INTERNATIONAL CIVIL AVIATION ORGANIZATION

ASIA AND PACIFIC OFFICE

REPORT
OF
THE ADS-B STUDY AND IMPLEMENTATION TASK FORCE MEETING

Brisbane, Australia
24-26 March 2003

The views expressed in this Report should be taken as those of the Task Force and not of the Organization. This Report will be submitted to the ATS/AIS/SAR/SG/13, CNS/MET/SG/7 and APANPIRG/14 Meetings for any formal action.

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1. Introduction

1.1 The Automatic Dependent Surveillance - Broadcast (ADS-B) Study and Implementation Task Force (ADS-B SITF/1) was held in Brisbane, Australia at the Brisbane Marriott Hotel from 24 to 26 March 2003. The meeting was hosted by Airservices, Australia.

1.2 On behalf of Airservices Australia, Mr. Bob Peake, Manager of Technology Development extended a warm welcome to all the participants. He mentioned that the large number of participants was very pleasing and confirmed that the holding of this meeting appeared timely to discuss ADS-B issues including a methodology for implementation in areas where it was appropriate to do so. The meeting was also reminded that this region earlier took the lead in FANS 1 based ADS implementation in 1990s.

1.3 Mr. Peake advised the meeting that they would have the opportunity to view a live demonstration of the work Airservices has been doing in respect to trials on ADS-B initiatives during the course of the next few days. He emphasised that this demonstration is not an engineering trial as such, but an operational trial to assist in developing ATC procedures as well as evaluate the introduction of ADS-B within normal ATC operations.

1.4 On behalf of Mr. L. B. Shah, ICAO Regional Director for Asia/Pacific Region, Mr. John Richardson, Regional Officer ATM of the ICAO Asia/Pacific Regional Office expressed gratitude and appreciation to Airservices Australia for hosting this important meeting and for the excellent arrangements made. He highlighted the main events which had taken place in the CNS/ATM field in the ASIA/PAC Region and asked the meeting to note that Australia has been a leading player in CNS/ATM system development and implementation in the region. He mentioned that international traffic in the region is expected to grow substantially over the next few years. The implementation of ADS-B has the potential to assist in handling this expected increase. He wished the meeting all the success in discussing this important issue of ADS-B implementation.

2. Attendance

3.1 The meeting was attended by fifty-three experts from Australia, China, Hong Kong China, Fiji, India, Japan, New Zealand, Pakistan, Singapore, Thailand, United States, IATA, IFALPA and SITA. The meeting was also attended by representatives from Industries including Airbus, Boeing, Thales ATM. Honeywell and Sensis. A list of participants is at Attachment 1.

3. Officers and Secretariat

3.1 Mr.Greg Dunstone, Senior Radar Engineer and ADS-B Project Manager from Australia was elected Chairman and presided over through the meeting.

3.2 Mr. John Richardson, Regional Officer, ATM and Li Peng, Regional Officer, CNS of the ICAO Asia and Pacific Regional Office were Secretaries for the meeting.

4. Organization, Working Arrangements and Language

4.1 The meeting met as a single body. 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.

4.2 The participants visited The Australian Advanced Air Traffic System (TAAATS) and appreciated the ADS-B operational demonstration at Brisbane ATM Centre.

Agenda Item 1: Adoption of Provisional Agenda and review of the TOR and tasks

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

Agenda Item 1: Adoption of Agenda

a) Adoption of the provisional agenda and tentative meeting programme;

b) Review of the TOR and tasks

Agenda Item 2: Review of ADS-B Activities

a) Review OPLINK Panel ADS-B activity;
b) Review SASP ADS-B activity;
c) Review SCRSP and AMCP ADS-B activities;
d) Review activities by Asia/Pacific States in trials and demonstration of ADS-B;
e) Review aircraft equipage and future plans by airlines, business aviation and general aviation sectors;
f) Review other ADS-B related activities;
g) Potential near term applications of ADS-B in Asia Pacific

Agenda Item 3: Evaluate information available on the selection of link technology as the preferred technology for Asia/Pacific Region

Agenda Item 4: Cost Benefit Studies

Agenda Item 5: Implementation Plan
Agenda Item 6: Work Programme Development
Agenda Item 7: Any Other Business

1.2 The meeting reviewed the Terms of Reference (TOR) of the Task Force approved by APANPIRG/13 meeting. In light of the identified new tasks, the meeting proposed a revision to the TOR and formulated the following draft decision:

Draft Decision XX - Revision of the Terms of Reference

That, the revised Terms of Reference of the ADS-B Study and Implementation Task Force be adopted as shown in Appendix 1.

1.3 The meeting noted that a new task for ADS-B was added to the list of key priorities of the CNS/ATM Implementation in the Asia/Pacific Region.

1.4 Based on the TOR and the item added to the list of key priorities, the following tasks were identified for the meeting:

- identify near term and long term benefits of ADS-B;
- recommend the most suitable technology for selection as a preferred link for implementation in the near term;
- the cost impact on avionics of mandatory carriage of the ADS-B link selected;
- recommend the most suitable technology for selection as a preferred link for implementation in the long term;
- develop a recommended implementation plan including a target date for the mandatory carriage of the selected ADS-B link.

1.5 The meeting noted that Air Navigation Commission in November 2002 reviewed the report of APANPIRG/13. While appreciating the efforts of APANPIRG in establishing a multidisciplinary task force to conduct a study for the selection of ADS-B link for use in the Asia/Pacific regions, the Air Navigation Commission encouraged States to participate in studies to select an ADS-B link, taking into account cost/benefit analysis.

