CIVIL AVIATION AUTHORITY OF BANGLADESH

PERFORMANCE BASED NAVIGATION (PBN)

IMPLEMENTATION ROADMAP

Version:V-2/7.12

1. INTRODUCTION

The continuing growth of aviation increases demands on airspace capacity therefore emphasizing the need for optimum utilization of available airspace. The increasing cost of fuel also presents a significant challenge to all segments of the aviation community, demanding shortest way to fly from point-to-point or on possible direct routings. This anticipated growth and higher complexity of the air transportation system could result in congestion along ATS routes, landing & departing phases of flights and increase flight delays, schedule disruptions, inefficient flight operations & Air Traffic Management, passenger inconvenience and higher environmental pollutions. Without improvements in system efficiency and workforce productivity, the aviation community and cost of operations will continue to increase. These circumstances can partially be alleviated by increasing efficiencies in airspace and flight procedures through the implementation of PBN concepts.

2. ICAO & APANPIRG'S RESOLUTIONS

2.1 Recognizing that the need for optimum utilization of available airspace can be obtained by the implementation of PBN, ICAO approached to address the issue. It was evaluated that PBN offers a number of advantages over the sensor-specific method of developing airspace and obstacle clearance criteria, i.e.:

a) reduces the need to maintain sensor-specific routes and procedures, and their associated costs;

b) avoids the need for developing sensor-specific operations with each new evolution of navigation systems, which would be cost-effective;

c) allows for more efficient use of airspace (route placement, fuel efficiency and noise abatement);

d) clarifies how RNAV systems are used; and

e) facilitates the operational approval process for operators by providing a limited set of navigation specifications intended for global use.

2.2 The 36th Session of the assembly of **ICAO in September 2007** adopted Resolution A36-23 thereby setting global goals for implementation of Performance Based Navigation (PBN). States agreed to the Resolution A36-23, which urges to **implement routes and airport procedures in accordance with the ICAO PBN criteria.**

2.3 Following the ICAO resolution, Asia Pacific Air Navigation Planning & Implementation Regional Group **(APANPIRG) in its 18th Meeting** considered the implementation of PBN in this region and took some conclusions.

2.4 **APANPIRG's Conclusion 18/52**:
Conclusion 52 of **APANPIRG's** 18th meeting states;
That, an Asia/Pacific PBN Task Force (PBN/TF) with terms of reference be established to develop a PBN implementation plan for the Asia/Pacific Region and address regional PBN implementation issues.

2.5 Following the APANPIRG's conclusion 18/52, Asia Pacific PBN Task Force (PBN/TF) was established in January 2008.

2.6 **APANPIRG's Conclusion 18/53:**

That the Regional Office encourages States to begin development of their State PBN implementation Plans in harmony with the development of the Asia/Pacific Regional PBN implementation plan being coordinated by the Asia/Pacific Regional PBN for submission to APANPIRG/19.

3. PBN IMPLEMENTATIONS IN BANGLADESH

3.1 BACKGROUND

31.1 The global expansion of passenger movement & transportation of goods by air has added more air traffic and ultra modern new generation wide bodied aircraft movement throughout the world. This rapid growth of air traffic has increased traffic movement in the South-Eastern region of Asia; consequently the traffic movement through Dhaka FIR and all three international airports in Bangladesh has been increased.

3.1.2 This rapid growth in traffic levels are leading to air traffic congestion and adding demands on more airspace capacity and emphasizing the need for the optimum utilization of the available airspace in Dhaka FIR. But the existing operational concept, available navigation aids infrastructure and technologies are unable to meet the requirements for safe operation.

3.1.3 There are constraints on the available airspace, trained/skilled human resources, infrastructure, CNS/ATM etc. in Bangladesh, and the existing operations are still fully dependent on the ground based infrastructure.

3.2 SCOPE OF IMPLEMENTATION OF PBN

Study on present ground based navigation infrastructure shows that, there are scopes to restructure existing routes and procedures to fly point to point in more direct routes to save time & fuel and avoid air traffic congestion. Bangladesh believes that PBN concepts and its proper implement can address to solve these problems.

