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Implementation Paper - Performance Based Communication and Surveillance (PBCS)



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References

ICAO Doc 9869

ICAO Doc 4444

ICAO Doc 10063

National Airspace and Air Navigation Plan

Civil Aviation Rules

Airways Manual of Air Traffic Services – Oceanic Services (Amd 41 2016)

ICAO Doc 7030 Proposed Revision – PAC and MID-ASIA

ICAO Annex 6 Vol Tenth Edition, July 2016

FAA Notices to Airmen Domestic/International 9 November 2017 – Part 3, Section 2

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Performance Based Communication and Surveillance (PBCS)

Ensures that Air Traffic Services in Oceanic Airspace can be provided safely by ensuring that communication and surveillance data links meet suitable performance specifications.

This document - What we need you to do

This implementation paper provides the background to PBCS, and then proposes an introduction plan. It also highlights the likely impacts on the various participants within the New Zealand aviation system. Please provide feedback and comments on any of the contents of this document by 21 December 2017 to:

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Background – PBN and PBCS

The ICAO Performance Based Communication and Surveillance (PBCS) concept is aligned with that of performance based navigation (PBN). While the PBN concept applies required navigation performance (RNP) and area navigation (RNAV) specifications to the navigation element, the PBCS concept applies required communication performance (RCP) and required surveillance performance (RSP) specifications to communication and surveillance elements, respectively.

Figure 1 provides an overview of the performance-based communication, navigation, and surveillance (CNS)/ATM model, which outlines the relationship of the performance-based specifications among CNS elements supporting an ATM operation. In this case, Reduced Longitudinal or Lateral Separation is enabled by application of appropriate RNP, RSP and RCP standards to ensure that the performance of each element of the CNS results in the safe provision of the service. If any of the underlying performance standards are not met, then the system must revert to a less demanding ATM operation. (such as the application of larger separations)

PBCS as an Enabler - Reduced Separation

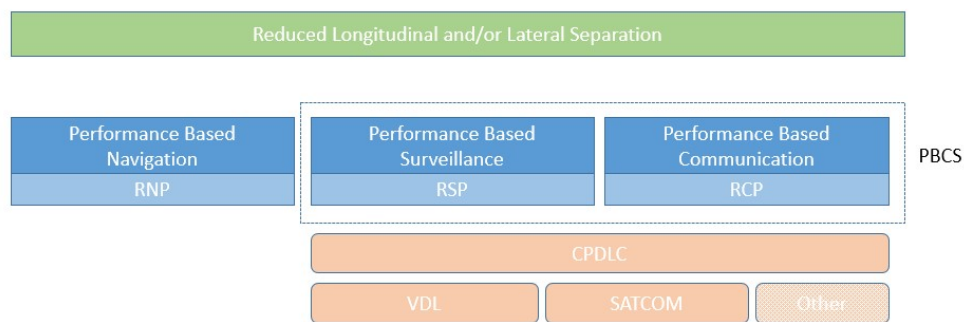


Figure 1 – PBCS and PBN standards enabling an ATM service

This document considers the elements within the PBCS box shown above, although the outcomes and benefits derived from the provided services are also considered.

PBCS is contained in the ICAO Standards and Recommended Practices (SARPs)

Required Communication Performance (RCP) and Required Surveillance (RSP)

The Required Communication Performance (RCP) and Required Surveillance Performance (RSP) specifications list transaction times, continuity, availability and integrity standards that correlate to the functional, safety and performance requirements for all components of communication and surveillance systems for a given service.

An example of the RCP₂₄₀ and ₄₀₀ specifications (safety criteria) is given below, taken from the ICAO PBCS manual.

Note: RCP transaction time is the time taken time taken for the controller to issue the instruction and receive the response from the Aircraft

RCP specification	RCP transaction time (sec)	RCP continuity (probability)	RCP availability (probability)	RCP integrity (acceptable rate/flight hour)
RCP 240	240	0.999	0.999	10^{-5}
RCP 400	400	0.999	0.999	10^{-5}

In addition, the PBCS monitoring programmes required as part of the concept will support hazard identification as well as safety risk assessment and management. It also supports exchange of safety information on a regional and global basis, and harmonises New Zealand with other states and Flight Information Regions.