1.6 The meeting also noted that ADS-B Study and Implementation Task Force is required to present its initial study results to:

APANPIRG ATS/AIS/SAR/SG/13	23-27 June 2003
APANPIRG CNS/MET/SG/7	15-21 July 2003
APANPIRG CNS/ATM IC/SG/10	
APANPIRG/14	4-8 August 2003

Agenda Item 2: Review of ADS-B Activities

a) Review OPLINK Panel ADS-B activity;
b) Review SASP ADS-B activity;
c) Review SCRSP and AMCP ADS-B activities;
d) Review activities by Asia/Pacific States in trials and demonstration of ADS-B;
e) Review aircraft equipage and future plans by airlines, business aviation and general aviation sectors;
f) Review other ADS-B related activities;
g) Potential near term applications of ADS-B in Asia Pacific

2.1 Under this agenda item, a number of papers on the latest developments of ADS-B were presented to the meeting.

2.1.1 A brief introduction on concept of ADS-B was provided by Australia. 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. The terms of "ADS-B in" and "ADS-B out" were explained. "ADS-B out" refers to the broadcast of ADS-B transmissions from aircraft without the installation of complementary receiving equipment to process and display ADS-B data on cockpit display to pilots. The complementary processing is called "ADS-B in"

2.1.2 An update on ADS-B related work being conducted by the Operational Data Link Panel (OPLINKP) was presented to the meeting. It was informed that ADS-B concept of use had been developed by OPLINK Panel and would be presented to Eleventh Air Navigation Conference subject to review by Air Navigation Commission. The latest draft version dated 28 February 2003 was provided to the meeting as a reference document.

2.1.3 The activities on the status of developing radar-like separation minima using ADS-B by SAS Panel was presented to the meeting based on a paper which was considered at the Second Working Group of the whole meeting of SASP held in Montreal October 2002. The paper provided an outline of a comparative assessment method which could be used to evaluate the use of ADS-B 1090 MHz Extended Squitter (1090 ES) surveillance for ATC separation as a recommended method in ICAO Manual on Airspace Planning Methodology for the Determination of Separation Minima (Doc9689). The reference system proposed is a four second update rate en-route SSR radar with a separation standard of 5 nautical miles. While the SAS Panel was proceeding using the comparison to a reference system methodology, some Panel members had indicated that a Collision Risk model approach should also be undertaken.

2.1.4 A summary of the activities conducted by ICAO Surveillance and Conflict Resolution Systems Panel (SCRSP) was presented to meeting. There was a proposal for SCRSP to recommend that 1090 ES be accepted by ICAO as the ADS-B link technology for achieving global interoperability in support of the initial introduction of ADS-B application. It was recognised that additional ADS-B links may also be deployed on a local or regional basis either in addition to 1090 ES for international air transport operations or in lieu of 1090 ES for other than international air transport operations. SCRSP is considering a proposal for the introduction of an ADS-B Event Driven message for broadcast of ACAS Resolution Advisory (RAs) on the 1090 MHz link. This would facilitate timely reception and display of RAs to controllers.

2.1.5 A summary of the worldwide ADS-B related activities taken by States and recent ADS-B related development in each ICAO regions as contained in the report of AMCP/8 meeting held 4-13 February 2003 was presented to the meeting.

2.1.6 It was noted that there was a coupling between ADS-B and GPS. Specifically, the GPS avionics has been developed to support navigation. However it has not well developed to support dependant surveillance.

2.1.7 As a result of reviewing ICAO Panels' ADS-B related activities, the meeting identified a need for positional source data integrity requirements for ADS-B services to be included in the appropriate standards and the need for high priority to be given to the further development of integrity data reporting in ADS-B SARPs and separation standards based on ADS-B surveillance. Therefore, the meeting developed the following draft Conclusion:

Draft Conclusion XX Needs for development of ICAO SARPs for ADS-B

That, ICAO consider, as high priority, in the technical work programs:

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.

2.1.8 It was suggested that work of related Panels should be actively supported by States. This is necessary to allow timely development and introduction of ADS-B from which benefits will flow.

2.2 The meeting reviewed the ADS-B related activities taken by States in the Asia/Pacific region and deliberations by APANPIRG as well as its sub-groups in the last two years.

2.2.1 Australia informed the meeting of progress and status of their operational pilot deployment of ADS-B in an area near Bundaberg, Queensland. The objectives of the trial were to provide and demonstrate operational benefits of ADS-B to the airspace users; to provide first hand operational experience of ADS-B for ATC surveillance and the use of ADS-B for separation in the Australian environment including the development of procedures and training; to provide cost-benefit information and practical information prior to widescale deployment of ADS-B for radar like surveillance within Australia. The goal of the trial is to use ADS-B for 5 NM separation. The trial is few months away from providing operational services. It was informed that Australia has many VHF outlets in remote locations where power supply used is from solar cells, and communications is via satellite link. Co-location of an ADS-B ground receiving station passing ADS-B data back to the ATC via the existing link would be very practical. A proposal has been made to deploy 20 ADS-B ground stations to support "radar like" services in airspace currently not supported by Radar typically above FL300 over the Australian continent. It needs to bring on board a group of stakeholders who believe in the benefits to successfully implement a new system. Bundling of products with synergies can be useful in gaining acceptance of a new system. More information can be obtained at:

http://www.airservicesaustralia.com or
http://www.airservicesaustralia.com/pilotcentre/projects/adsb/adsb.htm?/perfrep/default.asp

2.2.2 China informed the meeting of the ADS-B plan for operational evaluation in western China. SSR Mode S 1090 Extended Squitter will be used as the ADS-B link for such trial. It was informed that radar is the dominant surveillance means in eastern China but ADS-B is seen as the cost effective solution for western China. Discussions are in progress with airlines for participation in the trial. The early date for implementation should be from 2006 subject to the successful trial.

