



Policy on upgradation of CNS/ATM infrastructure at airports

Version 1.0 – May 2022



भारतीय विमानपत्तन प्राधिकरण
AIRPORTS AUTHORITY OF INDIA

CERTIFIED TRUE COPY OF THE EXTRACT FROM THE MINUTES OF 208TH
BOARD MEETING HELD ON MAY 13, 2022

208.9 SEEKING APPROVAL OF AAI BOARD FOR "POLICY ON
UPGRADATION OF COMMUNICATION, NAVIGATION, SURVEILLANCE/
AIR TRAFFIC MANAGEMENT (CNS/ATM) INFRASTRUCTURE AT
AIRPORTS"

Shri J. B. Singh, GM (SQA & Nav Aids) made a presentation to the Board. He informed the Board that:

- (i) There are no specific guidelines for provision of CNS/ ATM facilities considering type of air traffic control units and air traffic movements at an existing or upcoming airport. To overcome above issues, a draft policy has been formulated;
- (ii) The objective of this policy is to provide guidance to both internal and external stakeholders about the provision of minimum CNS/ ATM infrastructure needed for Air Traffic Services considering airports of different sizes, air traffic movement densities and complexities;
- (iii) The policy defines a set of CNS/ATM and ancillary system requirements identified as the "Minimum CNS/ATM Infrastructure" required depending on the regulatory requirements, operational requirements of air traffic control units and air traffic movements at an airport. The policy covers other regulatory requirements for provision of CNS facilities such as Aerodrome Committee Control Room and Search and Rescue Centers etc. The policy also covers requirements of facilities for training and maintenance purposes;
- (iv) The requirement of CNS/ ATM Facilities at Airports will be reviewed between January to March every year in order to evaluate existing infrastructure as per present technology and to meet other requirements i.e. regulatory, organizational and local level. After review, any additional requirements will be placed before Board in the month of April every calendar year. Upgradation of airports from "Existing to Higher or Lower Type" will be reviewed every 03 years;
- (v) In the draft policy, airports are categorised in five categories, considering type of ATC Centre at an airport for provision of Air Traffic Services and Air Traffic Movements;

The Board discussed the matter and directed that:

(1) while considering the categorization of Airports, for this policy, on the basis of Air Traffic Movements, the maximum Air Traffic Movements during last three years shall be considered;

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(2) The requirement of CNS/ATM Facilities at Airports will be reviewed between January to February instead of January to March every year. After review, any requirements will be placed before Board in the month of March instead of April every calendar year.

After discussion, the Board passed the following modified resolution:

“RESOLVED THAT the Board appreciated the efforts taken to streamline the complex issue of CNS equipment upgradation and accorded approval of the Board for the “Policy on upgradation of CNS/ATM infrastructure at airports and the details of Airports categorized into A to E is as per Annexure-1 to these Minutes with minor change as above.”

Apil Agrawal

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1. Introduction

Air Navigation Service Provider (ANSP) of a country is responsible for safe, orderly & expeditious flow of Air traffic in a country. Airports Authority of India is the ANSP for Civil Aviation in India.

The provision of Air Traffic Service is a sovereign function. Airports Authority of India Act lists, as a function, the provision of Air Traffic Service (and Air Transport Service) at any airport and civil enclaves and includes in its applicability “all private airports in so far as it relates to providing air traffic service”. Whereas, the installation of CNS-Automation / ATM infrastructure at various ATC Centres which serve the airports (Aerodrome Control Services) and Approach Control Services which may include one or more airports within its jurisdiction or Area Control Services and Oceanic Control Services (Enroute Air Traffic Services) is principally guided by the ICAO Standards and Recommended Practices and the DGCA Civil Aviation Requirements which provide for the national legislation of the ICAO SARPs.

CNS-Automation / ATM infrastructure at an airport are designed, provided and operated to primarily accomplish Safety of flight, Expeditious movement of aircraft, Efficient operation, Access and Equity, Global interoperability and Security with respect to civil aviation.

The use of airport facilities, the design and operation of the CNS-Automation /ATM facilities, the flight rules and procedures employed, and the conduct of operations are all guided by the principle that safety is the first consideration. Without compromising safety, the second goal is to permit aircraft to move from origin to destination as promptly and with as little interference as possible. This involves preventing conflicts between flights, avoiding delays at airports or en-route, and eliminating inefficient or circuitous flight paths. It also entails making maximum use of airport and airway capacity in order to satisfy demand, so long as safety is not compromised. The third goal is to provide airport and Air Traffic Services at low cost. This entails minimizing the costs to users—not only monetary costs but also the penalties of delay, inconvenience, or undue restriction. While safety cannot be compromised in the interest of cutting of costs, capacity and cost can be traded off for the sake of safety.

In this regard it may be noted that for efficient operations, the provision of CNS/ATM facilities at an airport also depends on number and type of air traffic. For efficient operations, requirements such as multi runway operations, redundant and multilayer Communication and Surveillance facilities are also to be considered for airport and en-route flights. For all weather operations, precision and non-precision approach operations are to be considered. Similarly, category of ILS in operation also has to be considered as per the visibility requirement and other supporting infrastructure available at the airport.



Currently CNS/ATM facilities are provisioned as per guidelines mentioned in **ANS Procurement Manual**. As per these guidelines, the indent for provision of new facilities, replacement of equipment/system, expansion of existing system or induction of new technology at existing or new airport is placed by Directorate of Air Traffic Management or by Directorate of CNS-OM to the Directorate of CNS-Planning after obtaining approval of Member (ANS).

In some cases, the requirement for provision of new facilities at a particular airport is received from aircraft operating agencies, through the regulator or to meet international commitments either directly or through airport concerned. In such cases too, an approval is required to be taken from Member (ANS).

This policy document defines a set of CNS/ATM and ancillary system requirements identified as the “Minimum CNS Infrastructure” required at an airport depending on the operational requirement. The objective of this document is to provide guidance to both internal and external stakeholders about the provision of minimum CNS-Automation/ATM infrastructure needed for Air Traffic Services considering airports of different sizes, air traffic movement densities and complexities.

This suggested guidelines in this document need to be read in tandem with extant and applicable laws and regulations. In case of any inconsistency therein, the provisions of the air regulations shall prevail. Furthermore, decisions taken by the Ministry of Civil Aviation and the AAI Board or in the bilateral agreement between AAI and Airport Operators shall take precedence over the guidelines provided in this document.

The guidelines given in this document are subject to review from time to time due to various reasons such as: -

- (i) Change in regulatory requirements;
- (ii) To meet new or additional operational requirements; and
- (iii) Change in Technology etc.

- 1.1 **Approval of policy:** - The policy has been approved by AAI Board in its 208th Meeting held on 13th May 2022.
- 1.2 **Review of policy** – The requirement of CNS/ATM facilities at airports will be reviewed between January and February every year. After review, any requirement will be placed before board in month of March. Further guidelines for policy review are given in Para 4.1.2 of policy.
- 1.3 **Responsibility for review** – The policy will be reviewed by Executive Director [ATM] / [ASM] and Executive Director CNS-P/II. The General Manager [ATS] will be responsible for convening review meetings.



2. GLOBALLY ACCEPTED AND HARNESSSED CNS/ATM TECHNOLOGIES:

2.1 Communication

Very High Frequency Radio Telephony has been the backbone of Direct Controller Pilot Communication. Initiatives, nevertheless, are being taken to support data link as a secondary means of controller-pilot communication while continuing the provision of voice communications for tactical interventions and non-routine communications. CPDLC (Controller Pilot Data Link Communications) coupled with ADS-C (Automatic Dependent Surveillance – Contract) has been increasingly used to effectively manage vast airspaces over the Arabian Sea, Indian Ocean and Bay of Bengal by Mumbai, Chennai and Kolkata OCCs (Oceanic Control Centre). Pre-millennium these remote airspaces were best managed through a third-party communication, i.e., HFRT (High Frequency Radio Telephony) which had limited the Air Traffic Services to Air Traffic Advisory Service and Flight Information Service. In the metro ATCCs and the major ATCCs such as Bengaluru and Hyderabad, PDC (Pre-Departure Clearances) are enabled through DCL (Departure Clearance) and/or ACARS (Aircraft Communication Addressing and Reporting System). The migration from voice to digital text communication between ATC and the FMS enables significant reduction in the safety issues arising out of “read-back hear-back” errors.

ICAO Doc 9869 - PBCS Manual contains non-prescriptive (equipment) performance-based standards for Communication dovetailed to PBN (Performance Based Navigation), however, it is limited to remote and oceanic region applications and has not attempted provisions for continental airspace applications.

2.2 Navigation

Conventional navigational equipment like DVOR/DME & ILS/LPDME are used at airports. The implementation of vertically guided approaches based on Performance-based Navigation (PBN) concept was decided in ICAO General Assembly A37-11. The inertia in migrating from terrestrial aids based non-precision approaches in a significant number of airports, with precision approaches mostly at airports with HIRO (High Intensity Runway Operations) and/or challenged by complexities including weather phenomenon leading to low visibilities and access to airport issues, to GNSS based RNP APCH procedures with Baro-VNAV which provide vertical guidance to pilots is a matter of concern for both airlines and the ANSPs. The latter may do well to enable aircraft operations at several airports which are not equipped with ILS, by introducing PBN procedures, in collaborative participation from Airlines, without which the time and resources spent on procedure design will not bear any returns or tangible benefits.

The migration is a slow weaning process through ANSP-Airlines CDM which will result in progressive rationalization of NDBs and VORs. However, some of the VOR approaches may be kept as a backup to the GNSS procedures since outages should not result in disruptions.



Furthermore, the vulnerability of satellites owing to successful “Anti-satellite Weapons Testing” should be factored at a strategic level by the ANSPs and retain some of the terrestrial Nav-aid based approach procedures given the fragility of geopolitics.

2.3 Surveillance

From closed architecture non-cooperative primary radar surveillance to cooperative secondary radar surveillance, to open architecture ADS-B (Automatic Dependent Surveillance Broadcast) with ground-based receivers and now the augmentation through a service provider space-based ADS-B, India has a well-organized and networked surveillance systems. Identification of any of the many surveillance sensors which enhance the quality of Air Traffic Services within the volume of airspace over which ATC exercises control and jurisdiction has been well conceived and executed. However, when the surveillance sensors are used on a stand-alone mode, it is important to plan the services in consultation with the users, viz., the airlines, since the surveillance services in such cases are provided only to equipped aircraft and they are in turn separated from other aircraft which are not equipped only using higher separation minima standards prescribed in ICAO PANS ATM (DOC 4444).

Space-based ADS-B has been provided especially for situational awareness over the remote oceanic region, and integrated into the ATS Automation System of Chennai, Mumbai and Kolkata ATCCs for the benefit of OCC (Oceanic Control Centre) Controllers. In the Oceanic Region, ADS-C (Automatic Dependent Surveillance – Contract) is available subject to establishment of a contract between the equipped aircraft and the ATCC, through a third-party Communication Service Provider (CSP), [SITA].

2.4 ATS Automation System

ATS Automation Systems (ATSAS) play an important role in Air Traffic Management. The ATSAS provide either an FDPS (Flight Data Processing System) or an FDPS cycling with an SDPS (Surveillance Data Processing System), additionally equipped with Safety Nets and Decision Support Tools (DST) to enable the Air Traffic Control effectively perform their tasks.

The ATSAS equipped with SDPS are capable of multiple surveillance sensor integration with the capability tailor made to the functionality required at an ATC Centre. The Air Situation Display (ASD) interchangeably called as Situation Data Display (SDD) provides a graphical/visual representation of the air traffic within the designated airspace(s).

Note: More Details of CNS/ATM equipment and their functionalities is attached as **Annexure VIII of this policy document.**



3. ATC CENTRES [ATCC] AND AIRPORTS

Provisioning of CNS/ATM systems should meet operational requirements of ATC Centres and airports to which they are predicated as described below: -

3.1 ATC Centres

ATC Centres, from time-immemorial have been '*in-situ*' and predicated to airports. ATC Centres provides Air Traffic Services within Flight Information Region subject to airspaces assigned under its control and jurisdiction and in adherence to the expected levels of service. Airspace Classifications, A to G (Refer ICAO Annex 11/Annex 2/Doc 4444) mandate different types and levels of service. An ATCC may have any of the following ATS Units.

1. Aerodrome Control Tower
2. Surface Movement Control
3. Clearance Delivery
4. Approach Control Unit
5. Area Control Centre
6. Oceanic Control Centre.
7. ATS Reporting Office

In addition, it should be noted that Alerting Service and Flight Information Services are provided as a part of the Air Traffic Services by the ATS Unit under whose control and jurisdiction a flight is. The ATC Services specific to an airport are the Aerodrome Control Services which may, subject to high density/ intensity operations result in the establishment of a separate Surface Movement Control and/or a Clearance Delivery. The Approach Control Services may either be provided to one or more airports within the Control Zone or airspace designated to be controlled by that Approach Control Unit. It is a matter of principle that the costs for the provision of Aerodrome and Approach Control Services (apportioned if it involves more than one airport) may be recovered by the ANSP.

Information Communication Technology [ICT] Revolution has ensured that ATC no longer needs to be provided the old school way, i.e., *in situ* ATCC. Remote Air Traffic Services which is discussed in detail in ICAO Aviation System Block Upgrades (ASBU) document and the Digital Remote Virtual Towers as well as the ability to transport surveillance data to any location through different electronic media point to a paradigm shift which is likely to be seen in future.



3.2 Airport categorisation

Considering type of ATC Centre at an airport for provision of Air Traffic Services, Airports are categorised as given below: -

- a) Air Traffic Services which are intended to provide both en-route, either Upper ACCs (UACC) or Lower (LACCs) and Terminal Surveillance Based Air Traffic Services. (Type A & B).
- b) Air Traffic Services which are intended to provide Air Traffic Services with Surveillance Based Approach Control Services & Aerodrome control services (Type C), Aerodrome and Procedural Approach Control Services (Type D), Only Aerodrome Control Services including Aerodrome Control Services at VFR airports. (Type E).

Along with ATC units as mentioned above, Air Traffic Movements is an important criterion for deciding Category of services at any particular airport. For any new/upcoming airport, predicted Air Traffic Movement (*Either in DPR of airport or by any reputed agency like IATA etc or by AAI*) is an important criterion for deciding Category of services.

Considering above, example of Categorization of airports are as given below: -

TYPE	ATC UNIT	DESCRIPTION	AIRPORTS (For example)
A	AIRPORTS SERVED BY THE METRO ATCC	Airports which are served by Metro ATCCs and include both Enroute and Terminal Approach/Tower Services, having ATS Units such as FIC, OCC, Upper and Lower ACC, Approach, Aerodrome, SMC, Clearance Delivery Position	CHENNAI MUMBAI KOLKATA DELHI
B	AIRPORTS SERVED BY THE ATCC WITH LACC+	Airports which are served by Major ATCCs and include both Enroute and Terminal Approach/Tower Services, having ATS Units such as Lower ACC, Approach, Aerodrome, SMC, Clearance Delivery Position	BENGALURU HYDERABAD(S) NAGPUR AHMEDABAD GUWAHATI TRIVANDRUM MANGALORE LUCKNOW JAIPUR VARANASI BHUBANESWAR PATNA...etc



C (Daily Air Traffic Movement >100) ##	AIRPORTS SERVED BY ATCC WITH SURVEILLANCE APPROACH + ADC	Airports which are served by ATCCs and include only Terminal Approach/Tower Services, having ATS Units such as Surveillance based Approach & Aerodrome Control Services (SMC, Clearance Delivery Position to be considered subject to traffic density)	TRICHY COIMBATORE.... etc
D (Daily Air traffic movement >50 <100) ##	AIRPORTS SERVED BY PROCEDURAL (NON-SURV) APPROACH + ADC	Airports which are served by ATCCs and include only Terminal Approach/Tower Services, having ATS Units such as Procedural (non-surveillance) based Approach & Aerodrome Control Services (SMC, Clearance Delivery Position to be considered subject to traffic density)	INDORE VIJAYWADA MADURAI.... etc
E (Daily Air Traffic Movement < 50) ##	AIRPORTS SERVED BY ADC (ONLY AERODROME CONTROL TOWER)	Airports which are served by ATCCs and include only Aerodrome Control Services or where approach control Service is combined with Aerodrome Control Service. (SMC, Clearance Delivery Position to be considered subject to traffic density)	LILABARI SHIMLA KULLU... etc

Note: While considering the categorization of Airports, on the basis of Air Traffic Movements, the maximum Air Traffic Movements during last three years shall be considered. List of airports categories as above and approved by AAI Board is attached with this policy as Annexure -I.

Whereas, the Communication systems including the VCCS (Voice Communication Control System), AFTN, AMSS etcetera and ATS Automation systems into which they are integrated are predicated to the ATCC and the ATS Units. VHF Communication Frequencies, Navigational Aids and Surveillance Systems are predicated to the Airports in the case of Terminal Services or suitable additional locations in the case of Enroute Services. Besides airports, CNS facilities are also required to be installed at en route stations also to meet efficient air space management requirements.

4. Policy Guidelines on provision of CNS/ ATM equipment at airports

This section provides guidelines for provision of minimum CNS/ATM infrastructure for Air Traffic Services at Indian Airports. In order to accomplish this, the CNS/ATM facilities to be provided at an airport may be predicated on the following factors:

- I. Safe & efficient air traffic operation.
- II. Globally accepted & harnessed CNS- ATM technologies.
- III. Regulatory requirements.
- IV. Various committee reports.
- V. Type of Airport –Green field or Brown field, International or Domestic, RCS Airports, Civil or Military Joint User Airport,



- VI. Type of Air Traffic Services.
- VII. Air Traffic Movements/Density.
- VIII. All Weather Operation Requirements, especially the requirements of access to an airport in conditions of low visibility.
- IX. Complexities in an airport especially owing to terrain challenges

4.1 CNS elements mapped to the Categories of Airports

Considering International (ICAO Annexes / DOCS) & National (CARs) regulatory requirements, technologies available, recommendations of various committee, synchronising AAI plan with Global plan for provision of CNS & ATM infrastructure, CNS & ATM systems are mapped to airports as below:

- a) CNS & ATM Facilities as per category of Airports.
- b) Communication Facilities at alternate ATC Sites at airport.
- c) Ancillary facilities at airports.

4.1.1 CNS & ATM Facilities as per category of Airports:

TYPE	COMMUNICATION	NAVIGATION	SURVEILLANCE	AUTOMATION
A	*HF: RDARA/MWARA	ILS and VOR/DME, (Number & Category of ILS as per Runway configuration & visibility minima requirements)	*PSR/ MSSR, *ADS-B/ADS-C *ASMGCS *Space Based ADS- B in OCCs. Note: - Provision of Surveillance System redundancy /Level and ASMGCS as per guidelines in Annexures II.	*Integrated ATM Automation System, *ADS/CPDLC, * ATC (Radar and Procedural) Simulators for training of ATCO *C-ATFM workstations Note: - Provision of ATM Automation System as per guidelines in Annexure II
	*International NOTAM office			
	* VHF for ATS units			
	*Emergency frequency			
	VIP OPS discrete frequency at Delhi ATCC	PROGRESSIVE SHIFT TO PBN PROCEDURES		
	DCL			
	DATIS			
	AMSS/AMHS, ASBS	GBAS/SBAS PROCEDURES Note: - Provision of Radio Nav aids as per guidelines in Annexure II		
	VCCS			
	CPDLC			
	DVR (Voice recorder)			
EBABX & Hot lines with related airports				
GPS Clock system				



	CCTV and Access Control for ANS installations.			
	VHF -FM Walkie Talkie Systems			
	Supporting IT and other Infrastructure like Desktop or Laptop with internet facility, MFD, UPS etc.			
	SWIM for Aeronautical Information Management (AIM)			
	<p>Remarks: -Presently provision of Performance Based Communication and Surveillance (PBCS) technologies are to be implemented at following OCCs:</p> <ul style="list-style-type: none"> • Chennai: SAT is completed, PDC: 30.04.2022 • Mumbai: Work in progress, PDC: 30.09.2022 • Kolkata: Will be taken up for implementation with ATM Automation system project at new ATS complex. 			
B	<p>*VHF for ATS units</p> <p>*Emergency frequency</p> <p>*DATIS</p> <p>*DCL</p> <p>*AMSS</p> <p>*VCCS</p> <p>*DVR (Voice recorder)</p> <p>*EBABX & Hot lines with related airports</p> <p>*GPS Clock system</p> <p>*CCTV and Access Control for ANS installations.</p> <p>*VHF -FM Walkie Talkie Systems</p> <p>*Supporting IT and other Infrastructure like Desktop or Laptop with internet facility, MFD, UPS etc.</p> <p>*SWIM for Aeronautical Information Management (AIM)</p>	<p>ILS and VOR/DME, (Number & Category of ILS as per Runway configuration & visibility minima requirements)</p> <p>PROGRESSIVE SHIFT TO PBN PROCEDURES</p> <p>GBAS/SBAS PROCEDURES</p> <p>Note: - Provision of Radio Nav aids as per guidelines in Annexure-II & XII</p>	<p>*PSR/MSSR, *ADS-B</p> <p>*SMR/ASMGCS, (if required.</p> <p>Note: - Provision of Surveillance System redundancy /Level and SMR/ASMGCS as per guidelines in Annexures-II</p>	<p>*Integrated ATM Automation System,</p> <p>*ATC (Radar and Procedural) Simulators for training of ATCOs.</p> <p>*C-ATFM workstations</p> <p>Note: - Provision of ATM Automation System as per guidelines in Annexure II</p>



<p>C</p>	<p>*VHF for ATS units *Emergency frequency in accordance with guidelines in Annexure-II *DATIS *AMSS/RWS *VCCS *DVR (Voice recorder) *EBABX & Hot lines with related airports *GPS Clock system *CCTV and Access Control for ANS installations. *VHF -FM Walkie Talkie Systems *Supporting IT and other Infrastructure like Desktop or Laptop with internet facility, MFD, UPS etc.</p>	<p>ILS and VOR/DME, (Number & Category of ILS as per Runway configuration & visibility minima requirements) PROGRESSIVE SHIFT TO PBN PROCEDURES GBAS/SBAS PROCEDURES Note: - Provision of Radio Nav aids as per guidelines in Annexure-II and XII</p>	<p>*PSR/MSSR *ADS-B * SMR/ASMGCS, if required. Note: - Provision of Surveillance System redundancy /Level and SMR/ASMGCS as per guidelines in Annexure-II</p>	<p>*Integrated ATM Automation System. *C-ATFM workstation Note: - Provision of ATM Automation System as per guidelines in Annexure II</p>
<p>D</p>	<p>*VHF for ATS units *DATIS (As per recommendation of the committee, Ref. Annex VII) *Emergency frequency in accordance with guidelines in Annexure-II. *AMSS/RWS *VCCS *DVR (Voice recorder) *EBABX & Hot lines with related airports *GPS Clock system *CCTV and Access Control for ANS installations. *VHF-FM Walkie Talkie Systems *Supporting IT and other Infrastructure like Desktop or Laptop with internet facility, MFD, UPS etc.</p>	<p>ILS and VOR/DME, (Number & Category of ILS as per Runway configuration & visibility minima requirements) PROGRESSIVE SHIFT TO PBN PROCEDURES GBAS/SBAS PROCEDURES) Note: - Provision of Radio Nav aids as per guidelines in Annexure II & XII</p>	<p>Not required</p>	<p>Tower ATS Automation System Note: - Provision of ATM Automation System as per guidelines in Annexure-II</p>
<p>E</p>	<p>*VHF for ATS units *DATIS (As per recommendation of the committee, Ref. Annex VII)</p>	<p>ILS (optional) and ILS and VOR/DME, (Number & Category of ILS as</p>	<p>Not required</p>	<p>Tower ATS Automation System Note: - Provision of ATM Automation System as per</p>



	<ul style="list-style-type: none">*Emergency frequency in accordance with guidelines in Annexure-II*AMSS/RWS in accordance with guidelines in Annexure-II*VCCS (optional/requirement basis)*DVR (Voice recorder)*EBABX & Hot lines with related airports*GPS Clock system*CCTV and Access Control for ANS installations.*VHF-FM Walkie Talkie Systems*Supporting IT and other Infrastructure like Desktop or Laptop with internet facility, MFD, UPS etc.	<p>per Runway configuration & visibility minima requirements)</p> <p>PROGRESSIVE SHIFT TO PBN PROCEDURES</p> <p>GBAS/SBAS PROCEDURES)</p> <p>Note: - Provision of Radio Nav aids as per guidelines in Annexure II & XII</p>		guidelines in Annexure -II
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Note 1: Guidelines for provision and equipage of Aerodrome Committee Control Room (ACCR) Central Committee Control Room and Committee of Secretaries on Aircraft Hijack (COSAH), New Delhi are attached as Annexure-III

Note 2: Guidelines for provision and equipage of Search and Rescue centres are attached as Annexure-V.

