International Civil Aviation Organization

FIFTEENTH MEETING OF THE COMMUNICATIONS/NAVIGATION/SURVEILLANCE AND METEOROLOGY SUB-GROUP (CNS/MET SG/15) OF APANPIRG

Bangkok, Thailand, 25 – 29 July 2011

Agenda Item 6: Surveillance

1) review report of the Tenth Meeting of ADS-B Study and Implemenation Task Force

REVIEW REPORT OF THE TENTH MEETING OF AUTOMATIC DEPENDENT SURVEILLANCE-BROADCAST (ADS-B) STUDY AND IMEPLEMENTATION TASK FORCE

(Presented by the Secretariat)

SUMMARY

This paper presents the work accomplished by the Tenth Meeting of ADS-B Study and Implementation Task Force Meeting. Action by the meeting is indicated at paragraph 3.1.

This paper relates to:

Strategic Objectives:
A: **Safety** – Enhance global civil aviation safety
C: **Environmental Protection and Sustainable Development of Air Transport** – Foster harmonized and economically viable development of international civil aviation that does not unduly harm the environment

Global Plan Initiatives:

GPI-1 Flexible use of airspace
GPI-2 Reduced vertical separation minima
GPI-5 RNAV and RNP (Performance-based navigation)
GPI-6 Air Traffic Management Flow
GPI-7 Dynamic and flexible ATS route management
GPI-9 Situational awareness
GPI-12 Functional integration of ground systems with airborne systems
GPI-17 Data link applications

1. Introduction

1.1 The Tenth Meeting of Automatic Dependent Surveillance – Broadcast (ADS-B) Study and Implementation Task Force (ADS-B SITF/10) hosted by Civil Aviation Authority of Singapore (CAAS) was held from 26 to 29 April 2011 in Singapore. An information sharing session on ADS-B development and implementation was organized on 26 April in conjunction with the ADS-B SITF/10 meeting. The outcome of deliberations at the information sharing session was taken into consideration at the 10th meeting of the Task Force.

1.2 The Meeting was attended by 78 participants from Australia, China, Hong Kong China, Macao China, Fiji Islands, India, Indonesia, Malaysia, Nepal, New Caledonia, Papua New Guinea, the Philippines, Republic of Korea, Singapore, Sri Lanka, Thailand, USA, Viet Nam, CANSO, IATA, SITA and representatives from industrial groups.

1.3 The Working/Information papers and the report of the meeting is provided on the following ICAO APAC webpage:
http://www.bangkok.icao.int/cns/meeting.do?method=MeetingDetail&meeting_id=60

1.4 The brief introduction on the outcome of the ADS-B SITF/10 was also provided to the Twenty-First Meeting of ATM/AIS/SAR Sub-group of APANPIRG held from 27 June to 1 July 2011. The meeting also discussed regional airspace concept that provides priority for aircraft operating ADS-B equipment.

2. Discussion

2.1 The ADS-B SITF/10 meeting formulated 2 draft Decisions and 7 Draft Conclusions for consideration by APANPIRG/22. The meeting considered 10 Information Papers and 21 Working Papers. 12 presentations were made at the ADS-B information sharing session.

2.2 The Information Sharing Session covered a comprehensive list of topics on the ADS-B, as follows:

- Operational use of ADS-B from user's perspective
- Updates from airframe manufacturers – Airbus and Boeing
- ANSPs perspective and benefits of implementation
- Regional implementation status and activities
- Updates from States' programme
- Presentations and Demo from Industry

Review the Terms of Reference and Subject/Tasks List

2.3 The meeting reviewed the TOR adopted by APANPIRG/18. The TOR was considered appropriate and the meeting did not propose any changes to the TOR. The meeting updated the Task List and Action Items and formulated following Draft Decision:

Draft Decision 10/1 - Subject/Tasks List of ADS-B Study and Implementation Task Force

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

Guidance Material on building a safety case for ADS-B separation service

2.4 The meeting reviewed and endorsed a draft guidance material on building a Safety Case for delivery of an ADS-B separation services presented by CASA Australia. The draft material provides guidance on the steps and contents with a brief description of each topic for inclusion in an ADS-B Design and Implementation of Safety Case. The list of topics has been derived from the Safety Case for the ADS-B Upper Airspace Program (UAP) prepared in Australia by the ANSP. The meeting noted that the ICAO Circular 311 had been pulled out of circulation and replaced by Circular 326 which will be ready for publication by September 2011. The meeting reviewed the structure and contents of the draft Guidance Material and proposed for adoption through a draft Conclusion.

Draft Conclusion 10/2 – Development of Guidance Material on Building a Safety Case for Delivery of an ADS-B Separation Service

That, the draft Guidance Material on Building a safety case for delivery of an ADS-B separation service provided in **Appendix B** to the Report be adopted.

Sample agreement for data sharing

2.5 Indonesia and Singapore shared with the meeting their experiences on the adoption of the sample agreement. The meeting reviewed the description of the changes to the original sample agreement and formulated a draft Conclusion for adoption of revised sample agreement on data sharing.

Draft Conclusion 10/3 – Adoption of Revised Sample Agreement for data Sharing

That, the revised Sample Agreement for Data Sharing contained in **Appendix C** to the Report be adopted.

Amendments to AIGD

2.6 The meeting noted that the Amendment No. 1 to the PANS-ATM (Doc 4444) will become applicable on 15 November 2012. The meeting discussed a proposal for a consequential amendment to the ADS-B Implementation Guidance Document (AIGD). The AIGD has a section which specifies a temporary procedure to be used prior applicable date of the amendment to the Flight Plan as described in the Amendment No. 1 to the PANS-ATM. The meeting also agreed to add a guidance material into AIGD which contains 5 recommendations for reliability and availability for ADS-B ground system. In this connection, the meeting formulated following draft Conclusion for consideration by APANPIRG.

Draft Conclusion 10/4 – Amendment to AIGD

That, Amendment to the ADS-B Implementation Guidance Document (AIGD) as shown in the **Appendix D** on consequential amendment to the Flight Plan and **Appendix E** on the reliability and availability for ADS-B ground system to the Report be adopted for inclusion in the AIGD.

Radio Frequencies for Provision of VHF Voice Communications

2.7 The meeting recalled that APANPIRG/19 urged States to support provision of VHF radio voice communication associated with ADS-B data sharing between adjacent States. In order to enable radar like separation, ADS-B based surveillance service must be complemented by the Direct Controller Pilot Communication (DCPC) such as VHF radio voice communication. Without supporting communication infrastructure, the ADS-B based surveillance will provide minimal operational benefits to the air space users. Viet Nam made a proposal that APANPIRG should further support the decision for States to provide VHF voice communications facilities for other States by developing a Conclusion. This would help in the domestic approval process for VHF radio frequency assignment. Australia and IATA supported Viet Nam's suggestion. The meeting reviewed and endorsed the following draft Conclusion.

Draft Conclusion 10/5 – Coordinate for VHF for sharing Voice Communication Capability

That,

a) States be urged to support provision of VHF radio voice air/ground communication infrastructure to adjacent States; and

b) The States sharing ADS-B data and supporting provision of VHF Voice air-ground communication infrastructure to adjacent States should co-ordinate with ICAO regional Office and their national Telecommunication Authority (Radio Frequency regulator) for assignment of VHF radio frequencies to be used by the adjacent States.

Requirement for SA Aware

2.8 The meeting discussed a proposal from IATA that the Australian ADS-B rule should be amended to extend the date of compliance by 2 years. Noting reasons stated and the date of 12 December 2013 becoming a generally accepted date among APAC Region States for the commencement of ADS-B mandates, the meeting considered that it would be a reasonable compromise to extend the date for SA aware forward fit compliance to the mandate date, rather than the 28 June 2012 date. It would provide for a reasonable compromise between the requirements of ATC service providers and airlines. In view of the foregoing, the meeting formulated following draft Conclusion for adoption by APANPIRG as recommendation for consideration by Australia.

Draft Conclusion 10/6 - Forward fit requirement for SA aware GNSS Equipment

That, based on information from IATA, the existing forward fit requirement in the Australian CAO 20.18 for SA Aware to be incorporated in GNSS receivers providing position source data for ADS-B be extended from 28 June 2012 to 12 December 2013.

Support for DO260B

2.9 The meeting noted that the difference between DO260/DO260A and DO260B may perhaps allow additional useful functionality to be deployed in the ATC automation system. Singapore and Hong Kong China were requested to prepare a paper for the next meeting, comparing the changes brought by DO260B and identifying any potential impacts on ATC systems.

2.9.1 The meeting recognized that aircraft equipped with ADS-B Out avionics compliant with DO260B are likely to enter Asia Pacific airspace in 2012-2015 timeframe. The meeting noted that at least one manufacturer (ACSS) has DO260B certified transponders available. There will be a need for States providing ADS-B based surveillance service to include the service to aircraft with DO260B compliant avionics. Therefore the meeting formulated a draft Conclusion as follows:

Draft Conclusion 10/7 – Support DO260B Compliant Avionics

That, States providing ADS-B based surveillance services be urged to upgrade their ADS-B ground stations in time (2012-2015) to receive DO260B standard transmissions in addition to those aircraft transmitting ADS-B data compliant with DO260 and DO260A.

Review of the TOR and Name of the SEA ADS-B Implementation Working Group

2.10 The meeting reviewed the outcome of the sixth meeting of the South East Asia ADS-B Implementation Working Group held from 24 to 25 February 2011 in Singapore. The meeting was attended by 54 Participants from Australia, China, Hong Kong China, Indonesia, Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Viet Nam, IATA and one representative from industry. The whole report is also available on the ICAO APAC website:
http://www.bangkok.icao.int/cns/meeting.do?method=MeetingDetail&meeting_id=36

2.10.1 The meeting noted that China and Hong Kong China agreed to join the working group as members. The meeting noted that the sixth meeting of the Working Group had adopted a revised Terms of Reference of the working group.

Bay of Bengal/South Asia Sub-regional Project

2.10.2 The meeting reviewed and discussed an initial proposal for deployment of ADS-B ground stations in the Bay of Bengal. The meeting noted that India plays a key role in the sub-region. In particular, installation of ADS-B stations at Port Blair and Car Nicobar. The meeting noted that India is developing ADS-B implementation plan in India and taking up issues concerning the implementation of ADS-B at Port Blair. Regarding proposed ADS-B location at Car Nicobar, it was informed that more complicated coordination process with military authority would be required. Sri Lanka informed the meeting the potential location of ADS-B ground station would be at Pidurzitalagala in the central part of Sri Lanka. CANSO stated that the proposed locations in Myanmar were provided by DCA Myanmar during the recent Seminar.

2.10.3 With respect to work proramme of the SEA ADS-B working group to cover the area of Bay of Bengal area, IATA noted that although the current name of this working group is for South East Asia, the TOR should be inclusive rather than exclusive. Expertise from this working group should be shared. Australia suggested changing the name of the working group to encourage non-SEA States to participate. Singapore suggested that States adjacent to FIRs of SEA states should be included as members. The meeting further discussed the proposal for changing the name of the working group. Considering the need to invite States in the Bay of Bengal area to participate in the working group meeting on a regular basis, the meeting agreed to propose changing the working group name into South East Asia and Bay of Bengal ADS-B Implementation Working Group (SEA/BOB ADS-B WG) and developed following draft Decision.

Draft Decision 10/8 – Name and Terms of Cooperation of ADS-B Implementation WG

That, Recognizing the need to expedite ADS-B implementation and surveillance data sharing in the Bay of Bengal area, the South-East Asia Sub-regional ADS-B Implementation Working Group be renamed as "South-East Asia and Bay of Bengal Sub-regional ADS-B Implementation Working Group". A revised Terms of Cooperation and work programme be developed by the working group.

Update on the ADS-B Collaboration Project in the South China Sea Area

2.11 Indonesia, Singapore and Viet Nam updated the meeting on the implementation of ADS-B in the South China Sea area. The project involves collaboration between Indonesia and Singapore as well as collaboration between Singapore and Viet Nam.

2.11.1 Prior to implementation of exclusive ADS-B within Singapore FIR, two operational trial phases will be carried out. This phased approach will allow air traffic controllers, pilots and stakeholders to be familiar with the operations.

2.11.2 In Phase I of the ADS-B operational trials, ADS-B/Radar-like separation will be applied between suitably equipped aircraft on ATS routes L642 and M771. ADS-B/Radar-like separation will be applied on an opportunity basis. It is foreseeable that longitudinal separation can be reduced in situations where two or more ADS-B equipped aircraft are flying in succession. The target commencement of Phase I Operation Trial is 2nd half of 2011.