2.2.3 Japan informed the meeting of the ADS-B activities being undertaken. ADS-B planning and implementation working group was established in July 2000 in Japan. Main task of the group is to clarify benefits derived from ADS-B. It was noted that due the mountainous terrain and complex terminal buildings in the airport, radar coverage is not complete. ADS-B is being evaluated as a supplementary means for surveillance. The use of ADS-B on the aerodrome for surface surveillance is also being investigated. A 1090 ES ground system is currently being developed. Japan believes that 1090 ES is the most appropriate ADS-B technical link for international commercial aircraft. UAT or VDL Mode 4 may be more appropriate for general aviation aircraft. Considering congestion in VHF band in Japan UAT is favored for general aviation. It was noted that ICAO has not yet standardized UAT.

2.2.4 Fiji informed the meting of their updates regarding ADS-B related studies progress in Fiji. A revised schedule for completing the cost benefit analysis study with aim of issue of a final report is by end of May 2003 and ADS-B trial is still planned for 2003.

2.2.5 An information paper regarding a simulation of ADS conducted by Mongolia was presented. Mongolian has undertaken combined simulation studies of ADS-C and ADS-B for Mongolian airspace. It has been found that the implementation of ADS-B in the upper airspace can improve the safety and efficiency of the air navigation system and implementation of ADS-B could enhance coverage of surveillance for traffic in the lower airspace. It was proposed using radar like separation standard. It was concluded that ADS-B used in a mixed environment with equipped and non equipped aircraft would be a risk because of different separation minima and the need to focus on both strips and screen by controllers. Mongolia would collaborate with ICAO and States concerned to reach a regional agreement on implementation of ADS-B. It was noted that VDL Mode 4 was used for a successful combined ADS-B/ADS-C demonstration conducted in Ulaanbaatar in September 2001.

2.2.5.1 Mongolia indicated that the value of ADS-B is high in upper airspace, particularly for safety improvements. Mongolia identified that its inability to demand the air companies to equip with ADS-B was a difficulty.

2.2.6 The United States of America provided an update to the FAA ADS-B Capstone Programme. After three years of the programme 194 aircraft have been equipped with UAT ADS-B link, multifunction displays and GPS input. Safety is the driver for the programme. Controllers in Anchorage began using ADS-B “radar like” services for the Bethel area in January 2001. All required operational evaluation and implementation activities were met. Some of the milestones on the path to ADS-B radar-like services and Flight Standards Service ADS-B en-route separation recommendation including procedures were provided to the meeting. The more information regarding the programme can be found on the website http://www.alaska.faa.gov/capstone.

2.3 An Airline perspective of ADS-B was presented by Qantas to the meeting. The benefits expected to be realised through the use of ADS-B include “radar” vectoring, vectoring to track, smaller separation standards, support for “free flight” in low-density air space and automatic compliance monitoring in ATC system. The ADS-B data can also be used to enhance ramp operations and SAR activities. The use of multiple data links would greatly increase avionics costs. Therefore strong preference for a single ADS-B link 1090 ES technology was expressed. Fitment of CDTI is being considered by Qantas. Little benefit is expected from TIS-B service. The introduction of ADS-B into the cockpit will also involve human and regulatory issues. GPS is a required enabler for ADS-B. Qantas is retrofitting its jet fleet with FMS loosely coupled with GPS. A “critical mass” of fitment is required for the benefits that ADS-B can be realised. Benefits should realised by those who equip and the pay back period should be short. It was advised that Qantas FANS-1/A has been used for six years in daily service across the Pacific. The fitment costs were recovered in the first 18 months of service. However, the lack of FANS-1 Separation Standards, widely deployed FANS-1 routes and full support from ground service providers have precluded realising the maximum benefit from FANS-1.

2.3.1 The meeting noted that fuel saving from ADS-B was not quantified but was considered to be very substantial. The benefits from User Preferred Routes would also provide major benefits.

2.3.2 IFALPA indicated that the requirement to get a return on investment should be in a reasonable time. States are requested to provide preferential service to airlines, which equip with new technology.

2.3.3 It was suggested that cost/benefits analysis should be conducted by States with strategic planning groups participated by airlines, aerodrome, service providers, regulators and defence for developing collaborated plans in order to foster fitment by airlines so that the required "critical mass" can be achieved.

2.3.4 It was noted that avionics for "ADS-B in" generally is much more expensive than "ADS-B out". Based on experience gained in Capstone project, cost of general aviation "ADS-B out" is around US$5,500 and cost of "ADS-B in" is about US$15,000. "ADS-B in" cost is heavily dependant on new fitment vs. retrofit. With retrofit, the cost is highly dependant on the existing fitment. "ADS-B out" should be a necessary step required before "ADS-B in".

2.4 ADS-B deployment from an avionics subsystem manufacturer was presented to the meeting by Australia. It was stated that 1090 ES data link builds upon a broadly established Mode S avionics install base and fits well within the current ATM surveillance infrastructure. Other link candidates in comparison to 1090 ES have technological merits, but require significant changes to surveillance infrastructure and airborne equipage. The cost and benefit of the ADS-B system is dependent on the functional level of the system configuration. Transmit only airborne equipage with receiving only ground station is one of the three identified configurations. It is a basic air-to-ground form of the ADS-B system, cost of which is minimized. Airborne avionics costs are kept to a minimum by requiring changes only to the transmitting capability of ATC transponders. For most modern transponders, this can be accomplished with software modification and addition of wiring to input GPS position information to the transponder for ADS-B reporting. Others not capable of software modification will require the addition or replacement of existing transponder equipment with avionics that support ADS-B capability.

