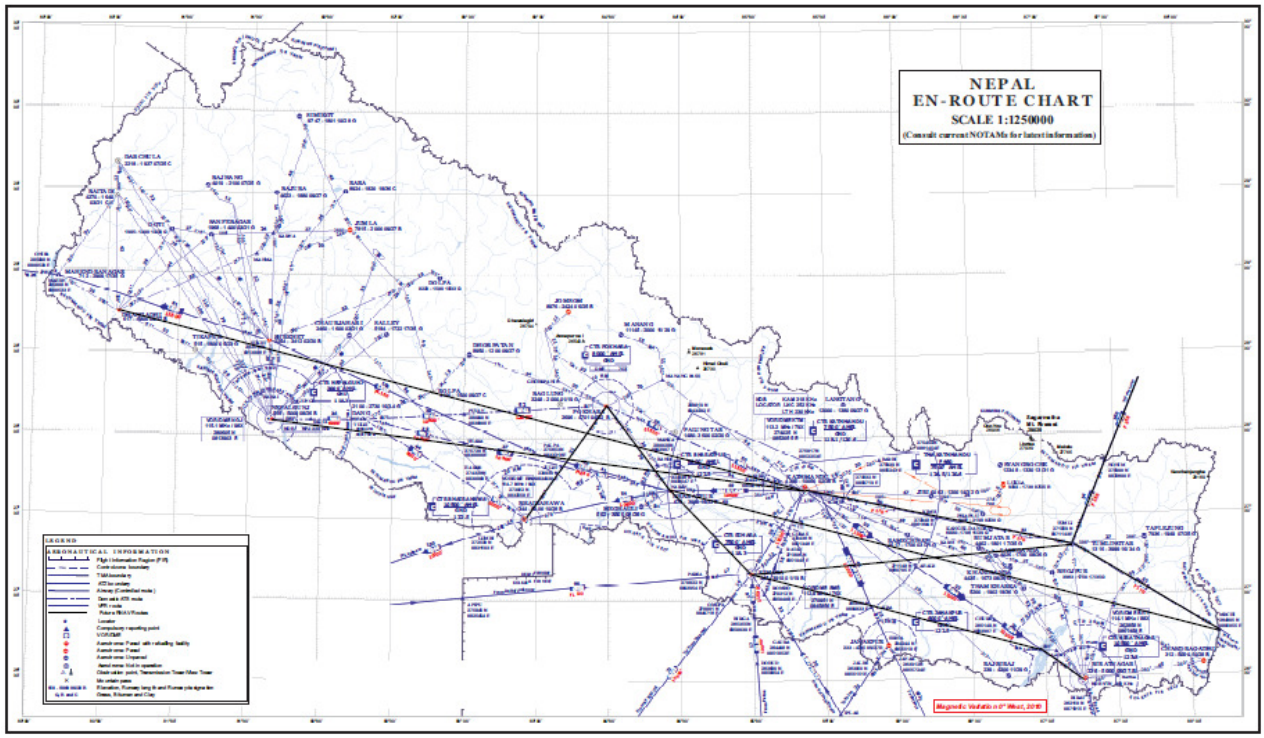
Nepal

PBN Implementation Plan



Civil Aviation Authority of Nepal

Babarmahal, Kathmandu

April 2011

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Amendments

Amendments and Corrigenda to this "PBN Implementation Plan" are issued by Director General of CAA, Nepal. The space below is provided to keep a record of such amendments.

RECORD OF AMENDMENTS AND CORRIGENDA

AMENDMENT				CORRIGENDA			
No.	DATE APPLICABLE	DATE ENTERED	ENTERED BY	No.	DATE APPLICABLE	DATE ENTERED	ENTERED BY

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NEPAL

PBN IMPLEMENTATION PLAN

Summary

In December 2010, Nepal National PBN Task Force Main Committee for PBN has reviewed the Nepal PBN Implementation Plan in accordance with the review report of ICAO APAC Regional Office. This Plan aims to provide aviation stakeholders with appropriate implementation guidance and timelines to allow proper preparation for PBN implementations within Kathmandu Flight Information Region (VNSM). This plan has been produced in line with Resolution A 36/23 adopted by ICAO Assembly in its 36th Session held in September 2007 and with the Asia/Pacific Regional PBN implementation Plan developed by ICAO Asia/Pacific PBN Task Force.

