new southern sky

Concept of Operations

2023

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Cover Image

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New Southern Sky Working Group

The NSSWG has produced this collaboratively prepared document. The NSSWG is made up of representatives from:

Aircraft Owners and Pilots Association

Air New Zealand

Airways Corporation New Zealand

Aviation Community Advisory Group

Aviation New Zealand

Civil Aviation Authority of New Zealand

Land Information New Zealand

MetService

Ministry for the Environment

Ministry of Transport

New Zealand Airports Association

New Zealand Aviation Federation

New Zealand Defence Force

QANTAS Group

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List of Acronyms

Acronym	Term
ACARS	Aircraft Communication Addressing and Reporting System
ACAS	Aircraft Collision Avoidance System
ACE	Airport Capacity Enhancement
ACDM	Airport Collaborative Decision Making
ADMS	Advanced Database Management System
ADS-B	Automatic Dependent Surveillance - Broadcast
ADS-C	Automatic Dependent Surveillance - Contract
AeroMACS	Aerodrome Mobile Airport Communication System
AFTN	Aeronautical Fixed Telecommunication Network
AIM	Aeronautical Information Management
AIP	Aeronautical Information Publication
AIS	Aeronautical Information Services
AIXM	Aeronautical Information Exchange Model
AMAN	Arrivals Manager
AMHS	ATS Message Handling System
ANSP	Air Navigation Service Provider
AOCC	Airline Operations Control Centre
A-PNT	Alternate Position Navigation Timing
APV	Approach Procedures with Vertical Guidance
ATC	Air Traffic Control – a sub-function of Air Traffic Service
ATM	Air Traffic Management
ATN	Aeronautical Telecommunication Network
ATS	Air Traffic Service – a sub-function of Air Traffic Management
Baro VNAV	Barometrical Vertical Navigation
BeiDou	China Global Navigation Satellite System, not yet fully operational
CAA	NZ Civil Aviation Authority.
CAM	Collaborative Arrivals Manager
CAR	Civil Aviation Rules
CASA	Civil Aviation Safety Authority (Australia)
CCO	Continuous Climb Operations
CDM	Collaborative Decision Making
CDO	Continuous Descent Operations
CFIT	Controlled Flight Into Terrain
Comms	Communications
CONOPS	Concept of Operations
CPDLC	Controller Pilot Data Link Communications
CA	Control Airspace
DCPC	Direct Controller Pilot Communication
DMAN	Departures Manager

Acronym	Term
DME	Distance Measuring Equipment
DST	Decision Support Tools
EGNOS	European Geostationary Navigation Overlay Service
FAA	Federal Aviation Administration
FANS	Future Air Navigation System
FDE	Fault Detection and Exclusion
FIR	Flight Information Region
FIS-B	Flight Information Service - Broadcast
FL	Flight Level
FMC WPR	Flight Management Computer Waypoint Position Reporting
FMS	Flight Management System
FTO	Flight Training Organisation
GA	General Aviation
Galileo	European Global Navigation Satellite System, not yet operational
GAGAN	GPS Aided Geo Augmented Navigation. India version of SBAS
GBAS	Ground Based Augmentation System
GBNA	Ground Based Navigation Aid
GLONASS	Globalnaya Navigazionnaya Sputnikovaya Sistema. Russian Global
GLS	GNSS landing System
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
HF	High Frequency
ICAO	International Civil Aviation Organisation
IFR	Instrument Flight Rules
ILS	Instrument Landing System
IRU	Inertial Reference Unit
LDACS	L-Band Data-link Aeronautical Communications System
LNAV	Lateral Navigation
LPV	Localizer Performance with Vertical Guidance
MBZ	Mandatory Broadcast Zone
MET	Meteorological
MLAT	Multilateration
MON	Minimum Operational Network
MOPS	Minimum Operating Performance Standards
MSAS	Multi-Functional Transport Satellite Augmentation System, MSAS-
Multiconstellation	Onboard receiver for satellite signals from more than just GPS
NAVAIDS	Navigation Aids
NDB	Non Directional Beacon. Ground based navigation aid
NM	Nautical Mile
NOTAM	Notice to Airmen
NPA	Non Precision Approach
NSS	New Southern Sky programme

Acronym	Term
PB	Performance Based
PBC	Performance Based Communications
PBN	Performance Based Navigation
PBN Manual	Performance Based Navigation Manual, ICAO Doc 9613 4th Edition
PBS	Performance Based Surveillance
RAIM	Receiver Autonomous Integrity Monitoring
RLP	Required Link Performance
RPT	Regular Passenger Transport
RNAV	Area Navigation
RNP	Required Navigation Performance
RNP-AR	Required Navigation Performance – Authorisation Required
RPAS	Remotely Piloted Aircraft System
RWY	Runway
SATCOM	Satellite Communication
SATVOICE	Satellite Voice Communication
SARPs	ICAO Standards and Recommended Practices
SBAS	Satellite Based Augmentation System
SDCM	System for Differential Correction and Monitoring. Russian version of
SESAR	Single European Sky ATM Research
SID	Standard Instrument Departure
SOA	Service Oriented Architecture
SOP	Standard Operational Procedure
SME	Subject Matter Expert
SMS	Safety Management System
SNAS	Satellite Navigation Augmentation System. Chinese version of SBAS
SNET	Ground Based Safety Net
SSR	Secondary Surveillance Radar
STAR	Standard Terminal Arrival Route
SUA	Special Use Airspace
SURF	Safety and Efficiency of Surface Operations
SWIM	System Wide Information Management
TIS-B	Traffic Information Service - Broadcast
UIR	Upper Flight Information Region
VDL	VHF Data Link
VFR	Visual Flight Rules
VHF	Very High Frequency
VMC	Visual Meteorological Conditions
VNAV	Vertical Navigation
VoIP	Voice Over Internet Protocol
VOR	VHF Omnidirectional Range. Ground based navigation aid
WAAS	Wide Area Augmentation System. USA
WIXM	Weather Information Exchange Model

Definitions

The following are standard ICAO definitions (Doc 4444); reproduced here for clarity.

ATM: Air Traffic Management. The dynamic, integrated management of air traffic and airspace including air traffic services, airspace management and air traffic flow management – safely, economically and efficiently – through the provision of facilities and seamless services in collaboration with all parties and involving airborne and ground-based functions.

ATS: Air Traffic Service. A generic term meaning variously; flight information service, alerting service, air traffic advisory service, air traffic control service (area control service, approach control service or aerodrome control service).

ATC: Air Traffic Control Service. A service provided for the purpose of:

a) preventing collisions:

1. between aircraft, and
2. on the manoeuvring area between aircraft and obstructions; and

b) expediting and maintaining an orderly flow of traffic.

FIR: Flight Information Region. Airspace of defined dimensions in which flight information service and alerting service are provided.

FIS: Flight Information Service. A service provided for the purpose of giving advice and information useful for the safe and efficient conduct of flights.

The following terms are used within, and for the purposes of, this report.

Contingency Situation: A non-normal situation following an unplanned event that has resulted in a loss of function or capability within the aviation system, and during which a fall-back or alternative mode of operation is required (*Recovery or Contingency Operations*). E.g. Loss of GNSS, partial or full loss of surveillance coverage, aircraft equipment failure etc. See and compare definition of disruption below.

Contingency Operations: Operations conducted during a *Contingency Situation* that are expected to endure beyond the recovery phase. See Recovery Operation below.

- Safety: The operating regime would be managed to ensure continued safe operations during the *Contingency Operations*.
- Impact: A degradation of social connections and economic efficiency would be expected.

Continuity: Within the context of safety criteria; 'continuity' means the continued safe service or operation of the part of the system in question.

Complexity: The measure of complexity is dependent on the variety of factors, including mix of aircraft types (e.g. equipment and aircraft performance), route structure, navigation/communication requirements, aerodrome structure, terrain, and airspace category.

Density: A measure of the number of aircraft versus airspace volume.

Disruption: A temporary, localised interruption to planned operations that does not require a change to the normal operation of the aviation system and so does not constitute a *Contingency Situation*.

- Safety: Safety continues to be assured through routine established procedures.
- Impact: Very limited economic disruption occurs.

Recovery Operation: The expected immediate operational response to a *Contingency Situation.*

- Safety: Procedures and fall-back system capability would ensure continued safety while aircraft are being recovered either onto the ground or into contingency operations.
- Impact: The priority will be to safely recover aircraft. Any other aviation activity will be limited during the recovery phase.

Integrity: The condition of being unimpaired or able to perform to the intended criteria, performance or meeting the design specification, internal consistency. Can be lack of, or corruption in, electronic data.

Interoperability: Interoperability is a characteristic of a product or system, whose interfaces are completely understood, to work with other products or systems, present or future, in either implementation or access, without any restrictions

'Minimum Operational Network' (MON): The minimum NZ aviation regime considered necessary to support essential safe recovery and contingency operations following an extended GNSS system failure.

Risk: A function or measure of the consequence of a future event and the chance of that outcome occurring.

- In the context of aviation safety risk, consequence is primarily a function of the number of people exposed to harm.
- Probability is a function of many local and system-wide factors and variables.

Safety Case: A safety case is a structured argument, supported by evidence, intended to justify that a system is acceptably safe for a specific application in a specific operating environment (*UK Def. Stan 00-56 Issue 4 (Part 1)*.

CONOPS Review

Revision	Date	Authorised By	
		Name	Signature
Issue 1	6 July 2016	Steve Smyth	Steve Smyth
Issue 2			
Issue 3			
Issue 4			
Issue 5			

The intention is for this CONOPS document to be reviewed and updated, as needed, to keep pace with change in the New Zealand aviation system.

This is a living document and this is version one. It is intended that it will be updated continually as further work matures and can be incorporated. It is acknowledged that two significant pieces of work need to be included as soon as it is feasible to do so. These are the Ground Based Navigation Aid Strategy paper and the GNSS Sole Means 'conditions' work, both of which are underway in the CAA. It will be necessary to review the CONOPS at this point to ensure integration of the new material. Director NSS will undertake to incorporate the output from these documents and from the NSS Performance Based Navigation Plan, as soon as they are released. This is likely to be September 2016 at the earliest.

New Southern Sky

Concept of Operations

1. Executive Summary

1.1.1 This document, the Concept of Operations (CONOPS) is a description of how a set of capabilities may be employed to operate in New Zealand's domestic airspace in 2023. The CONOPS is aligned with the National Airspace and Air Navigation Plan [1] (NAANP). The CONOPS is a collaborative document, produced with input from the stakeholders that has taken guidance from the NAANP and used it to provide a reference framework for the New Southern Sky (NSS) programme end state. The CONOPS models today's view of the airspace in the New Zealand Flight Information Region (FIR) aviation system 2023. Aviation industry input enables a segmented view, by operations type, of this system.

1.1.2 A wide spectrum of New Zealand's aviation industry operates throughout the FIR airspace. At one end of the spectrum are international flights entering or departing the FIR, there are domestic jet operations in airspace above FL245, medium level Regular Passenger Transport (RPT) operations between FL130 to FL245 and lower level operations through to FL130. Military and Corporate aircraft operate throughout this airspace range. General Aviation (GA) operates mainly in the airspace below FL130.

1.1.3 The scenarios provide a detailed stakeholder view of how these airspace layers will be flown by operators and the capabilities they will employ for optimum efficiency and safety.

1.1.4 By 2023, the New Zealand FIR will see greater use of digital data, providing a rich environment for information dissemination to aviation systems users. Optimal use of airspace will be achieved through suitably equipped aircraft operating in this airspace. This technology transition will be flexible, enabling growth in aircraft movements through the FIR and be able to accommodate aircraft with different capabilities.