Figure 2 shows a RCP and RSP being used during the provision of an Air Traffic Service. The RSP defines the performance of the ongoing ATM surveillance, while the RCP is used when communicating instructions with the aircraft.

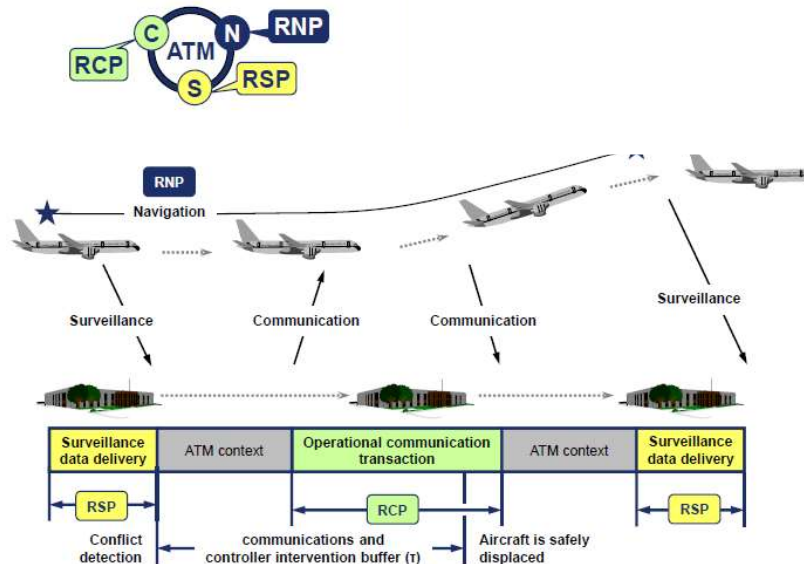


Figure 2 – Operational Use of an RSP and RCP specification

The importance of interface management for air traffic service providers and aircraft operators is highlighted in the PBCS concept. When communication and surveillance services are negotiated, the air traffic service provider and aircraft operator should establish proper mechanisms, such as administrative and legal arrangements (e.g. Service Level Agreements) that support the performance requirements needed for the Air Traffic Service. This should ensure the initial and ongoing compliance by the contracted Communications Service Provider (CSP) and Satellite Service Provider (SSP) with the functional, safety and performance requirements described in the RCP and RSP specification.

Any application for PBCS authorisation by an aircraft operator will consider the CSP and SSP arrangements as part of the authorisation criteria.

Assessing and applying a RCP or RSP Specification

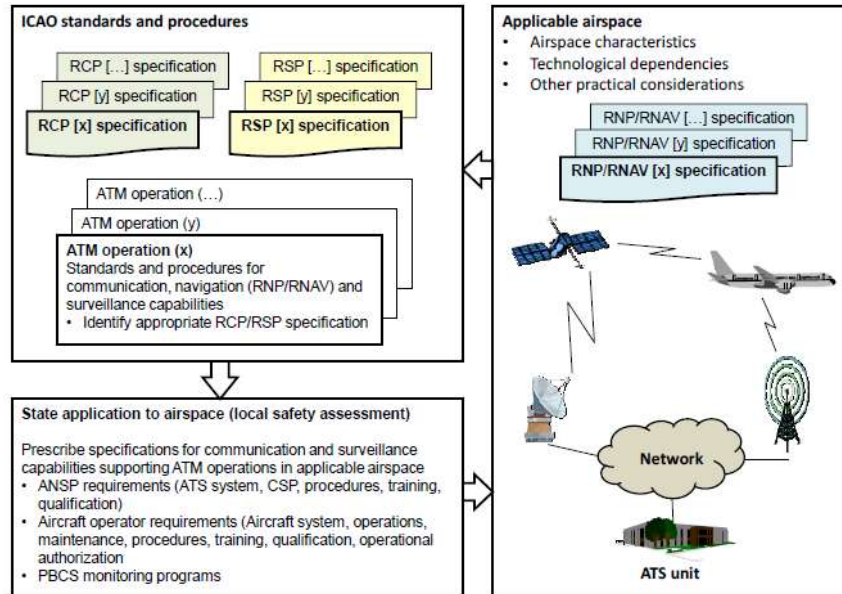


Figure 3 – Assessing and applying a RCP or RSP Specification

Figure 3 provides a synopsis for assessing the need for a required communication performance (RCP) and required surveillance performance (RSP) specification in a particular airspace. The potential need for an RCP/RSP specification is two-fold:

- the operational introduction of one or more new air traffic management (ATM) operations may prescribe an RCP/RSP specification (e.g. the introduction of reduced lateral and longitudinal separation minima or trajectory based operations); and
- the introduction of a new communication media technology may require an evaluation against the existing RCP/RSP specification (e.g. SATVOICE uses RCP₄₀₀, although this is outside the scope of this document)

In the New Zealand case, Oceanic reduced separation operation currently in use require both a RSP (for surveillance using ADS-C) and a RCP (for ATC-Aircraft communications using CPDLC) – see also next section.

New Zealand Oceanic Airspace

In the case of New Zealand, the airspace that is envisaged for PBCS is the Auckland Oceanic Flight Information Region (FIR), as this is the environment where Airspace Services (Separations) are currently used that are identified in PANS-OPS (ICAO Doc 4444) as requiring PBCS.

The applicable Longitudinal and Lateral Performance Based Separation Minima and RNP types and their respective RSP and PCP requirements from PANS-OPS (ICAO Doc 4444) are shown below:

LONGITUDINAL SEPARATION

<i>Separation minima</i>	<i>RNP</i>	<i>RCP</i>	<i>RSP</i>	<i>Maximum ADS-C periodic reporting interval</i>
93 km (50 NM)	10	240	180	27 minutes
	4	240	180	32 minutes
55.5 km (30 NM)	2 or 4	240	180	12 minutes
5 minutes	2 or 4 or 10	240	180	14 minutes

LATERAL SEPARATION

For a minimum spacing between tracks of 4.2.6 km (23 NM) a navigational performance of RNP 4 or RNP 2 shall be prescribed. The communication system shall satisfy required communication performance 240 (RCP 240) and the surveillance system shall satisfy required surveillance performance 180 (RSP 180).¹

Airways have been applying the longitudinal RNP₁₀ 50NM separation since the implementation of the Oceanic Control System in the 1990s, and the RNP₄ 30NM separation since 2007. Safety cases for both the 50NM and 30NM separations were prepared before they were implemented.²

PBCS specifically calls for the RCP₂₄₀ and RSP₁₈₀ requirements that were previously implicitly defined in the standard. Airways have been monitoring performance against both RSP₁₈₀ and RCP₂₄₀ since 2009, and have also taken a global lead in both PBCS monitoring and the development and managing of the Central Reporting Agency (CRA) problem reporting website since that time.

Airways are not proposing adopting any new Separation standards as a result of PBCS but require assurance of aircraft capability. In effect, PBCS further ensures the safety of the separations that are already in-use, chiefly by giving better knowledge of aircraft PBCS capabilities (via the Flight Plan) to the controller. Airways have already upgraded their Oceanic Control System to allow this information to be presented on-screen to the Oceanic Controllers.

It is worth noting that Airways withdrew the application of 30Nm and 50NM longitudinal separations from a specific operator's fleet in 2009 when monitoring determined that the performance of their aircraft had fallen below the 95% threshold for RCP₂₄₀ and RSP₁₈₀. In this respect, PBCS principles are already being applied in NZ Oceanic airspace.

PBCS AUTHORISATION = ELIGIBILITY FOR REDUCED SEPARATION (30 & 50 NM) IN AUCKLAND OCEANIC AIRSPACE

¹ Note that Airways in fact use a 30NM lateral separation according to MATS-OS

² Airways plan to implement the RNP₂ 20NM lateral standard for climb through and also the ADS-C CDP longitudinal standard later in 2017 or early 2018.. These new separations will be the subject of dedicated safety cases.

Note that for operators with existing RNP4 approvals, the introduction of PBCS requirements into Auckland Oceanic FIR does not mean these aircraft cannot use this airspace – it simply means they will not be eligible for 30 or 50NM separations without PBCS authorization from the State of Registry. Experience has shown that aircraft such as business jets are seldom subject to reduced separations as they typically operate at different levels to scheduled traffic, however this situation may change in the future as traffic density increases. In foreign airspace however, operators may be more disadvantaged by a lack of PBCS authorization.

