

PBN Implementation Plan – Maldives

1. Background

The 36th Session of the Assembly of ICAO in September 2007 adopted Resolution A36-23 urging member States to develop a national PBN implementation plan by the end of 2009 to achieve the following objectives:

1. To implement RANV and RNP operations (where required) for en route and terminal areas according to established timelines and intermediate milestones;
2. To implement instrument approach procedures with Vertical guidance (APV) for all instrument runway ends, either as the primary approach or as a back-up for precision approaches, by 2016; and
3. To include provisions for implementation of approach procedures with vertical guidance (APV) to all runway ends serving aircraft with maximum certified take-off mass of 5700kg or more according to established timelines and intermediate milestones.

2. PBN

PBN is a framework for defining navigation performance requirements that can be applied to an air traffic route, instrument procedure, or defined airspace. PBN represents a fundamental shift from sensor (equipment) based to performance (systems) based navigation. Navigation specification need no longer be met through prescribed equipment components, such as INS or VOR/DME receiver, but rather through an aircraft's navigation system ability to meet prescribed performance criteria.

PBN includes both Area Navigation (RNAV) and Required Navigation Performance (RNP) specifications. Both RNAV and RNP must meet the same navigation specification requirements however an RNP specification includes a requirement for on-

board self-contained performance monitoring and alerting while an RNAV specification does not.

Area Navigation (RNAV)

RNAV is the less capable of the two families of PBN navigation specifications. RNAV is suited to current and legacy aircraft operations however as a stand-alone specification it is insufficient to support many of the new Air Traffic Management (ATM) applications envisaged in strategic plans).

The RNAV Specifications are:

- (a) RNAV 10 (RNP 10): oceanic and remote continental
- (b) RNAV 5, 2 & 1: continental en-route and terminal

Required Navigation Performance (RNP)

RNP is the more capable of the two families of PBN navigation specifications having onboard navigation performance monitoring and alerting. The on board aviation performance monitoring and alerting is a necessary enabler for many new ATM applications.

The RNP Specifications are:

- (a) RNP 4: oceanic and remote continental (supports 30/30 separation)
- (b) RNP 2: en-route operations
- (c) RNP 1: terminal area operations
- (d) RNP APCH: LNAV, LP, LNAV/VNAV, LPV
- (e) RNP AR AP

3. Rationale to implement PBN in the Maldives

Maldives considers full implementation of PBN within Male' FIR will bring major safety, efficiency, financial and environmental benefits in the development of the country's aviation industry.

Maldives is a nation of dispersed islands. Travel by air has been considered crucial for the development of trade and tourism. There are five airports across the country. And the effort is to build additional small airports in order to boost trade and tourism.

Currently all aerodromes have ground based en-route and approach navigation aids (NDB, VOR/DME). These navigation aids are 70 year old technology and are becoming increasingly expensive to install and maintain specially at small aerodromes.

Only at the Male International Airport approaches are flown using VOR. And the other four airports have the less reliable NDB. Only one runway end—Male International Runway 36, has vertically guided approach using ILS. With the current prevailing market prices of conventional navigation and approach equipment the cost to install VOR/DME and ILS at all aerodromes is going to be extremely high.

The Boxing Day tsunami of 2004 has taught us a lesson when it virtually destroyed all the ground-based navigational infrastructures at the main airport in the Maldives. It took over a year to reinstall the equipments and at a huge financial cost.

PBN enables optimized flight path (lateral and vertical) increasing operating efficiency and minimize fuel consumption and emission. Example:

- Maldives has introduced Connector routes in Male FIR. RNAV 10 capable aircraft above FL285 may now fly between an entry point and an exit point without reference to the Air Traffic Services (ATS) route network.

GNSS-enabled PBN permit widespread reduction of ground navigation aids.

APV procedures supported by GNSS and/or Baro-VNAV provide continuous lateral and vertical guidance without the need for ground based navigation aid. APV approaches are recognized internationally as being 8 times safer than procedures using lateral guidance only.

