International Civil Aviation Organization
Eastern and Southern African Office

Eleventh Meeting of the APIRG Air Traffic Services, Aeronautical Information Services and Search and Rescue Sub-Group (ATS/AIS/SAR/SG/11)
[Nairobi, Kenya 26 – 30 April 2010]

Agenda Item 6: Performance – Based Navigation (PBN) and AFI ATS Route Network

Performance – based planning framework

(Presented by IATA)

SUMMARY

This paper presents the ATM operational requirements in an RNAV/RNP environment together with planning and implementation targets, as contained in AFI Doc 003 – CNS/ATM Implementation Plan.

The meeting is invited to review, amend as necessary and provide clear guidance concerning the separation minima to be applicable in AFI RNP10 and RNP4 airspace. A thorough assessment of AFI SUPPs (Doc 7030) provisions is required in light of PBN implementation.

Taking into consideration the multidisciplinary nature of related implementation activities, the meeting is also invited to consider merging the existing ATS/AIS/SAR and CNS Sub-groups into a single CNS/ATM Sub-group, in order to increase APIRG efficiency in addressing its work programme.

References:

- ICAO Special AFI RAN 2008 Report.

1. Introduction

1.1. The AFI Region had developed an extensive document to guide planning and implementation of air navigation facilities and services (CNS/ATM Implementation Plan for the AFI Region - AFI Doc 003).

1.2. ICAO Special AFI RAN 2008 agreed that the performance objectives and the associated performance framework forms (PFFs) should be integrated into Doc 003 which should then serve as an integrated planning document. The following recommendations were adopted:

Recommendation 6/1 — Regional performance framework

That:

a) APIRG adopt the performance-based framework for air navigation systems planning as detailed in the report of this meeting, identifying regional performance objectives and utilizing the performance framework forms (PFFs);

b) APIRG develop additional PFFs to meet new performance objectives as necessary; and

c) The performance objectives and the associated PFFs adopted by the meeting and any other PFFs developed by APIRG, be integrated into the CNS/ATM Implementation Plan for the AFI Region (Doc 003) which should then be updated to serve as an integrated planning document for the AFI Region.

Recommendation 6/2 — National performance framework

That States adopt a national performance-based framework for air navigation systems planning as detailed in the report of this meeting, identifying national performance objectives, aligned with the regional performance objectives, utilizing the performance framework forms.

2. Discussion

2.1. **Appendices A and B** to this paper show the current ATM operational requirements in an RNAV/RNP environment together with planning and implementation targets, as contained in the AFI Doc 003 – CNS/ATM Implementation Plan.

2.2. Appendix C shows the current provisions contained in *ICAO Regional Supplementary Procedures* (Doc 7030) and new provisions related to RNP4.

2.3. The meeting may wish to review these operational requirements and some proposed amendments taking into account PBN developments.

2.4. In so doing, the Sub-group should discuss and validate the separation minima to be applicable in AFI RNP10 and RNP4 airspace.

2.5. Furthermore, taking into consideration the multidisciplinary nature of related implementation activities, the meeting may also wish to discuss the merging of the existing ATS/AIS/SAR and CNS Sub-groups into a single CNS/ATM Sub-group, in order to increase APIRG efficiency in addressing its work programme. The following CNS/ATM implementation coordination groups (ICGs) were established by APIRG/14 (June 2003):

a) SAT Group: AR1and AR2

b) Continental AFI ICG: AR3, AR4 and AR5

c) Indian Ocean ICG: AR6.

2.6. APIRG/14 further agreed that the existing AFI/EUR interface meetings should continue and provide the CNS/ATM Implementation Coordination Sub-Group[1] with their inputs.

[1] Paradoxically, APIRG/14 also dismantled the CNS/ATM/IC/SG.

3. Action by the meeting

4.

