INTERNATIONAL CIVIL AVIATION ORGANIZATION

ASIA AND PACIFIC OFFICE

REPORT
OF
THE SECOND MEETING OF
AUTOMATIC DEPENDENT SURVEILLANCE – BROADCAST (ADS-B) STUDY AND IMPLEMENTATION TASK FORCE (ADS-B SI TF/2)

Bangkok, Thailand, 22-26 March 2004

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1. Introduction

1.1 The Second Meeting of Automatic Dependent Surveillance –Broadcast (ADS-B) Study and Implementation Task Force (ADS-B SI TF/2) was held from 22 to 26 March 2004 at the " Kotaite Wing " of the ICAO Asia and Pacific Office in Bangkok, Thailand.

1.2 Mr. Lalit B. Shah, Regional Director of Asia and Pacific Office, opened the meeting and expressed warm welcome to all the participants. He stated that APANPIRG/14 meeting appreciated the work done by the First Meeting of the Task Force held in March 2003.

1.3 He further stated that it was a matter of pride that the AN-Conf/11 noted the work done in this region for implementation of ADS-B and formulated Recommendations in line with the Conclusions of the First Meeting of this Task Force, particularly, the Near Term Strategy and Support of Long Term ADS-B requirements. This action has provided global endorsement of the work done in this region and has also created work for ICAO Panels, States and International Organizations to facilitate implementation of ADS-B. He further noted that APANPIRG has identified ADS-B as one of the Key Priority items and it has been included in the Key Priority List for CNS/ATM Implementation in the ASIA/PAC Region.

1.4 He informed the meeting that successful implementation of EMARSH Project and RVSM in this region has provided an excellent example of the inter-regional coordination and true partnership of States and organizations under the auspicious of ICAO and expressed the hope that the ADS-B will also be implemented in the similar manner. He also highlighted the work to be done at this meeting.

1.5 Mr. Greg Dunstone, Chairman of the Task Force, welcomed all the participants. He noted that the work carried out by the Task Force had a positive impact globally since the ADS-B link decision has been made. It is required to continue to develop implementation planning. He stated the need to develop a plan for radar like service between city pairs, carry out cost benefit and business case study. He further stated that Australia is committed to implement ADS-B, based on the work carried by the Task Force and the Conclusions formulated by APANPIRG.

2. Attendance

2.1 The meeting was attended by 33 participants from Australia, China, Hong Kong China, Fiji, India, Indonesia, Japan, Mongolia, New Zealand, Singapore, Sweden, Thailand, United States, IATA, SITA, and representatives from two industries. List of participants is at Attachment 1.

3. Officers and Secretariat

3.1 Mr. Greg Dunstone, Senior Technical Specialist of Airservices Australia Chaired the Meeting.

3.2 Mr. K.P. Rimal, Regional Officer CNS, acted as Secretary of the Meeting who was assisted by Mr. Li Peng, Regional Officer, CNS of the ICAO Asia and Pacific Regional Office. The meeting was also assisted by Dr. Paul G. Hooper, Regional Officer, Air Transport on matters relating to cost benefit studies.

4. Organization, Working Arrangements and Language

4.1 The meeting met as a single body except on 24 March when a Workshop was conducted to examine 3 city pairs to develop sample model business case study. The working language was English only inclusive of all documentation and this Report. Lists of Working Papers, Information Papers presented at the meeting are at Attachment 2.

Agenda Item 1: Adoption of Agenda

1. 1 The Agenda items adopted by the meeting were as follows:

Agenda Item 1: Adoption of Agenda

Agenda Item 2: Review results of:

a) APANPIRG/14 Meeting with respect to result of the First Meeting of the Task Force; and
b) AN Conf/11 on ADS-B.

Agenda Item 3: Review the progress made by ADS-B related ICAO Panels and the aviation industry:

a) AC Panel ADS-B activity;
b) OPLINK Panel ADS-B activity;
c) SAS Panel ADS-B activity;
d) SCRS Panel ADS-B activity;
e) Activities by ASIA/PAC States in trials and demonstration of ADS-B;
f) Availability of avionics; and
g) Aircraft equipage plans by airlines, business aviation and general aviation sectors.

Agenda Item 4: Cost Benefit Studies:

a) Develop methodology for presentation of cost/benefit analysis for the Near- Term use of ADS-B in the ASIA/PAC region; and
b) Identify factors to be considered in the analysis and sources of information.

Agenda Item 5: Development of an Implementation Plan

Agenda Item 6: Work Programme Development

Agenda Item 7: Any Other Business

Over View of ADS-B

1.2 A brief introduction to ADS-B “radar like” service and elements of ADS-B systems was provided by the Chairman of the Task Force. He explained in detail that ADS-B is a technology where aircraft avionics broadcasts the aircraft position, altitude, velocity and other parameters completely autonomously. The position information derived for ATC surveillance and/or for cockpit display is dependent on the aircraft position determination system.

Agenda Item 2: Review results of:

a) APANPIRG/14 Meeting with respect to result of the First Meeting of the Task Force; and
b) AN Conf/11 on ADS-B.

APANPIRG/14 Meeting with respect to result of the First Meeting of the Task Force

2.1 The meeting reviewed actions taken by APANPIRG/14 on the result of First Meeting of the ADS-B Study and Implementation Task Force. The meeting noted that the report of the First Meeting of the Task Force was reviewed by the Thirteenth Meeting of the ATS/AIS/SAR Sub-Group of APANPIRG held in June 2003 and by the Seventh Meeting of CNS/MET Sub-Group and Tenth Meeting of CNS/ATM/IC Sub-Group of APANPIRG held jointly in July 2003.

2.2 APANPIRG/14 held in August 2003 reviewed the report of the Task Force including the comments provided by Sub-Groups. APANPIRG/14 appreciated the task completed by the Task Force and adopted three Conclusions on the link selection for near term, the target date for implementation of "radar like" surveillance service and on the need for the development of ADS-B related standards. The meeting reviewed the following Term of Reference of the Task Force approved by APANPIRG/14.

2.2.1 TOR of the ADS-B Study and Implementation Task Force:

Complete an industry wide ADS-B cost/benefit study for the near term use of ADS-B throughout the ASIA/PAC region. Develop an implementation plan for near term ADS-B applications in ASIA/PAC including target dates taking into account available equipment standards and readiness of airspace users and ATS providers.

Note:

1) The Task Force, while undertaking the task, should take into account of the work being undertaken by OPLINK, SAS, SCRS and AC Panels with a view to avoid duplication.

2) The Task Force should report to the APANPIRG meeting to be held in 2004 and subsequent meetings.

2.3 The meeting was informed that the Key Priorities for CNS/ATM implementation in the ASIA/PAC region was updated by APANPIRG/14. ADS-B Task Force was tasked to develop an implementation plan for ADS-B on a sub-regional basis according to Item No.14 of the Key Priorities and Sub-Groups of APANPIRG were requested to foster the implementation of the plan.

2.4 The meeting noted that ICAO Council, at its 6th Meeting of its 171st Session held on 27 February 2004 and the Air Navigation Commission (ANC) at the 5th Meeting of its 165th Session on 27 January 2004 respectively reviewed the APANPIRG/14 Report and took action on the Conclusions of APANPIRG/14. In relation to ADS-B, the ANC noted that APANPIRG has selected the Mode S extended squitter as the data link for the near-term implementation. Furthermore, the Commission supported Conclusion 14/22 regarding the inclusion of source data accuracy and integrity in ADS-B standards and also the development of separation standards for ADS-B surveillance. This approach, which initially involved determining the operational requirements for a system and subsequently calling for development of SARPs, was appreciated by the Commission.

AN Conf/11 on ADS-B

2.5 The meeting reviewed result of the AN-Conf/11 with respect to ADS-B. The Meeting noted each item of Recommendations 1/6, 1/7, 4/1, 7/1, and 7/2 related to ADS-B formulated by the AN-Conf/11. Action taken by ANC on the above five Recommendations were also noted.

2.6 The meeting was pleased to note that the ANC had approved Recommendations 7/1 and 7/2 relating to strategy for the near-term introduction of ADS-B and support of longer term ADS-B requirements that were in line with the conclusions formulated by the first meeting of the Task Force held in Brisbane, Australia from 24 to 26 March 2003 and has provided a global endorsement of the work done in the ASIA/PAC region.

2.7 It was further noted that the Council on 10 March 2004 approved Report of the Eleventh Air Navigation Conference (AN-Conf/11). The Council, in confirming ICAO's role in the follow-up to Recommendations, called upon States, International Organization, all Planning and Implementation Regional Groups (PIRGs) and all the CNS/ATM partners to initiate action on specific Recommendations of AN-Conf/11, as required.

2.8 The meeting noted specific items of Recommendations 1/7, 4/1 and 7/1 of AN-Conf/11 that were assigned to States/ICAO/PIRGs for initial follow-up actions to ensure implementation of harmonized, compatible and interoperable ADS-B system with respect to operational procedures, supporting data links and ATM applications. The need for inter-regional co-ordination and the use of Mode-S Extended Squitter (ES) as a common element in national and regional implementation choice was also identified.

2.9 The meeting recognized that in view of the ADS-B trials and demonstrations carried out in various parts of the world and used as an operational system in the domestic field, it can now be called ADS-B system (instead of ADS-B concept) as it has reached maturity and has proven a reality.

2.10 The meeting recognized the need to develop a work programme of the Task Force taking into account the follow-up actions assigned to PIRGs for review and consideration by APANPIRG/15 to be held in August 2004.