4. GNSS as enabling technology

Maldives' existing network of terrestrial navigation aids is of insufficient density to support PBN navigation specification.

PBN implementation in Maldives will be supported by self contained aircraft navigation system—GNSS.

GNSS is more reliable and provides highly accurate position information in the en route, terminal and approach phase of flight than ground based navigation aids.

5. Key Partners

- Civil Aviation Department as State regulator
- Maldives Airports Company Limited as the ANSP
- Island Aviation Services as the domestic local carrier
- Emirates Airlines as the Lead Operator to conduct flight trials

6. Implementation

Short Term (2008-2013)

Plan:

- To implement RNAV 10 in the En route sector;
- RNAV 1 with surveillance provided by radar in the Male TMA;
- RNP APCH – LNAV/VNAV for all international runways either as primary or back up approach.

Progress:

En route

RNAV 10:

The following routes in Male' FIR are now designated RNAV 10:

- L894
- N628
- L516
- P756
- L899

Terminal

RNAV 1:

- SIDs and STARs have been implemented at Male International Airport.

Approach Procedures

RNP APCH – LNAV/VNAV:

Approach procedures based on APV Baro-VNAV criteria are now implemented at Male International Airport:

- ILS backup for RWY36
- Primary approach for the non-ILS equipped RWY18.

Medium Term (2013-2017)

En route

RNP4 (30/30) based routes in the oceanic en route airspace for FANS1 capable aircraft.

Terminal

Basic- RNP1 for routes without surveillance services.

Approach Procedures

Approach procedures based on APV Baro-VNAV criteria for the remaining aerodromes either as primary or back up approach.

Long term (2018-2022)

En route

RNAV 2 for all promulgated domestic routes with surveillance provided by ADS-B with limited WAM contingency.

Terminal

RNAV1 arrival and departure routes with surveillance provided by ADS-B with limited WAM contingency.

Approach Procedures

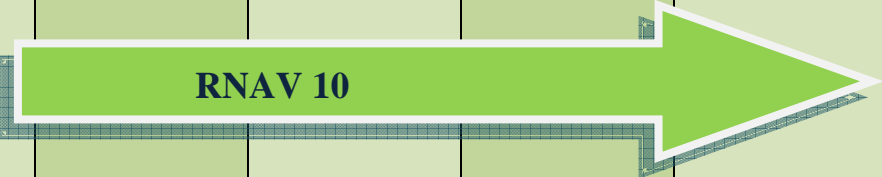
RNP AR Approaches for the major airports.

7. Challenges

Transition to a mature PBN environment means the government and the industry will face significant challenges:

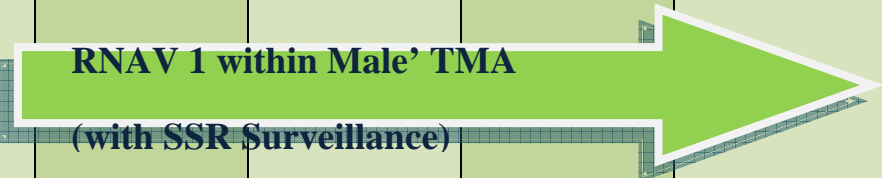
- Adoption of supporting Civil Aviation Rules
- Obtaining airworthiness and operational approval for air operators
- Integration of PBN capability into the ATM system (Flight Plan data fields)
- Mixed fleet/system operations
- Safety monitoring of ATM system
- Navigation database integrity and control
- GNSS system performance and prediction of availability service
- Continued involvement in CNS/ATM and PBN development
- Resources of the state regulator, ATS provider and aircraft operators to implement PBN
- Education and training of personnel employed by the state regulator, ATS provider and aircraft operators

