 ES) be used as the data link for ADS-B radar like services in the ASIA/PAC Region in the near term.
14/22	**Needs for development of ICAO SARPs for ADS-B**	That, in view of the progress made by States with operational trials for the implementation of ADS-B, ICAO be requested to give priority to: a) the inclusion of positional source data accuracy and integrity requirements for ADS-B services in the appropriate standards; and b) development of separation standards for ADS-B surveillance.

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INTERNATIONAL CIVIL AVIATION ORGANIZATION
ASIA AND PACIFIC OFFICE

ADS-B IMPLEMENTATION AND OPERATIONS GUIDANCE DOCUMENT

Edition ~~6~~7.0 ~~–~~ September~~June~~ 2014~~3~~

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TABLE OF CONTENTS

1. INTRODUCTION

The Eleventh ICAO Air Navigation Conference held in 2003 recommended that States recognize ADS-B as an enabler of the global ATM concept bringing substantial safety and capacity benefits; support the cost-effective early implementation of it; and ensuring it is harmonized, compatible and interoperable with operational procedures, data linking and ATM applications.

The Twelve ICAO Air Navigation Conference held in 2012 endorsed the Aviation System Block Upgrades (ASBU) to provide a framework for global harmonization and interoperability of seamless ATM systems. Among the Block Upgrades, the Block 0 module "Initial Capability for Ground Surveillance" recommends States to implement ADS-B which provides an economical alternative to acquire surveillance capabilities especially for areas where it is technically infeasible or commercially unviable to install radars.

This ADS-B Implementation and Operations Guidance Document (AIGD) provides guidance material for the planning, implementation and operational application of ADS-B technology in the Asia and Pacific Regions.

The procedures and requirements for ADS-B operations are detailed in the relevant States' AIP. The AIGD is intended to provide key information on ADS-B performance, integration, principles, procedures and collaboration mechanisms.

The content is based upon the work to date of the APANPIRG ADS-B Study and Implementation Task Force (SITF) and various ANC Panels developing provisions for the operational use of ADS-B. Amendment to the guidance material will be required as new/revised SARPs and PANS are published.

1.1 ARRANGEMENT OF THE AIGD

The AIGD consists of the following Parts:

Section 1	Introduction
Section 2	Acronyms and Glossary of Terms
Section 3	Reference Documents
Section 4	ADS-B Data
Section 5	ADS-B Implementation
Section 6	Template of Harmonization Framework for ADS-B Implementation
Section 7	System Integrity and Monitoring
Section 8	Reliability and Availability Considerations
Section 9	ADS-B Regulations and Procedures
Section 10	Security Issues Associated with ADS-B

1.2 DOCUMENT HISTORY AND MANAGEMENT

This document is managed by the APANPIRG. It was introduced as draft to the first Working Group meeting of the ADS-B SITF in Singapore in October 2004, at which it was agreed to develop the draft to an approved working document that provides implementation guidance for States. The first edition was presented to APANPIRG for adoption in August 2005. It is intended to supplement SARPs, PANS and relevant provisions contained in ICAO documentation and it will be regularly updated to reflect evolving provisions.

1.3 COPIES

Paper copies of this AIGD are not distributed. Controlled and endorsed copies can be found at the following web site: ~~www.bangkok.icao.int/edocs/index.html~~http://www.icao.int/APAC/Pages/edocs.aspx

Copy may be freely downloaded from the web site, or by emailing APANPIRG through the ICAO Asia and Pacific Regional Office who will send a copy by return email.

1.4 CHANGES TO THE AIGD

Whenever a user identifies a need for a change to this document, a Request for Change (RFC) Form (see Section 1.6 below) should be completed and submitted to the ICAO Asia and Pacific Regional Office. The Regional Office will collate RFCs for consideration by the ADS-B Study and Implementation Task Force.

When an amendment has been agreed by a meeting of the ADS-B Study and Implementation Task Force then a new version of the AIGD will be prepared, with the changes marked by an "|" in the margin, and an endnote indicating the relevant RFC, so a reader can see the origin of the change. If the change is in a table cell, the outside edges of the table will be highlighted; e.g.:

Final approval for publication of an amendment to the AIGD will be the responsibility of APANPIRG.

1.5 EDITING CONVENTIONS

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1.6 AIGD REQUEST FOR CHANGE FORM

RFC Nr:	

Please use this form when requesting a change to any part of this AIGD. This form may be photocopied as required, emailed, faxed or e-mailed to ICAO Asia and Pacific Regional Office +66 (2) 537-8199 or ~~icao_apac@bangkok.icao.int~~APAC@icao.int

1. SUBJECT:
2. REASON FOR CHANGE:
3. DESCRIPTION OF PROPOSAL: [expand / attach additional pages if necessary]

4. REFERENCE(S):			
5. PERSON INITIATING:		**DATE:**	
ORGANISATION:			
TEL/FA/X/E-MAIL:			
6. CONSULTATION	**RESPONSE DUE BY DATE:**		
	Organization	**Name**	**Agree/Disagree**	**Date**
7. ACTION REQUIRE :			
8. AIGD EDITOR		**DATE REC'D :**	
9. FEEDBACK PASSED		**DATE :**	

1.7 AMENDMENT RECORD

Amendment Number	Date	Amended by	Comments
0.1	24 December 2004	W. Blythe H. Anderson	Modified draft following contributions from ADS-B SITF Working Group members. Incorporated to TF/3 Working Paper #3.
0.2 (1.0)	24 March 2005	H. Anderson	Final draft prepared at ADS-B SITF WG/3
0.3 (1.1)	03 June 2005	Nick King	Amendments following SASP WG/WHL meeting of May 2005
0.4	15 July 2005	CNS/MET SG/9	Editorial changes made
1.0	26 August 2005	APANPIRG/16	Adopted as the first Edition
2.0	25 August 2006	Proposed by ADS-B SITF/5 and adopted by APANPIRG/17	Adopted as the second Edition
3.0	7 September 2007	Proposed by ADS-B SITF/6 and adopted by APANPIRG/18	Adopted as the second amendment (3rd edition)
4.0	5 September 2011	Proposed by ADS-B SITF/10 and adopted by APANPIRG/22	Adopted amendment on consequential change to the Flight Plan and additional material on the reliability and availability for ADS-B ground system
5.0	14 September 2012	Proposed by ADS-B SITF/11 and adopted by APANPIRG/23	Included sample template on harmonization framework
6.0	June 2013	Proposed by ADS-B SITF/12 and adopted by APANPIRG/24	Revamped to include the latest ADS-B developments and references to guidance materials on ADS-B implementation
7.0	September 2014	Proposed by ADS-B SITF/13 and adopted by APANPIRG/25	(i) Included guidance materials on monitoring and analysis of ADS-B equipped aircraft (ii) Included guidance materials on synergy between GNSS and ADS-B (iii) Revised ATC Phraseology ~~(i)~~(iv) Included clarification on Flight Planning

2. ACRONYM LIST & GLOSSARY OF TERMS

2.1 ACRONYM LIST

ACID	Aircraft Identification
ADS-C	Automatic Dependent Surveillance - Contract
ADS-B	Automatic Dependent Surveillance - Broadcast
AIGD	ADS-B Implementation and Operations Guidance Document
AIP	Aeronautical Information Publication
AIT	ADS-B Implementation Team
AMSL	Above Mean Sea Level
APANPIRG	Asia/Pacific Air Navigation Planning and Implementation Regional Group
ARINC	Aeronautical Radio Incorporate
ATC	Air Traffic Control (or Air Traffic Controller)
ATM	Air Traffic Management
ATS	Air Traffic Services
ATSP	ATS Provider
ATSU	ATS unit
CNS	Communications, Navigation, Surveillance
CRC	Cyclic Redundancy Check
CDTI	Cockpit Display Traffic Information
DAIW	Danger Area Infringement Warning
FIR	Flight Information Region
FLTID	Flight Identification
FMS	Flight Management System
FOM	Figure of Merit used in ASTERIX messaging
GPS	Global Positioning System (USA)
HPL	Horizontal Protection Level
ICAO	International Civil Aviation Organization
MSAW	Minimum Safe Altitude Warning
MTBF	Mean Time Between Failures
MTCA	Medium Term Conflict Alert
MTTR	Mean Time To Restore
NAC	Navigation Accuracy Category
NIC	Navigation Integrity Category
PRS	Problem Reporting System
RAI	Restricted Area Intrusion
RAM	Route Adherence Monitoring
RAIM	Receiver Autonomous Integrity Monitoring
RFC	Request for Change
RNP	Required Navigation Performance
SIL	Surveillance Integrity Level
SITF	Study and Implementation Task Force
STCA	Short Term Conflict Alert

2.2 GLOSSARY OF TERMS

ADS-B In	An ADS-B system feature that enables the display of real time ADS-B tracks on a situation display in the aircraft cockpit.
ADS-B Out	An ADS-B system feature that enables the frequent broadcast of accurate aircraft position and vector data together with other information.
Asterix 21	Eurocontrol standard format for data message exchange
FOM (Figure of Merit)	A numeric value that is used to determine the accuracy and integrity of associated position data.
HPL (Horizontal Position Limit)	The containment radius within which the true position of the aircraft will be found for 95% of the time (See DO229c).
NAC (Navigational Accuracy Category)	Subfield used to announce the 95% accuracy limits for the horizontal position data being broadcast.
NIC (Navigational Integrity Category)	Subfield used to specify the containment radius integrity associated with horizontal position data.
NUCp (Navigation Uncertainty Category)	A numeric value that announces the integrity of the associated horizontal position data being broadcast.
SIL (Surveillance Integrity Level)	Subfield used to specify the probability of the true position lying outside the containment radius defined by NIC without being alerted.

3. REFERENCE DOCUMENTS

Id	Name of the document	Reference	Date	Origin	Domain
1	Annex 2: Rules of the Air	Tenth Edition Including Amendment 43 dated 16/7/12	July 2005	ICAO	
2	Annex 4: Aeronautical Chart	Eleventh Edition including Amendment 56 dated 12/7/10	July 2009	ICAO	
3	Annex 10: Aeronautical Telecommunications, Vol. IV – Surveillance Radar and Collision Avoidance Systems	Fourth Edition Including Amendment 87 dated 12/7/10	July 2007	ICAO	
4	Annex 11: Air Traffic Services	Thirteenth Edition including Amendment 48 dated 16/7/12	July 2001	ICAO	
5	Annex 15: Aeronautical Information Services	Thirteen Edition	July 2010	ICAO	
6	PAN-ATM (Doc 4444/ATM501)	Fifteen Edition including Amendment 4 applicable on 15/11/12	2007	ICAO	
7	Manual on Airspace Planning Methodology for the Determination of Separation Minima (Doc 9689/AN953)	First Edition including Amendment 1 dated 30/8/02	1998	ICAO	
8	Doc 9859 Safety Management Manual (SMM)	Third Edition	2012	ICAO	
9	ICAO Circular 326 AN/188 “Assessment of ADS-B and Multilateration Surveillance to Support Air Traffic Services and Guidelines for Implementation”.	First Edition	2012	ICAO	
10	Regional Supplementary Procedures (Doc 7030)	Fifth Edition including Amendment 5 dated 22/7/11	2008	ICAO	

4. ADS-B DATA

APANPIRG has decided to use 1090MHz Extended Squitter data link for ADS-B data exchange in the Asia and Pacific Regions. In the longer term an additional link type may be required.

To ensure interoperability of ADS-B ground stations in the Asia Pacific (ASIA/PAC) Regions, during the 16th APANPIRG Meeting held in August 2005, the ASTERIX Category 21 version 0.23 (V0.23) which had incorporated DO260 standard was adopted as the baselined ADS-B data format for deployment of ADS-B ground stations and sharing of ADS-B data in the ASIA/PAC Regions. At this time, DO260A and DO260B standards were not defined.

This baselined version provides adequate information so that useful ATC operational services, including aircraft separation, can be provided. V0.23 can be used with DO260, DO260A and DO260B ADS-B avionics/ground stations to provide basic ATC operational services. However, V0.23 cannot fully support the more advanced capabilities offered by DO260A and DO260B.

States intending to implement ADS-B surveillance and share ADS-B data with others might consider to adopt a more updated version of ASTERIX in order to make use of the advanced capabilities offered by DO260A and DO260B compliant avionics.

A guidance material on generation, processing and sharing of ASTERIX Cat. 21 ADS-B messages is provided on the ICAO APAC website "http://www.icao.int/APAC/Pages/edocs.aspx~~http://www.bangkok.icao.int/edocs/index.html~~" for reference by States.

In this guidance material, the ADS-B data contained inside ASTERIX Cat 21 are classified as Group 1 (mandatory), Group 2 (Desirable) and Group 3 (Optional). It is required to transmit all data that are operationally desirable (Group 2), when such data are received from the aircraft, in addition to the data that are mandatory (Group 1) in ASTERIX messages. Whether Group 3 optional data will need to be transmitted or not should be configurable on item-by-item basis within the ADS-B ground station depending on specific operational needs.

It is considered necessary that all data that are mandatory in ASTERIX messages (i.e. Group 1 data items) and operationally desirable (i.e. Group 2 data items) when such data are received from aircraft, should be included in data sharing. In the event that the data have to be filtered, the list of optional data items (i.e. Group 3 data items) needs to be shared will be subject to mutual agreement between the two data sharing parties concerned.

5. ADS-B IMPLEMENTATION

5.1 INTRODUCTION

5.1.1 Planning

There are a range of activities needed to progress ADS-B implementation from initial concept level to operational use. This section addresses the issues of collaborative decision making, system compatibility and integration, while the second section of this chapter provides a checklist to assist States with the management of ADS-B implementation activities.

5.1.2 Implementation team to ensure international coordination

5.1.2.1 Any decision to implement ADS-B by a State should include consultation with the wider ATM community. Moreover, where ADS-B procedures or requirements will affect traffic transiting between states, the implementation should also be coordinated between States and Regions, in order to achieve maximum benefits for airspace users and service providers.

5.1.2.2 An effective means of coordinating the various demands of the affected organizations is to establish an implementation team. Team composition may vary by State or Region, but the core group responsible for ADS-B implementation planning should include members with multidiscipline operational expertise from affected aviation disciplines, with access to other specialists where required.

5.1.2.3 Ideally, such a team should comprise representatives from the ATS providers, regulators and airspace users, as well as other stakeholders likely to be influenced by the introduction of ADS-B, such as manufacturers and military authorities. All identified stakeholders should participate as early as possible in this process so that their requirements can be identified prior to the making of schedules or contracts.

5.1.2.4 The role of the implementation team is to consult widely with stakeholders, identify operational needs, resolve conflicting demands and make recommendations to the various stakeholders managing the implementation. To this end, the implementation team should have appropriate access to the decision-makers.

5.1.3 System compatibility

5.1.3.1 ADS-B has potential use in almost all environments and operations and is likely to become a mainstay of the future ATM system. In addition to traditional radar-like services, it is likely that ADS-B will also be used for niche application where radar surveillance is not available or possible. The isolated use of ADS-B has the potential to foster a variety of standards and practices that, once expanded to a wider environment, may prove to be incompatible with neighbouring areas.

5.1.3.2 Given the international nature of aviation, special efforts should be taken to ensure harmonization though compliance with ICAO Standards and Recommended Practices (SARPs). The choice of systems to support ADS-B should consider not only the required performance of individual components, but also their compatibility with other CNS systems.

5.1.3.3 The future concept of ATM encompasses the advantages of interoperable and seamless transition across flight information region (FIR) boundaries and, where necessary, ADS-B implementation teams should conduct simulations, trials and cost/benefit analysis to support these objectives.

5.1.4 Integration

5.1.4.1 ADS-B implementation plans should include the development of both business and safety cases. The adoption of any new CNS system has major implications for service providers, regulators and airspace users and special planning should be considered for the integration of ADS-B into the existing and foreseen CNS/ATM system. The following briefly discusses each element.

5.1.4.2 Communication system

5.1.4.2.1 The communication system is an essential element within CNS. An air traffic controller can now monitor an aircraft position in real time using ADS-B where previously only voice position reports were available. However, a communication system that will support the new services that result from the improved surveillance may be necessary. Consequently, there is an impact of the ongoing ADS-B related work on the communication infrastructure developments.

5.1.4.3 Navigation system infrastructure

5.1.4.3.1 ADS-B is dependent upon the data obtained from a navigation system (typically GNSS), in order to enable its functions and performance. Therefore, the navigation infrastructure should fulfill the corresponding requirements of the ADS-B application, in terms of:

a) Data items; and

b) Performance (e.g. accuracy, integrity, availability etc.).

5.1.4.3.2 This has an obvious impact on the navigation system development, which evolves in parallel with the development of the surveillance system.

5.1.4.4 Other surveillance infrastructure

5.1.4.4.1 ADS-B may be used to supplement existing surveillance systems or as the principal source of surveillance data. Ideally, surveillance systems will incorporate data from ADS-B and other sources to provide a coherent picture that improves both the amount and utility of surveillance data to the user. The choice of the optimal mix of data sources will be defined on the basis of operational demands, available technology, safety and cost-benefit considerations.

5.1.4.4.2 A guidance material on issues to be considered in ATC multi-sensor fusion processing including integration of ADS-B data is provided on the ICAO website ~~http://www.bangkok.icao.int/edocs/index.html~~http://www.icao.int/APAC/Pages/edocs.aspx for reference by States.

5.1.4.4.3 A guidance material on processing and displaying of ADS-B data at air traffic controller positions is provided on the ICAO website ~~http://www.bangkok.icao.int/edocs/index.html~~ "http://www.icao.int/APAC/Pages/edocs.aspx" for reference by States.

5.1.5 Coverage Predictions

5.1.5.1 Reliable and robust analysis and planning of ADS-B coverage to support seamless ATM initiative requires accurate and reliable coverage modelling. States should ensure that surveillance engineering/technical teams are provided with modelling tools to provide accurate and reliable coverage predictions for ATM planning and analysis.

5.2 IMPLEMENTATION CHECKLIST

5.2.1 Introduction

The purpose of this implementation checklist is to document the range of activities that needs to be completed to bring an ADS-B application from an initial concept to operational use. This checklist may form the basis of the terms of reference for an ADS-B implementation team, although some activities may be specific to individual stakeholders. An example of the checklist used by AirServices Australia is given at Appendix 1.

5.2.2 Activity Sequence

The activities are listed in an approximate sequential order. However, each activity does not have to be completed prior to starting the next activity. In many cases, a parallel and iterative process should be used to feed data and experience from one activity to another. It should be noted that not all activities will be required for all applications.