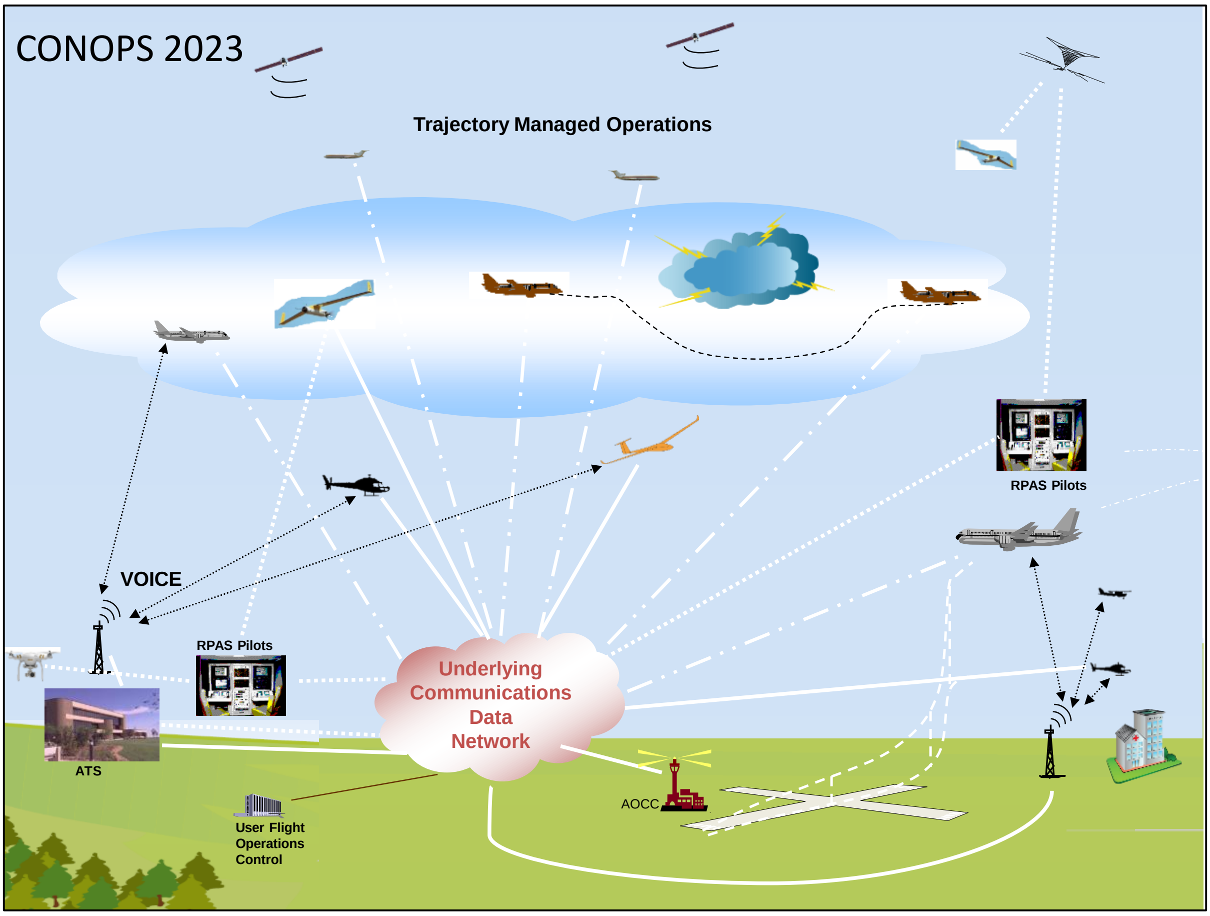
1.1.5 The design will be unique to New Zealand, providing operational ready airspace.

[1] New Southern Sky, National Airspace and Air Navigation Plan, June 2014

1.1.6 This CONOPS articulates what the NSS will deliver to the New Zealand aviation system. Ultimately it will be enabled through appropriate policy, regulations, where needed, and users deploying the appropriate equipment. The CONOPS adds to the NSS strategy and objective outcomes work programme.

1.1.7 As policy, regulations, collaborations and technology develop, the concept will be continually reviewed to keep pace with these changes.

Figure 1: CONOPS 2023



2. Introduction

2.1.1. This CONOPS document is a description of how a set of capabilities may be employed to operate in New Zealand's domestic airspace in 2023. The CONOPS is aligned with the NAANP.

> A Concept of Operations is a document describing the characteristics of a proposed system from the viewpoint of an individual who will use that system. It is used to communicate the quantitative and qualitative system characteristics to all stakeholders.

2.1.2. The CONOPS is a collaborative document, produced with input from the stakeholders, that has taken guidance from the NAANP and used it to provide a reference framework for the NSS programme end state. The CONOPS models today's view of the airspace in the New Zealand FIR aviation system in 2023. Aviation industry input enables a segmented view, by operations type, of this system.

2.1.3. There have been significant advances in technology that allow aircraft based positions to be pinpointed to within a few metres and radar networks to be replaced by new surveillance systems based on advanced aircraft transponder and satellite navigation systems. Digital and satellite derived data are transformed to information that is integrated into air traffic management systems (ATM), airline and airport operations and aviation system wide activity. Many of these activities will be transformational, providing for significant increases in safety, efficiency and reliability.

2.2. The aim of CONOPS is:

2.2.1. To provide an agreed stakeholder view of the New Zealand aviation system and how it will operate in 2023.

2.3. The objectives of the CONOPS are:

- To articulate the NSS 'target concept' in terms of a system
- To incorporate NSS System Safety Criteria as the foundation of a safe system approach
- To incorporate agreed assumptions as the foundation of a recognised system approach

- To provide an understanding of how stakeholders expect to operate by 2023 and the underpinning technology infrastructure required to enable safe and effective operations
- To provide stakeholder business planning alignment and coordinated decision making at all levels
- To step beyond the component proposals of the NAANP and provide an agreed stakeholder view of the 2023 'system end state'

2.4. We are changing the way we operate so that the aviation industry can achieve economic growth through efficiency gains

2.4.1. Change is being driven through a global model developed at ICAO and refined and modelled for the local region. Benefits increase as more industry stakeholders make strategic choices to engage in the process of change, to implement new technologies or to refine procedures.

2.4.2. New Zealand's National Airspace Policy[2] seeks 'a safe and capable airspace and air navigation system both within New Zealand and the international airspace it manages, that measures up to international safety standards and best practices, and contributes to economic growth through efficiency gains'.

2.4.3. We therefore need to contextualise and explain how that looks from a system perspective.

2.5. We aim for efficient, environmentally responsible, integrated and interoperable systems

2.5.1. The policy also sets out a number of other desired attributes of New Zealand's future airspace and air navigation system, which will be pursued as much as possible without compromising safety:

- **Efficient** – the air navigation system and the design and classification of airspace will facilitate the efficient operation of aircraft within New Zealand airspace.
- **Environmentally responsible** – the future airspace and air navigation system will be respectful of the impacts of aviation on the environment, and any development that can reduce the overall environmental impact of aviation will be pursued, as long as it can be achieved safely and at reasonable cost.
- **Integrated** – the aviation sector and local authorities will proactively address their respective interests in any future planning to facilitate the adoption of more efficient aircraft arrival and departure paths in a timely way and to avoid or mitigate

[2] The National Airspace Policy of New Zealand (2012).

incompatible land uses or activities and potential impacts or hazards that will impact, or have the potential to impact, on the safe and efficient operation of aircraft.

- **Interoperable** – The NAANP will be compatible with other global and regional plans, including the ICAO Global Air Navigation Plan, as much as practicable, while taking into account any unique aspects of airspace and ATM in New Zealand.

2.6. We will dynamically manage aircraft from 'gate to gate'

2.6.1. These attributes will be enabled, if not solely delivered, through the ability to dynamically manage aircraft from 'gate to gate' through:

- integrated communications data to information network
- integrated scheduling and flight planning
- enhanced surface operations
- streamlined departure management
- efficient cruise
- streamlined arrival management
- airport surface capacity enhancement

2.6.2. There is a cohesive relationship between all elements of the attributes sought and the delivery mechanisms.

2.6.3. For instance, a flexible data communications network provides information required for an integrated scheduling and flight-planning environment that enables more effective use of ramp space at the aerodrome that in turn enables airport capacity and activity planning. Capacity itself can be actively managed by integrating real-time MET information to forecast better when and where delays can be expected. Fuel and services can then be in the right place at the right time to enable a swift turnaround of the aircraft. Airport security staff, aircraft cleaners and customs and immigration staff will be available when required to minimise what is often the source of a delayed departure or arrival waiting for a 'gate' to be cleared by a delayed departure.

2.6.4. Operations other than scheduled airlines have available a flexible data communications network providing information required for an integrated flight-planning and operational environment that enables more effective use of capacity and aircraft capability. There will be integrated real-time MET information to forecast better when and where inclement weather can be expected. Fuel, services and the operation profile can be managed safely, efficiently and effectively.

2.7. Trajectory management is key to safety and efficiency

2.7.1. The trajectory management of aircraft will enable the new operating environment to manage an aircraft's profile from departure gate to arrival gate, including both civil and military operations. This environment will be achieved by greater strategic integration and coordination of ATM to enable efficient aircraft operations.

2.7.2. New trajectory management tools will enable controllers to safely manage potential conflicts and provide increased efficiencies across the network to the benefit of all users of the airspace.

2.7.3. The implementation of NSS enables optimisation of capacity in New Zealand airspace. The background to the NSS is at Appendix 1.

3. Assumptions

3.1.1. A number of assumptions have been applied to both the development of safety criteria and this CONOPS. Key assumptions are:

- The current aviation system is safe
- The civil aviation regulatory framework will continue to contain a mix of policy and performance and risk based rules to support this CONOPS
- The ICAO Standards and Recommended Practices (SARPs) are the basis for the aviation system
- The CONOPs are designed to meet the aviation system safety criteria
- The CONOPs describe an end state for NSS, with transition being out of scope
- All of the elements of the aviation system outlined in the NAANP have been considered
- The Navigation element of the CONOPs is Performance Based Navigation (PBN), based on GNSS, for IFR operations in controlled airspace
- The Surveillance element of the CONOPs assumes that ADS-B will be used in all controlled airspace
- The Communications element of the CONOPs assumes that VHF will remain the primary means of communication within the New Zealand FIR
- The CONOPs covers gate to gate and non-scheduled operations of all IFR aircraft, including flight planning and ground movements
- The CONOPs also includes VFR operations where they interact with controlled airspace
- Flight training operations will continue to access the New Zealand aviation system
- A Ground Based Navigation Aid (GBNA) network will be in place to support Recovery and Contingency operations
- A non-cooperative surveillance system is expected to be operating at Auckland, Wellington and Christchurch and other locations on a case-by-case basis

- The CONOPs assumes systems capacity will accommodate increases in IFR traffic demand
- Procedures will be in place to allow increasing numbers of RPAS to operate safely in the NZ FIR
- The aerodrome network for RPT aircraft will remain as it is today
- There will be increased pressure on the aviation system from environmental factors
- Airport Collaborative Decision Making (ACDM) will be used by the majority of New Zealand International airports
- Remote ATS are expected to be operated before 2023

3.2. Constraints and Limitations

3.2.1. The CONOPs is subject to the followed constraints and limitations:

- It is limited to the NZ FIR
- The aviation cyber security threat is not specifically covered by this CONOPS as this is in other Government documents
- GPS is the mode of GNSS navigation that the CONOPS is based upon
- Multiconstellation dual frequency GNSS may affect the changing nature of New Zealand's airspace in the future, but it is not a feature of this CONOPS
- GPS 'sole means' navigation[3] is not permitted under NZ CARs
- The CONOPS assumes that SBAS[4] will not be available
- GBAS is a Stage 2 NSS project

3.2.2. The GNSS Sole Means Recommendation Report expects some form of limited use of sole means navigation, however, more work is needed to frame and establish the appropriate procedures for this to occur. This work is underway.

3.2.3. An operational SBAS was not considered in the development of the CONOPS. SBAS is being considered by the Ministry of Transport and Land Information New Zealand as part of a wider intelligent transport system (ITS) capability and is a NSS Stage 2 work-stream. It is unlikely that a SBAS service could be delivered for the New Zealand FIR for the 2023 CONOPS timeframe.

3.2.4. The GBAS project in NSS Stage 2 will initially focus on a cost benefit analysis.

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[3] Appendix 3, Sole Means Navigation

[4] Appendix 4, SBAS

4. GNSS/PBN Conditions

4.1.1. There is still significant work to be done to determine the conditions necessary to enable limited use of GNSS sole means navigation for en-route and terminal areas outside ground based navigation aid coverage. However, it is considered that a number of the criterion set out in the safety criteria used to develop these CONOPS have established a framework for determining these conditions, namely:

- The PBN structure will be based on GNSS, managed for maximum benefit, whilst ensuring national resilience, safety and security are maintained
- PBN will be fully deployed in controlled airspace (CA)
- PBN infrastructure will be in place in the New Zealand FIR to enable primary means navigation, but may not permit 'free flight' routing
- GBNA network will be maintained to enable recovery of aircraft in the event of a failure (local, regional (solar flares, jamming, spoofing etc.), or aircraft equipment failure) of the GNSS and limited Contingency Operations post event
- Controllers and IFR rated pilots will maintain competency to operate within a GBNA enabled Recovery scenario. The CAA will develop competency and licensing requirements (to incorporate a balance of simulated and actual approaches)
- A Contingency Plan for use of CA if an aircraft is temporarily non-PBN capable will be developed. A risk-based approach will be adopted

4.1.2. Operators of less capably equipped aircraft may see little incentive to align their business plans with the NSS programme. However, optimisation of airspace and aviation systems management is delivered through the concept of 'best equipped best served'. Operators equipped to meet the requirements outlined in the CONOPS will therefore likely accrue the greatest efficiencies and resulting benefits within the NSS framework.

5. The Changing Nature of the Industry

5.1.1. RPAS have already begun to revolutionise industries such as agriculture, surveying and photography, and have applications in logistics, transport, infrastructure networks and security.

5.1.2. RPAS are a disruptive technology that will revolutionise some industry sectors. Importantly, RPAS are capital cost effective. Connecting RPAS abilities and attributes with business needs will see an exponential growth.

5.1.3. RPAS operations will proliferate and be integrated with CA and operations will occur close to airfields.

5.1.4. We may have manned flight in portable personal machines, such as the Martin Jetpack. There may be unmanned freight aircraft scheduled operations.

5.1.5. There will be new ATM procedures and new manned and unmanned aircraft types, but the benefits extend beyond these technologies and their control. There will be better use of airport infrastructure and our aircraft, not only on the ground, but also in the air.

5.1.6. With NSS we could have new safety tools, which are better able to predict risks and then identify and resolve hazards. These new safety tools should allow us to be more proactive about preventing incidents and accidents. Other options might include the use of new security tools that are able to automatically detect anomalous behaviour.

