AIRPORTS AUTHORITY OF INDIA

Performance Based Navigation (PBN) Implementation Road Map

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Directorate of Air Traffic Management

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1. INTRODUCTION

GNSS-centered performance-based navigation enables a seamless, harmonized and cost effective navigational service from departure to final approach that will provide benefits in safety, efficiency and capacity

A significant number of aircraft are capable of area navigation (RNAV) and required navigation performance (RNP). Where warranted, these capabilities should be further exploited to develop more efficient routes and aircraft trajectories that are not directly tied to ground-based navigation aids. Certain RNAV equipped aircraft also have a significantly enhanced capability to achieve sequencing requirements to runways, particularly through the use of the "required time of arrival" function within the flight management system (FMS).

The implementation of the concept of performance based navigation will lead to increased capacity and enhanced efficiency through reductions in separation minima, bringing benefits to aircraft operators that equip to meet performance requirements. Performance-based navigation will also improve safety, particularly on approach through a reduction of controlled flight into terrain.

The performance-based navigation concept, which comprises RNAV and RNP operations, recognizes that a clear distinction must be made in the designation of operations, between those aircraft operations that require on board self-contained performance monitoring and alerting and those that do not.

A major initiative for reorganizing the route structure and airspace was carried out in Aug 02 under the EMARSSH project wherein multiple parallel RNAV-10 routes were implemented in India which resulted in significant enhancements in Safety, capacity and efficiency in both Aircraft operations and ATM services. Subsequently a year later in Aug 2003 RVSM was implemented throughout the entire Indian FIRs in harmonization with other States in Asia-Pacific Region, which further enhanced the Capacity, efficiency and Safety. Subsequently in order to support smooth flow of traffic through Kabul FIR where CVSM is in still in force, additional routes, by-pass routes were implemented to support ATFM procedures.

Implementation of PBN procedures, (RNAV& RNP) in accordance with ICAO Global plan initiatives will further enhance Safety, Efficiency, capacity and environment. Significant benefits of PBN can be achieved through implementation of PBN procedures both in terminal approach areas and in enroute areas. A co-ordinated and collaborative approach involving various stakeholders of the industry, Airline, Airport, ANSP, Regulator, Air traffic controllers and pilots is essential to ensure smooth and timely implementation of PBN as mandated by ICAO.

A detailed Road map with strategic planning and implementation guidelines for implementation of performance-based navigation (PBN) is therefore essential.

Further, the PBN Roadmap will be the basic for the development of future navigation strategy for transition to Satellite based Navigation through implementation of GAGAN (SBAS), GBAS etc

EXPLANATION OF TERMS

The drafting and explanation of this document is based on the understanding of some particular terms and expressions that are described below:

PBN Roadmap. The document which provides details of PBN Concept, Operational guidelines and strategy for implementation of PBN based RNAV and RNP procedures in the short, medium and long term in India.

Area Navigation (RNAV): A method of navigation which permits aircraft operation on any desired flight path within the coverage of ground or spaced-based navigation aids or within the limits of the capability of self-contained aids, or a combination of these
Note— Area navigation includes performance based navigation as well as other operations that do not meet the definition of performance based navigation.

Performance Based Navigation (PBN): Area navigation based on performance requirements for aircraft operating along an ATS route, on an instrument approach procedure or in a designated airspace.
Note — Performance requirements are expressed in navigation specifications in terms of accuracy, integrity, continuity, availability and functionality needed for the proposed operation in the context of a particular airspace concept.

Navigation specification: A set of aircraft and air crew requirements needed to support performance based navigation operations within a defined airspace. There are two kinds of navigation specifications:

i. *RNP specification*. A navigation specification based on area navigation that includes the requirement of on board performance monitoring and alerting, designated by the prefix RNP, e.g. RNP 4,RNP-0.3 , RNP-0.1 , RNP APCH etc .

ii. *RNAV specification*. A navigation specification based on area navigation that does not include the requirement for performance monitoring and alerting, designated by the prefix RNAV, e.g. RNAV 5, RNAV 1.

