

INTERNATIONAL CIVIL AVIATION ORGANIZATION

EASTERN CARIBBEAN ATM/CNS TRANSITION PLAN

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7th November, 2001

1.0 INTRODUCTION

1.1 The E/CAR States have recognized the increasing limitations of the present air navigation system and the improvements needed to take civil aviation into the 21st century. The limitations of the present system are intrinsic to the system itself, and the problems cannot be overcome unless the E/CAR States embark on a new communications, navigation and surveillance (CNS) system to support future enhancements in air traffic management (ATM). The E/CAR States are also cognizant that implementation of the concept would require regional coordination and planning. The ATS Committee was established to, among other things, oversee aspects pertaining to the ATM/CNS Transition Plan.

1.2 The scope of the E/CAR ATM/CNS Transition Plan includes the airspace designated to the E/CAR States.

1.3 The E/CAR ATM/CNS Transition Plan outlines the current system limitations, the future ATM/CNS system components, applications and benefits, and the anticipated implementation timetable. Note that although this regional ATM/CNS Transition Plan can be used for general guidance of the E/CAR as a whole, it is advised that each State develop its own ATM/CNS implementation plan that is specific to its controlled airspace and in line with this regional plan.

2.0 BACKGROUND

2.1 Conclusion 4/37 of GREPECAS/4, relating to the preparation of national plans for the transition to the new ATM/CNS system, taking into account the established guidelines in the CAR/SAM. ATM/CNS Regional Plan. It was noted that Sub-Regional Plans must allow for easy coordination with adjacent Regions.

The fourth GREPECAS Meeting, held in Panama City (1994 September 20-26) approved the DRAFT CAR/SAM ATM/CNS Transition Plan prepared by the ATM/CNS Sub-Group, by means of Conclusion 4/38.

3.0 CURRENT SYSTEM LIMITATIONS

(The following information is provided in tabular form in Appendix A.)

3.1 Communications

3.1.1 Controller-Pilot

- a. Systems in use: VHF and HF voice.
- b. System limitations: VHF coverage gaps, VHF/HF reliability, atmospheric interference (HF), frequency congestion, language difficulties.

3.1.2 Controller-Controller

- a. Systems in use: AFTN, land-line.
- b. System limitations: inadequate availability and reliability.

3.2 Navigation

3.2.1 Systems in use

- a. En route navigation is supported by VOR/DME, NDB, INS/IRS, Omega (until 9/1997), Loran C and barometric altimetry.
- b. Approach navigation is supported by VOR/DME, NDB, ILS.

3.2.2 System limitations

- a. Aircraft that rely on VOR/DME/NDB for en route navigation are obliged to use a relatively inefficient route structure tied to Navaid location.
- b. Navaid range is limited.
- c. Navaid reliability is hindered by outages.
- d. Navaid accuracy is not optimized for en route (NDB) or instrument approach (VOR and NDB).
- e. Navaid purchase price and maintenance costs inhibit broad implementation.

3.3 Surveillance

3.3.1 Systems in use

- a. Voice position reports.
- b. PSR/SSR (Mode C).

3.3.2 System limitations

- a. Position report accuracy is not optimal.
- b. PSR/SSR coverage is limited. Procedural separation is inefficient in non-radar area.
- c. PSR/SSR is limited by line of sight.
- d. Widespread implementation is inhibited by high equipment cost.

3.4 Air Traffic Management

3.4.1 Systems in use: ICAO standards and recommended practices (SARPS) are used in conjunction with available equipment.

3.4.2 System limitations

- a. Lack of adequate radar coverage.
- b. Airspace configuration.
- c. Dissimilar ATS procedures.
- d. Unreliable communication facilities and language difficulties.
- e. Uncoordinated provision and implementation of present CNS equipment.

4.0 FUTURE ATM/CNS SYSTEM COMPONENTS, APPLICATIONS, BENEFITS

4.1 General

4.1.1 Following is a review of the components and applications that will comprise the fully implemented ATM/CNS system, as well as the benefits provided. The component/application information is presented in tabular form in Appendix B, the benefit information is presented in tabular form in Appendix C.

4.2 Communication

4.2.1 Controller-Pilot

- a. Voice communication (VHF/HF/SATCOM) will be used primarily for time critical information such as traffic avoidance vectors and landing clearances at busy airports. Voice communications will also serve as a backup for data link communication (VHF/HF/SATCOM).
- b. Data link communication (VHF/HF/SATCOM) will be used for routine information that is not time critical, e.g. pre-departure clearances, push back/taxi clearances, airborne re-touring requests/clearances, weather and NOTAMS. This Controller-Pilot Data Link (CPDLC) network will maximize efficiency, and reduce miscommunications and frequency congestion. The system design will ensure fault free data link communication, as well as data security.

4.2.2 Controller-Controller

- a. Controller-Controller Data Link (AIDC) will be used to communicate flight activity and resolve conflicts/alerts. The system design will ensure fault free data link communication, as well as data security.

4.2.3 All Controller-Pilot and Controller-Controller Communications

- a. The Aeronautical Telecommunication Network (ATN) will provide global and data inter-connectivity.

4.3 Navigation

4.3.1 The Global Navigation Satellite System (GNSS) will enhance safety by improving the pilots' position/situational awareness, reducing pilot workload, and enhancing navigational accuracy. Accordingly, GNSS is expected to reduce the potential for controlled flight into terrain (CFIT).

