

INTERNATIONAL CIVIL AVIATION ORGANIZATION

**FOURTH MEETING OF DIRECTORS OF CIVIL AVIATION OF THE
CENTRAL CARIBBEAN**

(Grand Cayman, Cayman Islands, 17-20 May 2000)

Agenda Item 3: Air Traffic Management

**c) Application of 10-minutes Minimum Longitudinal Separation
and 80 NM RNAV in the Central Caribbean**

**10-minute longitudinal separation minimum using the Mach Number Technique and/or
80 NM RNAV in the Central Caribbean**

(Presented by the Secretariat)

Summary

This working paper presents to the Meeting the need to introduce in the C/CAR the 10-minute longitudinal separation minimum applying the Mach number technique and/or 80 NM RNAV. This separation will permit in some Flight Information Regions (FIRs) of the Central Caribbean the improvement of the use of airspace at a significant rate, and thus making it more efficient by increasing the use of the optimum flight levels.

- References:
- Procedures for Air Navigation Services – Rules of the Air and Air Traffic Services Doc 4444 – RAC/501
 - Preliminary Report of the CAR/SAM/3 RAN Meeting, (Buenos Aires, October 1999)
 - Draft CAR/SAM Regional Air Navigation Plan , Volume II - FASID

1. Introduction

1.1 In some of the Flight Information Regions of the Central Caribbean, Area Control Centres (ACC), 15-minute longitudinal separation minimum for flights at the same level has been used for many years. The sustained increase of flights in the Caribbean region over the last few years is causing congestion at levels FL 310 through 390 when aircraft try to obtain their optimum cruising levels.

1.2 Until some years ago, 10-minute longitudinal separation minimum could only be used in places with enough nav aids allowing the constant verification of the position of aircraft or through regional supplementary procedures using that separation in conjunction with the Mach number technique.

1.3 Amendment 2 of the 13th edition of PANS/RAC 4444 effective 5 November 1998 allows the use of this 10-minute longitudinal separation minimum and/or 80 NM RNAV using the Mach number technique (see **Appendix A** to this Working Paper).

1.4 During the CAR/SAM/3 Regional Air Navigation Meeting, held in Buenos Aires, Argentina in October 1999, some recommendations relating to the use of 10-minute longitudinal separation minimum and/or 80 NM RNAV were formulated. Likewise, they have been included in the ATM evolution for the CAR/SAM Regions as the first phase of the application of separations in all the international traffic flows of the CAR/SAM Regions (See **Appendix B** to this Working Paper).

1.5 It is known that some States of the CAR and SAM Regions agreed during 1998 and 1999 to start using 10-minute longitudinal separation minimum in conjunction with the Mach number technique to replace the 15-minute separation (for instance COCESNA and Jamaica).

2. Discussion

2.1 The use of 15-minute longitudinal separation minimum for aircraft using the same cruising level is causing an inefficient use of airspace in some FIRs of the CAR region, where, due to lack of surveillance means such as radar, ATS coordination among the adjacent Area Control Centres obligates the use of conventional separations where aircraft are not obtaining the requested cruising levels that allows for optimum flight. Moreover, a high percentage of aircraft flying in the CAR Region is equipped with Area Navigation (RNAV), which allows aircraft positioning in a more precise way.

2.2 Both the PANS/RAC Doc 4444 and CAR/SAM/3 recommendations referred to in par. 1.3 and 1.4 respectively as well as ATM evolution contained in the CAR/SAM Air Navigation Plan FASID permits the use of the 10-minute longitudinal separation minimum and/or 80 NM RNAV. The Meeting should note the need for States of the Central Caribbean that have not yet done so, to study the application of 10-minute longitudinal separation minimum and/or 80 NM RNAV with the aim to achieving a more efficient use of airspace, thus allowing aircraft to use their optimum cruising levels when crossing their Flight Information Regions (FIRs).