**SHORT TERM (2008 - 2013) PBN IMPLEMENTATION TARGETS
EN-ROUTE (OCEANIC)**

2008	2009	2010	2011	2012	2013
					

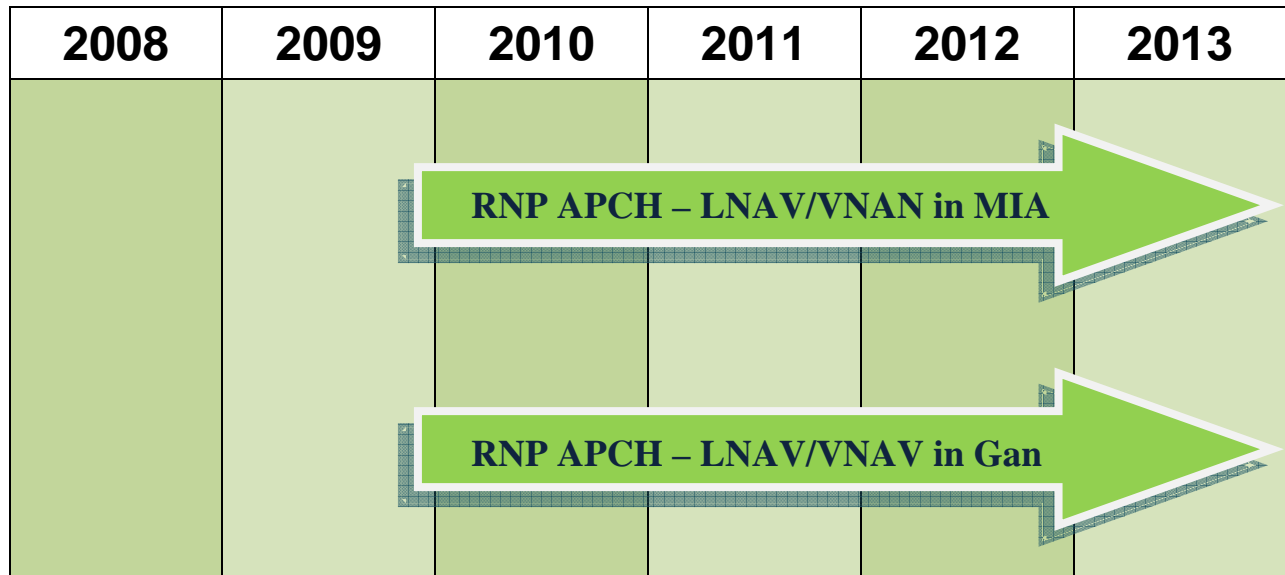
Progress: The following routes designated as RNAV 10;
L894, N628, L516, P756 and L899.