Agenda Item 3: Review the progress made by ADS-B related ICAO Panels and the aviation industry

a) AC Panel ADS-B activity;
b) OPLINK Panel ADS-B activity;
c) SAS Panel ADS-B activity;
d) SCRS Panel ADS-B activity;
e) Activities by ASIA/PAC States in trials and demonstration of ADS-B
f) Availability of avionics; and
g) Aircraft equipage plans by airlines, business aviation and general aviation sectors.

Aeronautical Communication Panel

3.1 An update on ADS-B related activities conducted by the Aeronautical Communication Panel (ACP) was presented to the meeting. It was noted that the work programme of ATN Panel and AMC Panel has been merged into work programme of ACP. It was noted that a comparative analysis of the ADS-B data links i.e. VDL Mode 4, UAT and Mode S extended squitter was completed by eighth meeting of AMC Panel (AMCP/8). The details of the analysis were included in Appendix A to the Agenda Item 4 of the report of AMCP/8. The working groups of ACP have been continuing its works on technical specifications of VDL Mode 4 and draft SARPs for universal access transceiver (UAT). The manuals on VDL Mode 4 are ready for publication. It is expected that during 2005 the draft SARPs for UAT can be completed and submitted to ANC for consideration. The SARPs are expected to be applicable in 2006. The other ACP task is to develop policies and ICAO positions for protection and management of aeronautical radio spectrum including those frequencies used for ADS-B links.

OPLINK Panel ADS-B Activity

3.2 An update on ADS-B related activities conducted by the Operational Data Link Panel (OPLINKP) was presented to the meeting. It was informed that ADS-B concept of use developed by OPLINK Panel had been presented as WP/6 and adopted by the AN-Conf/11. Current ADS-B related work includes proposed amendments to incorporate ADS-B into various ICAO documents including Annex 2, Annex 11 and PANS-ATM, Doc. 4444. The overall intentions of the amendment proposals is to make the procedures regarding the use of radar and ADS-B as identical as possible. The result of this, from an air traffic controller and pilot's perspective, is a technology providing high update rate surveillance system. The other tasks assigned by the ANC to the OPLINKP include RCP, ADS-C, CPDLC and AIDC.

SAS Panel ADS-B Activity

3.3 The activities on development of separation minima using ADS-B by SASP was presented to the meeting. The Panel is targeting the completion of the work by the end of 2004. The project team 13 of SASP had reviewed the applicability of the comparative assessment methodology using a reference system as detailed in ICAO Manual on Airspace Planning Methodology for the Determination of Separation Minima (Doc. 9689). After a significant debate, SASP has accepted that development of ADS-B minima using the comparative assessment methodology with an understanding that a collision risk model may be used to provide additional support. The safety assessment being developed by SASP is aimed at demonstrating the suitability of 5 NM separation minima using ADS-B in a similar application to that using radar. It is anticipated that this work will be further expanded to include 3 NM minima in the mid-term. SASP agreed to divide Chapter 8 of Doc. 4444 into two parts, one of which will keep the current radar services section as it is, and a new part will be for ADS-B. Future work in conjunction with OPLINKP will focus on a "super surveillance chapter" proposal to include radar services, ADS-B and ADS-C services.

SCRS Panel ADS-B Activity

3.4 Current ADS-B related activities conducted by Surveillance and Conflict Resolution Systems Panel (SCRSP) was presented to meeting. Two Working Groups have been set up under SCRSP. Working Group A is responsible for developing ICAO standards for Airborne Collision Avoidance System (ACAS) and Airborne Separation Assistance System (ASAS). Working Group B is responsible for developing ICAO standards for ATC Surveillance including Secondary Surveillance Radar (SSR) and ADS-B. Proposals for amendments to Annex 10 Vol. III and Vol. IV relating to indications of the accuracy and integrity of ADS-B position messages and the technique for performing global decoding of surface position messages, etc. will be presented to the next SCRSP meeting scheduled to be held in November 2004.

Trials and Demonstration of ADS-B conducted by States

Japan

3.5 Japan informed the meeting of the activities being undertaken by ADS-B Planning and Implementation Working Group (ADS-B WG), which was established in July 2000. The Working Group is composed of JCAB, Electronic Navigation Research Institute (ENRI), JAL, ANA, JAS, Japan Radio Air Navigation Systems Association (JRANSA), Data Link Service Providers, Air Traffic Services (ATS) automation system vendors and ATC related consultants. The main objective of the Working Group is to formulate implementation plan of ADS-B from both operational and technical perspectives taking into account of technological development in the world. The current work of the group is to clarify the benefit derived from using ADS-B for ATS in Japan. The enhancement of situation awareness of general aviation aircraft flying in the radar blind areas is desired and the use of ADS-B on the aerodrome for surface surveillance in high traffic density airport is highly desired as current airport surface detection equipment (ASDE) has some undetected radar area. In financial year (FY) 2001, the Working Group began to develop a roadmap for implementation of ADS-B, and also develop the concept of Operational Case Study (OCS) and based on each OCS, template of Operational Services and Environment Definition (OSED) will be developed.

3.6 Japan further informed the meeting of the evaluation of ADS-B using SSR Mode-S ES conducted by Electronic Navigation Research Institute (ENRI). ENRI has started development of an ADS-B experimental system since FY2001 during which system design was completed. The experimental system consists of 3 receiver units, 2 receiver/transmitter units, the target processor, the monitor equipment, a reference unit, a transponder simulator and an experimental aircraft (Beechcraft B-99). The receiver/transmitter units transmit Mode S and Mode A/C interrogation in order to improve acquisition at blind area, display aircraft ID and so on. The reference unit transmits squitter signal in order to calibrate time synchronization between receiver and receiver/transmitter units. A basic test using the experimental aircraft was conducted in Sendai airport area which is about 200 NM northeast of Tokyo. ADS-B avionics installed consist of a Mode S transponder (ACSS XS-950), a Processor unit (UPS-AT AT9051) and a GPS receiver. The flight tracks of the test was recorded. The flight level was 10,500ft and the target update rate was one second. The detection probability was 100% on the arc flight, but some lost targets occurred on the outbound and inbound flight. Performance tests for ADS-B and multilateration will be conducted on airport surface and terminal areas from March 2004. Evaluation items will include accuracy, detection probability, report update rate, coverage, etc. The comprehensive evaluation tests will be conducted in FY2005.

China

3.7 China informed the meeting that plan for implementation of ADS-B trial in western part of China is being worked out. SSR Mode-S 1090 ES will be used as the ADS-B link for such trial. Three airports will be included in this trial, two of which are primary sites and one is optional. In addition to performance and parameters of ADS-B equipment such as accuracy, reliability, update rate and

coverage, safety and operation evaluation will be also conducted. At the same time, another important work is to evaluate the feasibility using ADS-B in western part of China. Controller training and training to technical staff will be also conducted. To avoid impact to the operation of existing automation system, separate independent automation system will be used in the trial for data collection, analysis, process and comparison of radar information with ADS-B information. This trial will start before the end of 2004. The early date for implementation will be subject to the result of the trial.

New Zealand

3.8 New Zealand informed the meeting that the Airways Corporation of New Zealand is planning to conduct an ADS-B trial using Mode-S 1090 ES airborne equipment within the next twelve to eighteen months. This trial will be conducted over the southern region of the South Island of New Zealand, in a region that does not have radar surveillance below FL160.

Status of US ADS-B Operational Evaluation and Implementation Activities

USA

3.9 The United States provided details of the ADS-B operational evaluation and implementation activities under FAA Safe Flight-21 (SF-21) and Capstone Programmes. FAA has been developing and conducting technical evaluations of ADS-B technologies since 1992, and has been operationally testing and evaluating ADS-B and related broadcast service technologies since 1998. More recent activities are organized under the SF-21 programme, under a cooperative government/industry effort to develop enhanced capabilities based on the Communication, Navigation and Surveillance (CNS) technologies such as ADS-B, GPS, WAAS, FIS-B, and TIS-B to integrate with enhanced pilot and controller displays. SF-21 will evaluate the safety, efficiency, capacity, service, and procedure improvements these technologies make possible, and will facilitate their certification.

3.10 It was also noted that the USA is proceeding with a national 3 NM separation analysis, 1090 MHz ADS-B avionics TSO, and continued deployment of ADS-B ground stations (>40) and avionics (additional 300 aircraft). The USA has also observed 1090 ES ADS-B self equipage of national and international air transport category aircraft flying into and around the USA.

3.11 The USA is proceeding with operational evaluation of these "pockets" of ADS-B technology implementation to enable initial use of ADS-B and stimulate user equipage. These "pockets" of ADS-B technology implementation include: Alaska, Ohio River Valley, East Coast and Gulf of Mexico. The operational and technical results of these near-term initiatives will be leveraged to support investments and deployments for national use. Detailed information on the above developments can be obtained by accessing the following FAA websites:

Capstone Programme: http://www.alaska.faa.gov/capstone/
Safe Flight 21 Programme: http://www.faa.gov/safeflight21/

India

3.12 India informed the meeting of their initiatives for ADS-B study and implementation. ADS-B study group consisting of air traffic controllers and engineers of Airport Authority of India (AAI) and technical experts from THALES/ATM was constituted for carrying out a technical study and analysis of various issues pertaining to the implementation of ADS-B in India. The study group, in October 2003, reviewed the current situation of the CNS infrastructure in India including ATS route structure, aircraft movement data, VHF stations, RCAG stations, HFRT stations, surveillance radars and their coverages, details of NDB and DVOR stations, airline operators and their fleet, avionics equipage, etc. Additional data on current status of avionics fitment of the national carriers, current regulations on the mandate to carry Mode S transponders, etc. were also considered by the study group

in February 2004. Since the Indian continental airspace is almost covered by radar, ADS-B was be considered as:

- a supplement to fill the gaps which are not covered by radar to enhance surveillance and improve safety;
- a surveillance tool to enhance safety and reduce separation to expedite traffic at remote/secondary airports and to monitor enroute traffic in TMA to improve safety and airspace capacity; and
- support for search and rescue activities.