Note 3: Transition from terrestrial Nav aids/Surveillance to celestial Nav aids/Surveillance (e.g. PBN, RNP, SBAS-GAGAN etc.) and procedures predicated to them shall be resorted to, for enhancing safety and efficiency whilst reducing cost to ANSP.

Note 4: Consideration for provision of ILS at Airports: Requirement of ILS at the airports is to be assessed as per decision taken in the meeting of fog and IMD issues [Refer Annexure XII] and as per CNS/ATM agreement for non-AAI airports.

Note 7: Provision of DVOR/DME may be reviewed after necessary changes in CAR provisions for airport licencing. AAI has requested DGCA, to accept PBN routes/RNP approaches instead of NDB and VOR requirement for licencing of public use airport.

Note 8: CNS/ATM Systems, Simulators [Aircraft, Radar and procedure] and ancillary systems are required to be provided in addition to airports for training of ATCOs/ATSEPs at Training Centres and Hot Mock-ups for maintenance of CNS Systems at Specialised Maintenance Units [SMU]. If more than 10 CNS equipment's are procured, two additional equipment, one for SMU (maintenance purpose) and one for CATC (training purpose) should be considered for procurement, if similar make and model is already not available.

Note 9: Necessary infrastructure like special test equipment, tools, drawing section equipped with plotter, AutoCAD software system, simulation software, etc. for in house installation unit for CNS Facilities



(i.e. RCDU) & AFIS fitted aircrafts at Flight Calibration Unit for mandatory flight check of navigational aids should be provisioned.

4.1.2 Guidelines for review of policy

4.1.2.1 Type A Airport: These airports are fixed and dependent on provision of ATS and its architecture, independent of airport and intensity of the airport operations. A review of the equipage at these airports shall be done in case of technological advancement or if there is a mandate from ICAO/DGCA for installing a new/additional equipment.

4.1.2.2 Type B Airport: These airports are partly dependent on ATS architecture and partly on local requirements. These are presently fixed and would be reviewed every 3 years in the month of January by concerned ASM/ATM directorates. Any change or no-change, would be brought to notice of AAI Board for a decision. Concerned directorate would also mention whether CNS/ATM equipment's are adequate or not as per present technology. The shortages/ gaps are to be mentioned. Upgradation, if required will be done as per technical and financial feasibility. Local requirement would be changed as per traffic density, number of RWYs etc which will be reviewed every year in the month of January/February, so that a decision can be taken by the month of March for procurement during the next financial year.

4.1.2.3 Type C Airport: Airports having an average daily air traffic movement of 100 or more shall be equipped with ADS-B for Approach Surveillance Services. The requirement of Radar at an ADS-B equipped airport should be assessed on the basis of traffic density as well as the percentage of compliant aircraft movements. When the average daily air traffic movement at such airports, considered over a period of one year, exceeds 200 and expecting further traffic growth, provision shall be made to have PSR/MSSR for Approach Surveillance Services at these airports. If the percentage of non-ADS-B equipped aircraft movement at airports providing ADS-B based Approach Surveillance services which has less than 200 daily air traffic movements, is more than 40 percent of the daily total movement, then the additional provision of PSR/MSSR may be considered.

4.1.2.4 Change of Category of Airport (including Type "D" and "E"): - Depending on air traffic movements (existing or predicted), change in category of airport type is to be considered during review every year.

4.1.2.5 NDB: Alternate RNP procedures are to be developed to phase out NDBs. The requirement of both NDBs as well as DVOR/DME, if felt necessary, is to be re-assessed [Refer Annexure XII].

4.1.2.6 Whenever CNS/ATM equipment are planned, the cost of land should be kept in mind. Focus should be more on use of technology with minimum requirement of land.

4.1.3 CNS Facilities at alternate ATC Sites at airport

For contingency planning, all airports are required to have alternate ATC Site. Following minimum facilities will be provided at alternate ATC Site:

- i. ATM automation system as per the contingency plan of the station at Type A and B category of airports.
- ii. Tx/Rx for required operational VHF frequencies as per the Contingency plan of the concerned airport (*including DATIS at major airports [type A, B and C]*).
- iii. VHF-FM Walkie Talkie Systems.



- iv. Telephones (Fixed/mobile) and EPABX extension number.
- v. Any other facility as per contingency plan of airport

4.1.4 Ancillary Facilities at airports

- (i) Telecom & IT Facilities with internet/intranet facilities for operational and administrative works at CNS/ATS Units at airports are to be provided as per AAI Telecom and IT policy as amended from time to time.
- (ii) Lightning, Surge Protection and earthing systems are to be provided as per CNS Manual as amended from time to time on the subject.
- (iii) Power Supply to the CNS/ATM Facilities to be provided as per CNS Power Supply policy as amended from time to time.
- (iv) Test Equipment's as per the equipment manufacturer recommendation.

4.2 Other considerations

- (i) The CNS/ATM infrastructure already provided in Joint use airports may be continued to be governed by existing MoUs and future cases will be handled case by case, based on the need analysis and cost benefit analysis based on the TNLC which may accrue to AAI at that station.
- (ii) The Policy pertaining to CNS/ATM infrastructure at the un-served and under-served airports under the Regional Connectivity Schemes shall be governed by the NCAP-RCS policies and any given MoU between the Ministry of Civil Aviation, AAI and concern state govt. or airport operator as the case may be.
- (iii) Guidelines for provision of CNS/ATM Facilities at AAI and Non- AAI RCS airports are as per Dte of ATM ION AAI/ATM/OPS/30-233/2017 Dated 17/03/2017 and Dte. of CNS letter no NM-19023/7/2017/CNS-O &M/ Dated 30/03/2017. (Refer Annex IV)
- (iv) Normally a RCS airport operates under a Day VFR license which necessitates no NAVAIDs needed even for non-precision approaches and no surveillance elements. The communication equipment and frequencies required for the provision of Aerodrome Control Services shall be, in principle, kept to a basic minimum.
- (v) The requirements for Heliports and Water Aerodromes may be developed separately and incorporated in future versions of this document.
- (vi) To meet operational or any other requirement, Member [ANS] can approve installation of any CNS/ATM facility at any airport or en route station.



Annexure-I

Annexure-1

(pertains to the minutes of Item No. 208.9)

Airport (Air Traffic Services provided by AAI) Categorization as per ATS units/Total Air Traffic Movements

Airport Category - 'A'

S. No.	Airport Name	ATS Units	Total Air Traffic Movement per month (As on March 2022) Please See Note
Southern Region			
1.	CHENNAI	ADC, APP+APP(S)[COMBINED], ACC, ACC(S), OCC	9918
Northern Region			
2.	DELHI	ADC, APP+APP(S)[COMBINED], ACC, ACC(S)	34842
Eastern Region			
3.	KOLKATA	ADC, APP+APP(S)[COMBINED], ACC, ACC(S), OCC	10982
Western Region			
4.	MUMBAI	ADC, APP+APP(S)[COMBINED], ACC, ACC(S), OCC	21419

Airport Category - 'B'

S. No.	Airport Name	ATS Units	Total Air Traffic Movement per month (As on March 2022) Please See Note
Eastern Region			
1.	BHUBANESWAR	ADC+APP(Combined), APP(S)	2078
2.	PATNA	ADC+APP(Combined), APP(S)	2459
Northern Region			
3.	AMRITSAR	ADC+APP(COMBINED), APP(S).	1498
4.	JAIPUR	ADC+APP(COMBINED), APP(S), ACC	3315

[Signature]
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Airports Authority of India
Rajiv Gandhi Bhawan
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New Delhi-110 003



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5.	LUCKNOW	ADC, APP, APP(S), ACC, ACC(S)	3333
6.	VARANASI	ADC, APP, APP(S), ACC, ACC(S)	1751
North Eastern Region			
7.	AGARTALA	ADC+APP(Combined), APP(S)	938
8.	GUWAHATI	ADC, APP+APP(S)[COMBINED], ACC, ACC(S)	3523
Southern Region			
9.	BENGALURU	ADC, APP+APP(S)[COMBINED], ACC, ACC(S)	16400
10.	COCHIN	ADC, APP+APP(S)[COMBINED], ACC, ACC(S)	4229
11.	HYDERABAD	ADC, APP+APP(S)[COMBINED], ACC, ACC(S)	12314
12.	MANGALORE	ADC+APP(Combined), APP(S), ACC, ACC(S)	1116
13.	TRIVANDRUM	ADC, APP+APP(S)[COMBINED], ACC, ACC(S)	1628
Western Region			
14.	AHMEDABAD	ADC, APP+APP(S)[COMBINED], ACC, ACC(S)	4872
15.	NAGPUR	ADC+APP(Combined), APP(S), ACC, ACC(S)	1631

Airport Category - 'C'

S. No.	Airport Name	ATS Units	Total Air Traffic Movement per month (As on March 2022) Please See Note
Southern Region			
1.	CALICUT	ADC, APP, APP(S)	1593
2.	COIMBATORE	ADC+APP(Combined), APP(S)	1268
3.	TRICHY	ADC+APP(Combined), APP(S)	807

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Airport Category - 'D'

S. No.	Airport Name	ATS Units	Total Air Traffic Movement per month (As on March 2022) Please See Note
Eastern Region			
1.	GAYA	ADC+APP(Combined)	85
2.	RAIPUR	ADC+APP(Combined)	1670
3.	RANCHI	ADC+APP(Combined)	1504
Northern Region			
4.	DEHRADUN	ADC+APP(Combined)	1545
5.	UDAIPUR	ADC+APP(Combined)	929
North Eastern Region			
6.	DIBRUGARH (MOHANBARI)	ADC+APP(Combined)	612
7.	IMPHAL	ADC+APP(Combined)	939
Southern Region			
8.	BELGAUM	ADC+APP(Combined)	514
9.	KANNUR	ADC+APP(Combined)	995
10.	MADURAI	ADC+APP(Combined)	780
11.	MYSORE	ADC+APP(Combined)	362
12.	RAJAHMUNDRY	ADC+APP(Combined)	638
13.	TIRUPATI	ADC+APP(Combined)	858
14.	VIJAYAWADA	ADC+APP(Combined)	1108
Western Region			
15.	AURANGABAD	ADC+APP(Combined)	292
16.	BHOPAL	ADC+APP(Combined)	1074
17.	INDORE	ADC+APP(Combined)	2050
18.	JUHU	ADC	1680
19.	SURAT	ADC+APP(Combined)	1390
20.	VADODARA	ADC+APP(Combined)	597

Airport Category - 'E'

S. No.	Airport Name	ATS Units	Total Air Traffic Movement per month (As on March 2022) Please See Note
Eastern Region			
1.	COOCHBEHAR	ADC	0

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2.	DURGAPUR	ADC	276
3.	JAGDALPUR	ADC	124
4.	JHARSUGUDA	ADC+APP(Combined)	382
5.	KUSHINAGAR	ADC	56
6.	PAKYONG	ADC	108
7.	BILASPUR	ADC	66
Northern Region			
8.	BHUNTAR	ADC	86
9.	GAGGAL	ADC	320
10.	HISAR	ADC	4
11.	KANPUR	ADC	196
12.	KHAJURAHO	ADC+APP(Combined)	24
13.	KISHANGARH	ADC+APP(Combined)	244
14.	LUDHIANA	ADC	6
15.	PANTNAGAR	ADC+APP(Combined)	160
16.	PITHORAGARH	ADC	44
17.	SAFDARJUNG	ADC	0
18.	SHIMLA	ADC	138
19.	KOTA	ADC	0
North Eastern Region			
20.	BARAPANI (SHILLONG)	ADC+APP(Combined)	254
21.	DIMAPUR	ADC+APP(Combined)	591
22.	LENGPUI	ADC+APP(Combined)	330
23.	LILABARI	ADC+APP(Combined)	126
24.	TEZU	ADC	46
Southern Region			
25.	AGATTI	ADC	158
26.	BEGUMPET (VOHY)	ADC	155
27.	HUBLI	ADC+APP(Combined)	406
28.	KADAPA	ADC+APP(Combined)	38
29.	KALABURAGI	ADC	190
30.	KURNOOL	ADC	104
31.	PUDUCHERRY	ADC+APP(Combined)	16
32.	SALEM	ADC	0
33.	TUTICORIN	ADC+APP(Combined)	220
34.	VIDYANAGAR	ADC+APP(Combined)	6
Western Region			
35.	BHAVNAGAR	ADC+APP(Combined)	88
36.	DIU	ADC+APP(Combined)	92
37.	JABALPUR	ADC+APP(Combined)	583
38.	JALGAON	ADC+APP(Combined)	4

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39.	KANDLA	ADC	148
40.	KESHOD	ADC	2
41.	KOLHAPUR	ADC+APP(Combined)	190
42.	MUNDRA	ADC	0
43.	NANDED	ADC	16
44.	PORBANDAR	ADC+APP(Combined)	8
45.	RAJKOT	ADC+APP(Combined)	560
46.	SHIRDI	ADC	412
47.	SHOLAPUR	ADC	0
48.	SINDHUDURG	ADC	62

Note:- Air Traffic Movement data as on March 2022 has been taken from CP & MS Dte and is available on AAI website link “ <https://www.aai.aero/en/business-opportunities/aa-traffic-news>”.

Legend:

ADC: Aerodrome Control

APP: Approach

APP(S): Approach with Surveillance

ACC: Area Control Centre

ACC(S): Area Control Centre (Surveillance)

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Annexure II

(A) General - The configuration & scalability of CNS/ATM systems will depend on the operational requirement of ATC Units/airport and provisioned accordingly. Given below are configuration and scalability of some of CNS/ATM system. Addition/deletion to these may be done to meet the specific operational requirement of an airport.

(A) Communication Systems: -

1. Provision of Emergency Frequency: - Emergency Frequency shall be provided at All ACC and International airports. At any other airport Emergency frequency can be provide to meet safety requirements.

2. Provision of Voice – ATIS- Voice ATIS shall be provided at: -

(i) Airports where Aerodrome Control Tower is providing Aerodrome Control and Surface Movement Control Service and has Air Traffic Movement [ATM] of more than 8 for any two hours within 24 periods daily on monthly average basis.

(ii) Airports where Aerodrome Control Tower is providing Approach Control Service combined with Aerodrome and Surface Movement Control Service and has Air Traffic Movement [ATM] of more than 5 for any two hours within 24 periods daily on monthly average basis.

(iii) All airports having independent Approach Control unit.

(iv) Alternate ATC Sites of all major Airports.

3. AFTN connectivity: - Provision of RWS of AMSS should be considered at airports based on the total number of aircraft movements and /or overflying traffic at the airport being more than TEN (10) per day. Further, the assessment of requirement of RWS may be made based on system capability. At smaller airports, where traffic is minimal alternate means of communication like OFPL, Fax, email etc. may be used for the exchange of messages {Refer guidelines in CNS Circular 08 of 2020}

(B) Radio Navigational aids

1. VOR or NDB will be provided at all airports which are to be publicly licensed to meet DGCA Section 4 CAR requirement. After revision of CAR, this requirement will be reviewed.

2. Provision of ILS: - ILS will be provided at airports for precision approaches where: -

(i) ILS CAT-I will be provided at airports for precision approaches where Non-precision approach/RNP /LPV approaches are not meeting visibility operational requirements of airport. For this visibility requirements may be considered for an average period of one year resulting in flight diversion/cancellation etc.

(ii) ILS Cat-II/III may be provided at airports where ILS Cat-I approaches are not meeting visibility operational requirements of airport. For this visibility requirements, may be considered for an average period of one year.

(iii) ILS CAT-I/II/III can be provided as per CNS/ATM agreement with airport operator for green field or joint venture airports.

Note: - Before ILS (CAT-I/II/III) is considered for installation at an airport, the other operational requirements such as suitability of Runway and other airport infrastructure viz. airport lighting system and OFZ etc to support



intended type of instrument approach procedures is to be confirmed. At airports having terrain a CNS simulation study may be carried out to confirm that ILS will meet coverage and other technical requirements of System. In this regard CNS Circular 08 of 2021 may be referred.

(C) Surveillance Systems: -

1. PSR/MSSR/ADS-B: -

(i) There shall be three levels of redundant surveillance coverage for continental airspace. While MSSR will provide first two levels, third level will be provided by ADS-B.

(ii) High density airports will be provided with PSR/MSSR at two locations preferably within the airport.

(iii) Surveillance coverage (PSR/MSSR) may be provided for approach control for airports having more than 200 movements per day on average taken for one-year period and registering further traffic growth.

(iv) Surveillance Coverage [ADS-B] may be provided for approach control for airports having more than 100 movements per day on an average taken for one-year period and registering further traffic growth.

2. SMR/ASMGCS: -

2.1 SMR will be provided at all Airports having operations below 350 Meters RVR.

2.2 A-SMGCS is cost intensive and its requirement should be reassessed. ASMGCS can be considered for airports: -

(i) having more than 400 movements per day on average taken for one-year period and registering further traffic growth; and

(ii) having more than one runway operations.

3. ATM Automation Systems: -

(i) For type “E” airports – Provision of ATM Automation System will be considered, if the total Air traffic movements in a day is 10 or more and airport is having AFTN/AMHS link. Further, ATM Automation system will be provided at all International airports.

(ii) For Type A, B C and D (including type E where provided) airports, Provision of ATM Automation system shall be considered as per following: -

Facility	Type D & E Tower + Procedural Approach	Type C Procedural Tower + Surveillance APP	Type B Tower + Surveillance APP + Surveillance Lower ACC	Type A Tower + Surveillance APP + Surveillance Upper ACC+ OCC (at FIR)	Remarks
Sample Airport	Dehradun, Raipur etc	Imphal, Udaipur etc	Varanasi, Amritsar etc.	Delhi, Mumbai etc	
AFTN/AMHS Interface	Yes	Yes	Yes	Yes	



• EFS	Yes	Yes	Yes	Yes	
• AIDC	NO	Yes	Yes	Yes	
• ADEXP (CATFM)	Yes	Yes	Yes	Yes	
• Metar/SPECI/SNOWTAM/AIM / NOTAM	Yes	Yes	Yes	Yes	
ITWP					
• Touchscreen	No	No	Yes	Yes	
• ASMGCS Integration	No	No	Yes	Yes	Subject to ASMGCS availability/planned
• ACDM Integration	No	Yes	Yes	Yes	
• Airport Lighting	No	No	No	TBD	
• AOCC /AODB	No	No	Yes	Yes	
• DCL	No	No	No	Yes	
• FPL Manipulation	Yes	Yes	Yes	Yes	
SSR Code Management	No	No	Yes	Yes	
PBCS	No	No	Yes	Yes	Only at FIC
Point Merge facility	No	No	No	Yes	
NTZ	No	No	No	Yes	
MET Interface					
• Local Met interface	Yes	Yes	Yes	Yes	
• Upper Wind	No	No (only Grib2)	Yes	Yes	
• Doppler Radar	No	No	No	Yes	
Decision Support Tools					
MTCD	No	No	Yes	Yes	
AMAN	No	Yes	Yes	Yes	
DMAN	No	No	No	Yes	
Remote Tower Capability (As applicable)	No	No	No	TBD	
Record & Replay	No (Event Logging)	Yes	Yes	Yes	
SAR	No	No	No	Yes	
ADS-C/ CPDLC	No	No	No	Yes	
Contingency System/SIMULATOR	No	No	Yes	Yes	



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DMS	Yes	Yes	Yes	Yes	
SSF (CARO)	√	Not required			TBD
Billing Module	Yes	Yes	Yes	Yes	
ADC/YA	Yes	Yes	Yes	Yes	
HFRT Interface	No	No	No	Yes	Only at FIC

Controller & Technical work-position	No. of work positions			
	Type – D Airport	Type C	Type – B Airport (required at main & contingency system)	Type – A Airport (required at main & contingency system)
Tower	1 + 1	1 + 1	2 + 1	
ARO	----	1 + 1	1 + 1	
Approach	----	2 + 1	1 + 1	
Lower ACC	----	----	2 + 2	
ACC	--	--		
OCC	--	-		
HFRT	-	-		
TFM	----	----	1 + 1	
Operational Supervisor	----	1	3	
Tech Supervisor / AIS / Recording Manager / LAN Manager	1 + 1	1 + 1	2 + 1	
Simulator	----	----	2no. pilot position, 2no. controller work position (configurable as area, approach, tower)	2no. pilot position, 2no. controller work position (configurable as area, approach, tower)



Annexure III

Facility required in ACCR (Aerodrome Committee Control Room) & CCCR (Central Committee Control Room)

1. Aerodrome Committee Control Room

S. No.	Facility	Type A Airports	Type B Airports	Type C Airports	Type D Airports	Type E Airports
01	DSC system (Refer Note2 below)	√	√	√		
02	Auto telephones with STD (Refer Note 3 below)	√	√	√	√	√
03	Hotlines with required agencies as per the anti-hijack contingency plan of concerned station.	√	√	√	√	√
04	Local telephone (EPABX)	√	√	√	√	√
05	Communication link between ACCR & ATC TWR & between ACCR & CCCR	√	√			
06	Fax	√	√	√	√	√
07	VHF Transceivers	√	√	√	√	√
08	HF Transceivers	√				
09	Recording Device	√	√	√	√	√
10	PC/Laptop with MFD, AAI intranet, internet & UPS power supply	√	√	√	√	√
11	FM Walkie-Talkies with AAI Frequency and CISF Frequency	√	√	√	√	√



12	TV with cable connection	√	√	√	√	√
13	CCTV monitoring for isolation bay	√	√	√	√	√

Note 1: As per the instructions from MHA/BCAS, the ACCR shall be established at all airports across India.

Note 2: Facility at SN 01 is to be provided at all International & Hypersensitive airports.

Note 3: Facility at SN 02 is to be provided at airport where facility at SN 01 is not provided.

2. Central Committee Control Room and Committee of Secretaries on Aircraft Hijack (COSAH), New Delhi.

- 1) Telephones with ISD/STD facilities.
- 2) DSC system with all airports.
- 3) HF/VHF (Including guarded frequencies)
- 4) Hotline with required agencies as per the anti-hijack contingency plan.
- 5) Fax
- 6) Satellite telephones
- 7) VHF & HF Transceivers
- 8) Recording facilities



Annexure IV

Guidelines for provision of CNS/ATM Facilities at AAI and Non- AAI RCS airports



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AIRPORTS AUTHORITY OF INDIA

File No: NM-19023/7/2017-CNS-O&M/

Date: 30.03.2017

To:

Regional Executive Director
Northern/Southern/Western/Eastern/North Eastern
New Delhi/Chennai/Mumbai/Kolkata/Guwahati

Sub: Provision of CNS and other facilities for upcoming RCS Airports.

In view of Regional Connectivity Scheme (RCS), Competent Authority has accorded In-Principle approval for the provision of following facilities at RCS airports.

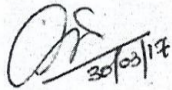
1. GPS Clock (standalone) with the capability of synchronizing other systems viz. DVTR.
2. Walkie-Talkie with base station along with **06 Nos** handheld sets.
3. UPS -05 KVA [dual].
4. Direct Telephone line with STD & Broad Band facility and FAX machine.
(Telephone connection may be provided under BSNL BBG Combo ULD-1199 plan wherein all local and STD calls are free with unlimited BB at 2Mbps speed to meet the requirement of internet).
5. Intercom facility with CNS Units, Fire Station etc as per the requirement of stations.
6. Desktop Computer with printer.
7. Mobile phone handset (with dual SIM) costing not more than Rs. 5000/- and two SIMs with a ceiling of Rs. 500/- each per month (One from BSNL and another from any other suitable service provider).
8. Hot Line with city fire brigade & nearest ATC station under Value added system.
9. Crash Fire Alarm and PA system.
10. Wherever possible feasibility for providing AMSS RWS for exchange of AFTN and FPL Data may be explored.

Action may be initiated on priority to ensure timely availability of above facilities at RCS Airports, if already not provided. The list of RCS airports with available CNS facilities is attached herewith.

In this regard, it is intimated that action for provision of VHF TX, Rx, VHF manpack, DVR and mobile Tower has been initiated at CHQ level and PDC for the same is given in the attached list of RCS airports.

The compliance report for the provision of the above facilities may be submitted to CHQ one month before starting the RCS operations at airports. The receipt of the letter may kindly be acknowledged.

Enclosure: As above


(C R Sudhir)
ED (CNS-O&M)

Copy to:

GM (CNS) -Region - Northern/Southern/Western/Eastern/North Eastern

Internal:

- Member (Planning) : for kind information.
- Member (ANS) : for kind information.
- Member (OPS) : for kind information.
- ED (RCS) / ED (CNS-P) / ED (ASM).
- ED (ATM) w.r.t. ION no. AAI/ATM/OPS/30-233/2017 dated 17.03.2017.
- ED (IT) for S.N. 6



Annexure V

SEARCH AND RESCUE CENTRES

Rescue coordination centre (RCC) is a unit responsible for promoting efficient organization of search and rescue services and for coordinating the conduct of search and rescue operations within a search and rescue region.

