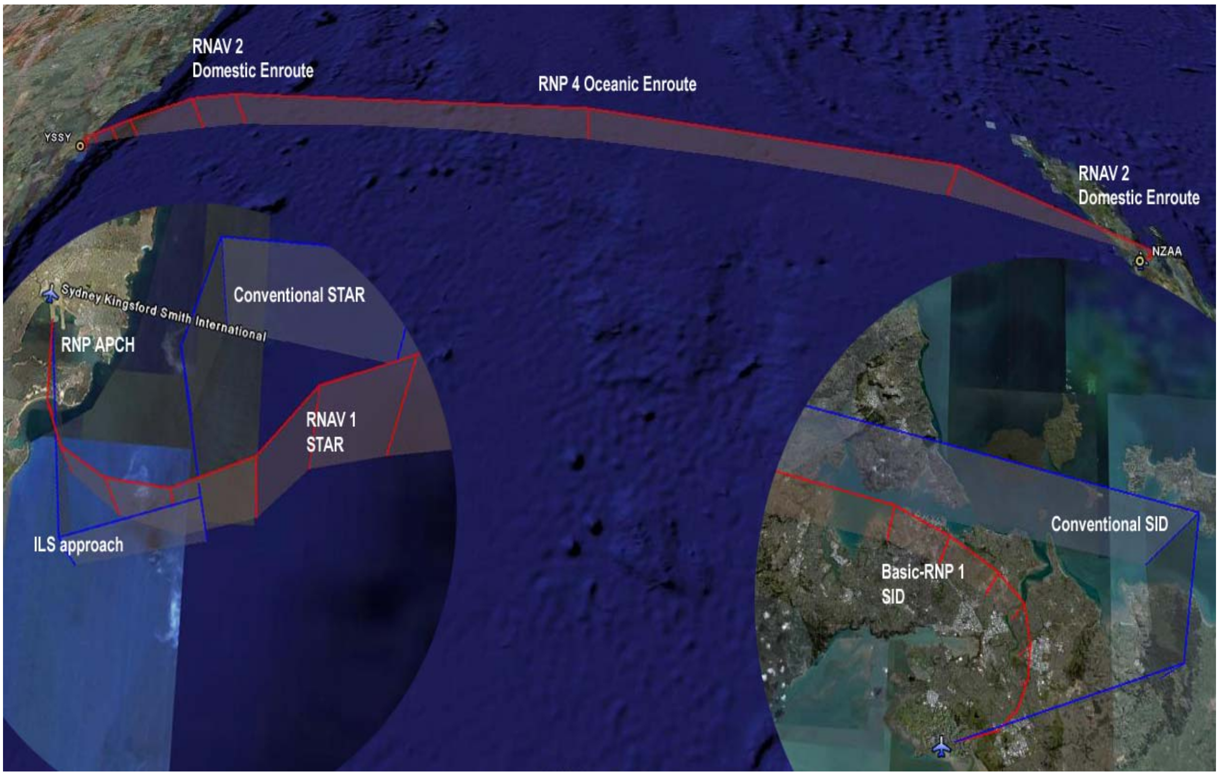
PBN Implementation Plan – New Zealand



Version 1 **16 December 2009**

Table of Contents

Acronyms

The following is a list of acronyms used in this document:

4DT	Four Dimensional Trajectory
ADS-B	Automatic Dependent Surveillance - Broadcast
ADS-C	Automatic Dependent Surveillance - Contract
ANSP	Air Navigation Service Provider
APCH	Approach
APV	Approach Procedures with Vertical Guidance
ATC	Air Traffic Control
ATM	Air Traffic Management
ATS	Air Traffic Service
AWS	Automated Weather Station
Baro-VNAV	Barometric Vertical Navigation
CAA	Civil Aviation Authority
CAR	Civil Aviation Rules
CDO	Continuous Descent Operations
CFIT	Controlled Flight into Terrain
CNS/ATM	Communication Navigation Surveillance/Air Traffic Management
CPDLC	Controller Pilot Data Link Communications
CTA	Controlled Airspace
DME	Distance Measuring Equipment
ETS	Emissions Trading Scheme
FANS	Future Air Navigation System
FMS	Flight Management System
GHG	Greenhouse Gas
GNSS	Global Navigation Satellite System
ICAO	International Civil Aviation Organisation
IFR	Instrument Flight Rules
ILS	Instrument Landing System
INS	Inertial Navigation System
IRU	Inertial Reference Unit
MOT	Ministry of Transport
MSSR	Mono-pulse Secondary Surveillance Radar
NDB	Non Directional Beacon
NZDF	New Zealand Defence Force
OCA	Oceanic Control Area
PBN	Performance Based Navigation
PSR	Primary Surveillance Radar
RAIM	Receiver Autonomous Integrity Monitoring
RCP	Required Communication Performance
RSP	Required Surveillance Performance

