ATMC

AIR TRAFFIC MANAGEMENT CIRCULAR NO. 15 of 2014

Automatic Dependent Surveillance – Broadcast (ADS-B)

1. Introduction:

1.1 AAI has installed Automatic Dependent Surveillance-Broadcast (ADS-B) ground receivers across India at the following locations:

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<tbody>
<tr>
<td>i.</td>
<td>Agartala</td>
<td>ii. Ahmedabad</td>
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<tr>
<td>x.</td>
<td>Mangalore</td>
<td>xi. Nagpur</td>
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<tr>
<td>xvi.</td>
<td>Bhubaneswar</td>
<td>xvii. Dibrugarh</td>
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</table>

1.2 ADS-B ground stations at these 21 locations, is envisaged to provide redundancy to existing Radar network and extend ATS surveillance to airports, continental and oceanic airspace currently without radar coverage and facilitate in filling the surveillance gaps in the airspace. The ADS-B surveillance information from any of the many ground stations are integrated with ATS Automation systems serving the ATC Centres at the Airport or Enroute Centres.

1.3 The advanced ATS Automation Systems at major ATC Centres, have the capability of processing ADS-B surveillance input and presenting the information on the Situation Data Display (SDD) as standalone ADS-B tracks or fused with radar position symbols, in a multi surveillance sensor environment.
1.4 ADS-B ground station at Port Blair provides surveillance coverage over the oceanic airspace in the Bay of Bengal Region, thereby converting significantly a remote airspace into a surveilled airspace. The Port Blair ADS-B information is integrated into the ATS Automation Systems at Chennai and Kolkata, to improve the efficiency of Oceanic Control.

1.5 ADS-B data sharing with neighbouring ANSPs is a key enabler to the implementation of Seamless ATM in the ICAO APAC Region.

1.6 ADS-B applications, requirements, functional capabilities are provided in detail in Part VII of Manual of Air Traffic Services Data Link Application (Doc 9694) and the standards and recommended practices pertaining to the use of ADS-B in the provision of ATS Surveillance services is provided in Chapter 8 of PANS – ATM (Doc 4444).

1.7 Procedures in this ATMC are supplementary to the procedures contained in MATS-1 chapter 8 and phraseology contained in Chapter 12. AIP Supplement 18 of 2014 and DGCA OC 17 of 2014 should be read in tandem with this Circular.

2 Purpose:

1.8 Purpose of this ATMC is to provide guidance to Controllers and CNS personnel, on the implementation and use of ADS-B.

3 Scope:

3.1 This ATMC is applicable to all Air Traffic Controllers working at various AAI airports/ATC Centres/ATS Units wherever ADS-B surveillance system is available and CNS personnel working at ADS-B ground receiver stations and ATC Centres wherever ADS-B surveillance system is available.

4 ADS-B system Description

4.1 ADS-B system architecture

4.1.1 The ADS-B system architecture comprises of aircraft avionics and ground infrastructure. On-board avionics determine the position of the aircraft, typically by using the Global Navigation Satellite Systems (GNSS) and transmit this and additional information about the aircraft to ground stations for use by ATC and to aircraft equipped with ADS-B IN capability.

4.2 ADS-B operating Frequency

4.2.1 In accordance with the recommendation made by Eleventh ICAO Air Navigation Planning Conference, India is using 1090MHz Extended Squitter data link for ADS-B data exchange over Indian Airspace.

4.2.2 ADS-B Ground stations shall be capable of detecting, identifying and tracking targets equipped with ADS-B transponders compliant with ICAO SARPS Annex 10. Volume IV and 1090MHz Extended Squitter avionics compliant with Manual on Secondary Surveillance Radar (SSR) Systems (DOC9684) and following RTCA (Radio Technical Commission for Aeronautics)
i) DO-260 (Minimum Operational Performance Standards for 1090 MHz ADS-B),
iii) DO-260B (Minimum Operational Performance Standards for 1090 MHz Extended Squitter ADS-B and TIS-B),
iv) DO-259 [Applications Descriptions for Initial Cockpit Display of Traffic Information (CDTI) Applications].

4.3 ADS-B Avionics Operating Modes

4.3.1 ADS-B OUT: The transmission of ADS-B information from aircraft is known as ADS-B Out.

4.3.2 ADS-B IN: The receipt of ADS-B information by an aircraft is known as ADS-B In.

5 Operational Requirement

5.1 ATS surveillance systems, such as primary surveillance radar (PSR), secondary surveillance radar (SSR) and automatic dependent surveillance — broadcast (ADS-B) may be used either alone or in combination in the provision of Air Traffic Services, including in the provision of separation between aircraft, provided:
   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.

