International Civil Aviation Organization

AUTOMATIC DEPENDENT SURVEILLANCE – BROADCAST SEMINAR AND TWELFTH MEETING OF AUTOMATIC DEPENDENT SURVEILLANCE – BROADCAST (ADS-B) STUDY AND IMPLEMENTATION TASK FORCE (ADS-B SITF/12)

Kolkata, India, 15-18 April 2013

Agenda Item 4: Review Subject / Task List and Action Items

PROPOSED AMENDMENTS TO AIGD

(Presented by Australia and Hong Kong China)

SUMMARY

This working paper summarizes a proposed revamp, upon a comprehensive review from ATC engineering and operations as well as avionics perspectives, on the ADS-B Implementation and Operations Guidance Document (AIGD) for the Asia and Pacific (APAC) Regions. ADS-B Out is one of the key Block 0 modules of the ICAO ASBU Framework. To reap full benefits and achieve better synergy, it is recommended that the AIGD for APAC Regions be promulgated to other Regions as guidance material to facilitate global harmonization and interoperability of seamless ATM systems.

1. Introduction

1.1 In accordance with the ADS-B SITF Terms of Reference, the ADS-B SITF is tasked to develop guidance material to assist States and airspace users in the Asia and Pacific (APAC) Regions on what is required to implement ADS-B In and Out. The 1st Edition of the ADS-B Implementation and Operations Guidance Document (AIGD) was prepared by the ADS-B SITF and endorsed during APANPIRG/16 in 2005. From 2005 to 2012, four subsequent Editions of the AIGD have been endorsed by APANPIRG to incorporate minor changes such as those arising from introduction of new Flight Plan and reliability/availability considerations for ADS-B ground systems. During the SEA/BOB ADS-B WG/8 held in December 2012, it was considered necessary to set up a small working team consisting of States advanced in ADS-B implementation to conduct a comprehensive review and revamp on the AIGD taking into account the latest ADS-B development and technologies. Australia and Hong Kong China were tasked by the meeting to take lead to review the AIGD and report to ADS-B SITF/12.

2. Discussion

2.1 Appendix A provides the proposed revision with track changes based on the 5th Edition of the AIGD endorsed during APANPIRG/23 in September 2012. In this proposed revision, there is a major revamp on organisation of the AIGD, especially on the ATC engineering and operations as well as avionics parts, which is a result of the joint efforts from Australia and Hong Kong China to streamline the contents. A summary of the re-organisation is given in Table 1.

5th Edition of AIGD	Proposed Re-organization
1. Introduction and Document Management	1. Introduction
2. Acronyms	2. Acronyms and Glossary of Terms
3. System Integrity and Monitoring	3. Reference Document (a newly added Section)
4. ADS-B Data Message Set	4. ADS-B Data
5. ADS-B Procedures	5. ADS-B Implementation
6. Emergency and Non-Routine Procedures	6. Harmonization Framework for ADS-B Implementation
7. ADS-B Implementation	7. System Integrity and Monitoring
8. Reliability and Availability Considerations	8. Reliability and Availability Considerations
9. Harmonization Framework for ADS-B Implementation	9. ADS-B Regulations and Procedures (included Emergency and Non-Routine Procedures)

Table 1 – Re-organization of AIGD

2.2 In addition, other changes have also been incorporated in this revision including the latest ADS-B development and applications such as the Aviation System Block Upgrades (ASBU) Framework endorsed in the Twelve ICAO Air Navigation Conference (AN-Conf/12) held in November 2012, new avionics standards, safety risk assessment guidance material, ADS-B regulations, safety implications in using ADS-B geometric altitude for ATC, procedures to handle non-compliant ADS-B aircraft / mis-leading ADS-B transmissions, harmonization framework for ADS-B implementation, and generation and sharing of ASTERIX Cat. 21 ADS-B messages guidance material.

2.3 With the ICAO ASBU establishing a framework for global harmonization and interoperability of seamless ATM systems which includes ADS-B as an economical alternative to acquire seamless surveillance capabilities, it is foreseeable that increasing number of States worldwide would start to formulate plans to implement ADS-B in order to meet their operational needs. The AIGD prepared by the ADS-B SITF is certainly beneficial to States not only within but also outside the APAC Regions. It is recommended that the AIGD should be promulgated to States in other Regions as guidance material for experience and knowledge sharing on ADS-B implementation in order to reap early operational benefits and save efforts.