RNAV	Area Navigation
RNP	Required Navigation Performance
RNP AR	Required Navigation Performance Authorisation Required
SID	Standard Instrument Departure
STAR	Standard Instrument Arrival
TMA	Terminal CTA
VOR	VHF Omni-directional Radio-range
WAM	Wide Area Multilateration

Executive Summary

The implementation of Performance Based Navigation (PBN) in New Zealand controlled airspace will be delivered in three major phases with target implementation dates of 2012, 2017 and 2020.

Each phase will enable progressively greater dependence on PBN (concepts and enablers) and ensure that the corresponding improvements to safety, efficiency and environmental impact are delivered to industry stakeholders.

The implementation of PBN in New Zealand controlled airspace will require the allocation of significant resources by each of the key industry stakeholders and the Civil Aviation Authority (CAA). This investment is considered essential to securing the benefits for New Zealand at the earliest opportunity. The benefits include:

- Safety improvements through greater adherence to a safe flight trajectory (e.g. use of Continuous Descent Operations (CDO) which is a key component of the ICAO strategy to address Controlled Flight into Terrain (CFIT) accidents).
- Efficiency improvements through changes to air route and approach procedure designs that minimise the air miles flown and enhance schedule reliability, provide greater conformance to the flight plan and reduce enroute traffic delays, which will collectively reduce total operating costs and improve on-time performance.
- Improved environmental performance through greater use of uninterrupted climb and descent trajectories which ensure that both Green House Gas (GHG) emissions and the noise footprint for aviation are minimised.

The key roles for stakeholders are:

CAA / MOT – Ensure that the relevant Safety Cases, CAA processes, Civil Aviation Rules and guidance material enable a safe and efficient PBN environment that aligns with both international and regional standards.

Aircraft Operators – Ensure that investment in aircraft fleet capability is aligned with both the performance specifications outlined in this plan and the timeframe associated with each phase.

Airways NZ – Ensure that the national infrastructure (CNS/ ATM capability) will support the airspace concepts and the performance specifications associated with each phase of PBN implementation.

Aerodrome Operators – Ensure the supporting aerodrome infrastructure for PBN operations is coordinated with aircraft operators and Airways NZ.

All Stakeholders ensure that sufficient trained and qualified personnel are available to support the implementation of PBN.

Introduction

ICAO Assembly Resolution A36-23 urged each member State to develop a national PBN implementation plan by the end of 2009, and for these plans to include 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. In New Zealand, implementation of RNAV, RNP and APV procedures is now well advanced. The Ministry of Transport and Civil Aviation Authority, together with Airways NZ and with the support from principle aviation industry stakeholders and interest groups have agreed that a State PBN Implementation Plan is needed to ensure that all sections of the industry are consulted and engaged appropriately in the change process.

The PBN Implementation Plan for New Zealand meets the intent of ICAO Assembly Resolution A36-23 and addresses the particular needs of the New Zealand aviation environment. The draft plan outlines how the ICAO PBN concept will be implemented in New Zealand to deliver improvements to: aviation safety, airspace access, capacity, predictability, operational efficiency and to minimise adverse environmental impacts from aviation activity. This plan is not binding and will be subject to change as PBN developments and user requirements evolve.