4.3.2 GNSS provides highly accurate and reliable navigation around the globe. Greater accuracy will enable a reduction in separation standards, increased capacity and potentially lower landing minima at airports served by only non-precision approaches. Greater reliability will reduce delays and cancellations caused by inoperative ground based en-route and approach Nav aids.

4.3.3 Instrument approach capability will be possible at airports where this was not possible previously due to Nav aid siting problems or cost. GNSS and its augmentation technologies

provide 4-dimensional guidance (latitude, longitude, altitude and time) that is not currently available with most non-precision approach navigation aids. GNSS increases flight safety by providing a precision approach capability to many airports previously served by only non-precision approaches.

4.3.4 On board direct from-any-to-anywhere capability will enable optimized routes and instrument approach procedures, and a reduction in user operating costs.

4.4 Surveillance

4.4.1 Global surveillance will be possible by down linking GNSS aircraft position to ATS providers.

4.4.2 In the long run, users will be able to install Cockpit Display of Traffic Information (CDTI) equipment to enhance traffic awareness and safety.

4.5 Air Traffic Management

4.5.1 The role of ATS providers will shift from active traffic control to traffic management, with intervention when necessary to avoid conflicts.

5.0 EASTERN CARIBBEAN ATM/CNS TRANSITION TIMETABLE

5.1 Guiding Principles

- 5.1.1 The E/CAR ATM/CNS Transition Plan recognizes several guiding principles.
- a. The plan must be practical and progressive in its implementation.
 - b. Each step of the transition will necessarily undergo a trial and demonstration phase, followed by a certification/approval process, which produces an operational introduction phase.
 - c. Early benefits must be achievable, measurable, and in reasonable step with investment.
 - d. A high degree of seamless-ness and inter-regional and intra-regional coupling must be achieved.
 - e. Synchronization of the airline plan with the ICAO ATM/CNS CAR/SAM Regional Implementation Plan must be maintained to ensure that benefits will materialize.
 - f. The real regional environment and operating realities must be recognized.

5.2 Implementation Periods

5.2.1 Three general stages are contemplated

TIMING	FOCUS
Near term – 1998-2001	GNSS Trials and Demonstrations and early implementation of basic GPS NAV services.
Mid term –2002-2005	Continue navigation application. Early implementation of communications elements.
Long term –2006-2010	Continue navigation and communications applications. Implementation of Surveillance and ATM.

5.2.2 The focus of the Near Term Plan is GNSS Trials and Demonstrations, followed by early implementation by lead States. This focus stems from the availability of a substantial portion of the GNSS system, and the probability that GNSS will produce early safety and operating benefits cost effectively. A regional GNSS trial and demonstration, designed to give the civil aviation authorities operational experience and early benefits to the users, is entering its second year. Numerous GPS routes have been developed. WGS-84 airport surveys have been completed for nearly all E/CAR States. Stand-alone non-precision approaches have been developed using the new survey data. The Caribbean GNSS Trial And Demonstration Plan, which outlines the approved operations and requirements, is provided in Appendix D ATM/CNS Implementation Timetable.

5.2.3 GNSS will be used extensively for en-route and non-precision approach navigation during the Mid Term. WAAS and GBAS (LAAS) precision approaches will be introduced. Implementation of the RNP Concept will lead to reduce longitudinal and lateral separation significantly. Likewise the implementation of the RVSM concept will result in reduced vertical separation. The Mid-term will also see early introduction of Controller-Pilot data link (CPDLC) using VHF and HF.

5.2.4 During the first part of the Long Term period navigation and communication applications will be widely implemented and CPDL communication and ADS surveillance will proliferate. Air Traffic Management concepts designed to increase system capacity, efficiency and safety will progress. As the Long Term period proceeds, ATM/CNS components and applications will mature toward full implementation, including completion of the Aeronautical Telecommunications Network.

Decommissioning and removal of conventional ATM/CNS systems and ground-based navigation aids that are deemed redundant and unnecessary will proceed after full implementation, but taking into consideration factors such as new system performance, user acceptance and user equipage.

5.3 Near Term

5.3.1 Communication

- a. Availability of VHF and Voice Position Reports
- b. Improved AFS for the E/CAR
- c. HF Voice

- d. VHF Data Link
- e. AIDC
- f. ATN
- g. ATIS
- h. HF Data link
- i. Better than ATN Compliant
- j. AMSS Data voice

5.3.2 Navigation

- a. Availability of NDB
- b. VOR/DME
- c. Barometric altimetry
- d. GNSS Navigation
- e. Utilization of ILS
- f. FMS/FMCS procedures
- g. WGS 84

5.3.3 Surveillance

- a. Continued use of voice position reports
- b. Availability of Monopulse SSR (Mode A/C)
- c. Mandatory carriage of transponders (Mode C)
- d. Linking of Existing and Proposed Radars
- e. MSSR to SSR Mode S
- f. ADS
- g. ADS/B to be determined

5.3.4 Air Traffic Management

(i) Airspace Management

- a. Fixed RNAV ATS Routes
- b. Random RNAV Routes
- c. Application of RNP Concepts
- d. Optimized sectorization
- e. Application of Required Communication Performance (RCP)-TBD
- f. Application of Required Surveillance Performance (RSP)-TBD

(ii) Air Traffic Services

- a. Reduced Vertical Separation Minima (RVSM) – To be determined
- b. Reduced Longitudinal Separation
- c. Reduced Lateral Separation
- d. Autonomous Flight – To be determined
- e. Minimum Safe Altitude Warning (MSAW)

(iii) Air Traffic Flow Management (ATFM)

