# GUIDANCE TO STATES ON BASIC RNAV ROUTE SPACING

(as approved by ANT/12, with slight editorial amendments)

## 1. INTRODUCTION

1.1 This guidance material describes minimum spacings between parallel Basic RNAV route centre lines applicable in ECAC airspace. The basis for this material consists of existing ICAO material and additional studies performed by EUROCONTROL in the framework of EATCHIP.

## 2. REFERENCE MATERIAL

### 2.1 ICAO Annex 11

2.1.1 ICAO Annex 11, Attachment B contains guidance material on route spacing. §2.3 of the Attachment B refers to the spacing between parallel routes (RNAV/RNAV and RNAV/conventional).

### 2.2 EUROCONTROL studies

2.2.1 EUROCONTROL safety studies into RNAV route spacing minima included theoretical collision risk assessments based solely on the navigation capability of the aircraft, as well as studies in which an ATC intervention capability and related theoretical radar controller intervention rates were calculated .

2.2.2 Results of these studies (including the applied assumptions) have been assessed on their operational merit and applicability, in order to ensure appropriate perception of the results.

### 2.3 ICAO Airspace Planning Manual

2.3.1 In 1997 the ICAO Document “Airspace Planning Methodology for Determining Separation Minima” (also called the Airspace Planning Manual) will become available, which gives guidance on the aspects which influence the safety of route spacing and separation minima, and on how to take these aspects into account. The document does not include separation or route spacing minima which would be applicable world-wide, although examples of safety assessments have been included.

2.3.2 As many of the safety assessment aspects in the Manual were derived from European (and EUROCONTROL/EATCHIP) activities, the methods applied within European safety assessments can be considered to be compatible with the contents of the Airspace Planning Manual. However, the Airspace Planning Manual is to be considered as a valuable overview of methods which have been applied for air traffic separation safety assessments throughout the world, and as a possible basis for safety assessments for application in particular air traffic environments.

### 2.4 ECAC Strategy

2.4.1 As reflected in the ECAC strategy, ECAC Airspace can be regarded as a radar environment, in which radar ATC service is provided. The provision of radar ATC service implies some form of radar monitoring of air traffic.

## 3. BASIC RNAV ROUTE SPACING IN ECAC AIRSPACE

3.1 ICAO Annex 11 material gives guidance on RNAV route spacing in §2.3 of Attachment B. That paragraph refers to VOR parallel route spacing as being applicable also to RNAV parallel route spacing. Attachment A states that the VOR route spacing values should only be applied after study of the underlying safety assessment and assumptions. For application in ECAC airspace this has been carried out in the context of EUROCONTROL studies.

3.2 EUROCONTROL considerations (theoretical risk assessment as well as an operational appreciation of assumptions and application) have concluded that the following route spacings are applicable in ECAC Basic RNAV airspace, without any additional ATC workload for correcting deviations due to inaccuracies of the navigation system:

- 18 NM for opposite direction routes,
- 16.5 NM for same direction routes, and
- 15 NM if the aircraft on adjacent (opposite direction) routes are not assigned the same flight levels, and the percentage of climbing and descending traffic is 40% or less.

## 4. REDUCTION OF BASIC RNAV ROUTE SPACING

4.1 Route spacing reductions to 10 - 15 NM are expected to be possible in ECAC Basic RNAV airspace by putting higher reliance on the radar ATC intervention capabilities. The circumstances in which such a reduction of route spacing is applied, will need to be assessed on a case by case basis.

4.2 It should be recognised that when route spacing is reduced through increased reliance on radar monitoring and radar intervention capabilities, acceptable ATC workload plays a primary role. This aspect depends largely on local ATC conditions, procedures and systems, and should therefore be subject to local appreciation, not different from existing operations and implicit responsibilities. In this context reference is made to material in ICAO Doc 4444 (PANS/RAC), PART VI on Radar Services, especially to §7.2: “Use of radar in the air traffic control service”.

4.3 In support of the assessment of acceptable Basic RNAV route spacing in ECAC airspace, results from EUROCONTROL studies into the theoretical radar ATC intervention rate for RNP 5 RNAV route spacings have been presented as guidance in Appendix A.

4.3.1 The results of the theoretical studies should be seen in the light of the assumptions made. First of all, the actual navigation performance in ECAC Basic RNAV airspace is expected to be much better than the theoretical 100% RNP 5 performance, which will significantly reduce the required controller intervention rate. Secondly, the number of required interventions will be reduced if the aircraft on adjacent (opposite direction) routes are not assigned the same flight levels. Moreover, the theoretical ATC intervention modes to correct navigational deviations which have been assumed in the study may often not be required due to early anticipation of undesirable traffic situations and due to implicitly required interaction with air traffic as part of normal radar supported ATM.