5.1.7. NSS will optimise the operational use of New Zealand airspace by improving capabilities that manage and use it. Each capability provides additional layers of operational improvement. The foundational infrastructure is either in-place or will be by 2021. That infrastructure incorporates transformational technologies that will improve operational efficiencies, including savings in time, fuel and emissions that will benefit New Zealand's economy and environment.

5.1.8. The latter will be delivered in part by a significant technology shift in digital data capability and availability. Turning this digital data into information or intelligence that is operationally useful will be key to the success of the NSS optimisation programme.

5.2. Discrete Operations

5.2.1. Discrete operations by the military or police are likely to occur in both CA and uncontrolled airspace. Procedures will be provided for discrete operations for Police and Defence operations that need to work covertly.

6. System Component Overview

6.1.1. The CONOPS takes a systems approach to IFR aircraft operations from 'gate to gate', including ground operations; however, the following paragraphs set out the characteristics of each of the component parts that make up that system as defined in the NAANP. They are:

- Performance Based Navigation
- Surveillance
- Communications
- Aeronautical Information Management
- Air Traffic Management (ATM)

- Airspace Design
- Aerodromes, and
- Meteorological Services

6.2. The Three Stages

6.2.1. The NSS delivers system outcomes through three stages to achieve the end state in 2023. This CONOPS is the end state, it is achieved through a staged implementation plan.

Table 1: Programme Stages

	Stage 1 by end of 2015	**Stage 2 by end of 2018**	**Stage 3 by end of 2023**
New Southern Sky *– implementation plan*	Continued use of legacy navigation applications while PBN capability is progressively implemented in aircraft fleets and the supporting infrastructure. The ground infrastructure associated with legacy navigation systems will be reviewed and progressively adapted.	Move to a more exclusive PBN environment that places greater reliance on the level of PBN capability in the national fleet and infrastructure. The ATM system will be managing a more homogeneous navigation capability.	A mature PBN environment with a comprehensive fleet and infrastructure capability. Air traffic management tools complement airborne systems and enable the management of those aircraft that may experience temporary loss of PBN capability. Contingency ground infrastructure that enables all aircraft to safely return to the ground.

6.3. Performance Based Navigation – Conventional to Performance Based Navigation

6.3.1. PBN involves area navigation procedures that are more accurate and allow for shorter, more direct routes. The use of PBN will enhance the safety, reliability and predictability of approaches resulting in improved airport accessibility.

6.3.2. Traditionally air navigation has relied on ground-based navigation aids to assist aircraft to fly safely under IFR. Advances in navigation including development of performance-based navigation specifications and increased functionality have enabled changes in airspace design, separation minima, route spacing, airport access, procedure design and ATM.

6.3.3. Progressive transition worldwide to PBN routes and departure and arrival procedures involves area navigation procedures that are more accurate and allow for optimised airspace routes. PBN provides a list of navigation specifications that have applicability to one or more types of airspace (terminal, en-route, and remote/oceanic) and is only one of several enablers (Surveillance, Communications and ATM) of an airspace concept.

6.3.4. PBN deployment in New Zealand will be consistent with PBN Manual ICAO Document 9613 latest version. This Manual includes detailed technical information, training and knowledge requirements for PBN and includes both RNAV and RNP specifications.

6.3.5. In the New Zealand FIR, PBN will be based on using GPS to enable both RNAV and RNP operations. All approved GPS equipped aircraft in New Zealand, when operated by approved pilots, will meet RNAV 1 and 2 and RNAV APCH standards and some of these may meet RNP 1 and 2 or other standards. Both RNAV and RNP enabled aircraft will operate directly between waypoints instead of ground based NAVAIDS, providing optimal flight path trajectory management, providing all the systems supporting PBN are incorporated and utilised.

6.3.6. PBN is currently being deployed in a staged approach consistent with ICAO, but this involves a mixed mode conventional and PBN environment; as a result, PBN efficiency is not optimised in New Zealand. By 2023, PBN will have been implemented, allowing all facets of the system (procedures, training, education, equipment, licensing, certification, policy, rules) to be joined up and working in harmony to deliver safety and efficiency benefits across the system.

6.3.7. Some Airline operators (Part 121) have on-board Inertial Reference Units (IRU) and Flight Management Systems (FMS) that enable greater PBN capabilities, including RNP-AR and curved procedures using Radius to Fix (RF). Other airspace users have not had this functionality to date. It is expected that greater functionality, although this may not include IRU equipment, will roll out across the aircraft fleets in New Zealand covering Medium Aeroplane Part 125 and Helicopter/Small Aeroplane Part 135 operators. By 2023 the majority of Large Part 121 and Medium Part 125 aircraft operators will have fleets with greater PBN capability, which supports a 'best equipped, best served' airspace philosophy. Many of the lighter aircraft (Part 135) will also be PBN enabled.

6.3.8. By 2023 ICAO[5] will have developed procedures enabling aircraft with MAUW of 5700kg or less and indicated airspeed on approach of less than 200kts with map display capability and CDI to do RF curved approaches and departures without an auto-pilot. This change will enable further optimisation of approach and departure procedures to/from aerodromes where these aircraft operate.

[5] ICAO Performance Based Navigation Manual 9613

6.4. Surveillance – Reducing our reliance on radar

6.4.1. Automatic Dependent Surveillance-Broadcast (ADS-B) technology is the primary method of air traffic control surveillance.

6.4.2. Surveillance will change; the current radar based surveillance model will not be in place in New Zealand as the current radar system reaches end of life in 2021. Transition to an initial ADS-B surveillance capability will begin in 2018 to provide for a full ADS-B capability by 2021.

6.4.3. ADS-B transponders, will be installed in all aircraft flying in CA to provide controllers with precise information about the position, identity and trajectory of aircraft, improving the safety of the system.

6.4.4. Complete removal of the existing ground-based radar network is not envisaged, as this would result in too much reliance on the satellite system – especially with PBN also becoming reliant on GNSS. A strategy for an appropriate contingency surveillance system will be in place to ensure that in case of GNSS failure, airborne aircraft can be recovered safely.

6.5. Communications – Incremental improvements

6.5.1. VHF will be the prime means of communication in the NZFIR with CPDLC and SATVOICE for oceanic communication and HF for some aircraft operations.

6.5.2. The VHF radio network remains a key element of this CONOPS. However, it is expected that data-link technology will be extended to some ground-ground communications and the technology as a whole will be reviewed in the future.

6.5.3. Controller Pilot Data Link Communications (CPDLC) and SATVOICE technology will be the primary means of communication in oceanic airspace with HF only used as a backup.

6.5.4. Voice over Internet Protocol (VoIP) will link remote sites for ground communication and aircraft applications. Exchange of messages and digital data between aviation users will use Air Traffic Service Message Handling System (AMHS) and ultimately the Aeronautical Telecommunication Network (ATN).

6.5.5. A key challenge is communications for Remotely Piloted Aircraft Systems (RPAS). Work at ICAO to identify how, with the use of datalink technology (C2Link) for operators to control these aircraft, RPAS will fit into the air traffic flow will inform the NSS RPAS integration project which will address communications requirements to enable these aircraft to integrate into the system.

6.6. Aeronautical Information Management – Digital integration

6.6.1. Aeronautical Information Services (AIS) will allow continuous, up-to-date and real-time information transfer, moving to Aeronautical Information Management (AIM).

6.6.2. AIM will be provided by a digital data-driven system that allow continuous, up-to-date and real-time transfer of the full range of aeronautical information, including meteorological products, to all participants in the aviation system. The system adopted will ensure that human factors associated with data accessibility do not introduce new risks into the system.

6.7. Air Traffic Management – From controlling to enabling

6.7.1. The ATM system will enable rather than control air traffic.

6.7.2. The ATM system is based on the provision of services with a view to becoming air traffic enabling, rather than air traffic controlling. Modern ATM tools, combined with the new surveillance, information and navigation technologies, will ensure more efficient flow management and conflict detection – reducing operator costs and improving safety. Procedures for contingency and recovery operations will be in place.

6.8. Airspace Design – Review and refine

6.8.1. Airspace will accommodate increasing traffic, new types of aircraft and more direct and efficient flight paths, including RPAS activity and rocket launch sites.

6.8.2. New Zealand's airspace design and designations will accommodate increasing traffic, new types of aircraft and more direct and efficient flight paths, including those required to accommodate the expansion in RPAS activity and the space industry (including more rocket launch sites).

6.8.3. Processes inclusive of consultation for changes to New Zealand airspace design and designations will be more efficient as the majority of operators equip appropriately to take advantage of the NSS system.

6.9. Aerodromes – increasing capacity

6.9.1. Airports will be subject to increased pressure from urban land uses, particularly residential intensification. Aircraft noise from flight operations and maintenance will require continued management and active land use planning. At the same time, accessible airports for both passengers and operators, with the associated benefits of air transport activities, will be increasingly valued by their regions.

6.9.2. Aerodrome Master Planning will ensure that core airfield infrastructure capacity keeps pace with forecast growth demand. Airport management will be driven by a collaborative process with all users, linking both airspace management requirements and land management planning to ensure a seamless service for passengers, operators and service providers. Changes in the Airspace and Air Navigation system will enable more aircraft movements, which may provide challenges to some aerodromes and associated airfield infrastructure.

6.9.3. Planning between international aerodrome operators[6], Airways and operators will be coordinated through ACDM, particularly to enable efficient management during localised MET and civil emergency events.

6.10. Meteorological Services – Integrating MET information

6.10.1. Full integration of MET information into air traffic management and performance-based navigation applications will help enable an interoperable, seamless air traffic management system.

6.10.2. The MET Information Exchange Model (WIXM) will provide a common format for MET data and enable integration with aeronautical information systems. Integration of MET data with other systems will enable real-time MET information to be provided directly to users, including into the cockpit. How pilots, ATC and aerodromes will access this data has yet to be addressed.

7. Information Management

7.1. Many of the benefits promised by NSS will be derived from effective information management

7.1.1. System Wide Information Management (SWIM) is an advanced technology programme designed to facilitate greater sharing of aviation system information, such as airport operational status, weather information, flight data and status of special use airspace. SWIM implementation is the optimal outcome for the aviation system in the conversion of digital data to information for systems users.

7.1.2. SWIM will support current and future NSS technologies by providing flexible and secure information management architecture for sharing aviation system information. SWIM will use commercial off-the-shelf hardware and software to support a Service Oriented Architecture (SOA) that will facilitate the addition of new systems and data exchanges, and increase common situational awareness. SWIM will make information readily accessible in a timely way for all users of the aviation system.

7.1.3. SWIM implementation will improve the New Zealand aviation system's ability to manage the efficient flow of information. This includes:

- reducing costs for all users to acquire data
- improving shared situational awareness among the user community

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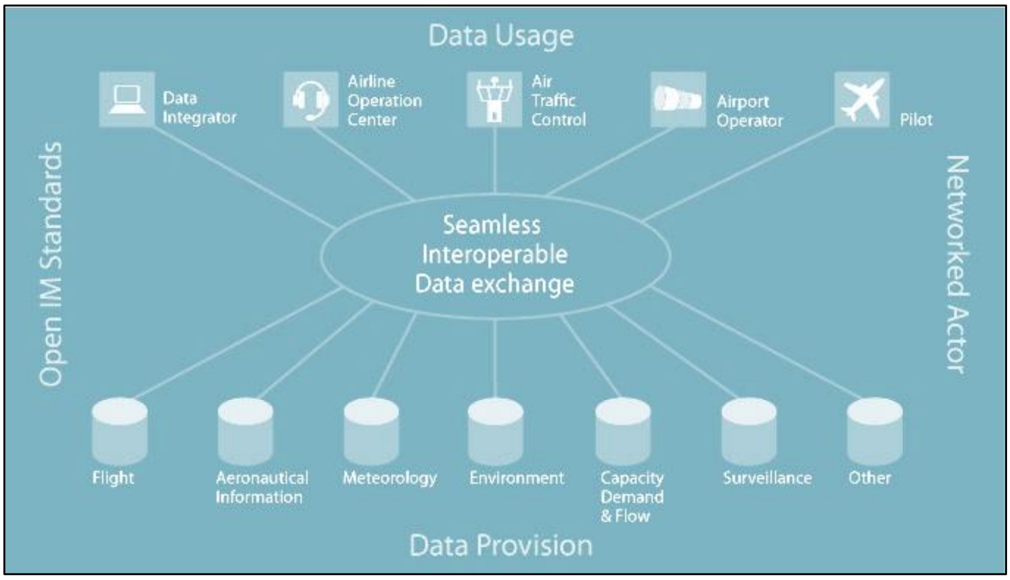
[6] Auckland International Airport has implemented Airport Capacity Enhancement (ACE)

- providing secure data exchange that meets current New Zealand security standards

7.1.4. SWIM makes it possible to have real time information, so users can respond faster and more accurately, creating collaboration opportunities within industry.

7.1.5. The CONOPS recognises that global interoperability and standardisation are essential and SWIM will be an important driver for new and updated standards.