4. GUIDANCE ON PBN IMPLEMENTATION

Herein the PBN Implementation Roadmap of Civil Aviation Authority of Bangladesh (CAAB) has been written following the ICAO Resolution and APANPIRG's Conclusion. The Implementation Roadmap is guided by ICAO Performance Based Navigation (PBN) Manual Doc. 9613 & relevant SARPS and Asia/Pacific Regional PBN implementation roadmap. This roadmap details the framework within which the ICAO PBN concept will be implemented in Bangladesh Airspace for the foreseeable future.

5. ADVANTAGES OF PBN

5.1 It is understood that, PBN offers a number of advantages over the sensor-specific conventional navigation method of developing airspace and obstacle clearance criteria. Implementation of PBN will;

5.1.1 Reduce the need to maintain routes and procedures based on existing ground navigation aids, and their associated costs. Presently, moving a single VOR ground facility can impact dozens of procedures, as that VOR can be used on routes, VOR approaches, as part of missed approaches, etc. Adding new sensor specific procedures will compound this cost, and the rapid growth in available navigation systems would soon make system-specific routes and procedures unaffordable.

5.1.2 Avoid the need for development of sensor-specific operations with each new evolution of navigation systems, which would be cost-prohibitive. The expansion of satellite navigation services is expected to contribute to the continued diversity of RNAV systems in different aircraft. The original Basic Global Navigation Satellite System (GNSS) equipment is evolving due to the augmentations of Satellite Based Augmentation System (SBAS), Ground Based Augmentation System (GBAS) and Ground-Based Regional Augmentation System (GRAS), while the introduction of Galileo and modernization of the Global Positioning System (GPS) and Global Orbiting Navigation Satellite System (GLONASS) will further improve performance. The use of GNSS/inertial integration is expanding.

5.1.3 Allow more efficient use of airspace (route placement, fuel efficiency, reduction of CO2 emissions, redress noise abatement).

5.1.4 Facilitate the operational approval process for operators by providing a limited set of navigation specifications intended for global use.

5.1.5 Clarify the way in which RNAV systems are used.

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

(i) Increase safety by using three-dimensional (3D) approach operations with vertical course guidance to the runway, which reduce the risk of controlled flight into terrain.

(ii) Improve airport and airspace access in all weather conditions, and the ability to meet environmental and obstacle clearance constraints.

iii) 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.

(iv) Improve efficiency and flexibility by increasing use of operator-preferred trajectories airspace-wide, at all altitudes. This will be particularly useful in maintaining schedule integrity when convective weather arises.

(v) Reduce workload and improve productivity of air traffic controllers.

6. OBJECTIVES OF PBN IMPLELEMNTATION

6.1 Objective of Bangladesh PBN roadmap is to;

- Improve airspace capacity by reducing lateral and longitudinal separation between air-routes and aircraft to accommodate more traffic;
- Increase airspace safety by implementing more precise airways, departure & arrival paths and approach procedures with continuous & stabilized descent procedures using vertical guidance;
- Improve aviation operational safety by decreasing ATC and pilot workload by utilizing RNAV/RNP procedures, increasing airborne capability of the aircraft, reducing the needs for ATC-Pilot communications & radar vectoring;

- Expedite traffic flow by reducing delays by implementing optimal flight paths & approach procedures and making use of the airports in all weather conditions.
- Improve operational benefits & environmental pollutions and lower operational costs through fuel savings, noise reduction, less carbon emission by the implementation of optimal flight paths.
- Reduce maintenance, flight inspection, procedure design and route establishment costs associated with conventional navigation aids.
- Achieve globally harmonized navigation standards.

7. STEPS TO THE PBN IMPLEMENTATION

7.1 Steps to be followed to realize the above objectives include;

- Evaluation of the existing CNS/ATM infrastructure of Bangladesh.
- Assessment of the present status of the stakeholders and their capability to transition to PBN.
- Formulation of regulation and standards for establishing routes, procedures, SID's & STAR's and its validation/approval process.
- Formulation of regulations, standards and approval procedure for carriage of on-board equipment and aircrew.
- Develop Civil/Military coordination.
- Replan the national and domestic ATS route structures with PBN concepts and selection of RNAV/RNP specification to enable gradual transition to RNAV or RNP en-route operations based on PBN navigation specification;
- Implementation of RNAV or RNP standard instrument departures (SID) and standard terminal arrival routes (STAR) procedures in the terminal areas;
- Implement RNP approaches, including RNP AR approaches for airports in need;
- ensure use of WGS84 coordinates for the accurate, integral and punctual aviation data;
- Upgrade the communication, navigation and surveillance (CNS) equipment and enable coordinated development with other new navigation technologies.