Rescue sub centre (RSC) is a unit subordinate to a rescue coordination centre, established to complement the latter according to particular provisions of the responsible authorities.

The Aeronautical SAR services are provided in Indian Search and Rescue Region (SRR) delineated & coinciding with four Flight Information Regions over land area. Airports Authority of India coordinates SAR services through four rescue Coordination Centres established at Delhi Mumbai, Kolkata & Chennai FIRs which are operational 24 hours. A Rescue Sub Centre (RSC) of Kolkata RCC has also been established at Guwahati to provide better search and rescue coordination in the North-East Region of India.

Each rescue coordination centre is staffed 24 hours a day by trained personnel proficient in the use of the language used for radiotelephony communications.

As per “National Aeronautical Search and Rescue Manual”

Para 4.3.4 SEARCH AND RESCUE EQUIPMENT

- 4.3.4.1** SAR units are fully equipped and trained to search for the site of accident and promptly provide assistance to the survivors at the scene of an accident.
- 4.3.4.2** In selecting equipment for SAR units, it is necessary to give due consideration to the size and passenger capacity of modern aircraft.
- 4.3.4.3** Each SAR unit has the means of rapid and reliable two-way VHF communication with other search and rescue units engaged in the SAR operation.
- 4.3.4.4** Each SAR aircraft is equipped to be able to communicate on aeronautical distress frequency 121.5 MHz and on-scene frequency 123.1 MHz and 3023 KHz, 5680 KHz.
- 4.3.4.5** Each SAR aircraft is equipped with a device for homing on distress frequency 121.5 MHz.
- 4.3.4.6** As per National Maritime Search and Rescue Manual, search and rescue aircraft when used for SAR over maritime areas, are equipped with 2182 KHz and 4125 KHz HF frequency and 156.8 MHz VHF FM to be able to communicate with vessels.



- 4.3.4.7** Each SAR aircraft when used for SAR over maritime areas carry a copy of International Code of Signals to enable it to overcome language difficulties that may be experienced in communicating with ships. These are published by International Maritime Organization in English, French and Spanish.
- 4.3.4.8** Unless it is known that there is no need to provide supplies to survivors by air, at least one of the participating aircraft in a SAR operation carries droppable survival equipment.
- 4.3.4.9** Survival equipment for dropping by aircraft for SAR over sea is provided by Indian Coast Guard and Indian Air Force.

APPENDIX-S: STANDARD LIST OF SEARCH AND RESCUE FACILITIES AT THE RESCUE COORDINATION CENTRES

- a. Establishment of dedicated RCC Units equipped with computerized SAR application
- b. Software Programme, MFD and Internet facility.
- c. Provision of dedicated STD / ISD Telephone with Fax facility.
- d. Maps and Charts.
- e. Plotting boards, Xerox Machines.
- f. SDD, FDD, AFTN / AMSS work station with printer, Automatic Speech switching system and intercom etc.



Annexure VI

**REPORT
ON
SURVEILLANCE COVERAGE**



1. **BACKGROUND**

In the 170th Board meeting of AAI, it was advised that comprehensive requirements of Radar (including replacement of Radars) for providing surveillance coverage of entire Indian Airspace may be assessed for placing it, in the next Board meeting, for its consideration. Accordingly ED-ATM constituted a committee comprising of the following Officers:

- (i) Sh. S. Chadha, GM (ATM-ATS)
- (ii) Sh. Vineet Gulati, GM (ATM-IPG)
- (iii) Sh. A.K. Meena, GM (ATM-FPD)
- (iv) Sh. G. Sambath Kumar, JGM (ATM-ASM)

The committee was required to assess the requirements of Radars i.e. MSSR MODE-S, PSR and ADS-B to supplement the existing Radar coverage for ensuring atleast 3 layers of surveillance coverage in high density TMA and minimum 2 layers of surveillance coverage in the rest of Indian Airspace.

2. **EXISTING SCENARIO**


2.1 Currently AAI has installed 43 Radars and 21 ADS-B stations across India for surveillance coverage. Except Delhi & Mumbai all the Metros are served with single Radar. Chennai & Kolkata have one MSSR outside airport premises for ACC. The MSSRs at Nagpur & Varanasi have outlived their usable life and have no overlapping coverage.

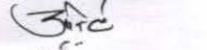
2.2 ANS procurement plan states the tentative life span of surveillance Radars as 12 years which is calculated from the date of commissioning. Considering significant delay from purchase to commissioning as in case of Vishakhapatnam, Chennai (Eldis) Lucknow & Imphal Radars, wherein the delay is more than five years, the actual usable period of the equipment will be less than five years as the tender agreement with supplier w.r.t spares is for ten years.

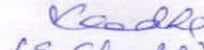
2.3 The theoretical coverage diagram provided by CNS and published in AIP supplement 18/2014 gives the coverage as 240NM at FL350 which is not the actual case, as the range is lower than that is published.

2.4 Integration issues. Existing Raytheon Automation systems at Mumbai & Delhi are not capable of Mode S or ADS-B. The Raytheon system at Chennai can only process basic elements of Mode S/ADS-B and also not capable of GRIB 2 data processing.

Operational limitations of Radar coupled with limited Radar/ADS-B input to automation systems (only four for Nagpur/Ahmedabad/Varanasi) further restricts the surveillance coverage.


(V. Gulati)


(A.K. Meena)


(S. Chadha)


(G. Sambath Kumar)



3. PROPOSED SURVEILLANCE COVERAGE POLICY

3.1 Three level redundant surveillance for continental airspace.

Any point in space within the continental airspace should be covered by three independent surveillance sensors. In the first phase this can be a target for the upper Airspace – FL250 and above.

3.2 Implementation of Reliable/Redundant data links for all communication & Surveillance networks.

From the existing station level agreements with service providers, AAI may consider a single service level agreement (MoU) with the service providers (atleast two) at CHQ level so as to get recognized as a priority customer status.

3.3 High Density Aerodromes should have PSR/MSSR (S- Band) Radars at least at two locations within the Airport premises and one MSSR (L-band) outside the Airport. As per existing policy PSRs at Delhi & Mumbai shall have a minimum range of 200NM and at other places shall have a range of 50NM.

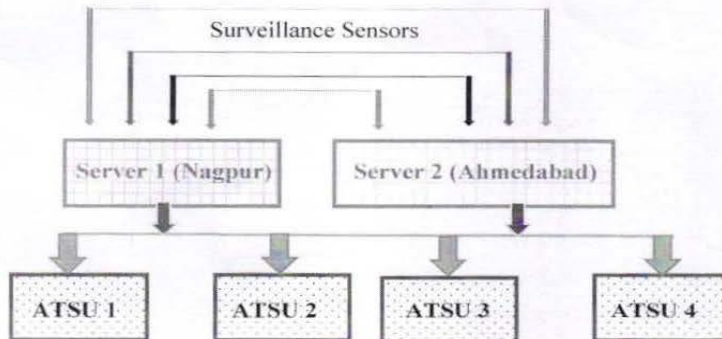
3.4 Procurement plans of Surveillance equipment's and automation systems should address the issues of integration with existing and proposed systems at the planning stage itself and also should be capable to process enhanced data (Mode-S, ADS-B, AIDC & GRIB 2) for surveillance use.

3.5 To address the delay in commissioning of equipment's a committee should be formed at CHQ level for monitoring the installation and commissioning of the equipment's in a timely manner.

3.6 ADS-B will be the third layer of Surveillance Coverage

3.7 Proposal:

To address integration issues a method of integrating all the surveillance sensors to a common server at two locations and then feeding the ATS units based on requirements should be planned as shown below:



CV-Gurus

(A.K. Meena)

(S. Chadda)

(G. Sambath ki)



4. PROPOSED LOCATIONS FOR ADS-B / RADAR

4.1 Proposed locations for ADS-B

To cover the gaps in ADS-B coverage it is proposed to install ADS-B in the following locations:

- 1) Gulbarga
- 2) Indore
- 3) Kadapa
- 4) Jabalpur
- 5) Dhanbad
- 6) Bikaner
- 7) Pantnagar
- 8) Aurangabad
- 9) Raipur
- 10) Agatti
- 11) Campbell Bay

Agatti & Campbell Bay for Surveillance in Oceanic Airspace

4.2 Proposed Locations of MSSR (S-band / L-band)

4.2.1 MSSRs under installation at Amritsar, Lucknow & Imphal are considered as existing facility

4.2.2 High Density Airports – Delhi, Mumbai, Kolkata, Chennai, Bengaluru, Hyderabad & Cochin should be supported by PSR/MSSR (S-band) at two locations within airport and one MSSR (L-band) outside the Airport.

- 1) Additional PSR/MSSR(S-band) within airport
- Chennai/Kolkata/Bengaluru/Hyderabad/Cochin
- 2) MSSR (L-band) outside Airport premises at
- Bengaluru / Hyderabad/ Cochin
- 3) Additional PSR/MSSR (S-band) at Guwahati

(To augment the surveillance coverage, as the aerodrome is surrounded by hilly terrain)

4.2.3 High Density Airspace – In addition to the existing Enroute MSSRs it is proposed to have an additional MSSRs at the following locations:

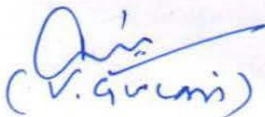
- 1) Nagpur
- 2) Varanasi
- 3) Bellary
- 4) Ahmedabad

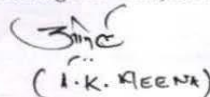
4.2.4 To address the gaps in coverage enroute MSSR at the following locations are recommended:

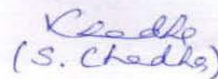
- 1) Madurai
- 2) Aurangabad

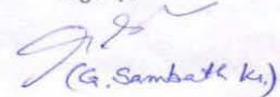
Report on Surveillance Coverage 17th Jan, 2017.

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(S. Chedda)


(G. Sambath Kumar)



- 3) Mopa (Goa)
- 4) Bikaner
- 5) Jaipur
- 6) Chandigarh

4.2.5 For providing redundancy in the surveillance coverage (second layer) enroute MSSRs Radars at the following locations are recommended:

- 1) Ooty
- 2) Raipur
- 3) Jalalabad
- 4) Gaya
- 5) Sonagarh
- 6) Khajuraho
- 7) Indore
- 8) Bhubaneshwar
- 9) Vijayawada
- 10) Kagaznagar (Private Aerodrome)

4.2.6 To provide Approach Control Service installation of PSRs are recommended at the following locations:

- 1) Nagpur
- 2) Varanasi
- 3) Jaipur

4.3 Professional consultant may be engaged to confirm the coverage as placed in Annexure 4 & 5 before finalizing the procurement plan.

4.5 The above proposal has considered surveillance coverage for approach control services at major aerodromes also. However, options for PSRs at the following locations may be kept as these airports which have more than 1000 movements per month and have been registering growth which may necessitate PSRs for providing approach control service:

- 1) Indore
 - 2) Coimbatore
 - 3) Vijayawada
 - 4) Calicut
 - 5) Patna
 - 6) Raipur
 - 7) Trichy
 - 8) Bhubaneshwar
 - 9) Mopa
 - 10) Kannur
 - 11) Bogapuram
 - 12) Navi Mumbai
- } Upcoming Green Field Airports with a potential for high density traffic.

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(A.K. Vengra)

(S. Chodha)

(G. Sambath ki)




5. SUMMARY OF SURVEILLANCE EQUIPMENT

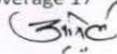
5.1 Existing Surveillance Systems

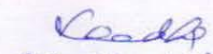
	PSR and MSSR	MSSR	ADS-B
1	Ahmedabad	Bellary	Agartala
2	Amritsar	Berhampur	Ahmedabad
3	Bengaluru	Bhopal	Amritsar
4	Chennai	Chennai	Bhubaneshwar
5	Cochin	Delhi	Calicut
6	Delhi		Cochin
7		Jharsuguda	Coimbatore
8	Guwahati	Katihar	Dibrugarh
9	Hyderabad	Kolkata	Guwahati
10	Imphal	Mumbai	Jaipur
11	Kolkata		Jaisalmer
12	Lucknow	Nagpur	Lucknow
13	Mangalore	Porbander	Mangalore
14	Mumbai	Udaipur	Mumbai
15		Varanasi	Nagpur
16	Trivandrum	Vishakapatnam	Patna
17			Portblair
18			Trichy
19			Trivandrum
20			Varanasi
21			Vijayawada
Total	16 *2 = 32	16	21


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(S. Chakraborty)


(G. Sambath Kumar)



5.2 Proposed Surveillance equipment Requirements: (S-band / L band) *

No.	PSR (50NM)/ MSSR	MSSR	PSR (50NM)	PSR Options (50NM)	ADS - B
1	Bengaluru	Ahmedabad	Jaipur	Bhubaneshwar	Agatti
2	Chennai	Aurangabad	Nagpur	Bogapuram	Aurangabad
3	Cochin	Bellary	Varanasi	Calicut	Bikaner
4	Guwahati	Bengaluru		Coimbatore	Cambell Bay
5	Hyderabad	Bhubaneshwar		Indore	Dhanbad
6	Kolkata	Bikaner		Kannur	Gulbarga
7		Chandigarh		Mopa (Goa)	Indore
8		Cochin		Navi Mumbai	Jabalpur
9		Gaya		Patna	Kadapa
10		Hyderabad		Raipur	Pantnagar
11		Indore		Trichy	Raipur
12		Jaipur		Vijayawada	
13		Jalalabad			
14		Kagaznagar			
15		Khajuraho			
16		Madurai			
17		MOPA (Goa)			
18		Nagpur			
19		Ooty			
20		Raipur			
21		Sonegarh			
22		Varanasi			
23		Vijayawada			
Total	6	23	3	12	11

*Cost permitting, it is proposed to have Primary and Secondary Surveillance Radars at above 23 Locations mentioned above in Column No.2, wherever primary Radar is not existing

5.3 Replacements requirements

The directorate of CNS may determine the replacement requirements of Surveillance equipments in accordance with ANS procurement plan of AAI

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5.4 Station wise Summary of existing and proposed surveillance systems: (S-band / L band)

No	Station	Existing			Proposed			
		PSR	MSSR	ADS-B	PSR	PSR Options	MSSR*	ADS-B
1	Agartala			1				
2	Agatti							1
3	Ahmedabad	1	1	1			1	
4	Amritsar	1	1	1				
5	Aurangabad						1	1
6	Bellary		1				1	
7	Bengaluru	1	1		1		2	
8	Berhampur		1					
9	Bhopal		1					
10	Bhubaneswar			1		1	1	
11	Bikaner						1	1
12	Calicut			1		1		
13	Cambell Bay							1
14	Chandigarh						1	
15	Chennai	1	2		1			
16	Cochin	1	1	1	1		2	
17	Coimbatore			1		1		
18	Delhi	3	3					
19	Dhanbad							1
20	Dibrugarh			1				
21	Gaya						1	
22	Gulbarga							1
23	Guwahati	1	1	1	1			
24	Hyderabad	1	1		1		2	
25	Imphal	1	1					
26	Indore					1	1	1
27	Jabalpur							1
28	Jaipur			1	1		1	
29	Jaisalmer			1				
30	Jalalabad						1	
31	Jharsuguda		1					
32	Kadapa							1
33	Kagaznagar						1	
34	Katihar		1					
35	Khajuraho						1	
36	Kolkata	1	2		1			
37	Lucknow	1	1	1				

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(A. K. AGENA)

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(G. Sambath ki)



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No	Station	Existing			Proposed			
		PSR	MSSR	ADS-B	PSR	PSR Options	MSSR*	ADS-B
38	Madurai						1	
39	Mangalore	1	1	1				
40	MOPA (Goa)					1	1	
41	Mumbai	3	3	1				
42	Nagpur		1	1	1		1	
43	Ooty						1	
44	Pantnagar							1
45	Patna			1		1		
46	Porbander		1					
47	Portblair			1				
48	Raipur					1	1	1
49	Sonegarh						1	
50	Trichy			1		1		
51	Trivandrum	1	1	1				
52	Udaipur		1					
53	Varanasi		1	1	1		1	
54	Vijayawada			1		1	1	
55	Vishakapatnam		1					
56	Bogapuram					1		
57	Kannur					1		
58	Navi Mumbai					1		
Total		18	30	21	9	12	26	11

*Cost permitting, it is proposed to have Primary and Secondary Surveillance Radars at above 26 Locations mentioned above, wherever primary Radar is not existing

Report on Surveillance Coverage 17th Jan, 2017.

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(A. K. Meena)

(S. Chodke)

(G. Sambath ki.)



Annexures:

- 1) References
 - 2) 140NM Surveillance coverage of existing ADS-B/MSSR facilities
 - 3) 140NM Surveillance coverage of existing ADS-B stations
 - 4) 140NM Surveillance Coverage of proposed ADS-B locations
 - 5) Combined 140NM coverage of Existing and Proposed ADS-B
 - 6) 140NM Surveillance coverage of existing MSSR Locations.
 - 7) 140NM Surveillance coverage of Proposed MSSR Locations
 - 8) Combined 140NM coverage of Existing and Proposed MSSR
 - 9) Proposed PSR (50NM) locations
 - 10) Aircraft Movement data of Airports
-



References:

2.1) **The Ajay Prasad committee 2007** which had been set up for formulating a Master Plan for Next Generation Futuristic Air Navigation Services had made the following recommendations on Comm & Surv:

- a) **On Voice Communication System (VCS)**, the Committee has said that the AAI plan to complete VHF coverage throughout the continental space at a height 20,000 feet and above should be implemented on priority by May, 2008. To meet the International Standards of ICAO, AAI should provide VHF coverage in Area Control Centres which have been declared as Class 'D' airspace and are required to provide VHF coverage to all Instrument Flight Rules (IFR) and Visual Flight Rules (VFR) flights. AAI should use the Dedicated Satellite Communication Network (DSCN) for operating the Remote Control Air to Ground (RCAG) VHF equipments.
- b) **On Surveillance Systems**, the Committee has recommended that the AAI should operationalise Behrampur Radar immediately by using dedicated Satellite Communication System. AAI should install all 10 Radars on priority as it helps reducing the spacing of aircraft and increasing the capacity of airspace. AAI should network all Radars by 2008-09 and the 10 new Radars being procured should be commissioned in the network permitting them to operate from the Area Control Centres of Delhi and Mumbai

2.1.1) Ajay Prasad Committee Recommendation 12.85:

Overlapping Terminal Area Radars at all approach control units where traffic density has reached 50 or more per day.

2.1.2) Ajay Prasad Committee Recommendation 12.86

AAI should provide independent Terminal Area Radars at all approach control units where traffic density has reached 50 or more per day

2.2) AAI - ANS Strategic Plan of 2008 and 2014 describes ATM operational objectives along with enabling communications, navigation and surveillance (CNS) road maps. The plan on Airspace Management is as below:

4.7.4.4. The sectorization plan is based on four layer concepts of Tower, Approach, Lower ACC and Upper ACC with vertical jurisdiction:

- Tower – Aerodrome Traffic Circuit;
- Approach – GND to F140; Buffer – F145
- Lower ACC – F150 to F250; Buffer – F255
- Upper ACC – F260 to F460.



Annexure VII

Guidelines for provision of Voice ATIS at airports

भारतीय विमानपत्तन प्राधिकरण
संचार दिक्चालन व निगरानी प्रचा. एवम् अनु.
निदेशालय



Guidelines for the deployment of Voice-
Automatic Terminal Information Service
(Voice-ATIS) facility at AAI Airports

CNS CIRCULAR 04/2022

Guidelines for the deployment of Voice-Automatic Terminal Information Service
(Voice-ATIS) facility at AAI Airports



भारतीय विमानपत्तन प्राधिकरण/ **Airports Authority of India**
संचार, दिक्चालन एवम् निगरानी - प्रचालन एवं अनुसंधान निदेशालय/**Directorate of CNS-OM**
राजीव गाँधी भवन/ **Rajiv Gandhi Bhawan**
सफदरजंग एयरपोर्ट/**Safdarjung Airport**
नई दिल्ली-110003/**New Delhi - 110003**

February, 2022

AAI/ED/CNS/2022/E 122747/CNSC/V-ATIS

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संचार दिक्कालन व निगरानी प्रचा . एवम् अनु.
निदेशालय



Guidelines for the deployment of Voice-
Automatic Terminal Information Service
(Voice-ATIS) facility at AAI Airports

CNS Circular 04 of 2022

File Reference No: - E 122747 NM-19017/1/2021-CNS-O&M

Subject: Guidelines for the deployment of Voice-Automatic Terminal Information Service (Voice-ATIS) facility at AAI Airports

1. Introduction and Background:

- 1.1. With the increase in Air traffic, there are constant request from the stations to have provisioning of Voice-Automatic Terminal Information Service (Voice-ATIS) facility to reduce the communication load on the ATS VHF air-ground communication channels.
- 1.2. The Regulatory requirement for provision of ATIS at aerodromes given in ICAO Annex - 11/corresponding CAR para 4.3.4.1 states that "Voice-automatic terminal information service (Voice-ATIS) broadcasts shall be provided at aerodromes where there is a requirement to reduce the communication load on the ATS VHF air-ground communication channels", which is very generic in nature.
- 1.3. As there are no existing guidelines for the deployment of Voice-Automatic Terminal Information Service (Voice-ATIS) facility at Airport, request for provisioning of the same are processed at CHQ on case to case basis. This sometimes results into delay and non-uniform response to requests.

2. Purpose and Objectives:

- 2.1. The purpose of this circular is to provide uniform guidelines for the deployment of Voice-Automatic Terminal Information Service (Voice-ATIS) facility at AAI Airports.
- 2.2. The objective of these guidelines is to provide a criterion so that decision on deployment of voice-ATIS at AAI Airports may be taken to meet the operational requirements in a timely manner.

3. **Scope:** This CNS circular is applicable for all AAI Airports.

February, 2022

AAI/ED/CNS/2022/E 122747/CNS/V-ATIS

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संचार दिक्कालन व निगरानी प्रचा एवम् अनु.
निदेशालय



Guidelines for the deployment of Voice-
Automatic Terminal Information Service
(Voice-ATIS) facility at AAI Airports

4. Guidelines: Voice-Automatic Terminal Information Service (Voice-ATIS) facility shall be provisioned at following AAI Airports.

- 4.1. Airports where Aerodrome Control Tower is providing Aerodrome Control & Surface Movement Control service and has hourly Air Traffic Movement (ATM) of more than 8 for any two hours within a period of 24 hours period daily, on monthly average basis.
- 4.2. Airports where Aerodrome Control Tower is providing Approach Control Service combined with Aerodrome Control & Surface Movement Control service and has hourly Air Traffic Movement (ATM) of more than 5 for any two hours within a period of 24 hours period daily, on monthly average basis.
- 4.3. All airports having an independent approach control unit.
- 4.4. Alternate ATC sites of all major airports.

The above guidelines, however, do not preclude the consideration for provisioning Voice-ATIS facility at any station having specific requirement with logical justification, on case to case basis.

5. Queries: Any queries or further guidance on the contents of this CNS Circular should be referred to:

**Executive Director [CNS-OM]
Airports Authority of India
Rajiv Gandhi Bhawan, Safdarjung Airport
New Delhi – 110003
Email: edcnsom@aai.aero , gmcnscom@aai.aero**

6. Validity: -

This CNS Circular shall remain in force until further notice.

G. S. Rao

[G S Rao]

Executive Director [CNS-OM]



Annexure VIII

Record of Discussion for finalizing operational & functional requirements of ATM Automation System for Type – B, C & D Airports

Date : 20th Dec 2021

Participants (Sh.)

1. A. K. Meena, ED (ATM-ASM)
2. Barun Sarkar, ED (ATM-ATFM)
3. S. K. Swami, ED (CNS-P)-I
4. R. G. Lama, GM (ATM-IPG)
5. R. R. Bassi, GM (CNS-P)-I
6. S. Swaminathan, GM (ATM-ATS)
7. Asit Sinha, JGM (ATM), Kolkata
8. Indu Shekhar, JGM (ATM), CHQ
9. G. Shiv Kumar, JGM (ATM), CARO, Hyderabad
10. Puneet Gupta, JGM (ATM), CHQ
11. S. Mondal, JGM (CNS), Kolkata
12. Munish Kr Mangla, AGM (CNS-P), CHQ
13. Abhay Singh, SM (CNS-P), CHQ
14. Ms. Nimisha Kakoty, JE (ATM), CHQ

Deliberations were held on operational & functional facilities to be provided at various airports and following are recommended:

- a. Functionalities to be provided are placed as annexure – A.
- b. Controller & Technical work-position to be provided are placed as annexure – B.
- c. Due to be number of flight movements Rajahmundry to be upgraded to Type - C airport (instead of Type - B).
- d. Due to existing lower ACC at Cochin, it is to be upgraded to Type - D airport (instead of Type - C)
- e. DMS is to be provided individually at all airports.
- f. AMAN functionality is required at Type – C & D airports.
- g. Contingency System & simulator will be provided at all Type-D airports.
- h. As per discussion, SSF is not required.
- i. Three-year warranty & Five-Year AMC is to be asked for the supplied system.