> *Other State PBN Implementation Plans or "Roadmaps" can be viewed on the PBN web site (www.icao.int/pbn), Documentation link.*

Both the ICAO Global and Regional PBN implementation plans provide a framework for the development of a National PBN Implementation Plan to enable a coordinated and cohesive global implementation programme for the aviation industry. This plan will enable the use of RNAV and RNP capabilities that will, when harmonised with ATM systems, deliver more efficient routes and predictability of service for the air transport industry, together with greater access to limited airspace resources for general and sport aviation. A PBN environment will deliver significant safety, economic and environmental benefits to all stakeholders. This is especially important as New Zealand and the rest of the world faces challenges from difficult economic conditions, volatile aviation fuel prices and climate changes driven by global warming.

The strategic objectives of the New Zealand PBN Implementation Plan are to:

1. Provide a high-level strategy for the evolution of navigation applications to be implemented within New Zealand airspace in the short term (prior to December 2012), medium term (2013-2017) and long term (beyond 2018) in accordance with the implementation goals of Assembly resolution A36-23;

2. Implement a strategy based on the concepts of PBN (includes RNAV and RNP specifications), that will be applied to IFR aircraft operations using instrument approaches, and ATS routes (including SIDs and STARs) in both oceanic and domestic airspace;

3. Ensure that the implementation of the navigation portion of the CNS/ATM system is based on clearly established operational requirements;

4. Ensure that navigation, surveillance, communications and ATM infrastructure is capable of supporting the operational airspace concept and the associated operational applications;

5. Establish equipment requirements that minimise the number of equipment types required on board aircraft and on the ground;

6. Establish common airworthiness and operational approvals for flight operations utilising PBN;

7. Provide a means of accommodating mixed-equipage operations; and

8. Recommend strategies to facilitate delivery of benefits and encourage equipage.

The New Zealand PBN Implementation Plan has been developed in consultation with the stakeholders of the aviation community and provides for a staged transition to RNAV and RNP based procedures. The following stakeholders have been consulted during the development of the National PBN Implementation Plan:

(a) Airspace operators and users (including NZDF)

(b) Airways New Zealand (air navigation services provider)

(c) NZCAA and Regulating Authorities from adjacent ICAO States

(d) National and international organizations

Refer to Appendix A for a list of aviation industry organisations consulted during the development of the Draft PBN Implementation Plan.

The PBN Implementation Plan will enable stakeholders of the aviation community to plan for regulatory changes, industry training, operational transitions and the associated investment strategies.

The following principles were applied in the development of the PBN Implementation Plan:

(a) Continued availability of essential conventional air navigation procedures during the transition period, to ensure appropriate technology and procedures design support for users that are not RNAV and/or RNP compliant;

(b) Development of airspace concepts and use of airspace modelling tools that enable real-time and accelerated simulations that identify the navigation applications that best support PBN implementation in specific airspace;

(c) Conduct of cost-benefit analyses to justify the implementation of the RNAV and/or RNP concepts;

(d) Conduct of pre- and post-implementation safety assessments to ensure the application and maintenance of the established target levels of safety.

(e) Harmonisation with the ICAO Asia/Pacific Regional PBN Implementation Plan.

An issues register has been developed and updated covering a range of issues to be addressed. This register will be used to identify work areas, resource requirements and organisations responsible for actions. A work plan will then be developed with identified working groups, including technical representatives, to address these issues to ensure the PBN Implementation Plan is progressed.

Information on PBN developments and implementation work will be provided on the CAA website at http://www.caa.govt.nz/PBN/pbn.htm

The PBN Implementation Plan

1. Background

Ground based navigation aids (Navaids) have been the basis of IFR navigation for aircraft since the Second World War. New Zealand has relied upon a network of ground based navigation aids (NDB, VOR/DME and ILS), which aircraft use to navigate along fixed routes (route navigation) and to conduct instrument approach procedures to land aerodromes.

Ground based navigation systems limit the safety and efficiency of aircraft operations because of their inherent characteristics e.g. with the exception of ILS, they do not support approaches with vertical guidance. Ground navaids are constrained by the location, accuracy, terrain and other performance limitations associated with the aid.