7.2 Formulation of Regulations and Standards:

CAAB will establish a complete regulation system conforming the ICAO PBN standards by the end of 2011. The regulations will cover-

- Standards for the RNAV, RNP & RNP AR routes/approaches.

- Route planning & flight procedure design criteria and validation procedure.
- Onboard equipment standards for aircraft.
- Aircraft capability.
- Aircrew qualifications.
- Operation procedures.
- Certification and approval procedure.
- Monitoring and inspection.
- Air traffic command.
- Training standards of personnel:
  Flight crew,
  Maintenance,
  Air Traffic Control,
  Inspection, etc.

7.3 COORDINATION WITH STAKEHOLDERS:

7.3.1 The stakeholders who will benefit from the concept of PBN include airspace users/operators, air traffic service providers, regulators & standards organizations. As driven by business needs, airlines and operators can use the PBN this Roadmap to plan future equipage and capability of investments.

7.3.2 To assist aviation stakeholders in understanding operational goals, determining requirements, and considering future investment strategies effective coordination through collaborative forums will taken over by CAAB . This, in turn, will enable the aviation stakeholders to focus on addressing future efficiency and capacity needs while maintaining or improving the safety of flight operations by leveraging advances in navigation capabilities on the flight deck.

7.4 Fleet readiness:

7.4.1 **A PBN implementation workshop,** held at Dhaka from 23-25 August 2011 **was jointly organized by** CAAB and COSCAP SA and was conducted by Flight Procedure Planning (FPP) office, Beijing, China. A total of 32 Participants, 12 from different Airlines, 1 from Bangladesh Air Force, 1 from COSCAP-SA and 18 Officers from CAAB, attended the workshop. The 'PBN Implementation roadmap of Bangladesh, Version: V-1/4.11 was discussed and everybody of the workshop shown their highest interest on the implementation of PBN routes and procedures.

7.4.2 Information from the different airlines personnel in the workshop and the latest study on the type of aircraft involved with the fleet of different airlines in Bangladesh are as follows:

Airlines	Type of aircraft	Flight/Week
AIR ARABIA	A320	12
BIMAN	B747 - 1 B773 -2 B738 - 2 A310 -2 DC10 -2 F28 - 1	10 28 25 37 33 14
BANGKOK AIR	A319/A320	07
CHAINA EASTERN	A333/B733	07
CARGO KING	B777	05
CHAINA SOUTHERN	B737	04
DRAGON AIR	A333	06
EMIRATES	A340/B777	18
ETHIHAD	A345/B777	07
FLY DUBAI	B738	07
GULF AIR	A340/A320/A332	12
JET AIRWAYS	B737	21
KUWAIT AIR	A340/B777	07
MIHIN LANKA	A320/A321	04
MALAYASIAN AIRLINES	A330/B733	07
OMAN AIR	A320	
PAKISTAN AIRLINES	A310/B777/B747	07
QATAR AIRWAYS	B7777/A340	11
RAK AIR	A320/B737	05
ROYAL BHUTAN	A319	06
REGENT AIRWAYS	DHC8 -2	
SINGAPRORE	A333/B777	07
SAUDIA	B747/B772	12
TURKISH AIR	A340/B777	04
THAI AIRWAYS	B777	07
TIGER AIR	A320	06
UNITED BD AIRLINES	A310 – 2 MD83 -3 ATR72 -2 DHC8 -2	07 21 42 42

Among these types, the modern and latest aircraft of Boeing and Airbus are already equipped with GNSS receiver and are capable of flying PBN routes & procedures, however, some older model of aircraft is not GNSS equipped. As per the airlines representative, it is not impossible to integrate or install GNSS receiver to those older aircraft for flying PBN routes and approaches if required.

