Fact SHEET 2

INTRODUCTION TO AIR TRAFFIC MANAGEMENT AND AIR TRAFFIC CONTROL

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CHRISTCHURCH AIRPORT

Air traffic management (ATM) systems are essential for the safe and efficient flow of aircraft in the air, on approach to and departure from an airport runway.

1 WHAT IS AN AIR TRAFFIC MANAGEMENT SYSTEM?

The ATM system provides for aircraft flights from departure and en-route to arrival and landing; elements include Air Traffic Services (ATS) such as Air Traffic Control (ATC), Airspace Management (ASM), and Air Traffic Flow Management (ATFM).

KEY COMPONENTS ARE:

- **Regulations, procedures, and organisation of airspace around the airport and en-route.**
- **An organisation and highly trained staff providing ATC services.**
- **Computer systems providing ATC with information on the status, location, separation, and projected flight paths of aircraft in the airspace and on the ground, and associated decision support to expedite air traffic flows safely and efficiently.**
- **Communications, navigation and surveillance (CNS) systems, employing digital technologies, including satellite navigation systems applied in support of a local and global ATM.**

2 EVOLUTION OF AIR TRAFFIC CONTROL

Conventional navigation was originally through visual flight. It then progressed to aircraft operations relying on ground-based radio navigation aids such as NDB (non-directional beacon), VOR (very high frequency omni-directional range), and DME (distance measuring equipment) to navigate to or from an airport. Where there is coverage, particularly in high density airspace corridors, there may be a higher level of intervention such as radar guidance from air traffic control centres.

Conventional air routes were based on old aircraft capabilities and navigation means. This resulted in large protection areas and separation criteria to cope with the limited accuracy of estimated aircraft positions. Navigation routes were based on ground-based navigation aids which were overflown and/or provided a position relative to these facilities. Consequently, flight path design had limited flexibility and air routes had limited capacity as traffic through the airspace increased. Although still in wide use, visual and ground-based navigation is no longer suitable for a modern aviation industry with denser air routes and higher levels of safety and efficiency in terms of aircraft fuel burn, emissions, noise impact, and maximising airspace and runway capacity.

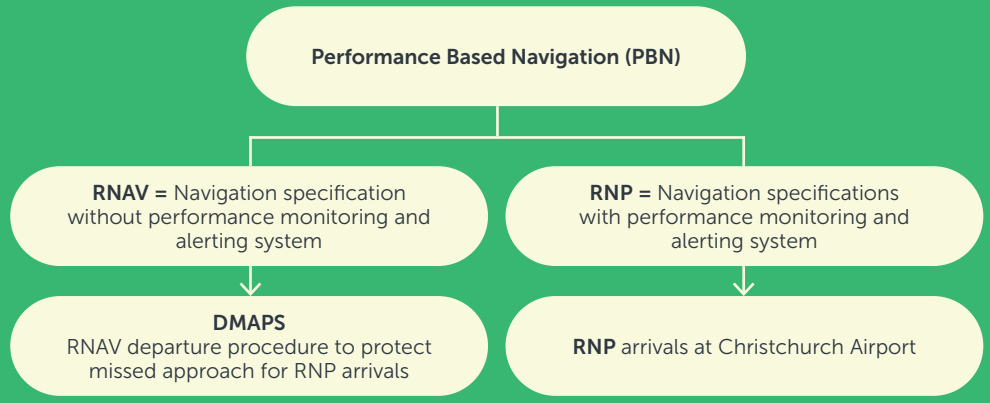
3 PERFORMANCE-BASED NAVIGATION (PBN)

Air navigation has transitioned from conventional ground-based radio navigation aids to **performance-based navigation (PBN)**. PBN is an advanced, satellite-enabled form of air navigation that creates precise three-dimensional (3D) flight paths. These procedures and routes offer several operational benefits, including enhanced safety, increased efficiency, reduced carbon footprint, and reduced cost. PBN allows more direct optimised flightpaths, continuous climb and descent, and other efficiencies in aircraft operations which translate into reduced aircraft fuel burn, emissions and airspace congestion.[1]

The objective of PBN is to improve the precision of aircraft navigation through the introduction of a globally recognised set of standards defined by the International Civil Aviation Organization (ICAO). Historically the air transport route network was designed with reference to ground-based radio navigation aids. Pilots navigated from point to point along a set of fixed routes based on the location of the aids. The development of area navigation (RNAV) in aircraft Flight Management Systems (FMS) removed the dependency on ground-based aids.

RNAV stands for **Area Navigation** and refers to the capability of an aircraft pilot to fly any desired flight path, defined by waypoints such as geographic fixes (latitude and longitude) and not necessarily by reference to ground navaids.

RNAV has been enhanced by the development of Global Navigation Satellite Systems (GNSS) that enable much more accurate aircraft positioning. There are different specifications of PBN which vary depending on the level of accuracy, consistency and functionality that the aircrafts' navigation systems have to meet.



RNAV specifications describe the basic level of performance. The New Zealand en-route network is based on RNAV 2 where '2' denotes a performance requirement of +/- 2 Nautical Miles for 95% of the flight time. The RNAV 1 specification (+/- 1 Nautical Mile) is considered the minimum standard for introducing new arrival and departure routes in busy terminal airspace like Auckland. In practice the track keeping accuracy achieved by aircraft is much more accurate than the 2 or 1 miles implied by 'RNAV 2' and 'RNAV 1'.