3.13 As the result of the study, it is expected to identify one suitable site from amongst the three possible sites that have been proposed for installation of ADS- B ground station, in the southern part of the country in Chennai FIR. Existing radar and VHF coverage at various heights, availability of communication links for data transfer etc will be taken into account for finalizing the site. AAI is planning to purchase a new aircraft for flight calibration purposes, equipped with SSR Mode-S ES for use of ADS-B trial. The ADS-B data will be sent to Chennai ACC through landlines or VSAT and processed separately and presented to the controllers in a separate workstation for trial operations.

Mongolia

3.14 Mongolia updated its ADS-B related activities. Increase of international traffic using the existing air routes with limited radar coverage will result in a need for increased surveillance capability. The domestic traffic throughout the national network of airports has a need for surveillance coverage to ease up constrains between national and international traffic. In addition, there is a need to enhance the national SAR (search and rescue) capability. FANS ADS-C was introduced a couple of years ago with a good coverage for the international air routes. A demonstration in Mongolia in 2001, using one ADS-B/ VDL Mode 4 ground station, two equipped aircraft and one airport vehicle showed clearly the system capability. In November 2002, a simulation was carried out at the Swedish ATS Academy (SATSA) where six (6) different scenarios were tested with Mongolian air traffic controllers participating as in real life. The results from the simulations proved that the concept fulfilled the required surveillance capability in Mongolian airspace in the foreseen future. To help the validation process and to provide input to the implementation planning, Mongolia has invested in two CNS/VDL 4 ground stations and 5 airborne units with CDTI´s (cockpit displays) for domestic operations. The airborne equipment has been installed on 3 AN-24 and 2 MI-8 helicopters. One ground station was installed in Ulaanbaatar and the second ground station was installed in Muren in 2003. Both ground stations are connected to the Ulaanbaatar ATC centre. Since it was supported at the first meeting of the ADS-B Study and Implementation Task Force to use Mode-S ES for international operation in the ASIA/PAC region, Mongolian CAA is also planning to start a trial with Mode-S ES ground station to be installed in Ulaanbaatar. Manufacturers of Mode-S ES general systems are invited to conduct trial in the Mongolian airspace. The trial will be very special since it will include ADS/C, ADS/B over VDL Mode-4 and ADS/B over Mode-S ES into one ATM workstation. Comprehensive comparison between systems can be made during this trial. Mongolia will coordinate with neighbouring States for future implementation of ADS-B to provide a seamless coverage.

Indonesia

3.15 The meeting noted the ADS-B related activities conducted in Indonesia. In July 1998 Indonesia had an experience with VDL Mode-4 prototype system in which the airborne equipment was installed in B200 aircraft and certified by manufacture through Indonesia Directorate of Airworthiness.

3.16 The SSR Mode S 1090 extended squiter is planned for implementation in Indonesia from 2005 to 2010 time frame in two Phases in non radar environment. In Phase I, 15 ADS-B ground stations will be established at different locations in Eastern part of Indonesia within the Ujung Pandang FIR. In phase II, 10 ADS-B ground stations will be established at different locations in the Western part of Indonesia within Jakarta FIR.

Australia

3.17 Australia updated the status of the operational trial conducted in airspace surrounding Bundaberg, Queensland approximately 300 km north of Brisbane. The ADS-B trial conducted by Airservices Australia includes:

- A duplicated ADS-B ground station installed near Bundaberg;
- Equipage of approximately 12 aircraft with ADS-B avionics; and
- Comprehensive integration of ADS-B processing and display functions into Australia's national air traffic management system

3.18 The ADS-B ground station located near Bundaberg has been operating since June 2002. Nine aircraft that regularly operate in the Bundaberg region, including 4 regional airliners have been fitted with ADS-B avionics. An additional 3 aircraft are expected to join the trial fleet this year. ADS-B processing and display functions have been fully integrated into The Australian Advanced Air Traffic System and the operational implementation process has commenced. The operational implementation process consists of the following three phases:

- Operational Exposure – controller familiarization at non-control positions (completed February 2004);
- Situational Awareness – display of ADS-B position and altitude information at control positions but not used in the provision of air traffic services (currently in progress); and
- Operational Use – operational commissioning and implementation of ADS-B derived air traffic services, including separation, subject to regulatory approval (scheduled May 2004).

3.19 A full safety case was prepared and reviewed by Airservices Australia's Directorate of Safety and Environment Assurance (DSEA) and the Civil Aviation Safety Authority (CASA). CASA has authorised operational implementation through the Situational Awareness phase pending review of ADS-B performance data. Following several months of data collection and analysis, ADS-B performance was compared to that of secondary surveillance radar. ADS-B performance is extremely encouraging. Since ADS-B functions are fully integrated into the existing air traffic system and given that ADS-B services are almost identical to radar services, controller training requirements are relatively small. In addition to the familiarization and situational awareness processes, air traffic controllers receive 2 hours classroom training followed by two hours of simulation covering ADS-B processing, new phraseologies and failure modes.

ADS-B Implementation Team

3.20 It was informed that Australia has formed an organization called Strategic Air Traffic Management Group (ASTRA) to develop strategic plans looking forward over the next 15 years. It has been recognised that future Air Traffic Management efficiencies will largely come from cooperative activities that require changes in the systems and procedures of numerous organisations rather than from a single organisations like an Air Traffic Control service provider. Efficiency and safety improvements require new avionics, ground systems, airport systems, operational procedures and regulations. The second version of the Australian Strategic Plan was signed in 2003. The signatories to this plan include: Qantas, Australian Department of Transport, Virgin Airways, Australian Airports

Association, CASA, Alliance Airways, AOPA, Coastwatch, RAPAC, GAPAN, and Defense. This plan is available at http://www.astra.aero. ADS-B is considered by ASTRA to be a key enabler to achieving the operational concept. An ATM Strategic Planning Forum held in September 2003 reinforced ASTRA's central role in coordinating the implementation of the Australian ATM Strategic Plan and accordingly, established three dedicated Implementation Teams – the Operational Strategies Implementation Team, the ADS-B Implementation Team (ABIT) and the GNSS Implementation Team. The objective of the ABIT is to support ADS-B deployment in Australia. ABIT is responsible for ensuring that the diverse elements of ADS-B deployment proceed in a timely manner, through coordination and sharing of experience between all the stakeholders, across a broad spectrum of the aviation community. The Terms of Reference for the ABIT was provided to the meeting as Attachment A to WP/4.

Regulatory Perspective on ADS-B Implementation

3.21 Australia provided an overview of regulatory issues associated with the implementation of ADS-B. In reviewing the Australian experience the paper recommended that States should consider the guidance material contained in the ICAO ADS-B Concept of use and initiate action to progress ADS-B regulatory issues.

3.22 In identifying regulatory issues for the implementation of ADS-B, it is important for States to consider not only the introduction of technology, but also the interaction with other CNS systems and the effect upon the wider ATM system. As an example, many ADS-B implementations will derive position data from the GPS constellation and will require appropriate GNSS receiver standards to support the surveillance function.

3.23 While these international standards are being developed, CASA has been working on the production of domestic standards to support early implementation. To this end, CASA and Airservices Australia have sought advice from, and shared information with, a number of other States, both directly and through ICAO forums. CASA has made particular study of the United States' pioneering Capstone Programme where 5 NM separation standards for ADS-B have been in use for some years.

3.24 Australia notes that the work on international standards for ADS-B applications will continue as the technology evolves to its full potential, particularly those supporting the ASAS applications being developed by ICAO. Australia and many other States are still considering issues such as personnel licensing, use of ADS-B in lieu of Mode A/C, separation standards, aircraft equipage and long-term global interoperability.

3.25 During the discussion on this issue of development of regulatory material by States to support CNS/ATM implementation, it was suggested that an appropriate mechanism be identified to develop a framework of regulatory materials that are required to assist States in the ASIA/PAC region to progress implementation of the new CNS technology. The Secretariat was requested to raise this issue with APANPIRG Future Programme Review Task Force.

Required ADS-B performance - Radar Like Services

3.26 Australia presented a paper identifying the need to establish required ADS-B performance criteria as the available materials do not define the characteristics of the data that are required to be verified before ADS-B can be used as ATC radar like services. It was stated that the position data must be as accurate as radar data and the data must have integrity as good as radar.

3.27 It was noted that the downlinked ADS-B Messages with Navigation Uncertainty Category (NUC) value equal or better than 5 can be used for ATC separation purposes, provided that NUC is derived from HPL or equivalent.

3.28 It was further noted that the more recent DO-260A replaces NUC with 3 values called NIC, NAC and SIL. A simple table of acceptable combinations of NIC, NAC and SIL can be constructed to provide the same check as used by this proposal. However, it can be noted that no avionics is yet certified using DO-260A.

3.29 It was stated that the Australian ADS-B ground station infrastructure would support both DO-260 and DO-260A. When DO-260A avionics become available, it is preferable that DO-260A avionics be used, however, ongoing use of DO-260 is expected to remain adequate for Australian requirements.

3.30 It was also noted that with respect to general aviation CASA has published an Australian TSO standard, which specifies the requirements for a SSR transponder that has minimum ADS-B capabilities in addition to operating as a Mode A/C transponder.