7.4.3 A PBN implementation committee was also formed as per the recommendation of the workshop.

7.5 ESTABLISH OPERATOR CAPABILITY:

The air operators shall, in accordance with the CAAB PBN Implementation Plan and operational requirements, gradually establish operational capabilities to implement PBN operations, ensure that their aircrafts are properly equipped to meet onboard navigation capability requirements as specified in PBN navigation specification, establish operation procedures, complete the training of personnel and apply for and obtain the operational approval from CAAB.

7.6 CIVIL MILITARY COORDINATION:

PBN may be used to support military flying with more efficiently and smoothly without having interruption to the civil traffic. To support and accommodate the unique missions and capabilities of military aircraft operating in civil airspace of PBN, coordination procedure & policies between Civil & Military will be developed.

7.7 ROUTE PLANNING AND FLIGHT PROCEDURE DESIGN:

CAAB will establish/ensure PBN flight procedure design capability and route planning capability, flight procedure verification/validation, quality control and on-job training of flight procedure designer & review personnel.

7.8 PROMOTE EDUCATION/TRAINING;

7.8.1 To ensure that both flight crew and ATC are aware of the navigation applications on specific routes or within a specific airspace and on-board area navigation (RNAV) system capabilities to ensure that the performance of the RNAV system for the specific airspace requirements, it is necessary to arrange proper training in this modern field of navigation.

7.8.2 The CAAB will, during PBN implementation process, enhance training and dissemination of educational information about its PBN implementation program. The trainings shall be provided to the personnel from the regulatory authorities, air traffic management agencies, airports, air carriers, etc according to the regulation standards.

8. INTERNATIONAL HARMONIZATION

8.1 As Bangladesh is a hub of international Air routes in South-East Asia, extensive regional coordination for PBN implementation will be required. Mainly:

- to coordinate with the regulatory authorities of adjacent States and other concerned States to avoid iterant airworthiness and operational approvals among countries/regions;
- to coordinate with foreign operators and aviation associations to inform them of PBN implementation progress and requirements in Bangladesh;
- to punctually know the implementation progress and requirements abroad and make the domestic operators ready for PBN operations;

- to coordinate with the adjacent countries and regions in implementing PBN routes;
- to coordinate with the aircraft manufacturers to know the evolution of aircraft performances and the present on-board equipment requirements;
- to report to the ICAO about the PBN implementation in Bangladesh and submit the proposal on international development;
- to provide help and guidance, if needed, on PBN implementation for related countries and regions.

9. PRESENT NAVIGATION INFRASTRUCTURE

9.1 ROUTES AND APPROACH PROCEDURES;

There are 10 international/regional and 14 domestic/national routes within Bangladesh FIR. All these routes and approach procedures in 3 international & 5 Domestic Airports are fully based on conventional navigation aids.

9.2 CONVENTIONAL NAVIGATION INFRASTRUCTURE :

The conventional ground-based navigation systems deployed by the CAAB mainly include:

- NDB
- VOR, DVOR
- DME
- ILS

These conventional navigation infrastructures are established primarily on the Airports and also in different parts of the country, but it does not cover the whole country for navigation.

9.3 Presently CAAB have 08 NDB units, 07 VOR units, 03 DME units, and 03 ILS units in operation. Due to the shortage of ground based navigation aids and considering the expenses involved with the establishment of new ground based navigation aids, CAAB is interested to transfer to PBN based on GNSS.

9.4 GNSS NAVIGATION AIDS

Satellite-based augmentation systems (SBAS) or ground-based augmentation systems (GBAS) are not available in Bangladesh.

10. PBN IMPLEMENTATION TIME FRAMES:

10.1 CAAB will implement GNSS based PBN in three phases: near term (2011–2012), medium term (2013–2015) and long term (2016–2018). Each term separately deals with the implementation of PBN specification related to enroute, Terminal and Approach phase of flight.

10.2 The near-term focuses on selected application of RNP in some selected Routes and RNP approaches in selected Airports. The medium-term focuses on application of RNP in some selected continental/national routes and in the terminal area. RNP approaches and ADS-B for surveillance will also be introduced within medium-term. The long-term targets integration of RNP with APV (Baro VNAV, GBAS etc).