3. Action by the Meeting

3.1 The meeting is invited to:

a) review and discuss the proposed changes to the AIGD as per Appendix A;

b) formulate a Draft Conclusion to endorse and adopt the proposed changes;

c) seek assistance from the ICAO Headquarters to promulgate the AIGD to States in other Regions to achieve better synergy in ADS-B implementation; and

d) discuss any relevant matters as appropriate.

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Appendix A

INTERNATIONAL CIVIL AVIATIN ORGANIZATION
ASIA AND PACIFIC OFFICE

ADS-B IMPLEMENTATION AND OPERATIONS GUIDANCE DOCUMENT

Edition ~~5~~6.0 - ~~September~~June ~~2012~~2013

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1. INTRODUCTION

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

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

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

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

The content is based upon the work to date of the APANPIRG ADS-B Study and Implementation Task Force (SITF) and various ANC Panels developing provisions for the operational use of ADS-B. ~~It should be noted that this edition of the document has been produced ahead of anticipated amendments to PANS-ATM (Doc 4444) and Annexes 2, 4, 11 and 15 to the convention. It is therefore likely that some a~~Amendment to the guidance material will be required as new/revised SARPs and PANS are published.

1.1 ARRANGEMENT OF THE AIGD

The AIGD consists of the following Parts:

Section 1	Introduction ~~and Document Management~~
Section 2	Acronyms and Glossary of Terms
Section 3	Reference Documents
Section 4~~3~~	~~System Integrity and Monitoring~~ADS-B Data
Section 5~~4~~	ADS-B ~~Data Message Set~~Implementation
Section 6~~5~~	~~ADS-B Procedures~~Template of Harmonization Framework for ADS-B Implementation
Section 7~~6~~	~~Emergency and Non-Routine Procedures~~System Integrity and Monitoring
~~Section 7~~	~~ADS-B Implementation~~
Section 8	~~Endnotes~~Reliability and Availability Considerations
Section 9	ADS-B Regulations and Procedures

1.2 DOCUMENT HISTORY AND MANAGEMENT

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

relevant provisions contained in ICAO documentation and it will be regularly updated to reflect evolving provisions.

1.3 COPIES

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

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

1.4 CHANGES TO THE AIGD

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

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

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

1.5 EDITING CONVENTIONS

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1.6 AIGD REQUEST FOR CHANGE FORM

RFC Nr:	

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

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

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

1.7 AMENDMENT RECORD

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

2. ACRONYM LIST & GLOSSARY OF TERMS

2.1 ACRONYM LIST

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

2.2 GLOSSARY OF TERMS

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

3. REFERENCE DOCUMENTS

Id	Name of the document	Reference	Date	Origin	Domain
1	Annex 2: Rules of the Air	Tenth Edition Including Amendment 43 dated 16/7/12	July 2005	ICAO	
2	Annex 4: Aeronautical Chart	~~Tenth~~ Eleventh Edition including A~~a~~mendment 5~~3~~6 dated ~~25~~12/7~~11~~/~~04~~10	July ~~2001~~2009	ICAO	
3	Annex 10: Aeronautical Telecommunications, Vol. IV – Surveillance Radar and Collision Avoidance Systems	~~Third~~ Fourth Edition Including A~~a~~mendment ~~77~~87 ~~dated~~dated ~~28~~12/~~11~~7/~~02~~10	July 200~~2~~7	ICAO	
4	Annex 11: Air Traffic Services	Thirteenth Edition including Amendment 4~~3~~8 ~~dated~~ dated ~~24~~16/~~11~~7/~~05~~12	July 2001	ICAO	
5	Annex 15: Aeronautical Information Services	~~Twelfth~~ Thirteen Edition	July ~~2004~~2010	ICAO	
6	PAN-ATM (Doc 4444/ATM501)	~~Fourteenth~~ Fifteen Edition including ~~latest~~ Amendment~~s~~ 4 applicable on 15/11/12	20070~~1~~	ICAO	
7	Manual on Airspace Planning Methodology for the Determination of Separation Minima (Doc 9689/AN953)	First Edition including Amendment 1 dated 30/8/02	1998	ICAO	
8	Doc 9859 Safety Management Manual (SMM)	Third Edition	2012	ICAO	
9	ICAO Circular 326 AN/188 "Assessment of ADS-B and Multilateration Surveillance to Support Air Traffic Services and Guidelines for Implementation".	First Edition	2012	ICAO	
10	Regional Supplementary Procedures (Doc 7030)	Fifth Edition including Amendment 5 dated 22/7/11	2008	ICAO	