To overcome the constraints of route navigation new navigation specifications have been developed to provide performance specifications firstly through RNAV specifications and more recently Required Navigation Performance (RNP). These are based on new navigation technologies including Global Navigation Satellite System (GNSS) and onboard aircraft systems. Area navigation allows an aircraft to fly any pre-defined path with high accuracy. The flight path is usually defined as a straight line between two points in space but some systems also have the capability to accurately fly curved paths. Area navigation systems generally have linear lateral performance requirements and they are recognised as necessary enablers to optimise aircraft operations, increase terminal area safety and provide flexibility in placement of aircraft flight path to minimise aircraft noise intrusion on the community. The key difference between the RNAV and RNP specifications is the onboard monitoring and alerting function that is associated with RNP.

The PBN concept represents a major shift from sensor-based to performance-based navigation.

The significant improvements in navigational performance provided by RNP and four dimensional trajectory (4DT - includes time dimension) will also be utilised by modern ATM systems to improve the sequencing of IFR Flights. Any sequencing delays that are needed in the future will be managed in a more strategic manner so that excess fuel burn can be minimised. This will deliver reduced operating costs to aircraft operators and improved environmental outcomes to both the local and global community.

2. Area Navigation (RNAV)

2.1 Capabilities

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 (eg: 3D, 4D ATM concepts).

2.1.1 The RNAV Specifications are:

(a) RNAV 10: intended for use in Oceanic airspace (referred to as RNP 10. Explanation of this usage is provided in the ICAO PBN Manual Vol.1 para. 1.2.5.5)

(b) RNAV 5 (no plan to use this specification in NZ airspace)

(c) RNAV 2: intended for use in Domestic Enroute airspace

(d) RNAV 1: intended for use in Domestic Terminal airspace

RNAV specifications do not require on board navigation performance monitoring and alerting. RNAV tracks (e.g.: RNAV 5, RNAV 2, RNAV 1) will normally require monitoring by ATC surveillance systems to achieve desired performance and separation safety standards. This requirement implies near universal surveillance coverage for RNAV specifications. In oceanic airspace this surveillance is provided by ADS-C and in domestic airspace by a network of radar systems (PSR & MSSR). The surveillance of domestic airspace will also include WAM (Wide Area Multilateration) and ADS-B when these systems are approved and operational.

3. Required Navigation Performance (RNP)

3.1 Capabilities

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

3.1.1 The RNP Specifications are:

(a) RNP 4: intended for use in oceanic operations (supports 30/30 separation)

(b) RNP 2: intended for use in continental en-route operations

(c) RNP 1: intended for use in terminal area operations

(d) RNP APCH

(e) RNP AR APCH

3.1.2 The RNP Approach Applications for New Zealand are:

(a) RNAV (GNSS) approach; which represents the application of RNP APCH navigation specification. This application can include APV where required and operationally feasible.

(b) RNAV (RNP) approach; which represents the application of RNP AR navigation specification. Barometric VNAV is an integral part of this application.

Both of these applications require the use of GNSS for navigation.

3.1.3 Responsibility for Navigation Performance Monitoring

RNP specifications require on board navigation performance monitoring and alerting. This assured aircraft performance allows lower separation standards to be applied and therefore ATC surveillance is not required.

Some of the RNP navigation specifications enable the application of more sophisticated functions available in RNP capable aircraft to further improve safety, reduce environmental impact and increase operating efficiency (e.g.: RNP AR APCH).

4. Current Status of RNAV & RNP Operations in New Zealand

4.1 Published Procedures

RNAV and RNP procedures have been implemented within NZ airspace at selected airports and on selected routes based on performance specifications that align with those in the PBN Manual.

(a) RNP 10 (RNAV 10) and RNP 4 in Oceanic Airspace

(b) RNAV SIDs and STARs at Auckland, Wellington and Christchurch

(c) RNAV(GNSS) approach procedures at 57 locations.

(d) RNAV (GNSS) Arrival and departure procedures at selected regional aerodromes (Basic RNP 1 application).

(e) APV for 16 runway ends based on Baro-VNAV criteria.

(f) RNP AR APCH at Queenstown.