Note— The Performance Based Navigation Manual *(Doc 9613), Volume II contains detailed guidance on navigation specifications*

Abbreviations

ADS/B	Automatic dependent surveillance-Broadcasting
ADS/C	Automatic Dependent Surveillance-Contract
ANS	Air navigation services
ANSP	Air Navigation Service Providers
ASM	Airspace Management
ATC	Air Traffic Control
ATFM	Air Traffic Flow Management
ATM	Air Traffic Management
ATN	Aeronautical Telecommunication Network
ATS	Air Traffic Services
CNS/ATM	Communications, Navigation , Surveillance/Air Traffic Management
CPDLC	Controller-Pilot Data Link Communications
CTA	Control Area
DME	Distance-Measuring Equipment
FANS-1/A	Future Air Navigation Systems - Avionics
FDE	Fault Detection and Exclusion
FIR	Flight Information Region
FMS	Flight Management System
GBAS	Ground-Based Augmentation System
GLS	GBAS Landing System
GNE	Gross Navigation Error
GNSS	Global Navigation Satellite System
GPMS	GPS Performance Monitoring System
HF-RT	High Frequency Radio Telephony
IRU/INS	Inertial Reference Unit/Inertial Navigation System
NOTAM	Notice to Airmen
PBN	Performance-Based Navigation
RNAV	Area Navigation
RNAV Route	Area navigation route
RNP	Required Navigation Performance
RNP AR	Required Navigation Performance - Authorization Required
SBAS	Satellite-based Augmentation System
SID	Standard Instrument Departure
SSR	Secondary Surveillance Radar
STAR	Standard Instrument Arrival
TLS	Target Level of Safety
TMA	Terminal Area
VHF	Very High Frequency
VDL	VHF Data Link
VOR/DME	Very High Frequency Omni directional Radio Range/Distance-Measuring Equipment

Objectives

The primary objectives of Indian PBN roadmap are as given below:

i) To ensure that the implementation of the navigation infrastructure to support efficient CNS/ATM system is based on Regional and Global operational requirements.

ii) To avoid unnecessarily imposing the mandate for carriage of multiple airborne equipment on-board or multiple ground systems.

iii) To avoid the need for multiple airworthiness and operational approvals for intra and inter-regional operations.

iv) To prevent commercial interests driving the Aircraft and ATM operational requirements, resulting in unnecessary expenditure for Airlines, ANSPs, States and International Organizations.

v) To highlight in detail, the Global plan initiatives of ICAO and relevant navigation applications to synchronise and harmonise with global Air Navigation plan objectives .

The PBN Roadmap will further provide a high-level strategy for the evolution of the navigation applications to be implemented in India, in the short term (2008-2012), medium term (2013-2016) and long term beyond 2016. This strategy is based on the concepts of Area Navigation (RNAV) and Required Navigation Performance (RNP), which will be applied to aircraft operations involving instrument approaches, standard departure (SID) routes, standard arrival (STAR) routes, and ATS routes in oceanic and continental areas.

2. PBN CONCEPTS

Performance based navigation specifies Area Navigation system performance requirements for aircraft operating along an ATS route, on an instrument approach procedure or in an airspace.

The aircraft system performance capabilities forms basis for the airspace design, obstacle clearance criteria, construction and implementation of flight procedures, application of aircraft separation minima etc. Utilization of such procedures and to operate in the defined airspace the aircraft shall meet the essential performance and operational capabilities. Once the performance level (accuracy) is established on the basis of operational needs, the aircraft's performance capability determines whether the aircraft can safely achieve the specified performance and thus qualify for the operation. Within the framework of performance-based navigation, ICAO has defined RNAV and RNP specifications that can be satisfied by a range of navigation systems

Performance requirements are defined in terms of accuracy, integrity, continuity, availability and functionality needed for the proposed operation in the context of a particular airspace concept. Performance requirements are identified in navigation specifications which also identify which navigation sensors and equipment may be used to meet the performance requirement. There are both RNP navigation specifications and RNAV navigation specifications. A RNP specification includes a requirement for onboard performance monitoring and alerting and is designated as a RNP-X. A RNAV specification does not have such requirements and is designated as RNAV- X.