1. Background

At the 36th Session of ICAO Assembly, it has been resolved: "All the contracting States should have a PBN implementation plan in place by 2009 to ensure a globally harmonized and coordinated transition to PBN by 2016." The specific requirements are as follows:

- Each contracting State should develop an implementation roadmap and implement RNAV and RNP operations in the en route to terminal areas according to the established schedule;

- Each contracting State should implement the approach procedures with vertical guidance(APV) (Baro-VNAV and/ or augmented GNSS) for all instrument runway ends, either as the primary approach or as a back-up for precision approaches, by 2016, and meet the intermediate implementation milestones of 30% by 2010 and 70% by 2014.

By introducing PBN System and GNSS technology, CAAN wants to facilitate more efficient use of airspace and more flexibility for procedure design which cooperatively result in improved safety, capability, predictability, operational efficiency, fuel economy, and environmental effects.

2. Benefits of Performance-Based Navigation (PBN)

The main benefits of implementing PBN in Nepal are:

a. Increased airspace safety through the implementation of continuous and stabilized descent procedures using vertical guidance;

b. Reduced need to maintain ground-based sensor-specific routes and procedures, and their associated costs;

c. Reduced aircraft flight time due to the implementation of optimal flight paths, with the resulting savings in fuel, reduction in noise and carbon emission, and enhanced environmental protection;

d. Use of the RNAV and/or RNP capabilities that already exist in a significant percentage of the aircraft fleet flying in Nepalese Airspace- both domestic and international operations;

e. 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 optimized RNAV or RNP paths;

f. Implementation of more precise approach, departure, and arrival paths that will foster smoother traffic flows;

g. Decrease ATC and pilot workload by utilizing RNAV/RNP procedures and airborne capability;

h. Increase of predictability of the flight path.

3. Objective

- To provide the continuity to the development in the field of air navigation including the GNSS-based procedures- a step for transitioning to PBN

- To implement the PBN (RNAV/ RNP) activities in a planned, harmonized and coordinated way and in line with the ICAO PBN guidelines.

4. Aircraft Fleet

The Air traffic in Nepal has increased tremendously in the last 10 years. International air traffic continues to record steady growth with more frequent services in many Indian cities and in the Middle East. The number of international aircraft movement at Tribhuwan International Airport (TIA), Kathmandu in 2010 was 23 % increase over that of 2009. In the case of domestic services, the traffic has increased in many folds.

4.1 International Operation

Tribhuvan International Airport is being served by 27 international airlines having air-links with 24 destinations in 14 countries. The aircraft fleet comprises A332, A320, A319, A310, B772, B752, B738, MD83 and ATR72. State registered airlines in international operations include Nepal Airlines and Buddha Air, the later being the major domestic airline has recently started international operations to India and Bhutan.

4.2 Domestic Operation

In the domestic sector, 23 operators operate 55 fixed wing aircraft, 24 rotor wing aircraft and 5 Aviation Sports aircraft. (Data: 2011) The aircraft fleet comprises ATR72, ATR42, B1900, J41, D228, DHC6, Pilatus, Cessna, rotor wing aircraft MI8, MI17, BA46, A320, B06, AL03 and microlights , paragliders in aviation sports.

5. Airspace and Air-route Structure

5.1 Airspace

Nepal is a mountainous country with 83% hills and mountains including the highest peak of the world Mt. Everest. It is rectangular and landlocked by India and China. Due to its topographical feature, there is limited airspace for the airspace design and air route planning limiting the efficient use of airspace. There are 48 aerodromes scattered all over country including one international airport, the Tribhuwan International. Despite this factor, traffic is increasing day by day both in domestic and international operation. The biggest issue following the traffic growth is the congestion of airspace. Over 80 % of the total traffic used Tribhuvan International Airport making it congested both in the air and on the ground. The congestion has caused delays both in the air and on the ground resulting in heavier ATC workload and impeding the efficient flight operation.