2.11.3 In Phase II of the ADS-B operational trials, ADS-B/Radar-like separation will be applied to the other routes within the parts of the Singapore FIR. In addition to ATS routes L642 and M771, ADS-B/Radar-like separation will also be applied to suitably equipped aircraft on ATS routes N891, M753 and L644. In this phase of the operational trials, priority will be accorded to suitably equipped aircraft. This would mean that ADS-B equipped aircraft will be given priority for their preferred optimal flight level over non-ADS-B equipped requesting for the same flight level. This will ensure that the capacity could be maximised by pooling two or more ADS-B equipped aircraft at their preferred optimal cruising flight level. The target commencement for Phase II Operational Trial is 2nd half of 2012.

2.11.4 The implementation of exclusive ADS-B airspace is targeted to be on or after 12 December 2013. Aircraft intending to operate at or above FL 290 within this defined ADS-B airspace will need to be ADS-B equipped and certified accordingly. The aircraft operator must have the relevant operational approval from the State of Registry. Aircraft that does not have the relevant ADS-B operational approval from the State of Registry will be assigned a flight level below FL 290 should they wish to operate within the lateral limits of the defined airspace.

2.11.5 The meeting was also informed that Singapore is now working towards conducting the necessary safety assessment before commencing the operational trials within the Singapore FIR. In the future, the collaboration project may be expanded to include the major routes ATS routes N892, L625, N884 and M767.

2.11.6 IATA applauded the efforts by the States collaborated for this project to enhance the operating efficiency on the at busy ATS routes in the South China Sea. IATA urged other States to explore the areas in which ADS-B implementation would lead to significant benefits for the airlines in those areas.

Seamless Surveillance Coverage on L642 and M771

2.11.7 Hong Kong noted that Indonesia, Singapore and Viet Nam are collaborating in the South China Sea Project to benefit traffic along routes L642 and M771. These routes pass through four FIRs, namely Singapore, Ho Chi Minh, Sanya and Hong Kong with distance over 1300NM.

2.11.8 As L642 and M771 will involve multiple ANSPs including Singapore, Vietnam, China and Hong Kong - China, there is an obvious need to harmonize both equipage requirements and timeline for ADS-B mandate among the concerned ANSPs. Hong Kong China recommended that the concerned CAA/ANSPs should review the adequacy of enhanced surveillance coverage to achieve seamless surveillance coverage and provide enhanced surveillance in supporting operations over the two parallel routes.

2.11.9 An ad hoc working group consisting of Singapore, Viet Nam, China and Hong Kong China at SEA ADS-B WG/6 Meeting worked out the harmonized requirements and timeline for implementation. The meeting further progressed the harmonized equipage requirements and timelines developed by the working group.

Proposal for harmonization of air traffic control procedure

2.11.10 Singapore provided an information paper on a proposal for harmonization of air traffic control procedures for ADS-B operations in the South China Sea area to be discussed at the SEACG meeting to be held in Bangkok from 3 to 6 May 2011. The paper proposes to discuss the harmonization of longitudinal spacing for pairs of ADS-B equipped flights during the operational trial and implementation on ATS routes L642 and M771 in order to reap the full benefits that come with the deployment of ADS-B based surveillance.

2.11.11 Current air traffic management initiatives utilizing Performance Based Navigation (PBN) specifications allows reduction of longitudinal separation minima from the conventional 10 minutes or 80 NM to 50 NM based on RNP10 PBN specification and 30NM based on RNP4 PBN specification. As such, Singapore proposes that the appropriate reduction of longitudinal spacing to quantify the benefit of implementing of ADS-B based surveillance service.

2.11.12 The reduction of the longitudinal spacing would enable more ADS-B equipped flights to operate at their optimum flight level. This will also help reduce the ground delays at the respective airports, reduce operating costs and carbon emissions. Singapore is now working towards conducting the necessary safety assessment before commencing the operational trials within the Singapore FIR.

2.11.13 Noting progress of ADS-B Implementation made by States in the South China Sea area, the meeting encouraged States concerned to expedite implementation of the project and developed the following Draft Conclusion:

Draft Conclusion 10/9 – Expedite ADS-B implementation project in South China Sea area

That, States concerned with ADS-B implementation in the South China Sea area be urged to expedite required actions and coordination to achieve the implementation.

Australia-Indonesia Data Sharing Project

2.12 Australia and Indonesia provided an update on their data sharing project between the Brisbane and Ujung Pandang FIRs. Under Phase 1A, Australia provides data from Gove and Thursday Island while Indonesia provides data from Merauke and Saumlaki. The plan was later revised to include sharing additional sites from each state at Broome, Doongan, Kintamani and Kupang. A satellite datalink was established to exchange the ADS-B data using multicast and using ASTERIX Category 21 Version 0.23. A Deed of Agreement to support ADS-B data sharing was signed on 20 September 2011. Full operation was achieved on 1 February 2011, with ADS-B data from foreign FIRs on screen in both Brisbane and Makassar ATC centers.

Aircraft equipage requirement

2.13 IATA noted that key to any ADS-B program is the publication of aircraft equipage requirements enabling the data to be used for operational purposes and that these requirements are published to provide operators sufficient lead time to plan for forward fit and retrofit programs. Recognising all the necessary guidance to promulgate equipage requirements that have been provided by APANPIRG,

2.14 In this connection, the meeting conducted a survey on the readiness of publishing ADS-B equipage requirements during the meeting. The results of the survey shown in **Appendix G** to the meeting report indicates that while some States including (Australia, China, Hong Kong China, Fiji, Malaysia, PNG and Singapore) have published or have indicated a target date to publish the requirement for a defined airspace, some States are still in a status of TBD. The meeting strongly recommended those States intending to implement ADS-B based surveillance to take firm and early action to publish the equipage requirements as requested by airspace users – as previously agreed by APANPIRG.

ADS-B Seminar in Myanmar and the Philippines

2.15 CANSO informed the meeting that ADS-B seminar concluded recently for DCA Myanmar in Yangon on 22 February 2011 as well as a similar seminar conducted for the CAA of the Philippines in Manila in August last year. Both seminars were conducted by CANSO to provide the latest updates on ADS-B and to reach out to as many participants as possible from the ANSPs of the DCA/CAA as well as their regulators and airlines.

2.15.1 CANSO stressed the need for States to work together to harmonise their individual ADS-B implementation plans so that overall benefits can be optimized for the region as a whole. States concerned were urged to follow up on the proposed expansion of ADS-B coverage over the South China Sea and the Bay of Bengal.

Review of Regulator Ad Hoc WG, South East Asia (SEA) and Bay of Bengal (BOB) Sub-regional Projects

2.16 The meeting reviewed the updates on the Sub-regional ADS-B implementation projects from SEA, BOB and Regulator's Working Group as presented by the Ad Hoc working groups at the ADS-B SITF/10 meeting. The discussions were based on the outcome of previous meetings of the ADS-B SITF/9 and SEA ADS-B WG/6. The outcome of discussions by Ad Hoc working groups is provided in **Appendix H** to the meeting report which could serve as a basis for further development of the sub-regional implementation plans.

States' activities on trials and implementation of ADS-B and multilateration

2.17 The meeting noted implementation activities and plan updated by following States: New Caledonia, Australia, Singapore, China, Hong Kong China, Fiji, Indonesia, Republic of Korea, Papua New Guinea, Sri Lanka, Myanmar, the Philippines and Viet Nam. The detailed information provided Administrations is provided in the meeting report.

Note of appreciation

2.18 The meeting expressed appreciation and gratitude to the Civil Aviation Authority of Singapore for hosting the Tenth Meeting of ADS-B Study and Implementation Task Force (ADS-B SITF/10) and the Sixth Meeting of the SEA ADS-B Working Group in February 2011 and for the excellent arrangements including all activities organized during the meeting.

Time and Venue of Next Meeting

2.19 The seventh meeting of SEA/BOB ADS-B Implementation Working Group is scheduled in November 2011. The next ADS-B Study and Implementation Task Force meeting is scheduled for April or May 2012. The meeting appreciated the kind offer made by the Republic of Korea to host the Eleventh ADS-B Study and Implementation Task Force meeting in Republic of Korea.

3. Action Required by the Meeting

3.1 The meeting is invited to review the report of the Tenth Meeting of ADS SITF and make recommendations on the draft Conclusions and Draft Decisions for consideration by APANPIRG/22.

– – – – – – – – – – –

UPDATED ADS-B SUBJECT/TASKS LIST

Serial No.	His No.	Subject/Tasks List	Associated with Strategic Objective	Associated GPI	Deliverables	Target Date	Status and Action to be taken and led by
1	3	Each member State report on the number of airframes fitted and transmitting with good NUC/NIC.	D. Efficiency	GPI01/05/06/09/14/16/ 17/21/22	Report on statistics conducted	4/2011	Closed
2	14	Guidance material on how to build safety case for delivery of separation services.	A.Safety	GPI01/05/06/09/ 14/16/17/21/22	Guidance material for implementation	Apr-11	Completed
3	17	Guidance on legal liability issues for ADS-B data sharing.	A.Safety	GPI01/05/06/09/ 14/16/17/21/22	Guidance material for implementation	Aug-12	U.S.A.
4	18	Develop and implement regional collaboration project for ADS-B Out operational use including data sharing in SEA and report on implementation progress.	D. Efficiency	GPI01/05/06/09/ 14/16/17/21/22	Sub-regional ADS-B collaboration project has been developed.	Jul-08/ Apr-11	SEA WG - On going
5	19	Develop and implement regional collaboration project for ADS-B out operational use including data sharing in South Pacific and report on implementation progress.	D. Efficiency	GPI01/05/06/09/ 14/16/17/21/22	Develop and implement sub-regional ADS-B collaboration project.	Apr-09/ Dec-11	South Pacific States On-going
6	21	Study application of ADS-B and multilat for precision runway monitoring.	D. Efficiency	GPI01/05/06/09/ 14/16/17/21/22	Guidance material for implementation	Apr-11	All Members
7	22	Perform data collection and data analysis of ADS-B messages to examine GPS performance in different geographic areas.	D. Efficiency	GPI01/05/06/09/ 14/16/17/21/22	Report of data collected and analyzed - continuous	Apr-11	All Members
8	23	Develop and implement regional collaboration project for ADS-B out operational use including data sharing in Bay of Bengal area and report on implementation progress.	D. Efficiency	GPI01/05/06/09/ 14/16/17/21/22	Develop and implement sub-regional ADS-B collaboration project.	Apr-09/ Dec-11	Bay of Bengal States

Serial No.	His No.	Subject/Tasks List	Associated with Strategic Objective	Associated GPI	Deliverables	Target Date	Status and Action to be taken and led by
9	25	Provide feedback to the proposed amendment and template for data sharing based on experience gained by Indonesia and Singapore.	D. Efficiency	GPI01/05/06/09/ 14/16/17/21/22	Comments	April-2011	Completed
10	26	Prepare a paper on the experience of using the ADS-B data sharing template and make any recommendations for change of the data sharing template.	D. Efficiency	GPI01/05/06/09/ 14/16/17/21/22	Comments	April-2011	Singapore & Indonesia
11	27	Clarify relation between DO260B and 3NM separation in TMA.	D. Efficiency	GPI01/05/06/09/ 14/16/17/21/22	Prepare a WP	April-2011	Completed
12	28	Renaming SEA ADS/B WG and relation between WG and TF.	D. Efficiency	GPI01/05/06/09/ 14/16/17/21/22	Comments	April-2011	All Members
13	29	Review the forward fit requirement for SA Aware compliance by June 2012.	D. Efficiency	GPI01/05/06/09/ 14/16/17/21/22	To develop a strategy to resolve this issue	April-2011	IATA & Australia
14	30	To exam existing air-ground communication and surveillance capability in the boarder area between China and Myanmar and identify the need and possibility for sharing ADS-B data from potential ADS-B ground station at Lashio.	D. Efficiency	GPI01/05/06/09/ 14/16/17/21/22	Report status and position	April-2011	China & Myanmar On-going
15	31	To exam possibility of sharing ADS-B data from potential ADS-B ground station from Coo Co and Pathein.	D. Efficiency	GPI01/05/06/09/ 14/16/17/21/22	Report status and possibility	April-2011	Myanmar & India
16	32	ATS operational letter of agreements between neighboring FIRs among South China Sea States for radar-like surveillance service	D. Efficiency	GPI01/05/06/09/ 14/16/17/21/22	Report progress	April-2011	China, Hong Kong China, Viet Nam and Singapore