RNP operations introduce the requirement for onboard performance monitoring and alerting. A critical characteristic of RNP operations is the ability of the aircraft navigation system to monitor the navigation performance it achieves and to inform the crew if the requirement is not met during an operation. This onboard monitoring and alerting capability enhances the pilot's situation awareness and can enable closer route spacing without intervention by air traffic control (ATC).

Certain RNP operations require advanced features of the onboard navigation function and approved training and crew procedures. These operations must receive approvals that are characterized as Special Aircraft and Aircrew Authorization Required (SAAAR), similar to approvals required for operations to conduct instrument landing system (ILS) Category II and III approaches.

RNAV and RNP specifications facilitate more efficient design of airspace and procedures, which collectively result in improved safety, access, capacity, predictability, operational efficiency, and environmental effects. Specifically, RNAV and RNP may:

- Increase safety by using three-dimensional (3D) approach operations with course guidance to the runway, which reduce the risk of controlled flight into terrain.
- Improve airport and airspace access in all weather conditions, and the ability to meet environmental and obstacle clearance constraints.
- Enhance reliability and reduce delays by defining more precise terminal area procedures that feature parallel routes and environmentally optimized airspace corridors. Flight management systems (FMS) will then be poised to save operators time and money by managing climb, descent, and engine performance profiles more efficiently.
- Improve efficiency and flexibility by increasing use of operator-preferred trajectories NAS-wide, at all altitudes. This will be particularly useful in maintaining schedule integrity when convective weather arises.
- Reduce workload and improve productivity of air traffic controllers.

Performance based navigation therefore depends on:

- Airborne avionics and equipment on board the aircraft that meet the performance and functional requirements of the navigation specification prescribed for specified operations in the relevant airspace

- Pilot performance capabilities that meet the operating requirements prescribed by the regulator for specified operations
- A defined airspace concept which includes RNAV/RNP operations; and
- Navaid infrastructure ;

3. BENEFITS OF PERFORMANCE BASED NAVIGATION

The main benefits derived from the implementation of PBN are:

- Increased airspace safety through the implementation of continuous and stabilized descent procedures that avoid controlled flight into terrain (CFIT);
- Reduced aircraft flight time due to the implementation of optimal flight paths, with the resulting savings in fuel and environmental protection.
- Use of the RNAV and/or RNP capabilities that already exist in a significant percentage of the aircraft fleet flying in CAR/SAM airspace.
- Improved airport and airspace arrival paths in all weather conditions, and the possibility of meeting critical obstacle clearance and environmental requirements through the application of optimised RNAV or RNP paths.
- Implementation of more precise approach, departure, and arrival paths that will reduce dispersion and will foster smoother traffic flows.
- Reduced delays in high-density airspaces and airports through the implementation of new parallel routes and new arrival and departure points in TMAs.
- Possible reduction of spacing between parallel routes to accommodate more traffic in the same flow.
- Reduced workload for air traffic controllers and pilots due to reduced communications time.

4. IMPLEMENTATION OF PERFORMANCE BASED NAVIGATION

Considering the current and future air traffic growth and to efficiently manage the operations, an integrated approach is adopted for the implementation. Airport operations, Air traffic control, airspace management, CNS infrastructure, Capacity enhancement (Airport& Airspace) , Environmental issues and above all Safety are the basic considerations for the implementation of PBN, The strategy for successful implementation is collaborative and co-ordinated approach involving all stakeholders in the process starting from initial concept stage till implementation and post implementation review. This strategy has been adopted for the PBN implementation at Mumbai, Delhi and Ahmedabad in August 2008, which has proved to be most successful strategy for smooth and timely implementation of PBN.