4.1. The meeting is invited to:

a) Review and update the ATM operational requirements shown in **Appendices A** and **B** to this paper;

b) Discuss and validate the separation minima to be applicable in AFI RNP 10 and RNP 4 airspace, based on the current provisions contained in *ICAO Regional Supplementary Procedures* (Doc 7030) shown in **Appendix C**;

c) Accordingly identify areas where APIRG needs to develop additional performance framework forms (PFFs) to in order to meet new performance objectives, and request the Secretariat to develop such PFFs;

d) Recognize the multidisciplinary nature of the related implementation tasks which were assigned to the previous APIRG CNS/ATM Sub-Group and Implementation Coordination Group (ICGs); and

e) Discuss the opportunity to create a single CNS/ATM Sub-group in replacement of the current ATS/AIS/SAR and CNS Sub-groups, with the objective to increase APIRG efficiency in addressing its assigned work programme in the performance-based approach context.

International Civil Aviation Organization
Eastern and Southern African Office

Eleventh Meeting of the APIRG Air Traffic Services, Aeronautical Information Services and Search and Rescue Sub-Group (ATS/AIS/SAR/SG/11) [Nairobi, Kenya 26 – 30 April 2010]

(Extract from Section III the Implementation Plan (Doc 003) identifying target dates, by which individual tasks are required to be accomplished)

	Planning Targets	**PBN Component**				**Status**
		Navigation specification *(Ref. ICAO Annex 11 Doc 8168 Doc 9613 Doc 9750)*	**Navaid infrastructure** *(Ref.ICAO Annex 10 Annex 11 Doc 9613 Doc 9750)*	**Communications and ATS surveillance** *(Ref.ICAO Annex 10 Annex 11 Doc 9613 Doc 9750)*	**Air traffic management system** *(Ref.ICAO Annex 11 Doc 4444 Doc 9613 Doc 9750)*	
~~1999~~	~~Uniform application of 10 minutes longitudinal separation in the upper airspace~~				~~X~~	Implemented
1999	Provision of area control service in upper airspaces				X	In progress
1999	Pursue the implementation of fixed RNAV routes contained in the AFI ANP	X			X	In progress
1999	Implementation and maintenance of WGS-84		X		X	In progress
1999	Data exchange between Flight Data Processing Systems (FDPS) in selected Air Traffic Control Centres			X	X	In progress
1999	Progressive introduction of Controller pilot data link communications (CPDLC) with full capacity in ~~2005~~?			X	X	In progress
1999	Complete implementation of all AFTN and ATS/DS circuits			X	X	Completed
2XXX	Progressive implementation of ATS Message Handling System (AMHS) with full capacity in xxx			X		Not implemented
1999	Extension of VHF coverage at all operationally significant altitudes			X	X	In progress

	Planning Targets	**PBN Component**				**Status**
		Navigation specification *(Ref. ICAO Annex 11 Doc 8168 Doc 9613 Doc 9750)*	**Navaid infrastructure** *(Ref.ICAO Annex 10 Annex 11 Doc 9613 Doc 9750)*	**Communications and ATS surveillance** *(Ref.ICAO Annex 10 Annex 11 Doc 9613 Doc 9750)*	**Air traffic management system** *(Ref.ICAO Annex 11 Doc 4444 Doc 9613 Doc 9750)*	
1999	Progressive provision of SSR in selected airspaces			X	X	In progress
2000	Progressive reduction of lateral separation minima in selected airspaces from 100 NM to 50 NM (in RNP 10 environment) ~~and eventually to 30 NM (in RNP 5 environment) as dictated by operational requirements~~	X			X	In progress
2000	Progressive introduction of Automatic Dependent Surveillance – Contract (ADS-C) Service with full ground capability by ~~2005~~?			X		In progress
2000	Introduction of Random RNAV routes in oceanic airspaces	X			X	In progress in South Atlantic *(Routing Area AR-2)*
2000	Progressive introduction of random RNAV routes above FL 350 in continental airspaces	X			X	Not implemented
2000	Progressive introduction of GNSS-based procedures	X	X		X	In progress
~~2000~~	~~Progressive introduction of RNP5 in selected upper airspaces~~	X		X	X	Not implemented
2001	Progressive introduction of Longitudinal RNAV/RNP separation minima of 10 minutes and / or 80NM RNAV derived distance in selected airspaces	X			X	10 minute longitudinal separation implemented
2005	Progressive introduction of AIDC with completion by ~~2008~~?			X	X	Not implemented.
~~2002~~	~~Progressive Implementation of 1000 FT Vertical Separation Minima airspaces~~				~~X~~	Implemented in 2008
2010	Progressive introduction of RNP4 in selected upper airspaces	X		X	X	Not implemented