5.2.3 Concept Phase

a) construct operational concept:

1) purpose;
2) operational environment;
3) ATM functions; and
4) infrastructure;

b) identify benefits:

1) safety enhancements;
2) efficiency;
3) capacity;
4) environmental;
5) cost reductions;
6) access; and
7) other metrics (e.g. predictability, flexibility, usefulness);

c) identify constraints:

1) pair-wise equipage;
2) compatibility with non-equipped aircraft;
3) need for exclusive airspace;
4) required ground infrastructure;
5) RF spectrum;
6) integration with existing technology; and
7) technology availability;

d) prepare business case:

1) cost benefit analysis; and
2) demand and justification.

5.2.4 Design Phase

a) identify operational requirements:

1) security; and
2) systems interoperability;

b) identify human factors issues:

1) human-machine interfaces;
2) training development and validation;
3) workload demands;
4) role of automation vs. role of human;
5) crew coordination/pilot decision-making interactions; and
6) ATM collaborative decision-making;

c) identify technical requirements:

1) standards development;
2) data required;
3) functional processing;
4) functional performance; and
5) required certification levels;

d) equipment development, test, and evaluation:

1) prototype systems built to existing or draft standards/specifications;
2) developmental bench and flight tests; and
3) acceptance test parameters; and
4) select and procure technology;

e) develop procedures:

1) pilot and controller actions and responsibilities;
2) phraseologies;
3) separation/spacing criteria and requirements;
4) controller's responsibility to maintain a monitoring function, if appropriate;
5) contingency procedures;
6) emergency procedures; and
7) develop AIP and Information documentation

f) prepare design phase safety case:

1) safety rationale;
2) safety budget and allocation; and
3) functional hazard assessment.

5.2.5 Implementation phase

a) prepare implementation phase safety case;

b) conduct operational test and evaluation:

1) flight deck and ATC validation simulations; and
2) flight tests and operational trials;

c) obtain systems certification:

1) aircraft equipment; and
2) ground systems;

d) obtain regulatory approvals:

1) flight operations; and
2) air traffic certification of use;

e) implementation transition:

1) Promulgate procedures and deliver training
2) continue data collection and analysis;
3) resolve any unforeseen issues; and
4) continue feedback into standards development processes;

f) performance monitoring to ensure that the agreed performance is maintained.

5.2.5.1 Once the implementation project is complete, ongoing maintenance and upgrading of both ADS-B operations and infrastructure should continue to be monitored, through the appropriate forums.

6. HARMONIZATION FRAMEWORK FOR ADS-B IMPLEMENTATION

6.1 BACKGROUND

6.1.1 It is obvious that full benefits of ADS-B will only be achieved by its harmonized implementation and seamless operations. During the 6th meeting of ADS-B SEA/WG in February 2011, Hong Kong, China initiated to strengthen collaboration among concerned States/Administrations for harmonized ADS-B implementation and seamless operations along two ATS routes L642 and M771 with major traffic flow (MTF). An ad-hoc workgroup comprising concerned CAAs/ANSPs from Hong Kong, China, Mainland China, Vietnam and Singapore was subsequently formed to elaborate and agree on a framework regarding implementation timelines, avionics standards, optimal flight levels, and ATC and engineering handling procedures. As a coherent effort, ADS-B implementation along ATS routes L642 and M771 has been harmonized while Hong Kong, China and Singapore have published respective Aeronautical Information Circulars and Airworthiness Notices on ADS-B mandates for these two routes with effect on 12 December 2013.

6.1.2 It is considered that the above implementation framework for ATS routes L642/M771 would serve as a useful template for extension to other high density routes to harmonize ADS-B implementation. Paragraph 6.2 shows the detailed framework.

6.2 TEMPLATE OF HARMONIZATION FRAMEWORK FOR ADS-B IMPLEMENTATION

Harmonization Framework for ADS-B Implementation along ATS Routes L642 and M771			
No.	**What to harmonize**	**What was agreed**	**Issue / what needs to be further discussed**
1	Mandate Effective	Singapore (SG), Hong Kong (HK), China (Sanya) : 12 Dec 2013 Vietnam (VN) : to be confirmed	
2	ATC Operating Procedures	No need to harmonize	Refer to SEACG for consideration of the impact of expanding ADS-B surveillance on ATC Operating Procedures including Large Scale Weather procedures.
3	Mandate Publish Date	No need to harmonize	To publish equipment requirements as early as possible.
4	Date of Operational Approval	No need to harmonize	

5	Flight Level	SG, HK, CN : - At or Above FL290 (ADS-B airspace) - Below FL290 (Non-ADS-B airspace) VN to be confirmed	
6	Avionics Standard (CASA/AMC2024)	SG - CASA or AMC2024 or FAA AC No. 20-165 HK - CASA or AMC2024 or FAA AC No. 20-165 VN - CASA or AMC2024 or FAA AC No. 20-165 CN - CASA or AMC2024 or FAA AC No. 20-165	ADS-B Task Force agreed that DO260B will be accepted as well. SG, HK, and CN agreed their ADS-B GS will accept DO260, DO260A and DO260B by 1 July 2014 (Note 1)
7	Flight Planning	Before 15 Nov 2012, as per AIDG On or after 15 Nov 2012, as per new flight plan format	
8	Aircraft Approval		
8a)	Procedures if Aircraft Not Approved or Aircraft without a Serviceable ADS-B Transmitting Equipment before Flight	SG, HK, CN : FL280 and Below VN to be confirmed	

8b)	Aircraft Approved but Transmitting Bad Data (Blacklisted Aircraft)	For known aircraft, treat as non ADS-B aircraft.	Share blacklisted aircraft among concerned States/Administration
9	Contingency Plan		
9a)	Systemic Failure such as Ground System / GPS Failure	Revert back to current procedure.	
9b)	Avionics Failure or Approved Aircraft Transmitting Bad Data in Flight	Provide other form of separation, subject to bilateral agreement. From radar/ADS-B environment to ADS-B only environment, ATC coordination may be able to provide early notification of ADS-B failure.	Address the procedure for aircraft transiting from radar to ADS-B airspace and from ADS-B to ADS-B airspace.
10	Commonly Agreed Route Spacing	SEACG	Need for commonly agreed minimal in-trail spacing throughout.

Note 1: Also included two ADS-B GS supplied by Indonesia at Matak and Natuna

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7. SYSTEM INTEGRITY AND MONITORING

7.1 INTRODUCTION

The Communications, Navigation, Surveillance and Air Traffic Management (CNS/ATM) environment is an integrated system including physical systems (hardware, software, and communication networks), human elements (pilots, controllers and engineers), and the operational procedures for its applications. ADS-B is a surveillance system that may be integrated with other surveillance technologies or may also operate as an independent source for surveillance monitoring within the CNS/ATM system.

Because of the integrated nature of such system and the degree of interaction among its components, comprehensive system monitoring is recommended. The procedures described in this section aim to ensure system integrity by validation, identification, reporting and tracking of possible problems revealed during system monitoring with appropriate follow-up actions.

These procedures do not replace the ATS incident reporting procedures and requirements, as specified in PANS-ATM (Doc 4444), Appendix 4; ICAO's Air Traffic Services Planning Manual (Doc 9426), Chapter 3; or applicable State regulations, affecting the reporting responsibilities of parties directly involved in a potential ATS incident.

7.2 PERSONNEL LICENSING AND TRAINING

Prior to operating any element of the ADS-B system, operational and technical personnel shall undertake appropriate training as determined by the States, including compliance with the Convention on International Civil Aviation where applicable.

Notwithstanding the above requirement and for the purposes of undertaking limited trials of the ADS-B system, special arrangements may be agreed between the operator and an Air Traffic Services Unit (ATSU).

7.3 SYSTEM PERFORMANCE CRITERIA FOR AN ATC SEPARATION SERVICE

A number of States have started to introduce ADS-B for the provision of Air Traffic Services, including 'radar-like' separation. The ICAO Separation and Airspace Safety Panel (SASP) has completed assessment on the suitability of ADS-B for various applications including provision of aircraft separation based on comparison of technical characteristics between ADS-B and monopulse secondary surveillance radar. It is concluded that that ADS-B surveillance is better or at least no worse than the referenced radar, and can be used to provide separation minima as described in PANS-ATM (Doc 4444) whether ADS-B is used as a sole means of ATC surveillance or used together with radar, subject to certain conditions to be met. The assessment result is detailed in the ICAO Circular 326 AN/188 "Assessment of ADS-B and Multilateration Surveillance to Support Air Traffic Services and Guidelines for Implementation".

States intending to introduce ADS-B separation minima shall comply with provisions of PANS-ATM, Regional Supplementary Procedures (Doc 7030) and Annex 11 paragraph 3.4.1. States should adopt the guidelines contained in this document unless conformance with PANS-ATM specifications requires change.

7.4 ATC SYSTEM VALIDATION

7.4.1 Safety Assessment Guidelines

To meet system integrity requirements, States should conduct a validation process that confirms the integrity of their equipment and procedures. Such processes shall include:

a) A system safety assessment for new implementations is the basis for definitions of system performance requirements. Where existing systems are being modified to utilize additional services, the assessment demonstrates that the ATS Provider's system will meet safety objectives;

b) Integration test results confirming interoperability for operational use of airborne and ground systems; and

c) Confirmation that the ATS Operation Manuals are compatible with those of adjacent providers where the system is used across a common boundary.

7.4.2 System safety assessment

The objective of the system safety assessment is to ensure the State that introduction and operation of ADS-B is safe. This can be achieved through application of the provisions of Annex 11 paragraph 2.27 and PANS-ATM Chapter 2. The safety assessment should be conducted for initial implementation as well as any future enhancements and should include:

a) Identifying failure conditions;

b) Assigning levels of criticality;

c) Determining risks/ probabilities for occurrence;

d) Identifying mitigating measures and fallback arrangements;

e) Categorising the degree of acceptability of risks; and

f) Operational hazard ID process.

Following the safety assessment, States should institute measures to offset any identified failure conditions that are not already categorized as acceptable. This should be done to reduce the probability of their occurrence to a level as low as reasonably practicable. This could be accomplished through system automation or manual procedures.

Guidance material on building a safety case for delivery of an ADS-B separation service is provided on the ICAO APAC website "~~http://www.bangkok.icao.int/edocs/index.htm~~http://www.icao.int/APAC/Pages/edocs.aspx~~1~~" for reference by States.

7.4.3 Integration test

States should conduct trials with suitably equipped aircraft to ensure they meet the operational and technical requirements to provide an ATS. Alternatively, they may be satisfied by test results and analysis conducted by another State or organization deemed competent to provide such service. Where this process is followed, the tests conducted by another State or

organization should be comparable (i.e. using similar equipment under similar conditions). Refer also to the *Manual on Airspace Planning Methodology for the Determination of Separation Minima* (Doc9689).

7.4.4 ATS Operation Manuals

States should coordinate with adjacent States to confirm that their ATS Operation Manuals contain standard operating procedures to ensure harmonization of procedures that impact across common boundaries.

7.4.5 ATS System Integrity

With automated ATM systems, data changes, software upgrades, and system failures can affect adjacent units. States shall ensure that:

a) A conservative approach is taken to manage any changes to the system;

b) Aircrew, aircraft operating companies and adjacent ATSU(s) are notified of any planned system changes in advance, where that system is used across a common boundary;

c) ATSUs have verification procedures in place to ensure that following any system changes, displayed data is both correct and accurate;

d) In cases of system failures or where upgrades (or downgrades) or other changes may impact surrounding ATS units, ATSUs should have a procedure in place for timely notification to adjacent units. Such notification procedures will normally be detailed in Letters of Agreement between adjacent units; and

e) ADS-B surveillance data is provided with equal to or better level of protection and security than existing surveillance radar data.

7.5 SYSTEM MONITORING

During the initial period of implementation of ADS-B technology, routine collection of data is necessary in order to ensure that the system continues to meet or exceed its performance, safety and interoperability requirements, and that operational service delivery and procedures are working as intended. The monitoring program is a two-fold process. Firstly, summarised statistical data should be produced periodically showing the performance of the system. This is accomplished through ADS-B Periodic Status Reports. Secondly, as problems or abnormalities arise, they should be identified, tracked, analyzed and corrected and information disseminated as required, utilizing the ADS-B Problem Report.

Guidance materials on monitoring and analysis of ADS-B Avionics Performance are given at Appendix 2.

7.5.1 Problem Reporting System (PRS)

The Problem Reporting System is tasked with the collection, storage and regular dissemination of data based on reports received from ADS-B SITF members. The PRS tracks problem reports and publish information from those reports to ADS-B SITF members. Problem resolution is the responsibility of the appropriate ADS-B SITF members.

The PRS Administrator shall:

a) prepare consolidated problem report summaries for each ADS-B SITF meeting;

b) collect and consolidate ADS-B Problem Reports; and

c) maintain a functional website (with controlled access) to manage the problem reporting function.

7.5.2 The monitoring process

When problems or abnormalities are discovered, the initial analysis should be performed by the organization(s) identifying the problem. In addition, a copy of the problem report should be entered in to the PRS which will assign a tracking number. As some problems or abnormalities may involve more than one organization, the originator should be responsible for follow-up action to rectify the problem and forward the information to the PRS. It is essential that all information relating to the problem is documented and recorded and resolved in a timely manner.

The following groups should be involved in the monitoring process and problem tracking to ensure a comprehensive review and analysis of the collected data:

a) ATS Providers;

b) Organizations responsible for ATS system maintenance (where different from the ATS provider);

c) Relevant State regulatory authorities;

d) Communication Service Providers being used;

e) Aircraft operators; and

f) Aircraft and avionics manufacturers.

7.5.3 Distribution of confidential information

It is important that information that may have an operational impact on other parties be distributed by the authorised investigator to all authorised groups that are likely to be affected, as soon as possible. In this way, each party is made aware of problems already encountered by others, and may be able to contribute further information to aid in the solution of these problems. The default position is that all states agree to provide the data which will be de-identified for reporting and record keeping purposes.

7.5.4 ADS-B problem reports

Problem reports may originate from many sources, but most will fall within two categories; reports based on observation of one or more specific events, or reports generated from the routine analysis of data. The user would document the problem, resolve it with the appropriate party and forward a copy of the report to the PRS for tracking and distribution. While one occurrence may appear to be an isolated case, the receipt of numerous similar reports by the PRS could indicate that an area needs more detailed analysis.

To effectively resolve problems and track progress, the problem reports should be sent to the nominated point of contact at the appropriate organization and the PRS. The resolution of the identified problems may require:

a) Re-training of system operators, or revision of training procedures to ensure compliance with existing procedures;

b) Change to operating procedures;

c) Change to system requirements, including performance and interoperability; or

d) Change to system design.

7.5.5 ADS-B periodic status report

The ATS Providers should complete the ADS-B Periodic Status Report annually and deliver the report to the regional meeting of the ADS-B SITF. The Periodic Status Report should give an indication of system performance and identify any trend in system deficiencies, the resultant operational implications, and the proposed resolution, if applicable.

Communications Service Providers, if used, are also expected to submit Periodic Status Reports on the performance of the networks carrying ADS-B data at the annual regional meeting of the ADS-B SITF. These reports could also contain the details of planned or current upgrades to the network.

7.5.6 Processing of Reports

Each group in the monitoring process should nominate a single point of contact for receipt of problem reports and coordination with the other parties. This list will be distributed by the PRS Administrator to all parties to the monitoring process.
Each State should establish mechanisms within its ATS Provider and regulatory authority to:

a) Assess problem reports and refer them to the appropriate technical or operational expertise for investigation and resolution;

b) Coordinate with aircraft operators;

c) Develop interim operational procedures to mitigate the effects of problems until such time as the problem is resolved;

d) Monitor the progress of problem resolution;
e) Prepare a report on problems encountered and their operational implications and forward these to the PRS;

f) Prepare the ADS-B periodic status report at pre-determined times and forward these to the Secretary of the annual meeting of the ADS-B SITF; and

g) Coordinate with any Communication Service Providers used.

7.6 APANPIRG

APANPIRG, with the assistance of its contributory bodies, shall oversee the monitoring process to ensure the ADS-B system continues to meet its performance and safety requirements, and that operational procedures are working as intended. The APANPIRG'S objectives are to:

a) review Periodic Status Reports and any significant Problem Reports;

b) highlight successful problem resolutions to ADS-B SITF members;

c) monitor the progress of outstanding problem resolutions;

d) prepare summaries of problems encountered and their operational implications; and

e) assess system performance based on information in the PRS and Periodic Status Reports.

7.7 LOCAL DATA RECORDING AND ANALYSIS

7.7.1 Data recording

It is recommended that ATS Providers and Communication Service Providers retain the records defined below for at least 30 days to allow for accident/incident investigation processes. These records should be made available on request to the relevant State safety authority. Where data is sought from an adjacent State, the usual State to State channels should be used.

These recordings shall be in a form that permits a replay of the situation and identification of the messages that were received by the ATS system.

7.7.2 Local data collection

ATS providers and communications service providers should identify and record ADS-B system component failures that have the potential to negatively impact the safety of controlled flights or compromise service continuity.

7.7.3 Avionics problem identification and correction

ATS providers need to develop systems to :

a) detect ADS-B avionics anomalies and faults

b) advise the regulators and where appropriate the aircraft operators on the detected ADS-B avionics anomalies and faults

c) devise mechanisms and procedures to address identified faults

Regulators need to develop and maintain systems to ensure that appropriate corrective actions are taken to address identified faults.

7.8 ADS-B PROBLEM REPORT

7.8.1 Report Form			**PRS #**
Date UTC		**Time UTC**	
Registration		**Aircraft ID**	
Flight ID		**ICAO 24 Bit Code**	
Aircraft Type			
Flight Sector/ Location			
ATS Unit			
Description / additional information			
Originator		**Originator Reference number**	
Organization			

7.8.2 Description of Fields

Field	Meaning
Number	A unique identification number assigned by the PRS Administrator to this problem report. Organizations writing problem reports are encouraged to maintain their own internal list of these problems for tracking purposes. Once the problems have been reported to the PRS and incorporated in the database, a number will be assigned by the PRS and used for tracking by the ADS-B SITF.
Date UTC	UTC date when the event occurred.
Time UTC	UTC time (or range of times) at which the event occurred.
Registration	Registration number (tail number) of the aircraft involved.
Aircraft ID (ACID)	Coded equivalent of voice call sign as entered in FPL Field 7.
ICAO 24 Bit Code	Unique aircraft address expressed in Hexadecimal form (e.g. 7432DB)
Flight ID (FLTID)	The identification transmitted by ADS-B for display on a controller situation display or a CDTI.
Flight Sector/Location	The departure airport and destination airport for the sector being flown by the aircraft involved in the event. These should be the ICAO identifiers of those airports. Or if more descriptive, the location of the aircraft during the event.
Originator	Point of contact at the originating organization for this report (usually the author).
Aircraft Type	The aircraft model involved.
Organization	The name of the organization (airline, ATS provider or communications service provider) that created the report.
ATS Unit	ICAO identifier of the ATC Center or Tower controlling the aircraft at the time of the event.
Description	This should provide as complete a description of the situation leading up to the problem as is possible. Where the organization reporting the problem is not able to provide all the information (e.g. the controller may not know everything that happens on the aircraft), it would be helpful if they would coordinate with the other parties to obtain the necessary information. The description should include: • A complete description of the problem that is being reported • The route contained in the FMS and flight plan • Any flight deck indications • Any indications provided to the controller when the problem occurred • Any additional information that the originator of the problem report considers might be helpful but is not included on the list above If necessary to contain all the information, additional pages may be added. if the originator considers it might be helpful, diagrams and other additional information (such as printouts of message logs) may be appended to the report.