**SHORT TERM (2008 - 2013) PBN IMPLEMENTATION TARGETS
TERMINAL AREA**

2008	2009	2010	2011	2012	2013
					

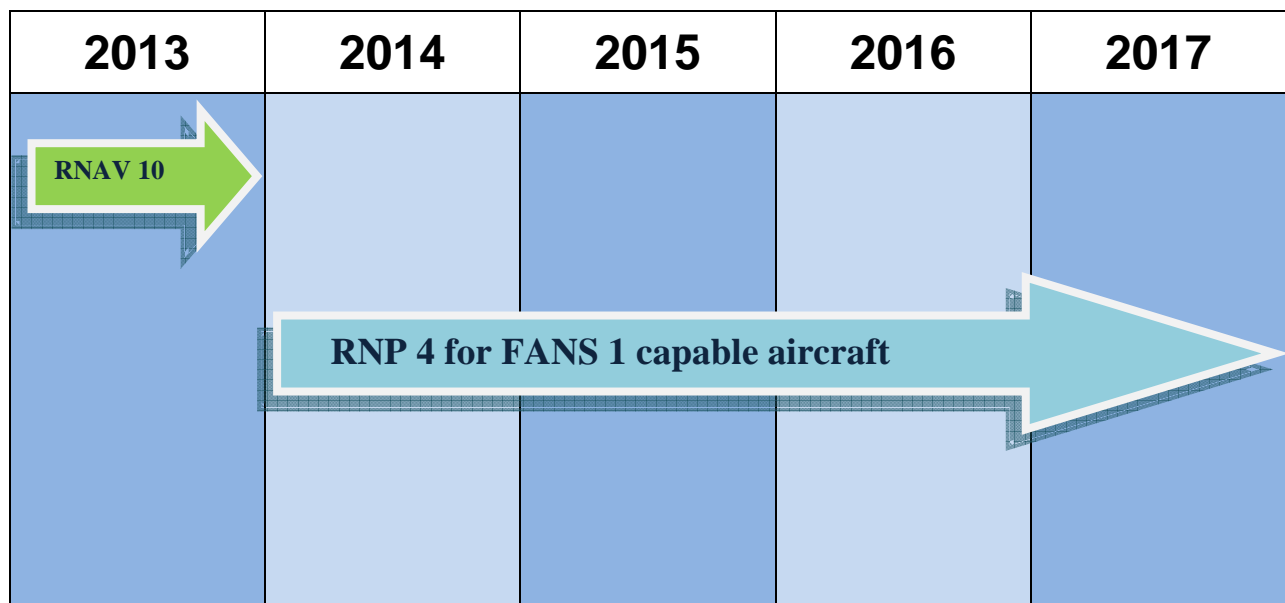
Progress: RNAV SID/STAR implemented at Male' International Airport.