This Australian TSO (Number ATSO C1004): see

http://www.casa.gov.au/avreg/aircraft/download/atsoc1004. pdf)

3.31 In order to meet the required ADS-B performance, the minimum avionics capability required for aircraft to participate in radar like separation services shall:

1. Generate the following ADS-B messages according to ICAO Annex 10 SARPS, DO260 or DO260A MOPs:

    - Airborne Position
    - Surface Position
    - Aircraft Identification and Type
    - Airborne Velocity, and
    - Extended Squitter Aircraft Status

2. Transmitted NUC value is 5 or better based on a GNSS HPL value or approved equivalent.

Maturity of ADS-B Standards

3.32 In a paper presented by Australia it was noted that certification of Airbus Mode S transponder new surveillance capabilities is based on TSO112/JTSO2C112A. As no reference document (TSO/JTSO, States AIC, JAA TGL, etc) it requires implementation in the transponder of 1090 ADS-B ES or compliance with DO-260, the ADS-B ES function in the transponder is not certified towards a specific air/air or air/ground operations. Airbus has certified the 1090 ADS-B ES function based on non interference with other aircraft functions, as is usual for new surveillance functions.

3.33 Equipment manufacturers supported Airbus by developing transponders capable of ADS-B air-ground surveillance. Without specific requirements, the level of compliance with ADS-B standards (DO-260, DO-260A, etc) was left to the transponder manufacturers. In some cases, the equipment gained from Australian trials and analysis.

3.34 Some transponders certified by Airbus were designed from early information from the ICAO Manual on Mode S Specific Services (Doc. 9688-AN/952) and coded NUCp using HFOM.

3.35 Airservices Australia analysis showed that integrity of positional data is critical for Air-Ground surveillance.

3.36 In order to provide the latest ADS-B functionality at the time of applicability, a transponder manufacturer, working with Airbus aircraft, proposed a software update to use HPL instead of HFOM to meet the released DO-260 requirements:

- It was suggested that when considering a mandate, the ASIA/PAC region needs to take into account different levels of aircraft functionality when standards are maturing. The present generation of Airbus aircraft (A300, A310/A300-600, A320 and A330/340 families), which is pioneering implementation of 1090 ES, cannot yet rely on mature ADS-B aircraft certification standards, since these are not presently available.

- Changes in the MOPS standard are expected. Therefore, ground stations must be ready to adapt to different levels of aircraft/transponder functionality.

Positional Data Noise and Velocity Vector Performance

3.37 The results of analysis of ADS-B data from an Airbus aircraft with ACSS avionics was provided by Australia. Airservices Australia's ADS-B ground station had received ADS-B reports from an Airbus A330 aircraft operating within both ADS-B and radar coverage areas. Information regarding ADS-B performance with respect to positional data noise and velocity vector performance was presented to the meeting. Some very minor anomalies were also noted. Compared to the commissioned radar performance the ADS-B positional data was indicated extremely well.

ADS-B Surveillance Quality Indicators

3.38 Australia presented a paper, written by Mitre corporation, which addressed the performance of ADS-B using a simple RAIM integrity check. It concluded that

> "*Target levels of Safety for aircraft separation based on the radar CAP model clearly show that GPS/ADS-B based surveillance presents little hazard risk under current separation standards when supported by RAIM, our most primitive means of GPS integrity monitoring*".

3.38.1 It was further noted that the United States was already using 5 NM separation in Alaska but is investigating the possibility of using ADS-B for 3 NM separation nationally.

ADS-B Upper Airspace Project (UAP)

3.39 It was noted that Airservices Australia had made progress in the ADS-B upper airspace project. The objective of the project is to provide additional safety benefits for equipped aircraft. It will also maximise operational flexibility for equipped airlines. Acquisition of the ADS-B ground stations through competitive tender processes has been completed. Taking into account the desires of Industry to minimise coverage gaps above Flight Level (FL) 300 Airservices Australia has purchased 26 ADS-B ground stations for use above FL 300 and 2 additional ground stations supporting airspace below FL 300. Each ground station comprises two antennas, two receivers and two site monitors. The site monitors provide assurance that transmitted signals are being received by the ground station and include a monitoring capability of positional data integrity as well. Two integrated GPS receivers at each site provide time tagging and information regarding GPS constellation status. A Software development environment was included in the acquisition package. Each site is expected to have coverage up to 250 NM. All installations will occur at locations at which Airservices Australia already has VHF communications – which are being upgraded under a separate VHF replacement project. In fact ADS-B radios will be installed during the same site visit to install new VHF radios.

3.40 The first ground station will be tested in Brisbane at the end of 2004. All subsequent ground stations will be delivered mid 2005 and are expected to be operating by the end of 2005. A contract is being developed to enhance the existing RAIM prediction service to provide ADS-B outage (GPS outage predictions) to the ATC automation system. Additional focus will be given to ATC procedure development, ATC training development and ATC standards development. A contract to further enhance the TAAATS ATC automation system was placed in December 2003, which includes following new capabilities:

- Ability to support 1000 ADS-B tracks and 200 ADS-B ground stations;
- Ability to graphically display predicted ADS-B outages due to inadequate GPS geometry to ATC controllers;
- Support ADS-B UAP interfaces using Eurocontrol's Asterix Cat 21 ADS-B messages;
- Allow an ADS-B equipage indicator in the flight plan;
- Allow an ADS-B indicator in a radar track so the controller knows that the track will not be lost once radar coverage end;
- Provide a different ADS-B track symbol if data come from a non duplicated site indicating inability to use the data for separation; and
- Provide the ability to filter out ADS-B aircraft, which are "on ground".

3.40.1 A number of additional ancillary systems are being developed including:

- ADS-B bypass processing for the ATC automation system, provided by a separate vendor to the ATC automation system;
- Updates to the ATC automation system "Ultimate fallback system";
- Updates to the independent ATC display replay capability; and
- Updates to the Radar analysis tools to support ADS-B.

ADS-B Lower Airspace Project (LAP)

3.41 Australia informed the meeting that Airservices Australia is examining the possible deployment of an additional network of ADS-B ground stations for lower airspace that will provide air to air services and ATC surveillance services to aircraft that are ADS-B equipped including:

- Advisory and separation services. Improved operating flexibility including reductions in track miles and higher probability of desired clearances;
- Improved safety alerting services;
- Improved search and rescue responsiveness; and
- With agreement of aircraft owners, provision of web pages showing the position of the owner's aircraft.

3.42 Two duplicated ADS-B ground stations have been purchased to be deployed to primarily support surveillance in lower level airspace. Aircraft above FL 300 will also be supported by these sites. Airservices Australia is working with a number of vendors to demonstrate low cost avionics. However, a challenging schedule is required, because unless a decision is made later this year, it is likely that Australia will need to replace the existing enroute radars since it is required to achieve a mandate with 5 years notice to allow manufacture and fitment, notice needs to be issued in 2004. The following challenges remain which could seriously limit the LAP project:

- A delay in availability of low cost ADS-B air-ground surveillance avionics;
- A delay in airframe OEMs making CDTI readily available for regional aircraft;
- Industry unwillingness to subsidize general aviation avionics; and

- Schedule pressures that may force Australia to purchase new enroute radars thus removing significant business case benefits.

ADS-B instead of Radar & ADS-B mandate

3.43 ADS-B is considered as a viable and economic alternative to existing SSR for enroute surveillance in Australia. The ADS-B UAP will provide ADS-B surveillance service to the airspace users. It was noted that operational priority would be given to those aircraft that have chosen to equip. However, fitment in the low-density airspace will be optional. As existing SSR enroute radars require replacement before 2009, the choices facing Airservices Australia and its users is either to replace these aging radars at a cost exceeding $40M AUD or switch to the less expensive ADS-B technology. It is recognized that cost for avionics fitment is also involved. Recognizing that ADS-B is a key component of the Australian ATM strategic plan, it is likely that aircraft will need to move to ADS-B at some stage. Assuming that the Australian Industry wish to avoid the costs of new radars, and the ongoing high costs to maintain radars, it is envisaged that mandatory fitment and use of ADS-B will be introduced in the medium traffic density enroute airspace of Australia before 2009.

ADS-B Capable Avionics

3.44 The meeting noted that the following lists contain some known ADS-B capable avionics. Other products may be also available.

ADS-B air-ground surveillance airborne equipment

Manufacturer	ACSS	Rockwell-Collins	Honeywell	GARMIN-AT
Type				
Air transport Mode S ARINC Bus	XS950	TPR901 upgrade	TRA67A upgrade	AT7000
Regional Mode S ARINC Bus	RCZ-852	TDR94 upgrade	MST67A Upgrade + Legacy upgrades on RS852	
GA/ Business Mode S			KT73 (with GPS KLN94 series)	Maybe GTX330 (not yet)

Note: It is understood that some niche products are also being developed by Microair and Filser.

CDTI

3.44.1 The following ADS-B capable receivers to support Cockpit display of traffic are known to be available. Other products may also be available.

Manufacturer	ACSS	Rockwell Collins	Honeywell	GARMIN-AT
TCAS based	TCAS 2000 AT2000 display	Future upgrade of TCAS	TPA100A (end 2003)	AT9011 & AT9051
TCAS based	TCAS RT950			

Note: It is known that a number of other companies are working on PDA based and MFD based CDTI as well as associated 1090 ES ADS-B receivers.