Serial No.	His No.	Subject/Tasks List	Associated with Strategic Objective	Associated GPI	Deliverables	Target Date	Status and Action to be taken and led by
17	33	Review of FPL Amendment to update AIGD and its effective date.	D. Efficiency	GPI01/05/06/09/ 14/16/17/21/22	Update the AIGD	April-2012	Australia and Secretariat
18	34	Identify new data sharing projects in the eastern part of South China Sea.	D. Efficiency	GPI01/05/06/09/ 14/16/17/21/22	Prepare a working paper	April-2011	Singapore
19	35	Identify new data sharing projects in Bay of Bengal.	D. Efficiency	GPI01/05/06/09/ 14/16/17/21/22	Prepare a working paper	April-2011	Australia
20	36	States to advise when their ground stations can be upgraded to receive ADS-B DO260B compliant ADS-B data.	D. Efficiency	GPI01/05/06/09/ 14/16/17/21/22		April/May12	All Members
21	37	Guidance material addresig military concerns regarding sharing ADS-B data	A. Safety	GPI01/05/06/09/ 14/16/17/21/22	Prepare a working paper	April-12	Australia
22	38	Bring attention of States concerned to the risk that ADS-B data without integrity (such as NUC=0) should not be used to support procedural control	A. Safety	GPI01/05/06/09/ 14/16/17/21/22	Letter to States	October-11	Regional Office
23	39	Comparing the changes brought by DO260B and identifying anny potential impacts on ATC systsms.	A. Safety	GPI01/05/06/09/ 14/16/17/21/22	Prepare a working paper	April-12	Hong Kong China & Singapore

INTERNATIONAL CIVIL AVIATION ORGANIZATION
ASIA AND PACIFIC OFFICE

DRAFT

GUIDANCE MATERIAL ON

BUILDING A SAFETY CASE FOR

DELIVERY OF AN ADS-B SEPARATION SERVICE

Version 1.0

May 2011

CONTENTS

GUIDANCE MATERIAL
ON
BUILDING A SAFETY CASE FOR DELIVERY OF AN ADS-B SEPARATION SERVICE

REFERENCES

The guidance material herein uses information in the three reference documents below:

1. ICAO Doc 9859 AN/474 Safety Management Manual (SMM), Second Edition 2009 – in particular Chapter 4 'Hazards', and Chapter 5 'Safety Risks'

2. ICAO Circular 326 AN/188 'Assessment of ADS-B and Multilateration Surveillance to Support Air Traffic Services and Guidelines for Implementation'

3. RTCA DO-303/EUROCAE ED-126 December 13, 2006 'Safety, Performance and Interoperability Requirements Document for the Non-Radar Airspace Application'

Much of the information needed for the preparation of a Design Safety Case for an ADS-B surveillance service can be derived from the above reference documentation. The aspects that need to be separately covered by a proponent are those arising from any differences in the specific airspace for the surveillance system, and the system engineering of the surveillance services if they differ from the reference systems.

INTRODUCTION

Basic guidance on the building of a Safety Case for delivery of an ADS-B separation service is provided in this document. It relies on referencing existing guidance material in the publications listed above, as well as some existing Safety Cases covering early ADS-B services.

A number of discrete 'steps' in the building of a Safety Case are described to progress to a completed document.

The first steps cover the generic requirements for the preparation of a Safety Case for any airways system, including any surveillance systems used for separation by ATC. The primary reference is Chapters 4 and 5 of ICAO Doc 9859.

The remaining steps cover the elements of a Safety Case specific to a new ADS-B surveillance service. The basic references are ICAO Circular 326 and RTCA DO-303/Eurocae ED-126. These documents contain a significant amount of information on hazard identification and risk assessment of an ADS-B service (as well as a MULTILAT service.) The final steps are guidance to the actual content headings of a Safety Case for an ADS-B service.

Definitions

Accuracy: A measure of the difference between the aircraft position reported by the surveillance system, as compared to the true position

ALARP: As Low as Reasonably Practicable (in risk mitigation)

Availability The probability that a system will be able to perform its intended function when required for use.

Continuity The probability of a system to perform its required function without unscheduled interruption, assuming the system is available when the procedure is initiated (Circ 326)

Failure: Inability of the system to perform its intended service or function

Fault: Degradation in the performance of a system

Hazard: A condition or set of conditions of a system, or an object, with the potential to cause injury to personnel, damage to equipment or structures, loss of material, or reduction of ability to perform a prescribed function.

Hazard identification: The process of recognising that a hazard exists and defining its characteristics

Integrity: The ability of a system to provide timely warnings to users when the system should not be used for navigation (and, in the case of ADS-B for surveillance).

Maintainability: The ability of a system to be retained in, or restored to service

NRA: Non-Radar Airspace

Operational Requirement: The stated purpose of the (surveillance) system

Reliability: The probability that, during a certain period of time, a system performs its prescribed functions (usually expressed in MTBF)

Risk: The probability of occurrence, together with the severity of the consequence(s), of a hazardous event

Risk assessment: The process of determining the risk involved in the occurrence of a hazardous event, and the tolerability of that risk.

Risk management: The systematic application of management policies, procedures and practices to the tasks of identifying hazards and assessing and controlling risks.

Safety: The state in which the possibility of harm to persons or of property damage is reduced to, and maintained at or below, an acceptable level through a continuing process of hazard identification and safety risk management. (Doc 9859)

Safety Case: A document which provides substantial evidence that the system to which it pertains meets its safety objectives

PART A: GENERIC GUIDANCE FOR SAFETY CASE PREPARATION

1 What is a Safety Case?

1.1 One of the primary purposes of a Safety Management System is to predict what accidents or incidents may occur, how they may happen, and how they may be prevented. The processes for safety assurance may differ in details; however they all prescribe the systematic undertaking of safety risk assessment and the presentation of evidence that the particular system is safe.

One way of presenting such evidence is by preparing a Safety Case. A Safety Case is an explicit documentation of a safety critical system, its corresponding safety objectives, and the associated safety risk assessment and risk management of the system, at appropriate milestones in the life of the system.

2 Generic contents of a Safety Case

2.1 A Safety Case is a documented record of the steps or processes undertaken by the system proponent to ensure that the system has been designed, tested and implemented as safely as reasonably practicable. Its basic component is a structured, comprehensive statement of the hazards and the corresponding safety risks of the occurrence of the hazards surrounding the provision of an operational service. This should include the significance of the hazards in terms of their likelihood of occurrence and potential effects on aviation safety, and the means whereby they are to be managed. The essential features of a Safety Case are that it should:

a) fully describe the surveillance system including the operational role and functions which it covers (i.e. the configuration and the boundaries of the system);
b) define or reference the performance standards and specifications of the system;
c) establish the safety objectives and the safety requirements for the system;
d) identify the hazards and the operational consequences of the hazards. Identification of hazards and consequences must ensure that all possible failure and fault modes have been identified under all normal and abnormal modes of operation;
e) assess the associated risks (in terms of frequency of occurrence and severity) of each identified operational consequence;
f) categorize each of the risks within a recognised risk tolerability classification scheme;
g) establish the controls necessary to ensure the risks are tolerable.

3 Safety planning

3.1 It is expected that safety will be built into any new surveillance system from its early inception and that the management of safety related activities will be undertaken in a planned manner over the lifecycle of the system.

3.2 The safety plan may be a discrete element of a project management plan, if applicable, or it may stand-alone. The Safety Plan is an important basic document that sets out the safety objectives and requirements and the actions and processes to be followed in the development of the system.

3.3 The safety plan should provide the basis for the development of the several parts of the Safety Case at defined milestones as the development, design and implementation of the surveillance system progresses to commissioning and normal day-to-day operation.

4 A Safety Case may have several discrete parts over the system lifecycle

4.1 ATC surveillance systems have a lifecycle consisting of several distinct phases. The safety hazards and associated risks may differ in type and degree in each phase, and their identification and control treatment will be more appropriately undertaken at a particular phase in the lifecycle. Accordingly, Safety Cases need to be developed to separately consider the safety situation in each of the lifecycle phases. This may require several parts of the Safety Case, with each part building on the previous part as the system is developed.

4.2 The distinct phases of a surveillance system's life which may be covered by a Safety Case, are normally:

a) **the operational requirements definition phase**, when the role and broad functionality of the new system is determined. This phase should identify the safety objectives of the system and its applicable system safety requirements, (these may be based on ICAO SARPS, the State's regulatory requirements, and the service provider's internal safety standards);

b) **the design and procurement phase**, when the system is designed and developed to meet the specified operational and/or engineering requirements. In this phase, the system configuration and operation is defined, incorporating the safety objectives and requirements within the evolving design. A full hazard and risk assessment is usually undertaken at this time;

c) **the implementation phase,** when the system is subject to procedural and/or engineering readiness testing against the design specifications, followed by operational trials, such as ghosting or mimicking. At this phase, the risk assessment is tested and validated by actual trials and testing of the installed system, and specific safety related operational, engineering and/or management procedures are developed to obviate or control the identified risks; and

d) **the routine operations phase,** when the safety of the system continues to be monitored and improved as any hazards are identified as they arise, and the risks are mitigated during actual operations.

4.3 The Safety Case should describe the historical and current safety status of the system or service as it develops throughout its entire lifecycle.

5 STEP 1 – State the purpose and scope of the safety case

5.1 The purpose and scope of the Safety Case should be clearly stated in its introductory paragraphs, and should include:

a) A statement of the purpose and role of the surveillance system under consideration, i.e. its Operational Requirement.

b) A description of the system and its location; its configuration including the sub-system elements; the system boundaries; the elements of the system which have been considered within the scope of the document, i.e., whether it covers equipment, procedures, airspace, personnel, etc.; and the interfaces with other external systems.
c) A statement of the assumptions upon which the Safety Case is based. This should include the defined or known levels of safety, or integrity, of each of the interfacing or support systems/services, and those other services externally provided by third parties, such as those provided by telecommunications service providers, electrical power service providers, etc.

5.2 The relevant lifecycle phase of the system, covered by the particular part/s of the Safety Case should also be defined.

6 STEP 2 – Develop and document the safety objectives and system safety requirements

6.1 The overall safety objectives and related system safety and safety related performance requirements supporting the objectives for the system should be defined as far as possible, particularly at the design stage. Safety objectives and system safety/performance can be derived by reference to the Operational Requirement and the type of service involved – for example an enroute surveillance service may have a lower level of criticality of availability and continuity than a terminal surveillance service. The safety requirements of a particular service may be established by assessing the effect of possible functional failure or fault modes as the source of safety hazards and the associated effect on the operation of the system.

6.2 The fault modes analysis should cover conceivable faults or eventualities affecting system performance including the possibility of human errors, common mode failures, simultaneous occurrences of more than one fault, and external eventualities which cause or result in the loss of, or affect the integrity of, external data, services, security, power supply, or environmental conditions.

6.3 The assessment of the safety objectives may then result in an iterative process of revision and further development of the system design, the adoption of modified operational procedures, or the establishment of contingency arrangements. For this reason, as far as possible the safety objectives should be expressed in a form that is clear and unambiguous so that they can be tested against, and the compliance of the system determined.

6.4 The selection of an appropriate way of expressing the safety objectives is important. Traditional measures include the specification of ***availability, continuity, accuracy, maintainability, recoverability,*** *etc.,* which have some interdependence. In the case of surveillance systems, specifying only availability, without also specifying a limit on the rate of occurrence of failures and faults, and the recoverability of the system following failure, could be insufficient to adequately define the safety requirements. For instance, a very infrequent occurrence of a fairly long down-time may be less hazardous than more frequent failures with shorter down-times, particularly for an ADS-B service in NRA where reversion to procedural separation is the contingency for system failure.

6.5 Quantitative statements of safety objectives and system performance requirements should be used where possible, however, in many areas (e.g.; where people and procedures are involved) it may not be feasible to define quantitative values. For these, qualitative values can be established. Where possible, these should be equated to or assigned corresponding quantitative values.

For a surveillance system, it is obviously important for safety that the voice or data communications service between pilot and ATC has a level of availability and continuity at least equalling same levels of performance as that assigned to the surveillance system itself. Obviously the two systems should be designed so that no single point of failure can result in both systems simultaneously failing at remote stations where single power source may only be available. Bearer links back to the ATC Centre will normally need to be duplicated on separate bearer circuits in order to achieve the reliability required for surveillance services.

