PBN Navigation Specification & TMA Design

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RO ATM/SAR
The latest edition of the PBN Manual, ICAO Doc 9613 contains navigation specifications that cover:

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<td>RNP APCH$^6$</td>
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<td>RNP AR APCH</td>
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8. The RNP 0.3 specification is primarily intended for helicopter operations.

$^1$ Missed approach

$^2$ RNAV 5 is an en-route navigation specification which may be used for the initial part of a STAR outside 30 NM and above MSA.

$^3$ The RNP 1 specification is limited to use on STARs, SIDs, and the initial and intermediate segments of instrument approach procedures and the missed approach after the initial climb phase; beyond 30 NM from the airport reference point (ARP), the accuracy value for alerting becomes 2 NM.

$^4$ Advanced RNP also permits a range of scalable RNP lateral navigation accuracies – see the PBN Manual, Vol. II., Part C, Chapter 4, paragraph 4.3.3.3.4.

$^5$ Optional - requires higher continuity.

$^6$ There are two sections to the RNP APCH specification; Part A is enabled by GNSS and Baro VNAV, Part B is enabled by SBAS.

$^7$ RNP 0.3 is applicable to RNP APCH Part A.

$^8$ Different angular performance requirements are applicable to RNP APCH Part B only.

$^9$ RNP 0.3 specification is primarily intended for helicopter operations.
Continuous Descent Operations (CDO's)

- RNP 1/2
- RNP 10-4 (Oceanic)
- RNAV 5/2 (Continental)
- RNAV 1/2
- RNP 2
- RNP 1/2
- RNP APCH
- RNP AR APCH

PBN Airspace Concept
Overview

OBJECTIVE

Methodology STEPS

This module will provide an good understanding of Airspace volumes and Sectorisation in support of Air traffic Management
Airspace Volumes protect the IFR Flight paths. They are Designed AFTER the routes have been designed.

Routes should not be designed so as to fit into pre-existing Airspace Volumes.

Only delineate as much airspace volume as needed.
**TMA**

*Terminal control area*

A control area normally established at the confluence of ATS routes in the vicinity of one or more major aerodromes.
**TMA** - Terminal area surrounds an airport, and it is an airspace within which air traffic control service is provided.

Such airspace predominantly contains traffic operating along Terminal Routes.

*The above description is aimed at including TMA, CTA, CTR, ATZ airspace classification or any other nomenclature used to describe the airspace around an airport.*
COMPETING INTERESTS

STRUCTURES & SECTORS: Objectives

ATC REQUIREMENTS
SAFETY, CAPACITY & EFFICIENCY
SUFFICIENT AIRSPACE TO ACCOMMODATE -
/ ROUTES (TACTICAL AND PUBLISHED)
/ HOLDING PATTERNS
/ TRAFFIC SEQUENCING TECHNIQUES

USER REQUIREMENTS
Unhindered airspace access

ENVIRONMENTAL REQUIREMENTS
Airspace 'Prohibitions' over cities, natural parks, residential areas

SAFETY, CAPACITY & EFFICIENCY
SUFFICIENT AIRSPACE TO ACCOMMODATE -
/ ROUTES (TACTICAL AND PUBLISHED)
/ HOLDING PATTERNS
/ TRAFFIC SEQUENCING TECHNIQUES
Airspace Volumes

 Controlled Airspace

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Airspace Volumes

Protect IFR Flight Paths
Airspace Volumes

Do not take more airspace than needed....
Terminal Airspace

1 Terminal Airspace (As per Chapter 6)

2 Terminal Airspaces
N Sectorised
New northern Holds
More IFR Traffic

3 Terminal Airspaces
Parallel RWY added at N
New southern Hold
More Traffic to Y

4 2 larger Terminal Airspaces
Two-Phase holding system
More Traffic

5 1 Terminal Airspace system
with Entry Gates; Revised Sectorisation

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TMA – May combine two or more sector volume, aimed at improving the design and management of terminal routes and ATC sectorisation, servicing several airports in close proximity.
Evolution of functions

Ref. Figure 7-1 (above): Evolution of Terminal Airspaces X in the vertical dimension and associated sample ATC functions.

Terminal Airspace System - Sectorisation & ATC function

<table>
<thead>
<tr>
<th></th>
<th>Terminal Airspace</th>
<th>Approach Control</th>
<th>Area Control</th>
<th>Hybrid ACC-APP Control</th>
</tr>
</thead>
</table>
ATC Sectorisation

Upper ACC Sectors

ACC S1

ACC S2

ACC S3

ACC Lower

Approach E

Approach W

AD

GEOGRAPHIC

FUNCTIONAL
## GEOGRAPHICAL SECTORISATION

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
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<tbody>
<tr>
<td>➤ Controller can fully exploit the space available in sector to manipulate best levels for inbounds/outbounds and expedite climb and descent without need for co-ordination.</td>
<td>➤ Controller handles mixed traffic i.e. arrival, departure and transit traffic.</td>
</tr>
<tr>
<td>➤ Easier to balance workload between sectors.</td>
<td>➤ In instances where the sector division runs along the runway centre-line, departing aircraft departing in different directions may be controlled by different controllers after take-off. (Effective mitigation can be provided by putting appropriate procedures in place).</td>
</tr>
<tr>
<td>➤ Can be less demanding in terms of the Radar Display and ATC system</td>
<td>➤ In cases where an aircraft is required to transit more than one geographic sector in the Terminal Airspace, this can add to complexity by requiring additional co-ordination.</td>
</tr>
<tr>
<td>➤ Relatively easily to describe operational instructions for ATC areas of responsibility.</td>
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## FUNCTIONAL SECTORISATION

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
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<tbody>
<tr>
<td>➔ Controller handles one traffic type i.e. either departures or arrivals because sector defined as a function of task.</td>
<td>➔ Vertical/Lateral limits of sector can prove overly restrictive as one (vertical) band is unlikely to cater for all aircraft performance types.</td>
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<tr>
<td>➔ Usually, <em>all</em> departing aircraft are on the same frequency after take-off.</td>
<td>➔ Difficult to balance workload between sectors especially where departure and arrival peaks do <em>not</em> coincide.</td>
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<tr>
<td>➔ In some configurations, can prove more flexible to operate.</td>
<td>➔ Can be demanding in terms of the Radar Display and ATC System</td>
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<td>➔ Operating instructions for ATC can be difficult to formulate with respect to areas of responsibility;</td>
</tr>
</tbody>
</table>
Avoid Sector designs that cause stepped climbs or descents
Sectorisation

Maintain holding area in same sector

Avoid crossing too close to sector boundary

Sector boundaries should not coincide with route centre lines

Preferably, keep sectors the same when runway changes

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**SE4.2:** The vertical limits of a geographically defined sector need not be uniform i.e. fixed at one upper level or one lower level, nor need these vertical limits coincide with the vertical limits of (horizontally) adjoining sectors.

**Figure 6-15:** Vertical Sector boundaries and crossing routes
Thank You