Annexure - A

Facility	CAT B Tower Procedural Approach	+ CAT C Procedural Tower + Surveillance APP	CAT D Tower + Surveillance APP + Surveillance Lower ACC
Sample Airport	Khajuraho	Imphal, Udaipur	Varanasi, Amritsar
AFTN/AMHS	Yes	Yes	Yes
• EFS	Yes	Yes	Yes
• AIDC	NO	Yes	Yes
• ADEXP (CATFM)	Yes	Yes	Yes
• Metar/SPECI/SNOWTAM/AIM / NOTAM	Yes	Yes	Yes
ITWP			
• Touchscreen	No	No	Yes
• ASMGCS Integration	No	No	Yes
• ACDM Integration	No	Yes	Yes
• Airport Lighting	No	No	No
• AOCC /AODB	No	No	Yes
• DCL	No	No	No
• FPL Manipulation	Yes	Yes	Yes
SSR Code Management	No	No	Yes
PBCS	No	No	Yes
Point Merge facility	No	No	No
NTZ	No	No	No
MET Interface			
• Local Met interface	Yes	Yes	Yes
• Upper Wind	No	No (only Grib2)	Yes
• Doppler Radar	No	No	No
Decision Support Tools			
MTCD	No	No	Yes
AMAN	No	Yes	Yes
DMAN	No	No	No



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Remote Tower Capability (As applicable)	No	No	No
Record & Replay	No (Event Logging)	Yes	Yes
SAR	No	No	No
ADS-C/ CPDLC	No	No	No
Contingency System/SIMULATOR	No	No	Yes
DMS	Yes	Yes	Yes
SSF (CARO)	√	Not required	
Billing Module	Yes	Yes	Yes
ADC/YA	Yes	Yes	Yes



Annexure – B

Controller & Technical work-position	No. of work positions		
	Type – B Airport	Type – C Airport	Type – D Airport (required at main & contingency system)
Tower	1 + 1	1 + 1	2 + 1
ARO	----	1 + 1	1 + 1
Approach	----	2 + 1	1 + 1
Lower ACC	----	----	2 + 2
TFM	----	----	1 + 1
Operational Supervisor	----	1	3
Tech Supervisor / AIS / Recording Manager / LAN Manager	1 + 1	1 + 1	2 + 1
Simulator	----	----	2no. pilot position, 2no. controller work position (configurable as area, approach, tower)



Annexure IX

SPACE BASED NAVIGATION IN INDIA

GAGAN is an acronym for GPS Aided GEO Augmented Navigation is a Space Based Augmentation System (SBAS) jointly developed by ISRO and AAI to provide the best possible navigational services over Indian FIR (Flight Information Region) with the capability of expanding to neighbouring FIRs.

GAGAN is a system of satellites and ground stations that provide GPS signal corrections, giving you better position accuracy.

GPS alone does not meet the ICAOs navigational requirements for accuracy, integrity and availability. GAGAN corrects for GPS signal errors caused by Ionospheric disturbances, timing and satellite orbit errors and also it provides vital information regarding the health of each satellite.

GAGAN consists of set of ground reference stations positioned across various locations in India called Indian Reference Station (INRES), which gathers GPS satellite data. A master station, Indian Master Control Centre (INMCC) collects data from reference stations and create GPS correction messages. The corrected differential messages are up linked via Indian Uplink Station (INLUS) and then broadcasted on a signal from three geostationary satellites (GSAT-8, GSAT-10 and GSAT-15). The information on this signal is compatible with basic GPS signal structure, which means any SBAS enabled GPS receiver can read this signal.

DGCA Certification

- The Director General of Civil Aviation (DGCA) has renewed the GPS Aided GEO Augmented Navigation (GAGAN) system for Navigation Performance level of Approach with Vertical Guidance (APV-1) over India & Required Navigation performance (RNP0.1) within Indian Flight Information Regions upto 18th July 2022.
- The Director General of Civil Aviation (DGCA) formed a Technical Review Team (TRT) to examine specific safety-related artefacts and hazard records and to provide recommendations for resolving any observed issues.
- AAI had engaged the MITRE Corporation to support the certification effort. A two-step certification decision was adopted for GAGAN implementation. The TRT reviewed the integrity-related artefacts and hazard records and recommended the findings to the certifying authority (DGCA) for certification. A Hazard Review Board analysed and reviewed the effect of software and hardware changes recommended by the TRT on system performance, and cleared GAGAN for certification.



The system and facility certification process was completed with joint inspection and review of all ground-based installations and documentation, as well as the system safety and environmental management processes. A team comprising members from DGCA, AAI, and ISRO conducted the inspection. Initially, the DGCA certified GAGAN for en route operations (RNP 0.1) on December 30, 2013, and subsequently on April 21, 2015, for precision approach services (APV 1). APV1-certified GAGAN signals are being broadcast since May 19, 2015.



Annexure X

REGULATORY REQUIREMENTS AND GAP ANALYSIS

1. Regulatory requirements and various committee recommendations for provisioning of CNS/ATM systems services at Airports and ATS units within Indian Airspace)

The details given below provide regulatory requirements and various committee recommendations for provisioning of CNS/ATM system at Airports and Indian Airspace in terms of utilizing the systems/technologies for provision of Air Traffic Services This has been further compared with Gap Analysis of Current India CNS/ATM Status and Future Requirements done by M/s Boeing under USTDA project.

1.1 Communications Systems

Technology / Application	Regulatory requirement/Committee recommendations	Boeing report gap analysis/Remarks
Time in Air Traffic Services	CAR, SECTION 9 – AIR SPACE AND AIR TRAFFIC MANAGEMENT, SERIES E, PART I Para 2.26- Time in Air Traffic Services – Air traffic services units shall be equipped with clocks indicating the time in hours, minutes and seconds, clearly visible from each operating position in the unit concerned.	AAI uses GPS clocks at all ATC Centres and Units. These systems are to be provided at all ATC centres and units. These systems are to be provided at all ATC centres and units. Not considered in Boeing report.
Communication Recorders	CAR, SECTION 9 – AIR SPACE AND AIR TRAFFIC MANAGEMENT, SERIES E, PART I Para 6.1.1.4- Recordings of communications channels shall be retained for a period of at least thirty days	AAI uses Digital Voice Recorders (DVRs) at all ATC Centres and Units. <u>These systems are to be provided at all ATC centres and units.</u> Not considered in Boeing report.
Ground to Ground Communications at airports	CAR, SECTION 9 – AIR SPACE AND AIR TRAFFIC MANAGEMENT, SERIES E, PART I Para 6.3.1 Communications for the control of vehicles other than aircraft on manoeuvring areas at controlled aerodromes - Two-way radiotelephony communication	AAI uses VHF -FM Walkie-Talkie systems for ground communications. These systems are to be provided at all ATC centres and units. <u>These</u>



	facilities shall be provided for aerodrome control service for the control of vehicles on the manoeuvring area, except where communication by a system of visual signals is deemed to be adequate	<u>systems are to be provided at all ATC centres and units.</u> Not considered in Boeing report.
AFTN Data Circuits/Voice Communication Hot lines	Para 6.2 (d) of ATTACHMENT-C OF CIVIL AVIATION REQUIREMENTS SECTION 9 – AIR SPACE AND AIR TRAFFIC MANAGEMENT, SERIES E, PART I: “Provision and operation of adequate air-ground communications, AFTN and ATS direct speech links, including reassignment, to adjacent States, of the responsibility for providing meteorological information and information on status of navigation aids;”	AFTN Data Circuits and Voice Communication Hot lines with adjacent FICs and ATC Centres are provided as per ICAO Air Navigation plan and local ATC requirements. <u>These systems are to be provided at all ATC centres and units.</u> Not considered in Boeing report
ATS Message Handling Services system (AMSS/AMHS)	Para 4.6 of CAR SECTION 9 – AIR SPACE AND AIR TRAFFIC MANAGEMENT, SERIES D, PART III: The ATS message service of the ATS (air traffic services) message handling service (ATSMHS) application shall be used to exchange ATS messages between users over the aeronautical telecommunication network (ATN) internet. Para 5.3.3.7.1 of STRATEGIC PLAN FOR AIR NAVIGATION SERVICES: AMHS is a modern electronic messaging system used to transfer and deliver ground to ground data such as flight plans, NOTAM and weather information amongst the members of the global air traffic control community. It is a replacement technology for the AFTN which is now technically obsolete.	Currently AAI uses AMSS. AMHS is installed at Mumbai. In future it is planned to use only AMHS on pan India basis. AMSS/AMHS is provided at major airports. At small airports RWS connected to AMSS are provided. At airports which have less or no traffic, fax or email links are used. As per Boeing Gap Analysis Para 2.3.2.2, full AMHS Capability is to be introduced. For provision of AMHS refer Para 5.3.3.7.1 of AAI STRATEGIC PLAN FOR AIR NAVIGATION SERVICES also.
VSAT	Para 5.4.1.1 of Naresh Chandra Committee Report Part-2 AVBL on	AAI has commissioned Dedicated Satellite



	<p>MOCA website: Link between controlled and controlling stations should be through end-to-end Optical Fibre Cable (OFC) connectivity with VSAT (Very Small Aperture Terminal) connectivity as back-up facility. VSAT could be used as the main link wherever OFC connectivity is not feasible. However, AAI owned VSAT Network (Dedicated Satellite Communication Network – DSCN) which was commissioned earlier is being decommissioned, as its utility is lost after the commissioning of AAI’s dedicated FTI (Futuristic Telecommunication Infrastructure)</p>	<p>Communication Network (DSCN) for VSAT from 2009 onwards. Due to obsolescence and implementation of FTI these systems are progressively being decommissioned and is currently operational at 22 airports only.</p> <p>Boeing Gap analysis has not considered VSAT.</p>
<p>AIDC</p>	<p>Para 5.4 of Ajay Prasad Committee Report AVBL on MOCA website: The ATM requirements in respect of Communication (Voice and Data Link) are as follows: Communication (Voice & Data Link) • DATIS (VOICE) to be extended to all operational airports. - AAI has informed that the equipment has been installed at 16 airports and 12 more equipment(s) are under order. Para 12.76: The Committee is of the opinion that it is essential that AAI provides AIDC to communicate with all ACCs and ATS units.</p> <ul style="list-style-type: none"> • AIDC/Data link communication between ACCs and major ATC units has already been successfully implemented, in pairs. AIDC with adjacent international units is either implemented in a few cases or on trial in other pairs. 	<p>As per Boeing Gap Analysis Para 2.3.2.2 - full AIDC Capability is to be introduced after implementation of AMHS.</p>
<p>Aero MACS</p>	<p>AeroMACS has the potential for providing a high-bandwidth, safety-</p>	<p>As per Boeing Gap Analysis Para 2.3.2.1.1.4 - the aircraft</p>



	services capable network for airport areas.	equipment has not yet materialized in a meaningful, consistent way. This means that few aircraft will be equipped in the near term. There may be advantages to further investigating AeroMACS for select airport locations, particularly where traditional cabled connectivity is difficult or cost-prohibitive.
LTE	System under development	Boeing Gap Analysis of has not considered this technology.
Air Ground Voice Communication (VHF Voice)	<p>Para 6.1 of CAR SECTION 9 – AIR SPACE AND AIR TRAFFIC MANAGEMENT, SERIES E, PART I: Aeronautical mobile service (air-ground communications) - Radiotelephony and/or data link shall be used in air-ground communications for air traffic services purposes for Aerodrome Control, Approach Control, Area Control and Flight Information Services</p> <p>Para 5.4.1.1 of Naresh Chandra Committee Report Part-2 AVBL on MOCA website: VHF (Very High Frequency) Communication: The entire terrestrial air space over India and maximum possible oceanic air space within the Indian Flight Information Regions (FIRs) is required to be covered by direct controller-pilot voice communication using VHF.</p>	<p>As per Boeing Gap Analysis Para 2.3.1.1 - The air-ground voice communications coverage in most areas across India is generally good, with only some small coverage gaps. The ground radios are modern, and those that are not, Internet Protocol (IP) based are planned to be upgraded. There are some areas that are suffering some Very High Frequency (VHF) congestion.</p> <p><u>These systems are to be provided at all ATC centres and units.</u></p>
HF Voice Communication System	<p>Para 4.3.2 of CAR SECTION 9 – AIR SPACE AND AIR TRAFFIC MANAGEMENT, SERIES E, PART I: HF operational flight information service (OFIS) broadcasts - HF</p>	In India HF communication is provided for oceanic communication at Mumbai, Chennai and Kolkata airports and as a backup at Delhi Airport.



	<p>operational flight information service (OFIS) broadcasts should be provided when it has been determined by regional air navigation agreements that a requirement exists.</p> <p>Para 5.2 (4) of Naresh Chandra Committee Report Part-2 AVBL on MOCA website: High Frequency (HF) back-up must be made available to Air Traffic Control Officers (ATCOs) with monitoring and intervention capability.</p>	<p>As per Boeing Gap Analysis Para 2.3.1.1- for remote (oceanic) areas, High Frequency (HF) voice communication is still widely used. Satellite Communication (SATCOM) voice capability, which is not currently used, would enhance capabilities, particularly in oceanic areas.</p> <p>However, Boeing has not considered Satvoice equipage in aircrafts</p>
SATVOICE	<p>AAI ANS STRATEGIC PLAN 2014-2018 Version 1.0</p> <p>5.3.3.10.2. India is permitting SATVOICE in place of one HF. In the oceanic airspace, SATVOICE is also provided as a back – up at Mumbai, Kolkata, Delhi and Chennai for seamless and interoperable communications. It is also proposed to provide SATVOICE at 8 other ATS centres to provide routine and emergency use communications including disaster management.</p>	<p>Refer Remarks in respect of HF Voice above.</p> <p>As per Boeing Gap Analysis of Para 2.3.1.1- Satellite Communication (SATCOM) voice capability, which is not currently used, would enhance capabilities, particularly in oceanic areas</p>
CPDLC	<p>Para 5.4.1.1 of Naresh Chandra Committee Report Part-2 AVBL on MOCA website: Controller Pilot Data Link Communication (CPDLC): Direct Controller to pilot data link is to be provided at all Flight Information Centres/Area Control Centres to ensure quick and reliable communication. All aircraft flying in Indian airspace above flight level 260 should necessarily be equipped with Future Air Navigation Systems (FANS) workstations in phased manner. DGCA may develop necessary regulations in this regard.</p>	<p>ACARS based CPDLC provided at all FICs for clearances and position reports.</p> <p>As per Boeing Gap Analysis Para 2.3.2.1.2 - CPDLC is not used in continental airspace at present.</p>



<p>VDL Mode 0/ ACARS VDL Mode 2 VDL Mode 3 VDL Mode 4</p>	<p>Para 5.4.1.1 of Naresh Chandra Committee Report Part-2 AVBL on MOCA website: VHF Data Link (VDL): All VHF stations shall have data link capability for establishing data communication with the pilot whenever the standards for data link communication on VHF are finalised.</p>	<p>As per Boeing Gap Analysis of Para 2.3.2.1.1.1- the current data infrastructure allows some usage of VHF Data Link Mode 0 (VDLM0), or Plain Old ACARS (POA). This provides an initial capability as a basis for data link services, although the performance of the network may not be suitable for all types of Air Traffic Services (ATS) operations, in particular domestic en route. Transition to VDLM2 is a stated goal, as VDLM2 gives higher performance to allow increased usage of ATS applications, such as Controller Pilot Data Link Communications (CPDLC), which is expected to allow the introduction of multiple services based on CPDLC.</p> <p>Boeing has not given any comments/views on VDL Mode 3/4 as the SARPs for same are still under development.</p>
<p>HFDL</p>	<p>Para 5.4.1.1 of Naresh Chandra Committee Report Part-2 AVBL on MOCA website: HF Communication (Voice/Data Link): HF Air Ground Communication is to be provided to work as backup to CPDLC.</p>	<p>As per Boeing Gap Analysis Para 2.3.2.1.1.3- HF data link is not generally in use</p>
<p>LDACS</p>	<p>LDACS is a terrestrial link and has been specified in ICAO and various versions of LDACS have undergone prototype and trial activities.</p>	<p>As per Boeing Gap Analysis Para 2.3.2.1.1.5, The L-band Digital Aeronautical Communications System (LDACS) is in the process of being defined within the industry and by ICAO.</p>



<p>ATN IPS</p>	<p>System under development</p>	<p>As per Boeing Gap Analysis Para 2.3.3.1.3- ICAO encourages IPS to be used for aeronautical safety services as soon as is practical. However, as the technical specifications for IPS are still under development, IPS is not yet implemented in India</p>
<p>ATIS (Voice-ATIS/D-ATIS)</p>	<p>Para 4.3.4 of CAR SECTION 9 – AIR SPACE AND AIR TRAFFIC MANAGEMENT, SERIES E, PART I: Voice-automatic terminal information service (Voice-ATIS) broadcasts shall be provided at aerodromes where there is a requirement to reduce the communication load on the ATS VHF air ground communication channel.</p> <p>Para 12.26 of Ajay Prasad Committee Report AVBL on MOCA website: The Committee is of the opinion that AAI should upgrade the ATIS facility to D-ATIS facility having both Voice and Data Link capabilities at the earliest as the equipment bought has a capability to provide the same.</p>	<p>AAI has provided Voice - ATIS at 56 airports and DATIS at 47 airports.</p> <p>No comments/views in Boeing Gap Analysis of Current India CNS/ATM Status and Future Requirements.</p>
<p>Emergency Frequency</p>	<p>Para 4.1.3.1.2 of ICAO Annex 10 Volume V Aeronautical Radio Frequency Spectrum Utilization The emergency frequency 121.500 MHz shall be provided at: a) all area control centres and flight information centres; b) aerodrome control towers and approach control offices serving international aerodromes and international alternate aerodromes; and</p>	<p>Being provided as per ICAO Annex 10 Volume V/DGCA CAR Guidelines. Not considered in Boeing report</p>



	<p>c) any additional location designated by the appropriate ATS authority, where the provision of that frequency is considered necessary to ensure immediate reception of distress calls or to serve the purposes specified in 4.1.3.1.1.</p> <p>Note: Where two or more of the above facilities are collocated, provision of 121.500 MHz at one would meet the requirement.</p>	
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Table 1 – Communication

1.2 Navigation Systems

Technology/ Application	Regulatory requirement/Committee recommendations	Boeing report gap analysis/Remarks
PBN	<p>Para 2.7.2 OF CIVIL AVIATION REQUIREMENTS SECTION 9 – AIR SPACE AND AIR TRAFFIC MANAGEMENT, SERIES E, PART I: Performance-Based Navigation operations shall be implemented as per the National Plan.</p>	Progressively being implemented at airports and ATS Routes
WGS-84	<p>Para 2.29.1.1 OF CIVIL AVIATION REQUIREMENTS SECTION 9 – AIR SPACE AND AIR TRAFFIC MANAGEMENT, SERIES E, PART I: World Geodetic System — 1984 (WGS-84) shall be used as the horizontal (geodetic) reference system for air navigation. Reported aeronautical geographical coordinates (indicating latitude and longitude) shall be expressed in terms of the WGS-84 geodetic reference datum.</p>	WGS 84 already implemented



<p>NDB</p>	<p>As per ANNEXURE- 3 of CIVIL AVIATION REQUIREMENTS SECTION-4, AERODROME STANDARDS & LICENSING SERIES 'F', PART I:</p> <p>6. PUBLIC USE AERODROME In so far as the aerodrome is open for public use of aircraft for carrying passengers for hire and reward, at least the following Navigational Aids and Visual Aids shall be provided:</p> <p>iii) FOR OPERATION BY DAY</p> <p>2. Non-Directional Beacon / VOR for navigational guidance.</p>	<p>As per ICAO Annex 10 Volume-I Attachment-H - STRATEGY FOR RATIONALIZATION OF CONVENTIONAL RADIO NAVIGATION AIDS AND EVOLUTION TOWARD SUPPORTING PBN (Extract):</p> <p>i. Except where no other alternative is available due to constraints in user fleet, financial, terrain or safety limitations the use of NDBs as en-route navigation aids or terminal area markers is generally obsolete.</p> <p>ii. Rationalize NDB and VOR and associated procedures; AAI has decommissioned more than 40 NDB/Locators in last 10 years in line with above strategy. CAR Should be changed and instead of NDB and VOR requirement for licensing of public use airport, PBN routes/RNP approaches should be acceptable. The above has been taken up with DGCA. Refer Attachment IV. Require further follow up.</p>
<p>VOR</p>	<p>3. Instrument approach procedures for IFR flights</p> <p>4. Visual approach slope indicator systems as applicable.3</p>	
<p>DME</p>	<p>Para 2.1.6 OF CIVIL AVIATION REQUIREMENTS SECTION 9 – AIR SPACE AND AIR TRAFFIC MANAGEMENT, SERIES D, PART II:</p> <p>When a radio navigation aid is provided to support precision approach and landing it should be supplemented by a source of guidance information which, when used in conjunction with appropriate procedures, will provide effective guidance to the desired reference path.</p> <p>Note: VOR, NDB, DME, GNSS and aircraft navigation systems have been established for purposes mentioned above.</p>	
<p>ILS</p>	<p>Para 5.4.2.2 of Naresh Chandra Committee Report Part-2 AVBL on MOCA website:</p>	<p>As per Boeing Gap Analysis Para 3.3.1- Major airports with high traffic volumes typically possess an ILS approach to each runway</p>



	<p>Instrument Landing System (ILS) along with instrument Runway Visual Range (RVR) facility should be provided at all airports that have jet aircraft operations to ensure greater reliable landing facility</p>	<p>end, facilitating precision approach capability for all arrival aircraft. However, most small and some medium sized airports have no precision approach capability, instead relying on published non-precision approaches utilizing ground-based NAVAIDS Approach technology development plans in India seem to be aligned with APV (Approach Procedure with Vertical guidance) criteria. This strategy, well aligned with the mandate for GAGAN fleet equipage, will provide safe landing capability in most weather to many of India's runways. At major airports, ILS is widely used, providing all weather landing capability (CAT III) to some of the major runways. In the interim, while the fleet isn't yet fully APV equipped, there is a gap in vertically guided approach capability, forcing the use of non-precision and/or visual approaches. In the near term, while aircraft are equipping with the equipment, many carry PBN capability that could be more widely utilized.</p>
GNSS	<p>Para 2.1.6 OF CIVIL AVIATION REQUIREMENTS SECTION 9 - AIR SPACE AND AIR TRAFFIC MANAGEMENT, SERIES D, PART II: When a radio navigation aid is provided to support precision approach and landing it should be supplemented by a source of guidance information which, when used in conjunction with appropriate</p>	<p>Progressively being implemented at airports</p>



	procedures, will provide effective guidance to the desired reference path. Note: VOR, NDB, DME, GNSS and aircraft navigation systems have been established for purposes mentioned above.	
ABAS	Para 3.7.2.2.1 OF CIVIL AVIATION REQUIREMENTS SECTION 9 - AIR SPACE AND AIR TRAFFIC MANAGEMENT, SERIES D, PART II:	Airborne Equipment requirement
GBAS	The GNSS navigation service shall be provided using various combinations of the following elements installed on the ground, on satellites and/or on board the aircraft:	System being implemented on trial basis at Chennai
SBAS	a. Global Positioning System (GPS) that provides the Standard Positioning Service (SPS) as defined in 3.7.3.1;g b. Global Navigation Satellite System (GLONASS) that provides the Channel of Standard Accuracy (CSA) navigation signal as defined in 3.7.3.2 c. aircraft-based augmentation system (ABAS) as defined in 3.7.3.3; d. satellite-based augmentation system (SBAS) as defined in 3.7.3.4; e. ground-based augmentation system (GBAS) as defined in 3.7.3.5; f. Intentionally Left Blank g. Aircraft GNSS receiver as defined in 3.7.3.6	GAGAN (SBAS) based procedures Progressively being implemented at airports
DFMC GNSS	Under development	
MLS	Not used in India.	
TACAN	Used in India by Defence Forces only	

