AUTOMATIC DEPENDENT SURVEILLANCE – BROADCAST (ADS-B) OUT BASED ATS SURVEILLANCE SERVICES

1. INTRODUCTION

1.1 ADS-B avionics enables an aircraft to broadcast its position information derived from GNSS, its identity, velocity and other information with a high degree of accuracy and integrity. ADS-B ground stations receive the information transmitted by an ADS-B equipped aircraft and distributes the received ADS-B data to ATS Surveillance systems. The ADS-B data sent by the ground receivers are processed by ATS Surveillance systems and presented to the Air Traffic Controllers as exclusive ADS B information or as integrated surveillance information thereby providing enhanced situational awareness to the Air Traffic Controllers.

1.2 India recognizes the ADS-B avionics as an enabler of the global ATM concept bringing substantial safety & capacity benefits and supports the cost-effective early implementation of it in line with ICAO Asia Pacific Air Navigation Planning and Implementation Regional Group (APANPIRG) Conclusion 19/37 and Conclusion 21/39. India plans to introduce ADS-B for the provision of Air Traffic Services, including ‘radar-like’ separation in a phased manner. The Automatic Dependent Surveillance Broadcast “(ADS-B) OUT” transmissions on 1090MHz Extended Squitter data link will be used for provision of ATS surveillance services to eligible aircraft within notified portions of Indian airspace(s).

1.3 The ADS-B Out implementation in India is aimed at providing redundancy where Radar surveillance is already available. In addition, ADS-B Out enables the expansion of Air Traffic Control (ATC) surveillance services in remote & high terrain areas, oceanic airspace and also to fill the surveillance gap over the Continental airspace.
2. **DEFINITIONS**

A. **ATS SURVEILLANCE SERVICE**

A term used to indicate a service provided directly by means of an ATS surveillance system.

B. **ATS SURVEILLANCE SYSTEM**

A generic term meaning variously, ADS-B, PSR, SSR or any comparable ground-based system that enables the identification of aircraft.

*Note: A comparable ground-based system is one that has been demonstrated, by comparative assessment or other methodology, to have a level of safety and performance equal to or better than monopulse SSR.*

C. **SURVEILLANCE**

For the purpose of this document, surveillance is defined as the display of aircraft identification, position, speed and altitude information on Air Traffic Control situation display which is derived from primary & secondary Radar systems and ADS-B.

D. **ADS-B (AUTOMATIC DEPENDENT SURVEILLANCE BROADCAST)**

A means by which aircraft, aerodrome vehicles and other objects can automatically transmit and/or receive data such as identification, position and additional data, as appropriate, in a broadcast mode via a data link.

*Note: ADS-B is a surveillance application of specialized aircraft avionics that transmits aircraft data at specified intervals via a broadcast mode, digital data link. Transmitted data includes position, altitude, aircraft identification and velocity.*

E. **ADS-B GROUND STATION**

ADS-B ground station is a ground based facility that receives ADS-B information from aircraft and transmits it to Air Traffic Control facilities.

F. **ICAO 24 BIT AIRCRAFT ADDRESS**

ICAO 24 bit aircraft address is a six character, alphanumeric identification code which is programmed into each specific aircraft’s Mode S transponder during installation. This code, sometimes is referred to as the 24 bit code, provides a digital identification of the aircraft and can be used by the Air Traffic System to link information contained in a flight notification to aircraft position information received via ADS-B.
3. **ADS-B/ADS-B-RADAR SURVEILLANCE COVERAGE**

3.1 ADS-B ground stations have been installed at 21 locations, including:

<table>
<thead>
<tr>
<th>i.</th>
<th>Agartala</th>
<th>ii.</th>
<th>Ahmedabad</th>
<th>iii.</th>
<th>Amritsar</th>
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<tbody>
<tr>
<td>x.</td>
<td>Mangalore</td>
<td>xi.</td>
<td>Nagpur</td>
<td>xii.</td>
<td>Port Blair</td>
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<td>xvi.</td>
<td>Bhubaneswar</td>
<td>xvii.</td>
<td>Dibrugarh</td>
<td>xviii.</td>
<td>Mumbai</td>
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(Refer *Annexure 1* for ADS-B location and coverage)

3.2 The combined surveillance information of ADS-B and RADARs provides continent wide line of sight surveillance coverage above 29000 feet and significant coverage at lower levels. In addition reliable line of sight surveillance coverage up to 250NM from each of the ADS-B ground stations is available.

(Refer *Annexure 2* for combined surveillance coverage)

3.3 The ADS-B ground receivers have two sensors at each ground station to provide redundancy and a higher level of availability.