5.2 Airspace Classes:

Class C Airspace- Within controlled airspace (TMA, CTR, ATZ and Airways)

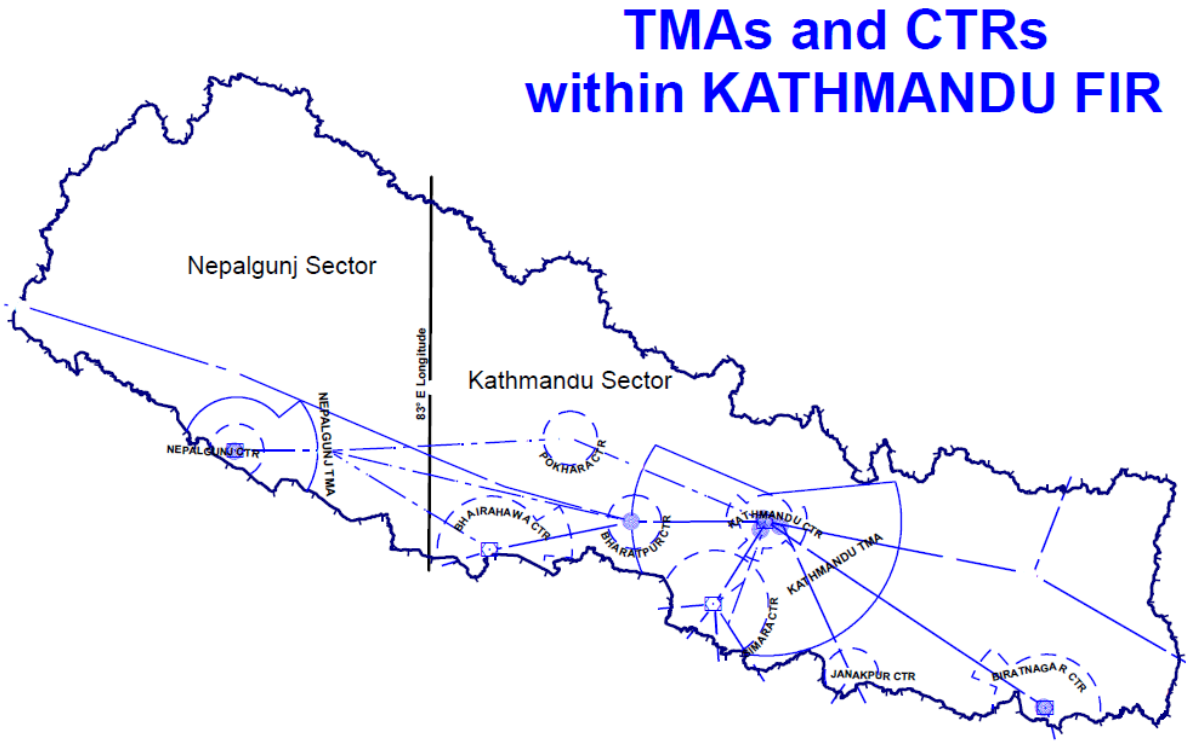
Class G Airspace- Outside controlled airspace