6.6 In the development of the Australian ADS-B surveillance service in low density enroute airspace, the following basic safety and performance requirement for both the ADS-B service and the related voice communication service were established:

Table 1 – Basic Performance Parameters for ADS-B ground system (aircraft component not included)

SERVICE	SERVICE CATEGORY	GROUND SYSTEM OPERATIONAL AVAILABILITY	GROUND SYSTEM RELIABILITY per sector. MTBF (95%confidence level)
Enroute surveillance and voice comms (low density airspace)	Essential	.999	5000 hours

Source: Airservices Australia Ops Requirements Doc v2.0

7 STEP 3 – Develop a Safety Risk management methodology

7.1 An appropriate, recognised methodology for safety risk management, i.e. for hazard identification; risk assessment; risk management, control, and mitigation, of a surveillance system, is required. The methodology may vary depending upon the type and safety implications of the proposed surveillance system, and the use of different methods, or combinations thereof, may be appropriate for the different elements and lifecycle phases included in the safety case.

7.2 Chapters 3 and 4 of the ICAO SMM are recommended as an appropriate methodology for States to adopt. Persons preparing Safety Cases are encouraged to familiarise themselves with the concepts in those two Chapters. The following Steps 4 – 8 inclusive are based on and derived from those Chapters.

8 STEP 4 – Process for Hazard Identification and Analysis

8.1 Surveillance systems for aircraft separation services provide significant safety enhancement compared with procedural systems. However, there are safety consequences that predominantly arise during abnormal conditions or in fault or failure situations. Potential risks arise if related systems for air ground communication fail, or aircraft navigation or transponder avionics lose integrity or fail. Lesser impacts on safety might occur where the integrity of a system is degraded or lost but where there are alternative back-up systems, or contingency arrangements, that can be reverted to in order to maintain separation.

8.2 The process for hazard identification and analysis is set out in section 4.5 of the ICAO SMM, from which some of the information in this section is extracted and summarised.
It is essentially a 3 step process:

a) First: Identify the generic hazard (also known as top level hazard, or TLH). Generic hazard is used as a term that intends to provide focus and perspective on a safety issue, while also helping to simplify the tracking and classification of many individual hazards flowing from the generic hazard.
b) Second: Break down the generic hazard into specific hazards components of the generic hazard. Each specific hazard will likely have a different and unique set of causal factors, thus making each specific hazard different and unique in nature.
c) Third: Link specific hazards to potentially specific operational consequences, i.e. specific events or outcomes of the occurrence of the hazard.
d) Fourth: Document the hazards and its consequence.

8.3 Techniques for hazard identification and analysis for a new surveillance system may include:

a) the use of data or experience with similar systems/changes undertaken by overseas or other
b) respected providers of ATC surveillance services;
c) quantitative modelling based on sufficient data, a validated model of the change, and analyzed assumptions; e.g. RAM modelling.
d) the application and documentation of expert knowledge, experience and objective judgement by specialist staff;
e) trial implementation of a proposed change in an “off-line” system, or under a pre-existing surveillance service, and with sufficient backup facility to revert to the existing system before the change, if risks cannot be mitigated;
f) event tree analysis (ETA);
g) failure modes and effects analysis (FMEA);
h) human factors analysis (HFA);
i) hazard identification workshop with expert personnel (HAZID).

9 STEP 5 – Establish the Safety Risk of each Hazard

9.1 The references for this process is section 5.4 and 5.5 of the ICAO SMM, and Tables 30 and 31 of RTCA DO-303/Eurocae ED-126.

9.2 For each of the identified operational consequences of the identified hazards, the safety risk should be established by assessing the probability of occurrence, and the severity of the consequence or outcome.

9.3 Safety risk probability is defined in the SMM as the likelihood that an unsafe event or condition might occur. Safety risk severity is defined as the possible consequences of an unsafe event or condition.

9.4 Particular attention should be given to hazards that have operational consequences of common mode failure. For example, for an ADS-B surveillance service, failure or drop-out or short term loss of integrity of the GNSS may lead to total or partial loss of ATC surveillance and aircraft navigation. The risk control avenues open to a service provider may identify that a safety requirement is to ensure a means of backup to provide continuity of navigation and surveillance during the loss of GNSS, particularly for a terminal area service. Alternatively procedural mitigation may be implemented. Service providers should identify the most appropriate means or combination of risk controls based on local infrastructure and operational circumstances.

9.5 The following tables have been extracted from the SMM as the criteria for the risk assessment process.

Table 2: Safety Risk Probability Table (source ICAO SMM)

Probability	Meaning	Value
Frequent	Likely to occur many times	5
Occasional	Likely to occur sometimes	4
Remote	Unlikely to occur, but possible	3
Improbable	Very unlikely to occur	2
Extremely improbable	Almost inconceivable that the event will occur	1

Table 3: Safety Risk Severity Table (source ICAO SMM)

Severity of Occurrence	Meaning	Value
Catastrophic	Equipment destroyed Multiple deaths	A
Hazardous		B
Major	A significant reduction in safety margins, physical distress or a workload	C
Minor	Nuisance Operating limitations Use of emergency procedures Minor incident	D
Negligible	Little consequences	E

10 STEP 6 – Establish the Safety Risk Assessment Criteria

10.1 In order to ensure that the range of possible safety risks are appropriately classified and controlled, it is necessary for service providers to establish standard, stand-alone, criteria for safety risk assessment and classification. Such a safety risk classification scheme provides a structure for deriving the safety requirements for any airways system, as well as the criteria for risk control decisions. Typically, such schemes provide a standard relationship between the probability of

occurrence of each risk and the categorised severity of the risk in terms of its potential impact on safety.

10.2 A Safety Case document must include or reference the risk assessment criteria (also termed a Risk Tolerability Classification scheme) adopted by the service provider for system safety management.

10.3 The following two Tables (Table 4 and Table 5) have been extracted from the ICAO SMM for Safety Risk Assessment criteria and Safety Risk Tolerability criteria:

Table 4: Safety Risk Assessment Matrix (source ICAO SMM)

Risk Probability	Risk Severity				
	Catastrophic A	**Hazardous B**	**Major C**	**Minor D**	**Negligible E**
Frequent 5	5A	5B	5C	5D	5E
Occasional 4	4A	4B	4C	4D	4E
Remote 3	3A	3B	3C	3D	3E
Improbable 2		2B	2C	2D	2E
Extremely Improbable 1	1A	1B	1C	1D	1E

Table 5: Safety Risk Tolerability Matrix (source ICAO SMM)

Suggested criteria	Assessment risk index	Suggested criteria
INTOLERABLE	5A, 5B,5C, 4A, 4B, 3A	Unacceptable
TOLERABLE/MITIGATE	5D, 5E, 4C, 4D, 4E, 3B, 3C, 3D, 2A, 2B, 2C	Acceptable based on risk mitigation. May require management decision
ACCEPTABLE	3E, 2D, 2E, 1A, 1B, 1C, 1D, 1E	Acceptable

10.4 A further reference, specifically for a surveillance service is shown in RTCA DO-303/EUROCAE ED-126. Table 30 of that document presents a qualitative Hazard Classification Matrix derived from ED-78A/DO-264 with 5 grades of risk severity. However, the Risk Classification Scheme (RCS) actually used in the Operational Safety Analysis presented in RTCA DO-303/EUROCAE ED-126 at Table 31 is derived from Table 30 and is based on 5 grades of Safety Targets with the Risk Classification per flight hour of each expressed quantitatively. The scheme is repeated in Table 6 below for reference:

Table 6: DO-303 OSA - Risk Classification Scheme for ADS-B Surveillance Service

Safety Targets	Risk per flight-hour	Risk per flight
ST1 Accident	**1e-08**	**1e-08**
ST2 Serious Incident	**1e-05**	**1e-05**
ST3 Major Incident	**1e-04**	**1e-04**
ST4 Significant Incident	**1e-02**	**1e-02**
ST5 No immediate effect on safety	**Not rated**	**Not rated**

11 STEP 7 – Process for Risk Control and Mitigation

11.1 A risk control process to eliminate, control or mitigate all risks categorised as intolerable or unacceptable, at least to a tolerable or acceptable level, must also be defined. Risk controls may vary considerably, and employ any one, or a combination of, the following:

a) system redesign, modification or replacement;
b) process or procedures redesign, particularly procedures by operational personnel;
c) reliability improvement schemes;
d) personnel education and/or training;
e) various management controls on personnel, operational procedures and equipment; and
f) regulatory controls; including aircraft equipage mandates, limitations on entry to airspace by unequipped aircraft; equipage requirements in accordance with ICAO SARPs, etc.

11.2 Any identified risks which cannot be controlled to a tolerable level shall be explicitly included in a section of the Safety Case which includes a full discussion on all relevant aspects of the risk. The rationale for any decision to proceed with the development or operation of the system while the risk prevails is to be stated and justified.

11.3 **Precedence of Risk Controls.** In the application of the above or other risk control processes, a safety precedence sequence should be adopted and applied. For instance, control of identified hazards should normally be sought first through improved system design or equipment changes, followed then by specific operational procedures or training. For some risks, only one type of mitigation process will be feasible, others may need several means of risk control to bring the overall risk into tolerability. Whichever means of control is implemented the control process should demonstrate how the risks are being brought within the acceptable or tolerable areas of the criteria.

12 STEP 8 – Document and track the Hazards and their Risks

12.1 A standard method of documenting and tracking Hazards and Risks should be established.

12.2 Figure 4.2 of Chapter 4 of the ICAO SMM indicates the process involved in hazard/risk documentation.

12.3 The proformae used for the purpose of documenting/tracking Hazards relevant to ADS-B service as used by two States are shown in ICAO Circular 326 at Appendices G1/G2 (Australia) and Appendix G3 (USA).

13 STEP 9 – Safety Case coverage over the lifecycle of the surveillance system

13.1 As previously discussed, Safety Cases should be developed in separate parts to define the safety situation of the system over the discrete stages of its lifecycle. A four part Safety Case has been adopted by some service providers to define the safety situation at the Operational Requirements Definition stage, at the completion of the Design and Procurement phase, at the Implementation stage, and for the routine Operational phase.

13.2 The contents of the Safety Case will differ for each part. For some systems, it may be appropriate to have more or fewer parts of the Safety Case. For all parts, the level of description and detail included should be sufficient to provide a reasonably informed reader with an understanding of the safety situation, without the need to refer extensively to supporting references. A decision on the number of Parts should be made at an early stage of a surveillance project.

13.3 A guide to the coverage of each part of a four part Safety Case is included in Attachment A 'Safety Case Coverage for a Four Part Safety Case'.

14 STEP 10 – Authority for issue and change of the Safety Case

14.1 Safety Cases should be placed under a documentation control process. The Safety Case should be authorised by competent authority designated by the service provider. An authority or authorities covering System Requirements, System Design, System Operation, and System Maintenance should be appointed, and the issue of the parts of the Safety Case should be made under the authorization of one or more of these designated bodies, as appropriate to the content of each part.

PART B: SPECIFIC ELEMENTS FOR INCLUSION IN SAFETY CASE COVERING ADS-B BASED SURVEILLANCE SYSTEMS

Primary references:

ICAO Circular 326, in particular:

Chapter 2: ATC Surveillance
Chapter 3: Assessment of ADS-B and MLAT surveillance
Chapter 4: State Implementation Roadmap
Appendix A: General Description of the Reference Radar
Appendix B: Technical Comparison between MSSR, ADS-B and MLAT
Appendix C: Key ADS-B Performance Requirements to Support the Claim that ADS-B Surveillance "Is As Good As the Reference SSR"
Appendix G1: HAZID and Mitigation (Australia)
Appendix G3: Hazard Analysis Report (US Capstone Program)

RTCA DO-303/EUROCAE ED-126 December 13, 2006 Safety, Performance and Interoperability Requirements Document for the ADS-B Non-Radar Airspace Application

Secondary reference:

ICAO Doc 9689 AN/953 Manual on Airspace Planning, Methodology for the Determination of Separation Minima, First Edition 1998

Introduction

This Part itemises the topics that should specifically be included in a Design and Implementation Safety Case for the introduction of an ADS-B based surveillance system. The information herein is derived from two sources; ICAO Circular 326 and the actual Design Safety Case that was produced by the Australian ANSP to gain the approval of the aviation regulator for the commissioning of the Upper Airspace ADS-B surveillance system. That Safety Case was essentially based on a comparative assessment showing that ADS-B was as good as or better than a Monopulse SSR system when used for the same surveillance purposes in the same airspace by ATC. This comparative assessment approach has been documented by the ICAO SASP in Circular 326 as an appropriate means of assessing the safety of an ADS-B separation service in low complexity airspace.