3.4 The ADS-B surveillance sensor data from the 21 ground receivers, depending on the requirement to service an airspace volume, is/are integrated into the ATS Surveillance systems of Chennai, Kolkata, Mumbai, Delhi, Ahmedabad, Nagpur, Guwahati, Thiruvananthapuram, Varanasi, Mangalore, Cochin, Amritsar, Lucknow, Jaipur, Patna, Agartala, Bhubaneswar, Calicut, Coimbatore, and Tiruchirappalli ATC Centers.

3.5 The ATS Surveillance services to be provided by an ATC Center, within a notified volume of airspace under its control and jurisdiction, based on ADS-B surveillance information from the ADS-B ground stations certified by the regulator, shall be notified through G- Series NOTAM.

4. **USE OF ADS-B IN THE PROVISION OF SURVEILLANCE SERVICES**

4.1 ADS-B shall only be used for the provision of air traffic control service provided the quality of the information contained in the ADS-B message exceeds the values specified (p or greater) by the appropriate ATS Authority (PANS-ATM 8.1.10) and provided further:

a) reliable coverage exists in the area;
b) the probability of detection, the accuracy and the integrity of the ATS surveillance system(s) are satisfactory; and

c) the availability of ADS-B data from participating aircraft is adequate.

Note: In India, ADS-B information shall be used for the provision of Air Traffic Surveillance Services, provided the NUCp is equal to 5 or greater, subject to other conditions specified above.

4.2 ADS-B may be used exclusively in the provision of separation between aircraft, provided:

a) identification of ADS-B equipped aircraft is established and maintained;

b) the data integrity measure in the ADS-B message is adequate to support the separation minimum;

c) there is no requirement for detection of aircraft not transmitting ADS-B; and

d) there is no requirement for determination of aircraft position independent of the position determining elements of the aircraft navigation system.

5. SURVEILLANCE SEPARATION MINIMA

5.1 The horizontal separation minimum based on ADS-B shall be as is applicable in the case of radar

a. 5NM within 60 NM of ADS-B ground station
   i.e. in the terminal airspace served by the ADS-B receiver.

b. 10NM beyond 60NM of ground station
   i.e. in the en route airspace

Note 1: An assessment of the use of ADS-B for the application of 9.3 km (5.0 NM) separation minimum has been performed based on a comparison of the technical characteristics of ADS-B and a single monopulse SSR. This comparison, including performance values, is contained in the Assessment of ADS-B to Support Air Traffic Services and Guidelines for Implementation (ICAO Cir 311/ICAO Cir 326).

Note 2: Local assessment(s) for integrity of data is being carried out at all ground stations prior to the application of the separation minimum based on ADS-B.
6. **AIRCRAFT OPERATIONAL APPROVAL**

6.1 ADS-B Out transmitting equipment should be of an approved type meeting the specifications contained in Annex 10 (Volume IV) to the convention on International Civil Aviation or that has been certified as meeting

a. the current version of FAA AC No. 20-165 – Airworthiness Approval of ADS-B or
b. EASA AMC 20-24, or
c. the equipment configuration standards in Appendix XI of Civil Aviation Order 20.18 of the Civil Aviation Safety Authority of Australia dated 23rd August 2012 and any amendment thereof.

6.2 The aircraft operator must have the relevant operational approval from the State of Registry.

7. **FLIGHT PLANNING REQUIREMENTS**

7.1 **Surveillance Equipment**

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

i. Either, **E** Transponder — Mode S, including aircraft identification, pressure-altitude and extended Squitter (ADS-B) capability,

or

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

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:

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

b. **B2** - ADS-B with dedicated 1090 MHz ADS-B “out” and “in” capability

*Note: V DL Mode 4 and UAT not supported at present*

7.2 **Flight Identity**

The aircraft identification (ACID) must be accurately recorded in section 7 of the ICAO Flight Plan form. 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 FMS (for transmission as Flight ID) in ADS-B transmissions as follows:

i. Either, the ICAO three-letter designator for the aircraft operating agency followed by the flight identification (e.g. AIC511, BAW213, and JAI25), when in radiotelephony the call sign used consists of the ICAO telephony designator for the operating agency
followed by the flight identification (e.g. AIR INDIA FIVE ONE ONE, SPEEDBIRD TWO ONE THREE, JET AIRWAYS TWO FIVE).

Or

ii. The registration marking of the aircraft (e.g. VTAKO, 4XBCD, OOTEK), when in radiotelephony the call sign used consists of the registration marking alone (e.g. VICTOR TANGO ALPHA KILO OSCAR), or preceded by the ICAO telephony designator for the operating agency (e.g. AIR INDIA VICTOR TANGO ALPHA KILO OSCAR),

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

7.3 Aircraft Address (24 Bit Code)

The aircraft address (in hexadecimal format) may, but is NOT required, to be recorded in field 18 of the ICAO flight plan as per the following example:

CODE/80039A

The Unique aircraft address expressed in Hexadecimal form provides a digital identification of the aircraft and facilitates Air Traffic System to correlate the ADS-B track data with flight plan data in the absence of down linked flight ID.