5.2 ADS-B may be used alone 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.

5.3 Operation of ADS-B transmitters

5.3.1 To indicate that it 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:
   - emergency;
   - communication failure;
   - unlawful interference;
   - minimum fuel; and/or
   - medical emergencies.

Note: Some aircraft equipped with first generation 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.
5.3.2 Aircraft equipped with ADS-B having an aircraft identification feature shall transmit the aircraft identification as specified in Item 7 of the ICAO flight plan or, when no flight plan has been filed, the aircraft registration.

5.3.3 Whenever it is observed on the situation display that the aircraft identification transmitted by an ADS-B-equipped aircraft is different from that expected from the aircraft, the pilot shall be requested to confirm and, if necessary, re-enter the correct aircraft identification.

5.3.4 If, following confirmation by the pilot that the correct aircraft identification has been set on the ADS-B identification feature, the discrepancy continues to exist, the following actions shall be taken by the controller:

a) inform the pilot of the persistent discrepancy;

b) where possible, correct the label showing the aircraft identification on the situation display; and

c) notify the next control position and any other unit concerned of the erroneous aircraft identification transmitted by the aircraft.

5.4 ADS-B Identification Procedures

5.4.1 Where ADS-B is used for identification, aircraft may be identified by one or more of the following procedures:

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

b) transfer of ADS-B identification;

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

5.5 Separation minima for ADS-B systems

5.5.1 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
5.6 **ADS-B Phraseology**

5.6.1 Phraseologies to be used for ADS-B has been provided in Chapter 12, of MATS Part 1. However, for quick reference phraseologies have been reproduced below:

<table>
<thead>
<tr>
<th>CIRCUMSTANCES</th>
<th>RADAR PHRASEOLOGY</th>
<th>ADS-B PHRASEOLOGY</th>
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<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 un-serviceability</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 MODES 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>
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6 **Training**

6.1 Since ADS-B is one of the surveillance systems and used for the provision of air traffic control service, procedure contained in Chapter 8 of MATS Part 1 shall
also be applicable to ADS-B. ADS-B Training and Rating Endorsement of ATCOs will be governed by AAI/ATM/HRD/29-12/2013 dated 20th June 2013.

7 ADS-B Security-related Vulnerabilities and Mitigation Measures

7.1 All ADS-B technologies are currently defined as “open systems”. The data, including position and flight identification are broadcast by aircraft and can be received by any airborne or ground based receiver. The signal and transmitted data are fully standardized and those standards are public. This situation is not specific to ADS-B and is very similar for other civil aviation CNS technologies.

7.2 It can also be noted that ADS-B transmission from commercial aircraft is a “fact of life” today. Many commercial aircraft are already equipped with ADS-B and have been transmitting data for some time. DGCA Operational Circular 17/2014 on the subject: “Automatic Dependent Surveillance-Broadcast (ADS-B) Operations and Operational Authorization”, states that the intent of this operations circular (OC) is to facilitate operations using Automatic Dependent Surveillance-Broadcast (ADS-B) technology. This OC applies to all Indian aircraft and operators intending to use ADS-B. India does not mandate ADS-B equipage at this time, however ADS-B ground infrastructure has been set up for implementation of ADS-B operations in Indian airspace. ADS-B shall be used for the provision of Air Traffic Services, including ‘radar-like’ separation. The Automatic Dependent Surveillance Broadcast “(ADS-B) OUT” transmissions on 1090MHz Extended Squitter (1090ES) data link will be used for provision of ATS surveillance services to eligible aircraft within notified portions of Indian airspace(s).

7.3 The nature and complexity of ATC provides for adequate mitigation to the security related issues, for which ICAO APAC has issued “GUIDANCE MATERIAL: SECURITY ISSUES ASSOCIATED WITH ADS- B. The primary objective is uniform adoption of the mitigation measures suggested in the Guidance Material which the ATS Surveillance and Automation Systems are capable of.

7.4 The security related vulnerabilities have been mainly classified as related to Confidentiality, Integrity and Availability. Confidentiality is the property that information is accessible only to those authorized to have access. Integrity is the property that data cannot be created, changed or deleted without authorization. Availability is the property that aircraft information is available to the ATM system/unit when needed.

7.5 Confidentiality

7.5.1 “Confidentiality” needs to be balanced against a significant intent of ADS-B; namely to allow all airspace users have visibility of all other airspace users.