SHORT TERM (2008 - 2013) PBN IMPLEMENTATION TARGETS APPROACH

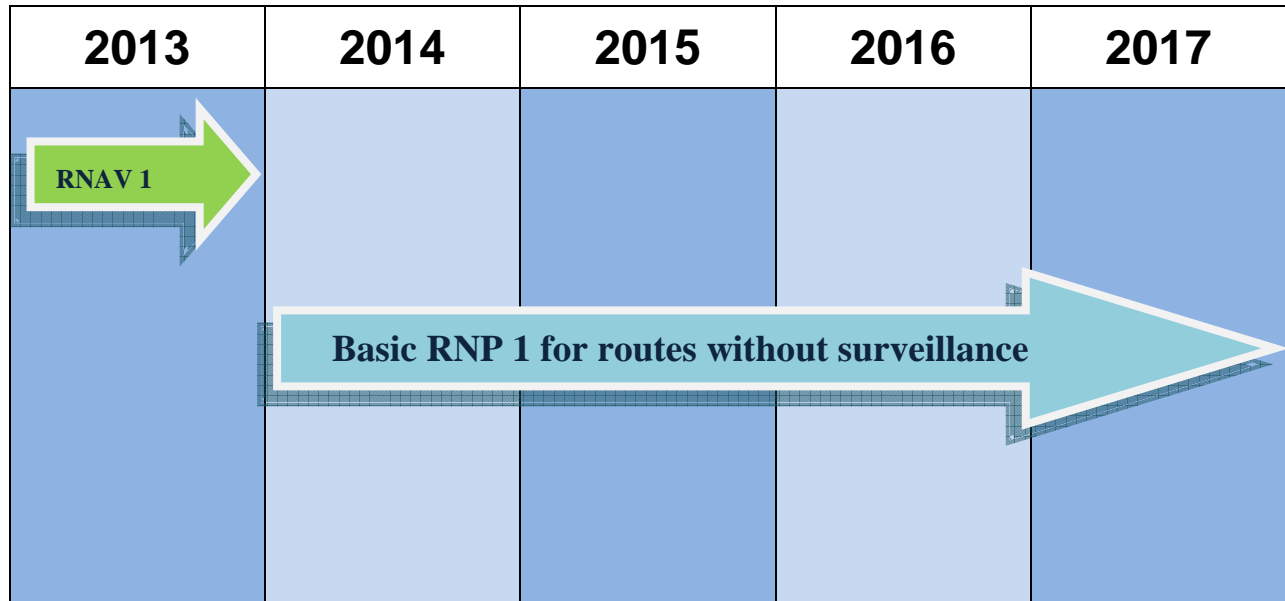


Progress: RNP APCH APV Baro-VNAV implemented at Male' International Airport

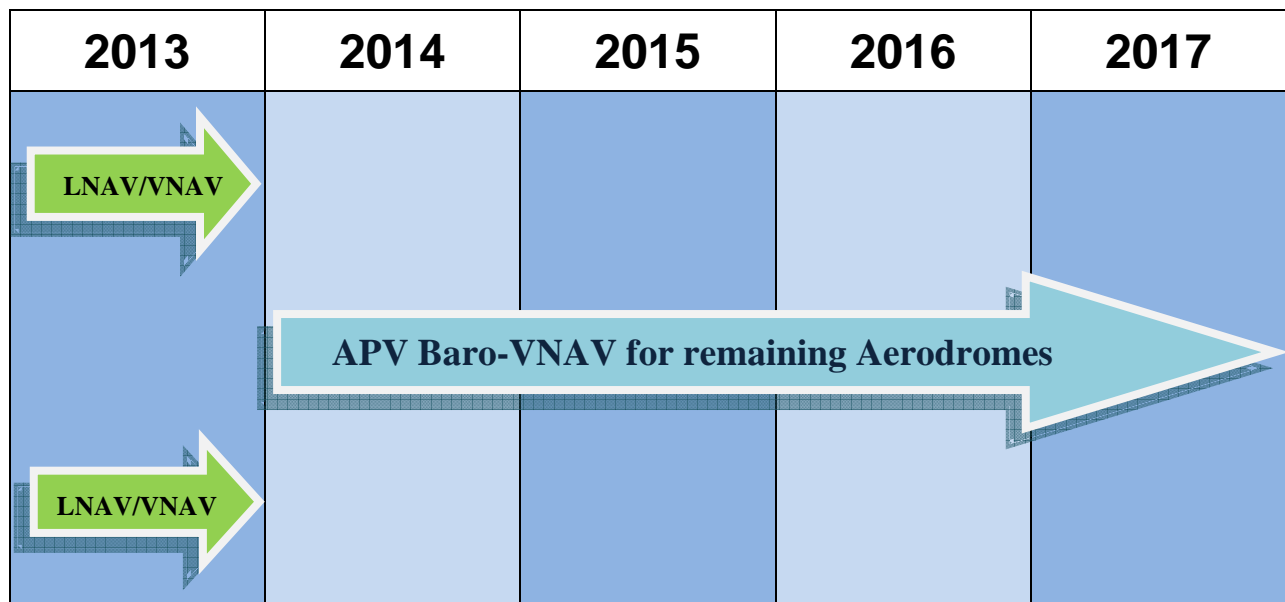
MEDIUM TERM (2013 - 2017) PBN IMPLEMENTATION TARGETS EN-ROUTE (OCEANIC)