4. ADS-B DATA

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

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

~~ADS-B data requirements for aircraft transmissions are contained in Annex 10 Vol IV. ADS-B data requirements for ground-ground messaging shall be determined by States. International exchange of ground-ground messaging should use ASTERIX 21 Version 0.23 format.~~To ensure interoperability of ADS-B ground stations in the Asia Pacific (ASIA/PAC) Regions, during the 16th APANPIRG Meeting held in August 2005, the ASTERIX Category 21 version 0.23 (V0.23) which had incorporated DO260 standard was adopted as the baselined ADS-B data format for deployment of ADS-B ground stations and sharing of ADS-B data in the ASIA/PAC Regions. At this time, DO260A and DO260B standards were not defined.

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

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

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

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

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

5. ADS-B IMPLEMENTATION

5.1 INTRODUCTION

5.1.1 Planning

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

5.1.2 Implementation team to ensure international coordination

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

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

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

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

5.1.3 System compatibility

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

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

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

5.1.4 Integration

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

5.1.4.2 Communication system

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

5.1.4.3 Navigation system infrastructure

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

a) Data items; and

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

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

5.1.4.4 Other surveillance infrastructure

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

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

5.2 Implementation checklist

5.2.1 Introduction

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

5.2.2 Activity Sequence

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

5.2.3 Concept Phase

a) construct operational concept:

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

b) identify benefits:

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

c) identify constraints:

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

d) prepare business case:

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

5.2.4 Design Phase

a) identify operational requirements:

1) security; and
2) systems interoperability;

b) identify human factors issues:

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

c) identify technical requirements:

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

d) equipment development, test, and evaluation:

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

e) develop procedures:

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

f) prepare design phase safety case:

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

5.2.5 Implementation phase

a) prepare implementation phase safety case;

b) conduct operational test and evaluation:

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

c) obtain systems certification:

1) aircraft equipment; and
2) ground systems;

d) obtain regulatory approvals:

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

e) implementation transition:

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

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

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

6. ~~Template of~~ Harmonization Framework for ADS-B Implementation

6.1 Background

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

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

6.2 Template of Harmonization Framework for ADS-B Implementation

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

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

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

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

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7. SYSTEM INTEGRITY AND MONITORING

7.1 INTRODUCTION

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

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

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

7.2 PERSONNEL LICENSING AND TRAINING

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

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

7.3 SYSTEM PERFORMANCE CRITERIA FOR AN ATC SEPARATION SERVICE

A number of States have started to introduce ADS-B for the provision of Air Traffic Services, including 'radar-like' separation. The ICAO Separation and Airspace Safety Panel (SASP) has completed ~~been~~ assessment ~~ing~~ on the suitability of ADS-B for various applications including provision of aircraft separation based on comparison of technical characteristics between ADS-B and monopulse secondary surveillance radar. It is concluded that~~using a comparative assessment methodology and, together with the ICAO Operational Data Link Panel (OPLINKP), is drawing on the experience of early implementers to develop operational provisions~~ that ADS-B surveillance is better or at least no worse than the referenced radar, and can be used to provide separation minima as described in PANS-ATM (Doc 4444) whether ADS-B is used as a sole means of ATC surveillance or used together with radar, subject to certain conditions to be met. The assessment result is detailed in the ICAO Circular 326 AN/188 "Assessment of ADS-B and Multilateration Surveillance to Support Air Traffic Services and Guidelines for Implementation"~~. It is anticipated that PANS-ATM (Doc 4444) will be amended to include ADS-B separation minima in 2007~~.