7.9 ADS-B PERFORMANCE REPORT FORM			
Originating Organization			
Date of submission		**Originator**	
Report Period			
TECHNICAL ISSUES			
OPERATIONAL ISSUES			
GENERAL COMMENTS			

8. RELIABILITY & AVAILABILITY CONSIDERATIONS

Reliability and Availability of ADS-B systems should normally be equivalent or better than the reliability and availability of radar systems.

Guidance material on Reliability and Availability standards for ADS-B systems and supporting voice communications systems are included in the document "Baseline ADS-B Service Performance Parameters" which is available on the ICAO APAC website at: http://www.icao.int/APAC/Documents/edocs/cns/ADSB_ServicePer.pdf~~http://www.bangkok.icao.int/edocs/cns/adsb_serviceper.pdf~~

The "Baseline ADS-B Performance Parameters" document contains three Tiers of service performance parameters with different reliability and availability standards for each Tier. The appropriate Tier should be selected for the type of ADS-B service intended:

(a) Tier 1 standards are for a high performance traffic separation service;

(b) Tier 2 standards are for a traffic situational awareness service with procedural separation; and

(c) Tier 3 standards are for a traffic advisory service (flight information service)

To achieve high operational availability of ADS-B systems to support aircraft separation services, it is necessary to operate with duplicated/redundant systems. If one system fails, the service continues using an unduplicated system. This is acceptable for a short period, whilst the faulty system is being repaired, because the probability of a second failure during the short time window of repairing is low.

However, it is necessary to ensure that the repair does not take too long. A long repair time increases the risk of an unexpected failure (loss of service continuity); which in turn, introduces potential loss of service (low availability) and loss of aircraft operational efficiency and/or safety impacts.

8.1 Reliability

8.1.1 Reliability is a measure of how often a system fails and is usually measured as Mean Time Between Failure (MTBF) expressed in hours. Continuity is a measure equivalent to reliability, but expressed as the probability of system failure over a defined period. In the context of this document, failure means inability to deliver ADS-B data to the ATC centre. Ie: Failure of the ADS-B system rather than an equipment or component failure.

8.1.2 Poor system MTBF has a safety impact because typically it causes unexpected transition from one operating mode to another. For example, aircraft within surveillance coverage that are safely separated by a surveillance standard distance (say, 5 NM) are unexpectedly no longer separated by a procedural standard distance (say 15 mins), due to an unplanned surveillance outage.

8.1.3 In general, reliability is determined by design (see para 8.3 B below)

8.2 Availability

8.2.1 Availability is a measure of how often the system is available for operational use. It is usually expressed as a percentage of the time that the system is available.

8.2.2 Poor availability usually results in loss of economic benefit because efficiencies are not

available when the ATC system is operating in a degraded mode (eg using procedural control instead of say 5 NM separation).

8.2.3 Planned outages are often included as outages because the efficiencies provided to the Industry are lost, no matter what the cause of the outage. However, some organisations do not include planned outages because it is assumed that planned outages only occur when the facility is not required.

8.2.4 Availability is calculated as

Availability (Ao) = MTBF/(MTBF+MDT)

where MTBF= Mean Time Between SYSTEM Failure
MDT = Mean Down Time for the SYSTEM

The MDT includes Mean Time To Repair (MTTR), Turn Around Time (TAT) for spares, and Mean Logistic Delay Time (MLDT)
NB: This relates to the failure of the system to provide a service, rather than the time between individual equipment failures. Some organisations use Mean Time Between Outage (MTBO) rather than MTBF.

8.2.5 Availability is directly a function of how quickly the SYSTEM can be repaired. Ie: directly a function of MDT. Thus availability is highly dependent on the ability & speed of the support organisation to get the system back on-line.

8.3 Recommendations for high reliability/availability ADS-B systems

A : **System design** can keep system failure rate low with long MTBF. Typical techniques are :

- to duplicate each element and minimise single points of failure. Automatic changeover or parallel operation of both channels keeps system failure rates low. Ie: the system keeps operating despite individual failures. Examples are :
  - Separate communication channels between ADS-B ground station and ATC centre preferably using different technologies or service providers eg one terrestrial and one satellite
- Consideration of Human factors in design can reduce the number of system failures due to human error. E.g. inadvertent switch off, incorrect software load, incorrect maintenance operation.
- Take great care with earthing, cable runs and lightning protection to minimise the risks of system damage
- Take great care to protect against water ingress to cables and systems
- Establish a system baseline that documents the achieved performance of the site that can be later be used as a reference. This can shorten troubleshooting in future.
- System design can also improve the MDT by quickly identifying problems and alerting maintenance staff. Eg Built in equipment test (BITE) can significantly contribute to lowering MDT.

B: **Logistics strategy** aims to keep MDT very low. Low MDT depends on logistic support providing short repair times. To achieve short repair times, ANSPs usually provide a range of logistics, including the following, to ensure that the outage is less than a few days :

- ensure the procured system is designed to allow for quick replacement of faulty modules to restore operations
- provide remote monitoring to allow maintainers to identify the faulty modules for transport to site
- provide support tools to allow technicians to repair faulty modules or to configure/setup replacement modules
- provide technicians training to identify & repair the faulty modules
- provide local maintenance depots to reduce the time it takes to access to the site
- provide documentation and procedures to "standardise" the process
- use an in-country spares pool to ensure that replacement modules are available within reasonable times
- use a maintenance contract to repair faulty modules within a specified turnaround time. I.e.: to replenish the spares pool quickly.

Whilst technical training and remote monitoring are usually considered by ANSPs, sometimes there is less focus on spares support.

Difficulties can be experienced if States :

a) Fail to establish a spares pool – because procurement of spares at the time of failure can bring extensive delays due to :
b) obtaining funds
c) obtaining approval to purchase overseas
d) obtaining approval to purchase from a "sole source"
e) difficulties and delays in obtaining a quotation
f) delays in delivery because the purchase was unexpected by the supplier
g) Fail to establish a module repair contract resulting in :
    - long repair times
    - unplanned expenditure
    - inability for a supplier to repair modules because the supplier did not have adequate certainty of funding of the work

Spares pool

ANSPs can establish, preferably as part of their acquisition purchase, adequate spares buffer stock to support the required repair times. The prime objective is to reduce the time period that the system operates un-duplicated. It allows decoupling of the restoration time from the module repair time.

Module repair contract

ANSPs can also enter into a maintenance repair contract, preferably as part of their acquisition purchase, to require the supplier to repair or replace and deliver failed modules within a specified time – preferably with contractual incentives/penalties for compliance. Such support contracts are best negotiated as part of the acquisition contract when competition between vendors is at play to keep costs down. Sometimes it is appropriate to demand that the support contractor also keep a certain level of buffer stock of spares "in country".

It is strongly recommended that maintenance support is purchased under the same contract as

the acquisition contract.

The advantages of a module repair contract are :

- The price can be determined whilst in the competitive phase of acquisition – hence avoids excessive costs
- The contract can include the supplier bearing all shipping costs
- Can be funded by a define amount per year, which support the budget processes. If the costs are fixed, the supplier is encouraged to develop a reliable system minimising module repairs.
- It avoids delays and funding issues at the time of the module failure

Other typical strategies are:

- Establish availability and reliability objectives that are agreed organization wide. In particular agree System response times (SRT) for faults and system failure to ensure that MDT is achieved. An agreed SRT can help organizations to decide on the required logistics strategy including number, location and skills of staff to support the system.

- Establish baseline preventative maintenance regimes including procedures and performance inspections in conjunction with manufacturer recommendations for all subsystems

- Use remote control & monitoring systems to identify faulty modules before travel to site. This can avoid multiple trips to site and reduce the repair time

- Have handbooks, procedures, tools available at the site or a nearby depot so that travel time does not adversely affect down time

- Have adequate spares and test equipment ready at a maintenance depot near the site or at the site itself. Vendors can be required to perform analysis of the number of spares required to achieve low probability of spare "stock out"

- Have appropriate plans to cope with system and component obsolescence. It is possible to contractually require suppliers to regularly report on the ability to support the system and supply components.

- Have ongoing training programs and competency testing to ensure that staff are able to perform the required role

The detailed set of operational and technical arrangements in place and actions required to maintain a system through the lifecycle are often documented in a Integrated Logistics Support Plan.

C: Configuration Management aims to ensure that the configuration of the ground stations is maintained with integrity. Erroneous configuration can cause unnecessary outages. Normally configuration management is achieved by :

- Having clear organizational & individual responsibilities and accountabilities for system configuration.

- Having clear procedures in place which define who has authority to change configuration and records of the changes made including, inter alia

- The nature of the change including the reason
- Impact of the change & safety assessment
- An appropriate transition or cutover plan
- Who approved the change
- When the change was authorized and when the change was implemented

- Having appropriate test and analysis capabilities to confirm that new configurations are acceptable before operational deployment.

- Having appropriate methods to deploy the approved configuration (Logistics of configuration distribution). Suggested methods;

  - Approved configuration published on intranet web pages
  - Approved configuration distributed on approved media

D: Training & Competency plans aim to ensure that staff has the skills to safety repairs Normally this is achieved by:

- Conduct of appropriate Training Needs Analysis (TNA) to identify the gap between trainee skill/knowledge and the required skill/knowledge.

- Development and delivery of appropriate training to maintainers

- Competency based testing of trainees

- Ongoing refresher training to ensure that skills are maintained even when fault rates are low

E: Data collection & Review :

Regular and scheduled review should be undertaken to determine whether reliability/availability objectives are being met. These reviews need to consider :

- Reports of actual achieved availability & reliability

- Data regarding system failures including "down time" needs to be captured and analysed so the ANSP actually knows what is being (or not being) achieved.

- Any failure trends that need to be assessed. This requires data capture of the root cause of failures

- Any environmental impacts on system performance, such coverage obstructions such as trees, planned building developments, corrosion, RFI etc. Changes in infrastructure may also be relevant including air conditioning (temperature/humidity etc) and power system changes.

- System problem reports especially those that relate to software deficiencies (design)

- System and component obsolescence

- Staff skills and need for refresher training

9. ADS-B REGULATIONS AND PROCEDURES

9.1 INTRODUCTION

ADS-B involves the transmission of specific data messages from aircraft and vehicle systems. These data messages are broadcast at approximately 0.5 second intervals and received at compatible ground stations that relay these messages to ATSU(s) for presentation on ATS situation displays. The following procedures relate to the use of ADS-B data in ATS ground surveillance applications.

The implementation of the ADS-B system will support the provision of high performance surveillance, enhancing flight safety, facilitating the reduction of separation minima and supporting user demands such as user-preferred trajectories.

9.2 ADS-B REGULATIONS

As agreed at APANPRIG 22/8, States intending to implement ADS-B based surveillance services may designate portions of airspace within their area of responsibility by:

(a) mandating the carriage and use of ADS-B equipment; or

(b) providing priority for access to such airspace for aircraft with operative ADS-B equipment over those aircraft not operating ADS-B equipment.

In publishing ADS-B mandate/regulations, States should consider to :

- define the ADS-B standards applicable to the State. For interoperability and harmonization, such regulations need to define both the standards applicable for the aircraft ADS-B position source and the ADS-B transmitter.

- define the airspace affected by the regulations and the category of aircraft that the regulation applies to.

- define the timing of the regulations allowing sufficient time for operators to equip. Experience in Asia Pacific Regions is that major international carriers are having high equippage rates of ADS-B avionics. However the equippage rates of ADS-B avionics for some regional fleets, business jets and general aviation are currently low and more time will be required to achieve high equippage rates.

- establish the technical and operational standards for the ground stations and air traffic management procedures used for ADS-B separation services, including the associated voice communications services.

States may refer to the APANPIRG Conclusion 22/36 on the template for ADS-B mandate/regulations on provision of ADS-B based ground surveillance. Some States listed below have published their ADS-B mandate/regulations on their web sites that could be used for reference.

(a) Civil Aviation Safety Authority (CASA) of Australia
Civil Aviation Order 20.18 Amendment Order (No. 1) 2009, Civil Aviation Order 82.1 Amendment Order (No. 1) 2009, Civil Aviation Order 82.3 Amendment Order (No. 2) 2009, Civil Aviation Order 82.5 Amendment Order (No. 2) 2009 and Miscellaneous Instrument CASA 41/09 – Direction – use of ADS-B in foreign aircraft engaged in private operations in Australian territory
"http://www.comlaw.gov.au/Details/F2012C00103/Download**"**

(b) Civil Aviation Department (CAD) of Hong Kong, China
Aeronautical Information Publication Supplement ~~Circular (AIC)~~ No. ~~09~~13/1~~1~~3 dated 2~~4~~9 ~~May~~October 201~~3~~1
"~~http://www.hkatc.gov.hk/HK_AIP/aic/AIC09-11.pdf~~http://www.hkatc.gov.hk/HK_AIP/supp/A13-13.pdf"

(c) Civil Aviation Authority of Singapore (CAAS)
Aeronautical Information Publication Supplment ~~Circular (AIC)~~ No. ~~14~~254/13~~0~~ dated 6~~28 December~~November 201~~0~~3
"~~http://www.caas.gov.sg/caasWeb2010/export/sites/caas/en/Regulations/Aeronautical_Information/AIC/AIC_PDFs/AIC_14_2010.pdf~~http://www.caas.gov.sg/caasWeb2010/export/sites/caas/en/Regulations/Aeronautical_Information/AIP_Supplements/download/AIPSUP254-13.pdf"

(d) Federal Aviation Administration (FAA)
ADS–B Out Performance Requirements To Support Air Traffic Control (ATC) Service, Final Rule
"http://www.gpo.gov/fdsys/pkg/FR-2010-05-28/pdf/2010-12645.pdf"

9.3 FACTORS TO BE CONSIDERED WHEN USING ADS-B

9.3.1 Use of ADS-B Level data

The accuracy and integrity of pressure altitude derived level information provided by ADS-B are equivalent to Mode C level data provided through an SSR sensor and subject to the same operational procedures as those used in an SSR environment. Where the ATM system converts ADS-B level data to display barometric equivalent level data, the displayed data should not be used to determine vertical separation until the data is verified by comparison with a pilot reported barometric level.

9.3.2 Position Reporting Performance

The ADS-B data from the aircraft will include a NUC/NIC/SIL categorization of the accuracy and integrity of the horizontal position data. This figure is determined from NIC/ NAC/ SIL values for DO260A/B compliant avionics and NUC values for DO260/ED102 compliant avionics.

In general, for 5NM separation, if the HPL value used to generate ADS-B quality indicators (NUC or NIC) is greater than 2 nautical miles the data is unlikely to be of comparable quality to that provided by a single monopulse SSR. ADS-B data should not be used for separation unless a suitable means of determining data integrity is used.

The key minimum performance requirements for an ADS-B system to enable the use of a 3 NM or 5 NM separation minimum in the provision of air traffic control is provided in the ICAO Circular 326 (especially Appendix C).

ADS-B reports with low integrity may be presented on situation displays, provided the controller is alerted (e.g. by a change in symbology and/or visual alert) to the change and the implications for the provision of separation. An ANS Provider may elect not to display ADS-B tracks that fail to meet a given position reporting performance criterion.

9.3.3 GNSS Integrity Prediction Service

Early implementations of ADS-B are expected to use GNSS for position determination. As such, availability of GNSS data has a direct influence on the provision of a surveillance service.

ATS Providers may elect to use a GNSS integrity prediction service to assist in determining the future availability of useable ADS-B data. The integrity prediction service alerts users to potential future loss or degradation of the ADS-B service in defined areas. When these alerts are displayed, the system is indicating to its users that at some time in the future the ADS-B positional data may be inadequate to support the application of ADS-B separation. It is recommended that the prediction service is made available to each ATSU that is employing ADS-B to provide a separation service, to ensure that air traffic controllers are alerted in advance of any predicted degradation of the GNSS service and the associated reduction in their ability to provide ADS-B separation to flights that are within the affected area. This is similar to having advance warning of a planned radar outage for maintenance.

ADS-B should not be used to provide separation between aircraft that will be affected by an expected period of inadequate position reporting integrity.

If an unpredicted loss of integrity occurs (including a RAIM warning report from aircrew) then;

(a) ADS-B separation should not be applied by ATC to the particular aircraft reporting until the integrity has been assured; and

(b) The controller should check with other aircraft in the vicinity of the aircraft reporting the RAIM warning, to determine if they have also been affected and establish alternative forms of separation if necessary.

9.3.4 Sharing of ADS-B Data

ADS-B Data-sharing for ATC Operations

Member States should consider the benefits of sharing ADS-B data received from aircraft operating in the proximity of their international airspace boundaries with adjacent States that have compatible technology in an effort to maximize the service benefits and promote operational safety.

Data sharing may involve the use of the data to provide separation services if all the requirements for delivery of separation services are satisfied, In some cases, States may choose to use a lower standard that supports surveillance safety nets and situational awareness whilst operations are conducted using procedural separation standards.

Any agreement on the sharing of surveillance data should be incorporated in Letters of Agreement between the States concerned. Such agreements may also include the sharing of VHF communication facilities.

A template for ADS-B data-sharing agreement is provided on the ICAO APAC website "~~http://www.bangkok.icao.int/edocs/index.html~~http://www.icao.int/APAC/Pages/edocs.aspx" for reference by States.