Transitional Strategies

The existing ground infrastructure for conventional navigation systems will continue to remain available while PBN implementation is in progress and transition period. Users will be consulted and given reasonable transition time to allow them to equip appropriately to attain equivalent PBN-based navigation performance, before planning for phasing out of existing ground infrastructure.

The following are the key tasks for smooth transition to performance-based navigation

- Planning of long term navigation service needs that will guide infrastructure framework
- Specify needs for navigation system infrastructure, and ensure funding for managing and transitioning these systems
- Define and adopt a national policy enabling additional benefits based on RNP and RNAV
- Identify operational and integration issues between navigation and surveillance, air-ground communications, and automation tools that maximize the benefits of RNP
- Support mixed operations throughout the term of this *Roadmap*, in particular considering navigation system variations during the near term until appropriate standards are developed and implemented
- Promulgate appropriate regulatory guidelines and for in advance
- To accommodate and support the military aircraft operating in civil airspace, develop appropriate the policies and co-ordination with military authorities.
- Harmonize the evolution of capabilities for interoperability across airspace operations
- Increase emphasis on human factors, especially on training and procedures as operations increase reliance on appropriate use of flight deck systems/ FMS
- Facilitate and advance environmental analysis efforts required to support the development of RNAV and RNP procedures
- Maintain consistent and harmonized global standards for RNAV and RNP operations.

Aircraft fleet readiness status

There has been phenomenal rate of growth in air traffic in India since year 2006. New operators have entered into business and to meet the current and future demand airline operators have placed orders with Boeing and Airbus, for new aircraft to augment the fleet strength and also to replace the old and ageing fleets.

Since all major commercial aircraft manufacturers since the 1980's have included RNAV capabilities and also the commercial aircraft currently produced incorporate an RNP capability, almost 80 -90 % of the new Indian fleet strength are RNAV and RNP capable. This is added advantage for India in smooth implementation and transition to PBN.

CNS Infrastructure

Navigation infrastructure

Global Navigation Satellite System (GNSS)

Global Navigation Satellite System (GNSS) is a satellite-based navigation system utilizing satellite signals, such as Global Positioning System (GPS), for providing accurate and reliable position, navigation, and time services to airspace users.

GNSS supports both RNAV and RNP operations. Through the use of appropriate GNSS augmentations, GNSS navigation provides sufficient accuracy, integrity, availability and continuity to support en-route, terminal area, and approach operations. Approval of RNP operations with appropriate certified avionics provides on-board performance monitoring and alerting capability enhancing the integrity of aircraft navigation.

GNSS augmentations include Aircraft-Based Augmentation System (ABAS), Satellite-Based Augmentation System (SBAS), Ground-Based Augmentation System (GBAS) would supplement GNSS for PBN implementation. Indian SBAS, GAGAN would play a key role in PBN implementation in India.

India is in the process of implementing Ground-Based Augmentation System (GBAS) for use in GNSS (Global Navigation Satellite System) Landing System (GLS)5 approach operations to improve access in low-visibility conditions. GLS will allow Category I, II and III precision approaches to non-ILS runways at Mumbai and Delhi where GBAS is being installed.

GLS will enhance efficiency and capacity by mitigating the need for critical area protection as is the case during ILS operations. It will also reduce the reliance on the conventional ILS infrastructure.

Other PBN navigation infrastructure

Other navigation infrastructure such as INS, VOR/DME, DME/DME, and DME/DME/IRU may satisfy the requirements of RNAV navigation specifications, but not those of RNP.

INS will be used to support PBN en-route operations with RNAV-10 and RNAV-5 navigation specifications.

VOR/DME will also be used to support PBN en-route and STAR operations based on the RNAV-5 navigation specification.

Use of DME/DME and DME/DME/IRU will also be used to support PBN en-route and terminal area operations based on RNAV-5, RNAV-2 or RNAV-1 navigation specifications.

Validation of DME/DME coverage area and appropriate DME/DME geometry would be conducted to identify possible DME/DME gaps, including identification of critical DMEs, and to ensure proper DME/DME service coverage.