Figure 2: System Wide Information Management



7.1.6. The CONOPS assumes that SWIM will be based on SOA and open and standard mainstream technologies and that the following will be able to share information:

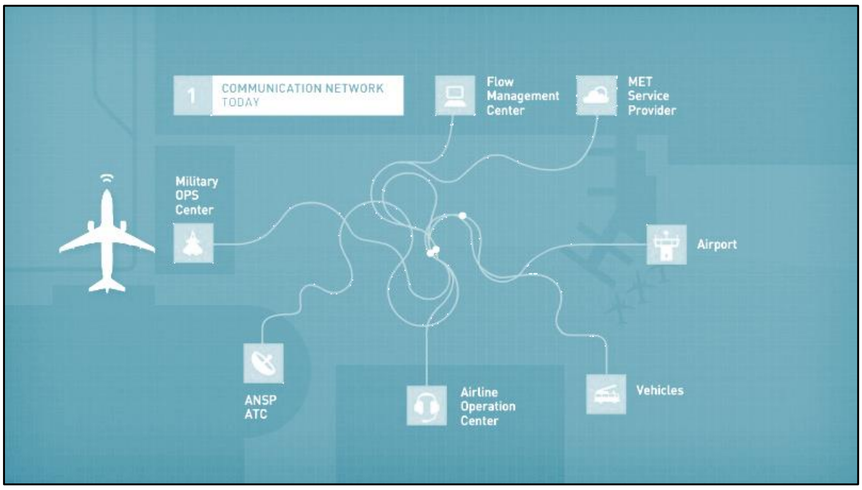
- **Pilots** – taking off, navigating and landing the aircraft.
- **Airport Operations Centres** – managing departures, surface movements, gates and arrivals.
- **Airline Operations Centres** – building schedules, planning flight routings and fuel uplift, ensuring passenger connections and minimizing the impact of delays.
- **Airways** – organising and managing New Zealand airspace and managing air traffic passing through that airspace through optimising tracks, arrivals and departures to minimise fuel burn while maximizing capacity when demand requires it.
- **Meteorology Service Providers** – providing MET reports and forecasts.
- **HQ Joint Forces NZ** – planning missions, coordinating airspace with Airways to conduct military training operations, fulfilling national security tasks.

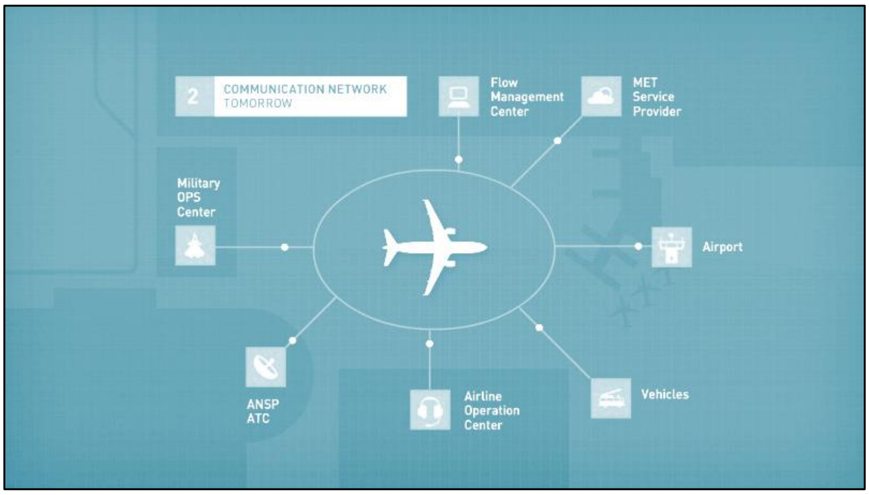
7.1.7. The following information will at best be integrated, but at a minimum be shared:

- **Aeronautical** - Information resulting from the assembly, analysis and formatting of aeronautical data.

- **Flight trajectory** – the detailed route of the aircraft defined in four dimensions (4D), so that the position of the aircraft is also defined with respect to the time component.
- **Aerodrome operations** – the status of different aspects of the airport, including aircraft operations, runways, taxiways, gate and aircraft turn-around information.
- **MET** – information on the past, current and future state of earth's atmosphere relevant for air traffic and ground operations.
- **Air traffic flow** – the network management information necessary to understand the overall air traffic and air traffic services situation.
- **Surveillance** – positioning information from surveillance systems, satellite navigation systems, aircraft datalinks, etc.
- **Capacity and demand** – information on the airspace users' needs of services, access to airspace and airports and the aircraft already using it.

Figure 3: Current versus NSS communication network





7.1.8. Information may be of use to other users beyond the airfield boundary, but those requirements will not drive the system requirements.

7.1.9. The implementation to a full SWIM enabled environment is expected to be through a staged process with WIXM and Aeronautical Information (AIXM) being the first data sources available. By 2023 we expect that the first user applications using these data sources will be in use.

7.2. Integration of the components within the NSS CONOPS builds on the seven concept components identified by ICAO[7]:

- **Airspace organisation and management** – dynamic and flexible to ensure that the allocation of resources, restrictions, activities and services support the traffic needs of the day. Restrictions to specific operations should be minimised to the extent possible, to ensure that the overall system is optimised.
- **Aerodrome operations** – enable the efficient use of the capacity of the aerodrome airside infrastructure.
- **Demand and capacity balancing** – enable collaborative decision-making to balance demand and capacity for the efficient management of air traffic flow within the airspace. This capability will be supported by the use of information on system-wide air traffic flows, MET and assets.
- **Traffic synchronisation** – support establishment and maintenance of a safe, orderly and efficient flow of air traffic, including four-dimensional trajectory controls, negotiated conflict-free trajectories, elimination of choke points and optimisation of traffic sequencing.
- **Airspace user operations** – accommodate aircraft with mixed capabilities or define minimum performance standards, while ensuring that relevant, secure and quality ATM data is fused with operational information and made available to airspace users.
- **Conflict management** – enable support of trajectory-based operations while accommodating application of varying standards, as defined by the operational needs relating to the specific body of airspace.
- **ATM service delivery management** – address the balance and consolidation of the decisions of the various other processes/services, as well as the time horizon at which, and the conditions under which, these decisions are made. In addition, the

[7] ICAO Global ATM Operational Concept (Doc 9854) 2005 to improve traffic flow and consistent with ICAO PBN Document 9613 and ICAO Global Air Navigation Plan Document 9750.

system must enable the exchange and management of information between the concept components to provide an integrated aviation network with secure, timely and high quality operational information available to all.

7.2.1. With these new tools, the ATM task becomes one of strategic management to ensure efficient use of airspace available, based on user preferences.

7.3. Components of the NSS CONOPS

7.3.1. All of New Zealand's flights are affected to some degree by the aerodrome environment. The CONOPS will address the aerodrome environment as a generic topic. It will then look at each of the following: high, medium and low level IFR CA, oceanic entry at the boundary to the FIR, entry to CA from uncontrolled airspace, Helicopter operations, RPAS and VFR.

7.4. The Ground Environment

7.4.1. All aviation activity; GA, airline, freight, commercial or agricultural operation and airports is driven by the economics of efficiently moving aircraft, customers, freight or products in order to generate revenue and minimise costs. The effective use of the assets (infrastructure, aircraft, personnel, ground handling equipment etc.) drives the efficiency of the operation and therefore the economics of the business. A private aircraft operator has the same interest; the more efficiently the aircraft can be operated the more rewarding the experience of aircraft ownership.

7.4.2. The relationship between the most effective use of the assets and the efficiency of the operation is complementary. The former comes from a schedule able to meet airport and operator customer needs, and the efficiency of the service by how efficient the services or aircraft can be operated. Both are enabled by this CONOPS.

7.4.3. There will always be a requirement to balance the needs of the customer, aerodrome or aircraft owner, and therefore the economics, against the availability of the assets required to operate the service or aircraft use and the capacity of the network (ramp space, gate capacity, traffic flow, airspace etc.) to do so safely.

7.4.4. Capacity constraints (e.g. during Low Visibility Operations) may require prioritisation of types of operations and flights to deliver the best passenger and economic outcome.

7.4.5. The international airports of Auckland, Christchurch, Wellington and Queenstown will be making use of ACDM to optimise the balance between demand and capacity. At peak times and during some MET events, there are capacity constraints due, to a greater or lesser extent, to the fact that each airfield is affected by only having a single runway in operation[8], or no parallel taxiway.

7.4.6. Real time schedules, MET reports and forecasts, departure information, surface movement, gates and arrivals information, flight planning routings and fuel uplift, ensuring passenger connections and the ability to minimise the impact of delays will be conducted via data messaging. Data messaging will have moved from AFTN to be delivered to aircraft via AMHS as the internet architecture that allows ground/ground, air/ground, and avionic data sub-networks to interoperate by adopting common interface services and protocols based on the ISO[9] Open System Interconnection (OSI) Reference Model.

7.4.7. Voice communication on the ground will be via VoIP in preference to VHF. VHF will remain primary means in the air. International and domestic pre-departure, and some en-route and arrival clearances, will utilise data-link.

7.4.8. Ground surveillance will be supported by ADS-B to improve safety and capacity.

7.5. Equipage

7.5.1. The network includes and is affected by all aspects of the NSS concept described in the earlier sections. Equally, it will be incumbent on the operator to equip to optimise the benefit from the NSS environment.

7.5.2. Surveillance is focussed within CA, however, the capacity for surveillance extends outside the CA provided aircraft are suitably equipped. Airways Corporation will provide surveillance by ADS-B.

- In the Auckland Oceanic FIR, surveillance is through Automatic Dependent Surveillance contact (ADS-C)[10], CPDLC position reports, Flight Management Computer Waypoint Position Reporting (FMC WPR) via data-link, and voice position reporting via HF radio and via satellite (SATVOICE)
- Potentially for surface movement surveillance at all controlled aerodromes through ADS-B
- Special use airspace may require aircraft to be ADS-B equipped

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[8] Christchurch Airport has intersecting cross runways, the airport does not have parallel runway capability

[9] ISO – International Standardisation Organisation.

[10] ADS-C transmits position and intent information in response to a 'contract' established by ATC.

7.5.3. Wide-area multilateration will provide limited surveillance contingency cover for the Queenstown area and most of Otago and Southland.

7.5.4. All aircraft will therefore need to be ADS-B OUT equipped to operate in CA. This requirement will be introduced in two stages. For aircraft operating above Fl245, the intention is that they will be required to use ADS-B OUT from 31 December 2018. This is intended to be extended to all NZ FIR CA from 31 December 2021[11]. There are no plans to adopt ADS-B IN in New Zealand domestic airspace.

7.5.5. To be compatible with the proposed ADS-B surveillance ground system, an aircraft ADS-B system requires a 1090 MHz Extended Squitter (1090 ES) transponder with an input from a GNSS receiver, either directly or via the flight management system; this is the system adopted internationally.

7.5.6. All IFR operations in CA will be conducted using PBN. PBN based on GNSS (GPS) is the primary method for flight operating under instrument flight rules (IFR) in CA.

7.5.7. There are two types of navigation equipment specifications required for PBN:

- **RNAV** (aRea NAVigation) equipment that permits any desired flight path within the coverage of ground or space-based navigation aids or within the limits of the capability of self-contained aids, or a combination of these[12]
- **RNP** (Required Navigation Performance) equipment facilitates a specific path between two three-dimensionally defined points in space and therefore RNP specifications are enabled using GNSS

7.5.8. The key difference between RNAV and RNP is that RNP requires equipage able to provide on-board performance monitoring and alerting so that the pilot is notified immediately of any degraded navigation performance level inputs; it is therefore a more robust system. Under the CONOPS, it is assumed aircraft operating commercial services will have certificated GNSS fitted with RNAV capability and with RNP, Receiver Autonomous Integrity Monitoring (RAIM) and Fault Detection and Exclusion (FDE) to meet this standard.

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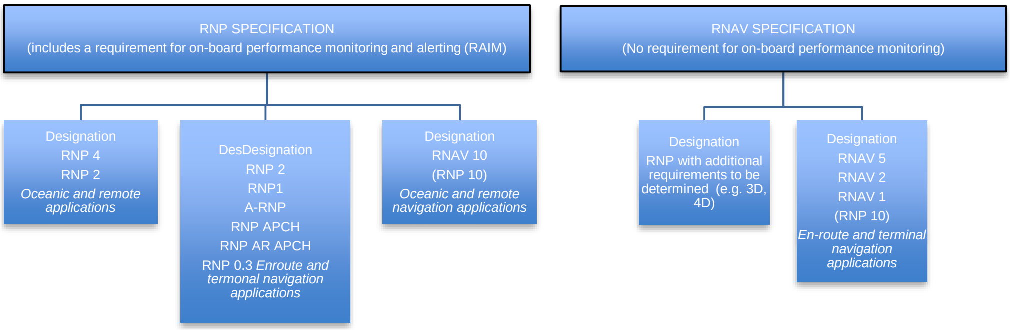
[11]This will be subject to the timely creation of supporting mandates and rules as regulatory projects.

[12] Area navigation includes performance-based navigation as well as other RNAV operations that do not meet the definition of performance-based navigation.

Figure 4: ICAO specifications for performance-based navigation



7.5.9. PBN approaches enable lateral and vertical guidance – called Approach Procedure with Vertical Guidance (APV) based on Baro-VNAV. It is therefore expected that aircraft and some airports will need to retain an ILS capability for precision approaches.

7.5.10. In line with international developments, New Zealand will be a PBN environment in CA. A mature set of ATM tools will complement the airborne systems and will enable the effective management of those aircraft that may experience a temporary loss of PBN capability. A GBNA network will be maintained for Recovery and Contingency operations. VOR/DME will be required to be maintained for these operations. The GBNA network will be centred on the main trunk airports of Auckland, Wellington and Christchurch with limited additional infrastructure located strategically at some airports. A non-cooperative surveillance system is expected to be operational at Auckland, Wellington and Christchurch.