RNP (Required Navigation Performance)[2] is a similar specification to RNAV but requires that aircraft have systems to monitor navigation performance and alert the flight crew if the required levels are not being achieved. RNP applications are also more precise and include advanced capabilities like curved paths.[3]

When PBN procedures were introduced at Christchurch International Airport via the RNP arrivals and Divergent Missed Approach Protection System (DMAPS) departures the opportunity was taken to mitigate noise impacts by making the turns in the direction of less populated areas, namely to the north-west and south-west, rather than north-east and south-east.

[1] CANSO and ACI, Use of Performance Based Navigation (PBN) for Noise Management, Shaping our Future Skies, Feb 2020. www.canso.fra1.digitaloceanspaces.com/ uploads/2021/04/use_of_performance_based_navigation_pbn_for_noise_management.pdf

[2] The latest version of Airways AIPs now denotes RNP (as described here) as RNP-AR (Authorisation Required), with RNP now referring to the RNAV specification described above. For the purposes of this report the terminology RNP is applied throughout as described above.

[3] Airbus ProSky, PBN Implementation from Industry perspective RNAV, RNP & RNP, ICAO AFI/MID ASBUS Implementation workshop 23-26 Nov 2015, Cairo. www.icao.int/MID/ Documents/2015/AFI-MID%20ASBU%20Impl.%20Workshop/2.1-3%20AIRBUS%20PBN%20Impl.%20from%20Industry%20perspective.pdf

4 REQUIRED NAVIGATION PERFORMANCE ARRIVALS AT CHRISTCHURCH AIRPORT

Advanced PBN procedures with CAA Authorisation Required (termed RNP AR) have been introduced to shorten flightpaths and reduce flight time, fuel burn and CO2 emissions for suitably capable aircraft arriving into Christchurch Airport (most jets and some turboprops).

5 DIVERGENT MISSED APPROACH PROTECTION SYSTEM AT CHRISTCHURCH AIRPORT

DMAPS is an innovative system that has been introduced at Christchurch Airport. DMAPS protects PBN approaches which, in the event of a go-around or missed approach, ensures pre-programmed routes will diverge at 30 degrees from aircraft on a PBN departure. This enhances safety, while improving aerodrome capacity by 40% in nearly all-weather conditions – a feature which reduces airborne and ground holding and so also reduces flight times and generates environmental efficiencies.

6 OTHER NAVIGATION TERMS AT CHRISTCHURCH AIRPORT

Parts of this report refer to the following terms which are briefly described below:

ILS approach

Visual approach

Radar tracks

SIDs/STARs/ Cancelled SIDs

INSTRUMENT LANDING SYSTEM (ILS) APPROACH

An aircraft in the final phase of flight to land on a runway, using guidance from a ground-based landing aid.

An Instrument Landing System (ILS) allows aircraft to land at an airport when there is poor or low visibility. An ILS is comprised of two transmitters—the localiser and glide slope. This ensures the aircraft is within the lateral and vertical parameters for the runway being used.[4]

VISUAL FLIGHT PATH AND VISUAL APPROACH AND DEPARTURE

Instrument flight procedure design and Instrument Flight Rules (IFR) are procedures and rules which enable aircraft to operate in all weather conditions, including when navigation by visual references is not possible. In contrast Visual Flight Rules (VFR) are procedures and rules for how aircraft are to be operated when the pilot uses visual reference to the ground or water to navigate. In the case of visual landing, the pilot must establish and maintain visual contact with the runway from a specified minimum altitude above the airport.

RADAR TRACKS

Radar tracks are a dataset of actual historical flown aircraft flight tracks departing from and arriving at Christchurch Airport. Airways provided this data to the project team for use in flight track modelling.

STANDARD INSTRUMENT DEPARTURES (SIDS), STANDARD TERMINAL ARRIVAL ROUTES (STARS), CANCELLED SIDS

'Standard Instrument Departure (SID)/Standard Terminal Arrival Route (STAR) procedures are a means of graphically communicating large amounts of complex information that would otherwise need to be issued by Air Traffic Control. Both depict the lateral profile of an instrument departure or arrival route and the level and speed restrictions along it. SID/STAR phraseology allows ATC and aircrew to communicate and understand detailed clearance information that would otherwise require long and potentially complex transmissions.[5]

SIDs and STARs are also used to de-conflict the departure and arrival paths of flights, and leverage the capabilities of modern flight management systems to fly precise trajectories. All of these, when coupled with good airspace design, facilitates the use of continuous climb operations (CCO)/continuous descend operations (CDO) procedures leading to an overall reduction in phraseology, workload and improves operational efficiency.'[6]

The pilot must comply with a published SID and STAR, both specify track, vertical profile and any speed requirements. Any specified element of a SID or STAR can be cancelled or amended by the air traffic controller. A pilot may request a SID or STAR (or portion of this) to be cancelled and ATC may approve or deny this request. A SID or STAR cancellation may facilitate a reduction in distance to be flown, an approval to avoid hazardous weather, or be required to maintain separation with other aircraft.

This is explained further in *Fact Sheet 4: Outcome of the peer review process – updates to the 2021 Draft Updated Noise Contours.*

[4] Air Services Australia, Our Technology. https://www.airservicesaustralia. com/about-us/our-services/how-air-traffic-control-works/our-technology/

[5] STARS, https://www.icao.int/airnavigation/sidstar/Documents/New%20 SID%20n%20STAR%20Phraseologies%20 Communication%20Leaflet.pdf

[6] https://www.icao.int/airnavigation/sidstar/Pages/Background.aspx