- a. Evaluation of current ATM Capacity
- b. Establishment of ATFM Data Bases

(iv) Human Factors

- a. Dissemination of Information on ATM/CNS Concepts
- b. Instruction and Training
- c. Dissemination of Human Aspects of ATM/CNS

5.4 Medium Term

5.4.1 Communication

- a. Availability of VHF and Voice Position Reports
- b. HF voice
- c. VHF data link
- d. AIDC
- e. ATN
- f. HF Data Link
- g. AMSS Data Voice
- h. AFTN/ATN Gateway
- i. ATN (ATS ES/Router)
- j. FANS 1 or equivalent

5.4.2 Navigation

- a. NDB
- b. VOR/DME
- c. Barometric altimetry
- d. GNSS Navigation
- e. FMS/FMCS procedures
- f. Utilization of ILS
- g. WGS 84
- h. SBAS
- i. GBAS
- j. INMARSAT Overlay

5.4.3 Surveillance

- a. Continued use of voice position reports
- b. Availability of PSR/SSR (Mode A/C)
- c. SSR to SSR Mode S – To be determined
- d. Mandatory Carriage of transponders (Mode C)
- e. Linking of Existing and proposed radars
- f. Mandatory use of ACAS
- g. ADS
- h. ADS/B – To be determined

5.4.4 Air Traffic Management

(i) Airspace Management

- a. Fixed RNAV ATS Routes
- b. Random RNAV Routes

- c. Application of RNP Concepts
- d. Sector Boundaries Transparent to users
- e. Optimized Sectorization
- f. Application of RCP – To be determined
- g. Application of RSP – To be determined

(ii) Air Traffic Services

- a. Reduced Vertical Separation Minima (RVSM) – To be determined
- b. Reduced Longitudinal Separation
- c. Reduced Lateral Separation
- d. Conflict predictions
- e. Conflict Alert
- f. Minimum Safe Altitude Warning (MSAW)
- g. Windshear Detection
- h. RNAV SIDS and STARS
- i. Autonomous Flight – TBD

(iii) Air Traffic Flow Management (ATFM)

- a. Interregional Cooperative ATFM
- b. Establishment of ATFM Data Bases
- c. Application of Strategic ATFM
- d. Application of PRE-TACTICAL ATFM
- e. Application of TACTICAL ATFM

(iv) Human Factors

- a. Dissemination of Information ATM/CNS Concepts
- b. Instruction and Training
- c. Dissemination of Human Factors of ATM/CNS

5.5 Long Term

5.5.1 Communication

- a. Availability of VHF and voice position reports
- b. VHF data link
- c. HF data link
- d. AMSS data/voice
- e. AIDC
- f. ATN
- g. AFTN/ATN Gateway
- h. ATN (ATS ES/Router)
- i. FANS 1 or Equivalent

5.5.2 Navigation

- a. GNSS Navigation
- b. Barometric altimetry
- c. FMS/FMCS Procedures
- d. Utilization of ILS

- e. WGS 84
- f. SBAS
- g. GBAS
- h. INMARSAT Overlay

5.5.3 Surveillance

- a. Continued utilization of voice position reports
- b. Availability of MSSR (Mode A/C)
- c. MSSR to MSSR Mode S – To be determined
- d. Linking of existing and proposed E/CAR Radars
- e. Mandatory Carriage of Transponders (Mode C)
- f. Mandatory use of ACAS (Airborne Collision Avoidance System)
- g. ADS
- h. ADS/B – To be determined

5.5.4 Air Traffic Management

(i) Airspace Management

- a. Fixed RNAV ATS Routes
- b. Random RNAV Routes
- c. Application of RNP Concepts
- d. Sector Boundaries Transparent to users
- e. Optimized Sectorization
- f. Application of Required Communication Performance (RCP) – TBD
- g. Application of Required Surveillance Performance (RSP) – TBD

(ii) Air Traffic Services

- a. Reduced Vertical Separation Minima (RVSM) – To be determined
- b. Reduced Longitudinal Separation
- c. Reduced Lateral Separation
- d. Conflict Predictions
- e. Conflict Alert
- f. Windshear Detection
- g. RNAV SIDS AND STARS
- h. Minimum Safe Altitude Warning (MSAW)
- i. Airborne Separation Assurance Systems (ASAS)
- j. Autonomous Flight

(iii) Air Traffic Flow Management (ATFM)

- a. Interregional Cooperative ATFM
- b. Establishment of ATFM Data Bases
- c. Application of Strategic ATFM
- d. Application of Pre-Tactical ATFM
- e. Application of Tactical ATFM
- f. ATFM Data Link Service

(iv) Human Factors

- a. Dissemination of Information ATM/CNS Concepts
- b. Instruction and Training
- c. Dissemination of Human Aspects of ATM/CNS