Boeing ADS-B Capable Transponders

3.45 Australia presented a paper prepared by Boeing which provided the meeting with a written update of Boeing's surveillance/ADS-B activities. Boeing has been working with airline customers, transponder suppliers, FAA, Eurocontrol, ARINC, ANSPs, and other stakeholders in pursing traffic surveillance upgrades that enhance safety and efficiency. While the major drivers for the recent upgrades have been European Elementary Surveillance (ELS) and Enhanced Surveillance (EHS) programmes, Boeing has taken the ELS/EHS upgrade opportunity to incorporate ADS-B/Mode-S ES in anticipation of upcoming ADS-B requirements. To support ELS and EHS and 1090 ES Boeing has upgraded the aircraft wiring for 737/747/767/777 model aircraft to add new wiring interfaces for FMC, IRU, MCP and MMR data. This upgrade is now complete and is available on every such type of aircraft in production today. It is also available as a customer option on the 717 and 757-airplane model. Boeing is upgrading the Mode-S transponder installation to ARINC 718A compliant transponders. ARINC 718A transponders, which are compliant with ICAO Annex 10, Amendment 77 and are capable of supporting ELS/EHS/ES functions and form a foundation for future Mode-S and ADS-B upgrades. Since ES functionality and certification criteria have not been fully delineated for transponder installations, ES capability is verified for proper operation and non-interference only. In January 2004, Boeing started the certification effort for ARINC 718A configurations. Certification of various transponder configurations is expected to continue into the second half of 2004.

Update of Airbus ADS-B Implementation

3.46 Australia presented an update of Airbus implementation of Automatic Dependent Surveillance-Broadcast out (ADS-B air-ground surveillance). In 2003, Airbus has certified Collins, ACSS and Honeywell Mode S Transponders with European Elementary Surveillance (ELS), Enhanced Surveillance (EHS) and 1090 ES ADS-B air-ground surveillance together with wiring provisions to bring the parameters to the transponders. Customers can request these modifications for production aircraft. Service Bulletins are available from Airbus to retrofit these installations on in-service aircraft. Airbus has launched a Mode S transponder enhancement programmes to enable operators to comply with ELS and EHS rules applicable to the airspaces of a number of States in Europe. This upgrade was an opportunity for initial 1090 ES function to be implemented and to install the appropriate aircraft wiring to provide the parameters to the transponder. The Airbus transponder installation is compliant with ICAO SARPS Annex 10 Amendment 77, RTCA DO181B or C, EUROCAE ED73A, and

ARINC/AEEC 718A. The ES function is partially compliant with RTCA DO260 and depends on transponder makers.

3.47 As no reference document (TSO/JTSO, States AIC, JAA TGL, etc.) requires the implementation of 1090 ADS-B ES or compliance with DO-260, Airbus has certified the 1090 ADS-B ES function based on non interference with other aircraft functions, as usual with new surveillance functionalities. At this initial implementation stage, the level of compliance of transponders with ADS-B standards is left to the equipment manufacturers' discretion. The airlines will benefit from initial ADS-B implementation, thanks to improved surveillance capability by en-route and airport surveillance installations that can receive and process 1090ES information. The meeting noted that Airbus and its Air Traffic Alliance partners support the efforts of the ASIA/PAC region to field new technologies and services based on ADS-B using 1090 ES. The ASIA/PAC live trial has already provided valuable contribution to Airbus engineering.

Development of ADS-B Avionics for General Aviation

3.48 The meeting noted the activities related to the development and demonstration of avionics for general aviation and small regional aircraft being conducted by Australia. The availability of ADS-B products for small regional aircraft and the General Aviation (GA) community is seen as a key activity towards wide scale fitment of ADS-B in the GA fleet. Until this segment of the aviation market is provided with avionics that will support air traffic control (ATC) surveillance, the existing enroute radar network, predominantly paid for by Air Transport Aircraft operators, will have to be maintained. Airservices Australia is therefore involved in a number of projects aimed at encouraging the development of ADS-B avionics for regional aircraft and the GA community. A contract has been established with an Australian avionics manufacturer to develop a prototype Mode A/C transponder capable of transmitting ADS-B messages. CASA has issued an Australian TSO (ATSO) for this device. An agreement is in place with a USA company for the development of a prototype cockpit traffic display based on ADS-B. Discussions are also taking place with European companies for the development of ADS-B cockpit traffic displays. While moving map cockpit displays depicting an aircraft's location in relation to a background map of the terrain are widely available, the part missing for traffic display is the 1090 MHz receiver and a standardised interface between the receiver and cockpit display. It is proposed to arrange demonstrations of cockpit displays for the GA community and regional airlines, to obtain feedback on the applicability and benefits of these devices.

Qantas Equipage Plans

3.49 The meeting noted that the Qantas group of airlines has expressed its support for the deployment of ADS-B as an ATC surveillance tool (ADS-B air-ground surveillance) as well as recognising its potential for airborne surveillance. New jet aircraft received by Qantas will have an ADS-B capability and European requirements for "elementary" and "enhanced" SSR operation offer a convenient opportunity to retrofit the long haul fleet. The meeting noted Qantas serious commitment to ADS-B by equipping several aircraft with ADS-B. It is also planned to make the B747-400 fleet compliant with European Mode-S "enhanced" requirements by 15 March 2005 (bypass the "elementary" stage).

3.50 During the presentation of this information to the meeting, it was recognized that it would be very beneficial to know the airlines plans to have ADS-B capability. Since IATA is in the best position to conduct a survey and provide the information to the next meeting of the Task Force it was agreed to request IATA to provide airline's plan and formulated the following draft Conclusion;

Draft Conclusion 2/1 - 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/PAC region and provide result to the next meeting of the ADS-B Task Force or its Working Group.

Industry's Perspective on ADS-B

3.51 Thales ATM as a ground equipment manufacturer informed the meeting of its perspective on ADS-B. It has developed ground infrastructure capabilities to support ADS-B based surveillance, which include ADS-B 1090 ES ground stations and ADS-B reports processing and display capabilities in the EUROCAT air traffic control center system. Within the framework of European Research and Technology programmes, Thales ATM is exploring the operational implementation of ADS-B based applications, addressing applications requirements and procedures, the evolution of ATC ground infrastructure. It was stated that the current status of standards and technology allows the early implementation of the simplest ADS-B applications, which requires minimum modifications on-board aircraft and on ground systems. Such early implementation will pave the way for more advanced applications as aircraft get equipped, while offering operational and safety benefits in the areas of implementation. Therefore, it has included ADS-B technology in its products range to allow implementation of ATC surveillance based on ADS-B. The goal is to allow Air Traffic Service Providers to offer separation services based on ADS-B. This development leads to a fully integrated ADS-B capability allowing the display of ADS-B tracks at ATM workstation when available:

- ADS-B tracks are computed taking benefit of frequent updates of down linked parameters including 3D position and speed vector. Before using ADS-B for separation, the integrity of ADS-B data is checked using on-board integrity qualification factors;

- ADS-B data are also used by the Flight Plan Data Processing to improve the calculation of the Estimated Time of Over flight (ETO) of subsequent points along the planned route;

- All usual safety nets functions that are provided based on radar surveillance sources, such as, for example, RAM (Route Adherence Monitor), STCA (Short Term Conflict Alert) or CLAM (Cleared Level Adherence Monitor) are available for ADS-B tracks as well; and

- The logic, which is implemented, is based on a priority scheme: radar tracks are used in priority when available, then ADS-B tracks, followed by ADS-C tracks and flight plan data.

3.52 It was further stated that the Thales ATM 1090 ES ground station is compliant with ICAO Annex 10 amendment 77, which defines the signal-in-space. It processes the airborne messages as defined in both RTCA DO-260 / EUROCAE ED-102. It will soon be upgraded to receive and process airborne messages according to RTCA DO-260A as well. The output format complies with the ASTERIX standard, Category 21 (dedicated to ADS-B reports).

3.53 It was also stated that in the scope of European Research & Development programme NUP Phase 1 (Northern Europe ADS-B Network Update Programme) Thales ATM had developed and delivered 6 VDL Mode 4 based ADS-B Ground Stations, installed in several European countries. This station is capable of receiving ADS-B reports from aircraft and vehicles and also of uplinking traffic data to mobile users to support advanced air-to-air applications. The output format complies with the ASTERIX standard, Category 21. A VDL Mode-4 Ground Station was installed in Papua New Guinea in 2001 to carry out ADS-B trials. Those trials have not started yet as aircraft equipage is still pending.

3.54 The meeting noted the current activities and programmes conducted by Sensis Corporation, which designs & manufactures ADS-B ground station infrastructure. The Burnett Basin ADS-B system is being prepared to be used in an operational environment in April 2004. Controllers in the Brisbane TAAATS Centre now have access to the ADS-B data being received by Sensis Corporation ADS-B Ground Station Units from equipped aircraft operating in and around the Burnett

Basin area. It was stated that the trial has proven that ADS-B technology is mature. In March 2004, the US FAA Capstone Programme received three prototypes UAT Ground Based Transceiver (GBT) Units as the first of three scheduled deliveries under the programme. Two major milestones are scheduled when Sensis Corporation will deliver 15 pre-production units in June 2004 and 78 production units between September and November 2004. In an extension of the HITS I Programme eight ADS-B ground stations were installed in the Gulf of Mexico to evaluate the deployment of ADS-B surveillance where radar coverage is limited. Recent testing has shown that ADS-B coverage continues well beyond that of coastal radar with better accuracy. There are currently more than 400 Mode-S ADS-B capable ground stations installed throughout the US and Europe today, and installation is being undertaken in Hong Kong, China.