PBN IMPLEMENTATION TIME FRAME

Airspace	PBN Specification	Near Term		Mid Term			Long Term		
		2011	2012	2013	2014	2015	2016	2017	2018
Enroute	**RNP 10** Remote/Oceanic	→							
	RNP 4 Remote/Oceanic		→	→	→				
	RNAV 5 Continental/National			→	→				
	RNP 4 Continental/National				→	→	→	→	
Terminal	**RNAV 2** **RNP SIDs & STARs**		→	→	→				
	RNAV 1				→	→	→	→	
Approach	**RNP** (One International Airport)		→	→					
	RNP (All International Airports)			→	→				
	RNP (All Domestic Airports)						→	→	
	RNP AR (if necessary) (One International Airport)					→	→		
	RNP AR (if necessary) (All International Airport)						→	→	
	Baro VNAV (One International Airport)						→	→	
	Baro VNAV (All International Airport)							→	

10.3 NEAR TERM (2011-2012)

10.3.1 Route (Oceanic and remote continental)

Based on the availability/readyness of WGS84 coordinates for the necessary waypoints, air transportation requirements, surveillance and communication capability, controller workload and fleet equipage, CAAB plans to selectively apply RNP-10 navigation specifications to certain remote continental and oceanic routes. Implementation process of RNP 4 routes for these routes will also be started within this period.

10.3.2 Terminal area & Approach:

CAAB plans to implement RNP approach to one of its international Airport (Hopefully, at Hazrat Shahjlal International Airport, Dhaka) and will start the process to implement RNAV 2 in the terminal routes (outside 30NM) and RNP SIDs & STARs within terminal area of Hazrat Shahjalal International Airport, Dhaka. Implementation of RNAV 2 and SIDs & STARs will be completed within mid-term.

10.4 MEDIUM TERM (2013-2015):

10.4.1 Route (Oceanic/remote continental & national):

After successful implementation of near term plan, CAAB plans to implement RNP-4 navigation specifications to those RNAV-10 remote continental & oceanic routes and RNAV 5 to some Continental/National routes. Process will be started to implement RNAV 2 operation to some continental/National routes.

10.4.2 Terminal area & Approach:

RNP approach of required specification will be implemented in other two International Airports and SID's & STAR's will be established in three international airports. Terminal areas will come under RNAV 2 operation, while process for RNP 1 operation will be started.

10.5 LONG TERM (2015-2018):

10.5.1 Route:

After successful implementation of medium term plan and after proper assessment of necessity & demand, CAAB plans to implement complete RNAV 2 operation in all continental & national routes with required specification in all ATS. New PBN routes may also be established to resolve airspace congestions and expeditious flow of traffic.

10.5.2 Terminal area & Approach:

Terminal areas will come under RNP 1 operation and RNP approaches will be established in all domestic airports. APV (Baro VNAV, GBAS etc.) will be incorporated with the RNP approaches in at three international airports and if necessary RNP AR approaches will be established at International airports.

11. NAVIGATION INFRASTRUCTURE PLANNING

11.1 Transition plan:

The PBN operations will rely primarily on the global satellite navigation system (GNSS), but some ground-based navigational aids shall be retained throughout the whole transition time frame for system robustness. Operations based on such ground-based navigational aids will coexist with PBN operations and provide backup in the event that satellite navigation should for any reason be unavailable. To ensure smooth transition to PBN, the CAAB considers taking the following safety principles in implementation.

11.1.1 During the coexistence period, sufficient conventional navigations systems will be retained to provide services for aircraft without PBN equipage. But CAAB will segregate traffic according to the navigation capability of the aircraft and grant preferred route access to aircraft with PBN capability, while the requirements of the State aircrafts will also be taken into consideration;

11.1.2 Before removal of the existing ground facilities, the operators will be given enough transition time to update the equipage. The operators and other airspace users are encouraged to install PBN avionics to become PBN-capable;

11.1.3 The CAAB will conduct safety assessment and periodic safety inspections and make emergency plans to ensure continuous operational safety;

11.1.4 Harmonized 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;

11.1.5 CAAB shall enhance trainings to controllers and have control plans and safety measures in place for blended operation environment to ensure safe separation;

11.1.6 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 domestic and foreign air carriers shall be actively conducted;

11.1.7 The CAAB will start to mandate PBN operations firstly at an airport on test basis then to an airport with operational benefits;

11.1.8 The CAAB will actively coordinate with the surrounding countries and regions to ensure uniform separation standards and procedures at all the flight information regions where the main traffic flows fly through.