7.5.2 Since the flight number and position of aircraft are available to the public, due to the open architecture of ADS-B, Controllers should be aware that procedures to the open architecture of ADS-B, Controllers should be aware that procedures to support sensitive flights to use different flight identities, may be developed and made applicable by security agencies/DGCA from time to time.
7.5.3 It is also pertinent to note that military flights may use DF19 (Military Extended Squitter) encrypted ADS-B transmissions, in future or DF 22 (Military use only) and Mode 5 [secure/crypto]. Controllers should keep themselves abreast of the regulatory provisions in force, from time to time.

7.5.4 Since, the unique 24 bit code identifies the aircraft and is available to the public, sensitive and military flights, which have the capability to switch off ADS-B may require special handling. Controllers should be aware that military flights may not carry ADS-B on board or switch off ADS-B in order to conceal the unique 24 bit code which uniquely identifies the aircraft. The provisions of PANS ATM (Doc4444) to apply appropriate separation between ADS-B tracks and non-ADS-B tracks, which may be Radar tracks or flight plan tracks, should be ensured by the Controllers.

7.5.5 Due to a threat perception regarding the use of position and aircraft ID data for the coordination of attacks against specific airborne targets (e.g. VIP), the flights operating on special missions, such as carrying VIPs on board may be allowed, by appropriate authority and/or the regulator, the use of different 24 bit codes. ATC Supervisors, Controllers and DBMS Managers should be aware of these provisions.

7.5.5 In order to mitigate the use of position and aircraft ID data for economic intelligence: surveillance of business aircraft or commercial aircraft, DGCA may prescribe procedures to support sensitive flights to use different flight identities. Controllers should be aware of such procedures prescribed, from time to time.

7.6 Integrity

7.6.1 Transmission of false messages from virtual aircraft (spoofing) and the risk of false alarms (STCA), false traffic information, spurious separation manoeuvres, thereof is a vulnerability related to integrity.

7.6.2 However, the fact that ATS Automation Systems (at the ATCCs) are capable of multiple surveillance sensor processing, providing the capability to fuse PSR/SSR and ADS-B tracks. The DBMS Managers/ Operational supervisors shall ensure that the Controllers are suitably updated about the availability/non-availability of PSR/SSR inputs either through systems alerts or through notices or both.

7.6.3 In addition, the ATS Automation systems installed at various ATC Centres are capable of identifying and differentiating a track with an aircraft ID different from that in an FPL.

- identifying and not correlating a FPL track with an ADS-B track if the ADS-B track’s position is more than a specified variable parameter (say 10NM).
- After proper correlation provide Route Adherence Monitoring and raising Route offset alert, in case of an ADS-B track outside the lateral clearance limits.
- Providing alerts in case of DUP ID
• Not updating flight plan if the surveillance position report off the route is beyond acceptable parameter(s).
• Providing level burst (LB) alert if the ADS-B track is outside the vertical clearance limits.
• Addressing Positional data “jumps” in a multi sensor surveillance processing environment and thereby providing the “reasonableness check”.
• Identifying an ADS-B track which is more than 0.5NM in position from a Radar track and not fusing the same, thus raising an alert.
• Not displaying ADS-B tracks with integrity value (NUCp) less than 5.
• Providing the Controller with the option to choose the associated FPL in case of multiple FPLs with the same callsign, and allow manual correlation.
• Not coupling ADS-B track data to a flight plan if the track arrives into coverage at an unexpected position or arrives into coverage at an unexpected time, or without coordination.

7.6.4 ATC Voice reports, CPDLC position reports, SSR and ADS-C surveillance backup provide a definite method to correlate the ADS-B track. In case of ambiguity regarding an ADS-B track, the Controller shall obtain through voice position reports, similar to identification of PSR tracks, the VOR Radial and distance from the DME to verify the ADS-B derived information. The ADS-B information obtained from the Port Blair ADS-B receiver, should be verified through ADS-C position reports or through CPDLC.

7.6.5 The multiple surveillance environment permits the comparison between PSR/SSR tracks and ADS-B tracks, in case of ambiguity and thus validate the range of the aircraft. The DBMS Managers and the Controllers shall be aware of these features and the Controllers should check the functionalities at least once during their assuming a Controller work position. The Operational Supervisor shall monitor the system for these functionalities and immediately report any anomaly to the DBMS team. Whereas, the automated tools are adequate to warn controllers of potential hazards, it is important to employ the tools effectively to mitigate the threats.

7.6.6 Although the vulnerability of alteration of messages during their transmission between the ground stations and the ATM system, is a theoretical possibility, in India, most of the ADS-B ground receivers are installed within the premises of the ATC Technical Building. The data received by the ADS-B antenna is transferred through physical media (LAN cable) to the equipment room situated in the same building and from there it is transmitted again through physical media to the ATS automation system. The end to end systems are located within the sterile and secure airside area of airports, and the entry to the ATS-Technical building is restricted to authorized personnel. The CNS Engineers are required to secure the ADS-B receivers and the data transmission cables/lines so that the physical access is absolutely restricted to authorized personnel only.