1 STEP 11 – State Implementation Roadmap

1.1 For this STEP, readers should first acquaint themselves with Chapters 3 and 4 of ICAO Circular 326.

1.2 In Chapter 3 of ICAO Circular 326, the ICAO SASP describes the assessment it undertook of the use of ADS-B to support ATS. The assessment methodology compared ADS-B to a Reference SSR which the SASP defined in terms of its technical performance. The assessment demonstrated that ADS-B surveillance is better or at least no worse than the

Reference SSR, and therefore no less safe than Radar. The SASP concluded that, if a number of ADS-B performance requirements relating to the integrity and accuracy of the received ADS-B transmissions from aircraft and the overall latency and update rates of the system are met, then ADS-B can be used as a means of supporting the provision of a 5NM separation (also 2.5NM and 3NM) minima similar to that used with radar.

1.3 However, in making that conclusion, the SASP noted that its assessment was undertaken based on global assumptions and was for low complexity airspace and for the defined reference radar. In its Conclusions to Chapter 3, for reasons it explains in that Chapter, it noted that there remains the requirement for a region or State to undertake a State or local assessment that demonstrates the intended safety level will be met using ADS-B surveillance. To this end, a 'State implementation roadmap' was provided for the guidance of States.

1.4 Circular 326 provides the references and technical evidence to show that ADS-B is as good as or better than an MSSR when used for a 3NM or 5NM separation service by ATC. It is therefore unnecessary to demonstrate that in a Safety Case covering a State or local surveillance service. A State can make reference to that finding in Circular 326 rather than prove that in a Safety Case. However, it should be noted that the Circular clearly points out that the analysis by the SASP makes assumptions on a generic airspace situation which may not be totally relevant to the airspace situation in any particular State and that State and/or local level assessments should be undertaken where there is any difference between the Sate's conditions and those in the assumptions made in the Circular, for example, in complex airspace. (Refer to Sections 4.12 and 4.14 of Circular 326.) Further, there always remains the requirement to undertake State or local level hazard identification and risk analysis of all hazards. For that purpose, the further value of Circular 326 as guidance material for ADS-B Safety Case preparation is that it provides a Compendium of Hazards and Mitigation Measures which has been extracted from several site-specific ADS-B Safety Cases of ADS-B trials and implementation undertaken in two States (USA and Australia). Further there are those identified by EUROCAE in the Annexes to ED-126. Those hazard compendiums will be of value as a reference to those States embarking on safety assessment of their own ADS-B programs.

1.5 The State Implementation Roadmap in Circular 326 comprises four distinct processes. These are:

a) Process A - Definition of Airspace Concept
b) Process B - Identification of ADS-B Performance Requirements
c) Process C – Safety Assessment
d) Process D – Preparation for Implementation

Those Processes imply that a four part Safety Case may best be adopted for those phases of system development. General guidance on the undertaking of all four Processes is given in Chapter 4 of Circular 326. It is recommended that authors of Safety Case documents for ADS-B surveillance should familiarize themselves with the Processes.

1.6 **ADS-B System Design - Performance standards**. In Appendix C to Circular 326 the ICAO SASP identifies the key ADS-B performance requirements for an ADS-B system to enable use of a 3NM or 5NM separation minimum in the provision of ATC. ADS-B 3NM and 5 NM separation services could be delivered when ADS-B data quality indicators meet the requirements in that Appendix. The Safety Case should therefore include the minimum values of quality indicators (in terms of NUC; NIC and NAC) of an aircraft ADS-B transmission before aircraft targets are displayed on ATC screens.

2 STEP 12 – Safety Case for ADS-B NRA

2.1 **RTCA DO-303/EUROCAE ED-126**. Extensive guidance material to assist in preparation of a Design Safety Case on the ADS-B NRA Application is contained in RTCA DO-303/EUROCAE ED-126. That document is a virtual Safety Case and the publication can be used as a reference alongside ICAO Circular 326. The complete document is relevant although the **Operational Safety Assessment** at Annex C has most relevance. Annex C contains the following Steps:

a) Hazard Classification Matrix as per DO-264/ED-78A (Table 30)
b) Safety Targets and Risk Classification Scheme (Table 31)
c) Operational Hazards Identification by Expert Analysis (Table 33)
d) Allocation of Safety Objectives (the maximum frequency or probability at which an operational hazard can be tolerated to occur) and the Safety Requirements for Operational Hazard mitigation.

3 STEP 13 – Safety Case Contents

3.1 **Contents of the Safety Case**. Guidance material on the **contents** (i.e. the topic headings, with a brief description of each topic that may be included under each heading) for inclusion in an ADS-B Design Implementation Safety Case is at Attachment B . This topic listing has been derived by reference to the Safety Case for the ADS-B Upper Airspace Program (UAP) prepared in Australia by the ANSP. (That particular Safety Case was the basis of the regulatory approval by CASA of the now implemented ADS-B UAP of Airservices Australia.)

ATTACHMENT A

Safety Case Coverage for a Four Part Safety Case

The following is a guide to the structure of a four part Safety Case over the life of an airways system.

Safety Case Part 1 - Operational Requirements Phase
A Safety Case Part 1 contains the Safety Objectives and the corresponding Safety Requirements for the proposed system, and will normally be the initial document provided to advise the proposed project's existence and its safety significance. The Safety Case at this stage should be an evaluation of the proposed system, perhaps most appropriately carried out by means of a Preliminary System Safety Assessment (PSSA), supplemented as necessary by overseas or previous experience, and in-house expertise and knowledge of deficiencies in existing systems which the new system is to replace.

Safety Case Part 2 - Design and Procurement Phase
Part 2 of the Safety Case is essentially to assure that the design of the system supports and provides for the safety requirements. Arguments to support the design rationale and the proposed technology of the system, and to verify and validate that such satisfies the safety requirements will be provided. The human factors aspects of the design, and the safety implications of the design of the procedures, and the ability of personnel to safely operate to the design procedures, should also be considered. Here, a full hazard and risk evaluation of the detailed design, including hardware, software, man/machine interface, human factors, equipment and administrative interfaces and external factors, should be undertaken.

Safety Case Part 3 – Implementation Phase
Part 3 of the Safety Case will provide an analysis of the safety situation following its installation and integration. The functional testing to be carried out for installation and pre-commissioning evaluation of the safety situation is detailed in this part. A testing regime aimed at validating the risk assessment made in Part 2 of the Safety Case, and identifying safety hazards not previously identified at Part 2 which arise during testing and integration and related activities, should be defined , with the strategy for assessing and managing these hazards and the safety issues which arise from such testing also specified.

Safety Case Part 4 - Normal Operations Phase
Part 4 of the Safety Case will provide the evidence that the system is safe in operational service. It will address all relevant operational and management issues, and will take account of the safety findings from the preceding three parts of the Safety Case. This part of the Safety Case is maintained as a living document for the life of the system, to define and document any further hazards, identified at post-commissioning or during routine operations, and the risk control actions taken to maintain compliance with safety objectives, in the light of actual day-to-day knowledge and experience with the system.

Note in respect to all Parts
It is important that all parts of the Safety Case be retained and maintained as necessary over the life of the system, reflecting the safety situation for any approved modifications or changes to the system.

ATTACHMENT B

Sample Headings and Content for ADS-B Design and Implementation Safety Case

No.	Heading	Brief Description of Content
1	Title	State the Title of the Safety Case. E.G. ADS-B Upper Airspace Program – Implementation Phase Safety Case
2	Purpose/Background/Operational Requirement	State the background to the development of the system. State the previous trials leading up to the implementation of the surveillance system. State the operational requirement of the system; the scope of the system and the scope of the safety case.
3	Scope	Define the scope of the system covered by the Safety Case. Operational staff impact. Technical staff impact. Changes to voice comms system. System coverage, engineering and operational standards adopted. Include coverage and location of ground station infrastructure, ground station design, bearer link network design, changes to ATM facilities at Area Centres. System transition management. Relativity to other programs. Existing system upgrade requirements. Development of new ATC procedures. Regulatory approval requirements/plans.
4	System Overview and Description	Overall system description/diagram. Ground Stations locations. Site Monitor. Terrestrial and satellite bearer links to ATC Centres. ATC System Processors. ATC Display. Remote Control and Monitoring System. RAIM prediction system. Power supply system(s). Provide schematic diagram of overall system including third party provided services and data-links
5	VHF Communication System	Overall voice comms system description/performance standards/overview/ bearers/third party provided services.
6	New ATC Procedures and Staff Training plan	Define existing separation standards and the intended new separation standard(s). Define ATC staff training required for ‘radar-like service’.
7	Logistics support	Define all aspects of the ILS plan including hardware and software maintenance, spares support plan,
8	Safety Requirements	Establish the safety standards and requirements in terms of system performance parameters (RAM).
9	Assumptions, Constraints and Dependencies	Comparison with radar for 5NM separation service. Proposed aircraft operational accuracy (NAC) and integrity (HPL) standards. State dependencies with related projects (voice, data bearers, aircraft equipage requirements, ATC system upgrades, etc)
10	Responsibilities	Establish the relevant staff responsibilities for the project implementation and safety management. Include all specialist and management personnel and responsibilities
11	Consultation and Communication	State the external consultation undertaken with stakeholders including any issues in relation to safety considerations. Provide references to documentation of

No.	Heading	Brief Description of Content
		consultation outcomes.
12	Design Process	Define the design process undertaken in system development. Define the design test plan/procedures and the outcome of design reviews.
13	Design Safety Risk Management	Describe the processes undertaken for Safety Risk Management at the design phase. Include reference to design HAZID and HAZLOG reviews undertaken. Establish the current status of all hazards identified in the design phase
14	Design Limitations and Shortcomings	Itemize all design phase deficiencies remaining (major and minor) and their safety status and impact
15	Implementation Process	Establish engineering transition plan. Establish operational transition plan. Establish contingency plan for reversion to existing system.
16	Status of Safety Controls and Safety Requirements	State the status of all safety controls and requirements. All outstanding Hazards and all safety requirements not satisfied to be subject to individual documentation
17	Engineering Support and Engineering System Maintenance	Describe the means of future engineering support – internally and externally to the organisation as applicable. Provide references to documented system maintenance procedures.
18	Criteria for Maintenance Technician certification	Establish the technician competency requirements for system monitoring, operation and maintenance.
19	Safety Performance Monitoring	Describe or reference the process for monitoring and management of safety performance after implementation of the system.
20	ATC Staff Training and Education Plan	Establish the ATC staff training plan and comprehensive training package.
21	Pilot Information Package	Provide reference to the Pilot Information and the dissemination of the package.
22	SystemTransition Plan	
23	RAM End-to-End System Analysis	Undertake Reliability, Availability, Maintainability analysis of the end-to-end system. (Use manufacturer provided RAM data or field data if available.) Compare results with established design standards/requirements.
24	System Test Procedure	Describe generally and provide reference to the detailed System Test Plan.
25	System Test Results	State the outcome of the system tests undertaken
26	**Define the System Safety Risk Management plan**	**Provide documentation of the safety risk management plan**
27	**Define Risk Management Process used for the Safety Case**	**Risk Management Process to be defined or referenced. Include process for Hazard Identification, Risk Assessment, Risk Classification, and Risk Control processes.**
28	**HAZID**	**Provide the record of all HAZID activities undertaken**
29	**Status of Hazards (HAZLOG)**	**Provide documentation of the status of all Hazards.**
30	**List all Hazards not controlled to tolerable level**	**List all Hazards not controlled to tolerable level, the reasons and justification.**

No.	Heading	Brief Description of Content
31	Post implementation review plan	Establish the plan, timing and procedures for post implementation review of the performance and safety of the system.
32	Related documentation	Include listing of references to all related or referenced documents

EDITION 2

**SAMPLE LETTER OF AGREEMENT
ON AUTOMATIC DEPENDENT SURVEILLANCE BROADCAST (ADS-B)
COLLABORATION BETWEEN
[PARTY 1]
AND
[PARTY 2]**

This Agreement is made on the [ ] day of [ ] 2011

BETWEEN

The [Party 1] of [Address], hereinafter referred to as "[.]",

And

The [Party 2] of [Address], hereinafter referred to as "[.]";

(each individually referred to as a "Party" and collectively as the "Parties").