7.5.11. VHF voice communication will remain the primary means of communication in domestic airspace. SATVOICE will be the primary means of voice communication in Oceanic controlled airspace, with HF as backup.

7.5.12. Most aeronautical information will be transmitted via data link using VDL Mode 2 ACARS. FANS 1A and ATN B2 will be available and useable by equipped aircraft.

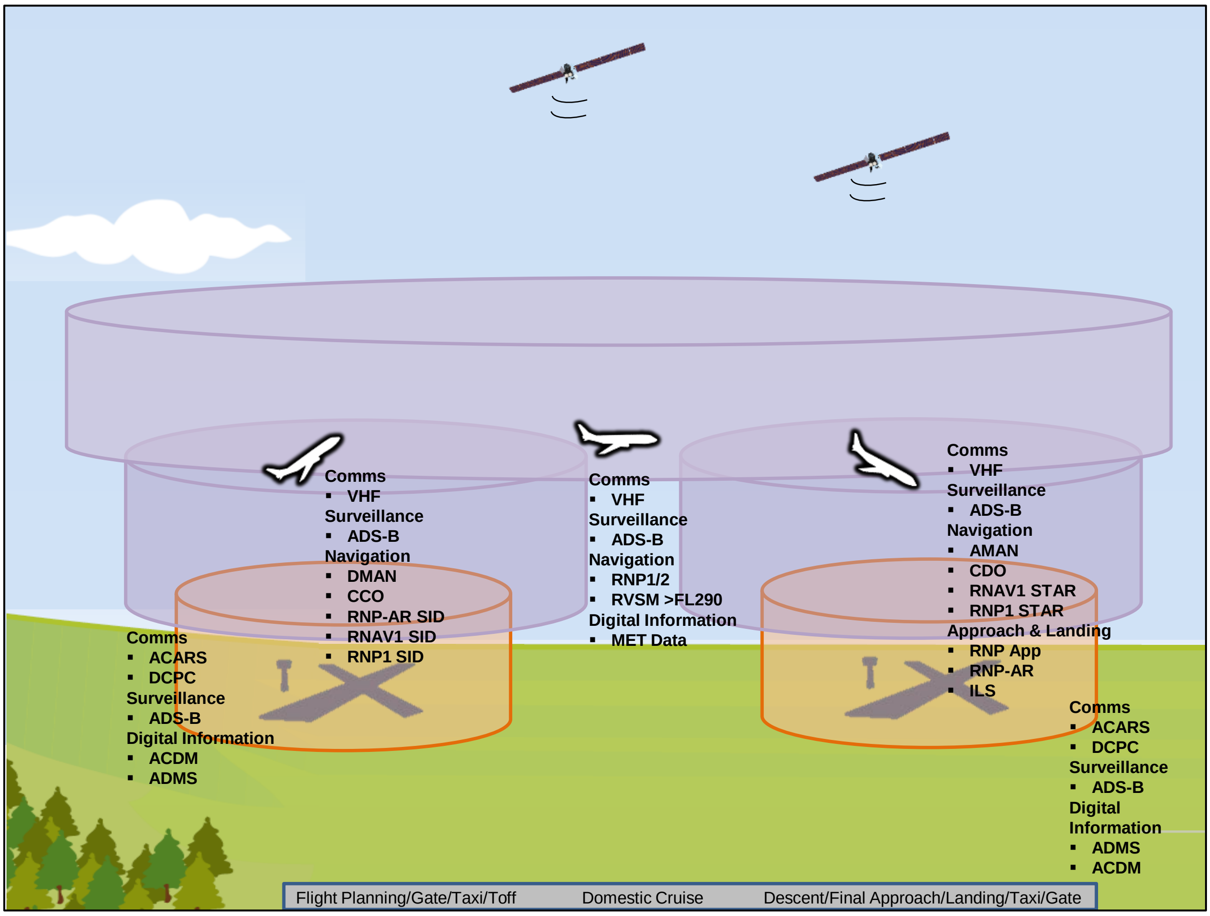
8. Layers of Airspace Use

8.1.1. A wide spectrum of New Zealand's aviation industry operates throughout the CA. At one end of the spectrum are international flights entering or departing the FIR, there are domestic jet operations in airspace above FL245, medium level RPT operations operating in the FL130 to FL245 range and lower level operations through to FL130. Corporate aircraft operate throughout this airspace range. General aviation operates mainly in the airspace below FL130.

8.1.2. The following scenarios will provide a detailed stakeholder view of how these airspace layers will be flown by operators and the capabilities they will employ for optimum efficiency and safety.

8.2. FL245 and Above

Figure 5: Above FL245 Controlled Airspace



8.2.1. Integrated flight plan and MET data functionality will be implemented enabling geo-referenced pilot briefings. Aeronautical information data exchange between systems will be supported through SWIM.

8.2.2. Pre-departure clearances will be achieved by silent clearance delivery for turboprop aircraft and digital clearance delivery for jet aircraft.

8.2.3. Access to optimum flight levels will be achieved through departure procedures that will allow the aircraft to fly their optimum aircraft profile taking account of airspace and traffic complexity. SIDs and STARs will be enabled by RNAV or RNP with Continuous Climb Operations (CCO).

~~8.2.4.~~ ATM will be enhanced through full surveillance coverage in CA to prevent aircraft being held at a sub-optimal altitude, which will reduce fuel burn. All ATS routes will be enabled by RNP.

~~8.2.5.~~ Surveillance coverage will be through ADS-B in all CA. Combining data from multiple sources will enable Airways services to be more consistent, accurate, timely and efficient. On the ground, data sharing will enhance gate-to-gate traffic management services and incorporate safety alerting technology. MLAT at Auckland and Queenstown provides additional data to ATS, ensuring safety and security of operations in the airspace and on the surface manoeuvring area.

8.2.6. There will be a Navigation Aid Contingency Network of GBNA in place to ensure that recovery of aircraft is achievable in non-normal operating conditions.

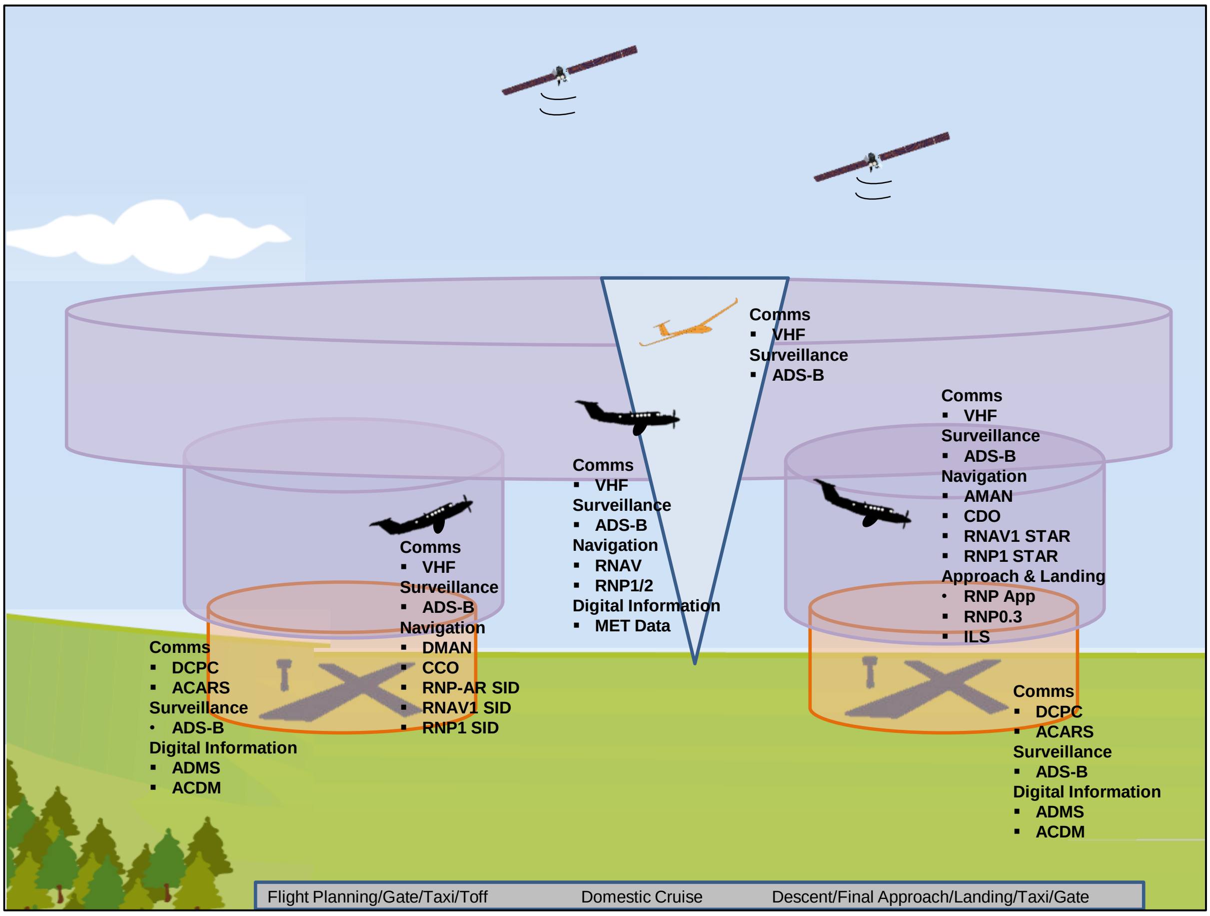
8.2.7. ATM procedures enabled by PBN and supported by full surveillance coverage should prevent aircraft being held at a sub-optimal altitude, which will reduce fuel burn. Continuous Descent Operations (CDO) will be facilitated through the use of PBN routes and arrivals management system (AMAN). All STARS will be enabled by RNAV or RNP. Performance-based airspace procedures will optimise the aircraft profile taking account of airspace and traffic complexity including optimised profile descents supported by trajectory-based operations and self-separation. Integration of PBN STARS directly to all approaches with vertical guidance allows for both curved approaches and segmented approaches in an integrated system.

8.2.8. All controlled aerodrome runways with instrument approach procedures will be enabled by RNP, these approach procedures should be optimised to take advantage of vertical guidance Baro-VNAV.

8.2.9. Departures and Arrivals will be managed by ATS to allow arrival or approach trajectories to dynamically avoid severe weather such as lightning from cumulonimbus clouds, MET data being a key enabler.

8.3. FL130-245

Figure 6: Mid-Level FL130-245 Controlled Airspace



8.3.1. Integrated flight plan and MET data functionality will be implemented enabling geo-referenced pilot briefings. Aeronautical information data exchange between systems will be supported through SWIM.

8.3.2. All radio communications will be digital capable.

8.3.3. Access to optimum flight levels will be achieved through departure procedures that will allow the aircraft to fly their optimum aircraft profile taking account of airspace and traffic complexity. SIDs and STARs will be enabled by RNAV or RNP with CCO.

8.3.4. ATM will be enhanced through full surveillance coverage in CA to prevent aircraft being held at a sub-optimal altitude, which will reduce fuel burn. All ATS routes will be enabled by RNP.

8.3.5. Surveillance coverage will be enabled through ADS-B in all CA. Combining data from multiple sources will enable Airways services to be more consistent, accurate, timely and efficient. On the ground, aircraft generated data will enhance gate-to-gate traffic management services and incorporate safety alerting technology. MLAT at

Auckland and Queenstown provides additional data to ATS, ensuring safety and security of operations in the airspace and on the surface manoeuvring area.

8.3.6. Where Special Use Airspace (SUA) is adjacent to a CA, for efficiency, safety and security of continued operations and to ensure effective use of the CA, it is expected that civil aircraft using the SUA will be equipped appropriately, including VHF and ADS-B.