International Civil Aviation Organization
Eastern and Southern African Office

Eleventh Meeting of the APIRG Air Traffic Services, Aeronautical Information Services and Search and Rescue Sub-Group (ATS/AIS/SAR/SG/11) [Nairobi, Kenya 26 – 30 April 2010]

APPENDIX G AFI CNS/ATM Implementation Plan Doc 003 G-2

ATM Operational Requirements in an RNP/RNAV Environment				
Code	**ATM operational enhancements***	**Required functions - air**	**Required services - ground**	**Notes**
1. Routings and required conventional functionalities				
1A	fixed routes	RNAV capability	NAVAID infrastructure	
1B	flexible routes	RNAV capability	NAVAID infrastructure	
2. Routings and required CNS/ATM functionalities				
2A	fixed routes	DCPC (voice/data) RNP/X approval/certification FMS	DCPC (voice/data)	see Notes 1, 2 and 3
2B	flexible routes	DCPC (voice/data) RNP/X approval/certification FMS	DCPC (voice/data)	see Notes 1, 2 and 3
2C	dynamic user-preferred re-route (e.g. DARPs)	DCPC (voice/data) RNP/X approval/certification AOC data link Direct flight plan uploads FMS	DCPC (voice/data) AOC data link flight plan generation AOC/ATS data communication	utilization dependent on airspace complexity see Notes 1, 2 and 3
2D	autonomy of flight** concept	to be developed	to be developed	concept still undergoing definition by ICAO

ATM Operational Requirements in an RNP/RNAV Environment				
Code	**ATM operational enhancements***	**Required functions - air**	**Required services - ground**	**Notes**
3. En-route vertical separation reductions				
3A	1 000 ft vertical separation between FL 290 and FL 410	RVSM certification/operational approval voice/data communication	height monitoring sampling voice/data communication	see ICAO Regional Supplementary Procedures (Doc 7030) ~~NAT/RAC~~ sampling to verify that aircraft population height keeping accuracy is in conformance with appropriate standards
4. En-route longitudinal separation reductions				
~~4A~~	~~80 NM (non-radar environment)~~	~~RNAV~~ ~~MNPS approval~~ ~~voice/data communication~~	~~Mach number technique (MNT)~~ ~~60-minute position reporting~~ ~~voice/data communication~~	~~MNT may be required~~ ~~MNPS is used in a generic sense and may not be required in all cases~~ ~~see Note 1~~
4B	50 NM (non-radar environment)	RNP/10 approval/certification FMS DCPC (voice/data)	30-minute position reporting MNT DCPC (voice/data)	final requirements to be developed MNT may be required see Notes 1, 2, and 3
4C	30 NM (non-radar environment)	FMS DCPC (voice/data) RNP 4 approval/certification ADS	DCPC (voice/data) ADS	final requirements to be developed see Notes 1, 2, 3, and 4
4D	. less than 30 NM (non-radar environment)	. FMS . DCPC (voice/data) . RNP/X approval/certification . ADS	. DCPC (voice/data) . ADS	. final requirements to be developed . see Notes 1, 2, 3, and 4
4E	. 10 minutes (non-radar environment)	. RNAV . voice/data communications	. MNT where prescribed . voice/data communications	. RNAV capability may not be required in all situations . accurate time requirement/common time reference

ATM Operational Requirements in an RNP/RNAV Environment				
Code	**ATM operational enhancements***	**Required functions - air**	**Required services - ground**	**Notes**
4F	. 7 minutes (non-radar environment)	. FMS . DCPC (voice/data) . RNP10 approval/certification	. DCPC (voice/data)	. final requirements to be developed . accurate time requirement/common time reference . see Notes 1, 2, and 3