2.5 An aircraft manufacturer perspective on ADS-B was presented to the meeting. It was informed that in the first semester of 2003, Airbus will certify Mode S Elementary Surveillance (ELS) and Mode S Enhanced Surveillance (EHS) together with 1090 Extended Squitter (ES) ADS-B output. Airbus has decided to support the use of 1090 ES first and will continue work on a second link if need in high-density areas. It was informed that Airbus will only manufacture and certify equipment on aircraft where there are worldwide standards and assurance of worldwide adoption. Airbus stated that VDL mode 4 would not be fitted to Airbus aircraft. The Mode S transponders installed on Airbus aircraft are designed and certified in accordance with ICAO Annex 10 Amendment 77, consistent with DO260 MOPS for 1090 ES. However MOPS standard changes are expected soon (DO260A). Therefore, ground stations must be ready to adapt to different levels of aircraft/transponder functionality. There are a number of notable differences between implementation by manufacturers. There is a concern that these differences may generate issues in operational use. Interoperability between aircraft and aircraft and between aircraft and ground systems should be assured in all environments and regions.

2.5.1 It was further informed that certification for ADS-In is expected in 2007. There are studies being undertaken on presentation to pilots of surveillance data. Correlation is performed between ADS-B data with ACAS data. Different symbols are used for ACAS, ADS-B and TIS-B. Data fusion is performed between the various data sources. It is proposed that the algorithms be standardised worldwide.

2.6 ADS-B deployment from an ATM ground equipment manufacturer perspective was presented to the meeting. Thales ATM has developed ground infrastructure including ADS-B 1090 ES Ground Stations, VDL Mode 4 Transceiver with GNSS corrections, ADS-B reports processing and

display capability in the EUROCAT ATC system. The 1090 ES Ground Station consists of a small-size low power compact unit, which can be hosted either indoor or outdoor. The 1090 ES messages are received and processed by the station and then forwarded to ATC system. The ground station includes Built In Test Equipment and local and/or remote monitor & control functions. It is compliant with ICAO Annex 10 Amendment 77, which defines the signal-in-space. It allows to process the airborne messages as defined in RTCA DO-260 / EUROCAE ED-102. The output format towards ATC is according to the ASTERIX standard, Category 21. It was suggested that ADS-B deployment in a non-demanding environment first and gradually to a more demanding environment as experience and confidence is gained.

2.7 ADS-B deployment from perspective of an ADS-B subsystem manufacturer regarding the maturity and availability of ADS Ground Infrastructure was presented to the meeting. It was advised that production quality of ground infrastructure hardware and software is now readily available and being deployed around the world. As a supplier of the ground infrastructure, Sensis has shipped over 150 ground stations capable of processing Mode S 1090 ES ADS-B messages and offers a DO-260A compliant airport vehicle transponder. It was advised that a single Mode S 1090 ES ADS-B ground station can cost from $150,000 - US$300,000 including installation. The variability of pricing typically depends upon customer requirements regarding redundancy, training, documentation, testing, logistic support and site preparation. It was clarified that there is a high level of synergy between the ADS-B and multi-lateration systems and hence consideration may be given to deploy both technologies in one system for airport surveillance.

2.8 A summary of organisations involved in determination of avionics standards was presented to the meeting by Australia. It was noted that the role of various international and national bodies in the determination of ADS-B technical standards. It was noted that there is little representation in Standards bodies by States in Asia/Pacific region. It was also noted that closer working together of the teams defining and implementing ground and airborne systems is required to efficiently deploy systems.

Near term applications of ADS-B in Asia Pacific

2.9 As a result of discussions, the meeting identified the following possible applications of ADS-B in the Asia Pacific region:

a) ground based radar-like services in areas not covered by radar:
- separation
- Directed Traffic Information (DTI)
- safety alerts
- FIR boundary safety

b) support surface movement surveillance:
- improved surveillance (detection and identification) of aircraft and vehicles
- runway incursion monitoring

c) operational control for operators
-surveillance data to airlines

d) improve military-civil coordination based on common surveillance
- airspace management and control
- implementation of Air Defence Identification Zone procedures

e) SAR support

f) provide enhanced pilot situational awareness

Agenda Item 3: Evaluate information available on the selection of link technology as the preferred technology for Asia/Pacific Region

3.1 Under this agenda item, the meeting discussed several papers and reached an agreement for a recommended link technology for the near term for the region.

3.2 The following three candidate datalinks were considered by the meeting for link selection for the Asia/Pac region:

a) Mode S Extended Squitter (1090 ES);
b) VHF digital link Mode 4 (VDL Mode 4); and
c) Universal access transceiver (UAT).

3.2.1 The meeting was informed that ICAO had formalized two ADS-B data links with SARPs in Annex 10 (1090 ES and VDL Mode 4), and the SARPs for Universal Access Transceiver (UAT) are being developed. Furthermore, it was noted that the three data links were not inter-operable.

3.2.2 Concerns were expressed that in various parts of the world all three systems are being proposed for deployment. It was noted that it may not be practical to fit all three systems to any aircraft as this certainly will be more expensive than fitting one system.

3.3 AMCP activities on comparative analysis of ADS/B data links was presented to the meeting. It was noted that the AMCP was tasked by the Air Navigation Commission for Comparative analysis of ADS-B data links. AMCP/8 held in Montreal from 4 to 13 February 2003 reviewed a report from its Working Group C on a draft comparative analysis of the three potential ADS-B data links. Two of these links, 1 090 ES and UAT are wide-band links operating in the L-Band. The third, VDL Mode 4, is using multiple narrow-band channels in the VHF band.

3.3.1 The data links were compared against a number of criteria and parameters. The results do not lend themselves readily to the development of a concise summary. Each of the three candidate ADS-B data links was seen to have relative advantages with regard to some criteria. For a complete assessment of the results of the analysis, reference should be made the full set of results contained in the Appendix to AMCP/8 Report on Agenda Item 4, which was provided to the meeting as a reference document.

3.4 A table listing some characteristics of the three candidate links proposed for ADS-B was provided by Australia. The meeting noted that the listed comparative characteristics of the links include: operating frequency; data rate; channel access; air-ground range; available standards and implementations factors, etc.