Summary of major ADS-B activities in ASIA/PAC region

3.55 Major ADS-B activities have been taken place in last year since the first meeting of ADS-B Task Force. States are deploying or actively planning deployment of ADS-B. Major Airlines are starting to equip. Summary of States actions are as follows:

- Japan is looking to ADS-B for supporting existing radar performance;
- Australia is deploying ADS-B in non radar areas;
- Indonesia envisages new sites (5 in phase 1 Stage 1). This is followed by 10 more in phase 1 Stages 2 & 3);
- India is looking to ADS-B as a supplement to radar to fill the gaps which are not covered by the radar. India proposes to conduct a trial at Chennai;
- Singapore, Japan and Australia envisage near term ADS-B in airport surface applications;
- China will conduct an ADS-B 1090ES trial before end 2004;
- Hong Kong, China is testing ADS-B on a airport surface;
- Mongolia is starting a 1090 ES ADS-B trial in conjunction with VDL Mode 4; and
- New Zealand has approval for an ADS-B trial over the South Island following a customer request.

3.56 ADS-B performance as experienced by States in trial and operational environments continues to exceed expectations.

3.57 Meeting reaffirmed it commitment to use ADS-B 1090ES in accordance with Conclusions formulated by APANPIRG and Recommended by AN-Conf/11 and approved by ANC. Early benefits are being achieved, and worldwide consensus is giving companies confidence to invest. Manufacturers of large transport category are making avionics available now but manufacturers of regional air transport aircraft (Bombardier, Embrarer, SAAB etc.) are yet to offer ADS-B avionics.

3.58 The meeting noted the analytical work being done by USA and the high confidence that can be obtained from using RAIM based GPS data for ADS-B. ADS-B based on GPS was assessed as good as or better than radar performance.

3.59 The meeting agreed to continue to focus on near term ATM (air to ground & airport surface surveillance) applications with early payback and recognized that other regions are concentrating on long-term applications. It was agreed that the major work of the Task Force should concentrate on the near-term applications that would be commissioned in the next 5 years and maintained in service till 10-15 years from now.

ADS-B Demonstration

3.60 The meeting appreciated the live demonstration on ADS-B provided by USA. The demonstration showed both regional air taxi ADS-B traffic in Western Alaska, and a large number of UPS Boeing 757/767 1090 ES ADS-B equipped aircraft operating in/out of Louisville, Kentucky.

Avionics Standards Organisations

3.61 The Task Force recommends that States in a position to do so actively participate in the ADS-B related meetings of Eurocae, AEEC and RTCA in order to bring the ASIA/PAC perspectives to the development of avionics standards to facilitate early implementation of air-ground ADS-B capabilities in ASIA/PAC region.

3.62 Furthermore, the Task Force felt that Eurocae, AEEC and RTCA should consider conducting some of their meetings in the ASIA/PAC region. This would enable ASIA/PAC States to participate and would allow members of those organisations to observe ADS-B progress and requirements of ASIA/PAC region.

Agenda Item 4: Cost /Benefit Studies

a) Develop methodology for presentation of cost/benefit analysis for the near-term use of ADS-B in the ASIA/PAC region; and

b) Identify factors to be considered in the analysis and sources of information.

4.1 The Secretariat explained the concepts and methods contained in ICAO Circular 257-AT/106 - *Economics of Satellite-based Air Navigation Services*. In particular, the reasons for conducting a cost/benefit analysis were discussed and the different roles of a cost/benefit analysis and a business case were explained. The meeting discussed an appropriate time horizon for the project and came to the conclusion that it would be useful to conduct cost/benefit analyses for three different city pairs. It was noted that credible cost/benefit analyses would have to convince decision makers that, among other things, the proposed projects are fully specified, that they are the best among the alternatives and that the timing is optimal.

4.2 In selecting the three city pairs for analysis, the meeting looked specifically for long haul; international routes where there was a demonstrated interest in implementing ADS-B and where the traffic flows are relatively dense. It was noted that ICAO's Digest of Statistics No. 518 *Traffic by Flight Stage* provides information on capacity, revenue traffic, aircraft operators and types of flight equipment for each station pair. The meeting noted that this information is now available on-line using ICAO's Integrated Statistical Database (ISDB) and this resource was demonstrated to the meeting. In addition, the Task Force noted the *Report of the ASIA/PAC Area Traffic Forecasting Group (APA TFG) Eleventh Meeting, Bangkok, from 30 September to 4 October 2002*. Attention was focused on the information provided in this report on zone pair traffic movements.

4.3 The meeting decided that the key indicator of activity on a route for the purposes of the analyses should be aircraft movement. In considering the data available, the meeting decided to examine Sydney-Singapore, Hong Kong, China-Tokyo, and Singapore-Delhi city pairs. The meeting then identified requirements for projects and listed some important sources of benefits and costs associated with the introduction of ADS-B for each of the city pairs, including cost savings (See Appendix A).

Priority to ADS-B equipped aircraft

4.4 Australia provided the meeting with a paper describing how it proposed to change its AIP to provide operational priority to ADS-B equipped aircraft in non radar airspace. This is viewed as a benefit of ADS-B equipage by the airlines.

4.5 The intent is to increase the efficiency in traffic management by exploiting the use of the improved aircraft position definition from ADS-B surveillance. The controller will be able to provide a more efficient service as a result of the improved surveillance capability. To do this may mean giving priority to ADS-B aircraft to airspace that may have been first used by another non-equipped aircraft. An example of this may give an ADS-B equipped aircraft priority to a particular level as the improved surveillance means more efficient traffic management at air route crossing points further into the flight.

4.6 The meeting was informed that in August 2003, Airservices Australia, announced its intention to modify AIP as follows:

> *An aircraft which is first able to use the landing area, or desired airspace, in the normal course of its operations will be given priority except:*

1) an RVSM-approved aircraft will be given priority for level requests between FL290 and FL410 inclusive over aircraft not RVSM-approved;

2) an ADS-B equipped aircraft will be given priority when by so doing an operational advantage is presented to ATC;

3) when significant economic benefit would result for a number of other aircraft by deferring this priority.

Upper Airspace ADS-B Outline business case material

4.7 The meeting noted that material contained in WP19 might be of assistance in the preparation of Business cases for individual States. Rather than the development of a cross Industry Business case, Australia provided the cost of ADS-B implementation to its customers/stakeholders and requested advice from the customer/stakeholders on whether the deployment should proceed. Australia proceeded with its Upper Airspace Programme based on the customer support.

Workshop Session on Three City pairs

4.8 A Workshop was conducted to develop sample model business case for three specific city pairs. The short and sample examination of city pairs provided in Appendix A highlighted a number of issues. As a result, it was recognized that:

- each State needs to evaluate the age of their radars and whether potential exists to replace them with ADS-B;
- there is a need to consider ADS-B in surface movement solutions;
- there is a lack of surveillance data sharing in ASIA/PAC region. An opportunity exists with ADS-B deployment to plan at the early stages of deployment to share data. eg: there is potential to share data in at least the following environments:

    - Australia & Indonesia (Christmas Is, Timor area, Bali…)
    - Australia & Papua New Guinea
    - Australia and Fiji
    - Australia and New Zealand
    - Indonesia & Singapore
    - China & Japan

- Each State will investigate and report on their organisational policy regarding sharing of ADS-B data with their neighbours given that this data is from co-operative targets only and is similar to FANS/1 in which the position is provided by the aircraft itself rather than being measured by radars; and

- Australia would prepare a working paper on how ADS-B data could be shared for presentation at the next meeting.

4.8.1 In view of foregoing, the meeting formulated following Conclusion:

Draft Conclusion 2/2 – 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.

4.9 It was recognised that work needed to continue on the development of plans for selected city pairs to highlight issues for possible implementation in any sub-region. It was considered necessary for a coordinator to gather information such as possible benefits and make proposals for each city pair to use ADS-B to improve capacity as follows:

- City pair 1 (Australia - Singapore): Singapore will act as co-ordinator;
- City Pair 2 (Hong Kong, China - Tokyo): Japan will act as co-ordinator; and
- City Pair 3 (Singapore - Delhi): India will act as co-ordinator.

4.9.1 The ICAO Secretariat will co-ordinate and identify contact persons in Myanmar and Malaysia.

4.10 The analysis activity also highlighted the lack of solid cost data. As a result, requests were made for provision of further data from States and manufacturers as follows:

- ADS-B ground station prices (from all ground station providers);
- Communication and ATC automation costs: each State;
- Big aircraft & regional aircraft avionics prices from IATA; and
- Small GA aircraft avionics prices from Australia.

4.11 In regard of the City Pair 3 (Singapore – Delhi), it was recognised that APANPIRG Sub-Group were examining the problems in the Bay of Bengal. IATA offered to facilitate a presentation on the envisaged airline benefits.

Agenda Item 5: Development of an Implementation Plan

Near Term

5.1 The meeting recognised that the work on City Pairs (outlined under agenda item 4) could be used as a template for preparation of a regional implementation plan.

5.2 The meeting discussed the meaning of "near term" and "long term". It was agreed that "Near-Term" means implementations which will be deployed approximately in the next 5 years. It was recognised that these implementations would have a life of at least 10 to 15 years.

5.3 It was agreed that the highest priority and focus of the Task Force should concentrate on the near term deployments of ADS-B air to ground surveillance including both "ATC radar like services" and airport surface surveillance, using 1090ES downlink.

5.4 It was recognised that important factors to consider in regional planning was the traffic density. States were requested to provide the following details before the next meeting:

- Maximum traffic densities now & expected in 2015;
- The locations of potential ADS-B ground station sites; and
- The capabilities of existing and planned ATC automation systems to support ADS-B

5.5 Aircraft fitment rates are also critical to deployment. USA and Sensis volunteered to collect, collate and present information regarding ADS-B equipped aircraft observed by their ground stations. It was agreed to provide at least the following at regular intervals.