ADS-B Data-sharing for Safety Monitoring

With endorsement of the methodology by both the ICAO Separation and Airspace Safety Panel (SASP) and the Regional Monitoring Agencies Coordination Group (RMACG), ADS-B data can be used for calculating the altimetry system error (ASE) which is a measure of the height-keeping performance of an aircraft. It is an ICAO requirement that aircraft operating in RVSM airspace must undergo periodic monitoring on height-keeping performance. The existing

methods to estimate aircraft ASE include use of a portable device, the Enhanced GPS Monitoring Unit, and ground-based systems called Height Monitoring Unit/Aircraft Geometric Height Measurement Element. The use of ADS-B data for height-keeping performance monitoring, on top of providing enhanced and alternative means of surveillance, will provide a cost-effective option for aircraft operators. States are encouraged to share ADS-B data to support the height-keeping performance monitoring of airframe.

Civil/Military ADS-B Data-sharing

Civil/military data sharing arrangements, including aircraft surveillance, were a key part of civil/military cooperation in terms of tactical operational responses and increasing trust between civil and military units.

Aircraft operating ADS-B technology transmit their position, altitude and identity to all listeners, conveying information from co-operative aircraft that have chosen to equip and publicly broadcast ADS-B messages. Thus there should be no defence or national security issues with the use and sharing of such data.

Some military transponders may support ADS-B using encrypted DF19 messages, but these data are normally not decoded or used at all by civil systems. In most cases today, tactical military aircraft are not ADS-B equipped or could choose to disable transmissions. In future, increasing numbers of military aircraft will be ADS-B capable, with the ability to disable these transmissions. ADS-B data sharing should not influence the decision by military authorities to equip or not equip with ADS-B. Moreover, it is possible for States to install ADS-B filters that prevent data from sensitive flights being shared. These filters can be based on a number of criteria and typically use geographical parameters to only provide ADS-B data to an external party if aircraft are near the boundary.

A guidance material on advice to military authorities regarding ADS-B data sharing is provided on the ICAO APAC website "http://www.icao.int/APAC/Pages/edocs.aspx" for reference by States.

9.3.5 Synergy of ADS-B and GNSS

States intending to implement GNSS/PBN or ADS-B should consider the efficiency of implementing the other technology at the same time due to the inherent efficiencies in doing so. GNSS systems provide navigation solutions to IFR aircraft for the conduct of enroute, terminal and non-precision approaches. The use of GNSS/PBN can provide higher performance and higher safety. Transition to GNSS can avoid significant ground infrastructure costs.

ADS-B systems provide surveillance based upon GNSS position source. ADS-B provides high performance and high update surveillance for both air-air and ATC surveillance. Transition to ADS-B can avoid the costs associated with ground based radar infrastructure. ADS-B system installations rely on acceptable GNSS equipment being installed in the aircraft to provide the position source and integrity.

If the fleet is equipped with ADS-B, they will already have most of the requirements to use GNSS for navigation satisfied. Similarly, if aircraft have suitable GNSS on board, they will have a position source to support ADS-B. It is noted however, that some care is needed to ensure that the requirements of GNSS/PBN and surveillance are both satisfied.

There is significantly less cost for these systems to be installed in an aircraft at the same time. A single installation of GNSS & ADS-B will involve :

- a single design activity instead of two
- a single downtime instead of two
- installation of the connection between GPS and ADS-B transponder
- a single test, certification and aircraft flight test

For the affected aviation community (ANSP, regulator and operator), the lessons learnt and issues faced in both GNSS and ADS-B have significant commonality. This can lead to efficiencies in Industry education and training.

9.4 Reporting Rates

9.4.1 General

The ADS-B system shall maintain a reporting rate that ensures at least an equivalent degree of accuracy, integrity and availability as for a radar system that is used to provide a similar ATC service. The standard reporting rate is approximately 0.5 second from the aircraft, but the rate of update provided to the ATM system (for the situation display) may be less frequent (e.g. 5 seconds), provided the equivalency with radar is preserved.

9.5 SEPARATION

9.5.1 General

ADS-B data may be used in combination with data obtained by other means of surveillance (such as radar, flight plan track, ADS-C) for the application of separation provided appropriate minima as determined by the State are applied. It should be noted that the quality of communications will have a bearing on the determination of appropriate minima.

All safety net features (MSAW, STCA, MTCA, RAM and DAIW/ RAI etc) should possess the same responsiveness as equivalent radar safety net features.

9.5.2 Identification Methods

Some of the methods approved by ICAO for establishing identification with radar, may be employed with ADS-B (see PANS-ATM chapter 8). One or more of the following identification procedures are suggested:

a) direct recognition of the aircraft identification in an ADS-B label on a situation display;

b) transfer of ADS-B identification;

c) observation of compliance with an instruction to TRANSMIT ADS-B IDENT.

Note: In automated systems, the "IDENT" feature may be presented in different ways, e.g. as a flashing of all or part of the position indication and associated label.

9.5.3 ADS-B Separation

ADS-B Separation minima has been incorporated by ICAO in PANS-ATM (Doc 4444), and in Regional Supplementary Procedures (Doc 7030).

In a mixed surveillance environment, States should use the larger separation standard applicable between aircraft in the conflict pair being considered.

9.5.4 Vertical separation

9.5.4.1 Introduction

The ADS-B level data presented on the controllers situation display shall normally be derived from barometric pressure altitude. In the event that barometric altitude is absent, geometric altitude shall not be displayed on displays used for provision of air traffic services. Geometric altitude may be used in ATM systems for other purposes.

9.5.4.2 Vertical tolerance standard

The vertical tolerances for ADS-B level information should be consistent with those applied to Mode C level information.

9.5.4.3 Verification of ADS-B level information

The verification procedures for ADS-B level information shall be the same as those employed for the verification of Mode C level data in a radar environment.

9.6 AIR TRAFFIC CONTROL CLEARANCE MONITORING

9.6.1 General

ADS-B track data can be used to monitor flight path conformance with air traffic control clearances.

9.6.2 Deviations from ATC clearances

The ATC requirements relating to monitoring of ADS-B traffic on the situation display should be similar to those contained in PANS-ATM Ch.8.

9.7 ALERTING SERVICE

For ADS-B equipped aircraft, the provision of an alerting service should be based on the same criteria as applied within a radar environment.

9.8 POSITION REPORTING

9.8.1 Pilot position reporting requirements in ADS-B coverage

States should establish voice and/or CPDLC position reporting procedures consistent with those applicable with radar for aircraft that have been identified by ATC.

9.8.2 Meteorological reporting requirements in ADS-B airspace

ATSUs may promulgate in the AIP meteorological reporting requirements that apply within the nominated FIR. The meteorological reporting data required and the transmission methods to be used by aircrew shall be specified in AIP.

9.9 PHRASEOLOGY

9.9.1 Phraseology Standard

~~States should note the requirement for ADS-B specific phraseology equivalent to radar specific phraseology as well as the opportunity to use generic phraseology applicable to multiple systems.~~States should use common phraseology for both ADS-B and radar where possible, and should note the requirement for ADS-B specific phraseology in some instances. States shall refer to PANS ATM Chapter 12 for ADS-B phraseology:

~~States shall refer to PANS ATM Chapter 12 for ADS-B phraseology:~~

ADS-B EQUIPMENT DEGRADATION
ADS-B OUT OF SERVICE (appropriate information as necessary).

TO REQUEST THE CAPABILITY OF THE ADS-B EQUIPMENT

a) ADVISE ADS-B CAPABILITY;
*b) ADS-B TRANSMITTER (data link);
*c) ADS-B RECEIVER (data link);
*d) NEGATIVE ADS-B.
* Denotes pilot transmission.

Note: For (b) and (c) – the options are not available for aircraft that are not equipped.

TO REQUEST RESELECTION OF AIRCRAFT IDENTIFICATION
REENTER ~~[ADS-B or MODE S] AIRCRAFT~~ FLIGHT IDENTIFICATION.

Note: For some aircraft, this option is not available in-flight

TERMINATION OF RADAR AND/OR ADS-B SERVICE
IDENTIFICATION LOST [reasons] (instructions).

TO REQUEST THE OPERATION OF THE MODE S OR ADS-B IDENT FEATURE
SQUAWK~~TRANSMIT ADS-B~~ IDENT.

Note: For some standalone ADS-B equipage affecting General Aviation, the option of "TRANSMIT ADS-B IDENT" may be available

TO REQUEST AIRCRAFT SWITCHING TO OTHER TRANSPONDER OR TERMINATION OF ADS-B TRANSMITTER OPERATION
a) SWITCH TO OTHER TRANSPONDER
b) STOP ADS-B TRANSMISSION. SQUAWK (code) ONLY.

Note:
a) In many cases the ADS-B transmitter cannot be operated independently of the SSR transponder and switching off the ADS-B transmission would also switch off the SSR transponder operation
b) "STOP ADS-B TRANSMISSION" applies only to aircraft that have the facility to switch off the ADS-B transmission, while maintaining SSR operation.
~~TO REQUEST TERMINATION OF SSR TRANSPONDER AND/OR ADS-B TRANSMITTER OPERATION~~

~~a) STOP SQUAWK. [TRANSMIT ADS-B ONLY];~~
~~b) STOP ADS-B TRANSMISSION [SQUAWK (code) ONLY].~~
~~*Note: In some cases the ADS-B transmitter cannot be operated independently of the SSR transponder and the loss of SSR and ACAS surveillance derived from the operation of the SSR transponder should be considered.*~~

9.9.2 Operations of Mode S Transponder and ADS-B

It should be noted that independent operations of Mode S transponder and ADS-B ~~may~~ will not be possible in ~~all~~ many aircraft (e.g. where ADS-B is solely provided by 1090 MHz extended squitter emitted from the transponder). Additionally, some desirable but optional features of ADS-B transmitters may not be fitted in some aircraft. Controller training on this issue, as it relates to the following examples of radio telephony and/or CPDLC phraseology is recommended.

9.9.2.1 STOP ADSB TRANSMISSION or STOP SQUAWK

Issue: In most commercial aircraft, a common "transponder control head" is used for SSR transponder, ACAS and ADS-B functionality. In this case, a pilot who complies with the instruction to stop operation of one system will also need to stop operation of the other systems – resulting in a loss of surveillance not intended or expected by the controller.

ATC need to be aware that an instruction to "Stop ADS-B Transmission" may require the pilot to switch off their transponder that will then stop all other functions associated with the transponder operations (such as ACARs etc). Pilots need to be aware of their aircraft's equipment limitations, the consequences of complying with this ATC instruction, and be aware of their company policy in regard to this. As with any ATC instruction issued, the pilot should advise ATC if they are unable to comply.

Recommendation: It is recommended that the concatenated phrases STOP ADSB TRANSMISSION, SQUAWK (code) ONLY or STOP SQUAWK, TRANSMIT ADSB ONLY are used. It is recommended that controller training highlights the possible consequences of **issuing** these instructions and that pilot training highlights the consequences of **complying** with this instruction. It is also recommended that aircraft operators have a clearly stated policy on procedures for this situation. Should a pilot respond with UNABLE then the controller should consider alternative solutions to the problem that do not remove the safety defences of the other surveillance technologies. This might include manual changes to flight data, coordination with other controllers and/or change of assigned codes or callsigns.

9.9.2.2 STOP ADSB ALTITUDE TRANSMISSION [WRONG INDICATION or reason] and TRANSMIT ADSB ALTITUDE

Issue: ~~Some~~ Most aircraft ~~may~~ will not have separate control of ADSB altitude transmission. In such cases compliance with the instruction may require the pilot to stop transmission of all ADSB data and/or Mode C altitude – resulting in a loss of surveillance not intended or expected by the controller.

Recommendation: It is recommended that, should the pilot respond with UNABLE, the controller should consider alternative solutions to the problem that do not remove the safety defences of other surveillance data. This might include a procedure that continues the display of incorrect level information but uses pilot reported levels with manual changes to flight data and coordination with other controllers.

9.9.2.3 TRANSMIT ADS-B IDENT

Issue: Some aircraft may not be capable or the ADSB SPI IDENT control may be shared with the SSR SPI IDENT function.

Recommendation: It is recommended that controllers are made aware that some pilots are unable to comply with this instruction. An alternative means of identification that does not rely on the ADSB SPI IDENT function should be used.

[m1]

9.10 FLIGHT PLANNING

9.10.1 ADS-B Flight Planning Requirement – Flight Identity

The aircraft identification (ACID) must be accurately recorded in section 7 of the ICAO Flight Plan form as per the following instructions:

Aircraft Identification, not exceeding 7 characters is to be entered both in item 7 of the flight plan and replicated exactly when set in the aircraft (for transmission as Flight ID) as follows:
Either,

a) The ICAO three-letter designator for the aircraft operating agency followed by the flight identification (e.g. KLM511, BAW213, JTR25), when:

in radiotelephony the callsign used consists of the ICAO telephony designator for the operating agency followed by the flight identification (e.g. KLM 511, SPEEDBIRD 213, HERBIE 25).

Or,

b) The registration marking of the aircraft (e.g. EIAKO, 4XBCD, OOTEK), when:

1) in radiotelephony the callsign used consists of the registration marking alone (e.g. EIAKO), or preceded by the ICAO telephony designator for the operating agency (e.g. SVENAIR EIAKO),

2) the aircraft is not equipped with radio.

Note 1: No zeros, hyphens, dashes or spaces are to be added when the Aircraft Identification consists of less than 7 characters.

Note 2: Appendix 2 to PANS-ATM refers. ICAO designators and telephony designators for aircraft operating agencies are contained in ICAO Doc 8585.

9.10.2 ADS-B Flight Planning Requirements

9.10.2.1 ICAO Flight Plan Item 10 – Surveillance Equipment and Capabilities

An appropriate ADS-B designator shall be entered in item 10 of the flight plan to indicate that the flight is capable of transmitting ADS-B messages.

~~For information, these include~~These are defined in ICAO DOC 4444 as follows:

B1 ADS-B with dedicated 1090 MHz ADS-B “out” capability

B2 ADS-B with dedicated 1090 MHz ADS-B "out" and "in" capability
U1 ADS-B "out" capability using UAT
U2 ADS-B "out" and "in" capability using UAT
V1 ADS-B "out" capability using VDL Mode 4
V2 ADS-B "out" and "in" capability using VDL Mode 4

During the ADS-B SITF/13 meeting held in April 2014, clarification of the B1 and B2 descriptors was recommended as follows. This will be progressed for change to ICAO DOC 4444, but may take some time for formal adoption:

B1 ADS-B "out" capability using 1090 MHz extended squitter
B2 ADS-B "out" and "in" capability using 1090 MHz extended squitter

States should consider use of the revised descriptors in AIP.

9.10.2.2 ICAO Flight Plan Item 18 – Other Information

Where required by the appropriate authority the ICAO Aircraft Address (24 Bit Code) may be recorded in Item 18 of the ICAO flight plan, in hexadecimal format as per the following example:

CODE/7C432B

States should note that use of hexadecimal code may be prone to human error and is less flexible in regard to airframe changes for a notified flight.

9.10.2.3 Transponder Capabilities

When an aircraft is equipped with a mode S transponder, that transmits ADS-B messages, according to ICAO Doc 4444, an appropriate Mode S designator should also be entered in item 10; i.e.: either

- E Transponder — Mode S, including aircraft identification, pressure-altitude and extended squitter (ADS-B) capability, or
- L Transponder — Mode S, including aircraft identification, pressure-altitude, extended squitter (ADS-B) and enhanced surveillance capability.

During the ADS-B SITF/13 meeting held in April 2014, clarification of the E and L descriptors was recommended as follows. This will be progressed for change to ICAO DOC 4444, but may take some time for formal adoption:

- E Transponder — Mode S, including aircraft identification, pressure-altitude and ADS-B capability, or
- L Transponder — Mode S, including aircraft identification, pressure-altitude, ADS-B and enhanced surveillance capability.

States should consider use of the revised descriptors in AIP.

9.10.3 Setting Aircraft ~~Flight~~ Identification (Flight ID) in Cockpits

(a) Flight ID Principles
The aircraft identification (sometimes called the flight identification or FLTID) is the equivalent of the aircraft callsign and is used in both ADS-B and Mode S SSR technology. Up to seven characters long, it is usually set in airline aircraft by the flight crew via a cockpit interface. It

enables air traffic controllers to identify and aircraft on a display and to correlate a radar or ADS-B track with the flight plan date. Aircraft identification is critical, so it must be entered carefully. Punching in the wrong characters can lead to ATC confusing once aircraft with another.

It is important that the identification exactly matches the aircraft identification (ACSID) entered in the flight notification.

Intuitive correlation between an aircraft's identification and radio callsign enhances situational awareness and communication. Airline aircraft typically use a three letter ICAO airline code used in flight plans, NOT the two letter IATA codes.

(b) Setting Flight ID
The callsign dictates the applicable option below for setting ADS-B or Mode S Flight ID:

(i) the flight number using the ICAO three-letter designator for the aircraft operator if a flight number callsign is being used (e.g. QFA1 for Qantas 1, THA54 for Thai 54).

(ii) the nationality and registration mark (without hyphen) of the aircraft if the callsign is the full version of the registration (e.g .VHABC for international operations).

(iii) The registration mark alone of the aircraft if the callsign is the abbreviated version of the registration (eg ABC for domestic operations).

(iv) The designator corresponding to a particular callsign approved by the ANSP or regulator (e.g. SPTR13 for firespotter 3).

(v) The designator corresponding to a particular callsign in accordance with the operations manual of the relevant recreational aircraft administrative organization (e.g. G123 for Gyroplanee 123).

9.11 PROCEDURES TO HANDLE NON-COMPLANT ADS-B AIRCAFT OR MIS-LEADING ADS-B TRANSMISSIONS

ADS-B technology is increasingly being adopted by States in the Asia/Pacific Region. Asia/Pacific Region adopted 1090 extended squitter technology. Reliance on ADS-B transmissions can be expected to increase over the coming years.

Currently a number of aircraft are transmitting ADS-B data which is misleading or non-compliant with the ICAO standards specified in Annex 10. Examples include:

a) aircraft broadcasting incorrect message formats;

b) aircraft broadcasting inertial positional data and occasionally indicating in the messages that the data has high integrity when it does not;

c) using GPS sources that do not generate correct integrity data, whilst indicating in the messages that the data has high integrity;

d) transmitting ADS-B data with changing (and incorrect) flight identity; and

e) transmitting ADS-B data with incorrect flight identity continuously.

If the benefits of ADS-B are to flow to the aviation industry, misleading and non-compliant ADS-B transmissions need to be curtailed to the extent possible.

The transmission of a value of zero for the NUCp or the NIC or the SIL by an aircraft indicates a navigational uncertainty related to the position of the aircraft or a navigation integrity issue that is too significant to be used by air traffic controllers.