E/CAR ATM/CNS TRANSITION PLAN

APPENDIX A: CURRENT SYSTEM LIMITATIONS

ITEM	PHASE OF FLIGHT				
	 PRE-DEPARTURE AND TAKE OFF TAXI	 CLIMB AND DEPARTURE TRANSITION	 ENROUTE	 DESCENT AND ARRIVEL TRANSITON	 APPROACH AND TAXI LANDING
COMMUNICATION					
Current Systems Controller-Pilot	VHF voice	VHF voice	- VHF voice - HF voice	VHF voice	VHF voice
Controller-Controller	- AFTN - Land line	- AFTN - Land line	- AFTN - Land Line	- Teletype (AFTN) - Land line	- AFTN - Land line
System Limitation - VHF voice - HF voice - AFTN	- Coverage gaps in remote areas (mountain, jungle), lagging infrastructure, frequency congestion at largest airports - Susceptible to interference, unreliable operation/service - Inefficient, unreliable, lagging infrastructure				
NAVIGATION					
Current Systems		VOR DME NDB INS IRS OMEGA FMS	VOR DME NDB INS IRS OMEGA FMS	VOR DME NDB INS IRS OMEGA FMS	ILS VOR DME NDB NOTE: MLS not planned
System Limitations		- Availability/reliability-VOR DME NDB - Accuracy-VOR DME NDB INS IRS OMEGA - RNAV limitations - OMEGA withdrawal - Facility siting limitation	- Availability/reliability-VOR DME NDB - Accuracy-VOR DME NDB INS IRS OMEGA - RNAV limitations - OMEGA withdrawal - Facility siting limitation	- Availability/reliability-VOR DME NDB - Accuracy-VOR DME NDB INS IRS OMEGA - RNAV limitations - OMEGA withdrawal - Facility siting limitation	- Availability/reliability-VOR DME NDB - Accuracy-VOR DME NDB - High cost –ILS - Facility siting limitation - System limitation - ILS

E/CAR ATM/CNS TRANSITION PLAN

APPENDIX A: CURRENT SYSTEM LIMITATIONS

ITEM	PHASE OF FLIGHT				
	 PRE-DEPARTURE TAXI & TAKE OFF	 CLIMB & DEPARTURE TRANSITION	 ENROUTE	 DESCENT & ARRIVAL TRANSITION	 APPROACH LANDING & TAXI
SURVEILLANCE					
Current Systems	Visual	- Primary radar - Secondary radar	- Primary radar - Secondary radar	- Primary radar - Secondary radar	- Primary radar - Secondary radar - Visual
System Limitations - Visual - Primary radar - Secondary radar	- Range, line of sight - Availability, reliability, range, cost - Availability, reliability, range, cost				
AIR TRAFFIC CONTROL					
Current System	- ICAO SARPS - Radar and procedural separation	- ICAO SARPS - Radar and procedural separation	- ICAO SARPS - Radar and procedural separation	- ICAO SARPS - Radar and procedural separation	- ICAO SARPS - Radar and procedural separation
System Limitations		- Inability to support efficient routings - Communication/language problems - Reactive - Accuracy - Traffic capacity - Communication dependent	- Inability to support efficient routings - Communication/language problems - Reactive - Accuracy - Traffic capacity - Communication dependent	- Inability to support efficient routings - Communication/language problems - Reactive - Accuracy - Traffic capacity - Communication dependent	- Inability to support efficient routings - Communication/language problems - Reactive - Accuracy - Traffic capacity

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APPENDIX B: FUTURE ATM/CNS SYSTEM COMPONENTS AND APPLICATIONS

COMPONENTS		APPLICATIONS			
	 PRE-DEPARTURE TAXI & TAKE OFF	 CLIMB & DEPARTURE TRANSITION	 ENROUTE	 DESCENT & ARRIVAL TRANSITION	 APPROACH LANDING & TAXI
COMMUNICATIONS					
CONTROLLER-PILOT					
VHF voice	Used for time critical communications (e.g. take off clearance)				
HF voice			Used in remote/oceanic areas		
SATCOM			Used in remote/oceanic areas		
- Data Link (CPDLC) - Used by aircraft to:	Obtain ATIS/NOTAMS, request engine start, push back, taxi clearances	- Request/forward weather reports - Request re-routings	- Request/forward weather reports - Request re-routings	- Obtain ATIS/NOTAMS - Request/forward weather reports - Request re-routings	
- Used by ATC to:	Issue route, engine start, push back, taxi clearances	- Request/forward weather reports - Forward NOTAMS - Issue re-routings - Issue altimeter setting	- Request/forward weather reports - Forward NOTAMS - Issue re-routings - Issue altimeter setting	- Request/forward weather reports - Forward NOTAMS - Issue re-routings - Issue altimeter setting - Assign runway	
CONTROLLER-CONTROLLER					
Data link (AIDC)	Used to communicate flight activity and resolve conflicts/alerts	Used to communicate flight activity and resolve conflicts/alerts	Used to communicate flight activity and resolve conflicts/alerts	Used to communicate flight activity and resolve conflicts/alerts	Used to communicate flight activity and resolve conflicts/alerts
ALL AIR-GROUND & GROUND-GROUND					
Aeronautical Telecommunication Network (ATN)	Will be used to provide global, seamless voice and data inter-connectivity				