Table 2 – Navigation



3.3 Surveillance

Technology/ Application	Regulatory requirement/Committee recommendations	Boeing report gap analysis/Remarks
PSR	<p>Para 12.86 A of Ajay Prasad Committee Report AVBL on MOCA website: AAI should provide independent Terminal Area Radars (TAR i.e. Primary +Secondary Radars) at all approach control units where traffic density has reached 50 or more per day.</p> <p>Para 3 of CIVIL AVIATION REQUIREMENTS SECTION 2 AIRWORTHINESS SERIES 'R', PART IV</p>	Boeing Gap Analysis Para 3.3.1 -The surveillance infrastructure in India is currently capable of providing full terrestrial coverage at en-route altitudes all through the Indian continental airspace. There are some limited coverage gaps, which are planned to be filled by adding cost-effective Automatic Dependent Surveillance – Broadcast (ADS-B) ground stations, and in some cases, additional secondary radar systems. Coverage gaps exist due to hilly or mountainous terrain, especially in the north eastern parts under Kolkata Flight Information Region (FIR), which could be addressed through Wide Area Multilateration (WAM) system technology. There is an understanding and acceptance of the need to use ground-based ADS-B stations for according better position information and accuracy; however, the facilities set up for the purpose are not being used, due lack of proper communication capability. As such, airspace with limited en-route radar coverage necessitates the use of
SSR Mode A/C	<p>3.1 Unless otherwise authorised by DGCA, no person shall operate in the Indian airspace, an aeroplane having maximum certified take off mass of 5700 kg and above and having maximum certified passenger seating configuration (excluding any pilot seats) of more than 30 seats or maximum payload capacity of more than 3 tones if such aeroplane is not equipped with Mode 'S' transponder.</p> <p>3.2 Unless otherwise authorised by DGCA, no person shall operate for commercial air transport operation in the Indian airspace, from 1st January, 2001, (a) an aeroplane having a maximum certified passenger seating configuration of 20 to 30 or a maximum certificated take off mass in excess of 5700kg, if such</p>	
SSR Mode S		



	<p>aeroplane is not equipped with Mode 'S' transponder.</p> <p>(b) an aeroplane having a maximum certified passenger seating configuration of 10 to 19 and a maximum certificated take off mass less than 5700kg, if such aeroplane is not equipped with Mode 'A' / 'C' transponder.</p> <p>(c) a twin jet engine aeroplane having a maximum certified passenger seating configuration of less than 10 and a maximum certificated take off mass less than 5700kg, if such aeroplane is not equipped with Mode 'A' / 'C' transponder (d) a helicopter if it is not equipped with Mode 'A' / 'C' transponder.</p> <p>3.3 Unless otherwise authorised by DGCA, no person shall acquire for the purpose of commercial air transport operation in the Indian airspace, from 1st January, 2000,</p> <p>(a) an aeroplane having a maximum certified passenger seating configuration of 20 to 30 or a maximum certificated take off mass in excess of 5700kg, if such aeroplane is not equipped with Mode 'S' transponder.</p> <p>(b) an aeroplane having a maximum certified passenger seating configuration of 10 to 19 and a maximum certificated take off mass less than 5700kg, if such aeroplane is not equipped with Mode 'A' / 'C' transponder.</p> <p>(c) a twin jet engined aeroplane having a maximum certified passenger seating configuration of less than 10 and a maximum</p>	<p>procedural separation. While safe, such operations are less flexible than tactical control and thus, may be less efficient and create higher workload. The ground infrastructure provides the basic needs of aircraft surveillance in the airspace, but the age and variability in surveillance ground equipage lead to system limitations, such as lack of support for additional ADS-B sensors. The multiple types of surveillance systems and automation systems added to the difference in vintage of the equipment creates frequent problems of data interchange between Area Control Centers (ACCs) and FIRs. If smooth data interchange is made possible, then it will enable controllers to carry out full radar handoff of traffic, thereby reducing workloads in the cockpit, as well as for the controllers.</p>
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	<p>certificated take off mass less than 5700kg, if such aeroplane is not equipped with Mode 'A' / 'C' transponder.</p> <p>(d) a helicopter if it is not equipped with Mode 'A' / 'C' transponder.</p> <p>3.4 Unless otherwise authorised by DGCA, no person shall operate for general aviation operation in the Indian controlled airspace or on promulgated ATS routes, from 1st January, 2003, an aeroplane or helicopter, if it is not equipped with Mode 'A' / 'C' transponder.</p> <p>Para 3.9 OF CIVIL AVIATION REQUIREMENTS SECTION 9 - AIR SPACE AND AIR TRAFFIC MANAGEMENT, SERIES E, PART I: Radar and ADS-B ground systems should provide for the display of safety related alerts and warnings, including conflict alert, conflict prediction, minimum safe altitude warning and unintentionally duplicated SSR codes</p> <p>Para 12.85 to 12.89 of Ajay Prasad Committee Report 12.85 Overlapping multiple radar cover and back up radars should be available in high density traffic areas to ensure uninterrupted radar service. 12.86 AAI should provide independent Terminal Area Radars (TAR i.e. Primary +Secondary Radars) at all approach control units where traffic density has reached 50 or more per day. 12.87 The entire control areas should be under radar cover and matching</p>	
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	<p>seamless air-ground communication should be available for efficient ATM.</p> <p>12.88 All radars should be networked to ensure entire continental airspace is covered under radar surveillance and seamless radar separation is achievable.</p> <p>12.89 Networked radar data should be available at all centres or alternately all centres should be amalgamated at one or two centres with multiple sectors. Dynamic consolidation and deconsolidation of sectors should be facilitated with supporting communication capabilities.</p> <p>Para 7.2- Two and more approach radars (TAR -PSR+MSSR) should be available at busy terminal approach control areas, especially at Mumbai and Delhi to support reduced spacing on final approach (3NM) and multiple runway operations to enhance capacity. This is essential from the backup point of view and also from maintenance point of view.</p> <p>Para 3 of CIVIL AVIATION REQUIREMENTS SECTION 2 AIRWORTHINESS SERIES 'R', PART IV - Para 3.1 to 3.4 - mandatory Equipage of aircrafts with Mode A/C/S transponders operating in Indian airspace.</p> <p>ICAO Doc 4444 –PANS ATM - Chapter 8 Surveillance Systems</p> <p>(i) Para 8.1.7 - ATS surveillance systems, such as primary surveillance radar (PSR), secondary surveillance radar (SSR)</p>	
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	<p>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:</p> <p>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) in the case of ADS-B, the availability of data from participating aircraft is adequate.</p> <p>(ii) Para 8.1.8- Primary Surveillance Radar (PSR) systems should be used in circumstances where SSR and/or ADS-B alone would not meet the air traffic services requirements.</p>	
<p>Ground Based ADS-B out/ MLAT</p>	<p>Para 12.53 of Ajay Prasad Committee Report - The Committee is of the opinion that it would be appropriate for AAI to start planning the ADS-B with extended Multilaterate infrastructure now rather than wait for regional plans, which are essentially to cater for international traffic.</p> <p>As per para 2 of AAI AIP supplement 148/2018 2.1 With effect from 1st January 2019, all aircraft flying on PBN Routes in Indian continental airspace with Designators L, M, N, P, Q, T and routes A201, A347, A465, A474, A791, B211, B466, G450, R457, R460, R461, W15,</p>	<p>ADS-B is being used as back up for radars.</p> <p>As per Boeing Gap Analysis of Current India CNS/ATM Status and Future Requirements, Para 3.3- Independent cooperative surveillance can be of use for aircraft operating out of airports in difficult geographical terrain, especially in some parts of north and northeast India. The use of wide area multilateration (MLAT) systems can help enhance safe operations in hilly areas and can be very effective if combined with ADS-B ground stations. This solution has not</p>



	<p>W19, W20, W29, W41, W43, W45, W47, W56S/N, W67, W111, W112, W114, W115, W118, W153, at or above Flight Level 290 must carry serviceable 1090 MHz ES ADS-B transmitting equipment that has been certified as meeting the requirements mentioned in paragraph 3.0.</p> <p>2.2 Aircraft not equipped with ADS-B would be permitted to fly on these routes below Flight level 290.</p> <p>Para 12.104 of Ajay Prasad Committee Report AVBL on MOCA website: AAI should actively consider implementation of ADS-B and Multilateration in combination to cover the entire Indian airspace as backup of radars.</p>	<p>yet been tried effectively in India</p>
<p>Surface Movement Radar (ASMGCS)</p>	<p>Para 3.10 OF CIVIL AVIATION REQUIREMENTS SECTION 9 - AIR SPACE AND AIR TRAFFIC MANAGEMENT, SERIES E, PART I: 3.10 Use of surface movement radar (SMR) 3.10.1 In the absence of visual observation of all or part of the manoeuvring area or to supplement visual observation, surface movement radar (SMR) or other suitable surveillance equipment, should be utilized to: a) monitor the movements of aircraft and vehicles on the manoeuvring area; b) provide directional information to pilots and vehicle drivers as necessary; and c) provide advice and assistance for the safe and efficient movement of aircraft and vehicles on the manoeuvring area. Note. — See the Manual of Surface Movement Guidance and Control</p>	<p>Boeing Gap Analysis Para 3.3- Most large (as well as many medium and small sized) airports in India utilize multiple CNS data sources and sensors. Large and medium sized airports possess advanced capabilities, such as Advanced Surface Movement Guidance and Control System (A-SMGCS) systems with multiple MLAT stations to provide a wealth of information to tower controllers in addition to traditional RADARS</p>



	<p>Systems (SMGCS) (Doc 9476), the Manual on Advanced-Surface Movement Guidance and Control Systems (A-SMCGS) (Doc 9830) and the Air Traffic Services Planning Manual (Doc 9426) for guidance on the use of SMR.</p> <p>Para 9.8.7 and 9.8.8 OF CIVIL AVIATION REQUIREMENTS SECTION 4 -Aerodrome Standards and Licensing, SERIES B, PART I:</p> <p>9.8.7 Surface movement radar for the manoeuvring area shall be provided at an aerodrome intended for use in runway visual range conditions less than a value of 350 m.</p> <p>9.8.8 Surface movement radar for the manoeuvring area should be provided at an aerodrome other than that in 9.8.7 when traffic density and operating conditions are such that regularity of traffic flow cannot be maintained by alternative procedures and facilities.</p> <p>Note: Guidance on the use of surface movement radar is given in the Manual of Surface Movement Guidance and Control Systems (SMGCS) and in the ICAO Air Traffic Services Planning Manual (Doc 9426).</p> <p>Para 7.2 of Ajay Prasad Committee Report: ASMGCS needs to be implemented at Mumbai, Chennai, Kolkata, Hyderabad, Bangalore.</p>	
PAR	Has been phased out globally by Civil ANSPs and in use in India only by Military ATSPs	



ADS-C	<p>ANS STRATEGIC PLAN 2014-2018 Version 1.0</p> <p>5.3.5.2.6. Oceanic airspace: ADS-C/CPDLC Systems are in operation at Mumbai, Kolkata and Chennai FIRs. In addition, Delhi Metro ATCC is equipped with ADS-C.</p> <p>ADS-C Surveillance coupled with CPDLC Communication and PBN by aircraft enable capacity enhancement in Remote and Oceanic Airspace.</p>	<p>ADS-C implemented at All FIC.</p> <p>ADS-B implemented/being implemented at 36 Ground based sensors.</p> <p>Space based ADS-B being implemented at OCC.</p> <p>ADS-B-IN implementation currently not planned by ICAO in APAC Region</p>
ADS-B OUT	<p>Para 12.53 of Ajay Prasad Committee Report AVBL on MOCA:</p>	
Space-based ADS-B	<p>The Committee is of the opinion that it would be appropriate for AAI to start planning the ADS-B with extended Multilateration infrastructure now rather than wait for regional plans, which are essentially to cater for international traffic.</p>	
ADS-B IN	<p>As per para 2 of AAI AIP supplement 148/2018</p> <p>2.1 With effect from 1st January 2019, all aircraft flying on PBN Routes in Indian continental airspace with Designators L, M, N, P, Q, T and routes A201, A347, A465, A474, A791, B211, B466, G450, R457, R460, R461, W15, W19, W20, W29, W41, W43, W45, W47, W56S/N, W67, W111, W112, W114, W115, W118, W153, at or above Flight Level 290 must carry serviceable 1090 MHz ES ADS-B transmitting equipment that has been certified as meeting the requirements mentioned in paragraph 3.0.</p>	



	2.2 Aircraft not equipped with ADS-B would be permitted to fly on these routes below Flight level 290.	
ADS B In & TIS-B		These are developing technologies and ADS-B In/TIS B implementation is not envisaged in ICAO Annex – 10 Volume IV, Annex 11 and ICAO Asia Pacific regional implementation plan

Table 3 – Surveillance

Note: Where there is a lack of ADS-B avionics equipage, MLAT can be an alternative mean to meet specific surveillance requirements, such as being a gap-filler of SSR coverages or supporting airport ground movement operations.

3.4 ATM Automation Systems

Technology/ Application	Regulatory requirement/Committee recommendations	Boeing report gap analysis/Remarks
ATM Automation System	<p>Para 12.59 of Ajay Prasad Committee Report recommendation: AAI should immediately evaluate the existing automation solutions/technologies and implement them expeditiously with a view to deliver near term Benefits.</p> <p>ICAO DOC 9426 Air Traffic Services Planning Manual- Part II Section 3</p> <p>(i) Chapter-3 Para 3.2.1.3 Automation is justified if further improvement in efficiency is required:</p>	ATM Automation system available at airports.



	<p>a) when any particular ATC functions or processes are becoming too burdensome or time-consuming to be carried out by human operators alone;</p> <p>b) when substantive improvement with regard to regularity and expedition of operations cannot adequately be obtained by other means;</p> <p>c) when safer or more efficient service is obtainable through introduction of automation.</p>	
Air Traffic Flow Management System	<p>Para 12.64 of Ajay Prasad Committee Report: - As International Standards of ICAO stipulated in Annex 11, which deals with Air Traffic Services and ICAO Doc 4444, makes it obligatory for India to have Air Traffic Flow Management System, AAI needs to implement AFTM system expeditiously preferably in the Near-Term-Immediate Plan</p>	<p>C-ATFM implemented.</p>



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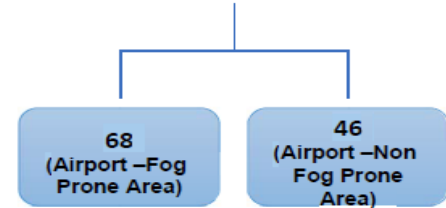
Annexure XI

**Analysis of
AAI Operational Airports
for
availability of CAT-I, CAT-II & CAT-III & IFR facilities
including JV/PPP Airports**



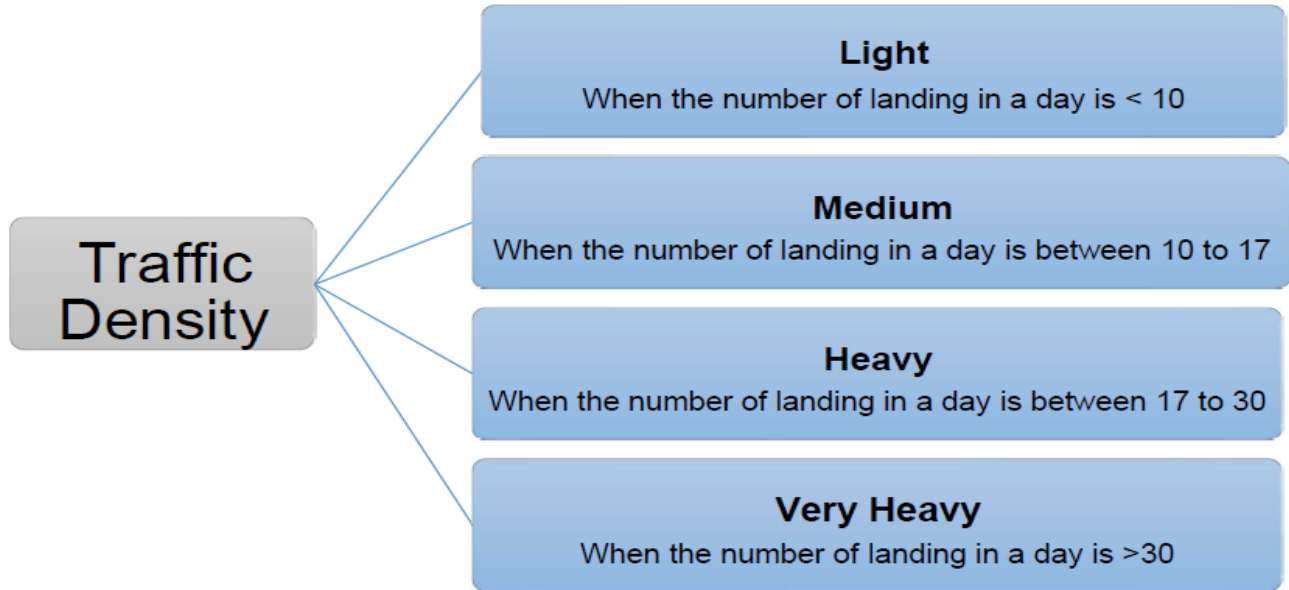
Overview of Operational Airports

Total Operational Airport	140
Heliport & Water Aerodrome (8+2)	10
Non Schedule Operational Airport	16
Operational Airport with Scheduled Operations	114





Traffic Density Definition



Criteria

S.No.				
1	Foggy	Very Heavy	CAT-III	08
		Heavy	CAT-II	12
		Other Airports	CAT-I	48
2	Non Foggy	Medium above	CAT-I	17
		Other Airports	IFR	29



Airports-Fog prone area (68 Airports)

Traffic Density \ Airport Category	<u>Very Heavy Traffic Density</u> (Required to be upgraded to CAT III)	<u>Heavy Traffic Density</u> (Required to be upgraded to CAT II)	<u>Medium/Low Traffic Density</u> (Required to be upgraded to CAT I)	Total
CAT III	2	3	-	5
CAT II	-	1	11	12
CAT I	2	3	16	30
	4	5		
IFR	-	-	2	4
			2	
VFR	-	-	2	14
			9+3*=12	
Day-IFR	-	-	2	3
			1	
Total	8	12	48	68

* Can be upgraded to IFR
 Already CAT III/ II/ I
 Upgradation Feasible
 Upgradation Not Feasible

Airports - Non Fog prone area (46 Airports)

Traffic Density \ Airport Category	<u>Above Medium Traffic Density</u> (Required to be upgraded to CAT I)	<u>Medium/Low Traffic Density</u> (Required to be upgraded to IFR)	Total
CAT III	1	-	1
CAT II	1	3	4
CAT I	15	7	22
IFR	-	8	8
Day-IFR	-	1	1
VFR	-	4	4
		6	6
Total	17	29	46

Already CAT III/ II/ I /IFR
 Upgradation Feasible
 Upgradation Not Feasible



Airport in Fog Prone Area

Very Heavy Traffic Density-Required to be upgraded to CAT-III

S.N.	Airport	Operator	Existing Facility	No of WH	ATCO	Diversion (2019-20)	Landing (2019-20)	% of Diversion	Remarks
Airports Already CAT-III									
1	Kolkata 3627m x 45m	AAI	CAT-III	H24	313	230	82881	0.28%	Already CAT-III
2	Delhi 3810m x 45m	JV	CAT-III	H24	384	139	225006	0.06%	Already CAT-III
Feasible									
1	Bhubaneswar 2743m x 45m	AAI	CAT-I(A)	H24	33	55	13966	0.39%	Feasible. Link taxi track and relocation of Glide Path work is in progress
2	Nagpur 3200m x 45m	JV	CAT-I	H24	109	31	11547	0.27%	Feasible (RWY Strip & Approach lights available)
Not Feasible									
1	Patna 2072m x 45m	AAI	CAT-I(A)	H24	33	23	15480	0.15%	Not feasible- due to Land constraints for full approach lights & RWY strip (dense habitation and railway track). 66.56 acres & 24.09 acres land required for RWY strip & approach lights respectively.
2	Varanasi 2745m x 45m	AAI	CAT-I(A)	H24	80	72	12028	0.60%	Not feasible- due to Land constraints for full Approach Lights (Railway line & Highway no. NH 31. Total 260.4 acres land required including for RWY strip & approach lights).
3	Ahmedabad 3505m x 45m	PPP	CAT-I(A)	H24	107	129	42289	0.31%	Not feasible- due to Land constraints for full Approach Lights (Sewage treatment plan of AMC in approach) and RWY strip at one place (dense habitation).
4	Guwahati 3103m x 45m	PPP	CAT-I(A)	H24	73	47	22770	0.15%	Not feasible- due to Land constraints for full approach lights (Road passing in Approach and Padma lake).



Airport in Fog Prone Area

Heavy Traffic Density- Required to be upgraded to CAT-II



S.No.	Airport	Operator	Existing Facility	No of WH	ATCO	Diversion (2019-20)	Landing (2019-20)	% of Diversion	Remarks
Airports Already CAT-III/II									
1	Jaipur 3500m x 45m	PPP	CAT-III	H24	56	62	19742	0.31%	Already CAT-III
2	Lucknow 2742m x 45m	PPP	CAT-III	H24	59	158	19247	0.82%	Already CAT-III
3	Amritsar 3658m x 45m	AAI	CAT-III	H24	36	21	8541	0.25%	Already CAT-III
4	Bagdogra 2744m x 45m	AAI(CE)	CAT-II	0800-1700 hrs	0	**	11609	**	Already CAT-II
Feasible									
1	Raipur 2286m x 45m	AAI	CAT-I(A)	0630-2115 hrs	16	16	8639	0.19%	Feasible
2	Ranchi 2713m x 45m	AAI	CAT-I(A)	0645-2115 hrs	21	37	9569	0.39%	Feasible - After acquisition of 83.05 Acres of land for Full Approach lights & RWY Strip , requested from State Govt.
3	Bhopal 2744m x 45m	AAI	CAT-I	0645-2230 hrs	16	38	7187	0.53%	Feasible- After 9.8 Acres of land for RWY Strip of Army Cantonment is made available by MoD.