5.3 FIR Sectorization:

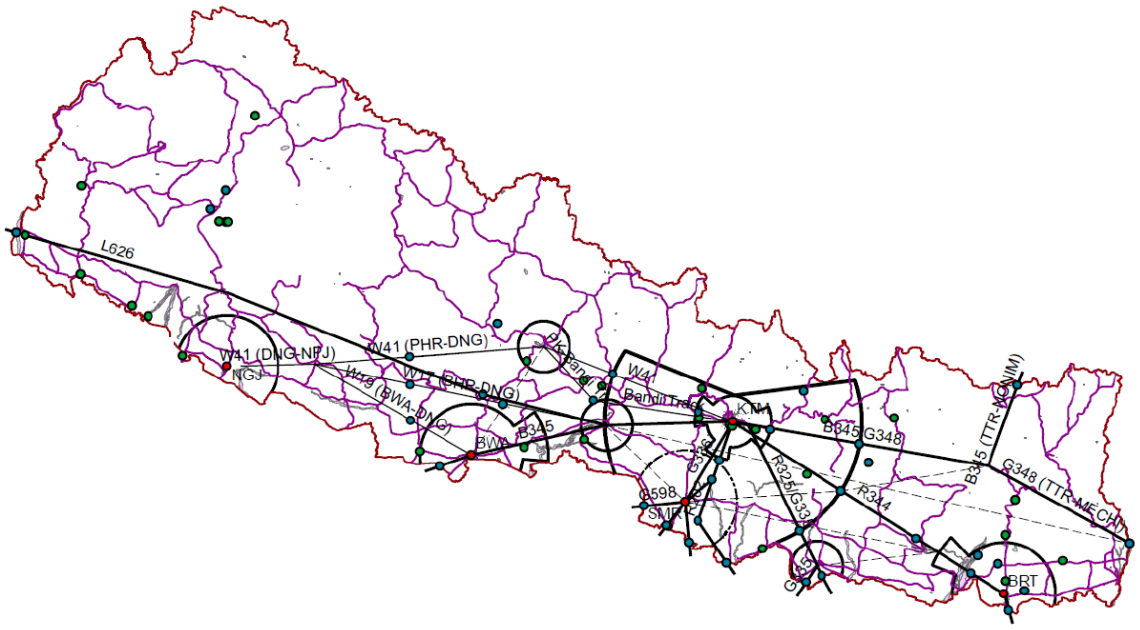
Kathmandu FIR (VNSM) is divided into two sectors- Kathmandu Sector and Nepalgunj Sector. These sectors are divided by 83°E longitude and has jurisdiction from ground level to unlimited vertical airspace over the territory of Nepal.

5.4 TMAs and CTRs:

There are 2 TMAs (Kathmandu and Nepalgunj) and 8 control zones (Nepalgunj, Bhairhawa, Pokhara, Bharatpur, Simara, Kathmandu, Janakpur and Biratnagar) within Kathmandu FIR.



5.5 Route Structure:



Legends

- - - - - - - - - - - - Future Routes

_____ Existing ATS Routes

_____ Existing Domestic Routes

- **International ATS Routes**

There are following airways to and from Kathmandu FIR:

L626 **Kathmandu-NARAN-PALPA-SUKET-MAHEN-ONISA**-Pantanagar-SSB- Delhi (RNP10)

B345: Lhasa-**NONIM-TUMLI-KTM-NARAN-BWA**-Lucknow

G335: **Kathmandu-LNC-LALBA-SEETA-JALES**-Patna

R325: **Kathmandu-LNC-LALBA-SEETA-JANAK**-Kolkata

G348: **Kathmandu-KIMTI-TUMLI-MECHI-BBD**-Paro

G336: Patna-**BIRGA-SMR-Kathmandu**

G590: Varanashi-**OMIPA-SMR**

G598: Lucknow-**APIPU-PARSA-SMR**

R581/G463 MONDA-IPLAS-**GAURA-ROMEO-SMR**

Note: Bold letters indicate the route segments within Kathmandu FIR.

- **Domestic Routes**

There are 3 domestic routes in Kathmandu FIR. They are:

W17: Bharatpur (NARAN)-JULET-THARA- Dang (TULSI)
W19: Bhairahawa-HARRE-Dang (TULSI)
W41: Kathmandu-MANKA-Pokhara-Dang (TULSI)-Nepalgunj

Routes (domestic routes and airways both) within Kathmandu FIR are redefined by waypoints instead of previously defined significant points based on NDBs. They are:

NARAN instead of BHP
TULSI instead of DNG
SEETA instead of JKP
TUMLI instead of TTR

6. Communication Infrastructure

- VHF- RCAG at Phulchoki and Nepalgunj

Newly installed VHF Remote Control Air Ground (RCAG) system at Nepalgunj airport provides ACC VHF coverage up to the western boundary of Nepal, and overall VHF coverage has been significantly increased.

- AFTN link with Beijing and Mumbai for data communication, and Lhasa for voice communication

- HF coverage in whole FIR for ground to ground communication and can be used for air to ground communication during contingency operation.

7. Navigation Infrastructure

NDB, VOR/DME and other ground radio navigation aids are developed in order to overcome operational restrictions posed by early navigation that relied on pilot's eye. In Nepal also conventional navigation that fly along the radio signals provided by ground facilities has contributed for enhancing flights safety and accessibility in far and wide. However, out of 17 NDBs in different parts of the country, 12 NDBs are already decommissioned and remaining NDBs have been planned to be withdrawn in another 5 years.