12. GNSS NAVIGATION AIDS

12.1 GNSS will be the primary navigation system for all RNP specifications in oceanic/remote, terminal area and approach procedures.

12.2 GNSS will be the auxiliary navigation system for all RNAV operations in the continental route and terminal area and will evolve into the primary navigation system in the long term phase.

12.3 GBAS will be established gradually in all three international airports, and if possible SBAS in Hazrat Shahjalal International Airport.

12.4 ADS-B will be established within medium term phase as an alternative to the RADAR for surveillance.

13. FUTURE SURVEILLANCE TECHNOLOGIES

13.1 At present, in the conventional ATC system, controllers use secondary surveillance radar (SSR) to verify whether the actions of flight crew are consistent with the voice instructions of controller. But the availability of the image in this type of ground based radar system is a function of distance & height/altitude of the target from the radar antenna. As the distance of the target increases, the height/altitude needs to be increased for constructing the radar image. Also, it is an error-prone method featuring complex management and limited information volume. It has high construction & maintenance costs.

13.2 Automatic dependent surveillance (ADS) technology, including ADS-B and ADS-A/C, is an easier way with much less construction costs compared with SSR and the position data/image of the target is independent of height/altitude & distance. The CAAB plans to gradually expand the use of ADS-B in the oceanic airspace, remote continental airspace, and airspace without radar coverage during the near term and medium term of PBN implementation, and will transition to the surveillance technologies primarily based on ADS-B in the long term.

14. PRE AND POST SAFETY ASSESSMENT

14.1 Before implementing PBN:

A safety assessment will be carried out in respect of the proposed PBN airspace reorganizations, introduction of new RNP Approach Procedures, SIDs, STARs and for significant changes in the provision of ATS procedures, such as:

a) separation minima to be applied within PBN airspace;

b) operating procedure, including, RNP SIDs & STARs to be established;

c) reorganization of the ATS route structure;

d) implementation of new communications, surveillance or other safety systems and equipment which will provide new functionality and/or capabilities.

14.2 Factors to be considered in pre-safety assessment

The safety assessment shall consider all relevant factors of significant safety, including:

a) types of aircraft and their performance characteristics, including aircraft navigation capabilities and navigation performance;

b) traffic density and distribution;

c) airspace complexity, ATS route structure and classification of the airspace;

d) aerodrome layout, including runway configurations, runway lengths and taxiway configurations;

e) type of air-ground communications and time parameters for communication dialogues, including controller intervention capability;

f) type and capabilities of surveillance system, and the availability of systems providing controller support and alert functions;

g) Where ADS-B implementation envisages reliance upon a common source for surveillance and/or navigation, the safety assessment shall take account of adequate contingency measures to mitigate the risk of either degradation or loss of this common source (i.e. common mode failure); and

h) any significant local or regional weather phenomena, that may effect the PBN operation;

i) ATS operations manuals, ATS unit instructions and air traffic control (ATC) coordination procedures are complete, concise and up-to-date for PBN operation.

j) the ATS route structure, where applicable, provides for:

i) adequate route spacing; and

ii) crossing points for ATS routes located so as to reduce the need for controller intervention and for inter and intra-unit coordination;

iii) Lateral or Longitudinal separation applied between aircraft are not less than the ICAO standard prescribed for RNAV & RNP operation in the airspace concerned.

k) appropriate procedures for low visibility aerodrome operations are in place;

l) controller workloads do not exceed safe levels and that procedures are in place for regulating traffic volumes whenever necessary;

m) procedures to be applied in the event of failures or degradations of GNSS, including communications, navigation and surveillance systems, are practicable and will provide for an acceptable level of safety.