Aircraft Equipage

For aircraft currently equipped for CPDLC and FANS1/A, there should be no need to change equipage on the aircraft. PBCS imposes standards and monitoring on the performance of such equipment to ensure it is sufficient for the airspace service (separation) being provided. Equipment that fails to perform to the required standards will require troubleshooting and rectification by the Operator.

It should be emphasised however, that experience to date has shown that HFDL does not meet the PBCS RCP240 standard. Note that although an existing NZ registered aircraft may already be equipped for PBCS, it will still be necessary to obtain operator authorisation from the CAA (see also PBCS authorisations section below). Such equipment will form part of the MEL for operations in PBCS airspace. (as per ICAO Annex 6, Chapter 7.1.3).

Flight Planning

When planning to operate in Airspace that includes PBCS, a PBCS authorised aircraft must file the relevant Indicators in the Flight Plan.

In the New Zealand case, this will then enable the Oceanic controller to apply reduced separations to this aircraft.

The New Zealand AIP will be updated by March 31 2018 to reflect these changes to the flight planning requirements, and an AIC issued in advance for general awareness.

The regional supplement (ICAO document 7030) will also be updated to reflect the PBCS status of the Auckland Oceanic FIR.

Monitoring and Troubleshooting

Central to the PBCS concept is ongoing monitoring of the PBCS performance of aircraft. This ensures that aircraft maintain the ability to deliver suitable communication and surveillance performance for the Air Traffic Service being provided. If an aircraft or operator falls below the threshold, they may be redirected to less advantageous separation standard and/or routing that has less stringent communication and surveillance performance requirements.

In New Zealand, Airways currently monitor the performance of all CPDLC and ADS-C equipped aircraft in the Auckland Oceanic Airspace on a monthly basis against the RCP240 and RSP180 specifications. Any performance deficiencies or interoperability issues are reported to the ISPACG CRA for investigation and resolution. Performance deficiencies may also be reported to the airline directly.

Note: Airways is reporting RCP240 and RSP180 performance on a per-aircraft/operator basis together with other ANSPs on the fans-cra.com website. The data is currently reported every six months.

The monitoring program also involves Operators, CSP and SSPs in seeking the source of substandard performance so that corrective actions can be taken to improve performance. For example, there have been examples of individual airframes showing significantly worse performance than the rest of an operator's fleet, which have been traced to installation issues or satellite provider misconfigurations.

The fans-cra.com website also maintains a list of recommended software versions for various aircraft, which seeks to ensure that the correct software to address identified issues is loaded.

PBCS Authorisation – NZ Registered Operator

A NZ registered aircraft operator may seek PBCS Authorisation from the CAA..

The exact requirements for this will be determined by the CAA, but are likely to encompass

- Aircraft capabilities, software versions and PBCS integration with Flight Management Systems.
- Statements of RCP and RSP Compliance from Aircraft Manufacturers and/or evidence of past RCP/RCP performance
- Participation in Monitoring Programs
- Evidence of agreements with CSPs and SSPs for performance level assurance, or evidence of agreement to the Performance-Based Communication and Surveillance (PBCS) Global Charter
- Aircrew training in PBCS awareness, and procedures for loss of PBCS capability

Authorised operators must demonstrate sufficient ongoing performance of their equipment, crew training and maintenance of the equipment.

Note that for operators with existing RNP₄ approvals, the introduction of PBCS requirements into Auckland Oceanic FIR does not mean these aircraft cannot use this airspace – it simply means they will not be eligible for 30 or 50NM longitudinal or 23 nm lateral reduced separations without PBCS authorisation. It is worth noting that experience has shown that aircraft such as business jets are infrequently subject to this reduced separation as they typically operate at different levels to scheduled traffic, however this situation may change in the future as traffic density increases. In foreign airspace however, operators may be disadvantaged by a lack of PBCS authorization.