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APPENDIX B: FUTURE ATM/CNS SYSTEM COMPONENTS AND APPLICATIONS

COMPONENTS		APPLICATIONS				
						
		PRE-DEPARTURE TAXI & TAKE OFF	CLIMB & DEPARTURE TRANSITION	ENROUTE	DESCENT & ARRIVAL TRANSITION	APPROACH LANDING & TAXI
NAVIGATION						
SPACE SEGMENT						
- GPS satellites (24) - May be used for supplemental navigation everywhere	May be used for guidance following take off	- Must maintain conventional navigation capability (INS/IRS/OMEGA or remain within service volume of VOR/DME/NBC) - It is not necessary to display/monitor conventional guidance provided RAIM is available	- Must maintain conventional navigation capability (INS/IRS/OMEGA or remain within service volume of VOR/DME/NDB) - It is not necessary to display/monitor conventional guidance provided RAIM is available	- Must maintain conventional navigational capability (INS/IRS/OMEGA or remain within service volume of VOR/DME/NDB) - It is not necessary to display/monitor conventional guidance provided RAIM is available	- When executing GNSS Class III overlay approach it is not necessary to display or monitor the underlying navaid, and the navaid may be inoperative¹ - When executing GNSS stand alone approach there does not need to be any other approach available¹	
- May be used for primary navigation in remote/oceanic areas	May be used for guidance following take off	It is not necessary to maintain conventional navigation capability. Dual installations are required except in areas designated as single-long-range-navigation-receiver areas	It is not necessary to maintain conventional navigation capability. Dual installations are required except in areas designated as single-long-range-navigation-receiver areas	It is not necessary to maintain conventional navigation capability. Dual installations are required except in areas designated as single-long-range-navigation-receiver areas	Same as above	
WAAS satellites	Will permit primary means navigation in non-remote/oceanic areas and CAT 1 (or near CAT I) precision approaches in coverage area					
GLONASS satellites	Will provide compatibility and functionality similar to GPS satellites					

¹Associated requirements: 1) RAIM must be available, 2) If destination weather required the filing of an alternate airport, the alternate must have a conventional approach which the aircraft is equipped to execute.

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APPENDIX B: FUTURE ATM/CNS SYSTEM COMPONENTS AND APPLICATIONS

COMPONENTS		APPLICATIONS				
	 PRE-DEPARTURE TAXI & TAKE OFF	 CLIMB & DEPARTURE TRANSITION	 ENROUTE	 DESCENT & ARRIVAL TRANSITION	 APPROACH LANDING & TAXI	
GROUND SEGMENT						
GPS ground station network	Controls GPS satellites					
WAAS ground station network	Determines regional position error and relays same to aircraft via WAAS geo-stationary satellites					
GLONASS ground station network	Controls GLONASS satellites					
GBAS (LAAS) reference stations.					Provides precision approach capability: initially CATI, then CAT II and III	
WGS-84 surveys	Since GNSS is based on the WGS-84 coordinate system, airports and obstructions must state in WGS-84 coordinates. In most cases this will require new surveys.					
AIRBORNE SEGMENT						
- GNSS receiver - RAIM - FDE - GPS/WAAS/Receiver	- This function monitors the integrity of satellite signals received and alerts pilot if: a) the signal of an unhealthy satellite is being received; or b) the ability to monitor integrity is lost (i.e. insufficient number of satellites is available) - This function detects a faulty satellite and excludes it from the position determination process - Used to receive the signal from WAAS Geosynchronous satellites and use this corrected GPS position for En Route, Non Precision and Precision operations.					
Local area differential receiver					Used to receive correction signals from local area differential ground stations	

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APPENDIX B: FUTURE ATM/CNS SYSTEM COMPONENTS AND APPLICATIONS

COMPONENTS		APPLICATIONS	
SURVEILLANCE			
ADS	Provides surveillance and surface traffic monitoring	- Provides surveillance in continental, remote and oceanic areas - Provides conflict search and resolution - Replaces ATC radar	Provides surveillance and surface traffic monitoring
ADS-B	Provides surveillance and surface traffic monitoring	- Provides surveillance in continental and non-remote areas - Provide conflict search and resolution - Replaces ATC radar	Provides surveillance and surface traffic monitoring
AIR TRAFFIC MANAGEMENT			
RNP		Users of selected high density airspace will be required to maintain a specified horizontal accuracy	
RVSM		Vertical separation, above a specified flight level, will be reduced form 2000 ft. to 1000 ft. for approved aircraft	
RTA		In certain airspace, appropriately equipped aircraft will be issued a required time of arrival at a specified fix in addition to route, altitude and airspeed clearances	
Air Traffic Flow Management	- Automated traffic management - Tactical and strategic conflict resolution - Capacity management		

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APPENDIX C: FUTURE ATM/CNS SYSTEM BENEFITS

ATM/CNS COMPONENTS	ATM/CNS BENEFITS				
	 PRE-DEPARTURE TAXI & TAKE OFF	 CLIMB & DEPARTURE TRANSITION	 EN ROUTE	 DESCENT & ARRIVAL TRANSITION	 APPROACH LANDING & TAXI
COMMUNICATION					
CONTROLLER-PILOT					
VHF voice	• Provides medium for time critical information (e.g. take off clearance). Provides back up for data link.				
HF voice		• Provides medium for time critical information such as traffic avoidance vectors. Provides back up for data link.			
SATCOM		• Provides medium for time critical information such as traffic avoidance vectors. Provides back up for data link.			
VHF data link (CPDLC)	• Maximizes efficiency and reliability of communications that are not time critical. Reduces miscommunications.				
HF data link (CPDLC)		• Provides medium for reliable, efficient, fault free communication of information that is not time critical. Reduces miscommunications.			
SATCOM data link (CPDLC)		• Provides medium for reliable, fault free communication of information that is not time critical. Reduces miscommunications.			
CONTROLLER-CONTROLLER					
AIDC	• Maximizes accuracy, efficiency, reliability				
ALL AIR-GROUND AND GROUND-GROUND					
ATN	• Maximizes accuracy, efficiency, reliability, connectivity				

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APPENDIX C: FUTURE ATM/CNS SYSTEM BENEFITS