- Number of equipped airframes observed;
- Number and names of airlines that have equipped aircraft;
- The aircraft types that are equipped; and
- The categorisation of the Accuracy/Integrity data available aircraft.

5.6 To support development of the regional plan, it was agreed that at subsequent meetings States should provide the following:

- A focal point of contact, and regulator (airframes & ground systems) point of contact
- A paper or presentation of their ADS-B plans (including associated VHF voice communications)
- Details of possible timing of implementation of ADS-B ground stations, sites being considered, plans for mandates (if any) etc

5.7 Discussion took place on the possible timing of activities to arrive at initial regional implementations through an amendment to the Doc. 7030 - The Regional Supplementary Procedures. The next meeting could develop proposal for amendment of the SUPPs for processing in accordance with established procedures.

Long-Term

European update

5.8 The technical advisor to Mongolia provided the meeting with an overview of ADS-B implementation activities in some parts of Europe. It was stated that ADS-B based service was

provided for general aviation, surveillance in non-radar environments, airport surface movement applications and for other ground applications using VDL Mode-4.

5.9 The presentation highlighted the high traffic densities and problems particular to Europe.

5.10 A general description of the Global ATM Operational Concept was also provided. It was noted that Sweden would have ADS-B over the whole country down to 3000 ft by 2007. It was further stated that in high density areas like core Europe, VDL Mode-4 will also need more VHF channels to provide ADS-B. A highlight of some European activities on ADS-B was also provided.

5.11 In the Mongolian context, it was stated that as an upcoming activity, VDL Mode 4 is also planned to be used for SMGCS purposes in Ulaanbaatar.

Regional Airline benefits

5.12 Australia presented a paper describing potential benefits to regional aviation of using cockpit display of traffic. The regional airlines in Australia believe that savings in the order of tens of millions of Australian dollars a year are achievable if they are able to observe nearby aircraft (including GA aircraft) and that this is associated with associated regulatory change.

Agenda Item 6: Work Programme Development

6.1 The meeting identified action items as shown in Appendix B that are required to be addressed. It was considered necessary to establish a Working Group to undertake these tasks and provide results to the next Task Force Meeting.

6.2 In view of the foregoing the meeting formulated the following Decision.

Decision 2/3 – Establishment of an ADS-B Working Group

That,

a) a Working Group consisting of representatives from Australia, China, India, Indonesia, Japan, Singapore, Thailand, USA, SITA, IATA and Industry partners be established to address the work items identified in Appendix B;

b) conduct its first meeting in October 2004; and

c) provide result to the Third ADS-B Study and Implementation Task Force Meeting in 2005.

6.3 The meeting identified various tasks to be undertaken by the ADS-B Study and Implementation Task Force and developed a Subject/Tasks List in line with other Task Force/Sub-Groups of APANPIRG. The Task List is provided in Appendix C.

6.4 The meeting formulated the following draft Decision for consideration by APANPIRG.

Draft Decision 2/4 – Subject/Tasks List of ADS-B Study and Implementation Task Force

That, the Subject/Tasks List of the ADS-B Study and Implementation Task Force provided in Appendix C be adopted.

Implementation Team

6.5 Australia presented a paper proposing that the Task Force establish a problem reporting database similar to that used successfully by ISPACG. The meeting endorsed the proposal of establishment of a database, which will be initially managed by Australia.

6.6 It was suggested that States move from trials to full-scale deployment, the Task Force need to transition into an Implementation Team role to ensure implementation of ADS-B in a harmonized evolution of ADS-B in the near future.

Agenda Item 7: Any Other Business

7.1 In order to cope with the rapid development of ADS-B technology the meeting propose to hold its meetings at six months intervals.

7.2 The meeting agreed that the next Task Force meeting should be preceded by a one or two day Seminar. The ICAO Regional office is requested to invite all States of the ASIA/PAC region to the Task Force meeting and Seminar.

7.3 The meeting agreed that a Working Group meeting be conducted in three working days and should take place in the third week of October 2004. The date of the Task Force meeting is to be determined at the Working Group meeting but tentatively planned for March 2005.

WORKSHOP SESSION ON 3 CITY PAIRS

A mini workshop of the whole meeting was conducted to examine 3 city pairs.

The objective was to commence the process of develop a sample model for a elected city pair. It was decided to include both

Air to Ground (downlink only) and surface movement surveillance (downlink only)

Furthermore, only large aircraft of the Boeing/Airbus type are to be considered:

The issues identified were:

a) What are the costs?

Airborne and Ground for current users
Use real costs wherever possible

b) What are the changes in Service Levels? (Benefits)

3 options
- Do nothing
- ADS-B deployment
- Radar, limited ADS-B

The following pages are notes related to the discussion:

City Pair 1: Sydney - Singapore

ATC providers
Singapore/ Australia/ Indonesia

Regulators
CASA, CAAS, DGAC

Airlines that use route

Alitalia	
BA	744
Emirates	(A340 & B777)
Egypt air	A340
Qantas	767, 744
KLM	744
SIA	744, 777
Swiss	MD11
ANZ	744
FedEx	
UPS	
DHL	

But crossing tracks & other aircraft that “mix” with city pair need to be equipped.

Say 10 airlines on route Say 10 airlines that cross/mix.

Number of airframes using route……

Existing radar sites – ability to replace?

Australia	Ability to replace
- Sydney TAR, , …….	No
- Mt Boyce	Yes
- Darwin military	No
Indonesia Existing radars - Banda Aceh - Medan - Natuna - Tanjung Pinang - Pontianak - Pekanbaru - Palembang - Jakarta - Semarang - Banjarmasin - Balikpapan - Yogyakarta - Surabaya - Bali - Waingapu - Ujung Pandang - Manado - Kendari Envisaged ADS-B Phase 1 (Eastern) Start at Semerang Phase 2 (Western) Plan for ADS-B 2005 5 Ground stations	May be
Singapore:	
- Singapore RSR 256nm	No
- Singapore TAR 200nm	No

ADS-B how many sites?

- ADS-B GS in Singapore (surface)
- ADS-B GS in Sydney (surface)
- ADS-B GS in Indonesia enroute & remote monitoring
- Data infrastructure to get data to centres
- Ensure VHF available where surveillance is provided.
- ADS-B processing capability in
- Singapore ASMGCS
- Sydney ASMGCS
- Indonesian centres (2) Ujung Pandang/Jakarta
- Say 8 ADS-B sites in Indonesia

- Say 2 ADS-B sites in Timor sea (oil rigs)
- Are "sites" available with power
- RAIM prediction service capability in Indonesia

Funding cycles
Sites available
Develop procedures
Documents MOU Indonesia/Australia

LOA on boundaries
Doc. 7030 "Standards over the high seas"
Doc. 4444 in process by SASP/OPLINK
Australian MATS document
Indonesian MATS
Singapore MATS
AIPs
FAA TSO for 1090
Update/ prepare safety cases

Training ATC
Training flight crews
Regulator cooperation
Maintenance training (Ground stations)

Benefits:

- Singapore & Sydney surface movement
  - (AUTOMATED) Runway incursion (safety) including service vehicles
  - Reduce surface coverage holes (blockages)
  - Provides identity to ASMGCS
  - Improved gate management (airline & airport)
  - Improve surveillance under heavy rain (L band coverage vs X band)
  - More efficiency in low visibility
  - Faster response from Airport emergency services
  - Improved ATC determination of aircraft position leading to reduced ground movement delays
  - Better airport charging veracity
  - Improved de-icing management due availability of positional and identity data
  - Reduced ground taxi time (in low visibility)
  - Reduced noise & environmental impact as a result
  - Improved surveillance performance (velocity vectors, accuracy…..) Lower risk of alert false alerts
  - Increased coverage & hence potential changed separation standards & associated benefits

Safety:

- Safety alerts
- ATC Situational awareness
- FIR boundary discontinuity surveillance

Operational benefits for users:

- Chance of preferred level (fuel, operating time, money)
- Probability of optimum route (fuel, operating time, money)

- Improved predictability (can allow increased payload)
- Reduced separation
- Improved coordination with Military for clearance release through active military areas
- Improved coordination between sectors/centres (earlier clearances….)
- Better conflict resolution solutions for users
- Improved recording & data capture and hence better planning capabilities
- Better incident analysis tools

Operational benefits for ATC providers

- Improve safety alert performance due better velocity vectors
- Optimise controller workload

Operational control

- Improved flight following
- Improved ramp management (inbound taxi times)

Environmental

- Reduced greenhouse gases (optimum flight levels, less “delay”).

City pair 2 : Hong Kong, China - Tokyo

ATC providers
Hong Kong, China ATC
Chinese Taipei ATC
China (ATMB) ATC
Japan(JCAB) ATC

Regulators
CAAC, CAD, Hong Kong, China, JCAB

Airlines that use route

CathayPacific	B744,777,743,a340,a330
All Nippon	744,767,772,777
Air Hong Kong	A300
JAL	747,767,777,dc10,md11
Nippon Cargo	747
Dragon Air	
China Eastern	
China Southern	
United Airlines	B777, B744

But crossing tracks & other aircraft that "mix" with city pair need to be equipped!

Number of airframes using route:……..

Existing radar sites – ability to replace

Hong Kong	
- 4 SSR 3 primary Beacon Hill Mount Parker Tai Mo Shan Sha Chau	Not in near future
Chinese Taipei ATC	
China (ATMB) ATC	
Japan(JCAB) ATC	5 or 6 radars involved & 1 Terminal area + 1 ASDE ADS-B/Multilat on surface

Japan: potential to reduce surveillance overlap

ADS-B how many sites?