WHEREAS

(A) Automatic Dependent Surveillance – Broadcast ("ADS-B") is a new surveillance technology that will enhance safety and efficiency of air traffic services provision, complementing the role of radars used by air navigation service providers currently;

(B) The Asia Pacific Air Navigation Planning and Implementation Regional Group ("APANPIRG"), recognising the benefits of ADS-B, has established the ADS-B Implementation Task Force under the auspices of the International Civil Aviation Organisation to progressively implement ADS-B in the Asia-Pacific region;

(C) It is the expressed desire of airlines, through representation by the International Air Transport Association, to reap operational benefits arising from the use of ADS-B surveillance by air navigation service providers in the separation of air traffic;

(D) In line with the global thrust towards seamless air traffic services including over oceanic airspaces, the Civil Air Navigation Services Organisation has voiced support for collaboration between air navigation services providers on sharing of ADS-B surveillance data and VHF communications facilities and services, in order to reap the full capabilities of advanced technology in the most cost-effective manner;

(E) The Parties are desirous of collaboration to enhance air traffic services in the South East Asia region by mutual sharing of the ADS-B surveillance data and to facilitate direct controller-pilot communications by availing communication facilities to each other (hereinafter referred to as "ADS-B Collaboration");

(F) The Parties have agreed to enter into this Agreement to govern their rights and obligations, to regulate their relationship with each other as Provider and User (defined below) of the ADS-B data and to reap the full potential of ADS-B for the benefit of airlines.

IT IS HEREBY AGREED as follows:

ARTICLE 1 – Definitions and Interpretations

1.1 For the purpose of this Agreement, the following definitions shall apply:

(a) "ADS-B" or "ADS-B OUT" means a function on an aircraft or vehicle that periodically broadcasts its state vector (position and velocity) and other information derived from on-board systems in a format suitable for ADS-B IN capable receivers.

(b) "ADS-B IN" means a function that receives surveillance data from ADS-B OUT data sources.

(c) "ADS-B data" means information regarding aircraft position, altitude and status received from aircraft or other information generated from the ADS-B Ground Stations that receive the information from the aircraft.

(d) "ADS-B Ground Station" means a duplicated ADS-B ground station comprising receivers and communications interfaces.

(e) "ADS-B Filtering System" means the system to process the ADS-B data from the ADS-B ground stations or from other ADS-B sources before the data are sent to the Users. It includes the data fusion equipment, filtering equipment and routers.

(f) Air Traffic Services ("ATS") includes flight information service, alerting service, air traffic advisory service, air traffic control ("ATC") service (area control service, approach control service and aerodrome control service).

(g) All Purpose Structured Eurocontrol Radar Information Exchange ("Asterix") means Eurocontrol standard format for data message exchange.

(h) "Direct Controller-Pilot Communication" ("DCPC") means VHF communications, or other approved communication media in future, which is the required means for communications in order to achieve radar-like separation.

(i) "Private Circuit" means dedicated communication links between equipment sites, including those between the Provider's and the User's premises.

(j) "Provider" means the respective party providing the ADS-B data, DCPC facilities or other services required for ADS-B Collaboration as stated in **Annex A.**

(k) "Premises" of each Party means the building or land belonging to the Party, or to the Party who has possession and control over the building or land, as the case may be.

(l) "User" means the respective party receiving the ADS-B data, using DCPC facilities or other services required for ADS-B Collaboration as stated in **Annex A**.

(m) Very High Frequency ("VHF") means the radio frequency band from 30MHz to 300MHz.

(n) "VHF Station" means a duplicated VHF ground station comprising transmitters, receivers and communications interfaces.

1.2 Unless the context or the provisions of this Agreement otherwise require:

(a) words importing the singular number include the plural number, and vice versa;

(b) references to the neuter gender include the masculine and feminine genders, and vice versa;

(c) words denoting one gender include all other genders;

(d) references to Articles and Annexes are references to Articles and Annexes of this Agreement; and

(e) the headings to the Articles hereof shall not be deemed to be a part thereof nor shall they be taken in consideration in the interpretation or construction of this Agreement.

ARTICLE 2 – Objective of the Agreement

2.1 The objective of this Agreement is to improve safety and operational efficiency in the Parties' respective provision of air traffic services for civil air traffic flow in the Parties' respective flight information regions by providing and enhancing ADS-B coverage, ADS-B data availability and DCPC facilities in these regions and where applicable, the areas including and up to 150 nautical miles from the boundaries of these flight information regions.

2.2 To achieve the objective specified in **Article 2.1**, the Parties shall provide their respective ADS-B data, DCPC facilities and other services required for ADS-B Collaboration in accordance with **Annex A** and according to the Implementation Schedule in **Annex B** and the Technical Scope of Works in **Annex C**.

2.3 The ADS-B data is to be provided for the technical and operational purposes specified in **Article 7.1**, including but not limited to:

(a) ATC situational awareness;

(b) ATC safety nets;
(c) Support of procedural separation procedures; and
(d) Updating flight plans

ARTICLE 3 – Provision of Equipment and Private Circuits

3.1 The Provider and the User shall be responsible for the provision, installation and commissioning of all equipment and private circuits required for the provision of ADS-B data, DCPC facilities and other services required for ADS-B Collaboration under this Agreement at their respective premises, unless otherwise stated in **Annex C**.

3.2 The technical requirement of the required equipment and private circuits are stated in **Annex C**.

3.3 The Provider and the User shall collaborate to test the above-mentioned equipment and private circuits to support ADS-B Collaboration before operational use.

ARTICLE 4 – Operations and Maintenance

4.1 The Provider and the User shall perform the routine maintenance, repair and replacement services of the equipment and the private circuits installed for the provision of ADS-B data, DCPC facilities and other services required for ADS-B Collaboration under this Agreement at their respective premises, unless otherwise stated in **Annex C**. The required standards of such maintenance, repair and replacement services shall be applied by the respective parties performing such services in a manner to keep the equipment and the private circuits in good working condition and fit for its purposes.

4.2 Where reasonably practicable, the Provider shall give the User a minimum of [.] days' notice in respect of any planned periodic break and a minimum of [.] hours' notice for any other planned non-periodic breaks in service.

4.3 The Provider shall report immediately or at the earliest opportunity any failure in the provision of the ADS-B data, DCPC facilities and other services required for ADS-B Collaboration, or any abnormality in the ADS-B data, DCPC facilities and other services required for ADS-B Collaboration, to the User's technical supervisor centre, as listed in **Annex C**.

4.4 The User shall monitor the ADS-B data, DCPC facilities and other services required for ADS-B Collaboration from the Provider and report immediately or at the earliest opportunity any failure in the reception or any abnormality of the ADS-B data, DCPC facilities or other services required for ADS-B Collaboration, to the Provider's technical supervisor centre, as listed in **Annex C**.

4.5 The User will engage a maintenance agent for the routine maintenance, repair and replacement services of the DCPC facilities and other services required for provision of DCPC facilities.

ARTICLE 5 – Modifications

5.1 From time to time, the equipment, private circuits and facilities provided by the Parties may need to be modified to meet new requirements., in such situations, the Provider and the User shall be responsible, upon agreement being reached pursuant to this Article, to implement such modifications on the equipment and private circuits provided by them respectively, within the agreed timeframe. The apportionment of the modification costs is specified in **Annex D**.

5.2 Any proposal for such modification shall allow at least [.] or any agreed period between agreement of the modification and the date that the modification is proposed to become effective.

5.3 The Provider and the User shall collaborate to test the equipment, private circuits and facilities affected by such modification before operational use.

5.4 No modification to a Party's equipment, private circuits or facilities shall be effected without the express agreement in writing of the other Party if the modification will require the latter to also modify any of its equipment, private circuits or facilities.

ARTICLE 6 – Cost

6.1 The cost apportionment for the use of ADS-B data, DCPC facilities and other services required for ADS-B Collaboration including maintenance costs is specified in **Annex D**.

ARTICLE 7 – Limitations on Use and Communication of ADS-B Data

7.1 The User shall use the ADS-B data provided to ensure the safe, efficient and regular provision of civil air traffic services and activities in support of his civil air traffic services and for investigation or technical demonstration, evaluation, and test purposes. The User shall not, at all times, use such data for any other purpose, nor communicate to any party not specified in this Agreement in any manner or form whatsoever any data supplied pursuant to this Agreement, without the prior written consent of the Provider.

ARTICLE 8 – Liability

8.1 [To be mutually agreed between the Parties]

ARTICLE 9 – Force Majeure

9.1 A Provider shall not be in breach of this Agreement if any failure to perform its duties or to provide the ADS-B data, DCPC facilities and other services required under the ADS-B Collaboration, arises from or is caused by any event or circumstance which is beyond its control and which constitutes force majeure. Such Provider shall promptly inform the User and take all reasonable steps (under the circumstances) to minimise the disruption and to resume normal operations as quickly as possible.

ARTICLE 10– Settlement of Disputes

10.1 [To be mutually agreed between the Parties]

ARTICLE 11 – Final Provisions

11.1 It is understood that nothing in this Agreement shall prejudice or detract from the primary obligation of the Parties whether under domestic law or applicable international law, to ensure the safe, efficient and regular provision of civil air traffic services for the areas within their respective areas of responsibility.

ARTICLE 12 – Duration

12.1 This Agreement shall enter into force on _____ for a contract period of **[.]** years.

12.2 This Agreement shall automatically be extended for a further contract period of [.] years upon expiry of each contract period unless either Party has givenwritten notice to the other of its intention to terminate at least [.] months before the date of expiry of each contract period.

12.3 in the event the provision of any ADS-B data as specified in **Annex A** hereof is to be permanently withdrawn from service, the Provider shall give the User not less than [.] year notice in writing in advance thereof.

ARTICLE 13 – Entire Agreement

13.1 This Agreement (including the Annexes hereto) constitutes the entire agreement between the Parties in relation to its subject matter and supercedes all prior or contemporaneous agreements and understandings whether oral or written with respect to that subject matter.

ARTICLE 14 – Amendment

14.1 This Agreement shall not be amended, modified or supplemented by the Parties in any manner, except by an instrument in writing signed on behalf of each of the Parties by a duly authorized officer or representative.

ARTICLE 15 – Rights of Third Parties

15.1 For the avoidance of doubt, the Parties agree and acknowledge that no person who is not a party to this Agreement may enforce any term of this Agreement in his own right, in particular and to the extent legally possible, the Parties specifically exclude the application of any law in [State of party1], [State of party2] or elsewhere which provides that any third party has the right to enforce this Agreement.

In witness whereof, the parties having been duly authorized, have entered into this Agreement on the day and year first above written.

Signed for and on behalf of [Party 1]	Signed for and on behalf of [Party 2]
[Name and title of authorised signatory]	[Name and title of authorised signatory]

ANNEX A

PROVIDERS AND USERS OF ADS-B AND DCPC FACILITIES

1 In this Agreement, the Providers and Users are as specified below:

(a) [Facility 1]

Provider: [.]
User: [.]

(b) [Facility 2]

Provider: [.]
User: [.]

(c) [Facility 3]

Provider: [.]
User: [.]

2 Each Provider authorizes the User to communicate the Provider's ADS-B data to the maintenance agents appointed by the User for the purposes of maintenance and management of ADS-B equipment.

ANNEX B

IMPLEMENTATION SCHEDULE

[To include time line for various facilities]

ANNEX C

TECHNICAL SCOPE OF WORKS

1 Equipment, Facilities And Services To Be Provided By Each Party

1.1 ADS-B Stations

[Description of equipment to be provided by each party]

1.2 ADS-B Filtering System

[Description of equipment to be provided by each party]

1.3 DCPC Facilities (VHF Radio Voice Communication Station)

[Description of equipment to be provided by each party]

1.4 Private Circuits between States

[Description of equipment to be provided by each party]

2 ADS-B Data Sharing Interface Specification

2.1 Data Elements

2.1.1 ADS-B messages will comprise the data elements defined in Eurocontrol Asterix Category 21 version 0.23.

2.1.2 ADS-B Data received from each aircraft will be transmitted from each ADS-B station to the User(s) at an update rate of 1second.

2.1.3 The Asterix Category 21 version 0.23 standard allows packaging of multiple ADS-B records into a single data block, or alternatively to place a single ADS-B record per data block. Record packaging should be performed to the extent possible to minimise communication bandwidth requirements without delaying transmission of any given record.

2.1.4 The ADS-B stations and routers / processors shall not alter the contents of the data elements.

2.2 Message Description

2.2.1 The message format will be in accordance with Asterix Cat 21 version 0.23.

2.3 Communication Protocol

2.3.1 The network layer is to be implemented using the Internet Protocol (IP). The network shall support Internet Group Management Protocol (IGMP) level 0, 1 and 2 as defined in RFC3300.

Note: IGMP level 1 supports transmission of Multicast datagrams, level 2 supports transmission and reception of multicast datagrams, while level 0 corresponds to IP unicast.

2.3.2 For Asterix messages, the Network Layer will use the IP for the delivery of packets. An addressing scheme, as agreed, shall be used. Multicast shall be used.