7.1 Conventional NAV Aids:

NAV Aid	Location	Remarks
DVOR	Kathmandu, Biratnagar, Nepalgunj, Bhairahawa and Simara	Facilities are being used as En-route and Landing Aids.
DME	Kathmandu, Biratnagar, Nepalgunj, Bhairahawa, Simara and Pokhara	With collocated VOR, En-route and landing aids.
NDB	Kathmandu, Biratnagar, Nepalgunj, Janakpur and Bharatpur	Homing Aids until the life of the facilities.
Locator	Nalinchowk and Thecho	Locator Nalinchowk is being used as En-route Aid.

7.2. GNSS

- WGS-84 Coordinates

CAA Nepal completed WGS-84 survey of the runway thresholds, critical positions of runway and Navigation Aids of TIA and all domestic airports in operation in 1999 and data have been published in the AIP Nepal.

Re-verification of WGS-84 data and survey of other essential points at Kathmandu & Biratnagar Airports has been carried out in 2010.

- **Transition to GNSS**

To take early benefit of the satellite based navigation, GNSS based approach procedures for TIA and 8 major domestic aerodromes were developed in 1999, some of them were flight validated.

GNSS NPA procedures were reviewed and some GNSS/RNAV departure procedures were developed based on PANS/OPS in 2005. Some of them were flight validated.

GNSS based approach and departure procedures have been designed at about nine domestic airports including Tribhuvan International Airport and some of them have been flight validated.

GPS with TSO C129 Standard has been mandated to be on-board the aircraft since 2001 on selected ATS routes within Kathmandu FIR for en-route purposely only.

8. Surveillance Infrastructure

- PSR/SSR in Kathmandu TMA
- Outside radar coverage, surveillance based on Voice Position Reporting

9. Future Plan

9.1 ATS route plan

- Domestic routes will be upgraded to RNAV routes.
- Existing airways will be redefined with PBN specifications after consultation with adjacent FIRs.
- New RNAV/RNP routes are under plan to be developed as follows:

  Bhairahawa - Pokhara,

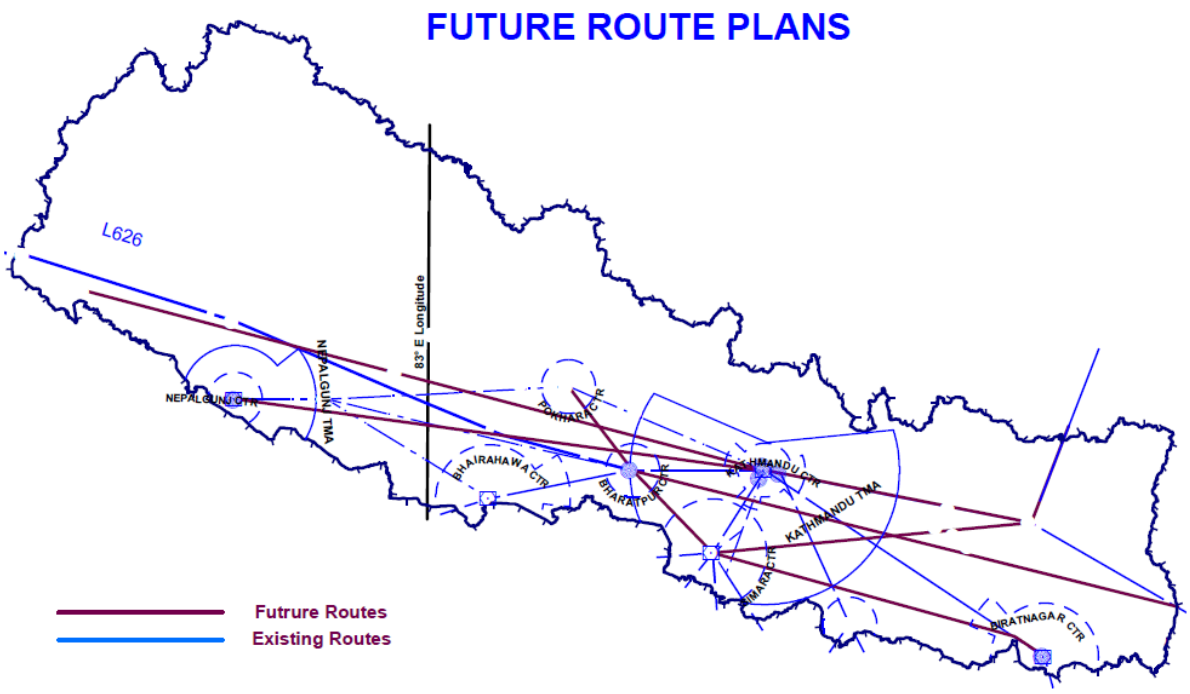
  Pokhara - Bharatpur - Simara,

  Simara - Biratnagar,

  Simara - Mechi

  Jakakpur - Biratnagar

  Himalaya 2 Route (Kathmandu – BBD – Guwahati – Imphal – Kunming) will be pursued to be developed and consultation will be done for the extension of L626 up to Mechi (FIR boundary)



9.2 Communication Plan

- Present AFTN will be upgraded to AMHS as per the ICAO requirements.
- VHF RCAG will be installed at Biratnagar to provide full VHF coverage towards eastern part of the country.
- ATS communication system at TIA will be enhanced by introducing automation and new communication equipments including consoles.

9.3 Surveillance Plan

- Replacement of present Radar system
- Installation of new SSR at suitable location
- Possibility of application of ADS-B outside Radar coverage will be considered.

10. PBN Implementation in Nepal

10.1 New Development

Due to the global air traffic growth and limitation of ground based navigation system, ICAO recommended GNSS as Future Navigation System. To cope with the increasing global traffic demands, ICAO further developed the concept of RNAV and RNP, which is now called as Performance Based Navigation (PBN). PBN is a broad airspace concept in the global CNS/ATM system environment.

10.2 Initiation toward implementing PBN

As per the ICAO Assembly Resolutions and APANPIRG Resolution, CAA Nepal has initiated various works towards PBN since 2009.

CAAN has formed a National PBN Task Force headed by Deputy Director General of CAAN and members from various disciplines including airline pilots. The National PBN Taskforce has been mandated to develop PBN implementation plan, continuously review it as per the guidelines of ICAO Regional PBN Implementation Plan and Global Plan.

PBN Focal Point has been nominated and tasked to coordinate ICAO and various stake-holders, follow up the PBN Implementations Program, regularly update about the progress to PBN National Taskforce.

CAAN has recently sent 4 persons for basic PAN/OPS, 2 persons for PBN Procedure Design and 2 persons for RNP-AR APCH Training Course organized in Beijing, China under ICAO/FPP Programme.

The CAAN has planned to introduce RNAV/GNSS approach and departure procedures in some major airports including RNAV/RNP SIDs and STARs within TMA.

11. PBN Implementation Road Map

CAAN in coordination with AAI has promulgated ATS route L626 (RNP 10) from November 2009 between Kathmandu and Delhi, and most of the international airlines departing from Kathmandu towards West destinations are using this route.

CAAN has decided to implement Required Navigation Performance – Authorization Required (RNP-AR) procedure for TIA with technical support from COSCAP and QUOVADIS, sister organization of Airbus Company. The procedure has been scheduled to implement by the end of 2011.

Furthermore, CAAN has formulated the PBN Implementation Road Map as short term (2010–2012), medium term (2013–2016) and long term (2017–2025) plan as shown in the table below:

Implementation Road Map

	En-Route	**DEP/ARR (Terminal)**	**Approach**
Short term (2010-2012)	• Nepal intends to extend and redefine L626 (RNP10) route direct without overflying Delhi in consultation with India. • Existing ATS routes within Kathmandu FIR will be revised and new domestic routes will be developed as RNAV 5 routes for domestic purpose.	• RNAV1 SIDs and STARs based on GNSS will be developed within Kathmandu TMA. • Basic RNP1 SIDs and STARs will be developed in some major domestic airports.	• Design, validation and test operation of RNP AR APCH for TIA. • Introduce GNSS based approach and landing procedure RNAV/GNSS at some major domestic airports.