PBCS Authorisations – Part 129 Operator

Foreign operators holding PBCS Authorisations from their state of registry will also wish want to be able to use reduced separation standards based on PBCS within Auckland Oceanic Airspace. As per the ICAO guidance, New Zealand would accept such foreign Authorisations, but will monitor such aircraft during the time they are within NZ Airspace.

Note that if their PBCS performance is shown to be below that required for the Air Traffic Services being provided, they may be denied such services despite their authorisation from their State of Registry.

PBCS in foreign airspace

To be offered air traffic services in foreign airspace with PBCS requirements, a NZ registered operator must generally provide evidence of PBCS authorisation from CAA New Zealand. This may affect operators entering the Mid-Asia, Pacific and North Atlantic regions. A lack of authorisation from CAA may disadvantage those operators by restricting them to less direct routings involving wider separation standards, or less efficient cruising altitudes.

**PBCS AUTHORISATION = ELIGIBILITY FOR REDUCED SEPARATION (30 & 50 NM)
IN AUCKLAND OCEANIC AIRSPACE**

Other Services and Applications

There are other future applications for PBCS, which are outside the scope of this document.

SATVOICE – The performance of SATVOICE is governed by specification RCP400. However, it is not currently used in New Zealand for the provision of an Air Traffic Service. The use of SATVOICE is currently under review by CAA, so operators are advised to ensure that any SATVOICE system installed in their aircraft is capable of meeting RCP 400, and must continue to meet Long Range Communications Systems (LRCS) requirements unless specifically authorized by CAA.

RPAS – There is an emerging standard called Required Link Performance (RLP), which uses the same PBCS concept for the communication between a Remotely Piloted Aircraft and its ground control station.

ICAO APAC Region PBCS Implementation Strategy and North Atlantic Implementation

The ICAO Asia-Pacific region has resolved to introduce PBCS. The following is an extract from the APAC Regional PBCS Implementation Strategy

States are urged to take appropriate measures to develop, establish, implement and promulgate, through advisory circular or other relevant State instruments, necessary policies and procedures to enable operators conducting flights in airspace where separations are dependent on Performance- Based Communication and Surveillance (PBCS) to start using required communication performance (RCP) / required surveillance performance (RSP) indicators in the flight plan as soon as possible.

...

The application of existing and planned RNAV and RNP-based 50 NM and 30NM longitudinal and 30NM lateral separation minima should continue, subject to the conditions that:

- a. PBCS monitoring is in place; and*
- b. Performance-based horizontal separation using PBCS designators in flight plans is implemented as soon as practically possible;*
- 3. Common implementation dates are applied by States using PBCS indicators to establish performance-based separation in adjacent airspace, supported by joint submission of Proposals for Amendment (PFA) to ICAO Doc 7030 – Regional Supplementary Procedures; and*
- 4. States that apply or plan to apply 30 NM and/or 50 NM longitudinal separation minima and/or 30 NM or 23 NM lateral separation minimum are urged to implement the ATM system capability to process and use ICAO PBCS flight plan indicators to determine aircraft eligibility for performance based horizontal separation by **not later than 29 March 2018**;*

...

Of these items, a number have already been achieved for New Zealand:

- As noted in previous sections, the Airways Oceanic Control System is already prepared to accept PBCS indicators in the flight plan, while PBCS monitoring is already ongoing and the results are being reported to the global Reporting Agencies.
- The requirement for the “ICAO Doc 7030 – Regional Supplementary Procedures” has also already occurred, with Proposals for Amendments (PFA) agreed by the ICAO regional and global offices for both the PAC and MID-ASIA regions.
- Updates to the New Zealand AIP (ENR 1-10) to include PBCS indicators to be used in flight plans occurred in September 2017. Further updates will occur in March 2018.

In parallel, the North Atlantic Region has been proposing a PBCS mandate for this airspace. The following is an extract from the FAA Notices to Airmen, 7 November 2017 Edition:

On 29 March 2018, the RLatSM trials will be replaced by 23 nautical mile (NM) (1/2-degree latitude) lateral track spacing for operators specifically authorized for PBCS and Performance Based Navigation (PBN) separation criteria. Three OTS tracks, between flight levels 350–390 inclusive, will be set aside for aircraft authorized for PBCS and PBN operations

PBCS Outcomes and Benefits

Within the New Zealand Aviation system, PBCS will contribute to performance-based Safety outcomes. For each group, the outcomes and benefits are listed below:

Operators

For operators with PBCS authorisation, unrestricted access to airspace where PBCS RCP and RSP standards are in place as entry criteria – for example the North Atlantic (NAT), where PBCS will be a requirement for access to the Organised Track System (OTS) tracks between FL350 and 390 after March 29 2018.