COMPONENTS		BENEFITS			
					
	PRE-DEPARTURE TAXI & TAKE OFF	CLIMB & DEPARTURE TRANSITION	ENROUTE	DESCENT & ARRIVAL TRANSITION	APPROACH LANDING & TAXI
NAVIGATION					
SAFETY All phases of flight: - Enhanced position awareness and reports - Reduced pilot work load	Taxi way moving map display	Enhanced navigation accuracy vs INS IRS OMEGA VOR NDG	Enhanced navigation accuracy vs INS IRS OMEGA VOR NDB	Enhanced navigation accuracy vs INS IRS OMEGA VOR NDB	- Enhanced navigation accuracy vs VOR NDB - Non-precision approach may be flown like precision approach, with pseudo glideslope and localizer. Some equipment permits horizon and vertical auto-pilot coupling.
EFFICIENCY Eventually one on board GNSS navigation system will replace the multiple navigation systems currently installed	Shorter GNSS routes will permit reduced fuel loads and greater payloads	- Routing may be optimized - Positive course guidance may result in lower climb gradient and higher payload where terrain is a restricting factor	- Routing may be optimized - Greater navigation accuracy permits reduced horizontal and vertical separation standards, greater capacity	4D navigation capability will lead to more efficient arrival routes and increased capacity	- Non-precision (eventually precision) approaches can be developed for all suitable runways - Procedure turns may be eliminated - Missed approach holding point may be located so as to not interfere with other aircraft on approach
DEPENDABILITY	Pre-departure satellite availability check ensures adequate satellite coverage	- FDE ensures satellite guidance is accurate - Signal reliability eliminates delays, cancellations due to inoperative ground based nav aids	- FDE ensures satellite guidance is accurate - Signal reliability eliminates delays, cancellations due to inoperative ground based nav aids	- FDE ensures satellite guidance is accurate - Signal reliability eliminates delays, cancellations due to inoperative ground based nav aids	- FDE ensures satellite guidance is accurate - Signal reliability eliminates delays, cancellations due to inoperative ground based nav aids

E/CAR ATM/CNS TRANSITION PLAN

APPENDIX C: FUTURE ATM/CNS SYSTEM BENEFITS

COMPONENTS		BENEFITS			
	 PRE-DEPARTURE TAXI & TAKE OFF	 CLIMB & DEPARTURE TRANSITION	 ENROUTE	 DESCENT & ARRIVAL TRANSITION	 APPROACH LANDING & TAXI
SURVEILLANCE					
EXPAND ADS and ADS-B	Will enable application of ATN technology				
AIR TRAFFIC MANAGEMENT					
RNP	Reduces terrain/obstacle clearance standards	- Reduces terrain/obstacle clearance standards - Reduces aircraft horizontal separation standards			Reduces terrain/obstacle clearance standards
RVSM		Increases system capacity / reduced vertical separation			
RTA		Increases system capacity / time and conflict resolution			
Air Traffic Flow Management	- Increased airspace capacity - More efficient airspace utilization - Reduced controller workload - Enhanced safety - More efficient flight profiles - Improved conflict and alert resolution				

E/CAR ATM/CNS TRANSITION PLAN

APPENDIX D: ATM/CNS IMPLEMENTATION TIMETABLE

CNS Implementation Timetable	Short Term					Medium Term					Long Term			
	97	98	99	00	01	02	03	04	05	06	07	08	09	10
COMMUNICATIONS														
Availability of VHF and Voice Position Reports														
Improved AFS for the ECAR														
HF Data Link (To Be Determined)														
AIDC														
HF Voice														
VHF Data Link														
AMSS Data Voice														
ATN														
BETTER THAN ATN COMPLIANT														
NAVIGATION														
FMS/FMCS Procedures														
Availability of NDBs														
Availability of VOR/DMEs														
Availability of Barometric Altimetry														
RNAV														
GNSS Navigation														
Utilization of ILS														
WGS 84														
SBAS														
GBAS														
INMARSAT OVERLAY														

SURVEILLANCE	97	98	99	00	01	02	03	04	05	06	07	08	09	10
Continued use of voice position reports														
Mandatory Carriage of Transponders Modes A/C														
MSSR to MSSR Mode S	To be determined													
Linking Existing and Proposed ECAR Radars														
Mandatory Use of ACAS														
ADS	To be determined													
ADS/B	To be determined													
Availability of MSSR (Mode A/C)														

E/CAR ATM/CNS TRANSITION PLAN

APPENDIX D: ATM/CNS IMPLEMENTATION TIMETABLE

ATM/CNS IMPLEMENTATION TIMETABLE	SHORT TERM				MEDIUM TERM				LONG TERM							
AIRSPACE MANAGEMENT	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010		
OPTIMIZED SECULARIZATION																
SECTOR BOUNDARIES TRANSPARENT TO USERS																
APPLICATION OF RNP CONCEPT																
APPLICATION OF RCP	To be determined															
APPLICATION OF RSP	To be determined															
ATM EVOLUTION	MINIMUM ON BOARD REQUIREMENTS							MINIMUM GROUND REQUIREMENT SERVICES							IMP. DATE	REMARKS
FIXED RNAV ATS ROUTES	RNAV CAPACITY RNPX CERTIFICATION DCPC VOICE (3)							RNPX PUBLICATION DCPC VOICE (1) (3) GROUND-GROUND SPEECH COM. (3)							2000 (4)	RNP CERTIFICATION AND PUBLICATION WILL DEPEND ON AIRSPACE AND/OR ATS ROUTES CONCERNED. WHEN NECESSARY CIVIL/MILITARY COORDINATION FOR THE LOCATION/REDESIGN OF PROHIBITED AND RESTRICTED ZONES WILL BE REQUIRED.
RANDOM RNAV ROUTES	RNAV CPACITY RNPX CERTIFICATION DCPC VOICE (3)							RNPX PUBLICATION DCPC VOICE (1) (3) GROUND-GROUND SPEECH COM. (3)							2004 RIO/NY 2005 N./S. AMERICA EUROPE	RNP CERTIFICATION AND PUBLICATION WILL DEPEND ON AIRSPACE AND/OR ATS ROUTES CONCERNED. CIVIL/MILITARY AGREEMENT FOR FLEXIBLE USE OF AIRSPACE WILL BE REQUIRED.
AUTONOMOUS FLIGHT	To be determined							To be determined							To be determined	CONCEPT BEING DEFINED BY ICAO.
ENHANCED FLEXIBLE USE OF AIRSPACE	NAV CAPACITY ACCORDING TO AIRSPACE							DCPC VOICE							To be	AGREEMENTS ARE REQUIRED TO OPTIMISE THE USE PROHIBITED AND RESTRICTED ZONES TO ACHIEVE AT