4.2 Aircraft Fleet Equipage

As at December 1 2009 there are approximately 270 aircraft with PBN capability on the NZ Aircraft Register. This is a significant proportion of the IFR capable fleet. However there is a diverse range of navigational capabilities of the aircraft operating in NZ airspace. The following table indicates the estimated state of PBN technical capability of major scheduled carriers in NZ as of December 2009:

Figure 1 – Current Estimated Airline Fleet PBN Capability

Aircraft Type	RNAV 2/ 1	RNP APCH Basic RNP 1	RNP AR APCH	APV (Baro-VNAV)
A320	100%	100%	100%	100%
B733	100%	40%	40%	40%
B734	100%	100%	100%	100%
B738	100%	100%	100%	100%
B744	100%	100%	0	100%
B763	100%	0	0	0
B772	100%	100%	100%	100%
ATR72	100%	100%	0	0
DH8-Q300	100%	100%	0	100%
B1900D	100%	100%	0	0
GIV	100%	100%	100%	0%
G200	100%	100%	100%	0%
WW24	100%	0%	0%	0%
BAe146	100%	0%	0%	0%
BAeJ32	100%	100%	0%	0%

5. Airspace Concept

An airspace concept may be viewed as a general vision or a master plan for a particular airspace. Each airspace concept is based on an agreed set of principles that support the achievement of specific objectives. The strategic objectives which most commonly drive airspace concepts are safety, capacity, efficiency, access and the environment.

5.1 Key Airspace Concepts

The agreed concepts for New Zealand will be implemented through a three-phase process that will deliver incremental improvements to:

- Safety improvements (through more precise trajectory management & CDO that support the ICAO strategy to address CFIT accidents)
- Predictability and repeatability
- Efficiency (min air distance / optimum aircraft determined profile)
- Minimising environmental impact (eg from carbon dioxide, oxides of nitrogen and noise)
- Maximising capacity utilisation (aerodrome & airspace)
- Higher aircraft utilisation (sectors flown per day)
- Schedule reliability
- Cost effective investment
- Minimised quantity of CTA and optimised design

All ATS routes (including SIDs and STARs) will be enabled by RNAV (or RNP, where required):

All runway ends with instrument approach procedures will be enabled by RNP (with APV where possible based on Baro-VNAV).

5.2 Operational Concept for Phase One

During Phase One the operational concept will be a mixed-mode navigation environment that allows continued use of legacy navigation applications while PBN capability is progressively implemented in aircraft fleets and the supporting infrastructure. The benefits to operators will be limited by the diversity of navigation performance and the ATM system's ability to manage this diversity. The ground infrastructure associated with legacy navigation systems will be reviewed and progressively adapted to reflect the progress made on implementation of PBN. General aviation VFR flight access to CTA will not be subject to any additional restrictions during this phase.

5.3 Operational Concept for Phase Two

During Phase Two the operational concept will move to a more exclusive PBN environment that places greater reliance on the level of PBN capability in the national fleet and infrastructure. This change will enable further realisation of the goals outlined in para 5.1. The ATM system will be managing a more homogeneous navigation capability and have greater ability to minimise the negative impact of aircraft that lack required navigation performance capability. General aviation VFR flight access to CTA may be restricted during periods of capacity constraint but only to the extent needed to ensure that the flight paths of PBN capable flights are not restricted.

5.4 Operational Concept for Phase Three

During Phase Three the operational concept will be a mature PBN environment with a comprehensive fleet and infrastructure capability that delivers the fullest expression of the airspace concept and goals outlined in para 5.1. A mature set of ATM tools will complement the airborne systems and will also enable the effective management of those aircraft that may experience a temporary loss of PBN capability without significantly impacting other airspace users. General aviation VFR flight access to CTA may be restricted during periods of capacity constraint but only to the extent needed to ensure that the flight paths of PBN capable flights are not restricted.