Airport in Fog Prone Area

Heavy Traffic Density- Required to be upgraded to CAT-II

S.No.	Airport	Operator	Existing Facility	Noof WH	ATCO	Diversion (2019-20)	Landing (2019-20)	% of Diversion	Remarks
Not Feasible									
1	Dehradun 2140m x 45m	AAI	CAT-I(A)	0640-2010 hrs	11	25	6564	0.38%	Not feasible- due to Land constraint (habitation) for RWY strip & Approach lights. Total 243 acres land required including 6.5 acres for approach lights.
2	Indore 2750m x 45m	AAI	CAT-I(A)	H24	22	21	11468	0.18%	Not feasible- due to Land constraints for Approach lights. Dense habitation after 450m of RWY end (Paramhans nagar)
3	Surat 2906m x 45m	AAI	CAT-I(A)	H24	15	23	7928	0.29%	Not feasible- due to land constraints for Approach lights & Obstacles in Approach.
4	Srinagar 3658m x 45m	AAI(CE)	CAT-I	0545-2145 hrs	0	**	9828	**	Not feasible- due to infringement of Parallel Taxi, service road & dispersal area in critical & service area of ILS. Land not available for approach lights CAT-I (ILS By AAI)
5	Chandigarh 2744m x 45m	JV	CAT-I	H24	0	**	9161	**	Not to be upgraded Reference MoD meeting under the chairmanship of CDS), Removal of IAF obstacle to facilitate CAT-III/II upgradation is not possible CAT-I (ILS By AAI on RWY11 & RWY 29 by IAF



Airport in Fog Prone Area
Medium/Low Traffic Density- Required to be upgraded to CAT-I
Already CAT-III/II

S.No.	Airport	Operator	No of WH	ATCO	Landing (2019-20)	Existing Facility/Remarks
1	Adampur 2746m x 45m	AAI(CE)	1400-1730 hrs (Pre Covid Watch: 0700 hrs to 1800 hrs IST)	0	5559	CAT-II
2	Gorakhpur 2744m x 45m	AAI(CE)	Sunrise to 2100 hrs	0	2261	CAT-II
3	Gwallior 2744m x 45m	AAI(CE)	0600-1800 hrs	0	2751	CAT-II
4	Bikaner 2746m x 45m	AAI(CE)	1200-1530 hrs	0	822	CAI-II
5	Agra 2744m x 45m	AAI(CE)	1000-1600 hrs Mon Wed Fri,1300-1500 hrs Tue Thu Sat ,1000-1300 hrs Sun	0	1803	CAT-II
6	Bareilly 2743m x 45m	AAI(CE)	0930-1800 hrs	0	1643	CAT-II
7	Tezpur 2744m x 45m	AAI(CE)	1230-1730 hrs	0	366	CAT-II
8	Jodhpur 2743m x 45m	AAI(CE)	0700-1800 hrs	0	346	CAT-II
9	Jorhat 2652m x 45m	AAI(CE)	0900-1300 hrs	0	4956	CAT-II
10	Pathankot 2744m x 45m	AAI(CE)	1200-1630 hrs Mon Wed Fri	0	5428	CAT-II
11	Bhatinda 2805m x 45m	AAI(CE)	Nil (Pre Covid Watch:1100-1500 IST (Monday to Friday))	0	7044	CAT-II



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Airport in Fog Prone Area
Medium/Low Traffic Density- Required to be upgraded to CAT-I
Already CAT-I

S.No.	Airport	Operator	No of WH	ATCO	Diversion (2019-20)	Landing (2019-20)	% of Diversion	Existing Facility/Remarks
1	Agartala 2286m x 45m	CAT-I(A)	0730-2015 hrs	15	3	5559	0.05%	CAT-I
2	Aurangabad 2835m x 45m	CAT-I(A)	0630-0815 & 1610-2050 hrs	8	7	2261	0.22%	CAT-I
3	Dibrugarh 1830m x 45m	CAT-I(A)	0655-1540 hrs Except Mon 0855-1540 hrs Mon	7	3	2751	0.11%	CAT-I
4	Dimapur 2290m x 45m	CAT-I(A)	0805-1520 hrs Mon Wed Sat; 0820-1425 hrs Tue Thu; 0805- 1555 Fri; 0820-1400 hrs Sun	5	0	822	0.00%	CAT-I
5	Gaya 2287m x 45m	CAT-I(A)	1100-1700 hrs	6	4	1803	0.22%	CAT-I
6	Jharsuguda 2391m x 45m	CAT-I(A)	1155-1930 hrs Mon Wed Fri Sun, Tue Thu Sat 0800-1000 & 1155-1930 hrs	5	7	1643	0.43%	CAT-I
7	Khajuraho 2286m x 45m	CAT-I(A)	1200-1600 hrs daily except Sun	4	1	366	0.27%	CAT-I
8	Shillong 1829m x 45m	CAT-I(A)	1020-1620 hrs Except Sun	4	0	346	0.00%	CAT-I
9	Imphal 2744m x 45m	AAI	0915-1740 hrs	8	2	4956	0.04%	CAT-I
10	Udaipur 2281m x 45m	AAI	0650-2135 hrs	12	19	5428	0.35%	CAT-I
11	Jammu 2042m x 45m	AAI(CE)	0840-2100 hrs	0	**	7044	**	CAT-I (ILS By AAI)
12	Prayagraj 2477m x 45m	AAI(CE)	Dawn to Dusk	0	**	2028	**	CAT-I (ILS By AAI)
13	Hindon 2743m x 45m	AAI(CE)	1135 to 1535 hrs Mon Wed Fri Sun 1015 to 1415 hrs Tue Thu Sat	0	**	150	**	CAT-I
14	Kanpur 2744m x 45m	AAI(CE)	1200-1700 hrs Daily	0	**	980	**	CAT-I (ILS By AAI)
15	Silchar 1785m x 45m	AAI(CE)	0615-1630 hrs	0	**	1951	**	CAT-I (ILS By AAI)
16	Durgapur (3315m x 45m)	STATE	1330-2230	5	0	762	0.00%	CAT-I



Airport in Fog Prone Area
Medium/Low Traffic Density-Required to be upgraded to CAT-I
Feasible Airports

S.No	Airport	Operator	Existing Facility	Noof WH	ATCO	Diversion (2019-20)	Landing (2019-20)	% of Diversion	Remarks
1	Jabalpur 1988m x 45m	AAI	IFR	0725-1045& 1125-1430& 1600-2110hrs Daily Except Sat, 0725-1045 & 1300-1430 & 1600-2110hrs Sat	8	20	2727	0.73%	Work in progress. PDC 31.03.23
2	Lilabari 2281m x 45m	AAI	IFR	0715-0915hrs Mon Wed Fri ; 0715-0915hrs & 1700-1900 hrsTue Thu Sat Sun	4	2	405	0.49%	Feasible-After acquisition of 84 Acres of land , requested from State Govt.
3	Kushinagar 3200m x 45m	AAI	VFR	1230-1430hrs Mon Wed Fri & Sun	3	0	0	0.00%	Feasible-RNPProcedureavailable ApplicationforIFRupgradationisfiledbasedon RNPprocedure. 34 AcresofLandisrequestedfromstateGovt.for RWYStripforupgradingtoCAT-I PDC:-15monthsafterhandingoverofLand.
4	Rupsi 1771m x 30m	AAI	VFR	1030-1215hrs & 1430-1630 hrsTue Thu Sat Sun	3	0	0	0.00%	Feasible-After acquisition of land (113 acres) for RWY strip & approach lights. RNP Prepared and Aircraft operator requested for flight trials .
5	Lengppui 2500mx45m	STATE	Day IFR	Mon-sat 1000- 1600hrs	4	5	1160	0.43%	Feasible -Subject to land to be made available by state govt.
6	Shirdi 2500 45	PVT	Day IFR	1035-1705hrs	5	26	3113		Feasible



Airport in Fog Prone Area
Medium/Low Traffic Density- Required to be upgraded to CAT-I
NOT Feasible Airports

S.No.	Airport	Operator	Existing Facility	No of WH	ATCO	Diverslon (2019-20)	Landing (2019-20)	% of Diverslon	Remarks
1	Pantnagar 1372mx30m	AAI	Day IFR	1000-1630 hrs Mon to Sat, 1330-1630 hrs Sun	4	3	375	0.80%	Already Day IFR-Not feasible due to Land constraints for approach lights & RWY strip (Highway NH 109 & habitation)
2	Kishangarh 2000mx45m	AAI	IFR	Mon Wed Fri Sat Sun 0850-1700 hrs & Tue Thu 0850-1010 & 1430-1700 hrs	6	8	1001	0.80%	Already IFR-Not feasible due to Obstacle (Prasar Bharati Tower & Hills in approach)
3	Bilaspur * 1455mx45m	AAI	VFR	1435-1605 hrs Mon Wed Fri; 1315-1440 hrs Tue Thu Sat; 1315-1605 hrs Sun	2	0	0	0.00%	Not feasible Airport is in dispute with State Govt. of Chhattisgarh.
4	Kangra 1376mx30m	AAI	VFR	0830-1300 hrs	5	22	1541	1.43%	Not feasible due to Land constraints (hilly terrain), draft VOR procedure designed and available
5	Kullu 1064mX 30m	AAI	VFR	0700-1300 hrs	4	10	724	1.38%	Instrument-NDB Not feasible due to terrain conditions. MoCA also advised not to go ahead for future development.
6	Ludhiana 1460mx30m	AAI	VFR	1200-1500 hrs Mon to Fri	2	3	226	1.33%	Not required as existing Airport will be closed .New CE is being developed at Halwara
7	Pakyong 1700mx30m	AAI	VFR	1100-1430 hrs	4	2	30	6.67%	Instrument VOR/DME, RNP Procedure available. Not feasible due to terrain conditions.
8	Shimla 1163mx30m	AAI	VFR	0930-1330 hrs	3	10	718	1.39%	Instrument-VOR DME Procedure-Yes VOR RWY 32 (Draft) Not feasible due to terrain conditions. MoCA also advised not to go ahead for future development.
9	Tezu * 1500mX30m	AAI	VFR	0750-1050 hrs Tue Thu Sat Sun	3	0	7	0.00%	Flight trial for VOR procedure is pending due to removal of obstacle in Visual slope segment (VSS). Not feasible due to land constraints for approach lights. (State Highway)
10	Darbhanga * 2743mx46m	AAI(CE)	VFR	1045-1645 hrs	0	**	0	**	Not feasible due to Land constraints for RWY strip, RNP procedure available
11	Leh 2922mx45m	AAI(CE)	VFR	0530-1335 hrs	0	**	2984	**	Not feasible due to Land constraints (hilly terrain).
12	Passighat 1006mx45m	S(CE)	VFR	0700 to 1600 hrs	0	**	108	**	Not feasible due to Land constraints .
13	Hisar 1220mx45m	STATE	VFR	Mon to Fri 1100 to 1300 & 1400 to 1600 hrs	2	0	7	0.00%	Not feasible-RNP Procedure will be developed If Airport operator makes a request.
14	Pithoragarh 1330mx20m	STATE	VFR	1100-1300 excluding Sun	2	0	288	0.00%	Not feasible due to Land constraints (hilly terrain).
15	Jalgaon 1700m x 45m	AAI	IFR	1425-1615 hrs & 1750-1940 hrs Wed Sat; 1020-1210 hrs & 1350-1540 hrs Sun	2	12	250	4.80%	Not Feasible- Due to Land Constraint, River passing in approach area, Simulation study to be done for installation of Localiser.



Airports - Non Fog prone area Above medium Traffic Density- Required to be upgraded to CAT-I

S.No	Airport	Operator	No of WH	ATCO	Diversion (2019-20)	Landing (2019-20)	% of Diversion	Existing facility/Remarks
Already CAT-II								
1	Bangalore 4000m x 45m	PVT	H24	138	78	115180	0.07%	(CAT-III)
2	Pune 2535m x 45m	AAI(CE)	H24	0	**	27131	**	(CAT-II)
Already CAT-I								
1	Chennai 3658m x 45m	AAI	H24	266	84	83991	0.10%	CAT-I
2	Goa 3430m x 45m	AAI(CE)	H24	0	**	28828	**	CAT-I (ILS By AAI)
3	Mumbai 3448m x 45m	JV	H24	338	72	152338	0.05%	CAT-I
4	Cochin 3400m x 45m	PVT	H24	61	31	33053	0.09%	CAT-I
5	Hyderabad (Shamsabad) 4260m x 60m	PVT	H24	107	42	91725	0.05%	CAT-I
6	Mangluru 2450m x 46m	PPP	H24	57	45	7843	0.57%	CAT-I(A)
7	Trivandrum 3398m x 45m	PPP	H24	72	17	14421	0.12%	CAT-I(A)



Airports - Non Fog prone area Medium/Low Traffic Density-Required
to be upgraded to IFR

S.No.	Airport	Operator	Noof WH	ATCO	Landing (2019-20)	Existing facility/Remarks
AlreadyCAT-I/IFR						
1	Jaisalmer 2744m x 45m	AAI(CE)	Dawn to Dusk	0	1480	Already CAT-II
2	Jamnagar 2514m x 45m	AAI(CE)	1130-1330 Mon Wed Fri Sun & 0845-1730 Tue Thu Sat	0	316	Already CAT-II
3	Bidar 2700m x 45m	S(CE)	H24 (Considering Demand)	0	--	Already CAT-II



Airports - Non Fog prone area

Medium/Low Traffic Density-Required to be upgraded to IFR
Already CAT-I/IFR

S.No.	Airport	Operator	No of WH	ATCO	Diversion (2019-20)	Landing (2019-20)	% of Diversion	Existing facility/Remarks
1	Bhuj 3515m x 45m	AAI(CE)	0615-1015 hrs Mon Tue Thu Sat	0	**	277	**	CAT-I
2	Port Blair 3414m x 45m	AAI(CE)	0800-1400 hrs	0	**	7118	**	CAT-I (ILS) By AAI
3	Visakhapatnam 3048m x 45m	AAI(CE)	H24	0	**	10468	**	CAT-I (ILS) By AAI
4	Calicut 2860m x 45m	AAI	H24	23	23	12678	0.18%	CAT-I(A)
5	Coimbatore 2990m x 45m	AAI	H24	21	3	11152	0.03%	CAT-I(A)
6	Madurai 2285m x 45m	AAI	0715-2045 hrs	13	6	7963	0.03%	CAT-I(A)
7	Hubli 2600m x 45m	AAI	0835-1350 hrs & 1625-2045 hrs	9	9	3472	0.26%	CAT-I
8	Tirupati 2285m x 45m	AAI	0650-2030 hrs	11	2	4850	0.04%	CAT-I
9	Trichy 2423m x 45m	AAI	H24	21	5	7130	0.07%	CAT-I
10	Vijayawada 3360m x 45m	AAI	0705-2215 hrs	14	7	7621	0.09%	CAT-I
11	Bhavnagar 1921m x 45m	AAI	0820-1150 hrs Wed Thu Sat, 0900-1020 hrs Fri Sun	4	1	1150	0.09%	CAT-I(A)
12	Rajkot 1843m x 45m	AAI	0540-1935 hrs	7	0	1042	0.00%	CAT-I(A)
13	Vadodra 2466m x 45m	AAI	0600-2140hrs Mon Tue Fri Sat Sun; 0600-0930hrs & 1115-2140hrs Wed Thu	13	17	3928	0.43%	CAT-I(A)
14	Belagavi 2300m x 45m	AAI	0830-2000 hrs Mon Tue Wed Thu Fri, 0900-2000 hrs Sat Sun	11	5	2869	0.17%	IFR
15	Kandla 1524m x 30m	AAI	0930-1050 & 1355-1630 hrs Mon Tue FriSun, 1355-1630 hrs Wed Thu Sat	4	2	740	0.27%	IFR



Airports -Non Fog prone area

Medium/Low Traffic Density-Required to be upgraded to IFR
Already CAT-I/IFR

S.N o.	Airport	Operator	Noof WH	ATCO	Diversion (2019-20)	Landing (2019-20)	% of Diversion	Existing facility/Remarks
16	Mysuru 1740m x 30m	AAI	All days Except Tue Sun 0900- 2045hrs Tue 0645-1800 hrs& 1815-2000 hrs Sun 0900-1100 hrs& 1345-2045 hrs	6	0	1574	0.00%	IFR
17	Porbandar 1371m x 45m	AAI	0745-0910hrs daily	8	0	746	0.00%	IFR
18	Rajamundhry 3165m x 45m	AAI	0800-1400hrs & 1545-2210hrs Mon Wed Fri; 0800-1400hrs & 1815-2210hrs Tue Thu Sat Sun	12	3	4843	0.06%	IFR
19	Tuticorin 1350m x 45m	AAI	0705-0830& 1030-1625hrs	6	0	1829	0.00%	IFR
20	Nasik 3000m x 45m	HAL	0800-2200hrs		**	1158	**	CAT-I(A)
21	Kannur 3050m x 45m	PVT	H24	18	6	7566	0.08%	CAT-I(A)
22	Mundra 1700m x 45m	PVT	Prior approval	2	0	181	0.00%	IFR
23	Nanded 2300m x 45m	PVT	TUE 1010-1130 1710-1830WED 1010-1130 1330- 1415 1710-1830 ,THU 1010-1130 1710-1830SAT 0800-0945	3	0	1090	0.00%	IFR



Airports - Non Fog prone area

Medium/Low Traffic Density- Required to be upgraded to IFR

S.No	Airport	Operator	Existing Facility	No of WH	ATCO	Diversion (2019-20)	Landing (2019-20)	% of Diversion	Remarks
Feasible									
1	Kolhapur 1370mx45m	AAI	Day IFR	1200-1800 hrs Mon Wed Sat Sun; 1200- 1630 hrs Tue Thu Fri	5	8	1390	0.58%	Already Day IFR
2	Cuddapah 1719mx30m	AAI	VFR	1315-1800 hrs Tue Wed Thu & 1445-1645 hrs Mon Fri Sat Sun	3	0	1059	0.00%	Feasible-Instrument-NDB RWY 11 PDC – 31 December 2022
3	Kalburgi 3175mx45m	AAI	VFR	1000-1650 hrs	4	0	149	0.00%	Feasible-RNP Procedure will be made: December 2022 PDC – 31 December 2022
4	Pondicherry 1502mx30m	AAI	VFR	Nil (Pre Covid watch:1100- 1430 hrs DLY EXC TUE SAT 1100- 1230 IST TUE SAT)	2	0	518	0.00%	NDB Procedure available . Feasible- after availability of Land. Land requirement of 57.5 Acres falling in Puducherry and 104 Acres Land falling in Tamil Nadu has been projected.
5	Salem 1829mx45m	AAI	VFR	Nil (Pre Covid watch: 0700- 1000 hrs daily)	3	0	351	0.00%	NDB Procedure available . Feasible- after availability of Land. 446 acres of land has been projected for development of Airport.



Airports - Non Fog prone area

Medium/Low Traffic Density- Required to be upgraded to IFR

S.No.	Airport	Operator	Existing Facility	No of WH	ATCO	Diversion (2019-20)	Landing (2019-20)	% of Diversion	Remarks
Not Feasible									
1	Diu 1825mx45m	AAI	VFR	1445-1745 hrs Mon-Sat & 1600-1745 Sun	3	1	683	0.15%	Not feasible- Design of Instrument flight procedure is not possible due to presence of Obstacles.
2	Aggati 1204mx30m	AAI	VFR	1005-1235 hrs Tue; 1215- 1440 hrs Other than tue	3	1	996	0.10%	Not feasible- due to non availability of RWY strip due proximity of sea.
3	Sindhugarh 2500mx45m	PVT	VFR	1200 to 1400 hrs	1	0	0	0.00%	Not feasible- due to non availability of required RWY Strip
4	Vidyanagar 1589mx30m	PVT	VFR	0830-1030 AND 1600- 1800	4	0	685	0.00%	Not feasible- due to non availability of required RWY Strip
5	Jagdalpur 1125mx30m	STATE	VFR	1130-1615	3	0	79	0.00%	Not feasible- due to non availability of required RWY Strip
6	Kurnool 2000mx30m	STATE	VFR	Mon ,Wed 7 Fri 1000 to 1130 & 1445 to 1615/Tue, Thu& sat 1515 to 1715 and Sun 1000 to 1130 & 1445 to 1715	3	0	0	0.00%	Not feasible- due to non availability of required RWY Strip



Annexure XII

Guidelines for provision/ upgradation of NDB/ Locator facilities



भारतीय विमानपत्तन प्राधिकरण AIRPORTS AUTHORITY OF INDIA

एएआई/एनएस/आईएलएस जेन/701/2013 / 249-259

दिनांक: 19/02/2021

सेवा मे,

महाप्रबंधक संचार (वैमानिक संचार केंद्र)
भारतीय विमानपत्तन प्राधिकरण
दिल्ली/ मुंबई/ कोलकाता/ चेन्नई

महाप्रबंधक संचार (क्षेत्र)
भारतीय विमानपत्तन प्राधिकरण
उत्तरी क्षेत्र, दिल्ली/ पूर्वी क्षेत्र, कोलकाता/ उत्तर - पूर्वी
क्षेत्र, गुवाहाटी/ पश्चिमी क्षेत्र, मुंबई/ दक्षिणी क्षेत्र, चेन्नई क्षेत्र

महाप्रबंधक संचार
भारतीय विमानपत्तन प्राधिकरण,
शमशाबाद (HIAL), देवनहल्ली (BIAL), सीएटीसी (प्रयागराज)/गगन (GAGAN) बैंगलुरु

महोदय/Sir,

विषय: हवाईअड्डों एवं वायु मार्ग स्टेशनों के एनडीबी/ लोकेटर्स को प्रचालन से स्थाई रूप से हटाने हेतु नीति।
Subject: Policy for permanent withdrawal of NDB/Locators from operations at airports and en- route stations.

In view of availability of alternate navigation and surveillance aids at various airports/ en-route stations, operational requirement for retention/ withdrawal of NDBs/ Locators is to be assessed from time to time. Operational requirement for NDB/ Locators has been coordinated with ASM dte and accordingly, competent authority has approved following policy for permanent withdrawal of NDBs/ Locators from operation:-

- The availability of an alternate aid (such as DVOR) at airport/ en route station
- IAL procedures based on the alternate facility along with additional IAL procedures in the form of PBN approach procedures at the airport would be sufficient to serve the airport concerned
- Availability of surveillance facilities serving the airport may be considered as long term measures,

In future, operational requirement of NDBs/ Locators will be assessed as per above policy guidelines.

This is for your information.

भवदीय/ Yours sincerely,

(जे.बी. सिंह/J.B. Singh)

महाप्रबंधक (सीएनएस- एसक्यूए & नेविगेशन सिस्टम)
General Manager (CNS- SQA & Navigation system)

प्रतिलिपि (Copy): -

- कार्यपालक निदेशक (एफआईयू/ आरसीडीयू)- सफदरजंग एयरपोर्ट, दिल्ली
- कार्यपालक निदेशक (सीएनएस- पी-1/2), सीएचक्यू, दिल्ली
- कार्यपालक निदेशक (एएसएम/ एटीएम/ एटीएफएम), सीएचक्यू, दिल्ली
- कार्यपालक निदेशक (विमानन संरक्षा), सीएचक्यू, दिल्ली

आंतरिक वितरण (Internal Distribution):-

- महाप्रबंधक(सीएनएस) - एफटीआई/ आटोमेशन- सर्विलेंस/ कॉम- सीएचक्यू, दिल्ली
- व्यक्तिगत सचिव- कार्यपालक निदेशक (सीएनएस-ओएम), सीएचक्यू, दिल्ली



भारतीय विमानपत्तन प्राधिकरण
AIRPORTS AUTHORITY OF INDIA



List of NDB stations with DVOR Availability/Non Availability Status						
Sl. No	Station	Eqpt	Availability of DVOR	Availability of R&P procedure at Airport	Availability of Land for DVOR	Remarks
1	Amritsar	NDB	Yes	No		ASM Dte. has prposed for Withdrawl/NDB Withdrawl under progress
2	Guwahati	NDB	Yes	No		ASM Dte. has prposed for Withdrawl/NDB Withdrawl under progress
3	Imphal	NDB	Yes	No		ASM Dte. has prposed for Withdrawl/NDB Withdrawl under progress
4	Lilabari	NDB	Yes	No		ASM Dte. has prposed for Withdrawl/NDB Withdrawl under progress
5	Tezu	NDB	Yes	No		ASM Dte. has prposed for Withdrawl/NDB Withdrawl under progress
6	Agartala	NDB	Yes	No		
7	Coimbatore	NDB	Yes	No		
8	Dibrugarh	NDB	Yes	No		
9	Dimapur	NDB	Yes	No		
10	Gondia	NDB	Yes	No		
11	Jharsuguda	NDB	Yes	No		
12	Kadapa	NDB	Yes	No		
13	Khajuraho	NDB	Yes	Yes (Rwy01 & Rwy19)		
14	Lengpui	NDB	Yes	No		
15	Madurai	NDB	Yes	No		
16	Mangalore	NDB	Yes	Yes (Rwy06 & Rwy24)		Operational use under review by ASM dte.
17	Porbandar	NDB	Yes	Yes (Rwy09 & Rwy27)		
18	Rajamundhry	NDB	Yes	No		
19	Rajkot	NDB	Yes	No		
20	Ranchi	NDB	Yes	No		
21	Udaipur	NDB	Yes	Yes (Rwy26)		
22	Vijaywada	NDB	Yes	No		
23	Tuticorin	NDB	Proposed/WIP	No		
24	Bhuntar	NDB	Proposed/WIP	No		
25	Agatti	NDB	No	No	No	HP-DME Available
26	Kandla	NDB	No	No	Yes	HP-DME Available
27	Pantnagar	NDB	No	No	Yes	HP-DME Available
28	Cooch Behar	NDB	No	No		No commercial operation.
29	Diu	NDB	No	No	YES	
30	Keshod	NDB	No	No	Yes	
31	Kolhapur	NDB	No	No	Yes	
32	Kota	NDB	No	No		No commercial operation.
33	Kurnool	NDB	No	No		State Govt. Airport. Data not available
34	Pondicherry	NDB	No	No	No	
35	Salem	NDB	No	No	No	
36	Tura	NDB	No	---		State Govt Airport. Airport Not operational
37	Songarh	NDB	No	---		Enroute Facility
38	Sholapur	NDB	No	No		No commercial operation.



LIST OF STATIONS WITH OUTER LOCATOR FACILITY

1	Chennai	OL RWY 07	Yes			ASM Dte. has prposed for Withdraw/OL Withdrawl under progress
2	Kolkata	OL RWY 19L	Yes			ASM Dte. has prposed for Withdraw/OL Withdrawl under progress
3	Ahmedabad	OL RWY 23	Yes			
4	Cochin	OL RWY 27	Yes			
5	Guwahati	OL RWY 02	Yes			
6	Jaipur	OL RWY 27	Yes			
7	Nagpur	OL RWY 32	Yes			
8	Delhi	OL RWY 27	YES			



Annexure XIII

CNS/ATM Equipment

1. Communications

1.1 Introduction

Communication is one of the three CNS elements used by both ATS and Airlines. Safety and efficiency of aircraft operations are directly related to the availability and performance of aeronautical communications and the supporting infrastructure. ANSPs, Aircraft Operators, Avionics Manufacturers, and other agencies providing supporting communication services and infrastructure depend on “Communication” and they participate in deciding specifications and harnessing technologies to ensure that Air Transportation and Air Traffic Service provision are effectively conducted in a safety critical domain for which Communication is the backbone.

The following sections describe the ground-to-ground and air-to-ground / ground-to-air subnetworks of the Communication Network, and the various technologies and their deployment.

1.2 Ground–Ground Communications

Ground-ground communications refer to exchange of ATM-related messages linking ground-based stakeholders, concerning planning and movement of aircraft. Such communications are transitioning from analogue to digital format and are becoming increasingly automated.

Technologies and applications reviewed in this section include:

- Aeronautical Fixed Telecommunications Network (AFTN) and ATS Message Handling Services (AMHS);
- Very Small Aperture Terminal (VSAT); and
- Air Traffic Services Inter-Facility Data Communications (AIDC)
- Hot lines for voice communication between adjacent ACC/ATC Centres.