	DCPC VOICE (3) DATA LINK							GROUND-GROUND AIDC (3) SPEECH COM./AIDC COM. WITH MILITARY UNITS CIVIL/MILITARY COORDINATION AUTOMATION							determined	ROUTES AS DIRECT AS POSSIBLE. DATABASE WILL CONTINUE INFORMATION SUCH AS AIRSPACE RESERVES, AERONAUTICAL INFORMATION, AERODROMES, TRAFFIC MET, SAR ETC.	
AIR TRAFFIC SERVICES	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010			
MINIMUM SAFE ALTITUDE WARNING (MSAW)																	
CONFLICT PREDICTION																	
CONFLICT ALERT																	
WINDSHEAR DETECTION																	
RNAV/SIDS AND STARS																	
CONFLICT RESOLUTION ADVICE																	
FUNCTIONAL INTEGRATION OF GROUND STATIONS WITH AIRBOURNE SYSTEMS																	
ATM EVOLUTION	MINIMUM ON BOARD REQUIREMENTS							MINIMUM GROUND REQUIREMENT SERVICES							IMP. DATE	REMARKS	
LONGITUDINAL SEPARATION																	
10 MINUTE MINIMUM	NAV CAPACITY ACCORDING TO AIRSPACE DCPC VOICE (3)							DCPC (1) (3) GROUND-GROUND SPEECH COM. (3) NAV AIDS OR MINT APPLICATION							2003	HARMONIZE SEPARATION AT FIRS LIMITS.	
USE OF 10-MIN. LONGITUDINAL SEPARATION USING MACH NUMBER TECHNIQUE AND/OR 80 NAUTICAL MILES RNAV – (NON RADAR ENVIRONMENT)	RNAV CAPACITY DCPC VOICE (3)							DCPC VOICE (1) (3) GROUND-GROUND SPEECH COM. (3) MNT APPLICATION 60” MAXIMUM POSITION INFORMATION							2001	PROCEDURES ARE CONTAINED IN DOC. 4444. ITS IMPLEMENTATION IS POSSIBLE AT ANY MOMENT AT THE DISCRETION OF THE STATES .	
50 NAUTICAL MILES MINIMUM – (NON RADAR ENVIRONMENT)	FMS (2) RNP 10 CERTIFICATION DCPC VOICE (3)							RNP 10 PUBLICATION DCPC VOICE (1) GROUND-GROUND SPEECH COM. (3) MNT APPLICATION 30” MAXIMUM POSITION INFORMATION							2006		
30 NAUTICAL MILES MINIMUM – (NON RADAR ENVIRONMENT)	FMS (2) RNP 4 CERTIFICATION DCPC VOICE AND DATA ADS CAPACITY							RNP 4 PUBLICATIONS DCPC VOICE AND DATA GROUND-GROUND SPEECH COM. AND AIDC MNT APPLICATION ADS PRESENTATION							2008	CORRESPONDING SARPS NOT AVAILABLE for THIS SEPARATION.	
LATERAL SEPARATION																	