Surveillance infrastructure

RNAV operations would be restricted in the airports and airspace where sufficient surveillance coverage is available to ensure the safety of the operations. Additional surveillance sensors would be provided at airports and airspace where traffic demand necessitates before RNAV operations are proposed /planned.

In Non- radar airspace and airports where radar surveillance is not available RNP operations would be considered.

Communication infrastructure

Communications requirements for PBN implementation in accordance with ICAO PANS-ATM (Doc 4444), ICAO RCP Manual (Doc 9869), and ICAO Annex 10 would be complied with for implementation of RNAV/RNP routes.

Short Term Implementation (2008-2012)

As the traffic growth continues to show positive indications and likely to gain further boost in the near future, there is a need to augment air traffic handling capacity at busy TMAs at International airports. Similarly there is also a need to ensure access and continuity of operations during exigencies and outage of ground facilities.

Route Operations

Enroute (Continental)

In the enroute airspace , to enhance airspace capacity and to offer optimum levels and reduce track miles route optimization will be carried out by implementing RANV-5 routes between selected city pairs in the domestic airspace where radar surveillance and VHF coverage is available. In non-radar environment, RNP-4 routes will be implemented. Subsequently RNP-2 routes will be implemented.

Enroute (Oceanic)

To support global harmonization and Regional co-operation, route spacing in oceanic airspace will be reviewed and reduced longitudinal and lateral separation minima between aircraft approved for RNP-10 and RNP-4 operations will be implemented. In the near term, in addition to current RNP-10 routes, RNP-4 routes will be implemented in the Bay of

Bengal and Arabian Sea airspace. Surveillance through ADS/CPDLC (Future Air Navigation System (FANS 1/A) will be maintained.

Terminal Approach Areas (TMA) operations (Arrival & Departures)

Application of RNAV in the terminal approach airspace improve airspace design through better use of arrival and departure corridors and reduce conflict between arrival and departure flows by consolidating flight tracks.
RNAV-1 SIDs and STARs improve safety, capacity, and operational efficiency. These procedures are already implemented at Mumbai, Delhi and Ahmedabad and there is significant reduction in controller-pilot communications and also reduction in communication errors.

In selected TMAs, the application of RNAV-1 in a radar environment can be supported though the use of GNSS or ground navigation infrastructure, such as DME/DME and DME/DME/IRU. In this phase, mixed operations (equipped and non-equipped) will be permitted.

In a non-radar environment and/or in an environment without adequate ground navigation infrastructure, the SID/STAR application of Basic-RNP1 is expected in selected TMAs with exclusive application of GNSS. In this phase, mixed operations (equipped and non-equipped) will be permitted.

RNAV-1 SIDs and STARs will be implemented at all operational airports in a phased manner in the near term..

Instrument Approaches

The application of RNP APCH with Baro-VNAV procedures is expected to be implemented in the maximum possible number of airports, primarily international airports.

To facilitate transitional period, conventional approach procedures and conventional navigation aids should be maintained for non-equipped aircraft.

APV procedures (Baro-VNAV or augmented GNSS) to enhance safety and accessibility of RNP approaches.

The application of RNP AR APCH procedures should be considered in selected airports, where obvious operational benefits can be obtained due to the existence of significant obstacles/terrain.

Medium Term Implementation (2013-2016)

Route Operations

Noting the current development of route spacing standards for RNAV-1, RNAV-2, RNP-2, in this phase, it is expected that the implementations of all existing RNAV/RNP routes are consistent with PBN standards. Harmonizing the RNAV/RNP routes in compliance with PBN navigation specifications and separation standards would be undertaken. Implementations of additional RNAV/RNP routes would also be considered as per the traffic demand and operational needs.

With the utilization of ADS and CPDLC, the application of RNP-4 routes in the Oceanic and Remote continental airspace in the ASIA/PAC Region would be considered. This will permit the use of smaller lateral and longitudinal separation, such as 30 NM.