3.5 Australia presented a summary of Near Term ADS-B Data Link decision of various States, manufacturers and relevant bodies. The meeting noted the following decisions made by major aviation organizations in favour of 1090 ES ADS-B link technology for Air Transport aircraft:

- The United States of America has announced that 1090 ES is selected for the airspace that is principally used by the domestic and international commercial aircraft and UAT is selected to provide ADS-B and associated services for the general aviation users. Operation in high altitude free flight airspace rule also requires that all aircraft are transmitting ADS-B (position, velocity, identity, etc.) on 1090 ES.

- Eurocontrol's Joint Coordination Board (JCB) for European ADS-B oriented projects has stated in version 1.4 of the draft document EUROPEAN RECOMMENDATION ON ADS-B DATA LINK SELECTION. It is not known whether the following position of Eurocontrol is final.

  "- It is confirmed that 1090ES will provide the required level of data link interoperability between Europe and the US for initial ADS-B applications forming part of Package 1

  - The view is shared with the airspace users that the adoption and early deployment of 1090ES will enable important progress in the areas of air-to- ground and air to air surveillance. Most importantly, it is expected to initiate essential work towards the definition of avionics enhancements including Cockpit Display of Traffic Information (CDTI) to provide Enhanced Situation Awareness.

  - While acknowledging that a 1090ES based single-link solution is an appropriate choice for ensuring early deployment of ADS-B applications for air transport category operations, it is confirmed that the full potential of Package 1 ASA applications cannot be realized in the expected future environment using any single data link selected from the three technologies currently available (1090ES,VDL Mode 4 and UAT).

  - It is considered that, for the expected future environment, the need for a dual ADS-B Data Link, based on 1090 ES and VDL Mode 4, is essential for the realisation of the full potential of the Package 1 ASA applications and beyond. The need for such a dual link is required as soon as ASA applications are due to become operational."

  - In June 2002, the Joint User Requirement Group (JURG) of Association of European Airlines and IATA concluded that 1090 MHz extended squitter ADS-B was the interoperable link;

  - IATA has also published in their magazine "One Sky (ISSUE 01 - October - November 2002) their draft policy on implementation of ADS-B as follows:

  " - ADS-B implementation worldwide must be interoperable, both in respect of the supporting data link and the ATM applications.

  - IATA supports 1090 Extended Squitter as the single, interoperable link until at least 2008.

  - Different link(s) may be deployed and used on a voluntary basis or based on regional agreement between the airspace users and Air Navigation Service Providers concerned, however, this shall in no circumstances penalise aircraft equipped only with 1090 Extended Squitter"

- Airbus has indicated that it will make ADS-B out capability; using 1090 MHz extended squitter, available on all aircraft produced after early 2003. Airbus also states that retrofit kits will also be made available at that time;

- Some Boeing aircraft are already equipped with ADS-B (e.g. some British Airways B747 and B757). Boeing is expected to consider ADS-B 1090MHz extended squitter implementation together with other transponder changes required for Europe's enhanced surveillance and the FAA's anticipated transponder rules regarding security enhancements.

- Customer demand from Airlines, not ATS providers, is needed for these units and the associated aircraft fitment STCs to become more readily available. This can be achieved through Airlines recognizing the benefits, and initiating fitment or through appropriate rulemaking.

3.6 Australia presented a summary of available Mode S 1090 Extended Squitter Avionics products from a number of vendors. A study based report concluded that "*Honeywell, ACSS, Rockwell Collins and UPS Aviation Technology have certified Extended Squitter capable Mode S transponders. By early 2003 there should be at least seven different transponder product lines that are capable of Extended Squitter transmission. Many existing Mode S transponders can be upgraded by Service Bulletin to include Extended Squitter and in the case of the ACSS product this can be done via a software load on the aircraft (note that the addition of wiring of data sources to the transponder is also required to activate Extended Squitter).*"

3.7 Information on timing of 1090 ES ADS-B fitment by other region was provided by Australia. It was noted that requirement of USA for operators to modify their ATC transponders to included new capabilities of hijack squawk is from March 2005. Eurocontrol decided in August 2002 to mandate Mode S enhancements able to downlink aircraft parameters by March 2005. Australia proposed that Mode S ADS-B could be linked to European Elementary and Enhanced Surveillance fitment and the proposed USA Anti Hijack fitment activities i.e. possible mandate for ADS-B in Asia and Pacific region from 1 January 2006.

3.8 Information on software upgradeable transponders was provided by Australia. It was noted that modern Mode S transponders are software based and hence future enhancements to ADS-B and Mode S standards will be performed by software upgrade only. Changes in Mode S and/or ADS-B requirements will likely to be able to be implemented by firmware change often without removal of the Transponder from the aircraft. It was suggested that States encourage airlines in their country to develop plans to equip their aircraft with ADS-B 1090 ES in a timely and economic manner.

3.9 Information on availability of low cost ADS-B avionics suitable for general aviation. was provided to the meeting by Australia. The use of 1090MHz Mode S ADS-B in general aviation means that a single avionics equipment can perform both the transponder and the ADS-B functions using the same RF components, antenna and antenna cabling. Aircraft which already have a transponder have a number of choices including:

a) Upgrade by replacing the existing transponder with an ADS-B capable transponder and reusing the existing antenna; or

b) Keep the existing transponder and install a new avionics equipment which transmits ADS-B messages only; or

c) Upgrade by installing a combined transponder, mode S receiver and associated cockpit display of traffic.

3.9.1 The meeting noted that a number of niche avionics manufacturers are making low cost Mode S transponder which they claim will be ADS-B capable. The meeting also noted that low cost ADS-B avionics may be available using mode S extended squitter – but not necessarily including full mode S transponder capabilities.