- ADS-B GS in Hong Kong (surface) – contract signed for trial. Trial period for 6 months. Option to buy after trial
- ADS-B GS in Tokyo (surface)
- ADS_B to supplement coverage to improve ATC tracking performance
- ADS-B GS in China enroute & remote monitoring
- Data infrastructure to get data to centres
- ADS-B processing capability in China (NESAC)

City Pair 3: Singapore- Delhi

ATC providers

Bangladesh
India
Malaysia
Myanmar
Singapore
Thailand

Regulators
CAA Singapore, DGCA India, DCA Thailand, DCA Myanmar and DCA Malaysia.

Airlines that use route

SQ	
Malaysian	
Thai	
AirIndia	
KLM	
CathayPacific	
JAL	
Qantas	
Gulf Air	
Korean	
ANA	
BA	
Emirates	

But crossing tracks & other aircraft that "mix" with city pair need to be equipped!

Number of airframes using route:……..

Existing radar sites from FASID – ability to replace/ new

Singapore	
Myanmar - Yangon 250 nm - ADS-B site (Pathein)	2 radars, Gaps exists – could be filled. Gaps in VHF as well

Bangadesh - Dhaka 200 nm	
India 4 sites en route – 2 PSR/SSR only & 2 SSR only (12 in total in India) - Ahmadabad - Trivandrum - Hyderabad - Guwahati - Calcutta - Chennai - Delhi - Mumbai - Mangalore - Berrhampur - Varanasi - Nagpur - Port Blair (ADS-B only)	No replacement in time horizon Some gaps in VHF & radar on route – could be filled (say 2 sites)
Malaysia - Langkawi - Subang - Genting Highlands - Senai Johor - Kota Kinabalu - Kuching - Kota Bahru - Kuala Lumpur - Sandakan - Miri	
Thailand - Bangkok - ChiangMai - Ubon - Suat - Hat Yai - Phuket - MaeHong Son - U Taphao	

Japan: potential to reduce surveillance overlap

ADS-B how many sites?

- ADS-B GS in Delhi (surface);
- ADS-B GS in Singapore (surface);
- ADS_B to supplement coverage to improve ATC tracking performance in Singapore Malaysia, India and Myanmar;
- ADS-B GS in Myanmar enroute & remote monitoring;
- Data infrastructure to get data to centres + VHF;
- ADS-B processing capability in Myanmar & India & Malaysia.

Appendix B to the report

WORK ITEMS OF THE ADS-B WORKING GROUP

Serial No.	Work Items	Action to be taken by	Target date
1	Ascertain timing with FAA for the issue of DO-260A based TSO.	USA	ASAP
2	Research maximum traffic densities now & expected in 2015.	All members	2005
3	Report organizational policy on ADS-B data sharing with neighbors.	All members	2005
4	Make available radar-ADS-B comparison analyses.	USA	2004
5	Distribute analyses on use of GPS TSO129 vs TSO145/6 avionics for ADS-B (Lee & Moody papers).	USA	2004
6	Prices: • GS prices (any ground station provider); • Communication and ATC automation costs (each State); • Big Aircraft & regional aircraft avionics prices: • Small GA aircraft avionics prices.	 Industry All members IATA Australia	 2004 2004 2004 2004
7	Coordinate examination of sites for city pairs (existing route structure: aim for capacity increase): • Australia – Singapore • Hong Kong, China- Tokyo • Singapore - Delhi	 Singapore Japan India	 2004 2004 2004
8	Bay of Bengal presentation of IATA envisaged benefits to ADS-B TF including avionics fit etc.	IATA	2004

SUBJECT/TASK LISTS OF THE ADS-B STUDY AND IMPLEMENTATION TASK FORCE

No.	Ref.	Task	Priority	Action Proposed/In Progress	Target
1	APANPIRG Concl.13/19 TOR	Subject: Selection of links for near term and long term. Task: 1) Select near term link; 2) Select long tern link.	A	1) SSR Mode S 1090 ES has been selected for the near term; 2) Additional data links may be specified as necessary.	Completed TBD
2	APANPIRG Concl. 14/21	Subject: Guidance material for implementation of ADS-B in ASIA/PAC region. Task: Develop a guidance package	A	1) Sample Business case component; 2) Based on OPLINK Concept of use and other ICAO Docs for ADS-B air-ground surveillance service.	2005
3	APANPIRG Concl. 14/21	Subject: Report of ADS-B problem. Task: Establish a problem reporting system	A	Develop a database and a form of report	2004 /Australia
4		Subject: Draft amendment proposal to SUPPs 7030 Regional Supplemental Procedures Task: Prepare a draft for consideration by ATM/AIS/SAR Sub-Group of APANPIRG.	B	Prepare a draft for amendment to Doc7030 for implementation of ADS-B in the ASIA/PAC region pending separation criteria developed by relevant ICAO Panel.	2005/ICAO Regional Office
5	APANPIRG Concl. 14/21	Subject: ASIA/PAC ADS-B operational manual Task: Develop operational procedure manual for using ADS-B.	A	Develop a draft operational manual (include material on NOTAM and available manual data)	2005 New Zealand/ USA

No.	Ref.	Task	Priority	Action Proposed/In Progress	Target
6	APANPIRG Concl. 14/21	Subject: Coordination between States at planning level Task: Coordination for timing of implementation and designate focal point of contact, points of contact for regulators, airframes & ground systems.	A	1) Develop an coordinated implementation plan by city pairs; 2) Inform ICAO regional office names of designated focal point of contact.	2005/States concerned 2004/States
7	APANPIRG Concl. 14/21	Subject: Regional implementation plan Task: Develop a Regional implementation plan taking into account the individual national plans in accordance with a coordinated plan between city pairs.	B	1) States present their ADS-B plans (including any necessary associated air ground voice communication) as WPs to ADS-B study and implementation Task Force; 2) Implementation date, sites being considered and plans for mandates (if any) should be specified; 3) Develop optimal regional plan based on State inputs.	2005
8		Subject: Number of airframes fitted Task: Report on number of airframes fitted	A	Collect and report to the Task Force information on types, operators (numbers of each) and NUC (NIC/NAC/SIL)	2005/USA

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Bangkok, Thailand, 22 – 26 March 2004

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International Civil Aviation Organization

Second Meeting of Automatic Dependent Surveillance – Broadcast (ADS-B) Study and Implementation Task Force (ADS-B SI TF/2)

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LIST OF INFORMATION PAPERS

IP No.	Agenda Item	Subject	Presented by
1	-	Meeting Bulletin	Secretariat
2	-	Report of ADS-B and Implementation Task Force Meeting 2003	Secretariat
3	3 e)	Evaluation of ADS-B Using Mode-S Extended Squitter at ENRI	Japan
4	3 e)	Activities of ADS-B WG in Japan	Japan
5	3 e)	Status of U.S. ADS-B Implementation	USA
6	3 e)	Preparation for ADS-B Trial	China
7	3 a)	Update on The ACP's ADS-B Link Related Activities	Secretariat
8	3 d)	SCRSP ADS-B Activities	Australia
9	3 c)	Development of ADS-B Separation Minima by ICAO SASP	Australia
10	3 b)	Update on the OPLINK Panels' ADS-B Activities	Australia
11	3 e)	Thales ATM Position on ADS-B	Australia
12	4 b)	ADS-B Surveillance Quality Indicators	Australia
13	3 e)	ADS-B Implementation – Sensis Corporation (former as WP/21)	Australia
14	3 e)	Indian Initiatives for ADS-B Implementation	India
15	3 e)	Automatic Dependent Surveillance-Broadcast Systems in Mongolia	Mongolia
16	-	Automatic Dependent Surveillance-Broadcast Systems in Mongolia (Prepared for 11th Air Navigation Conference in Montreal, Canada, from 22 September to 3 October 2003).	Mongolia
17	3 g)	ICAO Global ATM Operational Concept	Mongolia

LIST OF WORKING PAPERS

WP No.	Agenda Item	Subject	Presented by
1	-	Provisional Agenda	Secretariat
2	2 a)	APANPIRG Action on the Result of ADS-B Task Force/1	Secretariat
3	2 b)	The Eleventh Air Navigation Conference on ADS-B	Secretariat
4	3 e)	ADS-B Implementation Team	Australia
5	3 f)	Positional Data Noise And Velocity Vector Performance	Australia
6	6	Propose Break Into Working Groups	Australia
7	3 e)	Fitment of ADS-B	Australia
8	3 e)	Required ADS-B Performance - Radar Like Services	Australia
9	4 b)	Outline Business Case For Upper Airspace Projects	Australia
10	6	Establish ADS-B Problem Reporting Database	Australia
11	3 f)	ADS-B Capable Avionics	Australia

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WP No.	Agenda Item	Subject	Presented by
12	3 e)	ADS-B Lower Airspace Project	Australia
13	3 e)	ADS-B Upper Airspace Project	Australia
14	3 e)	A Regulatory Perspective on ADS-B Implementation	Australia
15	4 b)	Potential Benefits to the Regional Airline Industry in Australia Arising from a Wide Scale Deployment of ADS-B Technology	Australia
16	3 e)	Airservices Australia's ADS-B Operational Trial Programme Update	Australia
17	3 g)	Development of ADS-B Avionics for GA	Australia
18	3 f)	Boeing ADS-B Capable Transponders	Australia
19	3 f)	Update of Airbus ADS-B Implementation	Australia
20	3 f)	Maturity of ADS-B Standards	Australia
21	3 g)	Qantas Equipage Plans	Australia
22	4 a)	Operational Priority for ADS-B Equipped Aircraft	Australia