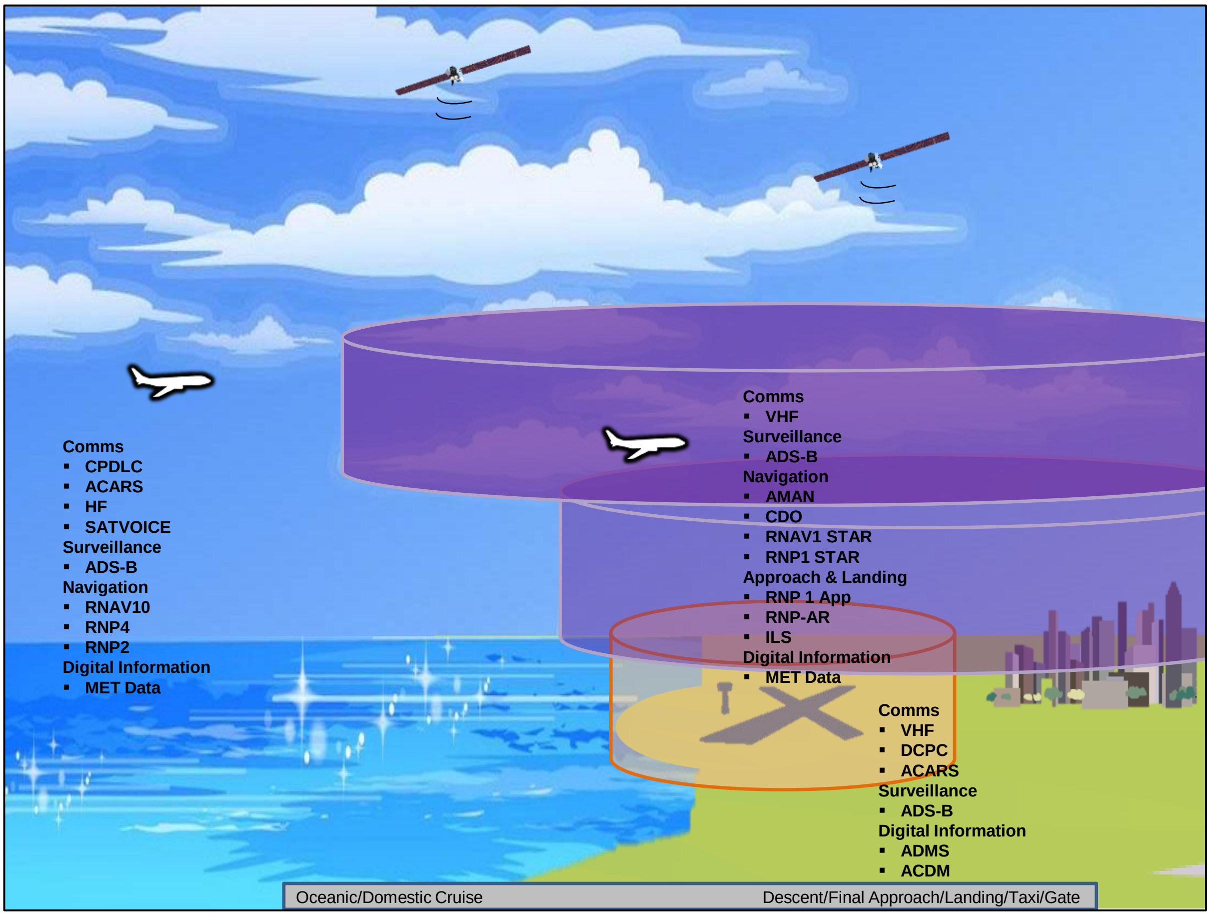
8.3.7. ATM procedures enabled by PBN and supported by full surveillance coverage should prevent aircraft being held at a sub-optimal altitude, which will reduce fuel burn. CDO will be provided through the use of PBN routes and AMAN. All STARs will be enabled by RNAV or RNP. Performance-based airspace procedures will optimise the aircraft profile taking account of airspace and traffic complexity including CDO supported by trajectory-based operations and self-separation. Integration of PBN STARs directly to all approaches with vertical guidance allows for both curved approaches and segmented approaches in an integrated system.

8.3.8. All controlled aerodrome runways with instrument approach procedures will be enabled by RNP, these approach procedures should be optimised to take advantage of vertical guidance. Vertical guidance will require Baro-VNAV or augmented GNSS. With the latter aircraft will be able to take advantage of the lowest possible minima through the extension of GNSS approaches.

8.3.9. Departures and Arrivals will be managed by ATS to allow arrival or approach trajectories to dynamically avoid severe weather such as lightning from cumulonimbus clouds, MET data being a key enabler.

8.4. Oceanic Arrival and Departure to FIR

Figure 7: Oceanic arrival Controlled Airspace



8.4.1. Oceanic Navigation will be RNAV10, RNP4 or RNP2 in Oceanic airspace.

8.4.2. Surveillance coverage will be enabled through ADS-B at the Oceanic/Domestic CA boundary. Combining data from multiple sources will enable Airways services to be more consistent, accurate, timely and efficient.

8.4.3. Communication at the Oceanic/Domestic CA boundary transitions from CPDLC to CPDC (VHF Voice). Descent procedures enabled by ADS-B will prevent aircraft being held at a sub-optimal altitude, which will reduce fuel burn. CDO will be provided through the use of PBN routes and AMAN. All STARs will be enabled by RNAV or RNP. Performance-based airspace procedures will optimise the aircraft profile taking account of airspace and traffic complexity including CDO supported by trajectory-based operations. Integration of PBN STARs directly to all approaches with vertical guidance allows for both curved approaches and segmented approaches in an integrated system.

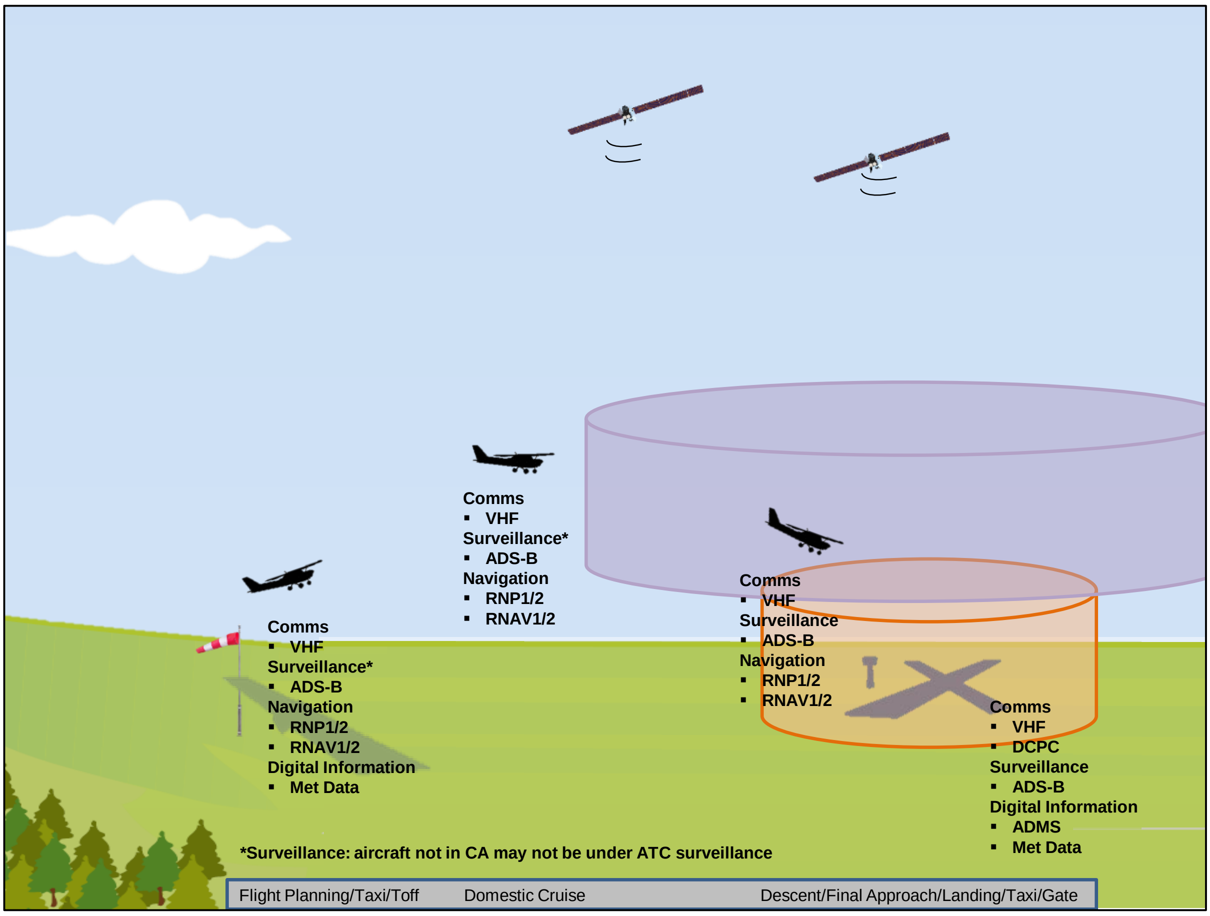
8.4.4. All runways with instrument approach procedures will be enabled by RNP, these approach procedures should be optimised to take advantage of vertical guidance.

8.4.5. Departures and Arrivals will be managed by ATS to allow arrival or approach trajectories to dynamically avoid severe weather such as lightning from cumulonimbus clouds, MET data being a key enabler.

8.4.6. On the ground, aircraft, ATM and ground systems generated data will enhance gate-to-gate traffic management services and incorporate safety alerting technology. ACDM will inform airport ground operations.

8.5. Surface to FL130 and VFR

Figure 8: Low Level IFR and VFR Controlled Airspace Below FL130



8.5.1. Recent accepted changes at ICAO will allow aircraft <5700kg and speed <200kts with map display capability and CDI minimum, to do RF hand flown curved approaches and departures. This change will enable optimisation of approach and departure procedures to/from uncontrolled and Mandatory Broadcast Zone (MBZ) aerodromes where the aircraft is then proceeding into or out of the CA.

8.5.2. The aircraft will have ADS-B for surveillance and VHF communications equipment for operations into CA. IFR capable light aircraft will be RNAV/RNP equipped for CA operations.

8.5.3. Integrated flight plan and MET data functionality will be implemented enabling geo-referenced pilot briefings. Aeronautical information data exchange between systems will be supported through SWIM.

8.5.4. VHF will be the primary Controller Pilot Direct Communications (CPDC) in domestic airspace.

8.5.5. All SIDs and STARs will be RNAV or RNP. IFR climb procedures will be enhanced through surveillance, all ATS routes will be enabled by RNP.

8.5.6. Surveillance coverage will be enabled through ADS-B. Combining data from multiple sources will enable Airways services to be more consistent, accurate, timely and efficient and provide separation between VFR and IFR in the CA.

8.5.7. Where a SUA is adjacent to a CA, for efficiency, safety and security of continued operations and to ensure effective use of the CA, it is expected the civil aircraft using the SUA will be equipped appropriately, including VHF and ADS-B.

8.5.8. Performance-based airspace procedures will optimise the aircraft trajectory in the CA and provide efficient and effective use of airspace and traffic separation. Integration of PBN STARs directly to all approaches with vertical guidance allows for both curved approaches and segmented approaches in an integrated system. Vertical guidance would enable aircraft to take advantage of the lowest possible minima through the extension of GNSS approaches.

8.5.9. For the flight training industry sector blocks of allocated airspace might need to be recognised, as challenges with the implementation of NSS and commercial aviation industry sector growth impact on Flight Training Organisations (FTO) operations, in particular IFR training. [13]

8.5.10. To continue operations in this modernised CA, some FTOs in New Zealand may have to undergo equipage upgrades for aging aircraft. Specifically, aircraft will need to be both ADS-B and RNAV/RNP capable for flight training purposes in CA.

8.5.11. Training aircraft suitably equipped and with ADS-B will enable more dynamic use of airspace close to airports where flight training is based from and co-located with RPT operations. Some airspace, in particular where there are high levels of RPT, may

[13]National Strategy for Flight Training, NSS, Aviation New Zealand, April 2016

need to be designed with consideration for the performance limitations of new technology light aircraft.

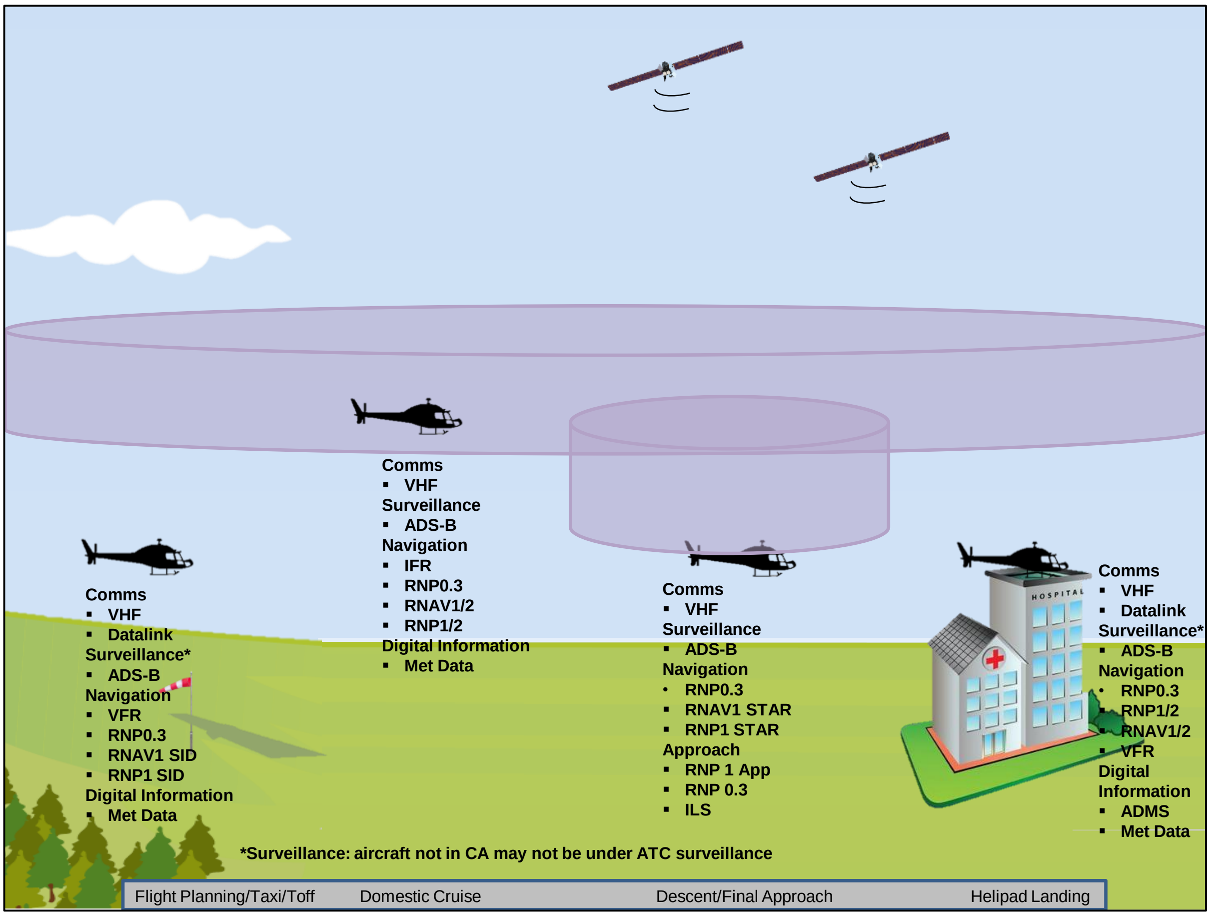
8.5.12. At airfields identified as having a high IFR training demand, alternate PBN procedures will be developed that can be flown safely by light aircraft and will not disadvantage the RPT traffic. The changes to ICAO document 9613 with RF curved approaches and departures for aircraft <5,700kgs and speed <200kts can optimise approach and departure procedures at controlled airfields where there is a mix of RPT and IFR training aircraft.