6. Challenges

6.1 Safety – Risks Associated with Major System Change

During the transition to a mature PBN environment the government and industry will face significant challenges. The government challenges will include support of Civil Aviation Rule changes and associated preparatory work. The industry challenges will involve resourcing and managing a diverse range of navigation systems with equally diverse requirements. Some of the key identified challenges are:

- Adoption of supporting Civil Aviation Rules
- PBN capability register and aircraft minimum equipment lists (MEL)
- Integration of PBN capability into the ATM system (Flight Plan data fields)
- Mixed fleet/system operations
- Safety monitoring of ATM system
- Approach naming and charting conventions
- Navigation database integrity and control
- GNSS system performance and prediction of availability service
- Continued involvement in CNS/ATM and PBN development
- Resources of the CAA, Airways and industry to implement PBN
- Education and training of personnel employed by the CAA, Airways and aircraft operators

6.2 Environment

Environmental challenges include minimising the impact of noise and emissions on both the communities in the proximity of aerodromes and the global environment. PBN will support the achievement of these goals while preserving aviation safety and efficiencies in the ATM system, but a collaborative approach will be essential to deliver all these objectives. The introduction of New Zealand's emission trading scheme (ETS) provides aircraft operators flying domestic routes with a commercial incentive to upgrade their fleet, including PBN capability. With the introduction of regional or global emissions trading schemes for aviation, this commercial incentive could significantly increase and extend to international aircraft operators flying to and from New Zealand.

Environmental challenges therefore include:

(a) Political developments/considerations

- Increased ATM system capacity due to PBN efficiency gains
- Emission control/management, including demonstrated efficiencies associated with PBN operations
- Noise control/management

(b) Technological developments

- Tension between noise outcomes and emissions reduction outcomes

6.3 Infrastructure Development

Design and implementation of RNAV routes and procedures is well advanced. Certificated Part 173 Procedure Design organisations have a significant workload in turning the design work into published documents. The following issues need to be addressed by CAA, Airways and the aviation industry:

(a) Terrestrial navaids

- Maintenance and upgrade of existing terrestrial navigation aid infrastructure
- Transition to GNSS based system
- Decommissioning of existing aids

(b) GNSS/RAIM prediction requirements including

- Overall GNSS status monitoring, reporting and recording
- Prediction of availability for a particular operation and aircraft

(c) Automatic Weather Station (AWS) for APV Baro-VNAV

- Implementation will require coordination between CAA, NZ Met Service, Airways NZ and aerodrome operators
- Responsibilities for funding of these initiatives will need to be determined

(d) Approach design

(e) Runway infrastructure

- Aerodrome obstacle survey
- Aerodrome lighting (approach and surface)

(f) Use of GNSS

- Use of GNSS within NZ airspace is subject to the requirements of NZ CAR Part 19. The current Rule does not account for improvements to GNSS performance that have evolved over the last fifteen years and does not allow "Sole Use" navigation for domestic IFR flights. The limitations of the current Rule need to be removed to enable greater use of GNSS to support RNAV, RNP and new surveillance technologies.
- A formal Safety Case will need to be developed to determine whether the performance of GNSS within NZ airspace is adequate to support the planned increase in reliance on this technology by the aviation industry.

(g) DME/DME updating

- RNAV 1 and 2 specifications require infrastructure support from either GNSS or DME/DME updating capability. The capability of the existing DME network to support DME/DME updating needs to be verified to ensure it will be adequate for planned future use in both en-route and terminal airspace.

7. Operational Efficiency Benefits

(a) Efficiency gains enabled through PBN include:

- Reduced separation standards for air traffic routes in oceanic and some portions of domestic en-route airspace
- Greater flexibility of airspace design in terminal area airspace
- Reduced track distance, noise and fuel consumption through PBN enabled ATS routes and approach procedures
- Reduced environmental impact.

(b) The synchronised integration of PBN and non-PBN air routes, airspace and aircraft will be vital if these efficiency gains are to be fully realised.

8. Approaches with Vertical Guidance

PBN approaches with vertical guidance in NZ will be based on Baro-VNAV specifications for the foreseeable future. The development of a GNSS enabled precision approach application will be monitored closely but early adoption is considered unlikely due to interoperability issues and the lack of suitable GNSS augmentation systems within New Zealand's airspace.

The Airways Aeronautical Design and Development Unit has an implementation schedule for En-route, Terminal and Approach procedures in New Zealand detailed in Appendix B.

9. Implementation

9.1 Short Term (NZ Implementation Target December 2012)

The ICAO time frame for short term implementation is 2008 – 2013.

9.1.1 En-route

Oceanic – Retain RNP 10 (RNAV 10) and RNP 4 with existing communications and surveillance requirements (CPDLC and ADS-C where necessary to support application of 30/30 separation standards).