2.3 The use of 10-minute longitudinal separation minimum and/or 80 NM RNAV would eventually allow an increase in capacity on some routes of up to 50% with regard to the current optimum cruising levels used. An example of this situation is route UA315 where the application of 15-minute longitudinal separation minimum in Port-au-Prince and Curaçao FIRs does not permit optimum cruising levels use during traffic peak periods.

2.4 It is important to note that the implementation of 10-minute longitudinal separation minimum needs to be pursued throughout the ICAO CAR Region to ensure the harmonization of the separation standards. This will ensure that there are no incompatibilities in separation standards between Area Control Centres (ACCs) in the CAR Region. Eventually, coordination will be conducted with those ACCs in the SAM Region that share boundaries with the CAR Region to adopt the same separation standards.

2.5 As is being conducted in the C/CAR DCA meetings by the presentation of this working paper, the ICAO NACC Office will begin the initial coordination in other DCA meetings and Informal Working Groups in the CAR Region to pursue this effort and when appropriate, begin the initial coordination with the SAM Region to harmonize the 10-minute longitudinal separation minimum.

2.6 **Appendix C** to this Working Paper shows the longitudinal separations minima used in the different FIRs of the Central Caribbean.

2.7 Taking into account the information shown in the table in Appendix C, it is of the utmost importance that CAR Region States that have not yet done so, take the necessary measures to implement as soon as possible 10-minute longitudinal separation minimum applying the Mach number technique and/or 80 NM RNAV separation, for those aircraft that possess this navigation capability instead of 15-minute longitudinal separation minimum. This might be attained through bilateral contacts with adjacent ATC units and/or coordinating through ICAO NACC Office in order to implement this ATM improvement.

2.8 Based on the above, the Meeting is suggested to adopt the following Draft Conclusion:

Draft Conclusion 4/x **Use of 10-minutes longitudinal separation minimum and/ or 80 NM RNAV in the Central Caribbean**

That,

- a) Central Caribbean States that have not yet done so, take the necessary measures to implement as soon as possible 10-minute longitudinal separation minimum applying the Mach number technique and/or 80 NM RNAV for those aircraft possessing this capability; and

- b) this implementation be carried out during 2000 to achieve the completion of this longitudinal separation reduction no later than the first semester of 2001, either through bilateral contacts and/or through coordination with the ICAO NACC Office.

3. Suggested Action

3.1 The Meeting is invited to:

- a) Take note of the need to improve the use of airspace in the Central Caribbean through the use of 10-minute longitudinal separation minimum applying the Mach number technique and/or 80 NM RNAV; and
- b) To approve Draft Conclusion shown in par. 2.8

Appendix A

8.2 Longitudinal separation minima based on time

8.2.1 Aircraft at the same cruising level

8.2.1.1 Aircraft flying on the same track:

- a) 15 minutes (see Figure III-8); or
- b) 10 minutes, if navigation aids permit frequent determination of position and speed (see Figure III-9); or
- c) 5 minutes in the following cases, provided that in each case the preceding aircraft is maintaining a true airspeed of 37 km/h (20 kt) or more faster than the succeeding aircraft (see Figure III-10):
 - i) between aircraft that have departed from the same aerodrome;
 - ii) between en-route aircraft that have reported over the same exact reporting point;
 - iii) between departing and en-route aircraft after the en-route aircraft has reported over a fix that is so located in relation to the departure point as to ensure that five-minute separation can be established at the point the departing aircraft will join the air route; or
- d) 3 minutes in the cases listed under e) provided that in each case the preceding aircraft is maintaining a true airspeed of 74 km/h (40 kt) or more faster than the succeeding aircraft (see Figure III- 11).

8.2.1.2 Aircraft flying on crossing tracks:

- a) 15 minutes (see Figure III-12); or
- b) 10 minutes if navigation aids permit frequent determination of position and speed (see Figure III-13).