States intending to introduce ADS-B separation minima shall comply with ~~not published in~~ provisions of PANS-ATM, ~~or~~ Regional Supplementary Procedures (Doc 7030) ~~should comply with the provisions of~~ and Annex 11 paragraph 3.4.1. States should adopt the guidelines contained in this document unless conformance with PANS-ATM specifications requires change.

7.4 ATC SYSTEM VALIDATION

7.4.1 Safety Assessment Guidelines

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

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

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

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

7.4.2 System safety assessment

The objective of the system safety assessment is to ensure the State that introduction and operation of ADS-B is safe. This can be achieved through application of the provisions of Annex 11 paragraph 2.2~~6~~7 and PANS-ATM Chapter 2. The safety assessment should be conducted for initial implementation as well as any future enhancements and should include:

a) Identifying failure conditions;

b) Assigning levels of criticality;

c) Determining risks/ probabilities for occurrence;

d) Identifying mitigating measures and fallback arrangements;

e) Categorising the degree of acceptability of risks; and

f) Operational hazard ID process.

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

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

7.4.3 Integration test

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

Refer also to the *Manual on Airspace Planning Methodology for the Determination of Separation Minima* (Doc9689).

7.4.4 ATS Operation Manuals

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

7.4.5 ATS System Integrity

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

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

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

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

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

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

7.5 SYSTEM MONITORING

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

7.5.1 Problem Reporting System (PRS)

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

The PRS Administrator shall:

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

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

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

7.5.2 The monitoring process

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

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

a) ATS Providers;

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

c) Relevant State regulatory authorities;

d) Communication Service Providers being used;

e) Aircraft operators; and

f) Aircraft and avionics manufacturers.

7.5.3 Distribution of confidential information

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

7.5.4 ADS-B problem reports

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

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

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

b) Change to operating procedures;

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

d) Change to system design.

7.5.5 ADS-B periodic status report

The ATS Providers should complete the ADS-B Periodic Status Report annually and deliver the report to the regional meeting of the ADS-B SITF*[D1]*. The Periodic Status Report should give an indication of system performance and identify any trend in system deficiencies, the resultant operational implications, and the proposed resolution, if applicable.

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

7.5.6 Processing of Reports

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

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

b) Coordinate with aircraft operators;

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

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

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

g) Coordinate with any Communication Service Providers used.

7.6 APANPIRG

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

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

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

c) monitor the progress of outstanding problem resolutions;

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

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

7.7 LOCAL DATA RECORDING AND ANALYSIS

7.7.1 Data recording

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

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

7.7.2 Local data collection

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

7.7.3 ~~Local~~ Avionics problem identification and correction

ATS providers need to develop systems to :

a) detect ADS-B avionics anomalies and faults

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

c) devise mechanisms and procedures to address identified faults

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

7.8 ADS-B PROBLEM REPORT

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

7.8.2 Description of Fields

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

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

8. RELIABILITY & AVAILABILITY CONSIDERATIONS

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

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

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

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

8.1 Reliability

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

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

8.1.3 In general, reliability is determined by design (see para 8~~9~~.3 B below)

8.2 Av**ailability**

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

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

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

8.2.4 Availability is calculated as

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

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

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

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

8.3 Recommendations for high reliability/availability ADS-B systems

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

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

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

- ensure the procured system is designed to allow for quick replacement of faulty modules to restore operations
- provide remote monitoring to allow maintainers to identify the faulty modules for transport to site
- provide support tools to allow technicians to repair faulty modules or to configure/setup replacement modules
- provide technicians training to identify & repair the faulty module~~(s)~~
- provide local maintenance depots to reduce the time it takes to ~~get~~ access to the site

- provide documentation and procedures to "standardise" the process
- use an in-country spares pool to ensure that replacement modules are available within reasonable times
- use a maintenance contract to repair faulty modules within a specified turnaround time. I.e.: to replenish the spares pool quickly.