As at December 2009, approximately 30% of current New Zealand oceanic airspace users are FANS 1A capable and therefore able to benefit from the 30/30 separation standard: traffic forecasts do not indicate capacity will be constrained with current standards.

Domestic – Specify RNAV 2 for all promulgated routes above flight level 145 or 245 in domestic CTA, subject to infrastructure capability.

Surveillance will be provided by the existing Mode–S capable MSSR network, supplemented by ADS-B and WAM systems when these are commissioned, integrated with the ATM system and certified for use.

Communications provided by VHF network.

ATM system capability as available in 2009.

9.1.2 Terminal Areas (Departures and Arrivals)

Specify RNAV 1 for all terminal routes with surveillance services and **Basic RNP 1** for routes without surveillance services.

Where a surveillance service is available, it will be provided by the existing PSR/Mode–S capable MSSR network, supplemented by ADS-B and WAM systems when commissioned, integrated with the ATM system and certified for use.

Communications provided by VHF network.

ATM system capability as available in 2009.

9.1.3 Approach Procedures

Facilitate a mix of ground based approaches, RNP APCH (RNAV GNSS) including Baro-VNAV enabled Approach with Vertical Guidance, where possible and RNP AR APCH.

Where a surveillance service is available, it will be provided by existing PSR/Mode–S capable MSSR network or ADS-B and Wide Area Multilateration systems when these are commissioned, integrated with ATM system and certified for use.

Communications provided by VHF network.

ATM system capability as available in 2009.

9.1.4 Helicopter Operations

No change to existing procedures but will be implemented as required.

9.2 Medium term (NZ Implementation Target 2017)

The ICAO time frame for the medium term is 2013 – 2018.

9.2.1 En-route

Oceanic – RNP 10 (RNAV 10) & RNP 4 (with CPDLC & ADS-C) in OCA CTA. There are no operational drivers to change navigation performance requirements from those used in phase one.

Domestic – RNAV 2 (Exclusive airspace above FL145). Surveillance will be provided by the existing Mode-S capable MSSR network or ADS-B and WAM systems.

Communications provided by VHF network.

ATM system capability as available in 2009.

9.2.2 Terminal Areas (Departures and Arrivals)

Terminal CTA – RNAV 1 & Basic RNP 1 (Exclusive airspace). Where a surveillance service is available, it will be provided by the existing PSR/Mode–S capable MSSR network or by ADS-B and WAM systems when these are commissioned, integrated with ATM system and certified for use.

Communications provided by VHF network.

ATM system capability will be enhanced with:

a) An improved version of the Collaborative Arrival Manager (CAM) and;

b) New ATC tools designed to improve sequencing of arrivals and departures and;

c) Improved ATM system trajectory modelling.

9.2.3 Approach Procedures

Approach Procedures – RNP APCH (RNAV GNSS) with APV where possible & RNP AR APCH.

Where a surveillance service is available, it will be provided by the existing PSR/Mode–S capable MSSR network or ADS-B and WAM systems when these are commissioned, integrated with ATM system and certified for use.

During this phase transition away from dependency on ground based approaches with the exception of ILS at major international airports and those ground based approaches that are considered essential for contingency purposes.

Communications provided by VHF network.

9.2.4 Helicopter operations

As per the medium term for aircraft operations listed above but further approach design criteria changes are expected from ICAO over the period 2010 – 2011. These will be incorporated as considered appropriate.

9.3 Long term (NZ Implementation Target 2020)

The ICAO time frame for the medium term is 2018 – 2022)

9.3.1 En-route

Oceanic – RNP 10 (RNAV 10) & RNP 4 (with CPDLC & ADS-C) in OCA CTA. There are no operational drivers to change navigation performance requirements from those used in phase one / two.

Domestic – RNAV 1 / RNP 1 exclusive airspace above FL145. Retain a minimal contingency infrastructure using terrestrial navigation systems (a VOR/DME network).

Surveillance provided by ADS-B with limited WAM contingency for the core of the main trunk network.

Communications provided by VHF network and possibly CPDLC.

9.3.2 Terminal Areas (Departures and Arrivals)

Terminal CTA – RNP 1 exclusive airspace (& Advanced RNP 1 limited to locations with specific operational requirements).