8.2.2 Aircraft climbing or descending

8.2.2.1 *Traffic on the same track.* When an aircraft will pass through the level of another aircraft on the same track, the following minimum longitudinal separation shall be provided:

- a) 15 minutes while vertical separation does not exist (see Figures III-14A and III-14B); or
- b) 10 minutes while vertical separation does not exist, provided that such separation is authorized only where navigation aids permit frequent determination of position and speed (see Figures III-15A and III-15B); or
- c) 5 minutes while vertical separation does not exist, provided that the level change is commenced within 10 minutes of the time the second aircraft has reported over an exact reporting point (see Figures III-16A and III- 16B).

Note.- To facilitate application of the procedure where a considerable change of level is involved, a descending aircraft may be cleared to some convenient level above the lower aircraft, or a climbing aircraft to some convenient level below the higher aircraft, to permit a further check on the separation that will obtain while vertical separation does not exist.

8.2.2.2 Traffic on crossing tracks:

- a) 15 minutes while vertical separation does not exist (see Figures III-17A and III-17B); or
- b) 10 minutes while vertical separation does not exist if navigation aids permit frequent determination of position and speed (see Figures III-18A and III-18B).

8.2.3 *Traffic on reciprocal tracks.* Where lateral separation is not provided, vertical separation shall be provided for at least ten minutes prior to and after the time the aircraft are estimated to pass, or are estimated to have passed (see Figure III- 19). Provided that it has been determined that the aircraft have passed each other, this minimum need not apply.

8.4 Longitudinal separation minima with Mach number technique based on time

8.4.1 Turbojet aircraft shall adhere to the Mach number approved by ATC and shall request ATC approval before making any changes thereto. If it is essential to make an immediate temporary change in the Mach number (e.g. due to turbulence), ATC shall be notified as soon as possible that such a change has been made.

8.4.2 If it is not feasible, due to aircraft performance, to maintain the last assigned Mach number during en-route climbs and descents, pilots of aircraft concerned shall advise ATC at the time of the climb/descent request.

8.4.3 Provided that:

- a) the aircraft concerned have reported over the same reporting point and follow the same track or continuously diverging tracks until some other form of separation is provided; or
- b) if the aircraft have not reported over the same reporting point and it is possible to ensure, by radar or other means, that the appropriate time interval will exist at the common point from which they either follow the same track or continuously diverging tracks; when Mach number technique is applied, minimum longitudinal separation between turbojet aircraft on the same track, whether in level, climbing or descending flight shall be:

- i) 10 minutes; or
- ii) between 9 and 5 minutes inclusive, provided:

the preceding aircraft is maintaining a Mach number greater than the following aircraft in accordance with the following table:

- 9 minutes, if the preceding aircraft is Mach 0.02 faster than the following aircraft;
- 8 minutes, if the preceding aircraft is Mach 0.03 faster than the following aircraft;
- 7 minutes, if the preceding aircraft is Mach 0.04 faster than the following aircraft;
- 6 minutes, if the preceding aircraft is Mach 0.05 faster than the following aircraft;
- 5 minutes, if the preceding aircraft is Mach 0.06 faster than the following aircraft.

8.4.4 When the 10-minute longitudinal separation minimum with Mach number technique is applied, the preceding aircraft shall maintain a Mach number equal to or greater than that maintained by the following aircraft.

8.5 Longitudinal separation minima based on distance using RNAV

Note.- Guidance material on RNAV operations is contained in the Manual on Required Navigation Performance (RNP) (Doc 9613).

8.5.1 Separation shall be established by maintaining not less than the specified distance between aircraft positions as reported by reference to RNAV equipment. Direct controller-pilot communications should be maintained, while such separation is used. Where high frequency or general purpose extended range very high frequency air-ground communication channels are used for area control service and are worked by air-ground communicators, suitable arrangements shall be made to permit direct controller-pilot communications, or monitoring by the controller of all air-ground communications.

8.5.1.1 To assist pilots to readily provide the required RNAV distance information, such position reports should, wherever possible, be referenced to a common way-point ahead of both aircraft.