3.10 Australia presented a paper on a number of criteria for selection of ADS-B data link against which States in the Asia and Pacific Regions could select the ADS-B data link for the near term. It was noted that Asia/Pacific requirements differ somewhat to the requirements in Europe and USA. In Asia/Pacific region, there is greater benefit for ADS-B to be used as an alternate surveillance tool, whereas in Europe/USA radars are commonplace. Much of Asia/Pacific does not have complete ATC surveillance radar coverage. Asia/Pacific region also differs in that traffic density which is not predicted to be equivalent of Europe/USA in the short term, although growth rates may be higher. Furthermore, the Asia/Pacific region does not need to support the large numbers of GA aircraft that are supported by the USA environment.

3.11 As result of review of all information available and lengthy discussion, the meeting unanimously supported the use of Mode S Extended Squitter datalink for ADS-B in the Asia/Pacific region for Air Transport category aircraft. In the longer term datalinks additional to 1090 ES may be required to support future ADS-B applications. However it is not possible to choose applications at this time. The meeting also agreed that early implementation of "ADS-B out" supports ground based surveillance immediately and that this can be regarded as an appropriate for first step. Accordingly, the meeting developed a draft Conclusion as follows:

Draft Conclusion XX: Near term ADS-B datalink selection

That, Mode S Extended Squitter (1090 ES) be used as the datalink for ADS-B radar like services in the Asia/Pacific region for Air Transport category aircraft in the near term.

Agenda Item 4: Cost Benefit Studies

4.1 Under this Agenda Item, the meeting discussed following two papers and identified near term benefits listed below.

4.2 A paper on Operational Flexibility provided by "ADS-B Out" in controlled airspace was presented by Australia. The paper described some benefits that may be derived from "ADS-B out" in airspace currently not supported by radar. The benefits include flexibility of operation; reduction of cockpit workload; user preferred routes (UPR) and flow management etc.

4.3 Australia also presented a paper regarding remote area non ATC ADS-B benefits. The paper indicated that regional airlines could benefit from ADS-B CDTI deployment in a number of ways when operating outside controlled airspace. The possible benefits include savings of some tens of millions of dollars per year in the Australian environment and safety benefits. Qantas acknowledged that the benefits identified in the paper would be realized by the regional operations. These benefits would be greatly realized in Class G airspace.

4.4 The near term benefits identified by the meeting are as follows:

a) Move from procedural to radar-like service:

- Reduced path length/time through reduction in separation requirements and, therefore, number of conflicts
- Increased access to optimum route through separation reduction
- Increased access to optimum altitude through separation reduction
- Predictable fuel burn reduction allows increased payload
- Predictable reduction in flight plan time leads to reduction in block time
- Predictable reduction in flight plan time leads to increase in aircraft ultilisation

b) reduction in the cost of the provision of air traffic services through operational efficiencies

- optimization of sectorisation
- increased controller capacity and efficiency
- reduced air-ground communication traffic (minimum R/T procedures)
- reduced ground-ground coordination
- reduced incident investigation

c) Enabling a seamless "gate-to-gate" surveillance service, not only to international civil aviation but should include general aviation and military operations.

d) Increased safety and efficiency through the use of aircraft-derived data in a variety of systems e.g. ground-based conflict alert, minimum safe altitude warning, danger area proximity warning, automated support tools, surveillance data processing and distribution, as well as enabling access by the controller to state vector parameters, (sometimes described as controller access parameters, CAP).

e) Increasing airport safety and capacity, especially under low visibility conditions, by providing airport surface surveillance and, at the same time protecting against runway incursions. ADS-B will enable the identification and monitoring of relevant airport vehicles as well as aircraft.

f) Changes to airspace sectorisation and route structure resulting from improved surveillance should provide more efficient routing.

g) Reduced infrastructure costs. Especially, in airspace in which all aircraft are ADS-B equipped, it may be possible to decommission some radar equipment. Where multiple surveillance coverage is presently required, optimisation of the surveillance infrastructure should be achieved by the implementation of the most efficient mix of radar sensors and ADS-B. Consequently, ADS-B coverage could reduce the required number of radar sensors.

h) Cost savings achieved from the implementation of an ADS-B based surveillance system rather than the lifecycle expenses associated with installing, maintaining, and extending existing radar-based surveillance systems.

i) Possibility of overall savings if associated with relevant navigation changes.

j) Improved SAR efficiency

k) Reduced impact on the environment

l) For those aircraft equipped with "ADS-B in" Airborne surveillance capability that can improve flight crew situational awareness.

- Reduced flight length/time through reduction in procedural avoidance
- Reduced flight length/time through avoidance of runway clearance manoeuvres
- Optimised flight time through ability to arrive in busy airspace with knowledge of traffic situation
- Reduced collision risk and reduced need for collision avoidance manoeuvres

Agenda Item 5: Implementation Plan

5.1 Under this Agenda Item, the meeting reviewed one working paper which was presented by Australia at the last CNS/ATM IC Sub Group meeting in March 2002. The paper proposed that ACAS equipped aircraft with suitable navigation system be encouraged to transmit Extended Squitter from their Mode S Transponder. The Extended Squitter is required to support automatic aircraft position reporting for use by Air Traffic Control and Enhanced ACAS. It was advised that upgrading of existing Mode S transponders required the implementation of a link between the navigation system and the transponder. Due to the technical simplicity, the provision of Extended Squitter from most aircraft already equipped with ACAS is expected to be inexpensive. This is totally consistent with the existing ICAO Annex 10 provisions and the development path of Mode S and ACAS. It recommended that the target mandatory carriage of 1 090 ES in the Asia/Pacific Region by 1 January 2006.

5.1.1 IATA suggested that it was premature to make a decision at this time. It was agreed that some time needs to be allowed so that planning and cost/benefit can be undertaken.

5.2 The meeting agreed that States in the Asia/Pacific Region should be encouraged to actively participate in avionics standards setting activities taking account of the Asia/Pacific environment particularly the issue of ADS-B support of ground based surveillance for ATC in airspace without radar coverage.