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

Difficulties can be experienced if States :

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

Spares pool

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

Module repair contract

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

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

The advantages of a module repair contract are :

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

Other t~~T~~ypical strategies are:

- Establish availability and reliability objectives that are agreed organization wide. In particular agree System response times (SRT) for faults and system failure to ensure that MDT is achieved. An agreed SRT can help organizations to decide on the required logistics strategy including number, location and skills of staff to support the system.
- ~~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: Configuration Management aims to ensure that the configuration of the ground stations is maintained with integrity. Erroneous configuration can cause unnecessary outages. Normally configuration management is achieved by :

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

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

  - The nature of the change including the reason
  - Impact of the change & safety assessment
  - An appropriate transition or cutover plan

- Who approved the change
- When the change was authorized and when the change was implemented

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

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

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

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

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

- Development and delivery of appropriate training to maintainers

- Competency based testing of trainees

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

E: Data collection & Review :

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

- Reports of actual achieved availability & reliability

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

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

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

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

- System and component obsolescence

- Staff skills and need for refresher training

9. ADS-B REGULATIONS AND PROCEDURES

9.1 INTRODUCTION

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

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

9.2 ADS-B REGULATIONS

States wishing to implement ADS-B based surveillance services need to consider publishing mandate/regulations in order to :

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

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

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

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

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

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

(b) Civil Aviation Department (CAD) of Hong Kong, China
Aeronautical Information Circular (AIC) No. 09/11 dated 24 May 2011
"http://www.hkatc.gov.hk/HK_AIP/aic/AIC09-11.pdf"

(c) Civil Aviation Authority of Singapore (CAAS)
Aeronautical Information Circular (AIC) No. 14/10 dated 28 December 2010

"http://www.caas.gov.sg/caasWeb2010/export/sites/caas/en/Regulations/Aeronautical_Information/AIC/AIC_PDFs/AIC_14_2010.pdf"

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

9.32 FACTORS TO BE CONSIDERED WHEN USING ADS-B

9.32.1 Use of ADS-B Level data

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

9.23.2 Position Reporting Performance

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

~~In general, for 5NM separation, if the NUC is less than 54 (or NIC is less than 46, or SIL is less than 22) the data is unlikely to be of comparable quality to that provided by a single monopulse SSR. ADS-B data should not be used for separation unless a suitable means of determining data integrity is used.~~ In general, for 5NM separation, if the HPL value used to generate ADS-B quality indicators (NUC or ~~,~~NIC) is greater than 2 nautical miles the data is unlikely to be of comparable quality to that provided by a single monopulse SSR. ADS-B data should not be used for separation unless a suitable means of determining data integrity is used.

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

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

9.23.3 GNSS Integrity Prediction Service

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

ATS Providers may elect to use a GNSS integrity prediction service to assist in determining the future availability of useable ADS-B data. The integrity prediction service alerts users to potential future loss or degradation of the ADS-B service in defined areas. When these alerts are displayed, the system is indicating to its users that at some time in the future the ADS-B

positional data may be inadequate to support the application of ADS-B separation. It is recommended that the prediction service is made available to each ATSU that is employing ADS-B to provide a separation service, to ensure that air traffic controllers are alerted in advance of any predicted degradation of the GNSS service and the associated reduction in their ability to provide ADS-B separation to flights that are within the affected area. This is similar to having advance warning of a planned radar outage for maintenance.

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

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

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

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

9.~~2~~3.4 Sharing of ADS-B Data

ADS-B Data-sharing for ATC Operations

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

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

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

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

ADS-B Data-sharing for Safety Monitoring

With endorsement of the methodology by both the ICAO Separation and Airspace Safety Panel (SASP) and the Regional Monitoring Agencies Coordination Group (RMACG), ADS-B data can be used for calculating the altimetry system error (ASE) which is a measure of the height-keeping performance of an aircraft. It is an ICAO requirement that aircraft operating in RVSM airspace must undergo periodic monitoring on height-keeping performance. The existing methods to estimate aircraft ASE include use of a portable device, the Enhanced GPS Monitoring Unit, and ground-based systems called Height Monitoring Unit/Aircraft Geometric Height Measurement Element. The use of ADS-B data for height-keeping performance monitoring, on top of providing enhanced and alternative means of surveillance, will provide a cost-effective option for aircraft operators. States are encouraged to share ADS-B data to support the height-keeping performance monitoring of airframe.