8.5.2 RNAV distance-based separation may be applied between RNAV-equipped aircraft when operating on designated RNAV routes or on ATS routes defined by VOR.

8.5.3 A 150 km (80 NM) RNAV distance-based separation minimum may be used on same-direction tracks in lieu of a 10-minute longitudinal separation minimum. When applying this separation minimum between aircraft on same direction track, the Mach number technique (MNT) shall be applied, and the preceding aircraft shall maintain a Mach number equal to or greater than that maintained by the following aircraft.

8.5.4 Turbo-jet aircraft shall adhere to the Mach number approved by ATC and shall request ATC approval before making any changes thereto. If it is essential to make an immediate temporary change in the Mach number (e.g. due to turbulence), ATC shall be notified as soon as possible that such a change has been made.

8.5.4.1 If it is not feasible, due to aircraft performance, to maintain the last assigned Mach number during en-route climbs and descents, pilots of aircraft concerned shall advise ATC at the time of the climb/descent request.

8.5.5 RNAV distance-based separation minima shall not be applied after ATC has received pilot advice indicating navigation equipment deterioration or failure.

8.5.6 Aircraft at the same cruising level

8.5.6.1 *Aircraft on the same track.* (See Figure III-24.) A 150 km (80 NM) RNAV distance-based separation minimum may be used provided:

- a) each aircraft reports its distance to or from the same "on-track" way-point; and
- b) separation is checked by obtaining simultaneous RNAV distance readings from the aircraft at frequent intervals to ensure that the minimum will not be infringed.

8.5.7 Aircraft climbing or descending on the same track

8.5.7.1 A 150 km (80 NM) RNAV distance-based separation minimum may be used while vertical separation does not exist, provided:

- a) each aircraft reports its distance to or from the same "on-track" way-point;
- b) one aircraft maintains a level while vertical separation does not exist; and
- c) separation is established by obtaining simultaneous RNAV distance readings from the aircraft (see Figures III-25A and III-25B).

Note.- To facilitate application of the procedure where a considerable change of level is involved, a descending aircraft may be cleared to some convenient level above the lower aircraft, or a climbing aircraft to some convenient level below the higher aircraft, to permit a further check on the separation that will obtain while vertical separation does not exist.

8.5.8 Aircraft on reciprocal tracks

8.5.8.1 Aircraft utilizing RNAV may be cleared to climb or descend to or through the levels occupied by other aircraft utilizing RNAV provided that it has been positively established by simultaneous RNAV distance readings to or from the same "on-track" way-point that the aircraft have passed each other by at least 150 km (80 NM) (see Figure III-26)

Appendix B

Excerpts from Item 5 of the Preliminary Report of the CAR/SAM/3 RAN Meeting

5.8 Air traffic services

Application of lateral and longitudinal separation minima

5.8.1 The meeting recognized that, for an ideal ATS route structure, the uniform application of the smallest longitudinal separation minimum available across several FIRs, would facilitate the most effective utilization of that airspace. However, several factors often inhibited the application of an optimum longitudinal separation minimum. These factors included the overall level and type of service provided by ATC, the location of en-route navigation aids, the availability and quality of air-ground communications and the implementation status and functioning of ATS direct-speech circuits as specified in the ANP.

5.8.2 In addition to the above, it was noted that aircraft with RNAV capability were widely used in the CAR/SAM Regions and were increasingly being equipped with GNSS. The improved navigation performance would enable improvements to be made in the design of the ATS route system and could allow for reductions in separation.

5.8.3 In view of the above, and in light of the fact that the *Procedures for Air Navigation Services - Rules of the Air and Air Traffic Services* (PANS-RAC) already contained provisions for the introduction of 10 minutes and 80 NM RNAV distance-based longitudinal separation minima, the meeting developed the following recommendation:

Recommendation 5/22 B Consistent application of 10-minute and 80 NM RNAV distance-based longitudinal separation minima

That States implement the facilities necessary to permit the introduction of 10 minutes and 80 NM RNAV distance-based longitudinal separation minima on high density ATS trunk routes.