8. FLIGHT CREW PROCEDURES

8.1 The flight crew shall adhere to the regulatory requirements pertaining to ADS-B issued from time to time.

8.2 The flight crew, on initial radiotelephony contact, or through CPDLC, where appropriate, shall inform the status of the aircraft’s ADS-B operational approval to the ATC Unit(s) which have notified (Refer 3.5) the provision of ATS Surveillance Services, based on ADS-B information, in airspace(s) under their jurisdiction and control.

8.3 The flight crew shall be aware that since GNSS provides the position information element of ADS-B, the action of turning the GNSS receiver off, will result in the aircraft becoming invisible to ADS-B surveillance. ADS-B equipment can have various pilot interfaces, ranging from a simple on/off switch for the transmitter to a pilot control interface with advanced features such as a cockpit display of traffic information. It may also be combined with other systems, such as an SSR transponder, TCAS or Multifunction display (MFD). It is therefore important that the crew be aware that if the SSR transponder controls are linked to the ADS-B transmitter, operating one system may only be possible by operating both systems.

8.4 If an aircraft operates within an Indian 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:
   
i. EASA AMC 20-24; or
   
ii. the equipment configuration standards in Appendix XI of Civil Aviation Order 20.18 of the Civil Aviation Safety Authority of Australia dated 23rd August 2012 and any amendment thereof; or
   
iii. with the current version of FAA AC No. 20-165 – Airworthiness Approval of ADS-B;

   or

b. the aircraft ADS-B transmitting equipment becomes unserviceable resulting in the aircraft transmitting misleading information; then, except when specifically authorized by the appropriate ATS authority, the aircraft shall not fly unless the equipment is:
   
i. deactivated;

   or

   ii. transmits only a value of zero for any one of the following:

      a. NUCp (Navigation Uncertainty Category – Position) or

      b. NIC (Navigation Integrity Category)

(Refer DOC 7030- Regional Supplementary Procedures, Asia Pacific)

9. **EMERGENCY PROCEDURES**

9.1 To indicate that an aircraft is in a state of emergency or to transmit other urgent information, an aircraft equipped with ADS-B might operate the emergency and/or urgency mode as follows:

a) emergency;

b) communication failure;

c) unlawful interference;

d) minimum fuel; and/or

e) medical emergencies.

Note: Some **DO 260 compliant ADS-B avionics do not have the capability described above and only have the capability to transmit a general emergency alert regardless of the code selected by the pilot.**
9.2 At present the ATC systems support only a general emergency alert regardless of the code/Emergency Mode selected by the pilot. Hence wherever feasible the pilot has to inform the controller on RT and adopt the emergency procedures as in Procedural environment. The ATC Centres have developed SOPs for ADS-B operations which include the procedures to be followed and their training plan includes emphasis on obtaining voice reports on the nature of emergency as per procedures laid down in ICAO Annex/Documents.

9.3 AMC 20-24 lists the transmission of generic emergency code as a permissible deviation for initial implementations. It is stated therein that “instead of the required transmission of the discrete emergency codes 7500, 7600 and 7700 when selected by the flight crew, the transmission of only the generic emergency indicator can satisfy this requirement. Such deviation from the above target requirement needs to be listed in the Aircraft Flight Manual: (refer to AMC 20-24 Sections 5.1.3, 8.8.2 & 9.3).

10. **ATS SURVEILLANCE SYSTEM – SAFETY FEATURES**

10.1 ATC surveillance systems provide for the display of safety-related alerts and warnings, including conflict alert, minimum safe altitude warning, conflict prediction and wrong aircraft identifications.

11. **ATC PROCEDURES**

11.1 The Air Traffic Controllers shall be presented, with either combined or standalone ADS-B surveillance processed information, in their ATS Surveillance System Situation Display, with well-defined symbology, and they shall use the information for the purpose of application of separation between eligible aircraft in accordance with the related provisions contained in DOC 4444, MATS, ATMC and/or Station level SOPs for the provision of ATS surveillance services.

11.2 The provisions, pertaining to an ADS-B “out of service” or ADS-B information being at a level lower than acceptable minimum values, shall be defined in the SOPs for the compliance of Air Traffic Controllers. Especially, the broadcast ADS-B data shall be discarded by the ATC system when NUCp or NIC = 0.