4.3.2 It is expected that in those situations where a specific route spacing smaller than 15 NM is currently applied, the mere introduction of Basic RNAV in 1998 on that same route system will not involve a sudden increase in the number of required ATC

interventions, given that currently an estimated 80% of aircraft apply some form of RNAV navigation on the VOR/DME route network.

4.3.3 Nevertheless, an important aspect to be recognised is that the results of the study indicate that when in a Basic RNAV environment the route spacing is reduced towards 10 NM, the number of required interventions would rise significantly. Depending on the acceptability of this, States may consider the application of ATC supporting tools like deviation alerts.

## 5. VOR/DME VERSUS RNAV NAVIGATION

5.1 One of the starting points for the requirements for Basic RNAV was that navigation performance of Basic RNAV would be similar to that currently achieved on VOR/DME defined routes. Considering this and several other reasons, RNP 5 was considered the appropriate RNP type to be associated with Basic RNAV in ECAC airspace. In general practice, however, it is expected that the navigation accuracy of Basic RNAV equipped aircraft is better than RNP 5. On the other hand it has been recognised that navigation solely through the use of RNAV equipment might show navigation errors which were not present when navigating on VOR/DME. These navigation errors include operational errors as related to the use of the on-board RNAV equipment. The safety assessment work undertaken by EUROCONTROL has indicated that the collision risk associated with closely spaced parallel routes is very sensitive to the frequency of these types of large errors and the efficiency with which ATC is able to detect and correct them. Currently not enough information on these errors is available.

5.2 Although, as stated previously (see §4.3.2), the introduction of RNAV in 1998 is not expected to introduce an instant increase in navigational errors, it is still deemed appropriate to define a method of obtaining data on actual RNAV performance in ECAC airspace. This data will be applied to assess the cause of errors and deviations, in order to take remedial action if required, e.g. by introducing flight deck and/or ATC procedures to prevent operational errors which are related to the use of RNAV equipment. Which method is best for this purpose is still under consideration by EUROCONTROL.

## 6. SUMMARY AND CONCLUSIONS

6.1 The following route spacings are applicable in ECAC Basic RNAV (RNP 5) airspace, without any additional ATC workload for correcting deviations due to inaccuracies of the navigation system:

- 18 NM for opposite direction routes,
- 16.5 NM for same direction routes, and
- 15 NM if the aircraft on adjacent (opposite direction) routes are not assigned the same flight levels, and the percentage of climbing and descending traffic is 40% or less.

6.2 Route spacing reductions to 10 - 15 NM are expected to be possible in ECAC Basic RNAV airspace by putting higher reliance on the radar ATC intervention capabilities. The reduced route spacing to be used will have to be determined on a case by case basis, i.e. should be based on the capabilities of the individual ATC centres. Before implementation, States should verify that the route spacing does not unduly affect controller workload.

6.3 Data on actual RNAV performance is required to assess RNAV specific causes for navigation deviations, as a basis for defining remedial actions, if so required.

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# APPENDIX A
# THEORETICAL ATC INTERVENTION RATES

This Appendix briefly outlines the results of a EUROCONTROL study into the theoretical ATC intervention rates in a Basic RNAV parallel route system. The study was performed to derive information on the effect which the reduction of route spacing may have on the required controller intervention rate.

The EUROCONTROL study into the theoretical intervention rate for Basic RNAV route spacing has been based on a number of assumptions. These assumptions include:

- 100% RNP 5 performing aircraft (i.e. 5 NM, 95%)
- The ATC sector contains a parallel route system of 100 NM in length
- The ATC sector contains 7 flight levels
- Aircraft are assigned the same flight levels on both (parallel) tracks
- The traffic flow is 25 aircraft per hour per track (divided over the 7 flight levels)
- Two intervention modes are considered:
    1. deviation mode:
        The controller intervenes to prevent an aircraft from entering the 5 NM wide middle zone between the two route centre lines.
    2. conflict mode:
        The controller intervenes to prevent a pair of aircraft to come within a 5 NM distance from each other.

The Table below contains the resulting theoretical ATC intervention rates, for route spacings of 10, 12 and 14 NM. Any change in the traffic flow or track length would produce a proportional change in intervention rates.

**Table** - Estimates of the ATC Intervention Rates (per hour) for closely spaced parallel B-RNAV/RNP5 Routes.

| Track Spacing - → | 10 NM | 12 NM | 14 NM |
|---|---|---|---|
| ↓ Type of ATC Intervention ↓ | | | |
| Conflict Mode - Same Direction<br>- Opposite Direction | 0.2 to 0.3<br>3 to 5 | 0.08 to 0.1<br>1 to 1.5 | 0.02 to 0.03<br>0.3 to 0.5 |
| Deviation Mode | 11 to 16 | 6 to 10 | 3 to 5 |

Considering these results, due account should be taken of:

1. the fact that the underlying assumptions can be regarded as a worst case scenario, and
2. the comments in § 4.3 of the body of the guidance material.

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