5.3 It was recommended that ICAO approval process of standards and procedures be expedited including possible development and approval of Regional Supplementary Procedures for ADS-B usage in ATM procedures.

5.4 The meeting agreed to take evolutionary approach for implementation of ADS-B out ground based surveillance service. The progressive implementation may be carried out along Asia/Pacific traffic flows. The meeting agreed to concentrate on benefits arising from this near term implementation

5.5 As a result of discussion, the meeting finally agreed the target implementation of "ADS-B out" for ground-based surveillance services in Asia/Pacific region commencing January 2006. Accordingly, the meeting formulated the following draft Conclusion:

Draft Conclusion XX: Target date of Implementation

That, States be encouraged to implement "ADS-B out" for ground-based surveillance services in Asia/Pacific region commencing January 2006.

5.6 The meeting recognized the desirability of States providing ATC clearance priority for ADS-B equipped aircraft to encourage fitment.

Agenda Item 6: Work Programme Development

6.1 The meeting identified the need for "the ADS-B Task Force" to provide ongoing monitoring and support ADS-B implementation issues.

6.2 The meeting identified the need for ongoing work of the ADS-B Task Force. It was also agreed that an "ICAO Core Team" be established to lead and provide ongoing monitoring and support to the Task Force.

6.3 Future meetings of ADS-B Task Force need to address how enough aircraft can be equipped to maximize the benefits to airspace users.

6.4 The meeting identified the need to study the cost/benefit of using ADS-B applications in some areas where stations may be established on islands or platforms to give additional coverage.

Agenda Item 7: Any Other Business

7.1 The Outcome of Discussions agreed at the meeting is provided in Appendix 2 to this report.

7.2 The meeting appreciated the offer made by USA to host the next meeting of the Task Force in Alaska in 2004. The meeting was also informed that the new conference building of the ICAO Asia and Pacific Office in Bangkok will be ready for meetings by the end of 2003. The venue and date of the next meeting of the Task Force will be further discussed at the APANPIRG CNS/MET/SG/7 Meeting to be held in July 2003.

7.3 The documents of this meeting including presentations were distributed in a CD-ROM for all the participants. The report of the meeting is provided on the ICAO website: http://www.icao.int/apac/

Automatic Dependent Surveillance – Broadcast (ADS-B)
Study and Implementation Task Force
Brisbane, Australia, 24-26 March 2003

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Attachment 1 - 2

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Brisbane, Australia, 24-26 March 2003

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Attachment 1 - 4

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Brisbane, Australia, 24-26 March 2003

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Automatic Dependent Surveillance – Broadcast (ADS-B)
Study and Implementation Task Force
Brisbane, Australia, 24-26 March 2003

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Automatic Dependent Surveillance – Broadcast (ADS-B)
Study and Implementation Task Force
Brisbane, Australia, 24-26 March 2003

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Automatic Dependent Surveillance – Broadcast (ADS-B)
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International Civil Aviation Organization

Automatic Dependent Surveillance – Broadcast (ADS-B)
Study and Implementation Task Force

Brisbane, Australia, 24-26 March 2003

LIST OF WORKING AND INFORMATION PAPERS

WP/No.	Agenda Item	Subject	Presented by
		WORKING PAPERS	
1	-	Provisional Agenda	Secretariat
2	1b)	Terms of Reference: The ADS-B Task Force and Key Priority	Secretariat
3	1a)	Task Force Proposed Detailed Agenda	Australia
4	2d)	Australian ADS-B Trial	Australia
5	4b)	Remote Area Non-ATC ADS-B Benefits	Australia
6	4b)	Direct ADS-B Safety Benefits	Australia
7	2g), 4a)	ADS-B Potential for Asia Pacific	Australia
8	5a)	Two Tier ADS-B Air Traffic Surveillance Services	Australia
9	2	What is ADS-B	Australia
10	2e)	An Airline Perspective	Australia
11	3	Timing of Mode S (1090mhz) ADS-B Fitment	Australia
12	4b)	Operational Flexibility Provided by "ADS-B Out" in Controlled Airspace	Australia
13	3	The Link Position of a Number off Organizations	Australia
14	3	Overview of Candidate ADS-B Link Characteristics	Australia
15	3	Proposed Near Term Criteria for Link Technology Choice	Australia
16	2b)	ADS-B Separation Standards under Development in the ICAO Separation and Airspace Safety Panel (SASP)	Australia
17	5a)	Mandatory Fitment of Extended Squitter ADS-B	Australia
18	3	Availability of Mode S Based ADS-B Avionics	Australia
19	3	Summary of Recent AMCP Activities on Comparative Analysis Of Ads/B Data Links	Secretariat
20	2	Outcome of OPLINKP	Australia
21	2	SCRSP ADS-B Activities	Australia
22	3	Software Upgradeable Transponders	Australia
		INFORMATION PAPERS	
1	-	Meeting Bulletin	Secretariat
2	2d)	ADS-B Activities in the ASIA/PAC Region	Secretariat
3	4b), 5a)	Australian Proposal to Deploy 20 ADS-B Ground Stations	Australia
4	2d), 4f)	THALES ATM Position on ADS-B	Australia/Thales
5	3	ADS-B Technical Standards Organizations	Australia
6	3	Ads-B Ground Infrastructure Availability	Australia/Sensis
7	2e)	Airbus Position On ADS-B	Australia/AirBus
8	2e)	ADS-B Deployment from the Airborne Equipage Perspective	Australia/Honeywell
9	2	ADS-B Related Activities by States	Secretariat

Attachment 2 - 2

IP/No.	Agenda Item	Subject	Presented by
10	2d)	ADS Real Time Simulation	Mongolia
11	2d	Status of ADS-B Activity in Japan	Japan
12	2d	ADS-B in China	China
13	3	General Aviation Avionics	Australia
14	2d	Status of U.S. Capstone Programme	USA
15	2	Visit to Brisbane ATC Centre	Australia
16	2d	ADS-B Activities in the Asia/Pacific region	Fiji

Appendix 1

Proposed revision to

ADS-B STUDY AND IMPLEMENTATION TASK FORCE

Terms of Reference

Complete an industry wide ADS-B cost/benefit study for the near term use of ADS-B throughout the Asia/Pacific Region.