6. En-route lateral separation				
~~5A~~	~~. 60 NM (non-radar environment)~~	~~. RNP 12.6 approval/certification~~ ~~. voice/data communications~~	~~. voice/data communications~~ ~~. pilot position reports~~	~~. presently implemented as MNPS and AUSEP in the NAT and Asia Pacific Regions respectively~~ ~~. performance monitoring may be required~~ ~~. see Notes 1, 3, and 5~~
5B	. 50 NM (non-radar environment)	. RNP 10 approval/certification . voice/data communications	. voice/data communications . pilot position reports	. performance monitoring may be required . see Notes 1, 3, and 5
5C	. 30 NM (non-radar environment)	. RNP 4 approval/certification . DCPC (voice/data)	. DCPC (voice/data)	. final requirements to be developed . performance monitoring may be required . see Notes 1, 3, and 5
5D	. less than 30 NM (non-radar environment)	. DCPC (voice/data) . RNP/X approval/certification . ADS	. DCPC (voice/data) . ADS	. final requirements to be developed . performance monitoring may be required . see Notes 1, 2, 3, 4 and 5
~~5E~~	~~. 16.5 NM (uni-directional) (non-radar environment)~~	~~. RNP 5 approval/certification~~ ~~. DCPC voice~~	~~. DCPC voice~~	~~. relates to VOR reference system~~ ~~. see Notes 3, 5, 6 and 7~~

~~5F~~	~~. 18 NM (bi-directional) (non-radar environment)~~	~~. RNP 5 approval/certification . DCPC voice~~	~~. DCPC voice~~	~~. relates to VOR reference system . see Notes 3, 5, 6 and 7~~
~~5G~~	~~. 10 to 15 NM (radar environment)~~	~~. RNP 5 approval/certification . DCPC voice .~~	~~. radar . DCPC voice~~	~~. System safety evaluation required . see Notes 3, 5, 6 and 7~~
5H	. 8 to 12 NM (radar environment)	. RNP 4 approval/certification . DCPC voice	. Radar . DCPC voice	. System safety evaluation required . see Notes 3 and 5
6. AIR SPACE MANAGEMENT				
6A	. airspace integration and flexible use of airspace**	. to be provided to all aircraft	. separate databases for: − aircraft − AOC − military reserved airspace − national security − environmental − aeronautcal information − airports − weather − traffic − SAR − rules of the air	. this provides the information that is necessary to create flexible use of airspace**

7. AIR TRAFFIC FLOW MANAGEMENT				
7A	. Integrated air traffic flow management	. to be provided to all aircraft	. separate databases for: − aircraft − AOC − airspace requirements − environmental − aeronautical information − airports − weather − traffic forecast . integrated automation of database management . AOC interface . ATC/ASM/ATFM interface	

* For each particular operational enhancement, there will be a need for the airlines and the ATS providers to review existing procedures to identify what new requirements are required prior to operational implementation.

** ~~Emerging concept or technology consensus still to be reached.~~

NOTES

1) When data link is used for communication, voice communications must be available. Depending upon the separation requirement, the voice requirement may be for direct voice.

2) Performance requirements of data link depend upon the application for which it is being used.

3) The approval for RNP operations is specific for each RNP type.

4) The ADS requirement is associated with and related to the over-all communication performance requirements for position reporting.

5) Lateral route systems require regional safety assessments and agreement.

6) In some cases, the RNP requirement may be met without the use of RNAV; however, in future CNS/ATM systems, all aircraft are expected to be RNAV-equipped.