8.5.13. Collaboration between users, Airways and the CAA will see policy and procedures designed that optimise airspace use for effective flight training. The use of this technology will enable development of procedures and operations to/from aerodromes of high RPT traffic density, yet provide separation criteria for safe and secure operations.

8.5.14. Increased use of synthetic trainers in the aviation training sector will alleviate some of the potential airspace congestion and wait time issues.

8.6. Helicopter Operations

Figure 9: Helicopter Operations Controlled Airspace



8.6.1. RNP 0.3 was developed in response to the helicopter community's desire for narrower IFR obstacle free areas to allow operations in obstacle rich environments and to allow simultaneous non-interfering operations in dense terminal airspace. While this specification has been defined primarily for helicopter applications, it does not exclude the application to fixed wing operations where demonstrated performance is sufficient to meet the functional and accuracy requirements of this specification for all phases of flight.

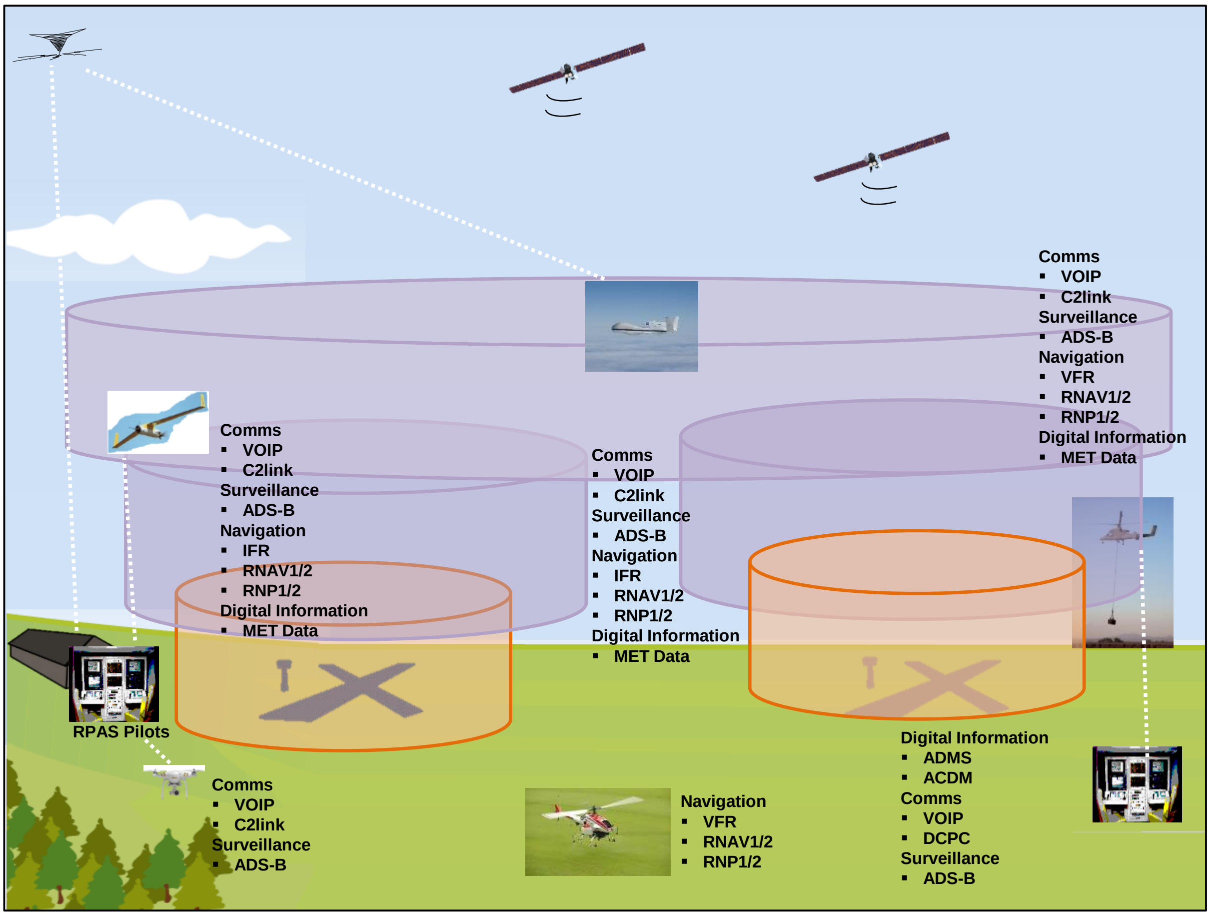
8.6.2. New helicopters and those retrofitted with new generation avionics are able to benefit from the introduction of PBN, RNAV and RNP routes, SIDs and STARs. Equipping with this functionality opens up opportunities, especially in the Emergency Medical Services, Search and Rescue, Police and Military operational environments. Development of specific departure and arrival approaches for helicopter operations and incorporating the new RF curved approaches and departures for aircraft <5,700kgs and speed <200kts can optimise approach and departure procedures at uncontrolled and controlled airfields and in uncontrolled environments, including heliports where specific procedures are developed.

8.6.3. The main form of communications will remain VHF, however, some helicopters will be equipped to accept data link communications. Surveillance will be through ADS-B. Integrated flight plan and MET data functionality will be implemented enabling geo-referenced pilot briefings. Aeronautical information data exchange between systems will be supported through SWIM.

8.6.4. Aircraft operations will be over RNAV/RNP enabled low level routes to a network of instrument approaches enabling continued VFR operations. The routes and approaches will be in a mix of both controlled and uncontrolled airspace, including controlled airfields, uncontrolled airfields, reference points and heliports. RNP and ILS approach capability is a feature of suitably equipped helicopters. Enabling these capabilities will enhance safety and security of operations and increase the flexibility of operational capability for suitably equipped operators. This functionality has wider context than the aviation industry, straddling New Zealand wider society across District Health Boards, Police and local community impacts.

8.7. Remotely Piloted Aircraft Systems (RPAS)

Figure 10: RPAS Operations Controlled Airspace



8.7.1. The CONOPS refer to operations under Part 102 operating outside of Part 101 requirements.

8.7.2. All data-link and voice CNPC links must operate over protected aviation spectrum, under International Telecommunications Union (ITU) designations Aeronautical Mobile (Route) Service (AM(R)S) and Aeronautical Mobile Satellite (Route) Service (AMS(R)S). RPAS will operate and be equipped as per the requirements for other IFR aircraft in controlled airspace.

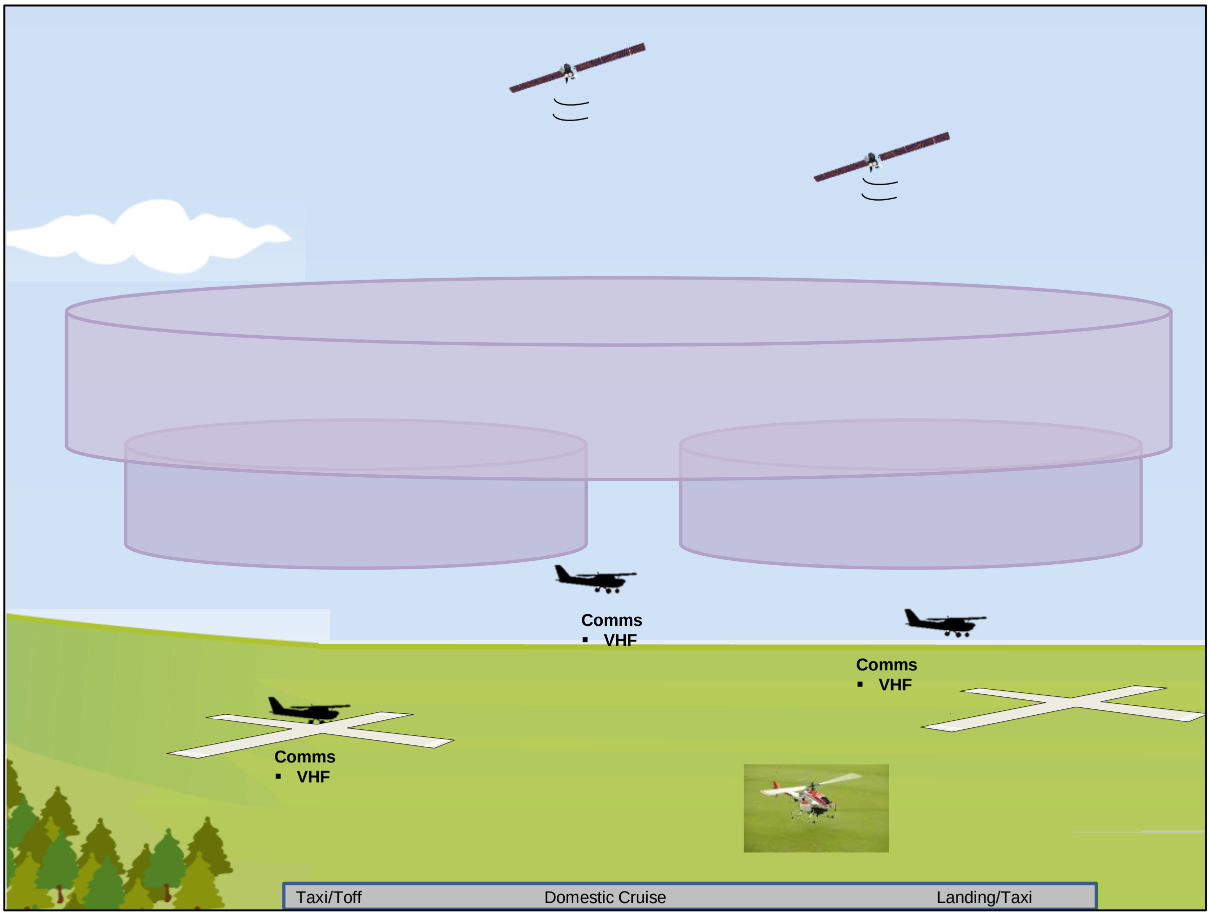
8.7.3. Communication will be enabled through datalink and VOIP to ensure clearance of a RPAS beyond line of sight and into controlled airspace. Surveillance will be through ADS-B, equipment that is available for the capability and performance of the RPAS. Loss of communications between the RPAS and operator, the RPAS will have a return to base of launch functionality, enabling safe recovery.

8.7.4. The RPAS will have extended operational capability, travel to/from base to destination, loiter and time on station to complete a mission. C2link communications between a pilot and the RPAS will help RPAS to integrate fully into controlled airspace. This will be enabled by the ICAO Required Link Performance

(RLP) concept. The RLP concept acknowledges that the C2link[14] may or may not carry ATC communications information and other types of CNS information. It also states that the RLP may be different for different RPAS, and is a function of the operational environment.