1.2.1 Aeronautical Fixed Telecommunications Network and ATS Message Handling Services

The AFTN is a message-handling network that has existed for over 50 years. It is a closed network in the sense that its users belong to ATS authorities and associated organizations such as airline operators, general aviation, and meteorological offices.



The AFTN is character-based only and cannot carry bit-oriented applications. The aviation industry has adopted AMHS to replace the AFTN. The AMHS can carry digital information such as text, graphics, images, files, databases, audio and video. ICAO has specified standards to ensure interoperability between AMHS and AFTN during the migration period.

1.2.2 Very Small Aperture Terminal (VSAT)

A VSAT ground station uses satellites to relay voice and data from small terminals to other terminals. VSATs are typically used for communications between ATC units in areas where line connections are unreliable or uneconomical.

Usages of VSAT ground station terminals on an established network and satellite are versatile, economical and scalable. However, a deployment of new VSAT networks and satellites is considerably more expensive.

Note: AAI owned VSAT Network (Dedicated Satellite Communication Network – DSCN) which was commissioned earlier, is being decommissioned in a phased manner, as it shall run out of utility when AAI's dedicated FTI based communication network shall be available with the ANSP.

1.2.3 Air Traffic Services Interfacility Data Communication (AIDC)

AIDC is a ground-ground data link communication service that provides the capability to automatically exchange data between ATS units for notification, coordination and transfer of aircraft between flight information regions (FIRs). AIDC message format and procedures is an international standard designed for use through any ground-ground circuit, including the legacy AFTN.

AIDC greatly reduces the need for voice coordination between ATC facilities, resulting in fewer errors and reduced workload.

1.3 Air-Ground Communications

Current controller-pilot communications use primarily voice links provided by analogue radios operating in the VHF and HF bands. Aviation is moving towards a new communications infrastructure that provides superior quality through use of air-ground data link. A first generation of ATC applications was implemented using Aircraft Communications Addressing and Reporting System (ACARS) air-ground data links. ACARS now needs to transition to modern communications protocols, such as VDL Mode 2 in order to support increasing user traffic and provide the performance needed for today and future air traffic management (ATM).

Adoption of Controller Pilot Datalink Communications (CPDLC) as the primary means of routine communication while maintaining the requirement for voice communications for non-routine, tactical communications and as a backup, is definitely not envisaged in near term (0-



5 years) and perhaps not even medium term (6-10 years). A long-term (11+ years) paradigm shift may have to be factored in for planning purposes.

This section provides an overview of currently available technologies supporting the following groups of applications:

- Communication in the vicinity of aerodromes [not explored as yet]
 - Aeronautical Mobile Airport Communications System (AeroMACS)
 - Long Term Evolution (LTE)
- Voice Communication
 - Very High Frequency (VHF) Voice
 - High Frequency (HF) Voice
 - Voice Communications through Satellites (SATVOICE)
- Data and Network Communication
 - Controller Pilot Data Link Communications (CPDLC)
 - Aircraft Communications Addressing and Reporting System (ACARS)
 - VHF Data Link (VDL) Modes 2–4
 - High Frequency Data Link (HFDDL)
 - L-Band Digital Aeronautical Communications System (LDACS)
 - Aeronautical Telecommunications Network over Internet Protocol Suites (ATN IPS)

1.3.1 Aeronautical Mobile Airport Communications System (AeroMACS)

AeroMACS is intended to support on-the-ground secured communication exchanges and is based on the IEEE 802.16-2009¹ mobile standards for WiMAX². The uses of AeroMACS are limited to aviation applications on the surface within the airport vicinity and can support three categories of users: ATC/ATM and infrastructure, airline operations and airport authority operations.

AeroMACS is a technology which has been standardized exclusively for aviation uses. A global frequency allocation for AeroMACS was introduced in the International Telecommunication Union (ITU) Radio Regulations for the frequency bands of 5000 – 5030 MHz and 5091 – 5150 MHz.

ICAO SARPs for AeroMACS are currently applicable and ICAO Doc 10044: Manual on AeroMACS has been published. The Airlines Electronic Engineering Committee (AEEC) is

¹ A series of wireless broadband standards written by the Institute of Electrical and Electronics Engineers (IEEE) for Local and metropolitan area networks. Part 16: Air Interface for Broadband Wireless Access Systems.

² Worldwide Interoperability for Microwave Access, which is a standards-based technology enabling the delivery of last mile wireless broadband access as an alternative to cable and DSL.



developing avionics specifications for AeroMACS and has started the development of aircraft installation architecture.

AeroMACS is a part of the Future Communication Infrastructure supporting the Airport Surface Component and is reflected within the ICAO Global Air Navigation Plan (GANP) and the ICAO Communication Roadmap in the GANP. In particular, a SESAR study indicated that AeroMACS is an enabler for ATN baseline 2 and can offload the saturated VHF datalink communications in the airport environment and support advanced surface CNS systems.

Notwithstanding the above, many airlines are using other more cost-effective, commercial solutions, such as LTE to support their general AOC operations.

IATA underlines the requirement for a positive business case for airlines, particularly regarding AOC applications, which is not yet available. Relevant business cases should consider the unique technical features of AeroMACS and evaluate their necessity and incremental benefits as related to actual operational requirements. Airline equipage decisions may be voluntary. A comparative evaluation with other wireless broadband technologies should also be conducted for non-safety related applications, such as aeronautical administrative communications (AAC) and aeronautical passenger communications (APC).

1.3.2 Long Term Evolution (LTE)

LTE is a technology for 4G mobile network, similar to that being used by mobile phones. The potential services and applications of LTE for aviation are airline operations, passenger in-flight communication and airport and/or port authority operations.

Each LTE base station can cover up to 150 km distance between aircraft and a ground LTE antenna. The air-ground coverage can be extended via terrestrial cellular network. It is also feasible to extend its coverage to oceanic and remote airspace via a hybrid solution with a satellite network.

LTE was standardized in 2008 as a telecommunication standard. Currently, there is no overt progress on aviation standardization of LTE. LTE also lacks a legal protection from radio frequency interference. LTE and its service are normally not exclusive for aviation use. A contractual Service Level Agreement between airlines and LTE service providers may be needed, therefore it is not seen to be easily implementable

Similar to AeroMACS, a formal business case for airlines is not publicly available for LTE as well. As LTE is not originally designed to support safety-critical applications, airlines should conduct a proper operational risk assessment and develop appropriate contingency measures/procedures in case of interruptions of LTE services. AAI as an ANSP has not explored both AeroMACS and LTE and may not do so in the near term.



1.3.3 Very High Frequency (VHF) Voice

VHF voice communication systems, used in the International Aeronautical Mobile Service are amplitude modulated (AM) carriers. VHF analogue radios use channels of varying bandwidth. The channel spacing can be defined as 100 kHz, 50 kHz, 25 kHz or 8.33 kHz, depending on the saturation of channels in the region of interest.

In March 2007, the ICAO European Region made the carriage and operation of 8.33 kHz radios mandatory above FL195.

8.33 kHz channel spacing implantation in regions where 25 kHz channel spacing does not provide an adequate number of frequencies may pose a challenge. Where implemented, carriage of 8.33 kHz-capable radios should be mandatory to ensure that all potential safety and capacity benefits are realized. Frequency Spectrum Management is an important activity which will lead to pragmatic solutions to reduction in overlaps and interferences.

1.3.4 High Frequency (HF) Voice

HF voice communication is used for air-ground ATC communications in remote and oceanic areas outside the range of VHF frequencies. In most cases, an HF radio operator functions as an intermediary between controllers and pilots, transcribing and relaying the contents of HF voice communications.

HF communications have long-distance coverage and aircraft can use radios operating in the HF radio band for long-range communications because signals are reflected by the ionosphere. Link quality and availability are variable, and influenced by a number of factors, including frequency congestion, sunspot activity, the eleven-year solar cycle, and day/night atmospheric and ionospheric conditions. Consequently, larger aircraft separation standards are used, thus reducing airspace capacity.

In most cases, Controller Pilot Datalink Communications (CPDLC) can replace HF voice communication.

CPDLC is increasingly being deployed as the primary means of communication for oceanic and remote areas while continuing to provide HF voice service as a backup. Ground based HF transceivers should be equipped with Selective Calling (SELCAL).

For oceanic and remote regions, it is expected that the migration from HF to SATVOICE will eventually occur. ICAO ANC Technical Panels are developing regulatory frameworks and separation standards to allow the use of SATVOICE capability in lieu of mandating HF Voice avionics.



1.3.5 Voice Communication via Satellites (SATVOICE)

Voice communication via satellites (often referred to as SATVOICE) is currently used to complement other forms of long-range communications, such as CPDLC and HF Voice. SATVOICE provides a means of reducing the risk of communication failures, and can improve the safety and efficiency of operations.

SATVOICE does not yet directly link pilots and controllers although there are plans to do so in the near future. Enhancement of SATVOICE is being developed to provide direct controller-pilot communications (DCPC) for more efficient ATS communications, such as in processing negotiations or requests from the flight crew. Furthermore, future capability of SATVOICE is being considered to provide an intervention capability in support of an ATS service.

ICAO is developing Satellite Voice Guidance Material (SVGM) with the aim to maximize the operational benefits of SATVOICE implementations by promoting seamless and interoperable SATVOICE operations throughout the world. The document addresses the use of SATVOICE for ATS communications, but assumes aircraft equipage and ground infrastructure will continue to maintain HF voice capability.

1.3.6 Controller Pilot Data Link Communications (CPDLC)

CPDLC refers to communications between controllers and pilots using pre-defined message sets, with a free-text option for non-routine messages.

CPDLC is a desirable form of controller-pilot communications, as it reduces voice errors and misinterpretations. It can be used for routine communications but is less suitable for tactical interventions as compared with VHF voice communications.

CPDLC as the primary means of communication in oceanic and remote airspace where the quality of voice communications is often poor, is the path Aviation industry is following. At the same time, CPDLC should be considered for implementation in appropriate enroute airspace in order to relieve congestion on voice channels.

1.3.7 Aircraft Communications Addressing and Reporting System (ACARS)

Aircraft Communication and Reporting System (ACARS) systems were originally used to exchange messages between aircraft and flight operations centres. Since the 1990s, the ACARS network and avionics have been used to support the exchange of pre-FANS and FANS 1/A messages (i.e. Automatic Dependent Surveillance-Contract (ADS-C) and Controller Pilot Data Link Communications (CPDLC)) between aircraft and ATS units. It is important to highlight that ACARS has not been standardized by ICAO; the technical and operational requirements are defined in a set of documents issued by ARINC.



Use of ACARS for ATS communications has reduced potential for error inherent in voice communications, and off-loaded congested ATS voice channels. ACARS is currently available via HF, VHF and satellite data links. The migration to IP based or multilink based ACARS is enabling the system to handle large sets of data and is expected to have been resuscitated, given the earlier limitations reducing its utility value eventually driving it towards being phased out.

1.3.8 VHF Data Link (VDL) Mode 2

VDL Mode 2 is a bit-oriented air-ground digital data link that was introduced as an VHF Mode 0 (VHF ACARS) upgrade for ATC controller-pilot data communications while still allowing ACARS equipped aircraft to use the same network. Being bit-oriented, it can transmit digital content rather than being limited to characters.

VDL Mode 2 delivers data at 31.5 Kbps, which is over 13 times faster than the VHF ACARS 2.4 kbps rate. This is the highest possible bit rate that can be supported by a 25 kHz channel while providing a range of 200 nautical miles.

VDL Mode 2 uses the Carrier Sense Multiple Access (CSMA) protocol to detect when a VHF channel is clear in order to avoid overlap with other transmissions. The VDL Mode 2 CSMA technology is superior to that of ACARS, as it detects a clear channel much quicker. This in turn results in reduced message delay and higher success rates under heavy loading conditions.

VDL Mode 2 has been accepted by the industry as the natural upgrade for VDL Mode 0 (VHF ACARS).

1.3.9 VHF Data Link (VDL) Mode 3

VDL Mode 3 data link was proposed to relieve VHF voice channel congestion in the U.S. It faced competition from 8.33 kHz channel spacing, which is implemented in Europe. Because many airlines have already equipped to 8.33 kHz, the proposal for VDL Mode 3 was withdrawn. VDL Mode 3 is not expected to be used given major stakeholders' concerns.

Note: 8.33 Khz VHF Channel spacing is not used in ICAO APAC Region, although India does support the concept.

1.3.10 VHF Data Link (VDL) Mode 4

VDL Mode 4 is a bit-oriented VHF data link capable of providing air-air and air-ground communications. VDL Mode 4 supports time-critical applications and it is efficient in exchanging short repetitive messages. It is based on the Self-organizing Time Division Multiple Access (STDMA) protocol. Through this self-organizing system, the time available for transmission is subdivided into multiple time-slots. Each time slot is planned and



reserved for transmission by users' radio transponders within range of each other. This enables efficient data link use and prevents simultaneous transmission from different users. STDMA allows users to mediate access to discrete time slots without reliance on a master control station. VDL Mode 4 was a data link candidate for ADS-B. However, 1090 MHz Mode S Extended Squitter (ES) has been chosen as the standard for international aviation. VDL Mode 4 too perhaps is a non-starter.

1.3.11 High Frequency Data Link (HF DL)

HF DL provides data-link coverage for polar operations, where geostationary satellites have no coverage. Because of this, and the small incremental cost to implement HF DL in HF equipped aircraft, many airlines use HF DL for operational communications outside of the coverage of VHF and satellites. HF DL however does not have the communication performance of VHF or SATCOM data link and has been shown to not meet RCP240/RSP180 performance requirements.

HF DL service availability in oceanic and remote areas, especially in the Polar Regions, to augment or to serve as a backup to other data communication methods, makes it a popular choice for local applications in that region.

1.3.12 L-band Digital Aeronautical Communications System (LDACS)

LDACS is a ground-based data link system being developed for continental airspace for en-route and terminal area communications. The technology is being developed to be accommodated in the L-band frequency which is heavily utilized by legacy navigation and surveillance aviation systems. LDACS is predicted to be part of the ATN over IP (ATN/IP) and is mainly under development by the SESAR Programme for the Future Communication Infrastructure (FCI). LDACS covers both high-rate data and voice communication and will support ICAO security requirements.

Besides communications, LDACS can support additional navigation functionality which aircraft can perform pseudo-range measurements to LDACS ground station, making it a potential technology for Alternative Position, Navigation, and Timing (APNT). Some research suggests the feasibility of APNT-based RNP 0.3 utilizing LDACS.

LDACS with its potential for communications and navigation can simplify deployments and usages of frequencies in L-band as it allows for a deployment/migration strategy based on a combined/holistic approach. Having the global availability of GNSS together with a robust and accurate APNT solution allows further reductions of conventional navigation infrastructure, such as DME. This in turn would free spectrum in L-band for additional communications usage.

Note: LDACS is under development and SARPs for system are yet to be notified by ICAO.



The on-going trials on electromagnetic spectrum compatibility, technical performance and use cases, points to further evaluation, prior to a final recommendation. Potential uses of LDAC for APNT applications should also be further explored.

1.3.13 Aeronautical Telecommunication Network over Internet Protocol Suites (ATN IPS)

ATN is an internetwork architecture that allows ground, air-ground and avionics data sub-networks to interoperate by adopting common interface services and protocols based on the International Organization for Standardization (ISO) Open Systems Interconnection (OSI) reference model.

Since 2003, ICAO has endeavoured to transform the ATN into a modern network by specifying use of Internet Protocol Suite (IPS). The relevant ICAO standards have been adopted by the ICAO Council and became applicable in November 2008. The ICAO GANP calls for a converging transition from FANS 1/A and OSI ATN to an ATN IPS, which is a strategy IATA endorses.

1.3.14 Other Data Link Services

1.3.14.1 Digital Automatic Terminal Information Service (D-ATIS)

ATIS is predominantly a voice broadcast service over a dedicated VHF frequency that provides operational information to aircraft operating in the vicinity of an airport, eliminating the need for a controller to transmit the information to each aircraft individually. It is normally accomplished through a voice recording, updated when conditions change.

Data link is an alternative mean of transmitting ATIS to equipped aircraft. It reduces flight crew workload as D-ATIS information is printed on a cockpit printer or is recallable on a data link display.

2. NAVIGATION

2.1 Introduction

Navigation infrastructures are an important backbone of Air Traffic Service (ATS) alongside communication and surveillance systems. Aircraft navigation has come a long way from those early days. From legacy ground-based navigation aids such as Distance Measuring Equipment (DME) and VHF Omni-directional Range (VOR) to satellite-based navigation aids such as the Global Navigation Satellite System (GNSS), pilots now have multiple means to safely navigate the sky. The accuracy in position reporting results in direct benefits of capacity enhancements owing to the ability to adopt reduced separation minima between aircraft.



It is therefore of utmost importance that ANSPs and regulators adopt a global and regional look at route and airspace design and management, with harmonization throughout all phases of flight from gate-to-gate and a collaborative approach involving Airspace Users during all levels of decision making. This collaboration is crucial in the navigation aspect of ATS as it links directly to aircraft equipage investments, safety and efficiency in flight operations. If a Flight Information Region which has a few segments of a long international route opts to enforce separation minima based on age old time based and predicated to terrestrial navaids for position reports, the benefit of better equipage and matching ground infrastructure in adjoining airspaces shall come to a nought. Area Navigation Capabilities of the aircraft and Required Navigation Performance (RNP) specifications have changed the paradigm which needs to be harnessed by the Airspace Planners of the ANSPs in consultation with the Airlines.

2.2 Performance-Based Navigation (PBN)

PBN is a global set of area navigation standards, defined by ICAO, based on navigation performance and functionality required for the proposed operation. PBN concept encompasses two types of navigation specifications:

- **RNAV Specification** – Navigation specification based on area navigation that *does not* include the requirement for on-board performance monitoring and alerting, e.g. RNAV 5, RNAV 2 and RNAV 1.
- **RNP Specification** – Navigation specification based on area navigation that *requires* on-board performance monitoring and alerting, e.g. RNP 4, RNP 2 and RNP APCH.

It is expected that all future navigation applications will identify the navigation requirements through the use of performance specifications, rather than defining equipage of specific navigation sensors.

The use of PBN avoids the need to purchase and deploy navigation aids for each new route or instrument flight procedure, allows for the design of routes and procedures that are not limited by ground-based infrastructure and facilitates the operational approval process for operators by providing a limited set of navigation specifications intended for global use.

The safety benefits of PBN are significant, as even airports located in the least privileged areas of the world can have runway-aligned approaches with horizontal and vertical guidance to any runway end without having to install, calibrate and maintain expensive ground-based navigation aids. In line with ICAO Assembly Resolution A37-11, Airlines support rapid deployments of vertical-guided approach procedures using RNP APCH navigation



specification, enabled by GNSS³ and barometric vertical navigation (Baro-VNAV) to all instrument runways.

Despite several ICAO Assembly Resolutions, including Resolution A37-11, and an industry-wide joint declaration providing full support and calling for the rapid implementation of PBN, some States and ANSPs have been slow to act. AAI as an ANSP has done a good measure, however, a lot is to be done.

2.3 World Geodetic System-84 (WGS-84)

There are many different geodetic reference datum in use throughout the world that provide reference to terrain and charting. However, the global standard for aviation is WGS-84. ICAO Annex 4 — Aeronautical Charts, Annex 11 — Air Traffic Services, Annex 14 — Aerodromes, and Annex 15 — Aeronautical Information Services state that “*World Geodetic System — 1984 (WGS-84) shall be used as the horizontal (geodetic) reference system for air navigation.*” These requirements became applicable on 1 January 1998.

Consequently, all aircraft navigation and terrain avoidance systems are based solely on WGS-84. All aircraft systems assume that the latitude and longitude coordinates provided are based on WGS-84. India has adopted WGS-84 and all routes and flight procedures are based on WGS-84 coordinates.

2.4 Conventional Ground-Based Navigation Aids

Ground-Based Navigation Aids are legacy, conventional navigation aids that came into the ATS environment in the early decades of the 20th century (earliest form of a marker beacon was flight tested in 1918) with the advent of wireless communications and advancement of radio telephony research. These navigation aids operate on the principle of radio propagation, where aircraft calculate their positions using a combination of radio signals received. With the advancement of onboard multi-sensor avionics and Flight Management Systems (FMS), aircraft are also able to achieve a level of navigation performance required for some PBN procedures.

As they rely on radio signals that only propagates within the line-of-sight and with limited coverage, these Ground-Based Navigation Aids come with limitations and are sometimes not deployable, particularly in remote mountainous or oceanic areas. Their maintenance and flight inspection costs are generally heavy and, in some cases, impose signal protection requirements that penalize the efficiency of airspace or airport usage. These limitations make satellite-based navigation system a more promising technology for PBN operations.

³ For details on GNSS, see section 5.5.



However, while a satellite-based navigation system seems more suitable for PBN operations, reliance on GNSS as the sole means of navigation presents vulnerability to possible disruptions of the services by interferences and other atmospheric anomalies. Supported by a positive cost-benefit analysis and driven by considerations on operational and business continuity requirements, it is expected that a reduced, selected Ground-Based Navigation Aids will still remain as a back-up capability in the ATS environment.

This section provides an overview of the following ground-based navigation aids:

- Non-Directional Beacon (NDB)
- Distance Measuring Equipment (DME)
- VHF Omni-directional Range (VOR)
- Tactical Air Navigation (TACAN) [used in India only by Defence forces]
- Instrument Landing Systems (ILS)
- Microwave Landing System (MLS) [not deployed in India]

2.4.1 Non-Directional Beacon (NDB)

The earliest form of enroute navigation aids, NDB operates by broadcasting non-directional radio signals. The signals are picked up by antenna on an aircraft, and its information is processed and used with the Automatic Direction Finder (ADF). The NDB can also be used for non-precision approaches at some airports. The limitations of NDB lie in its non-directional and unreliable quality of signal, rendering it inferior to other en-route navigation aids such as VOR and GNSS.

Many of the NDBs in service today are deemed to be obsolete and not required in a navigational environment utilizing GNSS. The use of NDBs for en-route should be replaced by PBN waypoints. Plans to phase out NDBs should be followed up by ASM Directorate and CNS-OM Directorate.

2.4.2 Distance Measuring Equipment (DME)

DME is a ground-based navigation aids that helps the aircraft measure its distance from the DME station by timing the propagation delay in the radio signals sent between the station and the aircraft. In area navigation, the aircraft can use multiple DME signals to triangulate its position by utilizing multiple DME-distance measurements and the published locations of the stations. Thus, DME can serve as a contingency navigation aid supplementing GNSS and is also part of navigation infrastructure that supports PBN operations down to RNAV1 specification. However, installations of additional DMEs to form DME/DME network for RNAV1 and RNAV2 operations are discouraged due to unnecessary DME costs, the global



availability of GNSS and widely-equipped inertial-based navigation systems in commercial aircraft.

2.4.3 VHF Omni-directional Range (VOR)

VOR is a navigation aid that transmits VHF navigation signals 360° in azimuth angles. Using signal phase measurement comparison, the aircraft with a VOR receiver can determine its radial from the VOR ground station. When used in conjunction with a collocated DME and the published location of the station stored in the on-board database, the aircraft can determine its coordinate location and thus conforming to RNAV-5 specification. Additionally, VOR frequency may also be used for ATIS delivery.

Due to its limited capability in terms of accuracy and signal line-of-sight, VORs are legacy navigation aids that are becoming difficult to maintain. Transitions from VORs have already begun by several ANSPs.

2.4.4 Instrument Landing System (ILS)

ILS is a navigation aid enabling precision approach and landing to a runway by a combination of horizontal and vertical guidance. The horizontal guidance signal is transmitted from a localizer (LOC) while vertical guidance signal is transmitted from a glide slope (GS); aircraft avionics process the information and present it as course deviation indicator on cockpit Primary Flight Display (PFD). Currently, the ILS is the primary technology that enables precision approaches down to Category III limits. It is a proven technology that meets user requirements today and is still considered an essential navigation system where precision approaches are required.

Due to cost and efficiency considerations, some States are rationalizing some of their ILS infrastructure, especially at airports with limited operational usage of Category-1 ILS. This rationalization needs a careful consultation with all airspace users. It needs to be a balance between getting cost-saving benefits from decommissioning some ILSs with limited operational use, while maintaining suitable level of service and airport access for flight operations.

2.5 Global Navigation Satellite System (GNSS)

Global Navigation Satellite System (GNSS) represents a transition from conventional Ground-Based Navigation Aids to Satellite-Based Navigation Aids, aiming to mitigate many limitations faced by the use of radio signals transmitted from ground. The GNSS concept came into being in the 1960s as part of a pilot research project and has gone through much advancement to where it is today.