As such, the following procedure, stipulated in the Regional Supplementary Procedures Doc 7030, shall be applicable in the concerned FIRs on commencement of ADS-B based surveillance services notified by AIP or NOTAM:

If an aircraft operates within an FIR where ADS-B-based ATS surveillance service is provided, and

a) carries 1090 extended squitter ADS-B transmitting equipment which does not comply with one of the following:
   1) EASA AMC 20-24; or
   2) the equipment configuration standards in Appendix XI of Civil Aviation Order 20.18 of the Civil Aviation Safety Authority of Australia; or
   3) installation in accordance with the FAA AC No. 20-165 – Airworthiness Approval of ADS; or

b) the aircraft ADS-B transmitting equipment becomes unserviceable resulting in the aircraft transmitting misleading information;

then:

a) except when specifically authorized by the appropriate ATS authority, the aircraft shall not fly unless the equipment is:

   1) deactivated; or
   2) transmits only a value of zero for the NUCp or NIC or SIL

States may elect to implement a scheme to blacklist those non-compliant aircraft or aircraft consistently transmitting mis-leading ADS-B information, so as to refrain the aircraft from being displayed to ATC.

A sample template is given below for reference by States to publish the procedures to handle non-compliant ADS-B aircraft or misleading ADS-B transmissions in their ADS-B mandate/regulations:

After <insert earliest date that ADS-B may be used for any relevant operational purpose> if an aircraft carries ADS-B transmitting equipment which does no comply with :

(a) EASA AMC 20-24; or
(b) the equivalent configuration standards in Appendix XI of Civil Aviation Order 20.18 of the Civil Aviation Safety Authority of Australia; or
(c) Installation in accordance with the FAA AC No. 20-165 – Airworthiness Approval of ADS;

or the aircraft ADS-B transmitting equipment becomes unserviceable resulting in the aircraft transmitting misleading information;

the aircraft must not fly unless equipment is:

(a) deactivated; or
(b) set to transmit only a value of zero for the NUCp or NIC or SIL.

Note:

1. It is considered equivalent to deactivation if NUCp or NIC or SIL is set to continually transmit only a value of zero.
2. Regulators should take appropriate action to ensure that such regulations are complied with.
3. ATC systems should discard ADS-B data when NUC or NIC or SIL =0.

9.12 EMERGENCY PROCEDURES

ATC surveillance systems should provide for the display of safety-related alerts and warnings, including conflict alert, minimum safe altitude warning, conflict prediction and unintentionally duplicated SSR codes and aircraft identifications.

The ADS-B avionics may transmit emergency status messages to any ADS-B ground station within coverage. The controller receiving these messages should determine the nature of the emergency, acknowledge receipt if appropriate, and initiate any assistance required. An aircraft equipped with ADS-B might operate the emergency and/or urgency mode as follows:

a) emergency;
b) no communications;
c) unlawful interference;
d) minimum fuel; and/or
e) medical.

Selection of an emergency transponder code (e.g. 7600) automatically generates an emergency indication in the ADS-B message. However, some ADS-B transponders may only generate a generic emergency indication. That means, the specific type of emergency, e.g., communication failure, is not always conveyed to the controller in an ADS-B environment. The controller may only receive a generic emergency indication irrespective of the emergency codes being selected by the pilot.

Due to limitations of some ADS-B transponders, procedures should be developed for ATC to confirm the types of emergency with pilots based on operational needs of States.

Executive control responsibility

The responsibility for control of the flight rests with the ATSU within whose airspace the aircraft is operating. However, if the pilot takes action contrary to a clearance that has already been coordinated with another sector or ATSU and further coordination is not possible in the time available, the responsibility for this action would rest with the pilot in command, and performed under the pilot's emergency authority.

Emergency procedures

The various circumstances surrounding each emergency situation preclude the establishment of exact detailed procedures to be followed. The procedures outlined in PANS-ATM Chapter 15 provide a general guide to air traffic services personnel and where necessary, should be adapted for the use of ADS-B.

10. SECURITY ISSUES ASSOCIATED WITH ADS-B

10.1 INTRODUCTION

ADS-B technologies are currently "open systems" and the openness is an essential component of successful use of ADS-B. It was also noted that ADS-B transmission from commercial aircraft is a "fact of life" today. Many commercial aircraft are already equipped with ADS-B and have been transmitting data for some time.

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

10.2 CONSIDERATIONS

A list of ADS-B vulnerabilities categorised into threats to Confidentiality, Integrity and Availability has been reviewed and documented into the guidance material on security issues associated with ADS-B provided on the ICAO APAC website "~~http://www.bangkok.icao.int/edocs/index.html~~http://www.icao.int/APAC/Pages/edocs.aspx" under "Restricted Site" for reference by States. States could contact ICAO Regional Office to get access to the guidance material. The following recommendations are made to States :

(a) While ADS-B is recognized as a key enabling technology for aviation with potential safety benefits, it is recommended that States made aware of possible ADS-B security specific issues;
(b) It is recommended that States note that much of the discussion of ADS-B issues in the Press has not considered the complete picture regarding the ATC use of surveillance data;
(c) For current ADS-B technology implementation, security risk assessment studies should be made in coordination with appropriate national organisations and ANSPs to address appropriate mitigation applicable in each operational environment, in accordance with ATM interoperability requirements; and
(d) Future development of ADS-B technology, as planned in the SESAR master plan for example, should address security issues. Studies should be made to identify potential encryption and authentication techniques, taking into consideration the operational need of air to ground and air to air surveillance applications. Distribution of encryption keys to a large number of ADS-B receivers is likely to be problematic and solutions in the near and medium term are not considered likely to be deployed worldwide. Internet based encryption strategies are not deployable when ground stations are pass receivers.

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Guidance Materials on Monitoring and Analysis of ADS-B Avionics Performance

1. Introduction

1.1 The APANPIRG has endorsed the following Conclusion during its 24th Meeting to encourage States/Administration to exchange their ADS-B performance monitoring results and experience gained from the process :

Conclusion 24/45 - Exchange ADS-B Performance Monitoring Result
"That, States be encouraged to exchange findings/result of their ADS-B performance monitoring including experience gained in conducting the required performance monitoring."

1.2 Since the ADS-B mandate for some airspace in the Region became effective in December 2013, monitoring and analysis on avionics performance of ADS-B equipped aircraft has become an increasingly important task for concerned States. The APANPIRG has also requested and the ICAO has agreed to support establishing a centralized database to be hosted by the ICAO Regional Sub-office (RSO) for sharing the monitoring results in order to enhance safety for the Region. The specification for the database and relevant access procedures are being developed by the ADS-B Study and Implementation Task Force, and will be shared with States in due course.

1.3 This document serves to provide guidance materials on monitoring and analysis of avionics performance of ADS-B equipped aircraft, which is based on the experience gained by States.

2. Problem Reporting and Feedback

2.1 For ADS-B avionics problems, it is critical that an appropriate reporting and feedback mechanism be established. It is highly desirable that those discovering the problems should report them to the appropriate parties to take action, such as study and analyse the problems, identify the root causes, and rectify them. Those action parties include :-

(a) Air Navigation Service Providers (ANSPs) – upon detection of any unacceptable ADS-B reports from an aircraft, report the observed problem to the performance monitoring agent(s), if any, and the Aircraft Operators for investigation. In addition, ANSPs should take all actions to avoid using the ADS-B reports from the aircraft until the problem is rectified (e.g. black listing the aircraft), if usage of such reports could compromise safety.
(b) Regulators – to initiate any appropriate regulatory action or enforcement.
(c) Aircraft Operators – to allow avionics specialists to examine the causes and as customers of the avionics manufacturers ensure that corrective action will take place.

(d) Avionics Manufacturers and Aircraft Manufacturers – to provide technical evidence and knowledge about the problem and problem rectification

2.2 Incentives should be received by those parties acting on the problems including :-

(a) Regulations that require deficiencies to be rectified
(b) Regulatory enforcement
(c) Consequences if conduct of operations with problematic equipment (e.g. no access to the airspace requiring healthy equipment)

2.3 When an ADS-B avionics problem is reported, it should come along with adequate details about the problem nature to the action parties. In addition, the problem should be properly categorised, so that appropriate parties could diagnose and rectify them systematically.

3. Problem Categorisation

3.1 Regarding ADS-B avionics, their problems are quite diversified in the Region but can be categorized to ensure they will be examined and tackled systematically.

3.2 Based on the experience gained from States, the common ADS-B avionics problems in the Region are summarized under different categories in Attachment A. It is noted that only a relatively minor portion of the aircraft population exhibits these problems. It must be emphasized that aircraft transmitting incorrect positional data with NUC = 0 or NIC = 0 should not be considered a safety problem. The data transmitted have no integrity and shall not be used by ATC. This situation exists for many aircraft when their GNSS receivers are not connected to the transponders.

4. Managing the Problem

4.1 There are two major approaches to manage the problems :-

(a) Regulatory approach
Regulations which require non-approved avionics to disable ADS-B transmission (or transmit “no integrity”), and the concerned operators to file flight plans to indicate no ADS-B equipage. APANPIRG has endorsed this approach which is reflected in the Regional Supplementary Procedures (Doc 7030).

(b) Blacklist approach
Filtering out (“black listing”) any airframes that do not comply with the regulations or transmitting bad data, and advising the regulator of the non-compliance. This approach is temporary which allows the ANSP to protect the system whilst regulatory action is underway.

5. Systematic Monitoring and Analysis of the Problem

5.1 For States who have radar coverage, a systematic and efficient means to monitor and analyse the problem could be considered on top of relying on ATC to report the problem / sample checking. This can be achieved by developing a system to automatically compare radar and flight plan information with ADS-B reported position, and examine the ADS-B quality indicators [1] and Flight Identification (FLTID) contained in the ADS-B reports.

5.2 The system will intake all recorded information on ADS-B, radar targets and ATS flight plans in an offline manner. For each ADS-B flight, the system will compare it with its corresponding radar and flight plan information, and analyse if the following pre-defined criteria are met :-

(a) Deviation between ADS-B reported position and independent referenced radar position is greater than 1NM for more than 5% of total number ADS-B updates; or

(b) NUC of each ADS-B reported position is smaller than 4 for more than 5% of total number of ADS-B updates; or

(c) FLTID entered via cockpit interface and downlinked in ADS-B data (i.e. I021/170 in Asterix CAT 21) does not match with aircraft callsign in the ATS Flight Plan for more than 5% of total number of ADS-B updates.

5.3 For (a) above, deviation between ADS-B and radar tracks is set to 1NM in accordance with ICAO Circular 326 defining position integrity (NUC) shall be at least 4 (0.5NM < HPL < 1NM) for 3NM aircraft separation use, on assumption that radar targets are close to actual aircraft position. A threshold of 5% is initially set to exclude aircraft only exhibiting occasional problems during their flight journey. The above criteria should be made configurable to allow fine-turning in future.

5.4 The system will generate a list of aircraft meeting the above pre-defined criteria showing full details of each occurrence such as date/time of occurrence, Mode S address, screen capture of radar and ADS-B history tracks, graphs of NUC value changes and deviation between radar and ADS-B tracks along the flight journey. A sample screen shot of the system is given at Attachment B for reference.

* * * * * * * *

[1] Navigational Uncertainty Category (NUC) for Version 0 avionics (DO260) and Navigational Integrity Category (NIC) and Source Integrity Level (SIL) for Version 1 and Version 2 avionics (DO260A and DO260B)

Attachment A – List of known ADS-B avionics problems

Ref.	Problem	Cause	Safety Implications to ATC (Yes / No)	Recommendations
1.	Track Jumping problem with Rockwell Collins TPR901 (See Figure1)	Software issue with TPR901 transponder initially only affecting Boeing aircraft. Does not occur in all aircraft with this transponder. Subsequent investigation by Rockwell Collins has found that the particular transponder, common to all of the aircraft where the position jumps had been observed, had an issue when crossing ±180 degrees longitude. On some crossings (10% probability), errors are introduced into the position longitude before encoding. These errors are not self-correcting and can only be removed by a power reset of the transponder. The problem, once triggered can last days, since many transponders are not routinely powered down.	**Yes.** Will present as a few wild/large positional jumps. Nearly all reports are tagged as low quality (NUC=0) and are discarded, however, some occasional non zero reports get through. Problem is very "obvious". Could result in incorrect longitudinal position of Flight Data Record track. Can trigger RAM alerts.	Rockwell Collins has successfully introduced a Service Bulletin that solves the problem in Boeing aircraft. The problem is known to exist on Airbus aircraft. Rockwell has advised that a solution will not be available in the near future because of their commitment to DO260B development. Rockwell Collins may not have a fix for some time. Workaround solutions are being examined by Airbus, Operators and Airservices Australia. The only workaround identified at this time is to power down the transponders before flight to states using ADS-B – after crossing longitude 180. It can be noted that in Airbus aircraft it is not possible to safely power down the transponder in flight. Airbus have prepared a procedure to support power down before flight. Airservices Australia have negotiated with 2 airlines to enact this procedure prior to flights to Australia.

Ref.	Problem	Cause	Safety Implications to ATC (Yes / No)	Recommendations
				An additional partial workaround is : to ensure that procedures exist for ATC to ask the pilot to changeover transponders if the problem is observed. Since there is a 10% chance of the problem occurring on each crossing of ±180 degrees longitude, the chance that both transponders being affected is 1%. There is no complete workaround available for flights that operate across 180 degrees longitude directly to destination without replacing the transponder. Airbus advise that a new TPR901 transponder compliant with DO260B will be available in 2014. This new transponder will not exhibit the problem.
2.	Rockwell Collins TDR94 Old version. The pattern of erroneous positional data is very distinctive of the problem. (See Figure 2)	Old software typically before version -108. The design was completed before the ADS-B standards were established and the message definitions are different to the current DO260. Rockwell has recommended that ADS-B be disabled on these models.	**Yes.** Will present as a few wild positional jumps. Nearly all reports are tagged as low quality (NUC=0) and are discarded, however, some occasional non zero reports get through. Also causes incorrect altitude reports. Problem is very “obvious”.	Problem well known. Particularly affects Gulfstream aircraft which unfortunately leave the factory with ADS-B enabled from this transponder model. Rockwell has issued a service bulletin recommending that ADS-B be disabled for aircraft with this transponder software. See Service Information Letter 1-05 July 19, 2005. It is easy to disable the transmission.

Ref.	Problem	Cause	Safety Implications to ATC (Yes / No)	Recommendations
				If a new case is discovered, an entry needs to be made to the black list until rectification has been effected.
3.	Litton GPS with proper RAIM processing	Litton GNSSU (GPS) Mark 1 design problem. (Does not apply to Litton Mark II). GPS does not output correct messages to transponder.	**No.** Perceived GPS integrity changes seemingly randomly. With the GPS satellite constellation working properly, the position data is good. However the reported integrity is inconsistent and hence the data is sometimes/often discarded by the ATC system. The effected is perceived extremely poor "coverage". The data is not properly "protected" against erroneous satellite ranging signals – although this cannot be "seen" by ATC unless there is a rare satellite problem.	This GPS is installed in some older, typically Airbus, fleets. Data appears "Correct" but integrity value can vary. Performance under "bad" satellite conditions is a problem. Correction involves replacing the GNSSU (GPS) which is expensive. If a new case is discovered, an entry needs to be made to the black list until rectification has been effected.
4.	SIL programming error for DO260A avionics	Installers of ADS-B avionics using the newer DO260A standard mis program "SIL". a) This problem appears for DO260A transponders, with SIL incorrectly set to 0 or 1 (instead of 2 or 3) b) As the aircraft enters	**No.** First report of detection appears good (and is good), all subsequent reports not displayed because the data quality is perceived as "bad" by the ATC system. Operational effect is effectively no ADS-B data. Hence no risk.	Would NOT be included in a "black list". Aircraft with "Dynon avionics" exhibit this behavior. They do not have a certified GPS and hence always set SIL = 0. This is actually correct but hence they do not get treated as ADS-B equipped.

Ref.	Problem	Cause	Safety Implications to ATC (Yes / No)	Recommendations
		coverage, the ADS-B ground station correctly assumes DO260 until it receives the version number. c) The transmitted NIC (DO260A) is interpreted as a good NUC (DO260) value, because no SIL message has yet been received. The data is presented to ATC.		
5.	Garmin "N" Flight ID problem (See Figure 3)	Installers of Garmin transponder incorrectly set "Callsign"/Flight ID. This is caused by poor human factors and design that assumes that GA aircraft are US registered.	**Yes.** Flight ID appears as "N". Inhibits proper coupling.	Can be corrected by installer manipulation of front panel. Does not warrant "black list" activity.
6.	Flight ID corruption issue 1 – trailing "U" Flight ID's received : GT615, T615U ,NEB033, NEB033U, QF7550, QF7550U, QF7583, QF7583U, QF7585, QF7585, QF7585U, QF7594, QFA7521, QFA7531, QFA7531, QFA7531U, QFA7532, QFA7532U, QFA7532W, QFA7550, QFA7552,	TPR901 software problem interfacing with Flight ID source. Results in constantly changing Flight ID with some reports having an extra "U" character.	**Yes.** Flight ID changes during flight inhibits proper coupling or causes decoupling.	Affects mainly B747 aircraft. Boeing SB is available for Rockwell transponders and B744 aircraft. Rockwell Collins have SB 503 which upgrades faulty -003 transponder to -005 standard. If a new case is discovered, an entry needs to be made to the black list until rectification has been effected.

Ref.	Problem	Cause	Safety Implications to ATC (Yes / No)	Recommendations
	QFA7581			
7.	Flight ID corruption issue 2	ACSS software problem results in constantly changing Flight ID. Applies to ACSS XS950 transponder Pn 7517800-110006 and Honeywell FMC (pn 4052508 952). ACSS fix was available in Sept 2007.	**Yes.** Flight ID changes during flight inhibits proper coupling or causes decoupling.	Software upgrade available. If a new case is discovered, an entry needs to be made to the black list until rectification has been effected.
8.	No Flight ID transmitted	Various causes	**No.** Flight ID not available. Inhibits proper coupling.	Aircraft could "fail to couple with Flight Data Record". Not strictly misleading – but could cause controller distraction.
9.	ACSS Transponder 10005/6 without Mod A reports NUC based on HFOM.		**Yes.** Appears good in all respects until there is a satellite constellation problem (not normally detectable by ground systems).	Not approved and hence not compliant with CASA regulations. If known could be added to black list. Configuration is not permitted by regulation.
10.	Occasional small position jump backwards (See Figure 4)	For some older Airbus aircraft, an occasional report may exhibit a small "jump back" of less than 0.1 nm Root cause not known	**No.** Not detectable in ATC due to extrapolation, use of latest data and screen ranges used.	ATC ground system processing can eliminate these.
11.	Older ACSS transponders report integrity too	Design error reports integrity one value worse than reality	**No.**	Can be treated in the same manner as a loss of transponder capability.