~~7) RNP/5 relates to a VOR reference system up to the year 2000, at which time safety assessments will be required against a new target level of safety.~~

— — — — — — — —

Appendix C

(Extract from ICAO Doc 7030)

Chapter 4. NAVIGATION

4.1 PERFORMANCE-BASED NAVIGATION (PBN)

Note.— As the Africa-Indian Ocean (AFI) Region transitions to PBN as contained in the Performancebased Navigation Manual *(Doc 9613),* the contents of 4.1 will be amended.*

4.1.1 Area navigation (RNAV) specifications

4.1.1.1 RNAV 10 (RNP 10)

Note.— RNAV 10 retains the RNP 10 designation, as specified in the Performance-based Navigation Manual *(Doc 9613),* 1.2.3.5.*

Area of applicability

4.1.1.1.1 For flights on designated controlled oceanic routes or areas within the Canarias FIR (southern sector), Dakar Oceanic, Recife and Sal Oceanic FIRs, and on designated routes over continental Africa, ***a lateral separation minimum of 93 km (50 NM) may be applied.***

4.1.1.1.2 For flights in the EUR/SAM corridor (Canarias (southern sector), Dakar Oceanic, Recife and Sal Oceanic FIRs), ***a longitudinal separation minimum of 93 km (50 NM) derived by RNAV may be applied*** between RNAV-equipped aircraft approved to RNP 10 or better, in accordance with the provisions of the PANS-ATM, 5.4.2.6.

4.1.1.1.3 Longitudinal distance-based separation minima of ***93 km (50 NM) between RNAV aircraft on the same track on RNP 10 routes over continental Africa shall not be used***.

Means of compliance

4.1.1.1.4 For application of 4.1.1.1.1 and 4.1.1.1.2, the aircraft and the operator must have been approved by the State of Registry or the State of the Operator, as appropriate, to meet the following requirements (or equivalent):

a) aircraft are approved to RNP 10 in accordance with provisions contained in the *Performance-based Navigation Manual* (Doc 9613);* and

b) operator programmes shall be established to mitigate the occurrence of large navigational errors due to equipment malfunction or operational error:

1) operator in-flight operating drills shall include mandatory navigation cross-checking procedures to identify navigation errors in sufficient time to prevent aircraft from inadvertent deviation from an ATC-cleared route; and

~~* In preparation.~~

2) the operator shall establish programmes to provide for the continued airworthiness of aircraft navigation systems necessary to navigate to the degree of accuracy required.

Note.— Detailed guidance material on RNP is contained in the Performance-based Navigation Manual *(Doc 9613).**

4.1.1.2 RNAV 5

Nil.

4.1.1.3 RNAV 2

Nil.

4.1.1.4 RNAV 1

Nil.

4.1.1.5 Pre-PBN navigation specifications

Nil.

4.1.2 Required navigation performance (RNP) specifications

4.1.2.1 RNP 4

4.1.2.1.1 For flights on designated controlled oceanic routes or areas within the Canarias FIR (southern sector), Dakar Oceanic, Recife and Sal Oceanic FIRs, and on designated routes over continental Africa, ***a lateral separation minimum of 55.5 km (30 NM) may be applied***.

4.1.2.1.2 For flights in the EUR/SAM corridor (Canarias (southern sector), Dakar Oceanic, Recife and Sal Oceanic FIRs), ***a longitudinal separation minimum of 93 km (50 NM) derived by RNAV may be applied between RNAV-equipped aircraft approved to RNP 4 or better***, in accordance with the provisions of the PANS-ATM, 5.4.2.6.

4.1.2.1.3 Longitudinal distance-based separation minima of ***55.5 km (30 NM) between RNAV aircraft on the same track on RNP 4 routes over continental Africa shall not be used***.

Means of compliance

4.1.2.1.4 For application of 4.1.1.1.1 and 4.1.1.1.2, the aircraft and the operator must have been approved by the State of Registry or the State of the Operator, as appropriate, to meet the following requirements (or equivalent):

a) aircraft are approved to RNP 4 in accordance with provisions contained in the *Performance-based Navigation Manual* (Doc 9613); and

b) operator programmes shall be established to mitigate the occurrence of large navigational errors due to equipment malfunction or operational error:

1) operator in-flight operating drills shall include mandatory navigation cross-checking procedures to identify navigation errors in sufficient time to prevent aircraft from inadvertent deviation from an ATC-cleared route; and

2) the operator shall establish programmes to provide for the continued airworthiness of aircraft navigation systems necessary to navigate to the degree of accuracy required.