In the Pacific, less need to change altitude or route. This is due to the application of Reduced Separation between PBCS approved aircraft to resolve possible conflicts without resorting to level or heading changes.

Note: After 29 March 2018 and without PBCS authorisation, an operator will only be eligible for 100nm separations, even if approved for RNP4.

Compliance with ICAO Annex 6 Tenth Edition 2016

Airways

Confident, safer decision making in applying Reduced Separations by making visible the capabilities of the aircraft on-screen for the controller.

Confirmation of aircraft capability from the filed flight plan.

Reduced controller workload by increased use of Reduced Separations to resolve conflicts.

Compliance with ICAO Document 4444.

CAA

Additional authorisations and oversight of Operators and ANSPs

Visibility and oversight of surveillance and communications performance, enabling safety assessments to be made.

Greater assurance that ATM services are being provided in accordance with ICAO SARPS

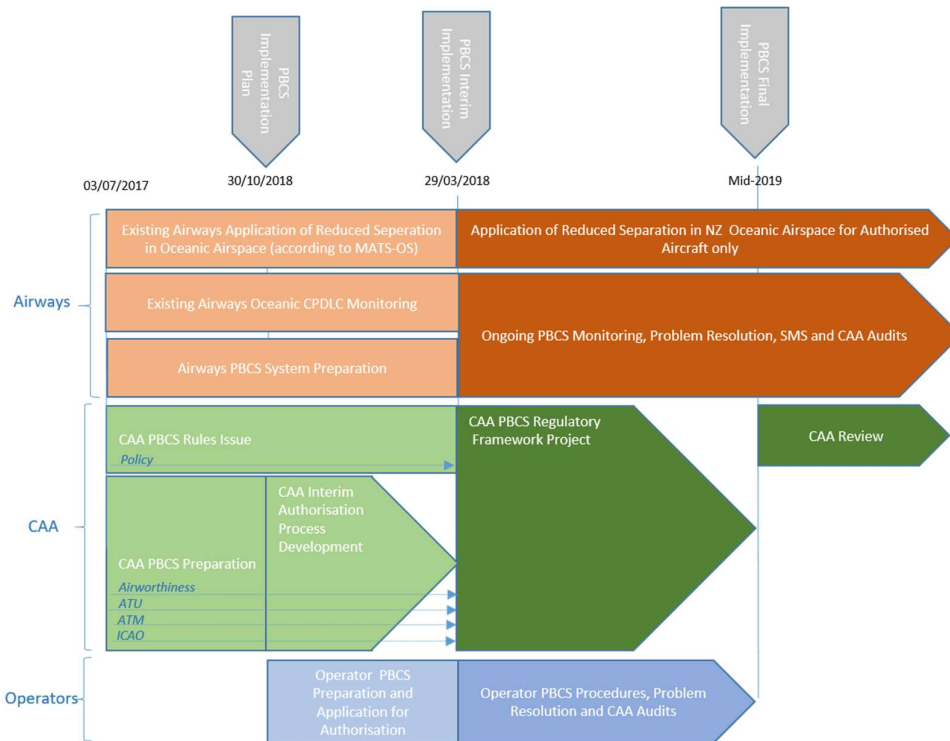
Additional regulatory options to ensure safe standards are maintained.

Compliance with ICAO Documents 4444, 9869 and Annex 6 Tenth edition.

Roadmap and Phased Introduction

As mentioned above, the ICAO Asia Pacific timeframe envisages 29 March 2018 as the date by which APAC states will introduce PBCS.