GNSS relies on satellites broadcasting signals containing timing information and data messages. GNSS receivers then measure the signal propagation time from each satellite to



measure the distance between the receiver and the satellite itself. By receiving a minimum number of signals from different satellites, GNSS receivers can then triangulate and derive their 3D position on a globally standardized coordinate system (WGS-84). By stringing together these continuously updated positions, the aircraft can fly on any desired flight path without the line-of-sight and radial interception restrictions associated with ground-based conventional navigation aids.

GNSS provides standardized positioning and time information to aircraft which are highly accurate. The accuracy level of GNSS and the absence of limitations previously faced by conventional navigation aids make GNSS an ideal navigation infrastructure to globally enable the full benefits from PBN, especially RNP.

With the continuous advancement in GNSS technologies and its demonstrated capabilities and operational benefits, support deploying and use of GNSS as the primary radio navigation aids for all phases of flight and as the primary enabler of PBN and RNP.

2.5.1 GNSS Augmentations

To meet required performance for the more stringent navigational applications, such as approach with vertical guidance (APV) and precision approaches, augmentation of the GNSS signal is required in order to improve navigation accuracy and integrity.

2.5.1.1 Aircraft-Based Augmentation System (ABAS)

ABAS is an aircraft-contained augmentation system that augments and/or integrates the information obtained from GNSS receivers with other navigation information available on board the aircraft. The most common form of ABAS is Receiver Autonomous Integrity Monitoring (RAIM) which monitors the integrity of the GNSS signals and automatically flags the insufficient integrity for aircraft operations. In some aircraft, ABAS also integrate information from other on-board sensors, such as Inertial Navigation System (INS) and/or barometric altimeters, with information derived from GNSS signals in updating aircraft positions. By utilizing already on-board system in a self-contained manner, ABAS is currently the most cost-effective augmentation system for GNSS.

In line with ICAO Assembly Resolution A37-11, ABAS should be used in combination with Barometric VNAV (Baro-VNAV) during RNP APCH approach operations to respectively provide horizontal and vertical guidance down to LNAV/VNAV minima. This combination of ABAS with Baro-VNAV is a readily-available technology which can cost-effectively manage today challenges from non-vertically-guided, non-precision approaches based on VORs or NDBs.



IATA supports ABAS as the preferred augmentation system for en-route and terminal-area navigation using GNSS. In line with ICAO Assembly Resolution A37-11, for approach operations, ABAS should be used in combination with Baro-VNAV to provide horizontal and vertical guidance, respectively. The use of ABAS depends on Airline decisions and the ANSPs may team up to provide BARO-VNAV procedures. It is not, however, envisaged to be put to use in near term.

2.5.1.2 Ground-Based Augmentation System (GBAS)

GBAS is a system that provides differential corrections and integrity monitoring of GNSS via a ground-based VHF Data Broadcast (VDB). The differential corrections are generated from a set of GNSS receivers, which are installed at known locations within the airport. With all common errors affecting both the aircraft and the reference stations, such as ionospheric delays, are eliminated, GBAS can provide the aircraft with very high accuracy three-dimensional positioning.

GBAS is a matured and evolving augmentation system that enables GNSS for precision approach, with operational certifications currently down to Category I Precision Approach. GBAS provides geometric vertical guidance for precision approaches. Additionally, GBAS supports additional operational flexibility through provision of displaced thresholds and multiple glide path approaches. A GBAS, unlike an ILS, can provide precision approach capability to multiple runway ends at an airport. In 2015, at least 24 States have reported GBAS-related activities.

ANSPs who are considering deployments of GBAS ground station should consult with airspace users and operators prior to making the investment decisions. Where applicable, ANSPs should ensure system interoperability among ILS localizer, VOR and GBAS VDB operating at the same airport by performing an appropriate frequency coordination and technical validation. Once GBAS CAT II/III becomes commercially available, options to upgrade the GBAS Category I ground station to CATII/III should be evaluated in coordination with airports and operators.

GBAS with geometric vertical guidance is a viable candidate to supplement ILS for Precision Approach Operations. GBAS infrastructure and GLS procedures should be implemented as appropriate based on a positive business case and consultation with airlines. Airlines with GLS avionics should approach their regulators to obtain operational approval as necessary.

2.5.1.3 Satellite-Based Augmentation System (SBAS)

SBAS is a satellite-based augmentation system in which the user receives augmentation information from a satellite. SBAS comprises a network of ground reference stations to



monitor satellite signals; master stations to process data from ground reference stations and generate SBAS signals; uplink stations to send messages to geostationary satellites, and satellite transponders to broadcast integrity and correction messages to aircraft. SBAS implementation requires a high-speed communication among SBAS ground facilities.

There are four operational SBASs for aviation. These are the Wide Area Augmentation System (WAAS) in North America, the European Geostationary Navigation Overlay Service (EGNOS) in Europe, the Multi-Functional Satellite Augmentation System (MSAS) in Japan, and the GPS Aided GEO Augmented Navigation (GAGAN) in India.

GAGAN supports LPV approach operations with the minimum decision height of 250 feet. It is certified ENR 0.3 specifications and Approach APV 1.0 specifications.

In line with institutional requirements established by the ICAO Convention, ICAO indicates that each State is responsible for approving SBAS-based operations within its airspace and for ensuring that all SBAS signals approved for operations meet all safety and performance requirements. It is therefore important to note that aircraft with certified SBAS avionics are not automatically qualified for any approach operations using SBAS unless they are flying within the declared service area of an SBAS and the State responsible for that airspace has authorized the use of such SBAS through published procedures. Airlines are equipping with SBAS based upon their own requirements and business case. As there are several acceptable enablers for vertical-guided approaches in compliance with ICAO Assembly Resolution A37-11, airlines who are not equipping with or planning for SBAS have a significant concern about any unilateral mandate of SBAS equipage by States and any unjustified operational restrictions that States may impose due to the lack of SBAS equipment. Retrofitting or equipping with SBAS avionics without operational need will incur substantial cost to airlines. Unnecessary overlapping of SBAS satellite coverage areas will also incur needless infrastructure and operational costs to SBAS service providers. Considering that airlines should not pay for costs related to services they are not using, operations and infrastructure for SBASs should not be funded through charges that are applied to all airlines, such as ANSP or airport charges.

3. SURVEILLANCE

3.1 Introduction

According to ICAO Aeronautical Surveillance Manual Doc 9924, an aeronautical surveillance system provides the aircraft position and other related information to ATM and/or airborne users. In most cases, an aeronautical surveillance system provides its user with knowledge of “*who*” is, “*where*” and “*when*.” Other information provided by an aeronautical surveillance



system may include horizontal and vertical speed data, identifying characteristics or intent. The required data and its technical performance parameters are specific to the application that is being used. As a minimum, the aeronautical surveillance system provides position information on aircraft or vehicles at a known time.

Aeronautical surveillance systems may include voice or automated position reporting, primary and secondary radar systems and advanced ATS surveillance systems that receive multiple types of data from aircraft. The more reliably, frequently and accurately ATC can be apprised of an aircraft's position, the smaller the separation standard among aircraft can be applied. In order to be provided with surveillance-based separations, such as 3-NM or 5-NM, uninterrupted and accurate surveillance needs to be provided. This can be achieved though having either a highly reliable single layer of surveillance sensors or multiple-layers forming a single highly reliable service. Significant unnecessary overlap of redundant sensors or systems is discouraged.

ATS surveillance systems can be classified in three categories, depending on how the aircraft signals are received and processed by the ground sensors;

Independent Non-Cooperative Surveillance: The aircraft position is derived from measurement not using the cooperation of the aircraft. An example is a Primary Surveillance Radar (PSR).

Independent Cooperative Surveillance: The position is derived from measurements performed by a local surveillance subsystem using cooperative aircraft transmissions. The Secondary Surveillance Radar (SSR) is an example of this category.

Dependent Cooperative Surveillance: Dependent Cooperative Surveillance derives the aircraft position using subsystem on board the aircraft and the aircraft position is then provided to the local surveillance subsystem, possibly along with additional data. Automatic Dependent Surveillance – Broadcast (ADS-B) is an example of this category.

Independent or Dependent refers to how the aircraft position is measured; if it is from the ground it is Independent, or if the aircraft position is determined on-board then it is Dependent.

Cooperative or Non-Cooperative Surveillance refers to the requirement of aircraft equipment; if required, then it is Cooperative, if the surveillance does not require aircraft equipment then it is Non-cooperative.

Technologies and procedures used for aeronautical surveillance are varied. Those that are currently employed include:

- Procedural Position Reports;
- Primary Surveillance Radar (PSR);



- Secondary Surveillance Radar (SSR) – Mode A, Mode C and Mode S;
- Multilateration (MLAT);
- Precision Approach Radar (PAR); [Not deployed any longer]
- Automatic Dependent Surveillance – Contract (ADS-C);
- Automatic Dependent Surveillance – Broadcast (ADS-B) – Ground Based
- Automatic Dependent Surveillance – Broadcast– Satellite Based (SBADS-B)

ANSPs traditionally base aircraft surveillance on radar in high traffic airspace and voice or ADS-C position reports in remote and oceanic airspace. Further details on surveillance technologies are provided in the following sections.

The use of Surveillance for ATM requires that complementary communications capability, that meets the Required Communications Performance (RCP) as required, be used to enable an operational benefit to airspace users.

3.1.1 Primary Surveillance Radar (PSR)

PSR is the only surveillance method that provides position information without any signal from the aircraft or information from the flight crew or aircraft systems. Primary radar surveillance operates by sending a signal and determining the azimuth and distance of an object from the radar site based on the direction the signal echo comes from and how long it takes to return. Primary radar systems require other systems or procedures to correlate the received “echoes” with specific flights.

The typical maximum detection range of dedicated terminal PSR systems is 60 NM. These terminal systems rely on a higher data refresh rate when using higher pulse repetition frequency (PRF) and higher antenna revolutions per minute (rpm). For most en-route PSR systems, the maximum detection range is 100 to 250 NM. These en-route PSR systems typically have lower PRF and slower rpm. For all PSR systems, the range and detection capability is subject to reflections and obstacles.

Continued use of PSR within terminal areas may assist detection and tracking of non-cooperative targets, including aircraft not equipped with SSR transponder or experiencing avionics failure.

PSR remains the system of choice for the identification of unknown or unlawful airspace intrusions. This is a national security service and its infrastructure cost should be borne by the State’s national security budget and not by air navigation fees for civil aviation.

3.1.2 Secondary Radar Surveillance (SSR)

SSR operates by the radar site sending an interrogation signal which triggers aircraft transponders to send replying signals. Replies are used to calculate aircraft position and



provide additional information such as identification and pressure-altitude reports. The “mode” of the aircraft transponder determines the information that is sent in response to the interrogation. Because they rely upon the ability to receive a signal transmitted from an aircraft, rather than a signal echoed off of an aircraft, Secondary Surveillance Radar (SSR) systems have a greater range than PSR systems, on the order of 250+ NM from the radar site.

Mode S (Selective Addressing) is now a commonly-employed SSR technique. Aircraft equipped with Mode S transponders are assigned a permanent and unique 24-bit ICAO address code. Mode S radars interrogate airframes selectively and receive individual replies. SSR Mode S improves the quality and integrity of the detection, identification and altitude reporting, overcoming some of the issues associated with Mode A/C, such as the 4096-code limitation, radio frequency (RF) pollution, and lost targets.

As compared to Mode A/C, aircraft compliant with Mode S Elementary Surveillance (ELS) provide additional automatic reporting on aircraft identity (e.g. call-sign), altitude (in 25ft intervals), transponder capability, flight status (airborne or on-the-ground) and Surveillance Identifier (SI) code.

Moreover, aircraft compliant with Mode S Enhanced Surveillance (EHS) provide the above ELS reporting functionalities plus some or all of the following downlinked aircraft parameters (DAPs):

- Selected Altitude - the flight level which is manually entered in the Flight Management System (FMS) by the pilot.
- Roll Angle, True Track Angle and Track Angle Rate - these parameters may be used to enhance the radar tracking capability and/or tactical trajectory prediction by ATC systems.
- Ground Speed - calculated aircraft speed relative to the ground.
- Magnetic Heading - the aircraft heading relative to magnetic north.
- Indicated airspeed (IAS) and Mach-number - Making this information available to ATCs supports separation provision tasks, reduces the R/T and hence ATC workload.
- Aircraft Vertical rate - barometric rate of climb / descent
- Traffic Collision Avoidance System (TCAS) downlinked resolution advisories (RAs).

Note: DGCA has mandated compulsory installation of SSR transponders for all aircraft operating in Indian Air space.

3.1.3 Multilateration (MLAT)

MLAT is a cooperative aircraft surveillance technology based on the time difference of arrival principle. It is a technique where several ground receiving stations listen to signals transmitted from an aircraft; then the aircraft's location is mathematically calculated --



typically in two dimensions, with the aircraft providing its altitude. Aircraft position, altitude and other data are ultimately transmitted to an ATC automation system, both for terminal or en-route.

Wide Area Multilateration (WAM) is a term commonly used to describe the surveillance of en-route airspace, while the abbreviation MLAT tends to be employed when discussing the monitoring of terminal airspace and airport surface traffic.

MLAT global separation standards of 5 NM and 3 NM have been promulgated as being equivalent to radar. Depending upon the required number of sites and their locations, MLAT/WAM systems can cost considerably less than conventional radar to purchase, install, and maintain.

A limited number of ANSPs have deployed MLAT/WAM for ATM surveillance in combination with ADS-B or SSR to meet specific surveillance requirements. Some ANSPs are also deploying MLAT as a Precision Runway Monitor (PRM) sensor and for surveillance of airport ground movements. Additional MLAT/WAM applications include ADS-B backup and RVSM height monitoring.

Note : Currently in India only local area Multilateration (MLAT) is used for ASMGCS, Wide area Multilateration is not used.

3.2 Dependent Cooperative Surveillance

IATA views ADS-B based on the 1090 Extended Squitter (ES) data link as the most desirable form of surveillance. Surveillance based primarily on ADS-B should be used, whenever operationally feasible, as the next generation replacement to radar.

Technologies reviewed in this section include:

- Automatic Dependent Surveillance Contract (ADS-C)
- Automatic Dependent Surveillance Broadcast (ADS-B) OUT, including space-based
- Automatic Dependent Surveillance Broadcast (ADS-B) IN
- Traffic Information Service Broadcast (TIS-B)

3.2.1 Automatic Dependent Surveillance Contract (ADS-C)

ADS-C provides information on aircraft positions to ATC. ICAO Performance-based Communications and Surveillance (PBCS) Manual focuses on the use of CPDLC in combination of ADS-C. ADS-C allows ATC to specify the frequency of position reports and the events that will trigger a position report. ADS-C reports are sent without flight crew intervention. Reports are automatically generated based on an electronic contract established between the aircraft Flight Management System (FMS) and a ground-based ATC installation. An aircraft typically transmits its information every 32, 27 or 14 minutes (per



ICAO PANS-ATM recommendation for 50-NM or 30NM longitudinal separation minima), as determined by the FMS electronic contract with ATC units. The contracts could be based on a specified reporting rate, event, or on-demand. ADS-C also has the ability for ATC to specify that a report be sent if certain flight profile parameters are exceeded, thereby enabling the detection of altitude and route deviations. The ICAO Separation and Airspace Safety Panel (SASP) has started evaluating reductions of separation minima for ADS-C based on increasing reporting rates and the use of other ADS-C parameters such as Extended Projected Profile (EPP).

In most cases, the position source for ADS-C reports is GNSS. The information is displayed to ATC and can also be used by automated flight tracking and monitoring systems. ADS-C reports are sent from the aircraft to ATC via a VHF or satellite data link and include position, velocity and intent.

Note: ADS- C is used for surveillance over the oceanic airspace. Equipage of suitable avionics is an issue. No mandate has been given by DGCA for equipping aircraft with ADS-C.

3.2.2 Automatic Dependent Surveillance Broadcast OUT (ADS-B OUT)

ADS-B OUT is a surveillance technology by which an aircraft periodically and automatically broadcasts its state vector (horizontal and vertical position and velocity) and other aircraft data such as identification. The aircraft's ADS-B transponder uses inputs from airborne navigation sensors, including GNSS receivers, as sources for information on the aircraft's current position, accuracy and integrity performances. Ground stations receive ADS-B OUT position reports and display them on air traffic controllers' screens. ADS-B OUT broadcasts may also be received, processed, and displayed by other aircraft in the vicinity that are equipped with ADS-B IN.

In air transport aircraft, ADS-B broadcast signals from Extended Squitter Mode S transponders.

Rather than a ground system "requesting" an aircraft signal, on-board ADS-B transponders broadcast aircraft parameters, such as identification (24-bit address and flight identification as per the flight plan), position (latitude, longitude and pressure altitude), 3-D velocity and position integrity, via a broadcast-mode data link. Aircraft identification information is broadcast every 5 seconds while aircraft position and velocity data is typically broadcast twice per second.

The flight identification included in the ADS-B signal is set per flight, making it susceptible to input errors. In general, however, there is higher reliability in positive identification if both the aircraft address and the flight identification match the flight record held by ATC. As with SSR, automated correlation of ADS-B messages with flight records relies upon ATC having supporting equipment and the ability for adjacent ANSPs to exchange detailed flight data.



Various States and Regions have implemented ADS-B aircraft equipage and performance mandates. If the mandates are necessary and justified, they should be harmonized and synchronized. Unfortunately, we see today divergence between the FAA mandates and the rest of the world including Europe's ADS-B mandates. For all operations in the US national airspace, including enroute and international overfly, the FAA requires ADS-B performance to meet more stringent performance requirements than those suggested by ICAO Circular 326 and being implemented elsewhere. While the FAA mandate is non-prescriptive and based on a set of performance requirements, it is noteworthy that the FAA requirements were selected as "one size fits all" and were based on 2.5 NM in-trail and closely-spaced parallel operations that may not be applicable to many airspace users.

For any specific operations, States and ANSPs are highly encouraged to follow the guidance in the ICAO Circular 326 and appropriate published ICAO provisions, while considering prescribing any performance requirement for ADS-B.

3.2.3 Space-based Automatic Dependent Surveillance Broadcast (Space-based ADS-B)

Space-based ADS-B service, provided by AIREON, enables global coverage, with a significant reduction in "line of sight" detection limitations. The planned service relies upon satellite reception of ADS-B messages from certified aircraft transponders. Space-based ADS-B OUT includes the reception by a network of satellites of the ADS-B messages broadcast from aircraft. The satellite network then relays the ADS-B data to Aireon's Command Centre in USA, which then forwards the data to subscribing ATC/ATM facilities. AAI as an ANSP has taken the lead and after extensive trials, has contracted Aireon to provide ADS-B Data for Oceanic Airspace and has integrated the data into the ATSAS in Chennai, Mumbai and Kolkata. ***SB-ADSB is put to limited use, i.e., for Oceanic Control Centre's situational awareness.*** In future however, the enhancement of capacity through application of reduced separation minima will be enabled in remote oceanic areas by SB-ADSB.

The ICAO Separation and Airspace Safety Panel (SASP) is now developing new reduced longitudinal and lateral separation standards, namely Advanced-Surveillance Enhanced Procedural Separation (ASEPS), to be supported by space-based ADS-B in combination with ADS-C, CPDLC and HF.

Note: All aircrafts are not equipped with ADS-B avionics. DGCA India's mandates may be referred to.

3.2.4 Automatic Dependent Surveillance Broadcast (ADS-B) IN

ADS-B IN is a surveillance technology by which an aircraft is able to broadcast as well as receive, process, and display the information broadcasted by another ADS-B equipped aircraft. Such information is shown on a Cockpit Display of Traffic Information (CDTI).



Although information obtained through ADS-B IN improves cockpit situational awareness and provides the potential for further shared air and ground separation responsibility, much remains to be accomplished in terms of system certification, application validation, human factors considerations / roles, procedures, and regulatory policies. Additionally, retrofit of existing fleets implies a major avionics upgrade and will require a lead-time of approximately ten years. ADS-B IN is less of an ANSP and more of an Airline investment decision. ATSPs, though, may be involved in development of procedures.

3.2.5 Traffic Information Service - Broadcast (TIS-B)

TIS-B enables SSR (Mode S and Mode A/C) or ADS-B surveillance data from multiple link sources to be combined and uplinked to an aircraft equipped with ADS-B IN, increasing situational awareness in the cockpit by providing the data to the Cockpit Display of Traffic Information (CDTI).

For some airspace, TIS-B is designed to support mixed surveillance environment during the transition from radar to ADS-B surveillance or in a dual link ADS-B environment. TIS-B implementation may be delayed owing to its acceptance by airlines and is predicated to ADS-B IN equipage.

Note: Currently in ICAO APAC region, implementation of ADS-B IN and TIS-B has not been proposed.



GLOSSARY

ABAS	Aircraft Based Augmentation System
ACARS	Aircraft Communications Addressing and Reporting System
ACAS	Airborne Collision Avoidance System
ACCR	Aerodrome Committee Control Room
ADS	Automatic Dependent Surveillance
ADS-B	Automatic Dependent Surveillance – Broadcast
ADS-C	Automatic Dependent Surveillance – Contract
AeroMACS	Aeronautical Mobile Airport Communications System
AIDC	Air Traffic Services Inter-Facility Data Communication
ANC	ICAO Air Navigation Conference
ANSP	Air Navigation Service Provider
AOC	Aeronautical Operational Control Communications
APV	Approach with Vertical Guidance
ASP	Aeronautical Surveillance Panel
ATC	Air Traffic Control
ATIS	Automatic Terminal Information Service
ATM	Air Traffic Management
ATN	Aeronautical Telecommunications Network
ATS	Air Traffic Services
AWOS	Automated Weather Observing System
BDSBAS	BeiDou Satellite-Based Augmentation System (China)
Baro-VNAV	Barometric Vertical Navigation
CANSO	Civil Air Navigation Services Organization
CDTI	Cockpit Display of Traffic Information
CNS/ATM	Communications Navigation Surveillance/Air Traffic Management
CPDLC	Controller Pilot Data Link Communications
CSMA	Carrier Sense Multiple Access
D-ATIS	Digital - Automated Terminal Information Service
DL	Data Link
DME	Distance Measuring Equipment



EUROCAE	European Organisation for Civil Aviation Equipment
EUROCONTROL	European Organization for the Safety of Air Navigation
FAA	Federal Aviation Administration (USA)
FANS	Future Air Navigation Systems (FANS)
FIR	Flight Information Region
FMS	Flight Management System
FSMP	Frequency Spectrum Management Panel (ICAO)
GAGAN	GPS Aided Geo Augmented Navigation (India)
GBAS	Ground Based Augmentation Service
GEO	Geosynchronous Orbit
GLS	GNSS/GBAS Landing System
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
HF	High Frequency
HFDL	High Frequency Data Link
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
IEEE	Institute of Electrical and Electronics Engineers
ILS	Instrument Landing System
ISO	International Organization for Standardization
IPS	Internet Protocol Suites
IT	Information Technology
ITU	International Telecommunications Union (ITU)
KASS	Korea Augmentation Satellite System (Republic of Korea)
LTE	Long Term Evaluation
LPV	Localizer Performance with Vertical Guidance
MLS	Microwave Landing System
MOPS	Minimal Operational Performance Standard (RTCA, EUROCAE)
MSAS	MTSAT Satellite Based Augmentation System (Japan)
MTSAT	Multi-functional Transport Satellites (Japan)



NextGen	Next Generation Air Transportation System
NDB	Non-Directional Beacon
NSP	Navigation Systems Panel (ICAO)
OSI	Open Systems Interconnection
PAR	Precision Approach Radar
PBN	Performance Based Navigation
PDC	Pre-Departure Clearance
PRM	Precision Runway Monitor
RAIM	Receiver Autonomous Integrity Monitoring
RCP	Required Communication Performance
RF	Radio Frequency
RNAV	Area Navigation
RNP	Required Navigation Performance
RNP APCH	Required Navigation Performance Approach
RNP AR	Required Navigation Performance Authorization Required
RVSM	Reduced Vertical Separation Minimum
RSP	Required Surveillance Performance
RTCA	Radio Technical Commission for Aeronautics
SARPs	Standards and Recommended Practices
SASP	Separation and Airspace Safety Panel (ICAO)
SBAS	Satellite Based Augmentation System
SESAR	Single European Sky ATM Research
SSR	Secondary Surveillance Radar
STDMA	Self-Organizing Time Division Multiple Access
SWIM	System Wide Information Management
TCAS	Traffic Collision Avoidance System
TDMA	Time Division Multiple Access
TDOA	Time Difference of Arrival
TIS-B	Traffic Information Service Broadcast
TMA	Terminal Area



TNLC	Terminal Navigation Landing Charges
UAT	Universal Access Transceiver
VDL	VHF Digital Link
VHF	Very High Frequency
VNAV	Vertical Navigation
VoIP	Voice over IP
VOR	VHF Omni-directional Range
WAM	Wide Area Multilateration
WAAS	Wide Area Augmentation System (USA)
WGS-84	World Geodetic System –1984