Ref.	Problem	Cause	Safety Implications to ATC (Yes / No)	Recommendations
	conservatively		In poor GPS geometry cases the ATC system could discard the data when the data is in fact useable. Will be perceived as loss of ADS-B data.	
12.	Intermittent wiring GPS transponder	ADS-B transmissions switch intermittently between INS position and GPS position.	**Yes.** Normally the integrity data goes to zero when INS is broadcast, but sometimes during transition between INS and GPS, an INS position or two can be broadcast with "good" NUC value. Disturbing small positional jump.	If a new case is discovered, an entry needs to be made to the black list until rectification has been effected.
13.	Wrong 24 bit code	Installation error	**No.** No direct ATC impact unless a rare duplicate is detected.	This is not a direct ADS-B problem, but relates to a Mode S transponder issue that can put TCAS at risk. Cannot be fixed by black list entry. Needs to be passed to regulator for resolution.
14.	Toggling between high and low NUC (See Figure 5)	Faulty GPS receiver/ADS-B transponder	**No.** ATC will see tracks appear and disappear discretely. No safety implications to ATC.	While it is normal for NUC value to switch between a high and low figure based on the geometry of GPS satellites available, it is of the view that more should be done to examine this phenomenon. It is observed that such switching between high and low NUC occurs on certain airframe and

Ref.	Problem	Cause	Safety Implications to ATC (Yes / No)	Recommendations
				not on others. The issue was raised to the airlines so as to get a better understanding. On one occasion, the airline replied that a module on their GPS receiver was faulty. On another occasion, the airline replied that one of the ADS-B transponder was faulty. Good NUC was transmitted when the working transponder was in use and poor NUC was transmitted when the faulty ADS-B transponder was in use.
15.	Consistent Low NUC (See Figure 6)	GNSS receivers are not connected to the ADS-B transponders.	**No.** Data shall be filtered out by the system and not detectable in ATC	Not considered a safety problem but a common phenomenon in the Region – the concerned aircraft will be treated equivalent to "aircraft not equipped with ADS-B". While it is normal for aircraft to transmit low NUC, it is of the view that "consistent low NUC' could be due to the avionics problem (e.g. GNSS receiver is not connected to the ADS-B transponder). It is recognised that operators may not be aware that their aircraft are transmitting unexpected low NUC / NIC values, due to equipment malfunction. Hence, it is desirable for States to inform the operators when unexpected low NUC

Ref.	Problem	Cause	Safety Implications to ATC (Yes / No)	Recommendations
				values are transmitted, where practicable. Concerned airline operators are required to take early remedial actions. Otherwise, their aircraft will be treated as if non-ADS-B equipped which will be requested to fly outside the ADS-B airspace after the ADS-B mandate becomes effective.
16.	ADS-B position report with good integrity (i.e. NUC >= "4") but ADS-B position data are actually bad as compared with radar (met criteria 5.2(a))	Faulty ADS-B avionics	**Yes.** As the ground system could not "automatically" discard ADS-B data with good integrity (i.e. NUC value >=4), there could be safety implications to ATC.	The problem should be immediately reported to the concerned CAA/operators for problem diagnosis including digging out the root causes, avionics/GPS types etc., and ensure problem rectification before the ADS-B data could be used by ATC. Consider to "blacklist" the aircraft before the problem is rectified.
17.	FLTID transmitted by ADS-B aircraft does not match with callsign in flight plan (see Figures 7a – 7d)	Human errors	**Yes.** Could lead to screen clutter - two target labels with different IDs (one for radar and another for ADS-B) being displayed, causing potential confusion and safety implications to ATC.	Issue regulations/letters to concerned operators urging them to set FLTID exactly match with callsign in flight plan.

Figure 1 - Track Jumping problem with TPR901

Figure 3 - Garmin "N" Flight ID problem

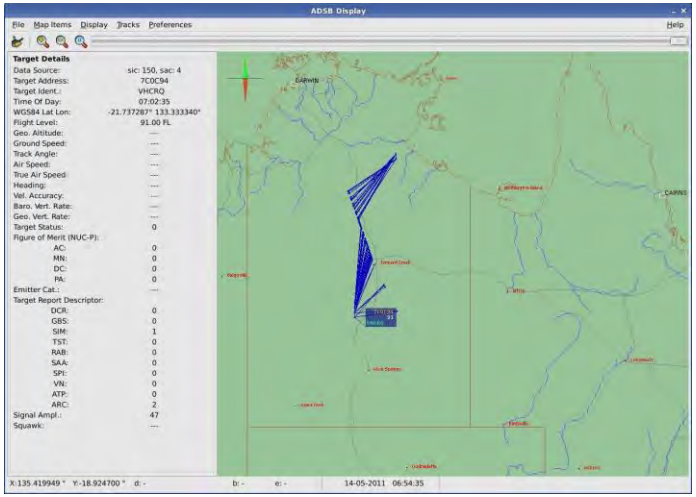


Figure 2 - Rockwell Collins TDR94 Old version. The pattern of erroneous positional data is very distinctive of the problem

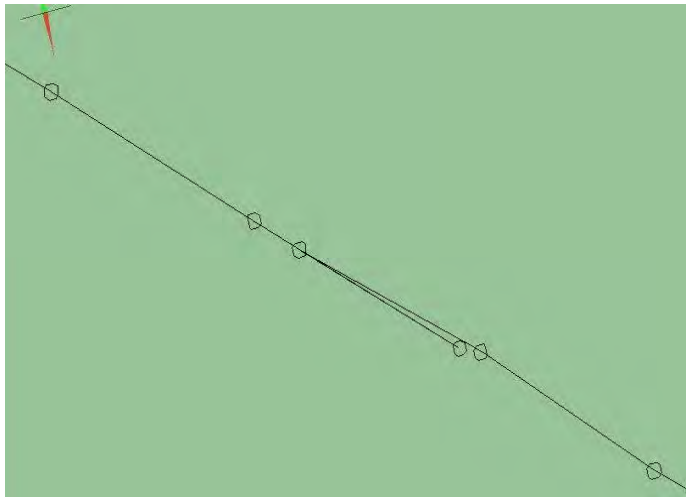


Figure 4 - Occasional small position jump backwards

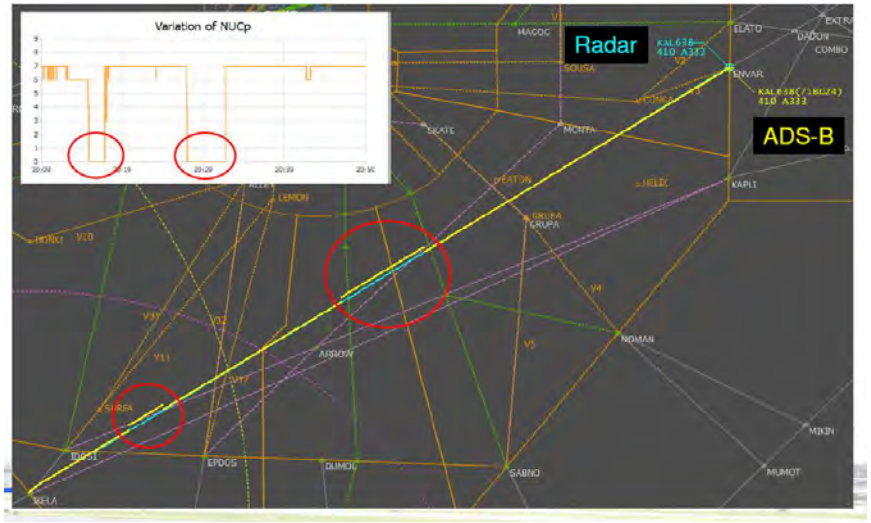


Figure 5 - NUC value toggling

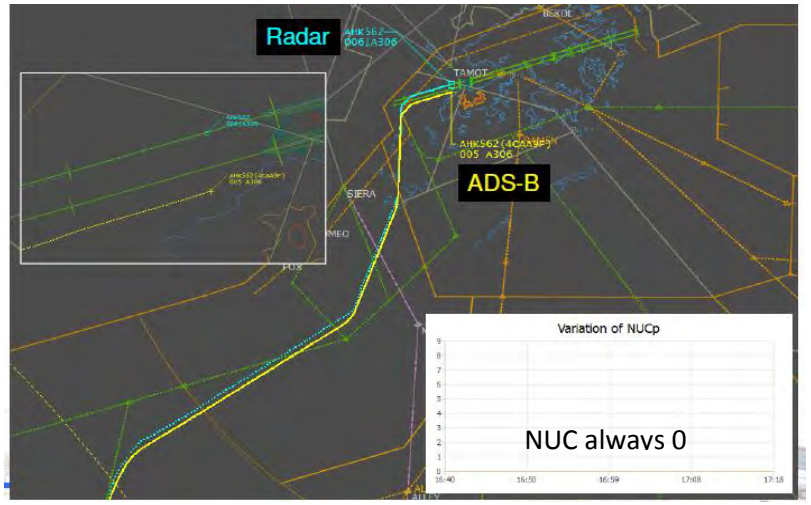


Figure 6 – Consistent low NUC

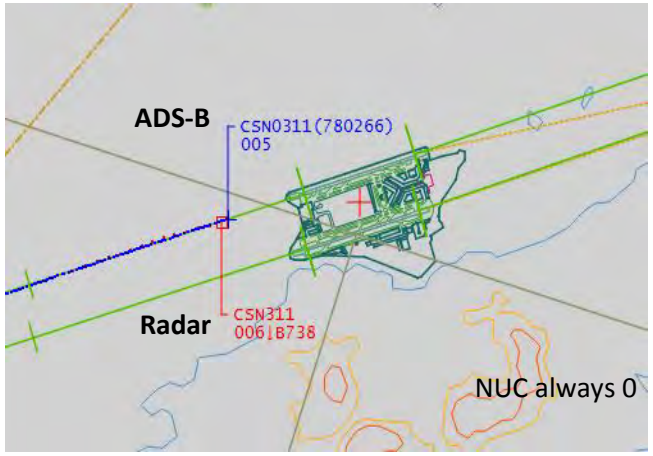


Figure 7a - Additional zero inserted

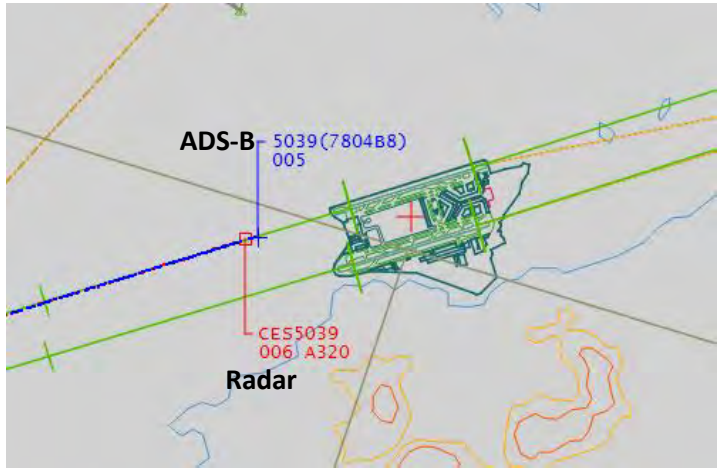


Figure 7b - ICAO Airline Designator Code dropped

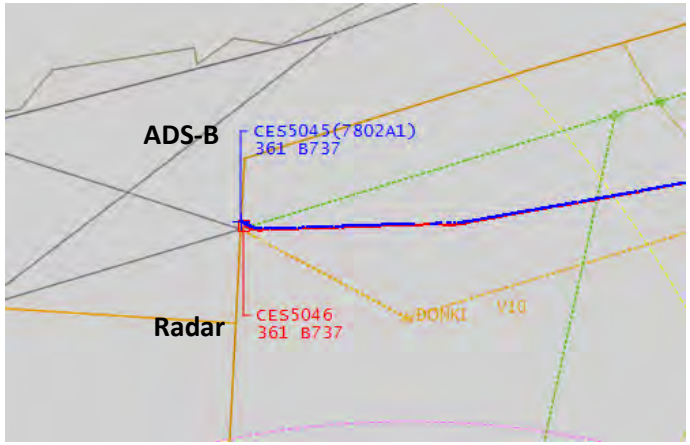


Figure 7c - Wrong numerical codes entered

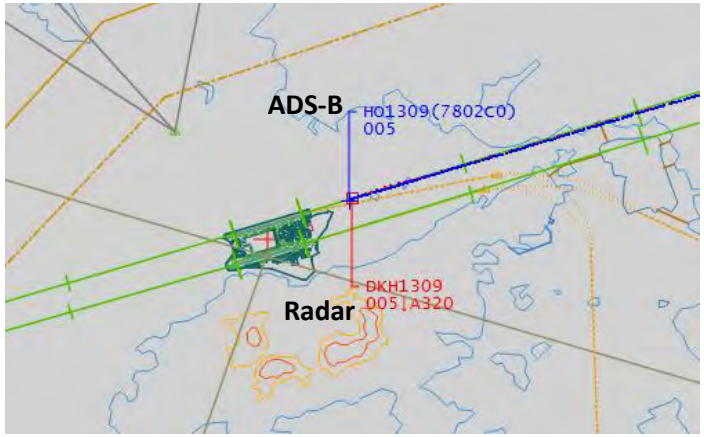
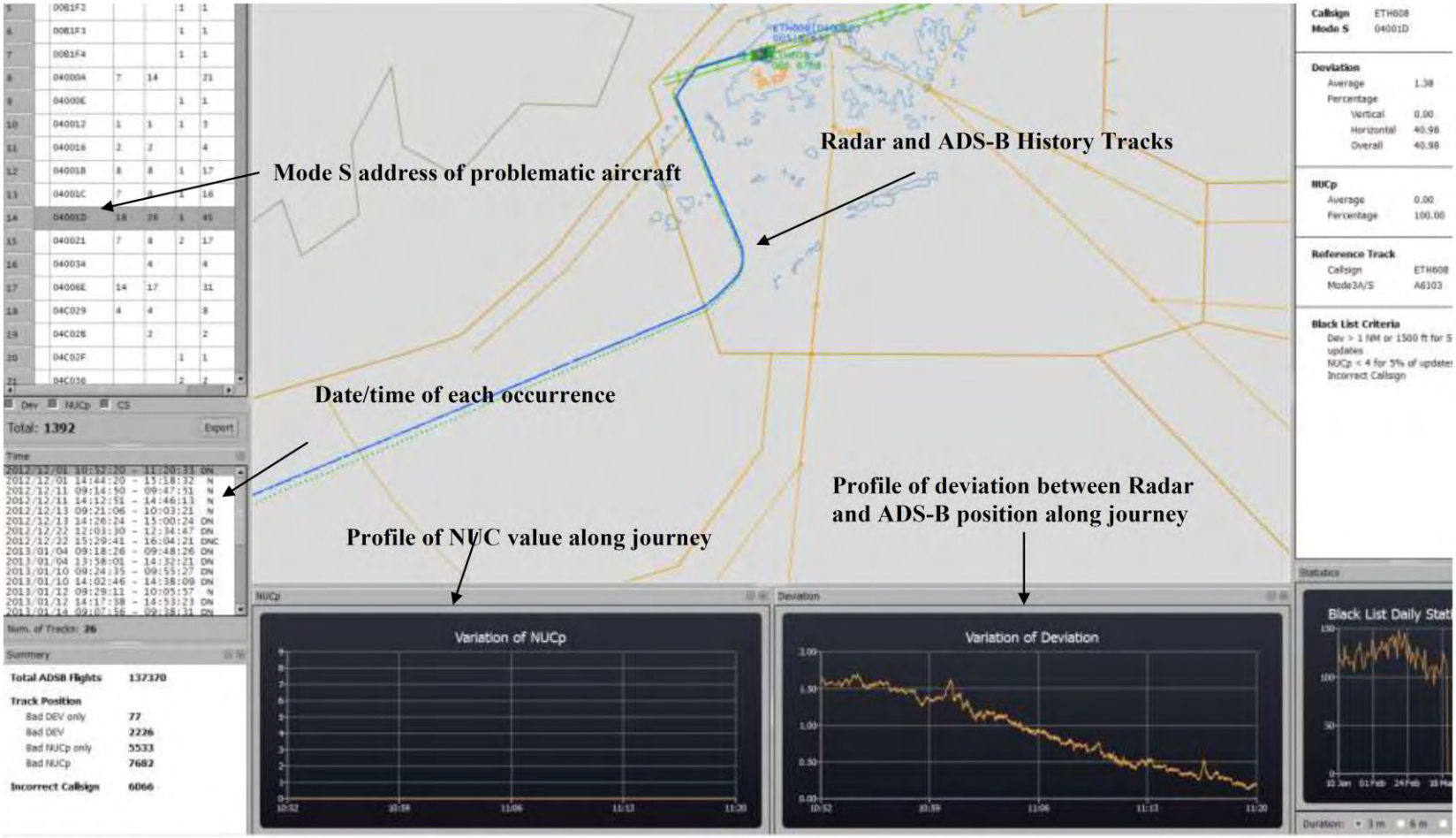


Figure 7d - IATA Airline Designator Code used

Attachment B - Sample screen shot of a system to monitor and analyse performance of ADS-B avionics



Appendix 1: Content and Format of the ADS-B Avionics Problems Reporting Database (APRD)

Mandatory Information
These fields must be provided in order to allow the data to be shared.

Desirable Information
These data are useful and desirable to be provided. However, as the data might not be always available at the time of problem being detected / observed, lack of these data shall not prevent the problem from being timely reported and shared.

Table 1a – Instances of Aircraft Exhibiting the Problem

Field	Description	Mandatory (M) or Desirable (D)
Instance ID	A unique identification number to specify the instance if aircraft exhibiting the problem	M
ICAO 24-bit Code	Unique aircraft address expressed in Hexadecimal form (e.g. 7432DB)	M
Date	UTC date when the problem was detected / observed for this aircraft	M
Time	UTC time when the problem was detected / observed for this aircraft	M
Aircraft Type	The aircraft type designator of the aircraft as specified in Doc 8643	M
Organisation*	The name of organisation reported the problem	M
Location	ICAO Designator of the Flight Information Region as specified in Doc 7910 where the problem was detected / observed	M
Problem Type	A reference linked to the Problem Type Table	M
Specific Description	Information to describe the problem specific to this occurrence in additional to the generic description under Problem Type	M
Operator	ICAO designator as specified in Doc 8585 for the current operator of the concerned aircraft	D
State of Registry	ICAO designator as specified in Doc 7910 for the current State of Registry of the concerned aircraft	D
State of Operator	ICAO designator as specified in Doc 7910 for the current State of Operator of the concerned aircraft	D
Departure Airport	The ICAO designator of the departure airport of the concerned aircraft as specified in Doc 7910.	D
Arrival Airport	The ICAO designator of the arrival airport of the concerned aircraft as specified in Doc 7910.	D
Registration	Registration number (tail number) of the concerned aircraft	D
Flight ID (FLTID)	The flight identification (Flight ID) transmitted by ADS-B for display on a controller situation display or a CDTI	D
Aircraft ID (ACID)	Aircraft Identification (ACID), not exceeding 7 characters, entered in Item 7 of the flight plan	D

Field	Description	Mandatory (M) or Desirable (D)
ADS-B Operational Approval	Yes or No to indicate whether ADS-B operational approval has been obtained from the State of Registry	D
Date of ADS-B Operational Approval	Date for granting ADS-B operational approval (if applicable)	D
Flight Plan	Text of the complete flight plan including surveillance indicators and field 18	D

Note : Data fields marked with asterisk (*) mean the data will only be accessible by the Database Administrator, and will not be shared in order to protect identity of the originator of the problem report.