For New Zealand, we propose the following timeplan, which includes CAA projects and reviews subsequent to this document, is shown below



In Detail:

By 29 March 2018 (ICAO Asia Pacific Implementation Date)

- Issue interim authorisation or letter acknowledging compliance upon request for NZ registered Operators subject to them meeting suitable criteria. In addition to the requirements listed in the "PBCS Authorisations" section, such criteria may also take into account historical performance of aircraft fleets, according to data already collected over a number of years by Airways, and/or be based on another state's requirements.
- Update Regional Guidance material (Doc 7030) to describe PBCS operations in NZ Oceanic Airspace within the PAC and MID-ASIA regions.
- Recognise PBCS authorisations from foreign states
- Allow approved Operators to file PBCS indicators in flight plans. This is assisted by adding the appropriate entries into the AIP.
- Update Airways procedures to include taking Fight Plan filed PBCS indicators into account when assigning separation in Auckland Oceanic Airspace.
- Ongoing monitoring of interim authorisations to gauge impact and improvements.

By mid-2019

- Enable appropriate rule changes to allow full NZ authorisations for PBCS, as determined by the current Rules Issue process underway, the PBCS Regulatory Framework Project and Ministry of Transport approval for appropriate rule changes
- Release an Advisory Circular (or other suitable notification) outlining the PBCS authorisation criteria and process.
- Commence review of PBCS, to determine if the Outcomes and Benefits described in this document have been realised and the level of Safety and Performance has not deteriorated compared with today, as evidenced by Performance Measurements and Airspace Incidents.

What does PBCS mean to me?

As a Part 121, Part 129 or other operator using CPDLC/FANS1A

If you wish to operate in airspace with PBCS procedures, and take advantage of reduced separation (e.g Auckland Oceanic) or more efficient cruising levels (e.g North Atlantic),

- Obtain PBCS authorisation from the CAA as an additional item on your Operational Specification. This will include
 - Engage with your CSP and/or SSP on SLAs or other suitable methods for meeting performance requirements
 - Obtaining a statement of compliance or other suitable evidence of suitability of your FANS1A aircraft equipage to meet PBCS requirements
 - Obtaining data on the past performance of your fleet from ANSP and/or CRA
 - Training flight crews
- Engage with other regulatory authorities on the requirements for operating PBCS in their airspace.
- Participate in ongoing monitoring of RCP and RCS performance of your fleet
- Be prepared to investigate and correct inadequate performance of you aircraft Communications and Surveillance equipment as reported from the CRA, ANSP or regulator.
- Keep your fleet onboard software up to date to avoid known issues
- Incorporate PBCS indicators into flight planning systems. These are listed in AIP Section ENR 1.10
- Development of maintenance procedures to ensure that PBCS-critical equipment is suitably maintained and available before flight into PBCS airspace
- Be prepared for PBCS to form part of regulatory oversight and inspections
- Develop operational procedures for loss of PBCS capability and provide crew training.

As a pilot flying in PBCS airspace

Training on operator PBCS procedures, including what to do in the event of loss of PBCS capability and likely ATC actions

As an ANSP

- Update ATM systems to include PBCS capabilities as notified by Flight Plan
- Review ATC procedures to include use of PBCS capabilities in existing reduced separation airspace, and contingencies for loss of PBCS capability in both single and multiple aircraft.
- Consider PBCS in safety cases for future Air Traffic Management enhancements.
- Air Traffic Controller training on application of PBCS in air traffic management,
- Procedures for moving aircraft from PBCS to non-PBCS environments
- Procedures for loss of PBCS capability, for either single or multiple aircraft scenarios.

As an Aircraft maintainer/despatcher

- Awareness of procedures concerning PBCS equipment, especially before despatching an aircraft into PBCS airspace or investigation of performance defects.

For the CAA

- Development of PBCS-related rules and guidance material
- Issue Authorisations of PBCS to New Zealand Register operators, and notification of this to ANSPs and CRAs
- Update of AIP and Regional guidance
- Ongoing regulatory oversight of PBCS including
 - Participate in ongoing monitoring of RCP and RCS performance of State of Registry aircraft.
 - Participate in ongoing monitoring of RCP and RCS performance of Foreign registered aircraft in terms of overall Airspace Safety
 - Regulatory action in the event of persistent or non-actioned inadequate PBCS performance.
 - Incorporation of PBCS into inspection and audit procedures for ATM, Flight Operations, Airworthiness and Maintenance.