Noting the current development of RNP-2 navigation specification, in this phase, the application of RNP-2 would be considered for the continental en-route airspace with high air traffic density. Depending on the sufficiency of DME/DME coverage or GNSS availability, the use of RNAV-2 navigation specification would be considered.

In this phase, the establishment of a backup system in case of GNSS failure or the development of contingency procedures would be put in place.

TMA Operations

Noting the current development of Advanced RNP-1 navigation specification, in this phase, application of RNAV-1 or RNP-1 will be considered in selected TMAs where traffic density is high and capacity constraint. The application of RNAV-1/RNP-1 will also depend on DME/DME infrastructure, GNSS availability and aircraft navigation capability. In TMAs of high air traffic complexity and movement (excluding airspaces), the use of RNAV-1 or RNP-1 equipments would be considered as mandatory requirement. In TMAs of less air traffic complexity, mixed operations will be permitted (equipped or non-equipped).

Instrument Approaches

In this phase, the extended application of RNP APCH with Baro-VNAV or APV in most airports is expected. These applications may also serve as a back-up to precision approaches and provide vertical guided approaches for the runways without precision approach capability.

The extended application of RNP-AR Approaches is expected for airports where there are operational benefits.

The introduction of application of landing capability using GNSS and its augmentations is expected to guarantee a smooth transition toward high-performance approach and landing capability.

Long Term Implementation Strategies (2016 and beyond)

In this phase, GNSS is expected to be a primary navigation infrastructure for PBN implementation. States should work co-operatively on a multinational basis to implement

GNSS in order to facilitate seamless and inter-operable systems and undertake coordinated R&D programs on GNSS implementation and operation.

During this phase, segregating traffic according to navigation capability and granting preferred routes to aircraft with better navigation performance would be considered.

With the expectation that precision approach capability using GNSS and GAGAN augmentation systems will become available, use of such capability where there are operational and financial benefits would be considered.

4. SAFETY ASSESSMENT & MONITORING REQUIREMENTS

Safety assessment

To ensure that the introduction of PBN en-route applications within India is undertaken in a safe manner, in accordance with relevant ICAO provisions, implementation shall only take place following conduct of a safety assessment that has demonstrated that an acceptable level of safety will be met.

This assessment is also essential to demonstrate that levels of risk associated with specific PBN en-route implementations are acceptable. Additionally, ongoing periodic safety reviews shall be undertaken where required in order to establish that operations continue to meet the target levels of safety.

On-going monitoring /Post implementation review

To demonstrate that the system is safe, ongoing monitoring of the PBN en-route implementation would be undertaken through appropriate post implementation review mechanism.

Assistance and support from Asia/Pacific regional Safety Monitoring Agency (SMA) would be availed wherever required. Necessary support to Regional SMA would be extended though provision of relevant data.

In undertaking a safety assessment and ongoing monitoring to enable en-route implementation of PBN the following strategy would be adopted on regular basis.,

- Establish and maintain a PBN approval database ;
- Monitor aircraft horizontal-plane navigation performance and the occurrence of large navigation errors and report results appropriately to the RASMAG;
- Conduct safety and readiness assessments and report results appropriately to the RASMAG;
- Monitor operator compliance with State approval requirements after PBN implementation;

- Initiate necessary remedial actions if PBN requirements are not met.

APPENDIX - A

Short Term (2008-2012)