2.4 Physical Aspects

2.4.1 The communication media will be VSAT data-link communications links and submarine cables. The bandwidth of the media shall be as follows:

[Description of communication media]

3 DCPC Facilities– VHF Radio Voice Communication interface

3.1 Communication Protocol

[Description of communication protocol]

3.2 Physical Aspects

[Description of communication media]

4 Maintenance

4.1 [Description of maintenance requirement]

5 Functional Performance Requirement

5.1 General Performance Requirements

5.1.1 The ADS-B data and DCPC facilities together with the systems and equipment that provide such data and DCPC will meet and comply with the relevant international standards and best practices for applying radar-like separation using ADS-B, or radar if such standards have not been defined for ADS-B.

5.2 Specific Performance Requirements

5.2.1 Unless otherwise stated, the ADS-B stations, ADS-B routers and DCPC facilities will be duplicated with no common point of failure.

5.2.2 The following standard will be met:

Aircraft Updates	1 second update rate
Network Latency	95%: < 2 seconds of ground-station output (from ADS-B ground station to input of the User)
Reliability 1	2 autonomous ground-stations including antennae, each providing data with no common point of failure
Reliability 2 - MTBF	Each ground-station including antenna to have MTBF >10,000 hrs
Reliability – Communications Infrastructure	Completely duplicated, no common point of failure
Reliability – Total ADS-B Service	Total Service MTBF > 50,000 hrs
Availability – Total ADS-B Service	Total Service Availability > 0.999
Integrity – Ground Station	Ground Station shall be checked by Site monitor and monitored by RCMS
Integrity – Data Communications & Processing	All systems up to ATM system, errors < 1 x 10E-6

5.2.3 The following standard for DCPC facilities will be met:

Type	System Monthly Availability Minimum Requirement
VHF Base Stations (Per Frequency)	[State required availability]

5.3 Filtering and Message Modification

5.3.1 The ADS-B data from aircraft is collected and formed into Asterix messages in accordance with the technical specification of the ground station. The content of the Asterix messages should not be removed or modified unless technically required.

6 Location and Contact Number of the Technical Supervisor Centres of Each Party

6.1 All routine co-ordination and fault reporting of the equipment, facilities or services provided by a Party will be addressed to the following technical supervisor centre at the Party's premises:

(a) Technical Supervisor Centre at [Party 1]'s premises:

[Contact details]

(b) Technical Supervisor Centre at [Party 2]'s premises:

[Contact details]

ANNEX D

COST

1 General

1.1 The costs to be borne by the Parties will be on a mutually-agreed basis between the Parties.

1.2 The costs will include equipment costs, installation and testing costs, maintenance and operating costs, private circuit or equipment lease costs, cost of performance reporting, administration costs and costs of relevant taxes including but not limited to goods and services tax and costs of relevant services including but not limited to consultancy services.

2 Costs for Provision of equipment, facilities and services

2.1 Unless otherwise specified in this Annex, each Party will pay for his own costs including all the capital and recurrent costs of the equipment, private circuits, facilities and associated services provided by him as specified in **Annex C**.

2.2 Costs of [Facility 1]

[Description on how cost of Facility 1 will be shared]

2.3 Costs of [Facility 2]

[Description on how cost of Facility 2 will be shared]

2.4 Costs of [Facility 3]

[Description on how cost of Facility 3 will be shared]

3 Technical and operational support costs

3.1 [Description on how technical and operational support costs will be shared]

4 Termination costs

4.1 [Description on how cost due to termination will be shared]

5 Modification costs

5.1 Unless otherwise agreed between the Parties, in the event of modification pursuance to **Article 5** of this Agreement, each Party will bear the modification costs of the equipment, private circuits, facilities and associated services provided by him as specified in **Annex C**.

6 Facilities Fees

6.1 [Description on fees for facilities, if any]

ANNEX E

CORRESPONDENCE

1. The correspondence between the Parties shall be posted and faxed or emailed to the addresses and attention it to the person indicated below:

To [Party 1]:
[Contact details]

To [Party 2]:
[Contact details]

2 Any Party may from time to time, by written notice to the other Party, designate a different person, facsimile or email to whom the correspondences, notices or communications must be attention to.

AMMENDMENT TO AIGD

5.9.2 ADS-B Flight Planning Requirements (Before transition to new DOC4444 format in 2012)

Until the new ICAO flight plan, which incorporates ADSB designators, is in use in 2012, the following shall apply:

5.9.2.1 Flight Notification

A remark shall be entered in section 18 of the fight plan to indicate that the flight is capable of transmitting ADS-B messages via the Mode S Extended Squitter data link. The format of the remark should be:
RMK/ADSB

Note: Only flights with ADS-C capability should use the surveillance equipment indicator"D"and only flights with CPDLC capability should use the equipment indicator "J".

5.9.2.2 Aircraft Address (24 Bit Code)

Where required, the aircraft address (in hexadecimal format) may be recorded in section 18 of the ICAO flight plan as per the following example:
CODE/7C432B
States should note that use of hexadecimal code may be prone to human error and is less flexible in regard to airframe changes for a notified flight.

5.9.3 ADS-B Flight Planning Requirements (After transition to new DOC4444 format in 2012)

After transition to the new flight plan format in 2012, the following shall apply:

5.9.3.1 Flight Notification

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

For information, these include:

B1 ADS-B with dedicated 1090 MHz ADS-B "out" capability
B2 ADS-B with dedicated 1090 MHz ADS-B "out" and "in" capability
U1 ADS-B "out" capability using UAT
U2 ADS-B "out" and "in" capability using UAT
V1 ADS-B "out" capability using VDL Mode 4
V2 ADS-B "out" and "in" capability using VDL Mode 4

5.9.3.2 Aircraft Address (24 Bit Code)

Where required, the aircraft address (in hexadecimal format) may be recorded in section 18 of the ICAO flight plan as per the following example:
CODE/7C432B
States should note that use of hexadecimal code may be prone to human error and is less flexible in regard to airframe changes for a notified flight.

5.9.3.3 SSR Mode S

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

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

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

– – – – – – – – – – – – – –

ADDITION TO AIGD SECTION 9

SECTION 9 : RELIABILITY & AVAILABILITY CONSIDERATIONS

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

9.1 Reliability

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

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

9.1.3 In general, reliability is determined by design (see para 9.3 B below)

9.2 Availability

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

9.2.2 Poor availability usually results in loss of economic benefit because efficiencies are not available when the ATC system is operating in a degraded mode (eg using procedural control instead of say 5 NM separation).

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

9.2.4 Availability is calculated as

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

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

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

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

9.3 Recommendations for high reliability/availability ADS-B systems

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

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

B: **Logistics strategy** aims to keep MDT very low. Typical strategies are :

- Establish availability and reliability objectives that are agreed organisation wide. In particular agree System response times (SRT) for faults and system failure to ensure that MDT is achieved. An agreed SRT can help organisations to decide on the required logistics strategy including number, location and skills of staff to support the system.
- Having appropriate maintenance support contracts in place so that faulty modules are repaired within contractually defined times – preferably with contractual

incentives/penalties for compliance. Such support contracts are best negotiated as part of the acquisition contract when competition between vendors is at play to keep costs down. Sometimes it is appropriate to demand that the support contractor also keep a certain level of buffer stock of spares "in country".

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

- Establish baseline preventative maintenance regimes including procedures and performance inspections in conjunction with manufacturer recommendations for all subsystems
- Use remote control & monitoring systems to identify faulty modules before travel to site. This can avoid multiple trips to site and reduce the repair time
- Have handbooks, procedures, tools available at the site or a nearby depot so that travel time does not adversely affect down time
- Have adequate spares and test equipment ready at a maintenance depot near the site or at the site itself. Vendors can be required to perform analysis of the number of spares required to achieve low probability of spare "stock out"
- Have appropriate plans to cope with system and component obsolescence. It is possible to contractually require suppliers to regularly report on the ability to support the system and supply components.
- Have ongoing training programs and competency testing to ensure that staff are able to perform the required role

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

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

- Having clear organizational & individual responsibilities and accountabilities for system configuration.
- Having clear procedures in place which define who has authority to change configuration and records of the changes made including, inter alia
  - The nature of the change including the reason
  - Impact of the change & safety assessment
  - An appropriate transition or cutover plan
  - Who approved the change
  - When the change was authorized and when the change was implemented

- Having appropriate test and analysis capabilities to confirm that new configurations are acceptable before operational deployment.
- Having appropriate methods to deploy the approved configuration (Logistics of configuration distribution). Suggested methods;
  - Approved configuration published on intranet web pages
  - Approved configuration distributed on approved media

D: <u>Training & Competency plans</u> aim to ensure that staff have the skills to safety repairs Normally this is achieved by :

- Conduct of appropriate Training Needs Analysis (TNA) to identify the gap between trainee skill/knowledge and the required skill/knowledge.
- Development and delivery of appropriate training to maintainers
- Competency based testing of trainees
- Ongoing refresher training to ensure that skills are maintained even when fault rates are low

E: <u>Data collection & Review</u> :

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

- Reports of actual achieved availability & reliability
- Data regarding system failures including “down time” needs to be captured and analysed so the ANSP actually knows what is being (or not being) achieved.
- Any failure trends that need to be assessed. This requires data capture of the root cause of failures
- Any environmental impacts on system performance, such coverage obstructions such as trees, planned building developments, corrosion, RFI etc. Changes in infrastructure may also be relevant including airconditioning (temperature/humidity etc) and power system changes.
- System problem reports especially those that relate to software deficiencies (design)
- System and component obsolescence
- Staff skills and need for refresher training

– – – – – – – – – – – –

STATUS OF EQUIPAGE REQUIREMENTS FOR A DEFINED AIRSPACE

State	Intention to publish Mandate	Target date	Planned effective date	Confirm implementation in accord with APANPIRG guidance	Comments
Australia	Published	2009	Dec 2013 at above Fl290	Yes	
	Possible	Late 2011	2015 above FL100 (500Nm Perth)	Yes	
	Possible	Late 2011	2017 above FL100	Yes	
China	Yes	2011-2012	Dec 2013 for L642 & M771 only	Yes	
Hong Kong China	Yes	Airworthiness notice in Nov 2010 AIC planned to be published by 3rd Qtr 2011	Dec 2013 for L642 & M771 only)	Yes	
Macao, China					Not applicable since Macao China has no FIR. However, local operators have been kept informed of ADS-B Implementation plan in SEA
Fiji	Yes	2011	Dec 2013	Yes	
New Caledonia	Yes	TBD	TBD	Yes	
India	Yes	TBD	TBD	Yes	
Nepal	Yes	TBD	TBD	Yes	
Malaysia	Yes	2018	2020	Yes	
Viet Nam	Yes	TBD	TBD		ATS routes not defined
Sri Lanka	Yes	TBD	TBD		
Thailand	TBD	TBD	TBD		
Philippines	TBD	TBD	TBD		
Singapore	Yes	AIC 28/12/2010	12/12/2013	Yes	Portions of WSJC FIR
Papua New Guinea	Yes	31/12/2011	31/12/2014		Upper airspace enroute
Indonesia	Yes	TBD	TBD		Upper airspace enroute

OUTCOME OF DISCUSSIONS BY AD HOC WORKING GROUPS

REPORT OF THE REGULATORY AUTHORITY Ad Hoc WORKING GROUP

Group discussed ADS-B Ground Station design standards – Reliability and Availability. "Certification" requirements to be adopted as 'design standards' by Regulators/ANSPs for surveillance and corresponding voice communication services.

WG also recalled that ADS-B/voice comms ground standards for ADS-B were included in a previous WP delivered in Seoul meeting of ADS-B SITF and endorsed by APANPIRG/18 September 2007.

Basic standards adopted by AsA and accepted by CASA for the Australian ADS-B system were as quoted in WP10 of the ADS-B SITF/10 Meeting:

Basic Performance Parameters for ADS-B ground system per ATC sector (aircraft component not included)

SERVICE	SERVICE CATEGORY	GROUND SYSTEM OPERATIONAL AVAILABILITY	GROUND SYSTEM RELIABILITY per sector. MTBF (95%confidence level)
Enroute surveillance and voice comms (low density airspace)	Essential	.999	5000 hours

Source: Airservices Australia Ops Requirements Doc. V2.0

WG reviewed WP /9 which discussed the need for a cooperative approach among APAC State Regulators in aircraft equipage and crew competency approvals. The WG agreed on the following report to the Meeting:

At the ICAO APAC ADS-B SITF/9 Meeting held in Jakarta in August last year it was agreed that individual aircraft operational approvals for ADS-B equipage and crew capability should follow the established procedures (e.g. Ops Specs) for other operational approvals such as RVSM and PBN. In addition it was decided under Conclusion 9/5 of SITF/9 that the State of Registry is responsible to undertake the operational and airworthiness approval of their aircraft to receive ADS-B services in any country. This was subsequently endorsed by APANPIRG.