Retain minimal contingency infrastructure using terrestrial navigation systems (VOR/DME network).

Surveillance provided by ADS-B with limited WAM contingency for core of main trunk network.

Communications provided by VHF network and possibly CPDLC.

9.3.3 Approach Procedures

Approach Procedures - RNP APCH (RNAV GNSS) with APV where possible & RNP AR APCH. The standard approach procedure will be GNSS based.

Consider location specific application of GNSS based precision approach where operational requirement and business case justifies this application.

Retain ILS at major international airports and those ground based approaches considered essential for contingency purposes.

Surveillance provided by ADS-B with limited WAM contingency for key airports in the network.

Communications provided by VHF network and possibly CPDLC.

9.3.4 Helicopter Operations

As per Long Term for aircraft operations listed above but with some special helicopter requirements.

10. Technology Recommendations

Aircraft equipment and ATM requirements will change as PBN is implemented with new technology needing to be utilised in the aviation system. These include the following which will be reviewed by the PBN technical groups to set specific timeframes and requirements.

10.1 GNSS Equipment

These requirements will be determined based on new equipment availability and industry developments. There will be a transition from single GPS to multi-constellation GNSS equipment.

This may include requirement for TSO C145/146 from 2018.

10.2 ATC Transponder

Possibly by 2012 the Transponder requirements will need to become Mode-S Elementary (minimum) and Mode-S Enhanced (recommended). Additionally ADS-B using Modes-S 1090Mhz extended squitter (DO260A or later) will be implemented toward the final phase in 2018.

Appendices

Appendix A – List of NZ organisations consulted and representative details

Organisation	Title
Air New Zealand	PBN Program Manager
Jetstar	Aerodromes and Airways Manager
Pacific Blue	Line Captain
Airways NZ	Mgr Strategy & Development
AIA	Chief Executive
Mount Cook Airlines	Flight Operations Manager
Air Nelson	Line Operations Manager
Eagle Air	Training & Standards Manager
NZALPA	Technical Officer
IFALPA	Executive VP - Asia Pacific
Auckland Airport	Manager Airside Operations
Gliding NZ	Executive Committee
Air National	Flight Operations
JetConnect	B738 Project Manager
RNZAC	Executive Secretary
CTC Aviation	Head of Line Operations
NZ Aviation Federation	
Sport Aircraft Assn	Vice President
RNZAF	
AOPA	Secretary & Treasurer
NZ Airports Assn	CEO
WIAL (Wellington Airport)	Airside Planning and Technical Officer
CIAL (Christchurch Airport)	Infrastructure
Airwork / Airpost	Flight Ops Manager
Aviation Community Advisory Group	Chairman
Vincent Aviation	
Sport Aviation Corp	
Recreational Aircraft Assn NZ	
Board of Airline Representatives NZ	

Appendix B – Implementation Schedule for En-route, Terminal and Approach Procedures by Aeronautical Design and Development.

Flexible
Fixed

ADD WORK PLAN

Programme:	2010 Jan-Mar	2010 Apr-Jun	2010 Jul-Sep	2010 Oct-Dec	2011 Jan-Mar	2011 Apr-Jun	2011 Jul-Sep	2011 Oct-Dec	2012 Jan-Mar	2012 Apr-Jun	2012 Jul-Sep	2012 Oct-Dec	2013 Jan-Mar	2013 Apr-Jun	2013 Jul-Sep
RNAV (GNSS)		CH, DN, WN		HK, WS			WK	Couple to Reg STAR/SID							
VNAV		CH,DN,WN	RO	GS,HK,WS,KK	WN		WB,WK				CL,KT,OU,TU,WU				
RNP AR		RO	AA		CH, WN										
RNAV STAR		AA, WN Revision		CH Revision											
RNAV SID		WN	AA Revision		CH Revision										
REGIONAL STAR/SID				QN		RO, HN, TG		NV,DN		NS,WB,NP		NR,GS		OH,PM,WP	
PBN ENROUTE				Removal of Existing low use conventional procedures				RNAV Enroute Structure 50%				RNAV Enroute Structure 100%			