ENROUTE		TERMINAL		APPROACH	
RNAV-5 Route (City pair)	Proposed date	RNAV-1/RNP-1 SIDs & STARs	Proposed date	Baro-VNAV Approach	Proposed date
Delhi – Mumbai	DEC 2010	Mumbai	AUG 2008	Mumbai (RW27, 14, 32, 09)	DEC 2010
Mumbai – Delhi		Delhi		Delhi (RW27, 28, 29, 09, 10, 11)	
Chennai - Hyderabad		Ahmedabad		Ahmedabad (RW05, 23)	
Hyderabad - Chennai		Chennai	AUG 2009	Calicut (RW10, 28)	
Chennai - Bangalore		Bangalore Intl. Airport	DEC 2009	Chennai (RW07, 25, 12, 30)	DEC 2011
Bangalore - Chennai		Kolkata	DEC 2010	Kolkata (RW01R, 01L, 19R, 19L)	
Mumbai – Chennai	DEC 2011	Hyderabad		Hyderabad Intl (RW09, 27)	
Chennai – Mumbai		Thiruvananthapuram		Bangalore Intl. (RW 09, 27)	DEC 2012
Kolkata - Chennai	DEC 2012	Guwahati	DEC 2011	Guwahati (RW02, 20)	
Chennai - Kolkata		Calicut			
Delhi - Kolkata		Cochin Intl			
Kolkata - Delhi		Jaipur			

APPENDIX - B

Medium Term (2013-2016)

<table>
<tr><th colspan="2">ENROUTE</th><th colspan="2">TERMINAL</th><th colspan="2">APPROACH</th></tr>
<tr><th>RNAV-5
(City pair)</th><th>Proposed date</th><th>RNAV-1/RNP-1 SIDs & STARs</th><th>Proposed date</th><th>Baro-VNAV Approach</th><th>Proposed date</th></tr>
<tr><td rowspan="10">Domestic routes connecting Mumbai-Nagpur, Delhi-Ahmedabad, Kolkata-Guwahati, Mumbai-Mangalore-Calicut, Calicut-ntl.,Delhi-Varanasi, Delhi-Lucknow, Chennai-Tiruchirapalli, Chennai-Madurai</td><td rowspan="10">DEC 2013</td><td>Nagpur</td><td rowspan="3">DEC 2013</td><td>Cochin Intl</td><td rowspan="14">DEC 2013</td></tr>
<tr><td>Amritsar</td><td>Jaipur</td></tr>
<tr><td>Mangalore</td><td>Mangalore</td></tr>
<tr><td>Coimbatore</td><td rowspan="3">DEC 2014</td><td>Coimbatore</td></tr>
<tr><td>Varanasi</td><td>Varanasi</td></tr>
<tr><td>Gaya</td><td>Gaya</td></tr>
<tr><td>Lucknow</td><td rowspan="3">DEC 2015</td><td>Lucknow</td></tr>
<tr><td>Patna</td><td>Patna</td></tr>
<tr><td>Tiruchirapalli</td><td>Tiruchirapalli</td></tr>
<tr><td rowspan="2">Bhopal</td></tr>
<tr><td rowspan="15">RNAV -1 routes between city – pair

Chennai – Hyderabad

Hyderabad – Chennai

Chennai - Bangalore

Bangalore – Chennai

Mumbai – Ahmedabad</td><td rowspan="15">DEC 2014</td><td rowspan="15"></td><td rowspan="15"></td><td>Indore</td></tr>
<tr><td>Agartala</td><td rowspan="13">DEC 2014</td></tr>
<tr><td>Belgaum</td></tr>
<tr><td>Bhavnagar</td></tr>
<tr><td>Bhubaneswar</td></tr>
<tr><td>Dibrugarh</td></tr>
<tr><td>Dimapur</td></tr>
<tr><td>Gondia</td></tr>
<tr><td>Hyderabad</td></tr>
<tr><td>Imphal</td></tr>
<tr><td>Jabalpur</td></tr>
<tr><td>Kandla</td><td>DEC 2015</td></tr>
</table>

Ahmedabad-Mumbai Delhi-Jaipur Jaipur - Delhi			Keshod	
			Khajuraho	
			Kota	DEC 2015
			Lengpui	
			Madurai	
			Mysore	
			Nanded	
			Pondicherry	
			Porbandar	DEC 2016
			Rajkot	
			Raipur	
			Rajahmundry	
			Ranchi	
			Surat	
			Tirupati	
			Udaipur	
			Vadodara	
			Vijaywada	
			RNP-AR	
			Cochin Intl	DEC 2013
			Calicut	
			Lengpui	DEC 2014
			Guwahati	

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