In consideration of that Conclusion, Regulatory Authorities agreed that they have a responsibility to approve aircraft of their State to receive ADS-B based separation services provided by any APAC ANSP. This effectively means that Regulators need to inform their airlines and aircraft operators of their obligation to gain such approvals.

WG noted that the State Regulators outside the ICAO APAC Region States will also need to be informed of these requirements and process and the resources of ICAO APAC Office are requested in that regard.

Australia noted that in relation to aircraft approvals for receipt of Australian ADS-B service, that action has already occurred with several regulators of APAC States and Australia acknowledged the cooperation of those States in already providing prior ADS-B approvals. Australia also appreciated that some States at this time may not have experience in ADS-B equipage approvals and in that situation Australia on request will be pleased to provide advice on equipage

combinations that have been found to be in compliance based on the experience and approvals made over previous years.

Action on aircraft not complying with ADS-B mandates

Several States are establishing mandates for the carriage of serviceable ADS-B equipment for flight in specified airspace from the date of 12 December 2013.

The ANSP's ATC system will have to assume that all aircraft have the approval of their relevant State regulators to receive an ADS-B service. Other than possibly (but not definitively) by entry in the flight plan of equipage status, the ATC system will not necessarily know whether aircraft have been previously approved or not by their regulator.

It was noted that, after the date of any mandate, Regulators will need to make arrangements to receive reports of non-fitted aircraft or aircraft detected with non-complying ADS-B transmissions from their ANSPs and perhaps by other means (carriage of Ops Spec docs/aircraft ramp checks, etc).

Where foreign registered aircraft are detected as not complying with the equipage requirements, the details of those aircraft should be reported to the relevant State regulator of the aircraft's state of registration who will be expected to take appropriate corrective action. That does not preclude any Regulator taking immediate corrective action as necessary to ensure safety.

Action by ANSPs

ANSPs will need to operate in accordance with their normal practices for exclusionary airspace in accordance with State and ICAO guidelines. Non-complying aircraft cannot expect any priority for clearance into ADS-B airspace and may be held until procedural separation can be arranged.

Conclusions:

1 It was agreed that APAC State regulators should establish cooperative arrangements and a contact network such that:

(a) APAC State Regulators undertake ADS-B approvals of their aircraft to receive ADS-B services provided by any other APAC States; and

(b) details of aircraft detected as not complying with any mandate by a regulatory authority in a State are reported to the Regulatory Authority of the state of registry of the aircraft who will then be expected to take appropriate steps for corrective action with their aircraft operators. (Such an arrangement will not preclude an ANSP taking immediate operational actions as necessary for ATM and non-complying aircraft may suffer delays as priority will be afforded to equipped aircraft.)

2 That ANSPs providing an ATC service in mandatory ADS-B airspace apply similar policy and procedures to those existing policies and procedures applicable to aircraft having non-serviceable ATC transponders in Class A airspace. For any aircraft not ADS-B equipped or transmitting non-complying ADS-B information that present at the airspace boundary, acceptance of entry would be dependent on State/ICAO guidelines and controller discretion/workload.

REPORT FROM SOUTHEAST ASIA SUB GROUP

Previously Identified Projects

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

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

Phase 1a

Indonesia and Australia sharing data from the following stations:

- Saumlaki ADS-B (Indonesia) (Installed)
- Merauke ADS-B (Indonesia) (Installed)
- Kupang ADS-B (Indonesia) (Installed)
- Kintamani - Bali (Indonesia) (Installed)
- Thursday Island ADS-B (Australia) (Installed)
- Gove ADS-B (Australia) (Installed)
- Broome ADS-B (Australia) (Installed)
- Doongan ADS-B (Australia) (Installed)

Data Sharing Agreement signed in Nov 2010; Operational service commenced in Feb 2011.

Initial Benefits
Data used for air situational awareness and safety nets.
Enhanced Safety at FIR boundary.

Phase 1b (Tentatively after 2012)

Indonesia and Australia plan to share data from the following stations:

- Waingapu ADS-B (Indonesia) (Installed and already sharing)
- Another station from Australia (Location to be determined)

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

Phase 1
Under the near term implementation plan, Indonesia, Singapore and Vietnam would share the ADS-B data from the following stations:

- Singapore ADS-B (Singapore provides data to Indonesia) (Installed)
- Natuna ADS-B (Indonesia provides data to Singapore) (Installed)
- Matak ADS-B (Indonesia provides data to Singapore) (Installed)
- Con Son ADS-B (Viet Nam provides data to Singapore) (To be installed by 2H 2011)

VHF radio communication services (DCPC) would be provided from the following stations to Singapore. This is to enable implementation of radar-like separations in the non-radar areas within the Singapore FIR.

- Natuna and Matak VHF (Install for Singapore by Indonesia) (Installed by 2H 2011)
- Con Son VHF (Install for Singapore by Viet Nam) (Installed by 2H 2012)

ADS-B Data sharing and DCPC services agreement between Singapore and Indonesia signed in Dec 2010.

ADS-B Data sharing and DCPC services agreement between Singapore and Viet Nam would be signed in 2H 2011.

Initial Benefits
The above sharing arrangement will benefit L642, M771, N891, M753 and L644. Enhanced safety and reduced separation may be applied. Mandate will be effective in 2013.

Phase 2
The Phillipines will look into the provision of four ADS-B stations in Puerto Princesa, Manila, Quezon Palawan and Pasuquin to help cover N884 and M767. They will consider sharing ADS-B data and VHF radio services with neighbouring States. The meeting urged the States involved in such collaboration to start discussion as early as possible. The meeting will request Brunei to install an ADS-B station at Brunei for data sharing to cover the said routes.

Phase 3
The group will further explore other possibilities to cover L625 and N892 in future discussions. In addition to Con Son ADS-B ground station, Viet Nam planned to install more ADS-B ground stations to overlap the exisiting ADS-C and radar coverage in South East part of Ho Chi Minh FIR. The data from these ground ADS-B ground stations may be shared with adjacent FIRs.

Additions to this project
China expressed the possibility of sharing data from an ADS-B station in Sanya FIR with other neighbouring FIRs. Currently, the ADS-B data is shared with Hong Kong, China. China planned to install 3 more ADS-B stations in Sanya FIR to enhance surveillance. The locations will be identified later. Eventually, the additional ADS-B stations may be available for sharing as well.

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

Indonesia would share the ADS-B data from Aceh with Malaysia. The station is already installed. The discussion on data sharing will commence around July 2011.

Malaysia currently has 1 ADS-B station at Terengganu. Malaysia plans to install more ADS-B stations between 2016 and 2020. The stations may be shared in future.

Initial benefits
Enhanced Safety at FIR boundary

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

Viet Nam has no plans to install ADS-B stations that cover Cambodia at the moment.
Discussion between the three parties has not taken place.

Initial benefits
Situational awareness

New Project Identified

During the 10th ADS-B SITF meeting, the following new project was identified.

Project 5 – ADS-B data sharing between Indonesia and the Philippines

There are possibilities of data sharing between Indonesia and the Philippines. This will be discussed at the next ADS-B working group meeting.

Harmonization Plan for L642 and M771 (Work in progress)			
/No	**What to Harmonise**	**What was agreed**	**Issue/What needs to be further discussed.**
1	Mandate Effective	SG – 12 Dec 2013 HK – 12 Dec 2013 VN – TBD (WG 7) CN – TBD (WG 7)	
2	ATC Operating Procedures	Don't need to harmonise	Refer to SEACG for consideration of the impact of expanding ADS-B surveillance on ATC Operating Procedures including Large Scale Weather procedures.
3	Mandate Publish Date	Don't need to harmonise	To publish equipment requirements as early as possible.
4	Date of Operational Approval	Don't need to harmonise	
5	Flight Level	SG – At or Above FL290 – ADS-B airspace Below FL290 – Non ADS-B airspace HK – At or Above FL290 – ADS-B airspace Below FL290 – Non ADS-B airspace VN – TBD (WG 7) CN – At or Above FL290 – ADS-B airspace Below FL290 – Non ADS-B airspace	
6	Avionics Standard (CASA/AMC2024)	SG – CASA or AMC2024 HK – CASA or AMC2024 VN – CASA or AMC2024 CN – CASA or AMC2024 (subjected to approval)	ADS-B Task Force agreed that DO-260B will be accepted as well.
7	Flight Planning	Before 15 Nov 2012, as per AIDG On or after 15 Nov 2012, as per new flight plan format	Same as Australia/Canada
	Aircraft Approval		

8			
a)	Procedures if aircraft Not Approved	SG – FL280 and Below HK – FL280 and Below VN – FL280 and Below (Subject to Confirmation – WG7) CN – FL280 and Below	
b)	Aircraft approved but Transmitting Bad Data	For known aircraft, treat as non ADS-B aircraft. If in-flight, provide other form of separation (subject to bilateral agreement). From radar/ADS-B environment to ADS-B only environment, system may be able to provide early notification of ADS-B failure.	Address the need of maintaining a black list/white list registry. Is this something that can be addressed by ICAO at the regional level?
9	Contingency Plan		
a)	Systemic Failure such as Ground System/GPS Failure	Revert back to current procedure	
b)	Avionics Failure	Provide other form of separation, subject to bilateral agreement.	Address the procedure for aircraft transiting from radar to ADS-B airspace and from ADS-B to ADS-B airspace.
10	Letter of Operation Agreement	SEACG	Need for commonly agreed minimal in-trail spacing throughout

REPORT FROM BAY OF BENGAL SUB-GROUP

The BoB sub group met and discussed potential opportunities within the sub-region referencing WP/20 presenting a possible project in the Bay of Bengal. The group agreed that prioritisation of efforts should be assigned based on the operational and/or safety benefits that could be derived. Some States already had significant radar coverage and unless a specific benefit could be derived, implementation of ADS-B would largely be considered as a replacement to radar in these cases. These benefits could include increased range enabled by ADS-B, data sharing arrangements with neighbouring FIRs and redundancy. It was also noted that certain portions of the BoB area would not covered by surveillance and/or VHF in the short term, therefore this could potentially be a limiting factor in some cases.
Several locations were identified to deliver potential benefits in the short/ medium term. A plan was developed for the participating States to report back to the BOB/SEA ADS-B WG/7 meeting later in 2011. The initial sites identified were:

- Aceh (IDN already installed)
- Nicobar/ Andaman Island – TBC (IND)
- Coco Is/ Pathein/ Sittwee (MYR)
- Nepal - tbc
- India (mainland, sites with potential to share with neighbours a priority) - TBC
- Sri Lanka – TBC

States agreed to report to BOB/SEA ADS-B WG/7 with a working paper each outlining the following:

- Viability of each site identified
  - Can also include alternative or additional locations.
  - Potential for higher site or higher tower to maximise coverage and minimise/eliminate coverage gaps
  - Line of sight coverage predictions at FL250, FL300, FL350
- Identify existing datalinks that may be able to be expanded or adapted to carry ADS-B traffic
- Potential timeline for installation and operationalisation (tentative)
- Identify potential issues or challenges (includes but not limited to)
  - ATM infrastructure (existing and planned)
  - Site infrastructure
  - Security issues/ access (military)
  - Linkages (own system and data sharing)
  - Regulatory issues
  - VHF coverage (existing and planned)
  - Other
- Assess ability to share data
  - Potential partners
  - Policy, legal or military aspects to be addressed
- Assess aircraft equipage capability
- Process required to be followed to establish a mandate on certain routes at certain levels
- Identify other issues as necessary

Based on this initial assessment by the States, the BOB/SEA ADS-B WG can assess the viability of establishing such a project to develop on a collective basis.

Brief on the discussions of the Pacific sub group:

- New Caledonia has in operation 3 ADS-B ground stations;

- Fiji has installed 11 ADS-B/MLAT ground stations which should be operational in 2012;

- As the New Caledonia airspace is a lower sector of Fiji FIR (until FL245), Fiji may be interested in receiving DATA from New Caledonia for its upper sector;

- This may be easy to realize because a data/voice link already exists between La Tontouta and Nadi airport; may need to extend the bandwidth;

- Need to verify respectively the coverage of our ground stations as New Caledonia may be interested in receiving data from the West Fiji area; the cost factor and operational need would also need to be considered; and

- We could also study the opportunity for data sharing between east Australia, Solomon Islands, Fiji and New Caledonia; again this would be dependent on coverage and the cost factor.

– – – – – – – – – – – –