Table 1b – Problem Type

Field	Description	Mandatory (M) or Desirable (D)
Problem Type	A unique identification number to specify a type of generic problem	M
Problem Description	A detailed description of this type of generic problem	M
Verifier	The name of organization verified the problem	M
Confirmed	Indication that whether the problem has been verified by the verifier (Yes / No)	M
Verifier comments	Comments by the verifier	M
ADS-B Transponder	Description on transponder manufacturer, parts number, software version as appropriate	D
Transponder Message Format	DO260, DO260A or DO260B	D
GNSS	GNSS manufacturer, parts number, software version as appropriate	D
Position Integrity	Description of NUC or NIC when problem is detected	D
Aircraft OEM Response	Response and/or rectification plans of Airframe Manufacturer when advised of problem	D
Avionics OEM Response	Response and/or rectification plans of Avionics Manufacturer when advised of problem	D
Problem Fixed	Indication that whether the problem has been rectified (Yes / No)	D

Field	Description	Mandatory (M) or Desirable (D)
Ground Station Manufacturer	Ground Station Manufacturer, model number and software version as appropriate (sometimes it is difficult to determine if the problem is airborne equipment or ground station equipment)	D

Table 1c - Format of the ADS-B Avionics Problems Reporting Database (APRD)

Field	Type	Size	Remark
Instance ID	Number	6 digits	1 - 999999
ICAO 24-bit Code	Text	6 chars	Hexadecimal form (e.g. 7432DB)
Date	Date	10 chars	Format : dd.mm.yyyy
Time	Time	5 chars	Format : hh.mm
Aircraft Type	Text	4 chars	e.g. A333
Organization	Free Text	200 chars	Name of the organization to which the originator belongs
Location	Text	4 chars	e.g. VHHK stands for Hong Kong FIR
Specific Description	Free Text	5,000 chars	Free text to be entered supplemented with attachments (e.g. diagrams, photos, screen shots etc.), if any, to illustrate any specific description on the instance
Operator	Text	3 chars	e.g. CPA stands for Cathay Pacific Airways
State of Registry	Text	2 chars	e.g. VH stands for Hong Kong China
State of Operator	Text	2 chars	e.g. VH stands for Hong Kong China
Departure Airport	Text	4 chars	e.g. VHHH stands for HKIA
Arrival Airport	Text	4 chars	e.g. VHHH stands for HKIA
Registration	Text	11 chars	The registration marking of aircraft (e.g. EIAKO, 4XBCD, OOTEK),
Flight ID (FLTID)	Text	7 chars	The ICAO three-letter designator for the aircraft operating agency followed by the flight identification (e.g. KLM511, BAW213, JTR25)

Aircraft ID (ACID)	Text	7 chars	The ICAO three-letter designator for the aircraft operating agency followed by the flight identification (e.g. KLM511, BAW213, JTR25)
ADS-B Operational Approval	Text	1 char	"Y" or "N" for Yes or No
Date of ADS-B Operational Approval	Date	10 chars	Format : dd.mm.yyyy or NA (not applicable)
Flight Plan	Text	5000 Chars	The ICAO Flight Plan
Problem Type	Number	4 digits	1 - 9999
Problem Description	Free Text	5,000 chars	Free text to be entered supplemented with attachments (e.g. diagrams, photos, screen shots etc.), if any, to illustrate the problem
Verifier	Free Text	200 chars	Name of the verifier on the problem
Confirmed	Text	1 char	"Y" or "N" for Yes or No
Verifier comments	Free Text	5,000 chars	Free text to be entered for verifier's comment
ADS-B Transponder	Free Text	5,000 chars	Free text to be entered on transponder manufacturer, parts number, software version as appropriate
Transponder Message Format	Text	6 char	DO260, DO260A or DO260B
GNSS	Free Text	5,000 chars	Free text to be entered on GNSS manufacturer, model number and software version as appropriate
Position Integrity	Free Text	200 chars	Free Text to be entered to describe the NUC or NIC value when the problem is detected
Aircraft OEM Response	Free Text	5,000 chars	Free text to be entered supplemented with attachments (e.g. diagrams, photos, screen shots etc.), if any, to illustrate the response and/or rectification plans of Aircraft Manufacturer

Avionics OEM Response	Free Text	5,000 chars	Free text to be entered supplemented with attachments (e.g. diagrams, photos, screen shots etc.), if any, to illustrate the response and/or rectification plans of Avionics Manufacturer
Problem Fixed	Text	1 char	"Y" or "N" for Yes or No
Ground Station Manufacturer	Free Text	5,000 chars	Free text to be entered on ground station manufacturer, model number and software version as appropriate

Appendix 2 : ADS-B Avionics Problem Reporting Form

ADS-B Avionics Problem Reporting Form			**ID :** (to be filled by ICAO)
***Date UTC :**		***Time UTC :**	
Registration :		**Aircraft ID :**	
Flight ID :		***ICAO 24-bit Code:**	
***Aircraft Type :**		***Location :**	
Departure Airport :		**Arrival Airport :**	

*** Problem Description**

This should provide as complete a description of the situation leading up to the problem as is possible. Where the organization reporting the problem may not be able to provide all the information (e.g. the controller may not know everything that happened on the aircraft), it would be helpful if they would coordinate with concerned parties to provide the requested information :

- A complete description of the problem being reported
- The route contained in the FMS and/or flight plan
- Any flight deck indications
- Any indications provided to the controller when the problem occurred
- Any additional information that the originator of the problem report considers might be helpful but is not included on the list above
- Diagrams and other additional information (such as printouts of message logs) may be appended to illustrate the reported problem if considered useful.

ADS-B Transponder :			
GNSS :			
Position Integrity :		**Transponder Message Format :**	
Ground Station Manufacturer :			
***Organization :**		**Operator :**	
State of Operator :		**State of Registry :**	
ADS-B Operational Approval (Y/N) :		**Date of ADS-B Operational Approval :**	
Flight Plan :			

Note :
(a) The fields marked with asterisk (*) are mandatory fields required to be filled in.
(b) Please refer to Table 1a - 1b in Appendix 1 for detailed description of each field on the Form.

Proposal for Amendment of
Regional Supplementary Procedures ICAO Doc 7030/5
(Serial No. xxx APAC-S 14/09 – MID/ASIA/PAC)

a) **Regional Supplementary Procedures, Doc 7030/5:** MID/ASIA and PAC

b) **Proposing State:** ICAO

c) **Proposed Amendment:** 7. On page MID/ASIA 5-3 dated 30/11/07

5.5 Automatic Dependent Surveillance – Broadcast (ADS–B)

Insert the following text on 5.5.1:

5.5.1 Carriage and operation of ADS–B OUT

~~To improve safety, efficiency and to maximize seamless delivery of ATC services within the region, harmonized ADS-B OUT equipage mandates may be applied as follows :~~ [SS1]

5.5.1.1 All aircraft operating within the following FIRs shall carry and operate a serviceable ADS–B ~~facility~~ OUT [SS2] equipment within designated portions of airspace and the conditions mandated by the State with responsibility for the FIR concerned: Auckland Oceanic, Bangkok, Beijing, Brisbane, Chennai, Colombo, Delhi, Dhaka, Fukuoka, Guangzhou, Hanoi, Ho Chi Minh, Honiara, Hong Kong, Incheon, Jakarta, Kabul, Karachi, Kathmandu, Kolkata, Kota Kinabalu, Kuala Lumpur, Kunming, Lahore, Lanzhou, Male, Manila, Melbourne, Mumbai, Nauru, Phnom Penh, Port Moresby, Pyongyang, Sanya, Shanghai, Shenyang, Singapore, Taibei, Ujung Pandang, Ulan Bator, Urumqi, Vientiane, Wuhan, Yangon.

5.5.1.2 The portions of airspace referred to in 5.5.1.1 may only be designated [SS3] after the following actions had been undertaken:

a) appropriate consultation with affected airspace users and affected Air Traffic Control (ATC) units;

b) conduct of a safety case, which includes, *inter alia*, a human factors review [SS4] and the integration of data into the ATC workstation;

c) appropriate pilot and ATC training [SS5];

d) the ability to provide an enhanced service delivery; and

e) promulgation of the airspace mandate with appropriate notice, and in accordance with the provisions of Annex 15.

8. On page PAC 5-3 dated 30/11/07

5.5 Automatic Dependent Surveillance – Broadcast (ADS–B)

Insert the following text on 5.5.1:

5.5.1 Carriage and operation of ADS–B OUT

~~To improve safety, efficiency and to maximize seamless delivery of ATC services within the region, harmonized ADS-B OUT equipage mandates may be applied as follows :~~

5.5.1.1 All aircraft operating within the following FIRs shall carry and operate a serviceable ADS–~~B facility~~B OUT equipment within designated portions of airspace and the conditions mandated by the State with responsibility for the FIR concerned: Anchorage Oceanic, Auckland Oceanic, Nadi, Tahiti.

5.5.1.2 The portions of airspace referred to in 5.5.1.1 may only be designated after the following actions had been undertaken:

a) appropriate consultation with affected airspace users and affected Air Traffic Control (ATC) units;

b) conduct of a safety case, which includes, *inter alia*, a human factors review and the integration of data into the ATC workstation;

c) appropriate pilot and ATC training;

d) the ability to provide an enhanced service delivery; and

e) promulgation of the airspace mandate with appropriate notice, and in accordance with the provisions of Annex 15.

Coordinated implementation of ADS-B equipage mandates and associated ATC ground systems are essential to the improvement of safety, and efficiency, and to the maximization of seamless delivery of ATC services within the region.

d) **Proposers' Reasons for Amendment:**

Since 2011, the Asia/Pacific Air Navigation Planning and Implementation Regional Group (APANPIRG) has agreed to a number of Conclusions designed to facilitate the enhancement of Air Navigation Services (ANS) within performance-based airspace. In essence, APANPIRG endorsed the concept of airspace mandates to improve the safety and efficiency of airspace, as long as there was

appropriate consultation and a performance benefit to airspace users. The development of the Seamless ATM Plan in 2013 was the main mechanism for States to improve ANS and airspace performance on a region-wide basis. The Conclusions are as follows:

APANPIRG/22 (2011)

C 22/8 ADS-B Airspace Mandate
That, States intending to implement ADS-B based surveillance services may designate portions of airspace within their area of responsibility:
a) mandate the carriage and use of ADS-B equipment; or
b) provide priority for access to such airspace for aircraft with operative ADS-B as equipment over those aircraft not operating ADS-B equipment.

C 22/36 Amendment to Regional Supplementary Procedures on ADS-B
That, the Regional Supplementary Procedure Doc7030 MID/ASIA Chapter 5 be amended in accordance with the established procedure to include regional requirements on ADS-B as provided in the Appendix N to the report on Agenda Item 3.4.

While it is recognised that States may introduce restrictions and performance-based measures over their sovereign territory, mandates over the High Seas need to be implemented in line with regional air navigation agreements; in this case through APANPIRG. Thus it is necessary to introduce an amendment to the Regional Supplementary Procedures (ICAO Doc 7030) for Asia/Pacific FIRs that allows States to designate portions of performance-based airspace when they are able to provide the performance benefit and in accordance with aircraft equipage and capability.

The level of ANS capability and aircraft equipage varies throughout the Asia/Pacific, so it is intended that States will designate airspace when possible, in either exclusive or 'non-exclusive' (mixed mode with lower priority for non-equipped aircraft), as appropriate.

e) **Proposed Implementation Date of the Amendment:** Upon approval of the Council

f) **Proposal Circulated to the Following States and International Organizations:**

Afghanistan
Australia
Bangladesh
Brunei Darussalam
Cambodia
China
(cc: Hong Kong, China)
(cc: Macao, China)
Cook Islands
Democratic People's
Mongolia
Myanmar
Nauru
New Zealand
Palau, Republic of
Papua New Guinea
Philippines
Republic of Korea
Samoa
Singapore

Republic of Korea	Solomon Islands
Fiji	Sri Lanka
France	Thailand
Indonesia	Timor-Leste
Japan	Tonga
Kiribati	United States
Lao People's	Vanuatu
Democratic Republic	Viet Nam
Malaysia	IATA
Maldives	IFALPA
Marshall Islands	IFATCA
Micronesia, Federated States of	IBAC

g) **Secretariat Comments:**

The amendment of Doc 7030 in respect of ADS-B, ADS-C, ACAS II and Mode S transponders, together with amendment proposals APAC-S 14/07 and 14/08 for MID/ASIA and PAC Regions, provides a framework for the state to establish performance based airspace, with consideration of such matters as existing and proposed airspace user equipages, mandate timing, definition of airspace volumes (both vertical and horizontal), exclusive or non-exclusive application, exemption provisions and management of State aircraft.

The amendment is specifically intended to enable States to promulgate airspace mandates over the High Seas, and to encourage a regional approach to the establishment of such mandates, where it is appropriate to do so and recognizing that it is not practical for the Asia/Pacific Region to establish Sub-Regional or Region-wide simultaneous mandates. This is in accordance with the concept of the Seamless ATM and performance-based approaches, as well as the Aviation System Block Upgrade (ASBU) initiative and Global Air Traffic Management Operational Concept (ICAO Doc 9854).

REPORT FROM SOUTHEAST ASIA AD HOC WORKING GROUP

(Hong Kong, China, 25 April 2014)

States/Administrations Presented:

Australia
Hong Kong, China
Indonesia
The Philippines
Singapore
Vietnam
IBAC (As observer)

Previously Identified Projects

The South East Asia Group provide an update 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 Australia and Indonesia

Phase 1a

Indonesia and Australia sharing data from the following stations:

- Saumlaki ADS-B (Indonesia) (Installed)
- Merauke ADS-B (Indonesia) (Installed)
- Waingapu ADS-B (Indonesia) (Installed)
- Kintamani - Bali (Indonesia) (Installed)
- Thursday Island ADS-B (Australia) (Installed)
- Gove ADS-B (Australia) (Installed)
- Broome ADS-B (Australia) (Installed)
- Doongan ADS-B (Australia) (Installed)

Data Sharing Agreement signed in Nov 2010;

Initial Benefits
Data used for air situational awareness and safety nets.
Enhanced Safety at FIR boundary.
Operational service commenced by Australia in Feb 2011;
Indonesia will publish their ADS-B mandate by 2013 to be effective after 2016.

Phase 1b (Timeline to be decided)

Indonesia and Australia plan to share data from the following stations:

- Bayu Udan ADS-B (Australia) (Location to be decided)
- Cilacap (Indonesia) (Installed)

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

Phase 1
Under the near term implementation plan, China, Hong Kong China, Indonesia, Singapore and Vietnam would share the ADS-B data from the following stations:

- Singapore ADS-B (Singapore provide data to Indonesia) (Installed)
- Natuna ADS-B (Indonesia provide data to Singapore) (Installed)
- Matak ADS-B (Indonesia provide data to Singapore) (Installed)
- Con Son ADS-B (Viet Nam provide data to Singapore) (Installed)
- Sanya ADS-B (China provide data to Hong Kong China) (Installed)
- Three more Sanya ADS-B (China provide data to Hong Kong China) (To be installed by end 2013)

VHF radio communication services (DCPC) would be provided from the following stations to Singapore and Hong Kong China. This is to enable implementation of radar-like separations in the non-radar areas within the Singapore FIR as well as routes L642 and M771.

- Natuna VHF (Install for Singapore by Indonesia) (Installed and under testing)
- Matak VHF (Install for Singapore by Indonesia) (Installed and under testing)
- Con Son VHF (Install for Singapore by Viet Nam) (Installed)
- Sanya VHF (Install for Hong Kong China by China) (Installed)

ADS-B Data sharing and DCPC services agreement between Singapore and Indonesia signed in Dec 2010.
ADS-B Data sharing and DCPC services agreement between Singapore and Vietnam signed in Nov 2011.
DCPC services agreement between China and Hong Kong China signed in 2005.
ADS-B Data sharing agreement between China and Hong Kong China in progress.

Operational Status
Singapore agreed on separation minima with Vietnam and have commenced on ADS-B operations.

Hong Kong is working with China (Sanya) to agree on the separation minima. The earliest date for the separation reduction from 50nm to surveillance based is tentatively in 3rd quarter 2015.

All 4 states (China, Hong Kong, Singapore, Vietnam) agreed that there is no need for harmonisation for the operational approval.

Initial Benefits
The above sharing arrangement will benefit L642, M771, N891, M753 and L644. Enhanced safety and reduced separation may be applied. Mandate will be effective in 2013.

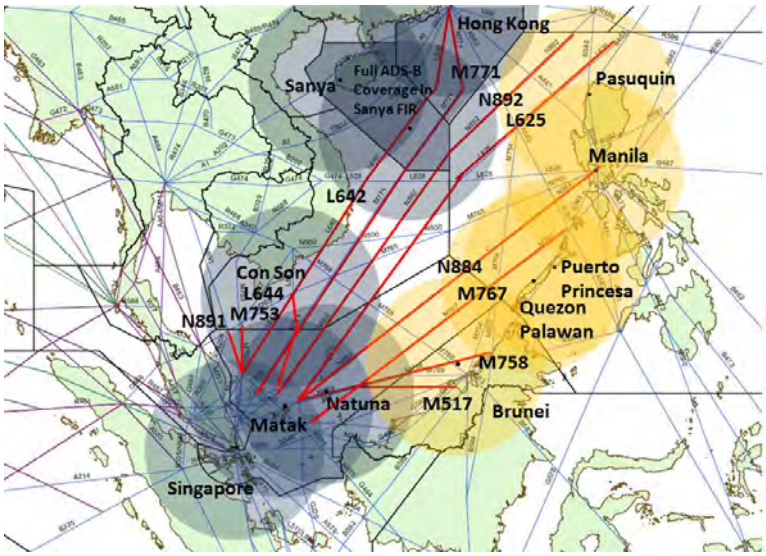
Phase 2
The Philippines CNS ATM project (under the review by Department of Transportation and Communication) includes Manila ADS-B stations.