100 NAUTICAL MILES MINIMUM – (NON RADAR ENVIRONMENT)	RNP 20 CERTIFICATION DCPC VOICE (3)	RNP 20 PUBLICATION DCPC VOICE (1)(3) GROUND-GROUND SPEECH COM. (3)	RIO/NYC 2001 N/S AMERICA/ EUROPE	PARTIALLY IMPLEMENTED. RNP CERTIFICATION/PUBLIC A- TION PENDING. PARTIALLY IMPLEMENTED.
50 NAUTICALMILES MINIMUM – (NON RADAR ENVIRONMENT)	RNP 10 CERTIFICATION DCPC VOICE (3)	RNP 10 PUBLICATION DCPC VOICE (1) (3) GROUND-GROUND SPEECH COM. (3)	2006	
30 NAUTICAL MILE – (NON RADAR ENVIRONMENT)	RNP 4 CERTIFICATION DCPC VOICE AND DATA ADS	RNP 4 PUBLICATION DCPC VOICE AND DATE GROUND-GROUND SPEECH COM./AIDC ADS	2008	CORRESPONDING SARPS NOT AVAILABLE FOR THIS SPACING.
18 NAUTICAL MILES (BIDIRECTIONAL) – (NON RADAR ENVIRONMENT)	RNP 4 CERTIFICATION VHF DCPC VOICE	RNP 4 PUBLICATION VHF DCPC VOICE APPROPRIATE NAV INFRASTRUCTURE GROUND-GROUND SPEECH COM./AIDC (3)	To be determined	NON APPLICABLE IN COEANIC OR REMOTE AREA. PROCEDURES ARE CONTAINED IN DOC. 4444. ITS IMPLEMENTATION IS POSSIBLE AT ANYMOMENT AT THE DISCRETION OF STATES.
16.5 MINIMUM (UNDIRECTIONAL) – (NON RADAR ENVIRONMENT)	RNP 4 CERTIFICATION VHF DCPC VOICE	RNP 4 PUBLICATION VHF DCPC VOICE GROUND-GROUND SPEECH COM./AIDC (3) APPROPRIATE NAV INFRASTRUCTURE	To be determined	NON APPLICABLE IN OCEANIC OR REMOTE AREA PROCEDURES ARE CONTAINED IN DOC. 4444. ITS IMPLEMENTATION IS POSSIBLE AT ANY MOMENT AT THE DISCRETION OF STATES.
BETWEEN 10 AND 15 NAUTICAL MILES – (RADAR ENVIRONMENT)	RNP 5 CERTIFICATION VHF DCPC VOICE SSR TRANSPONDER	RNP 5 PUBLICATION VHF DCPC VOICE GROUND-GROUND SPEECH COM./AIDC (3) APPROPRIATE NAV INFRASTRUCTURE RADAR SURVEILLANCE	To be determined	SAFETY OF SYSTEM MUST BE EVALUATED, INCLUDING VOLUME FO WORK OF CONTROLLER. PROCEDURES ARE CONTAINED IN DOC. 4444. ITS IMPLEMENTATION IS POSSIBLE AT ANY MOMENT AT THE DISCRETION OSTATES
			RION/NY	
			N./S. AMERICA- EUROPE	(same as above) NON APPLICABLE IN OCEANIC OR REMOTE AREA
BETWEEN 8 AND 12 NAUTICAL MILES – (RADAR ENVIRONMENT)	RNP 4 CERTIFICATION VHF DCPC VOICE SSR TRANSPONDER	RNP 4 PUBLICATION VHF DCPC VOICE ROUND-GROUND SPEECH COM./AIDC (3) APPROPRIATE NAV INFRASTRUCTURE RADAR SURVEILLANCE	To be determined	SAFETY OF SYSTEM MUST BE EVALUATED, INCLUDING VOLUME OF WORK OF CONTROLLER PROCEDURES ARE CONTAINED IN DOC. 4444. ITS IMPLEMENTATION IS POSSIBLE AT ANY MOMENT AT THE DISCRETION OF STATES.
			RIO/N.Y.	
			N./S. AMERICA- EUROPE	(same as above) NON APPLICABLE IN OCEANIC OR REMOTE AREA.

REDUCED VERTICAL SEPARATION MINIMA																
RVSM ONE THOUSAND FEET BETWEEN FLIGHT LEVEL 290 AND 410	RVSM CERTIFICATION DCPC VOICE (3)							SUPERVISION OF SYSTEM PERFORMANCE DCPC VOICE (3) GROUND-SPEECH COM.							To be determined	REGIONAL AGREEMENT REQUIRED. REFER TO RVSM IMPLEMENTATION MANUAL DOC. 9574.
AIR TRAFFIC FLOW MANAGEMENT	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010		
EVALUATION OF CURRENT ATM CAPACITY																
APPLICATION OF PRE-TACTICAL ATFM																
APPLICATION OF TACTICAL ATFM																
APPLICATION OF STRATEGIC ATFM																
AIR TRAFFIC FLOW MANAGEMENT																
ATFM DATABASE/FLOW MANAGEMENT UNIT (FMU)	DATALINK							AUTOMATION VOICE AND DATA COM. (ICC)							2008	DATABASE WILL CONTAIN INFORMATION SUCH AS AIR SPACE RESERVES, AERONAUTICAL INFORMATION, AERODROMES, MET, SAR, ETC. TRAFFIC,
CENTRALISED ATFM	DATALINK							AUTOMATION VOICE AND DATA COM. (ICC)							2010	CENTRALISED ATFM REQUIRES A REGIONAL AGREEMENT. DATABASE WILL CONTAIN INFORMATION SUCH AS AIRSPACE RESERVES, AERONAUTICAL INFORMATION, AERODROMES, MET, SAR, ETC. TRAFFIC,
HUMAN FACTORS	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010		
DISSEMINATION OF INFO ATM/CNS CONCEPTS																
INSTRUCTION AND TRAINING																
DISSEMINATION OF HUMAN ASPECTS OF ATM/CNS																
1. SPEECH COMMUNICATIONS THROUGH A THIRD PARTY (AERONAUTICAL TELECOMMUNICATIONS STATION) AT THE CRITERION OF COMPETENT ATS AUTHORITY ON THE BASIS OF AN EVALUATION OF THE IMPACT OF THIS COMMUNICATION PROVISION OF ATS AND THE CONSEQUENT EFFECT OF THE SAFETY AIR OPERATIONS WITHIN THE AIRSPACE IN QUESTION.																

2. IT IS ASSUMED THAT FMS AVAILABILITY INCLUDES RNAV CAPACITY.
3. for AIR TRAFFIC SERVICES, RADION TELEPHONY WILL BE USED IN AIR-GROUND COMMUNICATIONS AND COULD BE IMPROVED WITH DATA LINK
4. DATE REFERS TO IMPLEMENTATION OF NEW RNAV ROUTES WITH RNP REQUIREMENTS.
5.TRAFFIC IS CONSIDERED TO BE OF HIGH DENSITY WHEN 100 OR MORE AIRCRAFT OPERATE AT A GIVEN TIME WITHIN A CIRCLING HAVING A RADIUS OF 250 NAUTICAL MILES.

7th November, 2001