Medium term (2013-2016)	• An extension of L626 will be proposed from Kathmandu to Kunming via Bagdogra-Guwahati-Imphal, India in order to materialize the proposed Himalayan Route.	• RNP1 or RNAV1 STARs/SIDs will be introduced in other major airports.	• RNP Approach will be introduced in selective instrument runways of major airports. • Continue RNP AR APCH for full-fledged operation at TIA. • Introduce RNAV/GNSS approach and landing at other airports.
Long term (2017-2025)	• Selective ATS routes will be redefined as RNAV 5 routes in consultation with the adjacent FIRs.	• RNP1/RNAV1 STARs/SIDs will be fully implemented in all major airports.	• Feasibility study for RNP AR Approach will be conducted at some airports if needed.

11.1 Short Term (2010－2012)

En-route

- Nepal intends to extend and redefine L626 a RNP10 route to Amritsar after consultation with India.
- Existing ATS routes within Kathmandu FIR will be revised and new domestic routes will be developed as RNAV 5 routes.

Terminal

- Basic RNAV1/RNP1 SIDs, STARs will be developed within Kathmandu TMA and in some major domestic airports of Nepal by 2012.
- CAAN will selectively use GNSS navigation to implement basic RNP1 SID and STAR procedures in some major domestic airports.

Approach

- RNP AR APCH at TIA will be designed and validated and start test operation by December 2011.
- GNSS based approach and landing will be introduced at TIA and some major domestic airports.

11.2 Medium Term (2013-2016)

En-route

- An extension of L626 route up to MECHI will be implemented in order to materialize the proposed Himalayan Route in consultation with India.
- An extension of L626 or new route will be proposed from Kathmandu to Kunming via Bagdogra-Guwahati-Imphal, India in order to materialize the proposed Himalayan Route.

Terminal

- RNP1 or RNAV1 STARs/ SIDs will be introduced in other major airports.
- All major airports will be capable of serving RNAV/ RNP terminal operations by the end of Mid-term Plan.

Approach

- RNP Approach with BARO-VNAV will be introduced in selective instrument runways.
- RNP AR APCH will be continued for full-fledged operation at TIA.
- RNP (GNSS based) approach and landing will be introduced at all other major airports by 2016.

11.3 Long Term (2017-2025)

PBN operations will be introduced in all phases of flight, including en route, terminal and approach operation, and the co-existence of conventional operations and PBN operations will evolve into full PBN operations.

En-route

- Selective ATS routes will be redefined as RNAV 5 routes in consultation with the adjacent FIRs.
- The overall route structure will be re-planned with PBN technology, and all the conventional routes will be transitioned to RNP routes.

Terminal

- RNP1 STARs/SIDs will be fully implemented in all major airports.
- Overall terminal operations will be transitioned to RNAV/RNP operations by 2025.

Approach

- RNP AR Approach will be introduced at other major airports on need basis.

12. Transitional Considerations

- During the coexistence period, conventional navigations systems will be retained to provide services for aircraft without PBN equipage;
- The operators and other airspace users are encouraged to install the avionics that are necessary for the PBN operations;
- The CAAN will conduct safety assessment and periodic safety inspections and make contingency plans to ensure continuous operational safety;
- Thorough operation monitoring will be carried out, including the operator qualifications, aircraft navigation performance, navigation error, etc, and corrective measures will be formulated;
- Harmonization of conventional procedure and PBN flight procedure shall be considered in flight procedure design to reduce the risk of procedure conflict while conventional operations and PBN operations coexist;
- Air traffic control trainings to controllers and safety measures will be in place for blended operation environment to ensure safe separation;
- The operators shall be informed as early as possible before PBN operations are to be implemented at the airports or en route and airworthiness and operational approval to the national air carriers shall be actively conducted.

13. SAFETY ASSESSMENT & MONITORING REQUIREMENTS

13.1 Safety Assessment

- To ensure that the introduction of PBN applications within Nepal is undertaken in a safe manner, in accordance with relevant ICAO provisions, implementation shall only take place following the 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 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.

13.2 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 Airspace Safety Monitoring Advisory Group (RASMAG) would be availed wherever required. Necessary support to Regional

Airspace Safety Monitoring Advisory Group (RASMAG) 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.

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