Singapore signed an MOU with the Philippines to share ADS-B data from Quezon Palawan.

The Brunei CNS ATM project includes ADS-B stations. The locations of the stations are yet to be determined. Tentative location would be an oil rig 20NM North of Brunei. The meeting encouraged Brunei to share the ADS-B data and VHF facilities with Singapore to cover N884, M767, M758 and L517. Brunei in-principle agreed to share ADS-B data and provide the VHF facilities for Singapore.

China will install three more ADS-B stations in Sanya FIR. The additional ADS-B stations may be available for sharing with the Philippines to benefit N892 and L625.

Phase 3
The group will futher explore other possibilities to cover the Southern part of L625 and N892 in future discussions.



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

Indonesia is willing to share the ADS-B data from the following stations:

- Aceh ADS-B (installed) - to help cover Kuala Lumpur FIR
- Tarakan ADS-B (installed) - to help cover Kota Kinabalu FIR
- Pontianak ADS-B (installed) - to help cover Kota Kinabalu FIR.

The project is still under discussion between Malaysia and Indonesia.

Initial benefits
Enhanced Safety at FIR boundary

Malaysia currently has 1 ADS-B station at Terrengganu. Malaysia plans to install more ADS-B stations before 2020. The stations may be shared in future.

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

Cambodia is willing to share the ADS-B data from the following stations:

- Phnom Penh International Airport ADS-B (installed)
- Siem Reap International Airport ADS-B (installed)
- Stung Treng City ADS-B (installed)

Vietnam is planning to install stations in the south of HCM FIR from 2015 to 2016. Vietnam is willing to share with Cambodia and Thailand.

Discussions between the three States are on-going.

Initial benefits
For redundancy

Project 5 – ADS-B data sharing between Indonesia and the Philippines

Indonesia is willing to share the ADS-B data from the following stations:

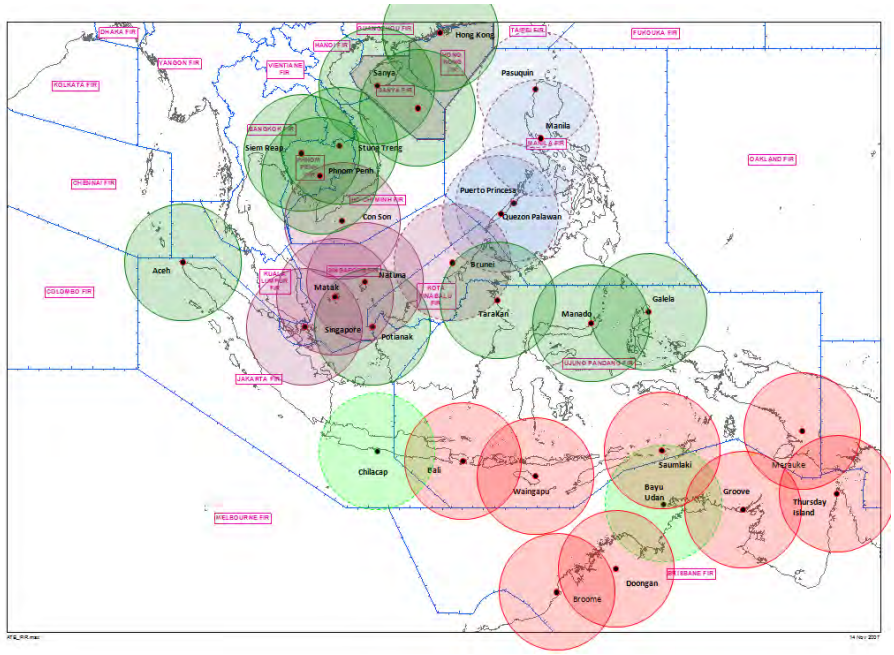
- Manado ADS-B (installed)
- Galela ADS-B (installed)
- Tarakan ADS-B (installed)

Where possible, Indonesia would like to receive ADS-B data from the Philippines from ADS-B stations near the Manila FIR – Ujung Pandang FIR boundary

Currently, the Philippines has no plans to install ADS-B stations at the Southern part of Manila FIR.

The project is still under discussion between Indonesia and the Philippines.

Initial benefits
Situational awareness



Project 6 – ADS-B data sharing between Australia, Indonesia and Papua New Guinea

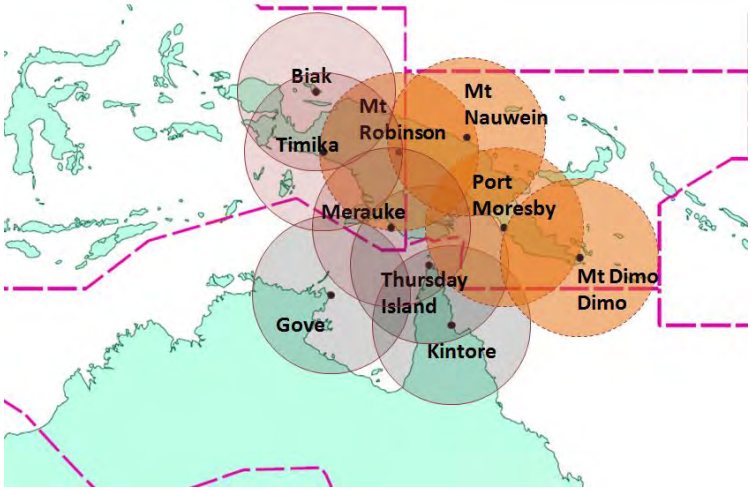
Data Sharing between Australia and Papua New Guinea

- Thursday Island (Australia) (installed)
- Gove (Australia) (installed)
- Kintore (Australia) (installed)
- Burns Peak – Port Moresby (PNG)
- Mt Dimo Dimo (PNG)
- Mt Robinson (PNG)

Data Sharing between Indonesia and Papua New Guinea

- Burns Peak (PNG)
- Mt Nauwein (PNG)
- Mt Robinson (PNG)
- Merauke (Indonesia) (installed)
- Timika (Indonesia) (installed)
- Biak (Indonesia) (installed)

The project is still under discussion between Australia, Indonesia and Papua New Guinea.


Biak
Mt
Robinson
Mt
Nauwein
Timika
Port
Moresby
Merauke
Thursday
Island
Mt Dimo
Dimo
Gove
Kintore

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Harmonization Plan for L642 and M771			
No.	**What to harmonize**	**What was agreed**	**Issue / what needs to be further discussed**
1	Mandate Effective	SG, HK, VN: 12 Dec 2013 CN: (to be confirmed).	
2	ATC Operating Procedures	No need to harmonize	Refer to SEACG for consideration of the impact of expanding ADS-B surveillance on ATC Operating Procedures including Large Scale Weather procedures.
3	Mandate Publish Date	No need to harmonize	To publish equipment requirements as early as possible.
4	Date of Operational Approval	No need to harmonize	States to remind airlines that operational approval from State of registry is required.
5	Flight Level	SG, HK, VN, CN: - At or Above FL290 (ADS-B airspace) - Below FL290 (Non-ADS-B airspace) SG: AIC issued 28 Dec 2010, AIP Sup issued 6 Nov 13 VN: AIP Sup issued 31 Oct 13 HK: AIC issued 24 May 2011, AIP Sup issued 29 Oct 13	CN (need to be confirmed)
6	Avionics Standard (CASA/AMC2024)	SG - CASA or AMC2024 or FAA (ES) HK - CASA or AMC2024 or FAA (ES) VN - CASA or AMC2024 or FAA (ES) CN (TBC)	ADS-B Task Force agreed that DO260B will be accepted as well. States should include supplement to include the FAA standard. Status for CN to be confirmed. Indonesia will consider and

		SG, HK and VN confirmed that their ADS-B GS can accept DO260, DO260A and DO260B.	have a willingness to upgrade their stations shared with other States.
7	Aircraft Approval		
7a)	Procedures if Aircraft Not Approved or Aircraft without a Serviceable ADS-B Transmitting Equipment before Flight	SG: FL280 and below. HK, CN, VN: Dependent on situation. ADS-B equipped aircraft will be given priority to operate above FL280.	
7b)	Aircraft Approved but Transmitting Bad Data (Blacklisted Aircraft)	For known aircraft, treat as non ADS-B aircraft. (China, Hong Kong - China and Singapore)	Share blacklisted aircraft among concerned States/Administration.(Hong Kong China, Singapore and Vietnam) China to be confirmed.
8	Contingency Plan		
8a)	Systemic Failure such as Ground System / GPS Failure	Revert back to current procedure.	
8b)	Avionics Failure or Approved Aircraft Transmitting Bad Data in Flight	Provide other form of separation, subject to bilateral agreement. From radar/ADS-B environment to ADS-B only environment, ATC coordination may be able to provide early notification of ADS-B failure.	Address the procedure for aircraft transiting from radar to ADS-B airspace and from ADS-B to ADS-B airspace.
9	Commonly Agreed Route Spacing	SEACG	Need for commonly agreed minimal in-trail spacing throughout.

REPORT FROM BAY OF BENGAL AD HOC WORKING GROUP

(Venue and Date: CAD Headquarters, Hong Kong, China, 25 April 2014)

States Presented:

Bangladesh;
India;
Maldives
Nepal
Pakistan
Thailand

Sri Lanka and Myanmar were absent in the meeting.

The participants met to update the status of implementation of ADS-B and possible data sharing between the neighboring States.

1. Bangladesh has planned to install four ADS-B ground stations at Dhaka, Barisal, Saidpur and Coxs Bazaar by 2H2016.

2. India informed that 21 ADS-B ground receivers have already been installed and AIP SUPP has been published to use ADS-B in the provision of ATS surveillance service. The data sharing agreement between India and Myanmar can be signed by 2H2014

3. Maldives has installed and commissioned ADS-B ground stations at three locations. The integration of data to the ATM systems has already been completed. Maldives is willing to share ADS-B data with India and Sri Lanka (Expected date: 2015). Also, Maldives has planned to implement exclusive ADS-B airspace at and above FL290 by 2016

4. Nepal is planning to install ADS-B ground stations in future. New MSSR system is going to install and the project will be completed by 2015. MLAT is under the process for a tender.

5. Pakistan has informed the meeting that most of the Pakistan airspace currently is already under RADAR surveillance; some gaps in the West, Northern mountain regions and some portion in the South and the South-West airspace need to be brought under positive feasibility or 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. Regarding data sharing neighboring countries will be co-ordinated through PCAA.

6. Thailand informed that a new ATM system with capability of processing ADS-B data is expected to be operational in 2015.

ADS-B DATA SHARING

The following locations for data sharing were agreed upon during the sub-group meeting.

INDIA-BANGLADESH
Agartala and Dhaka (2H2016)

BANGLADESH-MYANMAR
Coxs Bazaar and Sittwe (2H2016)

INDIA – MYANMAR
Agartala – Sittwe (2H2014)
Portblair – Coco Island (2H2014)

INDIA – INDONESIA
Portblair – Aceh (2H2014)

INDIA – MALDIVES
Trivandrum – Kulhudhuffushi (2H2014)

MALDIVES – SRI LANKA
Male' – (TBD)

INDIA – SRI LANKA
Trivandrum - (TBD)

EAST ASIA AD HOC GROUP (JAPAN AND REPUBLIC OF KOREA

(Hong Kong, China 25 April 2014)

Republic of Korea and Japan had discussed and shared the information about the ADS-B implementation status of each country including the ADS-B evaluation system, Multilateration system for airport surface and Wide Area Multilateration system.

ROK and Japan already have radar coverage, the implementation of ADS-B is considered as the future surveillance system.

In this sub-region region, there is no data sharing project at present. But, the group agrees that data-sharing would be benefit efficiency of air traffic control in the region.

REPORT FROM REGULATORY AD HOC GROUP

(Hong Kong, China, 25 April 2014)

States represented: Australia, Hong Kong China, Indonesia and USA

Australia described the current "cooperative" approach with operators transmitting incorrect ADS-B or Mode S data. This has proven effective as the local operators and avionics installers become familiar with the testing and set up requirements. Australia provided details of Advisory Circulars listing acceptable transponders and GNSS navigation equipment and technical standards as follows:

http://www.casa.gov.au/wcmswr/_assets/main/rules/1998casr/021/021c45.pdf

AC 21-45 v2.1

AIRWORTHINESS APPROVAL OF AIRBORNE AUTOMATIC DEPENDENT SURVEILLANCE BROADCAST EQUIPMENT

http://www.casa.gov.au/wcmswr/_assets/main/rules/1998casr/021/021c46.pdf

AC 21-46(1)
AIRWORTHINESS APPROVAL OF AVIONICS
EQUIPMENT

http://www.casa.gov.au/wcmswr/_assets/main/rules/1998casr/021/021c36.pdf

AC 21-36(1)

GLOBAL NAVIGATION SATELLITE SYSTEM (GNSS) EQUIPMENT:
AIRWORTHINESS GUIDELINES

In addition, Australia also described subject of ATC training at the plenary session.

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READINESS CHECKLIST TABLE

Readiness	AUS	SING	INDO	VIET	CHINA	HK	INDIA	MAL	BAN
ADS-B targets displayed on operational ATC screen?	✓	✓	✓	SEP	✓	○	✓	Nov13	✓
Blacklist filtering system & procedures	✓	✓	○	○	TBC	✓	○	×	✓
Foreign Filter system and Datasharing capability/willingness	✓	✓	✓	✓	TBC	✓	✓	×	✓
ATC procedures & ATC training 7 ATC manual	✓	✓	○	✓	✓	○	✓	×	✓
Maintenance support contract or arrangements	✓	✓	○	✓	TBC	✓	✓	✓	✓
Maintenance staff training & certification	✓	✓	✓	✓	TBC	○	✓	✓	✓
Mandate & process for ADS-B avionics failure	✓	✓	○	✓	✓	✓	○	×	✓
Extensive publicity about mandate	✓		○	○	×	✓	○	×	✓
Recording, monitoring, analysis and feedback capability?	✓	✓	✓	✓	TBC	✓	✓	✓	✓
Avionics installer community engaged (GA &/or Bizjet)	✓		○	○	TBC	Biz	○	×	NA
Contacts in Airlines, A/C Manufacturers, Avionics Co	✓	AL	○	AL	○	✓	✓	✓	A/L
Regulator & ATC management of Exemption flights inc state aircraft	✓	✓	○	○	✓	×	○	×	TBD
Fitment rate (do NOT include NUC=0 aircraft)	>90%	75	NA	60	85	85	60	75	
Remove display if without “operational approval”	×	×	×	×	×	×	○	×	×
AIP SUP or AIC	✓	✓	○	✓	×	✓	soon	×	✓
Flight ID correction & pilot performance	✓	✓	○	○	✓	○	✓	×	✓
Has State given operational approval to own aircraft	×	✓	× will	✓	✓	✓	× will	TBD	× will
Airline Flight planning OK	✓	✓	○	✓	○	○	○	adhoc	✓

Automatic Dependent Surveillance – Broadcast (ADS-B)
Seminar and the Thirteenth Meeting of ADS-B Study and
Implementation Task Force of APANPIRG (ADS-B SITF/13)

Hong Kong China, 22 – 25 April 2014

Attachment 1 to the Report

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International Civil Aviation Organization

AUTOMATIC DEPENDENT SURVEILLANCE – BROADCAST SEMINAR AND THIRTEENTH MEETING OF AUTOMATIC DEPENDENT SURVEILLANCE – BROADCAST (ADS-B) STUDY AND IMPLEMENTATION TASK FORCE (ADS-B SITF/13)

Hong Kong, China, 22 - 25 April 2014

民航處 Civil Aviation Department

LIST OF WORKING, INFORMATION PAPERS AND PRESENTATIONS

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		WORKING PAPERS	
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WP/2	2	Outcome of ADS-B SITF/12 & APANPIRG/24 on ADS-B	Secretariat
WP/3	2	Review Report of the Ninth Meeting of South-East Asia Bay of Bengal Su-regional ADS-B Implementation Working Group (SEA/BOB ADS-B WG/9)	Secretariat
WP/4	3	Follow-up Work on Recommendations of AN-Conf/12	Australia, Hong Kong China and Singapore
WP/5	2	Report of Regional Priorities and Targets Resulted from the Meeting of Chairpersons of SGs	Secretariat
WP/6	4	ADS-B Operational Approval for Operations Outside of U.S. Domestic Airspace	USA
WP/7	5	ADS-B Implementation – ATC Phraseologies	IATA
WP/8	5	The Use of Flight Plan to Support Air Traffic Management and the Effect of Variable of Flight Planning Requirements	Australia
WP/9	5	Air Traffic Service Provision and Regulator Roles in ADS-B	Australia
WP/10	5	The Requirements for ICAO Aircraft Address to be included in Flight Planning and Associated Issues	Australia
WP/11	6	Separation Minima, Airspace Capacity and ADS-B Mandates	Secretariat
WP/12	7	Regional Supplementary Procedures Amendment to Support ADS-B Mandates	Secretariat

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WP/13	5	Progress on Possible Project : Papua New Guinea (PNG) and Australia and Indonesia	Australia
WP/14	5	Surveillance on Low-Flying Aircraft Using ADS-B	Hong Kong, China
WP/15	4	Review Terms of Reference and Tasks List of ADS-B Study and Implementation Task Force	Secretariat
WP/16	4	ADS-B Implementation Status in APAC Region and APANPIRG Conclusions on ADS-B	Secretariat
WP/17	4	Proposed Amendment to AIGD	Australia, Hong Kong China & Singapore
WP/18	6	ADS-B Data Sharing between India and Myanmar	India
WP/19	7	Security Issue of ADS-B Operations	India
WP/20	4	Centralized Database for ADS-B Avionics Performance Monitoring	Hong Kong China, Australia & Singapore
WP/21	4	Task List : Synergy between ADS-B and GNSS/PBN	Australia
WP/22	6	Automatic Dependent Surveillance-Broadcast (ADS-B) Implementation in Singapore FIR	Singapore
WP/23	6	Development of Asia/Pacific Regional ADS-B Implementation Plan and Sub-regional ADS-B Implementation plan	Singapore
WP/24	4	Performance of ADS-B Stations and Avionics in Singapore FIR	Singapore
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IP/9	2	Approval of SUPPs 7030 on Disabling Non-compliant ADS-B	Secretariat
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		PRESENTATIONS	
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