Civil/Military ADS-B Data-sharing

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

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

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

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

9.43 Reporting Rates

9.43.1 General

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

9.54 SEPARATION

9.54.1 General

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

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

9.54.2 Identification Methods

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

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

b) transfer of ADS-B identification;

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

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

9.54.3 ADS-B Separation

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

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

9.54.4 Vertical separation

9.54.4.1 Introduction

The ADS-B level data presented on the controllers situation display shall normally be derived from barometric pressure altitude. In the event that barometric ~~geometric~~ altitude ~~data~~ is absent, geometric altitude shall not be presented on the situation display unless intentionally requested by the air traffic controller. The geometric altitude so displayed shall be in a distinguishable format from barometric altitude. ~~,~~ T~~t~~he air traffic controller should be alerted to the fact that the displayed geometric altitude~~this~~ data shall~~ould~~ not be used for vertical separation.

9.54.4.2 Vertical tolerance standard

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

9.54.4.3 Verification of ADS-B level information

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

9.65 AIR TRAFFIC CONTROL CLEARANCE MONITORING

9.65.1 General

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

9.65.2 Deviations from ATC clearances

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

9.7~~6~~ ALERTING SERVICE

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

9.8~~7~~ POSITION REPORTING

9.8~~7~~.1 Pilot position reporting requirements in ADS-B coverage

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

9.8~~7~~.2 Meteorological reporting requirements in ADS-B airspace

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

9.9~~8~~ PHRASEOLOGY

9.9~~8~~.1 Phraseology Standard

States should note the requirement for ADS-B specific phraseology equivalent to radar specific phraseology as well as the opportunity to use generic phraseology applicable to multiple systems.

States shall refer to ~~Until such time as~~ PANS ATM Chapter 12 ~~is amended to include ADS-B provisions, the following phraseology is recommended for consideration by States~~for ADS-B phraseology:

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

TO REQUEST THE CAPABILITY OF THE ADS-B EQUIPMENT

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

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

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

TO REQUEST THE OPERATION OF THE ADS-B IDENT FEATURE
TRANSMIT ADS-B IDENT.

TO REQUEST TERMINATION OF SSR TRANSPONDER AND/OR ADS-B TRANSMITTER OPERATION
a) STOP SQUAWK. [TRANSMIT ADS-B ONLY];
b) STOP ADS-B TRANSMISSION [SQUAWK (code) ONLY].
Note: In some cases the ADS-B transmitter cannot be operated independently of the SSR transponder and the loss of SSR and ACAS surveillance derived from the operation of the SSR transponder should be considered.

9.9~~8~~.2 Operations of Mode S Transponder and ADS-B

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

9.9~~8~~.2.1 STOP ADSB TRANSMISSION or STOP SQUAWK

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

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

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

9.9~~8~~.2.2 STOP ADSB ALTITUDE TRANSMISSION [WRONG INDICATION or reason] and TRANSMIT ADSB ALTITUDE

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

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

9.9~~8~~.2.3 TRANSMIT ADS-B IDENT

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

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

9.10~~9~~ FLIGHT PLANNING

9.10~~9~~.1 ADS-B Flight Planning Requirement – Flight Identity

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

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

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

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

Or,

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

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

2) the aircraft is not equipped with radio.

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

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

~~**5.9.2 ADS-B Flight Planning Requirements**~~

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

~~Until the new ICAO flight plan, which incorporates ADS-B 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.~~

9.109.23 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:~~

9.109.32.1 ~~Flight Notification~~ICAO Flight Plan Item 10 – Surveillance Equipment and Capabilities

An appropriate ADS-B designator shall be entered in ~~section~~item 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

9.109.23.2 ~~Aircraft Address (24 Bit Code)~~ICAO Flight Plan Item 18 – Other Information

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

CODE/7C432B

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

9.109.23.3 ~~SSR Mode S~~Transponder Capabilities

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~~item 10; i.e.: either

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

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

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

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

a) aircraft broadcasting incorrect message formats;

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

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

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

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

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

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

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

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

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

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

then:

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

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

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

9.1~~0~~2 EMERGENCY PROCEDURES

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

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

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

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

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

Executive control responsibility

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

Emergency procedures

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

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