7.6.7 From ADS-B stations such as Port Blair, ADS-B data is transmitted to the ATC Centres (to Chennai or Kolkata) through secure data transmission channels provided by BSNL, which is State owned and provides suitable security to the data transfer, as a service provider. The Technical Supervisor at these ATC...
Centres shall perform hourly checks by verifying the ADS-B derived information and SSR data when available, or alternately ADS-C derived position reports.

7.6.8 Although, the chances of alteration of ADS-B messages during their transmission between the ground stations and the ATM system is extremely improbable, the CNS engineers at the ATC Centre(s) should carry out periodic checks to ensure that there is no scope for alteration of ADS-B messages during their transmission.

7.6.9 Another integrity related vulnerability is the possible loss of aircraft visualisation on controller display due deleted messages. Appropriate protections are available for the security of ADS-B transmission network between Ground station and ATC Centre(s) and there is no possibility for deletion of ADS-B data before it reaches the ATS Automation system, which may lead to loss of aircraft visualization on SDD.

7.6.10 Doc 4444 clearly lists the separation to be applied between ADS-B tracks (surveillance separation minima) and between ADS-B and FPL tracks (procedural separation minima). Provision of traffic information to aircraft and use of flight progress strips (manual or electronic) is an additional mitigation measure. The Controllers should strictly adhere to the SARPS in the PANS – ATM (Doc 4444).

7.6.11 Controllers should further ensure that in NRA, there is a proper record of flight progress through paper or electronic strip markings, so as to enable a smooth transition from the application of surveillance based separation minima to procedural separation minima.

7.7 Availability

7.7.1 ATM systems and controllers typically have processes to be used following loss of surveillance and other information. These should take into account possible loss of ADS-B information for both malicious and inadvertent or accidental outages.

7.7.2 The jamming of a receiving ground station has an effect which is somewhat identical to ground station failure. In case of an unusual occurrence of jamming, Radar based surveillance may be continued in RAD environment and procedural control should be resorted to in NRA environment. In the event of jamming of GPS in a particular geographical area, Controllers should be aware that avionics are becoming available that meld GPS with inertial positional data to coast through. However, outages of a longer duration may result in loss of position information which is dependent on GPS.

7.7.3 In the event of spoofing, which has an effect, somewhat identical to ground station failure, ADS-B ground station (if data flooding occurs) should be disconnected.

7.7.4 In summary, from the ATC perspective, if any of the above mentioned events occur, use of ADS-B for ATC purposes shall be discontinued. ADS-B input from the sensor, which is the source of such events, to the ATS automation system
should be disabled immediately. The Controller shall warn aircraft under his/her control about the presence of a spurious ADS-B transmissions in the area and should be discouraged from using ADS-B IN functionalities, if the capability is so recorded in its flight plan.

7.8 Performance Monitoring and Reporting

7.8.1 The ATM and CNS in charge of the ATC Centres shall review the performance of ADS-B and prepare a quarterly report taking into consideration the following parameters:
   a) ADS-B ground receivers (each sensor) (serviceability/unserviceability) to provide availability information.
   b) The medium used for data transfer and data security
   c) Integration of ADS-B data into the ATS Automation system and period disabled, if any.
   d) Performance parameters to ensure integrity of ADS-B information in the ATS Surveillance (Automation) System, by verification through comparison with SSR data and/or voice report based on aircraft’s VOR/DME derived position information.

7.8.2 In brief, the quarterly report should contain details of downtime, anomalies, occurrence of spoofing, if any and the action taken on observing undesirable occurrences or non-adherence to prescribed performance parameters.

7.8.3 The quarterly reports should be analyzed by the ED (CNS) and ED (ATM) who shall in turn ensure that further measures are employed to mitigate the threats and enhance safe operations while using ADS-B information in providing ATS Surveillance Services.

8 Queries:

8.1 Any queries or further guidance required on the contents of this ATMC should be addressed to:
   Executive Director [ATM]
   Airports Authority of India
   Rajiv Gandhi Bhawan
   Safdarjung Airport
   New Delhi-110003
   E-mail: edatm@aai.aero

9 Validity:

9.1 This ATMC supersedes ATMC 2 of 2012 and will remain in force until further notice.

(P.K. Mishra)
EXECUTIVE DIRECTOR [ATM]
AIRPORTS AUTHORITY OF INDIA
Dated: 24-12-2014.