Note. B The text is included in the Basic ANP at Appendix A, as paragraph 7.15.

5.8.4 The meeting noted that, in addition to the improvements which could be obtained by using RNAV to reduce longitudinal distance-based separation to 80 NM between RNAV-equipped aircraft, further reductions to the lateral and longitudinal separation minima to 50 NM could be achieved in accordance with Annex 11, Attachment B and the PANS-RAC, Part III, 8.6, in airspace and/or on routes in the CAR/SAM Regions designated as RNAV and RNP 10. It was noted that, in order to ensure the safe introduction of a 50 NM lateral separation minimum, and eventually a 50 NM longitudinal separation minimum, safety management measures would need to be established. This included, *inter alia*, that an appropriate safety assessment of the airspace be undertaken prior to implementation and that an airspace monitoring programme be established to ensure that the required safety level was maintained.

5.8.5 In view of the above, the meeting developed the following conclusion:

Conclusion 5/23 B Application of 50 NM lateral separation minimum based on RNAV and RNP 10, and future airspace requirements in the CAR/SAM Regions

That the CAR/SAM Regional Planning and Implementation Group (GREPECAS), in coordination with other regional groups, as appropriate:

- a) identify areas within the CAR/SAM Regions suitable for the implementation of RNP, RNAV and reduced lateral separation minima;
- b) establish the airspace safety management arrangements to ensure the safe operation of airspace where reduced lateral separation minima are to be introduced;
- c) complete appropriate safety assessments prior to any implementation;
- d) determine implementation timescales;
- e) establish a monitoring agency to ensure that the operating environment can meet the safety requirements for the introduction and ongoing operation of 50 NM lateral separation minimum based on RNAV and RNP 10; and
- f) develop appropriate regional guidance material.

5.8.6 The meeting discussed a proposal to implement a minimum longitudinal separation of 10 minutes with Mach number technique. The meeting was of the opinion that Mach number technique offered a safe means of reducing longitudinal separation in areas lacking appropriate communications, navigation and surveillance facilities, resulting in a substantial increase in airspace capacity. Consequently, the meeting agreed to the following recommendation.

Recommendation 5/24 B Implementation of 10 minute longitudinal separation minimum with Mach number technique

That a 10-minute longitudinal separation minimum with Mach number technique be implemented in the CAR/SAM Regions in areas lacking appropriate communications, navigation and surveillance facilities to support other separation minima.

Note. B The text is included in the Basic ANP at Appendix A, as paragraph 7.14.

Appendix C

Longitudinal separations applied between Central Caribbean FIRs and adjacent ACC's

Central America FIR

Between CENAMER ACC/FIC and:

Mérida ACC:

- a) **Radar:** i) 40 NM radar longitudinal separation to aircraft operating at the same level, route, speed and rumbo, except from those boundary points where there is no simultaneous radar coverage in both ACC's (UL312/KATIS, UG428/NOTOS, UL308/VENUS, UL318/ALSAL, UA317/TAPACHULA, UA552/ERBOR, UG633/EMADA, UR640/DANUL and other points located in the limit of both FIR's in direct trayectorias out of ATS routes with no radar coverage).
- b) **Non radar:** i) In points where there is no radar coverage (or when there is failure of the radars), **10-minute** separation is applied, except from Pacific Oceanic Routes: UL308/VENUS, UG428/NOTOS and UL312/KATIS.
ii) In the Pacific oceanic area, routes UL308, UG428 and UL312, 15-minute separation is applied
iii) In the lower airspace: 15 minutes.