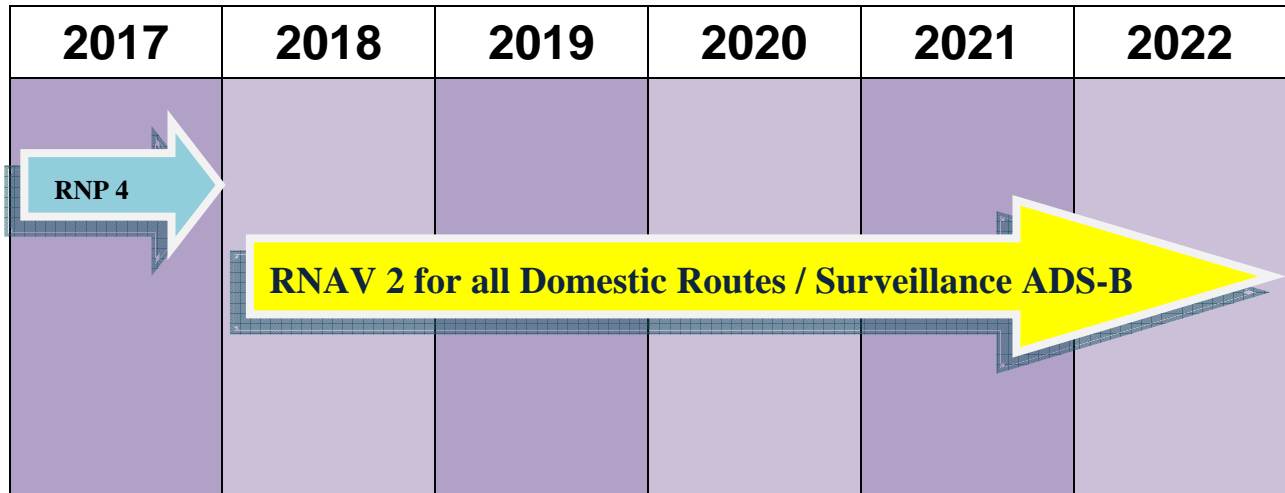
**MEDIUM TERM (2013 - 2017) PBN IMPLEMENTATION TARGETS
TERMINAL AREA**



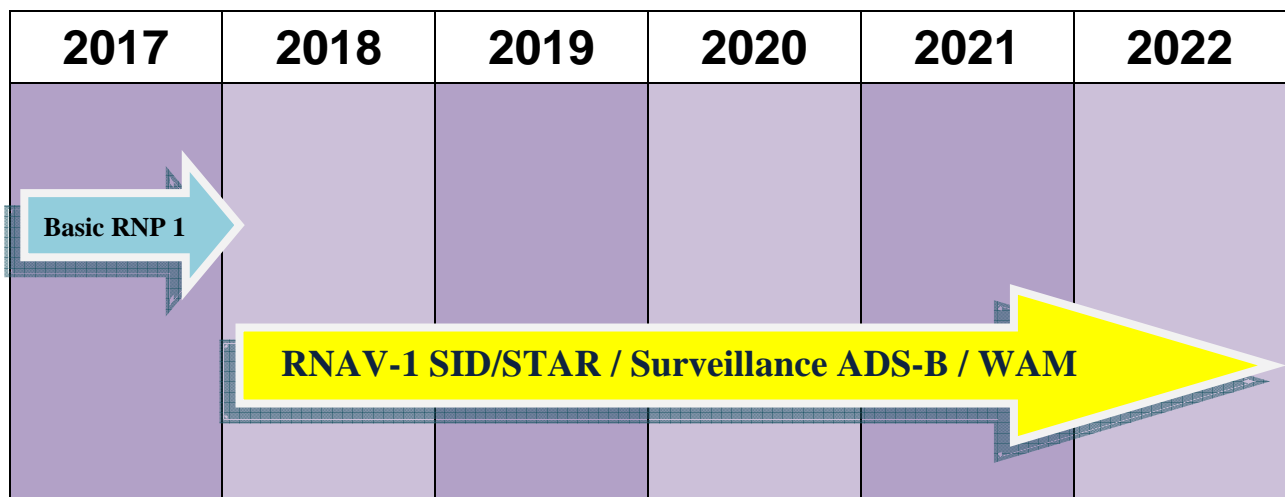
**MEDIUM TERM (2013 - 2017) PBN IMPLEMENTATION TARGETS
APPROACH**



**LONG TERM (2017 - 2022) PBN IMPLEMENTATION TARGETS
EN-ROUTE (OCEANIC)**



**LONG TERM (2017 - 2022) PBN IMPLEMENTATION TARGETS
TERMINAL AREA**



**SHORT TERM (2017 - 2022) PBN IMPLEMENTATION TARGETS
APPROACH**