(Ref. 1. Amendments to Doc 7030- Regional Supplementary Procedures, Asia Pacific

2. ICAO Circular 326 Appendix C provides guidance on the minimum accuracy & integrity standards for terminal and enroute ADS-B separation services)

12. **PROVISION OF ATS SURVEILLANCE SERVICES TO ELIGIBLE AIRCRAFT**

12.1 In conformance with APANPIRG Conclusion 21/39 to mandate ADS-B through a prescribed standard format and APANPIRG Conclusion 22/8 to provide priority for access to such airspace for aircraft with operative ADS-B equipment over those aircraft not operating ADS-B equipment, ATS Surveillance Services will be provided to aircraft equipped with operative ADS-B equipment on an opportunity basis for the optimum utilization of the airspace.
12.2 The provision of ATS Surveillance services to eligible aircraft shall be applicable in notified airspace or along notified ATS Routes. (Refer 3.5)

13. **ADS-B OUT IMPLEMENTATION IN INDIA**

13.1 The provision of ATS Surveillance services using ADS-B Out information, in terminal and en route airspace, to eligible aircraft, on an opportunity basis, is envisaged to continue until the DGCA (India) considers mandating the carriage of ADS-B Out equipment, from an appointed date.

13.2 There are important safety benefits of the ADS-B implementation. In addition, search and rescue activities can be improved both inside current radar coverage and outside of radar coverage. The last few ADS-B position reports are invaluable in helping rescuers locate a force landed aircraft.
ADS-B COVERAGE WITHIN INDIAN FIR

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ANNEXURE 3

**ADS-B PHRASEOLOGY**

The ADS-B phraseology shall be similar to Radar phraseology and generic in nature wherever the commonality so demands, specific otherwise.

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<thead>
<tr>
<th>CIRCUMSTANCES</th>
<th>RADAR PHRASEOLOGY</th>
<th>ADS-B PHRASEOLOGY</th>
</tr>
</thead>
<tbody>
<tr>
<td>TERMINATION OF RADAR AND/OR ADS-B SERVICE</td>
<td>IDENTIFICATION TERMINATED [DUE (REASON)] (INSTRUCTIONS)</td>
<td></td>
</tr>
<tr>
<td>RADAR OR ADS-B GROUND EQUIPMENT UNSERVICEABILITY</td>
<td>SECONDARY RADAR OUT OF SERVICE (APPROPRIATE INFORMATION AS NECESSARY) OR PRIMARY RADAR OUT OF SERVICE (APPROPRIATE INFORMATION AS NECESSARY)</td>
<td>ADS-B OUT OF SERVICE (APPROPRIATE INFORMATION AS NECESSARY).</td>
</tr>
<tr>
<td>TO REQUEST THE AIRCRAFT’S SSR OR ADS-B CAPABILITY</td>
<td>ADVISE TRANSPONDER CAPABILITY</td>
<td>ADVISE ADS-B CAPABILITY</td>
</tr>
<tr>
<td>TO ADVISE THE AIRCRAFT’S SSR OR ADS-B CAPABILITY</td>
<td>TRANSPONDER (ALPHA, CHARLIE OR SIERRA AS SHOWN IN THE FLIGHT PLAN) OR NEGATIVE TRANSPONDER</td>
<td>ADS-B TRANSMITTER (TEN NINETY DATALINK) OR ADS-B RECEIVER (TEN NINETY DATALINK) OR NEGATIVE ADS-B</td>
</tr>
<tr>
<td>TO REQUEST RESELECTION OF FLT ID*</td>
<td>RE-ENTER MODE S AIRCRAFT IDENTIFICATION</td>
<td>RE-ENTER ADS-B AIRCRAFT IDENTIFICATION</td>
</tr>
<tr>
<td>TO REQUEST THE OPERATION OF THE IDENT FEATURE*</td>
<td>SQUAWK [(code)] [AND] IDENT</td>
<td>TRANSMIT ADS-B IDENT</td>
</tr>
<tr>
<td>TO REQUEST TERMINATION OF SSR TRANSPONDER OR ADS-B TRANSMITTER OPERATION*</td>
<td>STOP SQUAWK [TRANSMIT ADS-B ONLY]</td>
<td>STOP ADS-B TRANSMISSION [SQUAWK (CODE) ONLY]</td>
</tr>
<tr>
<td>TO REQUEST TRANSMISSION OF PRESSURE ALTITUDE*</td>
<td>SQUAWK CHARLIE</td>
<td>TRANSMIT ADS-B ALTITUDE</td>
</tr>
<tr>
<td>TO REQUEST TERMINATION OF PRESSURE ALTITUDE TRANSMISSION DUE TO FAULTY OPERATION*</td>
<td>STOP SQUAWK CHARLIE WRONG INDICATION</td>
<td>STOP ADS-B ALTITUDE TRANSMISSION [(WRONG INDICATION OR REASON)]</td>
</tr>
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INSERT IN e-AIP INDIA ENR 1.6 ACCORDINGLY.