Havana ACC:

- a) **Radar:** No radar separation applied
b) **Non radar:** i) Upper airspace: 10 minutes
ii) Lower airspace: 15 minutes

Kingston ACC:

- a) **Radar:** No radar separation applied
b) **Non radar:** i) Upper airspace: 10 minutes
ii) Lower airspace: 20 minutes

Panama ACC:

- a) **Radar:** No radar separation applied
b) **Non radar:** i) Upper airspace:
 - In routes UA317, UG440, UA502 and UB690: 10 minutes
 - At request of the accepting ACC: 15 minutes
 - In other routes and/or out of ATS routes: 15 minutesii) Lower airspace: 15 minutes

Bogota ACC:

- a) **Radar:** No radar separation applied
b) **Non radar:** i) Upper airspace: 15 minutes
ii) Lower airspace: 20 minutes

Guayaquil ACC:

- a) **Radar:** No radar separation applied
b) **Non radar:** i) Upper airspace: 15 minutes
ii) Lower airspace: 20 minutes

Curaçao FIR

FIR	FL 200 and above	Below Fl 200	Other
Kingston FIR	15 mins	20 mins	
Port-au-Prince FIR	15 mins	20 mins	
Sto. Domingo FIR	15 mins	20 mins	
San Juan FIR	15 mins	20 mins	
Maiquetia FIR	15 mins	20 mins	10 mins **
Barranquilla FIR	15 mins	20 mins	

** = For aircraft on G442/UG442, G446/UG446, A574/UA574, A563/UA563, R568, A567/UA567, G431/UG431 y A315/UA315.

For aircraft on A516/UA516, A511/UA511, A554/UA554 -- 15 and 20 mins.

Although this is the separation agreed upon in the OLA it is only being applied for aircraft landing and departing from/to resp. the Maiquetia FIR and the Curaçao FIR.
Also for overflights with destination Brazil, Maiquetia requests a separation of 20 mins between succeeding aircraft.

Havana FIR

The following are longitudinal separations currently applied between the adjacent FIRs between Havana ACC and adjacent units:

FIR	Longitudinal separation
Miami	20 NM (RADAR)
Port-au-Prince	15 minutes*
CENAMER	10 minutes
Merida	10 minutes
Kingston	10 minutes
Grand Cayman	10 minutes

*There is no operational letter of agreement and currently, there is little traffic crossing the limit between both FIRs.

Kingston FIR

At present, Kingston ACC is using 10-minute longitudinal separation with all adjoining FIRs except Curaçao and Haiti. As soon as they conclude discussions on new LOAs with these States, they should also be utilizing 10 minutes with them.

Miami FIR

In Miami the separation depends on what the adjacent FIR has for equipment (radar vs non-radar) and what type of separation they need to give the next person.

FIR	Longitudinal Separation
Miami to New York	10 minutes w/ Mach
Miami to Santo Domingo	radar - 10 miles (radar must be reliable)
	- non-radar 10 minutes (most of the time non-radar separation)
Miami to Port-au-Prince	15 minutes
Miami to Havana	non-radar (10 minutes) w/prior communications 40NM
	radar – south inbound to Havana (landing within Havana FIR - 10 miles). All others 20 miles for southbound aircraft northbound aircraft - 10 miles.
Miami to Houston	at and above FL200: 15 minutes
	below FL200: 20 minutes

Port-au-Prince FIR

- Traffic entering Miami airspace: 10 minutes
- Traffic from Miami entering Port-au-Prince airspace: 15 minutes

- Kingston and Santo Domingo
- Longitudinal separation 15 minutes

- Curacao
- 15 minutes at or above flight level 200
- 20 minutes below FL 200

Santo Domingo FIR

ATS Unit	Longitudinal Separation
San Juan CERAP	
RADAR	10 NM
*NON RADAR	15 minutes from flight level 200 or higher.
*NON RADAR	20 minutes under flight level 200
Curaçao ACC	
NON RADAR	15 minutes from flight level 200 or higher.
NON RADAR	20 minutes under flight level 200.
Miami ARTCC	
RADAR	10 NM
NON RADAR	10 minutes at the same level.
Port-au-Prince ACC/APP	
NON RADAR	15 minutes.

* only applicable in case of radar system failure