14.3 Factors to be considered in post safety assessment:

The post safety assessment shall consider the following factors:

a) procedures for the formal reporting of ATS incidents in PBN airspace/operation and other safety-related occurrences are implemented;

b) the reporting of incidents is encouraged;

c) controller competency is maintained by adequate and appropriate refresher training, including the handling of aircraft emergencies in PBN operation and operations under conditions with failed and degraded facilities and systems;

d) controllers, where the ATC unit/control sector is staffed by teams, are provided relevant and adequate training in order to ensure efficient teamwork;

e) the implementation of new or amended procedures, and new or updated communications, surveillance and other safety significant systems and equipment is preceded by appropriate training and instruction;

f) controller competency in the English language is satisfactory in relation to providing ATS to international air traffic; and

g) standard phraseology is used.

h) other relevant issues.

14.4 Post safety assessment data:

To evaluate impact of the implemented PBN operation (RNP approach, SIDs, STARs etc.) the PBN implementation committee will collect relevant operational data on a regular basis at their own to monitor the safety issues. However, the formal incident reporting system for ATS personnel on actual or potential safety hazards, deficiencies, air traffic incidents related to:

a) the provision of ATS for PBN operation including RNAV/RNP routes, RNP approaches, departure and arrival procedures;

b) communications, navigation and surveillance systems and other safety significant systems and equipment;

c) controller workloads;

d) any other factors that may endanger the operation;

shall be the main source of post safety assessment.

14.5 Review of data/incident and mitigation measures;

14.5.1 All the operational data and reports collected from various sources (ATS units/personnel, Pilot, Airlines etc) units shall be systematically reviewed/evaluated by a team of personnel qualified through training, experience and expertise and having a full understanding of relevant Standards and Recommended Practices (SARPs), Procedures for Air Navigation Services (PANS), safe operating practices and Human Factors principles.

14.5.2 The team will detect any adverse trend in the number and types of incidents which occur and will classify the incidents.

14.5.3 Except when the risk can be classified as acceptable, the assessment team shall, as a matter of priority and as far as practicable, implement or advice appropriate ATS authority to implement appropriate measures to eliminate the risk or reduce the risk to a level that is acceptable.

14.5.4 If it becomes apparent that the level of safety applicable to an airspace or an aerodrome is not, or may not be achieved, the appropriate ATS authority shall, as a matter of priority and as far as practicable, implement appropriate remedial measures.

14.5.5 Implementation of any remedial measure shall be followed by an evaluation of the effectiveness of the measure in eliminating or mitigating a risk.

15. BENEFITS OF PBN IN BANGLADESH

15.1 From the implementation of PBN, Bangladesh will be benefited in various ways, some important benefits of PBN are;

i) it will reduce the need to add new ground based navigation aids;
ii) it will minimize associated maintenance cost for ground based navigational aids, and routes and procedures based on existing ground navigation aids;
iii) the number of instrument approach procedure will be reduced;
iv) dependency of a number of instrument approach procedures or routes on a single ground based navigation or landing aids will be reduced.
v) less dependency of the segments of an instrument approach procedures on a single ground based navigation aids.
vi) enable implementation of instrument approaches, SIDs & STARs with shortest flying distances;
vii) it will reduce dependency on weather or terrain,
viii) it provides same navigation signal accuracy everywhere;
ix) more precise flying path can be designed;
x) spacing between routes and procedures can be reduced, thus more routes can be accommodated within a defined airspace;
xi) more traffic can be accommodated safely;
xi) fuel consumption of the aircraft will be reduced;
xii) reduce carbon emission thus improving environmental pollution;
xiii) reducing controller and pilot workload;
xiv) less radar vectoring;
xv) will enable continuous descent;
xvi) easy management for noise abatement;
xvii) flexibility in operation;
xviii) reducing delay,
xix) optimum use of airspace;
xx) more flexible, efficient and accurate flying environment; etc.

16. REVISION OF PBN ROADMAP

This document is the revised version of first PBN Roadmap version V-1/4.11 of CAAB, and updated/corrected version will be published time to time as and when necessary. The CAAB welcomes questions and comments related to the PBN Roadmap.