Develop an implementation plan for near term ADS-B applications in Asia Pacific 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 AMC Panels with a view to avoid any duplication.

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

Outcome of Discussions

1. (a) TOR: recommend the most suitable technology for selection as a preferred link for implementation in the near term;

The meeting unanimously supported the use of Mode S Extended squitter datalink for ADS-B in the Asia Pacific region, for Air Transport category aircraft.

The meeting agreed that early implementation of "ADS-B out" supports ground based surveillance immediately and that this can be regarded as an appropriate first step.

1. (b) TOR: recommend the most suitable technology for selection as a preferred link for implementation in the long term;

In the longer term datalinks additional to 1090 ES may be required to support future ADS-B applications. However it is not possible to choose applications at this time.

Hence it is recommended that APANPIRG continues to monitor ongoing developments in applications and datalinks.

2. TOR: identify near term and long term benefits of ADS-B;

The meeting identified the following near term benefits:

a) Move from procedural to radar-like service:

- Reduced path length/time through reduction in separation requirements and, therefore, number of conflicts
- Increased access to optimum route through separation reduction
- Increased access to optimum altitude through separation reduction
- Predictable fuel burn reduction allows increased payload
- Predictable reduction in flight plan time leads to reduction in block time
- Predictable reduction in flight plan time leads to increase in aircraft utilisation

b) reduction in the cost of the provision of air traffic services through operational efficiencies

- optimisation of sectorisation
- increased controller capacity and efficiency
- reduced air-ground communication traffic (minimum R/T procedures)
- reduced ground-ground coordination
- reduced incident investigation

c) Enabling a seamless "gate-to-gate" surveillance service, not only to international civil aviation but should include general aviation and military operations.

d) Increased safety and efficiency through the use of aircraft-derived data in a variety of systems e.g. ground-based conflict alert, minimum safe altitude warning, danger area proximity warning, automated support tools, surveillance data processing and distribution, as well as enabling access by the controller to state vector parameters, (sometimes described as controller access parameters, CAP).

e) Increasing airport safety and capacity, especially under low visibility conditions, by providing airport surface surveillance and, at the same time protecting against runway incursions. ADS-B will enable the identification and monitoring of relevant airport vehicles as well as aircraft.

f) Changes to airspace sectorisation and route structure resulting from improved surveillance should provide more efficient routing.

g) Reduced infrastructure costs. Especially, in airspace in which all aircraft are ADS-B equipped , it may be possible to decommission some radar equipment. Where multiple surveillance coverage is presently required, optimisation of the surveillance infrastructure should be achieved by the implementation of the most efficient mix of radar sensors and ADS-B. Consequently, ADS-B coverage could reduce the required number of radar sensors.

h) Cost savings achieved from the implementation of an ADS-B based surveillance system rather than the lifecycle expenses associated with installing, maintaining, and extending existing radar-based surveillance systems.

i) Possibility of overall savings if associated with relevant navigation changes.

j) Improved SAR efficiency

k) Reduced impact on the environment

l) For those aircraft equipped with "ADS-B in" Airborne surveillance capability that can improve flight crew situational awareness.

- Reduced flight length/time through reduction in procedural avoidance
- Reduced flight length/time through avoidance of runway clearance manoeuvres
- Optimised flight time through ability to arrive in busy airspace with knowledge of traffic situation
- Reduced collision risk and reduced need for collision avoidance manoeuvres

3. TOR : Develop recommended implementation plan including a target date

- progressive implementation along Asia/Pacific traffic flows
- target implementation of "ADS-B out" for ground-based surveillance services in Asia Pacific commencing January 2006.

The meeting agreed to concentrate on benefits arising from this near term implementation.

Other Report Outcomes

1. The meeting identified the need for ongoing work of the ADS-B Task Force. It was also agreed that an "ICAO Core Team" be established to lead and provide ongoing monitoring and support to the Task Force.

2. The meeting identified the following possible applications of ADS-B in the Asia Pacific region:

(a) ground based radar-like services in areas not covered by radar
- separation and DTI
- safety alerts
- FIR boundary safety

(b) support surface movement surveillance
- improved surveillance (detection and identification) of aircraft and vehicles
- runway incursion monitoring

(c) operational control for operators
-surveillance data to airlines

(d) improve military-civil coordination when based on common surveillance
- airspace management and control
- implementation of Air Defence Identification Zone procedures

(e) SAR support

(f) provide enhanced pilot situational awareness

3. Asia Pacific needs to influence, by active representation and participation, avionics standards setting organisations to take account of the Asia Pacific environment particularly the issue of ADS-B support of airspace without radar coverage.

4. (a) The meeting urged that any review of the ICAO Panels technical work programs that occurs following ANC 11 include the need for high priority to be given to the development of ADS-B SARPS and separation standards.

(b) Urged that ICAO approval process of standards and procedures be expedited including development and approval of Regional Supplementary Procedures for ADS-B usage in ATM procedures.

5. The meeting recognised the desirability of States providing ATC clearance priority for ADS-B equipped aircraft to encourage fitment.

6. Subsequent meetings need to address how enough aircraft can be equipped to maximise the benefits to airspace users.

7. ICAO ensure that the positional source data accuracy and integrity requirements for ADS-B services are included in the appropriate standards. Priority should be given to air-ground surveillance applications.

8. Study the benefits and costs of using ADS-B applications in some areas where stations may be established on islands or platforms to give additional coverage.