8.8. VFR

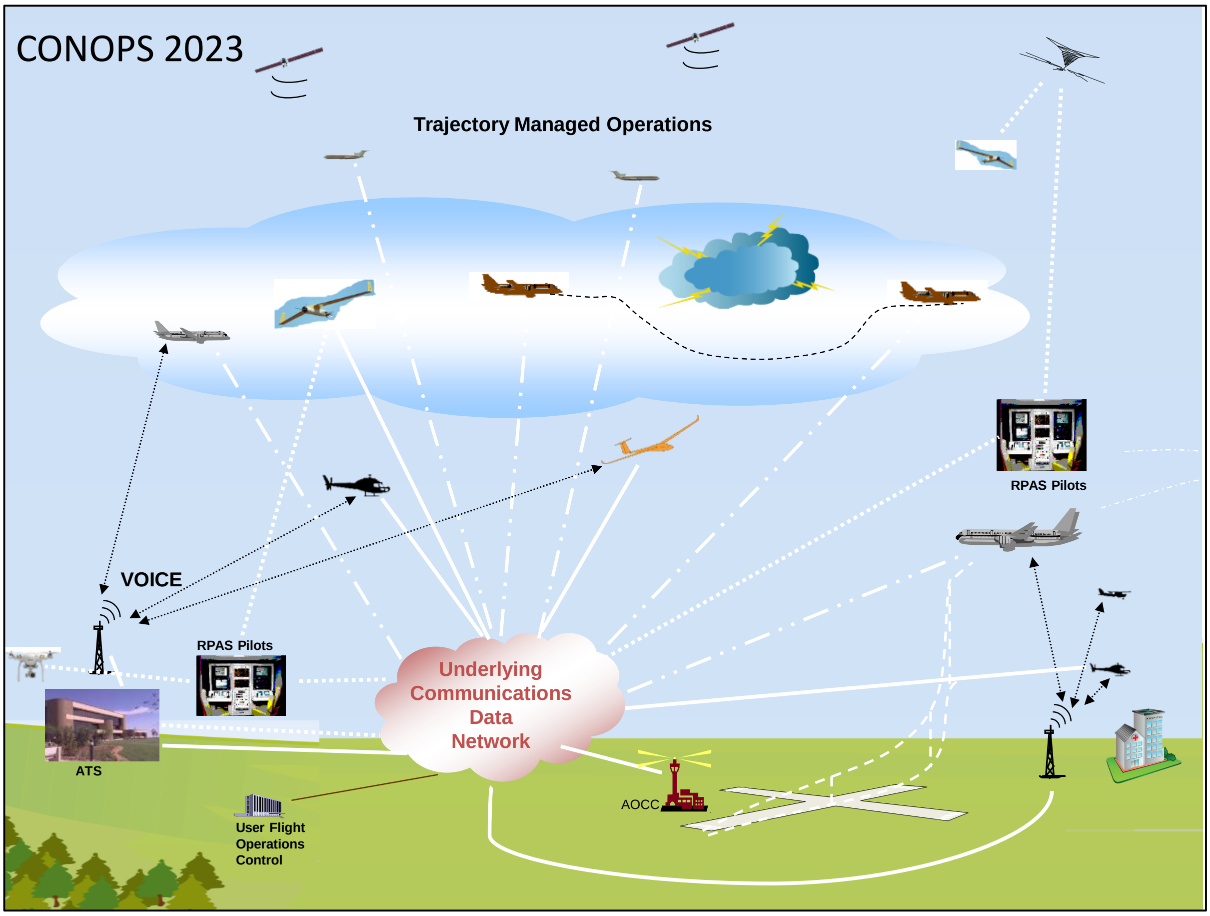
Figure 11: VFR Operations Uncontrolled Airspace



[14] C2 link is the aggregation of the airborne and ground-based functions, command and control, executed between the RPAS as commanded by the remote operator or automated to achieve the interactions required to ensure the safe and efficient flight of the RPAS during all phases of operations.

8.9. CONOPS 2023

Figure 12: CONOPS 2023



8.9.1. In 2023, at the end of stage three in the transformation of New Zealand FIR we will see greater use of digital data, providing a rich environment for information dissemination to aviation systems users. Optimal use of airspace will be achieved through suitably equipped aircraft operating in this airspace. This technology transition will be flexible, enabling growth in aircraft movements through the FIR and be able to accommodate aircraft with different layers of capability.

8.9.2. The design will be unique to New Zealand, providing operational ready airspace.

8.9.3. This CONOPS articulates what NSS will deliver to the New Zealand aviation system. Ultimately it will be enabled through appropriate policy, regulations, where needed, and users deploying the appropriate equipment. The CONOPS adds to the NSS strategy and objective outcomes work programme.

8.9.4. As policy, regulations, collaborations and technology develop the concept will be reviewed to keep pace with these changes.

Appendix 1: Background

The International Civil Aviation Organization (ICAO) is leading the global transition to an integrated and interoperable global air navigation system. ICAO has produced a Global Air Navigation Plan (GANP) to guide countries in their uptake of these new technologies. Many countries have their own plans, including the United States, which has put in place the NextGen programme[15]. Single European Sky (SESAR) is a multinational programme for the modernisation of European airspace.

In recognition of these technologies the New Zealand Cabinet approved in early 2014 the NAANP which was to be subsequently implemented through the New Southern Sky (NSS) programme to give a clear direction on incorporating new and emerging technologies into the New Zealand aviation system to ensure the safe, cohesive, efficient and collaborative management of New Zealand's airspace and air navigation to 2023.

The NAANP recognises these advances in technology and capability and provides the industry with a clear indication of the pathway that will be followed to modernise the aviation system in New Zealand and the investments that may be required in order to change the way New Zealand's airspace is managed.

NSS has been developed under The National Airspace Policy of New Zealand (2012), and Connecting New Zealand, a policy transport paper (2011).[16] It is also a key initiative in the Intelligent Transport Systems Action Plan[17], which outlines a proposed work programme on Intelligent Transport Systems for New Zealand.

There is no optimum time to make these changes, but it is the goal of the New Southern Sky programme to do so in a timely manner – working towards alignment in the industry and staying ahead of key areas of industry need. Proposed actions from the NAANP are staged over the periods 2014-15, 2016-18 and 2019-23.

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[15] NextGen is a wide-ranging transformation of the entire US national air transportation system.

[16] Connecting New Zealand

[17] Intelligent Transport Systems Action Plan 2014-2018

As a direct reaction of that endeavour, activities being planned in New Zealand are mapped to the global harmonisation activities of ICAO through the ICAO Aviation System Block Upgrades[18]. None of these initiatives would be possible without the input and collaboration of the New Zealand aviation industry and other key stakeholders.

To assist with the progressive implementation of NSS programme, a set of safety criteria for the New Zealand aviation system was developed for the period 2021/2023[19].

The objective of safety criteria is to ensure that the aviation system will meet the safety objectives set out in the New Zealand NAANP to ensure operations remain at a level of safety acceptable to the Director of Civil Aviation with system changes under the NSS programme. The safety criteria were designed to form the safety foundation of this Concept of Operations and other critical NSS projects.

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[18] Attachment 1

[19] Establishment of Aviation System Safety Criteria, Prepared for CAA by Navigatus Consulting, 15 April 2016.

Appendix 2: System Component Overview Transition

Performance Based Navigation – Ground-based to Performance Based Navigation

PBN involves area navigation procedures that are more accurate and allow for shorter, more direct routes. The use of PBN will enhance the reliability and predictability of approaches resulting in improved airport accessibility.

	Stage 1 by end of 2015	Stage 2 by end of 2018	Stage 3 by end of 2023
Performance Based Navigation (PBN) – *Ground-based to performance based navigation*	Continued use of legacy navigation applications while PBN capability is progressively implemented in aircraft fleets and the supporting infrastructure. The ground infrastructure associated with legacy navigation systems will be reviewed and progressively adapted.	Move to a more exclusive PBN environment that places greater reliance on the level of PBN capability in the national fleet and infrastructure. The ATM system will be managing a more homogeneous navigation capability.	A mature PBN environment with a comprehensive fleet and infrastructure capability. Air traffic management tools complement airborne systems and enable the management of those aircraft that may experience temporary loss of PBN capability. Contingency ground infrastructure that enables all aircraft to safely return to the ground.

Surveillance – Reducing our reliance on radar

Automatic Dependent Surveillance-Broadcast (ADS-B) technology is the primary method of air traffic control surveillance.

	Stage 1 by end of 2015	Stage 2 by end of 2018	Stage 3 by end of 2023
Surveillance – *Reducing our reliance on radar*	Planning for progressive implementation of ADS-B, including rule development and training and education programme development.	ADS-B exclusive airspace above FL 245 with supporting network of ADS-B receivers.	ADS-B exclusive in all controlled airspace. Some provision for back-up ground surveillance network and special areas for non-ADS-B equipped aircraft.

Communication – Incremental improvements

VHF will be the prime means of communication in the NZFIR with SATVOICE for oceanic communication and digital data exchange where possible

	Stage 1 by end of 2015	Stage 2 by end of 2018	Stage 3 by end of 2023
Communication – *incremental improvements*	Ongoing maintenance of the VHF network. Complete transition from AFTN to AMHS. Develop policy for Remotely Piloted Aircraft.	International pre-departure clearances via data-link. Review demand for additional use of data-link technology. VoIP for ground and remote communications. Implement Remotely Piloted Aircraft Policy.	VHF communication remains the primary means of domestic communication. Approve SATVOICE as a primary means of communication in oceanic controlled airspace. Implement results of review on Data-link technology. Transition to ATN protocol.

Aeronautical Information Management – Digital integration

Aeronautical Information Services will allow continuous, up-to-date and real-time information transfer

	Stage 1 by end of 2015	Stage 2 by end of 2018	Stage 3 by end of 2023
Aeronautical Information Management – *Digital integration*	Going digital: transition from AIS to AIM in accordance with ICAO roadmap.	Information management – system integration through common data standards and communications.	Real-time availability of aeronautical information and data into aircraft.

Air Traffic Management – From controlling to enabling

The Air Traffic Management (ATM) system will enable rather than control air traffic

	Stage 1 by end of 2015	Stage 2 by end of 2018	Stage 3 by end of 2023
Air Traffic Management – *From controlling to enabling*	Infrastructure, procedure and tool development towards trajectory-based management including education programmes.	Implementation of trajectory-based management tools, training programmes.	Trajectory-based management in place, supported by integrated information and collaborative processes.

Airspace Design – Review and refine

Airspace will accommodate increasing traffic, new types of aircraft and more direct and efficient flight paths, including remotely piloted aircraft activity and rocket launch sites

	Stage 1 by end of 2015	Stage 2 by end of 2018	Stage 3 by end of 2023
Airspace Design – *Review and refine*	Review existing designations and develop methodology and triggers for future reviews.	Full review of New Zealand airspace to be completed by this time.	Revised airspace in place, review options for transponder mandatory in uncontrolled airspace and for reduced need for control areas with greater use of aircraft self-separation.

Aerodromes – increasing capacity

Airport management will link in with both airspace management requirements and land management planning to ensure a seamless service for passengers and operators.

	Stage 1 by end of 2015	Stage 2 by end of 2018	Stage 3 by end of 2023
Aerodromes – *increasing capacity*	Establish collaborative decision-making forums and ensure effective contingency plans are in place.	Ensure that New Zealand's network of airports can support the changes occurring in the airspace and air navigation system.	Aerodrome master plans have regard to objectives and actions set out in the Plan.

Meteorological Services – Integrating MET information

Full integration of meteorological information into air traffic management and performance-based navigation applications will enable an interoperable, seamless air traffic management system

	Stage 1 by end of 2015	Stage 2 by end of 2018	Stage 3 by end of 2023
Meteorological Services – *Integrating MET information*	Develop WXXM format for MET reporting.	Integration of MET data with aeronautical information.	Real-time availability of MET data into aircraft.

Appendix 3: GNSS Sole Means Navigation

GNSS Sole Means Navigation based on the development of criteria introduced in the CAA report[20], notes limited sole means GPS navigation (ICAO PBN with segments of GPS sole means), is possibly viable. The extent to which this navigation means may be practiced depends on further assessment of a number of factors, such as flight procedures, satellite coverage forecast services, aircraft equipment requirements, airspace characteristics, local terrain assessments, crew training, and air traffic management system characteristics and requirements.

The precision enabled by GNSS navigation can improve safety throughout all phases of flight, as there is potentially a greater degree of certainty for both crew and air traffic control as to the accurate location of the aircraft. It does, however, rely on GNSS signal availability and continuity. An RNP specification includes a requirement for on-board performance monitoring and alerting, while an RNAV specification does not.

On-board performance monitoring and alerting is the main element that determines whether the navigation system complies with the necessary safety level associated to an RNP application; whether it relates to both lateral and longitudinal navigation performance; and whether it allows the aircrew to detect that the navigation system is not achieving, or cannot guarantee with integrity, the navigation performance required for the operation.

RNP systems provide improvements on the integrity of operations; this may permit and provide sufficient integrity to allow only RNP systems to be used for navigation in a specific airspace. The use of RNP systems for Sole Means Navigation may therefore offer significant safety, operational and efficiency benefits allowing Sole Means Navigation.

Sole Means Navigation could be supported by a combination of satellite information with inertial sensors (IRU), because the latter are an ideal complement to GNSS due to their good dynamic behaviour, although they are characterized by long-term drift as a result of misalignment, accelerometer and gyro errors. Within the New Zealand

[20] GNSS Sole Means Recommendation v2.0 2016

FIR, provided suitable SOPs and risk mitigation is undertaken, would provide the functionality and continuity required for Sole Means Navigation.

Primary Means Navigation functionality, where satellite signal continuity risk needs to be mitigated and GNSS is only available, could be supported through selection of a suitable alternate aerodrome, where a GBNA is located.

Appendix 4: SBAS

SBAS is being considered by the Ministry of Transport and Land Information New Zealand as part of a wider intelligent transport system (ITS) capability and is a NSS workstream. If adopted, the enhanced functionality offered by SBAS would allow aircraft to take advantage of the lowest possible minima through the extension of GNSS approaches. SBAS provides horizontal, lateral and vertical precision similar to Cat 1 ILS and therefore provides precision like capability across a wide number of airports, including sealed and grass airfields, heliports and selected reference points. SBAS was not considered, at this stage, in the development of the CONOPS

The introduction of SBAS would provide increased confidence in RPT scheduled service continuity to regional airports. SBAS would enhance the provision of airspace available for the flight training industry sector, including a wider choice in the development and design of IFR approach and departure procedures from airfields.

SBAS would also provide increased functionality for suitably equipped helicopter operations. Trajectory management capability of helicopters provides opportunities in arrival and departure design of STARs, approaches and SIDs.

It is worth noting that the installation of ADS-B equipment on GA aircraft will support SBAS functionality. However, without a SBAS service in the FIR this capability cannot be utilised.

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